Flood Detection with NPP/VIIRS and SRTM DEM Around New York Area

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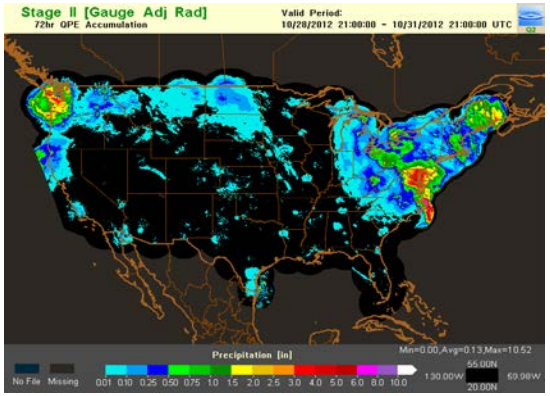
Topics: Satellite data application in Hydrology

Program: JPSS RR/PG

2. Introduction

- **Hurricane Sandy,** the largest Atlantic hurricane on record, devastated portions of the Mid-Atlantic and Northeastern United States in late October 2012. The powerful storm brought intensive rainfall and transformed some of Atlantic City's streets into rivers and inundated parts of Lower Manhattan, water forming whitewater cascades in Ground Zero and swamping New York's financial district.
- In this study, we use NPP/VIIRS Imager data along with 30-m SRTM DEM data to detect flood information caused by hurricane Sandy around New York area. The detection includes water extraction, water fraction retrieval and integration with SRTM DEM to derive a 30-m resolution water map with VIIRS 375-m water fraction product. The results show good consistency with ground truth and other data source in location of inundated areas.

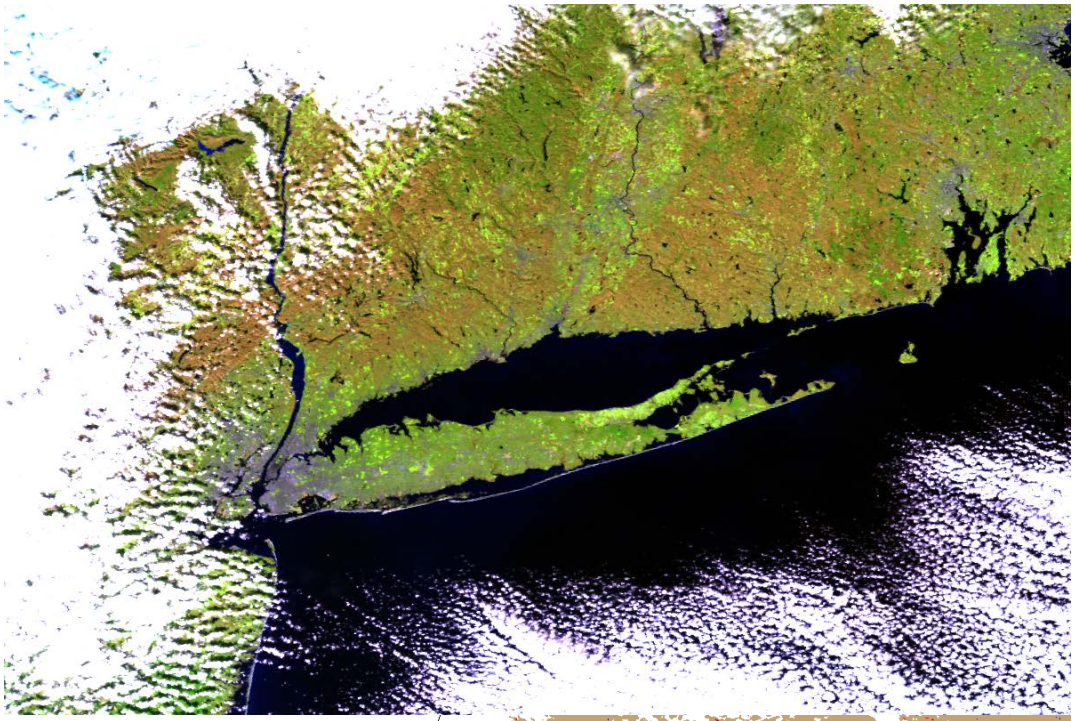


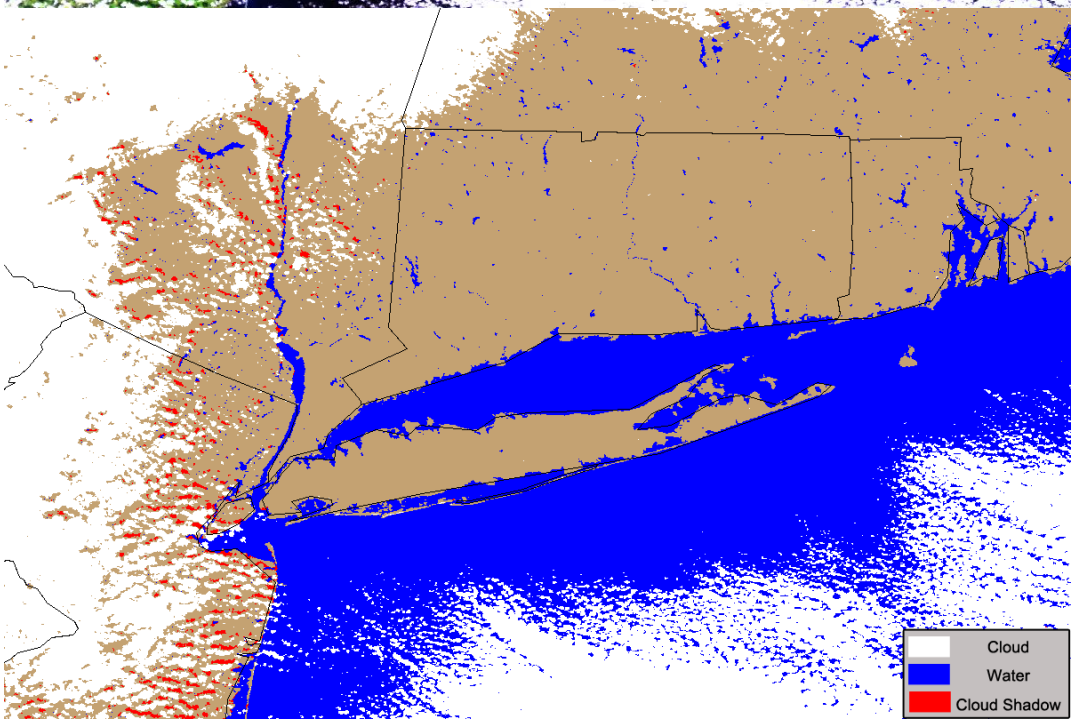
Precipitation from Oct. 28 to Oct. 31, 2012

Inundated roads and communities in New York

3. Methodology/Expected Outcomes

- We use NPP/VIIRS Imager multi-spectral channels (I1, I2,I3 and I5) to detect water information
- Water detection with NPP/VIIRS data proceeds by exploring spectral characteristics in multiple MODIS channels through a decision-tree method (Sun et al., 2011). A geometric method is also developed to remove cloud shadows from water detection results (Zhang et al., 2012; Li et al, 2013).
- Water fraction retrieval from NPP/VIIRS data is with dynamic nearest neighboring searching method (DNNS) (Li et al, 2012).
- Based on the water fraction result, an integration method is developed to derive 30-m water map from NPP/VIIRS along with use of SRTM 30-m DEM data around New York area.
- The 30-m water map is also validated with ground truth and other data source from internet.



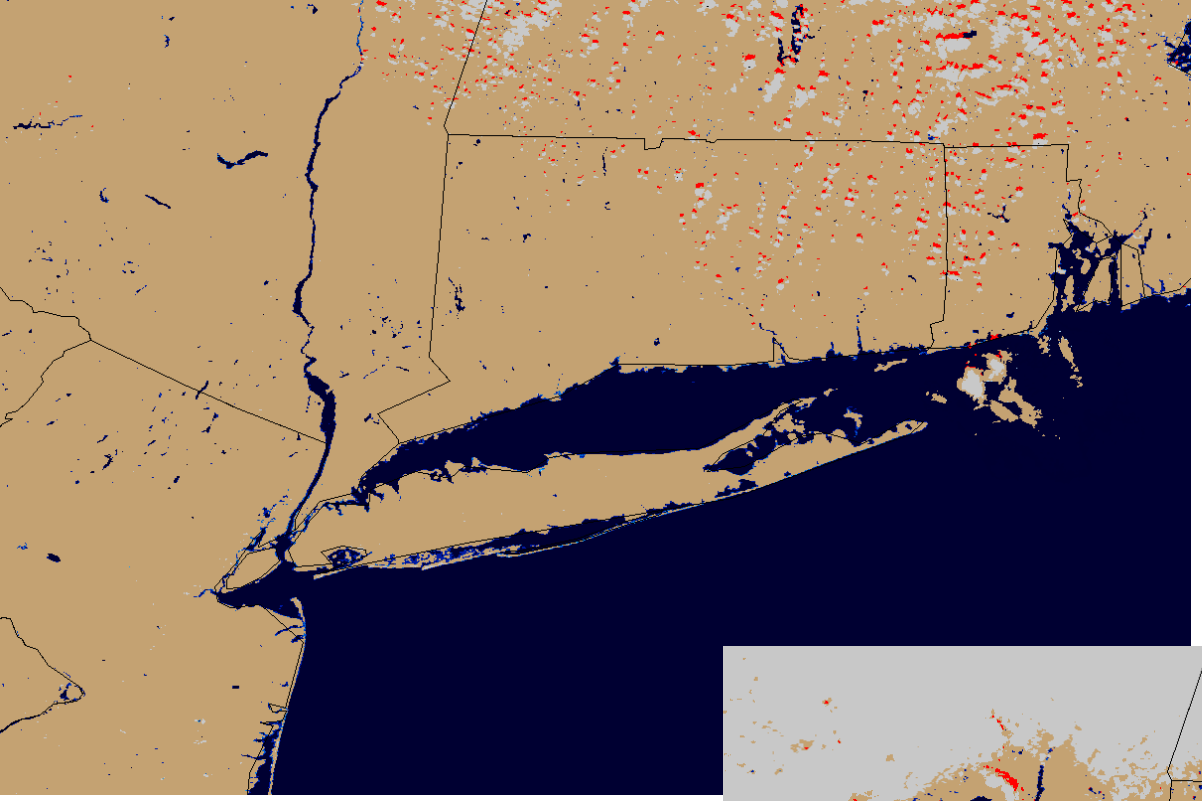


Water Detection with NPP/VIIRS

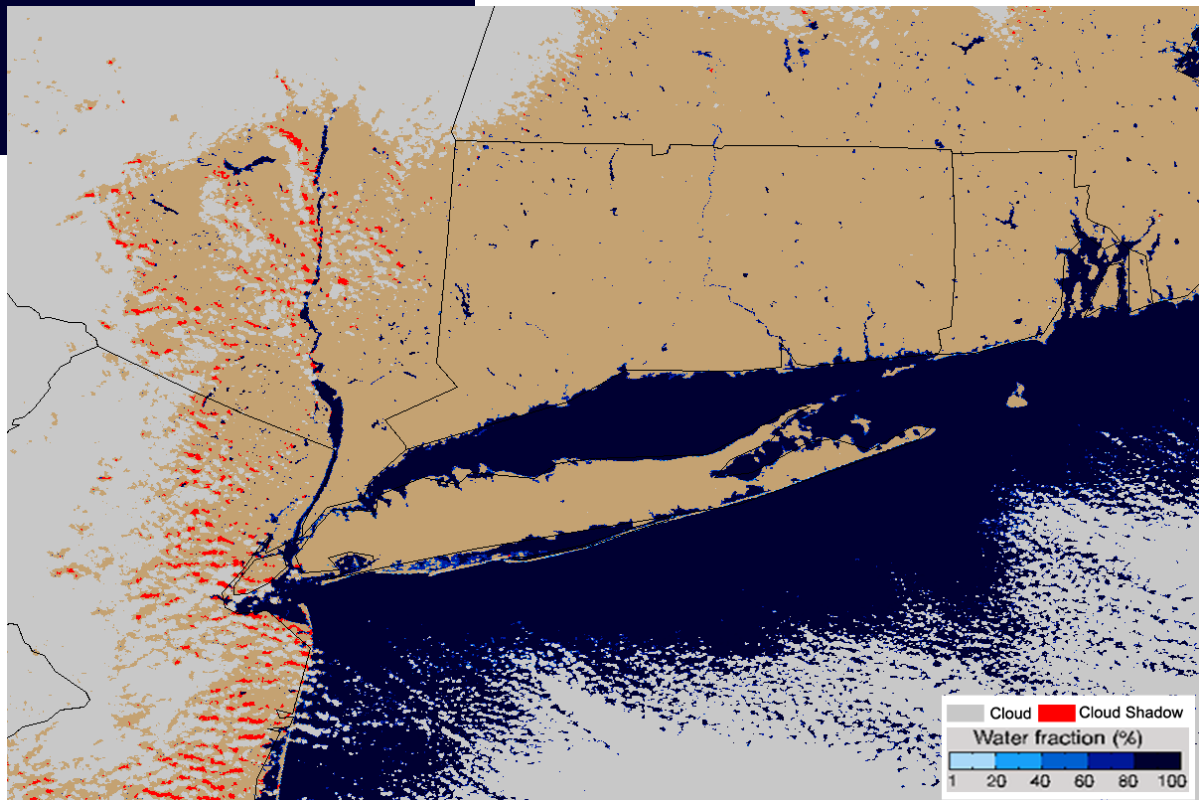
- Decision-tree for water detection
- A geometric method is also developed to remove cloud shadows from water detection results

Top: NPP/VIIRS false-color composite image on Nov. 04, 2012
Bottom: NPP/VIIRS water detection result on Nov. 04, 2012

Water Fraction retrieval with NPP/VIIRS using DNNS method

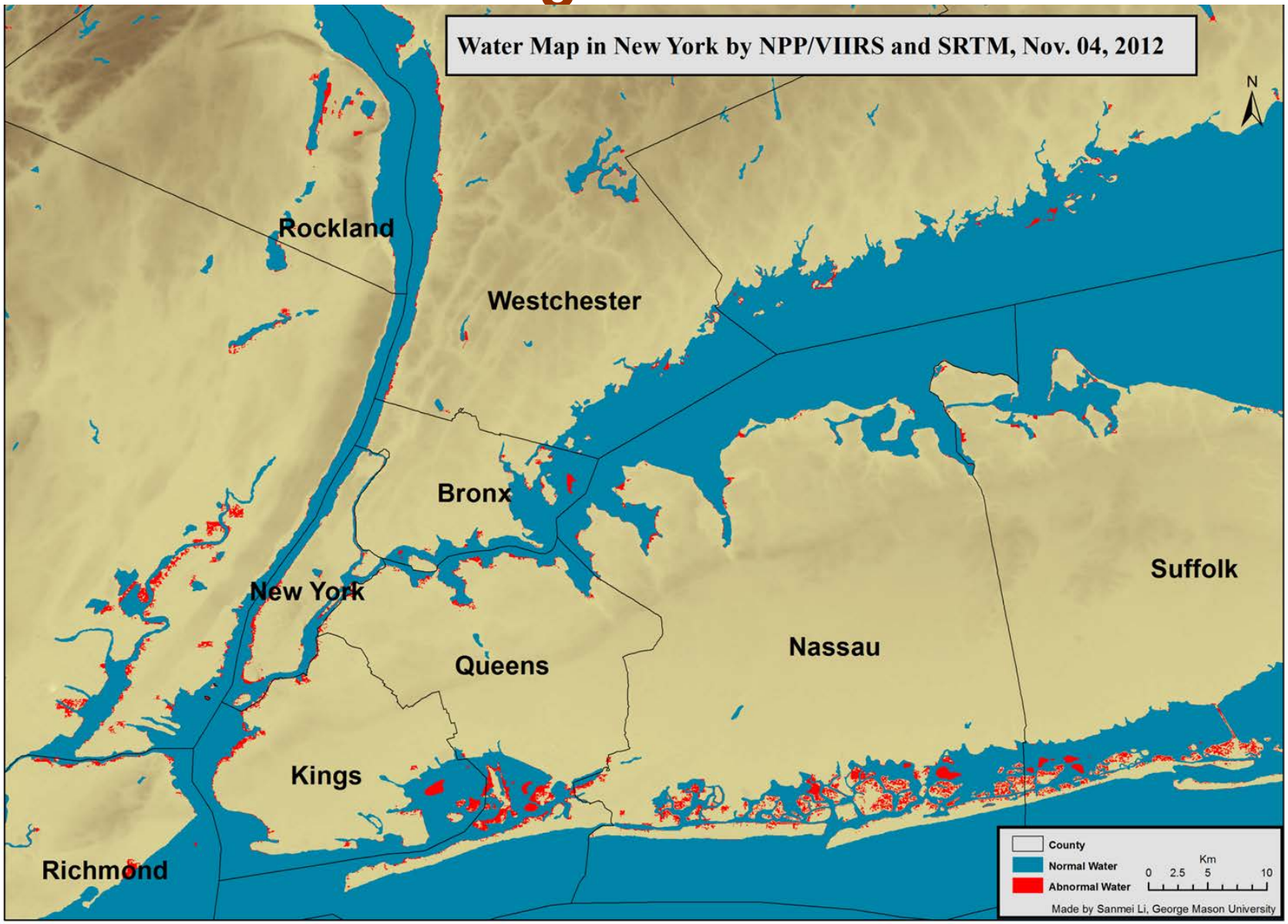


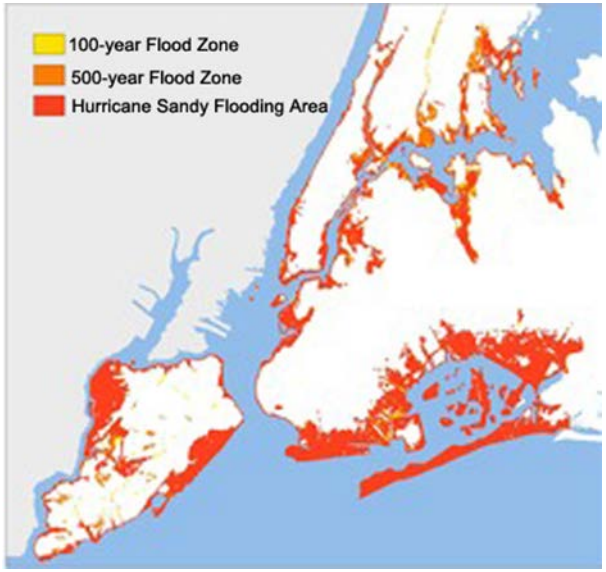
NPP/VIIRS Water fraction map on Oct. 22, 2012

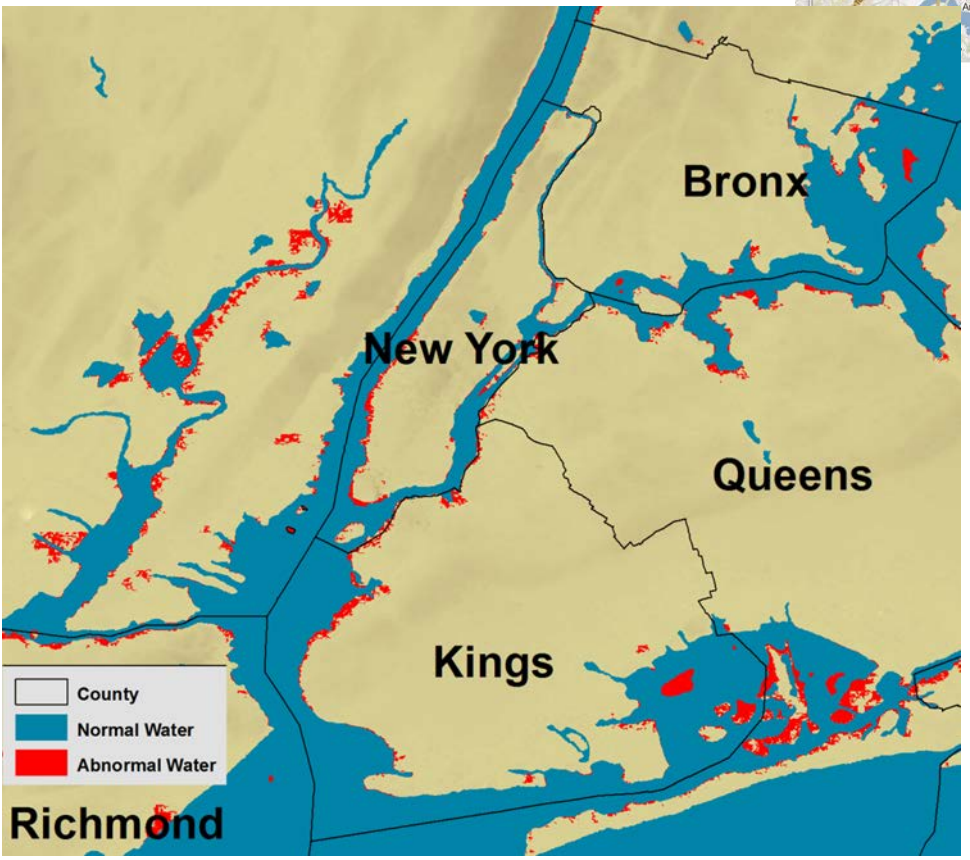


NPP/VIIRS Water fraction map on Nov. 04, 2012

VIIRS 30-m water map using integration method along with SRTM DEM







- Compared with the Flooding zone map and Google map for evacuation due to Hurricane Sandy around New York, the VIIRS 30-m water map. shows consistent inundated locations.
- The difference between the flooding areas might be mainly caused by the observation time difference. On Nov. 04, 2012, most of the flooding water had retreated and not much flooding water could be seen.

5. Possible Path to Operations

- The high temporal resolution and large coverage of coarse- to moderate-resolution satellite imagery, such as NPP/VIIRS and EOS/MODIS, are very advantageous for flood monitoring.
- A further combination of VIIRS water fraction product with SRTM 30-m DEM data shows even better application for VIIRS data on flood monitoring.
- The algorithms can be directly adapted for operation use.

6. Future Plans

- Continue efforts to improve water fraction retrieval algorithm over complex conditions
- Continue efforts to improve the integration method to get more robust result
- Include microwave data and precipitation data in our algorithms
- Validation

7. Publication List

- References
  - Sun, D. L.; Yu, Y. Y.; Zhang, R.; Li, S. & Goldberg, M. D. (2012). Towards Operational Automatic Flood Detection Using EOS/MODIS data. Photogrammetric Engineering & Remote Sensing, 78 (6), 637-646.
  - Li, S.; Sun, D. L.; Yu, Y. Y.; Csiszar, I.; Stefanidis, A. & Goldberg, M. D. (2012). A New Shortwave Infrared (SWIR) Method for Quantitative Water Fraction Derivation and Evaluation with EOS/MODIS and Landsat/TM data. IEEE Transactions on Geoscience and Remote Sensing, 99
  - Li, S.; Sun, D. L.; Mitchell Goldberg & Stefanidis, A. (2013). Derivation of 30-m-resolution Water Maps from TERRA/MODIS and SRTM (under revision)
  - Li, S.; Sun, D.L.; Yu, Y (2013). Automatic Cloud Shadow Removal from Flood/Standing Water Maps using MSG/SEVIRI Imagery (under revision)
- Project Publications
  - Li, S.; Sun, D. L.; Mitchell Goldberg & Stefanidis, A. (2013). Derivation of 30-m-resolution Water Maps from TERRA/MODIS and SRTM (under revision)
  - Li, S.; Sun, D.L.; Yu, Y (2013). Automatic Cloud Shadow Removal from Flood/Standing Water Maps using MSG/SEVIRI Imagery (under revision)