Experiences in applying Earth observing satellite technology in SERVIR regions with an emphasis on disasters: successes, lessons and paths forward

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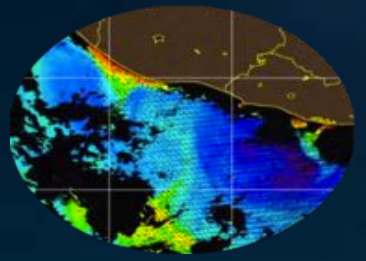
Outline

- Background on SERVIR and contributions to disaster risk reduction
- Case briefs on trainings, applied research, and disaster preparedness and response support
- Summary of lessons learned from previous efforts
- Thoughts on paths forward

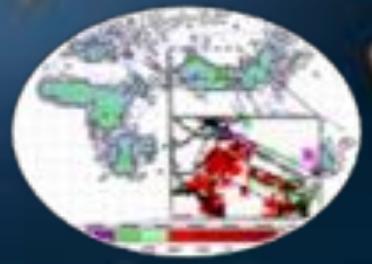
SERVIR is a joint development initiative of NASA and USAID, working in partnership with leading regional organizations around the globe, to help developing countries use information provided by Earth observing satellites and geospatial technologies to address Food Security, Water and Disasters, Weather and Climate, and Land Use/Land Cover Change.



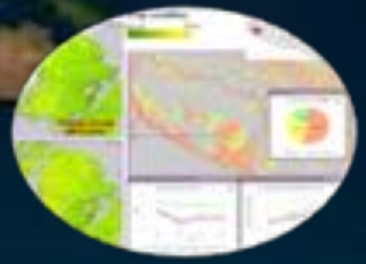
Preventing seafood-borne illnesses in Central America by mapping harmful microalgae

Helping herders and farmers in West Africa by detecting ephemeral water bodies

Conserving forests in eastern and southern Africa by mapping land cover and land use change



Protecting lives in South/Southeast Asia by monitoring and forecasting intense thunderstorms



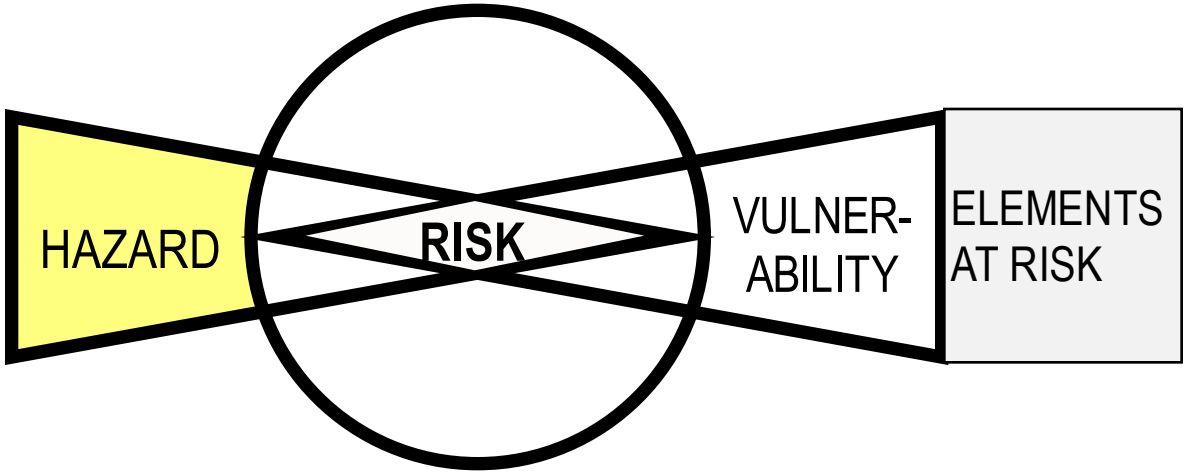
Supporting food security in Nepal by monitoring agricultural drought

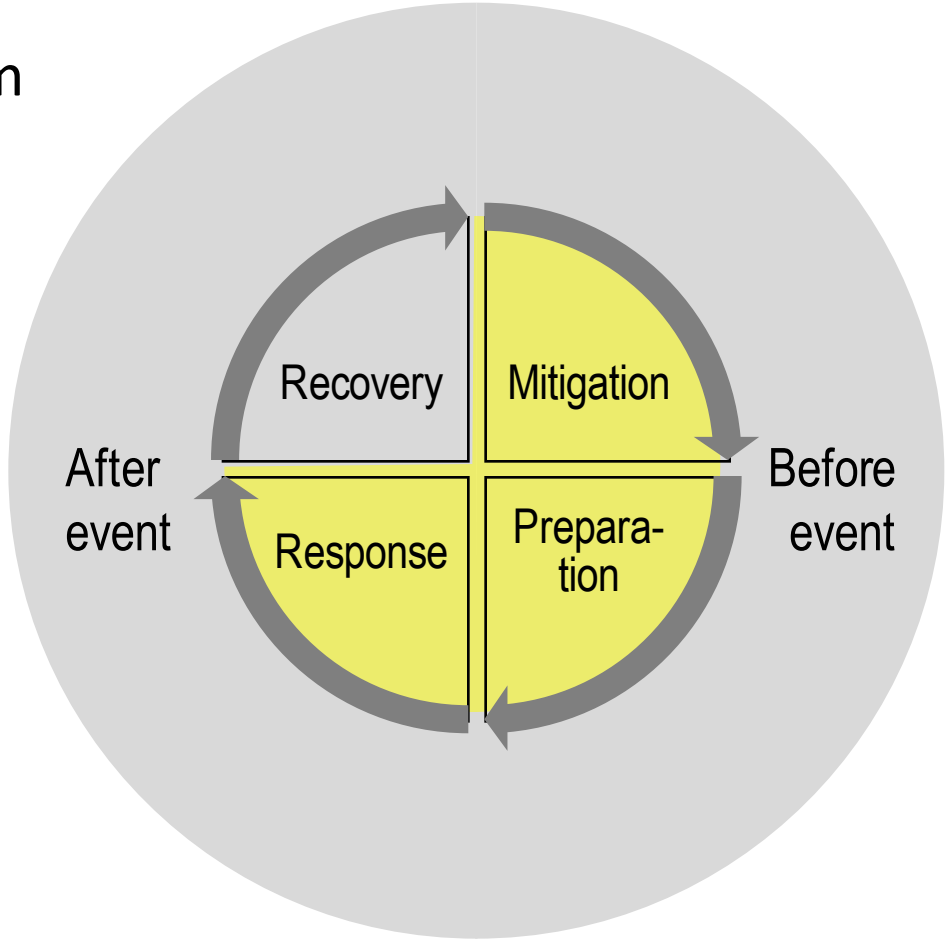
The Current SERVIR Hub Network

SERVIR's contributions to disaster risk reduction

1. Synthesis of SERVIR-Mesoamerica attention to disaster events
2. Water and Water-related Disasters Thematic Service Area of SERVIR
3. International and regional roles of SERVIR Hubs
4. SERVIR's Role in NASA Earth Science Disasters Program

SERVIR's Main focus within Risk Management and Disaster Cycle

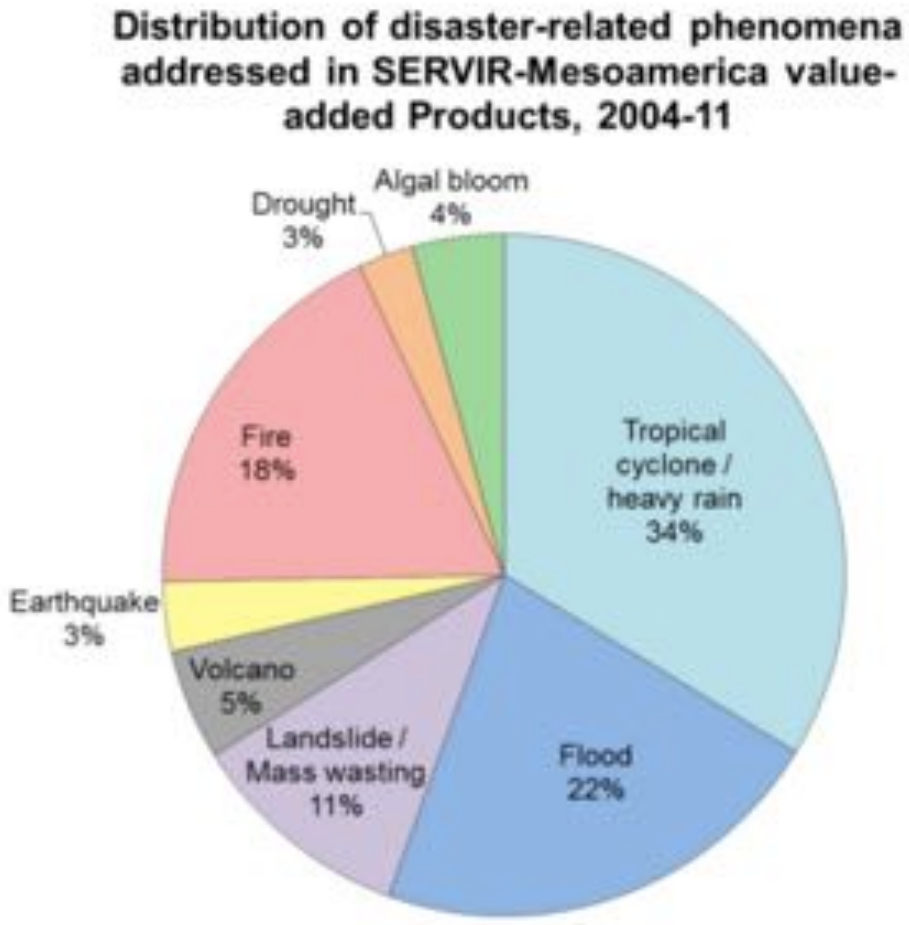




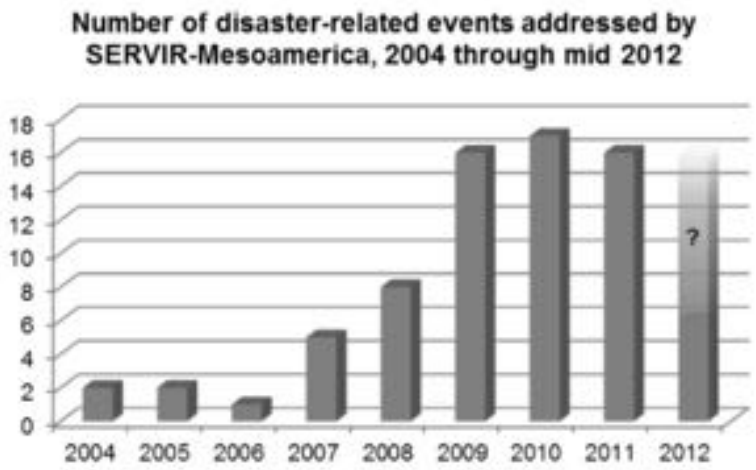
(Anderson 2013, adapted from Alexander 2002)

SERVIR's contributions to disaster risk reduction

1. Synthesis of SERVIR-Mesoamerica attention to disaster events, 2005-2011



(Flores Cordova, Anderson, et al., 2012)



Focus on technical training and creating value-added products

"Demand for space data and derived products greatly increased … once countries were exposed to more and more demonstrations of the data's utility in addressing disaster monitoring and assessment needs."

SERVIR's contributions to disaster risk reduction

2. Water and Water-related Disasters Thematic Service Area of SERVIR

- ✓ Shifting from product creation to **service design and delivery**
- ✓ Improving **scientific and technical rigor** of services through external "Technical Assessment Groups"
- ✓ Bringing **more innovative and appropriate science** from the US
  - 118 US institutions across all thematic service areas
- ✓ Enhancing **collaboration** across SERVIR hubs

SERVIR's contributions to disaster risk reduction

3. International and regional role

- We support international and regional programs and frameworks for DRR
  - Most institutions that host SERVIR hubs are
    - UN-SPIDER Regional Support Offices; support Technical Advisory Mission
    - Project Managers for the International Charter for Space and Major Disasters
    - Sentinel-Asia Data Analysis Nodes
  - UNISDR participation
  - Other focus areas such as the World Landslide Forum, Global Flood Partnership

- We link on-the-ground development and disaster risk reduction with the unique perspective from space and our Earth system models

- We inform development and infrastructure investment decisions for DRR

SERVIR's contributions to disaster risk reduction

4. Role of SERVIR in NASA Earth Science Disasters Program

- ✓ Match needs on the ground with technical response support that scientist experts in Earth observations and models can provide
- ✓ Build capacity of agencies around the world to use such information
- ✓ Provide feedback to NASA on the utility of science products for disaster management
- ✓ Provide input from the international "applications" community perspective

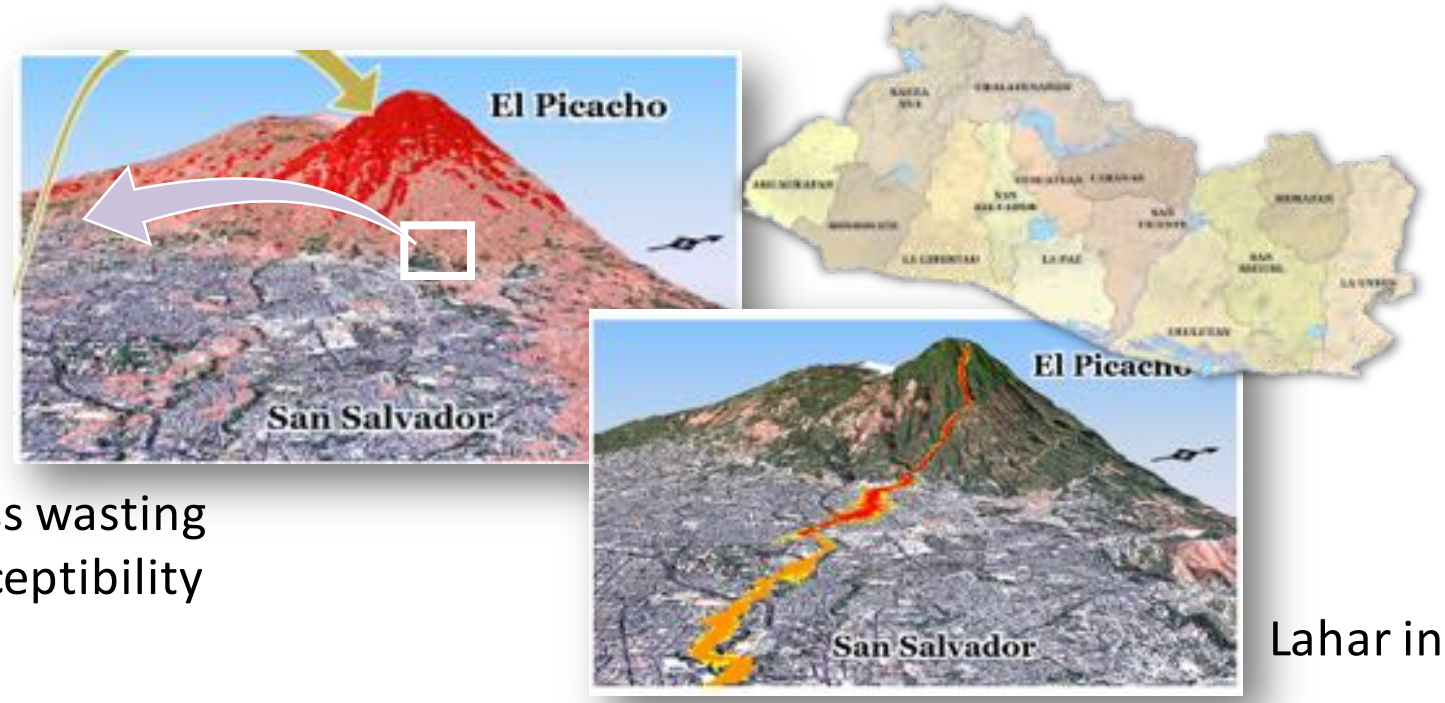
Case briefs

- 2009 Landslides in El Salvador, and follow-on hazards analysis
- 2010 Algal Bloom outbreak, and repeated events, in Guatemala
- 2010 Haiti earthquake
- 2014 Floods in Bangladesh
- 2015 Gorkha earthquake in Nepal
- 2016 Glacial lake outburst flood mitigation via lake lowering in Nepal
- 2016 Flood prevention in Kenya
- Ongoing work in the Lower Mekong to identify flooded areas and forecast floods
- Future work to support SERVIR-E&S Africa and USAID/Rwanda on landslide mitigation

Case brief: 2009 El Salvador landslides

- Convergence of a tropical storm in the Pacific and a low pressure system in the Atlantic led to extremely intense and prolonged rainfall, and resulting floods and landslides, in El Salvador in November of 2009

Data from disconnected decision support tools are difficult to assimilate and can provide conflicting information



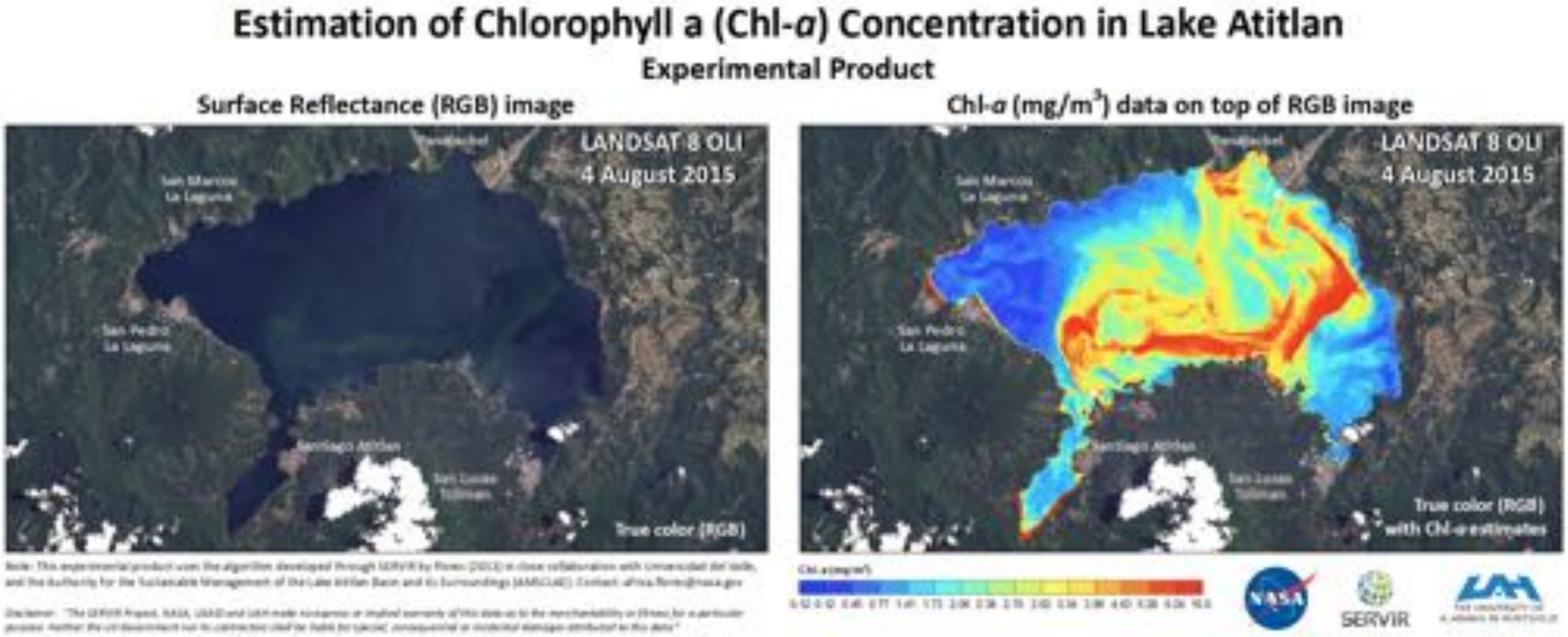
Mass wasting susceptibility

Lahar inundation zone

(Anderson, 2013)

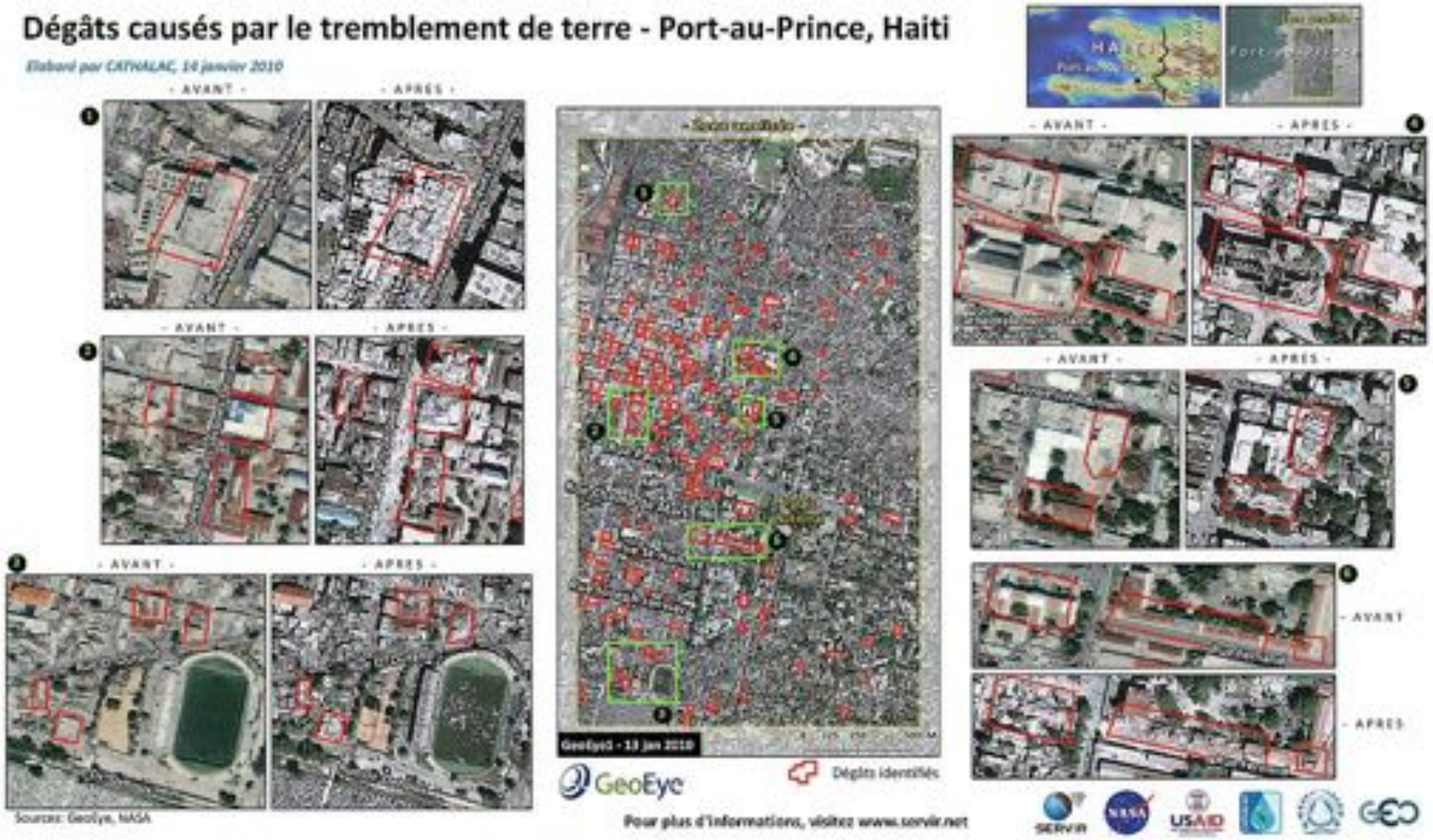
- Charter activation involving rapid response mapping
- Realized that follow-on applied research was needed

Case brief: 2010 Algal Bloom outbreak, and repeated events, in Guatemala



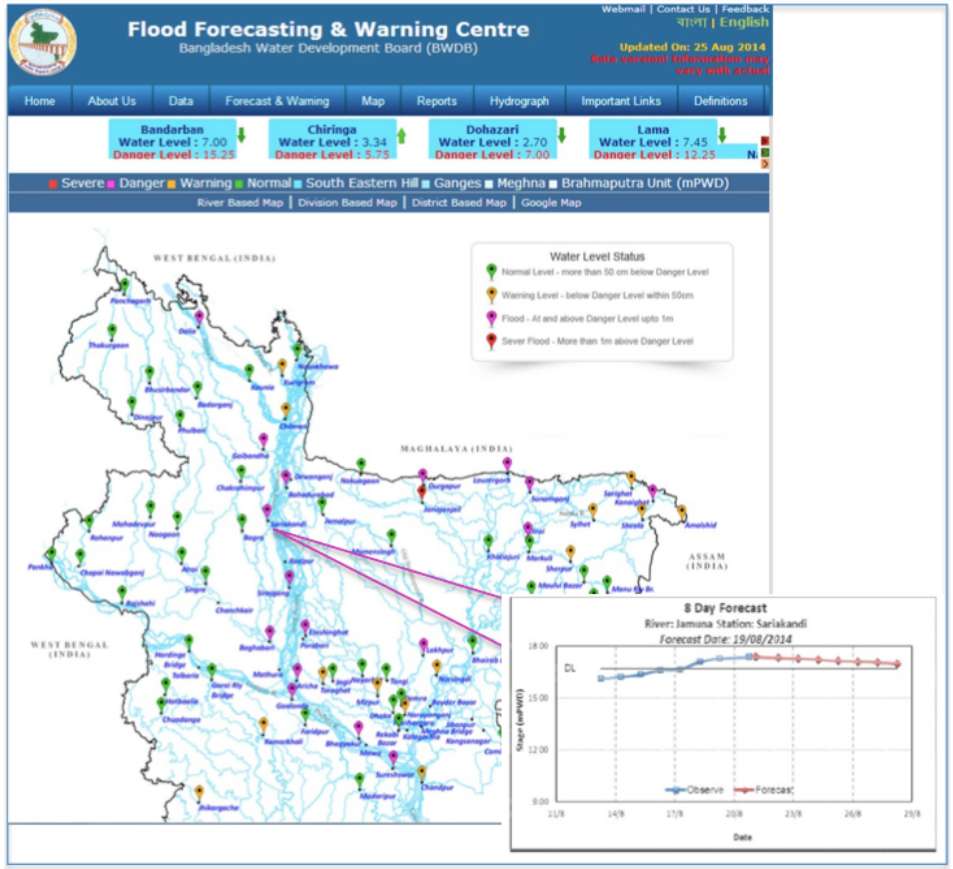
- Perspective from space drew much needed attention
- Co-development of a lake-specific chlorophyll-a algorithm; agencies can apply this whenever needed

Case brief: 2010 Haiti earthquake



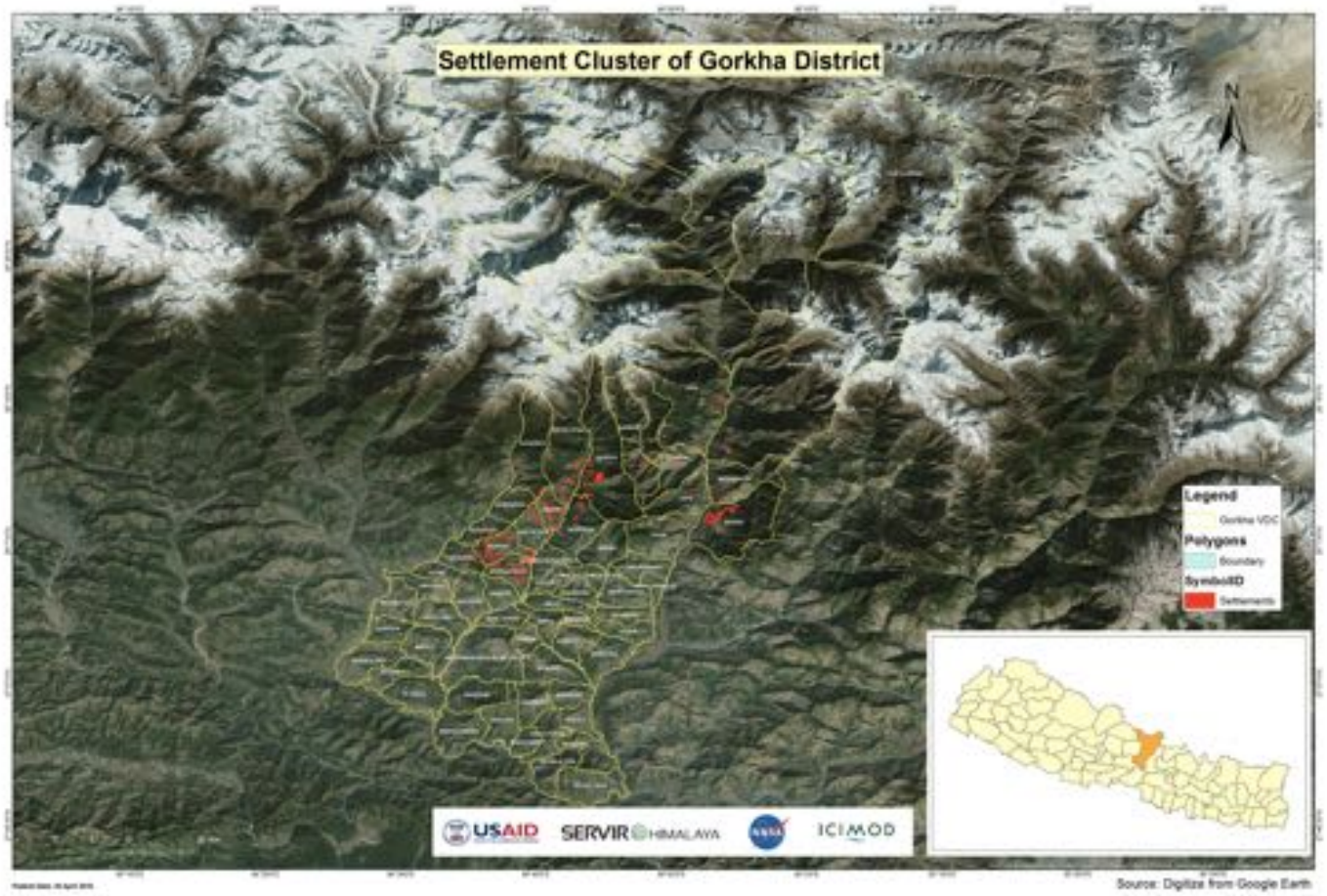
- Mapping disaster
- Backup of environmental information

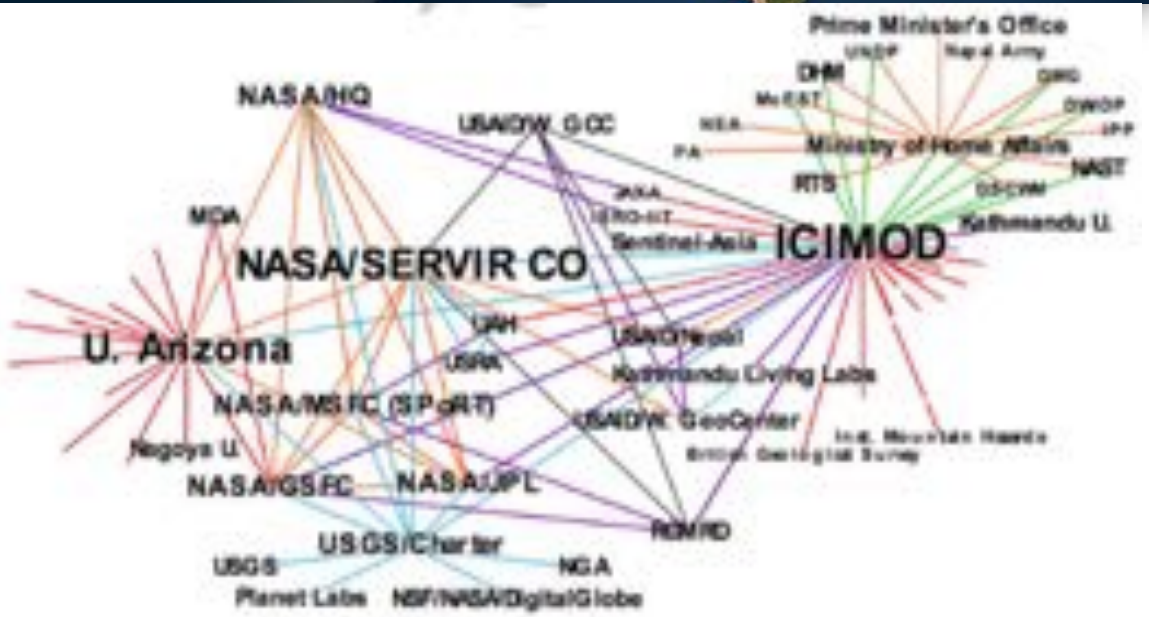
Case brief: 2014 Floods in Bangladesh

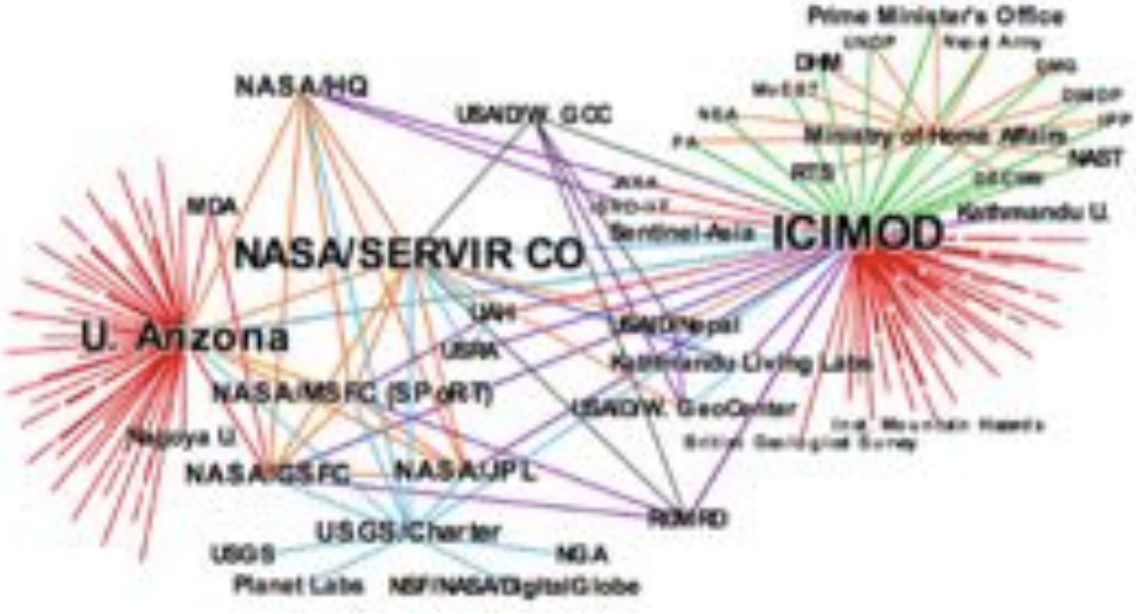


- Addresses cross-boundary data sharing
- Very engaged user agency with specific need / interest
- Replicating science & technical and capacity building approaches

Case brief: 2015 Gorkha earthquake in Nepal

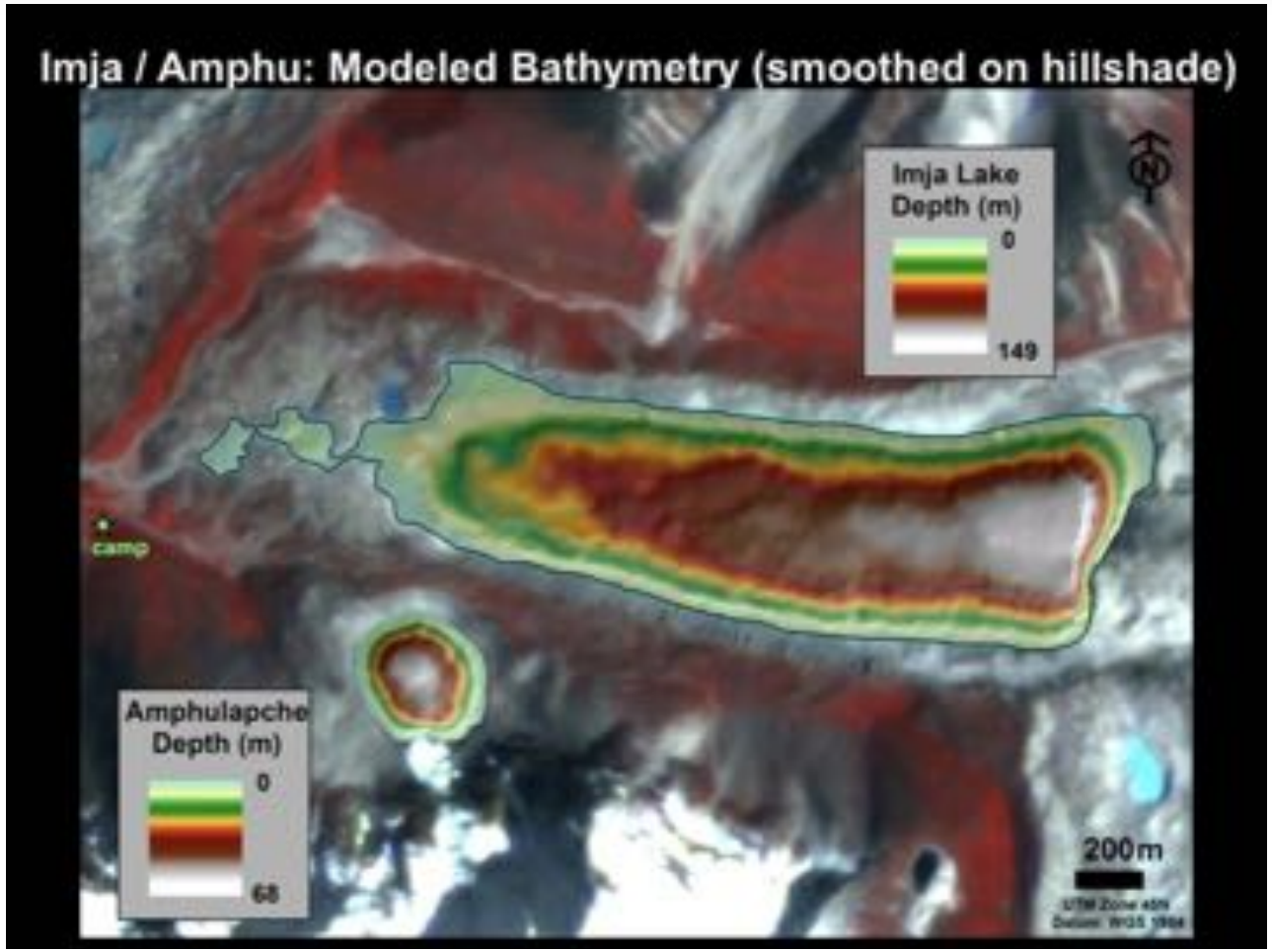






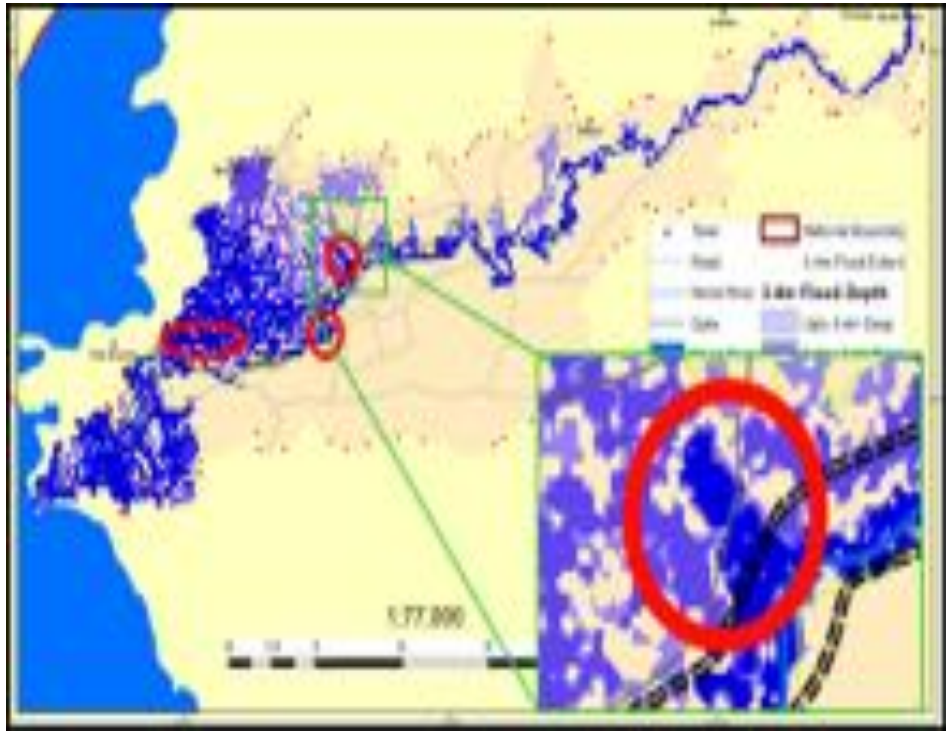
- Open Street Map and preparedness / ability to respond
- Data volume, transfer, and role of cloud
- Existing network of organizations and professionals

Case brief: Glacial lake outburst flood mitigation via lake lowering in Nepal

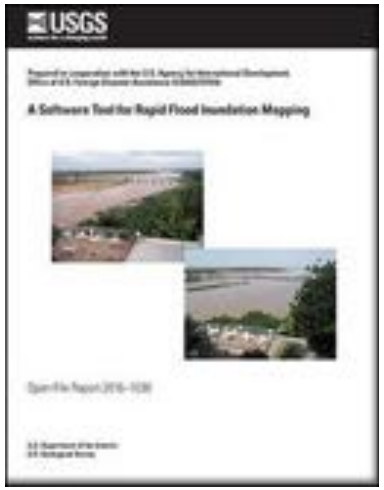


- Being ready to help answer some questions that would have direct mitigation and development implications

Case brief: Flood prevention in Kenya



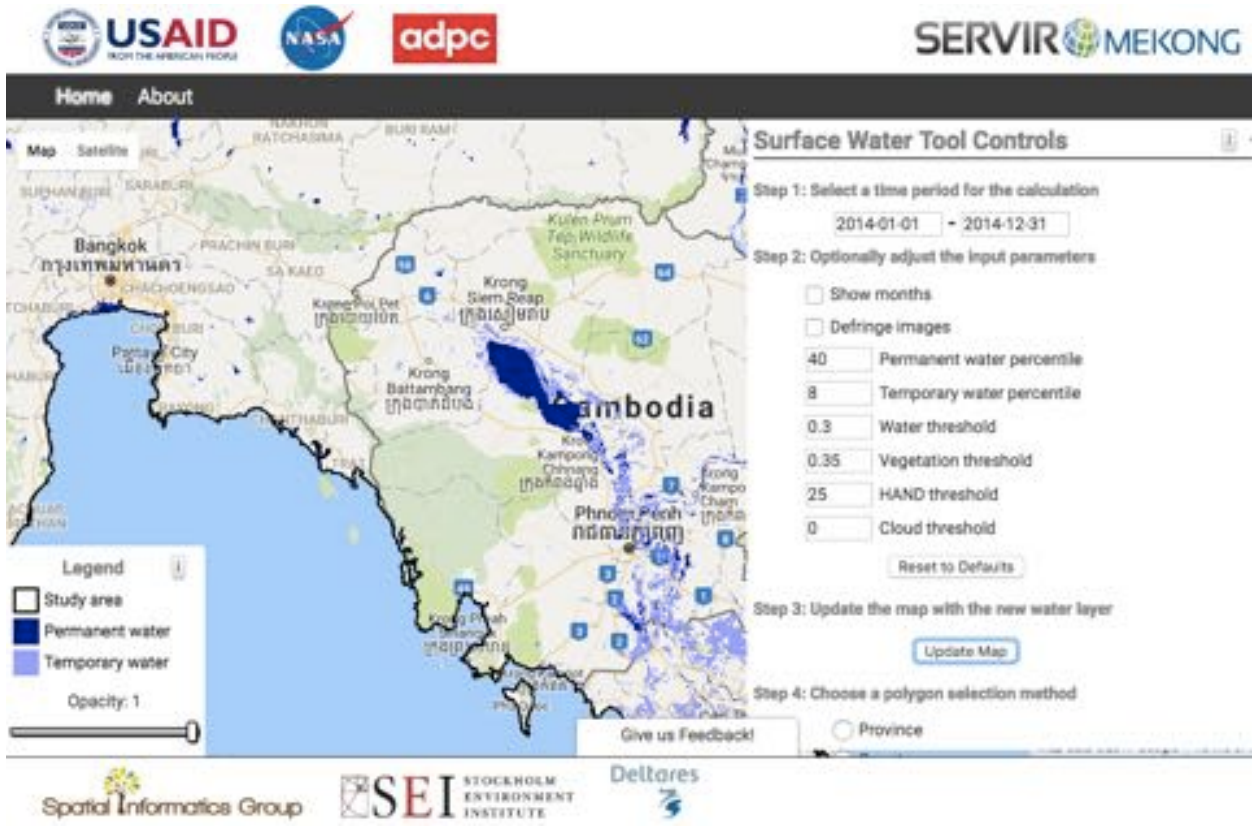
High-accuracy flood level scenario maps led to World Bank repairs of flood protection dikes in Kenya.

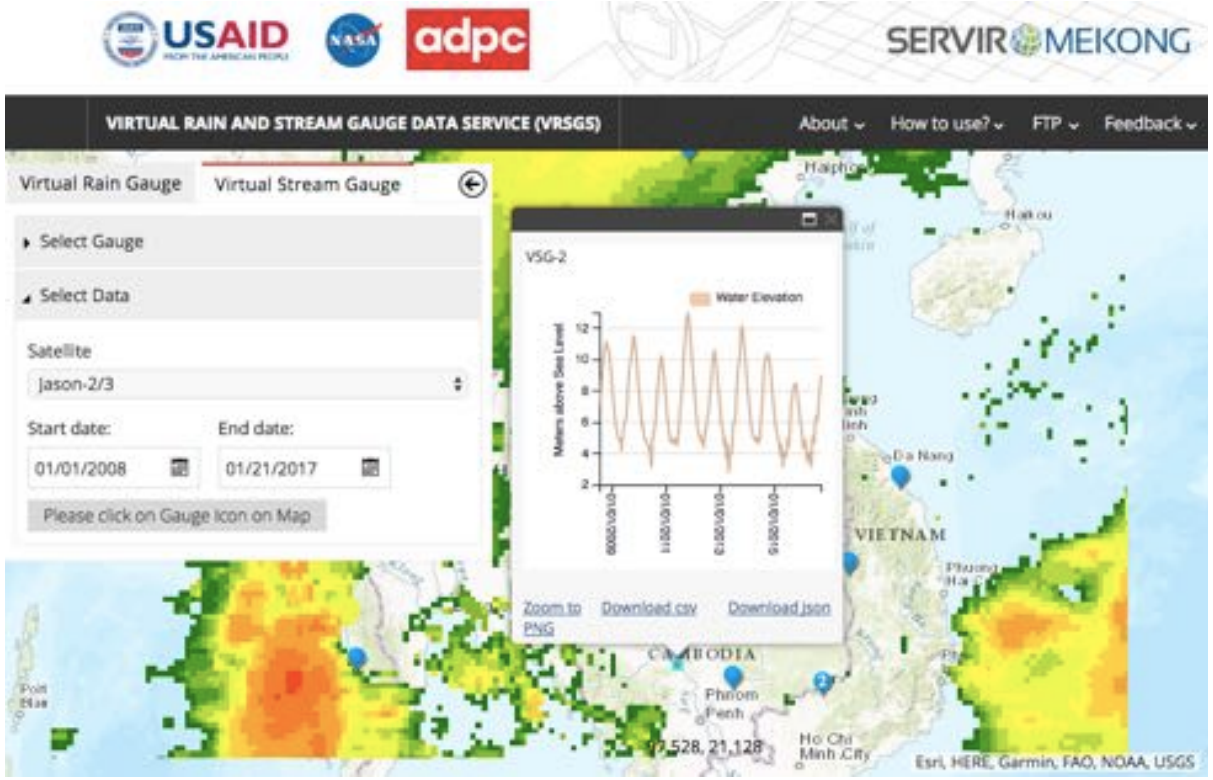


Loosely coupled hydrology model (CREST) with an online GIS inundation tool

- Being ready to help answer some questions with direct mitigation and development implications

Case brief: Ongoing work in the Lower Mekong to identify surface water and forecast floods





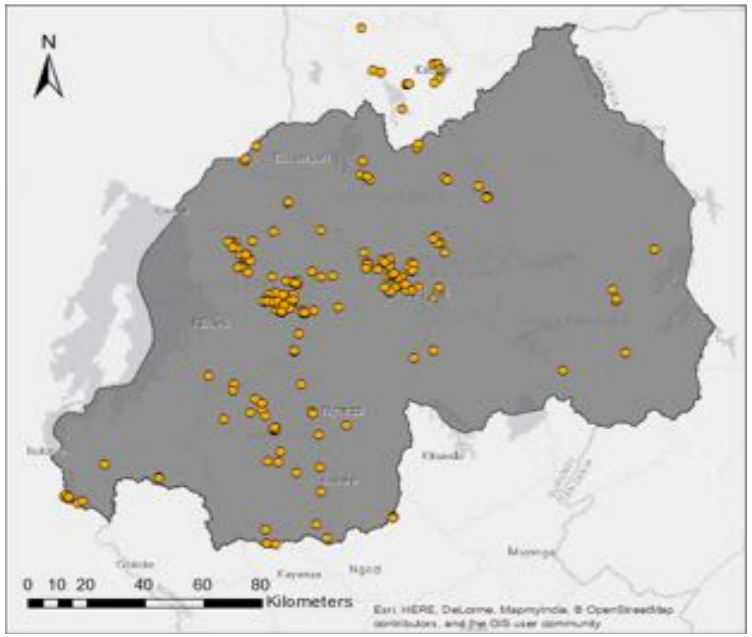
http://surface-water-servir.adpc.net/

http://vrsg-servir.adpc.net

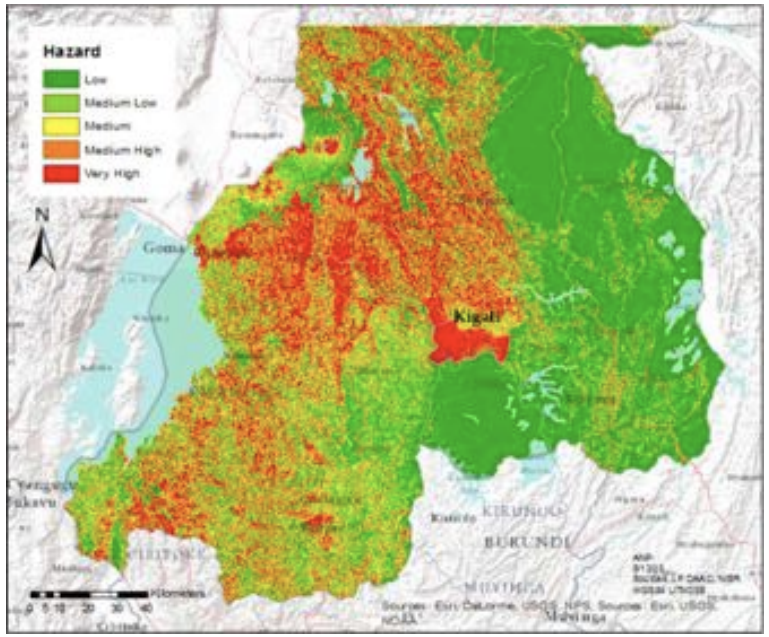
- Addressing variety of needs ranging from historical flood frequency to near real time monitoring and short term forecasting

Case brief: Future work to support landslide mitigation in Rwanda

- From US Geological Survey, we need to know 4 things about landslides
  1. When will they happen?
  2. Where will they start?
  3. Where will the go?
  4. What could be affected?



254 landslide events identified through visual interpretation of high resolution images in Google Earth



Preliminary hazard map derived through logistic regression testing (Piller and Anderson 2015)

Next steps: Refine "need," from stakeholder consultation, design a service that meets this need; could include other new ways to collecting crowd-sourced data (i.e., Space Apps Challenge)

Summary of Lessons Learned

Training	• Appropriate technical training—and follow-up support—can increase good use of Earth observations (EO) for environmental monitoring and disaster management.
Understanding	• Sometimes in mapping a disaster, we realize that more applied research is needed to best integrate (EO) into diverse decision making contexts. Conducting this research together is a way to build trust and confidence.
Backup	• Offsite or cloud backup of data should be part of a data/knowledge preservation strategy.
Champions	• Finding "champion" user agencies can help the scientific community advance the appropriate application of EO data and models. Encourage those agencies to train their counterpart agencies.
Contacts	• Know your contacts before a disaster strikes. Have lines of communication and information flow determined, and have a backup ready during crisis.
Relevance	• Be prepared with relevant information that can help guide development decisions.

Thoughts on paths forward, immediate term

Need	Solution
Improved inventories of disaster events	→ Collect Earth Online being co-developed between SERVIR and FAO → NASA Space Apps Challenges ("Hackathons") and Citizen Science call seeking innovative approaches to crowd-source event data
Improved situational awareness of physical conditions	→ Near real time surface water and flood identification using optical and radar sensors
Improved connections of relevant information to the individual, household, and community levels	→ Deeper involvement with government agencies responsible for community level disaster mitigation and preparedness → Partnership with NGOs working at local level such as MercyCorps, and universities
Improved flood forecasting, especially across borders	→ Coupling satellite altimetry measurements and precipitation estimates and forecasts with hydrology models to increase flood forecast skill and length, especially across borders
Sharing knowledge and experience across regions	→ Ephemeral water body mapping and prediction in West Africa to support pastoralists faced with water stresses (will leverage SERVIR-Mekong experience in water mapping)

Thoughts on paths forward

- Regularly re-assess our role in providing information during phases of the Disaster Cycle; this is different for different types of disasters

- Prepare for data from recent and new satellites
  - Sentinel series (ESA) – already coming online
  - NISAR
  - SWOT
  - Landsat 9

- Continue to promote free and open data policies

Thank you