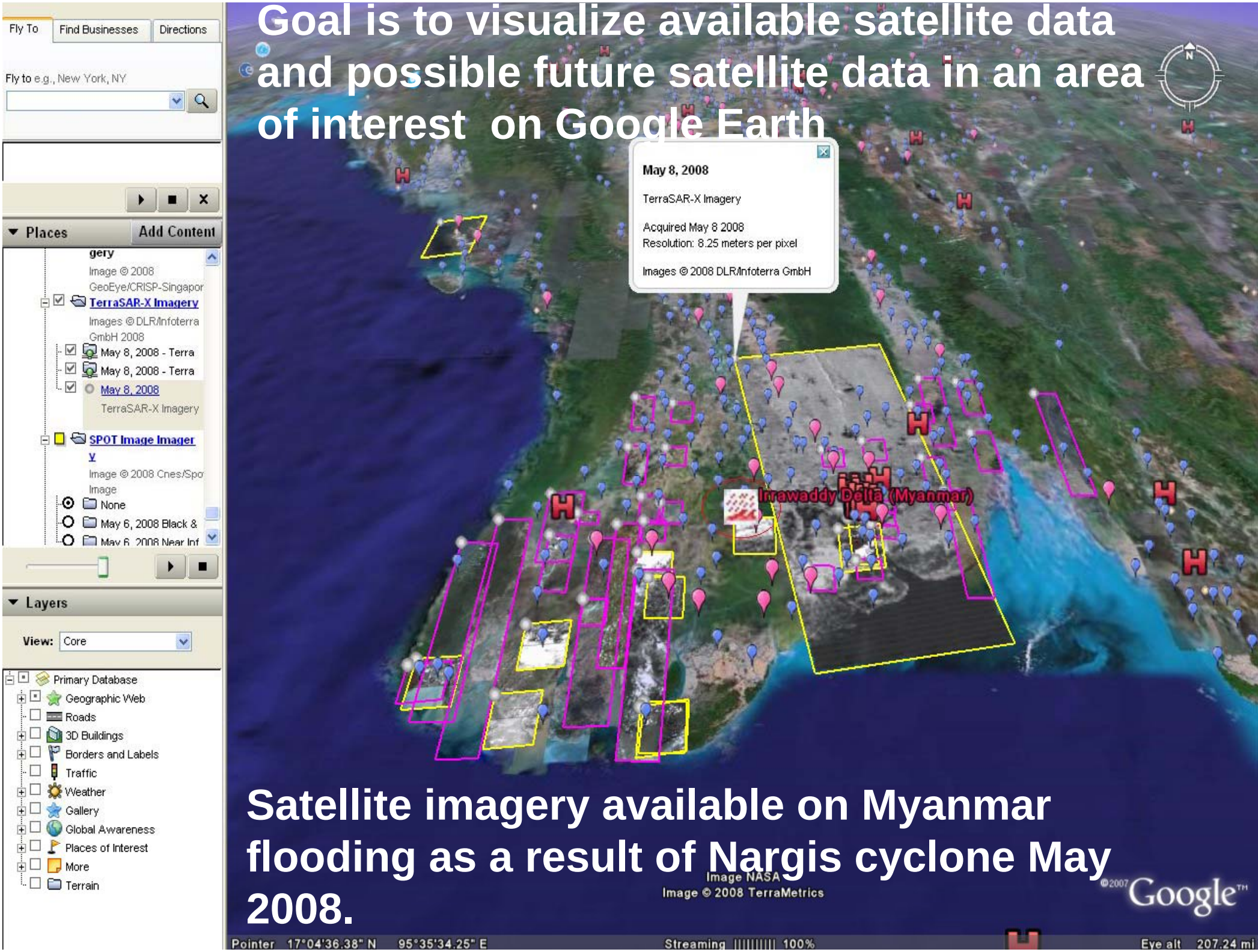
OGC Standards to Enable SensorWebs for Disaster Management

(Session 10 Working Groups: Data Center Migration for Ground Systems: Geospatial Clouds)

Daniel Mandl - NASA/GSFC 3/3/10

Overview

- Goal: Enable user to cost-effectively find and create customized data products to help manage disasters
  - On-demand
  - Low cost and non-specialized tools such as Google Earth and browsers
  - Access via open network but with sufficient security
- Use standards to interface various sensors and resultant data
  - Wrap sensors in Open Geospatial Consortium (OGC) standards
  - Wrap data processing algorithms and servers with OGC standards
  - Use standardized workflows to orchestrate and script the creation of these data products
- Make use of cloud computing
  - On-demand computing
  - On-demand storage
- Target Web 2.0 mass market
  - Leverage new capabilities and tools that are emerging
  - Improve speed and ease of production


Goal is to visualize available satellite data and possible future satellite data in an area of interest on Google Earth
Fly To
Find Businesses
Directions
Fly to e.g., New York, NY
Places
Add Content
Image © 2008 GeoEye/CRISP-Singapor
TerraSAR-X Imagery
Images © DLR/Infoterra GmbH 2008
May 8, 2008 - Terra
May 8, 2008 - Terra
May 8, 2008
TerraSAR-X Imagery
SPOT Image Imagery
Image © 2008 Cnes/Spo
Image
None
May 6, 2008 Black &
Layers
View: Core
Primary Database
Geographic Web
Roads
3D Buildings
Borders and Labels
Traffic
Weather
Gallery
Global Awareness
Places of Interest
More
Terrain
May 8, 2008
TerraSAR-X Imagery
Acquired May 8 2008
Resolution: 8.25 meters per pixel
Images © 2008 DLR/Infoterra GmbH
Irrawaddy Delta (Myanmar)
Satellite imagery available on Myanmar flooding as a result of Nargis cyclone May 2008.
Image NASA
Image © 2008 TerraMetrics
©2007 Google
Pointer 17°04'36.38" N 95°35'34.25" E
Streaming 100%
Eye alt 207.24 mi

SensorWeb High Level Architecture

floods, fires, volcanoes etc

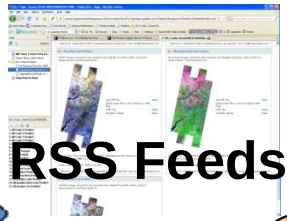
Data Processing Node

SensorML
Capabilities
Documents

Web Coordinate Transformation Service (WCTS)

Web Processing Service (WPS)

Web Coverage Service (WCS)

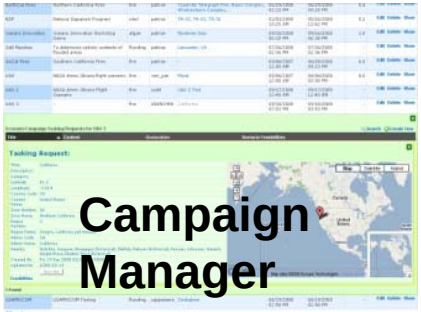


RSS Feeds

Sensor Data Products

Internet

OpenID 2.0



Campaign Manager

Workflows

In-situ Sensor Data Node

UAV Sensor Data Node

SensorML

SensorML

SensorML
Capabilities
Documents

Web Feature Service (WFS)

Satellite sensor data product

Sensor Planning Service (SPS)

Sensor Alert Service (SAS)

Sensor Observation Service (SOS)

Satellite Data Node

Use of Cloud Computing

- Migrating components to commercial cloud computing servers (Joyent)
  - Campaign Manager
  - Data processing services
  - Data feeds
- Joyent servers allow surge in demand and will absorb extra need for CPU utilization and extra storage short term
- Can increase CPU and storage capacity instantly for long term by providing credit card for extra capacity
- Experimental since security on open network still has issues
- Speeds up production services via web and OGC enabled services

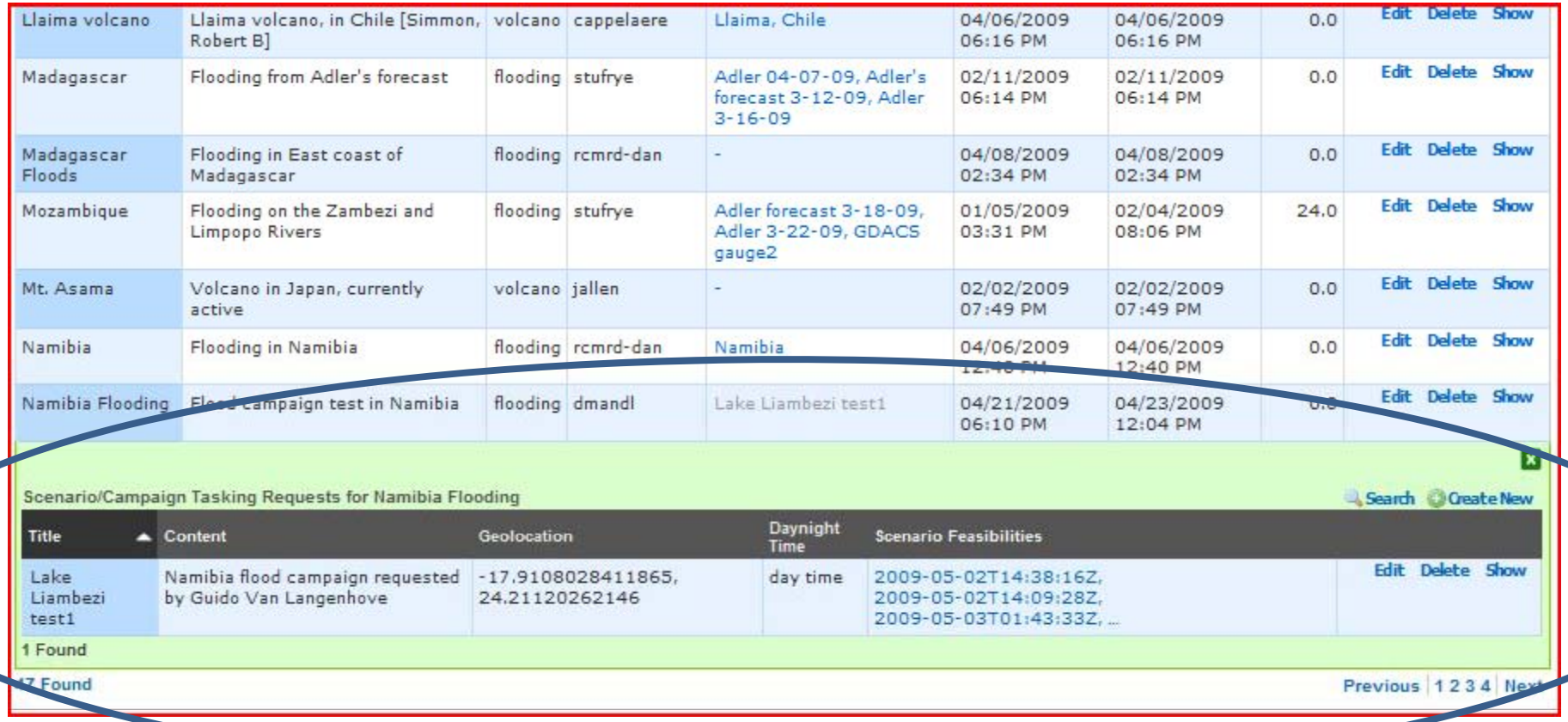
Campaign Manager Tasking Request Page

Create a campaign

Title	Content	Theme	User	Scenario Requests	Created At	Updated At	Weight	
Guatemala Zacapa Landslide	Landslide in La Union, Zacapa, Guatemala	flooding	CATHALAC	Landslide in La Union, Zacapa, Guatemala	08/05/2008 01:50 PM	10/23/2008 05:23 PM	1.0	Edit Delete Show
Guyana Flood	World Bank request for coastal coverage	flooding	stufrye	Guyana test case, New Guyana tasking	12/18/2008 01:15 AM	01/19/2009 03:54 PM	24.0	Edit Delete Show
Huahua landslide	Landslide and flooding, Cerro el Socorro, Huahua Mexico	flooding	gimnastaverde	Landslide Cerro el Socorro	10/15/2008 07:30 PM	10/23/2008 02:33 PM	0.5	Edit Delete Show
Joggins Cliffs	UNESCO site on the Bay of Fundy	intel	jallen	Joggins Cliffs	02/04/2009 08:30 PM	02/04/2009 08:30 PM	0.0	Edit Delete Show
Karumba	Karumba, Queensland	flooding	jallen	-	03/12/2009 05:40 PM	03/12/2009 05:40 PM	0.0	Edit Delete Show
Lake Eyre	(anticipated) refilling of Lake Eyre from heavy rains upstream in Queensland	flooding	jallen	Lake Eyre	02/19/2009 02:53 PM	02/19/2009 02:53 PM	0.0	Edit Delete Show
Lake Eyre (North)	Floodwaters entering Lake Eyre basin from Queensland floods	flooding	jallen	Lake Eyre (North)	03/11/2009 01:56 PM	03/16/2009 02:04 PM	0.0	Edit Delete Show
Land Information System	Soil Moisture	drought	stufrye	Friday 4-17, Thursday 4-16 (3), Thursday 4-16 (1), ...	03/19/2009 05:31 PM	03/19/2009 05:31 PM	0.0	Edit Delete Show
Llaima volcano	Llaima volcano, in Chile [Simmon, Robert B]	volcano	cappelaere	Llaima, Chile	04/06/2009 06:16 PM	04/06/2009 06:16 PM	0.0	Edit Delete Show
Madagascar	Flooding from Adler's forecast	flooding	stufrye	Adler 04-07-09, Adler's forecast 3-12-09, Adler 3-16-09	02/11/2009 06:14 PM	02/11/2009 06:14 PM	0.0	Edit Delete Show
Madagascar Floods	Flooding in East coast of Madagascar	flooding	rcmrd-dan	-	04/08/2009 02:34 PM	04/08/2009 02:34 PM	0.0	Edit Delete Show
Mozambique	Flooding on the Zambezi and Limpopo Rivers	flooding	stufrye	Adler forecast 3-18-09, Adler 3-22-09, GDACS gauge2	01/05/2009 03:31 PM	02/04/2009 08:06 PM	24.0	Edit Delete Show
Mt. Asama	Volcano in Japan, currently active	volcano	jallen	-	02/02/2009 07:49 PM	02/02/2009 07:49 PM	0.0	Edit Delete Show
Namibia	Flooding in Namibia	flooding	rcmrd-dan	Namibia	04/06/2009 12:40 PM	04/06/2009 12:40 PM	0.0	Edit Delete Show
Namibia Flooding	Flood campaign test in Namibia	flooding	dmandl	Lake Liambezi test1	04/21/2009 06:10 PM	04/23/2009 12:04 PM	0.0	Edit Delete Show

Campaign Manager Tasking Request Page

Select Namibian Flooding Campaign and create first scenario—Lake Liambezi imaging



Llaima volcano	Llaima volcano, in Chile [Simmon, Robert B]	volcano	cappelaere	Llaima, Chile	04/06/2009 06:16 PM	04/06/2009 06:16 PM	0.0	Edit Delete Show
Madagascar	Flooding from Adler's forecast	flooding	stufrye	Adler 04-07-09, Adler's forecast 3-12-09, Adler 3-16-09	02/11/2009 06:14 PM	02/11/2009 06:14 PM	0.0	Edit Delete Show
Madagascar Floods	Flooding in East coast of Madagascar	flooding	rcmrd-dan	-	04/08/2009 02:34 PM	04/08/2009 02:34 PM	0.0	Edit Delete Show
Mozambique	Flooding on the Zambezi and Limpopo Rivers	flooding	stufrye	Adler forecast 3-18-09, Adler 3-22-09, GDACS gauge2	01/05/2009 03:31 PM	02/04/2009 08:06 PM	24.0	Edit Delete Show
Mt. Asama	Volcano in Japan, currently active	volcano	jallen	-	02/02/2009 07:49 PM	02/02/2009 07:49 PM	0.0	Edit Delete Show
Namibia	Flooding in Namibia	flooding	rcmrd-dan	Namibia	04/06/2009 12:40 PM	04/06/2009 12:40 PM	0.0	Edit Delete Show
Namibia Flooding	Flood campaign test in Namibia	flooding	dmandl	Lake Liambezi test1	04/21/2009 06:10 PM	04/23/2009 12:04 PM	0.0	Edit Delete Show

Scenario/Campaign Tasking Requests for Namibia Flooding

Search Create New

Title	Content	Geolocation	Daynight Time	Scenario Feasibilities	
Lake Liambezi test1	Namibia flood campaign requested by Guido Van Langenhove	-17.9108028411865, 24.21120262146	day time	2009-05-02T14:38:16Z, 2009-05-02T14:09:28Z, 2009-05-03T01:43:33Z, ...	Edit Delete Show

1 Found

17 Found

Previous 1 2 3 4 Next

Campaign Manager Tasking Request Page

Perform “Get Feasibility” and Campaign Manager searches available Sensor Planning Services (SPS) for available sensors to image Area of Interest (AOI)

Namibia Flooding	Flood campaign test in Namibia	flooding	dmandl	Lake Liambezi test1	04/21/2009 06:10 PM	04/23/2009 12:04 PM	0.0	Edit Delete Show

Scenario/Campaign Tasking Requests for Namibia Flooding — Search | Create New

Title	Content	Geolocation	Daynight Time	Scenario Feasibilities	
Lake Liambezi test1	Namibia flood campaign requested by Guido Van Langenhove	-17.9108028411865, 24.21120262146	day time	2009-05-02T14:38:16Z, 2009-05-02T14:09:28Z, 2009-05-03T01:43:33Z, ...	Edit Delete Show

Scenario/Campaign Tasking Request Feasibility for Lake Liambezi test1 — Search | Generate New Feasibilities

Asset	Date	Weather	
EO-1	2009-04-24T08:09:00Z	88	Edit Delete Show
ALOS	2009-04-24T23:24:50Z	0	Edit Delete Show
FORMOSAT-2	2009-04-25T00:45:28Z	1	Edit Delete Show
QB-2	2009-04-25T08:00:21Z	3	Edit Delete Show
SPOT-5	2009-04-25T21:15:14Z	2	Edit Delete Show
EO-1	2009-04-27T08:25:00Z	62	Edit Delete Show
FORMOSAT-2	2009-04-27T12:24:02Z	37	Edit Delete Show
SPOT-5	2009-04-28T06:24:02Z	3	Edit Delete Show
QB-2	2009-04-28T19:10:07Z	1	Edit Delete Show
ALOS	2009-04-29T00:35:33Z	0	Edit Delete Show
EO-1	2009-04-29T08:04:00Z	11	Edit Delete Show
ALOS	2009-04-29T20:38:33Z	0	Edit Delete Show
FORMOSAT-2	2009-04-29T23:19:50Z	0	Edit Delete Show
QB-2	2009-04-30T02:52:57Z	1	Edit Delete Show
SPOT-5	2009-04-30T11:02:33Z	-1	Edit Delete Show

20 Found — 1 2 | Next

1 Found

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

Campaign Manager Tasking Request Page

Visualize request using Google Earth

					12:40 PM	12:40 PM		
Namibia Flooding	Flood campaign test in Namibia	flooding	dmandl	Lake Liambezi test1	04/21/2009 06:10 PM	04/23/2009 12:04 PM	0.0	Edit Delete Show

Scenario/Campaign Tasking Requests for Namibia Flooding

Search Create New

Title	Content	Geolocation	Daynight Time	Scenario Feasibilities

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

Campaign Manager Tasking Request Page

Select one of the available satellites and task the asset to make it part of the campaign once the weather forecast for the overflight is checked by pressing forecast button

Namibia Flooding	flooding	Lake Liambezi test1	dmandl	UNKNOWN	EO-1	2009-04-24T08:09:00Z	88	0	-	Veto Task Edit Delete Show
Earthquake in Italy	quake	L'Aquila earthquake	sfrye	UNKNOWN	EO-1	2009-04-24T09:31:00Z	93	15	-	Veto Task Edit Delete Show
Etna	volcano	Mt. Etna	stufrye	SGT	EO-1	2009-04-24T09:32:00Z	13	15	-	Veto Task Edit Delete Show
Fernandina	volcano	Isla Fernandina	jallen	UNKNOWN	EO-1	2009-04-24T16:17:00Z	75	0	-	Veto Task Edit Delete Show

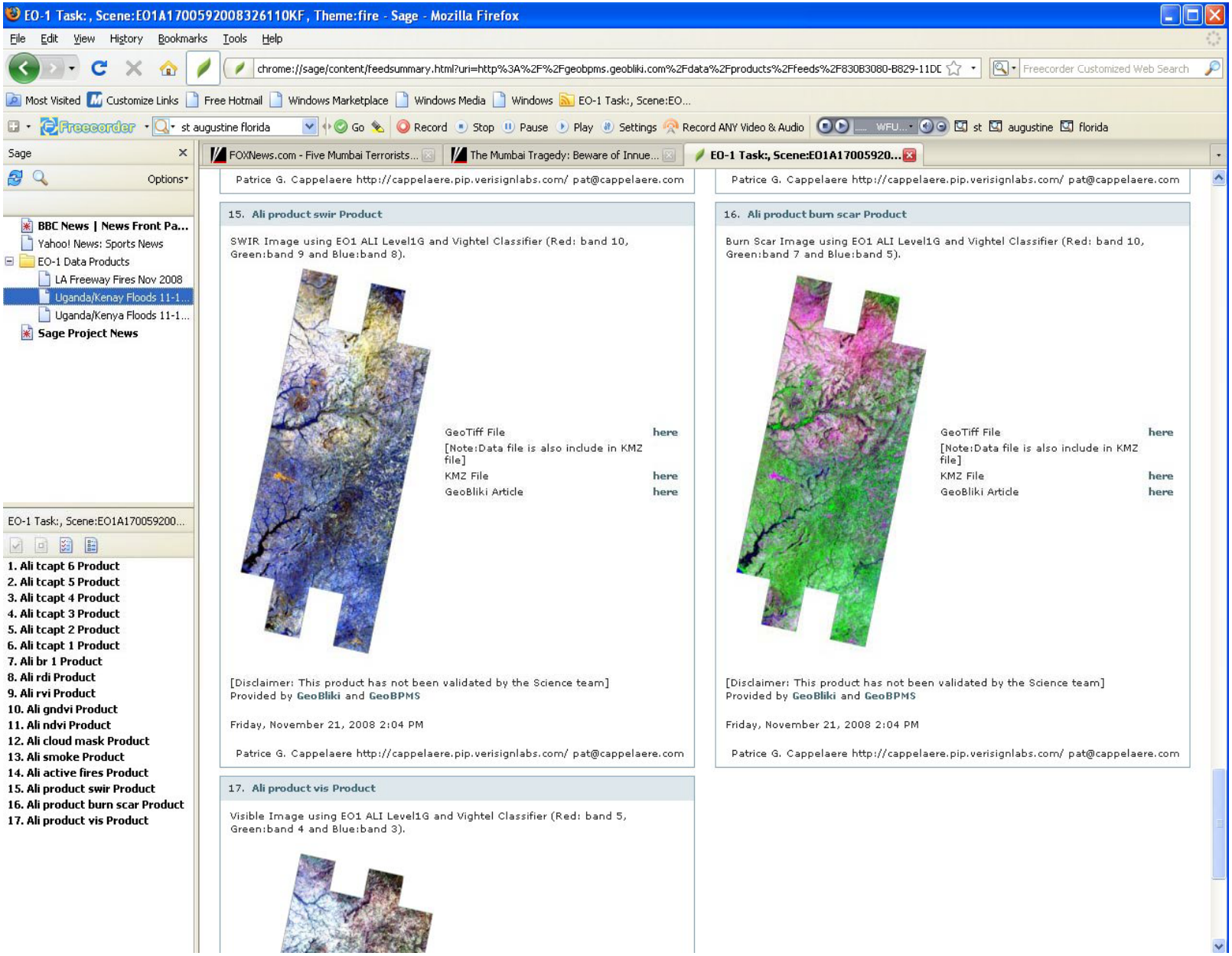
Tasking Opportunity:

Campaign: Namibia Flooding
User: dmandl
Organization: UNKNOWN
Theme: flooding
Request: Lake Liambezi test1
Latitude: -17.9108028411865
Longitude: 24.21120262146
Date: Fri, 24 Apr 2009 23:24:50 -0000
Weather: 0
Score: 0
Veto: 0
Notes:

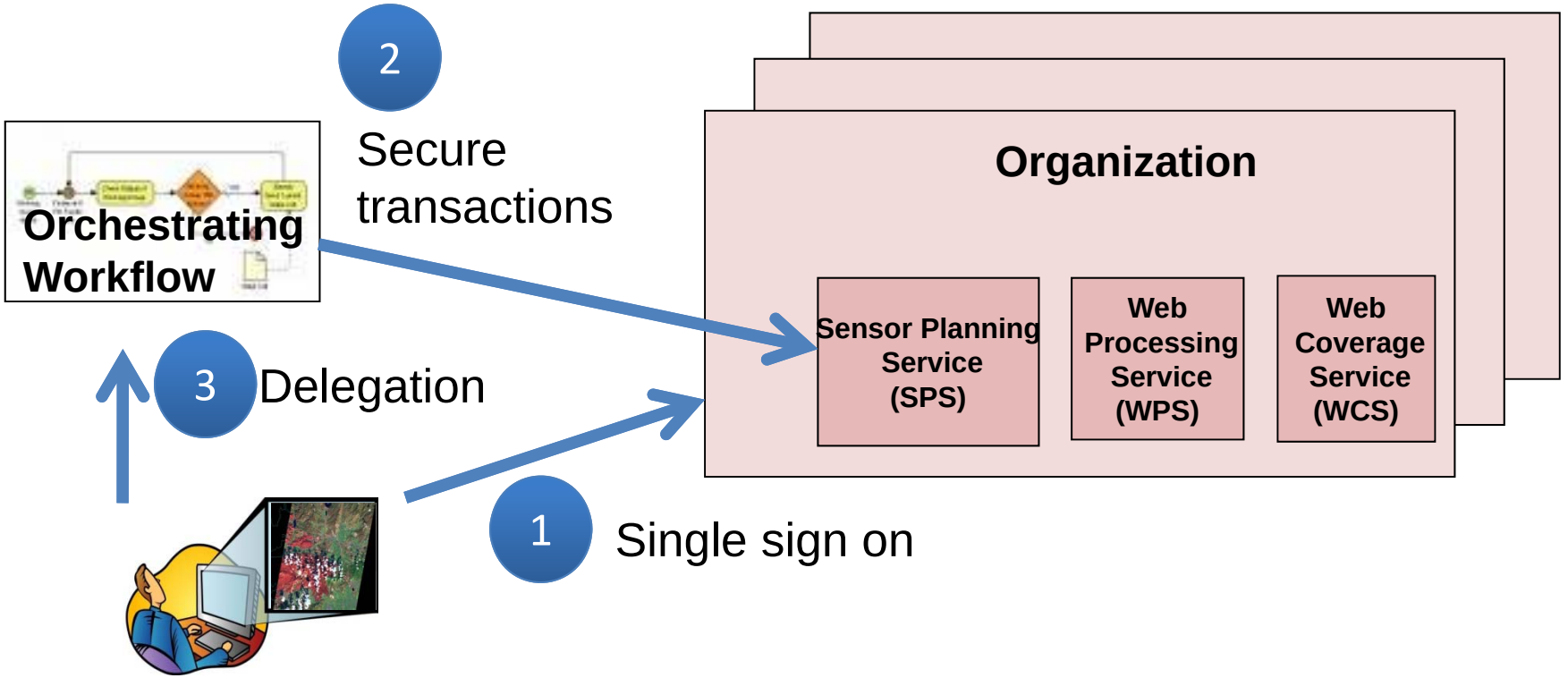
Show Map
Show Weather Forecast

Namibia Flooding	flooding	Lake Liambezi test1	dmandl	UNKNOWN	FORMOSAT-2	2009-04-25T00:45:28Z	1	0	-	Veto Task Edit Delete Show
Namibia Flooding	flooding	Lake Liambezi test1	dmandl	UNKNOWN	QB-2	2009-04-25T08:00:21Z	3	0	-	Veto Task Edit Delete Show

Deliver Level 2 Products via News Feeds to Users Along with Links to GeoTiff, KML and information about Image



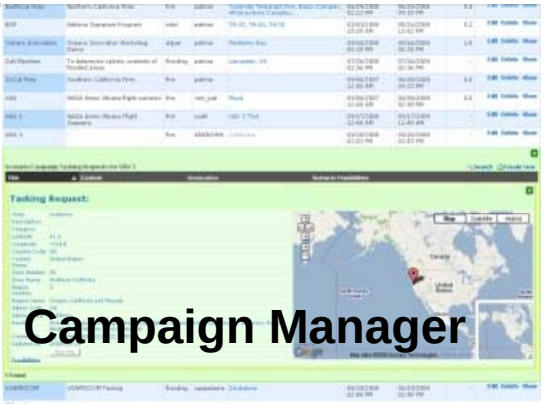
Key Implementation Challenges (Open yet secure)



Sample Application: Flood SensorWeb

Top Level Flood SensorWeb Functional Flow

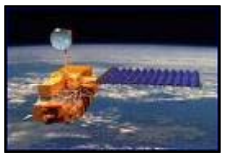
Request for satellite imagery in area of interest



Customized plan of needed satellite images

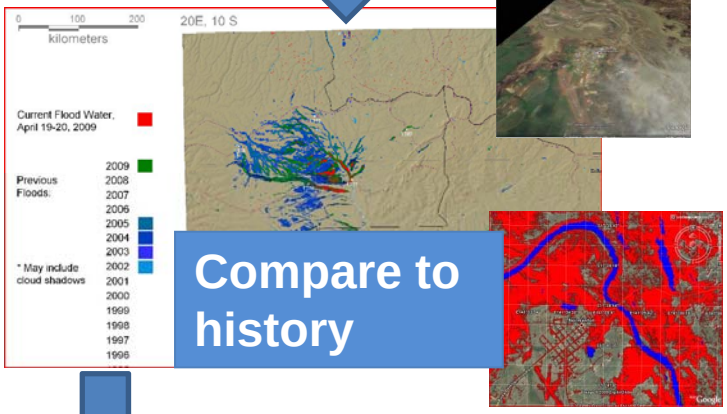
SPS

SPS



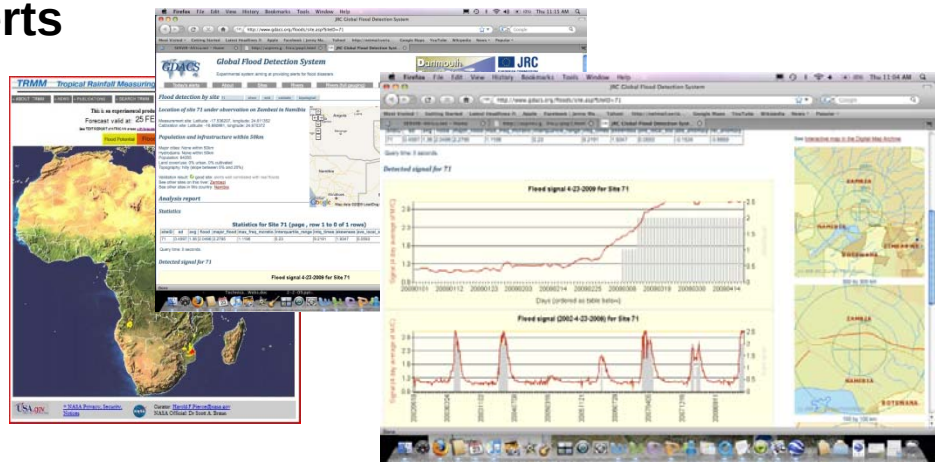
SPS

Flood conditions



ground flood measurements

Flood alerts



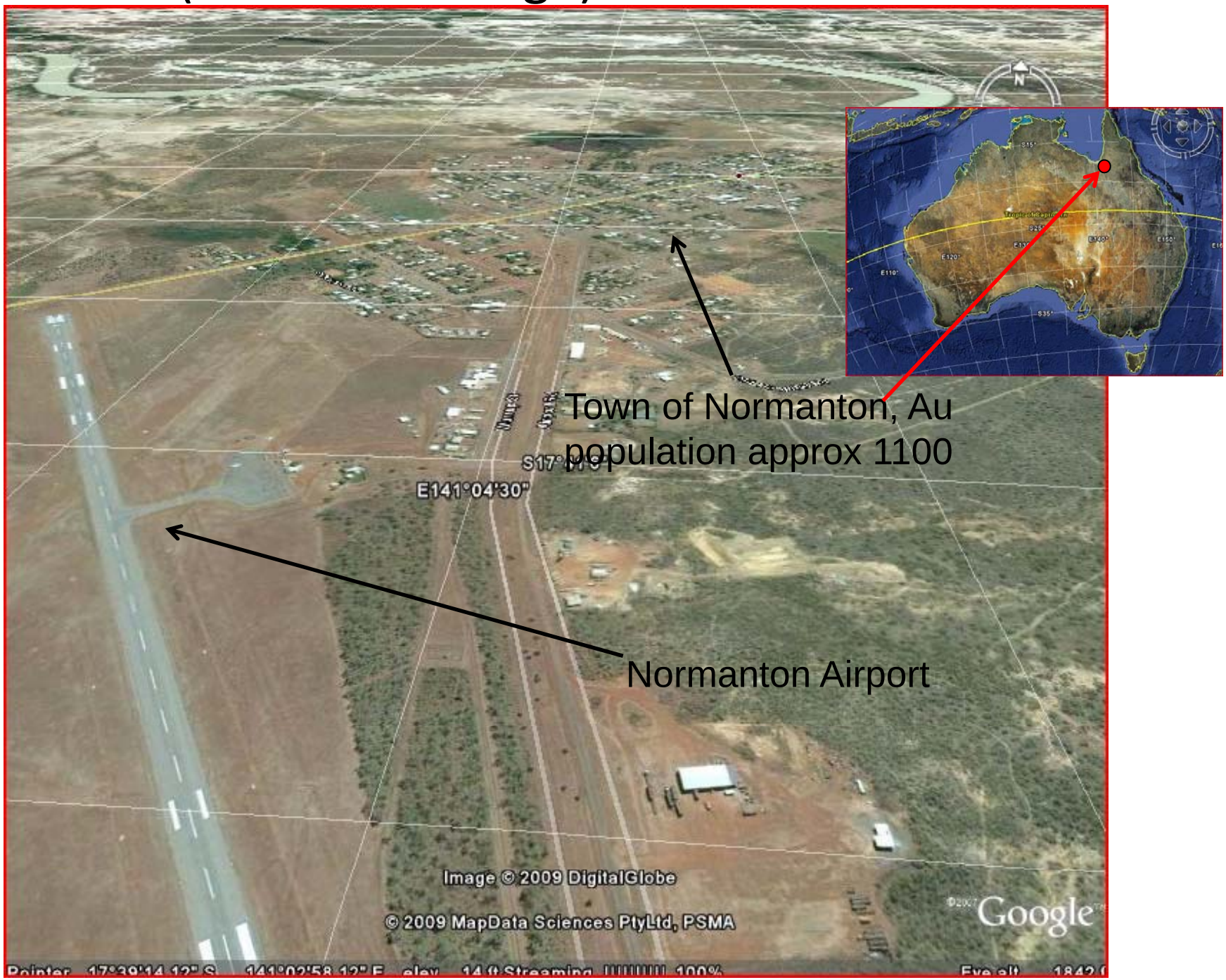
Improved Flood Prediction Model

***SPS – Sensor Planning Service**

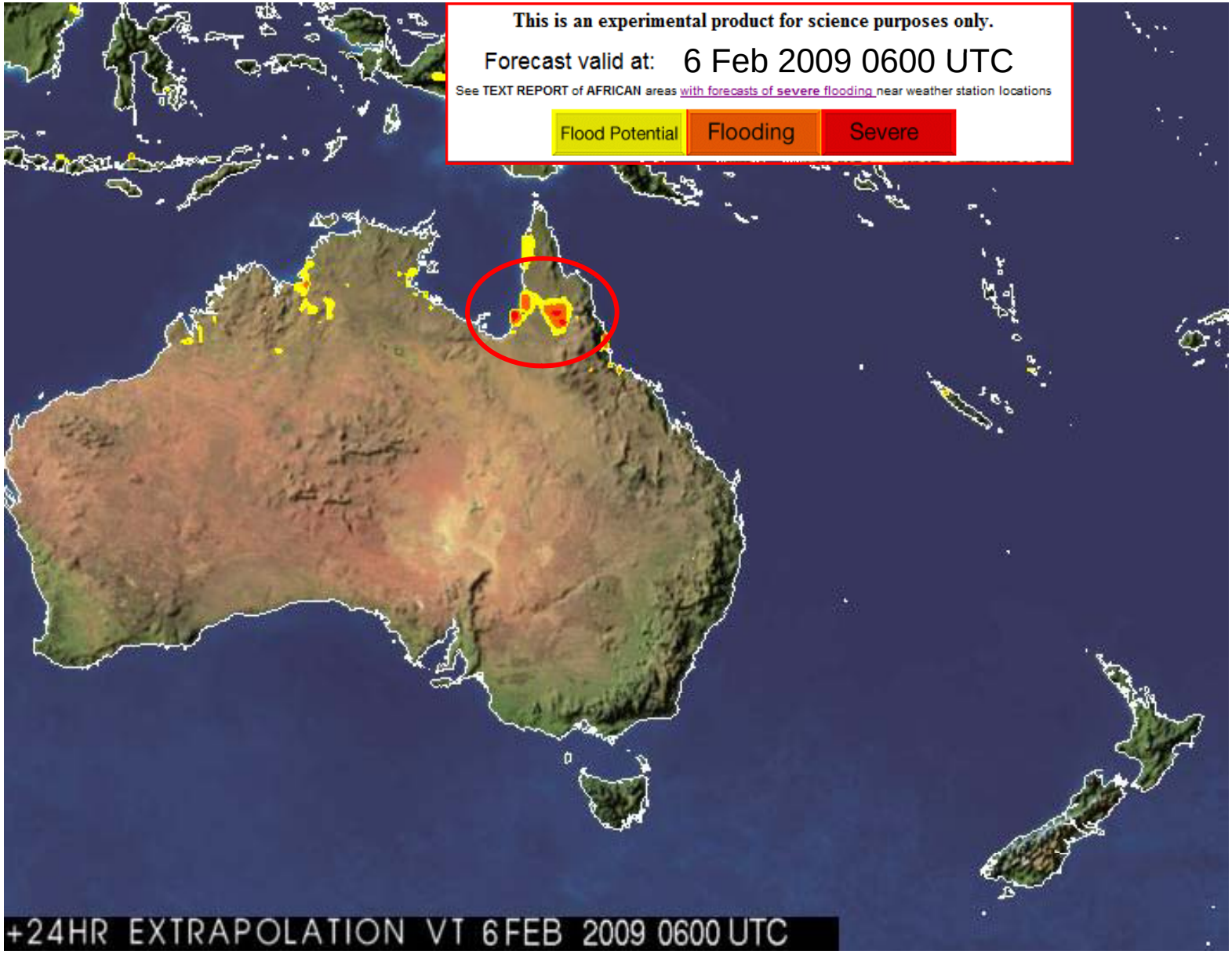
Normanton, Queensland, Australian Floods February 2009 Data Simulation

- **Prediction:** TRMM-based Predictive Flood Potential Model
  - Robert Adler/University of Maryland –NASA/GSFC
- **Survey:** MODIS Flood Map
  -Robert Brakenridge/ Dartmouth Flood Observatory
- **Details:**
  - Earth Observing 1 Advanced Land Imager and Hyperion
    -NASA/GSFC – Image acquisition, flood map, automation
      -- Mandl, Frye, Cappelaere
  - Radarsat Flood Image
    -MDA/Canadian Space Agency – Image acquisition
    -Space Research Institute NASU-NSAU, Ukraine – Flood Map Production
      - Serhiy Skakun and Natalia Kussul
  - Landsat Water Mask
    -Space Research Institute NASU-NSAU, Ukraine – Water Mask
      - Serhiy Skakun and Natalia Kussul
  - Formosat Flood Image
    -Taiwan National Program Science Office – Image acquisition
    - National Cheng-Kung University – Data processing
      - Cheng-Chien Liu

Normanton Floods- Google Earth view from before floods (Quickbird image)



TRMM-based flood potential forecast for February 6, 2009 **Prediction**



Specific Water Level and Lat/Long Projected for Normanton Area

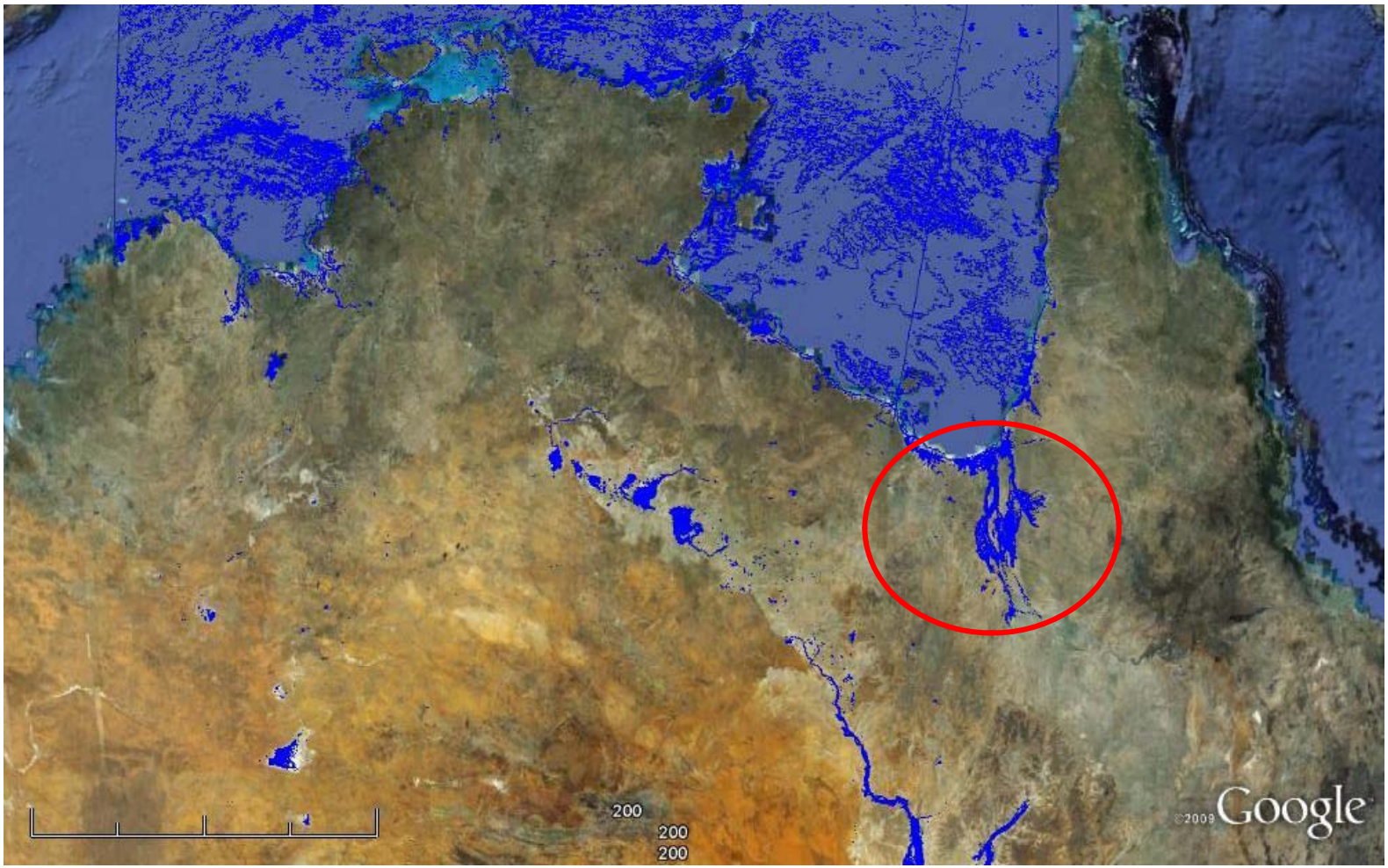
FORECASTED Flood Potential at 02/06/2009 0600Z

Forecast generated at 02/05/2009 0600Z

Use this lat/long to trigger other assets

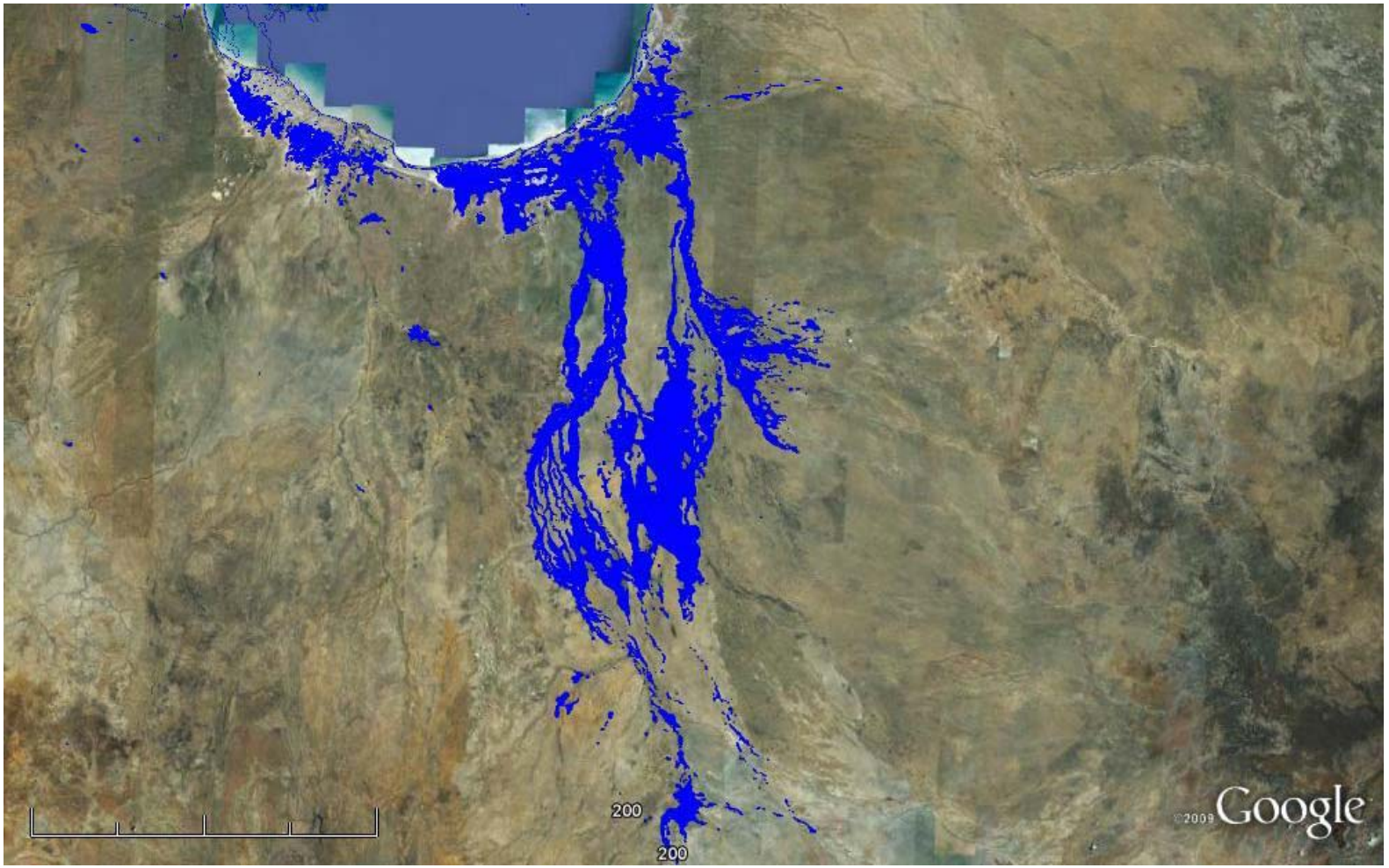
COUNTRY	WATER LEVEL & Latitude/Longitude	NEARBY LOCATION
Argentina	134mm -32.63 -60.88	~ 33.96km from ROSARIO AIRPORT -32.92 -60.78
Argentina	151mm -32.88 -61.13	~ 32.39km from ROSARIO AIRPORT -32.92 -60.78
Argentina	163mm -33.13 -60.88	~ 23.41km from ROSARIO AIRPORT -32.92 -60.78
COUNTRY	**WATER LEVEL & Latitude/Longitude**	**NEARBY LOCATION**
Australia	126mm -16.88 143.63	~ 107.79km from PALMERVILLE QU-16.00 144.07
Australia	127mm -16.88 141.13	~ 89.09km from NORMANTON QU-17.67 141.08
Australia	129mm -14.88 129.88	~ 84.91km from PORT KEATS AWS(AUT) NT-14.23 129.45
Australia	129mm -16.38 143.13	~ 109.00km from PALMERVILLE QU-16.00 144.07
Australia	131mm -15.63 141.63	~ 20.25km from KOWANYAMA QU-15.47 141.73
Australia	137mm -16.38 141.38	~ 107.91km from KOWANYAMA QU-15.47 141.73
Australia	138mm -16.38 143.38	~ 84.60km from PALMERVILLE QU-16.00 144.07
Australia	139mm -16.38 143.63	~ 62.37km from PALMERVILLE QU-16.00 144.07
Australia	148mm -18.13 146.13	~ 17.03km from CARDWELL QU-18.25 146.02
Australia	181mm -16.63 141.13	~ 116.07km from NORMANTON QU-17.67 141.08
Australia	187mm -16.88 143.88	~ 99.04km from PALMERVILLE QU-16.00 144.07
Australia	201mm -16.38 141.13	~ 119.57km from KOWANYAMA QU-15.47 141.73
Australia	216mm -17.63 146.13	~ 15.56km from INNISFAIL QU-17.52 146.02
COUNTRY	**WATER LEVEL & Latitude/Longitude**	**NEARBY LOCATION**
Indonesia	170mm -8.13 120.38	~ 154.43km from ENDEH/IPI -8.80 121.60
Indonesia	174mm -5.13 105.63	~ 51.55km from TELUKBETUNG/BRANTI -5.27 105.18
Indonesia	179mm -5.38 105.63	~ 50.22km from TELUKBETUNG/BRANTI -5.27 105.18
Indonesia	224mm -5.13 105.88	~ 78.64km from TELUKBETUNG/BRANTI -5.27 105.18
COUNTRY	**WATER LEVEL & Latitude/Longitude**	**NEARBY LOCATION**
Mozambique	169mm -25.88 32.63	~ 7.07km from MAPUTO/MAVALANE -25.92 32.57
COUNTRY	**WATER LEVEL & Latitude/Longitude**	**NEARBY LOCATION**

MODIS Flood Extent on Google Earth as KML File February 18, 2009 **Survey**



Robert Brakenridge – Dartmouth Flood Observatory

MODIS Flood Extent on Google Earth as KML File February 18, 2009 **Survey- Zoom**



Robert Brakenridge – Dartmouth Flood Observatory

MODIS Flood Extent on Google Earth as KML File February 18, 2009 **Survey- Closeup Normanton**

Robert Brakenridge – Dartmouth Flood Observatory

Article on Normanton Floods from the Northwest Star

Minister faces hazards in Gulf
TROY ROWLING
2/4/2009 9:05:00 AM
OVERFLOWING sewerage, crocodiles and mosquito-borne diseases were among the possible hazards Queensland Emergency Services Minister Neil Roberts faced when he arrived in the Gulf yesterday. Mr Roberts visited Karumba and Normanton to gauge the impact the floodwaters were having on the region.

And according to a statement released by Carpentaria Shire Council yesterday, there were quite a few issues making an impact on the isolated communities.

A spokesperson for Carpentaria Shire Council said the council was anticipating possible sewage overflows in the towns due to the inundation of pump stations.

The spokesperson also said there had been increased sightings of large crocodiles in the floodwaters surrounding Normanton and that Queensland Health had recommended the public avoid wading and playing in floodwaters due to mosquito-borne diseases.

However, despite the possible dangers, the Minister pressed on with his trip undeterred. “I’m here to be shown around the district and to talk to locals about the impact of the flooding,” Mr Roberts said. “I really need to take advice from local governments and emergency services personnel on the ground. So I’ll be waiting for their advice about what other measures need to be taken.”

The Carpentaria Shire Council spokesperson said another issue they planned to discuss with the minister was the upgrade of the Einasleigh and Gilbert crossings. They said this would enable road access for the essential re-supply of goods.
The isolated communities were currently reliant on food drops via aircraft and a fortnightly barge service from Cairns to Karumba to supply food, fuel and essential items to residents in the area.

With the Norman River continuing to rise, the communities could be cut off for a further six weeks.
Carpentaria Shire Council and Emergency Management Queensland met with local retailers and suppliers to discuss re-supply sustainability.

Article on Normanton Floods from the Northwest Star (continued)

Retailers were encouraged to monitor stocks and liaise with the Council to ensure all residents had adequate food and other essential items.

A business advisor from the Department of Tourism, Regional Development and Industry was flown into Normanton at the weekend to help the businesses manage the effects of ongoing flooding on their bottom line.

His feet firmly on dry ground, Mr Roberts took time during his brief stopover in Mount Isa to thank local emergency services leaders for their hard work.

“I’ve received very good feedback from the Mayors in the local communities about the work and support the emergency service crews are doing,” he said.

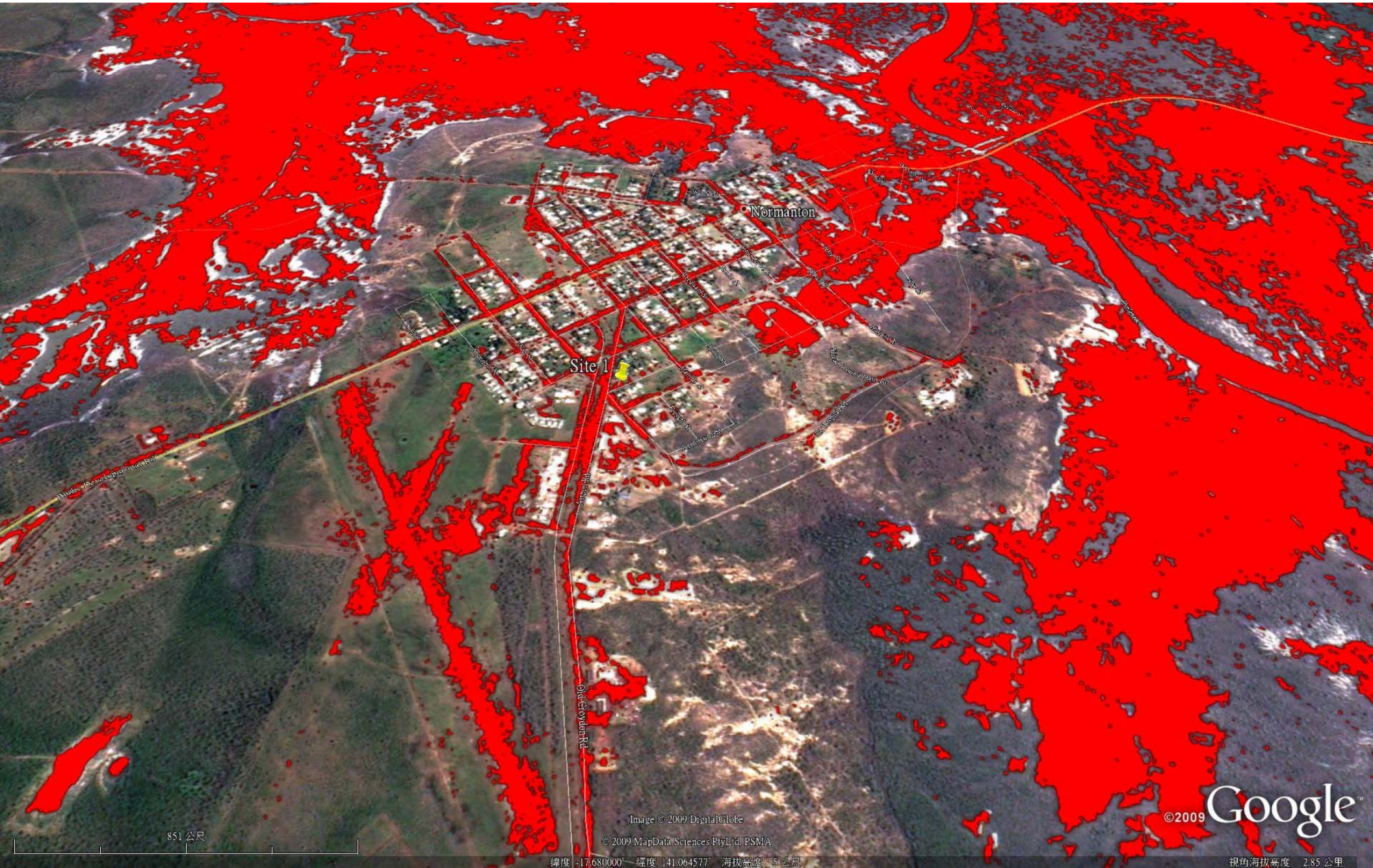
Normanton Airport Ground View 2-15-09

http://blogs.abc.net.au/.shared/image.html?/photos/uncategorized/2009/02/15/normanton.jpg

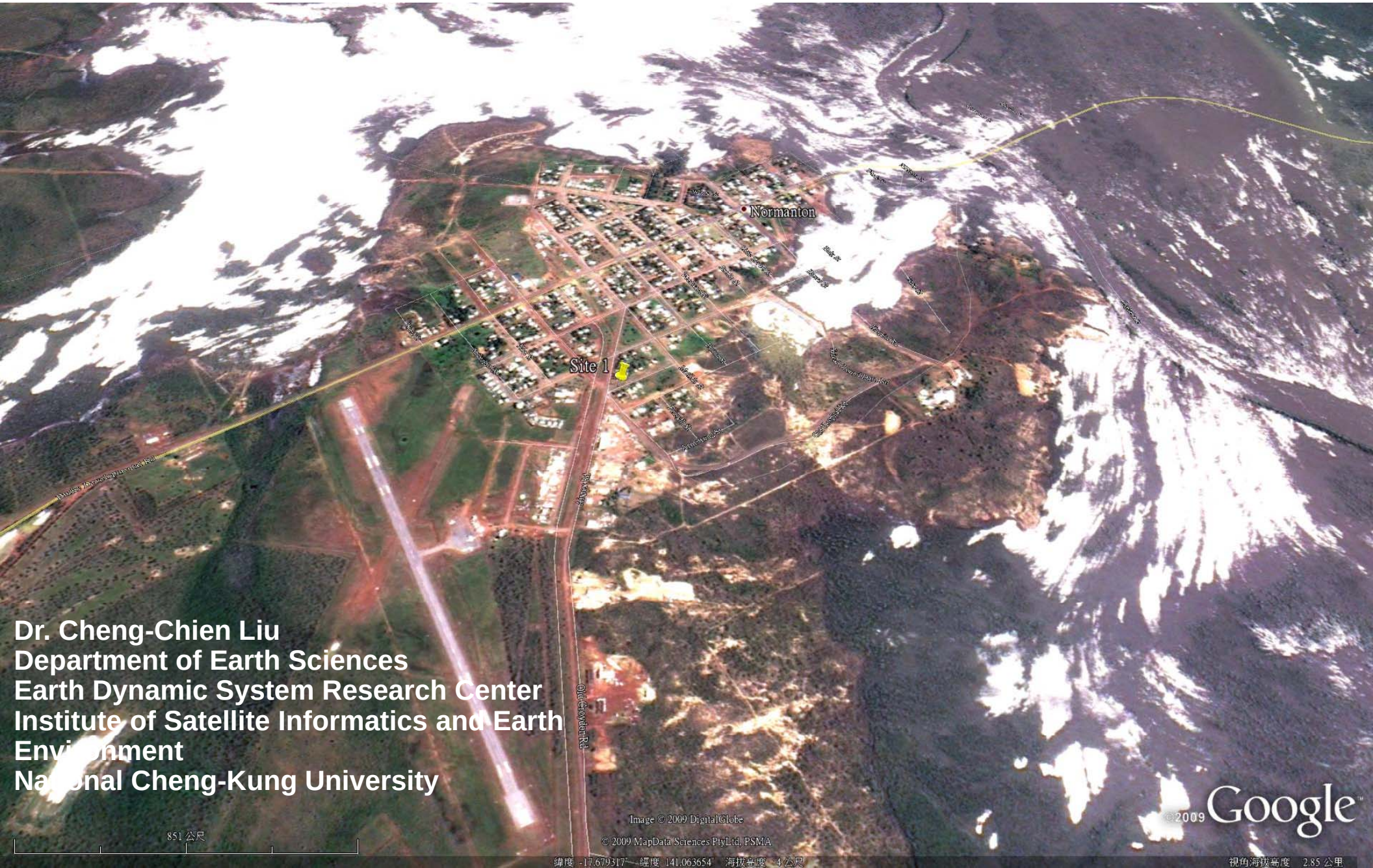
Normanton Airport View 2 2-15-09

http://blogs.abc.net.au/.shared/image.html?/photos/uncategorized/2009/02/15/normanton.jpg

Radarsat-2 Water regions 14 Feb 2009)



Formosat-2 image 18 Feb 2009

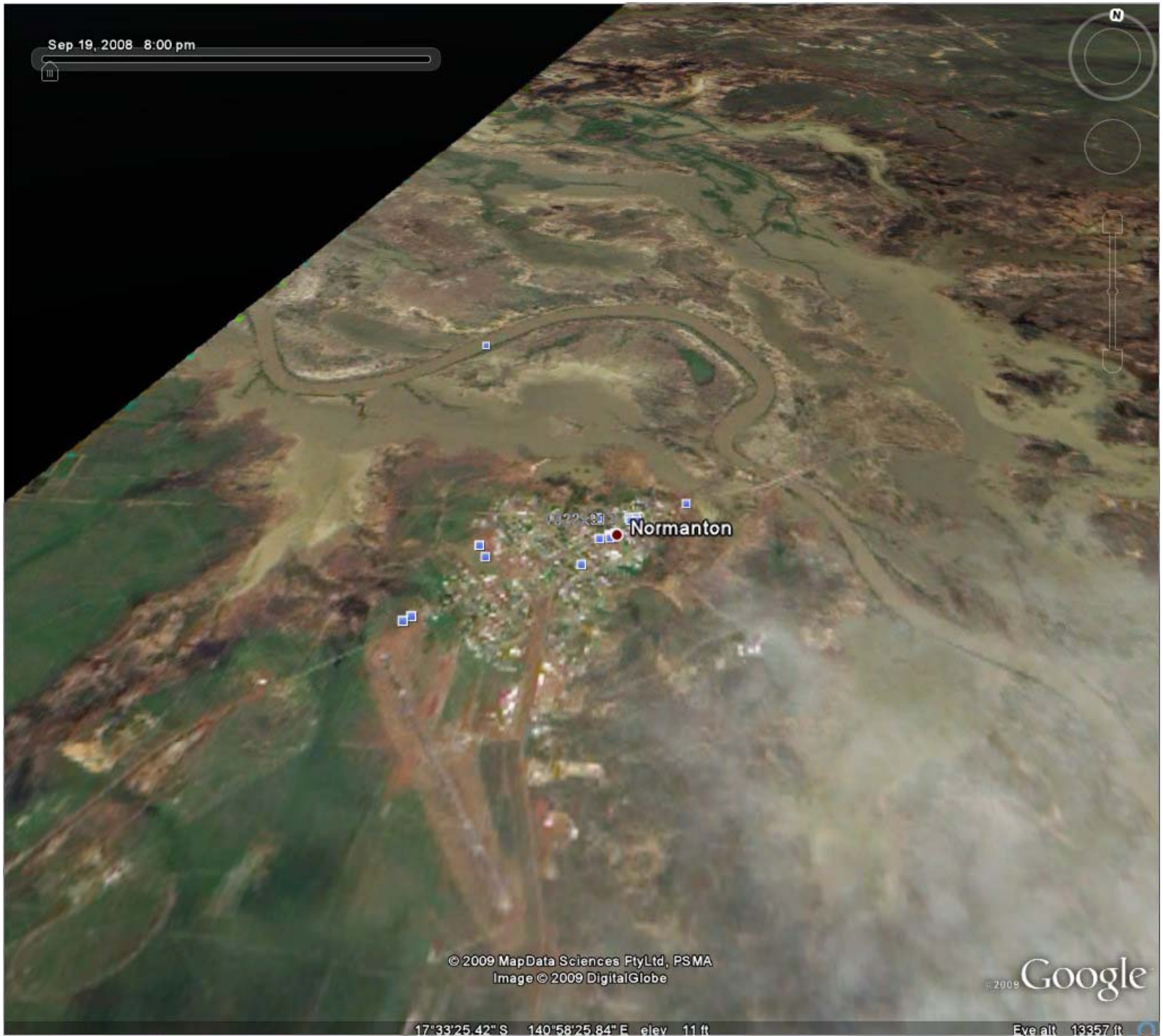


Dr. Cheng-Chien Liu
Department of Earth Sciences
Earth Dynamic System Research Center
Institute of Satellite Informatics and Earth Environment
National Cheng-Kung University

Normanton Floods - February 18, 2009 Zoom 1

Normanton Floods - February 18, 2009 Zoom 2

EO-1 Image March 11, 2009

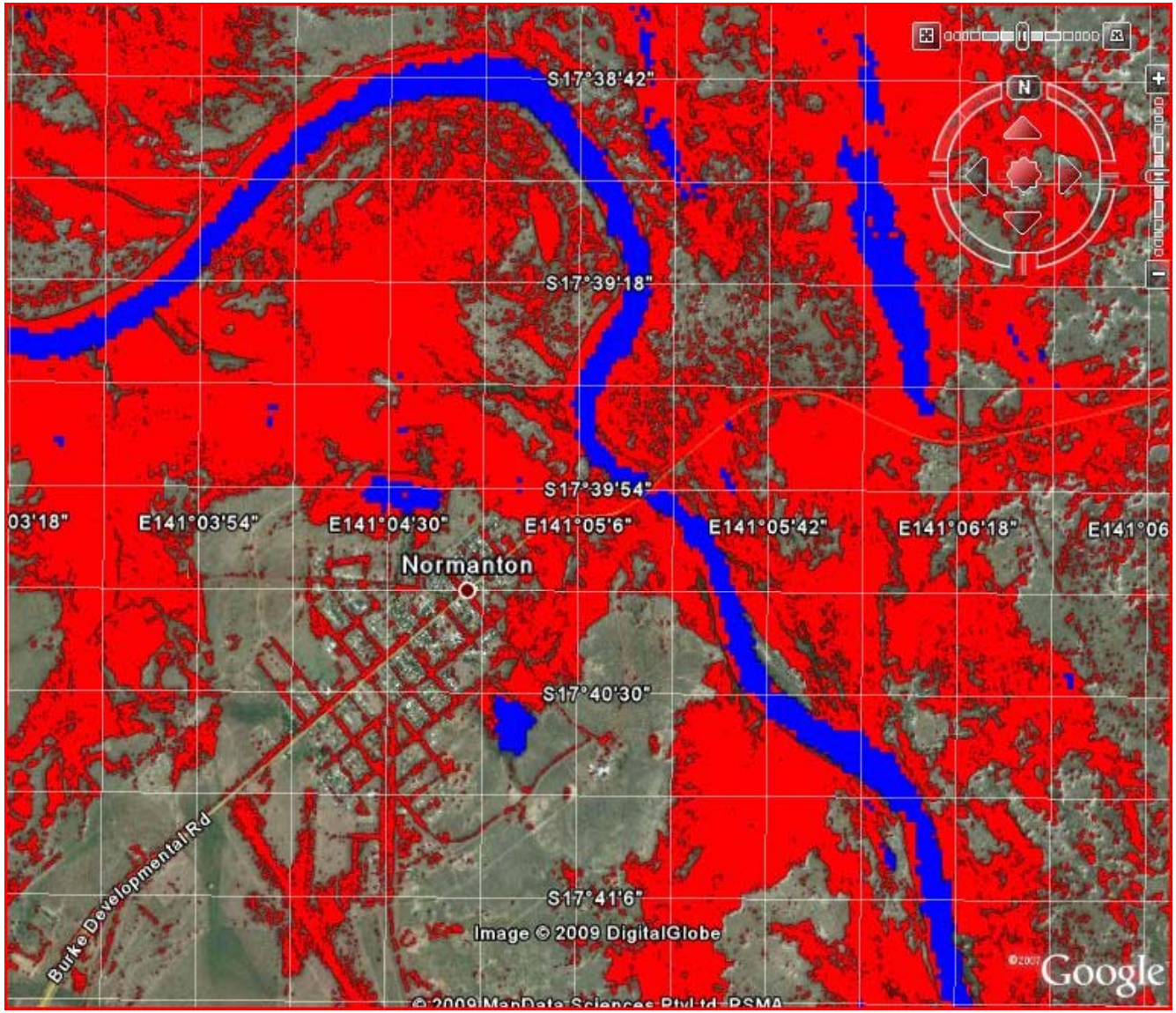


Radarsat/Landsat Flood Map

Radarsat Image 2-14-09 (red), 3 meter resolution

Landsat Image pre-flood 5-6-02 (blue), 30 meter resolution

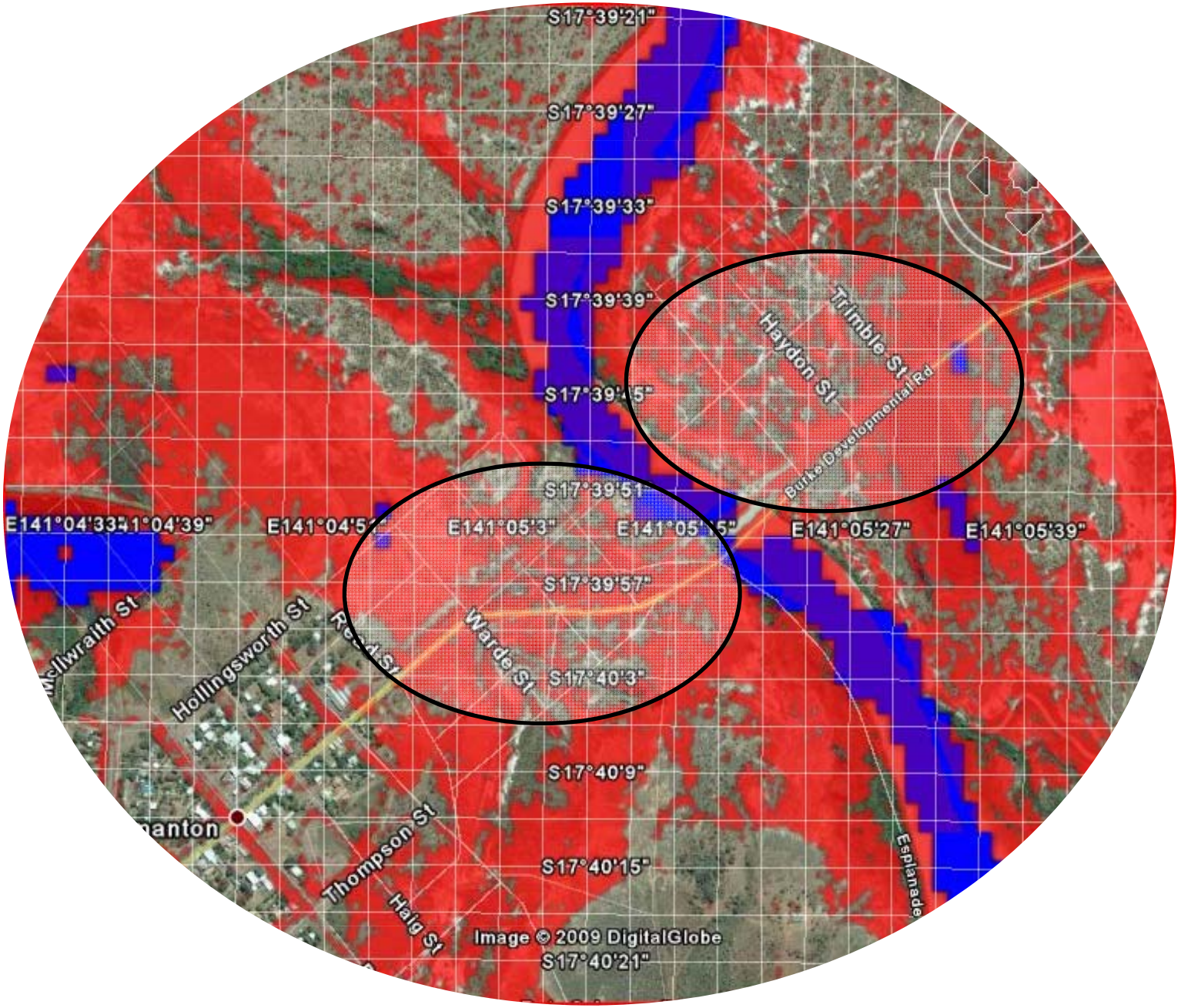
Flood maps produced by the Space Research Institute NASU-NSAU, Ukraine



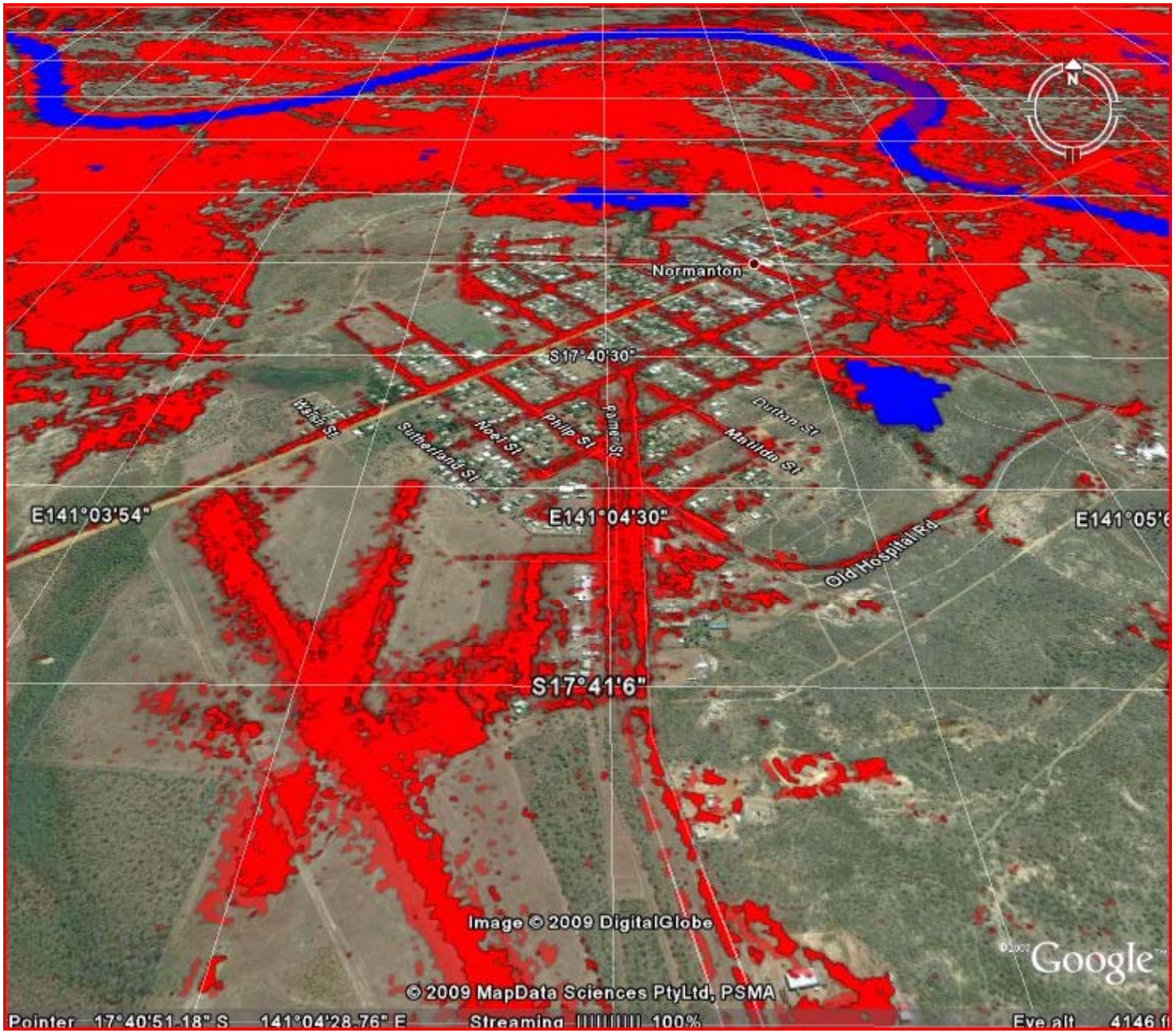
Red – flood waters

Blue – Existing waters

Find Flooded Streets



Normanton with Landsat 7 5-7-02, Radarsat 2 Flood Extent Overlay February 14, 2009 and February 17, 2009 3m resolution



Namibian Floods 2009

Namibian Flood-Disease SensorWeb Emergency Response Pilot Project

- Extensive flooding in Namibia in 2009
- Worked with Guido Van Langenhove, head of Hydrological Services in Namibia, to identify flood sensorweb pilot scenario
- Collected satellite imagery for months in the Lake Liambezi area
- Collected the following:
  - Ground measurements (Guido Langenhove)
  - Rainfall estimates, and predictions for first three months of 2009 (Policelli)
  - Flood predictions for 1st three months of year (TRMM – Policelli)
  - Assets:
    - EO-1 30 meter/10 meter 1 -2 times per week(Frye)
    - Formosat 2 meter data, once per week for 4-6 weeks (requested from Cheng-Chien Liu
    - MODIS flood map , once per week 4-6- weeks (Requested from Bob Brakenridge)
    - Radarsat about once per week

Namibian Flood-Disease SensorWeb Emergency Response Pilot Project

- Namibian Dept of Hydrology installing flood gauges and rain gauges
- Will correlate ground measurements with satellite imagery to calibrate imagery and thus improve flood forecast models
- NASA will improve our flood forecast model and assist in improving Riverwatch system (Dartmouth Flood Observatory)

Campaign Manager (GeoBPMS 1.0) Triggering EO-1 Flood Image and Possible Other Satellites to Use

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
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Potential Feasibility	Asset: QB-2, Date: 2009-04-30T02:52:57Z
Potential Feasibility	Asset: SPOT-5, Date: 2009-04-30T11:02:33Z
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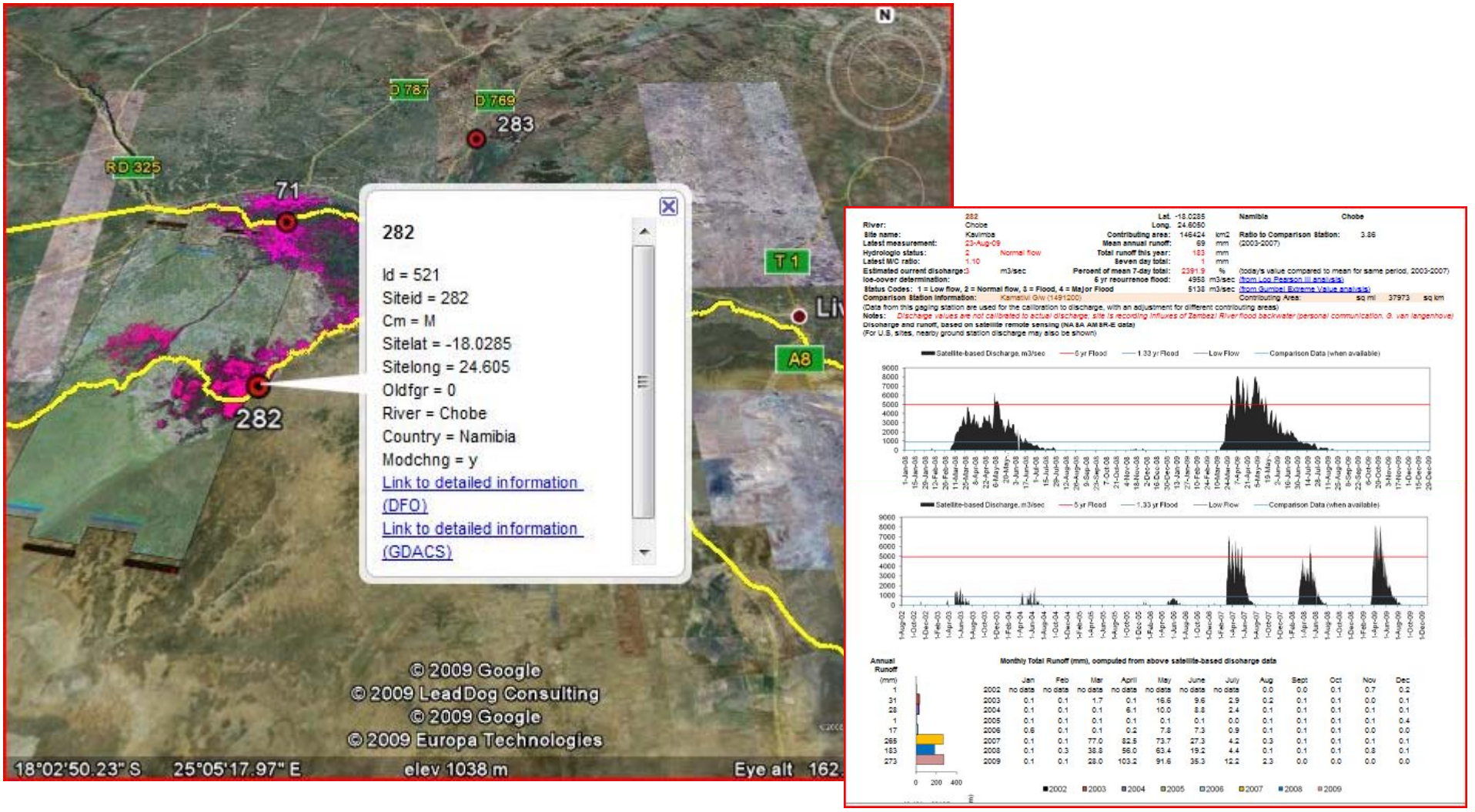
Potential Feasibility	Asset: ALOS, Date: 2009-05-02T14:09:28Z
Potential Feasibility	Asset: QB-2, Date: 2009-05-02T14:38:16Z
Potential Feasibility	Asset: SPOT-5, Date: 2009-05-03T01:43:33Z
Potential Feasibility	Asset: FORMOSAT-2, Date: 2009-05-03T09:47:24Z

EO-1, Radarsat, River Watch Example

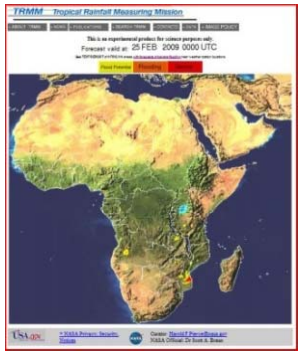


Goal is to calibrate River Watch measurements which use AMSR-E to calculate river flows and thus provide early warning for flooding downstream

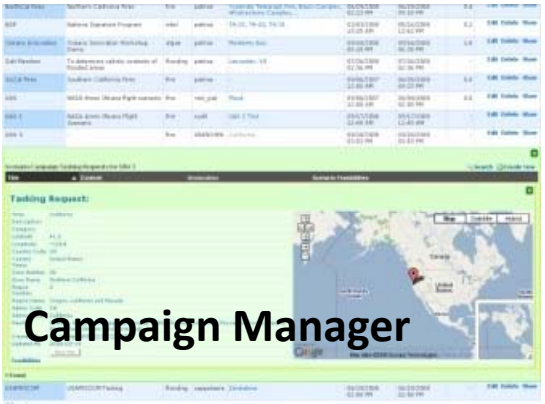
Another Sample Application: Disease SensorWeb

Top Level Malaria Early Warning SensorWeb Functional Flow

Flood Predictions



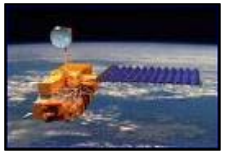
Flood alerts



Customized plan of needed satellite images

SPS

SPS



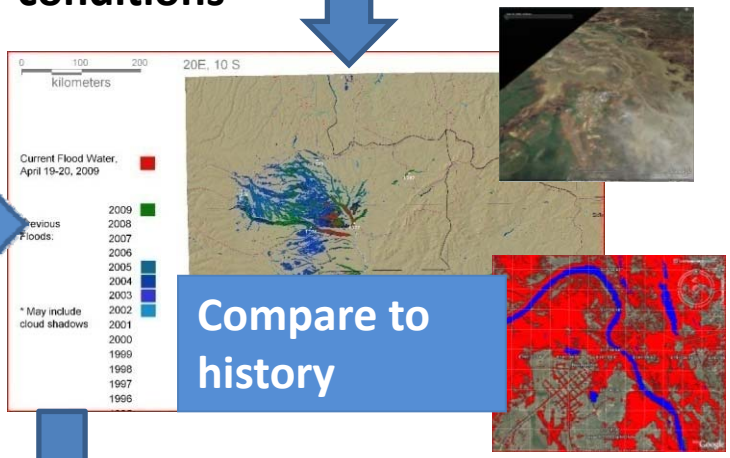
SPS

Flood alerts

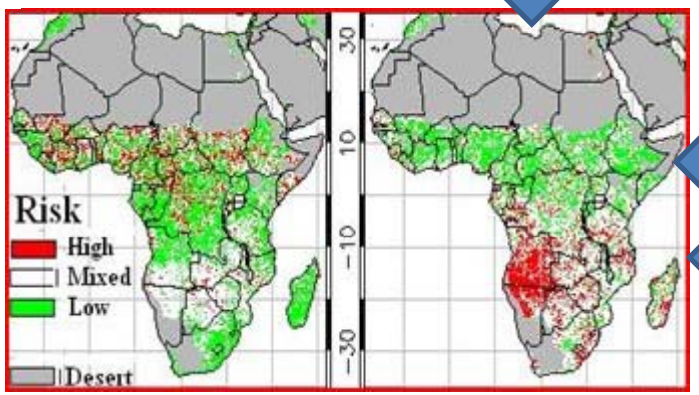
Request for satellite imagery in area of interest

Climate & vegetation conditions

Flood conditions



EFTB



Statistical disease risk alerts

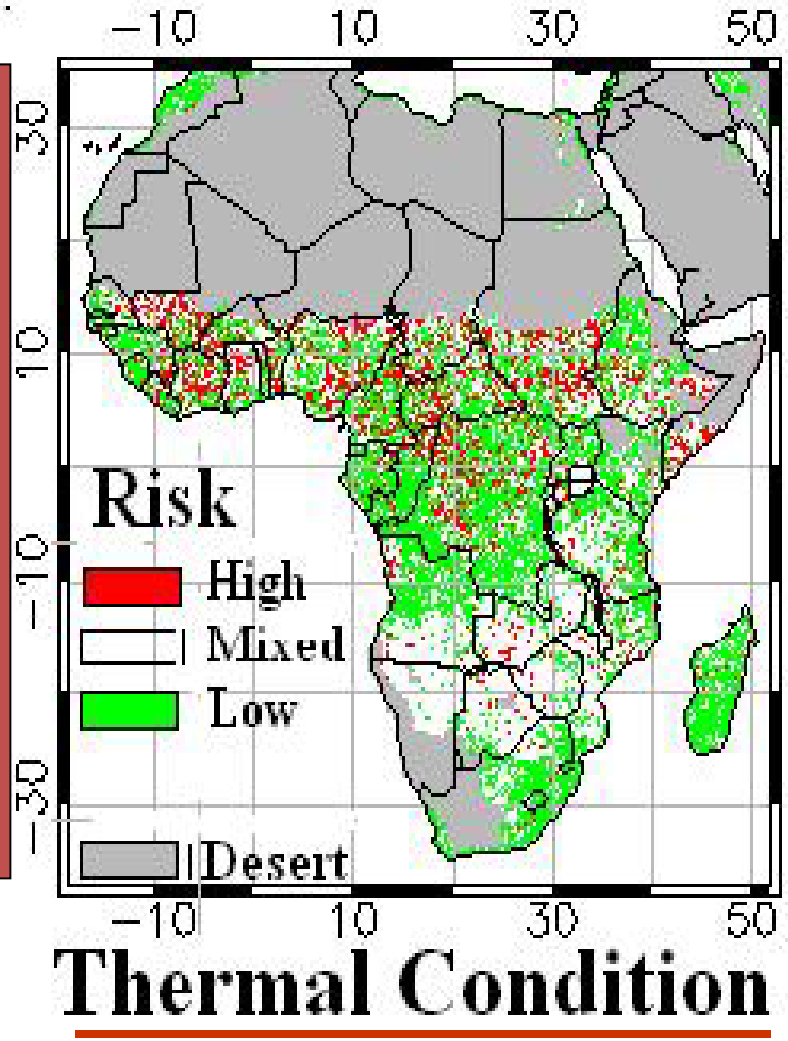
Historical epidemiological data

***SPS – Sensor Planning Service**

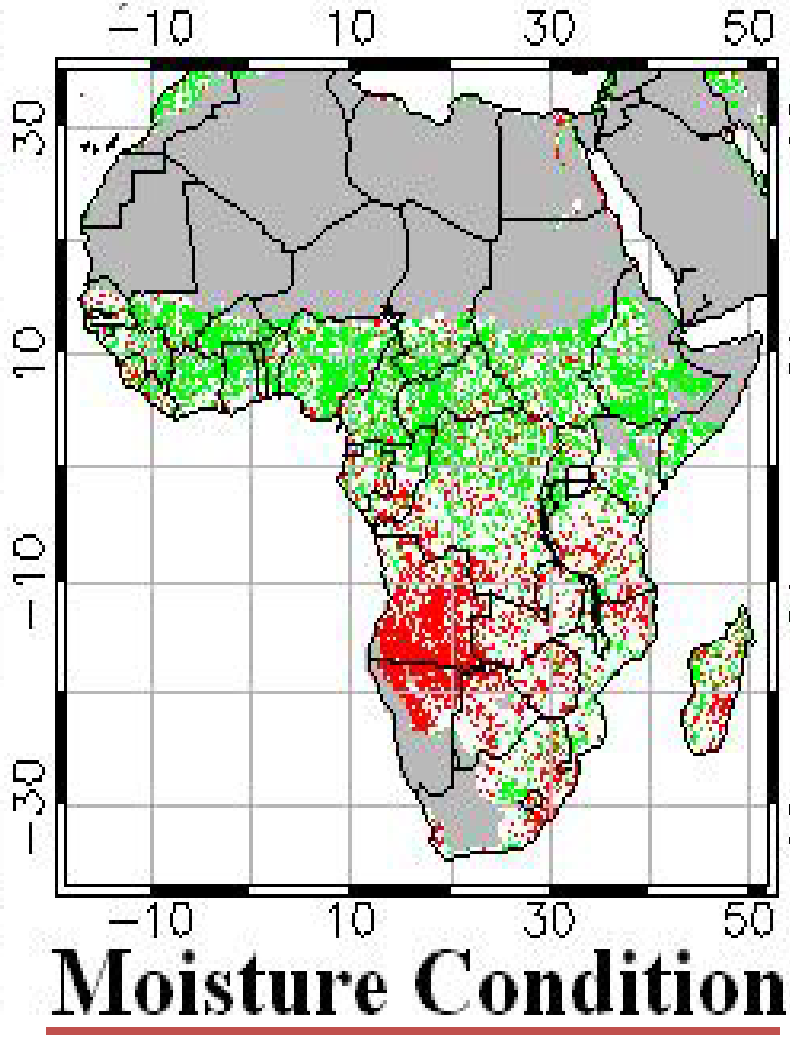
Strategy: WEATHER PROXY

AUGUST 26, 2008

Malaria risk map identifies priority areas and additional resources needed to fight epidemics effectively



Thermal Condition



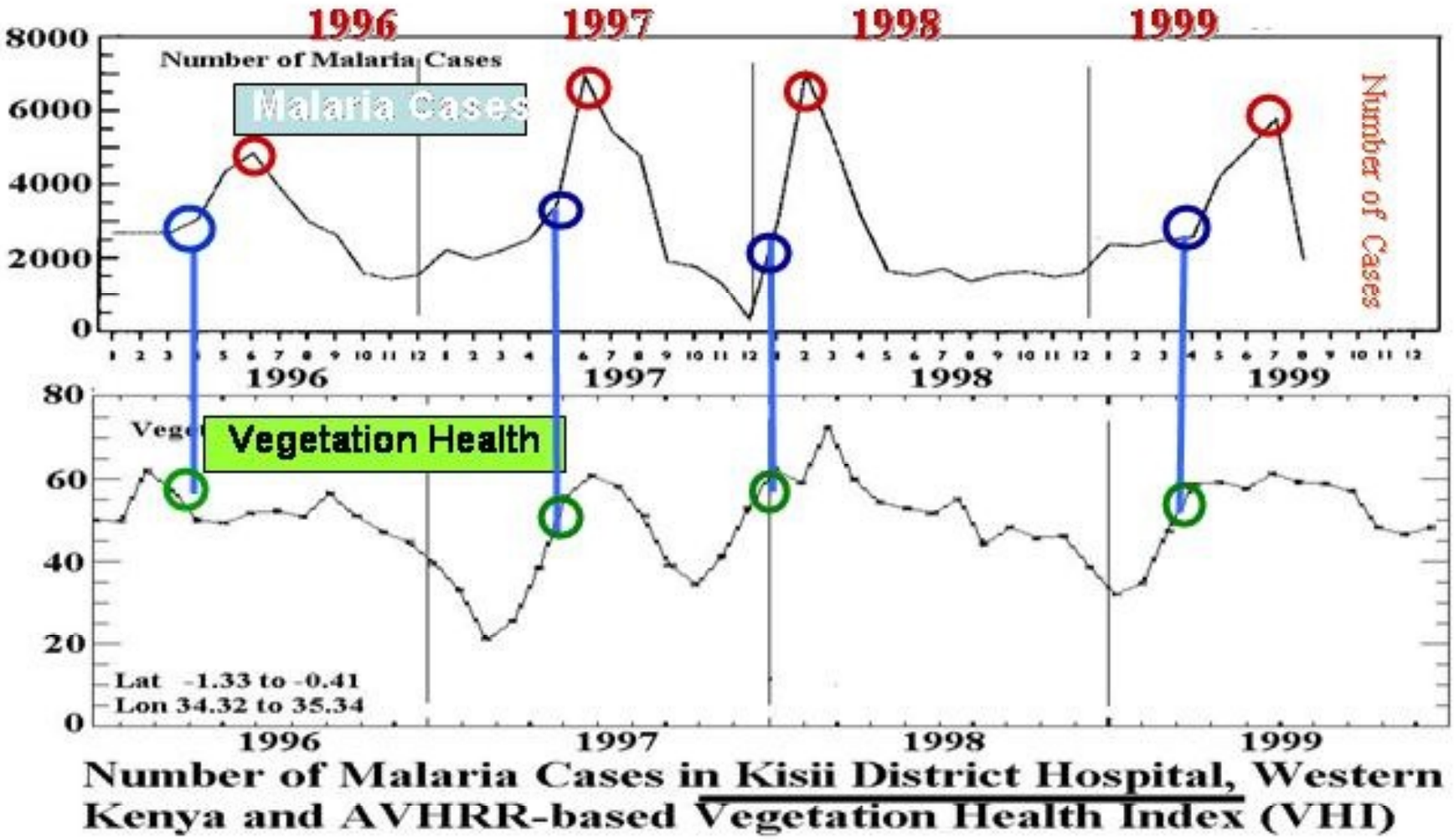
Moisture Condition

INTENSIVE MALARIA

42

Felix Kogan/NOAA/NESDIS

Predicting Malaria in KENYA



Number of Malaria Cases in Kisii District Hospital, Western Kenya and AVHRR-based Vegetation Health Index (VHI)

VH provides up to 4 months advance malaria warning

Felix Kogan/NOAA/NESDIS

Conclusion

- Sensorwebs, OCG standards and cloud computing
  - Lower cost to provide data products to disaster management personnel
    - Easier implementation
    - User provided with tools to “do-it-yourself”
- Ease of use increases via the use of this approach
  - Leverages internet approach to user applications