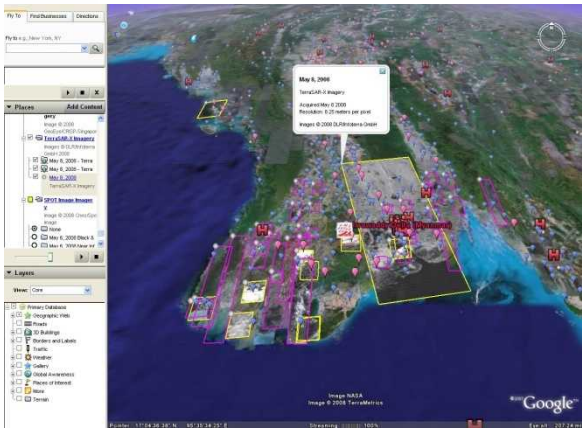
# *Flood SensorWeb*

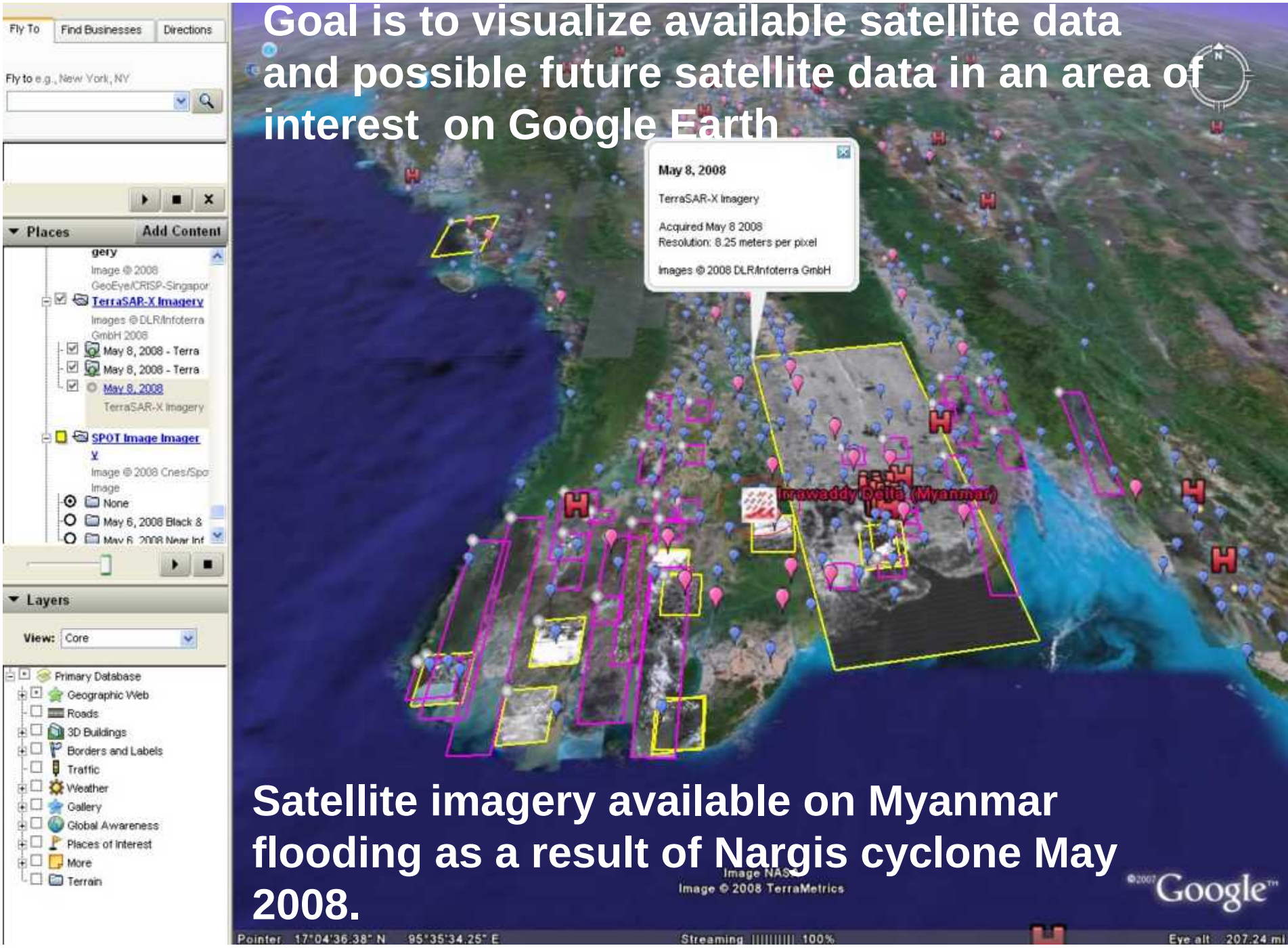
***Dan Mandl / Fritz Policelli – NASA/GSFC***

***10-16-08***



# Purpose

- Vision of Flood Sensor Web
- Present status of Flood SensorWeb initiative
- Some relevant examples from Fire SensorWeb efforts

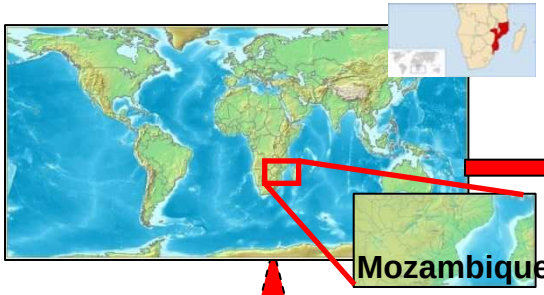

Goal is to visualize available satellite data and possible future satellite data in an area of interest on Google Earth
Fly To
Find Businesses
Directions
Fly to e.g., New York, NY
Places
Add Content
TerraSAR-X Imagery
May 8, 2008 - Terra
May 8, 2008 - Terra
May 8, 2008
TerraSAR-X Imagery
SPOT Image Imagery
None
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)
Image NASA
Image © 2008 TerraMetrics
©2007 Google
Satellite imagery available on Myanmar flooding as a result of Nargis cyclone May 2008.

User selects desired theme

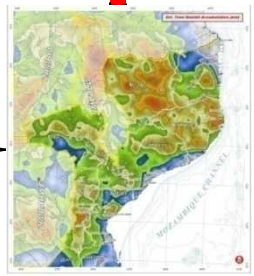
Disaster Management Information System (DMIS)

- Air Quality
- Coral Bleaching
- Droughts
- Earthquakes
- Excessive Heat
- Fire Weather
- Flooding
- Harmful Algal Blooms (HABs)
- Hurricanes/Tropical Weather
- Oil Spills
- Rip Currents
- Severe Weather
- Space Weather
- Tsunamis
- Volcanoes

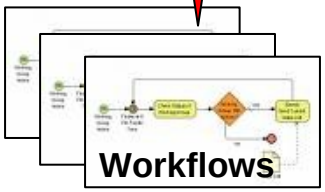
Collate user's area of interest with predicted flood potential

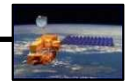


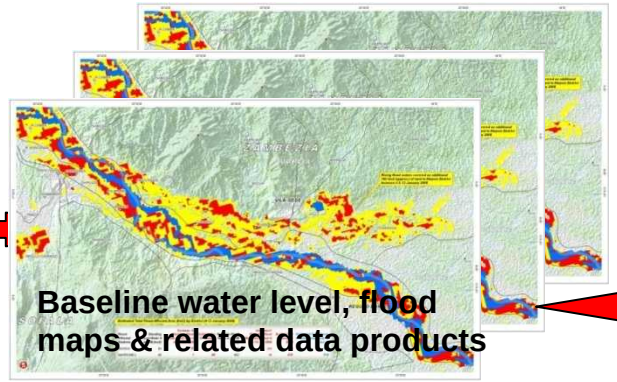

Multi-asset campaign manager provides information on available existing images and possible future images/data products and triggers workflows to get those products



Global Flood Forecast






Multi-spectral
Radar
Low resolution fast response
High resolution



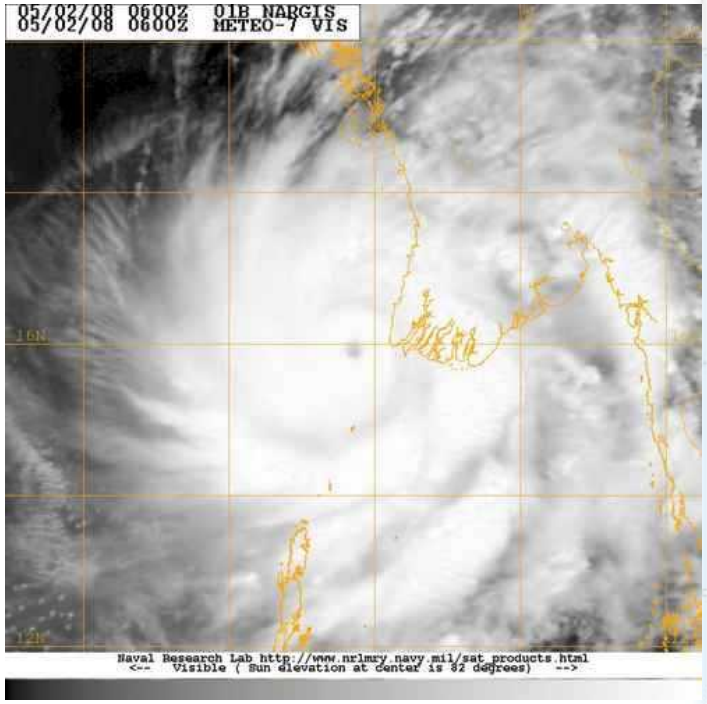
# Vision: Theme-Based Flood Product Generation

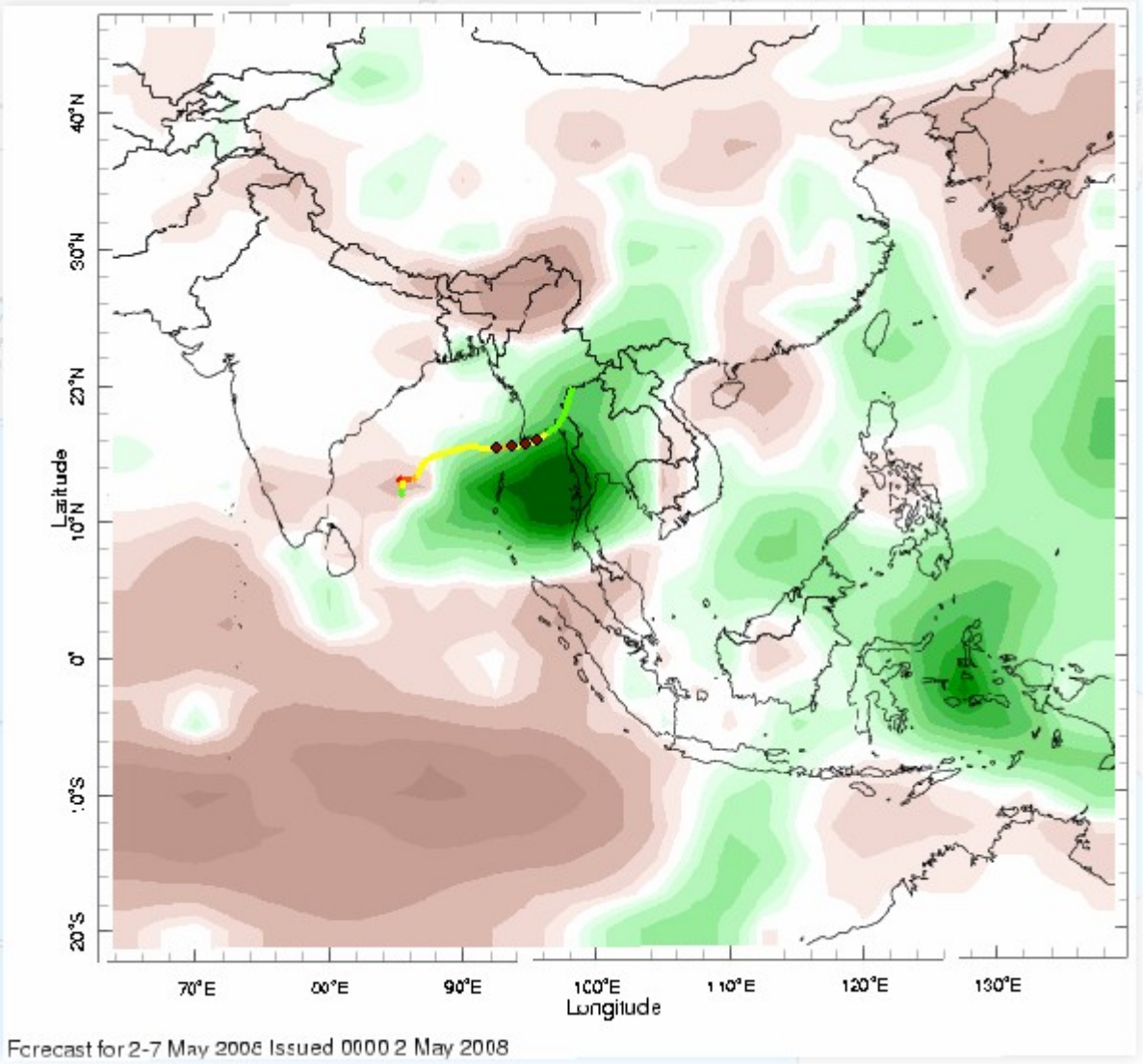
# Ran Experiment with Myanmar Floods Using What We Had

- Ran experiment with Myanmar floods in collaboration with International Federation of Red Cross/Red Crescent (IFRC)
  - Columbia Univ. International Research Institute Rainfall Anomaly Maps
  - TRMM Estimated Rainfall and Flood Potential Model
  - MODIS on Terra and Aqua for Flood Extend
  - EO-1 for more details
- Assessed results
- Made plans to search for additional capability to more closely match Red Cross desired workflow

# Myanmar Flood Sensor Web Exercise
# 2 May

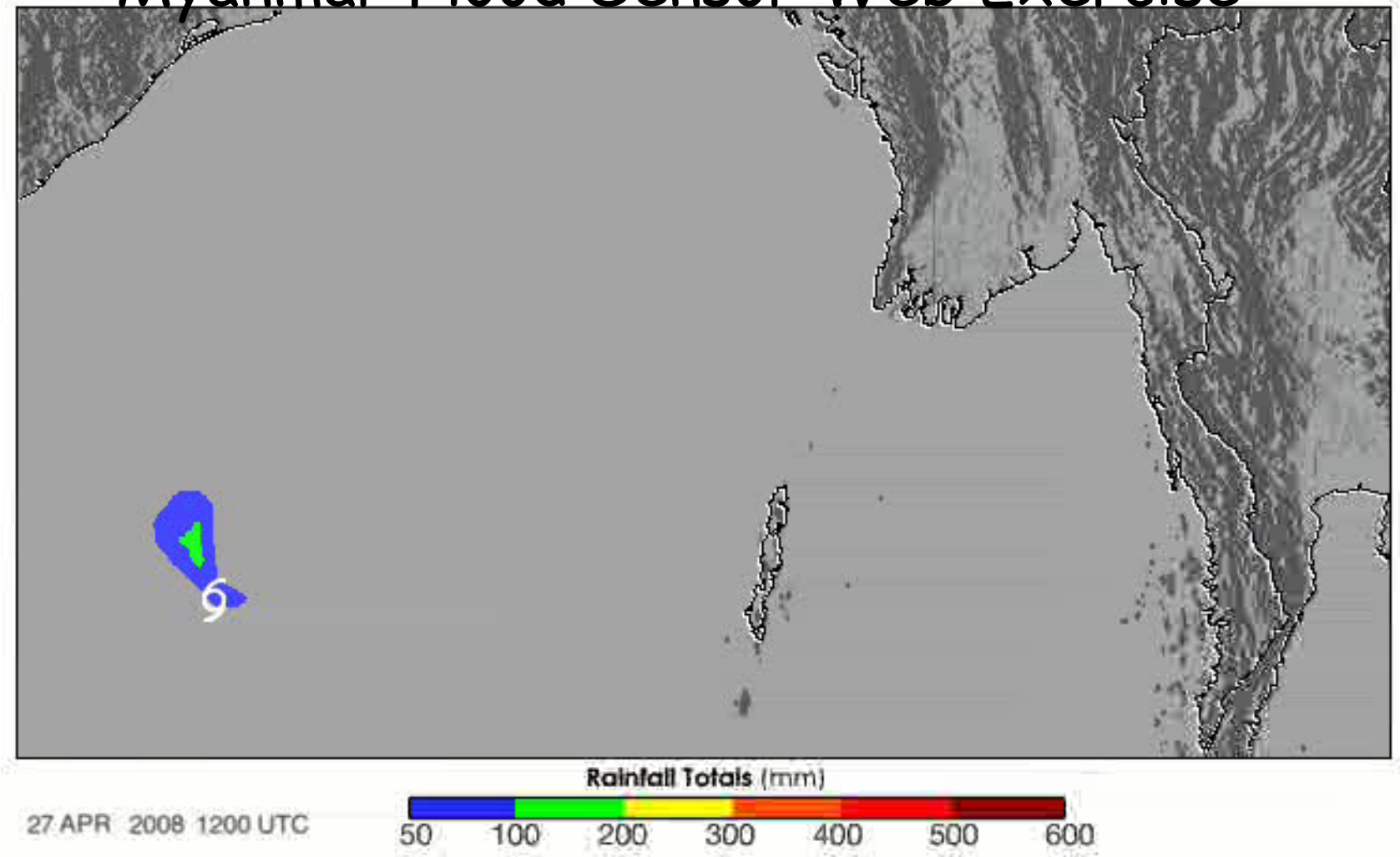
Columbia Univ IRI
Average climatic rainfall
as compared to current
Predicted rainfall. Thus looking
for rainfall anomalies as
Possible early flood warning.



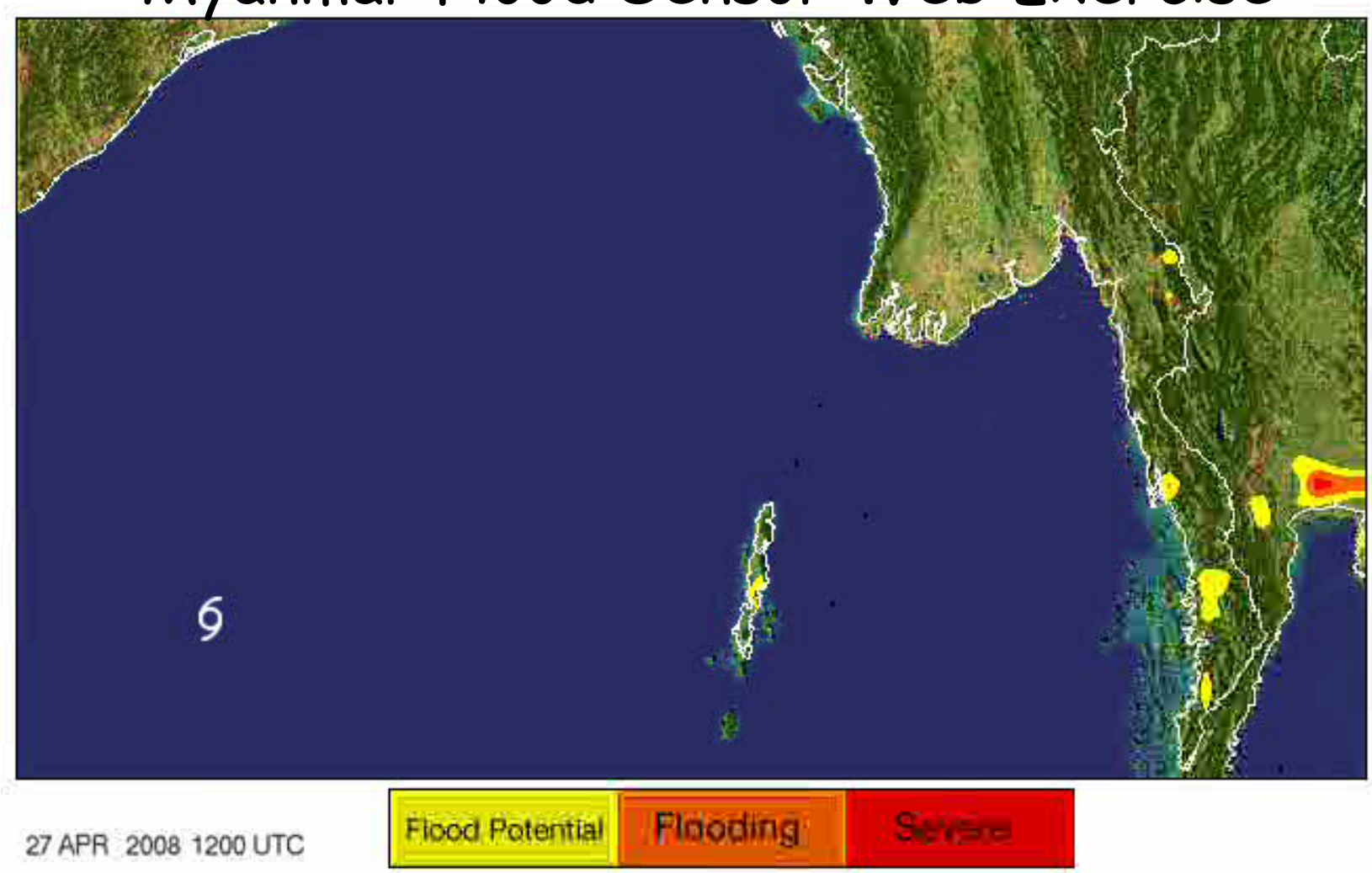

Category 3 -> 4 -> 2

# Myanmar Flood Sensor Web Exercise




**NARGIS TRMM Animation of Rainfall Progression** (put in presentation mode & click to see movie)

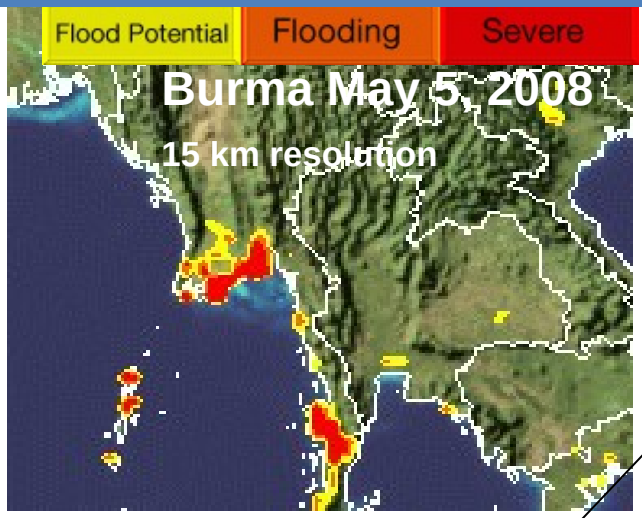
# Myanmar Flood Sensor Web Exercise



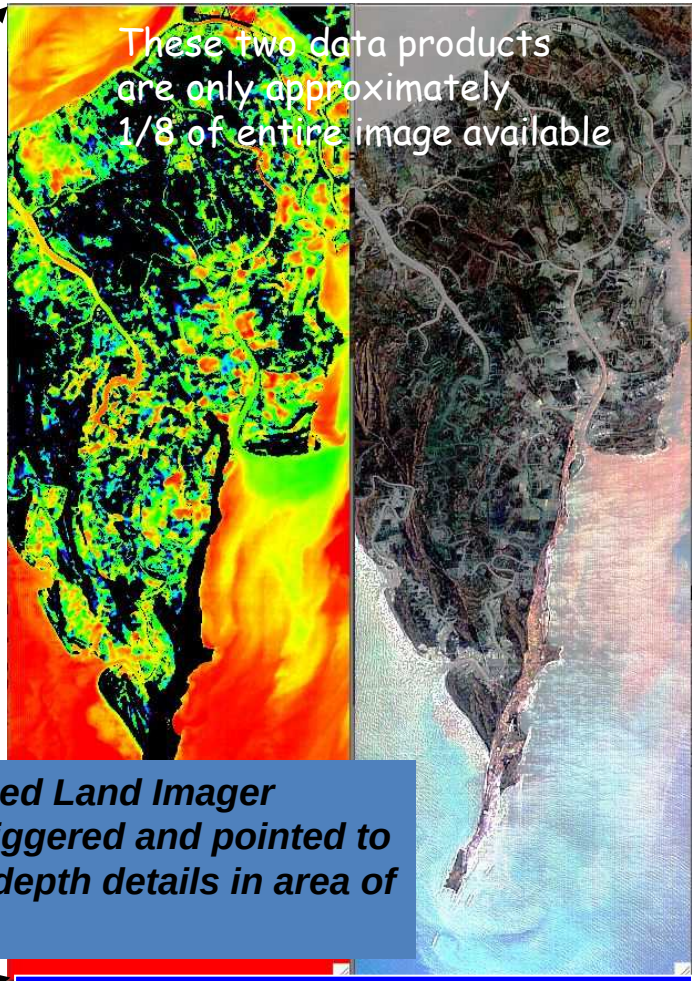

**NARGIS TRMM Animation of Flash Flood Potential (put in presentation mode & click to see movie)**

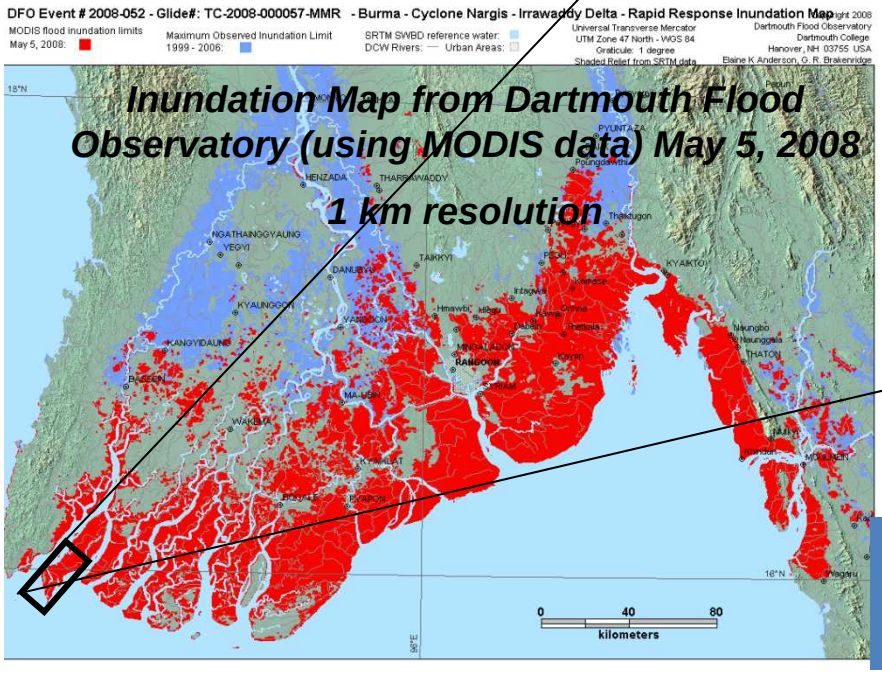
# Myanmar Flood Sensor Web Exercise

***1. Real-time flood estimate using global hydrological model and satellite rainfall estimate - Adler***




***4. Future experiment will be to substitute predicted rainfall versus real time rainfall estimate into Adler model to obtain predicted flood warning and automatically task EO-1 in area of interest and create MODIS and EO-1 data products***




***Inundation Map from Dartmouth Flood Observatory (using MODIS data) May 5, 2008***

***1 km resolution***

***3. EO-1 Advanced Land Imager automatically triggered and pointed to get more water depth details in area of interest.***

**Water Depth Classifier True color**
**Advanced Land Imager 30m**
**May 5, 2008**

**Red - deep**
**Yellow - medium 1**
**Green - medium 2**
**Blue - shallow**
**Black - no water**

***2. MODIS used to validate flood locations with direct observation***

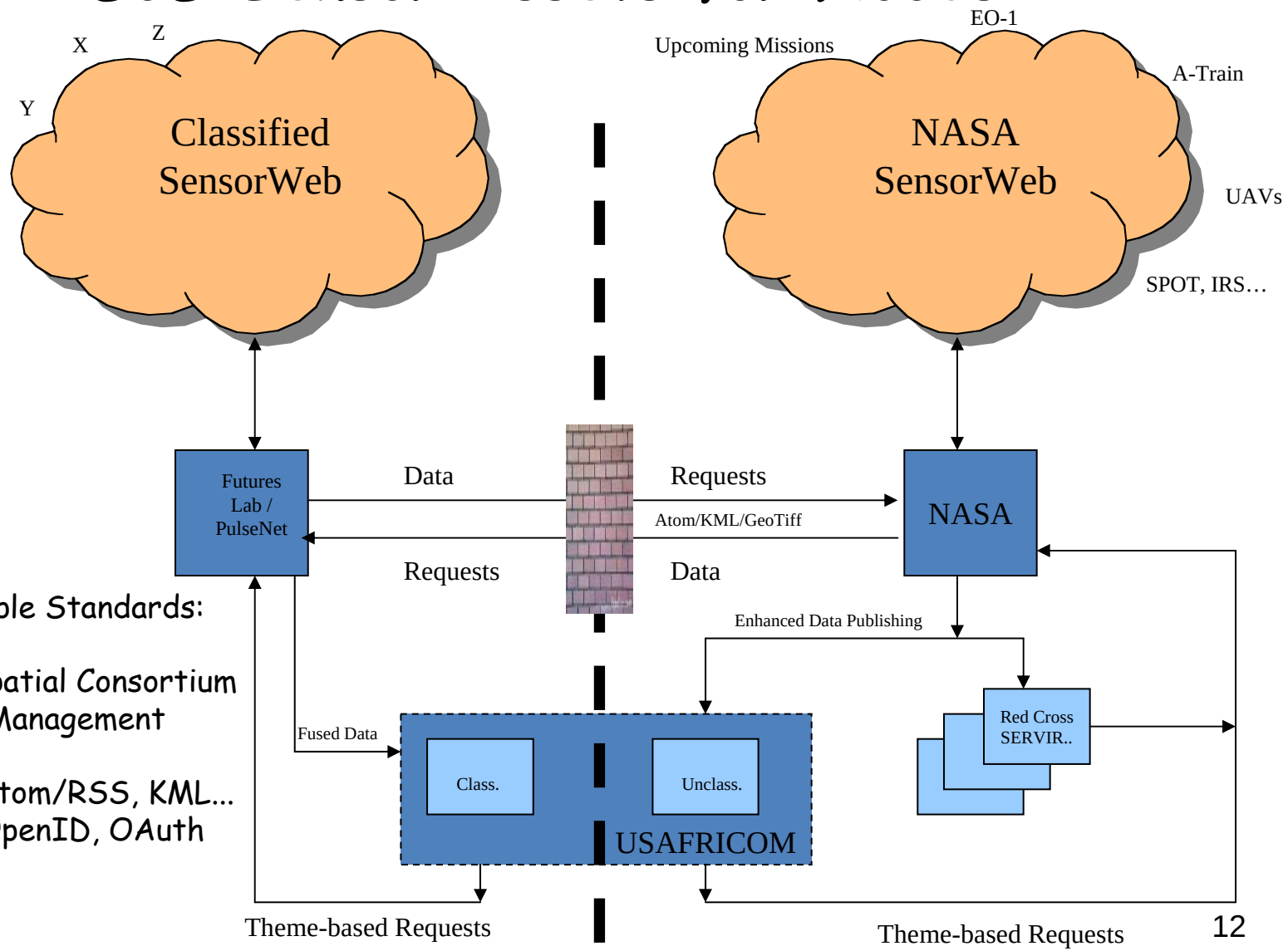
# Myanmar Flood Sensor Web Results & Future Work

- Prediction/alerts are good
- MODIS timely flood updates good
  - We can improve the timeliness to MODIS flood data to daily and also add original water mask to show before and after flood
- Need more details to actually use for tactical decisions or the last mile as Head of Ops Support at the Red Cross refers to it
- Examples of possible added capability that would be useful
  - Sample decision
    - Detect whether flood water is fresh or salty water
    - If fresh water then send water purifiers valued at $500K to $1 million
    - If salty water then send water
    - Problem – have not identified how to classify water as fresh or salty
- Obtain precise ( cm precision) Digital Elevation Model and correlate storm surge height against land surface that is likely to stay dry. Governments can use to direct people to likely dry areas.
- Working with CEOS to further develop use case in conjunction with GEOSS 2008 Architecture Implementation Pilot
  - Disaster scenario led by Stuart Frye
- r

# Active Flood SensorWeb Efforts

- Prototyping the triggering of MODIS data subsets near real-time based on results of Flood Potential Model
- Detailed validation of flood potential model
- Development of second generation of global hydrological model
- Development of high resolution hydrological model of Lake Victoria basin in Africa in collaboration with Regional Centre for Monitoring of Resources for Development (RCMRD) in Nairobi, Kenya
- Prototyping flood forecasting model based on use of precipitation forecasts
- Developing methods to automate declassification of US DoD imagery for infusion into flood SensorWeb
- Initiated small effort with Univ. of Puerto Rico to show whether we can detect salt water by looking for certain types of plant distress
  - Some plants show distress after one day of exposure to salt water

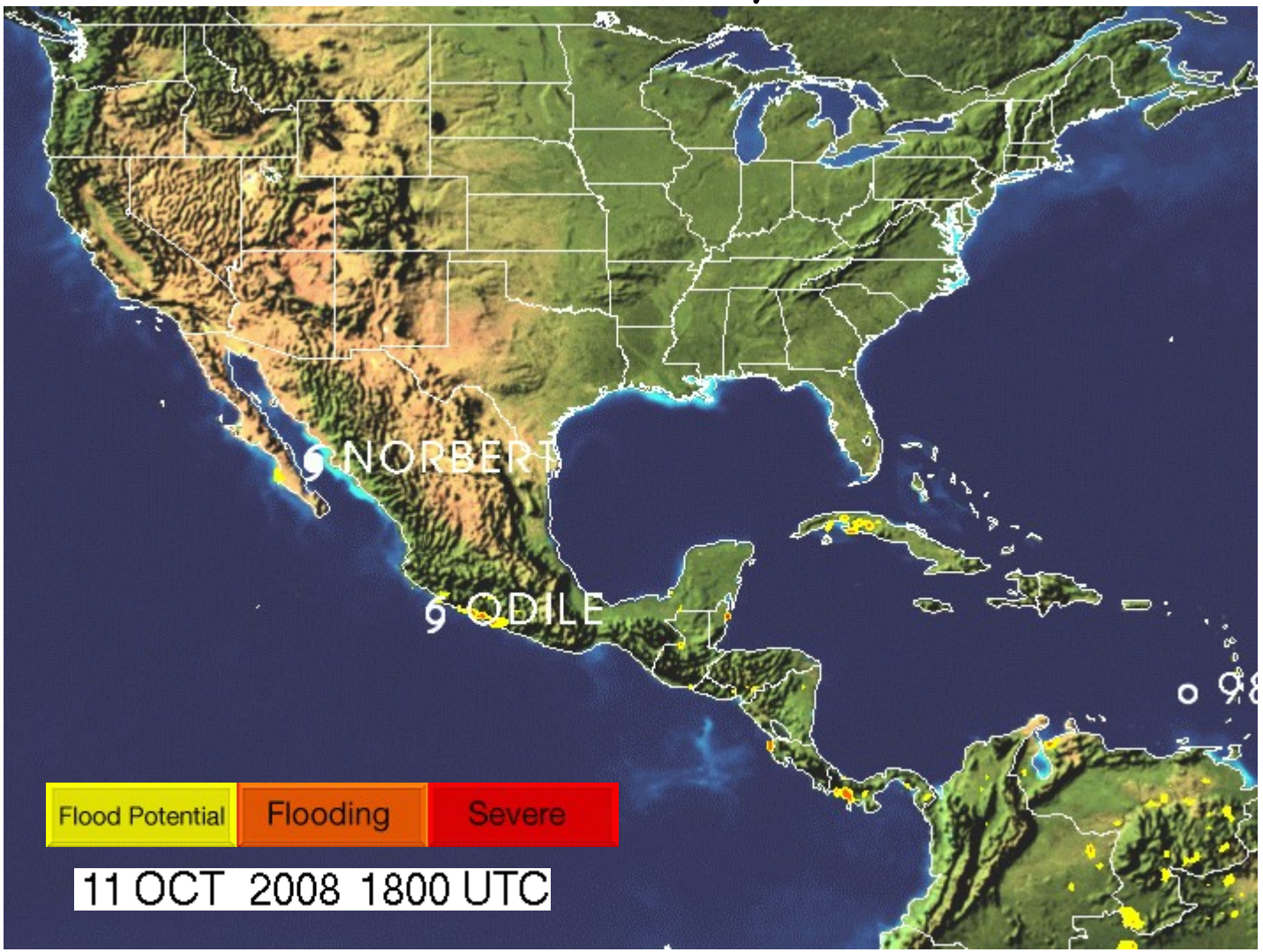
# Working with US Department of Defense (DoD) to Create Cross-Domain SensorWeb to Enable Use DoD Sensor Assets for Floods



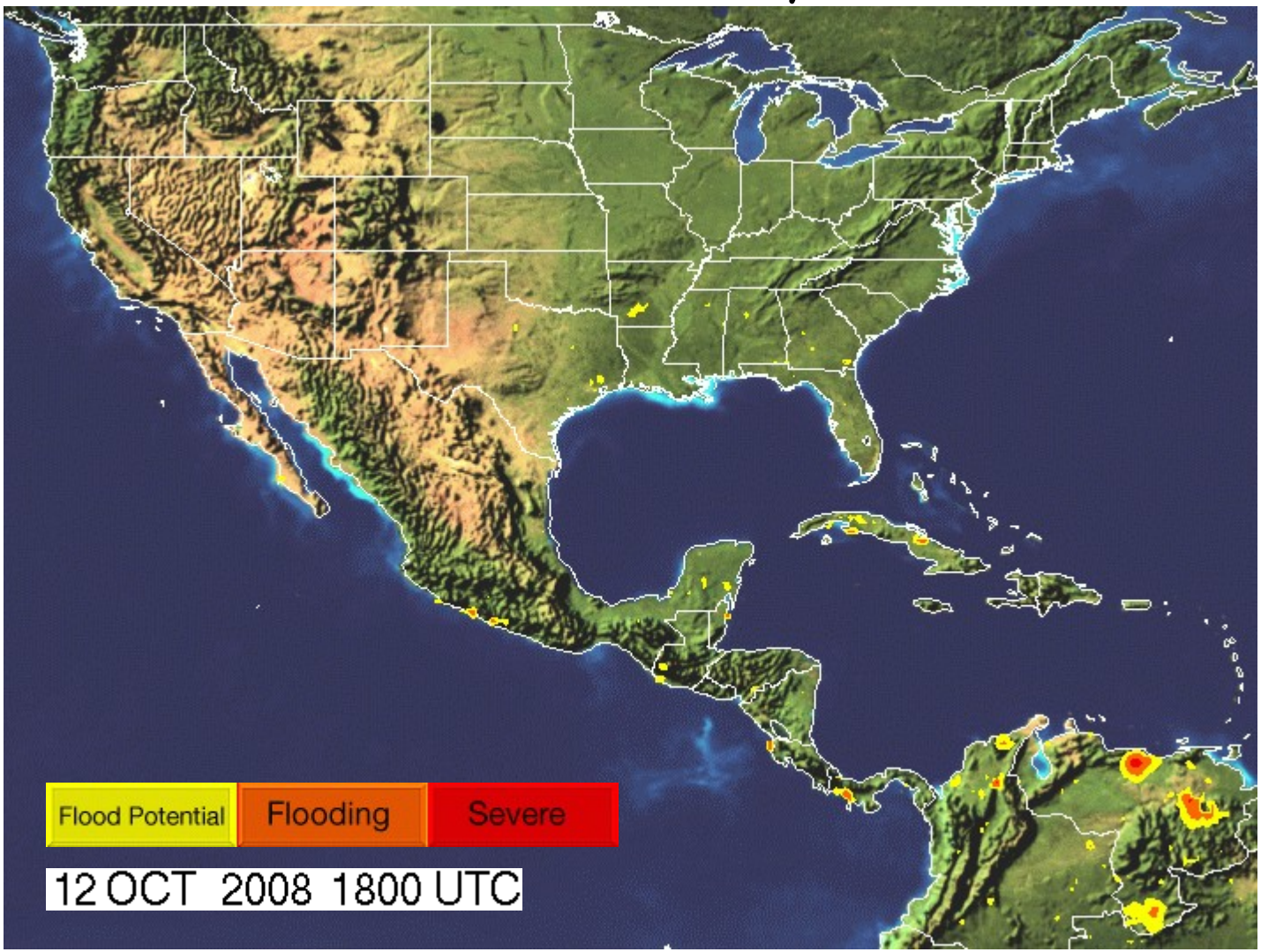

Based on Simple Standards:
- REST
- Open Geospatial Consortium
- Workflow Management Coalition
- Web 2.0: Atom/RSS, KML…
- Security: OpenID, OAuth

# Quickbird Image (2 ft res) – May 5, 2008  Myanmar

# Flood Potential Model Derived from TRMM Nowcasting Data Created Oct 11, 2008



# Flood Potential Model Derived from 24 Hour Global Forecast System Rainfall Prediction – Created Oct 11, 2008



# Earth Observing 1 (EO-1) Campaign Manager

## Current EO-1 Schedule

KML file available here

# Earth Observing 1 (EO-1) Campaign Manager

## Current EO-1 Schedule

KML file available here

# Campaign Manager View of Future Tracks and Possible Tasking Area

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NorthCal Fires | Northern California Fires | fire | patrice | Yosemite Telegraph Fire, Basin Complex, Whiskeytown Complex, ... | 06/29/2008 02:13 PM | 06/29/2008 09:18 PM | 0.4 | Edit Delete Show |
| NSP | Nationa Signature Program | intel | patrice | TA-03, TA-02, TA-01 | 03/03/2008 10:25 AM | 05/16/2008 12:42 PM | 0.2 | Edit Delete Show |
| Oceans Innovation | Oceans Innovation Workshop Demo | algae | patrice | Monterey Bay | 09/10/2008 06:18 PM | 09/16/2008 06:38 PM | 1.0 | Edit Delete Show |
| Salt Marshes | To determine salinity contents of flooded areas | flooding | patrice | Lancaster, VA | 07/26/2008 02:36 PM | 07/26/2008 02:36 PM | - | Edit Delete Show |
| SoCal Fires | Southern California Fires | fire | patrice | - | 09/06/2007 12:00 AM | 06/28/2008 09:23 PM | 0.0 | Edit Delete Show |
| UAV | NASA Ames Ihkana flight scenario | fire | veri_pat | Flood | 09/06/2007 12:00 AM | 06/04/2008 02:00 PM | 0.0 | Edit Delete Show |
| UAV 2 | NASA Ames Ihkana Flight Scenario | fire | scott | UAV 2 Test | 09/17/2008 12:40 AM | 09/17/2008 12:40 AM | - | Edit Delete Show |
| UAV 3 | - | fire | UNKNOWN | California | 09/18/2008 03:53 PM | 09/18/2008 03:53 PM | - | Edit Delete Show |

Scenario/Campaign Tasking Requests for UAV 3

Search Create New

| Title | Content | Geolocation | Scenario Feasibilities |
|---|---|---|---|

## Tasking Request:

| | |
|---|---|
| Title: | California |
| Description: | |
| Category: | |
| Latitude: | 41.3 |
| Longitude: | -123.8 |
| Country Code: | US |
| Country Name: | United States |
| Zone Number: | 36 |
| Zone Name: | Northern California |
| Region Number: | 3 |
| Region Name: | Oregon, California and Nevada |
| Admin Code: | CA |
| Admin Name: | California |
| Nearby: | Notchko, Surgone, Shregegon (historical), Mettah, Pekwan (historical), Pecwan, Johnsons, Waseck, Wright Place, Martins Ferry (historical) |
| Created At: | Fri, 19 Sep 2008 02:32:22 -0000 |
| Updated At: | 2008-09-19 |

Show Map

**Feasibilities**


1 Found

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| USAFRICOM | USAFRICOM Testing | flooding | cappelaere | Zimbabwe | 06/19/2008 02:58 PM | 06/19/2008 02:58 PM | - | Edit Delete Show |

# Attending UN-SPIDER Meeting in Bonn, Germany 9-13-08 to Initiate Collaboration with International Charter for Disaster Management

- The International Charter aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through Authorized Users. Each member agency has committed resources to support the provisions of the Charter and thus is helping to mitigate the effects of disasters on human life and property.
- Members
  - ESA ERS, Envisat (Europe)
  - CNES SPOT, Formasat (France)
  - CSA Radarsat (Canada)
  - ISRO IRS (India)
  - NOAA POES, GOES (US)
  - CONAE SAC-C (Argentina)
  - JAXA ALOS (Japan)
  - USGS Landsat, Quickbird (2 ft res), GeoEye-1 (2 ft res) (US)
  - DMC ALSAT-1 (Algeria), NigeriaSat, Bilsat (Turkey), UK-DMC, Topsat
  - CNSA FY, SJ, ZY satellite series (China)

# Radarsat (3 m) – May 7, 2008 Myanmar


Qualitative water depth estimates in paddy fields using Radarsat-2 ultra fine mode image acquired the 07th of May 2008

Deep — Shallow

Permanent water during dry season



**Interpretation**

Qualitative water depth estimates derived from a context and textural analysis of ultra fine mode Radarsat 2 image acquired the 07th of May 2007. Darker blue indicates potentially deeper water would during the future draw-off process correspond to the areas of long staying water, whereas the light blue areas, actually covered by a lower level of water would become drier the first.

0 500 1 000 1 500 Meters

N

**Projection & Grid Information**

| | *Reference Grid* | *Geographic Grid* |
|---|---|---|
| Projection: | UTM Zone 47 North | Geographic (DMS) |
| Spheroid: | WGS 84 | WGS 84 |
| Datum: | WGS 84 | WGS 84 |

**Crisis Satellite Metadata**

| | |
|---|---|
| Satellite: | SPOT 5 & Radarsat-2 |
| Pixel Size: | 10m & 3m |
| Acquisition Date: | 02/03/2008 & 07/05/2008 |
| Geometric processing: | Georeferencing and Orthorectification |

**Credits & Copyright**

- ©MDA Ltd 2008, Radarsat 2, courtesy of MDA Ltd
- ©CNES 2008, distribution Spot Image SA
- ©USGS 2000, SRTM DEM 90m
- ©NGA, ©ESRI - Other data

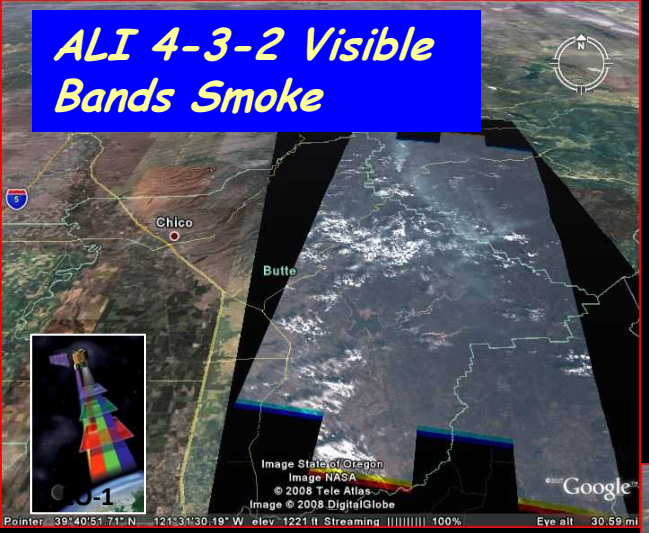
| | |
|---|---|
| Date: | 17 May 2008 |

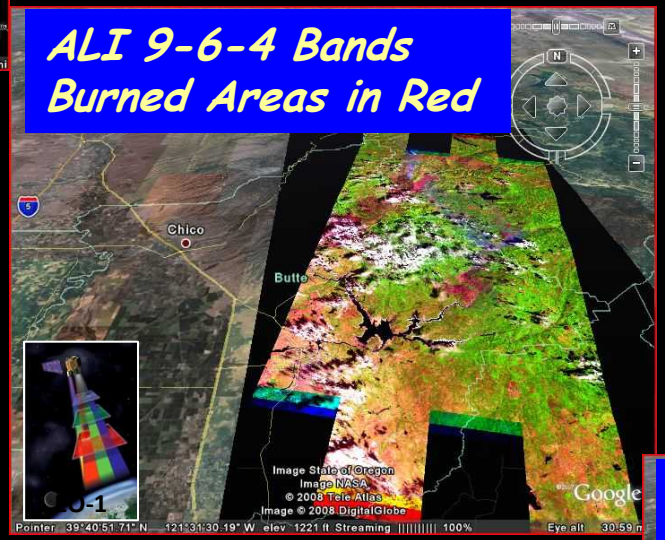
# Cross Integration of First Steps Via Fire SensorWeb

- Following slides show some sample capabilities being developed for Fire SensorWebs that are applicable to Flood SensorWeb

# Summer 2008 Fire Sensor Web Demo

Earth Observing 1 Image of Northern California Active Fires, Smoke and Burned Areas July 20, 2008 11:28 am Pacific



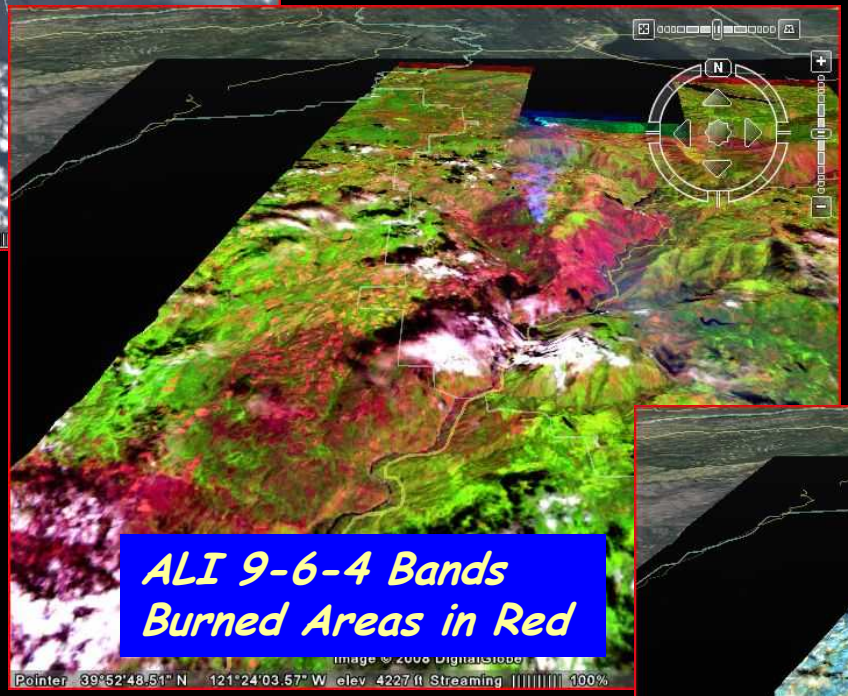



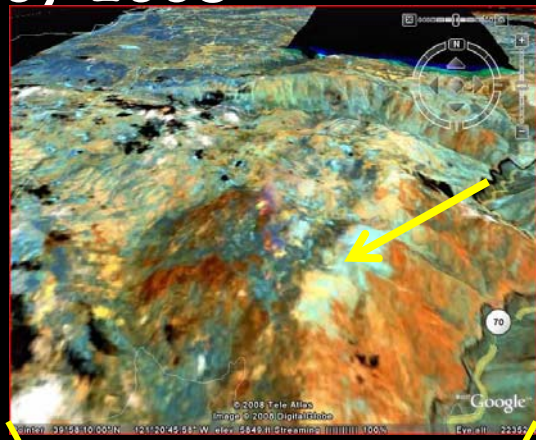


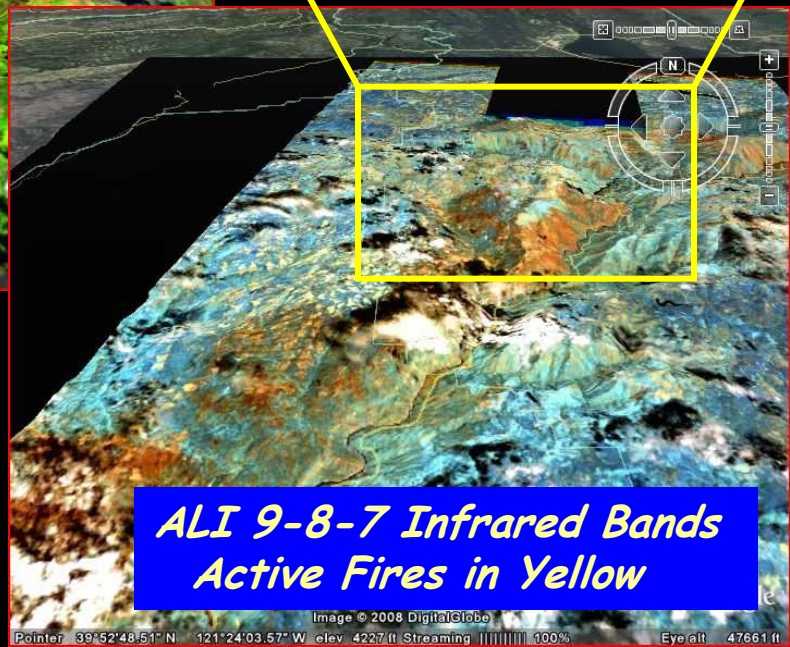

Year 2 Accomplishments & Activities

# Summer 2008 Fire Sensor Web Demo

## Zoom In of Earth Observing 1 Image of Northern California Fires and Smoke, July 20, 2008 11:28 am Pacific

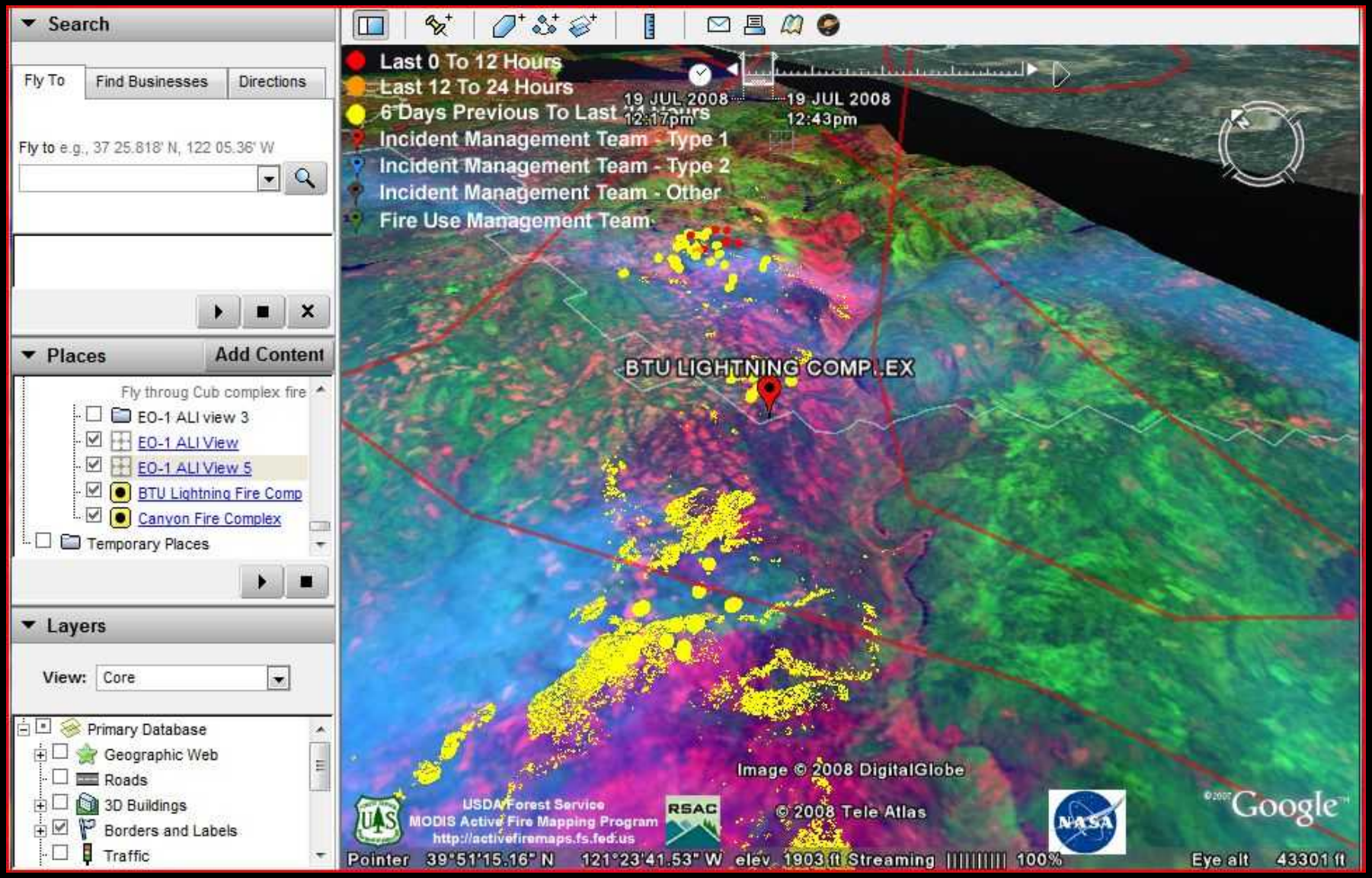



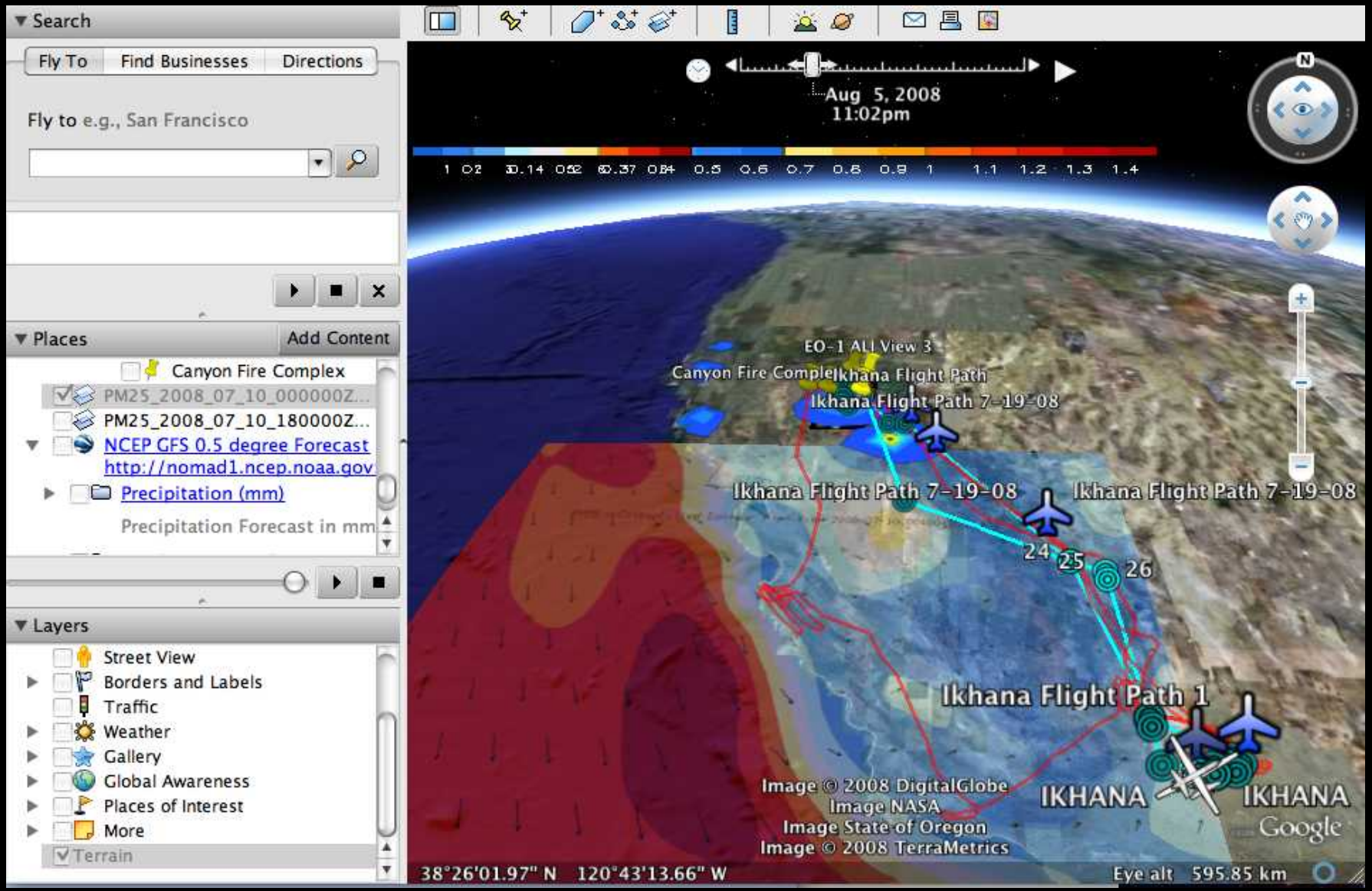



- Smoke can be seen in the visible bands (4-3-2)
- Burned area is depicted in red using bands (9-6-4)
- Active fires appear yellow in bands (9-8-7)
- Use of higher numbered bands penetrate smoke

# AMS hot pixels, MODIS hot pixels and EO-1 ALI Burn Scars

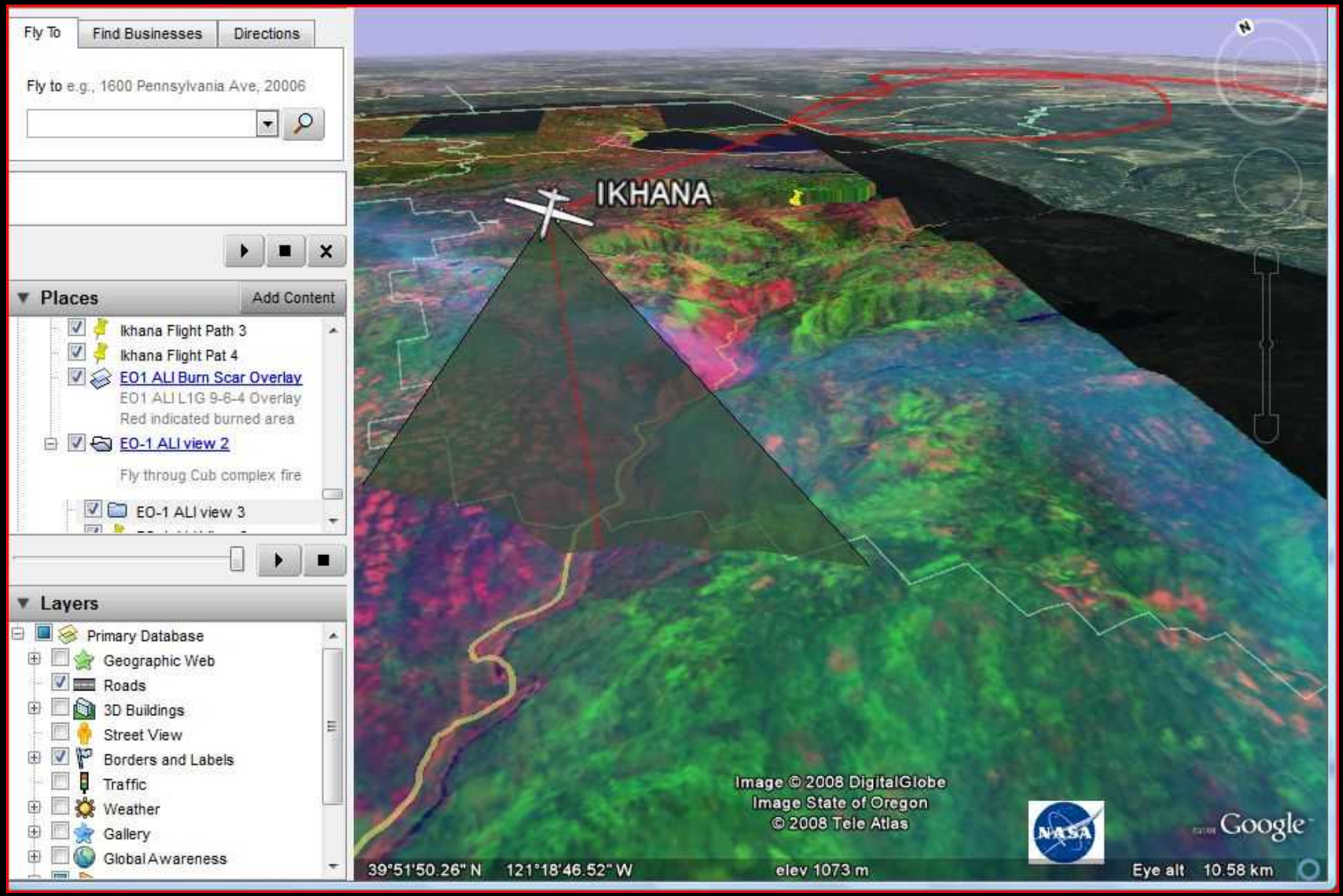


# Summer 2008 Fire Sensor Web Demo
# With Smoke Forecast (Falke) and Wind Forecast (NOAA)




Year 2 Accomplishments & Activities

# Monitoring Ikhana Overflight on July 19, 2008 in Realtime



# Conclusion

- Making good progress towards creation of real SensorWeb capabilities towards the SensorWeb vision
- Soliciting other organizations to build additional capabilities to provide critical mass of resources to make SensorWeb compelling
- Goal is to double assets, users and products of SensorWeb every 18 months