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Casey D. Allen
The University of the West Indies

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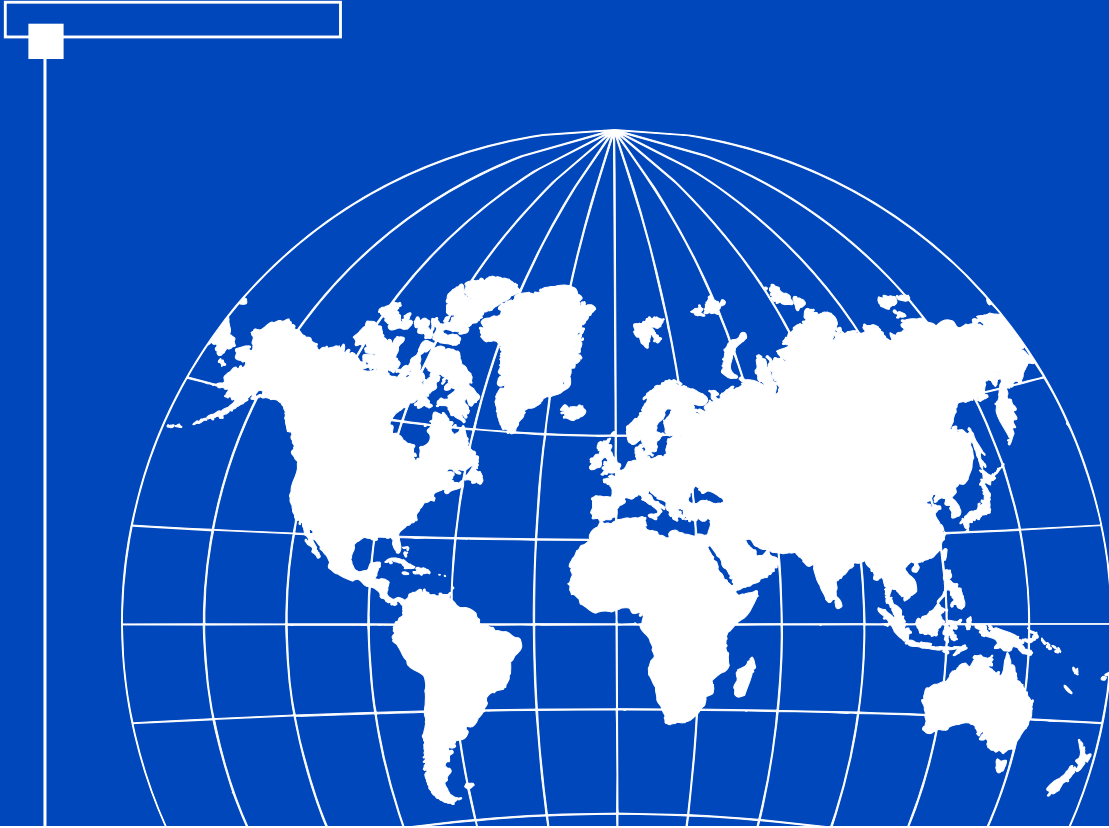
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Gamma Theta Upsilon and *The Geographical Bulletin*

Gamma Theta Upsilon (GTU) was established in 1928 as a professional geography honor society. The organization was founded by faculty members and students at Illinois State University in Normal, Illinois to recognize and promote scholarship in geography. Since its inception, over 300 chapters have been added, mostly in the United States. Currently, the society has over 70,000 members worldwide.

The purpose of the society remains embodied in the symbolism found in the key insignia printed on the back cover of the Geographical Bulletin. The body of the key is seven-sided and represents the seven continents of the Earth. The Greek letters ΓΘΥ represent the three great environmental domains of our planet: Ge (Earth), Thalassia (sea), and Hypaithrois (atmosphere). The waves in the center of the key signify the major oceans of the world and the star is symbolic of Polaris, which guided travelers over the lands and oceans of the northern hemisphere for centuries.

With the rise of globalization, the need to have an understanding of the complex array of forces that shape our world is more critical than ever before. Gamma Theta Upsilon is committed to fostering geographic knowledge and education among the public. Currently, the society awards five scholarships to undergraduates, graduating seniors, and to a graduate student in the field of geography that hold membership in the society. In cooperation with the Association of American Geographers, the society also funds the "Visiting Scientist Program," which sponsors prominent geographers to work with university and college Geography Departments.

Gamma Theta Upsilon also publishes The Geographical Bulletin, a peer-reviewed journal that publishes articles and reviews of interest to geographers and laypersons alike. While The Geographical Bulletin began publication as an outlet for student research in 1970, it welcomes submissions from established geographers, researchers, and other scholars, and publication occurs biannually (usually in May and November). Many students who have gone on to graduate school in geography and related fields have seen their first professional publication appear in The Bulletin. To encourage student publication, Gamma Theta Upsilon awards a "Best Student Paper Award" and a two hundred dollar prize annually. Published articles are available free of charge in PDF form on the GTU website, as well as being indexed through EBSCO's databases and selectively abstracted in Current Geographical Publications of the American Geographical Society, Geo-Abstracts, and Sociological Abstracts.

www.gammathetaupsilon.org

SUBSCRIPTION INFORMATION

The Geographical Bulletin is published semi-annually (May and November) by the Geography honor society, Gamma Theta Upsilon. In keeping with its goals of promoting geography awareness, GTU offers *The Geographical Bulletin* as an open-access, online journal that does not charge authors for either submission or subsequent publication.

The Geographical Bulletin began publication in 1970. A complete 25-year cumulative bibliographic index, by author, is printed in Volume 38, Number 1 (May 1996), and available on the website. While supplies remain, back issues from 1970 through the present are available for $5.00 per issue.

For questions about *The Geographical Bulletin*, including potential article submission, please visit the website (http://gammathetaupsilon.org/geographical-bulletin.html) or contact:

Dr. Casey D. Allen, Editor
The Geographical Bulletin
E-mail: caseallen@gmail.com

The Geographical Bulletin

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Gamma Theta Upsilon

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Email: ddrake4@missouriwestern.edu

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School of Natural and Social Sciences
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Wayne, NE 68787
Email: RaBerto1@wsc.edu

EDITOR, *THE GEOGRAPHICAL BULLETIN*
Dr. Casey D. Allen (ex-officio)
Faculty of Science and Technology
Department of Biological and Chemical Sciences
The University of the West Indies
Cave Hill, Barbados
Email: caseallen@gmail.com

EDITOR'S NOTE

Since beginning my duties as Editor for *The Geographical Bulletin* in 2017, I've striven for including articles which cover the breadth of geography as a discipline. I'm happy to say this issue continues that tradition, with articles spanning geography's triumvirate: physical, human, and technical (geospatial). Not to spoil anything, but as you peruse this issue, you'll be treated to the socio-political landscape of Paris' Algerian immigrant community, an atmospheric analysis of Michigan's Granite Island, Kuwait's burgeoning population, the US's Civil War History, and even a geospatial-focused geography education piece. Quite the variety, indeed.

This issue remains a bitter sweet one for me personally as, after six years and 12 issues, I have decided to step-down as Editor. When I was asked to be Editor, I outlined four main goals I hoped to accomplish: streamlining the submission and review process, raising the journal's visibility, increasing online availability, and integrating more undergraduate research into the mix. The first three goals were accomplished by making *The Geographical Bulletin* a fully online, open access peer-reviewed journal. Now, more people than ever have access to *every* article as soon as they are published – and you can download one article or an entire issue. I am grateful to GTU's Executive Committee for supporting the fully-online open access, and free(!) nature of the journal.

My final goal of promoting undergraduate research was challenging. I remember when I was pursuing my PhD (at ASU…go Sun Devils!) and a professor spoke up during a guest speaker's talk, asking if they had seen the work done by so-and-so. The speaker admitted they had not. The professor replied, "I'm not surprised, since it was a master's thesis, and although thesis research often contains interesting findings, we seldom utilize them for our own research". That comment struck me as interesting, and I made it a point to chat with this professor afterwards, asking if they felt the same way about undergraduate theses. Their response was a resounding "of course!" and then they went on to explain how student research – even student-led or student-driven projects – remains one of the most untapped research-rich outlets. I agreed. And still do. I'm happy to say that, reviewing issues since I began as Editor in 2017, *The Geographical Bulletin* hosts an average of just over one peer-reviewed article by an undergraduate (solo or part of a team) per issue. Of course, some of these represent students who had already graduated and were now working in professional level jobs or heading to graduate school, but the published research was conducted while they were an undergraduate. The neatest thing about this, I believe, is that their research was subjected to the same rigorous peer-review process as a high-ranking journal. What other peer-reviewed journal can boast giving (undergraduate) students such an experience? How wonderful! As always, I encourage you to think of *The Geographical Bulletin* for your own research – whether a student, faculty member, or other professional.

Looking back at my tenure as Editor, it has been a privilege to serve in such a capacity. One of the benefits of being Editor for a journal like *The Geographical Bulletin*, is that it keeps you aware of trends and research across the discipline. I get to read every article, discuss it with peer-reviewers and authors alike, and then share it with the world. What an exciting thing! We've even had a few special issues: the recent *Food, Fermentation, and Drink* (issue 63, volume 1, guest edited by Nancy Hoalst-Pullen and Mark W. Patterson), the first-ever double issue on *Tales From the Field* (issue 62, volumes 2A & 2B), and an issue devoted to *Inspirational Geographers* (issue 62, volume 1) – the latter of which includes the late (and great!) Yi-Fu Tuan's final, formal journal publication.

But there's more! *The Geographical Bulletin* hosts a rich legacy. At least one issue has been published every year since 1970. All of its issues are available free of charge online and with color graphics (where applicable). Each article is subjected to a rigorous double-blind peer review process, ensuring the research remains sound, with reviewers selected based on expertise in their fields. To top it off, some of geography's luminaries have published in *The Geographical Bulletin*, as I've noted previously (Allen 2019). Not many other peer-reviewed geography journals can claim such a long-lasting trend. It's just a fabulous publication that showcases all sorts of geography! *The Bulletin* reminds me of something a great geographer once said, "Geography is an art that is structured, research-driven, and challenging like a science, but also a science that is creative, open-ended, and inspiring like art". As Editor – and as a Geographer – I've taken that to heart. And through the years I've learned that the best way to experience a landscape (geography!) is by walking in/through it, making time for pauses in the midst of your life, because that's exactly when appraising the meanings of your experiences occurs. Savor life. With zest.

I am grateful for the continual support Gamma Theta Upsilon's Executive Committee provided (and continues to provide) over my tenure as Editor. Without strong leadership, GTU – and its flagship publication – would be lost. Although I was familiar with GTU since my days as an undergrad, and even more so after founding and subsequently sponsoring the Mu Lambda chapter at the University of Colorado Denver, I had no idea the organization was so focused on promoting geography and students until I was *in* it. You could not ask for a better, more friendly, open, and gracious group of colleagues or organization. I will cherish the collegiality and friendships made during my tenure as Editor, and consider myself very lucky to have been associated with such a diverse publication as *The Geographical Bulletin*.

Special thanks should also be extended to the numerous peer reviewers over the years. The peer-review system plays such an important role in professional settings, and the willingness to take the time and help was/is

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always very much appreciated. I wish there were some way to compensate reviewers for the copious amounts of time and effort which go into reviews. Until something gets established however, please accept my profuse thanks and sincere gratitude. I would also like to thank Dewayne Gimeson at Chadron State College, who is *The Geographical Bulletin's* longtime layout editor. He dealt with many changes during my tenure, including revising the journal's size and format, but always came through in a timely manner.

I wish an amazing future for the new Editor, *The Geographical Bulletin*, and GTU. I am certain the next Editor will continue GTU's long-standing tradition of helping people (students!) pursue excellence in research while also encouraging our next generation of Geographers to disseminate their research. Success is a process, not an event, and we sometimes need to be reminded of that. Getting our research published may take time – sometimes a LONG while – but the end result is worth it. I encourage you to think of *The Geographical Bulletin* for your next publication, whatever the topic. Serving as Editor has been a pleasure. Thank you for allowing me to do so.

Casey D. Allen, Editor

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Allen, C.D. 2019. Editor's Note. *The Geographical Bulletin* 60(1): 1.
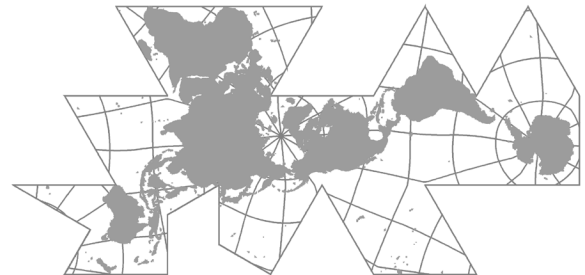
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RESEARCH ARTICLES

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GIS-based Spatial Analysis of Population Density in Kuwait, 1957 to 2020

Dr. Nayef Alghais* and Dr. Saad Algharib

Department of Geography, Kuwait University, State of Kuwait

*Corresponding author: nayef.alghais@ku.edu.kw

ABSTRACT

Population density is among the most insightful demographical metrics for urban planners, land developers and researchers in the geography sector. In this article, a Geographical Information System (GIS) framework is designed to study the spatial and temporal population density trends and investigate whether any notable patterns may be attributed to the socioeconomic factors prevalent in each period. The methodology involves collecting spatial population data over time and using GIS to overlay the population density changes against various socioeconomic parameters in Kuwait. The results indicate that the population density is strongly correlated to the national and international economic and political conditions of each respective period. Furthermore, the population tended to form high density clusters. The findings suggest that future development shall aim to address the impacts of high population density, and the effects of the pandemic and global energy and economic turbulence on Kuwait's labor market and lifestyle over 2020-2022.

***Keywords*:** spatial analysis, population density, population changes, GIS, Kuwait

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INTRODUCTION

Population geography is a broad field that encompasses the study of various topics related to social phenomena and trends, such as fertility, mortality, migration, population structures and population distribution and density (Clarke 1980; Selya 2019). However, in some regions, such as the Arabian Gulf, population geography research is still in its infancy. Arabian Gulf countries have traditionally been of interest to geographers around the world due to their distinguishing history, unique economy and geopolitical situation (Ashwan, Salam, & Mouselhy 2012; Khraif, et al., 2015; Shah 2013; Valenta & Jakobsen 2016).

The Arabian Gulf region is home to the largest concentration of crude oil in the world, with more than 30% of the global proven reserves (Alqahtani, Bouri, & Vo 2020). Naturally, the national economies and prosperity of Gulf countries in the last decades have been tied to oil and its products (Fasano & Iqbal 2003). The era of modern urban renaissance (Al-Nahda) started in Gulf countries, such as Kuwait, the UAE and Qatar around the 1950s (Al-Nakib 2013; De Bel-Air 2018; Elessawy 2017). In stark contrast, before the discovery of oil, the regional economy was predominantly agricultural and relied on fishing, farming, grazing and trade of commodities such as pearl. At that time, the local community was limited in population and socioeconomically homogeneous (Crystal 1992; Nedjat-Haiem 2018).

The availability of newly acquired wealth, was sufficient to fund a new, different lifestyle with ambitious socioeconomic changes that converted the once small towns to modern global cities. Life was changing rapidly by the 1960s and 1970s, with evident consequences in urbanization, education, jobs, houses and sociocultural behaviors. The literature often describes this period of rapid and unprecedented change as a civilization shock. Besides the obvious economic and lifestyle benefits that oil wealth had brought to the region, it also introduced certain demographic challenges. The composition of the Gulf societies underwent a transition from being almost completely homogeneous into heterogeneous communities with the majority of non-citizens being economic migrants that often had low relative incomes and education levels compared to the locals (Fargues 2011). Furthermore, the population growth was much higher than urban planners expected and as such, the population density increased to a level that it put notable pressure on infrastructure. The economic and social impacts of the shift between pre-oil and post-oil eras in Gulf countries was studied in depth by numerous social and human geography researchers (Khalaf & AlShehabi 2014; Mohammed 2003). As of 2022, there are very few studies that examine the change of population density dependence on socioeconomic factors driven by the fundamental restructure of the economy in the Gulf countries.

One of the earlier generations of research on urban population density in the first stage of the quantitative revolution in geography field is Bruce Newling's work (1969). As, he examined urban population density gradients and how they related to different stages of urbanization. However, to study the population density trends over time, this article will rely on the geo-historical and spatial analyses using Geographical Information Systems (GIS) tools. This notion is relatively innovative in the field of population geography, with most relevant literature having been published in the last 7 years or so. Bonnier, Finné, and Weiberg (2019) used GIS data from an intensive survey in the Berbati-Limnes area, Greece to demonstrate and produce cluster-based density surfaces that may be linked to past land-use strategies. They asserted that GIS provides a useful tool that allows them to visualize changes in the spatial extent and shifts in the topographic context of possible land-use over time. Another study by Gomes (2017) utilized GIS to visualize wide variations in population density in mainland Portugal. It assigned three parameters: (1) spatial units; (2) spatial variation; and (3) map scale. It asserts that this method can play an important role in spatial planning issues. Weerakoon (2013) analyzed the spatial distribution of population in the Colombo Metropolitan Region with the help of GIS and developed an analytical framework to examine urban population distribution and spatial structure by visualizing urban densities in maps. Ottensmann (2015) studied the population density of large urban areas in the U.S. using census data for 1950 to 2010. His work identified some factors associated with density levels and changes in density such as sizes of areas, prior densities, rates of growth, and the presence of barriers to urban expansion.

Another important work that contributed towards the understanding of how to apply GIS in population density studies was published by Khatun, Falgunee, and Kutub (2015). The methodology used GIS and census data with two main objectives. The first objective was to analyze the population density gradient of Dhaka Metropolitan Area in Bangladesh and the second objective was to understand how this density has been changed over time and which were the factors driving any changes. Furthermore, they tried to associate the population density trends to the distance from the Central Business District (CBD). They found that the population density increased in the areas located further from the CBD than in areas adjacent to it and the obvious reason was attributed to the improvements in transportation and communications infrastructure.

Another piece in the literature that inspired the authors of the current article was published by Marti-Henneberg, Franch-Auladell, and Solanas-Jiménez (2016). In this study, they examined the changes in population density in Spain between 1877 and 2001 by using spatial analysis tools in GIS. To evaluate the spatial evolution of the concentration of population within the territory of study, both global Moran I and the local Moran I tools were utilized. Global Moran I was applied to confirm the spatial autocorrelation of data, whereas local Moran I was applied to determine the locations of the clusters of the highest and lowest values are concentrated within the territory.

Using the modelling tools and frameworks set by the aforementioned works and introducing certain innovations, the current article will conduct geo-historical and spatial analysis in order to study and visualize the trends in population density in Kuwait from 1957 to 2020. Geographic Information Systems (GIS) tools will be used to both compare the density differences across different periods, but also to extract possible explanations of those changes, as well as quantify their positive and negative impacts on the local contemporary society. The novelty value of this research lies on the fact that Kuwait is a unique case, with non-citizens outnumbering the locals; this creates an interesting dynamic in urban development and population density patterns, much different to those found in countries with majority local population that did not change much in composition over the last decades. The results can help decision makers in Kuwait and other Arabian Gulf Corporation Countries in their future planning.

STUDY AREA BACKGROUND

Kuwait is a country in the Arabian Peninsula located in the northwestern corner of the Arabian Gulf with a total area of Kuwait of 17,818 km². The population of Kuwait increased notably after the exploration of oil in the 1950s, consistent with the trends observed in the region and described earlier (Fig. 1).

The population of Kuwait as of 2020 was 4.6 million, with 68% consisting of non-citizens (PACI 2021). This unusually high ratio of non-citizens is due to the high immigration rates for decades by laborers supporting the oil industry construction and operations. The percentage of non-citizens in late 1950s was 45% based on the first official census in Kuwait (Abu-Ayyash 1980). This percentage increased in the following decades, fueled by additional rounds of investment, which in turn were caused by the oil boom in the 1970s. Visual assessments of these trends are illustrated in figures 2-4.

MATERIALS AND METHODS

Data Preparation

The first stage for analyzing and visualizing the population density trends involves the collection and preparation of data. Two types of data were used in this study:

1. Population data, further classified as:
   a. Official census data collected via the Central Statistical Bureau in Kuwait for years: 1957, 1965, 1975, 1985, 1995, 2005 and 2011 tabular in JPEG format (CSB 2021).
   b. Latest population data of districts in 2020. The type of data was tabular in Excel format (PACI 2021).
2. 2GIS data for Kuwait districts in 2020 (GIS & RS Consultation Unit 2021).

Eight GIS layers were created, one for each census year. The population data was entered in the attribute tables for all districts as layers labelled by year: 1957, 1965, 1975, 1985, 1995, 2005, 2011 and 2020. The results can be seen in figure 5.

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Population of Kuwait (1957-2020)
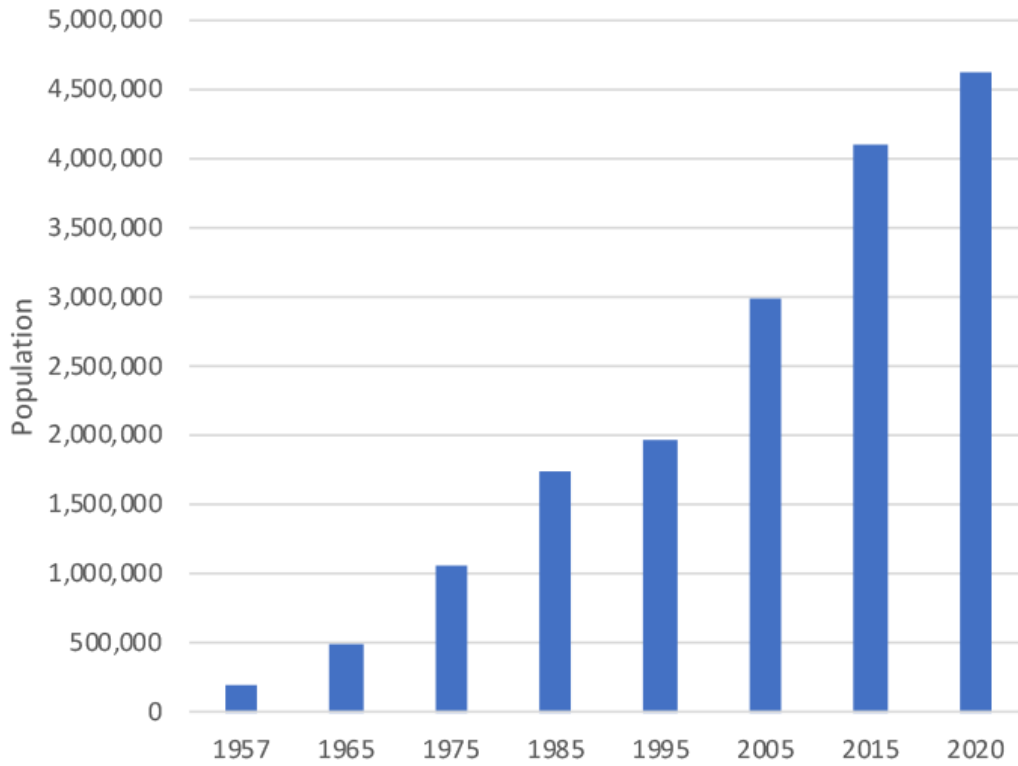
Figure 1. Population growth in Kuwait, 1957 – 2020, illustrating the almost tenfold population increase in 70 years.

Population percentage based on nationality in Kuwait
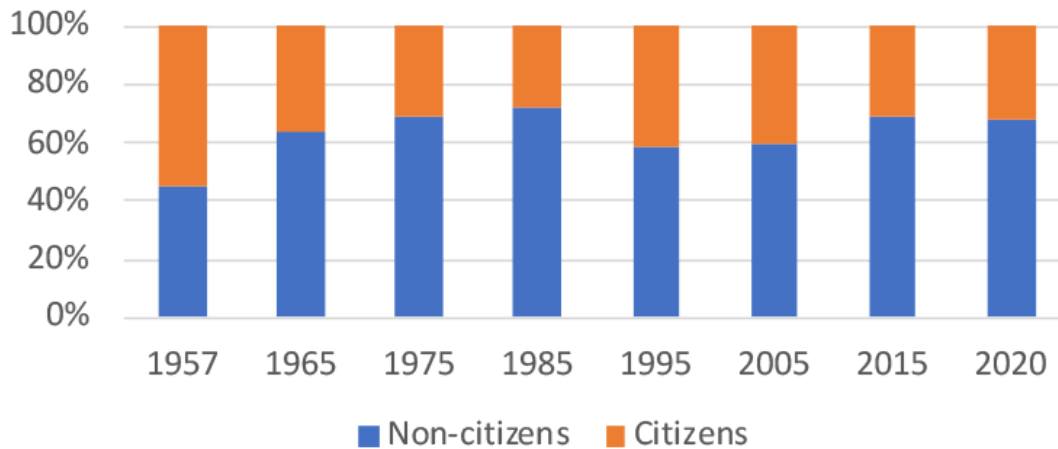
Figure 2. Evolution of citizenship status in Kuwait between 1957-2020.

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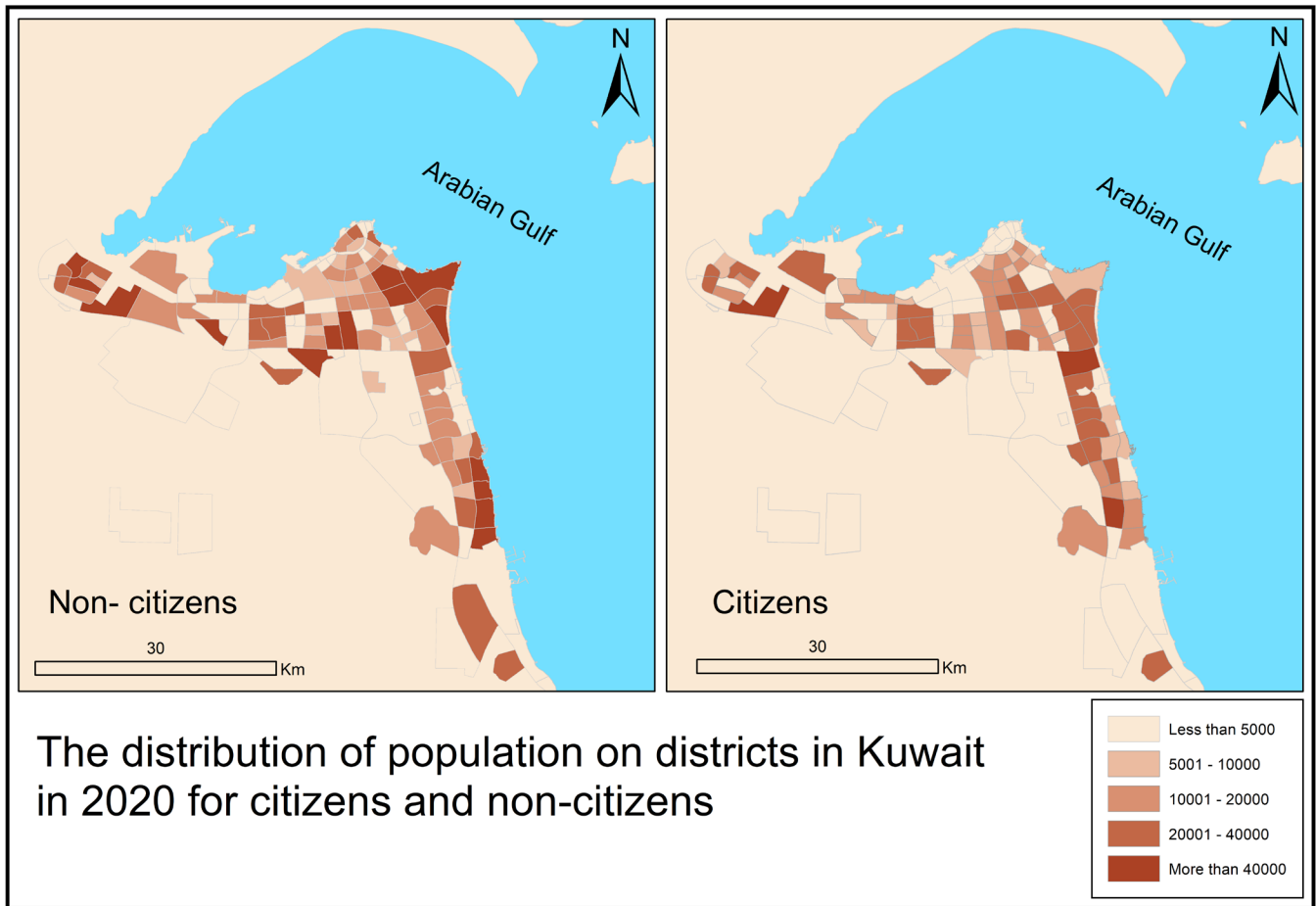
Figure 3. The distribution of population within districts in Kuwait in 2020 for citizens and non-citizens.

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Figure 4. Kuwait's main/single urban area, including the administrative and economic capital of Kuwait City.
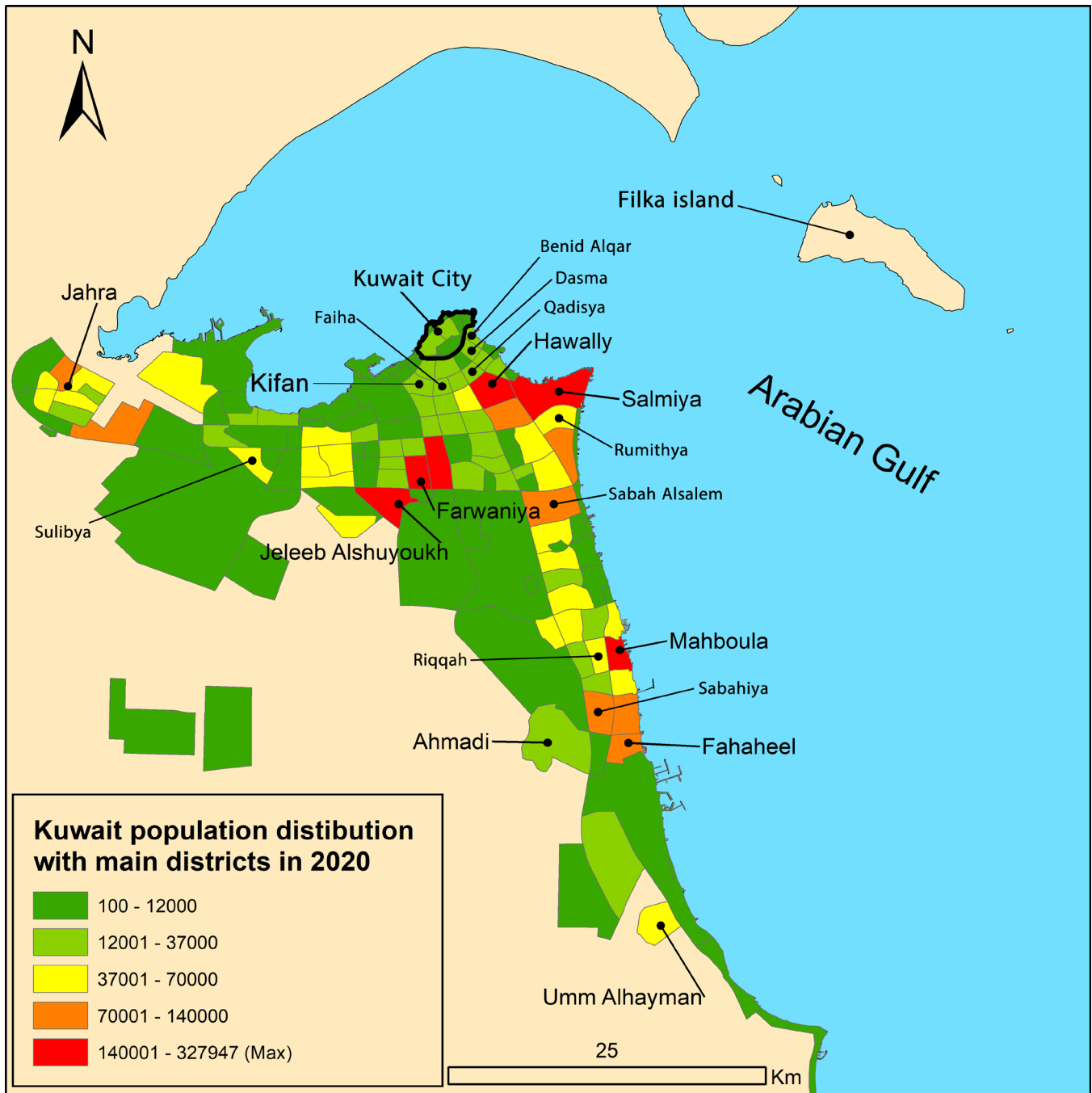
Figure 5. Population in districts within Kuwait's main urban area in 2020.

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Average Annual Population Growth Rate Calculation

After overlaying the population data on the map, the average annual growth rates were calculated for each time period. The change in population over each period spanning over n years is equal to the difference between the population of each period minus the population of the previous period. The percentage population change over a period is calculated as the population change over the population in the previous period. Finally, the population change is divided by the number of years (n) in each period to obtain the average annual growth as seen Equation 1:

$$Average\ annual\ growth\ rate\ (n+1) = \frac{Population\ (n+1) - Population\ (n)}{Population\ (n)} \times \frac{1}{r_n},$$

$$where\ n = 0, 1, 2, \dots, 7$$

n represents the time interval where the data was taken, with 1957 being assigned the value n=0 and 2020 being assigned the value n=7. r_n represents the number of years included in the respective time interval. For instance, for the interval n=7, the data spans from 2011 to 2020, and hence r_7=9.

Population Density Calculation

The next step involved calculating the area of each district by using *Calculate Geometry Tool.* The population density was obtained for all districts (i) for each layer (n) by dividing the total population of each district at the respective period over its area as shown in Equation 2.

$$Population\ density(n, i) = \frac{population\ (n, i)}{area(i)}$$

Spatial Analysis of Population Density

Two tools, the *Global Moran I* and the *local Moran I* were used for analyzing the distribution, concentration, and composition of population within the study area.

The Spatial Autocorrelation *Global Moran's I tool* is able to measure the spatial autocorrelation based on both feature locations and the attribute values of data at the same time. The global measurement of spatial autocorrelation is summarized by a value known as the Moran's Indicator, which can be utilized to model the spatial distribution of population density in all districts in Kuwait from 1957 to 2020. Using this information, it is possible to classify the districts depending on the way the population density changes over time, as either clustered, dispersed, or random manner. A positive Moran's Indicator means that similar values cluster together, in other words high density areas are close to high density areas and low-density areas are close to low density areas. A negative Moran's Indicator means dissimilar values are next to each other (dispersed population density, where high density areas are next to low density areas and vice versa). If the Moran's Indicator is close to zero, this indicates that data (and hence population density) is random; the high and low density areas are randomly distributed all over the region (ESRI 2021a). The null hypothesis of spatial autocorrelation assumes that the distribution of population in Kuwait evolved randomly and hence the Moran Indicator is equal to zero. The hypothesis will be tested based off the results presented in section 4.3.

The *Local Moran I tool* serves the purpose of determining the locations of the highest and lowest values within the study area. This tool creates a series of maps that show positive spatial autocorrelation, which means similar values are surrounded by similar values (ESRI 2021b).

RESULTS AND DISCUSSION

Population Growth Rate

As shown in Figure 6, the growth rate was the highest between 1957 and 1965. The reason for this was due to unusually numerous grants of citizenship status to immigrants at the time. From 1975 to 1990, the annual growth rate was slightly decreased (but still high by international standards). In contrast, in 1990, the total population decreased rapidly because of the reverse migration (first time in Kuwait history) due to the Gulf War. During this turbulent period, population decreased by as much as 10%. However, after the liberation of Kuwait, the population growth trend resumed and its annual growth rate picked up gradually. reaching 40% total growth between 2005-2011 and 60% between 2011-2020. Notably, the growth rate after the Gulf War was lower than before.
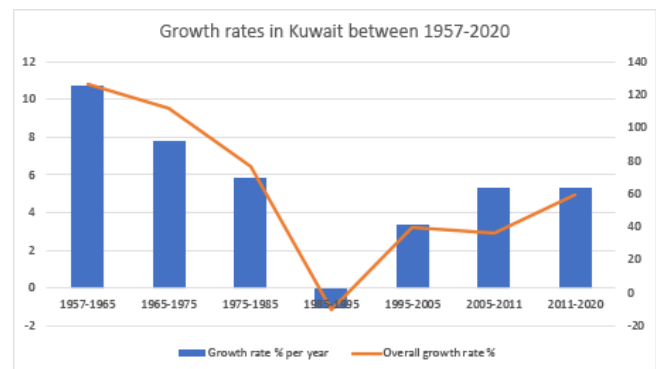
Figure 6. Average annual growth rates in Kuwait between 1957-2020.

To simplify the comparisons and analysis of the results, population growth was studied across three periods of interest: 1957-1965, 1985-1995 and 2011-2020. The periods were selected to be approximately 20 years apart from each other. This would broadly align with the different socioeconomic conditions each generation had to face; as such, it shall be possible to detect any population density changes and attribute them to the aforementioned factors. Consequently, maps were produced for each period using the data extracted with the method described in section 3, visualizing the aggregate population growth in each district.

Population growth was positive in all districts area during the 1st period except in Kuwait City and some other minor districts (Fig 7).

During the 2nd period, the second half of which is dominated by the Iraqi invasion and the Gulf War, the majority of districts experienced negative growth. Two districts, in fact,
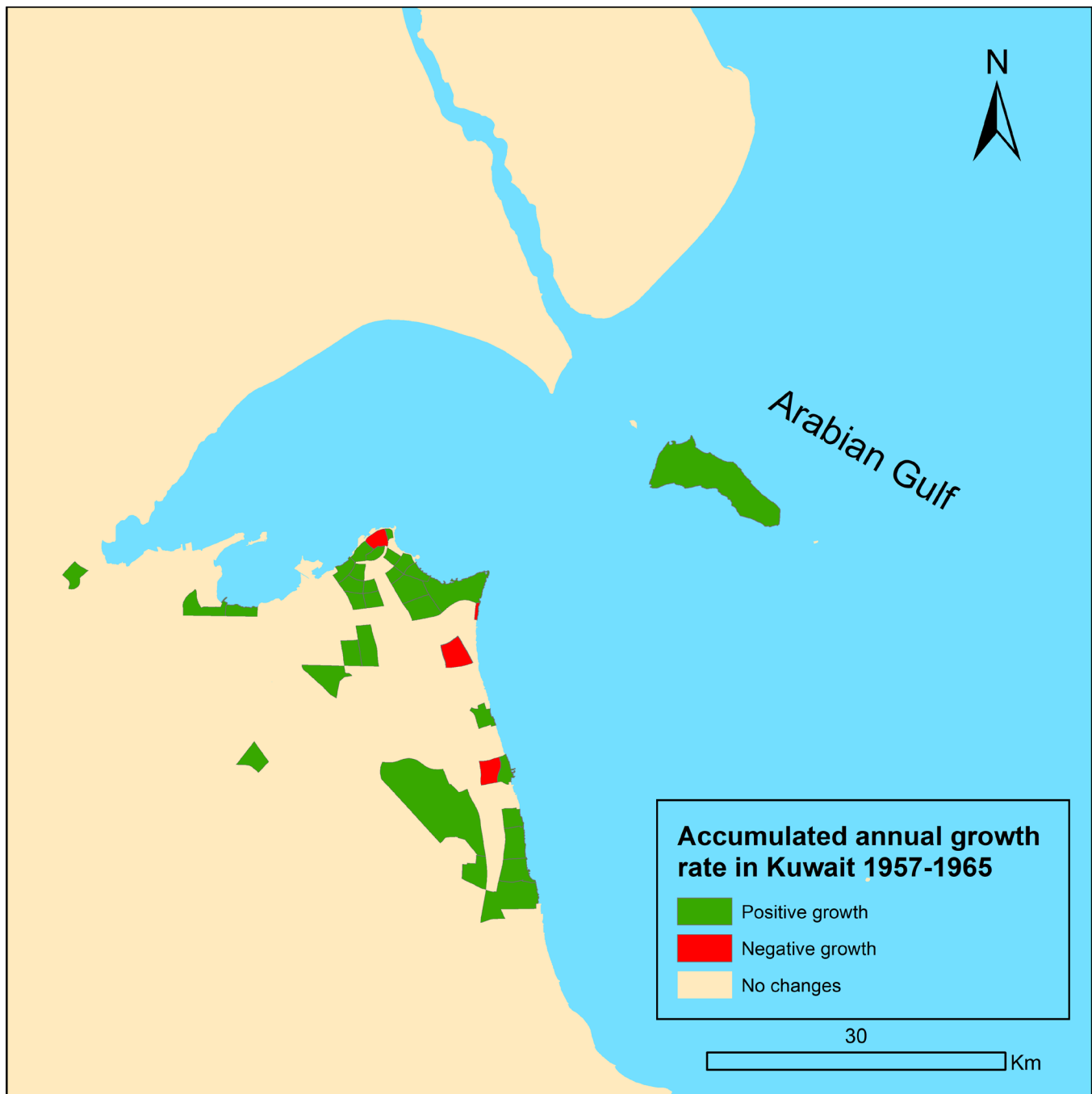
Figure 7. Aggregate growth rate in Kuwait's districts between 1957 and 1965.

were completely abandoned. Those were Filka island and Umm Alhayman in the south region of Kuwait. Filka island was never repopulated and Umm Alhayman took around 10 years to be rebuilt and start accepting new residents (Fig. 8).

In the last and most recent interval of interest in this study, all Kuwait's districts experienced an increase in population, except some non-residential areas (Fig. 9).

Population Density

After calculating the population density in Kuwait from 1957 to 2020, the study found some interesting trends throughout the study period. In 1957, the highest density district was by far Kuwait City (old town). Following that, other high-density districts included Hawally, Farwaniya (right in the middle of the urban area), Ahmadi, Fahaheel (in the

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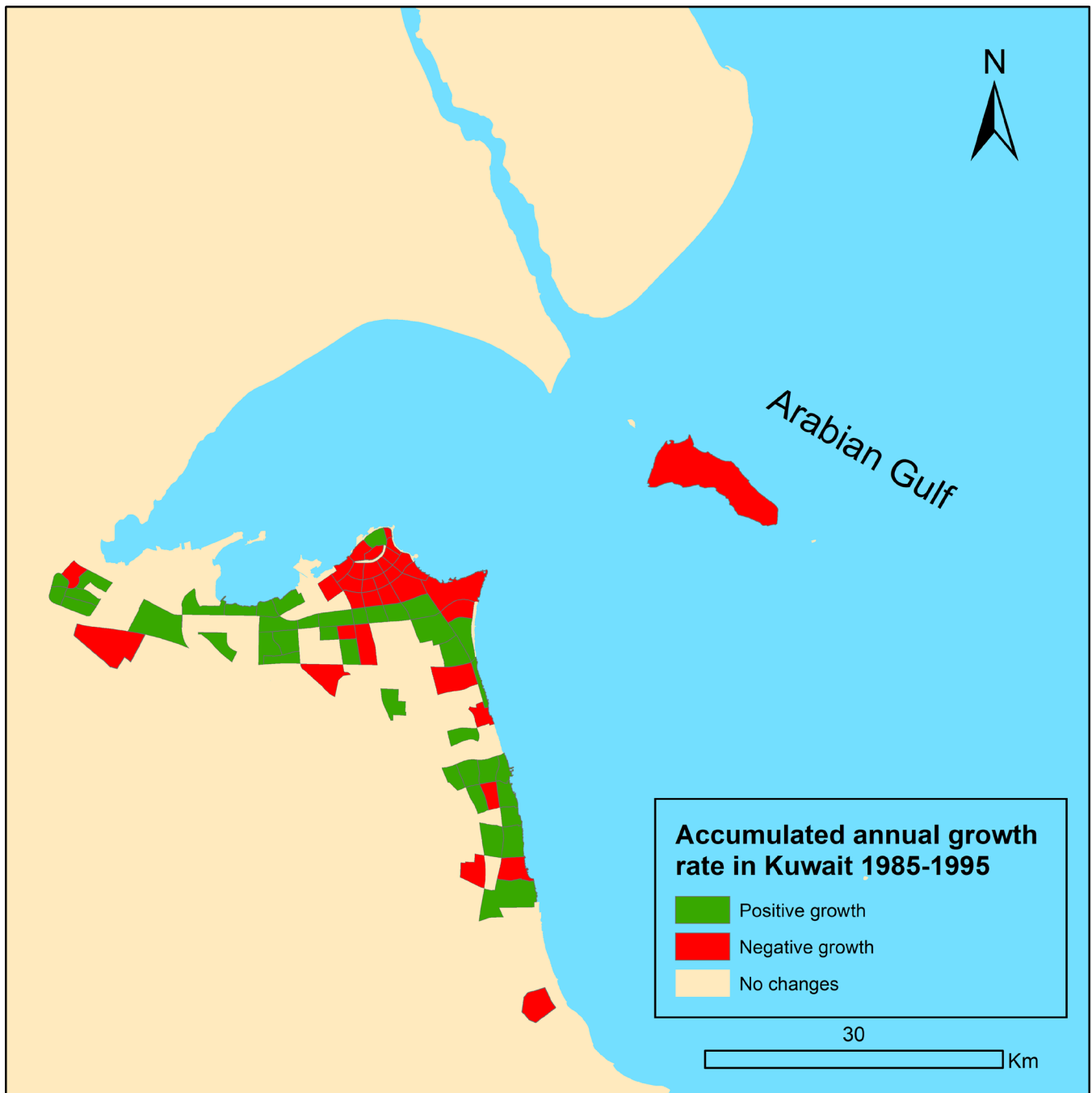
Figure 8. Aggregate growth rate in Kuwait's districts between 1985 and 1995.
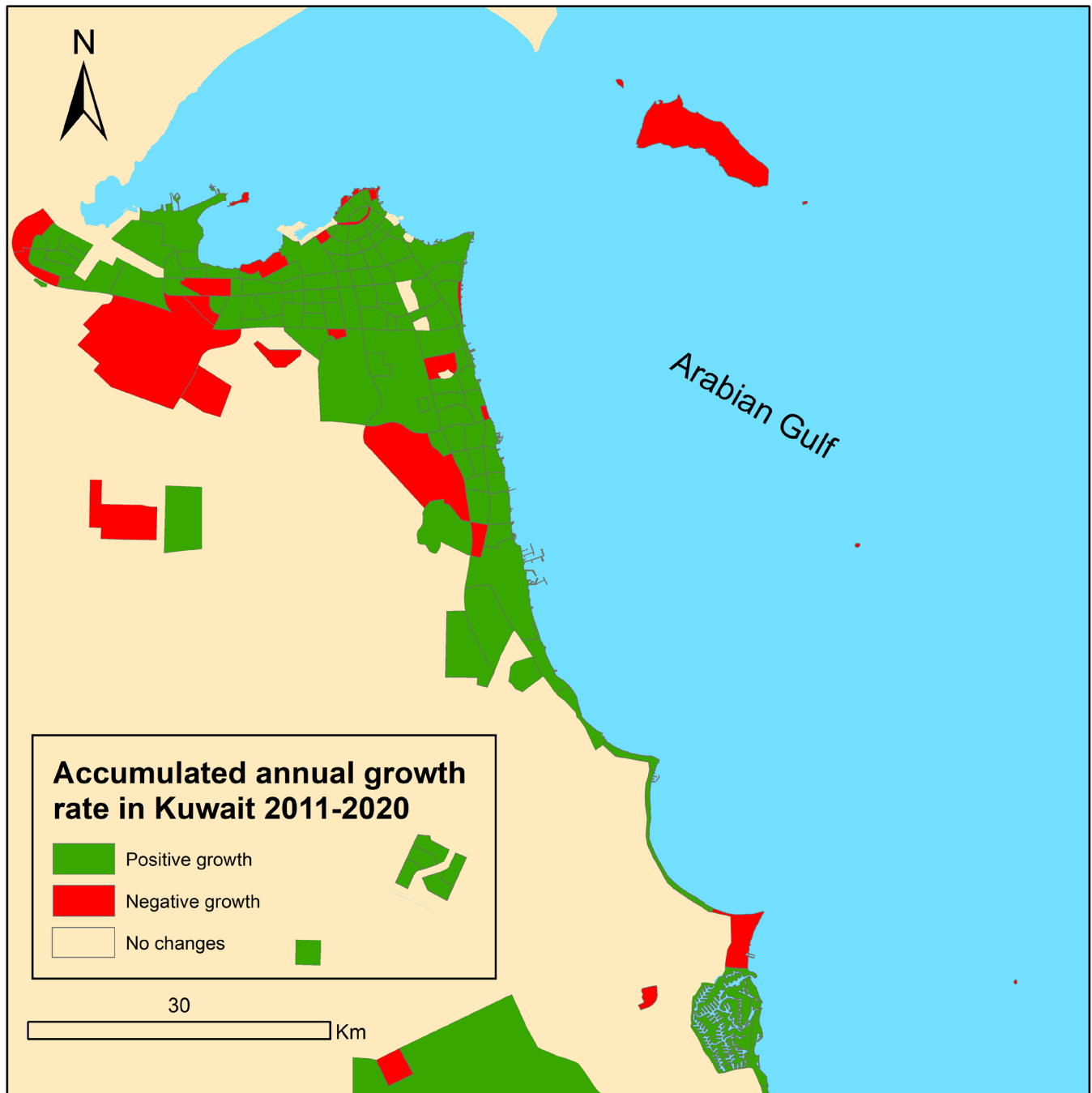
Figure 9. Aggregate growth rate in Kuwait's districts between 2011 and 2020.
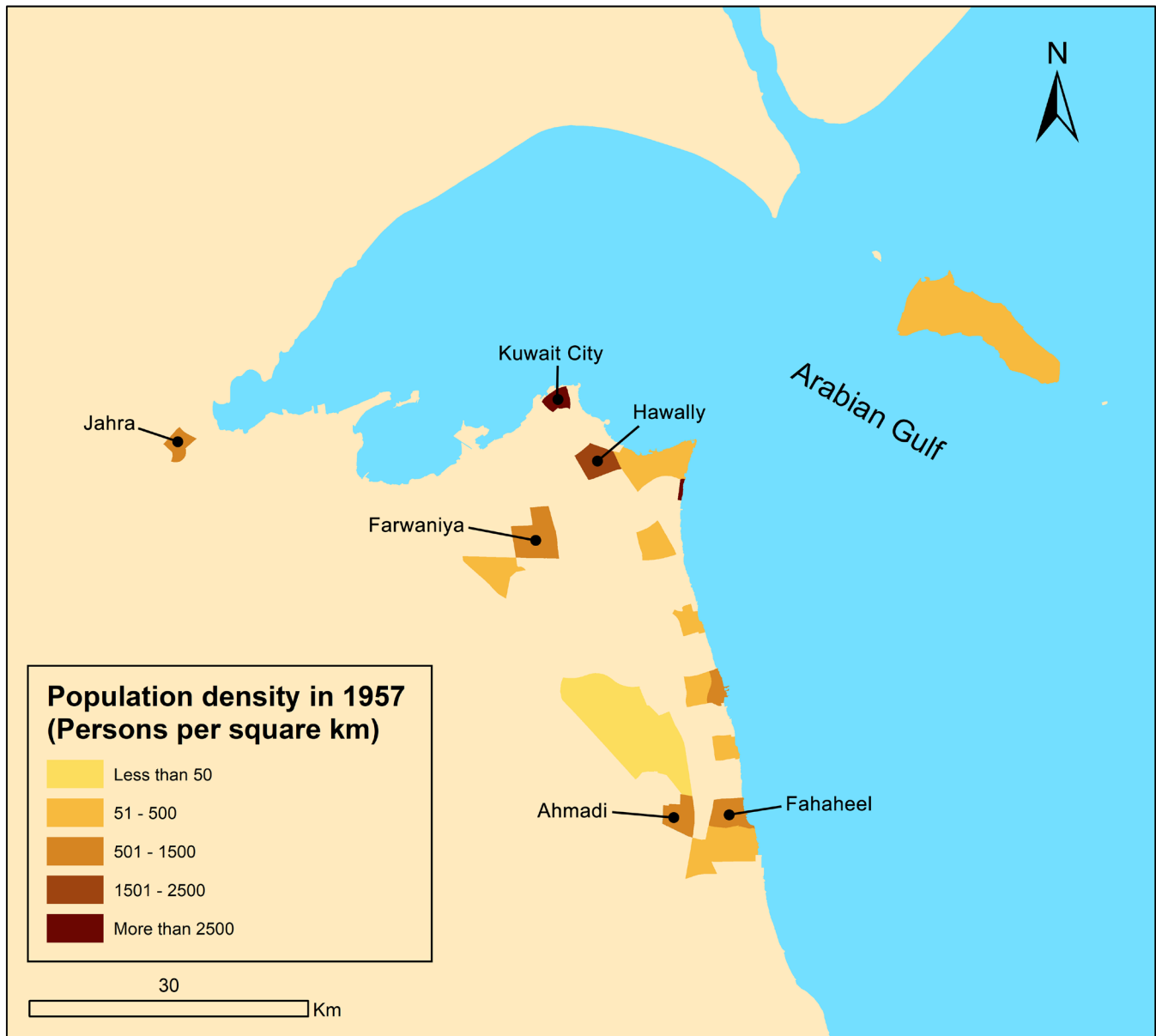
Figure 10. Population density by district in 1957.

south of Kuwait City) and Jahra (West side of Kuwait City; see Fig. 10).

This was the result of the contemporary urban revolution, which in turned was caused by significant oil revenues and the consequent arrival of many immigrants. Bedouins from the desert was an additional group that arrived and settled in the newly built districts at the time. Although Fhaheel and Ahmadi are located far from Kuwait City, they were strategically close to the main oil field (Burgan) so they accommodated many workers in oil sector, hence the high density.

By 1965, Kuwait City still remained very densely populated. Hawally increased in its density because of the further influx of immigrants working in the oil industry. Many new districts surrounding Kuwait City appeared and quickly reached high

population density, including Faiha, Qadsiya and Dasma. Population pressure eased in Kuwait City, as some residents moved to the new nearby suburbs (Fig. 11).

In 1975, certain districts, such as Salmiya, Rumithya, Fahaheel and Benid Alqar reached very high population density. This can be attributed to the arrival of more immigrants which coincided with the oil boom of the 1970s. The previously high-density districts remained densely populated in the 1970s (see figure 12).

By 1985, the population density of Kuwait City dropped significantly as a result of the establishment of new districts which attracted many of the old town's residents. The districts with the highest population density in 1985 were Jahra, Salmiya and Hawally. Notably, new districts that quickly reached high
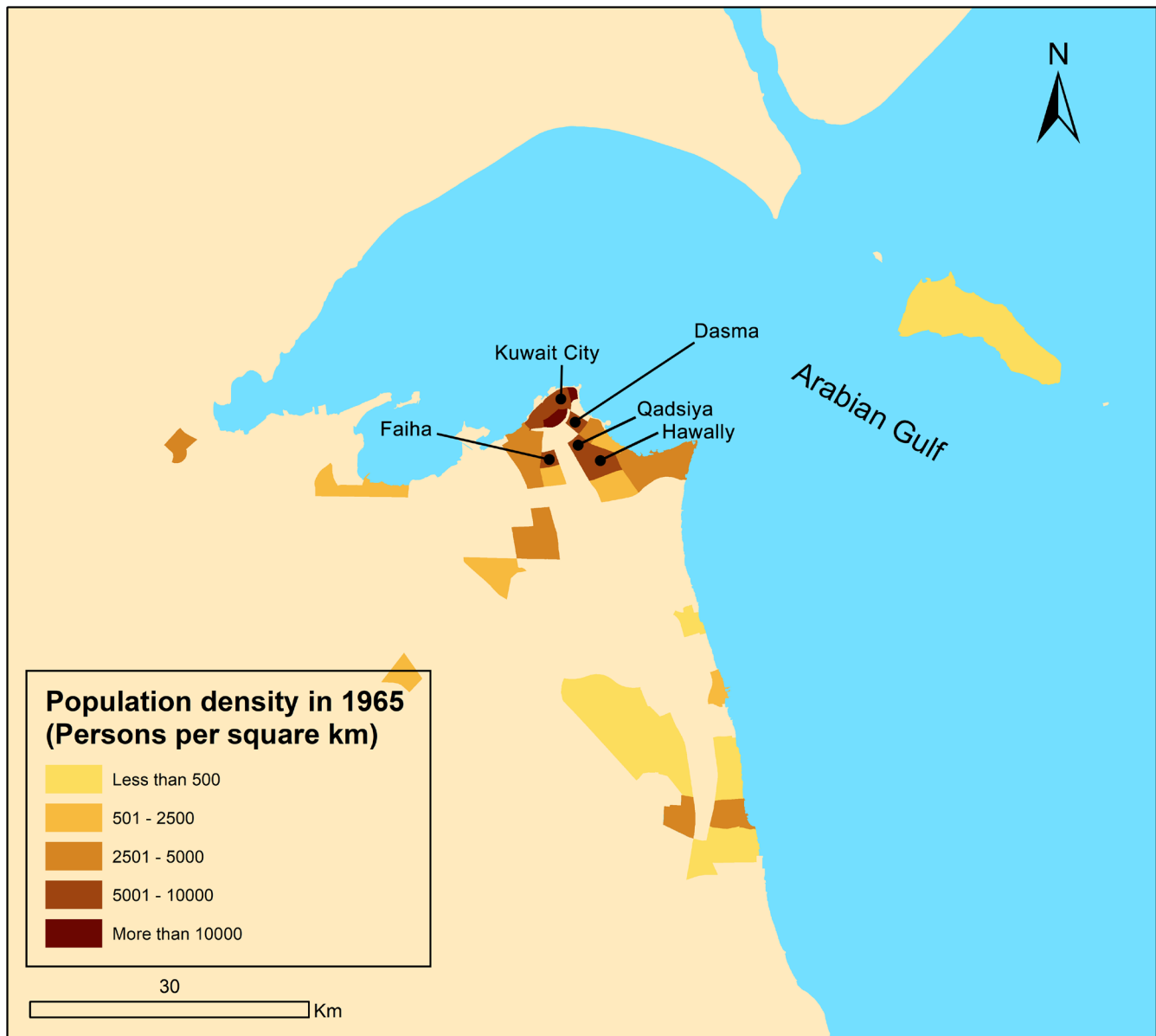
Figure 11. Population density by district in 1965.

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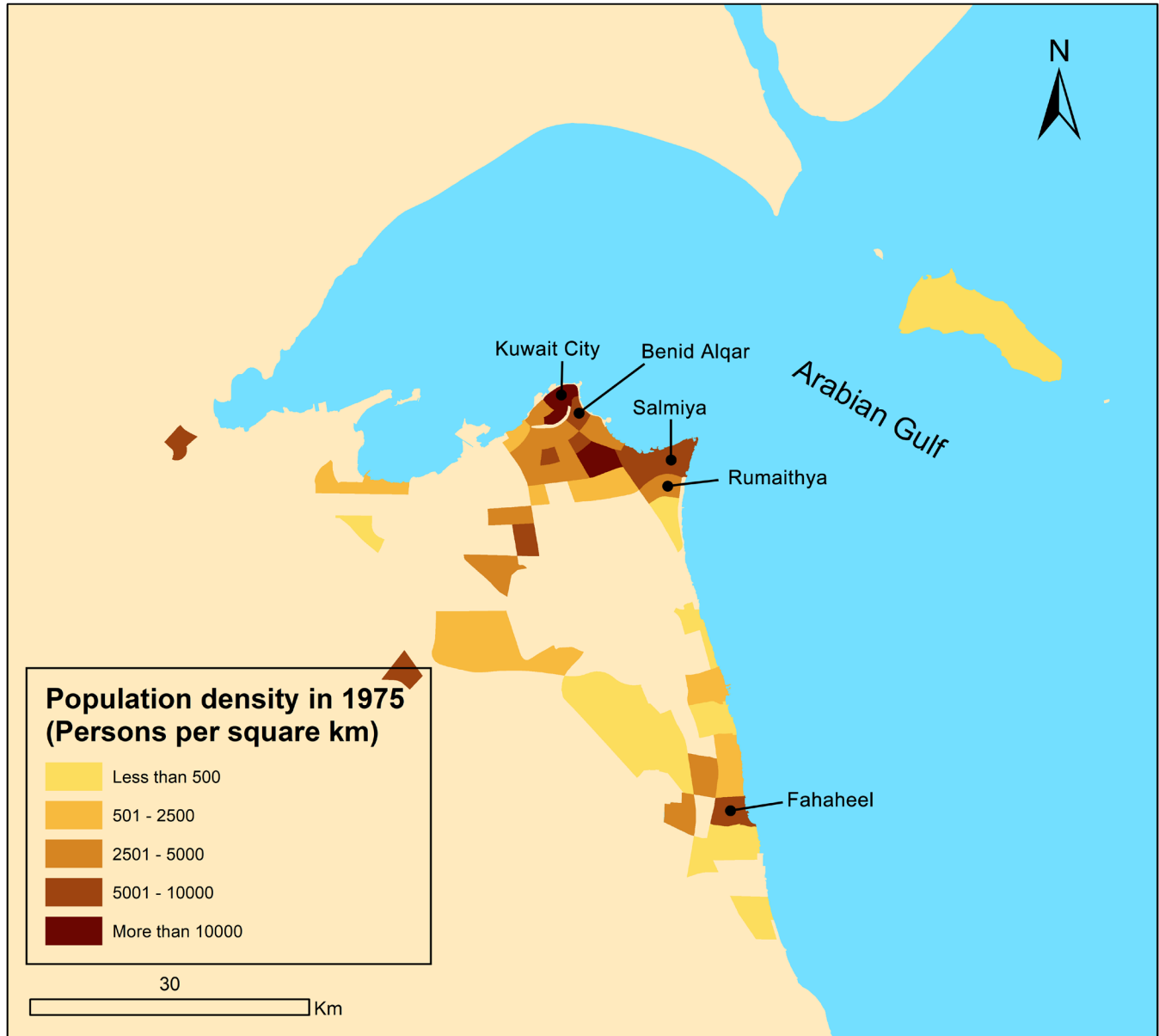
Figure 12. Population density by district in 1975.
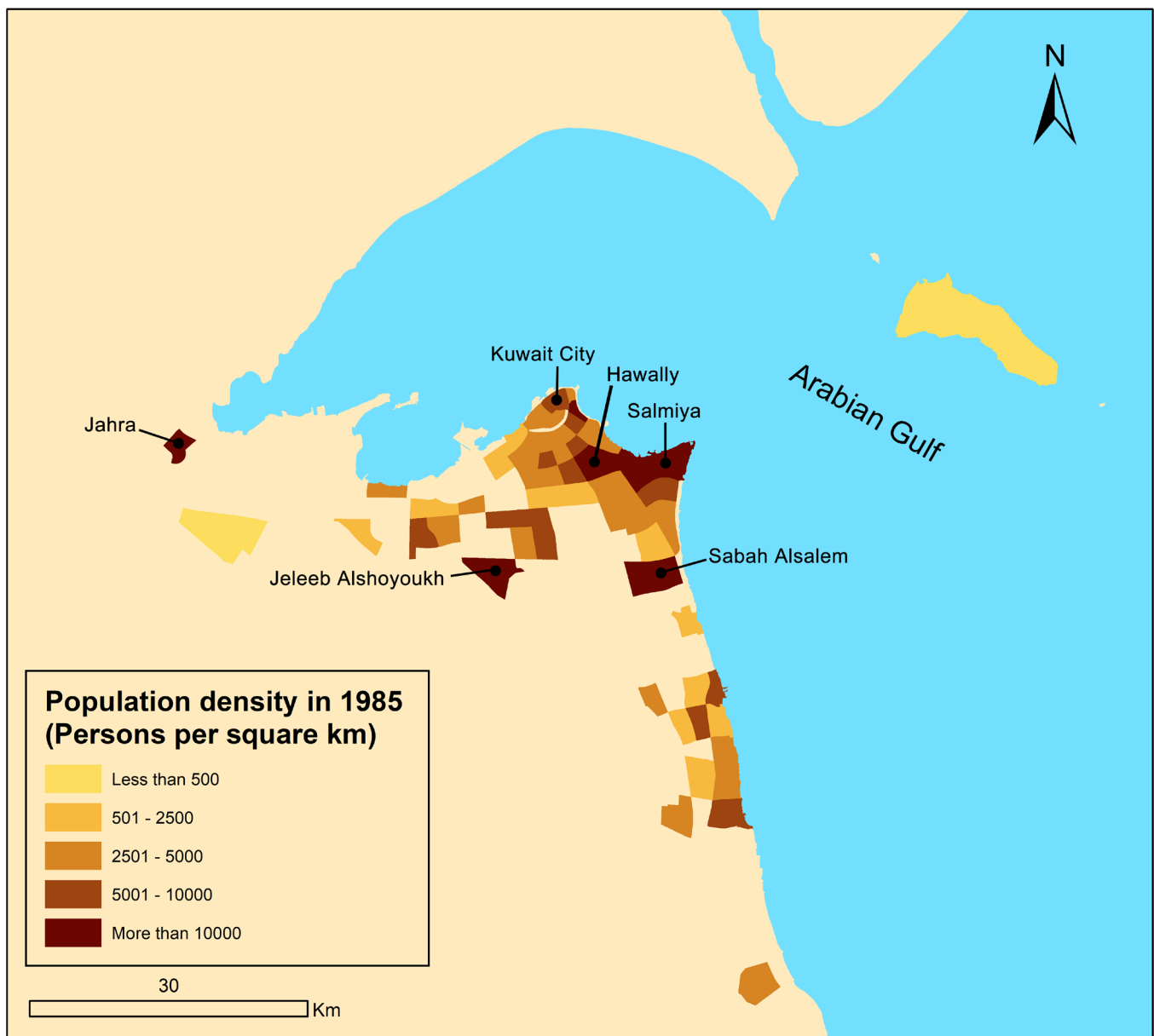
Figure 13. Population density by suburb in 1985.

density were Sabah Alsalem and Jeleeb Alshuyoukh (Fig. 13).

After the Iraqi invasion and the Gulf war in 1990-1991, the population growth decreased dramatically as discussed in the previous section. This negatively affected the population density in almost all districts in 1995 (Fig. 14). Some notable, new, and high-density districts that appeared during this period include Sulibya, Tima and Waha at the west side of Kuwait City and Sabahiya and Riqqah in the south side of Kuwait City.

Finally, from 2005 to 2020, Kuwait's districts underwent more density changes, illustrating the dynamic nature of the city. Hawally, Jeleeb Alshuyoukh and Farwaniya became the most densely populated districts during that time period. Mahboula is the newest district with very high density, mainly

due to the concentration of non-Kuwaitis in it; a common observation for all high density population districts in this period (Fig 15).

Population Density Distribution Evolution

Due to the barren nature of large parts of Kuwait and to avoid underestimating the results in some large districts, the population density (Fig. 16) was calculated only taking into account the urban areas instead of the total area. The Global Moran's indicator of the urban population density was calculated for each study period (from 1957 to 2020, see figure 17).

The results have shown that the Indicator's value was positive for all periods except in 1957. Hence, the null hypothesis

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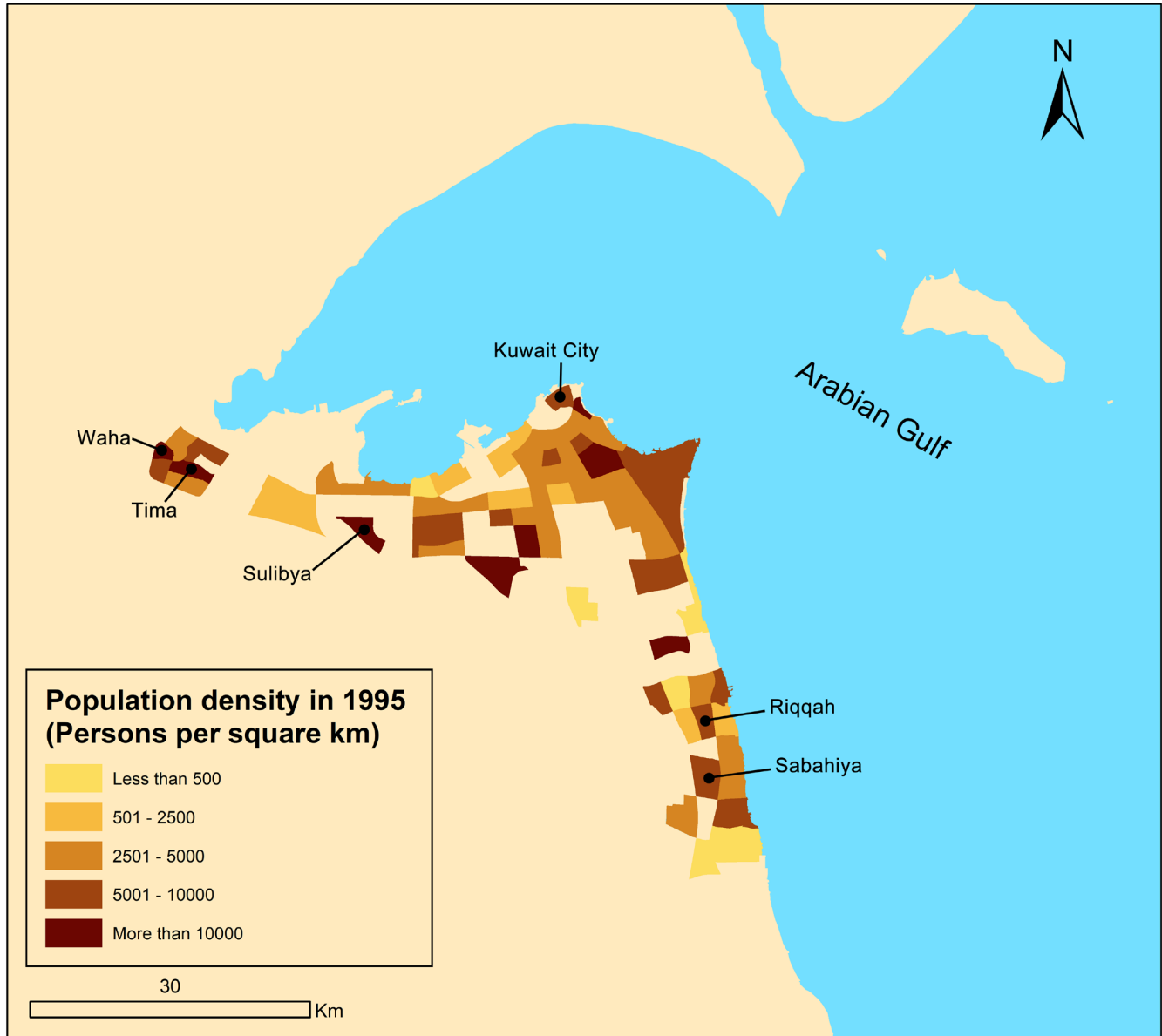
Figure 14. Population density by district in 1995.
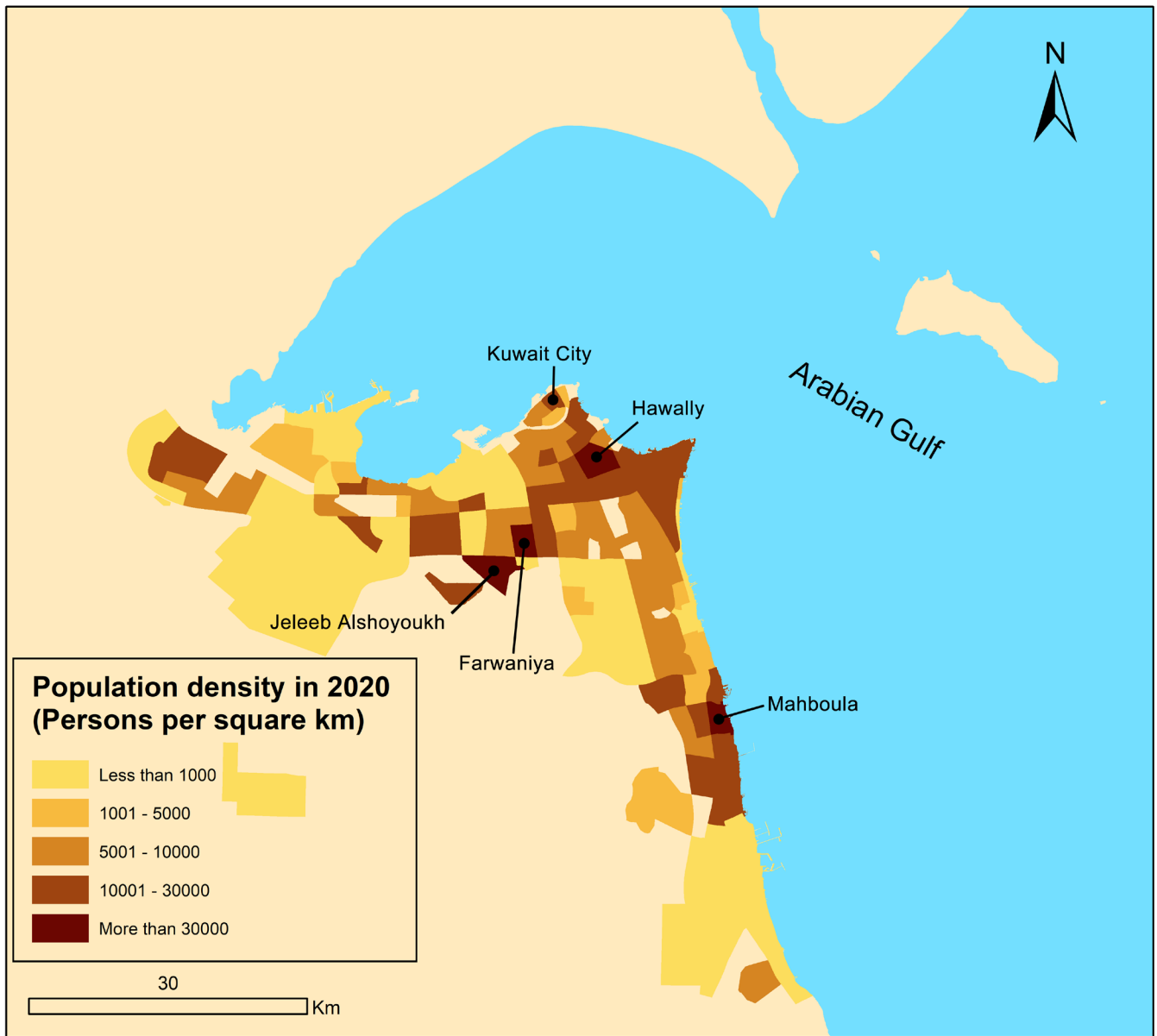
Figure 15. Population density by district in 2020.
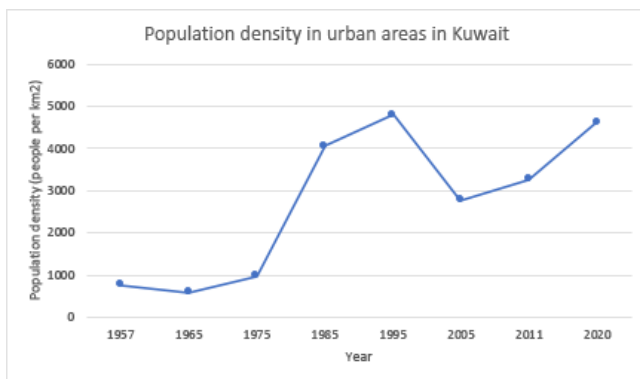
Figure 16. Kuwait's urban population density between 1957-2020
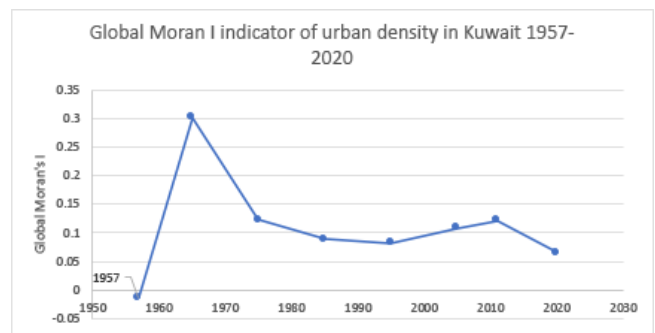
Figure 17. Trends of Global Moran Indicator for Kuwait's urban population density overtime.

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of zero spatial autocorrelation (meaning random population density growth) was rejected. On the contrary, the zero value of Moran's Indicator in 1957 indicates that the population density was randomly distributed (this means the null hypothesis was accepted for this period alone, see Table 1).

Table 1: Summary of Global Moran' I results.

Year	Index	Z-score	Remark
1957	- 0.013250	- 1.247840	Random
1965	0.302167	7.401149	Clustered
1975	0.122928	5.283715	Clustered
1985	0.088253	8.175422	Clustered
1995	0.081992	7.317404	Clustered
2005	0.108564	9.598062	Clustered
2011	0.120916	10.636322	Clustered
2020	0.065388	5.818388	Clustered

However, the dominant trend and major conclusion by analyzing the Global Moran I Indicator, is that the distribution of population density is clustered from 1965 to 2020; in other words, the most densely populated districts are distributed close to each other, and the least densely districts are distributed close to each other respectively. The random distribution of population in 1957 can be explained by the fact that this was the first time of establishing new areas outside the Kuwait City border and the government encouraged people to move to these newly built districts. For instance, one of these new districts, which was populated quickly was Ahmadi, an oil worker city located in the south near main oil fields.

The spatial autocorrelation value presented in Figure 17 is the average across Kuwait. Within the area of study, there are certainly variations which are of interest to the analysis in this study. Anselin Local Moran's I tool was used to obtain series of maps of population density during the study period to identify locations with notably positive spatial autocorrelation showing high/low population density districts surrounded with high/low population density districts respectively. In addition, locations with negative spatial autocorrelation were detected,

Local Moran's I for Kuwait population density in 1965- 2020
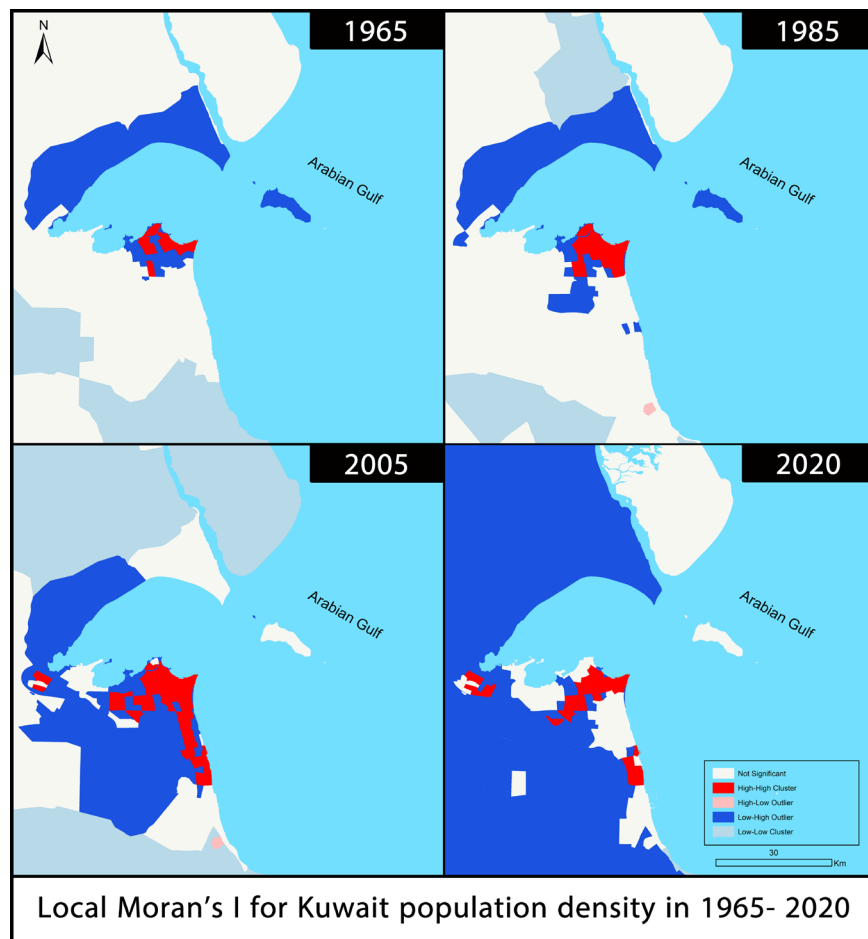
Figure 18: Local Moran's I Indicator for Kuwait population density between 1965-2020.

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which consist of high population density districts surrounded by low population density districts or vice versa (Fig. 18).

It was found that during the period between 1965 to 1985 the high population density districts surrounded by other high population density districts were mainly located around Kuwait City, the Southeast (such as Salmiya and Hawally) and the Southwest (such as Farwaniya). During the period from 1985 to 2005, however, districts with high population density surrounded by other high-density districts became more common, as seen in the whole urban area in the West side of Kuwait City (Jahra district), and along the coastal line from Kuwait City to the south near to Fahaheel district with some districts in the southwest side of Kuwait City such as Jeleeb Alshuyoukh and Farwaniya.

In the period from 2005 to 2020, the most notable change was that Kuwait City saw its population density decreasing. Districts with high population density surrounded by other densely populated districts appeared in Hawally (East side), Farwaniya (Southwest of Kuwait City), Jahra (West side) and Fahaheel (South side).

By studying and overlaying the historical and planning decisions made in each respective period, it is possible to conclusively attribute any changes in population density to three major sociopolitical and geographical reasons. Firstly, the high income from oil exports allowed the Kuwait government to establish many new districts outside the center of Kuwait City and encourage people to move to these new areas. In parallel, Kuwait City was rebuilt as a modern capital city. Secondly, the high immigration rate from foreign countries, was funneled mainly in new districts with industrial and in commercial nature such as Salmiya, Hawally, Farwaniya, Fahaheel. Thirdly, most of the high population density districts are located by the coast and major highways, benefiting from easy commuting and relatively favorable climatic conditions to the inland regions.

CONCLUSION

This paper investigated the historical population density in Kuwait between 1957 to 2020 using GIS. Population growth rates and population density were calculated based on official census data. Spatial analysis was utilized to discover any notable spatial patterns of population density and a series of maps were created to visualize the population density distribution evolution by applying Local Moran's I as a spatial analysis tool.

The study concludes in agreement with other recent works, that spatial analysis tools in GIS are essential for studying any changes in population density over time. Such tools provide researchers with a simple, yet powerful, comparison view for the population density distribution. Spatial pattern identification is important for urban planners and policy makers for infrastructure and services decisions in any country, and especially in Kuwait and similar Gulf countries with large population increases in short time due to oil.

The results of the study indicate that population density in Kuwait during the study period increased, whereas the population density distribution pattern changed from random in 1957 to clustered from 1960s until 2020. The interpretation of this trend is that population tends to form highly dense

clusters in established areas or newly developed purpose-built towns that quickly attract large numbers of residents. Decision makers in Kuwait should take this spatial pattern in consideration whilst designing the new master plan in Kuwait (in 2040 to avoid any potential mismatch in service and public transportation infrastructure distribution.

The findings also showed that Kuwait City (oldest district) lost its relative desirability over time, due to establishment of new districts with equal or higher levels of infrastructure and job opportunities. The government rebuilt the city to be a commercial and administrative center, which further reduced its desirability as a residential district. As a result of that the population decreased in Kuwait City and increased the population density in the surrounding suburbs.

The most populated districts in the country are occupied by non-Kuwaitis. This demographic statistic is valuable to the Kuwait government, which should consider the social and economic impacts of this unusual dynamic in future planning decisions. It is not within the scope of this study to assess the potential decisions, but both redistribution and aggregation of non-citizens in certain districts may lead to major detriments to further socioeconomical development if not handled with care.

Finally, the authors recommend that the Kuwait government and the governments of other similar countries with high population density to incorporate GIS and its tools in population density related policy making, due to the benefits of detecting and modelling population phenomena graphically. Future work may focus on applying similar analytical methodology on studying the population distribution and density based on nationality and the spatial distribution of infrastructure and services. In addition, future research for Kuwait may study the mobility patterns across suburbs area and its correlation with population density.

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Nayef Alghais is an assistant professor in the Department of Geography at Kuwait University since 2018. He obtained MSc. and PhD in geography from The University of Queensland, Australia. His research interests are in GIS, urban modelling, population geography, urban planning, and urban geography.

Saad Algharib is an assistant professor in the Department of Geography at Kuwait University since 2011. He earned his MA and PhD in geography from Kent State University, USA. His research field is in GIS, spatial analysis, urban planning and urban geography.

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Of Revolution or Postcoloniality? Identity Practices of Algerian Immigrants and Their Descendants in France

Elizabeth Nelson

Montana State University, Department of Earth Science, Bozeman, MT, USA

Email: elizabeth.nelson11@montana.edu

ABSTRACT

Using qualitative research techniques, this article demonstrates how colonial memory and postcolonial dynamics permeate the everyday lives and encounters of Algerian-origin people in France and inform the ways they conceive of, and experience, social membership and belonging. This work investigates what it means to be a racialized minority in a postcolonial context and to learn and experience the boundaries of 'Frenchness' and 'Algerianness.' It is based on the narratives of Algerian immigrants who have migrated to Paris, France and their French-born children. The empirical evidence highlights how Algerian immigrants and their descendants encounter and structure their interactions with French society. This work explores how individuals draw upon historical and present-day experiences to articulate their sense of membership and belonging. Ultimately, this work situates the idea of immigrant integration in a broader historical and geographical context, examining how 'belonging' becomes a matter of contention in receiving contexts marked by post-colonial anxiety.

Keywords: France, Algeria, identity, postcolonial, immigrant-integration

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INTRODUCTION

"I do not label myself in the same way in all situations. For example, I would insist on my Algerian roots if I am in a French context for three reasons. First, because I know that racism and contempt are very important in France, and I want people to associate my academic and professional success with my [Algerian] roots. Second, because I know that the [republican] French nation that I admire is mythical…I consider myself French in the sense that I want to belong to the community of philosophers and writers, but not in the sense that I have a common interest with all of my compatriots. Third, because since my

father's death, I feel like I am required not to forget him and his [Algerian] origins."

- Abdel[1], 25-year-old son of Algerian immigrants

Abdel's narrative about identity and belonging illustrates the complicated reality of identity and the tangled relationships that migrants and their children have with places. Abdel's sense

of self is bound with multiple places and with the difficult histories that bind them together. Migrants are often described as living between two different worlds, but in this case, the 'worlds' in question are not entirely separate. France and Algeria are not simply connected; rather, they have come to define each other over the course of nearly two centuries. In articulating who he is and where he is, Abdel refers to the 'mythical aspect' of French republicanism, the persistence of racism in French society, and a familial loyalty to Algeria. We can see in his statement some of the ways that people of Algerian origin engage with identity categories and find a sense of belonging in a sometimes-hostile context. In this example, Abdel mentions membership in different communities and polities, recognizing the terms and conditions associated with each. He outlines the boundaries of identities and communities, but then moves between them and muddles them. Abdel is one example of how Algerian immigrants and their descendants learn what it means to be 'French' and 'Algerian' through everyday actions and encounters; 'integration' for them involves negotiating a social position vis-à-vis Frenchness and Algerianness. This

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negotiation involves a creative interplay of identity whereby respondents qualify, reformulate, subvert, discard, and/or re-work identities and the meanings attached to them. Practices of being French and/or Algerian both reinforce and destabilize these categories.

Further, the politics of immigrant integration are rooted in historical dynamics, but the meaning and relevance of 'history' changes. This article shows how colonial memory and postcolonial dynamics permeate the everyday lives and encounters of Algerian-origin people in France and inform the ways they conceive of, and experience, social membership and belonging. Entering the national community of France requires mastery of the attributes, habits, dispositions, and mores of French society and culture, as defined by the French political elite. Some research participants are able, willing, and even desirous to do this; for some, being 'French' comes somewhat 'naturally.' But for others, French 'culture' is a constant affront, one that they might resist (for instance, by creating alternative spaces of community), even as they conform to its strictures in certain contexts. This analysis highlights the political, rather than simply adaptational, nature of integration. Integration does not have any clear trajectory or end point; instead, it continuously unfolds, altering the significance of historical relationships.

This article proceeds as follows: in the following section, I describe the conceptual framework of this research by addressing the meaning of postcolonial and how it relates to discussions and debates about integration. In the third section, I focus on the historical relationship between France and Algeria and the ways this relationship continues to shape the lives of Algerian-origin people in France. In the fourth section, I outline the qualitative methods used to gather and analyze the data collected during fieldwork including the methods used to identify and recruit study participants and conduct interviews. In the fifth section, I draw from interviews to investigate the ways that Algerians in France articulate their identities and conceptualize belonging in France; I begin by analyzing immigrant identities, as they function along prescriptions of 'Frenchness' and 'Algerianness,' paying special attention to the postcolonial aspect of Algerian identity via iterations of oppression, revolution, and victory. A summary and discussion are presented in the final section.

Postcolonial Identity in the Context of Integration

This article focuses on Algerian-origin communities in France, examining how identity practices function in receiving contexts marked by anxiety and hostility toward immigrants. Immigrant integration is a key concept in the social sciences and it frequently appears as a 'problem' to be solved by policy interventions. Since the early 20th century, the concept of integration has referred to a process of adaptation, adjustment, and acculturation, whereby immigrants become part of 'mainstream,' national society (Castles et. al 2014). The concept of integration (commonly referred to as 'assimilation' in U.S. literature) suggests that immigrants are absorbed into a host-society over successive generations in ways that render their behavioral patterns and identities indistinguishable from the majority group (Alba and Nee 2003). The fundamental

concern of scholarly and political discourse on integration has been the extent to which immigrants are 'succeeding' in disappearing as distinct socio-cultural entities—as ethnic colonies or clusters. This 'success' has typically been assessed and measured vis-à-vis indicators such as educational attainment, language acquisition, employment, intermarriage, naturalization, civic participation, and residential location (Crenshaw et al. 1996; Nagel 2009).

The objective of integration is absorption into a national host society, the boundaries of which are clearly defined and relatively static – both geographically and temporally. Thus, the concept of integration[2] assumes a defined and bounded national society but does not seek to explain or account for the ways that national society has been shaped by transnational historical forces (including imperialism), nor does it acknowledge how national identity is deeply contested. Here I offer an extension of these understandings of immigrant integration to include longer, transnational histories relating to colonialism by bringing the postcolonial element of integration more squarely into analyses of integration and assimilation in the French context. This research seeks to understand how different elements of French society (e.g., the French state, French citizens, postcolonial migrants) are constantly formulating the object of integration and assimilation debates.

In France, discussions of integration have revolved around the notion of 'failure' of immigrants from North Africa (and their descendants) to assimilate into French society (Silverman 1992). This interpretation of failed assimilation effectively places Algerian-origin individuals—even those who are French citizens and born in France—as 'internal outsiders' (Costelloe 2015; Driggers 2018). In discussing 'failed' integration, most commentators and politicians put the blame on people of Algerian descent – failed integration, in other words, is a matter of the unwillingness of Algerian-origin people to shed their 'homeland' identities, particularly religious (i.e., Muslim) identities. In this sense, France's assimilation discourse revolves less around the "spread of French customs" than on "the rejection of the cultural values and practices of migrants" (Sánchez 2019, p. 1).

Postcolonial immigrants thus have come to symbolize the ultimate figure of strangeness and alterity – the Other who does not belong and who is a threat to national cohesion. Tellingly, the French-born children of Maghrebi[3] immigrants are "still routinely (and unrealistically) imagined as 'first' generation" (Rosello 2001, p. 89). To be sure, plenty of attention is given to the material conditions of Maghrebian immigrants and their families and the poor living conditions found in the immigrant-dominated *banlieues*[4]; yet this attention serves to reinforce the main narrative of immigrant deviance, rather than to compel a deeper reckoning with high unemployment, economic insecurity, social exclusion, and persistent discrimination in the labor market. While French attitudes toward immigrants, in a general sense, is one of unease and distrust, it is the Algerian immigrant (and descendants) that draws the most visceral resentments. According to Imad Atoui (2021, quoted in Sofuoglu 2021), an Algerian political analyst, one of the main reasons for this tension is related to France's inability to reconcile their loss and withdrawal from Algeria in 1962.

Moreover, the French government and society continuously

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draw "a line between 'them' and 'us': that is, between those they deem unworthy of, or unable to access, 'Frenchness,' and those who are seen as properly 'French' and 'Republican'" (Tchumkam 2015, p. 1). These practices of social bordering are inflected with republican concepts and sensibilities. French republicanism is against separation of people based on their social, political, and intellectual views. The process of negotiating identities involves the attachment of particular values, roles, and responsibilities to identities, and also involves the placement of these identities into specific realms of interaction and social activity. It is this context within which identity is tied to a historical binary between the Centre and the Periphery, the colonizer and the colonized. The links between colonization and the Republic remain relevant to contemporary French society. From this depiction of immigration in France, it may seem that France struggles with immigration more than other countries – however, immigration trends in France are comparable to other similar countries in Europe (Boubtane 2022). Immigrants represent an estimated 10 percent of France's total population and the numbers have not increased dramatically in recent years (Boubtane 2022). To more fully understand these historical relationships and their modern-day implications, the following section offers a brief historical overview of the Franco-Algerian relationship, bringing special attention to the transnational historical forces that have, and continue to, shape French national society.

Historical Relationship between France and Algeria

Algeria was a French colony for 132 years (1830–1962) and a symbol of France's perceived greatness and unquestionably the most important French possession (Stora 2004). Algeria was defined as an extension of France on the other side of the Mediterranean, a vast territory to be settled by Europeans and assimilated to France (Stora 2004). Algeria was not merely a colony, rather, it was an integral part of France and was under the administrative authority of the Interior Ministry (rather than the Colonial Office), just as any other *département* of France (Cohen 2003). The geographic proximity of France and Algeria is shown in Figure 1.

The French colonization of Algeria engaged the *mission civilisatrice*[5] which assumed that France had a "duty and a right to remake 'primitive' cultures along lines inspired by the cultural, political, and economic development of France" (Conklin 1997, p. 2). Algeria was to be assimilated into France by means of the French colonizing mission. The official colonial structure in Algeria was constructed with severe discriminating practices along a binary of French citizens versus indigenous Algerians. French citizens enjoyed full civil rights (to these were added Algerian Jews in 1870), while Algerians were ruled by an entirely different set of laws, *le Code de l'Indigénat* – the Native Code (Stora 2004).

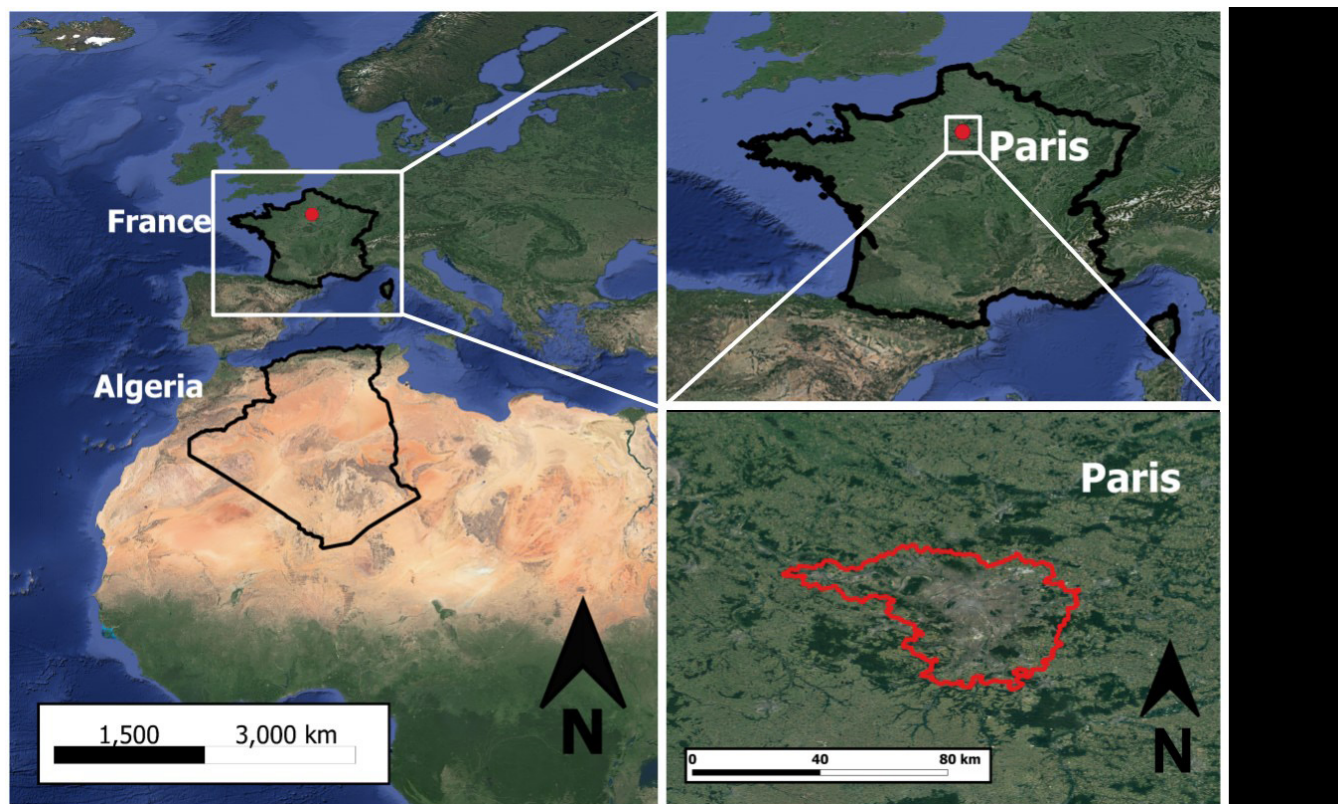During World Wars I and II, Algerians were conscripted into

Figure 1. Map of Algeria, France, and the city of Paris, France. Map by H. Adams.

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the French army. The military service of Algerians obliged the French government to scramble for new ideological justifications for the persistence of inequality – which inadvertently provided colonial subjects the conceptual tools with which to contest this inequality (Mann 2017). The resolute refusal of the colonial administration to extend equal political and legal rights to Algerians worked to fatally undermine the validity of French assimilation discourse, thereby fundamentally altering the nature of power relations between France and Algeria (Mann 2017). The rejection of rights for Algerians during this time fueled the emergence of more radical forms of contentious politics in interwar Algeria (Mann 2017).

Following the end of World War II in 1945, demonstrations for independence broke out across Algeria. In response, the French perpetrated massacres in Sétif and Guelma, triggering a cycle of extreme violence (Stora 2004). This was to be the prelude to the Algerian war of decolonization, which started in 1954 and ended in 1962 with the country's independence (Babicz 2013). It was an extremely brutal conflict, with nearly 30,000 French soldiers killed or missing and more than one million Algerians killed or missing over the course of the conflict (Babicz 2013; Ben Salem 2014; Stora 2006). Consequences of this conflict continue to play out in both France and Algeria. In Algeria, the war represents the ultimate legitimation of the existence and identity of the nation. In France, the loss of Algeria was seen as an amputation of the homeland (Stora 2006).

Though France officially ended its imperial rule over Algeria in 1962, the notion of 'empire' remains indelibly imprinted on relationships between France and its Algerian-origin communities. These (post)colonial relationships are not static, rather, they are constantly evolving. In Algeria, for instance, postcolonial political instability encouraged the rise of an Islamist political movement which, in turn, led to French intervention and a deepening of hostilities toward France. France, in turn, experienced its own 'imperial hangover' (Puri 2020) with the migration of hundreds of thousands of former colonial subjects to the former metropole (along with hundreds of thousands of European colonists, known as *pied noirs*) in the two decades after Algerian independence. In 2018, France was home to over 6.5 million immigrants, equal to 9.7 percent of the population, and many politicians (including those aligned with the conservative far right) perceive immigration and immigrant integration to be an intractable problem (INSEE 2020; Benaissa 2021).

This historical overview underscores that France is a "country faced with its inability to confront its colonial enterprise" in Algeria (Tchumkan 2015, p. 2). France's relationship with Algerian immigrants and their descendants is structured around "the long hatreds" produced by the original French invasion in 1830, sustained over the 132 years of colonization, and increased through their defeat in the Algerian War of decolonization (Evans 2012, p. xi).

METHODS

The French state does not officially collect census data according to "race" or religion owing to the republican commitment to universalism and its aversion to "communalism" – an aversion that stems partly from the Vichy regime's registration of Jews during World War II (Hargreaves 1995). But the state does collect information by place of birth. According to the *Institut national d'études démographiques* (The National Institute for Demographic Studies, INED), there were 845,000 Algerian immigrants in France in 2018 (INED 2020). Algerians represent the largest immigrant population in France, totaling 13 percent of all immigrants in France (the second largest group of immigrants is from Morocco with 11.9 percent) (INED 2020). In 2011, there were an estimated 4.6 million people of Maghrebi origin (with at least one Maghrebi grandparent from Algeria, Morocco, or Tunisia) living in France (up from an estimated 3 million in 1999) (Tribalat 2015, pp. 1-2). Between 2006 and 2008, an estimated 16 percent of newborns in France had at least one Maghrebi grandparent (Breuil-Genier, Borrel, and Lhommeau 2011, p. 33). This population is not evenly distributed across the country. As in many immigrant-receiving societies, Maghrebi immigrants and their children are highly concentrated in certain districts within certain cities. In 2005, Maghrebi-origin young people under the age of 18 constituted about 7 percent of the population of Metropolitan France, 12 percent in Île-de-France, 22 percent in the department of Seine-Saint-Denis, and 37 percent in 18th arrondissement of Paris (Tribalat 2009, p. 436). The Algerian immigrant community in Paris is diffused throughout the city. There are noticeable spatial patterns to immigrant settlement in greater Paris, as shown in Figure 2. In this figure, the 20 arrondissements of the city of Paris are shown in orange, the outlying districts, "*departements*" are shown in red (92, 93, and 94). The immigrant population of each geographical unit is shown as a percentage of the population.

I conducted formal, semi-structured interviews in the summers of 2016 and 2017 with members of the Algerian-origin community from a variety of class backgrounds, ethnicities (i.e., Arab and Berber), generations, and cohort groups. I used snowball recruitment[6] to build a pool of 73 research participants. I had informal conversations with many others, as interviews were conducted in homes, cafes, restaurants, and other social spaces where friends and family members of my interviewees were often present. I used a series of semi-structured questions to uncover how immigrants and their children articulate their identities, how they describe their family history, how they position themselves in social categories, how they interpret and interact with different "communities", and how they go about their daily business in the spaces of Paris. My goal was to reveal the linkages between identity and everyday socio-spatial activities and behaviors, to explore how people draw upon both historical and present-day experiences to articulate their sense of membership and belonging.

This research applied qualitative research methods in the framework of a narrative case study and attempted to accomplish findings that are valid and reliable through meaningful ordering, organizing, and analyzing the data collected. The highly contextual and subjective explanations of the immigrant experience and the processes of identity creation and belonging presented by Algerian-origin individuals in France required the use of qualitative techniques to produce substantive and thorough arguments about such abstract and unquantifiable subjects. This article focuses on using conclusions to engage

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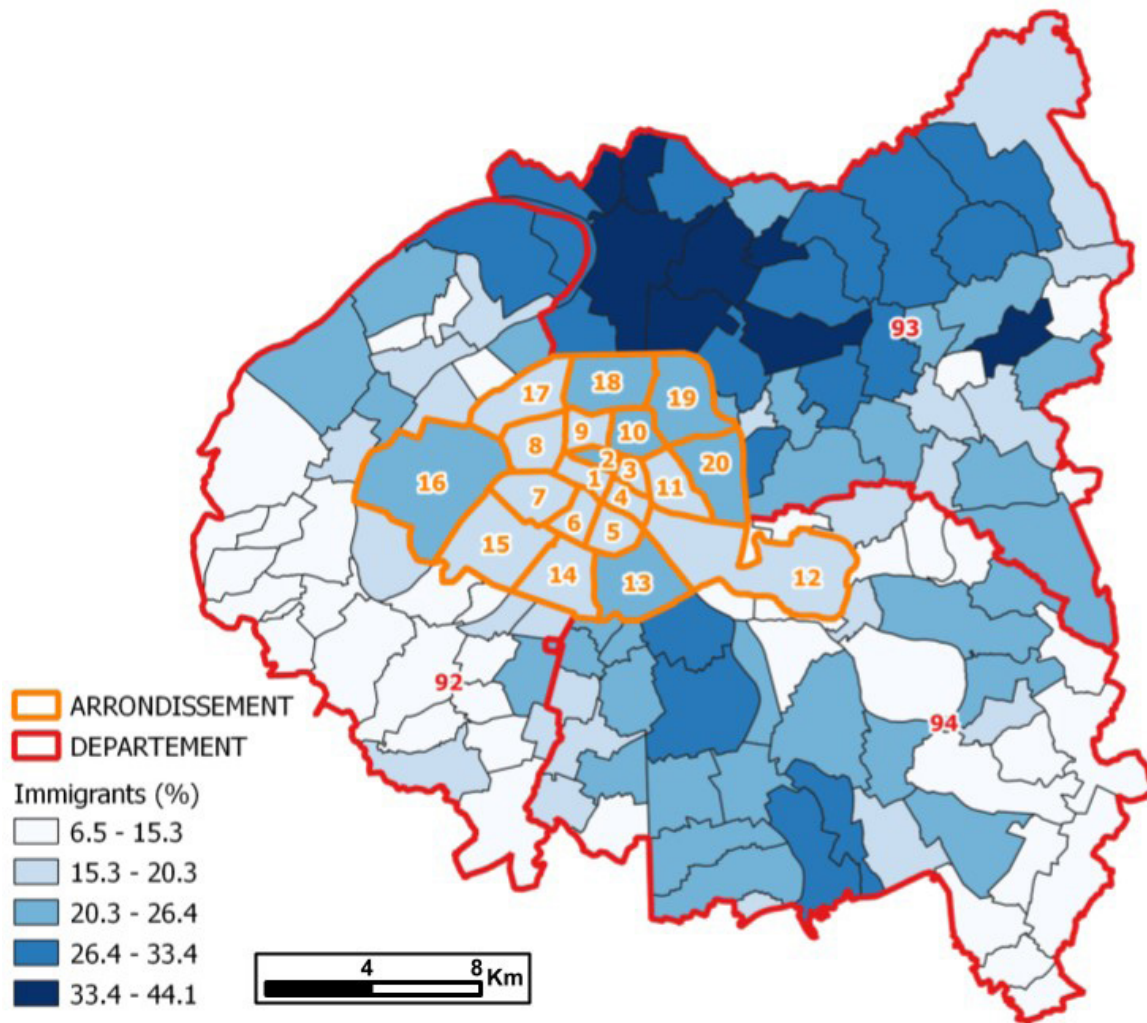
Figure 2. Migrant Population Rates in the Greater Paris Region based on OECD (2018) data. Map from Nelson (2021), cartography by C. Krause. Used with permission.

with and contribute to existing theories about identity, belonging, and immigrant integration in a postcolonial context. Importantly, I do not claim these findings to be generalizable to the entire Algerian-origin community in France.

FINDINGS

The preceding sections have provided conceptual and historical frameworks for understanding identity, belonging, and integration in the immigrant-receiving context of France.

Immigrant identities are configurations of both "self" and "other" that are expressed and materialized through categories of ethnicity, heritage, race, religion, and citizenship. While they occupy a politically and socially subordinate position in France, Algerian immigrants and their descendants position themselves in relation to these identity categories and assign values and meanings to them; as well, they act upon these values and meanings within the realms and spaces of everyday life. Algerian-descent individuals negotiate these identity

categories by embracing or rejecting the traits, values, and meanings associated with each; in doing so, they often engage with ideas of what is "appropriate" or "socially acceptable" in different socio-spatial contexts.

My research participants draw on multiple identities and place themselves in several social groups simultaneously. Their narratives reveal complexity and fluidity, though, paradoxically, this complexity and fluidity draws upon and reinforces binaries. Algerian immigrants and their descendants continuously reproduce ideas about Algerianness, albeit in ways that attribute much more positive meanings to this category than one finds in French national discourse. Of the 73 people interviewed for this study, 53 referred to themselves primarily as "Algerian", seemingly confirming perceptions among dominant groups that Algerians are not 'assimilating' into French society. Respondents' articulations of Algerian identity most often revolve around notions of family and obligation, kindness and hospitality, and of morality and religion. They argue that strong attachment and dedication to family is what sets Al-

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gerians apart from the French and they define the French as more individualistic, self-centered, and isolated. Their Algerian identification was sometimes combined with religious identity (e.g., Muslim), and a more specific ethnic identity (e.g., Berber or Arab). Here, I am focusing just on "Algerianness" as this is the primary way that individuals identified themselves.

Algerian Identity: Hospitality

Interview participants identify hospitality as a key feature of Algerianness. Hospitality is often identified as a hallmark of Arab and Muslim cultural traditions, and the scholarly literature on North Africa recognizes hospitality rituals as a way of maintaining the family's status (Ben Jelloun 1999). Engaging with this cultural performance of hospitality, Algerian immigrants and their descendants weave common hospitality activities into their everyday lives in France. Algerian hospitality involves providing accommodation, food, and drink to visitors and extends to helping others, both friends and strangers. Hospitality, in my study respondents' narratives, is also associated with kindness and forgiveness – a willingness to grant outsiders some measure of welcome and inclusion within the "community", even if only temporarily. The opposite of hospitality is total, permanent exclusion – an unwillingness to accept outsiders even as guests; this way of defining themselves as hospitably Algerian versus inhospitably French is common among my research participants. Hospitality incorporates a number of social experiences ranging from acts of service, the providing of food and shelter, and protection from exclusion; my participants contrast these "Algerian" traits with the racism and rejection they experience in France. Expressions and performances of hospitality are central to the formulation of community and individual identity – and in the specific case of Algerians in France, hospitality is practiced intentionally, that is, it is practiced *because* it is *not* French. The conscious and intentional acts of hospitality practiced by Algerians in the context of France is an identity practice with heightened importance, both in its seeming ordinariness and its clear difference from what is perceived of as French.

For instance, Said, a 53-year-old immigrant, living in the 13th arrondissement, works to keep Algerian cultural traditions alive in his life and work through his practices of hospitality. As a café owner, Said takes hospitality seriously; he is well known in his neighborhood for helping newly arrived immigrants to find work and housing. Said regularly gives free meals to weary travelers and immigrants; his hospitality is something that nearly everyone in his neighborhood has experienced. During the Syrian refugee crisis in 2015-2016, a "pop-up" refugee camp existed a few blocks east of Said's café. The camp held hundreds of refugees living in tents in an open area under a bridge along the Seine River. Said regularly took leftover couscous to the migrants living there. While French society relegated these refugees to homelessness, Said sought to relieve their burdens, if only with a warm meal. Said's practices of hospitality also include acts of forgiveness. For instance, one of his regular customers at the café is a Frenchman who is a veteran of the Algerian war (he was a French paratrooper) who participated in the Battle of Algiers against Algerian revolutionaries. The two men laugh about this now. Said explains,

"It is in the past. If it was my father standing here, yes, there would be a problem. But for me [makes a sweeping motion over his shoulder with his hand] it is in the past," despite the importance of this war to Algerian identity, as I later explain.

In another example, Kahina, practices hospitality in many of the same ways that Said does. Kahina's apartment is often the first stop for many newly arrived immigrants; in her home, she can offer a cup of coffee and an Algerian meal or dessert, while also providing a place to speak Arabic or Berber freely with her. Her home is a meeting place of sorts, commonly filled with relatives who live nearby, neighbors from North Africa, and other Algerian friends from the city. Kahina even goes so far as to offer the use of her address to newly arrived Algerians. Her postal code shows a residence in the 20th arrondissement, within the city limits of Paris. This is important because job applications are often rejected by postal code alone. Bonnet et al. (2016) note, for instance, that "job applicants have lower interview rates when their curriculum vita provides an address indicating a poor suburb" outside the city limits of Paris (p.5). Algerian immigrants come regularly to collect their mail and visit with Kahina. The assistance that Kahina provides follows the notion of social capital—the range of thinking around norms and networks, the values and resources that are the result (and product of) socially negotiated ties and relationships (Edwards 2004). In her own way, Kahina practices hospitality to honor her Algerian heritage, and in other ways, to distinguish herself from the French; this is illustrated in her efforts to help others of Algerian origin bypass French prejudicial practices involving residential location, in this small act, she maintains a sense of opposition to Frenchness. The practices of hospitality shown by Said and Kahina are thus central to the performance of Algerian identity, they are intentional, rather than random, isolated actions.

Algerian Identity: Revolution

In addition to the concepts of hospitality and familial dedication, the notion of revolution is central to the Algerian identity. Just as French public intellectuals connect French identity to the French Revolution, many of my respondents connect Algerian identity to the Algerian Revolution against France. Algeria's struggle against French colonial rule serves as an important reservoir of memories and discourses that my respondents draw upon in articulating their identities and subjectivity. Algerians have a tradition of cultural and political resistance that dates back to the colonial encounter. From the moment of the French conquest of Algeria in 1830, "the indigenous society, in spite of enormous land expropriations and violent repression, sought to defend its core identity through a complex range of cultural resistances" (MacMaster 1997, pp. 218-219). During the colonial period, many Algerians refused assimilation, resisting their domination by and absorption into 'French civilization.' Though excluded from the realm of formal politics, Algerian colonial subjects were dynamic political actors who continually contested colonial policies and the authority of the colonial state. The legacy of this resistance plays out in Algerian immigrants' engagements with the dominant narrative of liberal republicanism in modern France. Just as the French hold an illusion of neutral,

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republican citizenship while dealing with the fallout of their racist imperialism, Algerian immigrants and their descendants maintain and assert a revolutionary identity even while, in many cases, holding French citizenship.

The paradox of living in a former imperial power's land is not lost on people of Algerian origin. My research subjects speak of honoring their forbearers' refusal to surrender to the French by resisting cultural assimilation in contemporary French metropolitan society. Interviewees frequently recounted cultural memories of the 1962 Algerian victory in the war against the French. According to Hakim, a 28-year-old immigrant, living in the 15th arrondissement, "there is a huge proudness" among Algerians that comes from winning the Algerian war of decolonization. From Hakim's perspective, people of Algerian descent do not experience a sense of Frenchness but rather they substitute that feeling with a sense of pride from beating the French, being a part of a great revolution, the victors of a great struggle. He says, "In Algeria when they would talk about the French, they were our invaders, we had a war with them, and a lot of people were killed by the French…It's a lot about culture and mistrust."

This pride often translates into practices of recounting memories of family members who participated in the liberation of Algeria. For example, Hassan, a 33-year-old son of immigrants, living in the 18th arrondissement, is working on a documentary about his father's life as a revolutionary in Algeria and France. Hassan becomes animated when he speaks of his father's accomplishments, and he has devoted his spare time and money to this project over the years. The stories of fathers smuggling weapons for the freedom fighters or of grandfathers being tortured but unwilling to betray Algeria are plentiful in the narratives of my research participants, and they use these nostalgic explorations of family history to situate themselves in French society. Embracing the colonial/revolutionary past with pride gives Algerians in France a degree of personal dignity and social prestige in an otherwise exclusionary social context.

Postcolonial discourses and historical memories circulate through their everyday lives, contributing to their conceptions of belonging and identity. In another example, Youcef, a 35-year-old immigrant, living in the 94th district outside of Paris, describes his pride in his revolutionary roots, as both sides of his family were heavily involved with the FLN[7] during the Algerian revolution. He explains that there were two kinds of revolutionaries: the first kind was actively participating in the resistance – keeping gun caches and plotting actions, typically from the mountains; the second type, often labeled as "administrative", found desk jobs within the French system and acted against the French from within. Youcef's grandfathers represent both types of revolutionaries. His maternal grandfather oversaw weapons stashes in the eastern part of Algeria while his paternal grandfather worked with the French *colons*[8] in the western part of Algeria. His paternal grandfather was so heavily enmeshed with the French that he feared for his life and his family's safety after the war; he was considered to be a Harki (a French sympathizer) by many locals. Youcef's mother remembers her father being taken nightly and tortured, only to be returned to her childhood home in Constantine, Algeria. One story that Youcef remembers clearly is of the night when his grandfather was taken by French soldiers to a graveyard,

handed a shovel, and instructed to dig his own grave. This story gave Youcef nightmares as a child. Both families relocated to Algiers after the war ended in 1962.

For Youcef's family, the revolutionary spirit did not fade after Algerians achieved independence. His father was politically active before the Algerian civil war in the 1990s and was part of a group who started the Social Democratic Party of Algeria. When the violence of the civil war escalated, Youcef's father became frightened for his family's safety (because of his political activism) and sent Youcef's sister to France to live with relatives; he sent Youcef to a private French school in Algiers. Youcef follows in his ancestor's footsteps and is politically active in France, regularly participating in protests against the mistreatment of immigrants and social injustices in France. He frequently organizes groups through Facebook to bring together like-minded people (mostly Algerian) to talk about their common struggles in French society. He claims that he has revolutionary blood in his veins, and he honors his family tradition of fighting against political oppression, corruption, and social unrest – continuing the work in France, though in a much smaller capacity than his ancestors.

Numerous participants wove their revolutionary roots into their interviews in similar ways to Youcef and Hassan and work to honor and remember their Algerian heroes and heroines in modern France. Djamila, a 34-year-old immigrant, living in the Bobigny *banlieue* in the 93rd district outside of Paris, was named for Djamila Bouhired, a famous female Algerian revolutionary. Omar, a 28-year-old immigrant, living in the 20th arrondissement, speaks with pride about his mother, who was born and raised in the Casbah of Algiers, where Omar's grandfather worked with the so-called "terrorist cells" of Algerian revolutionaries during the Battle of Algiers. Abdel, a 25-year-old son of immigrants, living in the 16th arrondissement, describes his father's participation in the revolution. His father joined the FLN after moving to France and collected money from the Algerian workers as a "revolutionary tax" for the war; three of Abdel's uncles died in the Algerian War.

These stories appeared constantly in my interviews, though there was not a specific question that directed my respondents to identify a part of their familial history related to the revolution. This 'revolutionary energy' that Algerians so clearly identified with has been described as something like inventiveness, creativity, or self-management (Lyotard, 1988). The participants who speak of their revolutionary identity clearly link it to a sense of autonomy, resistance, pride, and struggle. From a French perspective, the notion of a revolutionary identity instead signifies a social problem with direct links to "Islamist separatism" that is placed squarely on Algerians: "the bloody Algerian war and the colonial past [is] still imprinted" in the "collective psyche" of France, according to French President Emmanuel Macron (quoted in McAuley 2020b, p. 1). This accusatory approach of holding Algerians responsible for Islamism in France has recently been taken to a grossly excessive level – in a January 2021 report, the socalled 'Algeria Report,' the recent brutal attacks carried out in France by Islamist terrorists (one a Russian passport-holder in a Paris suburb, and three attacks by a Tunisian immigrant in the southern city of Nice) ties these acts of terror to Algeria, the Algerian war, and the 'collective psyche' of the Algerian

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revolution, even though these "heinous crimes [are] wholly unrelated to Algeria" (Ramdani 2021, p. 1).

Macron addressed the specific matter of identity among the postcolonial population living in France, saying, "we see children of the Republic, sometimes from elsewhere, children or grandchildren of citizens from immigrant backgrounds and from the Maghreb and sub-Saharan Africa revisiting their identity through a post-colonial discourse," calling this identity practice "a form of self-hatred" (quoted in McAuley 2020, p. 1). Here, we can see how identity and memory within the Algerian community becomes, from a French perspective, an indicator of community pathology – the Algerian War is not in the past, it continues on in both French and Algerian identity practices.

Some of my research respondents asserted the superiority of Algerian-origin peoples over the *français de souche*[9]. For instance, Lakhdar, a 48-year-old café owner, living in the 10th arrondissement, holds strong opinions about the differing work ethics he perceived between French and Algerian (particularly Berber Algerian) workers. Lakhdar hesitates to elaborate but admits that he does not typically hire French people to work in his café because "they are lazy" and unreliable. In Lakhdar's experience, his Berber employees work harder, stay longer, do not call in sick, and are reliable and easygoing. This positioning of himself (and his fellow Algerians/ Berbers) within French society is part of the relational process of identity formation.

Lakhdar identifies strongly as Algerian and feels disdain for the French. Lakhdar moved to France as an adult, after his parents and other siblings had immigrated to France. When asked about his identity, he says, "My name is Lakhdar, not François" and explains that he is always working to defend and take pride in his Algerian heritage. When Lakhdar was in his 20s, his father offered to help him file paperwork to change his name to something more French (a practice that Lakhdar says was common), but Lakhdar had no interest in becoming "François or Pierre" he says. Yet Lakhdar also shows a willingness to forgive, explaining that even though there was a war between his countries of France and Algeria, "the enemy is our friend."

In fact, Lakhdar sees Algerians as holding a privileged place in French society because of their victory in the war: "We have a special history with France, Algeria has made France what it is [today]" he says. Lakhdar offers examples of how he perceives Algerian immigrants to be more accepted in French society than Tunisians or Moroccans: "In Paris, more of the hotels and bars are Berber, the Moroccans are only butchers. Algerian people, we can do anything, but Moroccan and Tunisian people cannot." In these ways, Lakhdar understands his position as an Algerian in French society as subordinate, but he contextualizes his social position within an immigrant hierarchy where Algerians are placed above other immigrants. From Lakhdar's example, the tension between being at once privileged and disadvantaged is real; his practices of exclusion of other immigrants (and in some cases, the French) in a way that replicates the practices of exclusion by French society show the nuanced ways that Algerians occupy social positions of power and disadvantage simultaneously.

Lakhdar's identity practices follow anthropologist Michael Herzfeld's (2005) understanding of "cultural intimacy," which

he describes as "the recognition of those aspects of a cultural identity that are considered a source of external embarrassment but that nevertheless provide insiders with their assurance of common sociality" (p. 3). Herzfeld further understands stereotypes, woven into the social fabric of a society, as generalizations that are "by definition reductive, and, as such, always mark the absence of some presumably desirable property in its object." For Herzfeld (2005), stereotypes are "a discursive weapon of power" that inform how individuals articulate who they are in a wider social milieu (p. 202). Cultural intimacy can, in part, explain why Algerian immigrants and their descendants chose to migrate and live in France—there is a common sociality between French and Algerian individuals that ties them together. From an outside perspective, they systemic racism and exclusion experienced by Algerian immigrants and their descendants can be interpreted as a reason to live elsewhere, but when interpreted from within the paradox of France and Algerian relationships, it is a factor of cultural intimacy that ties these groups (and identities) together.

Algerian Identity: Exclusion from 'Frenchness'

The examples described thus far demonstrate how Algerian immigrants and their descendants continuously reproduce stark binaries between Algerian and French identities, indicating a pronounced sense of alienation from French society. The constructs of Algerianness (e.g., hospitality, dedication to family, revolution) become meaningful to individuals in their everyday lives. Identity formation is taking place relationally, with Algerian-origin individuals formulating a sense of who they are through interactions with fellow Algerian-origin people and with non-immigrant French people. This involves a degree of self-stereotyping, as well as a stereotyping (both positive and negative) of other groups. A key point is that the Algerian identity expressed by my respondents, while drawing on historical memories of Algeria and performed through visits to Algeria or the replication of "typical" Algerian behaviors, is not a simple 'carry-over' from the 'old country.' It involves an active production of community and belonging and the attribution of meanings to one's own behavior and experience. This becomes especially evident in cases where respondents have "failed" in their efforts to be French and have made a conscious choice to identify more closely with their Algerianness.

To elaborate, some of my respondents described their efforts to be French and to conform with the expectations of membership in French society, only to be rejected and rebuffed. For some, then, the adherence to an Algerian identity and an explicit rejection of French identity comes from tangible reminders that they are not French, rather than an incapacity to assimilate, or a choice not to assimilate. Some of these respondents viewed education or social status as their tickets into the majority French identity but found themselves reconnecting with their Algerian identity in the face of discrimination and exclusion. For example, Sakina, a 31-year-old daughter of immigrants, living in the 20th arrondissement, has developed a strong association with her parents' homeland over the course of her child and adulthood. Growing up, Sakina excelled in school, often despite discriminatory treatment from her teachers for being Algerian. Sakina explains that she was expected

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to work harder in school to prove herself next to her French peers, and she finished high school second in her class. She earned her bachelor's degree in Lille before moving to Paris to find work. Though she is from a working-class background (her father was a manual laborer, her mother stayed at home), Sakina has achieved a tenuous status within the middle-class with her job at an advertising firm in Paris.

Sakina describes that while she presents herself as (and feels) French (e.g., "French" clothing, French language without accent, etc.) she is still frequently singled out as "Algerian" by her name and skin color. Sakina describes the inhospitable environment in France for people of Algerian descent and her personal experiences of racism, stating that she has "experienced racism all my life." She describes times during her childhood, growing up in Lille, where she felt more racism than in metropolitan places (e.g., Paris). People would regularly yell at her, "You're not in your country!" When she was growing up, if her father was late coming home at the end of the day, she assumed it was because the police stopped him, as this was just a normal part of her life.

Sakina told me of an experience when a French coworker was surprised that she spoke so many languages (she speaks six languages); Sakina took offense to this perception, feeling that people assume she is uneducated because she is of Algerian descent. In another example from work, she says that she is not included in what she perceives as the "French" social groups – she describes her cohort (women around the same age, also single, etc.) who regularly go out for drinks after work – an event that Sakina is never invited to: "Maybe it's because I don't drink [alcohol] that they don't ask me [to join them]", she says. Many interview participants identified drinking alcohol[10] as a marker of difference between Frenchness and Algerianness. Sakina's exclusion from socializing with her coworkers, and the social networking benefits within that everyday activity speak to the settings in which these experiences of exclusion occur.

Sakina, in some ways, is an 'ideal' second-generation immigrant who tries to "earn her Frenchness" through hard work in school and her career. Yet though she possesses the degree and the career, she has still experienced rejection in these areas, causing her to turn toward her Algerian roots and become involved with the local Berber Cultural Association in Paris, where she spends most of her free time. Sakina had always felt alienated from French society, yet it was not until adulthood that she developed, and began to act upon, a stronger attachment to her Algerian roots. Having once identified as French, she now distinctly claims an Algerian and Berber identity.

The feelings that Sakina describes of being excluded from French society are echoed by Ferhat, a 45-year-old son of immigrants, living in the 19th arrondissement. Initially in our interview, he proudly declared "I am French!" However, he followed this by discussing his struggle with identity. Like Sakina, Ferhat spent his younger years in pursuit of Frenchness, yet, over time and after experiences of exclusion, he admits, "When I look in the mirror, all I see is my parents' Algerian son." Consequently, his feelings of Frenchness are countered by his feelings of rejection from French society. Ferhat speaks of childhood experiences at school when he found himself only around other children of immigrants. He grew up in the *banlieue* and does not have memories of "French" classmates.

When he went to university in Paris, he, like Sakina, was not included within the social activities of his French classmates. Ferhat talks indirectly about desperately wanting to acquire more "Frenchness" because he is French. For example, from the time he arrived as his university, he was drawn to French philosophers' work, "especially if they do not believe in God," because it provided a perspective that he did not get from his Muslim upbringing. Ferhat's attempt at gaining Frenchness through embracing French philosophy and gaining expertise in French subject matter did not achieve the desired result of acceptance within French society. As much as Ferhat tries to fit in as "French", he has repeatedly fallen short of his goal and describes painful experiences of exclusion from French society.

Though he grew up around other immigrant families, Ferhat's childhood experiences were different from others in his generational position in that he has only been to Algeria twice – once at age 16 and again at age 24. His family does not make the typical yearly trip to see his extended family and he does not feel a connection to Algeria in the same way that other participants describe. Most notably, he does not have Algerian citizenship, only French.[11] Further, Ferhat does not speak Arabic, though he understands a little bit of the language. His parents spoke Algerian Arabic sometimes when he was a child but wanted him and his five siblings to speak only French. Here, Ferhat represents a sort of 'double-exclusion' where he is not accepted within 'French' society and has not fully developed a connection to "Algerian" identity, thus, he experiences feelings of isolation between his French and Algerian identities.

Algerian Identity: Identity and Social Categories

The examples presented thus far from interview participants highlight the complexity of cultural identity and social categories. My interviews with individuals of Algerian origin reveal a wide variety of values and meanings attached to their identity practices, as well as many contradictions and ambiguities in their understandings of self and other. Being an immigrant in a nationally defined polity requires the comprehension of categories and hierarchies as well as navigation of membership within these categories. Despite adopting a somewhat combative stance toward France and French identity – treating Frenchness as the opposite of Algerianness – many of the research respondents do incorporate French identity into their own identities and reconcile what might otherwise seem like mutually exclusive constructs. My study participants may see themselves as Algerian, but they also understand that being Algerian does not mean that they are completely isolated from Frenchness. In this way, being "Algerian" or 'French' is a matter of degree, content, and situation rather than a static or zero-sum state of being. As might be expected, my second-generation respondents consistently displayed an increased capacity to explore different identities and to challenge or reject certain elements of identities. Engaging with multiple identities destabilizes the assumed boundaries between "Frenchness" and "Algerianness" and, paradoxically, also works to reinforce them.

In other words, "paths of integration" are neither clear-cut along generational lines nor unambiguous in their endpoints.

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First- and second-generation respondents alike embraced and rejected both French-coded and Algerian-coded norms and values. What is clear from the narratives in this chapter is that that French national identity, despite the pretentions of French national discourse, is not universal, but particularistic. While my respondents vary in their attitudes and stances toward Frenchness, the fact of their need to consider how or whether they can be French tells the lie of French cultural neutrality.

DISCUSSION

In the previous sections, I have shown how Algerian immigrants and their descendants in France draw on multiple, intersecting, and sometimes contradictory identities simultaneously, and how identities emerge from interactions with others in particular settings and contexts. Acts of negotiation and arrangement of identities vary within the study population; the constructs of French and Algerian identities work together for some individuals and collapse for others. The ways that different components of identity work together for individuals are indicative of the intersectional quality of Algerian identity in France. The meanings attached to certain identities reflect stereotypes and prejudices, impressions and experiences; thus, contradictions are woven throughout the identity expressions presented in this article.

This article argues that the socio-cultural norms that define French identity and that form the basis of membership in the French polity took shape through the colonial encounter. After the 1789 Revolution in France, the term "empire" "...came to denote the personality of the entire French nation" and the "unification of disparate local groups into a single whole" (Pagden 2001, p. 132). However, for immigrants to enter the national community of France, it has been necessary to master the attributes, habits, dispositions, and mores of French society and culture, as defined by the French political elite (Fogerty and Osborne 2003). When the French empire undertook their *mission civilisatrice* to civilize the native people of its colonies, concepts of "civilized" and "uncivilized" were created with reference to an idealized, universal French culture. Historically in France, there have been clear lines to distinguish those "who did and did not have the right to be seen, and see themselves, as French" (Welch and McGonagle 2013, p. 3).

French racism has continued to deepen the divide between people of Algerian descent and other post-colonial immigrants, on the one hand, and European-origin French citizens on the other. This racism has been self-sustaining: "once anti-Algerian racism had been established and consolidated it, like anti-Semitism, was able to take on a 'life of its own,' a kind of autonomy, and to reproduce itself through time regardless of changes within the economy and regardless of the degree of Algerian incorporation/integration into French society" (MacMaster 1997, p. 222).

Throughout the Franco-Algerian relationship, notions of "us" and "them" show up again and again, and like their predecessors, contemporary French governments continue to draw lines between "those they deem unworthy of, or unable to access, "Frenchness," and those who are seen as properly "French" and "Republican" (Tchumkan 2015, p. 1). The polarization of official rhetoric in France between 'us' and 'them'

reveals that the notion of Frenchness continues to be highly selective and is developed to keep Algerian immigrants and their descendants out of socially accepted concepts of Frenchness. Citizenship and belonging for those of Algerian origins has been, and continues to be, tenuous and partial. Social alienation of Algerians is occasionally attributed to intentional acts of Algerian-origin individuals to differentiate themselves from French society (cf., Costelloe 2015; Driggers 2018); my findings indicate that more often, intentional acts of separation are only taken after the failure of attempts to join or be included within French society.

Still, there is further need to look beyond the historical drama of colonialism and structural racism and consider in more detail the ways that immigrants themselves negotiate membership in contexts of settlement and origin. To understand the experiences of Algerian immigrants and their descendants in France, it is necessary to contextualize their experience within a historical-structural framework that includes postcolonialism. The grand narrative of colonial and postcolonial analysis can erase the individual agency of immigrants and the fluid co-production of contemporary national societies. To avoid the decontextualized analysis that assimilation studies are often faulted for, this research seeks to engage not only with the global level of postcolonialism, but also with the more intimate scale of individual existence and experience – to consider what race, identity, and the postcolonial mean in the innumerable encounters between immigrants and non-immigrants that occur in everyday places and spaces. This research aims to understand integration by bridging the scalar gap between global postcolonialism and personal everyday politics, and by exploring social interactions that take place simultaneously across urban landscapes and nation-state borders.

This approach asks how relationships of power and domination persist over time and how politics interfere in the efforts of immigrants to seek entrance to national society. In the case of Algerians, dominant constructions of French society can be subverted by referencing Algeria's rebellion against and defeat of French colonialism. This shared sense of solidarity among a "victorious" Algerian population is sometimes shared with immigrants from other former colonies. Yet, despite memories of French defeat, immigrants find themselves in a subordinate position to their former colonizer, which frames its particularisms as the universal traits of belonging. This can motivate some racialized immigrants and minorities to adopt assimilatory behaviors (i.e., conformity) rather than experience marginalization and exclusion from the spheres and spaces of mainstream French society. Others, of course, might bristle against dominant constructions of host-society identity. In either case, postcolonial scholarship urges us to recognize the political acts involved in the everyday life of immigrants.

I have explored the experiences of Algerian immigrants and their children, examining how they enact identity and belonging in French society, and how they navigate systems of racialized exclusion. The narratives of my study respondents reveal the varying ways that formerly colonized people structure their interactions and engagements with people and institutions who once subjugated them and who largely continue to view them as outsiders and foreigners. These narratives show how, in such circumstances, former colonial subjects might exercise

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some agency in formulating their identities and their sense of community within the former metropole. Untangling colonial histories is key to understanding the immigration politics in France today, and in many other postcolonial contexts. France and Algeria are forever imbricated, and the colonial past continues to haunt the presence. Violent events in the French colonial past have led to feelings of distrust toward Islam in French society (Bancel et al. 2005). At the same time, memories of the Algerian War and of the highly discriminatory treatment of Algerians both before and after independence inform my respondents' understandings of their position in France and of the possibility (or lack thereof) of equality. French society has unquestionably been (and continues to be) influenced by transnational historical forces that alter the ways in which immigrants integrate into, or experience exclusion from French society.

ENDNOTES

1. All names of interview participants are pseudonyms.
2. The terms integration and assimilation have been used and criticized in academic and public discourses. Integration is often viewed as a less-aggressive form of assimilation where an immigrant is incorporated into the host society without forced cultural homogenization, whereas assimilation demands immigrant sameness with the host society by abandoning cultural traits from the home-country. In this article, I treat the concepts similarly as they are concerned with the extent to which immigrants come to resemble society at large.
3. *Maghreb* is an Arabic term that references a region in Northwest Africa stretching from Mauritania to Libya (Maghreb Studies Association 2021). General use of the term (from colonial times to the present) refers to Morocco, Algeria, and Tunisia. 'Maghrebi' refers to a person with North African heritage.
4. According to Loïc Wacquant (2007), the term *banlieue* technically refers to a "peripheral urban county or township administratively attached to a larger urban center" (p. 32). However, since the 1980s, the term has come to denote any working-class area with high densities of deteriorating public housing and is considered "prime breeding grounds for urban ills such as crime, physical dilapidation, economic deprivation, and immigration" (Wacquant 2007, p. 32).
5. The *mission civilisatrice* was a secular notion that rested upon certain fundamental assumptions about the superiority of French culture and the "perfectability of humankind," and it implied that the French were particularly suited to carry out this task by temperament and by virtue of their revolutionary past and their industrial strength (Conklin, 1997, p. 1).
6. Snowball sampling is a technique for finding research subjects where one subject refers the researcher to another subject, who in turn provides the name of a third, and so on (Vogt, 2005).
7. The FLN is the *Front de Libération Nationale* (The National Liberation Front), established in October of 1954 (Stora 2001).

8. By 1962, there were 1.5 million Europeans, *colons* or *pied noirs*, living in Algeria (Choi 2016, p. 1). For reference, there were just 500,000 Europeans living in colonial Morocco (de Azevedo 1994, p. 25).
9. The term *français de souche* translates to 'native-born French' or 'ethnic French.' The term is used to delineate those with a dominant group (French) ancestry and those without (immigrant) (Décimo, 2013).
10. Participants also identified drinking alcohol as a marker of integration, such that, if a person drinks alcohol, they are 'integrated.'
11. Ferhat is the only second-generation Algerian who did not hold dual citizenship in France and Algeria from the group of research participants interviewed for this research.

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Elizabeth Nelson is a geographer specializing in cultural geography. Currently, her research examines Algerian immigrant integration in France with a focus on identity, religion, and spatial practices. With research experience in France, Algeria, Montserrat, and the U.S., her studies have covered topics ranging from renewable energy in the American Southwest, to the geomorphological landscapes of the West Indies. In the classroom, Dr. Nelson focuses on providing her students with the conceptual tools to critically assess and understand the contemporary world.
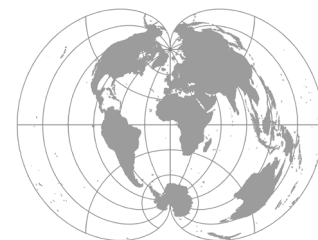
Aerosol Concentration and Atmospheric Conditions:
A Case Study at Granite Island, Michigan

Elizabeth Hoffmann[1], Fred Denn[2,3], Bryan Fabbri[2,3], Jay Madigan[2,3], and Susy S. Ziegler[1]*

[1]*Department of Earth, Environmental, and Geographical Sciences, Northern Michigan University, Marquette, MI, USA*
[2]*Science Systems and Applications, Inc. (SSAI), Hampton, VA, USA*
[3]*NASA Langley Research Center, Science Directorate, Hampton, VA, USA*

[*] *Corresponding author: ejh257@gmail.com*

ABSTRACT

The Granite Island Aerosol Robotic Network (AERONET) location became a new ground-based remote sensing aerosol site in 2018, and is the first site to collect aerosol data in Michigan's Upper Peninsula using a Cimel sun photometer. The purpose of this study was to analyze the first complete year (2019) of AERONET data collected at Granite Island, Michigan, and to seek explanations for sudden increases in aerosol optical depth (AOD) values. The Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery, solar irradiance data, and meteorological data were used in conjunction with AERONET data for further validation. Granite Island had fairly low AOD levels during 2019, with a few exceptions. The highest AOD levels of the year were measured on July 7, 2019 and coincided with distant wildfires adding particulates to the air. MODIS satellite imagery and solar irradiance data corresponded with the short-term high AOD levels observed at Granite Island, validating the AERONET measurements.

Keywords: *Aerosol Optical Depth (AOD), Aerosol Robotic Network (AERONET), Baseline Surface Radiation Network (BSRN), Clouds and the Earth's Radiant Energy System (CERES) Experiment, Moderate Resolution Imaging Spectroradiometer (MODIS), Solar Irradiance*

INTRODUCTION

The Aerosol Robotic Network (AERONET) is comprised of 879 sites worldwide as of 2022, however not all sites are currently active (Giles 2022). These sites each have Cimel Electronique Sun-sky radiometers, which are used to provide ground-truth measurements for aerosol data (Giles, et al. 2019). Aerosol data can help to monitor air pollution, understand how particulates circulate in the atmosphere, and make sense of how aerosols affect fluctuations in the Earth's radiation budget.

The National Aeronautics and Space Administration (NASA) partnered with Scott Holman, the owner of Granite Island (Figure 1), which is along the southern shore of Lake Superior about 18 km (11 mi) offshore from Marquette, Michigan's Lower Harbor (Evans 2018; *Granite Island Light Station - Lake Superior* 2018). In June 2018, government contractors from Science Systems and Applications, Inc. established a new surface-validation site for satellites that contributes to a NASA project known as the Clouds and the Earth's Radiant Energy System (CERES) project (Evans 2018). A suite of radiometric and meteorological instruments, including a Cimel sunphotometer, were installed. As of 2022, the only operational AERONET site in Michigan's Upper Peninsula was this station named Granite_Island (46.721 N, 87.412 W) (Giles 2022). The next closest active AERONET site is NEON_UNDE, 200 kilometers away in Land O' Lakes, Wisconsin, (46.234 N, 89.537 W), established in December 2014 (Figure 1) (Giles 2022).

The objective of this case study was to analyze the first complete year (2019) of AERONET data at Granite Island to assess the air quality of the Marquette, Michigan, region based primarily on aerosol content. A Cimel sun photometer (Figure 2) measured the concentration of aerosols in the vertical column of atmosphere above Granite Island and interpreted the values as aerosol optical depth (AOD). The Cimel measures direct and diffuse multiband radiance at wavelengths ranging from 340 nm to 1640 nm. The Cimel determines AOD by observing how much sunlight attenuates to the Earth's surface after

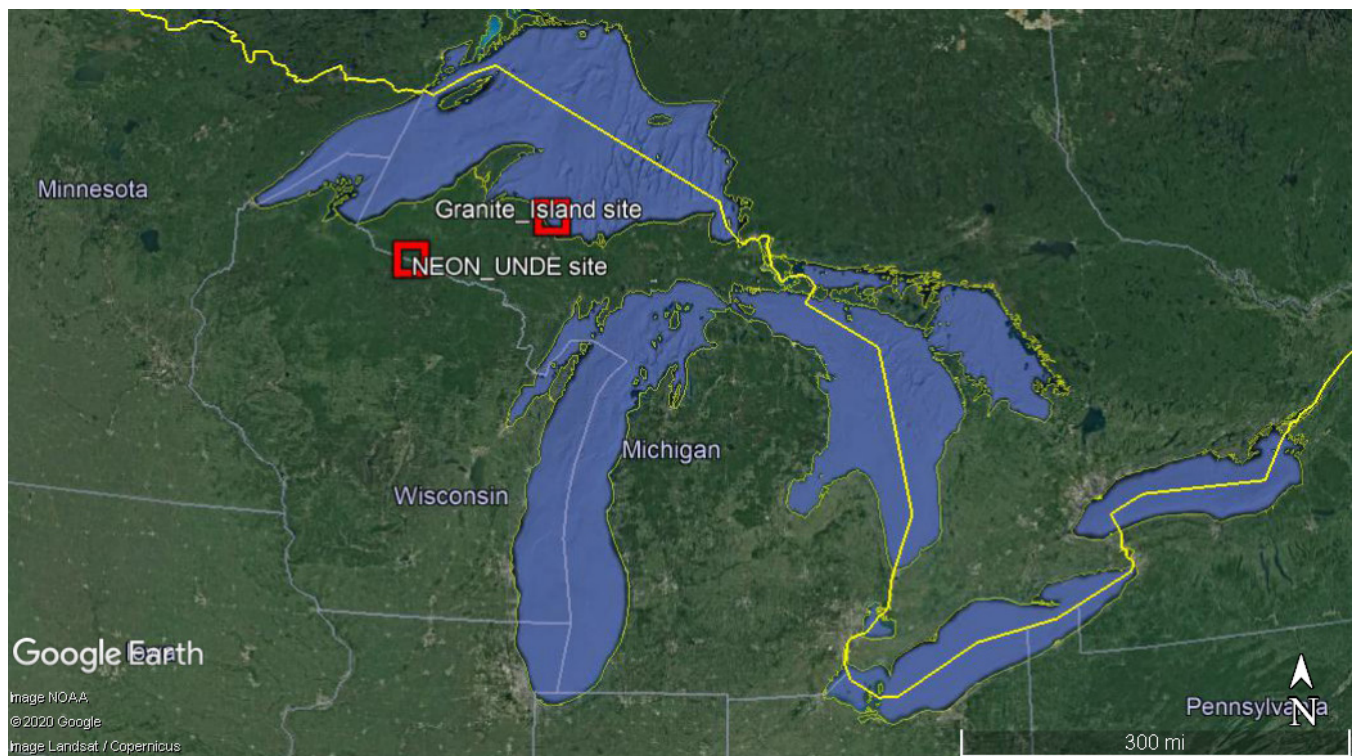*Elizabeth Hoffmann, Fred Denn, Bryan Fabbri, Jay Madigan, and Susy S. Ziegler*

Figure 1. Great Lakes region of the United States and Canada (north of the yellow line). The red boxes indicate the only two active AERONET locations in or near the Upper Peninsula of Michigan. Granite Island is the site of this study. The Granite_Island site is in Lake Superior, 18 km offshore of Marquette, Michigan. The NEON_UNDE site is 200 km away in Land O' Lakes, Wisconsin. Source: Google Earth.

Figure 2. A Cimel sun photometer collecting aerosol data at NASA Langley Research Center. Photo taken by first author.

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interacting with the aerosol particulates in the atmosphere. The remaining amount of sunlight to reach the surface depends on how it is scattered, absorbed, or reflected by those aerosol particulates (U.S. Department of Commerce, NOAA 2020). By observing AOD levels, we can determine localized air quality of a region and understand how relatively safe or harmful the conditions are to our health. We sought to explain sudden increases in the AOD levels by locating sources of polluted air parcels using Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery. Solar radiation and meteorological data collected at Granite Island were used to cross-reference the AERONET data.

BACKGROUND LITERATURE

Aerosols, or particulate matter (PM), are tiny particulates of solid material suspended in the Earth's atmosphere differing in size, shape, texture, chemistry, and origin source. Air currents can transport suspended aerosols different distances depending on their lifetimes and the fetch—how far the wind blows over water without changing direction (Ramachandran, Rajesh, and Kedia 2019). Aerosols also absorb and reflect incoming direct solar radiation and have been shown to cause a cooling effect at the Earth's surface where higher concentrations of aerosols are present (Srivastava, et al. 2012; Voiland 2010). As incoming solar radiation enters the atmosphere it reacts with the aerosols before reaching the Earth's surface, therefore the ground surface does not warm as much as it would have. If aerosols absorb

more sunlight than they reflect, this can lead to atmospheric heating in the layer where aerosols are present (Voiland 2010). Aerosols serve as condensation nuclei for water vapor, which facilitates cloud formation (Ramachandran, Rajesh, and Kedia 2019; Voiland 2010). An increased presence of aerosols in the atmosphere may lead to conditions more favorable for cloud formation. As a result of high aerosol concentration, more radiation is either reflected back toward space or absorbed by the aerosols in the clouds, depending on the aerosol type.

Aerosols originate from both natural and anthropogenic sources, about 90% and 10% respectively by mass (Voiland 2010). Natural sources include volcanic ash, dust or soil from dust storms, sea salt from ocean spray, pollen, and smoke particulates from wildfires (Chin, et al. 2007; Ramachandran, Rajesh, and Kedia 2019; Voiland 2010; Zhang, et al. 2018). Anthropogenic sources mostly include agricultural fires and the wide variety of combustion emissions for transportation or industrial uses (Chin, et al. 2007; Ramachandran, Rajesh, and Kedia 2019; Voiland 2010; Zhang, et al. 2018). When comparing natural and anthropogenic aerosols, the latter causes more serious consequences to human health due to their physical properties. Impacts on human health have been assessed and have resulted in prediction modeling of aerosol transport in an effort to notify the public to reduce exposure to unsafe conditions. Because PM sizes are determined by AOD measurements, AODs can help decipher whether conditions are safe or hazardous. AOD is a unitless value that is, "related to the amount of aerosol in the vertical column of atmosphere over the observation location" (U.S. Department of Commerce, NOAA 2020). It describes the relationship between aerosol concentration and how much direct sunlight is prevented from reaching the Earth's surface (U.S. Department of Commerce, NOAA 2020). AOD indicates how clean or dirty the atmosphere is at the study site. According to NOAA, extremely clean conditions correlate to AOD of 0.01, and very hazy conditions to AOD of 0.4 (U.S. Department of Commerce, NOAA 2020).

Similarly, weather patterns could also affect wind direction on a synoptic scale as fronts pass over a location. Wind speed may either help or hinder transport of aerosols and affect "mixing-related changes to aerosol optical depth" (Chin, et al. 2007). Seasonal trends in AODs could be observed when comparing levels during different times of the year. An example would be during the northern hemisphere's summertime. When the jet stream is farther to the north, air currents could carry biomass aerosols from wildfires along the northern West Coast of the United States to the East Coast (Eck, et al. 1999) which is the slope of the logarithm of aerosol optical depth (τa. A study of surface PM and column aerosols at a rural site in New Hampshire presented results stating that the highest AOD levels occurred during the summer months and the lowest AOD levels occurred during the winter months (Slater and Dibb 2004).

Granite Island, located fairly close to shore in Lake Superior, could show diurnal AOD patterns that match either inland or coastal characteristics. Lennartson et al. (2018) found that "the coastal sites have lower average values near 0.3 at 550 nm while the inland sites have higher values near 0.4" (Lennartson, et al. 2018)both long term and short term, is studied by\nusing

9 AERONET (AErosol RObotic NETwork. Lennartson, et al. (2018) advised using a minimum observation of two years for coastal sites to recognize normative diurnal patterns (Lennartson, et al. 2018)both long term and short term, is studied by\ nusing 9 AERONET (AErosol RObotic NETwork. Because the AERONET site was established in 2018 and our study analyzed the first year (2019) of complete data, further analysis over multiple years is needed to help determine whether Granite Island fits better under the inland or the coastal category.

METHODS

Data Collection

Data for this study were acquired through the AERONET home website, regulated by NASA's Goddard Space Flight Center (Giles 2022; Holben 2020). Data are available to the public and can be downloaded by year, month, or day for each site. We used Version 3 of the AERONET database for this study, which improved on Version 2 by automating data quality confidence and updating cloud screening techniques to provide a more dependable database source (Giles, et al. 2019). From the same website, we acquired daily images from MODIS on the Terra and Aqua satellites. These satellite images were used to cross-reference the AOD levels observed.

Monthly solar radiation data for Granite Island were retrieved from NASA's CRAVE website (Schuster 2022). Solar irradiance is a measurement of radiant energy from the Sun that reaches Earth. Instruments, called radiometers, measure different kinds of solar radiation. Direct radiation is measured by pointing the radiometer toward the Sun with a 5-degree field of view. To measure diffuse radiation, the radiometer is shaded from the direct sunbeam, has a 180-degree field of view, and measures radiation scattered by molecules, aerosols, and clouds in the atmosphere. Global radiation is the total sky radiation – a combination of direct and diffuse radiation. The radiometer is exposed to the Sun and has a 180-degree field of view of the horizon. At Granite Island we compared the global, direct, and diffuse radiation data with the corresponding AERONET data. Meteorological data collected at Granite Island were obtained upon request from the station's managers.

Data Analysis and Interpretation

This study focused on three AOD wavelengths of visible light – 440 nm (blue), 500 nm (green), and 675 nm (red) – even though AERONET measures multi-band radiances. The visible wavelengths provided a sufficient overview of the atmospheric conditions and made it possible to compare with the other datasets from: Baseline Surface Radiation Network (BSRN), MODIS imagery, and meteorological data.

The 2019 Granite Island AERONET AOD data were organized, plotted, and analyzed with Excel 2016 and Igor Pro 8. Data associated with the three specific wavelengths were formatted and selected in Excel, and then transferred to Igor Pro. Igor Pro is a data analysis software program that allows the user to plot data in a more intuitive way than Excel. Using Igor Pro, the selected data were graphed, assigned colors to each wavelength to make for easier interpretation, and analyzed

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visually by individual days. The radiation and meteorological data were organized and graphed in Excel.

RESULTS AND DISCUSSION

The plotted AERONET data for 2019 revealed that the air around Granite Island, Michigan, was generally clean with a few exceptions (Figure 3). On only three days of the year did AOD levels rise above 0.5. July 7 had the highest AOD levels recorded for the year (Figure 4). The highest AOD levels of 2019 for wavelengths 440 nm, 500 nm, and 675 nm were 4.61, 4.60, and 3.68 respectively, and were measured on July 7 at approximately 9:00 pm UTC (or at approximately 5:00 pm EST local time). When cross-referenced with the MODIS satellite images (Figures 5a and 5b), it was apparent what presumably caused the extremely high AODs. Wildfires in western Ontario, Canada, had generated plumes of smoke that spread across much of the surrounding area. It is unclear from the MODIS imagery exactly when the wildfires started, but by July 4, smoke plumes were moving southeastward toward Granite Island. On July 6, the smoke plumes concentrated and approached Granite Island. Then on July 7, there was so much smoke that it nearly covered the entire Upper Peninsula of Michigan.

The BSRN data for Granite Island for July 7, 2019, was incomplete. Only the global and diffuse irradiance measurements were good for this day. The direct irradiance measurements were considered invalid and were not included because spiderwebs had accumulated on the instruments (Figure 6). However, the global irradiance dips noticeably at 6:00 pm and 9:00 pm UTC, which coincides with the two AOD level spikes on the same day. These decreases in global irradiance implies that the smoke was thick enough to obstruct the sun. The BSRN data corresponds with the aerosol data and the images captured by MODIS Terra and Aqua.

We also considered the meteorological data (air temperature, relative humidity, and air pressure) collected at Granite Island during July 7, 2019 (Figure 7). The air pressure changed minimally throughout the day – only a range of 996.0 mb to 998.8 mb – and steadily decreased after reaching a maximum air pressure of 998.8 mb at noon on July 7. The air temperature was steady throughout the day and night. The relative humidity slowly increased and oscillated until 11:16 am UTC, when it reached the maximum relative humidity of 98.2% for the day. It then slowly decreased to approximately 80% and held steady from 2:30 pm UTC to just before 6:00 pm UTC.

The only other day in 2019 that showed exceptionally high AOD levels was on May 31, with levels at almost 2.0. Although this second spike in aerosols probably was also the result of a wildfire, the source was a greater distance away than the fire in early July. The MODIS satellite imagery zoomed out to show nearly all of North America (not included in this paper) shows a possible source of the discolored stretch of clouds. They seem to have developed either in the mountains of the U.S. state of Montana, or in the Canadian province of Alberta over 2,000 kilometers away.

In contrast, the day with the cleanest air for 2019 was January 4 (Figure 8). The lowest AODs measured for that day were 0.033, 0.020, and 0.012 for wavelengths 440 nm, 500 nm, and 675 nm respectively. The BSRN data for January 4 were good only for global irradiance. It is possible that a strong storm mis-aligned the solar tracker in late 2018 and affected the diffuse and direct radiation measurements. Global radiation data indicate that there were scattered clouds with varied thicknesses throughout the day and it was partly sunny (Figure 9). There is enough of a bell-curve to the global irradiance to indicate some sunlight made it through the clouds, but also jagged enough of a curve to indicate that it was also cloudy, with the thickest cloud cover occurring around 4:15 pm UTC. This observation seems to agree with the aerosol data for Janu-
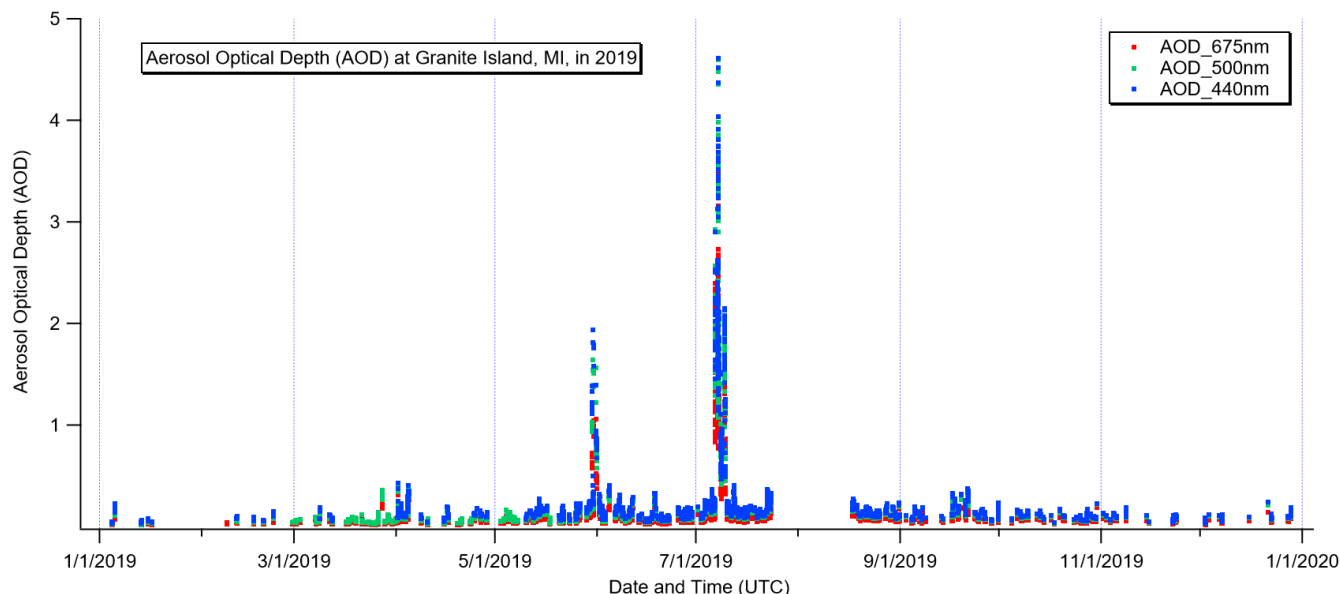

Figure 3. Three visible wavelengths of aerosol optical depths recorded at the Granite Island AERONET site for the entire 2019 year. Downloaded data courtesy of The International AERONET Federation and NASA Official Brent Holben.

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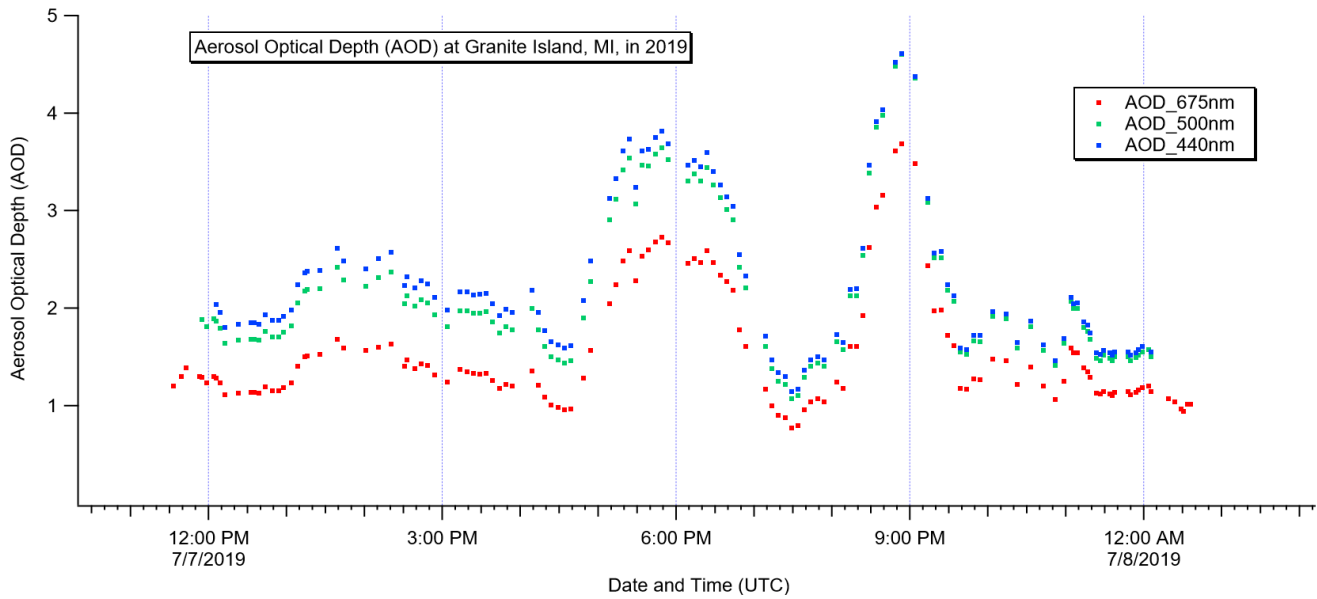
Figure 4. AERONET data recorded the highest AOD levels of 2019 on July 7. These extremely high AOD levels were probably the result of wildfires in Canada about 1000 km northwest of Granite Island.
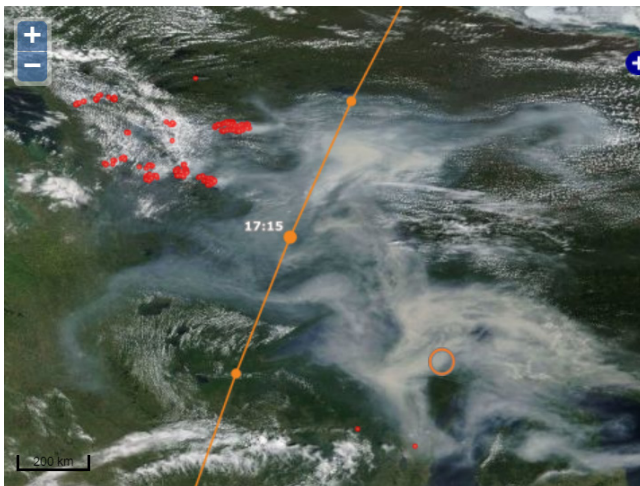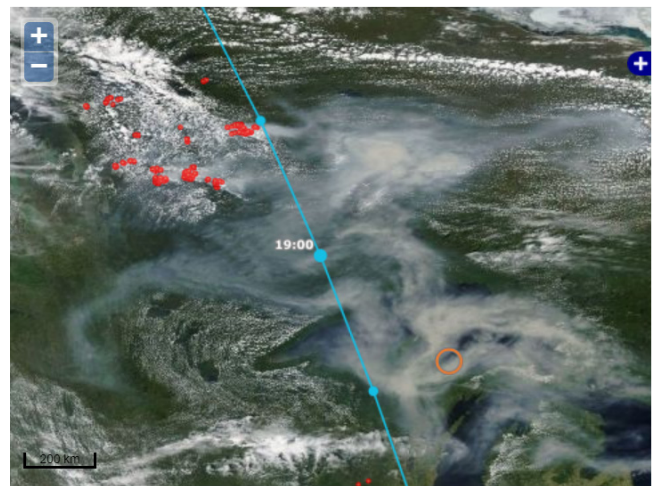
(a)   (b)

Figure 5. (a) MODIS image from Terra satellite of the Upper Peninsula on July 7, 2019 around 17:15 UTC. (b) MODIS image from Aqua satellite of the Upper Peninsula on July 7, 2019 around 19:00 UTC. The gold ring in each image indicates Granite Island's location. The red patches in the top left part of the images indicate active wildfires. Particulates from wildfires in Canada extended over most of Michigan's Upper Peninsula on this date. Source: https://go.nasa.gov/3co9nXd

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Global and Diffuse Irradiance at Granite Island on July 7th, 2019, Measured by NASA's GIMI_rad Station

Figure 6. Global and diffuse radiation at Granite Island on July 7, 2019. Only the global and diffuse irradiances were plotted because of data errors with the solar direct measurements.

Meteorological Data at Granite Island on July 7th, 2019, Measured by NASA's GIMI_met Station

Figure 7. Air temperature and relative humidity (primary Y-axis), and air pressure (secondary Y-axis) at Granite Island on July 7, 2019. Time of day (X-axis) is in Coordinated Universal Time.

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Figure 8. Zoomed-in view of the AERONET data on January 4, 2019. This day had the lowest AOD levels observed for 2019. The gaps in data during the daylight hours were because the Cimel parked itself during unfavorable weather conditions.
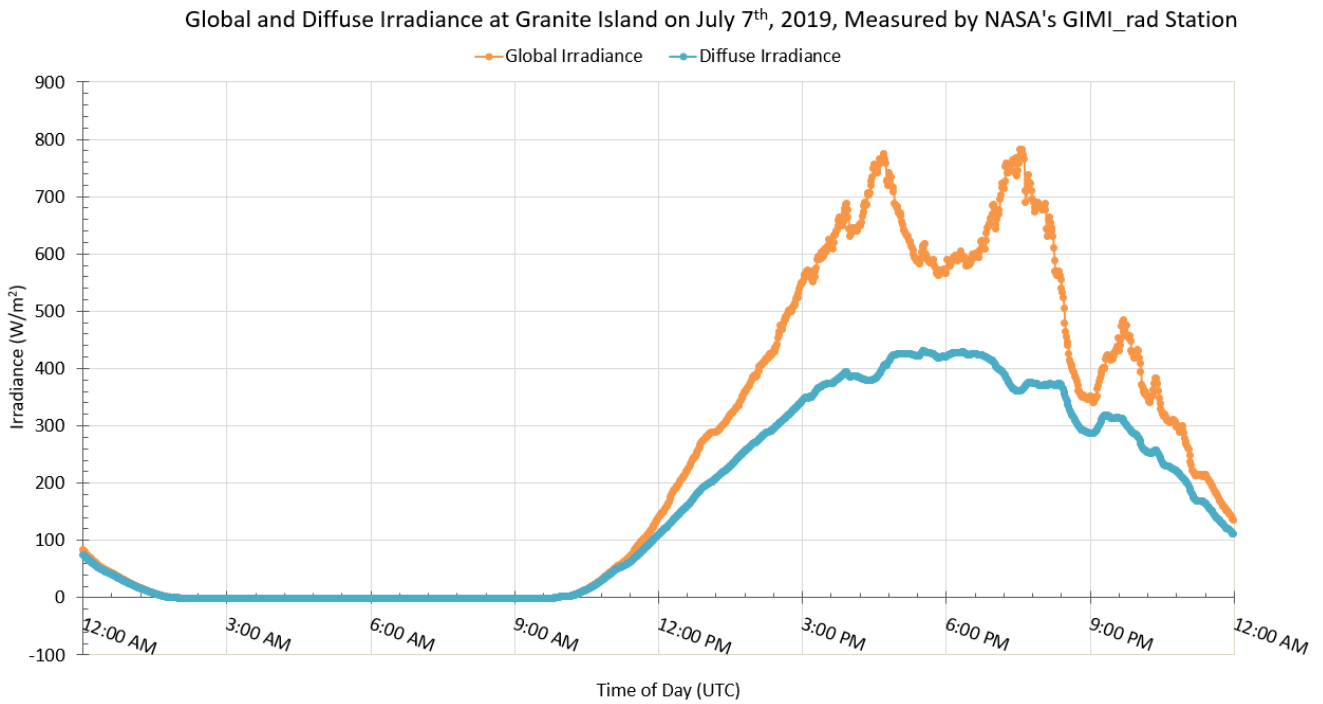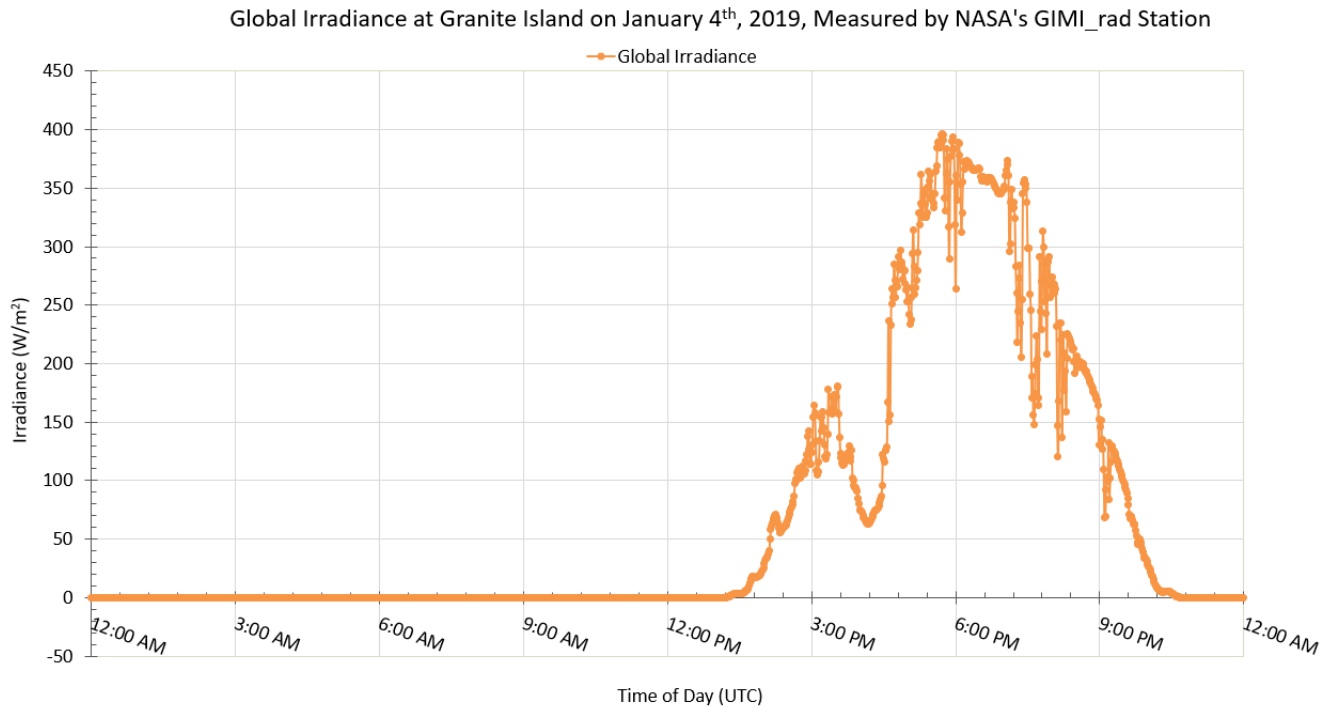

Figure 9. Global radiation at Granite Island on January 4, 2019. Only the global irradiance was plotted because of data errors with the solar direct and diffuse measurements.

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ary 4; the two groups of consecutive AOD data points (Figure 8) coincide with the times of somewhat clear skies (Figure 9).

On January 4 the air pressure remained low until midday when it increased by approximately 3 mb (Figure 10). The change in air pressure and increased relative humidity presumably correlated with the heavy cloud cover recorded at 4:15 pm UTC. Afterwards, both the air pressure and relative humidity decreased a small amount before continuing to increase after 7:45 pm UTC. The air temperature changed very little throughout the day, increased just before sunset, and then decreased after sunset (Figure 10).

Besides the two days with the highest and lowest AOD levels of the year, the majority of the 2019 AERONET aerosol data fell into two broad categories: varied conditions and steady conditions. Varied conditions, for which AOD levels either fluctuates throughout the day or notably increased or decreased, were a common pattern observed on many days throughout 2019. April 4, 2019 was chosen to represent varied conditions because the aerosol data for that day were most complete and the AOD fluctuations were distinct (Figure 11). The images taken by MODIS on April 4 (Figures 12a and 12b) show a snow-covered landscape, cirrus clouds over Granite

Meteorological Data at Granite Island on January 4th, 2019, Measured by NASA's GIMI_met Station
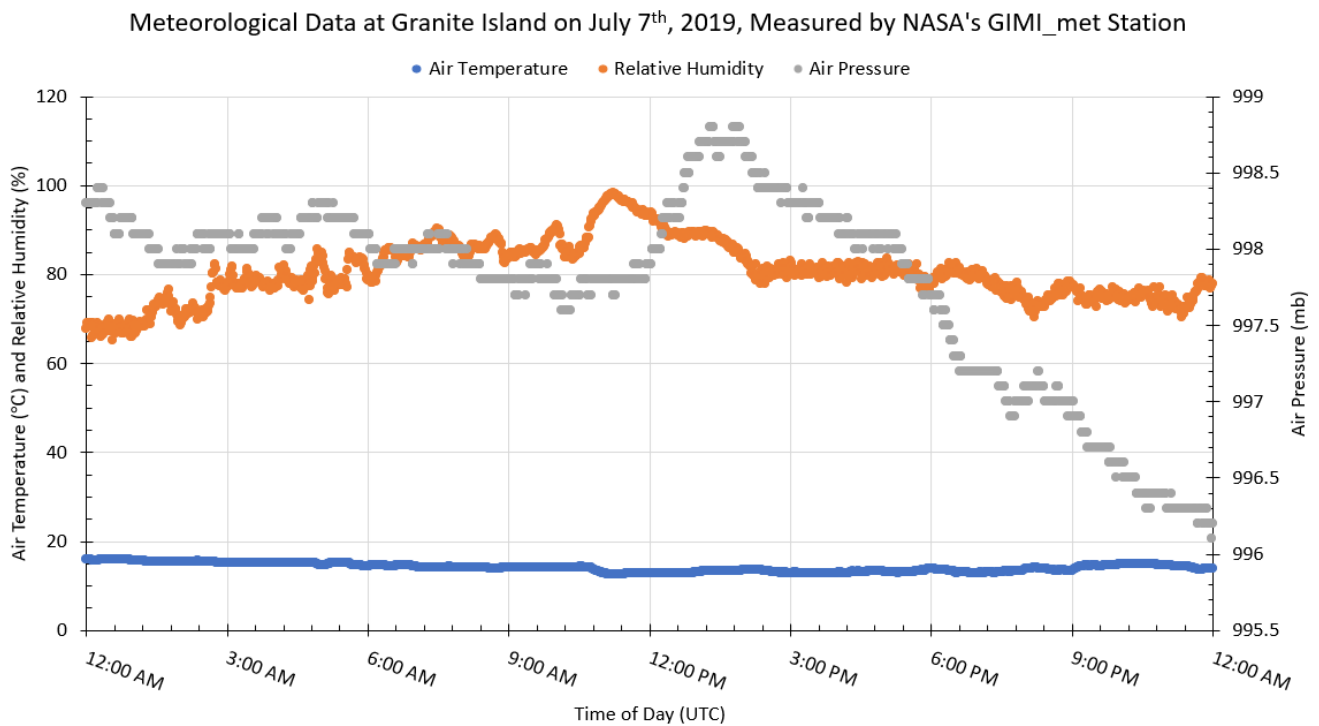

Figure 10. Air temperature and relative humidity (primary Y-axis), and air pressure (secondary Y-axis) at Granite Island on January 4, 2019. Time of day (X-axis) is in Coordinated Universal Time.
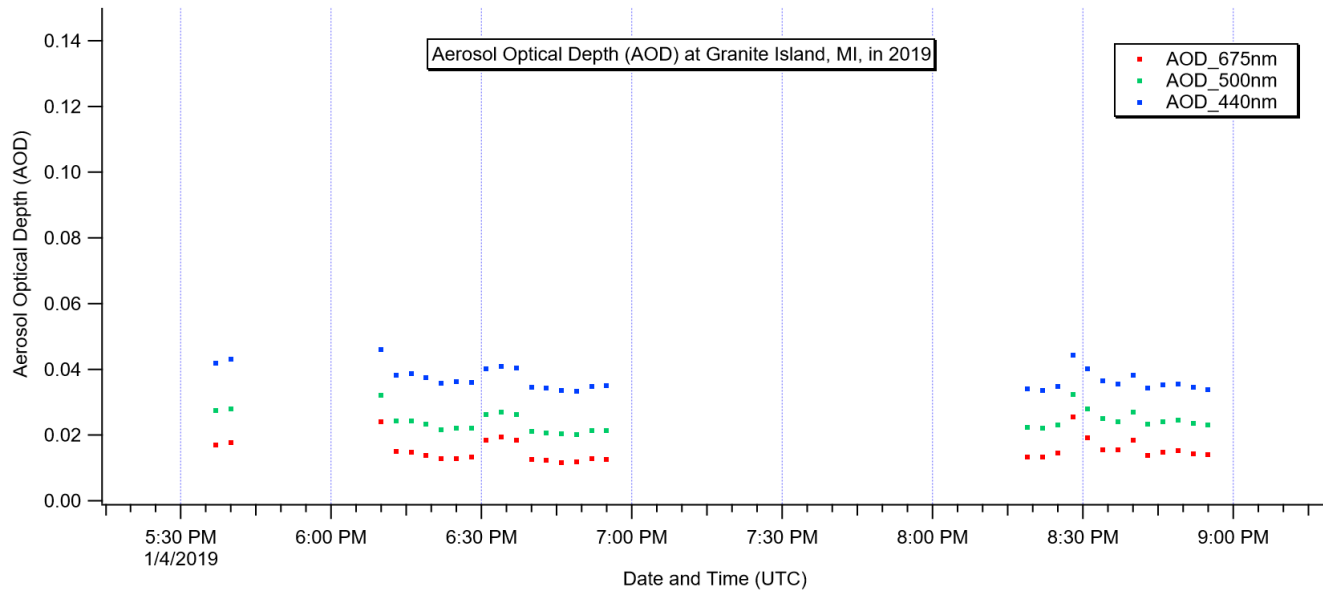

Figure 11. Zoomed-in view of the AERONET data for April 4, 2019. AOD levels varied throughout the day. AODs were low overall and the air was fairly clean.

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(a) (b)
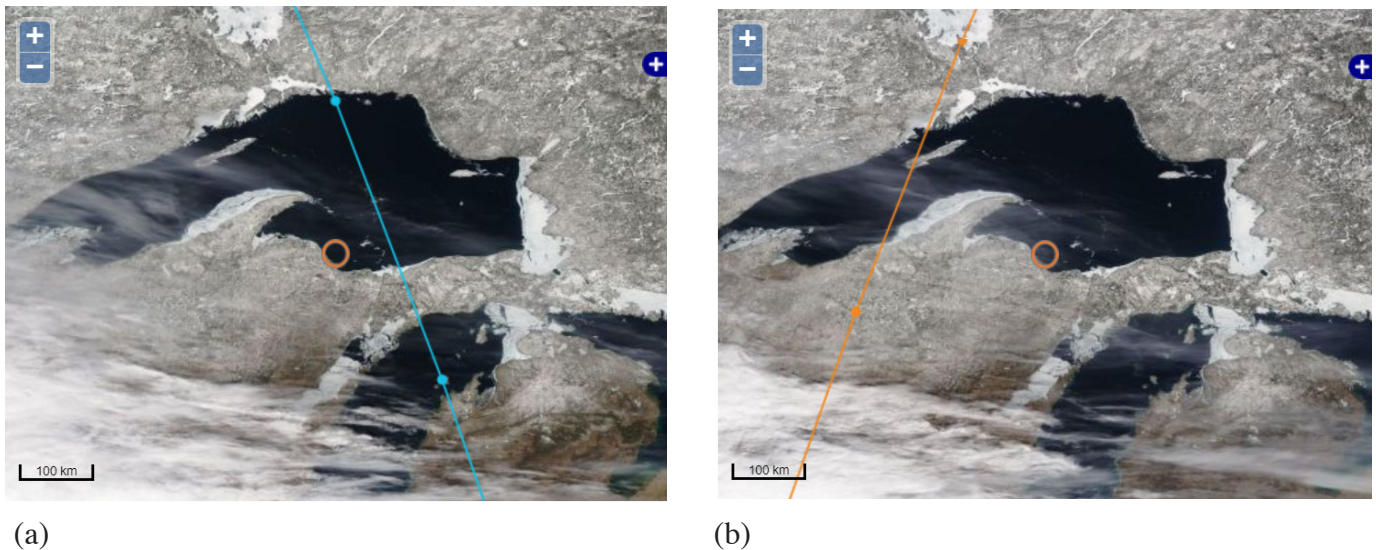
Figure 12. (a) MODIS image from Terra satellite of the Upper Peninsula on April 4, 2019 around 17:04 UTC. (b) MODIS image from Aqua satellite of the Upper Peninsula on April 4, 2019 around 18:46 UTC. Source: https://go.nasa.gov/3oxGo5F

Island, and the accretion of ice on Lake Superior and northern Lake Michigan that has been pushed by the east-bound winds.

The BSRN data for April 4 were good only for the global irradiance (Figure 13) because of issues with the solar tracker. The graphed irradiance for April 4 had a wider bell-curve range than on January 4 because of more daylight hours in April. A maximum global irradiance of 832.78 W/m^2 for April 4 occurred around 6:35 pm UTC. According to the BSRN and weather data, it was a mostly sunny spring day with some thin scattered cloud cover.
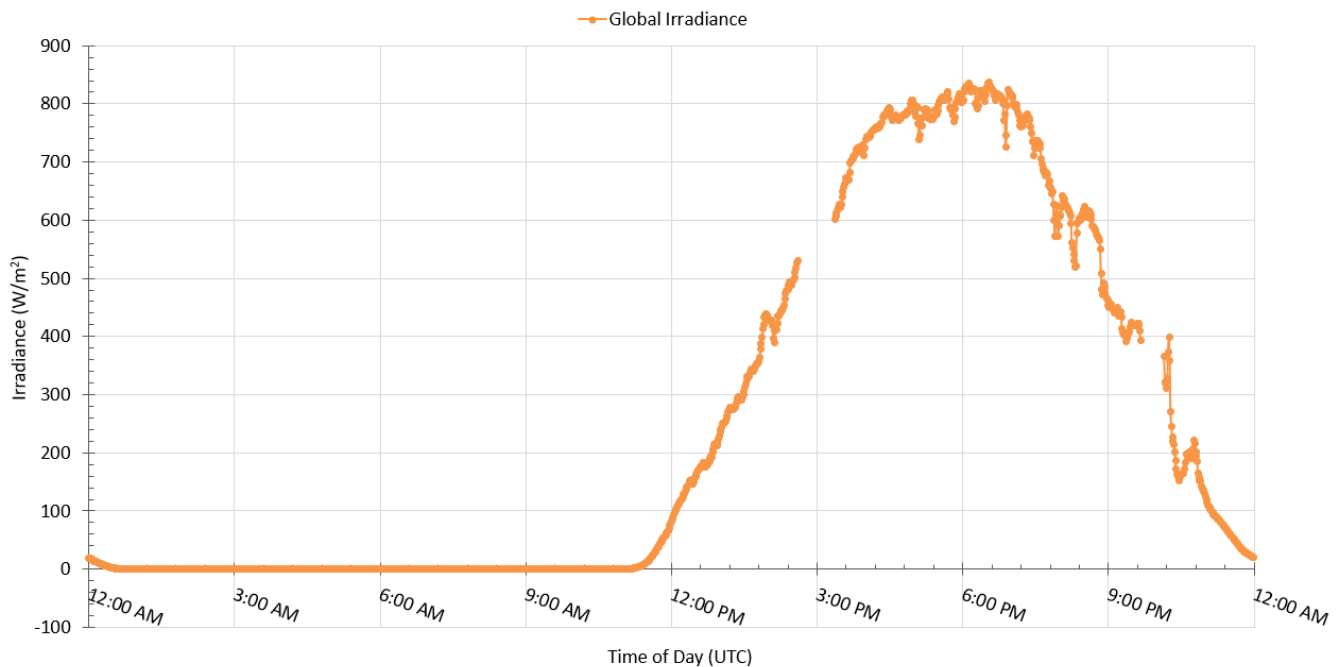
Figure 13. Global radiation at Granite Island on April 4, 2019. Only global irradiance was plotted because of issues with the solar tracker, which affected the solar direct and diffuse measurements.

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The meteorological data for April 4 show the air pressure increasing from 1000 mb at 12:00 am UTC to 1009.7 mb at approximately 3:50 pm UTC before decreasing to 1004 mb by 12:00 am UTC the next day (Figure 14). The relative humidity almost mirrors this increase and decrease from noon to midnight. The air temperature reached a daily maximum of 2 °C, and the relative humidity ranged from 78.8% to 37.6%.

For steady conditions, AOD levels remain mostly unchanged throughout the day. The best example of steady conditions was October 20, 2019 (Figure 15). This day had the most complete aerosol data and the fewest fluctuations of the year. Minor AOD level changes were recorded early in the day, but the overall changes are comparatively minute. The lower AOD levels suggest clean air conditions that may have been
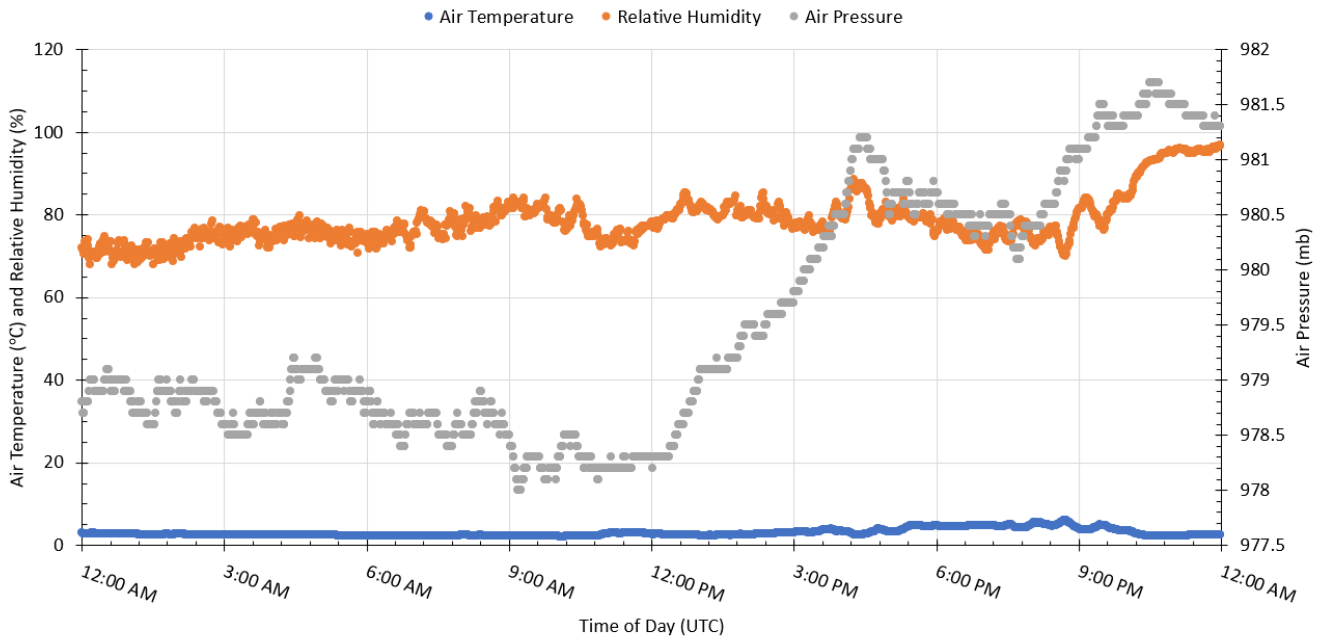

Figure 14. Air temperature and relative humidity (primary Y-axis), and air pressure (secondary Y-axis) at Granite Island on April 4, 2019. Time of day (X-axis) is in Coordinated Universal Time.
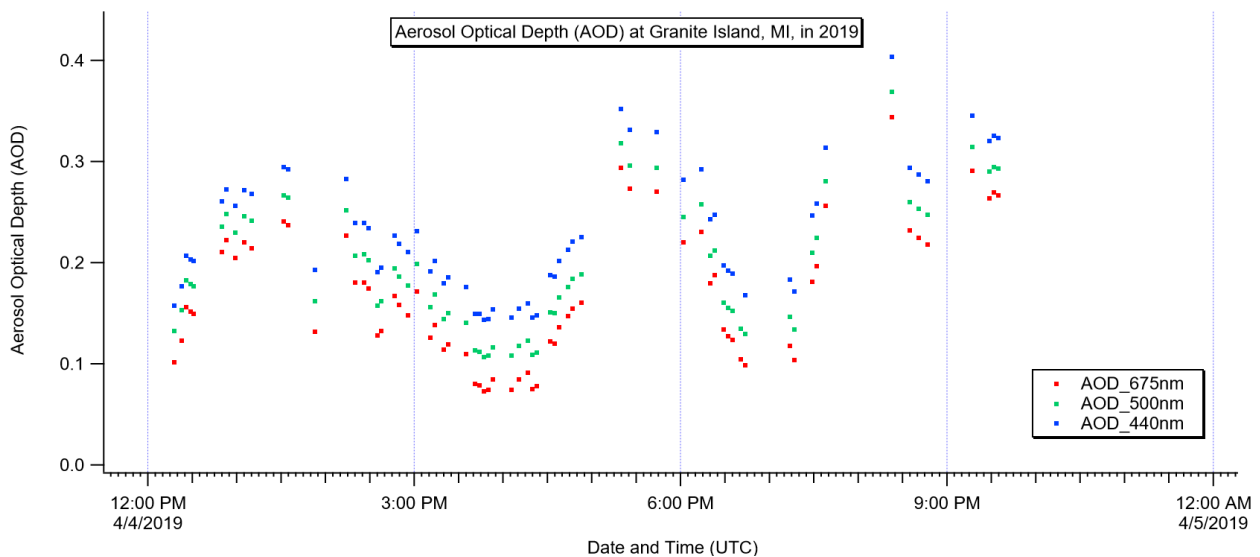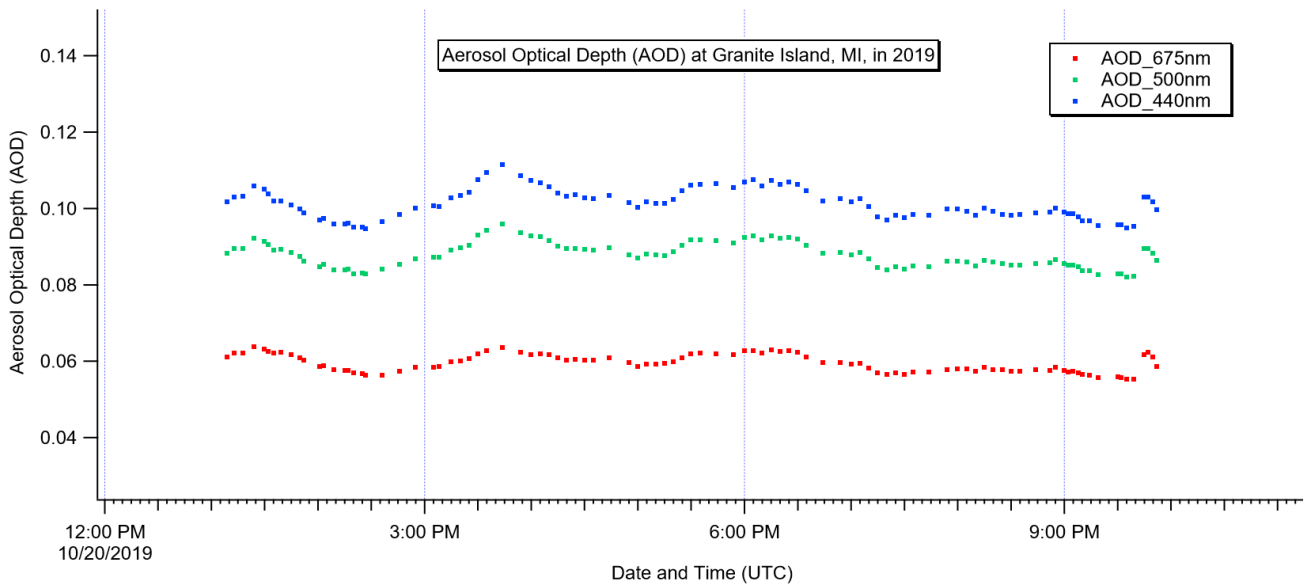

Figure 15. Zoomed-in view of the AERONET data for October 20, 2019. AOD levels were quite low and were steady throughout the day, indicating that the air was remarkably clean.

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created by the cold front that moved through the region the previous night.

The BSRN data for October 20, 2019, are nearly complete for all three parameters: global, direct, and diffuse irradiances (Figure 16). The gap in the graph from 08:32 pm UTC to approximately 10:00 pm UTC is intentional because the station's managers determined that the data were inadequate. Sky conditions were clear and sunny as illustrated by the distinct bell-curve on the plot. The global irradiance maximum of the day was 563.62 W/m^2 at 5:32 pm UTC. Direct irradiance reached a maximum of 869.32 W/m^2 first at 5:01 pm UTC. And the highest diffuse irradiance reading for the day was 86.42 W/m^2 and held steady from 5:37 pm UTC to 5:49 pm UTC. The MODIS images (Figure 17) show that the sky conditions above Granite Island were indeed clear and sunny at the time the images were captured.

The meteorological data may indicate that a low-pressure system had passed through the region, and a high-pressure
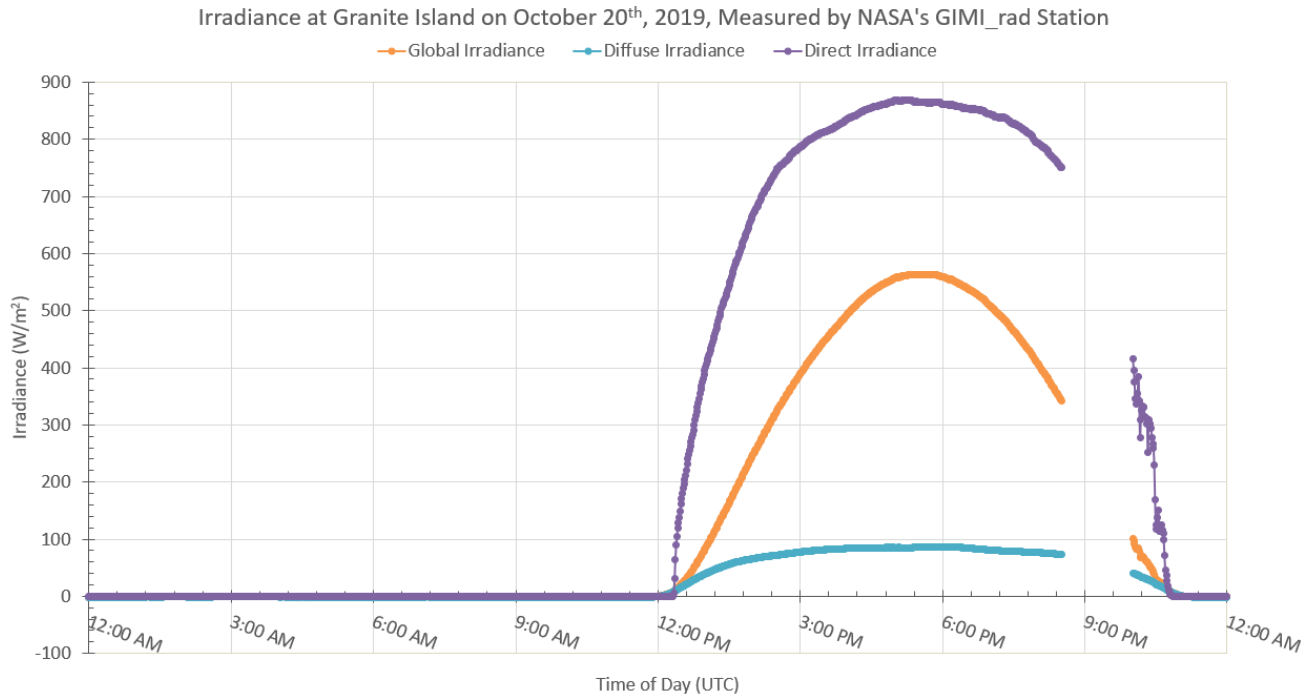
Figure 16. Global, diffuse, and direct radiation at Granite Island on October 20, 2019. The intentional gap in the curve is because of data errors.

(a)　　　　　(b)
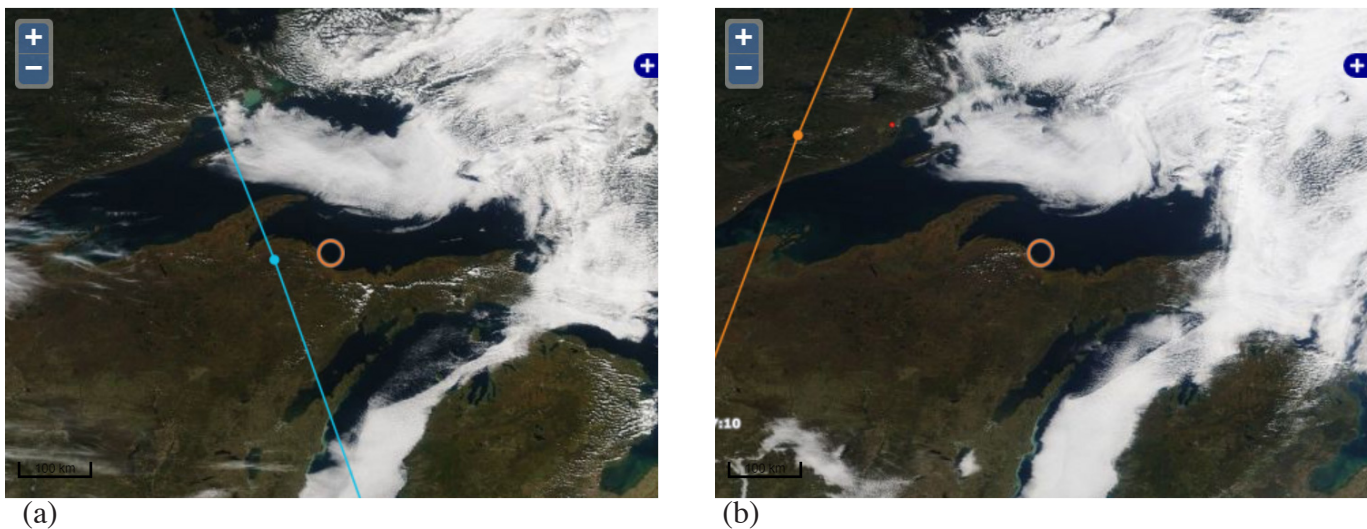
Figure 17. (a) MODIS image from Terra satellite of the Upper Peninsula on October 20, 2019 around 17:09 UTC. (b) MODIS image from Aqua satellite of the Upper Peninsula on October 20, 2019 around 18:53 UTC. Skies were very clean above Granite Island on this day. The orange tint of fall foliage is visible in these two satellite images. Source: https://go.nasa.gov/3j3fiSP

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system moved in (Figure 18). Air pressure steadily increased throughout the entire day – from around 982 mb to 990.8 mb by midnight. Air temperature increased slightly as the day progressed, with two notable increases around 4:00 pm UTC and 8:30 pm UTC. Relative humidity decreased very slowly throughout the day, oscillating at approximately 3:45 pm UTC, and then continuing to decrease slightly. At approximately 8:30 pm UTC relative humidity decreased, before increasing to the highest daily value of 96.7% at 11:15 pm UTC.

FUTURE RESEARCH

At the time of this research, we did not have two consecutive years of data to determine whether Granite Island should be considered as an inland or a coastal monitoring site. This case study should be built upon with more recent data to fulfill the recommended observational period of two years needed to understand how to categorize a site like Granite Island, which in turn will help with further analysis and interpretation of radiation data collected at the site.

For future research, the plan is to incorporate information from the Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observer (CALIPSO). CALIPSO provides a profile of the atmosphere to show the altitude at which aerosols are located (Voiland 2010), which could then be cross-referenced with the AERONET data. Backward trajectories could be incorporated to pinpoint possible sources of polluted air (Slater and Dibb 2004). HYSPLIT – or Hybrid Single Particle Lagrangian Integrated Trajectory Model – from NOAA's Air Resources Laboratory could be used to determine where parcels of air

came from before they arrived at the Granite Island observation site (NOAA 2020).

Follow-up analysis could also examine more closely the meteorological data collected at and near Granite Island to determine whether passing weather fronts alter or influence AOD levels, whether similar seasonal trends occur in subsequent years, and what discrepancies in observations exist between local weather stations. Such additional research could reference NOAA's National Centers for Environmental Information – formerly the National Climatic Data Center – website for local and national archived weather history. Granite Island has dynamic weather throughout the year, and analyzing data from multiple local sources could add robustness to the next study.

CONCLUSIONS

Representative aerosol data for air quality in the Upper Peninsula of Michigan have been collected for only the past couple years, and this is the first study to analyze and interpret the information on aerosol optical depth measurements at Granite Island in 2019. The air quality – described by aerosol data – at Granite Island was good for the majority of 2019, with a few exceptions. Both instances of high AOD levels coincided with wildfire smoke being carried across Lake Superior to Granite Island. On the day with the lowest air quality (July 7, 2019) the polluted air lingered until a weather front pushed it away. January 4, 2019 had the lowest observed AOD levels of the year. The vast majority of the year had AOD levels categorized as varied or steady conditions; the AOD levels were no greater than 0.5 for both conditions.
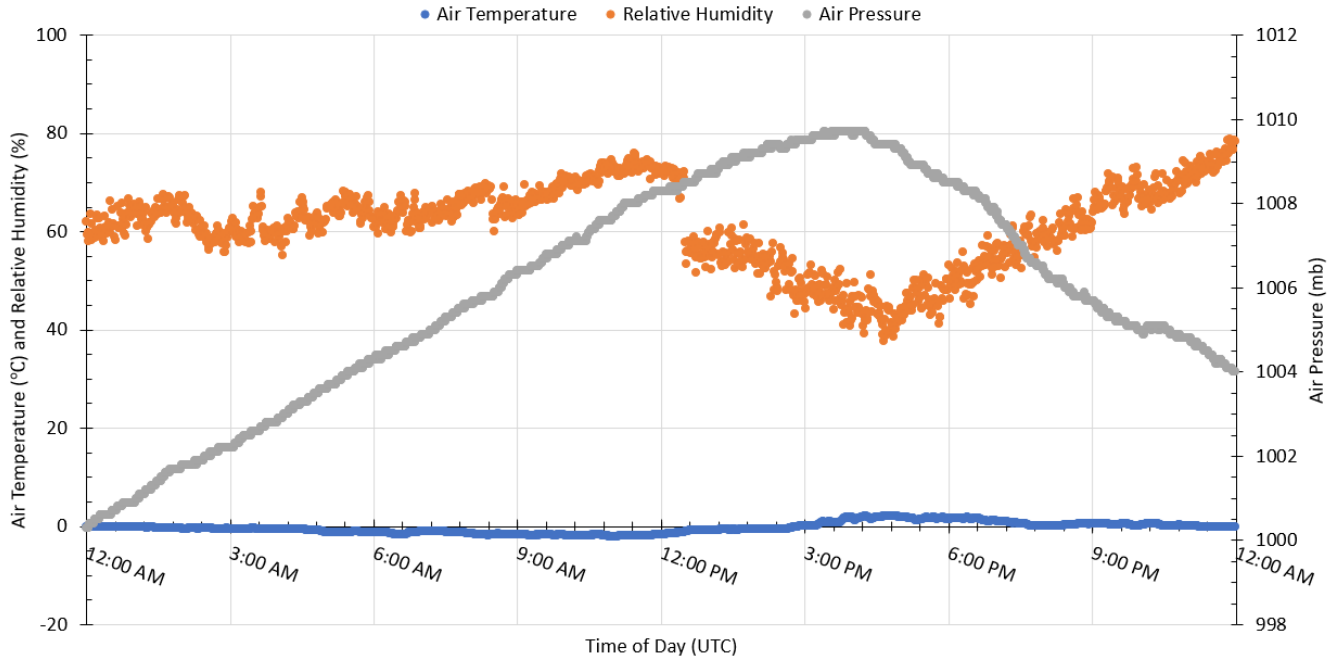

Figure 18. Air temperature and relative humidity (primary Y-axis), and air pressure (secondary Y-axis) at Granite Island on October 20, 2019. Time of day (X-axis) is in Coordinated Universal Time.
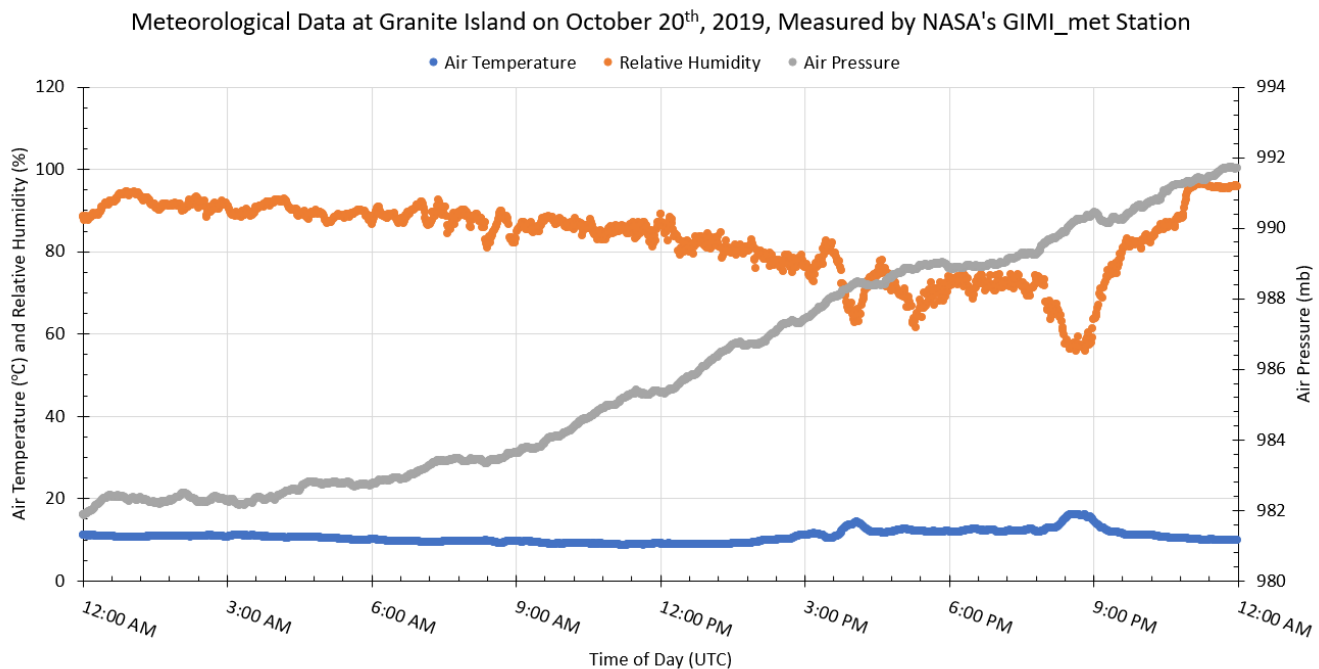
During this study, clear atmospheric conditions did not always guarantee low AOD levels. Although surface wind speeds at Granite Island were higher on January 4 than they were on July 7, it is uncertain whether the wind speeds affected the observed AOD levels. It seems like wind direction may be a better predictor of air quality. Southerly winds from the nearby city and westerly winds from areas with forest fires may carry aerosols toward Granite Island. North winds across Lake Superior especially in the winter may bring cleaner air to the site.

In the future, BSRN data collection at Granite Island may require additional trips for regular instrument maintenance to promote higher quality data. Granite Island is a relatively new site with unanticipated challenges to prepare for and overcome—particularly spiderweb buildup in the summer and ice accumulation in the winter. Data collection and research at Granite Island should continue because of the unique surface validation located on Lake Superior and the contributions this site provides to NASA's CERES project.

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Elizabeth Hoffmann is a 2020 graduate in Earth Science from Northern Michigan University and a member of GTU's Eta Chi Chapter. She interned at NASA Langley Research Center in summer 2019 and 2020 where she met her co-authors. She currently works for SGS North America Inc. Minerals Division.

Fred Denn is a Senior Research Scientist with Science Systems and Applications, Inc. (SSAI); supporting the CERES Radiation and Validation Experiment (CRAVE) at NASA Langley Research Center in Hampton, Virginia. CRAVE measurements provide surface validation of satellite measurements and are part of the Baseline Surface Radiation Network (BSRN).

Bryan Fabbri is a Senior Research Scientist with Science Systems and Applications, Inc. (SSAI); supporting the CERES Radiation and Validation Experiment (CRAVE) at NASA Langley Research Center in Hampton, Virginia. CRAVE measurements provide surface validation of satellite measurements and are part of the Baseline Surface Radiation Network (BSRN).

Jay Madigan is a Senior Systems Engineer and Web/Science Programmer with Science Systems and Applications, Inc. (SSAI); supporting the CERES Radiation and Validation Experiment (CRAVE) and the Science Directorate Communications Team at NASA Langley Research Center in Hampton, Virginia. CRAVE measurements provide surface validation of satellite measurements and are part of the Baseline Surface Radiation Network (BSRN).

Susy S. Ziegler is Professor and the Head of the Department of Earth, Environmental, and Geographical Sciences at Northern Michigan University. She serves as faculty sponsor of the Eta Chi Chapter of GTU, and immediate Past-President of GTU. Her academic training is in physical and environmental geography and biogeography.
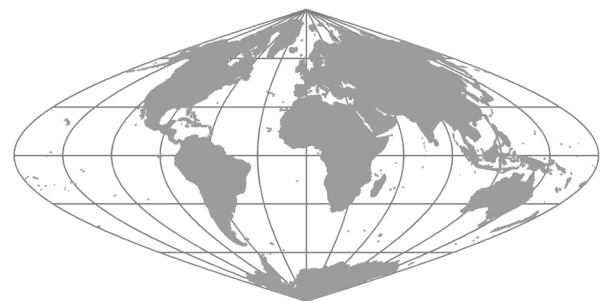
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Examining the Perspectives of Practitioners and Educators toward a Geospatial Competency Matrix: A Q Methodology Approach

Rodney D. Jackson[1]* and Thomas R. Mueller[2]

[1] *Department of Geography, Planning and Environment, East Carolina University, Greenville, NC, USA*
[2] *Geosciences Department, PennWest – California University, California, PA, USA*

*Corresponding author: jacksonro22@ecu.edu

ABSTRACT

This study intended to provide insight into geospatial practitioners' and educators' viewpoints toward the National Geospatial Technology Center of Excellence (GeoTech Center) Geospatial Competency Matrix. These viewpoints are significant since educators and business professionals use workplace competencies for curriculum development, professional certification, and defining workforce requirements. The research question sought to determine the viewpoints toward the geospatial competencies and provides the field an understanding of how practitioners perceive these competency statements. Seventy participants sorted 72 cards (with Geospatial Competency Matrix Statements) on a scale of -6 to 6 and completed two short surveys with demographic and open-ended questions. The data was evaluated using factor analysis, descriptive statistics, and a crib sheet of high, low, and distinguishing statements to provide meaning to the viewpoints. This study found seven viewpoints toward a geospatial competency matrix: Factor 1: We are Cartographers (map evaluators); Factor 2: Vector Data are our Paramount Focus; Factor 3: Analysis is the Key to Addressing Geospatial Problems; Factor 4: Using Programming to Support Analysis; Factor 5: Where in the World is the Data; Factor 6: Data Refinements are a Critical Step in Spatial Analysis, and Factor 7: We have a Love/Hate Relationship with Data.

Keywords: competency, geospatial, Q Methodology, workforce

NATURE OF THE PROBLEM AND PROBLEM STATEMENT

Researchers have attempted to capture the skills needed for workers to succeed in the geospatial field. These studies include the analysis of learning outcomes found in higher education (Schulze, Kanwischer & Reudenbach, 2013), professional geography competency models (Solem, Cheung, & Schlemper, 2008), content analysis of job advertisements (Hong, 2016), surveys (Wikle & Fagin, 2015), and an examination of job titles (Wikle, 2010). The research efforts above represent an evaluation of competencies in the geospatial field, but they did not force participants to discriminate between the relevance of the competencies.

This research study uses Q Methodology to assess respondents' perceptions of the National Geospatial Technology Center of Excellence (GeoTech Center) Geospatial Competency Matrix. This study's results could help redefine the competencies receiving attention moving forward and assist in the professional preparation of students as they transition into the workforce. Q Methodology was chosen for the analysis given that the study's goal was to reveal varied perspectives rather than generalize a population (Watts & Stenner, 2012).

PURPOSE STATEMENT

The purpose of the study is to explore the viewpoints of practitioners and educators toward the GeoTech Center Geospatial Competency Matrix and why they hold these views. There are challenges to assuring competence within the geospatial field (Albrecht, 1998), but assessing viewpoints toward these competencies will enable a better understanding of the needs within the geospatial workforce. Also, identifying commonalities across viewpoints may reveal widely held beliefs within the field. Attempts to standardize the core competencies within the geospatial discipline are progressing, and developing a connection between the learning outcomes achieved in academia and the practical knowledge demonstrated in the workplace is a viable path to establishing competence (Mathews & Wikle, 2017).

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The study results address the following research questions:

1. How do practitioners and educators view the competency statements located within the GeoTech Center Geospatial Competency Matrix, and why?
2. Do perceptions of the geospatial competencies differ based on the respondents' industry- sector, experience in the geospatial profession, area of employment, or educational level where they received most of their geospatial instruction?

LITERATURE REVIEW

One of the challenges associated with geospatial science is its application across various disciplines. Johnson and Sullivan (2010) found that while geospatial techniques were most common in Geography Departments, many academic departments provide instruction couched regarding how geospatial techniques could be integrated within that discipline. Many institutions conduct a *Developing A CUrriculuM* (DACUM) task analysis with industry partners to identify geospatial knowledge, skills, and abilities (KSAs). Unfortunately, DACUMs tend to be very localized and can only provide a limited amount of data at a national level.

Competency models define what employees should know and need to do for success, and they have been used to establish employee educational guidelines and selection criteria (Hong, 2016). Determining the competencies needed in the geospatial field has been difficult due to various technology applications (Wikle, 2010). There has been general agreement that to understand the needs of the geospatial workforce, researchers had to define "core" knowledge, skills, and abilities of all geospatial professionals (Huxhold & Craig, 2003). For this reason, the focus went first to defining core competencies as a starting point for creating an industry framework (Sullivan, 2007) to establish a connection between instruction and application.

The University of Southern Mississippi (USM) led an effort to create the first geospatial competency model and built the most comprehensive work on the geospatial workforce competencies (Samborski, 2006) at the time. In 2010, the U.S. Department of Labor Employment and Training Administration (DOLETA) issued a Geospatial Technology Competency Model (GTCM), documenting the specialized KSAs and educational preparation necessary to become a successful geospatial professional (Sinton, 2012). The DOLETA GTCM is based on a standardized model framework of convertible building blocks representing domain-specific and generic competencies needed in the geospatial workforce (Veenendaal, 2014).

After years of discussion, the Association of American Geographers (AAG) published the UCGIS Body of Knowledge (BoK) in 2006 (DiBiase et al., 2006) with an inventory, categorized as knowledge areas, of the evolving intellectual content within the GIS&T field (Johnson & Sullivan, 2010; Prager, 2012). Johnson and Sullivan (2010, 9) add that the BoK "represents an attempt to define parameters for the field of GIS&T, albeit from an academic rather than an industry-driven perspective". The GIS&T BoK is seen by many as the most successful effort yet to create a comprehensive inventory of knowledge, skills, and abilities unique to the geospatial domain (Veenendaal, 2014).

METHODOLOGY

Selection of Concourse and Q-Sample (Q-Set)

A Q Methodology study begins with developing a comprehensive collection of possible statements regarding a given topic, otherwise known as a concourse (Dziopa & Ahern, 2011; van Exel & De Graaf, 2005). The concourse is an extensive collection of possible statements that capture individual viewpoints of topics within a domain (Cuppen et al., 2016; Zabala & Pascual, 2016) and is sampled to build a Q-set. The sampling process from the concourse can present challenges (Simons, 2013) as the statements must be reduced to a reasonable count and be typical of all statements and accurately represent a cross-section of the concourse (Brown, 1993).

The authors developed a set of statements, known as the Q-set, from the 190 competencies found in the GeoTech Center's Assessment Tool. These competency statements incorporate the accepted knowledge, skills, and abilities needed by geospatial practitioners. The assessment was selected as the concourse as it is designed to provide a system to evaluate the configuration of KSAs that geospatial professionals should possess. This study comprises the 72 geospatial competency statements from the GeoTech Center Geospatial Competency Matrix.

P-Set Demographics

The sampling of a limited population is supported by Wright (2013, 154), who stated that "P-set membership should reflect a body of participants who are 'theoretically salient' to the issue under study." The participant pool was comprised of attendees at the GeoTech Center's 2020 and 2021 annual conferences and educators participating in geospatial training during the same time. Seventy practitioners and educators completed a Q-sort activity for 72 competency statements in the GeoTech Center Geospatial Competency Matrix. The respondents are varied and knowledgeable, averaging 19.5 (SD = 11.6) years of experience with 12.9 (SD = 8.7) years within the geospatial field.

Data Collection and Analysis

Q Methodology is an appropriate approach to reveal individual beliefs (Cuppen et al., 2016; Steelman & Maguire, 1999; Varnadore, 2018) and was used in this study to gauge the perceptions of practitioners and educators regarding the relevance of competency statements. The 70 Respondents completed an online sorting activity indicating each competency statement's particular relevance from most relevant (+6) to least relevant (-6). In conjunction with qualitative questions after the survey, these data construct themes relating to shared views of relevance for the competencies. The sorting grid is customarily shaped as a quasi-normal distribution, with a prescribed number of rows and columns, and is considered forced due to the grid's restrictions. The model's prescriptive nature encourages respondents to reflect on their feelings more carefully and approach the exercise systematically (Steelman & Maguire, 1999; van Exel & De Graaf, 2005). Perspective is at the center of this research. The P-set must be built upon a collection of representatives within the realm who can thought-

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fully evaluate the statements under consideration (van Exel & De Graaf, 2005).

Correlation Matrix

The researchers analyzed the Q-sort data using Ken-Q Analysis Desktop Edition (KADE) (Banasick, 2019). Data analysis begins with a correlation matrix, which establishes the relationship between the Q-sorts. Correlation statistics range between -1.00 (signifying an entirely negative relationship) and +1.00 (signifying an entirely positive relationship) between Q-sorts, while a 0.00 value would reflect a lack of association (Watts & Stenner, 2005). The highest correlation was 66 (.66), shared between Respondents 23 and 53, with the subsequent highest correlation being 65 (.65), which was shared between respondents 23 and 39. The lowest correlation was -37 (-.37) between Respondents 20 and 42, with the lowest correlation of -35 (-.35), which was shared between respondents 42 and 53. Correlation coefficients between the individual Q-sorts help identify shared views held by respondents (van Exel & De Graaf, 2005). Bartlett and DeWeese (2015, 79) noted, "The goal of this process is to determine the variability of Q-sorts to determine how many shared factors are in evidence".

Factor Analysis and Rotation

The researchers applied factor analysis to reduce the data to a few summarizing unrotated factors indicative of representative responses (Zabala & Pascual, 2016). Researchers reduce data using either centroid factor analysis (CFA) or principal components analysis (PCA) during factor analysis. Watts and Stenner (2012, 97) noted that PCA would "resolve itself into a single, mathematically best solution" and "deprives us of the opportunity to properly explore the data". The researchers used the KADE software to analyze and begin data reduction of the 70 submissions.

The unrotated factors' task is to explain the variance found in the correlation matrix by loading as many Q-sorts as possible (Zabala et al., 2018). The factors represent a hypothetical best-representative Q-sort, and, typically, only a few factors are selected (van Exel & De Graaf, 2005). The number of factors selected depends on the Q-sorts' variability, but there are usually no more than seven factors (Dziopa & Ahern, 2011; Wright, 2013). It is generally accepted that only factors with an eigenvalue higher than one (1.00) are selected for extraction and interpretation (Dziopa & Ahern, 2011; Shemmings, 2006). An eigenvalue (E.V.) is calculated by summing the squared loadings of the Q-sorts defining a factor and indicates the extractors' ability to explain variance (Watts & Stenner, 2012). A researcher can also use a scree plot (see Figure 1) to
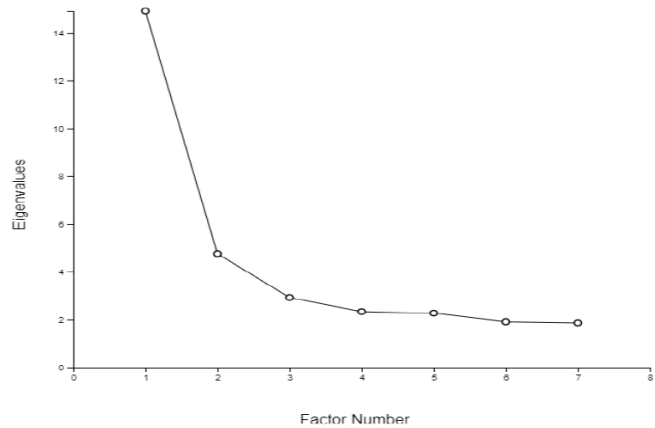
Figure 1: Scree Plot of the initial 7-Factor Solution

support a decision on the number of factors selected.

The researchers selected a 7-factor solution (EV=1.86) with 47 participants with no fewer than three loadings on any factor and explained 44% of the variance. The researchers believe the 7-factor solution balances the competing needs to load as many participants as prudent onto each factor, cumulatively explain the most variance possible, and develop a logical narrative of the expressed views (Wright, 2013; see Table 1).

Factor Characteristics

The general characteristics used in determining each factor include the number of Q-sorts loaded, eigenvalues, percentage of variance explained, composite reliability, and the standard error (S.E.) of the z-scores (see Table 2). Eigenvalues are signs of the extractors' ability to explain variance (Watts & Stenner, 2012). The composite reliability is an indication of a factor's strength (Zabala & Pascual, 2016, 6), where "the value 0.8 is the customary value used in Q methodology for the average reliability coefficient, which is the expected correlation between two responses given by the same person". Watts and Stenner (2012) indicate that the standard error for z-scores can be calculated as $1 / (\sqrt{}$ number of items in the Q-set). A *SE* of 0.12 was calculated: *SE* = $1 / (\sqrt{72})$; *SE* = $1 / (8.485)$; *SE* = 0.117 (rounded to 0.12); *SE* = 0.12. Watts and Stenner (2012) prefer that the cross product of the two highest loadings of any factor double the standard error (0.24), which occurred in this study.

The next step in data analysis is factor rotation, which attempts to reveal the best combination of relationships between variables (Q-sorts) and maximize the explained variance (Watts & Stenner, 2012). There are two options for factor rotation,

Table 1. Factor Solutions

Factors	Significant Loads	Variance Explained (%)	Lowest Eigenvalue	Composite Reliability	Highest Factor Correlation	Range of Sorts
7	47	44	1.86	0.92	0.47	3 – 19
6	42	44	1.91	0.80	0.55	1 – 16
5	49	40	2.26	0.96	0.55	6 – 18

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statistical or judgmental, depending on the study. A statistical rotation is often used if the research is exploratory, whereas a judgmental rotation is appropriate if driven by prior research or theory (Cuppen et al., 2016; Wright, 2013). The researchers applied a varimax (statistical) rotation, as this study was exploratory.

Factor Correlation

The level of agreement or disagreement seen in the correlation matrix is represented similarly in factor score calculations. Highly correlated Q-sorts form the factors used in the analysis, standardized using z-score analysis, with the highest scoring statistically significant ($p < 0.05$) sorts flagged for inclusion in a factor. Initially, comparisons cannot be made between factors due to the different number of contributing Q-sorts (Watts & Stenner, 2012) loading upon the identified factors. The factor scores must first be standardized by converting them to z-scores (see Appendix C) before conducting any cross-factor analysis (Zabala et al., 2018). A z-score defines a factor by illustrating a relationship between statements and factors, compared within a data matrix (Bartlett & DeWeese, 2015).

Factor Loadings

The intent of using factor analysis is to identify underlying patterns within the data and reveal collections of like-minded respondents who rank the statements based upon shared beliefs (Shemmings, 2006; Zabala & Pascual, 2016). Individual Q-sorts with a substantial loading on a factor are exemplars, as their sort configuration is characteristic of that factor (Simons, 2013; Watts & Stenner, 2012). A factor loading is calculated for each Q-sort and is comparable to correlation coefficients, as it denotes the degree to which a Q-sort aligned with each factor (Cross, 2005; Zabala et al., 2018). While the number of factors will vary, van Exel and De Graaf (2005, 6) suggest there is an optimal number of Q-sorts for each factor when stating, "The aim is to have four or five persons defining each anticipated viewpoint".

The researchers began the factor extraction with centroid factor analysis. The 8-factor solution generated a factor without a Q-sort, and the 6-factor solution produced a negative loading on one factor and a single Q-sort loading on another.

The 7-factor solution (EV=1.86) included 47 participants, with no fewer than three significant loadings ($p < 0.05$) on any factor and explained 44% of the variance. The authors determined that the 7-factor solution most effectively balances the competing needs to load as many participants as prudent onto each factor, cumulatively explain the most variance possible, and develop a logical narrative of the expressed views (Wright, 2013; see Table 1).

The seven themes developed from the analysis are Factor 1: We are Cartographers (significant loadings range in value from 0. 7221 to 0. 4621) explains 21% of the variance (Q-sorts 2, 3, 4, 5, 7, 8, 10, 15, 16, 17, 18, 20, 21, 22, 23, 46, 52, 53, 69); Factor 2: Vector Data are our Paramount Focus (significant loadings range in value from 0.6747 to 0.3993) explains 7% of the variance (Q-sorts 11, 24, 25, 40, 62, 63, 65); Factor 3: Analysis is the Key to Addressing Geospatial Problems (significant loadings range in value from 0.6911 to 0.3952) explains 4% of the variance (Q-sorts 12, 13, 57, 59, 60); Factor 4: Using Programming to Support Analysis (significant loadings range in value from 0.628 to 0.4766) explains 3% of the variance (Q-sorts 26, 29, 32, 41, 47, 61); Factor 5: Where in the World is the Data (significant loadings range in value from 0.4989 to 0.2799) explains 3% of the variance (Q-sorts 31, 34, 64); Factor 6: Data Refinements are a Critical Step in Spatial Analysis (significant loadings range in value from 0.5014 to 0.4545) explains 3% of the variance (Q-sorts 33, 44, 48, 50); Factor 7: We have a Love/Hate Relationship with Data (significant loadings range in value from 0.5922 to 0.409) explains 3% of the variance (Q-sorts 14, 67, 68).

Factor Arrays

A factor array represents a composite Q-sort for a conceptual best-fit of respondents loading predominantly on that factor (Dziopa & Ahern, 2011). Factor arrays are a strength of Q Methodology (Cuppen et al., 2016) and allow the researchers to interpret how the statements rank within each factor (Bartlett & DeWeese, 2015). Factor arrays play a role in factor interpretation and theme development, as the arrays act like a typical Q-sort for the factor (Cuppen et al., 2016; McKeown & Thomas, 2013). The factor scores allow the researchers to evaluate the configuration of all items within the array and the significance of specific statement locations (McKeown &

Table 2. Factor Characteristics

Factor	Participants Loaded	Eigenvalues	Variance Explained	Composite Reliability	*SE* of Factor Z-scores
1	19	14.91	21	0.99	0.11
2	7	4.75	7	0.97	0.18
3	5	2.92	4	0.95	0.22
4	6	2.33	3	0.96	0.20
5	3	2.27	3	0.92	0.28
6	4	1.91	3	0.94	0.24
7	3	1.86	3	0.92	0.28
Total variance			44		

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Thomas, 1988; Watts & Stenner, 2012). In developing a factor array, a calculation of each Q-sort's weighted scores that load significantly on the factor are combined for a total weighted score for the factor (Watts & Stenner, 2012). The array is complete when the z-score is translated back to the sorting exercise's initial scale. In this study, the converted values will range from -6 to +6 (see Table 3).

Factor Interpretation

Factor interpretation involves the identification of statements useful in the analysis. A distinguishing statement will score significantly different on one factor than another, but consensus statements tend to align themselves similarly across the factors (Zabala & Pascual, 2016). The study revealed no consensus statements. Statements within the factor array with

Table 3. Factor Arrays

No.	Statement	Factors						
		1	2	3	4	5	6	7
1	Explain what topology means in relation to geospatial data (i.e., adjacency, connectivity, containment, proximity)	1	-1	-2	0	0	-4	0
2	Identify spatial patterns; apply knowledge of how people and places are linked (spatial thinking and Tobler's First Law of Geography)	5	-4	3	4	0	4	2
3	Explain how to use geospatial technology to solve a problem	6	3	4	1	3	0	0
4	Describe how planar geometry (e.g., points, lines, polygons) are used to convert real-world features into digital representations of features	1	-3	-3	-2	2	3	-3
5	Define data's spatial reference	1	3	0	-1	1	2	2
6	Transform spatial data (e.g., reprojections, datums)	-2	3	2	2	3	2	-1
7	Apply appropriate map projections based on the type of analysis	1	1	3	-1	1	3	1
8	Describe the characteristics and appropriate uses of datums	-1	1	-1	-6	6	1	-5
9	Compare large-scale maps and small-scale maps	1	-1	-4	0	-1	-1	-4
10	Explain how interpretation and visualization of data in a map is influenced by the area of its boundary polygon (i.e., county versus state or state versus country, MAUP).	2	-2	-1	0	-5	-3	-5
11	Describe different map elements and how they may or may not be needed for different audiences or media	3	0	1	0	-4	-3	-4
12	Demonstrate knowledge of map interpretation	4	2	1	0	-1	2	2
13	Create charts, graphs, tables	1	1	-3	0	-4	-2	5
14	Critique the design of a given map in light of its intended audience and purpose	3	0	0	-1	2	-2	-1
15	Present results of an analysis using data visualization (cartography, charts, and graphs)	3	2	5	4	1	2	4
16	Create maps using cartographic principles (color, symbols, text, elements, etc.)	4	3	1	1	-1	0	1
17	Determine appropriate map scale	2	0	-1	-1	2	2	-2
18	Describe why acknowledgment of contributors and copyrights is necessary	2	-4	-2	-5	-2	-2	-1
19	Create a problem statement outlining the problem and ways to solve it using geospatial technology	5	-1	3	2	3	-1	6
20	Determine data needs and formats	4	3	0	2	0	1	-1
21	Compare basic analysis methods (point pattern analysis, cluster analysis, multi-criteria evaluation, and spatial process models)	0	-2	1	3	0	-1	-5
22	Perform buffer, slope, hillshade analysis	0	1	5	0	-3	-1	0
23	Derive new data (e.g., generate contours from DEM, data generalization, etc.)	-3	-2	3	-3	1	1	3
24	Perform overlay analysis	0	2	3	3	-2	0	2
25	Perform site selection	-1	-2	-2	-2	-3	-1	-2
26	Perform viewshed analysis	-3	-2	1	-2	-5	-4	-2

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#	Task							
27	Interpret results from an analysis (is it appropriate/good)	3	1	4	5	5	6	3
28	Pre-process data (e.g., generalize, subset, reproject, clip, mosaic, etc.)	-2	1	-2	1	1	1	-1
29	Create elevation datasets (rasters) from vector data	-4	-1	3	-1	-2	-2	2
30	Perform network analysis (i.e., roads, streams, etc.)	-2	0	2	0	-1	-2	0
31	Create TINs from feature data	-5	-3	0	-4	-3	-6	-1
32	Describe different data formats (Vector, Raster, TIN, etc.)	2	0	-3	-3	-1	1	0
33	Apply appropriate data formats (Vector, Raster, TINs, Imagery)	0	1	2	-2	-2	4	0
34	Design database structure (e.g. schema)	-1	5	1	3	4	-1	-2
35	Create and maintain data dictionary	0	-2	-5	1	-1	-3	-2
36	Create database tables	0	5	-3	4	1	-1	1
37	Define data requirements to help solve a problem	5	2	5	3	4	-1	-3
38	Input data into a relational database	-2	0	-2	4	1	-4	0
39	Develop (construct) databases (e.g. define geometry & attributes)	-2	4	0	6	4	0	3
40	Apply different geoprocessing methods, including clip, buffering, and overlay	2	2	4	3	0	5	1
41	Edit and update attribute and spatial data geometry	0	5	1	2	-1	5	1
42	Demonstrate ability to carry out mathematical operations including addition, subtraction, multiplication, and division	-3	-3	-6	-2	-1	2	-3
43	Perform descriptive statistical analysis (mean, median, mode, etc.)	-2	-3	-5	0	3	5	3
44	Create programming code (i.e., Python or other languages)	-5	-1	-4	5	-5	0	2
45	Apply basic programming principles (SQL statements, Boolean logic, macros)	-3	-1	-4	5	-3	1	2
46	Perform data format conversions (vector to raster, raster to vector, raster to TIN)	-3	-1	6	-4	0	3	-3
47	Explain why map scale affects the resolution of data creation or acquisition for a given application	2	-1	-2	2	0	0	-4
48	Describe different methods of indicating locations (e.g., decimal degrees, UTM, military grid)	-1	-1	-3	-3	4	0	-3
49	Perform proximity analysis	1	3	2	2	-2	1	4
50	Describe how to geocode data	-1	0	-4	2	-4	-2	-2
51	Create and update attribute data	0	4	-1	3	0	4	4
52	Demonstrate how to create/update vector data	1	2	0	1	-2	3	3
53	Georeference data	0	6	0	1	5	2	5
54	Define data requirements (format, projections, scale, etc.)	3	4	1	-1	2	1	-2
55	Research and evaluate data sources	3	0	-1	0	2	1	0
56	Explain how to acquire data (create, purchase, locate)	2	1	-5	1	2	-3	-1
57	Demonstrate how to import/export data from various sources (e.g. spreadsheets)	1	2	-2	-2	0	2	4
58	Describe how to verify spatial data accuracy, quality, compatibility, and appropriateness for application	2	0	-1	1	3	3	1
59	Create/update metadata	0	0	-3	1	2	0	3
60	Perform spatial and non-spatial data table joins	-1	2	0	2	-3	4	0
61	Collect field data using GNSS (location and attribute)	-1	4	2	-2	-1	0	-1
62	Describe different data collection methods (e.g. GNSS, aerial, drones)	-1	-2	-1	-4	-4	0	-1
63	Conduct ground-truthing	-3	1	1	-4	5	-5	2
64	Describe basic remote sensing science concepts, including the electromagnetic spectrum, sensors, and bands	-1	-4	-1	-3	-3	-1	-3
65	Create composite images using imagery bands	-4	-3	2	-5	1	-5	0
66	Create index/ratio images (NDWI, NDVI, MSI, LAI, EVI, snow, etc.)	-6	-5	0	-2	-2	-3	-4

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67	Perform change detection using imagery from different dates	-2	-2	2	-1	0	-5	1
68	Collect spectral signatures for imagery classification	-5	-6	-2	-5	-6	-4	1
69	Conduct image classification (e.g., supervised or unsupervised)	-4	-5	4	-3	-2	-2	1
70	Perform feature extraction from imagery	-4	-3	2	-1	1	-2	-2
71	Explain imagery resolutions (Spatial, Temporal, Radiometric, and Spectral)	-2	-5	-1	-3	3	-3	-6
72	Explain why ethics is important to the geospatial technology field	4	-4	0	-1	2	3	5

the highest and lowest scores are typically more helpful in interpreting themes (Bartlett & DeWeese, 2015; Zabala et al., 2018), defining a factor and distinguishing it from another factor (Cuppen et al., 2016; Wright, 2013). The statements with the highest and lowest scores (z-scores) for each factor are anchor statements in Tables 4 and 5, respectively. The authors used a crib sheet approach to organize the relative ranking of statements and facilitate factor interpretation. The crib sheet used is modeled after one referenced by Watts and Stenner (2012) and is in Appendix B.

Following the Q-sort, participant responses to the open-ended questions (see Appendix A) assisted the researchers' interpretation of the factors. The results provide a qualitative narrative, summarized in a title, derived from the most distinguishing characteristic of the perspective (Cuppen et al., 2016). The title offers easy identification, and the narrative delivers an overview of the factor, highlighting various critical elements (Cuppen et al., 2016; Simons, 2013). This study identified seven viewpoints held by practitioners and educators toward the Geospatial Competency Matrix's competencies. The

factors representing these perspectives: The seven documented factors characterize a substantial variation in the perceptions of technical geospatial competencies. The emergent factors were Factor 1: We are Cartographers (map evaluators); Factor 2: Vector Data are our Paramount Focus; Factor 3: Analysis is the Key to Addressing Geospatial Problems; Factor 4: Using Programming to Support Analysis; Factor 5: Where in the World is the Data; Factor 6: Data Refinements are a Critical Step in Spatial Analysis, and Factor 7: We have a Love/Hate Relationship with Data.

RESULTS

Analysis of Research Question One

Factor 1: We Are Cartographers (Map Evaluators)

Factor 1 had 19 Q-sorts and explained 21% of the study's variance, accounting for the most variance explained in the study. The respondents are varied and experienced, averaging

Table 4. Highest Ranking Statement for Each Factor

Factor	Number	Statement	Z-score
1	3	Explain how to use geospatial technology to solve a problem	2.48
2	53	Georeference data	1.93
3	46	Perform data format conversions (vector to raster, raster to vector, raster to TIN)	2.03
4	39	Develop (construct) databases (e.g. define geometry & attributes)	2.15
5	8	Describe the characteristics and appropriate uses of datums	2.3
6	27	Interpret results from an analysis (is it appropriate/good)	2.28
7	19	Create a problem statement outlining the problem and ways to solve it using geospatial technology	2.24

Table 5. Lowest Ranking Statement for Each Factor

Factor	Number	Statement	Z-score
1	66	Create index/ratio images (NDWI, NDVI, MSI, LAI, EVI, snow, etc.)	-2.38
2	68	Collect spectral signatures for imagery classification	-1.98
3	42	Demonstrate ability to carry out mathematical operations including addition, subtraction, multiplication, and division	-2.35
4	8	Describe the characteristics and appropriate uses of datum	-1.85
5	68	Collect spectral signatures for imagery classification	-2.52
6	31	Create TINs from feature data	-2.02
7	71	Explain imagery resolutions (Spatial, Temporal, Radiometric, and Spectral)	-2.25

20.6 (SD=12.2) years of experience with 9.4 (SD=7.3) years spent in geospatial science. The following number of participants received formal geospatial instruction at the Associate's (1), Bachelor's (4), Masters (8), or Doctorate (0) level, with 6 possessing no formal geospatial education.

The Q-sorts loading onto Factor 1 demonstrated an appreciation for the skills needed by cartographers and map interpreters. The highest distinguishing statement (Table 6), Statement 11 (3), is representative of the factor and is supported by Distinguishing Statements 10 (2) and 18 (2), and 9 (1). Three of these, Statements 11, 10, and 18 were significant at $p < 0.01$. Also, Statements 16 (4), 12 (4), 14 (3), and 17 (2) were ranked higher on Factor 1 than any other factor. The respondents held a generally negative view of remote sensing and competencies connected to manipulating datasets. The only distinguishing statement was Statement 66 (-6). The one remaining imagery competency, Statement 70 (-4), was a distinguishing statement and ranked lower in Factor 1 than any other factor. Numerous data handling competencies ranked lower on Factor 1 than any other factor, including Distinguishing Statements 29 (-4), 23 (-3), 6 (-2), and 28 (-2).

Factor 2: Vector Data Are Our Paramount Focus

Factor 2 had 7 Q-sorts and explained 7% of the variance in the study. The respondents are practitioners and educators with a wide range of years in the practice, averaging 22.4 (SD=12.2) years of experience with 16.3 (SD=7.9) years spent in geospatial science. The following number of participants received formal geospatial instruction at the Associate's (1), Bachelor's (3), Masters (2), or Doctorate (0) level, with 1 possessing no formal geospatial education.

The factor's title reflects respondents' opinion that the most relevant statements are those connected to competencies aligned to vector data processes. The competencies are a collection of database operations, spatial reference, and data transformation undertakings. Statement 61 (4), only one was distinguishing (Table 7). Regardless, all positive statements were ranked higher in Factor 2 than any other factor. Statements 53 (6), 61 (4), 6 (3), and 5 (3) are aligned with spatial referencing. Statements 41 (5), 54 (4), and 28 (1) address data manipulation. Finally, Statements 34 (5), 36 (5), and 51 (4) were connected to database actions. The participants' negative views towards digital imagery and remote sensing competency areas are reflected in Distinguishing Statement 35 (-3). Also, Statements 64 (-4), 69 (-5), and 68 (-6) are ranked lower in Factor 2 than in another array.

Factor 3: Analysis Is the Key to Addressing Geospatial Problems

Table 6. Distinguishing Statements for Factor 1

No.	Statement	Factor 1 Q-SV	Factor 1 Z-score	S
3	Explain how to use geospatial technology to solve a problem	6	2.48	*
11	Describe different map elements and how they may or may not be needed for different audiences or media	3	1.07	*
10	Explain how interpretation and visualization of data in a map is influenced by the area of its boundary polygon (i.e., county versus state or state versus country, MAUP).	2	0.73	*
18	Describe why acknowledgment of contributors and copyrights is necessary	2	0.53	*
9	Compare large-scale maps and small-scale maps	1	0.27	

Note: $p < 0.05$: Asterisk (*) Indicates Significance at $p < 0.01$

Table 7. Distinguishing Statements for Factor 2

No.	Statement	Factor 2 Q-SV	Factor 2 Z-score	S
61	Collect field data using GNSS (location and attribute)	4	1.3	
22	Perform buffer, slope, hillshade analysis	1	0.67	
45	Apply basic programming principles (SQL statements, Boolean logic, macros)	-1	-0.31	
65	Create composite images using imagery bands	-3	-0.97	
72	Explain why ethics is important to the geospatial technology field	-4	-1.27	*
2	Identify spatial patterns; apply knowledge of how people and places are linked (spatial thinking and Tobler's First Law of Geography)	-4	-1.7	*

Note: $p < 0.05$: Asterisk (*) Indicates Significance at $p < 0.01$

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Factor 3 had five Q-sorts and explained 4% of the variance in the study. The respondents are practitioners and educators with 18.0 (SD=4.2) years of experience with 12.2 (SD=5.3) years spent in geospatial science. The following number of participants received formal geospatial instruction at the Associate's (0), Bachelor's (1), Masters (2), or Doctorate (1) level, with 1 possessing no formal geospatial education.

Factor 3 was built from Q-sorts representing that spatial analysis is crucial to the geospatial field. Four of the five highest-scoring distinguishing statements (Table 8), Statements 22(5), significant at $p < 0.01$, 67(2), 30(2), and 26 (1), relating to the performance of various analyses. An additional competency, Statement 24 (3), was ranked higher in Factor 3 than any other factor. The competencies judged to have less relevance to the geospatial field were split between data acquisition and development. Statement 59 (-3) was the only negatively perceived distinguishing statement significant at $p < 0.01$ and related to data acquisition or data development. While not distinguishing statements, Statements 53 (0), 28 (-2), 36 (-3), 59 (-3), 50 (-4), and 35 (-5) related to data development and ranked lower in Factor 3 than in any other factor array. There were no distinguishing statements aligned with data acquisition, but Statements 51 (-1), 58 (-1), 55 (-1), 57 (-2), and 56 (-5) scored lower in Factor 3 than in any other array. Regardless of where data management activities fell within the spectrum, respondents held a dim view of this competency area, with 11 statements located lower in this array than in any other factor.

Factor 4: Using Programming to Support Analysis

Factor 4 had six Q-sorts and explained 3% of the variance in the study. The respondents are practitioners and educators with a wide range of years in the practice, averaging 15.5 (SD=12.9) years of experience with 14.2 (SD=12.9) years spent in geospatial science. Three respondents received formal geospatial instruction at the Bachelor's level, and the three remaining participants at the Master's level.

The factor's title reflects the appearance of numerous competencies connected to computer programming to facilitate spatial analysis. There are only two programming competencies within the matrix. Both were the highest-rated distinguishing statements (Table 9) within this factor, significant at $p < 0.01$, and ranked higher in Factor 4 than in any other array. The two highest-scoring distinguishing statements, Statements 45 (5) and 44 (5), are central to Factor 4 and supported by aligned competencies related to analysis. The connection between programming and spatial analysis is provided by Statement 21 (3), which is also a distinguishing statement significant at $p < 0.01$. Additionally, Statement 24 (3) is ranked higher in Factor 4 than any other array.

There was an absence of a dominant theme connected to irrelevant competency areas within Factor 4, but two competing collections of statements, geodesy, and data tasks, stood out. Respondents included within the factor appeared to devalue the maintenance of a dataset's spatial reference, as Statement 7 (-1) indicated, the lowest-ranked distinguishing statement in Factor 4. Furthermore, Statements 5 (-1), 7 (- 1), 48 (-3), and 8 (-6) were ranked lower in Factor 4 than in any other factor. The respondents loading upon Factor 4 exhibited a general aversion to activities relating to data formats, as represented by Statements 33 (-2) and 32 (-3), data conversion, Statements 23 (-3)

Table 8. Distinguishing Statements for Factor 3

No.	Statement	Factor 3 Q-SV	Factor 3 Z-score	S
46	Perform data format conversions (vector to raster, raster to vector, raster to TIN)	6	2.03	
22	Perform buffer, slope, hillshade analysis	5	1.63	*
69	Conduct image classification (e.g., supervised or unsupervised)	4	1.38	*
67	Perform change detection using imagery from different dates	2	0.93	
30	Perform network analysis (i.e., roads, streams, etc.)	2	0.67	
61	Collect field data using GNSS (location and attribute)	2	0.67	
34	Design database structure (e.g. schema)	1	0.2	
26	Perform viewshed analysis	1	0.14	
59	Create/update metadata	-3	-1.21	*
42	Demonstrate ability to carry out mathematical operations including addition, subtraction, multiplication, and division	-6	-2.35	*
46	Perform data format conversions (vector to raster, raster to vector, raster to TIN)	6	2.03	
22	Perform buffer, slope, hillshade analysis	5	1.63	*
69	Conduct image classification (e.g., supervised or unsupervised)	4	1.38	*
67	Perform change detection using imagery from different dates	2	0.93	

Note: *p* < 0.05: Asterisk (*) Indicates Significance at *p* < 0.01

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and 46 (-4), and data collection, as indicated by Statements 61 (-2), 57 (-2) and 62 (-4). Also, all the data-specific statements were ranked lower in Factor 4 than in any other factor.

Factor 5: Where in The World Is the Data

Factor 5 had three Q-sorts and explained 3% of the variance in the study. The respondents are practitioners and educators having various years in the practice, averaging 30.3 (SD=22.4) years of experience with 27.3 (SD=18.7) years spent in geospatial science. The following number of participants received formal geospatial instruction at the Bachelor's (1) or Doctorate (1) level, with one possessing no formal geospatial education.

Factor 5 was built from Q-sorts signifying that respondents believe that the accurate representation of spatial data location is essential in geospatial work. Distinguishing Statements 8 (6) and 48 (4), significant at the p <0.01, represent a focus on location determination (Table 10). Statement 58 (3) was an additional statement ranked higher in the array than any other factor. Closely related to these competencies were Statements 63 (5), significant at the p <0.01 level, 6 (3), and 28 (1) focused on getting data into the correct location and representative of real-world features.

The participant Q-sorts used to construct Factor 5 were split in their opinion between cartographic and analytical work as the least relevant competency areas. Distinguishing Statement 49 (-2) was the lowest-ranked distinguishing statement in Factor 5. Statement 49 (-2) was joined by Statements 24 (-2), 25 (-3), 22 (-3), and 26 (-5), all of which ranked lower on Factor 5 than in any other array. Competencies relating to the application of cartographic principles were also seen as lacking as Statements 12 (-1), 16 (-1), 13 (-4), and 11 (-4) are ranked lower in Factor 5 than in any other factor array.

Factor 6: Data Refinements Are a Critical Step in Spatial Analysis

Factor 6 had four Q-sorts and explained 3% of the variance in the study. The respondents are practitioners and educators having substantial years in the practice, averaging 14.8 (SD=7.5) years of experience with 12.8 (SD=6.7) years spent in geospatial science. Two of the respondents received formal geospatial instruction at the Bachelor's level, with another doing so at the Master's level and one possessing no formal

Table 9. Distinguishing Statements for Factor 4

No.	Statement	Factor 4 Q-SV	Factor 4 Z-score	S
45	Apply basic programming principles (SQL statements, Boolean logic, macros)	5	2.08	*
44	Create programming code (i.e., Python or other languages)	5	1.76	*
38	Input data into a relational database	4	1.58	*
21	Compare basic analysis methods (point pattern analysis, cluster analysis, multi-criteria evaluation, and spatial process models)	3	1.35	*
43	Perform descriptive statistical analysis (mean, median, mode, etc.)	0	-0.03	*
7	Apply appropriate map projections based on the type of analysis	-1	-0.52	

Note: p < 0.05: Asterisk (*) Indicates Significance at p < 0.01

Table 10. Distinguishing Statements for Factor 5

No.	Statement	Factor 5 Q-SV	Factor 5 Z-score	S
8	Describe the characteristics and appropriate uses of datums	6	2.3	*
63	Conduct ground-truthing	5	2.01	*
48	Describe different methods of indicating locations (e.g., decimal degrees, UTM, military grid)	4	1.15	*
71	Explain imagery resolutions (Spatial, Temporal, Radiometric, and Spectral)	3	1.02	*
2	Identify spatial patterns; apply knowledge of how people and places are linked (spatial thinking and Tobler's First Law of Geography)	0	-0.08	
49	Perform proximity analysis	-2	-0.65	

Note: p < 0.05: Asterisk (*) Indicates Significance at p < 0.01

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geospatial education.

Factor 6 was assembled from Q-sorts, demonstrating the perception that the development, enhancement, and preservation of data are essential competencies. There were no distinguishing statements (Table 11) supporting data improvement activities, but six of the eight statements, Statements 41 (5), 40 (5), 60 (4), and 51 (4), 33 (4), 52 (3), and 28 (1) ranked higher in factor 6 than in any other factor array. The views regarding less relevant competencies were not nearly so united. Participants were split between seeing competencies focused on solving problems, Statements 3 (0) and 19 (-1), data operations Distinguishing Statements 1 (-4) and 38 (-4), and digital imagery, Distinguishing Statement 67 (-5) and Statement 65 (-5), as lacking consequence in the field. All the previously mentioned statements were ranked lower in Factor 6 than any other factor array.

Factor 7: We Have a Love/Hate Relationship with Data

Factor 7 had three Q-sorts and explained 3% of the variance in the study. The respondents are practitioners and educators having substantial years in the practice, averaging 16.7 (SD=14.0) years of experience with 10.0 (SD=13.1) years spent in geospatial science. One respondent received formal geospatial instruction at the Associate's level, with the remaining two possessing no formal geospatial education.

The factor's title refers to the bifurcated views of the Q-sorts loading onto the factor as they concern data competencies. Statements 51 (4), 57 (4), 23 (3), and 52 (3), associated with the creation or acquisition of data, were ranked higher in the array than any other factor. Conversely, Statements 20 (-1), 34 (-2), 54 (-2), and Distinguishing Statement 37 (-3) leaned toward defining the data needs for a project or scenario and ranked higher in the array than any other factor (Table 12). The paradoxes continue with Statements 19 (6) and 3 (0), Statements 68 (1) and 71 (-6), Statements 13 (5) and 9 (-4), Statements 49 (4) and 21 (-5). The only consistency with Factor 7 appeared to be the inconsistency of the shared opinions, as the statements were ranked higher or lower, depending upon the competency, in the Factor 7 array than in any other array.

Analysis of Research Question Two

The hypothesis for the second research question is that the participants will not reflect differences in opinion due to the respondents' experience in the geospatial profession, area of employment, industry-sector, or educational level. The re-

Table 11. Distinguishing Statements for Factor 6

No.	Statement	Factor 6 Q-SV	Factor 6 Z-score	*S*
46	Perform data format conversions (vector to raster, raster to vector, raster to TIN)	3	1.21	
53	Georeference data	2	1.01	
42	Demonstrate ability to carry out mathematical operations including addition, subtraction, multiplication, and division	2	0.89	*
37	Define data requirements to help solve a problem	-1	-0.31	
1	Explain what topology means in relation to geospatial data (i.e., adjacency, connectivity, containment, proximity)	-4	-1.29	
38	Input data into a relational database	-4	-1.33	
67	Perform change detection using imagery from different dates	-5	-1.4	

Note: *p* < 0.05: Asterisk (*) Indicates Significance at *p* < 0.01

Table 12. Distinguishing Statements for Factor 7

No.	Statement	Factor 6 Q-SV	Factor 6 Z-score	*S*
13	Create charts, graphs, tables	5	1.88	*
44	Create programming code (i.e., Python or other languages)	2	0.61	
68	Collect spectral signatures for imagery classification	1	0.21	*
37	Define data requirements to help solve a problem	-3	-1.11	
47	Explain why map scale affects the resolution of data creation or acquisition for a given application	-4	-1.46	
21	Compare basic analysis methods (point pattern analysis, cluster analysis, multi-criteria evaluation, and spatial process models)	-5	-1.87	*

Note: *p* < 0.05: Asterisk (*) Indicates Significance at *p* < 0.01

searchers conducted tests of Independence to determine if differences in perception were related to the participants' level of geospatial experience. The results were not significant, with an X^2 of 24.264, 24 degrees of freedom, a *p*-value of > .4466, and a Fisher's Exact two-sided probability of $p \leq .5384$ (Table 13).

The researchers conducted tests of Independence to determine if differences in perceptions were related to the participants' area of employment. The results were not significant, with an X^2 of 20.709, 18 degrees of freedom, a *p*-value of > .2943, and a. Fisher's Exact two-sided probability of $p \leq .1619$ (Table 14).

The researchers conducted tests of Independence to determine if differences in perceptions were related to the participants' industry sector. The results were significant, with an X^2 of 34.565, 18 degrees of freedom, a *p*-value of > .0107 (significance level of 0.05). Fisher's Exact Test yielded results that were also significant with a two-sided probability of $p \leq .0011$ and indicates that the association between the variables is statistically significant (Table 15). These results reject the null hypothesis of the absence of a relationship between the

industry sector and a shared perspective (factor).

The researchers conducted tests of Independence to determine if differences in perceptions were related to the participants' level of geospatial education. The results were not significant, with an X^2 of 26.48, 24 degrees of freedom, a *p*-value of > .01, and a Fisher's Exact two-sided probability of $p \leq .4125$ (Table 16).

LIMITATIONS

The study did not require respondents to hold any credential indicating geospatial science proficiency. A P-set built to reflect a professional geospatial workforce more accurately may prove more valuable. The researchers completed factor extraction with a seven-factor solution. The development of seven factors is not a limitation, but two of the factors included only three Q-sorts, limiting the degree to which a shared perspective exists. The researchers used the 72 competencies gleaned from a more extensive 190 competency assessment tool constructed from numerous external sources. As such, the statements vary

Table 13: Test of Independence – Geospatial Experience

Experience	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Total
0 – 5 Years	8	1	1	2	0	0	2	14
6 – 10 Years	4	1	1	1	1	1	0	9
11 – 16 Years	3	1	2	0	0	2	0	8
17 – 22 Years	3	2	1	2	0	1	0	9
23+ Years	1	2	0	1	2	0	1	7
Total	19	7	5	6	3	4	3	47
Statistic	Value	df	Probability	Significant				
Chi-Square	24.264	24	$p > *.4466$	No				
Fisher's Exact			$p \leq .5384$	No				

* Chi-Square (X^2) is not a reliable test with cell counts of less than 5.

Table 14: Test of Independence – Area of Employment

Employment	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Total
Private Industry	1	3	1	2	2	1	0	10
Public Sector	4	3	2	3	1	2	1	16
Secondary Education	10	1	1	0	0	0	1	13
Post-Secondary Education	4	0	1	1	0	1	1	8
Total	19	7	5	6	3	4	3	47
Statistic	Value	df	Probability	Significant				
Chi-Square	20.709	18	$p > .2943*$	No				
Fisher's Exact			$p \leq .1619$	No				

* Chi-Square (X^2) is not a reliable test with cell counts of less than 5.

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Table 15: Test of Independence – Industry Sector

Sector	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Total
Analysis & Modeling	3	2	3	4	1	4	0	17
Positioning & Data Acquisition	1	2	0	0	1	0	0	4
Software & Application Development	1	2	0	2	0	0	1	6
Education	14	1	2	0	1	0	2	20
Total	19	7	5	6	3	4	3	47
Statistic	Value	df	Probability		*Significant*			
Chi-Square	34.565	18	$p > .0107*$		Yes			
Fisher's Exact			$p \leq .0011$		Yes			

* Chi-Square (X^2) is not a reliable test with cell counts of less than 5.

Table 16: Test of Independence – Geospatial Education

Education	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Total
Associate	1	1	0	0	0	0	1	3
Bachelor	4	3	1	3	1	2	0	14
Master	8	2	2	3	0	1	0	16
Doctoral	0	0	1	0	1	0	0	2
No Formal Education	6	1	1	0	1	1	2	12
Total	19	7	5	6	3	4	3	47
Statistic	Value	df	Probability		Significant			
Chi-Square	26.48	24	$p > *.3293$		No			
Fisher's Exact			$p \leq .4125$		No			

* Chi-Square (X^2) is not a reliable test with cell counts of less than 5.

in the level of granularity and focus. This variation may have influenced the behavior of the respondents.

FINDINGS

The geospatial profession is built upon a defined set of workforce competencies. Previous research has sought to determine the skills needed by geospatial professionals. However, the absence of a study evaluating the perceived relevance of geospatial competencies by practitioners and educators represented a gap in practice. This research study uses Q Methodology to assess respondents' perceptions towards the core competencies contained within the GeoTech Center Geospatial Competency Matrix. This article describes the results of a research study consistent with Q Methodology and attempts to reveal varied perspectives rather than generalize a population (Watts & Stenner, 2012).

Due to various applications and users, there are numerous challenges to assuring competence within the geospatial field (Albrecht, 1998). Attempts to regulate the discipline are progressing, but a connection between the learning outcomes achieved in academia and the practical knowledge demon-

strated in the workplace is an excellent path to establishing competency (Mathews & Wikle, 2017). The study results address the following research questions:

1. How do practitioners and educators view the geospatial competency statements within the GeoTech Center Geospatial Competency Matrix, and why?
2. Do perceptions of the geospatial competencies differ based on the respondents' industry- sector, experience in the geospatial profession, area of employment, or educational level where they received most of their geospatial instruction?

Finding 1. This study revealed seven viewpoints, representing the different perspectives of practitioners and educators participating in the research project. The seven documented factors characterize a substantial variation in the perceptions of technical geospatial competencies. The emergent factors were Factor 1: We are Cartographers (map evaluators); Factor 2: Vector Data are our Paramount Focus; Factor 3: Analysis is the Key to Addressing Geospatial Problems; Factor 4: Using Programming to Support Analysis; Factor 5: Where in the

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World is the Data; Factor 6: Data Refinements are a Critical Step in Spatial Analysis, and Factor 7: We have a Love/Hate Relationship with Data.

Finding 2. The Chi-Square and Fisher's Exact Tests of Independence determined a relationship between the participants' industry sector and the factors. The analysis revealed an X^2 of 34.565, 18 degrees of freedom, and a p-value of > .0107 (significance level of 0.05). A Fisher's Exact Test yielded results having a two-sided probability of p ≤ .0011 and indicating a statistically significant association reject the null hypothesis of the absence of a relationship between the industry sector and a shared perspective (factor).

Finding 3. No competency cluster dominated the most relevant skills. However, positively viewed competency areas included using geospatial science to solve problems (Statements 3, 19, and 37, with a mean score of 0.83), spatial analysis (Statements 27, 49, and 24, with a mean score of 0.81), and database operations (Statements 39, 51, and 34), with a mean score of 0.65. The participants negatively viewed competency areas related to digital imagery and remote sensing, with seven statements falling in the bottom quarter of the array and three of the bottom four ranked statements. These competency statements, Statements 70, 69, 65, 64, 71, 66, and 68, were deemed less relevant to the geospatial field, with a mean value of -0.86.

CONCLUSION

This study represented the results of an investigation to address how practitioners and educators view the geospatial competency statements located within the GeoTech Center Geospatial Competency Matrix. The researchers collected data from 70 respondents, with 47 loading onto seven factors. The study found no consensus statements but revealed distinctly negative opinions connected with remote sensing competencies. Also, the research revealed a statistically significant relationship between the participants' industry sector and the factors. This research study validates using a Q Methodological study to examine the statements within a competency model. Moreover, it demonstrated a process to evaluate a conceptual model of competencies. Better data analysis sources, such as those found in this study, could enable educational institutions to engage industry partners more effectively.

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Dr. Rodney Jackson an adjunct geography faculty at East Carolina University, a Certified Geographic Information Systems Professional (GISP), and a Senior Researcher with the National Geospatial Center of Excellence.

Dr. Tom Mueller has been a geography professor at PennWest – California University since 1999. His interests include GIS, Crime Mapping, and geography education. His goal is to apply spatial theory to the real world, mainly using GIS.

APPENDIX A

POST-SORT QUESTIONS

Select a statement that you placed in the "6" column and share the reason for your decision. Please include what aspect of your education, experience, or expertise brought you to this determination (i.e., what made you make the decision?)

Select a statement that you placed in the "-6" column and share the reason for your decision. Please include what aspect of your education, experience, or expertise brought you to this determination (i.e., what made you make the decision?)

Which statement did you have the most difficulty placing and why? Please include as much detail as you feel is appropriate.

What factors helped to determine your sorting decisions? Please include as much detail as you feel is appropriate.

Please share any additional thoughts not addressed by the questions above (these answers are used as data in determining how we characterize the cumulative perspective held within the geospatial industry).

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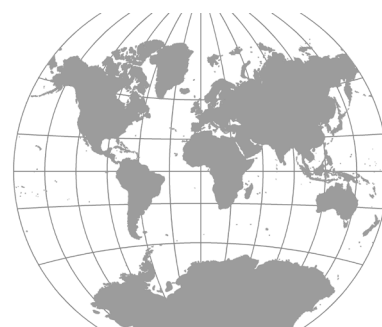
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"Leaves From my Journal": William T. Beatty's Civil War Account of the 2nd Ohio Volunteer Infantry

H. Jason Combs*, Tate Combs, Paul R. Burger

University of Nebraska-Kearney, Department of Geography, Kearney, NE, USA

*Corresponding author: combshj@unk.edu

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INTRODUCTION

During the Civil War, the Ohio Valley played an essential role in the eventual Union victory (Holcomb 2004). At the start of the war, Ohio had the third largest state population (2,339,511) and ranked third in wealth. In the 1850s and 1860s, Ohio also contained many of the nation's largest cities – Cincinnati, Cleveland, Columbus, and Dayton were all in the top fifty largest cities in 1860. Geographically, the state was centrally located in the heart of the country, connected to the Ohio and Mississippi rivers, and Ohio led the nation in railroad track mileage as well (Dee 2006).

Ohio contributed a substantial number of men to the Union effort and initially responded to the war with great excitement. Following Fort Sumter's surrender, President Abraham Lincoln issued a call for seventy-five thousand troops – Ohio's quota was thirteen thousand. Without hesitation and prior to the War Department's establishment of an official quota, Governor Dennison wired Lincoln and asked "What portion of the 75,000 militia . . . do you give Ohio? We will furnish the largest number you will receive." Governor Dennison went even further after learning of Kentucky's refusal to supply troops: "If Kentucky will not fill her quota, Ohio will fill it for her" (Coles 1962, 3; Starr 1961).

A "total of 313,180 Ohioans served in 198 infantry regiments and 13 cavalry regiments, in addition to several artillery regiments and various independent units" (Maness and Combs 2010, 9). Ohio most likely led the northern states in the percentage of its eligible men serving in military forces and was outranked in total numbers enrolled only by New York (448,850) and Pennsylvania (337,936) (Wheeler 1998; Harper 1961). One such Ohio soldier was William Beatty, a member of the 2nd Ohio Volunteer Infantry (Fig. 1).

Beatty, at the age of forty-three, joined the 2nd Ohio Volunteer Infantry, Company C, on July 27, 1861 at the rank of Captain. Beatty served in that capacity until March 2, 1863, when he was promoted to Major and became a member of the Field and Staff Officers for the 2nd Ohio Volunteer Infantry.

Figure 1. William Beatty, 2nd Ohio Volunteer Infantry.

Beatty was later captured at the Battle of Chickamauga on September 20, 1863 and ultimately discharged on November 10, 1864 (Roster Commission 1886a.).

During his time in service, Beatty kept a journal and meticulously recorded dates and key events, though Beatty was

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not unique in doing so, as diaries, journals, and letters were essential correspondence during the Civil War (Maness and Combs 2010). However, Beatty, who moved to Gibbon, Nebraska following the war in 1872, later shared his original journal entries which were reprinted in the *Buffalo County Beacon* (Gibbon, Nebraska's newspaper). Over the course of thirty-three newspaper articles – running from February 1, 1883 to September 21, 1883 – Beatty provided his personal account in the *Buffalo County Beacon* and referred to each article as "Leaves From my Journal" (Fig. 2).[1] These first-hand accounts serve as a unique way to track both physical and political landscapes during the Civil War.

2ND OHIO VOLUNTARY INFINTRY

Beatty, a member of Company C of the 2nd Ohio Volunteer Infantry, enlisted at Goshen, Ohio in Clermont County in July of 1861 and officially mustered into service on August 20, 1861 at Camp Dennison, Ohio under the command of Colonel L.A. Harris of Cincinnati, Lieutenant Colonel John Kell of Franklin, Ohio and Major Anson McCook of Steubenville, Ohio (Fig. 3).[2] Beatty notes that John D. Randall and Nelson Schooley along with Bradford Ringer were part of the Kentucky contingent along with several other soldiers of "other companies of the regiment" who eventually moved west after the war, many to Nebraska.

Throughout the initial entries, Beatty writes of several smaller skirmishes and places, including Mount Sterling, Kentucky along with Olympian Springs–a noted "summer resort for the chivalry of Kentucky, such as Henry Clay, Taylor, Webster, Marshal, Crittenden and others."[3] Beatty also mentions Licking Station and Prestonburg in central Kentucky along with a confrontation near the Big Sandy River (Figure 4). Beatty's fourth entry in the *Buffalo County Beacon* (March 2, 1883) provides an account of the Battle of Ivy Ridge (Battle of Ivy Mountain) the first major clash in eastern Kentucky, where General "Bull" Nelson was ordered to confront a Confederate camp near Prestonburg (Fig. 4) (Richards 2003; Scalf 1958). Beatty notes that as "soon as the battle was over our regiment was called into line, killed, wounded and missing ascertained, and a detail made to bury the dead and care for the wounded.

The regiment then moved on up the river about three miles, and encamped in an open field, the rain pouring in torrents and not a tent or shelter to cover us, and a great many of us who were unused to sleeping under such circumstances could not possibly keep our thoughts from wandering back toward home and home comforts, which was kind of natural, I suppose."[4]

November of 1861 found the 2nd Ohio Infantry on the move again. Near Prestonburg they marched toward the mouth of the Big Sandy River with orders to "proceed to Cincinnati" (*Buffalo County Beacon* March 9, 1883). Arriving at Catlettsburg, Kentucky where the Big Sandy meets the Ohio River, they "found one of Cincinnati's best steamers waiting for us, the Jacob Strader . . . arriving at Cincinnati we found our friends from the homes of Company C. with a supply of underclothing, socks, mittens and gloves–a God-send to us" (Fig. 5).[5] Soon under way again this time bound for Louisville, Kentucky where they arrived the morning of November 25, 1861 (*Buffalo County Beacon* March 9, 1883).

Weeks later on February 9, 1862 Beatty boisterously states that "peal on peal the hurrah sounds and immediately the order comes; strike tents; into line; on to Nashville! and now what a commotion is seen and heard, officers flying steeds rushing from point to point giving orders, while the rumbling thud of heavy bodies of cavalry, the rattle of artillery wheels" (Fig. 3).[6] A short march "brings us to Green river; here the rebels had destroyed the railroad bridge and McCook's division had rebuilt it, three hundred feet long and one hundred and thirty feet above the water. We cross the bridge, march three miles up the river and encamp in a beautiful grove."[7] Beatty writes that "appearances are here of an extensive rebel encampment now deserted. A battle was fought here two weeks since, Col. Willick commanding the 32nd Indiana was practicing his men in the skirmish drill when he was attacked by a regiment of cavalry called the Texas rangers under Colonel Terry, supported by two regiments of infantry and a section of artillery.[8] The Rangers charged Willick with a yell, but got themselves most terribly whipped; their colonel and a large number of men and horses killed before their supports could come up."[9] Beatty continues, "dead horses lay all over the field, and
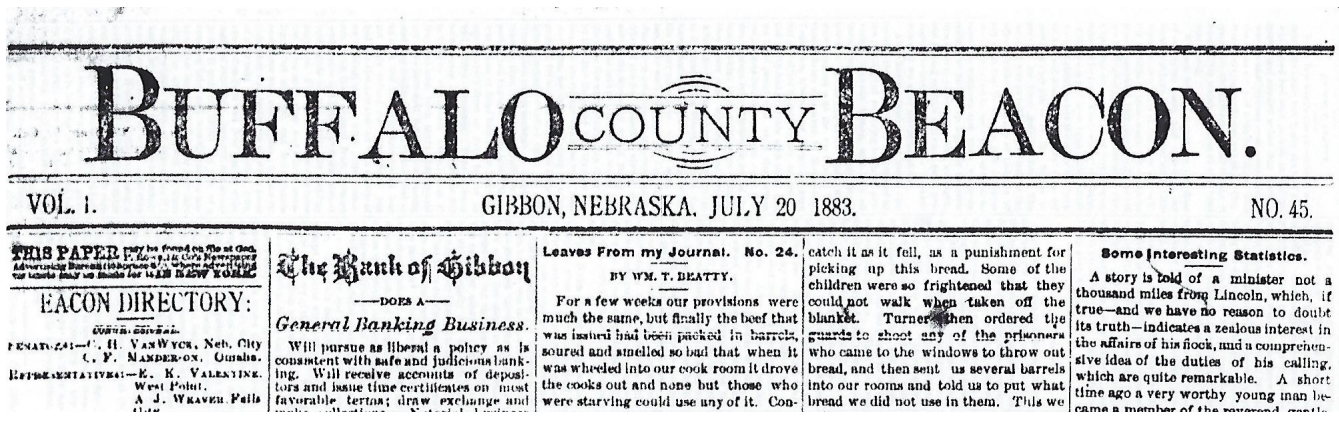

Figure 2. Buffalo County Beacon, July 20, 1883.

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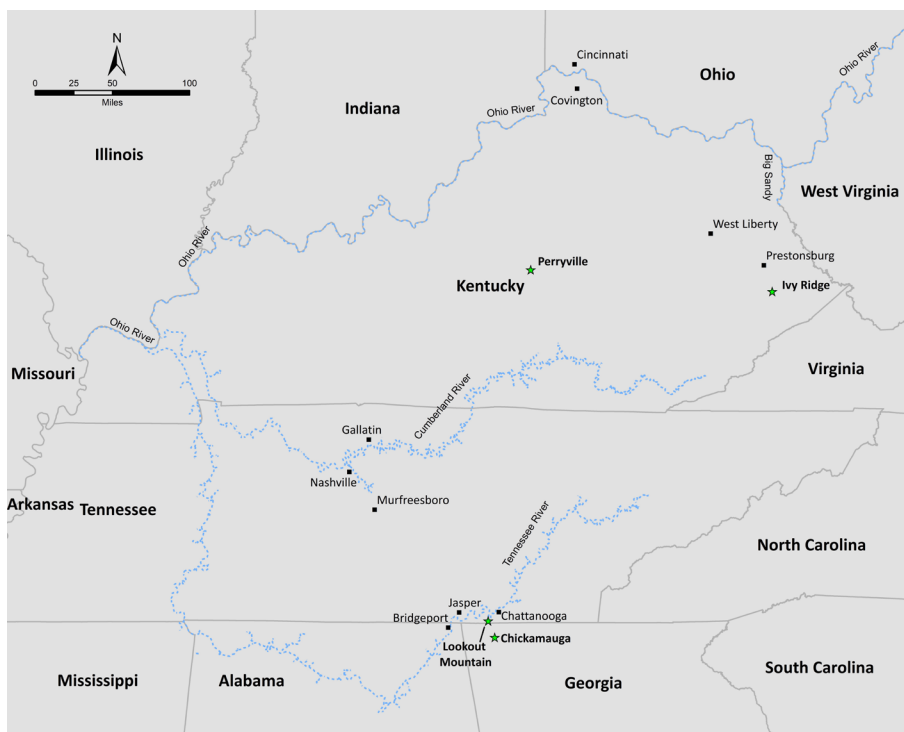Figure 3. Major Battles and Cities Mentioned by Beatty in Ohio, Kentucky, and Tennessee.

Figure 4. Major Battles and Engagements Mentioned by Beatty, Including Lookout Mountain, Chickamauga, Perryville, and Ivy Ridge.
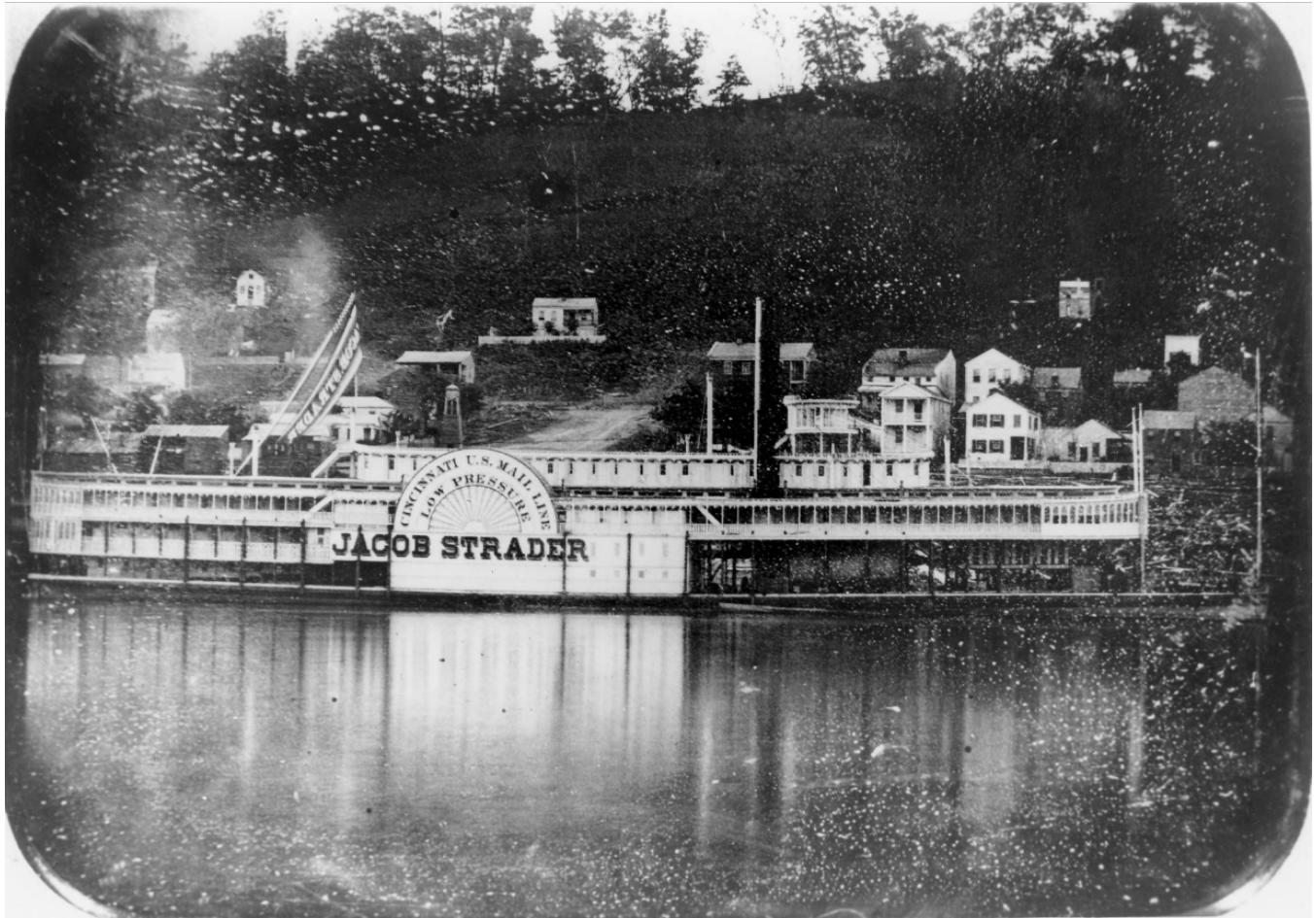
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Figure 5. Jacob Strader Steamboat.

the 2nd Ohio boys gathered up quite a number of cavalry revolvers which had been lost in the fight" (*Buffalo County Beacon* March 23, 1883).

Beatty's next entry begins on February 16, 1862 and continues through the middle of March. On the 16th they boarded a "long train of flat cars" where General O.M. Mitchell "stood upon a bank by the track and sang us a thrilling war song" (*Buffalo County Beacon* March 30, 1883). Troops traveled some twenty-five miles until the track had been "destroyed by water." The next day the regiment marched toward Gallatin and on February 20th General Mitchell "rode to our camp and informed us that the rebels had fled from Nashville and the city had surrendered." By February 22, 1862 they were within a few miles of Nashville and on February 27 "crossed the Cumberland river on the steamer Silver Moon [which was launched around 1860 and sank in 1869] the rebels having destroyed all the bridges" (Fig. 4).

The 2nd Ohio Infantry camped in a "beautiful park, formerly a place of resort for the Southern chivalry," grounds that recently contained a "beautiful mansion" and they referred to this as "camp Andrew Jackson . . . the tomb of the hero of New Orleans being in the vicinity."[10] On March 8, 1862 the

"long roll was beaten, and in about two minutes our regiment was double-quicking it up the turnpike toward Murfreesboro. We soon learned that the noted guerilla John Morgan, had captured about forty men and eighty horses from the train belonging to the Ohio cavalry, that regiment being encamped about four miles in advance. The rebels left the wagons standing in the road and made off with their prize. But the fourth immediately gave chase and soon recaptured the horses and most of the men, killing and capturing eight or ten of Morgan's men."[11]

On April 11, 1862 the Ohio troops arrived in Huntsville, Alabama and captured "fifteen locomotives, a large number of cars, depots roundhouse and machine shops all complete. Also two trains loaded with wounded and paroled or furloughed soldiers just arrived from the battle of Corinth or Pittsburgh Landing" (Fig. 6) (*Buffalo County Beacon* April 6, 1883). Beatty describes Huntsville, Alabama as one of the "most beautiful and pleasant places in the south. It is built upon a hill out of which issues a stream of water as clear as crystal and of sufficient quantity to be called a river . . . the best and most beautiful of evergreens and flowering trees and plants adorn the streets, sidewalks and gardens; and the most beautiful of

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Figure 6. Key Battles and Locations Mentioned by Beatty, Including Huntsville, Alabama and Richmond, Virginia.

southern flowers, the magnolia, is constantly seen in the parks and gardens."[12]

From mid-April until the second week of June the 2nd Ohio stayed near Huntsville. Huntsville was a key position, holding the city along with controlling the Memphis & Charleston railroad, and the "Tennessee river for over 100 miles" was essential. Entry number twelve continues and Beatty notes that "there are three splendid church edifices in Huntsville, belonging to the Methodist, Baptists and Presbyterian denominations. The church members here, and especially the ministers, are the worst of rebels, and have done more at instigating and encouraging rebellion, than any other class" (*Buffalo County Beacon* April 27, 1883). A few days later Beatty writes that Reverend M.P. Gaddess had just returned from Cincinnati and "our officers took possession of one-half of the Huntsville cemetery and buried our dead there, and every time we went to bury a soldier the young ladies of the rebel persuasion would appear with baskets of flowers, and decorate the graves of rebel soldiers, while contemptuously scorning the graves of those

who died in defense of the union" (*Buffalo County Beacon* April 27, 1883). Beatty writes that "we of course said nothing to them, as we had no fight with the ladies, unless they PANTED for military glory, donned the rebel uniform and stood in the confederate ranks."

By June 13, 1862 they approached Jasper, some twenty miles from Chattanooga on the Tennessee River (Fig. 4). At Jasper the 2nd Ohio found Colonel Sill of the 33rd Ohio and members of the 10th Wisconsin. They determined that the enemy was nearby and they "fell back . . . to the mouth of Battle creek" and were reinforced by "20,000 troops, they being part of Buell's army" (*Buffalo County Beacon* April 27, 1883). According to Beatty the Union troops were on the river's north bank, while the Rebels were on the south. Troops would "hail each other across the stream, enquiring as to the news, and proposing an exchange of late newspapers. The details amicable arranged, one from each side would plunge into the stream with the papers in his teeth, the two meeting in the middle of the river, completing the exchange, and swimming back to their respec-

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tive shores, thus contributing to the spread of information as to what was going on in the different parts of the world."

Beatty's journal next turns toward late 1862 into the early part of 1863 near Chattanooga and events that included Beatty sustaining severe injuries in battle. Beatty begins on October 9, 1862 and writes that "both armies claimed the battle field at dark last night. This morning brought to light the fact that General Bragg with his army of rebels, has silently withdrawn during the night, and was in full retreat south towards Chattanooga" (*Buffalo County Beacon* May 4, 1883). Beatty continues, but a "greater surprise to the union troops was the fact that our most generous Gen. Buell lay quietly in camp for three days, refusing to let his army pursue Bragg, suffering him to forage, and carry away all the supplies that he could find conveyance for. This was to us an unaccountable inconsistency, for all our officers were satisfied that we could have captured his entire army but Gen. Buell forbade our doing so. It was said at the time that Bragg and Buell were brothers-in-law, and the consequence was that Gen. Buell was relieved, and Gen. Wm. Rosecrans placed in command, and who immediately pursued Bragg."[13] Beatty was not able to provide particulars of the pursuit, as he was "severely wounded in battle" receiving a "minnie ball through my thigh, seven ball holes through my coat, and seventeen ball holes through my colors" (Fig. 4).[14]

Toward the end of January of 1863, Beatty rejoined his regiment and recovered while they were at Murfreesboro for four months and during this time he was promoted to major. The 2nd Ohio was "reorganized and refitted" and by the end of April marched for Chattanooga (Fig. 4). When Rosecrans attacked Bragg the conflict raged for two days, "when rebels concentrated their forces, and with desperate energy and reckless courage forced McCook back at right angles to Thomas who, pouring a desperate fire of shot and shell into their flank, compelled them to fall back, and let McCook partly recover his ground" (*Buffalo County Beacon* May 4, 1883).

Writing of this battle a few days later near Murfreesboro, Beatty notes that on the "east side of the river was a large field and it was over this that the rebels had driven Crittenden's corps until they were reinforced by Thomas, and then quickly rallying under their brave and noble General, they threw themselves with the most desperate courage on the enemy; and now comes the real test of brute force against physical force, the corn fed mud sills of the north on one side and on the other side the cotton stuffed chivalry of the south. The southerners were flushed with their success, and the northerners stung by their repulse, and both sides were determined to win" (*Buffalo County Beacon* May 11, 1883). Beatty concludes that "awful and desperate was the struggle. Officers and men were cut down by the hundreds, and the roar of artillery and musketry, and the clash of sabers was most terrible and entirely beyond description, and for hours the carnage went on, until the physical endurance began to tell heavily on the cotton chivalry, and mere physical or brute force won the day, equal valor being displayed by both officers and men on either side."

Nearly three weeks later, the battlefield and cedar forest "where McCook's corps fought" were still covered with "broken remnants of the fight" including "artillery wheels, caissons, baggage wagons, muskets, swords, sabers, pistols, bayonets, cartridge boxes, caps, hats, and shoes, and tons of shot and shells, with great furrows plowed in the ground by heavy shot and shells" (*Buffalo County Beacon* May 11, 1883). Beatty notes that after the battle many of the cedar trees "were cut and manufactured into canes, rulers, toilet boxes and other articles of various kinds as mementoes of the tearful conflict, a great many pieces still having the leaden balls sticking in them."[15]

Soon they were preparing for a march over Lookout Mountain where the states of Alabama, Georgia, and Tennessee come together (Fig. 4).[16] Beatty writes that on September 7, they departed Bridgeport and crossed the Tennessee River and camped at the foot of Lookout Mountain "on the north side, 23 miles west of Chattanooga." It took three days to cross Lookout Mountain where they "encamped in McLemores on the south side," a valley named for John McLemore, chief of the Cherokee Nation, who was the son of a white trader and Cherokee mother. In "short time" the 2nd Ohio Infantry "commenced a forced march to intercept Bragg before he could reach Chattanooga." Beatty contends that some "60,000 union yanks marching day and night" arrived at "Chicamauga creek right in Bragg's front about noon" on "September 19, 1863" (*Buffalo County Beacon* June 8, 1883). Bragg supposedly had "95,000 men, Rosecrans about 70,000 fit for duty" with the Rebels having the "advantage of position, having cut us off from water."

Beatty's following entry provides a first-hand account of events at Chickamauga, the first major battle in Georgia and the most significant Union defeat in the western theater, which he described as a "furious battle" and was initially reported as a "stunning Confederate victory" (Fig. 4) (Goodwin 2005, 556). Beatty in great detail notes that "here a shell falls close behind our works, right among our men, bursts and sends a dozen men, brave and true, into the air, and now the sharp hiss of a Minnie ball knocks a man out here, and there another, and still another, our ammunition is giving out and no reinforcements." Officers seeing the "best men falling on every hand, and the cry coming from right and left, 'Colonel, we are out of ammunition,' and 'we are dying for want of water.'" Orders were given to go and retrieve supplies, but soldiers in their attempts to gather items were captured. Beatty shares, for instance, the order for "Lieut. Crebbs, go quickly to the rear and see if you can procure reinforcement or ammunition." Crebbs leaves but does not return. Beatty "now smarting under three wounds" takes his "pocket-knife and running along in the rear of my men cut the cartridge-boxes from the waists of my dead soldiers, and throw them in among my men. Soon we hear a tremendous rebel yell on our right, and looking in that direction see the rebels limbering up a battery on an eminence only a short distance off, which completely commands our position. Instantly springing on our works and looking to the left, I see the rebels swarming to our rear. Discovered our position entirely untenable, our last hope fled. Pointing my sword to the north I called out, every man save himself that can, there is your only chance, we are surrounded. Away they went like sheep before a wolf, and the battle of Chicamauga was ended." All told, Union casualties totaled some 16,000 men. General Rosecrans concluded "we have met with a serious disaster." A Confederate victory, but Union General George Thomas had held his ground during the conflict and the "rebels had lost even more troops than the Federals" (Goodwin 2005, 557).

The next entry reveals events that dramatically changed the war for Beatty. A continuation of the previous entry, Beatty notes that he along with several officers and men came into "full view of the rebel battery referred to in my last, and it immediately opened on us with grape and cannister, which strewed the field with dead and wounded" (*Buffalo County Beacon* June 29, 1883). Beatty was not injured in the fight but as they departed the field an "officer on horseback" approached. "Everything looked blue with smoke" and Beatty "mistook him for one of our cavalry officers and thought we were safe." The officer wearing Rebel gray "drew a revolver, and in a rough voice demanded my sword." Beatty initially hesitated and then changed "my sword from my right to left hand, turning the guard up, and catching my own revolver with my right hand, intending to shoot him while he was in the act of receiving my sword." Before this could be done, however, "eight or ten of his command came up" and "surrounded us . . . so I did not draw my revolver but was made a prisoner" along with all "my command that was near me at the time." Those captured were taken through the battlefield three or four miles to a "field hospital" where after receiving a drink of "cool water" they "tumbled on the ground, so completely worn out that we cared but little whether we lived or died."

Beatty adds that the "next morning about 300 of us were given in charge of a Lieutenant from North Carolina who, with his company of about 100 men, were to take us back to Atlanta" (Figure 6).[17] They walked over a day without provisions and "finally we came to a field of sorghum and I requested the Lieutenant to let us get some of the stalks, as we were starving." They were allowed to cut "two stalks for each man, and this was all that we had to eat from Sunday morning till Tuesday night, when we arrived at Ringold, Ga." (*Buffalo County Beacon* June 29, 1883).

The prisoners "lived through the night" and the next "evening arrived at Atlanta." Conditions were bleak, as Beatty points out that "without shelter or bunk of any kind except a few blankets that some of our private soldiers had we were compelled to spend the night in this mud-hole. I remember I thought myself very fortunate in obtaining the seat of an old stump, which was all the bed I had for that night" (*Buffalo County Beacon* June 29, 1883). The following day they marched into Atlanta and were "exhibited as Abe Lincoln's hirelings."[18] Beatty and his fellow prisoners "were badly snubbed and jeered at by the so-called Southern ladies, some of whom were not slow to show their sympathy in spiteful words and actions, which gave us Northern mudsills a pretty strong dose of Southern high life." From Atlanta they marched to a "stockade [that] had been used as a jail to punish their negroes in" and at the "gate was stationed some soldiers" who searched all "their blankets, knapsacks, haversacks, pen-knives or money were taken from them." Some of the men handed some of their items to officers, Beatty himself "carried two pair of army blankets into the stockade and returned them to my men, for the rebels did not take anything from our officers."

In the next newspaper account Beatty writes that "near the gate of this stockade was a raised platform, which had probably been used by the auctioneer when selling slaves" (*Buffalo County Beacon* July 6, 1883). On this platform "stood quite a number of woman" and "from their style of dress, they were of the very elite of Atlanta. Those ladies seemed to enjoy the sight of the prisoners exceedingly and indulged in slang phrases and sarcasm, laughing heartily at each other's comments." Beatty notes that "this rather stirred up my composition until it boiled over, and I said, 'ladies, it is your turn to laugh now, but in less than one year from this time I expect to see you here begging the Union authorities to release your own husbands, brothers and lovers.' At this they hooted, hissed and laughed me to scorn."

The Union prisoners remained in the stockade for two days, then "were placed in stock and box cars on the railroad, and started for Richmond, Va., each car being crowded as full as we could possibly stand" (Fig. 6). Before departure, they were issued crackers and some were "mixed with beans and peas" which were a "blue mud color." They left for Libby Prison and along the way stopped at Augusta, Georgia where they were "unloaded" and "marched into the town" in front of officers and who was thought to be the "Governor of Georgia" who ordered that no one "abuse us or take anything from us, but to put us on the cars and take us to Richmond and turn us over to the authorities." While waiting an "officer came up to me and seeing my watch-chain, which was made of hair and gold thread, asked what I would take for it. I said $10 in your money; he immediately handed me $10 and took the chain. I returned him the money and asked him if he would step into the bakery close by and get me $10 worth of bread which he did, returning me ten small loaves. I took one and gave the rest to my men."

Beatty and his fellow prisoners arrived in Richmond on September 29, 1863, arriving near sunset and marched to Libby Prison.[19] Beatty mentions Major Turner, Latoosh the adjutant, and Ross the secretary and that the officers were searched for arms, ammunition, and money . . . all being considered "contraband."[20] The other soldiers were sent "across the street" to "Scott's building and Castle Thunder," which was an enormous tobacco warehouse where prisoners were held (Beszedits 1999).

Before leaving Atlanta, Beatty notes in the next entry that a roll call was made so that upon arrival at Libby everyone was accounted for in the same fashion.[21] At Libby, two colonels were called first, "stripped and searched and all their money taken from them." Beatty was the third called and had "in my pocket $80, fearing the Rebs. would appropriate it, I had divided it leaving $10 in my pocket-book, putting $10 in my vest pocket and $60 in my sock inside of my boot" (*Buffalo County Beacon* July 13, 1883). Beatty was able to escape the search and retain the $60 hidden in his boot. After the inspection the prisoners were marched to the third story of the "old tobacco warehouse . . . which still hung the sign of LIBBY AND SONS" (Fig. 7).

The next account reveals that after weeks of provisions that were often fly infested, beef was issued that had been packed in barrels but had "soured and smelled so bad that when it was wheeled into our cook room it drove the cooks out and none but those who were starving could use any of it" (*Buffalo County Beacon* July 20, 1883). They remained in Libby with few if any utensils while the large windows that had once been fitted with "wooden shutters" had the glass "broken out and the shutters torn off and iron bars placed in the frame to prevent us from getting out."

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Figure 7. Union Captives at Libby Prison in Richmond, Virginia.

Beatty writes that Colonel A.D. Strait of Indiana had made several attempts to escape, once bribing a guard with money and another time using a gold watch as bounty. This time, however, Colonel Stone of the 77th Pennsylvania Infantry "conceived the idea of tunneling out" (*Buffalo County Beacon* July 27, 1883).[22] Colonel Stone's initial plan was to go under the foundation wall and into the sewer, but "water filled the sewer and he was compelled to back out." Next was to tunnel under a vacant lot between the "Libby building and some tobacco ware houses on the south." A stable was located adjacent to the vacant lot, yet knowing the distance was key. Beatty notes that to determine distance, two captains from Ohio – Captain William Randall and Captain John Galagher – were employed. Both captains "had been receiving boxes of provisions from home, and Capt. Galagher requested Maj. Turner the prison commander issue him a box of provisions which he pretended he knew had come and was stored over in those tobacco warerooms." The box of provisions did not exist which the prisoners apparently knew. An orderly could not find the box, but Captain Galagher "informed Turner that it must be there and if he would suffer him to go and look for it, he would divide the contents with him, and it was very valuable." Turner, the prison commander, sent a guard along with Galagher to search for the box and in doing so Galagher was able to step off the distance and "returned with the information Col. Stone so much needed." With an accurate distance at hand, the digging proceeded. The "men who dug the hole used a strap hinge, which had formerly been on the window shutter." It had been made by a blacksmith and was "about 15 inches long," with one end filed sharp with "rags around the big end to make a handle which would not hurt their hands . . . the tunnel was dug with this instrument." Twine from boxes was attached to haversacks which were filled with dirt and removed, in all the expedition required "about fifteen days, or rather nights digging the tunnel."Beatty next reported that more than a single tunnel was nearing completion, the "north had their tunnel pretty near finished" and the "company of the east were pretty well along with their tunnel" (*Buffalo County Beacon* August 24, 1883). Things were apparently going smoothly but the "very next day our prison inspector brought a body of soldiers" who took a "ramrod from one of the guns . . . and commenced probing with the ramrod giving us the first intimation that he knew anything about our digging." The Rebels found all the tunnels that "convinced us that we had been betrayed in suspicion rested on a Tennessee officer who previously had been quite intimate with our superintendent." Beatty continues, "had we been positive that he was the man, he would have hung to a limb of one of the pine trees that night in such a way that he would not have needed any more corn rations."

For the next few months they remained at Libby, with new prisoners from Sherman's advance on Atlanta arriving every few days.[23] Beatty notes that new prisoners were called "fresh fish and every time any were put in those old prisoners near the gate would sing out fresh fish, others would repeat it until the cry of fresh fish, fresh fish, would be heard throughout the prison, and all would rush to the entrance to see the new comers . . . asking and answering questions, so as to get all the news possible" (Miller 2001; Osman 1995).

There are a handful of entries missing toward the journal's conclusion, but the last two entries do remain. The penultimate entry details Beatty's exchange as he notes that the "Rebel officer in charge was there with an order to send on for exchange all the officers captured from Sherman in his advance on At-

lanta" (*Buffalo County Beacon* September 14, 1883). Beatty was not part of this outfit, being captured at Chickamauga. The Rebel officer in charge, however, called Beatty's name and asked if he would promise to not attempt an escape as they were moved to Atlanta, Georgia. Beatty responded "my dear sir, I will most gladly do so and I think nothing but a wooden man would have refused." Beatty notes that "153 officers were selected out of some 1,500 that were confined . . . put upon box cars and taken to Macon, Georgia." The next day the "Rebs discovered that quite a number of us did not belong to Sherman's army," even with the mistake a number of us would still be exchanged. The count now was that eighty-three of the 153 selected would be exchanged and once the "officer called out Wm. T. Beatty, Major, 2nd O.V.I., captured Sept. 21st. My heart at one bound came back to blood heat, and it seemed to me that all nature looked much fairer than it did a few minutes before, so I gathered the old quilt and started for the gate and now about a dozen officers who had been captured with me who belonged to the regular army, came around me to bid me good bye and these brave fellows who did not fear to rush up to the cannons mouth in battle cried like children when they found I going and they were to be left."

Those selected for the exchange boarded a train and departed toward Atlanta but quickly came to the "end of the road" as Sherman's blue coats had destroyed the road by taking up the rails, piling the ties and heaps setting them on fire [then] throwing the rails across the fire until they became hot in the center then taking them and bending them around trees or telegraph poles." The so-called "Sherman neckties" caused them to disembarked and walked the remaining "18 miles . . . to a place called Rough and Ready" (*Buffalo County Beacon* September 14, 1883).

The final entry, number thirty-three, was also titled "Leaves From my Journal" similar to all other entries. The Union prisoners arrived at Rough and Ready Station on the Macon & Western Railroad line just south of Atlanta which consisted of a few scattered buildings and had been used by Confederate General William Hardee for a time. Major Fry, "belonging to a Pennsylvania regiment, who had also been speaker of the house of representatives," was also in the exchange by mistake "as he did not belong to Sherman's army" (*Buffalo County Beacon* September 21, 1883). He was uneasy about the exchange because of that, yet Beatty remained determined considering it a "providential" case. Sherman sent a train with Confederate officers and soldier for exchange, the same train would return with former Union prisoners. A muster roll call was made for "W.T. Beatty, Major, 2nd O.V.I., captured at Chickamauga" on September 21 yet no year was associated with Beatty's capture, and "here I found the key to exchange as the Rebs. had neglected to put the year that I was captured." Beatty points out that the Rebels "supposed I belonged to Sherman's army, as some of his officers had been captured the same day of the month, but a year later." Ultimately, this mistake was realized yet Beatty was allowed to "pass on" which made him feel as "brisk as a boy" even though reduced to nothing but a "skeleton." Sherman gave "quite a speech" making note of the "nerve muscle to stand the rebel provisions and return alive." One of the officers was "Col. Lafavor of the 22nd Michigan Vol. infantry" who had been Beatty's cellmate at "Libby for

7 months and was now acting provo-marshal at Atlanta."[24] Colonel Heber Le Favour provided Beatty with a "suit of new clothes" and remarked that he "reminded him of an old Irish ditch digger up in Michigan." Beatty, who spent a year and seven days in Libby Prison, concludes and notes that the 2nd Ohio Volunteer Infantry had served its three-year enlistment and returned to Ohio. Beatty later returned to Columbus, Ohio and mustered out of service on November 10, 1864.

AFTER THE WAR . . .

Following the war westward migration, which had been stymied during the conflict, resumed (Hudson 1985). The Civil War's closure coupled with passage of the Homestead Act (May 20, 1862) and the rapid expansion of rail lines during the 1870s and 1880s fueled a rush to the Great Plains, Nebraska in particular (Meyer 2001). In 1870, Nebraska's population stood at 122,993 and by 1880 the number had increased to 452,402. Ten years later, the state's population jumped to 1,062,656 (Condra et al. 1951; Olson 1955). Many "new" Nebraskans were Civil War veterans eager to take advantage of land policies that encouraged and promoted westward migration (Wexler 1995). William Beatty – who was born in Goshen, Ohio on September 11, 1817 – was one such example.

Shortly after the war in October of 1872, Beatty moved west to Gibbon, Nebraska in south-central Nebraska. Gibbon, which was initially laid out in April of 1871, was settled by a "colony from Ohio" referred to as the "Soldiers' Free-Homestead Temperance Colony" and comprised primarily of "ex-soldiers and their families" (Andreas 1882, 440). Gibbon, located in the Platte River valley just south of the Wood River in eastern Buffalo County, proved attractive to settlers coming west, especially pioneers like William Beatty and other Civil War veterans who were familiar with the area after venturing through the valley on the gold rush in the early 1850s (Combs and Bratton 2018). Beatty initially purchased a hotel, "which he conducted about three years" and later "took up a homestead five miles northwest of Gibbon" (Andreas 1882, 442). By the late 1870s, Beatty was in possession of a "fine tract of eighty acres of land, one and one-half miles east of the village" (Andreas 1882, 442).

More than a decade after his move to Nebraska, Beatty shared his war experiences in thirty-three newspapers articles titled "Leaves From my Journal" that originally ran in the *Buffalo County Beacon* from February 1, 1883 to September 21, 1883. Through these meticulous journal entries that recorded key dates and events, Beatty shared his first-hand experiences of the war. Beatty ultimately died at his son's home in Pamona, California on November 2, 1903 after spending time there in hopes of "recuperating his health" (*Kearney Hub* 1903). Beatty returned to Gibbon for internment in Riverside Cemetery, where a total of ninety-three Civil War veterans are buried (Vohland 1971).

ENDNOTES

1. Six of the thirty-three entries are lost—numbers 19, 26, 27, 28, 30, and 31. Neither the Buffalo County Historical Society or the state archives in Lincoln have the missing entries – the microfilm reel for the Buffalo County Beacon

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for whatever reason skips those dates.

2. According to the official roster, Colonel Leonard Harris joined the 2nd Ohio Infantry on August 6, 1861 and resigned on December 24, 1862. Lieutenant Colonel John Kell joined on August 6, 1861, was later promoted to colonel, and was killed in the Battle of Stones River, Tennessee on December 31, 1862. Colonel Anson McCook also joined on August 6, 1861, was later promoted to colonel, and ultimately mustered out with the regiment on October 10, 1864 (Roster Commission 1886a).

3. Henry Clay (1777-1852) was born in Hanover County, Virginia, on April 12, 1777 (Van Deusen 1937). A three-time presidential candidate, Clay served several terms in both the U.S. House of Representatives and the U.S. Senate. Referred to as Kentucky's most famous senator, Clay is best known for his attempts to forge compromises between the North and South on the issue of slavery, including the Missouri Compromise of 1820, the South Carolina crisis of 1833, and the Compromise of 1850 (Brands 2018; Remini 1991). John Jordan Crittenden was born near Versailles, Kentucky in 1787. After graduating from law school at William & Mary, Crittenden intermittingly served in the U.S. Senate from 1817 through 1861. Crittenden also served in a number of presidential administrations and played key roles on many vital issues while in the Senate, one of which was slavery. Perhaps best known for the Crittenden Compromise, a proposal that would have re-established slavery's boundaries as demarcated by the Missouri Compromise of 1820 and extend slavery to the Pacific Ocean based on Missouri's southern state boundary (Wexler 1995). Debated in late 1860 into early 1861, the compromise ultimately failed and Crittenden died shortly thereafter on July 26, 1863. Brands (2018, 4) notes that John Calhoun (1782-1850) in serving South Carolina "tainted himself in the eyes of America." Brands (2018, 4) adds that "his defense of states' rights, and especially of the right most important to Southern planters, the right to own slaves, became a monomania. Where other defenders of slavery were content to call it a necessary evil, essential to the operation of the Southern economy but nothing to boast of, Calhoun pronounced it a positive good, an ornament of the South's superior culture." Brands (2018, 4) points out that Daniel Webster (1782-1852) "perfected the art of persuasion in the courtroom and became the most sought after, and generously compensated, advocate of his era. The stern justices of the Supreme Court were no match for Webster, at the conclusion of his argument for Dartmouth College in a landmark case, even John Marshall – John Marshall – wept. When Webster spoke in Congress, Washington stopped what it was doing and hurried to hear him" (Brands 2018, 5).

4. In this same entry, Beatty mentions Thomas Cramer who had been "cool" under fire. Cramer was nineteen years old when he joined Company C of the 2nd Ohio Volunteer Infantry and ultimately mustered out with the company on October 10, 1864 (Roster Commission 1886a).

5. Steamboats were essential for travel and along with the distribution of supplies during the Civil War. One of those ships, the Jacob Strader a 347-foot sidewheel steamer, was constructed in 1853 by the Marine Railway Company and launched at Cincinnati. The steamer was initially used to ship mail and during the Civil War it was a troop carrier (www.riverboatdaves.com; Myers 1952).

6. Fought on December 15-16 in 1864, the Battle of Nashville represented the end of large-scale fighting in the Western Theater. In battle, the Union's General George Thomas destroyed the South's holdings under General John Bell Hood. The Union lost 387 soldiers during the conflict, while Confederate estimates have ranged as high as a few thousand, with over 4,000 Confederate prisoners captured. General Hood was relieved of his command and ultimately resigned on January 13, 1865 (McDonough 2004).

7. General Alexander McDowell McCook was born in Lisbon, Ohio in 1831. McCook graduated from West Point in 1852 and is best-known as one of the "Fighting McCooks." Alexander fought in the Civil War alongside his father, seven brothers, his uncle, and five cousins. McCook served in a variety of capacities during the war and was aide-de-camp to General Sherman after the war from 1875 to 1881. McCook went on to serve in the military until his retirement in 1895 (Leech 1989).

8. The 32nd Indiana, also referred to as the "1st German" regiment, was led by Colonel August Willich (U.S. Sanitary Commission 1866). Willich, a former Prussian officer who led troops during the German revolution of 1848, led Indiana's 32nd Infantry comprised of troops with German ancestry in the Civil War's western theater (Reinhart 2006).

9. Barnhart (2016, 44) describes Terry's Texas Rangers as "one of the most effective cavalry units," noting they were officially the 8th Texas Cavalry. The rangers were "organized under sugar planter Benjamin F. Terry on September 9, 1861, the 8th was made up of cowboys, farmers, shopkeepers and former Texas Rangers." They went on to serve in "every major campaign in the Western Theater, serving mostly as scouts, pickets and raiders."

10. Andrew Jackson (1767-1845) served as the 7th president of the United States, elected in part because of earlier events at New Orleans. Meacham (2008, 32) notes that Jackson "engaged the enemy in a climactic battle on Sunday, January 8, 1815" in New Orleans. Though the "battle came after the war had ended – news of the treaty signed in Ghent on Christmas Eve would not reach New Orleans for several weeks—the victory was stunning." Meacham (2008, 32) adds that Jackson was "now a national, in fact international, figure of renown. In the city on Monday, January 23, 1815, the city's ranking Roman Catholic priest thanked God for Jackson." Ultimately, "New Orleans made him, and he was becoming a player on a larger stage" (Meacham 2008, 33).

11. General John Hunt Morgan was referred to as the "Thunderbolt of the Confederacy" and conducted a number of raids to "recruit troops, disrupt Union plans, and gather supplies" during the Civil War (Maness and Combs 2010, 107). Harrison and Klotter (1997, 202) contend that "despite the hard riding and the danger involved, there was an air of romance and adventure about his early forays."

One later unsuccessful raid, "quelled sympathy for the Southern cause in Indiana and Ohio, encouraged Northern enlistment, and stimulated patriotism and support for the United States government" (Ramage 1986, 181). Morgan was ultimately killed in action near Greeneville, Tennessee on September 4, 1864 (Maness and Combs 2010).

12. Harwell (2011, 14) describes Huntsville at the time of the Civil War as "one of the neatest and most beautiful little cities to be found in any country." Besides aesthetics, Huntsville played an essential industrial role for the Confederacy and occupied a strategic location as a rail center. The Madison Iron Works in Huntsville, for example, which before the war had produced consumer items, such as, cookware and farm machinery, transitioned to military items, producing both "cannons and gun carriages" just a block from the depot (Harwell 2011, 8).

13. Engle (1999, 291) writes that "for months rumors had been passing through the ranks that Buell was a traitor and a coward, and the Munfordville episode convinced soldiers that knew hearsay that Buell and Bragg were brothers-in-law and had visited each other while near Munfordville were indeed true. Soldiers could see no other logical reason for not fighting."

14. William Rosecrans was born in September of 1819 and graduated near the top of his class at West Point in 1842. Once the Civil War began, Rosecrans enlisted in Ohio and was later promoted to brigadier-general. Rosecrans requested a transfer to the west and later took command of the Army of the Cumberland in late 1862. Rosecrans was replaced after the Union's defeat at Chickamauga by General George Thomas. The Union army bounced back at Chattanooga, but Rosecrans was relieved of his command which essentially ended his involvement in future campaigns. After the war, Rosecrans moved west and became involved with mining operations and railroad ventures, along with serving in the U.S. House of Representatives from California (Sutherland 2002).

15. With thousands of engagements the American Civil War produced an abundance of mementos, many of which are prized for their connections to an individual or a certain battle (Miller 2001). Harrison (2010, 286) contends that many even collected human remains as "enemy skulls and other bones" became "souvenirs or trophies in the American Civil War."

16. Lookout Mountain, a 2,126' elevation peak next to the Tennessee River, held little tactical value but the Federal capture of it on November 24, 1863 was key. Confederates maintained a siege line from Lookout Mountain to Missionary Ridge, but Union troops captured Orchard Knob a post near the base of the ridge on November 23. The following day, Union troops in a battle known as the "Battle Above the Clouds" swept Confederates from the crest (Allen 1992).

17. Home to manufacturing facilities and a strategic railroad hub, Atlanta was key. The Battle of Atlanta was a strategic turning point in the greater Atlanta campaign, a tremendous Union victory. The four-month campaign included a number of battles and skirmishes culminating with the Union's capture of Atlanta on September 2, 1864 (Woodworth 2005).

18. "Abe Lincoln's hirelings" was a pejorative term used throughout the Civil War to describe those who supported Lincoln's presidency (Barrett 1903). Lincoln, the 16th president, was born in Kentucky in 1809 and spent much of his early life in southwestern Indiana. Running for office in 1860, Lincoln was not a popular candidate in the South. Brookhiser (2014, 177) notes that Lincoln won a "mere 1,000 votes each in Virginia and in his birthplace, Kentucky, and was not even on the ballot in any state farther south."

19. Virginia voted for succession on May 23, 1861 yet remained independent until June 17 when it officially joined the Confederacy. Richmond was selected as the capitol, a mere 106 miles from Washington, D.C. Korda (2014, 244) notes that making Richmond the capitol "ensured that great battles would take place there, thus pinning down a large proportion of the limited strength of the Confederacy in northern Virginia, and ensuring that there were never enough troops to hold large parts of Missouri, Kentucky, and Tennessee."

20. Beszedits (1999) states that Libby's "commandant, Thomas P. Turner, called an 'infernal brute' by one Northern newspaper, was a Virginian who had attended but not completed both West Point and Virginia Military Institute." Second in command was Richard R. Turner and the adjutant was Lieutenant John La Touche, who was described by prisoners as "outwardly friendly and ready to laugh, but treacherous and spiteful" (Beszedits 1999). Sergeant Erasmus Ross, described by "many as a comical little fellow, was the prison clerk" (Beszedits 1999, 46, 48).

21. Libby Prison, a Confederate military prison in Richmond, Virginia had been a tobacco warehouse before the war and simply appropriated by the Confederacy (Sanders 2005). Prisoners first arrived in March of 1862 and at "times there were as many as twelve hundred prisoners confined there, most of them being Federal officers" (Peelle 1956, 9). Most of the "rooms were given names" with prisoners referring to "Streight's Room," "Milroy's Room," and the "Chickamauga Room" (Beszedits 1999, 44). After the war in 1889, Libby's buildings were carefully deconstructed and reassembled as a museum in Chicago (Peelle 1956).

22. No soldiers with the last name "Stone" from the 77th Pennsylvania Infantry appear in the official records.

23. William Tecumseh Sherman was born on February 8, 1820 in Lancaster, Ohio. Sherman graduated from West Point in 1840, graduating sixth in his class. In June of 1861 Sherman accepted the rank of colonel in the 13th Infantry. Sherman was soon appointed brigadier-general and was involved in a number of significant battles including Shiloh and Missionary Ridge. By September of 1864, Sherman had captured Atlanta and prepared for his "March to the Sea" campaign. Sherman left much of Atlanta in ruins and reached Savannah in late December that same year, presenting it to Lincoln as a Christmas gift. Sherman fought against Johnston in early 1865, accepting his resignation in April of that year at Raleigh, North

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Carolina. Sherman later became commander-in-chief and ultimately passed away in February of 1891 (Sutherland 2002).

24. Heber Le Favour, just twenty-four years old when he joined Union forces, of Company F of the 5th Infantry was commissioned June 19, 1861 and mustered into service on August 28, 1861. Le Favour was wounded in action at Williamsburg, Virginia on May 5, 1862. Le Favour was next commissioned as Lieutenant Colonel, 22nd Infantry, August 30, 1862 and received the rank of Colonel on January 5, 1863. He was taken prisoner at Chickamauga, Georgia on September 20, 1863 and exchanged on May 7, 1864. Le Favour mustered out of service on June 26, 1865 (Senate and House of Representatives of the Michigan Legislature 1905).

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H. Jason Combs is a professor of geography at the University of Nebraska-Kearney, specializing in cultural geography, historical geography, population geography, and research methods. He has written a number of articles appearing in refereed journals. Dr. Combs has co-authored two books, one a Civil War book (published by Ohio University Press 2010) and the other published by the Center for Great Plains Studies at Emporia State University (2017).

Tate Combs is a recent graduate from the University of Nebraska-Kearney, graduating with Honors with a degree in Health Sciences and Philosophy. He was a Research Fellow as an undergraduate working on several projects, one of which was published in Nebraska History in 2019. He is currently pursuing a bachelor's degree in Nursing at the University of Nebraska Medical Center.

Paul R. Burger is a professor in the Department of Geography at the University of Nebraska-Kearney. His research interests include GIScience, marketing, economic and population geography. His research has appeared in the Journal of Cultural Geography, Great Plains Quarterly, Pennsylvania Geographer, Great Plains Research and Papers in Applied Geography.

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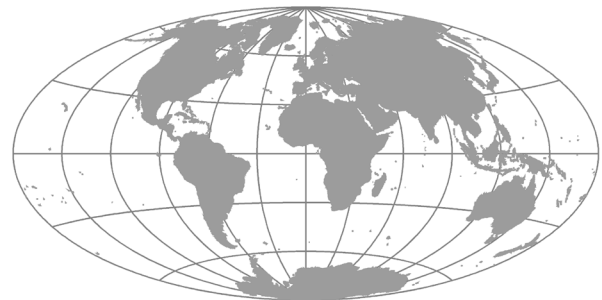
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    Cite ***in-text*** references, tables, charts, and other graphics such as maps and photographs parenthetically as follows: (Wilhelm 2015), (Table 3), (Fig. 2). If a published statement is quoted, use page numbers e.g., (Wilhelm 2015, 3-4). In text, more than three authors should be listed parenthetically, like so: (Zelinsky, et al. 2018).

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    Multiple-authored book chapter:
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    > Delhi Development Agency. 2007. Master Plan for Delhi, 2021. https://dda.org.in/ddaweb/pdf/Planning/reprint%20 mpd2021.pdf. Last accessed 14 April 2018.

    Website:
    > U.S. Census Bureau. 2017. Subcounty Population Estimates. [http://www.census.gov/popest/cities/SUB-EST2006. states.html]. Last accessed 02 July 2017.

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