



Partner

# Imaging Large-Scale Earthquakes Using Interferometric Synthetic Aperture Radar (InSAR)

Jia Michel, Pearl Oyewole, Nalini Agnihotri, Pablo Echevarria Cuesta, Raj Mhetar, Amaris Sacalxot

Mentor: Dr. Ann Chen

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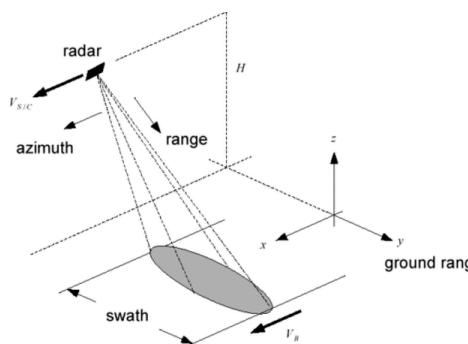
## Introduction

Every year, earthquakes take 10,000 lives and cost the U.S. approximately \$4.4 billion. Understanding the impact of earthquakes is critical towards evaluating hazards. Remote Sensing is a technique that can be used to evaluate the impact of earthquakes.



## Remote Sensing

Remote Sensing is the technique of acquiring data from a distance. In relation to geophysics, radar remote sensing techniques can measure the physical characteristics of the Earth's surface using the reflected radar echoes.



## Synthetic Aperture Radar

Synthetic Aperture Data, also known as Synthetic Aperture Radar (SAR), is a remote sensing technology that uses radar signals to capture high-resolution images of the Earth's surface. Its all-weather capability and wide area coverage make it valuable for applications such as environmental monitoring, disaster management, agriculture, and even defense.

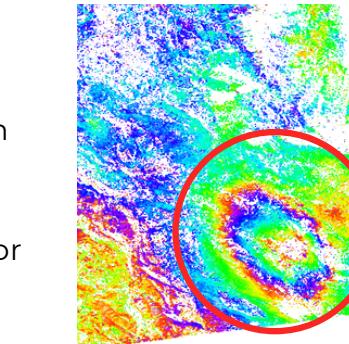
## Interferometric Synthetic Aperture Radar

Interferometric Synthetic Aperture Radar (InSAR) is a remote sensing technique for mapping deformation from imaging radar satellites. This method utilizes two radar images taken from different times but similar flight path positions to form an interferogram.

## Earthquake Interferogram Samples

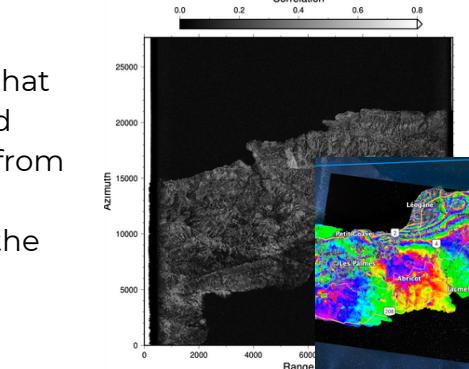
### Italy, 2009

This 5.9 earthquake occurred in central Italy with an epicenter in the city L'Aquila. 308 people died, making it the deadliest earthquake in Italy since the 1980 Irpinia earthquake. Members of the Italian National Commission for the Forest and Prevention of Major Risks were convicted for downplaying extremity of the earthquake.



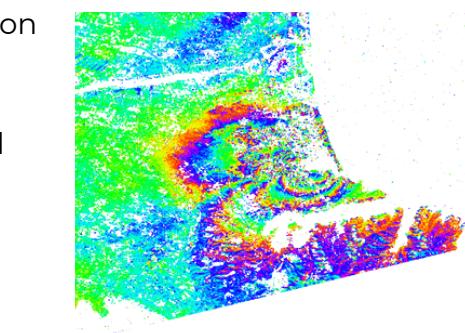
### Haiti, 2010

In July of 2010, there was a 7.0 earthquake in Haiti that impacted nearly 3 million people and killing around 250,000. Initially they thought the movement was from the Enriquillo vault, but through data visualization geophysicists were able to understand that it was the Léogâne fault.



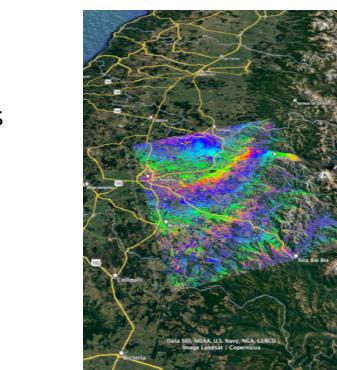
### New Zealand, 2011

The 7.0 magnitude Christchurch Earthquake occurred on February 22, 2011. It caused widespread damage to buildings, infrastructure, and took 185 lives. This earthquake was particularly severe because it occurred very close to the city at a shallow depth of just 3 miles underground.



### Chile, 2010

The earthquake occurred in tangent with a tsunami on February 27, 2010. It was only a 3 minute earthquake but caused the country damage that took more than 4 years to recover. Just offshore in Maule, Chile, the earthquake caused more than \$30 billion in damages with magnitude 8.8.

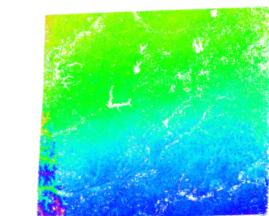


## Technological Limitations

ALOS PALSAR, the satellite we acquired our data from, utilizes L-band radar frequency. This makes the resulting imaging sensitive to vegetation, deep earthquakes, and rocky terrain.

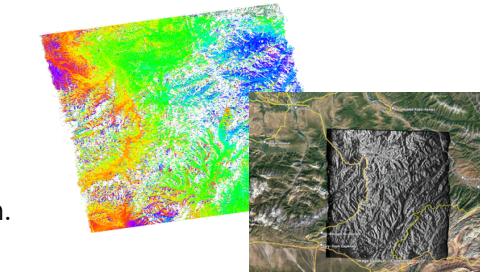
### Oklahoma, 2010

This induced seismicity had a magnitude of 4.3, which was too small to detect on an interferogram.



### Kyrgyzstan, 2008

This earthquake was not as detectable either due to the earthquake being too deep, or the terrain of the region was too rough.



## Future Usage

We plan to classify and catalog data to build a pattern recognizer for predicting whether a future earthquake can be detected with sufficient Signal-to-Noise Ratio using a single L-band interferogram.

## NASA SEES

NASA SEES has allowed every member of our team to conduct valuable research, learn from experts in the remote sensing field and connect with a diverse community of high school students.

