Validation of GOES-R ABI flood and standing water algorithm

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Abstract

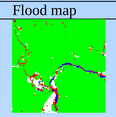
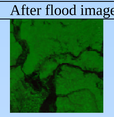
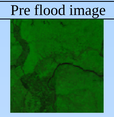
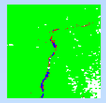
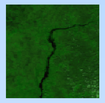
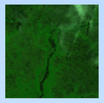
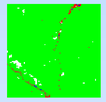
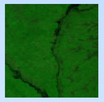
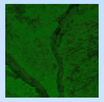
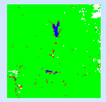
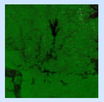
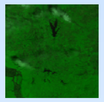
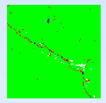
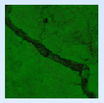
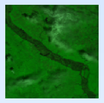
Validation is an important task in the development of satellite remote sensing products. Strategies for validation vary depending on the nature of the products. In this study, the validation process of the flood and standing water (FSW) product for the Geostationary Operational Environmental Satellite - R series (GOES-R) is presented. A major challenge in the validation of the FSW product is the lack of ground truth flood maps and similar reference products from other satellite systems and other sources. To overcome this limitation, a two-level validation scheme for the FSW product is developed using the Moderate-resolution Imaging Spectroradiometer (MODIS) data as a proxy.

Methods

In the first level, gauging station data collected by the U.S. Geological Survey (USGS) are employed as ground truth flood point information on local scales to verify the effectiveness of the proposed algorithm for flood detection. In the second level of validation, a classification plus human interpretation-based flood area validation is performed. Flood detection accuracies for three major flood events are evaluated. FSW results detected using the proposed algorithm are compared to the interpreted reference flood maps, which are generated from a supervised support vector machine (SVM) classification followed by human interpretation and further editing. Confusion matrices are employed as the accuracy measurement for the second level of the validation.

First level Results

Gauging station data collected during 34 flood cases that occurred in 2010 and 2011 in the continental US are validated and assessed according to the rate of correct detection.

No	Flood map	After flood image	Pre flood image	Result
1				Omit
2				Correct
3				Not detectable
4				Correct
5				Correct

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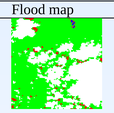
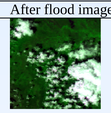
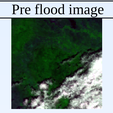
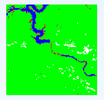
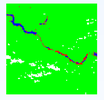
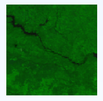
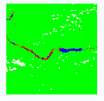
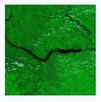
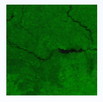
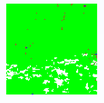
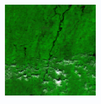
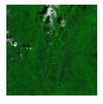
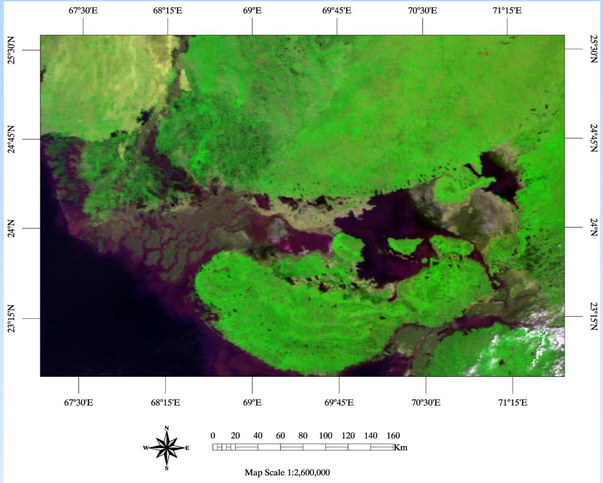
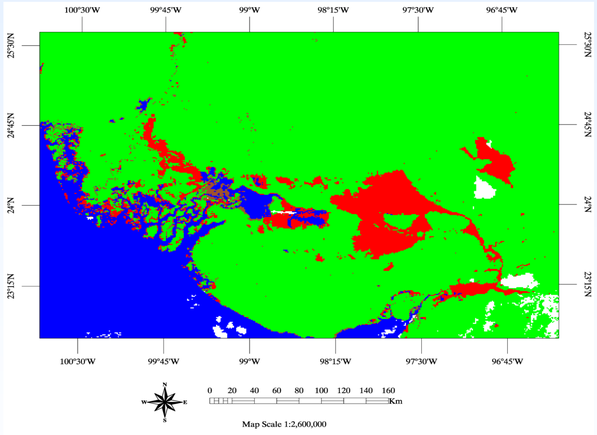
1				Commit
2				Omit
3				Correct
4				Correct
5				Not detectable

Second level Results

Just inland from the Arabian Sea, wetlands line the border between Pakistan and India. Water levels rise and fall with the seasons, but after weeks of devastating monsoon rains that displaced millions of Pakistanis, water levels in the typically shallow lakes stayed high in late summer 2010 .



MODIS Terra reflectance composite image view for the Pakistan-India Border flood case. Channel 1 (R), channel 2 (G), channel 3 (B) is shown in composite.



Color-coded flood detection map for the Pakistan-India Border flood case. Flood (red), land (green), permanent water (blue), and cloud (white) are displayed.

Quantitative Analysis

Class	Flood	Water	Land	Total
Flood	8782	332	2066	11180
Water	231	23699	229	24159
Land	699	63	107091	107853
Total	9712	24094	109386	143192

Overall accuracy = (139572/143192) 97.4719%
Kappa coefficient = 0.9353
Flood commission error = (2398/11180) 21.45%
Flood omission error = (930/9712) 9.58%

Conclusion

In the first level of validation, the sensitivity of the selected channels and the applicability of the proposed algorithm were validated using gauging station data. 79.71% of the flood events detection rate calculated on 34 flood cases was achieved. The validation results indicate that the selected predictors and classification algorithm are capable of detecting floods based on 1 km MODIS data. In the second level of the validation process, accuracy evaluations against classified and visual interpreted reference flood maps were performed. The commission and omission errors of the detected flood pixels were less than 25% for all tested cases, which are significantly less than the required 40% incorrect classification accuracy.

Acknowledgment

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