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H. A. Zurqani
Clemson University

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H.A Zurqani[1,3], C.J Post[1], E.A Mikhailova[1], K. Ozalas[1], and J.S. Allen[2]

[1]Department of Forestry and Environmental Conservation, Clemson University, SC 29634

[2]South Carolina Water Resources Center, Clemson University, Pendleton, SC 29670

[3]Department of Soil and Water, University of Tripoli, Tripoli 13538, Libya

ABSTRACT

Flooding impacts from hurricanes and other natural hazards are an important concern in many areas of the world. The objectives of this study were to: (1) develop a framework to identify flood-affected areas after storm impact; (2) map the flooded areas caused by the hurricane Florence; and (3) assess the major effect of the hurricane on the land cover and agricultural crops in the coastal South Carolina during the flood period. The coastal South Carolina regions are recognized as the most important agricultural area in the state. The developed framework identified and mapped the affected areas during the hurricane season. Based on the results the hurricane-flooded areas were approximately 681 km^2, and the major affected counties in both analysis flood frequency and flooded areas are Charleston, Georgetown, Berkeley, Florence, Marlboro, Marion, Horry, Chesterfield, Sumter, Clarendon, and Darlington. These results not only indicate flood risk on the land cover but also demonstrate the advantage of utilizing Google Earth Engine and the public archive database in its platform to track and monitor the natural hazards over time.

INTRODUCTION

- Flooding is one of the main natural disasters that can cause loss of human life, damage to property, destruction of vegetation and animals (Samuael., 2019). Figure 1 shows rapid water levels rise as a result of Hurricane Florence.
- There are various techniques used in analyzing flood risk on the land cover. Remotely sensed data holds an advantage in monitoring and observing the change on earth surface because of the large spatial coverage, high temporal resolution, and wide availability (Zurqani et al., 2018).

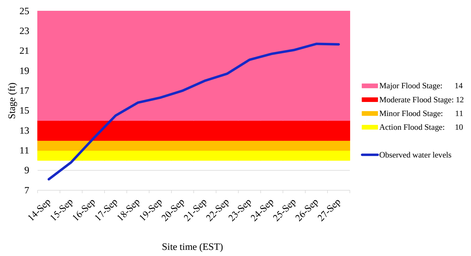

Figure 1. Water levels for the Waccamaw River near Conway, SC in the aftermath of Hurricane Florence by the flood stage (in feet) (e.g., major, moderate etc.) (Adapted from the National Weather Service, 2018).

OBJECTIVES

- Develop a framework to identify flood-affected areas after storm impact;
- Map the flooded areas caused by the hurricane Florence;
- Assess the major effect of the hurricane on the land cover and agricultural crops in the coastal South Carolina during the flood period.

MATERIALS AND METHODS

Study Site

The study area is situated in the coastal South Carolina between 81° 02′ 57.05″ – 78° 34′ 52.41″ W and 32° 30′ 11.59″– 35° 04′ 17.07″ N (Fig. 1). It is a part of the most important agricultural area in the state.

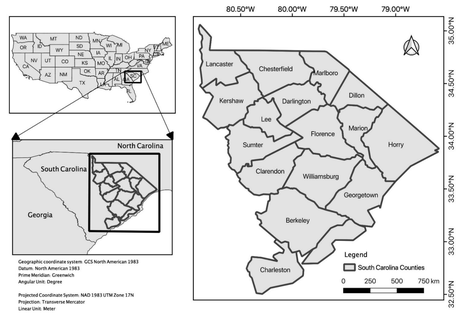

Figure 1. Location of study area (30408 km^2) in in the coastal SC.

Data Processing

- Data (Table 1) processing used the cloud-computing technology in the Google Earth Engine platform (https://earthengine.google.org/).
- In the flood occurrence analysis, the Joint Research Centre (JRC) monthly water history v1.0 data were used that acquired from 1985 until 2015.
- The flooded areas were mapped based on Sentinel-1 data (28 Aug - 10 Sep, 2018) were used as a reference "before flooding", and from 12-25 Sep, 2018 were used as "after flooding." Figure 3 explains data processing and the analysis steps carried out in this study.

Table 1. Data sources and description.

Data Layer	Provider	Source	Date
JRC Monthly Water History, v1.0	EC JRC / Google	Google Earth Engine	1985-2015
Sentinel-1 SAR GRD	European Union/ESA/Copernicus	Google Earth Engine	2018
Cropland Data Layer	USDA National Agricultural Statistics Service	Google Earth Engine	2017

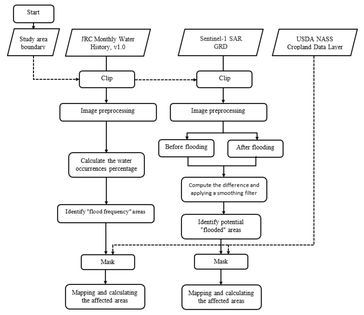

Figure 3. A flow diagram for data processing and the analysis steps.

RESULTS AND DISCUSSION

Flooding before and after hurricane Florence

Counties with highest flood frequency and flooded areas in 2018 are: Charleston, Georgetown, Berkeley, Florence, Marlboro, Marion, Horry, Chesterfield, Sumter, Clarendon, and Darlington (Fig 4, and Table 2).

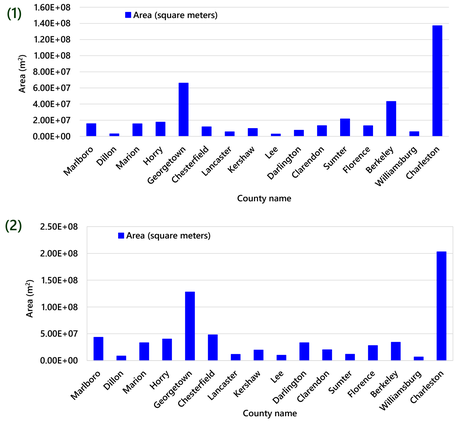

Figure 4. Flood-prone areas: (1) Flood frequency, and (2) Flooded areas per county in the coastal SC.

Table 2. Flood occurrence areas using the Joint Research Centre (JRC) and Flooded areas (using Sentinel-1).

County name	Flood occurrence areas using the Joint Research Centre (Km^2)	Flooded areas (using Sentinel-1) (Km^2)
Marlboro	15.76	43.45
Dillon	3.16	8.60
Marion	15.63	33.25
Horry	17.64	40.26
Georgetown	66.02	128.02
Chesterfield	11.87	48.03
Lancaster	5.67	11.74
Kershaw	9.85	19.62
Lee	2.84	9.99
Darlington	7.64	33.35
Clarendon	13.26	20.22
Sumter	21.67	11.87
Florence	13.16	28.11
Berkeley	43.28	34.18
Williamsburg	5.85	6.78
Charleston	137.13	202.98

Most of flooded areas identified with Sentinel-1 data were matched with the flood occurrence results using the Joint Research Centre (JRC) data (Fig. 5).

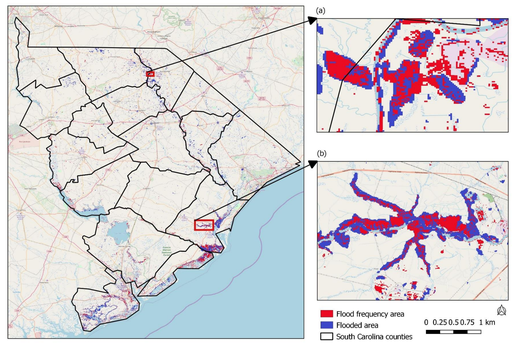

Figure 5. Flood occurrence in the identified flooded areas.

RESULTS AND DISCUSSION

Effect of the hurricane Florence on the land cover

The affected land cover/agricultural crops areas per county in coastal South Carolina based on the cropland layer 2017 (USDA, 2017) (Fig. 6).

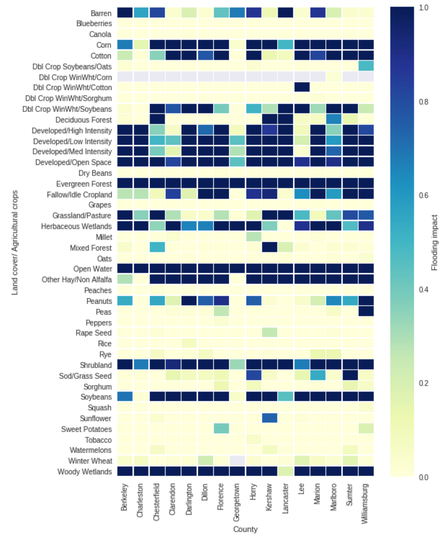

Figure 6. Heatmap of flooding impact (scale gradient: grey=no impact, beige=low impact, and dark blue=high impact) by land cover/agricultural crops per county in coastal SC based on the cropland layer 2017 (USDA, 2017).

CONLCUSIONS

The results show that the major affected land cover/ agricultural crops areas were soybeans, shrubland, other hay/non-alfalfa, evergreen forest, cotton, corn, herbaceous, grassland/pasture, fallow/idle cropland, woody wetlands, open water, barren and developed areas.

ACKNOWLEDGEMENTS

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