



NASA Sensor Web Technology for Autonomous Asset Tasking and Customized Data Delivery

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Overview

- State of Practice: Coordination of satellites to observe event driven targets is still primarily based on telephone calls and Emails between those in the know
- NASA is developing technology to improve coverage of events such as disasters, ground-truth science campaigns, and other remote sensing observations for societal benefit through web service automation
- Web service interfaces are based on Open Geospatial Consortium Sensor Web Enablement specifications vetted in pilot and testbed activities on a global scale
- NASA is collaborating in efforts across civilian, military, and commercial satellite providers to prototype these standardized capabilities
- The collaboration combines predictive models, nowcast low resolution observations, triggered high resolution observations, and rapid product/map delivery from a sensor web of satellites, aerial systems, and in-situ nodes
- Civilian activities are coordinated through the Committee on Earth Observation Satellites and satisfy Group on Earth Observations work plan requirements
- The work addresses needs of UN, World Bank, USAID, Red Cross, and other international aid and donor organizations
- Pilot activities involve regional centers of excellence and national partners from the Caribbean and Southern Africa in pilot calibration and validation efforts

Satellites Involved with SensorWeb

Active

- NASA - EO-1 (ALI/Hyperion), Terra (MODIS), Aqua (MODIS and AMSR-E), TRMM
- Taiwan National Space Program Office – Formosat-2
- Canadian Space Agency (CSA) – Radarsat 1 and 2
- European Space Agency (ESA) – Envisat (ASAR)
- SPOT/Image - SPOT-5

In Discussion With

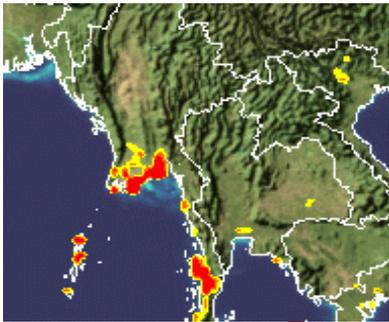
- German Aerospace Center (DLR) - TerraSAR X
- Japanese Space Exploration Agency (JAXA) – ALOS (PALSAR)
- Italian Space Agency (ASI) - Cosmo SkyMed

Commercial

- GeoEye
- Quickbird

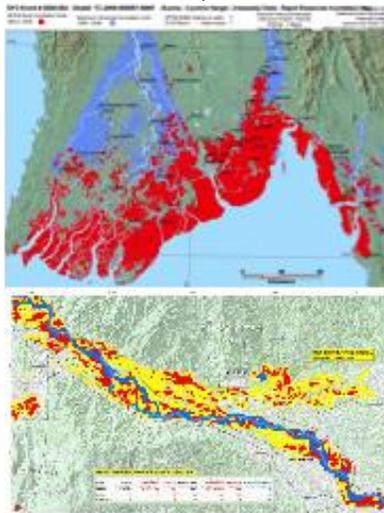
“Sensor Web” – Real-time Satellite Situational Awareness

1. Global and regional flood prediction models detect risk (DEMs + TRMM, MODIS)



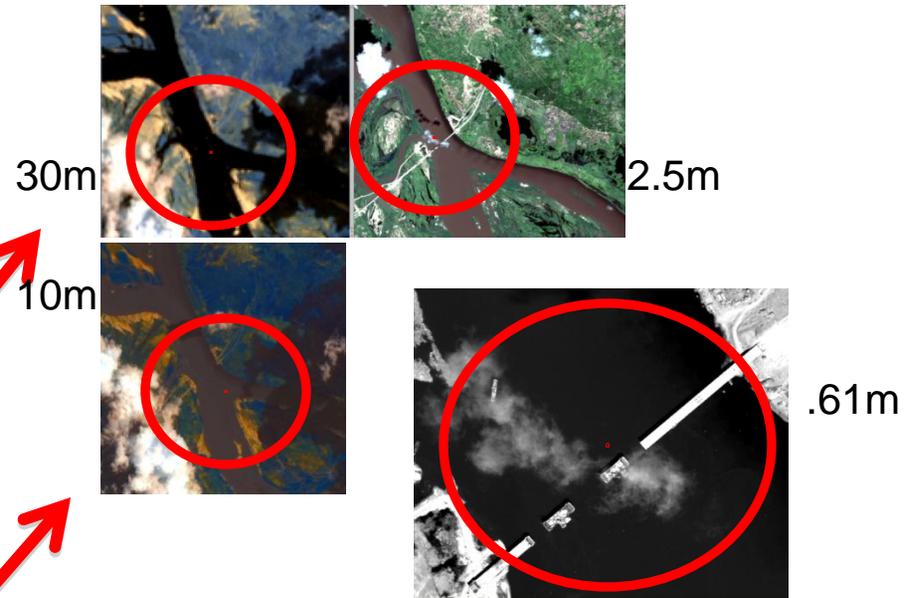
2. Automated broad area satellite data acquisitions as event unfolds

Daily Flood Map (MODIS 250m)



2-3 day Radar Flood Map (100m RSAT, Envisat, with MODIS Global Flood Mask)

3. Targeted high-res image acquisitions during/after event for most affected areas (optical or hi-res SAR)



4. Integrated information managed with multi-sensor campaign manager

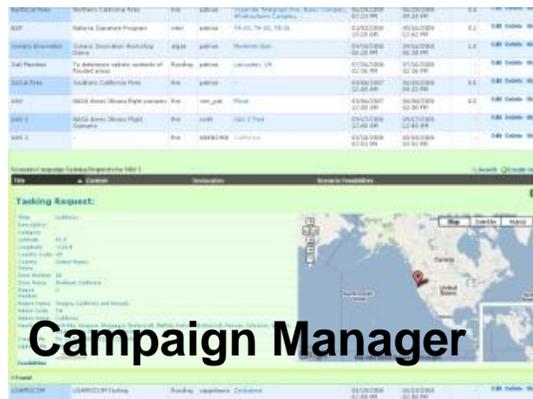


Typical User Scenario

Area of interest &
type of satellite
data

UN-Spider Portal

Namibian in-country
data center



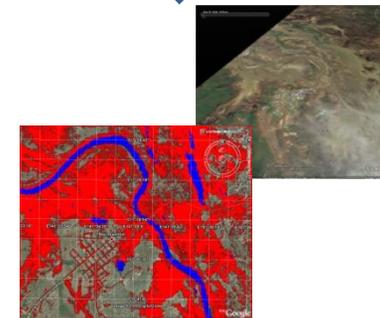
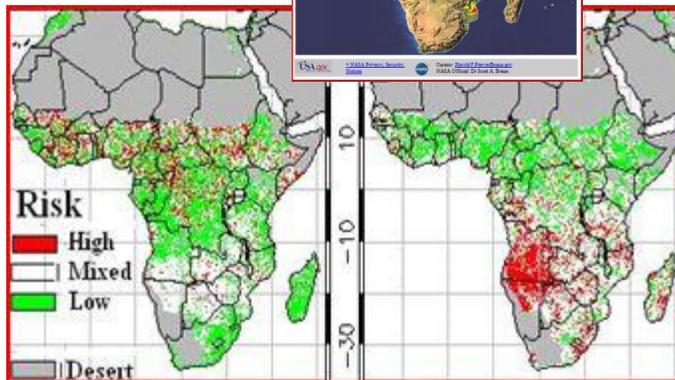
Customized plan
of needed
satellite images

Satellite Sensor
Planning Services

Needed
satellite data

Flood and
disease risk
maps

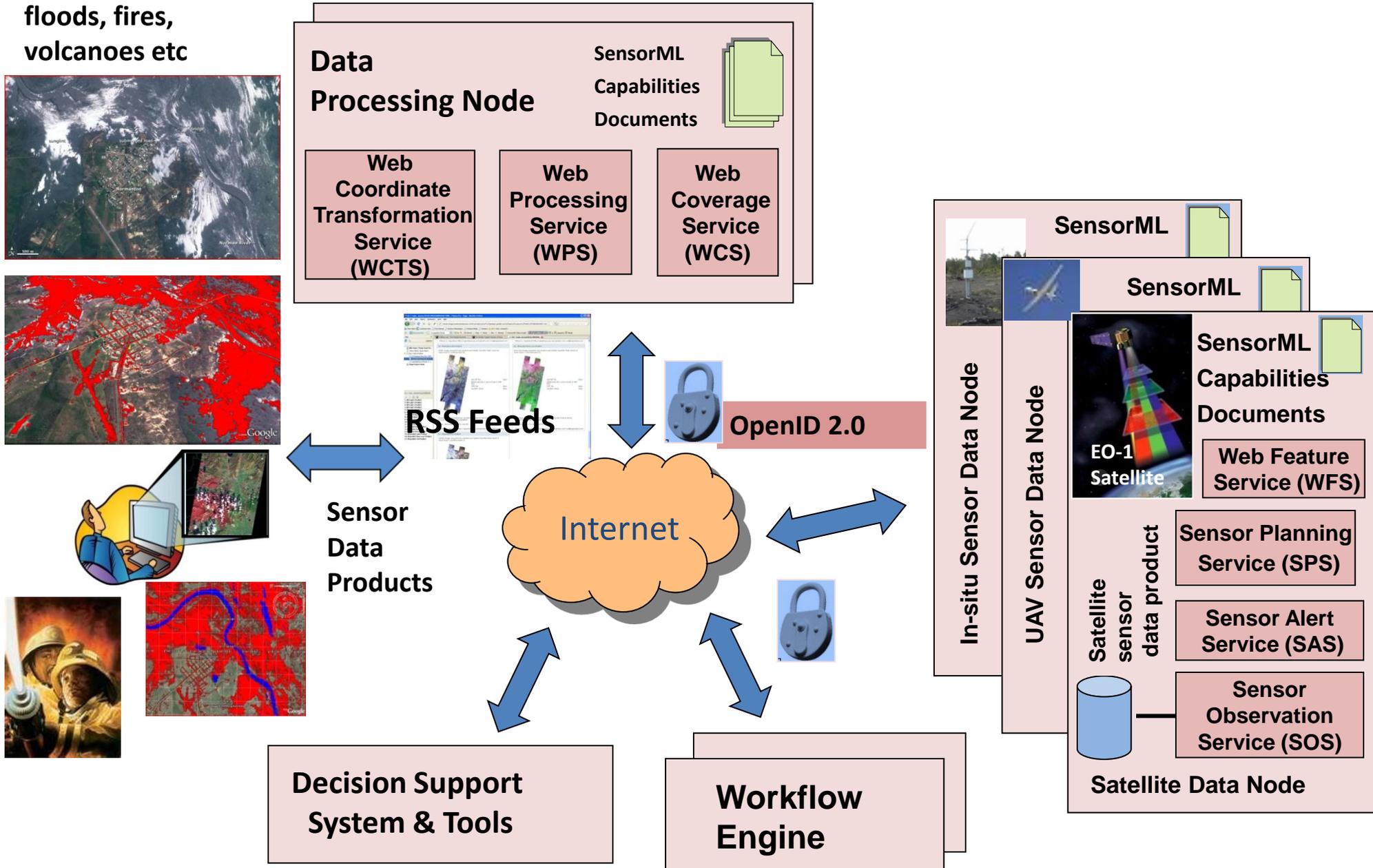
Flood &
disease
models



Basic Components

- Encapsulate satellite sensor components and data processing algorithms within web services compliant with Open Geospatial Consortium (OGC) Sensor Web Enablement (SWE) standards
- Geospatial Business Processing Management System (GeoBPMS) – also called Campaign Manager
 - Manages user inputs and sends tasking requests to satellite assets
 - Manages data product retrieval and alerts for users
 - Geotorrent servers
 - Twitter alerts
- Security over the open networks
 - Experimenting with various approaches (e.g. OpenID)

Basic Components Used in SensorWeb



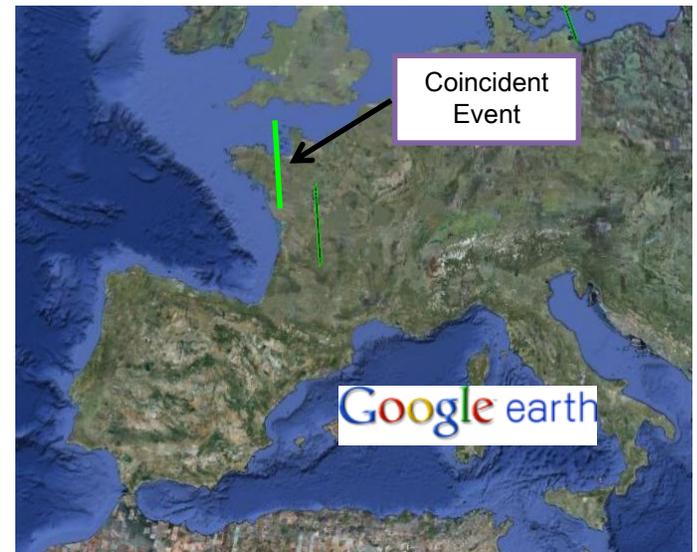
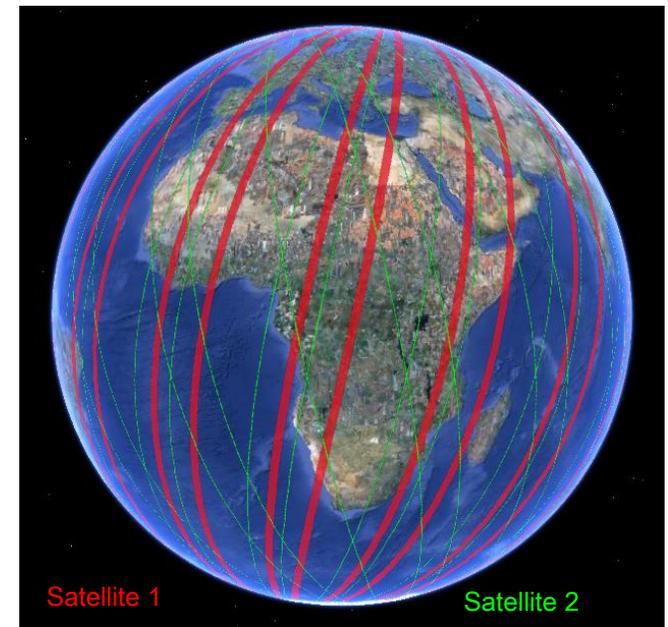
CEOS Visualization Environment (COVE)

Background

- COVE is a Web-based Google-Earth Coincident Imaging Tool for Satellite Calibration and Validation (Cal/Val) developed by SEO for WGCV.
- COVE supports on-orbit and ground-based Cal/Val of CEOS missions to improve data continuity, interoperability, and data fusion by calculating coincident viewing events for multiple satellites.
- COVE is a systems engineering tool with broad international interest for enhanced collaboration and data evaluation.
- Prototype version now under development with a first release by the CEOS WGCV Meeting (March 2010). A working beta version can be demonstrated by SEO, upon request.

Features

- Simple and intuitive Google-Earth interface with dynamic menus, multiple viewports, and a Mission Database.
- Rapid calculation of coincident events and orbit groundtracks
- User-defined evaluation periods and regions of interest
- Multi-user collaboration and EXCEL table output format



Campaign Manager Tasking Request Page

Visualize request using Google Map

Tasking Request:

Title: Lake Liambezi test1
Description: Namibia flood campaign requested by Guido Van Langenhove
Category:
Latitude: -17.9108028411865
Longitude: 24.21120262146
Day/Night: day time
Country Code:
Country Name:
Zone Number: 576
Zone Name: Zambia
Region Number: 37
Region Name: Africa
Admin Code:
Admin Name:
Nearby:
Created At: Thu, 23 Apr 2009 02:37:14 -0000
Updated At: 2009-04-23
[Show Map](#)



Feasibilities

Potential Feasibility Asset: EO-1, Date: 2009-04-24T08:09:00Z
 Potential Feasibility Asset: ALOS, Date: 2009-04-24T23:24:50Z
 Potential Feasibility Asset: FORMOSAT-2, Date: 2009-04-25T00:45:28Z
 Potential Feasibility Asset: QB-2, Date: 2009-04-25T08:00:21Z
 Potential Feasibility Asset: SPOT-5, Date: 2009-04-25T21:15:14Z
 Potential Feasibility Asset: EO-1, Date: 2009-04-27T08:25:00Z
 Potential Feasibility Asset: FORMOSAT-2, Date: 2009-04-27T12:24:02Z
 Potential Feasibility Asset: SPOT-5, Date: 2009-04-28T06:24:02Z
 Potential Feasibility Asset: QB-2, Date: 2009-04-28T19:10:07Z
 Potential Feasibility Asset: ALOS, Date: 2009-04-29T00:35:33Z
 Potential Feasibility Asset: EO-1, Date: 2009-04-29T08:04:00Z
 Potential Feasibility Asset: ALOS, Date: 2009-04-29T20:38:33Z
 Potential Feasibility Asset: FORMOSAT-2, Date: 2009-04-29T23:19:50Z
 Potential Feasibility Asset: QB-2, Date: 2009-04-30T02:52:57Z
 Potential Feasibility Asset: SPOT-5, Date: 2009-04-30T11:02:33Z
 Potential Feasibility Asset: EO-1, Date: 2009-05-02T08:21:00Z
 Potential Feasibility Asset: ALOS, Date: 2009-05-02T14:09:28Z
 Potential Feasibility Asset: QB-2, Date: 2009-05-02T14:38:16Z
 Potential Feasibility Asset: SPOT-5, Date: 2009-05-03T01:43:33Z
 Potential Feasibility Asset: FORMOSAT-2, Date: 2009-05-03T09:47:24Z

Deliver Data Products via News Feeds to Users Along with Links to GeoTiff, KML and information about Image

EO-1 Task, Scene:EO1A1700592008326110KF, Theme:fire - Sage - Mozilla Firefox

chrome://sage/content/feedssummary.html?url=http%3A%2F%2Fgeobpms.geobliki.com%2Fdata%2Fproducts%2Ffeeds%2F830B3080-B829-11DC

FreeRecorder Customized Web Search

Most Visited | Customize Links | Free Hotmail | Windows Marketplace | Windows Media | Windows | EO-1 Task, Scene:EO...

FreeRecorder | st augustine florida | Record | Stop | Pause | Play | Settings | Record ANY Video & Audio | WFU... | st | augustine | florida

Sage

Options*

- BBC News | News Front Pa...
- Yahoo! News: Sports News
- EO-1 Data Products
 - LA Freeway Fires Nov 2008
 - Uganda/Kenya Floods 11-1...
 - Uganda/Kenya Floods 11-1...
- Sage Project News

EO-1 Task, Scene:EO1A170059200...

1. Ali tcapt 6 Product

2. Ali tcapt 5 Product

3. Ali tcapt 4 Product

4. Ali tcapt 3 Product

5. Ali tcapt 2 Product

6. Ali tcapt 1 Product

7. Ali br 1 Product

8. Ali rdi Product

9. Ali rvi Product

10. Ali gndvi Product

11. Ali ndvi Product

12. Ali cloud mask Product

13. Ali smoke Product

14. Ali active fires Product

15. Ali product swir Product

16. Ali product burn scar Product

17. Ali product vis Product

Patrice G. Cappelaere <http://cappelaere.pip.verisignlabs.com/> pat@cappelaere.com

15. Ali product swir Product

SWIR Image using EO1 ALI Level1G and Vigtel Classifier (Red: band 10, Green:band 9 and Blue:band 8).



GeoTiff File [here](#)

[Note:Data file is also include in KMZ file]

KMZ File [here](#)

Geobliki Article [here](#)

[Disclaimer: This product has not been validated by the Science team]
Provided by Geobliki and GeobPMS

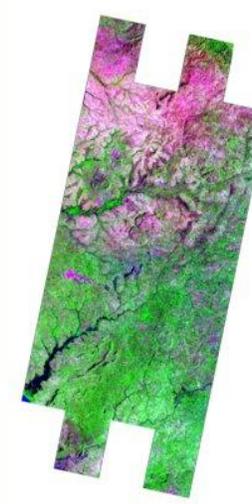
Friday, November 21, 2008 2:04 PM

Patrice G. Cappelaere <http://cappelaere.pip.verisignlabs.com/> pat@cappelaere.com

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16. Ali product burn scar Product

Burn Scar Image using EO1 ALI Level1G and Vigtel Classifier (Red: band 10, Green:band 7 and Blue:band 5).



GeoTiff File [here](#)

[Note:Data file is also include in KMZ file]

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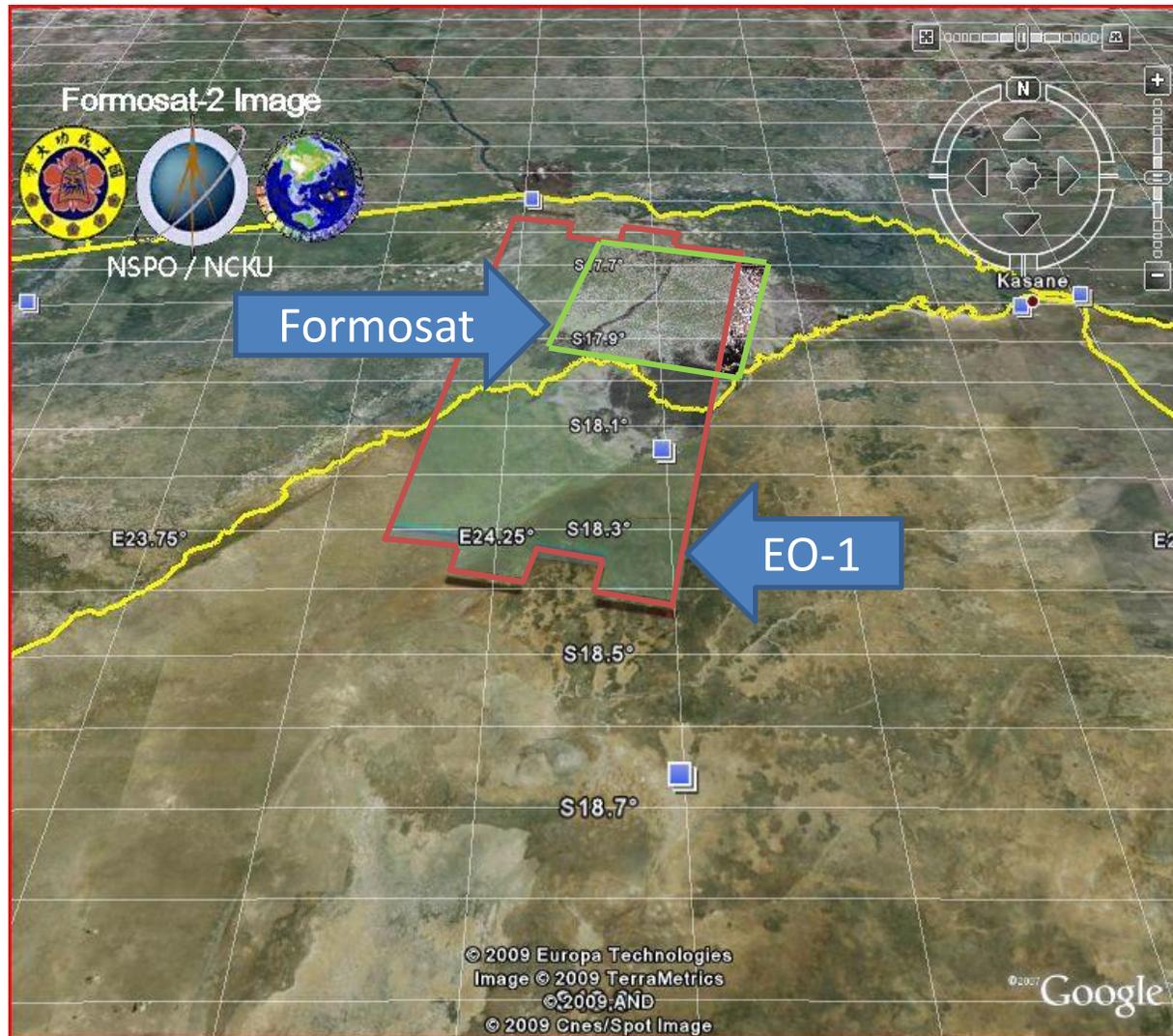
Patrice G. Cappelaere <http://cappelaere.pip.verisignlabs.com/> pat@cappelaere.com

17. Ali product vis Product

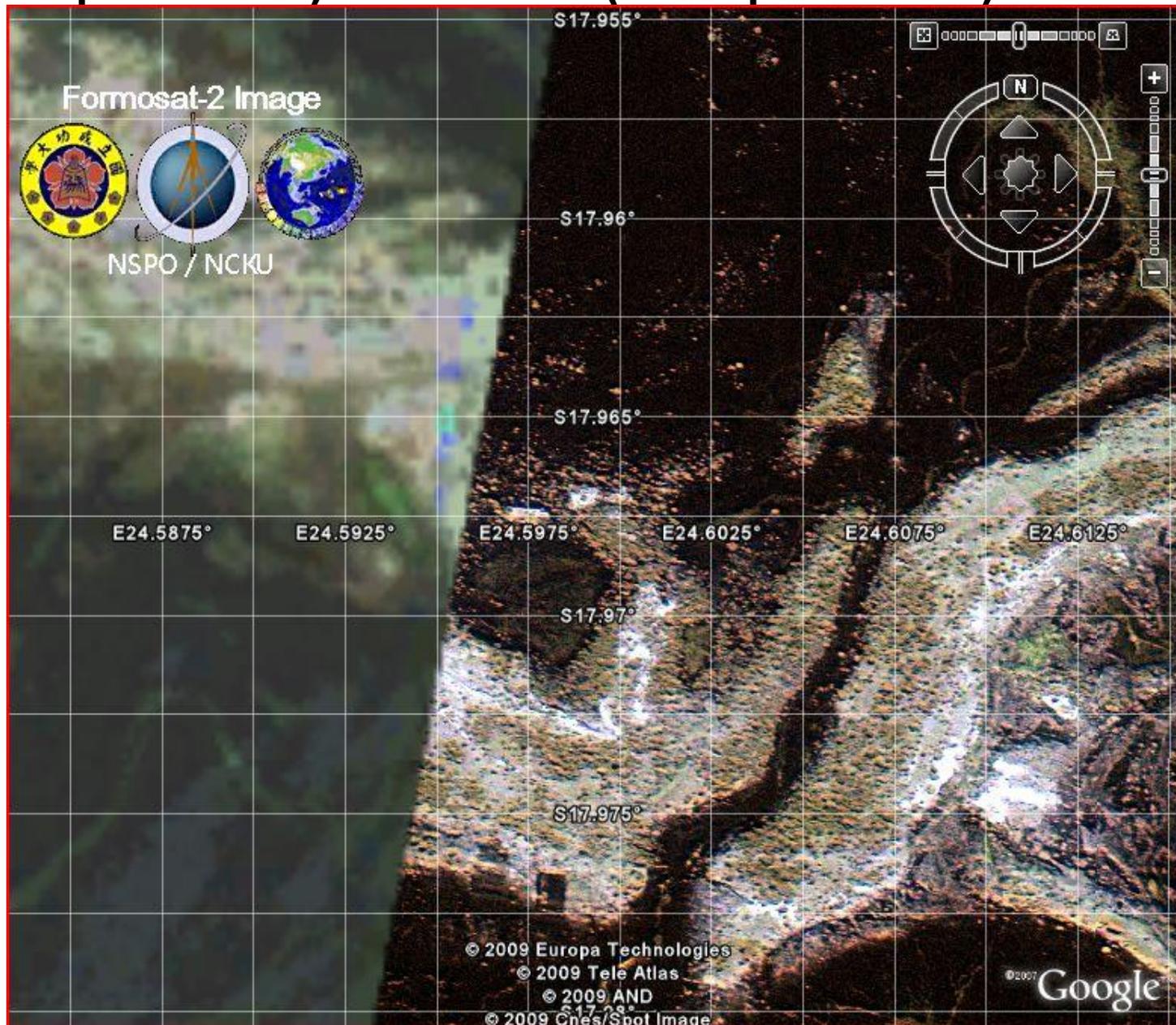
Visible Image using EO1 ALI Level1G and Vigtel Classifier (Red: band 5, Green:band 4 and Blue:band 3).



Lake Liambezi: EO-1 ALI Image 4-9-09 (30 m resolution) Overlaid on Formosat Image 4-5-09 (2 m resolution) on Google Earth Both images Geo-tiled



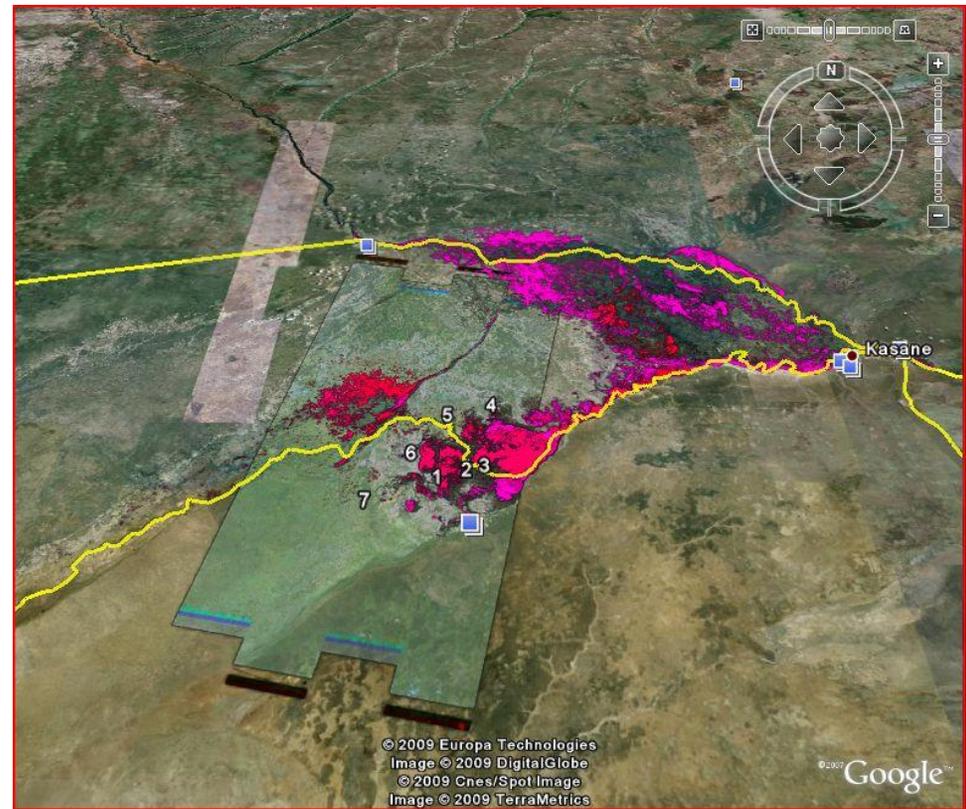
Zoom – Note increased detail of Formosat(right portion) vs EO-1 (left portion)



EO-1 & Radarsat 2 Flood Image



EO-1 Image 5-11-09 on Google Earth



EO-1 Image 5-11-09 overlaid with Radarsat 2 data from 3/25/09, 5/20/09, 5/22/09 and 5/29/09 on Google Earth

SensorWeb Value

- Build social networks connecting users, satellites, data products and algorithms to process data products
 - Use simple tools such as browsers, twitter, email , Google Earth and newsfeeds
 - Use standard wrappers to allow nodes to easily interoperate
 - Possible use of cloud computing
 - Users do not need expensive tools such as ENVI and ArcGIS
- User communities evolve based on interests and needs
- SensorWeb builds tools and connectivity around user based on distributed assets
- No portals, clearinghouses and central archives in typical configuration, although, these items can be integrated in the user experience
- Examples – Namibian Flood Pilot and Caribbean Satellite Disaster Pilot
 - Connecting flood models, river gauges, and various satellite observations to provide situational awareness on a catchment basin level
 - Providing graphical views of rainfall estimates upstream and evaluate whether certain thresholds predict flood waves downstream
 - Using thresholds to trigger automatic high frequency, high resolution satellite campaigns for rapid map generation
 - Delivering all views and data using simple Web 2.0 tools with little manual interaction

Future Activities

- Expand flood and disease early warning systems to include
 - Food security
 - Early drought warning
 - Sustainable development
- Expand satellite, aerial, and in-situ sensors included in the sensor web
- Automate the generation of disaster maps
- Refine global forecast and nowcast models to include validation feedback and new data offerings
- Improve visualization in tasking clients and product processing systems
- Implement 2-factor authentication and federated web service security
- Experiment with data sharing technology (e.g., peer-to-peer, digital rights management)

Contact stuart.frye@nasa.gov, Reference <http://eo1.gsfc.nasa.gov>