

Caribbean Satellite Disaster Pilot

A CEOS Activity for GEO in Support of GEOSS

Presented at IGARSS 2012
by Stu Frye for NASA
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Key CSDP Partners and Stakeholders



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CSDP Objectives

- 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

CSDP Approach

- Focus on areas where Earth Observations can have most impact (flooding, landslides) and on large-scale disasters
- Select a small number of regional and national partners to validate usefulness of Earth Observations
- 24 countries solicited – 12 expressed strong interest, 5 selected as Phase I national partners based on:
 - Commitment of national government to make relevant national data sets available
 - Agreement to provide direct support (in-kind)
 - Assurance of close collaboration between key national players (particularly met and disaster agencies)
 - Representative cross-section of GIS capability development
- National Teams created in all five National Partner countries with broad participation from concerned Departments

Flood Data – Caribbean Requirements

Phase Requirements	Mitigation and Preparedness	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 & 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>

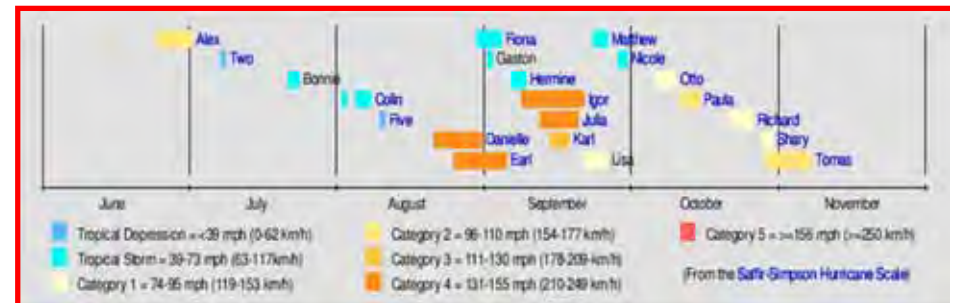
Milestones

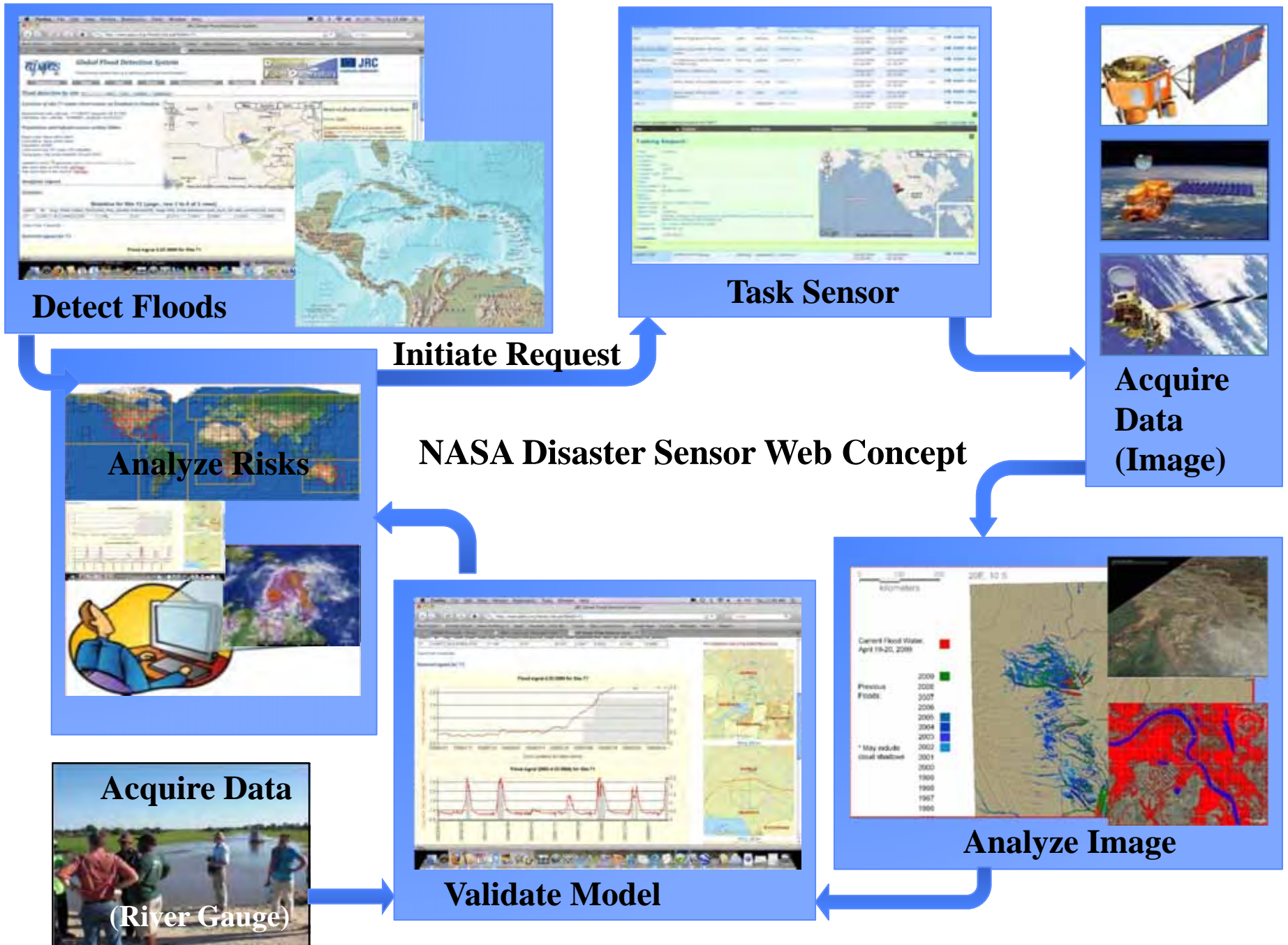
- **December 2010:** Hurricane Season report and progress review for Phase I projects; in-country review meetings
- **Feb-March 2011:** CSDP in-country training
- **April 2011:** Year One (2010) report and recommendations for next steps
- **May-July 2011:** presentations to donor agencies: results of Year One; development of Year Two Workplan
- **July-December 2011:** Rapid satellite tasking and data delivery for Caribbean areas impacted by disasters
- **January-June 2012:** Year Two (2011) report, Workplan update for program-level continuity, coordination meetings with donor agencies and stakeholders



Hurricane Season 2011

- Very busy season with 18 named storms
- Maria, Ophelia, and Rina had most severe impact
- ‘Anticipatory’ radar, optical, and infrared data plans informed by National Hurricane Center storm tracks and information from project partners
- Successful ‘post event’ satellite data capture to match with pre-season data; over 30 acquisitions over affected areas from various satellites
- BVI, St Lucia, Dominica, Mexico, El Salvador, and Panama coverage provided





Flood Maps Accessible via Browser or Application Programmer Interface (API)

- Global maps based on MODIS data are available daily in 10 degree tiles
 - Browser= <http://oas.gsfc.nasa.gov/floodmap/>
 - API= <http://modis.geobliki.com/modis>
- Maps from EO-1 images (both interfaces) are available at <http://matsu.opencloudconsortium.org/wcps>
- Maps from Radarsat images are being produced by CSA and as new products are posted will be available at <http://radarsat.geobliki.com/radarsat> (also provided in both interfaces)

Integration with Post Disaster Assessments

Rapid Needs Assessment Protocol	2010 Satellite Response	2011 Response
Day 0 - Event		Satellite tasking using standardized formats
Day 1	Ad hoc satellite tasking	Automated Satellite tasking and data delivery
Day 2	Rapid Needs Assessment Team (RNAT) deployed	RNAT has initial sat imagery (RSAT, EO-1, etc) in GeoTiff or GIS (KML, Shape) format showing damaged areas and flooding
Day 3	Imagery received in PDF format	Imagery used in initial report draft
Day 4	RNAT 1 st report prepared. Additional imagery received	RNAT has second EO product set showing changes since initial collect, used to support report update
Day 5 and 6	On-going assessment	On-going assessment
Day 7	Debrief report to Eastern Caribbean Donor Group – deployment of detailed damage assessment team	3 rd satellite product set developed showing detailed change analysis and quantified damage assessment. Detailed assessment team has access to all 3 sat products before deployment

Summary of Satellite Contributions

Agency	Contribution	Comments
NASA	EO-1 data, processing, other imagery, archive mining, management support	Integration of data from wide range of sources to meet user needs
CSA	RSAT-1 and 2 data, archive mining, processing, value-added products, training	RSAT-2 background mission modified to increase Caribbean collects
ESA	Envisat data, archive mining	Envisat background mission modified to increase Caribbean collects
JAXA	ALOS data	Only archive data since instrument failure in June
ASI	TBD	Agreement in principle for Cosmo-SKYMED data
DLR	TBD	Possible interferometric data over Haiti

Issues Addressed

- **Resolution/scale:** CSDP has ensured higher resolution data is available and that products generated are useful even at local scales, as evidenced by MapAction use of CSDP 2 maps in Saint-Lucia this year
- **Cloud-cover:** CSDP has ensured access to RSAT-2 high resolution imagery which is merged with optical data for best results and is delivered to project partners as raw data as well as processed images
- **Data vs. Products:** value added providers are contributing information in near-real time
- **Capacity:** CSDP organized five training sessions in Feb-March 2011 for partner nations
- **Mitigation:** work underway to generate a series of mitigation products that address longer-term concerns of disaster managers

Status and Challenges - Summary

Objectives	Status	Challenge
Demonstrate the effectiveness of satellite EO to strengthen regional, national and community level capacity for DM	1 st -year has several examples of successful use (Tomas, Earl, Nicole); lessons learned being integrated for 2011/2012	Need to move from ad hoc approach to systematic integration (cf. Recommendations from year one report)
Identify specific satellite-based products that can be used for DM on a regional level	Spin-offs from CSDP 1, 2 and 5 show promise for longer-term use; products to be refined in year 2	Need to ensure longer-term sustainability and increase input from regional centres of expertise (CIMH, UWI)
Identify capacity building activities that will increase the ability of the region to integrate satellite-based information into DM	Activities identified and in-part delivered; longer-term plan under development	Need to anchor activities with sustainable vision for implementation

Steering Committee

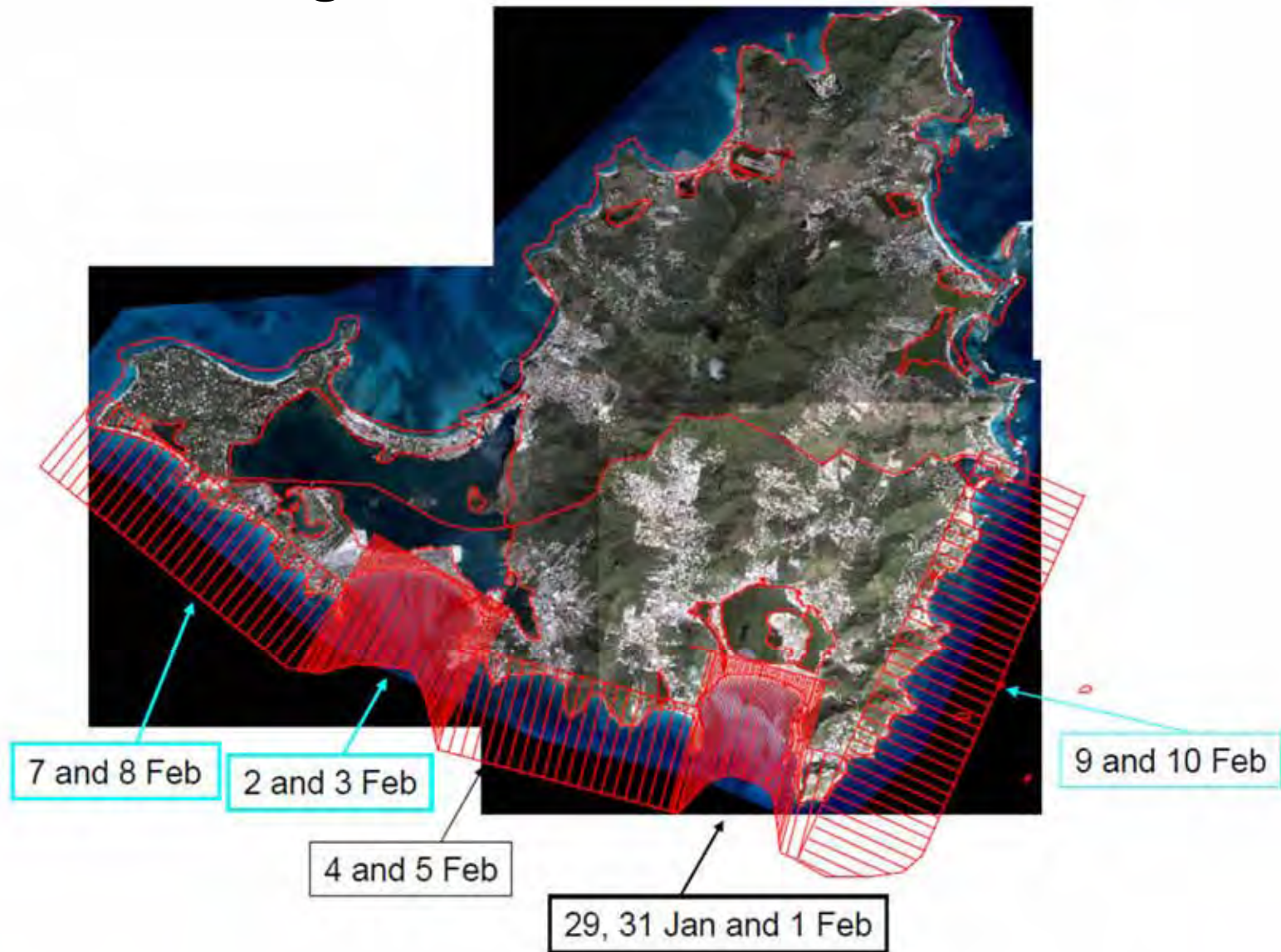
- Nicole Alleyne (CDEMA) - nicole.alleyne@cdema.org
- Guy Aube (CSA)
- Philippe Bally (ESA)
- Emil Cherrington (Cathalac)
- Alessandro Coletta (ASI)
- Lorant Czarán (UN-SPIDER)
- Andrew Eddy (CSA/Athena Global) - andrew.eddy@athenaglobal.com
- David Farrell (Caribbean Institute for Meteorology and Hydrology)
- Stuart Frye (Chair, NASA/GSFC/SGT) – stuart.frye@nasa.gov
- Francesco Gaetani (GEO Secretariat)
- Niels Holm-Nielsen (World Bank)
- Kenneth Korporal (Environment Canada, GEOSS in the Americas)
- Jennifer Lewis (NOAA)
- Dan Mandl (NASA/SensorWeb)
- Jacob Opadeyi (University of the West Indies)
- Bruce Potter (Island Resources)
- Guy Seguin (CSA/CEOS Disaster Lead)

Web Service URLs

- The first two services don't require any login information are:
 - MODIS Flood Server (GUI) = <http://oas.gsfc.nasa.gov/floodmap/> where you can point your browser to manually check on daily MODIS flood maps for the entire globe.
 - Flood Dashboard Client = <http://matsu.opencloudconsortium.org/namibiaflood> this is an example of a client implementation that runs on a cloud computing platform to show a mash-up of disaster data.
- The following servers have browser and API interfaces, but do require a login setup that is freely provided as a means of ensuring the identity of different users so that authorization levels can be enforced:
 - OpenID Provider-Server = <https://op.geoblivi.com/> controls the single sign-on security mechanism for all other services. This is where you setup your self-assigned account name, password, and security credential for two-factor authentication). All other services can be accessed once you are logged in by merely entering your username.
 - Campaign Manager = <http://geobpms.geoblivi.com/home> allows tasking requests to be submitted (i.e., target lat/lons) for future acquisitions from pointable sensor assets, such as satellites and UAVs.
 - EO-1 Server = <http://eo1.geoblivi.com/> this is where EO-1 data can be found along with the status of future and past acquisitions.
 - Radarsat Server = <http://radarsat.geoblivi.com/radarsat> where you can access Radarsat-2 raw data, browse images, metadata, and tiled flood products.
 - MODIS Flood Server (API) = <http://modis.geoblivi.com/modis> is the server that provides an API for accessing the daily MODIS maps. By using this API, you can be notified when the particular tile you are waiting for is posted and will be given a location to pull your data automatically for ingest into your local client.
 - WCPS Server = <http://matsu.opencloudconsortium.org/wcps/session/login> is where you go to generate and run algorithms against satellite data. It hosts over 80 algorithms including atmospheric correction, true color rendering, burn scar, oil slick on shallow water, etc...
 - Pub/Sub Server = <http://opsb.geoblivi.com/session/new> is where you setup a subscription for requesting notifications about new data in your area or from a particular instrument or with a particular feature. The notifications come via Email, SMS, or twitter and contain RSS or Atom feeds for you to follow to find the processed or raw data. Clients can be automated to monitor the feeds and pull the data they are programmed to look for.

St Maarten Bathymetry Experiment Feb 2011

Using EO-1 and Ocean Color



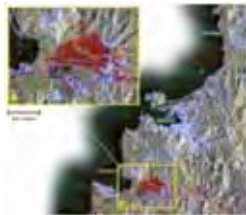
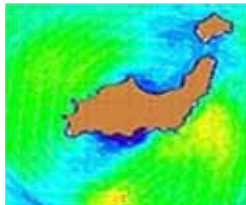
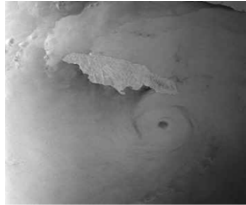
UNDP using shallow water depth measurements as input into storm/tsunami surge model

**EO-1
Image
Matthieu
Landslide
Dam
Breach
In
Dominica
Taken
31 July
2011
The Day
After
The
Event**





Backup Slides



CSA Contributions of Detailed RADARSAT-2 Products in 2010 and 2011 for Rapid Disaster Assessment in the Caribbean and in Central America

Guy Aubé

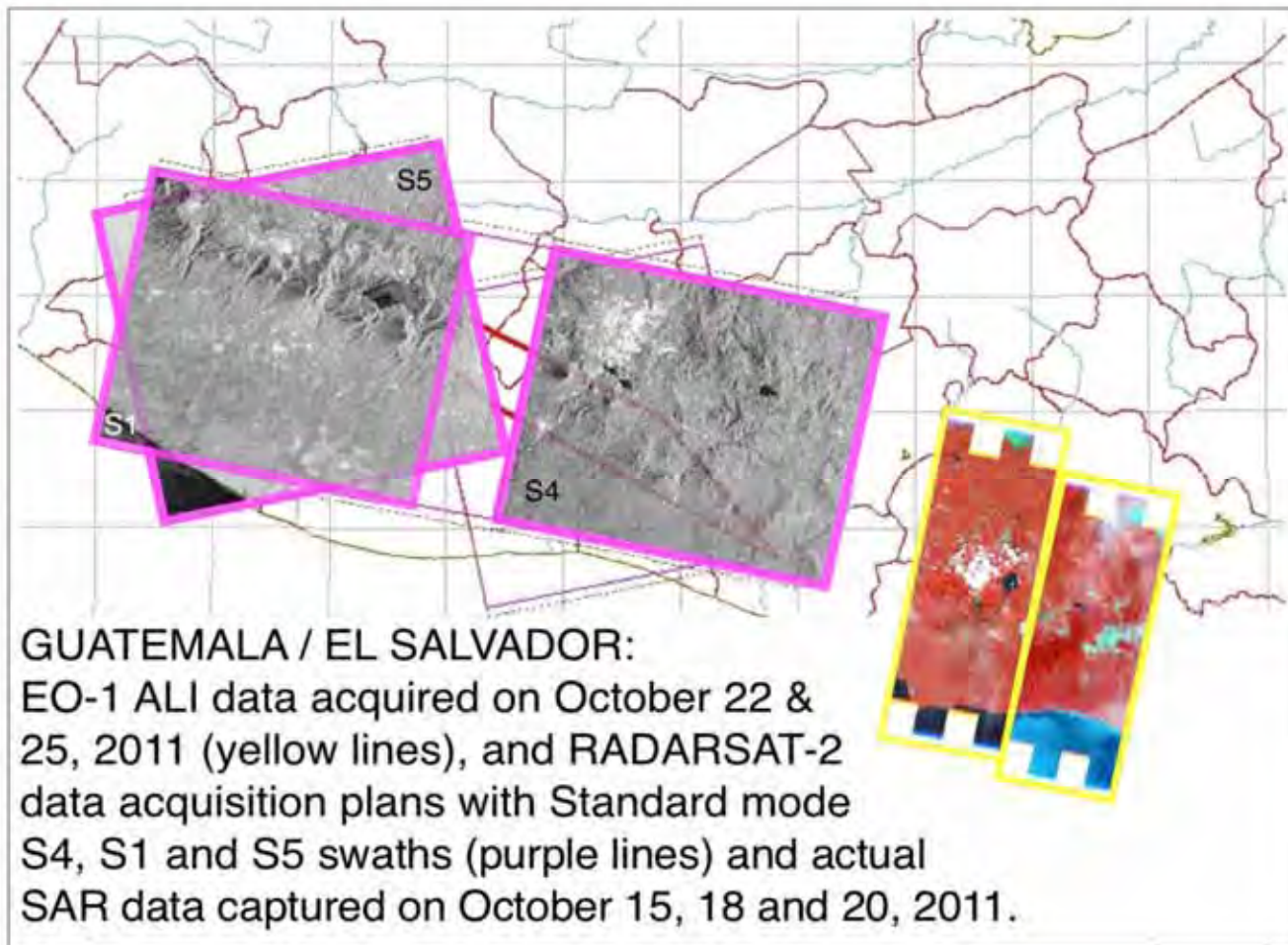
Canadian Space Agency

guy.aube@asc-csa.gc.ca

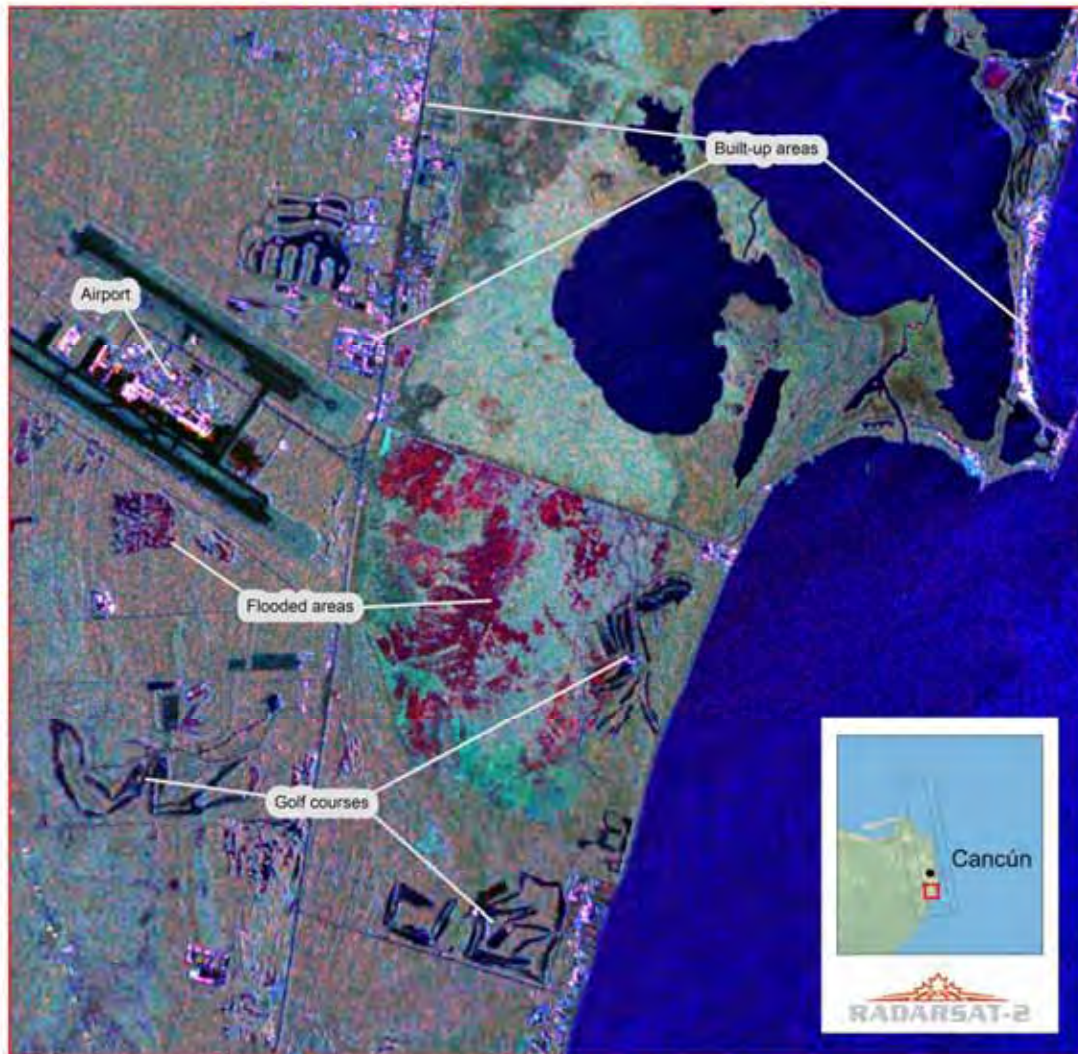
Co-authors:

**Dirk Werle (AERDE), Jean-François Saulnier (CSA),
Guy Séguin (CSA), Nicole Alleyne (CDEMA), Stu Frye (NASA)**

Example: RADARSAT-2 and EO-1 data acquisition support for CATHALAC / SERVIR – severe rainfall and flooding, 2011



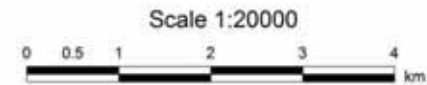
Example: CSA rapid response product



Caribbean Satellite Disaster Pilot
CSDP Rapid Response Product

Cancún, MEXICO

Event: Tropical Storm Rina
Location: Cancún, Mexico
Sensor: RADARSAT-2 SAR
Resolution: 4 meters
Image date / before storm: 08.06.2011 (W3)
Image date / after storm: 30.10.2011 (U17 W2)



Note:
This is a small sample of a high resolution satellite change detection map product provided by the Canadian Space Agency (CSA).

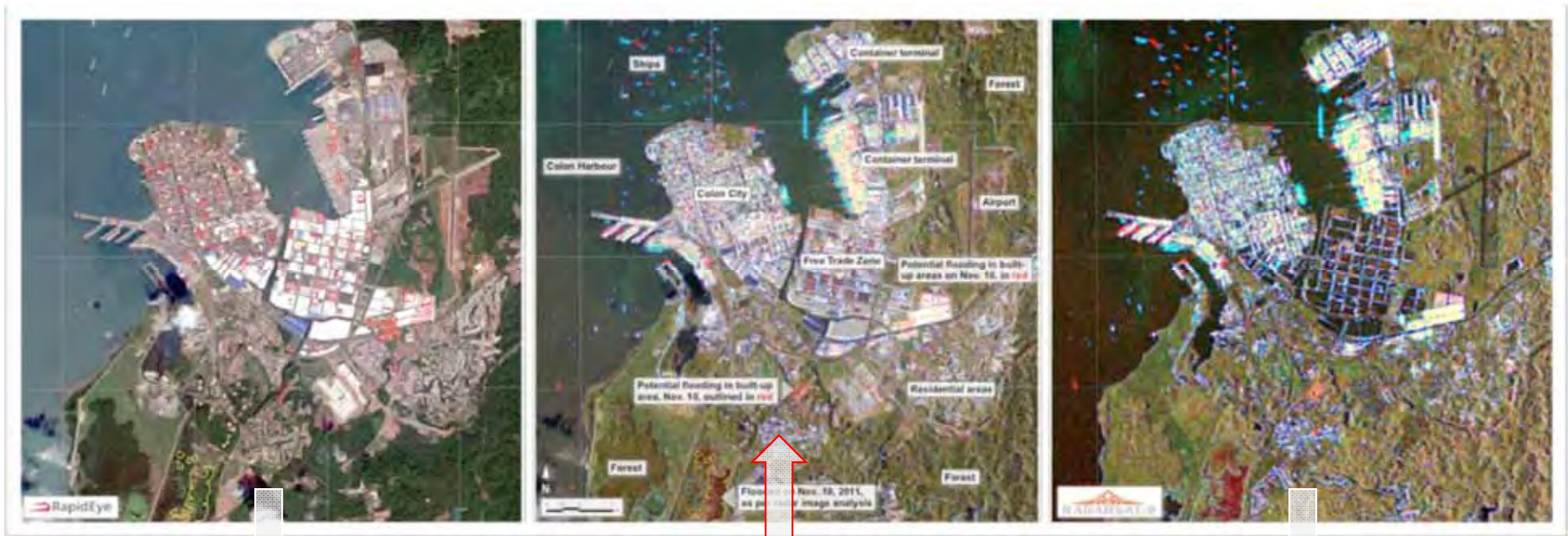
Initial processing and analysis conducted by VIASAT Geotechnologies (Montreal, Canada) and CSA indicate some flooded areas following the passage of tropical storm Rina which left about 48 mm of rain in the Cancún area on October 27th.

Copyright:
RADARSAT-2 data and products copyright by MacDonald Dettwiler and Associates Ltd. (2011)
RADARSAT is an official trademark of the CSA.

(Thumbnail version, actual product at scale 1:20,000)

Example: “Colon, Panama” 2011 – comparison and validation of RADARSAT-2 flood analysis with optical Rapid Eye-4 imagery

(Thumbnail version, actual product at scale 1:25,000)



Pre-event Rapid Eye-4 image
(February, 2011)

**Merged product for
comparison and
initial validation**

Post-event RADARSAT-2 image
(November 10, 2011)

Summary of CSDP data and products, 2010

Country	Production of EO Info Maps	RADARSAT-2 (before event)	RADARSAT-2 (after event)	EO-ALI (2010)	Other EO Data Sources	DEM and GIS Data Layers
British Virgin Islands	2 (Road Town) 2 (Anagada)	4 scenes ultrafine res.	4 scenes Hurricane Earl	-	GeoEye, GOES, recent ISS astronaut photography, digital aerial photography	Desirable, but not available to-date
Grenada	None to-date (no hurricane or major storm)	4scenes ultrafine res., 12 scenes fine res.	4 scenes ultrafine res. Training	2 scenes >70% cloud over land	Recent ISS astronaut photography	Desirable, but not available to-date
Jamaica	1 (E Jamaica) 3 Kingston & Spanish Town	4 scenes ultrafine res.	3 scenes ultrafine res. 2 scenes fine 4 scenes EH, 1 scene EL TS Nicole	2 scenes 20% and 70% cloud over land)	GOES, MODIS, Recent ISS astronaut photography	Desirable, but not available to-date
Saint Lucia	1 N Saint Lucia 1 S Saint Lucia	6 scenes ultrafine res.	10 scenes ultrafine res. 1 scene EH Hurricane Tomas	2 scenes 60% cloud over land	GOES, MODIS, Recent ISS astronaut photography	Desirable but not available to-date
Total #	10 products	30 scenes	29 scenes	6 scenes	~ 20 images	--

Summary of CSDP data and products, 2011

Country	Production of EO Info Maps	RADARSAT-2 (before event)	RADARSAT-2 (after event)	EO-ALI (2011)	Other EO Data Sources	DEM and GIS Data Layers
British Virgin Islands	2 (VirginGorda) 2 (Anagada)	4 scenes Ultrafine res.	9 scenes Hurricane Maria, Ophelia	-	GOES, ASCAT, MODIS, TRMM	Desirable, but not available to-date
Guatemala El Salvador	Various flood maps (by SERVIR / CATHALAC)	1 scene	6 scenes Standard and Wide mode res.	2 scenes (El Salvador)	GOES, MODIS, TRMM	SERVIR
Mexico	2 (Cancun, rapid response product and flood map)	1 scene Standard mode res.	9 scenes Ultrafine res., Standard mode Hurricane Rina		GOES, , ASCAT, MODIS, TRMM	Flood vector maps delivered to CATHALAC
Saint Lucia	1 (Saint Lucia)	2 scenes ultrafine res.	2 scenes ultrafine res. Hurricane Maria		GOES, ASCAT, MODIS, TRMM	Available but not practical (projection)
Panama	3 (Colon, rapid response product, flood map, optical)	1 scene, Fine mode res.	2 scenes, Fine and Standard mode res.		GOES, TRMM, RapidEye, MODIS	Flood vector maps delivered to CATHALAC
Total #	10 products	9 scenes	28 scenes	2 scenes	~ 20 images	--