



Committee on Earth Observation Satellites

## GEO/LEO/SAR Flood Pilot

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WGDisasters-16 Meeting

Virtual Meeting

21 – 23 September 2021



- WGDasters Flood Pilot Implementation Plan was endorsed during the CEOS 2020 Plenary
- Key Milestones:
  - 2020-21
    - Begin regional studies; collect data; establish relationships
  - 2021-22
    - Provide derived products to users for feedback and explore refinement of monitoring strategies. Initial evaluation of pilot results to GFP and international conferences.
  - 2022+
    - Develop reports from users on derived products, best practices, and evaluate results from study sites. Explore whether broader EO strategies can be developed.



- Objective A
  - Solicit input from CEOS partnering agencies and participants on current and upcoming efforts to map water and flood extent from diversity of LEO/GEO and SAR contributions.
- Objective B
  - Capture underlying requirements and future needs to sustain and improve upon these capabilities.
- Objective C
  - Explore ideal combination of LEO/GEO/SAR flood mapping outputs, using representative regional events of interest to partners.
  - Develop and document best practices for combining and sharing flood information from multiple platforms with diversity in sensor, spatial/temporal resolution, etc.



- SG1: Red River of the North
  - Vince Decker, Natural Resources Canada
- SG2: Bermejo and Picomayo Basins
  - Marcelo Uriburu Quirno, CONAE
- SG3: Brahmaputra River and Mahanadi Delta
  - G S Rao, ISRO
- SG4: Pearl River Basin
  - Weiyuan Yao, CAS
- SG5: Balkans
  - Issaak Parcharidis, Harokopio University of Athens
- SG6: Myanmar
  - Patrick Matgen, LIST







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## Earth Analytics Interoperability Lab – Getting Started

This document provides a basic introduction to using the Earth Analytics Interoperability Lab (EAIL) Datacube JupyterHub environment. Please review this before using EAIL and take particular note of the suggestions regarding shutting down your server when you finish.

The datacube has been built and configured by CSIRO and is hosted by the Chilean Data Observatory ([www.dataobservatory.net](http://www.dataobservatory.net)). AWS resources are provided by the Data Observatory.

This is currently a prototype system and is for non-commercial use only. Please contact [jonathan.hodge@csiro.au](mailto:jonathan.hodge@csiro.au) if you have any questions regarding other use.

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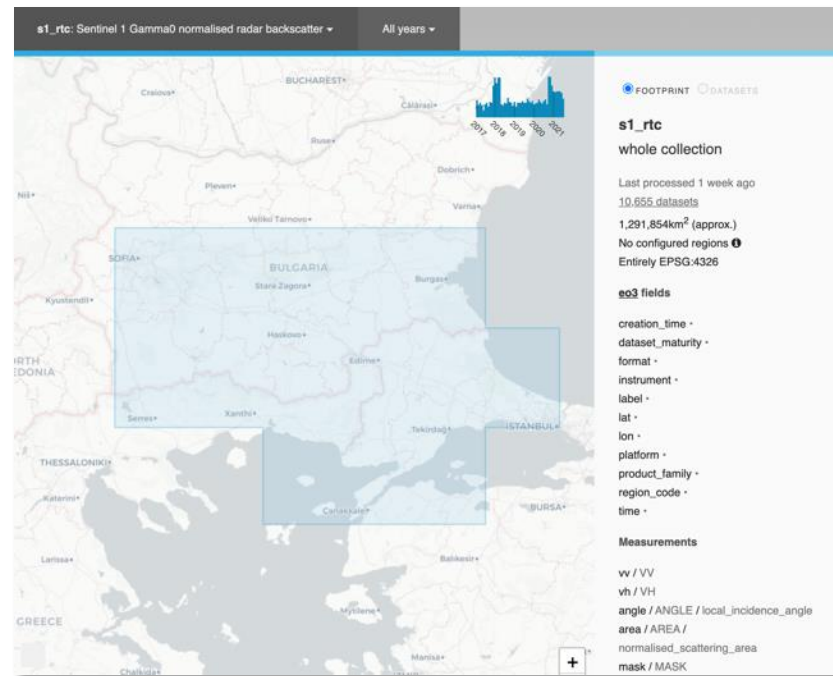
- CEOS EAIL accounts distributed to all Flood Pilot members, with Getting Started and Background content
- Leverage the Lab with all relevant and available data. Bring code to the infrastructure & collaborate towards improving existing mapping tools: open water, flooded vegetation, urban and critical infrastructure, multi-platform downscaling, identify gaps, etc



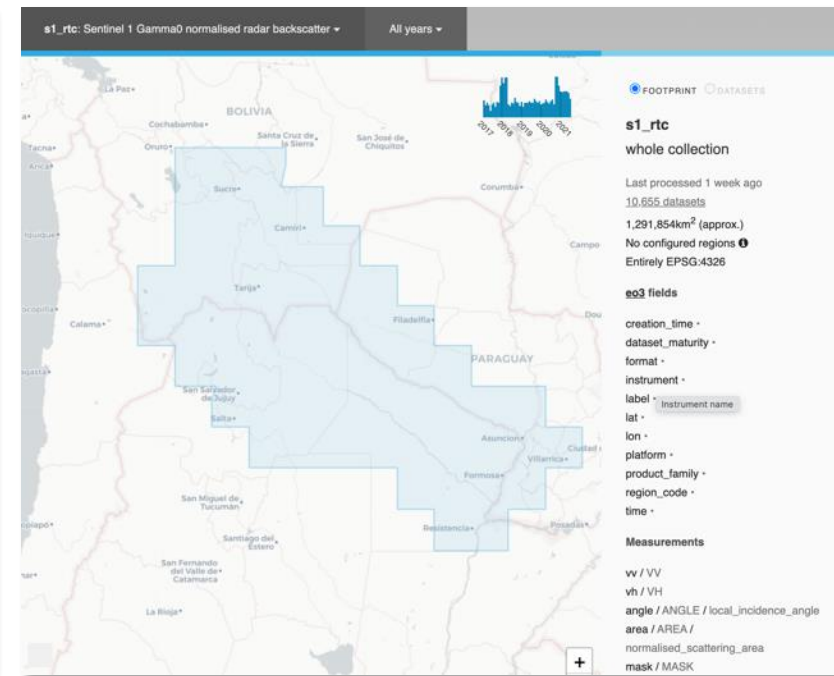
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# EAIL Data Holdings

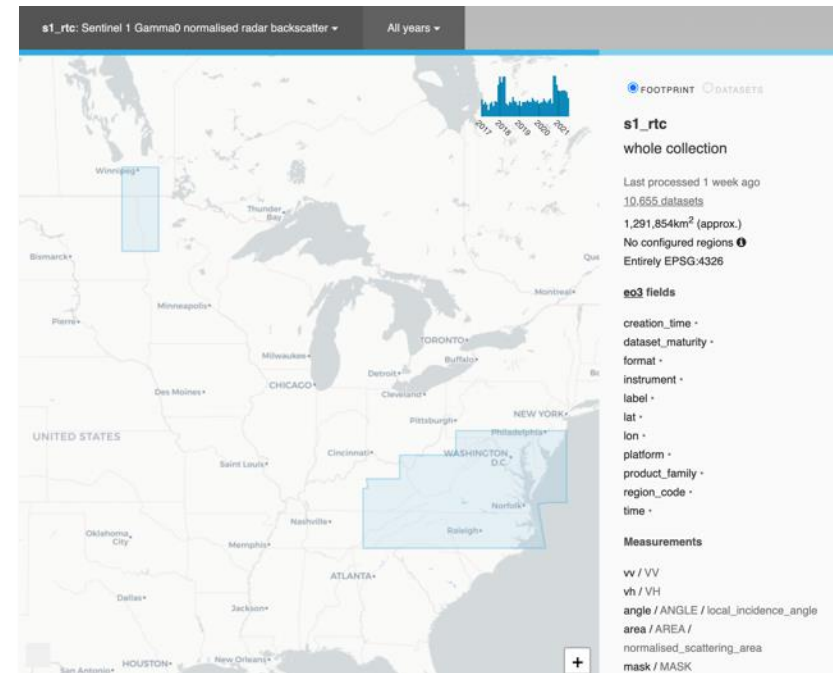
- Sentinel 1 example
- Red River, Balkans and Argentina/Paraguay for dates identified
- East coast USA 2017-2021



Evros Basin, Balkans



Bermejo, Picomayo Basins



Red River of the North

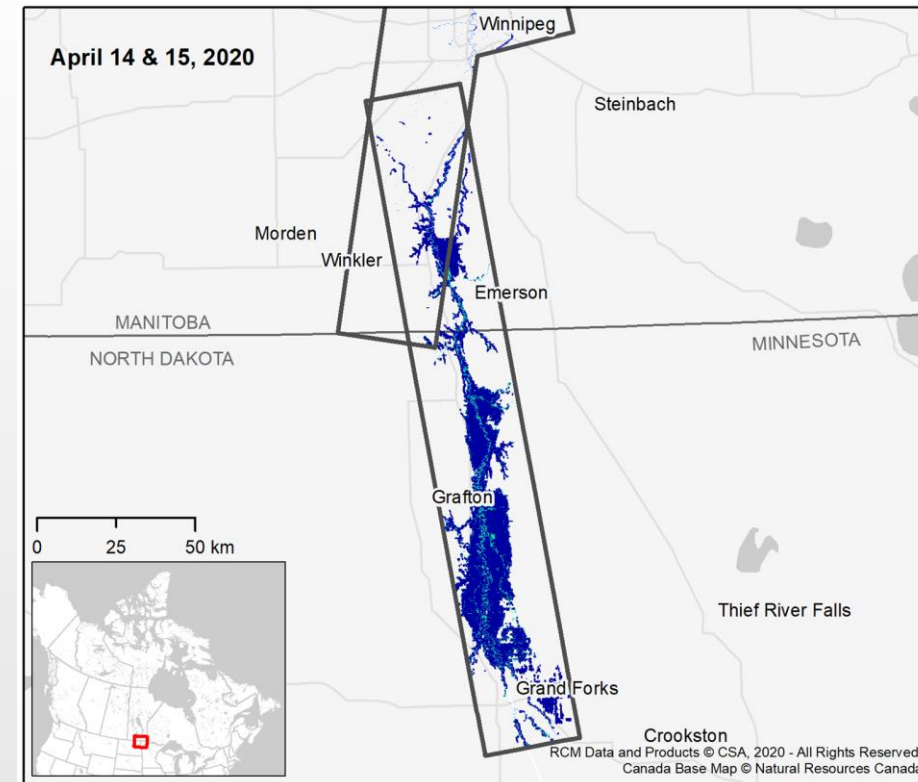
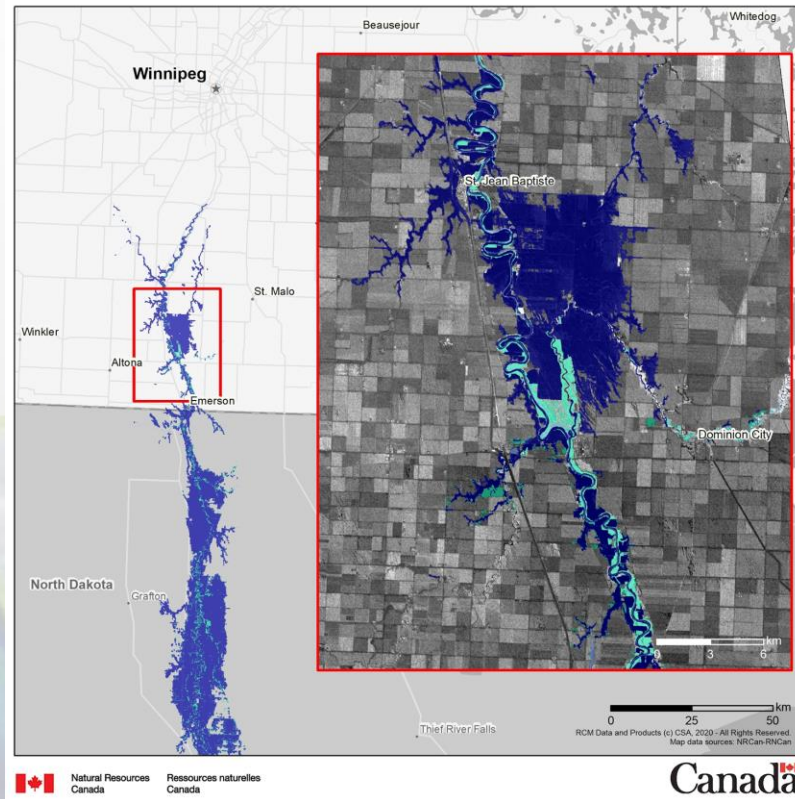
Credit: Jonathan Hodge, CSIRO Chile

[https://explorer.eail.easi-eo.solutions/s1\\_rtc](https://explorer.eail.easi-eo.solutions/s1_rtc)



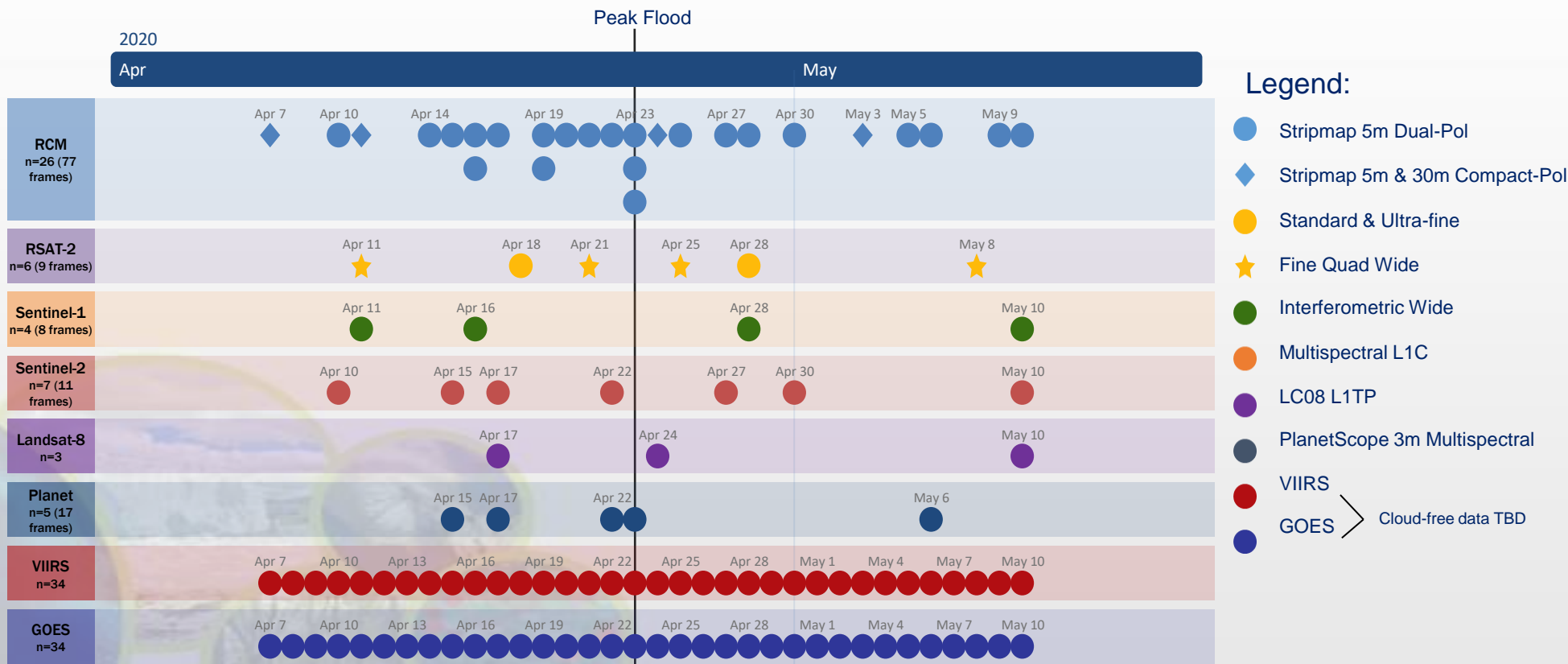
From the Natural Resources Canada/Red River of the North team:

- 77 RCM scenes used to create 20 flood maps between April 14th and May 10<sup>th</sup>
- Preliminary plans on algorithm sharing for community use and development





Red River of the North Team / NRCan have demonstrated their need and goals for multi-platform and partner data supporting analysis in the 2020 event and year



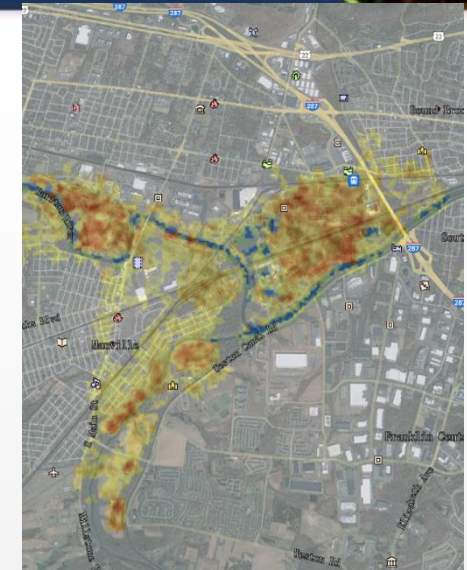




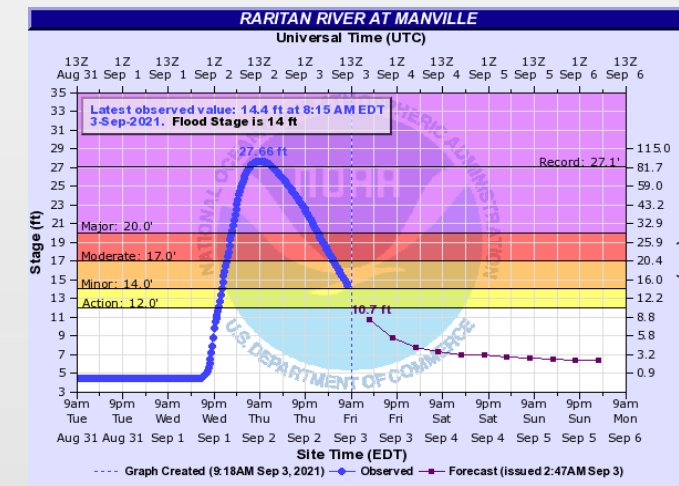
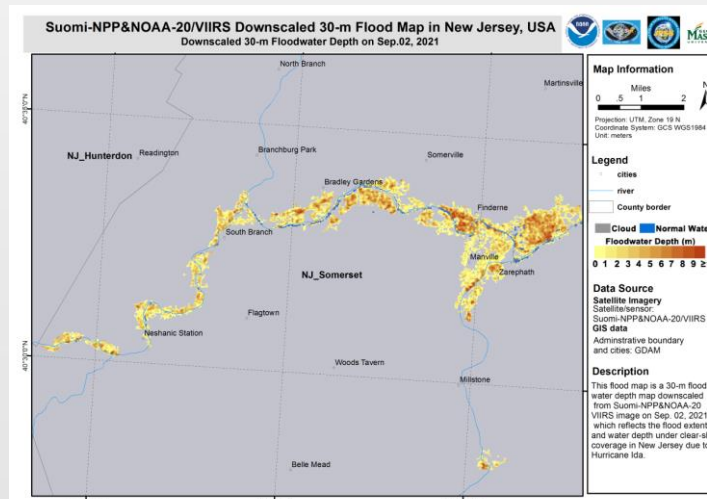
- The NOAA LEO/GEO Flood program is working on a downscaled (30m) product to further enhance response to flood events. **This product is part of the Red River pilot study of the flood pilot.**
- An example of the downscale product from Manville, NJ which had large amounts of flooding, resulting from Hurricane Ida, is shown to the right and is compared to GEOEYE-01 (MAXAR) imagery from the same day (2 September 2021). High resolution imagery is utilized as a validation source along with river gauge information (also show) to help improve the product
- While downscaling is currently being done with VIIRS only, research is ongoing to apply it to GEO (ABI/AHI) imagery
- This downscaled product is what will be used in conjunction with SAR flood inundation products (ex. RCM or Sentinel) to develop a LEO/GEO/SAR flood product.

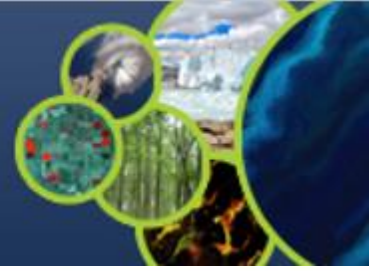


Image from GEOEYE-01 MAXAR around Manville, NJ after Hurricane Ida on Sep. 02, 2021

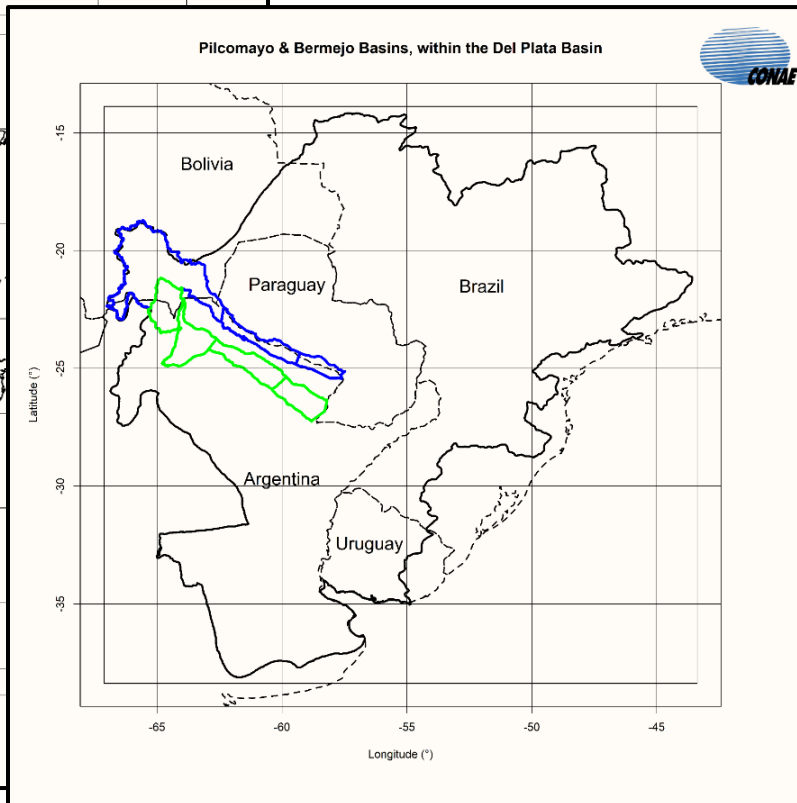
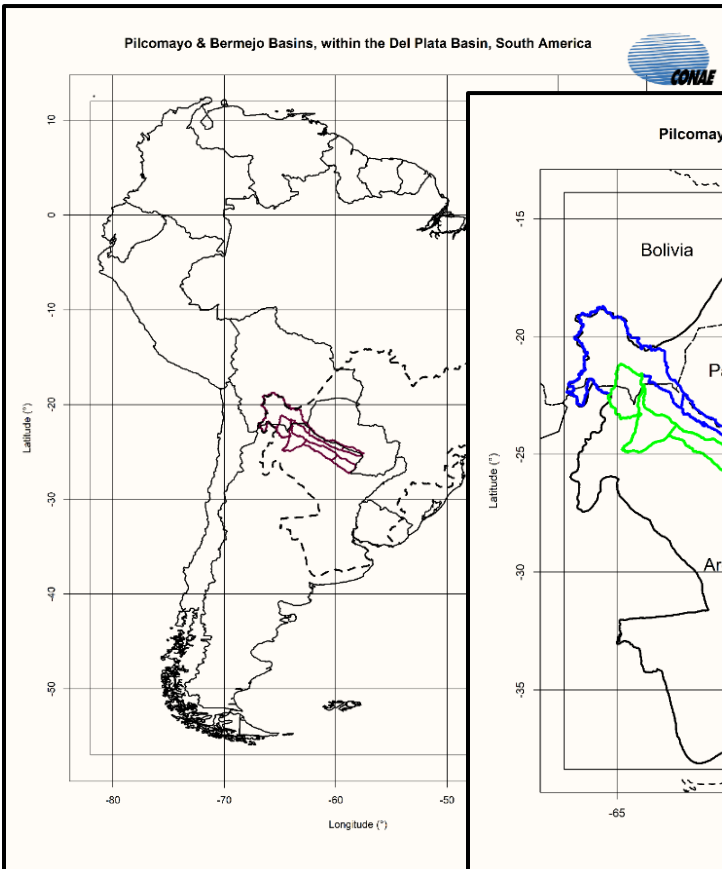


VIIRS downscaled floodwater depth map around Manville, NJ on Sep. 02, 2021



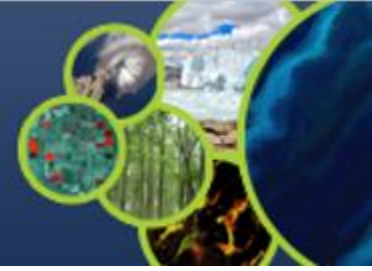


- Improving the application of satellite information in all stages of a flood event: early warning, emergency management and post-event recovery.



## Facts & Figures

- Combined basin area: 413,162 km<sup>2</sup>
- Sub-basins of the Del Plata Basin in South America
- Shared by Argentina, Bolivia and Paraguay (Pilcomayo) and by Argentina and Bolivia (Bermejo)
- Basin headwaters at the Andes Range
- Annual floods occur between December and April, mostly due to intense precipitation in the upper basins
- Socio-demographic characteristics: about 2.5 million people living in conditions of extreme poverty

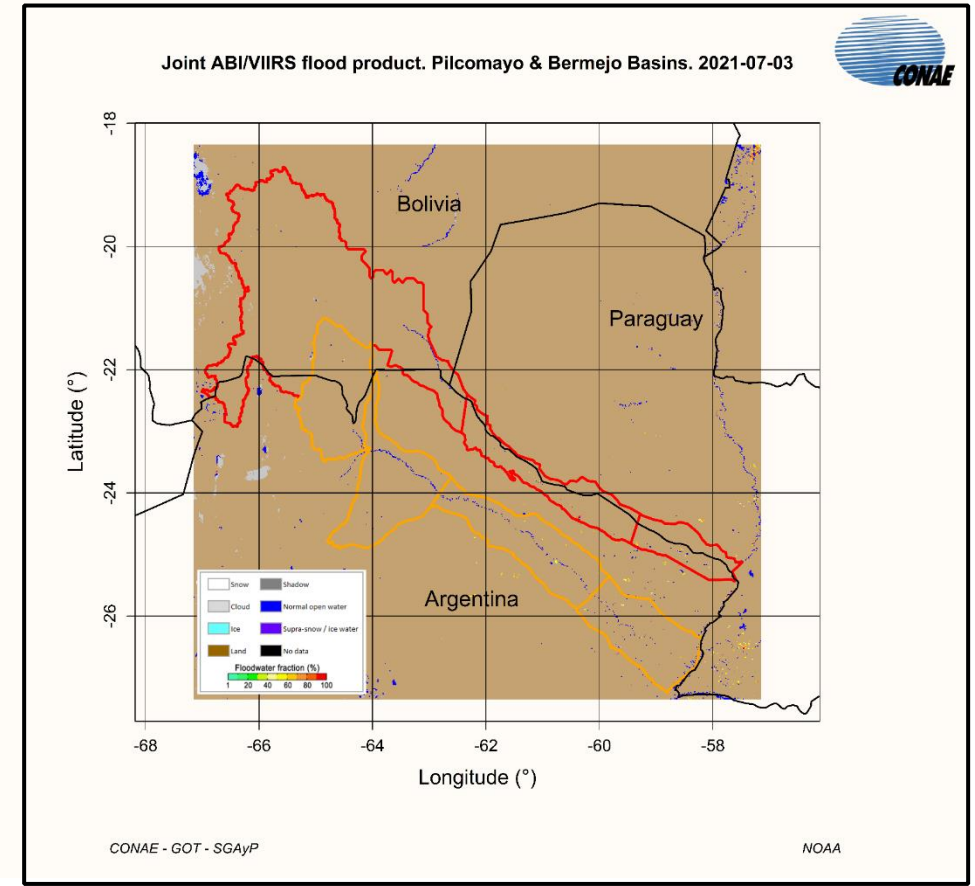
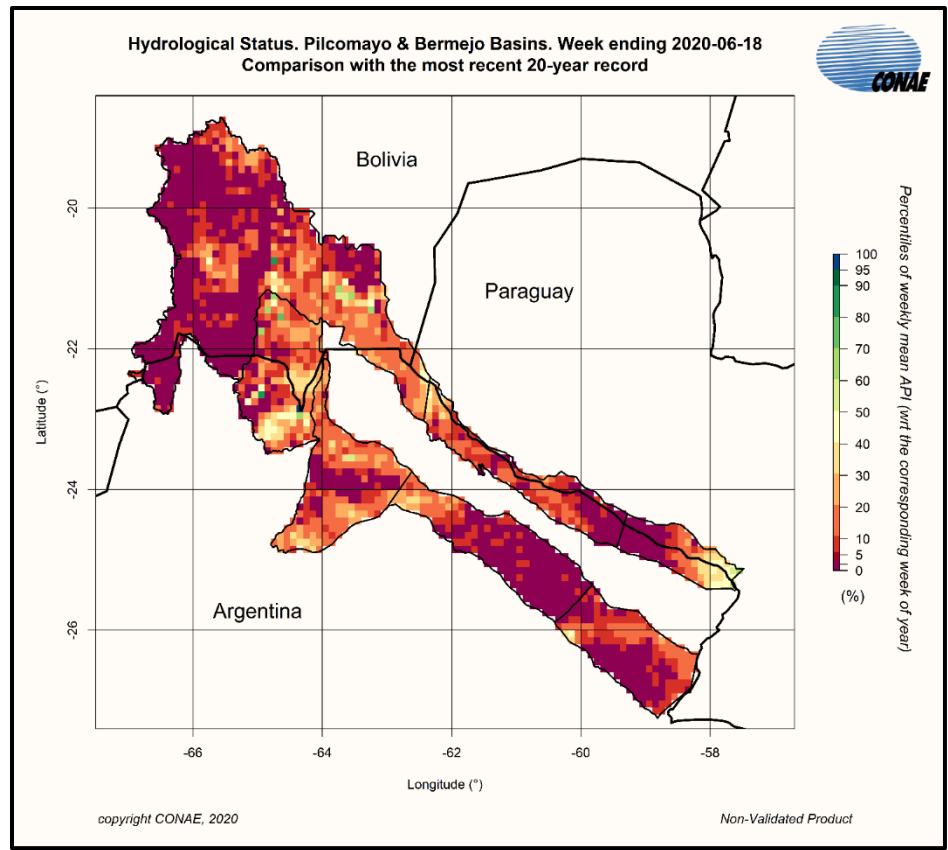


## Pre – event monitoring of basin antecedent conditions

- Hydrological status. Percentiles of weekly mean API (GPM and TRMM)
- Daily API, as a proxy of soil moisture (GPM)

## Post – event assessments

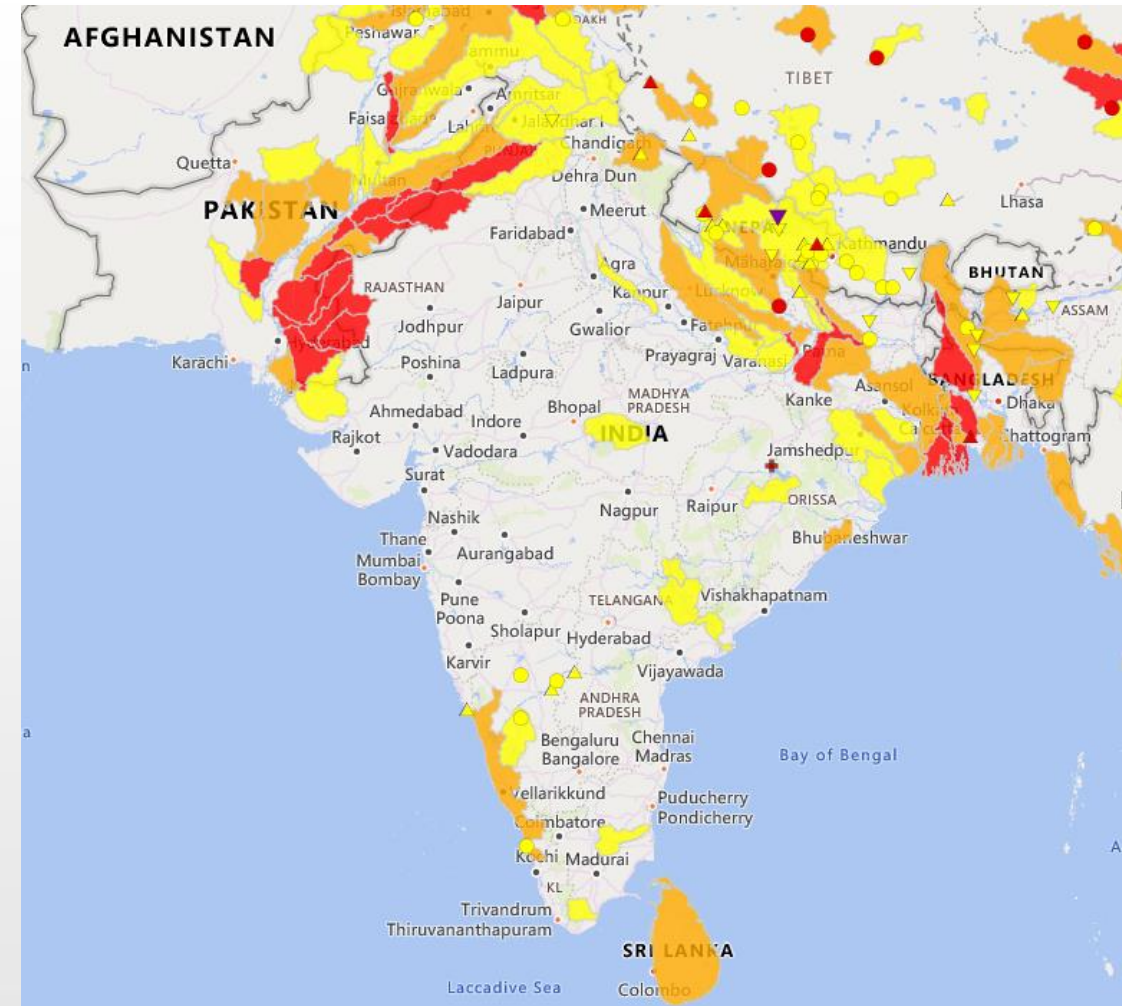
- Flood extent mapping with SAR (SAOCOM, COSMO-SkyMed, Sentinel-1)
- Joint ABI/VIIRS flood product





Under NASA Solicitation A.37 “Earth Science Applications: Disaster Risk Reduction and Response,” NASA’s Applied Sciences Disasters Program is currently funding a set of projects focused on flood forecasting, flood severity estimation, post-event, flood mapping, flood depth estimation and resulting flood severity, using remote sensing-based flood information derived from SAR and optical imagery.

- The purpose of this initiative is to disseminate the flood products from different sensors to global stakeholders - via the Pacific Disaster Center’s DisasterAWARE®, the NASA Disasters Mapping Portal and potentially other mechanisms
- The initiative will also generate integrated products similar to the Model of Models (MoM) approach (that provides flood severity globally on a daily basis at sub-watershed level) using SAR and optical imagery derived flood outputs to stakeholders globally.

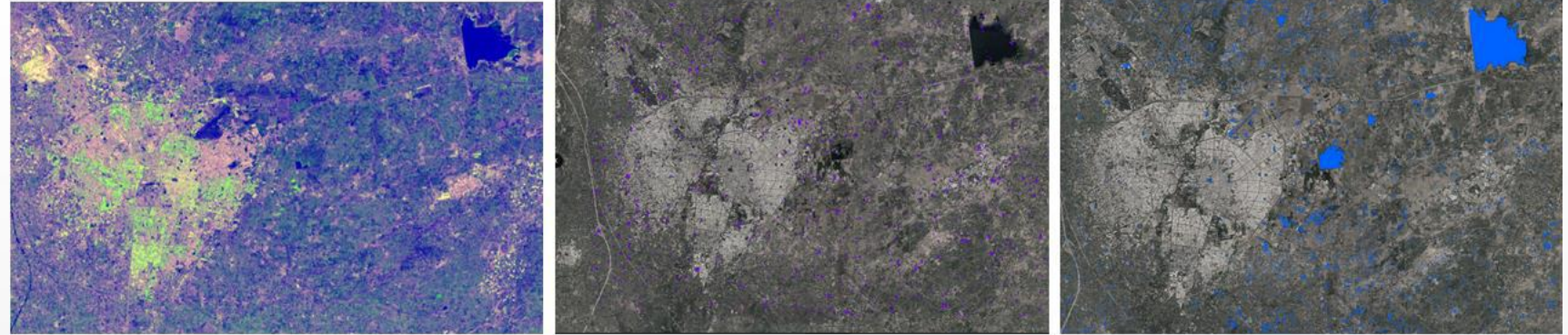


Flooding in Northern India Based on MoM Flood Severity (June 21<sup>st</sup>, 2021)





- This initiative focuses on improving response capacity and use of application outcomes by a broader community.
- The main objective is *Dissemination of Global Flood Products Derived from SAR and Optical Imagery.*



[Left:] Flood water pixels (dark blue) identified using unsupervised classification of combined VV and VH polarizations, Sentinel-1A/B GRD images, June 8, 2020, Vadodara, India. [Center:] Flood water pixels (purple), identified from coherence differences using Sentinel-1A/B SLC images, July 26, 2020, Vadodara, India. [Right:] Flood water pixels (light blue) identified from the specular bounce of the radar off the water surface, Sentinel-1A/B GRD images, August 13, 2020, Vadodara, India. All images processed at a pixel spacing of 10 m.

- We will leverage collaborations with PDC and NASA funded Disasters projects to devise a global flood prediction, detection, and monitoring capability.
- The result is a new global flood capacity to showcase the analytical products derived from Disasters projects and make these products available for decision-making by stakeholders around the world.
- The main flood products to be disseminated are those derived from SAR and optical imagery (from MODIS – DFO and VIIRS), and integrated Model of Models flood severity outputs.

- Address outstanding licensed data sharing opportunities with CSA & CONAE.
- Continue collaboration with CEOS WGISS & SEO to add data/algorithms to EAIL
- Planning underway to hold hands on technical EAIL training session with Flood Pilot and COAST teams
- Engage CNES staff interested in joining Flood Pilot and request new EAIL accounts.
- Fold in new NASA Global Flood Initiative Project
- Continue close collaboration with CEOS COAST Ad Hoc Team.
  - Specifically their 'Sea to Land' Subgroup focused on coastal inundation.
- Documentation of methodologies, successes, challenges to inform Pilot Deliverables to include GEO/LEO/SAR data fusion towards improved flood mapping.