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**"Book Review: 'Open space: The global effort for open access to environmental satellite data'."**

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*Published in:*  
Astropolitics

*DOI:*  
[10.1080/14777622.2018.1534470](https://doi.org/10.1080/14777622.2018.1534470)

**IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.**

*Document Version*  
Publisher's PDF, also known as Version of record

*Publication date:*  
2018

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Olbrich, P. (2018). "Book Review: 'Open space: The global effort for open access to environmental satellite data'.". *Astropolitics*, 16(3), 230-236. <https://doi.org/10.1080/14777622.2018.1534470>

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# Astropolitics

The International Journal of Space Politics & Policy

ISSN: 1477-7622 (Print) 1557-2943 (Online) Journal homepage: <http://www.tandfonline.com/loi/fast20>

## Open space: The global effort for open access to environmental satellite data

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To cite this article: Philipp Olbrich (2018) Open space: The global effort for open access to environmental satellite data, *Astropolitics*, 16:3, 230-236, DOI: [10.1080/14777622.2018.1534470](https://doi.org/10.1080/14777622.2018.1534470)

To link to this article: <https://doi.org/10.1080/14777622.2018.1534470>



Published online: 30 Oct 2018.



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BOOK REVIEW

**Open space: The global effort for open access to environmental satellite data**, by M. J. Borowitz. Cambridge, MA, MIT Press, 2017, 432 pp., \$40.00 S or £30.00, ISBN 9780262037181

Changes in the satellite-based remote sensing industry are evident in recent years. Formerly a domain reserved for the military and intelligence agencies of governments, there now exists a so-called geospatial revolution due to the ongoing commercialization of Earth observation (EO).<sup>1</sup> Backed with money from government contracts, angel investment, and venture capital, private companies have launched hundreds of EO satellites featuring various instruments and sensors. The result of this surge of privately owned satellite constellations is a similar level of satellite data.<sup>2</sup> Beside country-specific data policies, access to this supply of satellite data is governed by competitive pricing. However, the industry is still in the process of effectively marketing the benefits of remote sensing data to commercial clients, finding profitable business models, and recouping financial investment.<sup>3</sup>

The book *Open Space: The Global Efforts for Open Access to Environmental Satellite Data* offers interesting parallels to this situation by looking at the evolution of data policies for environmental satellite data since the 1960s. Mariel Borowitz tackles an important puzzle by explaining why some governments have opted for open access policies, while others chose to limit access to environmental satellite data. More specifically, Borowitz wonders that, given the potential benefits of satellite data for myriad environmental and social problems, why “in many cases the space and meteorological agencies around the world that collect satellite data essential to addressing these issues do not share that data freely[?]”<sup>4</sup> Borowitz identifies a certain pattern in data sharing policies from open access, in the early phases of government remote sensing, to more restrictive regulations, and then back to open data sharing. In this context, the book explains what drove government agencies to change their data sharing policies in this particular sequence.

To address these issues, Borowitz develops a theoretical framework and applies it to seven empirical case studies that comprise relevant agencies from the United States, Europe, and Japan. Altogether, the book finds compelling answers for the questions raised, effectively creates a reference guide for data policies of current government Earth observation programs, and provides policy recommendations to increase sharing of global satellite data. This review first presents the central arguments of the book, followed by a summary of pertinent points in the individual chapters. After that, it discusses the book’s strengths and weaknesses in context of the current state of commercial remote sensing.

### **Central factors of environmental satellite data sharing policies**

Above all, *Open Space* makes two central arguments: First, despite a global trend in favor of open access schemes and climate monitoring, some government space agencies restrict data access because of narrow mission objectives of their remote sensing programs, as well as economic aspirations. Agencies that do not share their data fall into either of two categories: “those that do not see data sharing as central to their agency’s

mission and those who are attempting, often under pressure from national-level policymakers, to promote cost recovery and growth of the commercial sector.”<sup>5</sup> More rarely, it is related to national security. In particular, countries with small satellite programs focus on capacity building and technology development so that data sharing policies become a secondary concern or are not considered important enough for budgetary allocations.

Second, Borowitz identifies a pattern of data sharing policies developing over time, in that data from early, unclassified government satellites were shared rather freely. This was followed by restrictive policies that complicated data access, bringing about significant effects on overall demand and usage in the commercial and scientific communities. More recently, government agencies switched back to open data sharing policies, which quickly reinvigorated access to and use of global satellite data. In order to explain this pattern, Borowitz argues that economic factors, such as cost recovery and the creation of a commercial industry, fueled the interest of governments in restricting data access. National legislators and policymakers recognized the value of early environmental satellite data. As a result, they urged their space and meteorological agencies—which were supporters of open data policies from the beginning—to develop and implement commercial models. When they failed to produce significant revenue, but instead reduced the use of data, governments backtracked and restarted previous open access policies.

In making these arguments, the book introduces various nuances and context information that complement these central points. For example, the initial economic considerations of national leaders shifted in light of the overall development of information and communication technologies that significantly decreased the marginal cost of sharing data.<sup>6</sup> The book supports and expands on these arguments with detailed discussions and examples.

## Theoretical approach to national data policies

Before probing empirical material, the book outlines a theoretical approach and develops a model of data sharing policy development by drawing on insights from multiple disciplines. In terms of basic definitions, the book is about data sharing policies of publicly collected data, in contrast to data collected by non-governmental entities, such as researchers or businesses. Moreover, it does not address negotiated bilateral or multilateral data exchange agreements, but instead focuses on general data sharing policies of government agencies in an independent context that regulate what data will be shared, with whom, and under what conditions. As expected from a study that examines policymaking, the first conceptual chapter starts with the government agency as the primary actor in developing data sharing policy. It further considers the structures and interactions of additional actors that influence this process, including at the national government level, non-governmental actors, as well as intergovernmental organizations.

Moving beyond an actor perspective, the second chapter adds the impact of data attributes on data sharing policy, like economic and societal value of data, its technical characteristics, and the implications of security and privacy concerns. Without explicit reference, this corresponds with recent social science research that highlights the impact of material and technical factors on political and social issues.<sup>7</sup> Borowitz highlights that these data attributes are dynamic because “[a]lmost every element of the model is subject to change over time.”<sup>8</sup> For instance, agencies adapt their missions following new budgetary conditions, intergovernmental organizations choose to push a specific agenda, competitors change their data policies, and technological development affects economic

incentives. Data, in this sense, are not neutral, but norm-laden and come with particular constraints and possibilities with regard to policymaking. At the end of the section, the theoretical model is translated into a table with key questions and their implications for data sharing policies, which is helpful for policy analysis, as well as an accessible summary of the model.

### **International environment of satellite data**

The empirical part of *Open Space* examines different case studies. Instead of reporting on each chapter in strict order of appearance, this review combines discussions of international organizations, national agencies (United States, Europe, and Japan), and commercial remote sensing. Additionally, the data sharing policies of Brazil, Russia, India, China, and South Africa (BRICS) are covered in one chapter of the book as well as other national remote sensing programs, which are covered in the book's appendix.

Starting with the World Meteorological Organization (WMO) and the Group on Earth Observation (GEO), the book provides an overview of the global trends and environment of satellite-based data. Of note is that international bodies formed for cooperation and exchange of meteorological and environmental data. For example, the WMO and GEO are strong proponents of free and unrestricted data sharing. By the 1980s, several national meteorological organizations were under political pressure to commercialize their weather data and effectively restrict access. This threatened the very mission of the WMO for free data sharing and led to a compromise in the form of WMO Resolution 40: since 1995, national members are required to freely share essential data necessary to support safety and security, but are allowed to commercialize other data products.<sup>9</sup> In contrast, GEO operates on a voluntary basis and facilitates discussions about sharing of EO data that are not limited to the weather and climate, but also include environmental issues at large.

### **Case studies: United States, Europe, and Japan**

Diving into the core case studies, the book starts with the United States, represented by the National Oceanic and Atmospheric Association (NOAA), the U.S. Geological Survey (USGS), and the National Aeronautics and Space Administration (NASA). Continuing previous activities of meteorological organizations, NOAA, the operator of the U.S. weather satellite constellation, pursued a free and open data policy in the beginning. Meanwhile, government officials found value in a program that boosted national prestige and soft power through U.S. technological capabilities. However, tightening budgets, expensive technology, and the proven worth of weather satellites brought back discussions of commercialization in the 1980s. The compromise was a tiered policy "in which NOAA was required to charge market prices to commercial users, but could continue to provide data to international and research users at the marginal cost of reproduction."<sup>10</sup> Despite these laws, NOAA remained a proponent of free and open data sharing and it took the lead in forming GEO. Over time, low marginal cost of distribution and vague laws allowed NOAA to *de facto* provide the majority of satellite data at no cost, although the tiered data policy remains in place.

The USGS chapter offers a similar story focusing on data sharing policies concerning the Landsat satellites. After free data access early in the program, U.S. legislators promoted a full privatization of the system to create revenue. In contrast to the NOAA case and weather data, there were no established norms of sharing land remote

sensing data with an international organization or a scientific community, so objections to commercialization lacked urgency. However, the rising prices for Landsat imagery did not create a commercial market, nor did the expected revenue recoup investments. After a transition period that charged access fees at marginal cost level, USGS pressed for free and unrestricted access to Landsat data and its use by the scientific community, U.S. agencies, and the business sector.

In 1958, NASA was established as a decidedly civilian, peaceful, and globally oriented organization of U.S. space activities. In doing so, it encouraged international scientific cooperation, and data and information sharing. From early on, NASA promoted open-data policies, only to be constrained at some points by national-level actors who advocated for more commercial industry involvement. However, given NASA's specific mission and culture, which was different from NOAA and USGS, data attributes played an important role in maintaining open access regulations, since "[u]nlike operational data collected by the other two agencies, data from NASA's experimental scientific satellites was unlikely to have any immediate commercial value."<sup>11</sup>

Borowitz also embeds a chapter on "U.S. Defense, Intelligence, and Commercial Satellites." Although it is not part of the core case studies, Borowitz discusses how the U.S. government continued to pursue the commercialization of high-resolution satellite imagery. Despite experiences with Landsat data, international competition and retaining U.S. technological leadership served to justify this course. It is noteworthy that the U.S. military and intelligence communities are the largest customers of this data.<sup>12</sup>

Two chapters on Europe's satellite data sharing policies focus on the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the European Space Agency (ESA). When EUMETSAT was founded in 1986—and eventually assumed operations of European weather satellites—its data policies were developed in an environment of U.S. leadership and WMO ideas of free and open data policies. Given various trends towards commercialization, budget constraints, and coordinating multiple national interests, policy development was not a straightforward process. Bound by preferences of national-level actors to recover costs, EUMETSAT advocated for restricted data access. Over time, arguments of the economic benefits of open data prevailed over cost recovery models (also due to the U.S. example and data sharing technologies). As a result, national pressure subsided and EUMETSAT increasingly opted for free and open data access. In line with WMO Resolution 40, however, EUMETSAT still charges a fee for some non-essential weather data and prohibits redistribution.

Despite a similar mission to NASA as a science and technology agency, ESA followed a more restrictive data policy and tried to retain control over data distribution. Following a familiar pattern, early ESA meteorological data were freely accessible. But adding land remote sensing programs in a time of commercial trends led to more restrictive data policies: "ESA adopted a data policy that differentiated access procedures and cost based on the use of the data and restricted redistribution."<sup>13</sup> As these efforts did not turn out to spur commercial success and stifled scientific interest, restrictions slowly decreased. One significant change took place in 2013, when the European Union (EU) endorsed a new policy to provide all standard Copernicus EO data free of charge and worldwide.

The Japan section of the book deals with the Japan Meteorological Agency (JMA) and the Japan Aerospace Exploration Agency (JAXA). In contrast to U.S. and European cases, there is consistency in JMA's data sharing policy. Despite problems to secure funding for its satellite missions, it continuously shared its data freely with other national meteorological agencies within the WMO framework. In effect, Japan still operates according to data policies from the 1990s so that data sharing is not restricted by legal

regulations. Instead, outdated technology and processes to share this data in an efficient manner limit public and scientific access.

When JAXA's predecessor started land and ocean remote sensing programs, they quickly followed the EU and NASA in technological sophistication. The data were made available in a tiered model differentiating between scientific and commercial use to recover cost and promote a national remote sensing industry. While the eventual creation of JAXA led to some organizational reshuffling, the same data sharing policy remained in place. However, the growing importance of climate change and Japan's participation in GEO increased interest in open data access. But it was not until 2013 that JAXA implemented a policy change. Since then, the agency provides essential environmental data for free, while restrictions apply to data with higher commercial potential, such as high-resolution and synthetic aperture radar (SAR) imagery.

### Toward more open data policies

The third part of the book ties together the results of the empirical case studies and substantiates the two central arguments presented earlier. National policymakers still ponder the question of whether at least some satellite data can lead to a functioning market that requires data access restrictions. In countries with developed satellite programs, access to high-resolution and radar imagery remains restricted by commercial regulations. Countries with smaller remote sensing programs apply access restrictions to national satellite data because of a narrow mission focus and economic reasons.

The case studies also present space and meteorological agencies as global leaders of open and free data access that were ahead of their time. Even before recent trends of unrestricted data sharing, "they had always preferred to make their data available as widely as possible in support of their missions. They were pushing in these areas, rather than being pulled, and adopted open data policies as soon as they were allowed, rather than waiting for national-level initiatives that instructed them to do so."<sup>14</sup>

The final chapter offers insightful starting points for future policy development. For example, when economic constraints stand in the way of emerging remote sensing agencies to include data sharing into their mission, it might be helpful to engage them and point out the existing demand for particular data sets and related reputational gains, as well as to offer funding support and technical assistance in establishing economical ways for sharing data. More generally, data sharing policy development benefits from clear assessments of the viability of a commercial market and the extent of the non-commercial user to weigh the net benefits of open data policies, in contrast to data sales and tiered policy approaches.

### Conclusion

Overall, *Open Space* is an insightful study of the global and national data sharing policies of remote sensing programs. Borowitz strikes a relevant chord by highlighting the importance of data in global politics.<sup>15</sup> In doing so, there is a wider-than-usual perspective through an interdisciplinary framework. Moving beyond strictly space-focused literature, Borowitz integrates organizational theory, information policy, and research on international organizations. The individual chapters draw on an abundance of empirical material that convincingly supports the main arguments and offers additional starting points for further research. This is also illustrated by the comprehensive appendix, which discusses the state of global satellite data sharing policies. The detail of those

descriptions is guided by the maturity and extent of the respective remote sensing programs. In total, the book offers an overview of 39 countries, including the EU, which makes it a useful reference guide.

In pursuing such a task, the author makes some decisions regarding the focus of attention. As mentioned earlier, the book offers the most foundational analysis of the U.S. remote sensing program with four detailed and dedicated chapters. In contrast, the core case study of Japan is covered in two shorter chapters. This is partly understandable, given the different size and influence of their global space and remote sensing programs. However, the JMA could have benefited from an extended discussion. Although Japan launched its first meteorological satellite in a time when commercial trends gained momentum and JMA had repeated problems with acquiring sufficient funding, the agency did not opt for a commercial sales model. JMA is an interesting case to reflect more on the overall theoretical model in that it represents an outlier from the usual pattern to commercialize satellite data before returning to more open data policies.

Nevertheless, the book offers a compelling account of the development of global satellite data policies. Given the structure of the book, it appeals to a wide range of readers, including experts and students of public policy, international relations, space policy, and data policy. The chapters are also accessible individually, with helpful introductions and summaries that frame the more detailed main text. As such, readers with varying backgrounds can navigate the book in line with their interest and specialty. Most importantly, the book offers an understanding of the past and present of the remote sensing sector. It exists at a favorable moment when the EO ecosystem faces radical change in light of a growing number national space programs, as well as private satellite constellations on a global scale. When uncertainty in industry and policy circles is high, basic assumptions and expectations often differ in discussions about the future. Grounded in empirical research, *Open Space* provides solid ground to better understand and structure these discussions about the development of commercial remote sensing.

## Notes

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<https://doi.org/10.1080/14777622.2018.1534470>

