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
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.
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

- River Ice Product developed at City College of New York (CCNY)
- 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
River Ice Products

- Ice mask
  - Water
  - Mixed
  - Ice
  - Cloud
- Ice concentration
  - Ice concentration percentage
  - Cloud
  - Cloud shadow
Verification and Quality Assessment

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

FAA camera FOV

Grayling, AK

FAA camera in Grayling, AK
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

AWIPS help document: [https://docs.google.com/document/d/1mEDFEXzIXCTEGXfb_c0Lgm2fkONdsPl9Gohj7xS2AYM/edit#heading=h.gjdgxs](https://docs.google.com/document/d/1mEDFEXzIXCTEGXfb_c0Lgm2fkONdsPl9Gohj7xS2AYM/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
RealEarth - app

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

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