



UNITED NATIONS  
Office for Outer Space Affairs



# Caribbean Flood Pilot, an activity under GEO DI-09-02b\_1 (Regional End-to-End Demonstrations)

Presentation for GEOSS in the Americas  
Forum on Coastal Zone Management  
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# Genesis of the Caribbean Flood Pilot

- CEOS Disaster Management tasks for GEO
  - Task DI-06-09 looking at Use of Satellites for Risk Management
    - DI-06-09\_6 – International Disaster Charter for GEO led Philippe Bally/ESA
    - DI-06-09\_7 – WGISS/UN-SPIDER Disaster Response led by Lorant Czaran/UN-SPIDER and Pakhorn Apaphant/Thailand
    - DI-06-09\_8 – Requirements and Architecture Disaster Management led by Guy Seguin/CSA
  - Task DI-09-02b\_1 covers Disaster Management Pilots
  - Task AR-09-02c\_2 applies WGISS Sensor Web technologies to Pilot efforts
- UN-SPIDER: Platform for Space-based Information for Disaster Management and Emergency Response – Bonn Workshop in 2007 identified need for a demonstration showcase to highlight space contributions to Disaster Management
- CEOS: Disaster Team created specific work package to address Caribbean/Latin American disaster management issues and space contributions

# Genesis of the Caribbean Flood Pilot

- CEOS: Strategic Implementation Team created a work package to apply Sensor Web technologies to Pilot efforts and briefed it at the SPIDER workshop in Barbados during July 2008 with NASA (Stu Frye) as lead
  - Barbados workshop hosted by the Caribbean Disaster and Emergency Management Agency (CDEMA), a 16-nation coalition and one of the potential end user groups for this scenario
- CEOS: WGISS initiated Sensor Web activities to support Disaster Management Pilots in August 2008
- NASA: Proposed Caribbean Flood Pilot as activity under GEOSS Architecture Implementation Pilot Phase 2 in September 2008

# Genesis of the Caribbean Flood Pilot

- Stu Frye has been conducting and organizing teleconferences weekly for the collaborations between the National Partners (disaster management, meteorology, hydrology, communications, and other local participants in the region) and the Caribbean Flood Pilot Steering Committee that was formed in February 2009 to oversee the Caribbean Flood Pilot
  - GEO
  - World Bank
  - UN-SPIDER
  - NOAA and NASA
  - CATHALAC/SERVIR
  - CDEMA
  - Caribbean Institute of Meteorology and Hydrology
  - West Indies University
  - CSA, ASI, DLR, and ESA

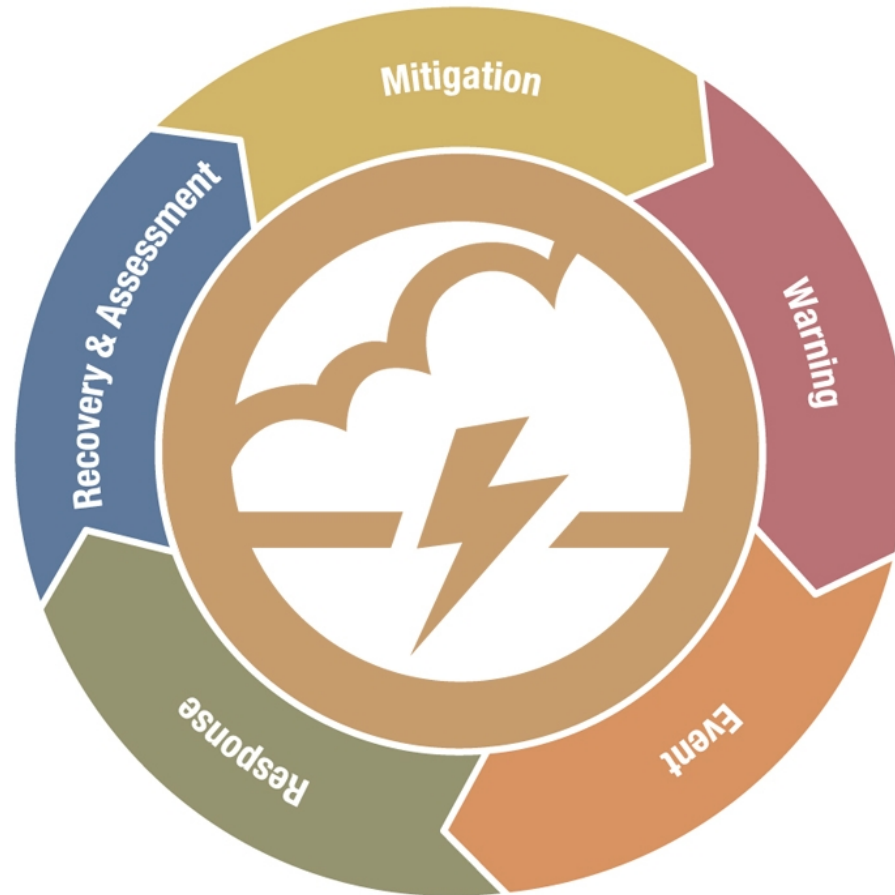
# Genesis of the Caribbean Flood Pilot

- Held first national partner meeting in Grenada April 2009
- Pilot expected to start in September 2009 and continue for 2 years
- Main source of data will be CEOS member satellites such as Envisat (ESA), Radarsat (CSA), ALOS (JAXA), EO-1(NASA), Terra(NASA), Aqua(NASA), Cosmo-SkyMed (ASI), Terrasar-X (DLR), and also some non CEOS participants such as Formosat-2 from Taiwan
- Splinter session scheduled for October 20 in Bonn Germany in conjunction with the UN-SPIDER annual Disaster Management Workshop
- Wrap-up for phase 1 scheduled for national meeting in Kingston Jamaica December 2009

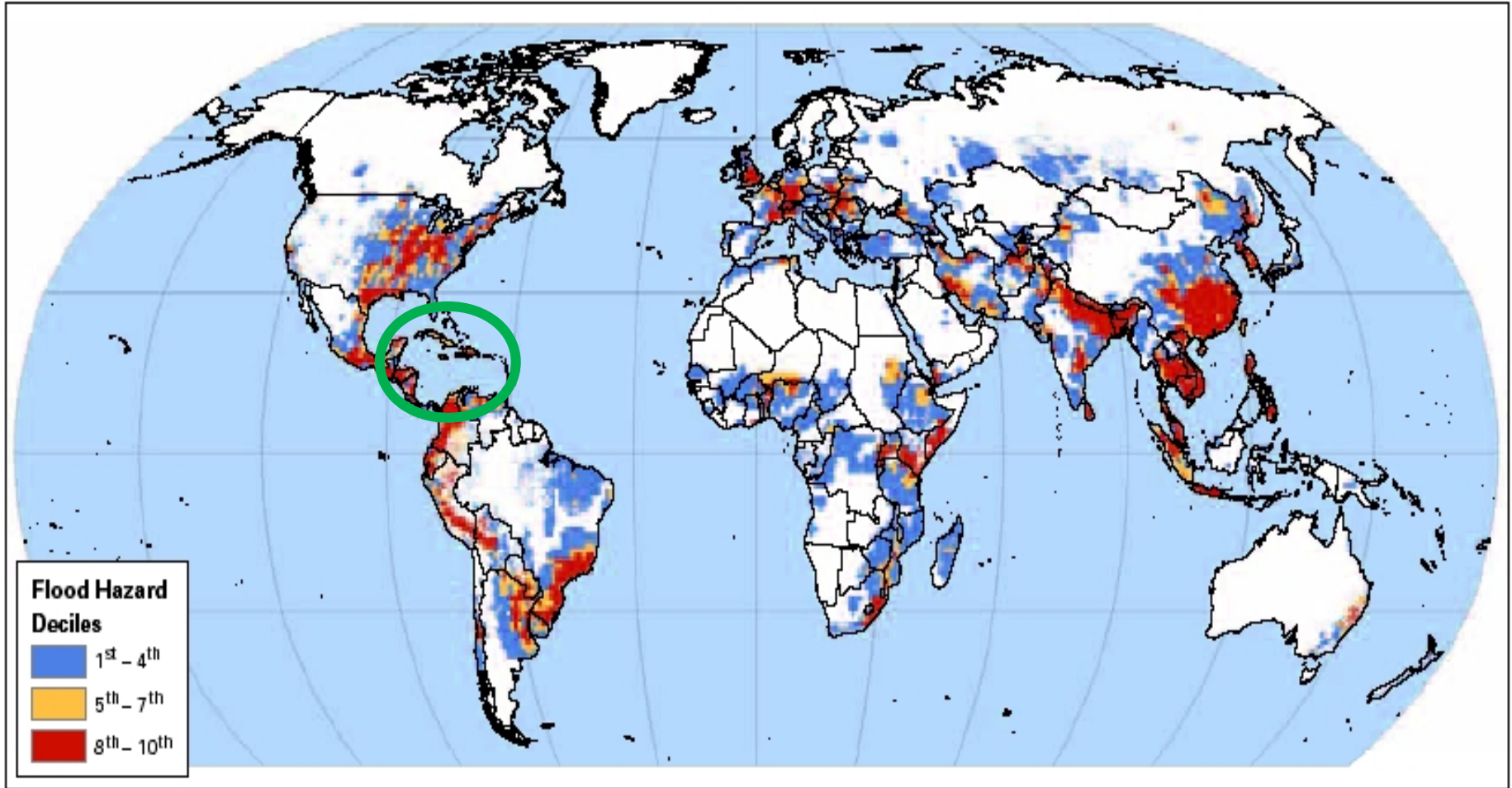
# Objectives of the Pilot

- 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

# Disaster Cycle



# Floods



# Scope of Activities

- Phase 1:
  - Hurricane warning, response and recovery at Caribbean-wide level: use of Sensor Web to predict flooded areas; near real-time acquisition of optical, thermal infrared, and radar satellite data; post event mapping
  - Mitigation activities with five national partners (Barbados, British Virgin Islands, Grenada, Jamaica, Saint-Lucia): satellite data archive mining, background mission imaging, collaboration at national and local level, identification of national projects
- Phase 2:
  - Extension of projects to Phase 2 countries and development of statement of requirements for Caribbean-wide approach for satellite-based mitigation

# Partnership Commitments

as of September 21<sup>st</sup>, 2009

- Phase 1 National Partners: Barbados, British Virgin Islands, Grenada, Jamaica, Saint-Lucia
- Phase 2 National Partners: Belize, Dominica, St-Vincent and the Grenadines, Trinidad and Tobago
- Other local users: CDEMA, CIMH,
- Satellite Data providers: ASI (Italian Space Agency), CSA (Canadian Space Agency), DLR (German Space Agency), ESA (European Space Agency), NASA, USGS, and NSPO/Taiwan
- Value-added and related contributions: Cathalac/SERVIR, ESA (through value-added industry), University of the West Indies (UWI) Ukrainian Space Agency, CSA (TBC), DLR (TBC)

# Flood Data – Caribbean Requirements

Phase Requirements	Mitigation	Warning	Response	Recovery
Target	<p>Topography</p> <p>Hydrological models</p> <p>Historical atlas of floods</p> <p>Flood models/simulations</p> <p>New infrastructure, houses</p> <p>Land-use classification</p> <p>Monitoring of dikes and dams</p> <p>Tropical cyclone seasonal predictive models/simulations</p> <p>Monitoring sea surface temps</p> <p>Monitoring sea-level rise</p>	<p>Precipitation</p> <p>Water level (rivers, lakes)</p> <p>Weather forecast</p> <p>Soil moisture</p> <p>Snow-water equivalent</p> <p>Signs of catastrophic infra failure</p> <p>Signs of active or high tropical cyclone activity</p> <p>Sea-level</p> <p>Signs of coastal erosion and inundation</p>	<p>Water level (rivers, lakes)</p> <p>Extent of flood</p> <p>Status of critical infrastructure</p> <p>Weather forecast</p> <p>Status of coastal infrastructure</p> <p>Predictive model simulations for rising sea level effects</p>	<p>Status of critical infrastructure</p> <p>Damage assessment</p> <p>Flooded areas</p>
Revisit	<p>Monthly (models during season)</p> <p>1 to 3 years (imagery)</p> <p>5 to 10 yrs (topography)</p>	<p>Daily or better during high risk period</p>	<p>Daily in early morning; twice daily if possible</p>	<p>Weekly (major floods) for several weeks to several months</p>
Timeliness	<p>Weeks</p> <p>Months (for seasonal predictions)</p> <p>Years (for Global Change)</p>	<p>Hours</p> <p>Days to Months (for tropical cyclone activity)</p>	<p>Hours (2-4 max)</p>	<p>1 day</p> <p>Years (for Global Change)</p>
End use	<p>Integration in land use planning/zoning</p> <p>Baseline for response</p> <p>Integration in coastal area planning/zoning (Global Change)</p>	<p>Decision support for warnings &amp; evacuation</p> <p>Decision support for infrastructure building and population relocation</p>	<p>Situational awareness</p> <p>Resource allocation support</p> <p>Initial damage assessment</p> <p>Impact planning/action</p>	<p>Tracking affected assets</p> <p>Charting progress</p> <p>Assessing scope of Global Change impacts and ability to cope</p>

# Mitigation Projects involving National Partners and Value Added Providers

- Coastal Erosion Monitoring and **Coastal Decision Support** Tool (focussed on impact of extreme weather events on coastal erosion)
- **Urban Flood Mitigation** (focus on high resolution issues in urban context)
- **Flood Vulnerability Mapping** (with local focus)
- **Ecosystem Monitoring for Flooding and Landslides** (focus on **sensitive areas** and landslide prediction)
- **Integration of Satellite Data into Local Operational Flood Warning and Response** Systems

# Issues

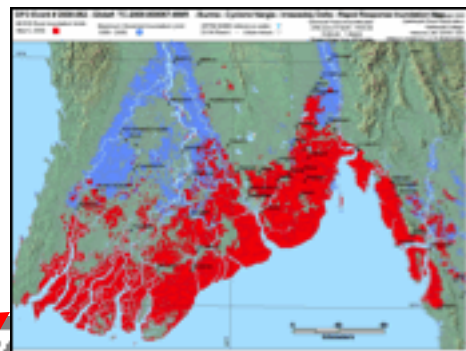
- **Resolution:** existing satellite-based tools and products mostly utilise imagery at low resolution that is not always useful to local responders, planners or analysts
- **Cloud-cover:** most satellite data used is optical imagery and does not provide useful information during periods of cloud cover, which are common during flooding
- **Data vs. Products:** most users would like end-products focussed on specific disaster relevant information, not data
- **Capacity:** many countries have limited capacity to work with data and develop products
- **Mitigation:** most efforts focus on response while limited resources are available for mitigation, which may save more lives and prevent disasters

# Scale

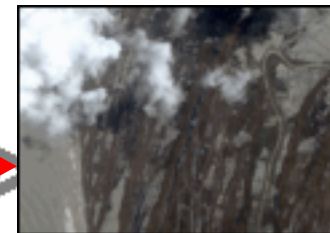
- Scale for most Caribbean countries is a critical issue
- Many sensors provide data at too low a resolution to be useful in small island contexts, particularly given the nature of the threat and damage, which is most often flash flooding causing infrastructure and housing damage rather than large flat flooded areas.
- User reports from CDEMA indicate that working at a scale greater than 1:25000 and in some cases 1:10000 is not useful at local level (local level is where the work takes place)

# Flood Sensor Web Product Service Chain

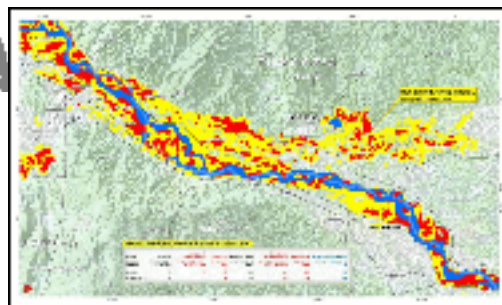
Global Flood Potential Model – based TRMM and other satellites  
-Adler Univ. of Md



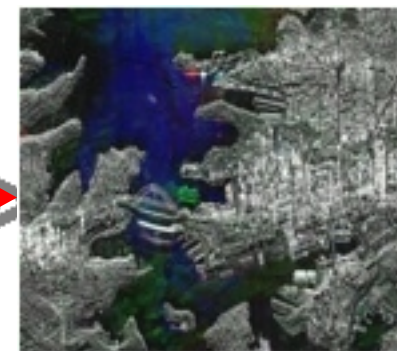
Daily MODIS Flood Map  
- Brackenridge, Dartmouth Flood Observatory



High resolution optical TBS



Envisat Flood Map  
- Kussul, Skakun, National Space Agency of Ukraine



High resolution SAR such as TerraSAR TBS



Multi-sensor campaign manager  
-GSFC et al

Global Water

Univ. of Md –Sohlberg

**BACKUP SLIDES**

# Remarks on Technologies (hi res optical)

- From Holland (UK Ordnance Survey), 2006:
  - 1 m or better: satisfactory maps produced at 1:6000; best use change detection
  - Quickbird (61cm): produces satisfactory 1:10,000 map which will **usually** capture:
    - buildings, lakes, rivers, streams, tracks and paths
  - ...but **not usually** capture:
    - fences, walls, narrow tracks and paths, electricity transmission lines, field and property boundaries, high and low tide lines
- All optical sensors present issue of cloud cover for periods of most likely flooding

# Remarks on Technologies

## (Synthetic Aperture Radar (SAR))

- SAR data not currently actively used for hazard mitigation in Caribbean
- Use in conjunction with low res optical information may correct some problems incurred by users
- Need for more research into what can and cannot be detected using SAR (flash flood damage, landslide scarring, ideal resolution vs coverage, differences in bands (C/X/L))
- Need for capacity development to address SAR use on an operational basis beyond scope of pilot

# Deliverables and Timeline

- **D1. Summary report on requirements and current use of satellite data (PPT) – January 23, 2009. *Lead Athena Global/CDERA - Completed***
- **D2. Directory of available tools, data sets and methodologies – 1<sup>st</sup> draft May 2009; 2<sup>nd</sup> draft December 2009. *Lead NASA/GSFC***
- **D3. Meeting with users – April 6-7, 2009. *Lead CDERA***
- **D4. Completed workplan for 2009 – May 2009 *Lead NASA/Athena Global***
- **D5. Satellite data collection kick-off – May 2009. *Lead NASA/GSFC***
- **D6. Post hurricane season analysis and reporting – December 2009. *Lead CFP Steering Committee***

# Steering Committee

- Nicole Alleyne (CDEMA)
- Philippe Bally (ESA)
- Curt Barrett (NOAA)
- Emil Charrington (Cathalac)
- Carlos Costa (World Bank)
- Lorant Czarán (UN-SPIDER)
- Andrew Eddy (Athena Global)
- David Farrell (Caribbean Institute for Meteorology and Hydrology)
- Stuart Frye (Chair: NASA/GSFC/SGT)
- Kenneth Korporal (Environment Canada, GEOSS in the Americas)
- Ahmed Mahmood (CSA)
- Bruce Potter (Island Resources)
- Giovanni Valentini (ASI)
- Marian Werner (DLR)

The Steering Committee also includes (ex officio):

- Veronica Grasso (GEO Sec)
- Dan Mandl (NASA as lead of the Flood Sensor Web Project)
- Guy Seguin (CSA as lead for GEO Task DI-06-09\_8)

# Remarks on Needs and Priorities

- Key finding from 2005 OAS Study (IDB, IMF, OAS and WB):
  - “Natural Hazard Information: as part of the concept of the public good, there is a need for collaboration and coordination between national government agencies, regional and international development assistance agencies, the private sector, professional associations and the research community in preparing and distributing necessary natural hazard information based on shared hazard type and geographical location priorities”