Evaluating near-real time satellite flood mapping for humanitarian early action: a case study on the 2020 Cambodia floods

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1. Introduction

The **Hydrological Remote Sensing of Floods (HYDRAFloods) tool** is a web service that processes satellite imagery to generate flood extent maps in near-real time (NRT). Unlike previous remote sensing-based services for flood management, HYDRAFloods processes imagery from multiple active- and passive-sensor satellites to update flood extent maps more frequently. During widespread flooding in Cambodia in 2020, HYDRAFloods provided NRT flood extent maps to local agencies and the humanitarian response community. The goal of the tool's implementation was to increase the speed at which initial estimates of flood exposure can be produced to support more rapid and efficient interventions

PROBLEM STATEMENT: This research evaluates whether disaster managers involved in the 2020 Cambodian floods appreciably benefitted from HYDRAFloods' novel components, namely

- Capacity for **NRT updates**
- **Automatic integration into decision support** tools like PRISM

The ultimate goal of this evaluation is to provide takeaways that will help the Earth observation (EO) communities more effectively inform flood mitigation and preparedness activities, while also strengthening the technical capacity of agencies mandated with response

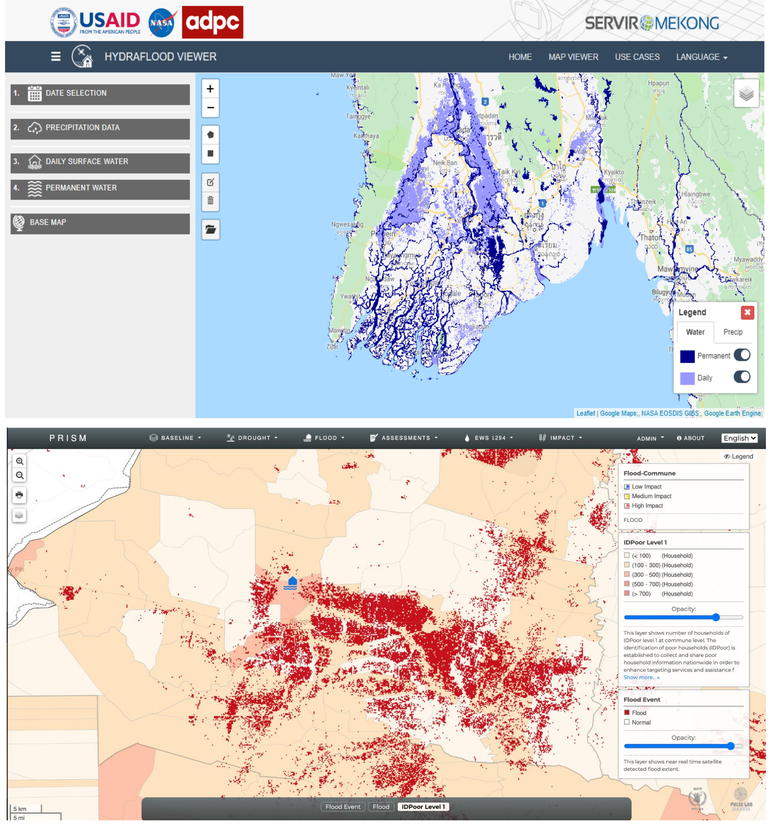

Fig 1. *Examples of the user interfaces for HYDRAFloods (top) and World Food Programme's PRISM (bottom). Flood extent pixels from HYDRAFloods are automatically fetched by PRISM and displayed against population and socioeconomic vulnerability data to generate information that is as up-to-date as possible and actionable to disaster managers.*

2. Inputs & Methods

SERVIR, a joint NASA/USAID program, helps decision-makers use EO to adapt to climate change and foster disaster-resilient communities through 'hubs' in Asia, Africa, and the Americas. SERVIR hubs regularly engage co-developers and users in national governments, NGOs, etc., to strengthen national & regional institutions, inform early actions, and reduce losses from disasters. HYDRAFloods was co-developed by SERVIR-Mekong and the SERVIR Science Coordination Office to process satellite imagery of floods and automatically transmit information to local responders and authorities. Similar services have relied on individual satellites, whose return intervals limit the frequency of reporting. HYDRAFloods merges data from multiple satellites, including active-sensor satellites that can image during clouded or night-time conditions, to improve this frequency.

HYDRAFloods works by increasing the speed and efficiency of the information chain between satellites to geoscientists to authorities. During the 2020 floods, the tool fed NRT flood inundation data into the Platform for Real-time Impact and Situation Monitoring (PRISM), a disaster decision support tool used by the World Food Programme (WFP). PRISM aggregates geophysical data on hazards and socioeconomic data into a central source to provide actionable reports to local responders. These reports can help authorities estimate the number of people affected and target mitigation and aid efforts.

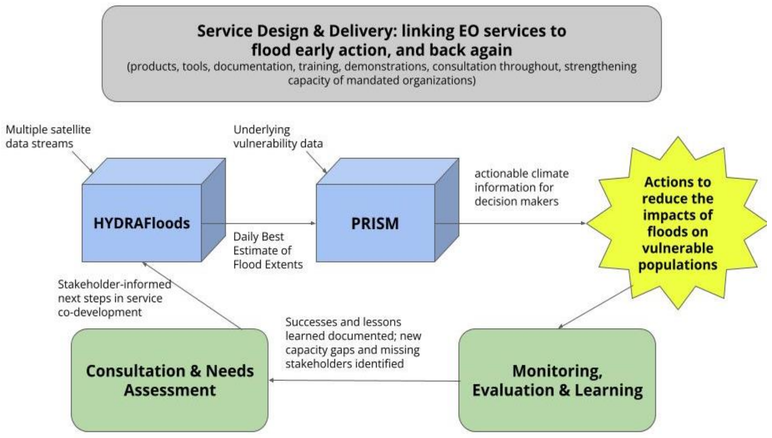

Fig 2. *Workflow diagram of SERVIR/WFP collaboration on the design, delivery, and evaluation behind HYDRAFloods.*

3. Initial Evaluation

During the 2020 floods, inundation maps produced via HYDRAFloods and PRISM were disseminated to the Humanitarian Response Forum (HRF) in Cambodia with regular updates. This information was used by HRF members to plan the roll-out of multi-sector mitigation and relief efforts, including food and cash aid that reached 200,000+ affected people.

SERVIR-Mekong and the WFP's joint efforts generated data that was instrumental in identifying locations and people affected by floods for initial impact assessments by HRF members and partners. The findings from these assessments supported the development of a coordinated flood response plan which complemented the national response from the Government of Cambodia and Cambodian Red Cross. This plan guided distribution of $2.2+ million worth of food aid, sanitation measures, medicine, and shelter for displaced persons, and an additional $7.2 million was requested.

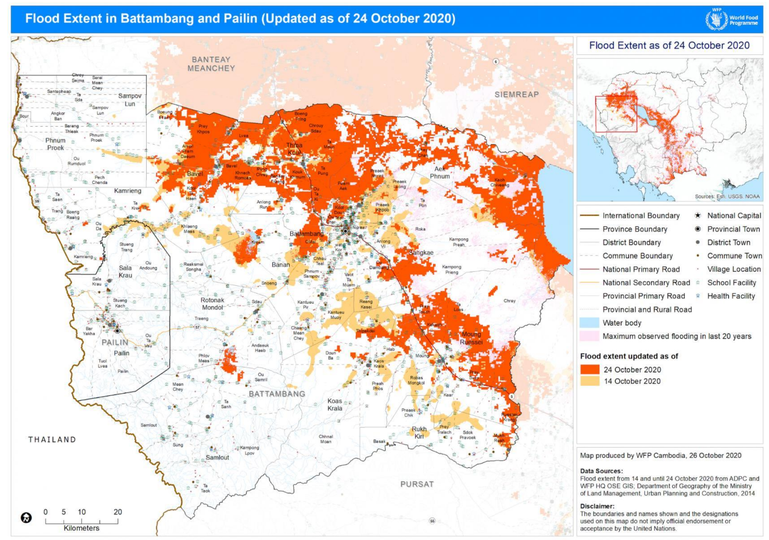

Fig 3. *An example of the flood situation reports released by the Humanitarian Response Forum during the October 2020 Cambodia Floods. (Image: World Food Programme, via Humanitarian Response Forum)*

4. Challenges, Lessons, & Next Steps

Notable methodological challenges for the further development HYDRAFloods include:

- precision/recall of flood detection with dense forest and urban development
- insufficient data on existing surface water
- lacking data on critical infrastructure
- balancing consistency-of-information demanded by operational systems with cutting-edge science applications

Increasing ground validation and the pursuit of additional data providers are helping to address these issues. The team has a further commitment to deeper monitoring, evaluation & learning for improvements along the entire service life cycle. Despite these limitations, HYDRAFloods was also applied during Hurricanes Eta/Iota in Central America in November 2020.

As the humanitarian sector is shifting increasingly towards early and anticipatory actions, the WFP and SERVIR-Mekong collaboration also seeks to research and design methods which can leverage weather forecasts and near real-time tracking tools to facilitate earlier interventions. Currently, SERVIR-Mekong is evaluating new monitoring and forecasting tools for precipitation, landslides, and flooding to provide further NRT information that can inform humanitarian responses.

Improving the speed and reliability of information passed from satellite to scientist to decision-maker increases the potential for earlier, more effective disaster risk intervention

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