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DHS Science and Technology Directorate

Identifying the Inundation— Utilizing the Landsat Mission and Spectral Indices to Automate Flood Extent Mapping

Flood Impact and Current Identification Efforts

Despite flood mitigation and prevention efforts being a priority in the United States, floods cause more than $6 billion in damages and approximately 140 fatalities a year. This makes floods the leading cause of losses from natural disasters. It is important to develop accurate flood inundation maps for disaster relief efforts and for the creation of floodplain management regulations. Monitoring floods through traditional ground surveying is expensive, time-consuming, and resource intensive. Newly available space-borne and airborne observations provide a cost-effective method for evaluating flood events.

A variety of passive and active sensors operating in the visible and microwave range can be used for deriving flood extent; however these sensors, such as Synthetic Aperture Radar (SAR), are expensive and not readily available. Multispectral data available through passive sensor satellites such as Landsat are preferable for flood monitoring because data is readily accessible and free through the U.S. Geological Survey's (USGS) Land Processes Distributed Active Archive Center.

Figure 1: Landsat Image Displaying Flood over Houston

Study Objectives and Flood Extent Product

This study will search for ground truth data (e.g. high water marks, historic flood boundaries, etc.) along with stream gauge information and other publicly-available optical data from Landsat to delineate flood extent via image interpretation and analysis. Use of the historic record of Landsat data will assist with the identification of areas subject by flooding that are not identified by FEMA flood maps. Thirty-four years of Landsat data will be spectrally analyzed to produce an 'Inundation Extent and Vegetation Stress' layer for five areas of interest across the U.S. The resultant 'Inundation Extent and Vegetation Stress' layer will be broken up into five categories.

Category 1	Permanent Water
Category 2	Observed Flood Water
Category 3	Observed Vegetation Stress
Category 4	Mapped Wetland
Category 5	Mapped 100-Year Flood

Table 1: 'Inundation Extent and Vegetation Stress' Categories

The Permanent Water and Observed Flood Water categories are derived from a USGS water detection algorithm. The Observed Vegetation Stress category is delineated by thresholding vegetation and moisture related spectral indices. The Mapped Wetland category is derived from the USGS National Wetland Inventory, and the Mapped 100-Year Flood category is from 100-year flood layers available in Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMS).

Study Impact

Because of Landsat's resolution and recent technological advances, the delineation of flood extent through the analysis of Landsat imagery is a valuable supporting dataset for the evaluation of FIRMS. This new dataset will help enforce floodplain management regulations, mitigate the effects of flooding on infrastructure, and will reduce the socio-economic impact of disasters.

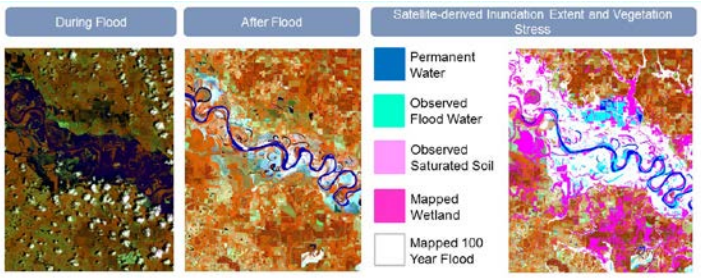

Figure 2: Resultant Inundation Extent and Vegetation Stress Layer

Accomplishments To-Date

- Derived study areas based on FIRM availability and economic and spatial priority
- Collected datasets and available Landsat imagery

Upcoming Milestones

- Compute the flood inundation and vegetation stress layer for all areas of interest
- Perform manual flood extent exercise for comparison
- Validate the automated flood inundation and vegetation stress layer

To learn more about the Flood Apex Program, contact First Responders Group at first.responder@hq.dhs.gov

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