NOAA and CEOS Space Applications for Disaster Management

Jacob Sutherlun
National Oceanic and Atmospheric Administration
Committee on Earth Observation Satellites Working Group on Capacity Building and Data Democracy – Vice Chair
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NOAA Space Related DRM Activities

- FFG

CEOS DRM Activities

- CEOS WGCapD
- Regional End-to-End Pilots
Floods and flash floods are one of the deadliest and most costly natural disasters worldwide.

Many deaths could be prevented by adequate warning.

Estimates of rainfall from satellites are being used to support flash flood forecasting in many parts of the world through the Global Flash Flood Guidance initiative.
Collaboration between NOAA and the Hydrologic Research Center (HRC) to provide Flash Flood Guidance (FFG) systems for different parts of the world is supported by a MOU among NOAA, HRC, WMO, and USAID.

NOAA provides satellite rainfall estimates for a HRC-developed forecasting tool used by in-country weather services to identify regions of flash flood risk.

- Each system is run by the host country—a local solution to a local problem.

- Currently serving nearly 10% of the world’s population.
A Success Story: Namibia

February/March 2011—heaviest rainfall in many areas in >120 years of records.

Satellite rainfall estimates used extensively in Namibia Hydrological Service (NHS) bulletins—very positive feedback from NHS after the event.
Satellite Rainfall Estimation: Bob Kuligowski, NOAA (Bob.Kuligowski@noaa.gov)

Flash Flood Guidance System information and implementation: Konstantine Georgakakos, HRC (KGeorgakakos@hrc-lab.org) and Bob Jubach, HRC (RJubach@hrc-lab.org)
Shuttle Radar Topography Mission 2 Data Being Released for Humanitarian Causes

Working on Future Releases for Flood Prone Areas

Scheduling Workshops with Regional Partners to Increase Local Capacity to Use SRTM Data

Partnering with the Regional Center for Mapping of Resources for Development

CEOS WGCapD/RCMRD joint

- Refugee planning
- IWRM
- Flood Forecasting
- Agriculture Products
CEOS Regional End to End Projects

- Two Projects
  - Namibia Flood Pilot
  - Caribbean Satellite Disaster Pilot

- To demonstrate the effectiveness of satellite imagery to strengthen regional, national and community level capacity for mitigation, management and coordinated response to natural hazards

- To identify specific satellite-based products that can be used for disaster mitigation and response on a regional level

- To identify capacity building activities that will increase the ability of the region to integrate satellite-based information into disaster management initiatives

- Define & facilitate implementation of a sensor web-based architecture for risk management from a multi-hazard perspective
CEOS Regional End to End Projects

• **Expected Impact:**
  • Reduce the time to acquire and improve the use of relevant satellite data for flood assessment and forecasting
  • Increase the usefulness of derived satellite flood data products for local populations

• **Approach:**
  • Document and prototype a disaster management architecture to demonstrate improved decision support capability and access to remote sensing assets
  • Conduct socioeconomic surveys in flood prone areas
    • Identify local concerns/cultural barriers which prevent use of local flood forecasts
    • Explore methods to incorporate local observations into decision support systems and social networking technology (e.g., crowd sourcing)
Objectives Illustrated

\[ E = 1 - \frac{\sum_{t=1}^{T} (Q_t^d - Q_t^f)^2}{\sum_{t=1}^{T} (Q_t^d - Q_t^o)^2} \]

Satellite Observation

In-Situ Gauge

Predictive Flood Model

SensorWeb Processing

Namibia Flood Dashboard

Decision Support System

Household Surveys

Economic Impacts

Local Notification
NASA Flood SensorWeb Concept

Detect Heavy Rains and Floods Upstream at a coarse level

Analyze Risks

Automatically Acquire Insitu Data

Task Multiple Sensors in Area of Interest

Acquire Satellite Data (Images)

(River Gauge)

(1) Automatically update model and validate
(2) Display data on Web

Analyze Images
Approach

- Namibia Department of Hydrology, Namibia Ministry of Health
  - In-country equipment, personnel and other resources
  - Logistics support
  - Direct technology development of other stakeholders
  - Local conditions expertise

- NASA, Univ. of Maryland, Univ. of Chicago, Univ. of Oklahoma, Open Cloud Consortium
  - Satellite imagery
  - Training on how to process the imagery to extract salient flood information
  - Preliminary flood models
  - Training on further refinement of flood models
  - Computation cloud and web interface to host data, models and displays

- Univ. of Namibia and Univ. of Maryland
  - In country survey development and design
  - Conduct case study surveys in flood prone areas
  - Culturally informed data analysis
Training for Data Capture

Georeferenced photos to enable Rob Sohlberg from Univ. of Maryland to train classifier to detect presence of water in grassy marsh lands via from satellite data.

McCloud Katjizeu (orange) Dept of Hydrology compares GPS readings of control point with UNAM students for mapping exercise.
Preliminary visits to flood prone villages to gauge community interest in participating in socioeconomic surveys and assess familiarity and perceptions of radio flood forecasts.

Left to Right: Matt Handy (NASA), Reinhold Kambuli (NDH), Village Resident, Dr. Julie Silva (UMD), John Moyo (Local Guide)
Flooding and Impacts on Local Livelihoods

Villager shows flood damage and impact during team site assessment
Flood Impact on Wild Life and Subsequently on Humans Nearby

Hippo tracks near villager
Crop fields. Hippo crop destruction is big impact to villagers.
Monitor flooding in near-real time

Create classification products
- partition floodwaters by turbidity
- presence of grasses, etc.

Demonstrate rapid prototyping utilizing Web Coverage Process Services (WCPS)
- To be used to both inform civil managers and – more importantly – to developed and validate predictive models.

Improved hydrological model based on CREST
- Model developed by University of Oklahoma

Improved data products pipeline (more automation)
Contributions of Namibian Partners

- Local terrain expertise to improve modeling
- Expertise on conducting local surveys
- Develop new techniques and products useful to decision makers
- Namibian model will be extended to other countries and applications.

Dan Mandl/NASA, Alphans Mosimane/UNAM, Selma Lendevlo/UNAM, Dr. Julie Silva/UMD, Dan Mandl/NASA, Victoria Shifidi/Dept Hydrology, Dr. Simon Angombe/UNAM, Margaret Angula/UNAM

Socioeconomic team discusses desired outcomes, timeline and next steps to develop a village level study which is integrated with Hydrology Dept. effort.
Namibia Flood Dashboard

SensorWeb enabled for early flood warning
Questions?