Integrating Landsat and ASTER Imagery for Post-Disaster Change Detection in Eastern Japan

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On March 11, 2011, a magnitude 8.9 earthquake struck approximately 80 miles off the coast of Honshu, Japan. The resulting tsunami reached heights of over 30 feet and affected areas up to 10 miles inland. In this study, a Landsat image from June 4, 2004 was compared to an ASTER image of the same area taken three days after the disaster.

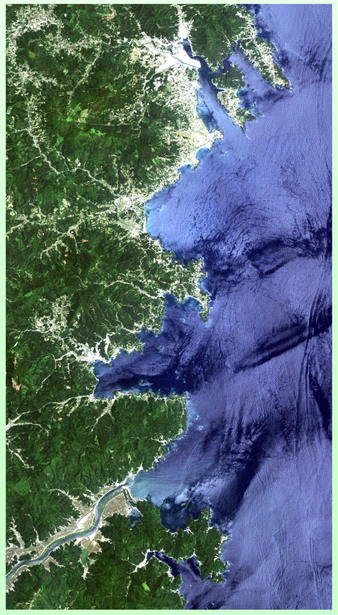
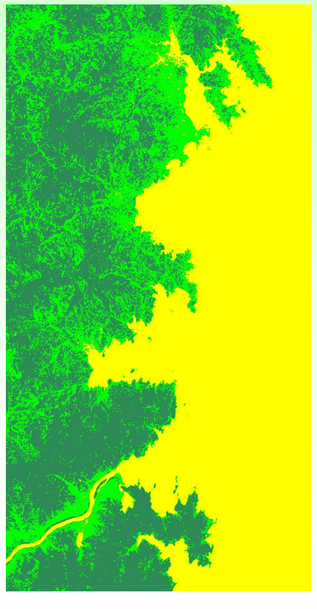
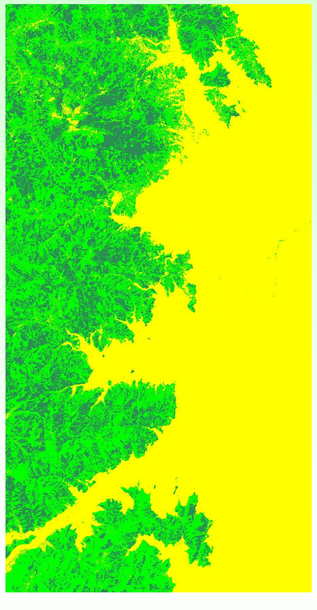


Image: Landsat-5TM, 6-4-2004.

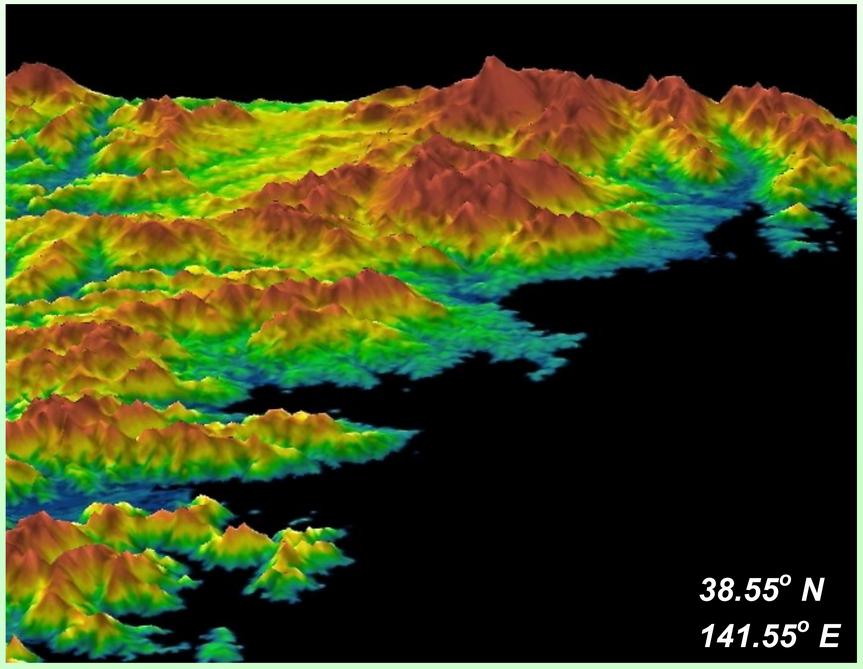
Image: ASTER, 3-14-2011.

An NDVI was created for each image to show differences in vegetation cover from 2004-2011. Areas in dark green represent densely-vegetated areas, while areas in light green indicate sparsely dispersed or unhealthy vegetation. Areas in yellow are un-vegetated.

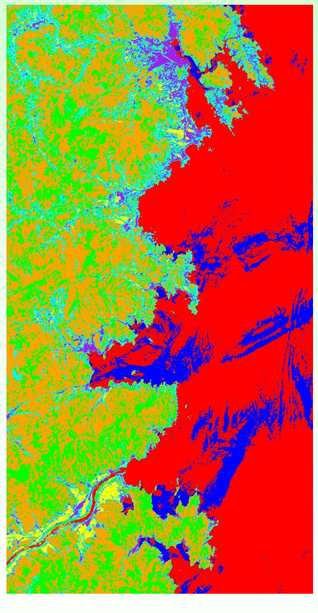


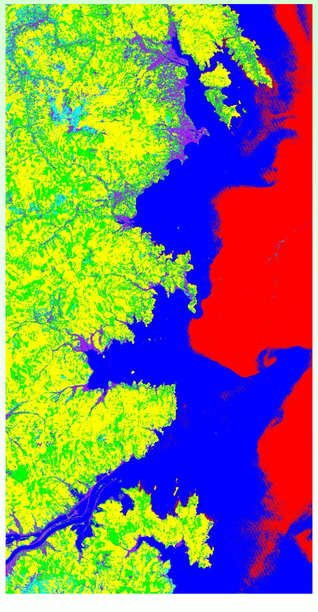


A digital elevation model of the study area derived from ASTER data highlights the diverse topography of the region. Located on converging tectonic plate boundaries, these areas are associated with subduction zones and high levels of seismic activity.

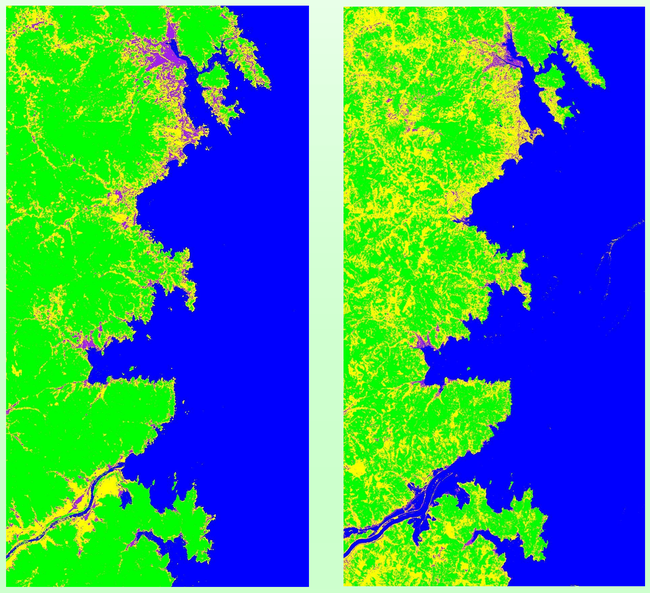


Images were classified using the Maximum Likelihood algorithm. Seven initial classes were established using 25 training sites per class. Training data were normally distributed and spectrally separable when graphically assessed.





The seven initial classes were combined into 4 final classes: Dense Vegetation (green), Sparse Vegetation / Un-vegetated Soil (yellow), Urban / Concrete Structures (purple), and Water (blue). For both images, class accuracy was greater than 97%, and Kappa values were greater than 0.94.



Change detection statistics were calculated using the Post-Classification Comparison method. Class totals for each type of coverage show an overall loss of urban and densely-vegetated areas, and an overall gain of water and sparsely-vegetated areas. Inland vegetation density differences can be attributed to cold weather exposure over the winter months, while most coastal differences are tsunami-related. Urban loss and water gain are direct effects of the tsunami on Japan's eastern coastline.

LAND COVER	6-4-2004	3-14-2011	Change (km^2)
Dense Vegetation	**589.73**	**422.11**	**-167.62**
Sparse Vegetation/ Un-vegetated Soil	**150.10**	**303.17**	**+153.07**
Urban/ Concrete Structures	**31.08**	**15.11**	**-15.97**
Water	**636.76**	**667.28**	**+30.52**

Sources

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