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 Philippine plates.

As the Pacific Plate slides slowly below the Eurasian Plate, intense pressure develops over long 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
Ground Displacements in Japan Post 2011 Earthquake
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.
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

Graphics are for demonstration only and should not be used to estimate current or future inundation scenarios.
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

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

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Half Life</th>
<th>Density (Bq/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cesium 134</td>
<td>2 Years</td>
<td>160,000</td>
</tr>
<tr>
<td>Cesium 137</td>
<td>30 Years</td>
<td>150,000</td>
</tr>
<tr>
<td>Iodine 131</td>
<td>8 Days</td>
<td>4,100</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Assumed amount of the discharge from Fukushima Dai-ichi NPS</th>
<th>(Refereed Amount of discharge Chernobyl accident)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated by NISA</td>
<td>Announced by NSC</td>
</tr>
<tr>
<td>131I ... (a)</td>
<td>1.3×10^{17} Bq</td>
</tr>
<tr>
<td>137Cs</td>
<td>6.1×10^{15} Bq</td>
</tr>
<tr>
<td>(Converted value to 131I) ... (b)</td>
<td>2.4×10^{17} Bq</td>
</tr>
<tr>
<td>(a) + (b)</td>
<td>3.7×10^{17} Bq</td>
</tr>
</tbody>
</table>
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.
Long Term Monitoring Perspective

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