Real-time Generation of Flood and River Ice and Products Derived from VIIRS Direct Broadcast Imagery

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Partnerships

- Product development
  - Flood Product developed at George Mason University (GMU)
  - River Ice Product developed at City College of New York (CCNY)
- Direct broadcast processing
  - SSEC/CIMSS: CONUS
  - GINA: Alaska
  - CSPP (Flood product undergoing alpha level testing)
- Project support
  - JPSS Program Office
- Users
  - NOAA River Forecast Centers
    - Primary users North Central and Alaska
    - Interest from North East, South East, Missouri Basin, Colorado Basin, West Gulf
  - FEMA
    - Tropical storm Cindy
    - April 2017 flooding
  - NOAA National Water Center
  - Cost Guard
  - Army Corps of Engineers

Flood Product

- Flood Product developed at George Mason University (GMU)
- Provides an estimate of flooding water fractions, regions of ice, cloud, snow cover, and shadows.
  - Products are generated with direct broadcast VIIRS data in near real-time
    - Products generated at
      - SSEC/CIMSS
      - GINA
    - Products distributed
      - AWIPS
      - RealEarth Web Map Service
    - CSPP version to be released

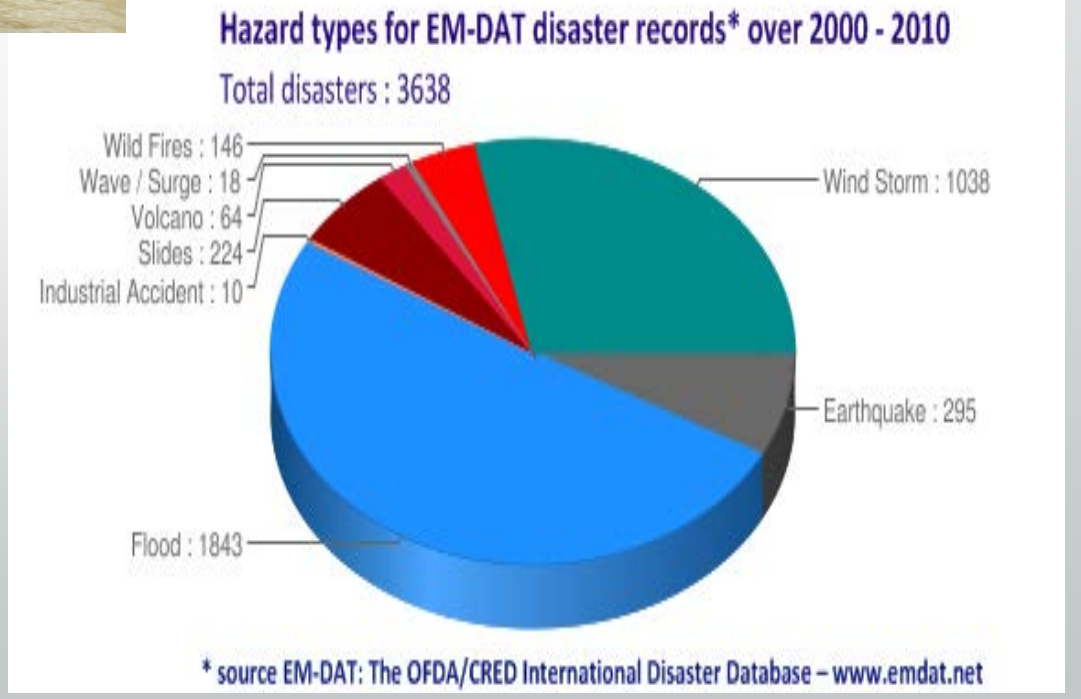
Why Floods?

Galena, AK ice-jam flood in 2013:
90% buildings were destroyed.

Mississippi River flood in 2011:
392 killed, economic loss: $2.8B

New York flood in 2012:
233 killed, economic loss: $75B

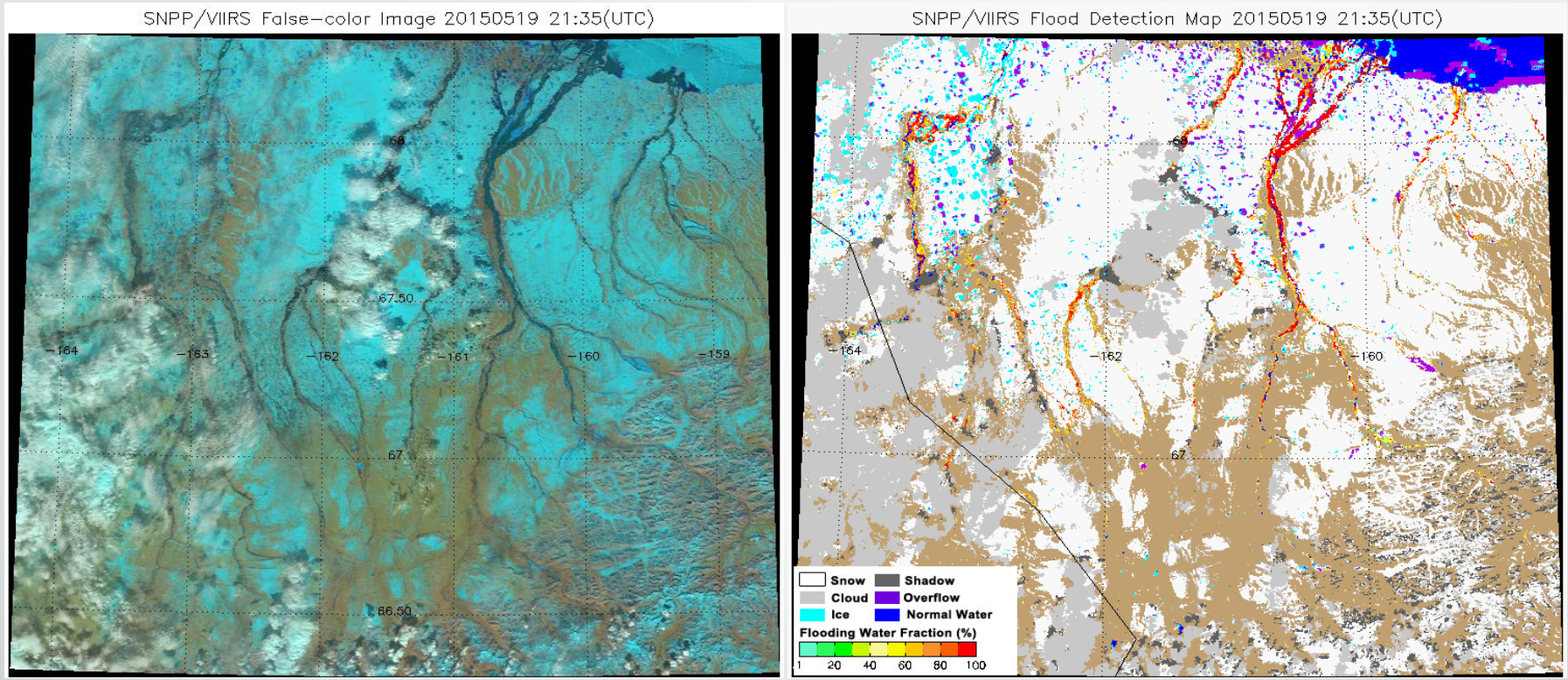
In the U. S., floods caused more loss of life and property than other types of severe weather events.



Background

- With climate change, floods are expected to be more frequent with complex underlying conditions
  - Most floods occur with over bare vegetation conditions.
  - Floods occur over snow ice surface.
- SNPP/VIIRS data show special advantages in flood detection.
  - 3,000 km swath
  - More constant spatial resolution (375-m) in Imager bands
  - Multiple daylight observations per day in high latitudes
  - Particularly good detecting at snow-melt and ice-jam floods (less cloud contamination than intense rain floods)

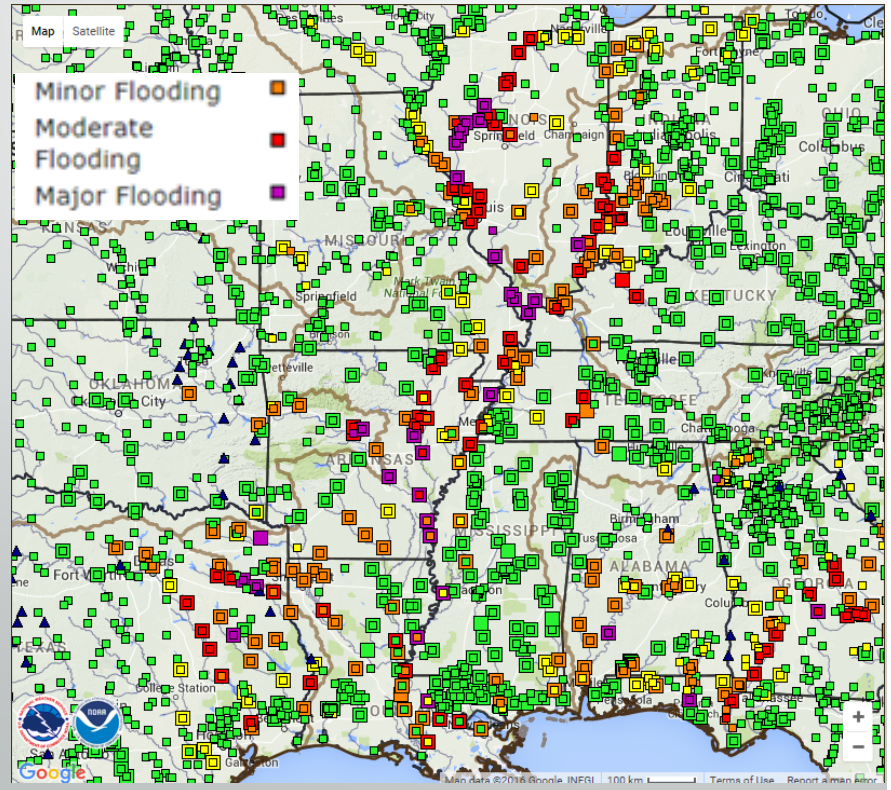
Near real-time flood extent monitoring



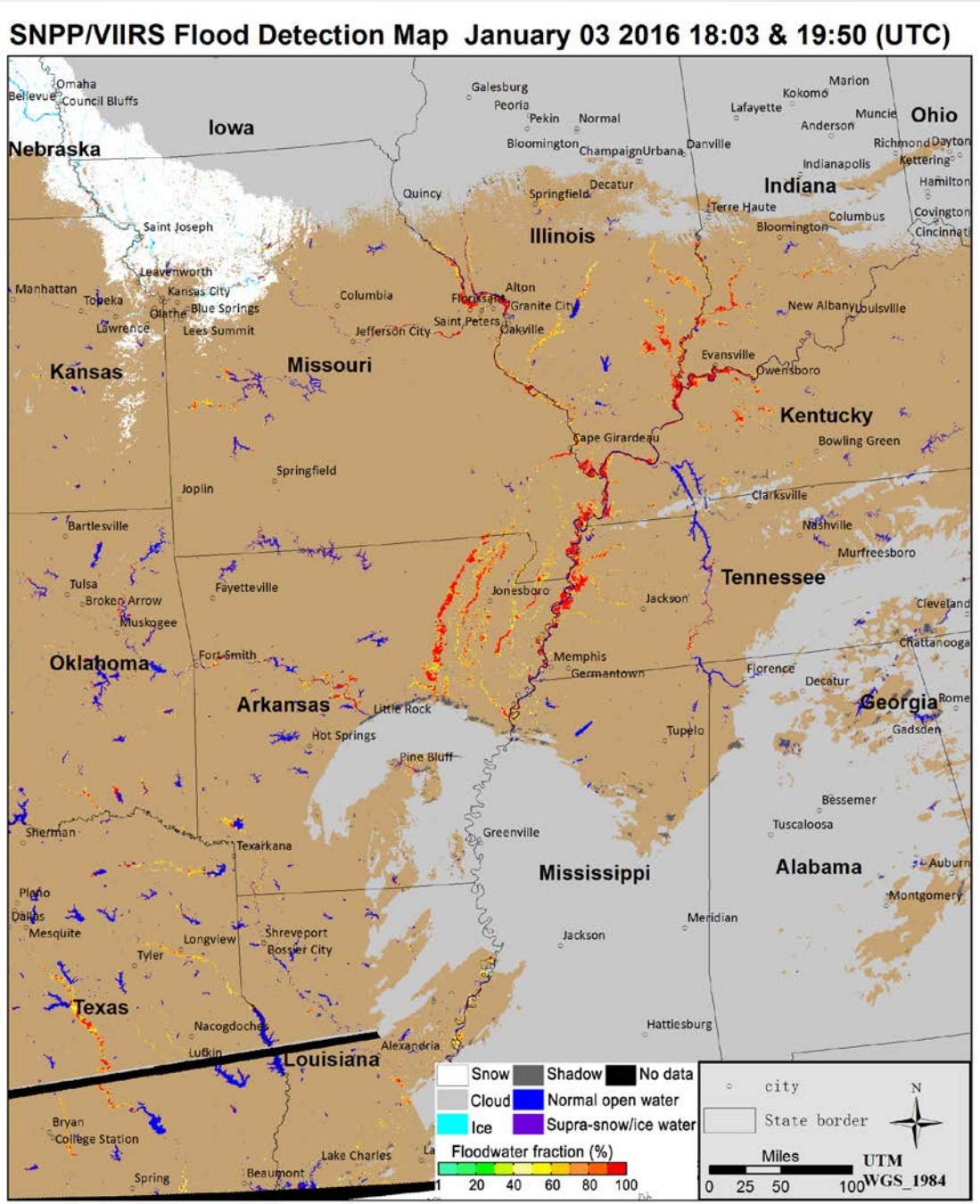
- Spatial resolution: 375-m
- Flood types: supra-veg/bare soil flood and supra-snow/ice flood.
- Flood maps: In a flood map, there are cloud, snow, River/lake ice, shadow (cloud shadow and terrain shades), supra-snow/ice flood cover, normal open water and flooding water fractions of supra-veg/bare soil floods.

Validation

A good supplementary resource to river gauge observations.

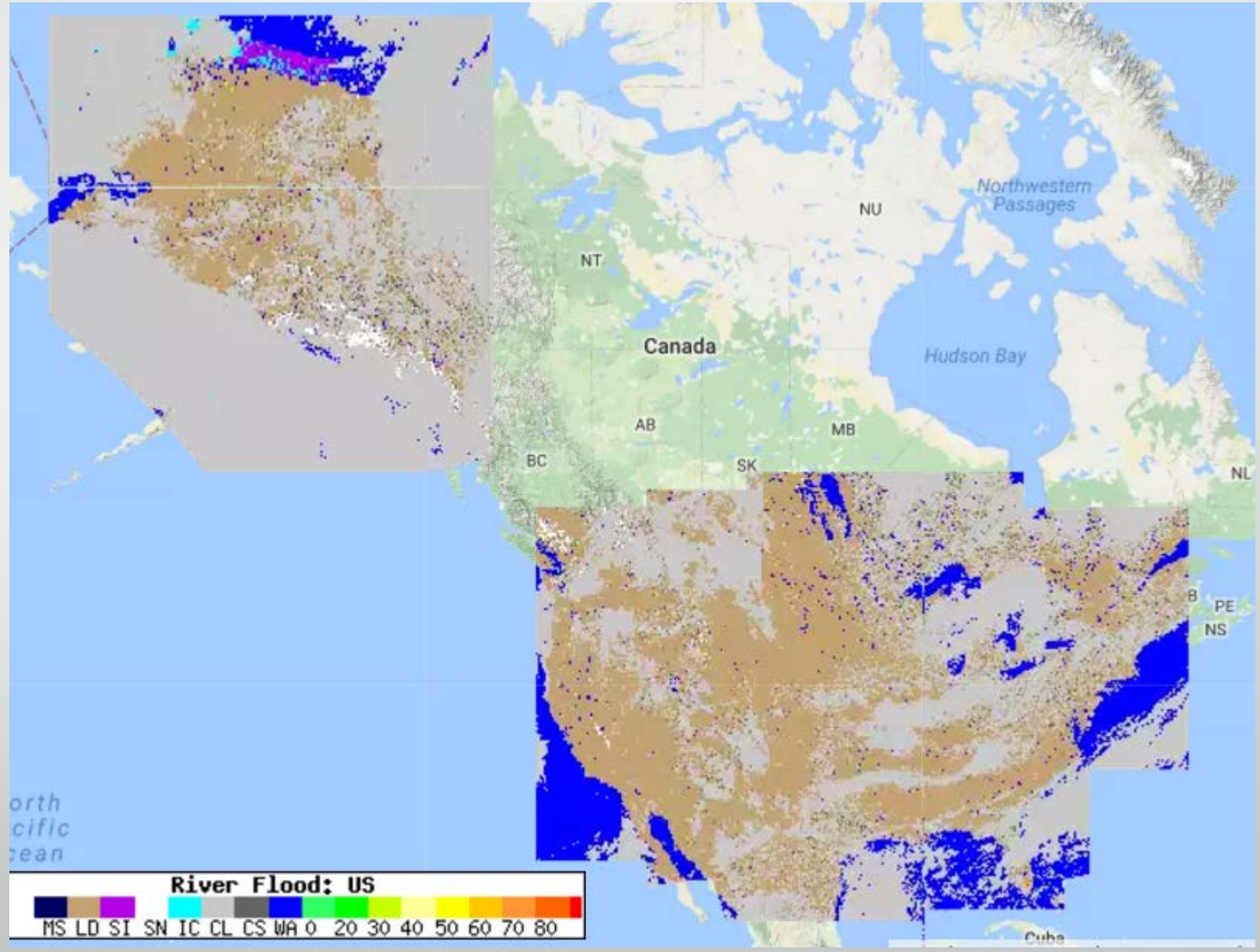


River gauge map on Jan. 03, 2016



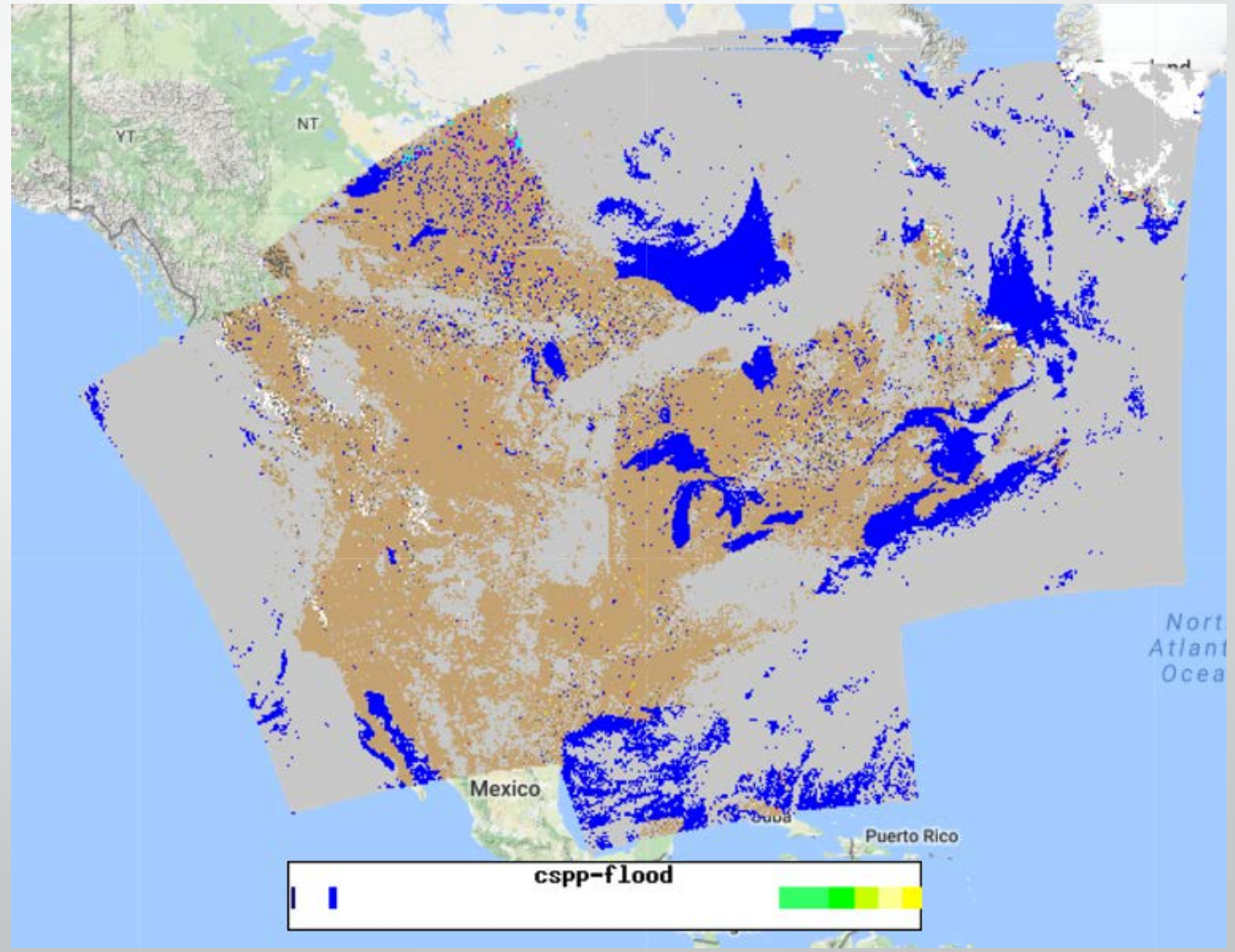
Flood Coverage

- CONUS
  - North East
  - North Central
  - South East
  - Missouri Basin
  - West Gulf
  - North West
  - South West
- Alaska
- Available via
  - RealEarth
  - AWIPS



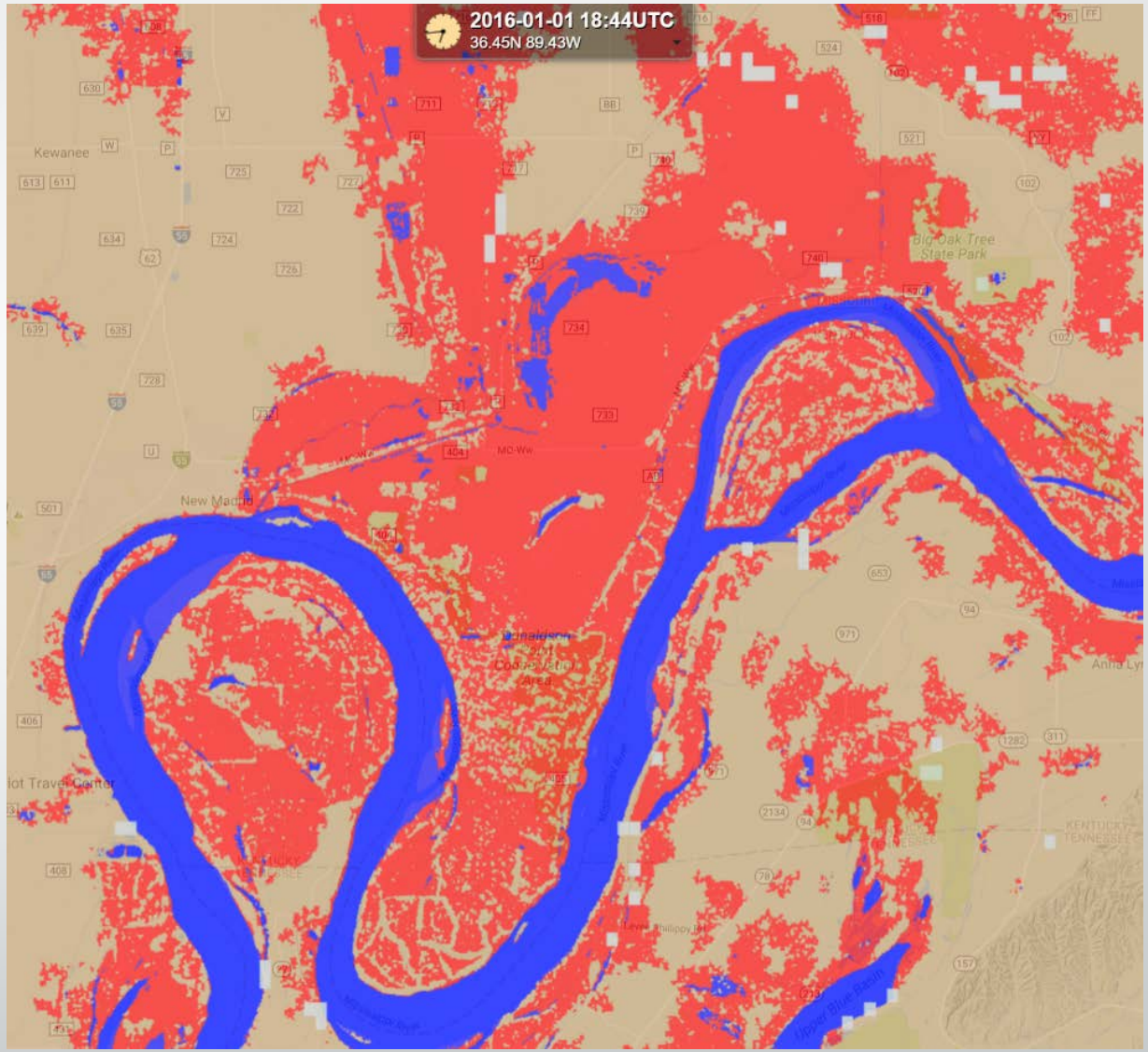
Future Developments

- CSPP flood product
  - Going through alpha testing
- Expanding to global coverage
  - 80°N to 80°S



Future Developments

- 30 m resolution product
- GOES-R product development



Experimental 30m flood product, loaded in RealEarth, showing flooding along the Mississippi River in Missouri, Kentucky, Tennessee boarder region on January 1, 2016 18:44UTC

River Ice Product

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- Products are generated with direct broadcast VIIRS data in near real-time
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    - GINA
  - Products distributed
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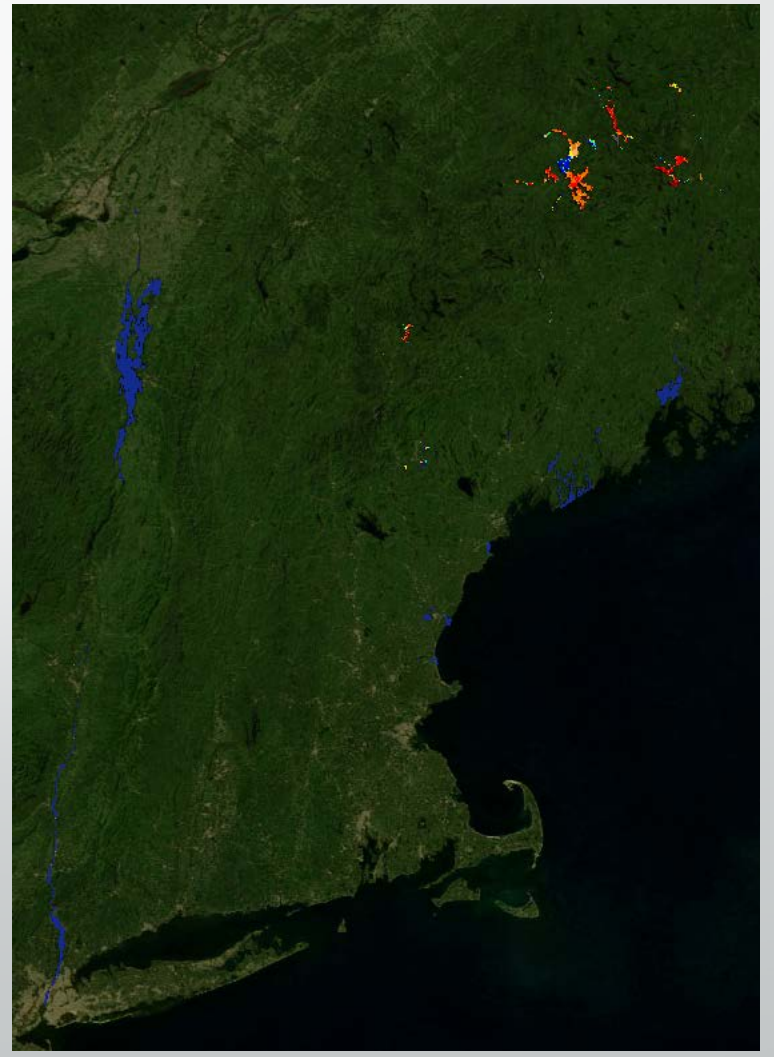
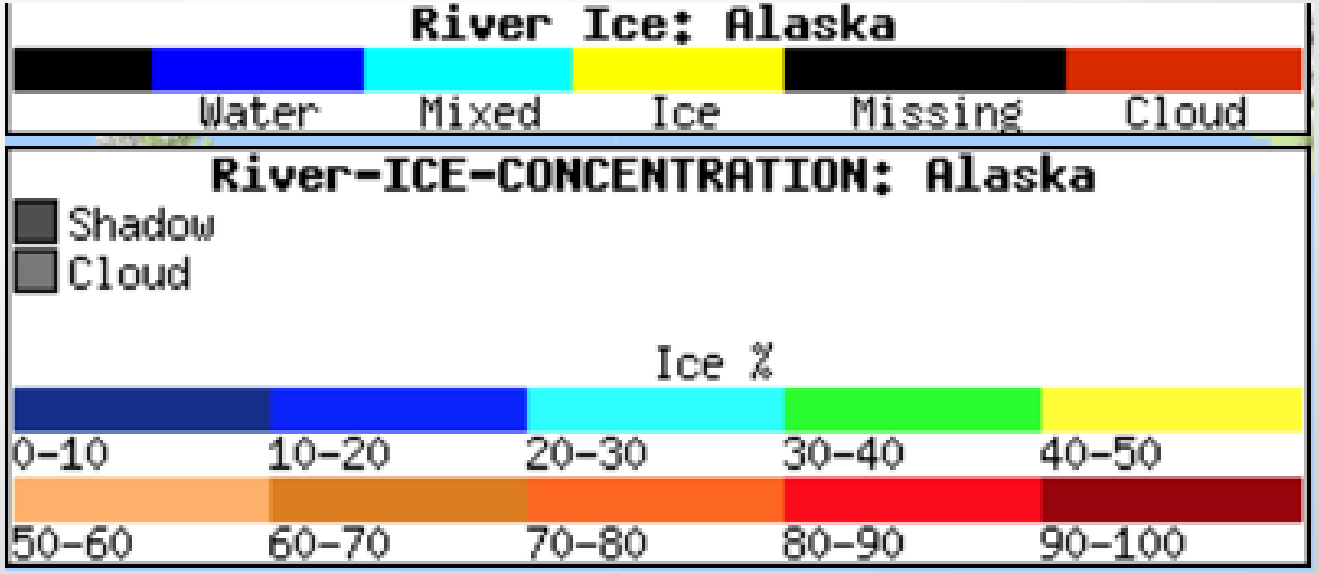
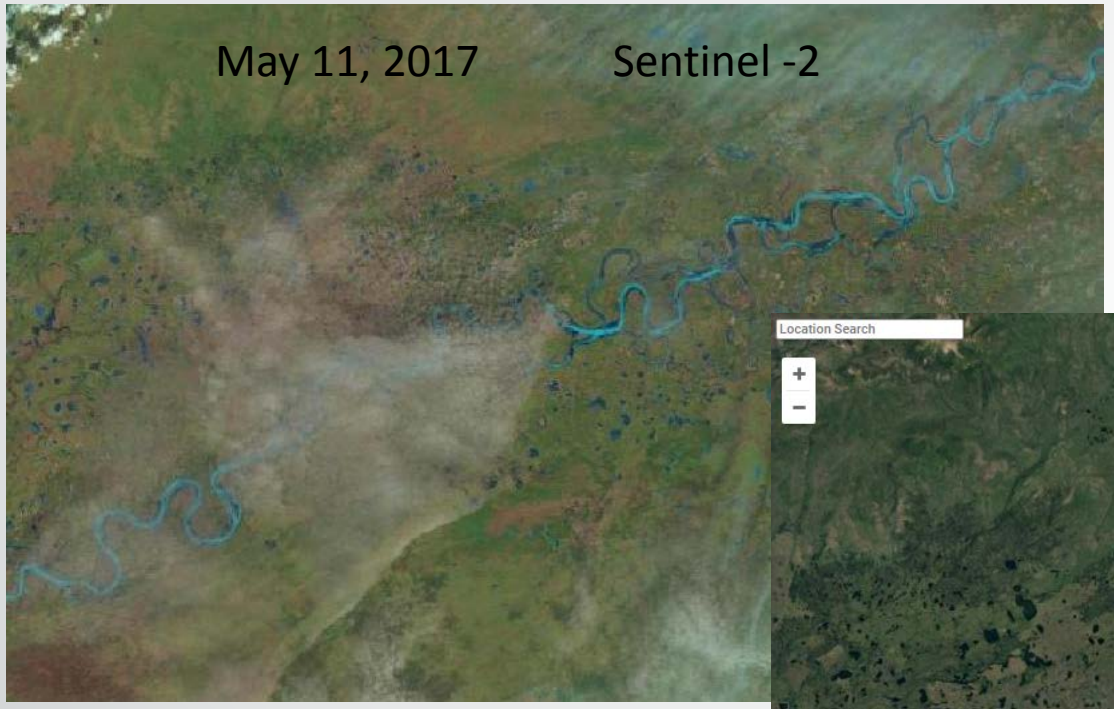


River Ice Products

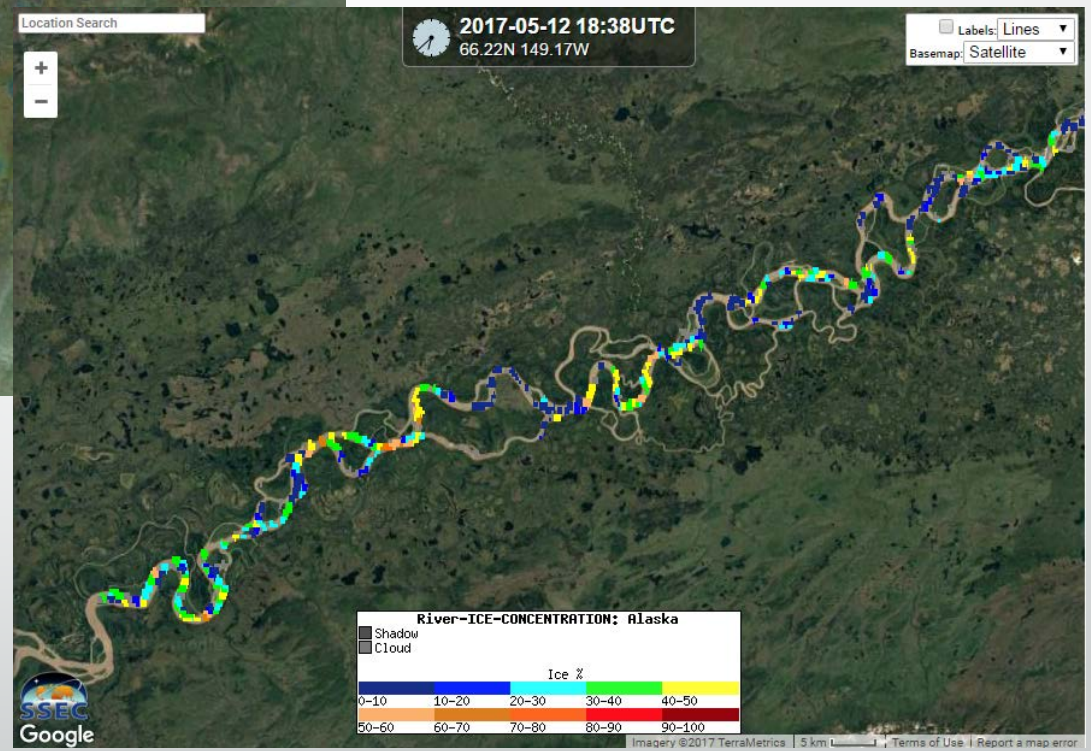
- Ice mask
  - Water
  - Mixed
  - Ice
  - Cloud
- Ice concentration
  - Ice concentration percentage
  - Cloud
  - Cloud shadow

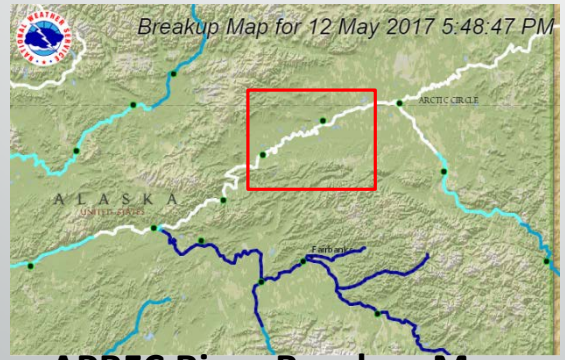


Verification and Quality Assessment



VIIRS-based river ice maps are compared with high resolution satellite imagery, available airborne imagery, in situ reports

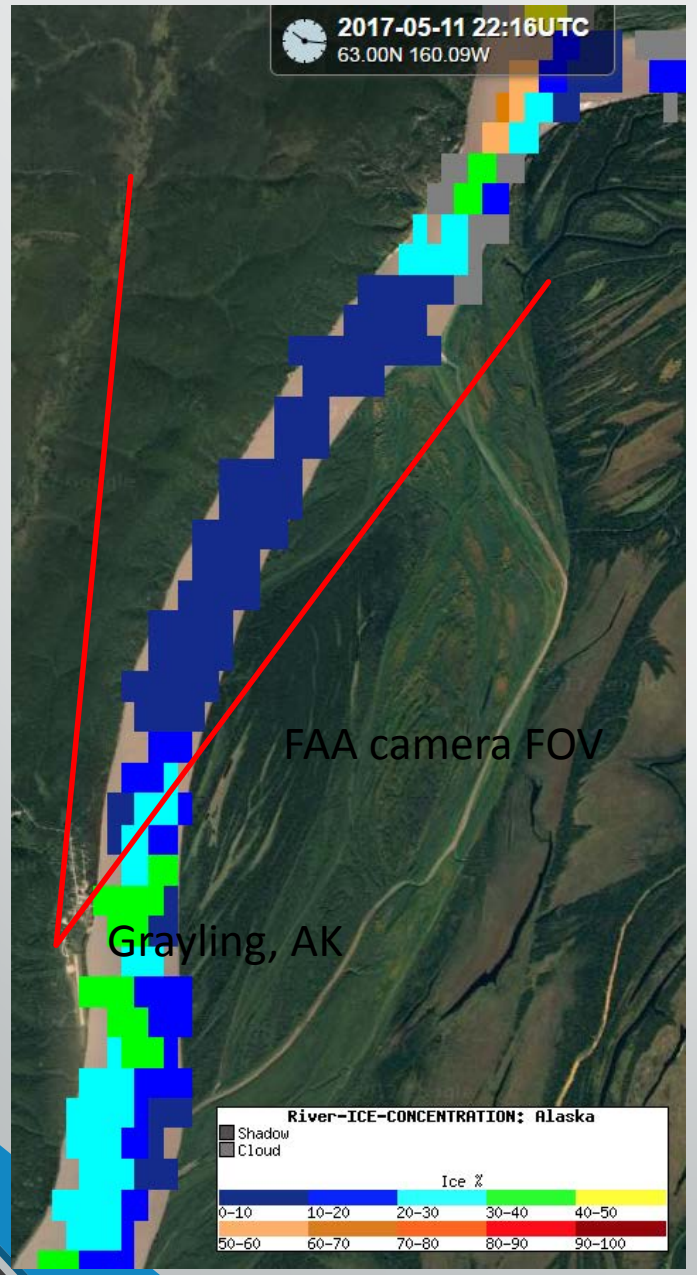




APRFC River Breakup Map

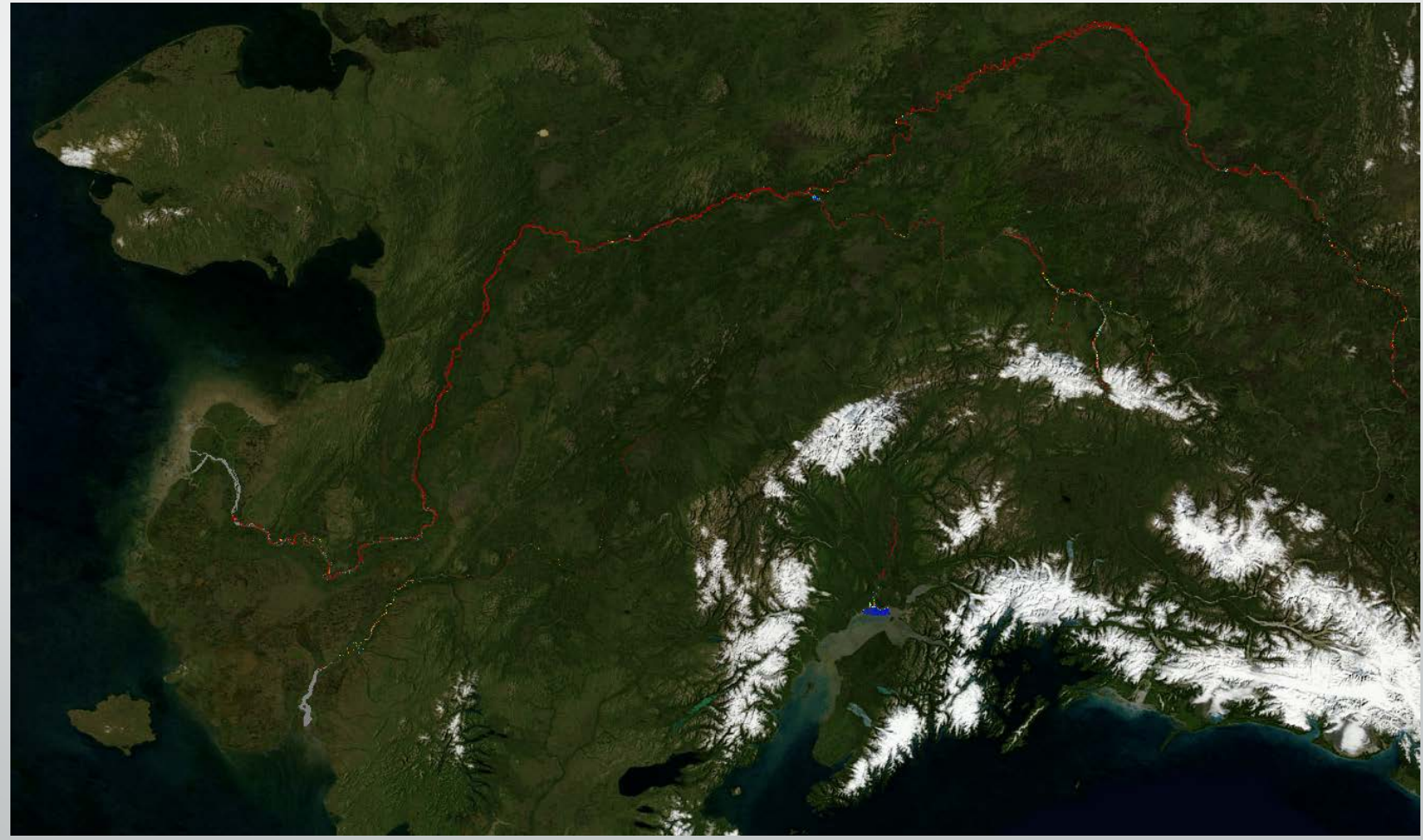
Some open water on Yukon between Beaver and Stevens Village in the VIIRS product supported by Sentinel-2 RGB image. APRFC labels this portion of Yukon as “mostly ice”

Verification and Quality Assessment



River Ice Coverage

- Regions
  - North East
  - North Central
  - Missouri Basin
  - Alaska
- Limited to large rivers only
  - Recently (version 3.2) expanded number of rivers

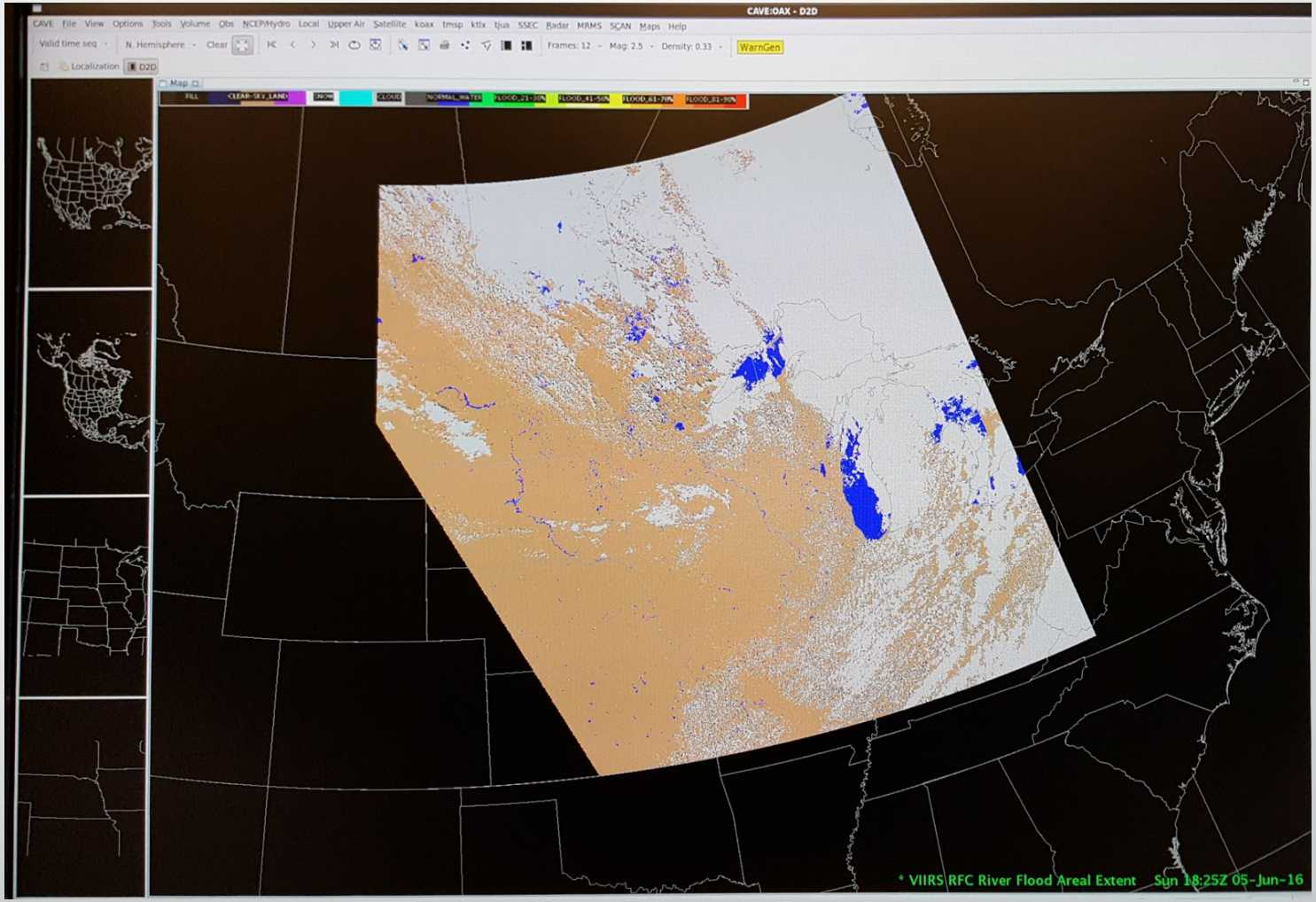


Future Work

- Ice detection on narrow (subresolution) rivers
- Improve late season ice retrievals:
  - Temperature-dependent ice reflectance model
- Extend area coverage
  - Rivers
  - Lakes
  - Coastal areas

Product Distribution / Visualization

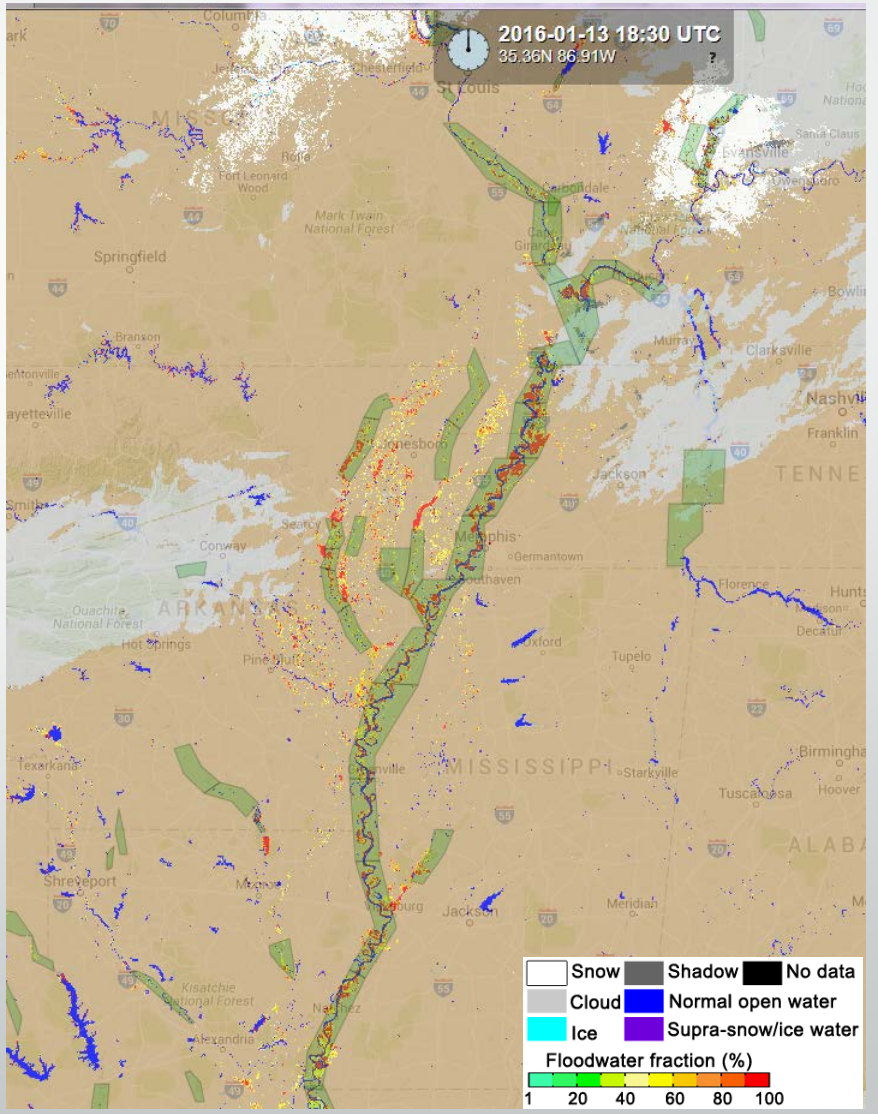
- AWIPS II
- RealEarth



AWIIPS help document: https://docs.google.com/document/d/1mEDFEXzIXCTEGXfb_coLGm2fkONdsPl9Gohj7xS2AYM/edit#heading=h.gjdgxs

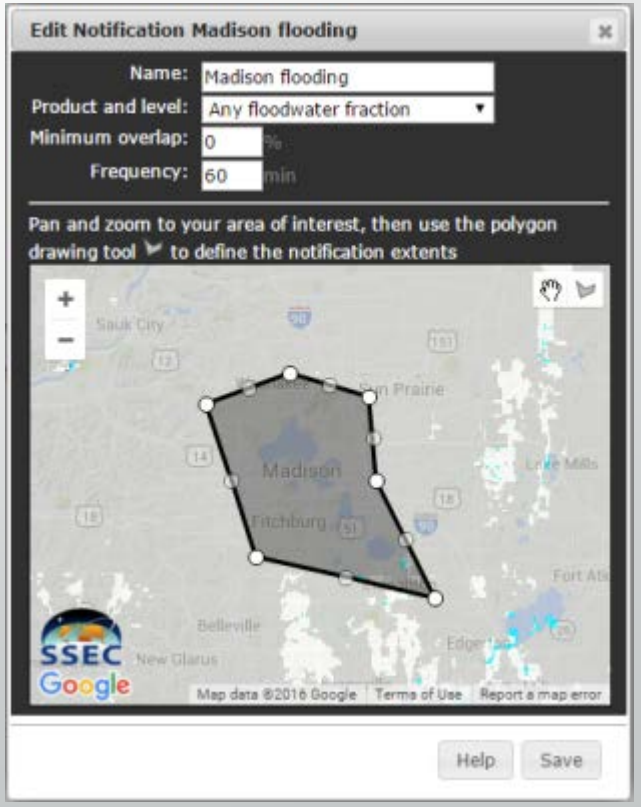
RealEarth - Overlays

- Flood product with flood warning product (right)
- RealEarth can also display
  - Landsat
  - Aerial photography
  - Weather radar
  - And much more



RealEarth - Notifications

- Register at: realearth.ssec.wisc.edu/users
- Define a region of interest
  - Use Google's draw tools to define a polygon of interest
- Select a product
  - River Flood options are "any floodwater fraction" or "Floodwater fraction >50%"
- Define an overlap threshold
  - This is the percentage of the area of the polygon that must be at or above the product threshold.
- Define a frequency
  - This is how often the system will check for new product imagery



RealEarth - notifications

- The notification email will show:
  - Name of the region that triggered
  - Time of the notification
  - Amount of the polygon above the warning threshold.
  - A preview image of the product
  - A link to view the product in RealEarth

From SSEC-RealEarth <notify@realearth.ssec.wisc.edu>
Subject **SSEC-RealEarth Notification: Madison flooding** 8/14/2016 3:53 PM
To Jay Hoffman

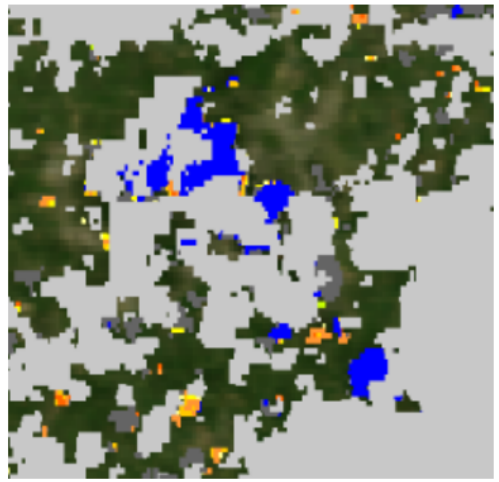
Hello Jay,

Notification "Madison flooding" occurred on Sun Aug 14 at 20:53 UTC with 1% overlap of your region of interest:

Notification triggered

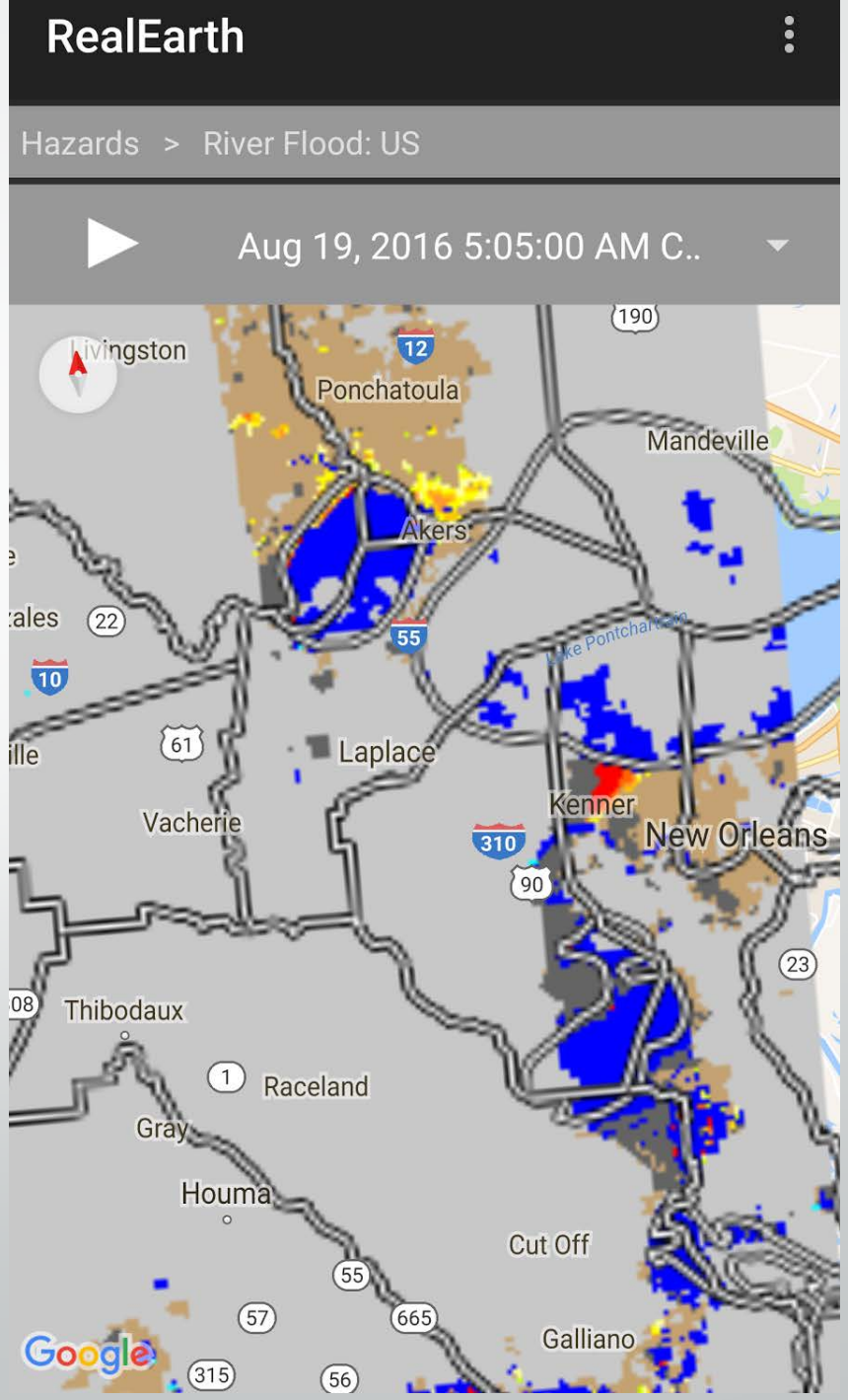
https://re.ssec.wisc.edu/s/!7Uy

notify_31569.png



RealEarth - app

- Available for Android and iOS
- All products that are available on the website are available on the app



Questions

- Flood Product
  - Sanmei Li slia@gmu.edu
- River Ice Product
  - Peter Romanov peter.romanov@noaa.gov
- RealEarth
  - realearth@ssec.wisc.edu