SWAC Module 12:

Case Study: JAPAN

EARTHQUAKE • TSUNAMI • NATURAL-TECH HAZARDS

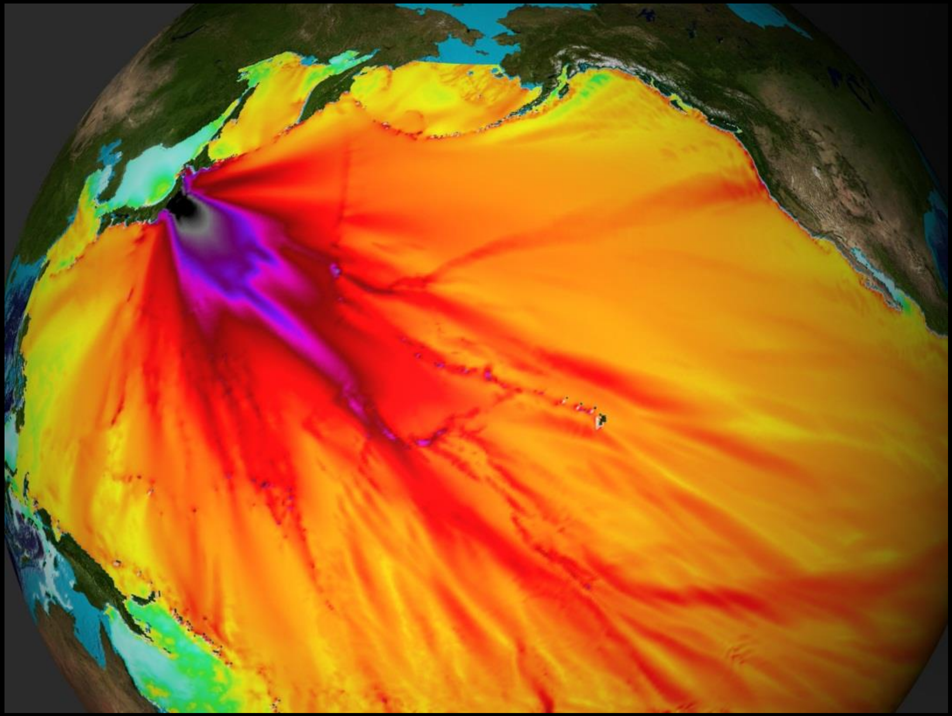
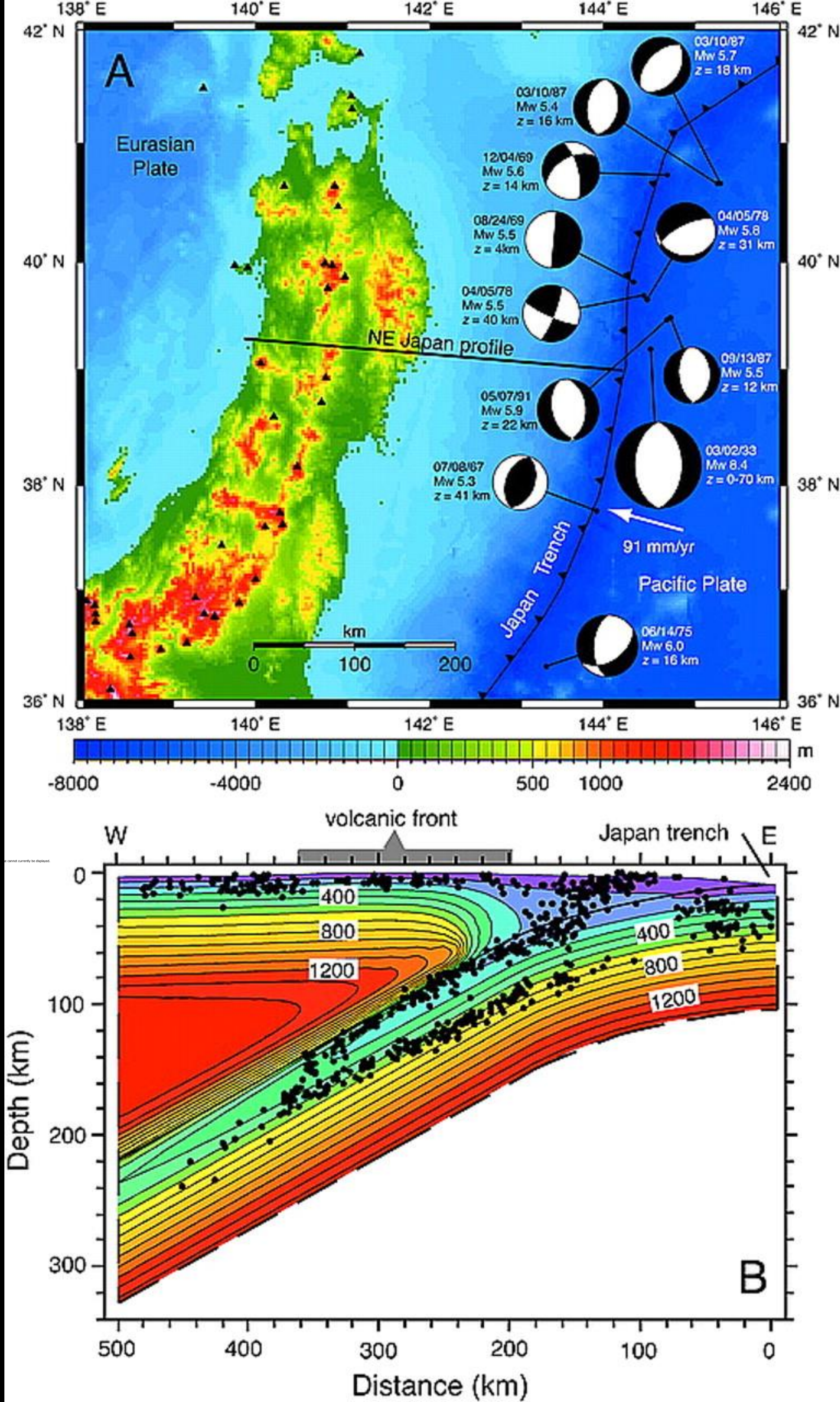


Plate Tectonics

The islands that comprise Japan are located along a subduction zone between the Eurasian, Pacific, and Phillipine plates.

As the Pacific Plate slides slowly below the Eurasian Plate, intense pressure develops of large periods of time.

This pressure is relieved in the form of earthquakes:



Earthquake Remote Sensing

SCIGN- Southern California Integrated GPS Network

- Deploy a network of sophisticated GPS devices
- Measure exact <1cm Geographic Position
- Observe changes over time

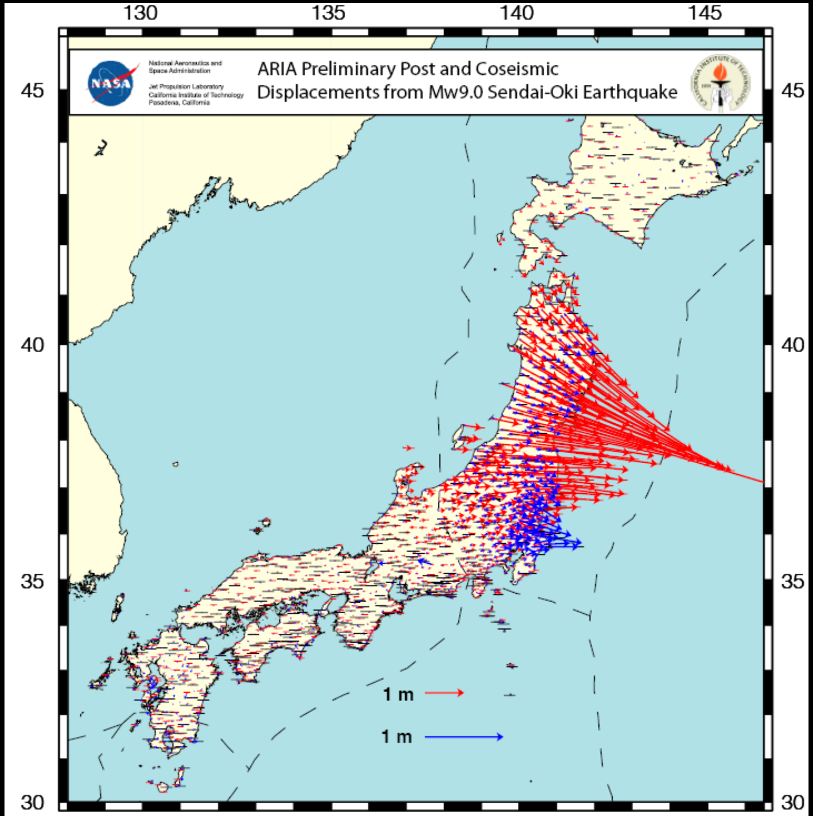


Figure shows horizontal displacements based on ARIA verion 0.3 position estimates for GEONET stations. Coseismic displacement is shown in red, and first 8 hours of postseismic motion is shown in blue, including motion caused by aftershocks. Bars at end of vector show 95% error estimate. Solutions courtesy of ARIA team at JPL and Caltech (email aria@jpl.nasa.gov or aria@caltech.edu). All original GEONET RINEX data provided to Caltech by the Geospatial Information Authority (GSI) of Japan.

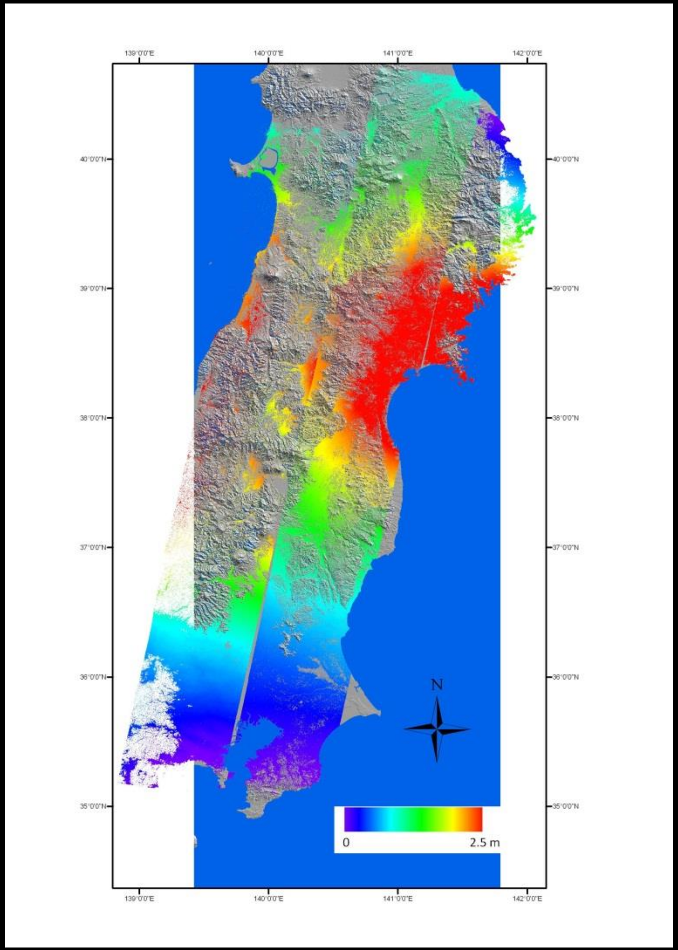
Ground Displacements in Japan Post 2011 Earthqake

InSAR

Interferometric Synthetic Aperture Radar

- “Actively” send RADAR signal towards ground
- OUTGOING phase of wave is known
- Signal hits Earth and is reflected back to space
- INCOMING phase is recorded
- Process is repeated over a time series

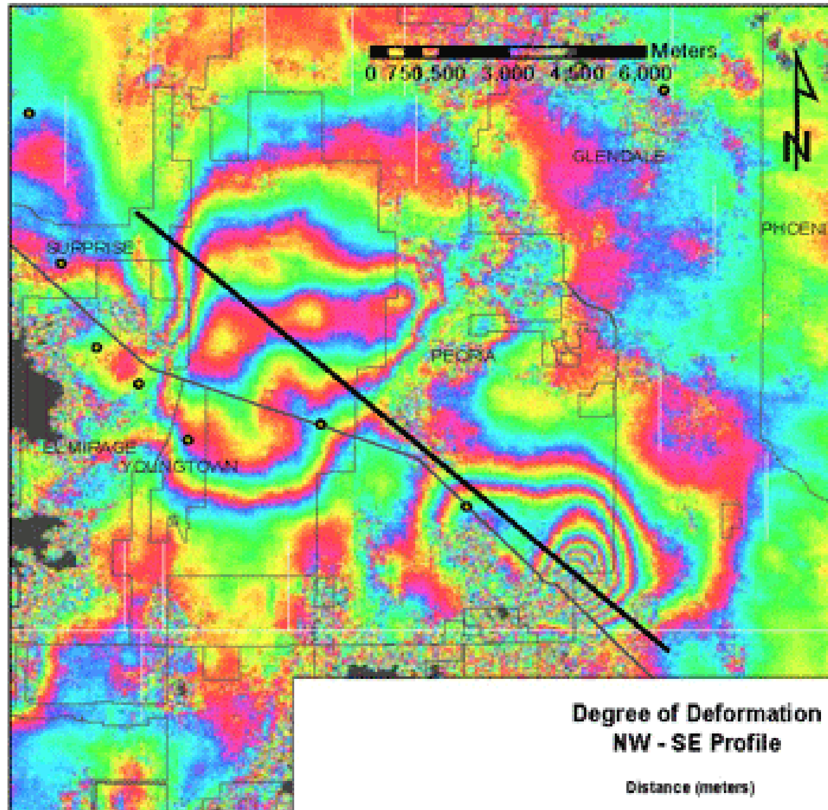
Differences in phases of same area over time reveal changes in ground surface.

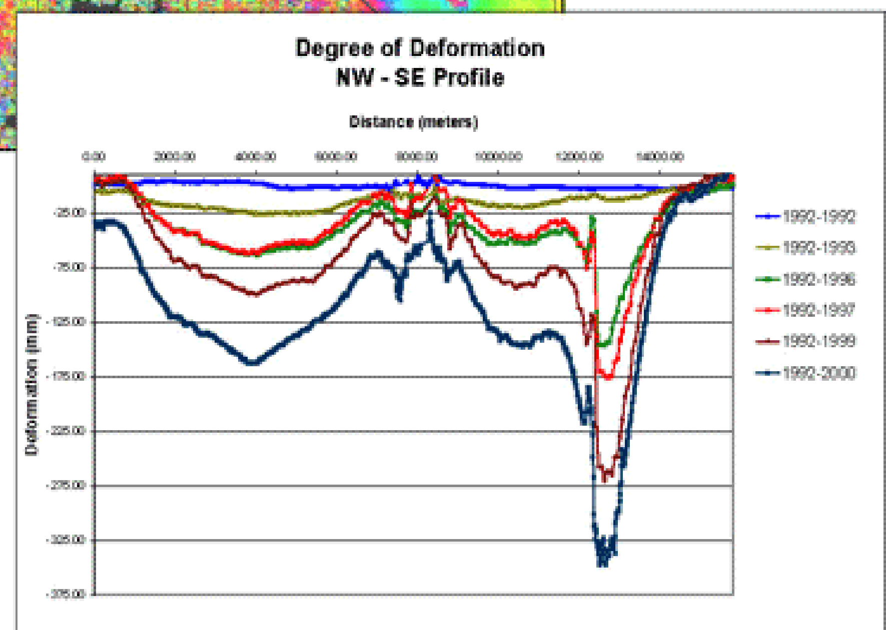


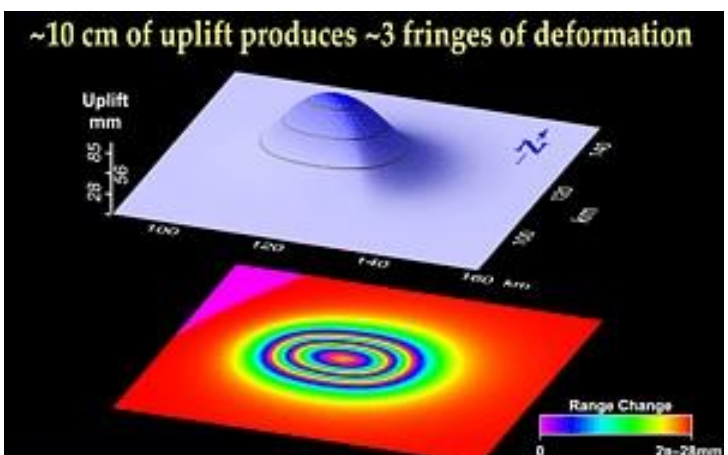
Each {STRIPE} of colors represents a change in surface height

More on inSAR

1 Fringe = +/- 3 cm deformation







Tsunamis

Tsunamis are caused by rapid displacement of water by mass movement of material.

They are often caused by Earthquakes, but can also be caused by volcanic eruptions, landslides, etc.

Tsunamis are not restricted to oceans - they can occur wherever large volumes of water can be rapidly displaced.

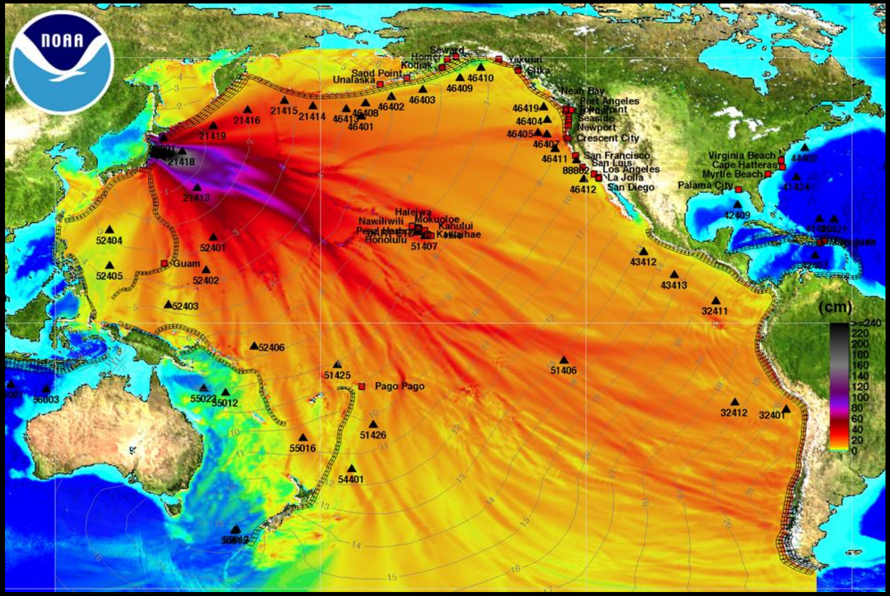
Animated Tsunami Formation

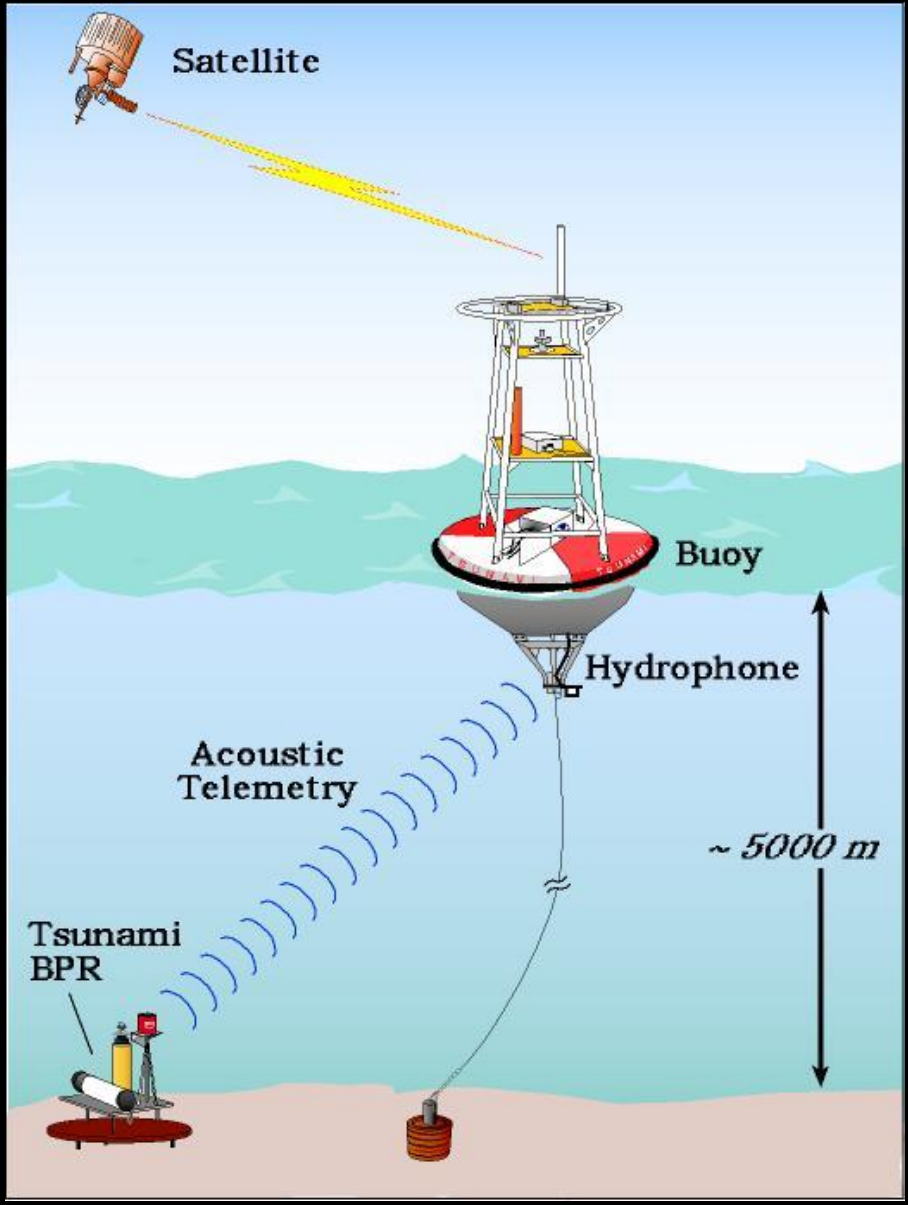
Tsunami Monitoring and Warning

The NOAA Dart System

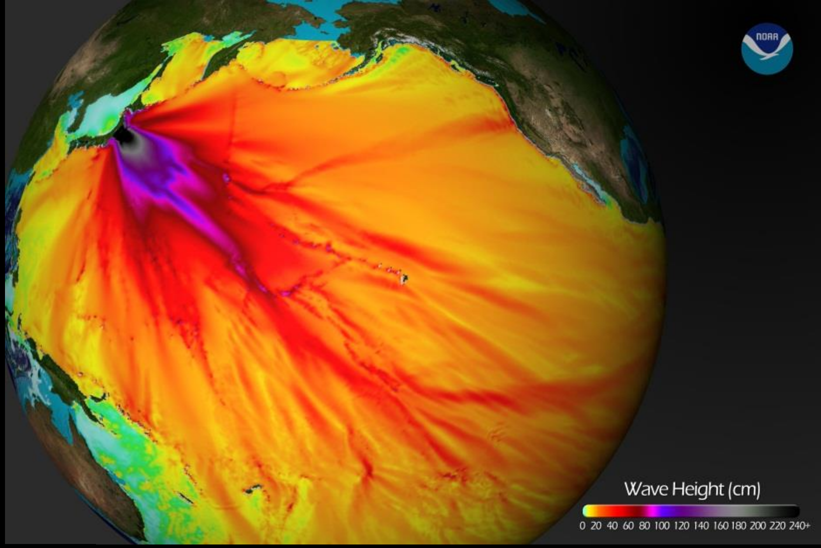
(Deep Ocean Reporting of Tsunami) is composed of floating surface buoys that are tethered to stationary ocean floor sensors.

These couplings are strategically placed throughout oceans in locations that allow Tsunamis to be detected in sufficient time to permit the evacuation of coastal areas.





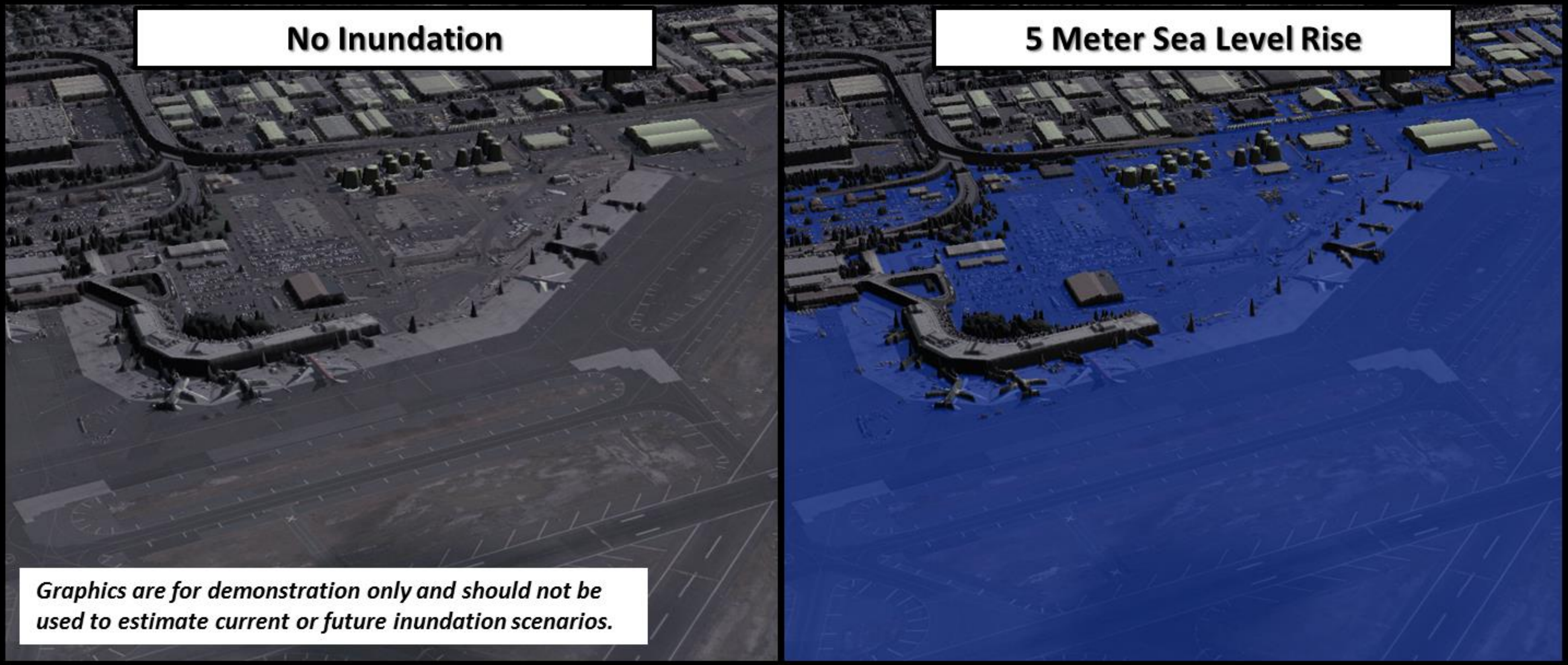
Tsunami Modeling

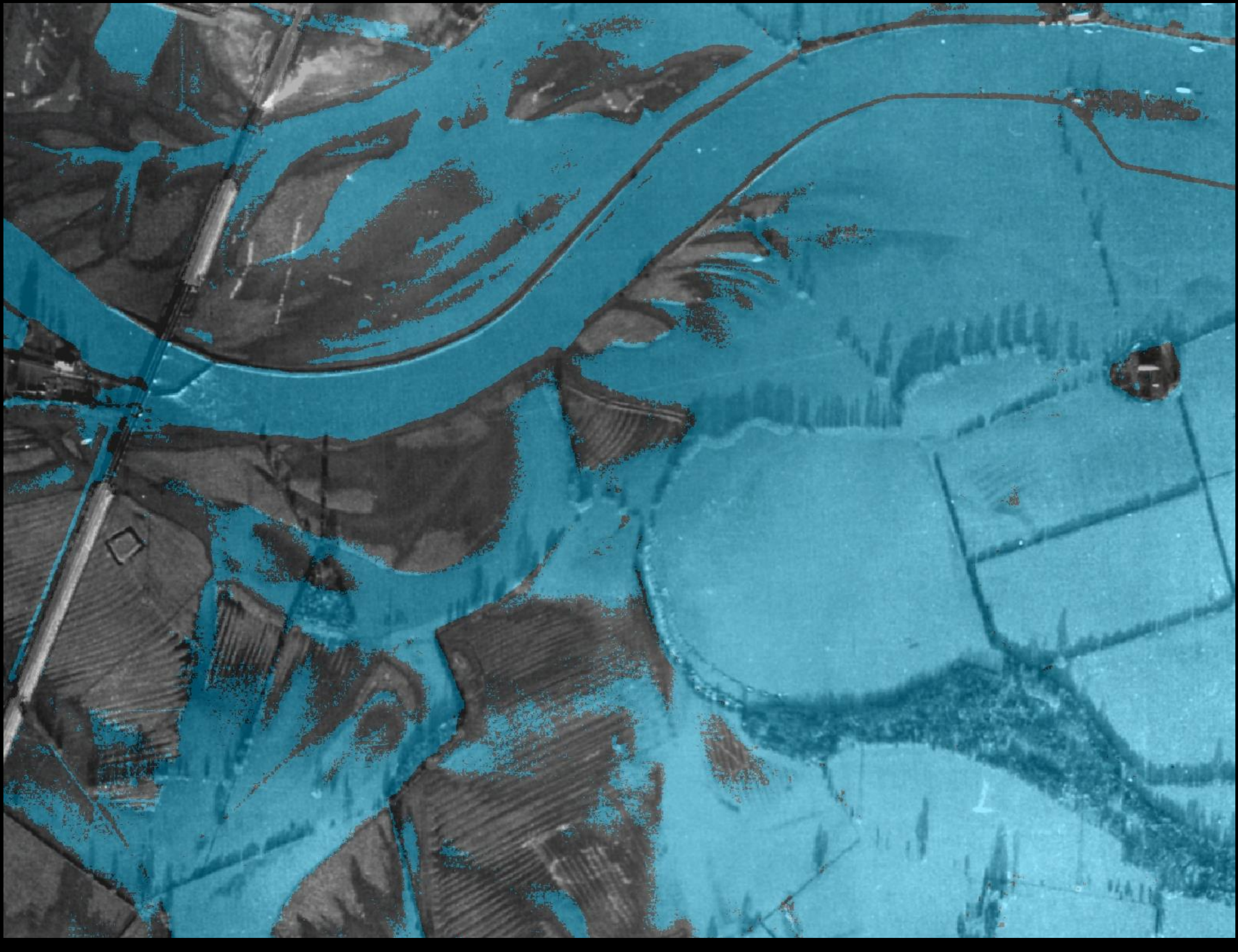


LiDAR Mapping

Use high precision (x < 1 cm) data to model inundation scenarios.

Help predict flood situations and allow advanced planning for municipalities





Remote Damage Assessment

Satellites offer the ability to capture imagery of dangerous areas…

In this case they are assessing an area that has radiation levels too high for human inspection. Modern sensors are able to capture images at the <1’ level.

Radioactive Release

One Bq (Bequerel) is defined as the activity of a quantity of radioactive material in which one nucleus decays per second

	Assumed amount of the discharge from Fukushima Dai-ichi NPS		(Refere Amount discharge Chern accid
	Estimated by NISA	Announced by NSC	
^{131}I … (a)	1.3×10^{17} Bq	1.5×10^{17} Bq	1.8×10¹
^{137}Cs	6.1×10^{15} Bq	1.2×10^{16} Bq	8.5×10
(Converted value to ^{131}I) … (b)	2.4×10^{17} Bq	4.8×10^{17} Bq	3.4×10
(a) + (b)	3.7×10^{17} Bq	6.3×10^{17} Bq	5.2×10

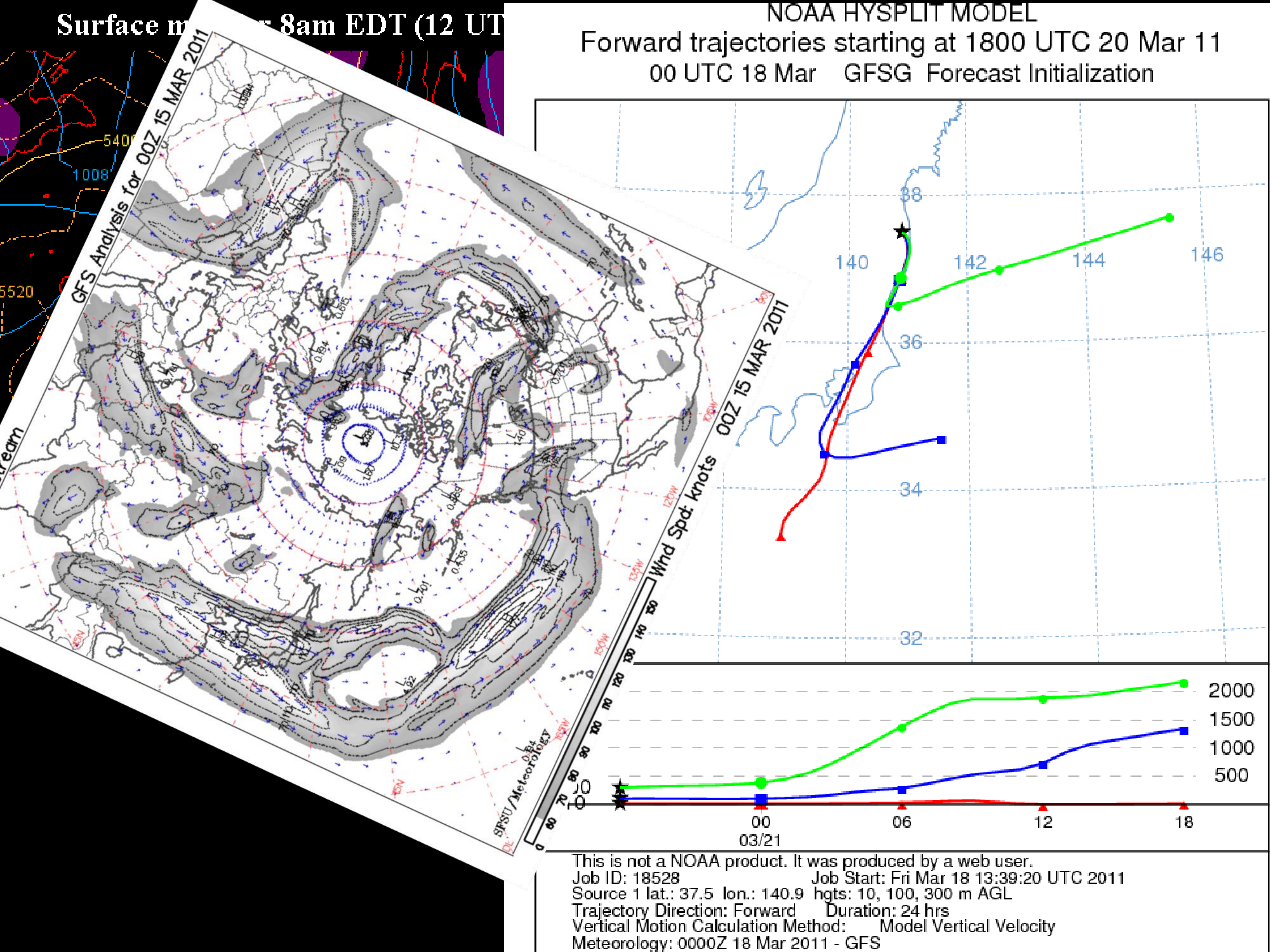
US EPA maintains an updated database (RADNET) of radioactive contaminants in the US

Plume Modeling

- What, how much, and where was released
- Strength of the release (or in most cases blast)
- Detailed wind and weather information

Radioactive Plume Dispersion similar to standard Air Pollution EXCEPT:

FALLOUT of particles travelling in plume have SIGNIFICANTLY more serious effects on health.

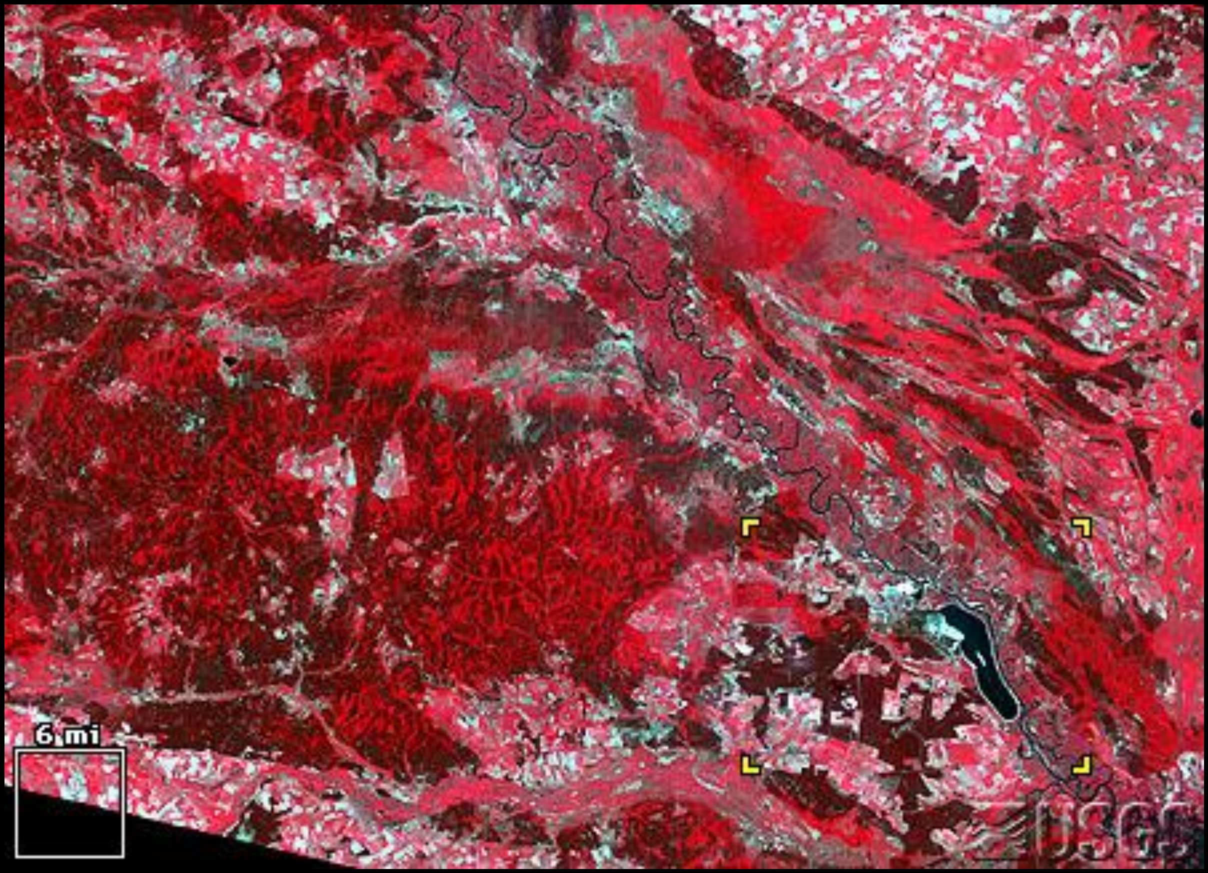


Surface m   r 8am EDT (12 UT
5400
1008
5520
GFS Analysis for 00Z 15 MAR 2011
00Z 15 MAR 2011
Wnd Spd: knots
SFSU/Meteorology
NOAA HYSPLIT MODEL
Forward trajectories starting at 1800 UTC 20 Mar 11
00 UTC 18 Mar   GFSG Forecast Initialization
38
36
34
32
140
142
144
146
2000
1500
1000
500
00
03/21
06
12
18
This is not a NOAA product. It was produced by a web user.
Job ID: 18528   Job Start: Fri Mar 18 13:39:20 UTC 2011
Source 1 lat.: 37.5 lon.: 140.9 hgts: 10, 100, 300 m AGL
Trajectory Direction: Forward   Duration: 24 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 18 Mar 2011 - GFS

Long Term Monitoring Perspective

Chernobyl Landsat images from 1986 and 1992 show extensive changes in vegetation after disaster in 1986…

1986



1992