Near Real-Time Use of Optical Remote Sensing and Synthetic Aperture Radar for Response to Central U.S. Flooding in Late April-Early May 2017

Jordan R. Bell1, Lori A. Schultz1, Madeline Jones2, Andrew Molthan3, Scott A. Arko4, Kirk Hogenson4, Franz J Meyer4
1Earth System Science Center, University of Alabama in Huntsville, Huntsville, AL, 2New Light Technology Inc./FEMA, Washington D.C., 3NASA Marshall Space Flight Center, Huntsville, AL, 4Alaska Satellite Facility, University of Alaska Fairbanks, Fairbanks, AK

Introduction

- Satellite remote sensing provides a large scale view at areas impacted by disasters, especially in widespread flooding events.
- A constellation of NASA, NOAA, commercial and international partner satellites provide a wide array of information in varying wavelengths, spatial resolutions and repeat cycles.
- Effort to focus on optical remote sensing (VIS, NIR, IR) are often thwarted by widespread cloud cover, especially in flooding events.
- Storm systems (tropical or extratropical) can bring cloud cover that can linger for several days

Optical vs SAR Remote Sensing

- Optical systems passively receives thermal emissions or reflected components from the object they are observing, while synthetic aperture radar (SAR) allows for penetration through most clouds and precipitation, varying with wavelength.
- SAR systems also penetrate through dense vegetation canopy, depending on wavelength. Allows for through-cloud observations of floods and other severe weather damage.
- Backscattering mechanisms depend upon the surface that is being sampled:
  - Smooth surfaces like undisturbed water can appear dark (low dB)
  - Vegetation orientation impacts dB return from various polarizations.

Collaborations with Alaska Satellite Facility

- The Alaska Satellite Facility (ASF) at the University of Alaska Fairbanks is the NASA Distributed Active Archive Center (DAAC) specializing synthetic aperture radar processing and archiving. The DAAC is part of the Earth Science Data and Information System (ESDIS) Project based at Goddard Space Flight Center.
- ASF maintains an archive of the European Space Agency’s Copernicus Sentinel 1A and 1B satellites. Sentinel 1A/1B are two C-Band instruments that provide a 12 day repeat cycle of most places on Earth. In addition to the Sentinel 1 data, ASF also has archived data from ALOS-1, ERS-1 & 2 and UAVSAR.
- ASF and Marshall Space Flight Center (MSFC) have been working together to better connect SAR data and products with decision makers, especially in disaster response.
- In order to expedite the processing and reduce latency of the data, ASF designed a collaboration tool, that helps with prototyping tools and recipes that use SAR imagery.
- The Hybrid Pluggable Processing Pipeline (HyP3) provided ASF a way to process Sentinel 1 data during the floods and pass that data off to MSFC, who in turn generated flood products for government agencies such as the Federal Emergency Management Agency (FEMA) during their response.

Late April/Early May 2017 Flooding Response with FEMA

- In late April 2017, a storm system brought several days of heavy rain to portions of Missouri that caused rivers to swell and begin flooding.
- Collaborations with ASF provided several products to be used to during the response to this flooding event
  - RTC-Radiometrically terrain corrected images are corrected for SAR geometry and radiometry.
  - Change detection product identifies change between two images that meets a certain threshold.
- False color composite allows for rapid, visual identification of key features and potential changes in those features.
- FEMA used these products to help with their modeling and analysis of infrastructure impacted and potential damage replacement costs.