2022-10-27 | Session 8-7 | Pecora 2022

Application of Earth observation data for improved environmental and disaster monitoring in Central America

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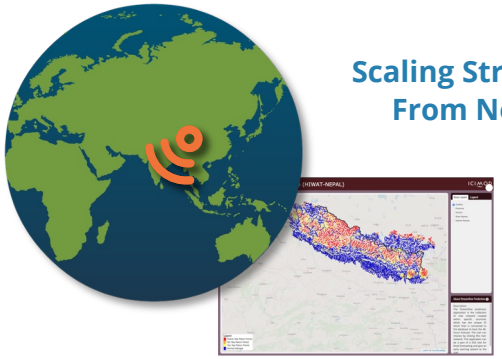
slides modified from Kel Markert

SERVIR's global network

SERVIR's Global Network Enables Scaling, Sharing & Replicating



Scaling Streamflow Prediction From Nepal to the Globe

The Streamflow Prediction Tool supports official flood bulletins in Nepal, and has been adapted for other parts of the world through GEOGLOWS

Sharing Land Cover Mapping Methods from the Mekong to the Himalayas

The Regional Land Cover Monitoring System (RLCMS) supports forest & agricultural mapping at the country-level while also scaling to entire regions

Teaming Up to Detect Cross-Atlantic Illegal Gold Mining from West Africa to Amazonia

Originally developed for Ghana's forest zones, a similar radar-based tracking system has been adapted for use in the Peruvian Amazon

Replicating Flood Maps Across Southeast Asia

HYDRAFloods has been replicated from Myanmar to Cambodia to prioritize food assistance in the face of floods via the World Food Programme (WFP)

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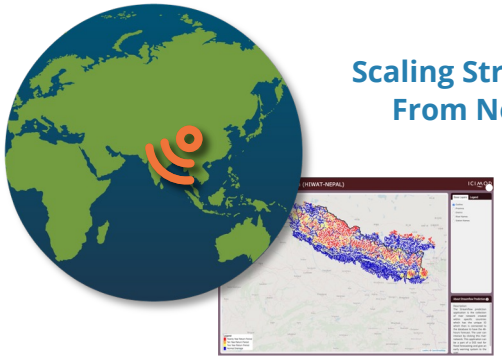

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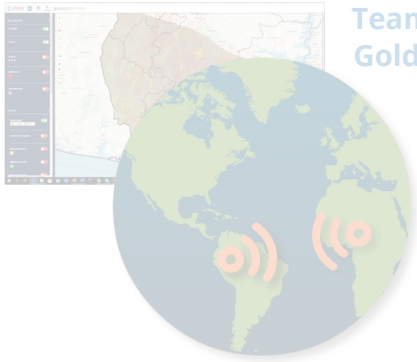

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Planning the SERVIR Hub in Central America

NASA / SICA joint statement (2019)

- Support Earth observation research and applications
- Priorities span Group on Earth Observations, Applied Sciences Program, Research & Analysis
- Explore concrete joint activities

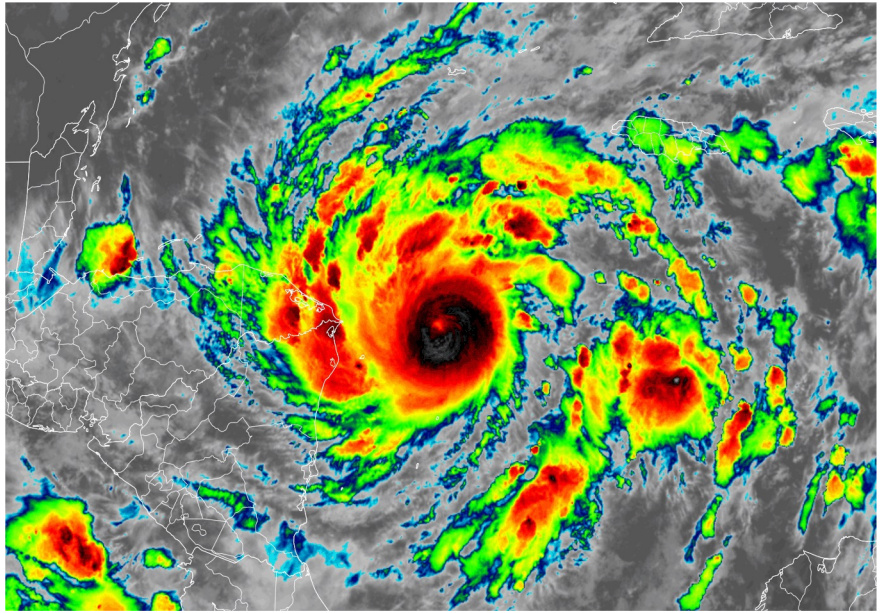
SICA / World Bank agreement (2020)

- Provide additional support to the NASA-SICA joint statement

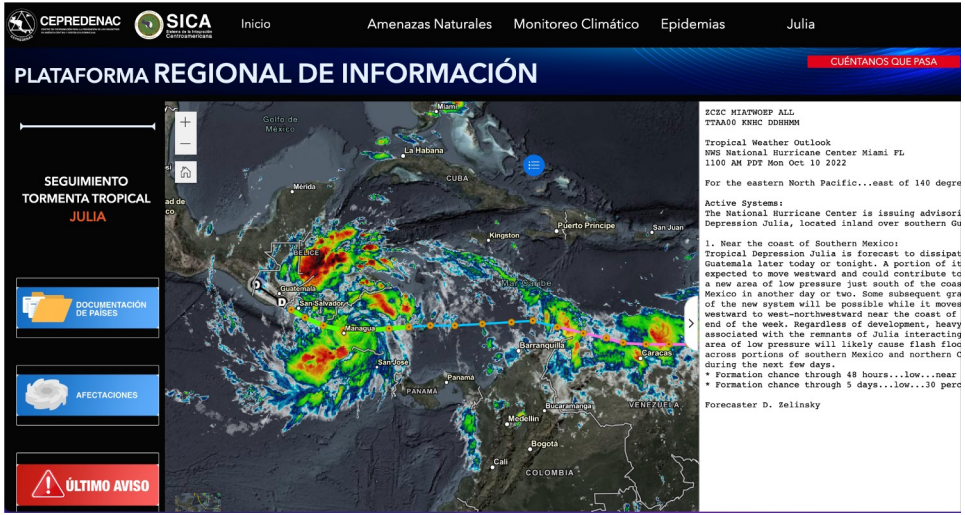
Action Towards a SERVIR Central America Hub (2021-2022)

- USAID-funded geospatial assessment
- NASA and USAID joint planning and co-design
- Supports Administration climate adaptation and resilience priorities for the region

Hurricanes Eta & Iota 2020 / Hurricane Julia 2022



Hurricane Eta about to make landfall | credit: NOAA NESDIS



Tropical Storm Julia from CEPREDENAC platform | credit: CEPREDENAC

Stakeholders

CEPREDENAC - Coordination Center for the Prevention of Disasters in Central America and the Dominican Republic

Provides and coordinates international cooperation and knowledge exchange, expertise, and scientific & technical advising on prevention, mitigation, response, and recovery from disasters.

CRRH - Regional Water Resource Committee

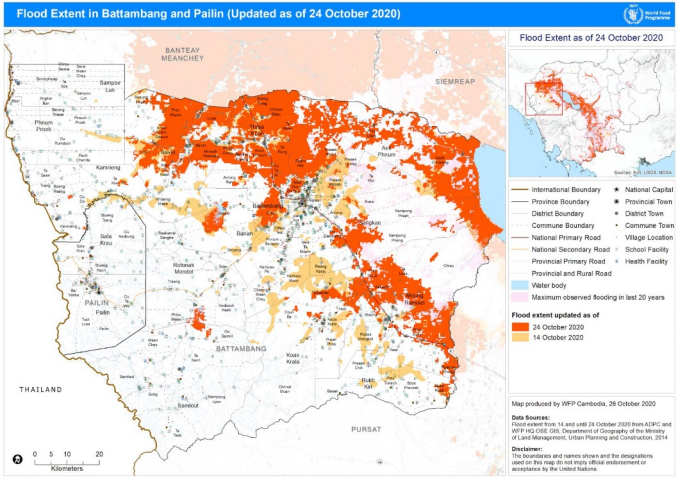
Coordinates and facilitates projects relating to water resources issues, including institutional strengthening and transboundary resources management. Strengthens ties with global programs for meteorological surveillance, hydrological cycle, and climate change adaptation and mitigation.

Both operate through the **Central American Integration System (SICA)**

Existing Services

HYDRAFloods

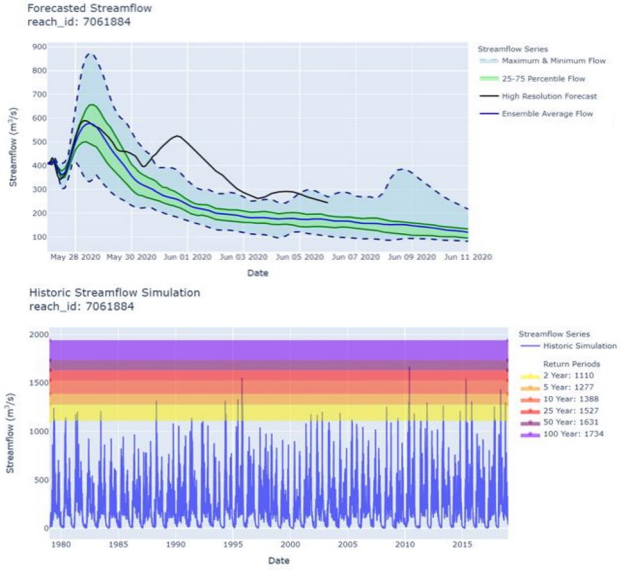
- Multisensor framework for producing surface water/flood information
- Used by WFP during Oct 2020 flooding event in Cambodia to inform emergency assistance and long-term recovery plans



Flood map from Situation Report for Cambodia Oct 2020 event | Credit: Humanitarian Response Forum

GEOGloWS Streamflow

- Global streamflow information with 40-year historical reanalysis and 15-day ensemble forecasts

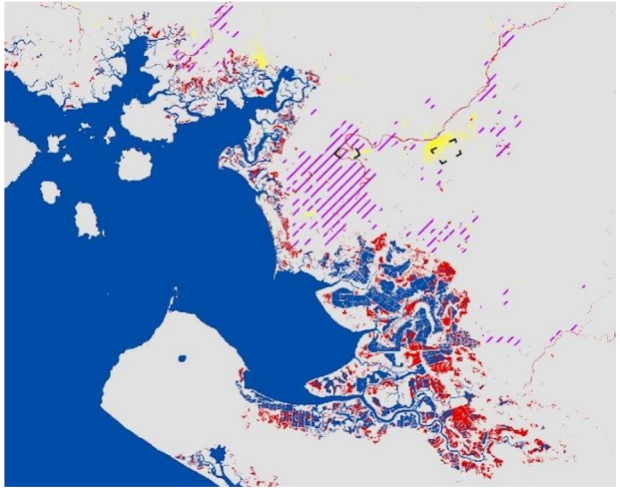


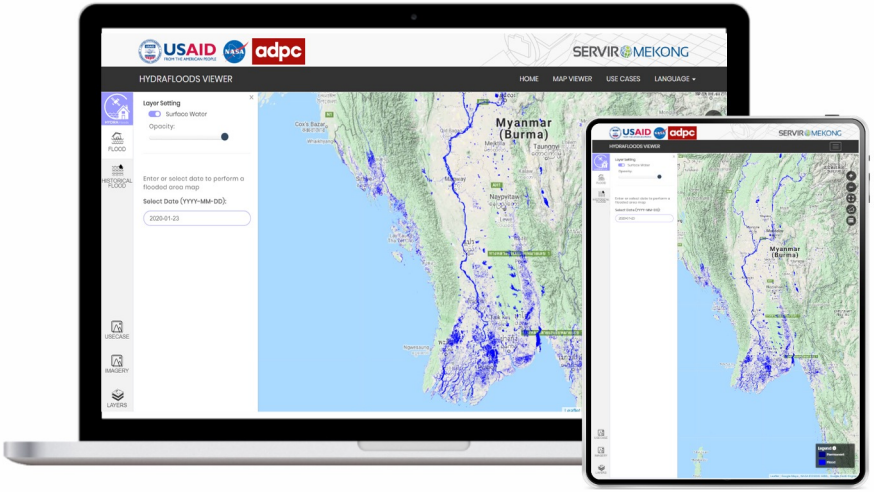
Example 15-day ensemble forecast and historical streamflow | Credit: ECMWF/GEOGloWS

HYDRAFloods

HYDrologic **R**emote sensing **A**nalysis for **Floods** https://servir-mekong.github.io/hydra-floods/

- Open source - anyone can use/modify for free
- Documented to increase transparency
- Cloud-based - overcome big data challenges
- End-to-End processing - users have all the tools needed to create their own high quality surface water/flood maps





Flood mapping

SERVIR

Automated SAR derived flood maps during events

My Drive > etaiota_water_maps > 20201103

Name

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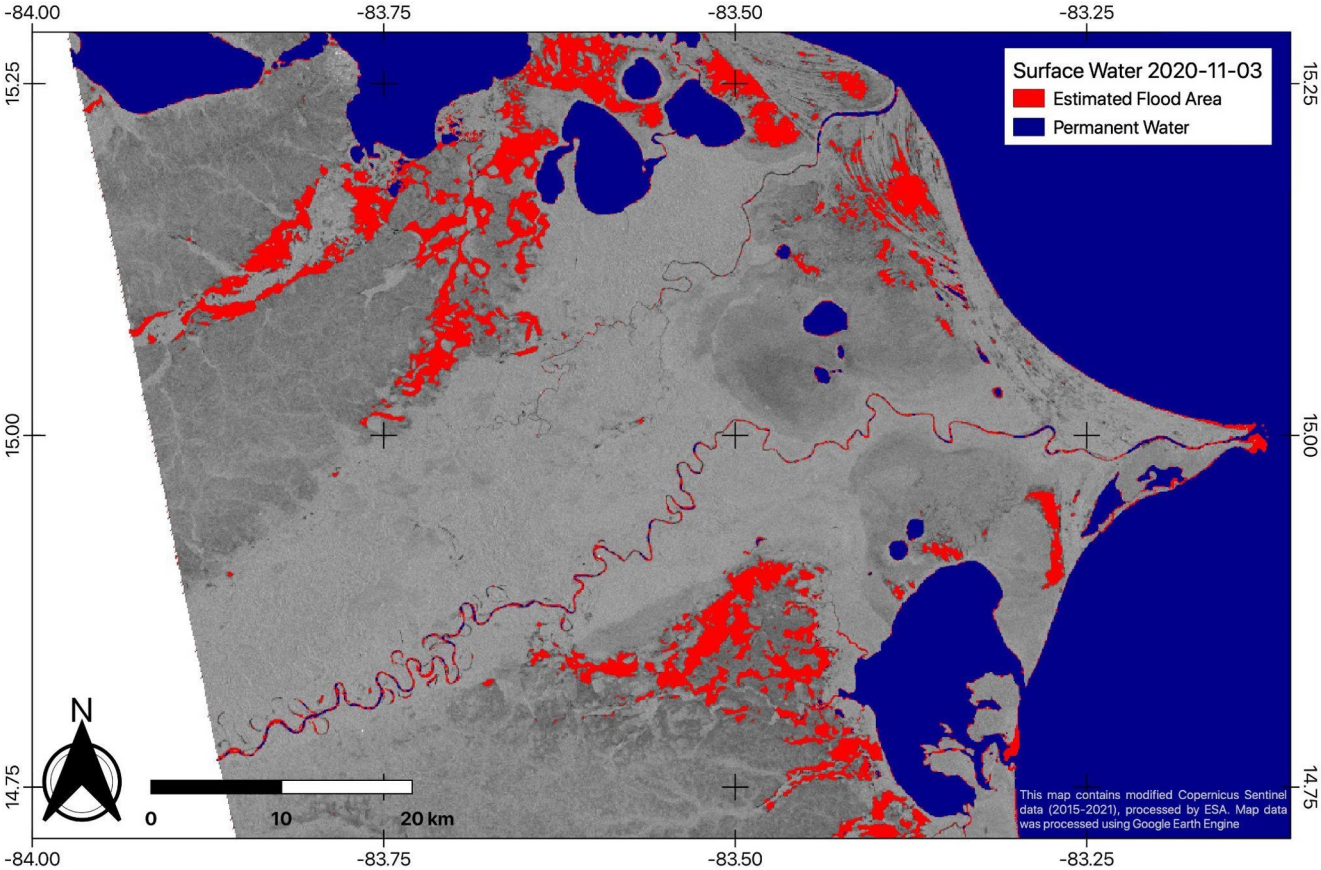
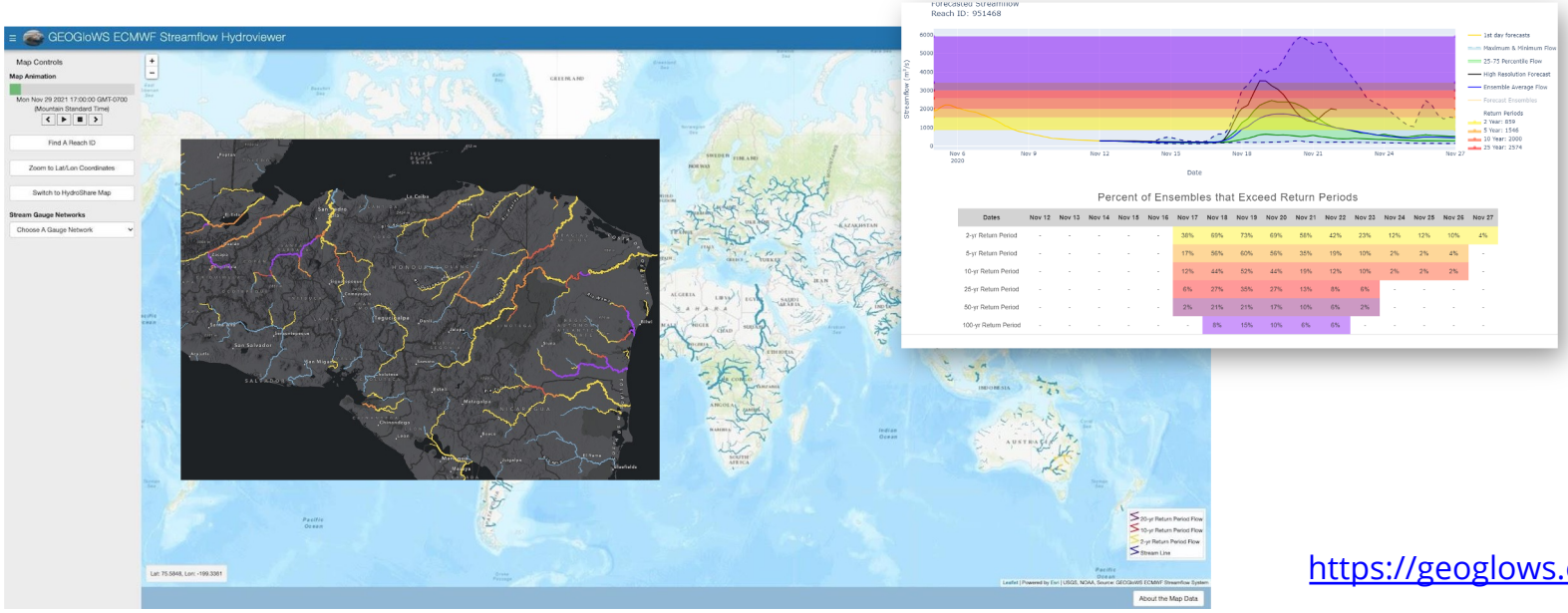


GEOGloWS / HydroViewer

Operational global streamflow service

Runoff predictions from the European Centre for Medium Range Weather Forecasts (ECMWF) routed through the Routing Application for Parallel Computation of Discharge (RAPID) model.



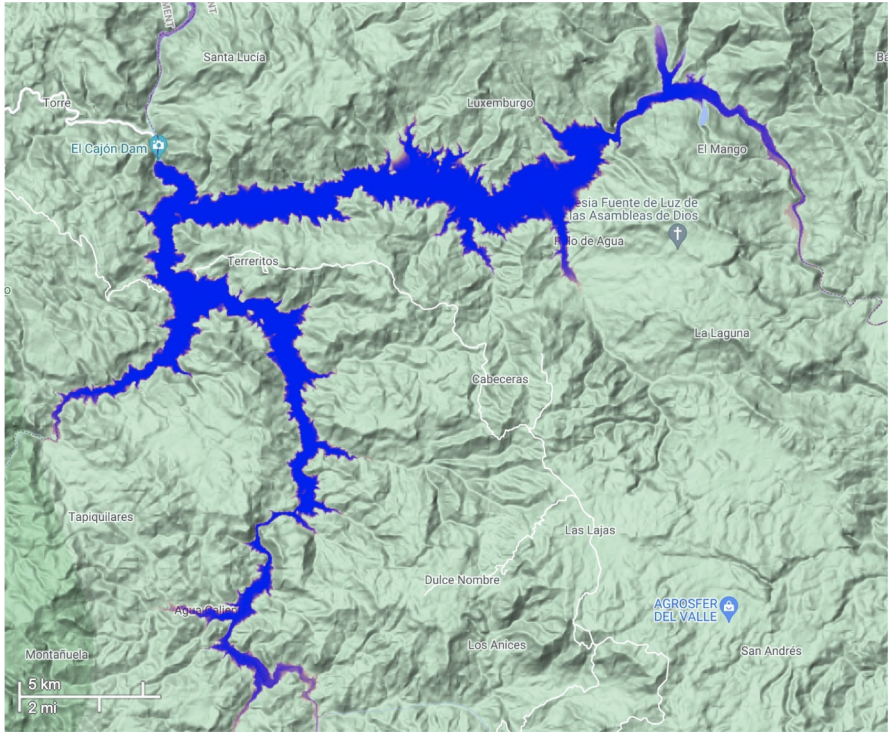
https://geoglows.ecmwf.int/

Informing Reservoir Operations

Central Hidroelectrica Francisco Morazán - “El Cajón”

With Eta's arrival, the water elevation increased, surpassing the 285 m maximum level of the reservoir.

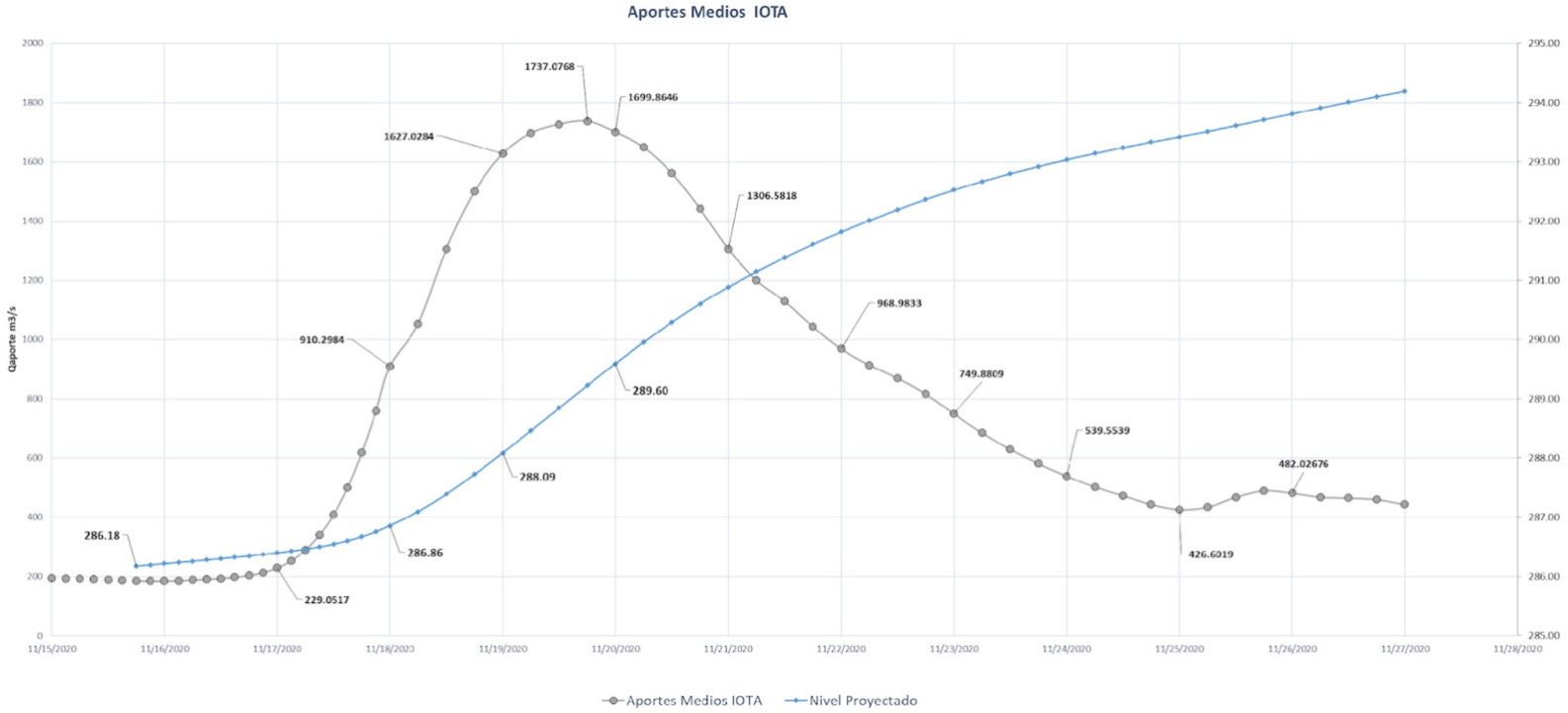
Image of El Cajón dam structure | Credit:Wikimedia Commons



Map of reservoir extent created by El Cajón dam | Data Credit:Google / EC JRC

Informing Reservoir Operations

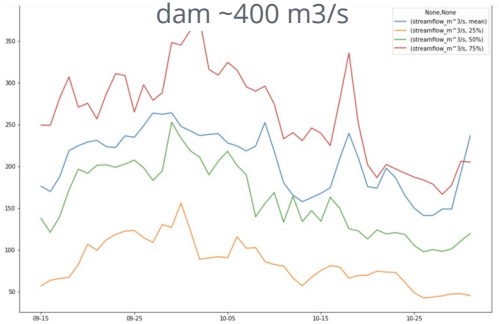
Nov. 12, 2020 – Analysis and Projections based on GEOGloWS forecast for Hurricane Iota indicated that reservoir capacity insufficient.



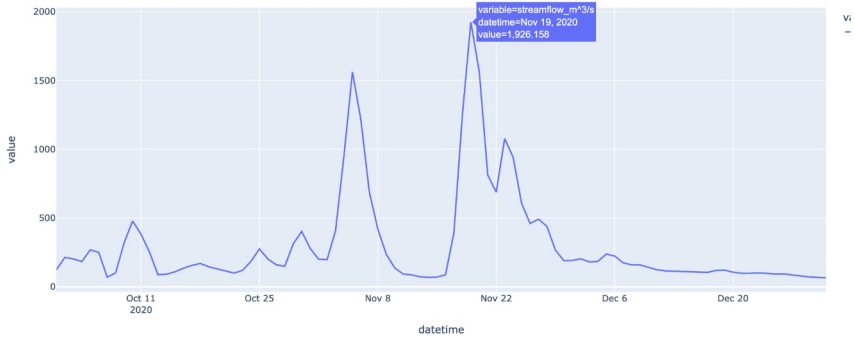
Informing Reservoir Operations

October 2022 – Analysis and projections based on the GEOGloWS forecasts for Hurricane Julia indicated that the water levels of the El Cajon hydroelectric dam in Honduras could reach similar levels to those reached during Hurricane Iota, two years prior.

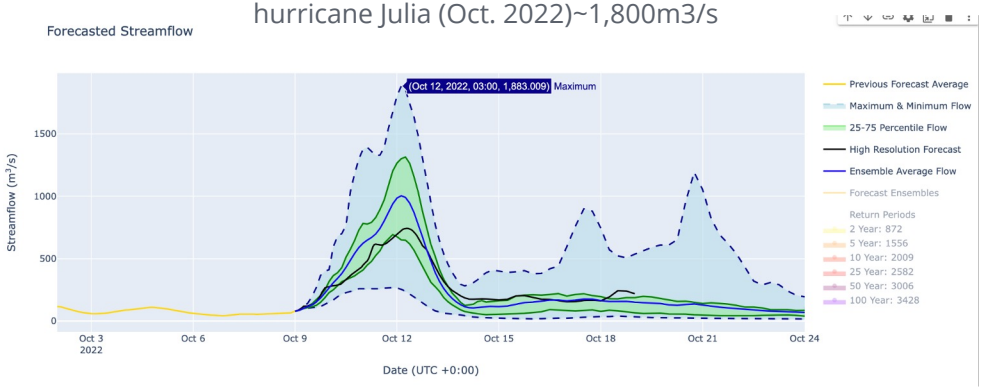
Maximum pick of the flow of the section of the dam ~400 m3/s



Maximum pick of the flow during the hurricane Eta and Iota (Nov. 2020) 1,926 m3/s

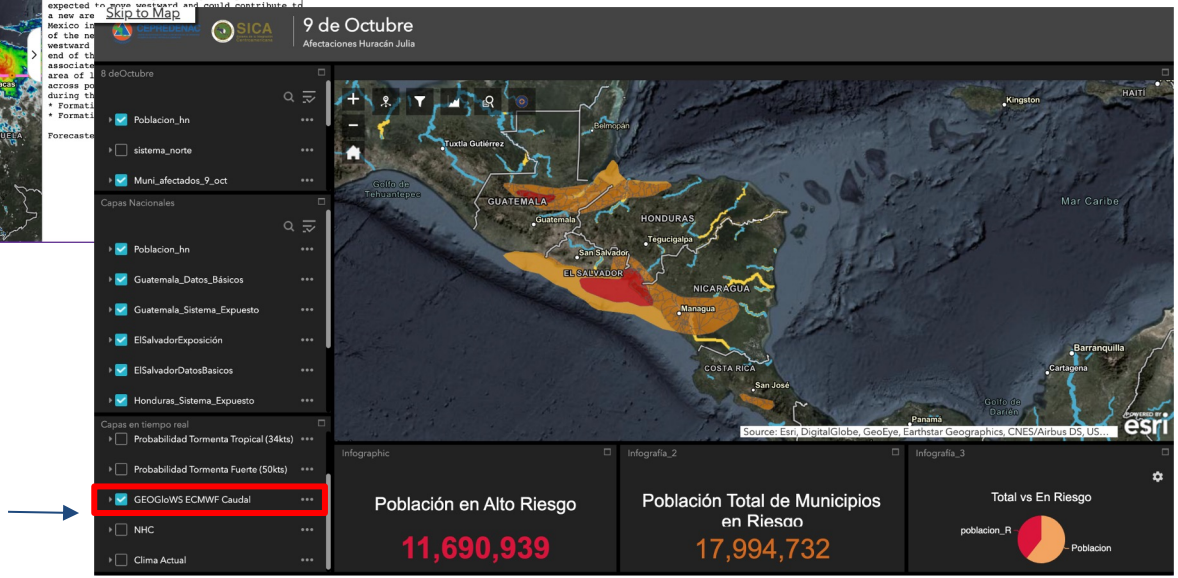


Maximum pick of the flow forecasted during the hurricane Julia (Oct. 2022)~1,800m3/s



GEOGloWS HydroViewer supports decision-making

Tropical Storm Julia from CEPREDENAC platform | credit: [CEPREDENAC]



Tropical Storm Julia from CEPREDENAC platform | credit: [CEPREDENAC]

Testimonials

"*Use of the Hydroviewer supported the region's hydrometeorological services, especially in watersheds without real-time monitoring and hydrological models, for decision-making for river early warning systems*," said **Berta Olmedo, CRRH's Executive Secretary**. She also highlighted the need for more research to improve forecast results, including tapping the expertise of the region's hydrologists.

"*The [El Cajon] dam situation was complex, and information was needed for quickly making decisions. Had the dam burst, literally hundreds of thousands of people would have been affected. The information provided by NASA, from GEOGloWS, from HYDRAFloods, and from the other systems was essential to the timely decision-making which likely saved lives*," said **Claudia Herrera, CEPREDENAC's Executive Secretary**

https://www.climatelinks.org/blog/connecting-space-village-reduce-flood-impacts

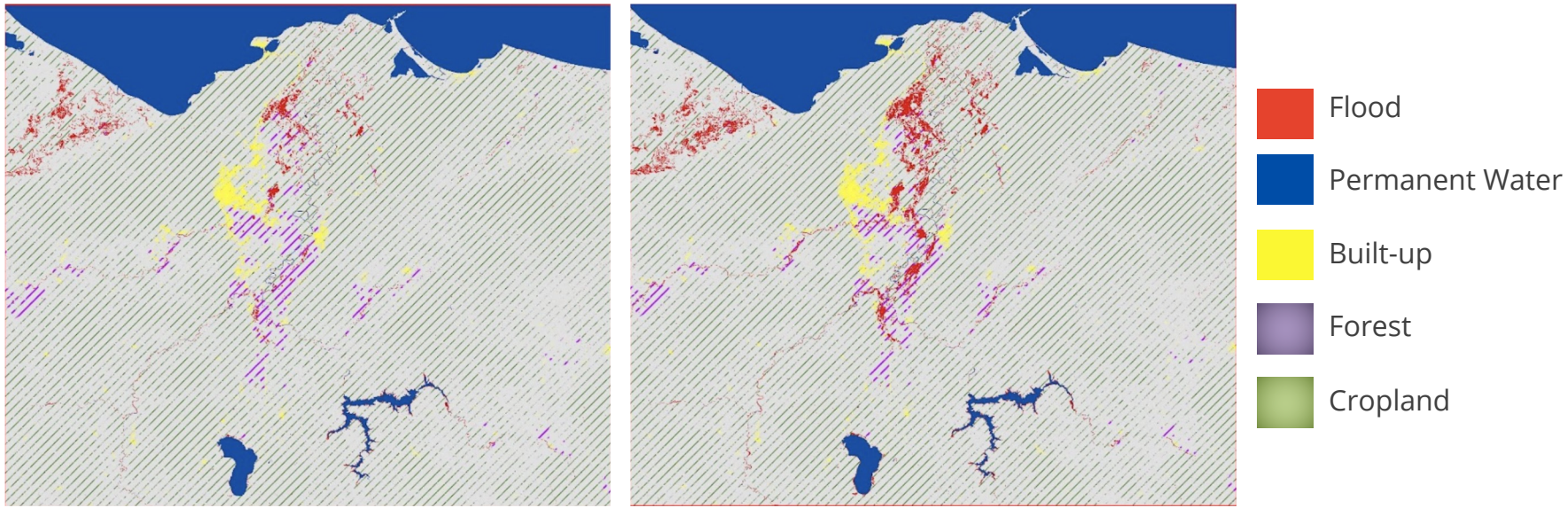
Related efforts

NASA DEVELOP project (Fall 2021)

- Analyzed historical surface water extents in Central America
- Case study analysis for Hurricanes Eta and Iota
- Developed a code tutorial for stakeholders to replicate

During Eta/Iota: Oct. 31 - Nov. 18, 2020

After Eta/Iota: Nov. 18 - Dec. 2, 2020



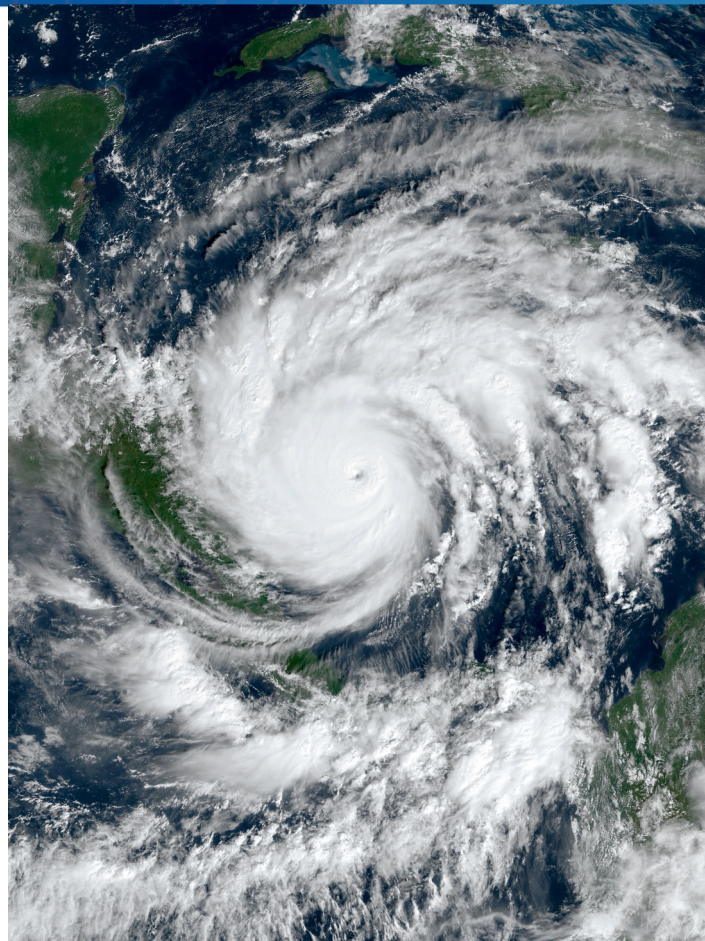
Lessons learned

- HYDRAFloods was replicated to Central America, with caveats:
  - High cloud cover brought on by Hurricanes Eta and Iota occluded optical data, leading to need to use SAR data
  - Sentinel-1 SAR overpasses during Eta and Iota did not coincide with peak flooding (independent of HYDRAFloods) → affected estimates of affected areas
- Interest by national and regional disaster management agencies in integrating HYDRAFloods into their workflows
- Focus in Central America was largely on evaluating agricultural impacts of flooding
- GEOGloWS streamflow forecasts provided reliable information and supported avoiding severe socio-economic losses and damages in the Sula Valley, Honduras.

Next Steps

Continued engagement with stakeholders (e.g., CEPREDENAC, CRRH, SICA General Secretariat) to better prepare for future hurricanes

- Adjustment of outputs (bias correction)
- Understand specific actions and decisions in flood risk reduction to production and flows of information
- Build capacity and enable stakeholders to take action during events



GOES-16 imagery of Hurricane Iota | Credit: NOAA

Thank you for your attention!

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