

Tomography Applied to Earthquake Monitoring and Prediction

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Tomography refers to imaging a three dimensional object, section by section, through the use of electromagnetic waves. The waves will penetrate the object and send back reflection signals characteristic of the magnetic properties of the object. These reflection signals can in turn be used to produce a three dimensional image of the object. In most cases, the imaging procedure is based on a set of mathematical techniques called tomographic reconstruction. The method is used in several branches of sciences such as: radiology, archaeology, biology, geophysics, oceanography, materials science and astrophysics.

The ionosphere is a shell of electrons and electrically charged atoms and molecules that surrounds the Earth, stretching from a height of about 50 km to more than 1000 km above the Earth's surface. The ionosphere has practical importance because, among other functions, it influences radio and communication propagation to distant places on the Earth. The ionosphere has also been receiving some additional interest because of its potential for characterizing pre-seismic activities in several tectonically active regions around the globe.

In the last ten years, several earthquakes have occurred most notably in Haiti, Chile and Japan causing considerable disruption and damage. These events have reignited scientific interest in the area of earthquake monitoring and prediction. To date, abnormal motion of the earth's crust near fault lines, related seismic activities, have been observed using GPS positional data. Seismic activities have also been monitored using seismographs. In general, when these data are available, it is often too late to use them for predictive and corrective means.

This presentation will discuss the basics of Tomography and its potential application to ionospheric modeling and seismic predictions. The primary objective of this research is to investigate the potential correlation between electron density perturbations and processes within the earth's core, mantle and crust typically associated with the onset of seismic activities. Preliminary results seem to suggest that pre-earthquake signals can be detected, in some cases, months before the actual earthquake occurs.