

# **Complimentary nature of land, ocean and atmospheric parameters associated with coastal earthquakes**

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The recent observations after the earthquakes have revealed significant changes on the land, ocean, atmosphere and ionosphere. These parameters are easily mapped using optical and microwave remote sensing satellites through day and night. The earthquakes occur at a depth of 5 km and below, the slow deformation gives changes in various parameters near the Earth surface and surrounding regions. The emission of acoustic and electromagnetic waves are responsible for the changes on the infrared thermal temperature of the land and several parameters of the land, ocean, atmosphere and ionosphere. In the present talk, we present the analysis of multi sensor remote sensing data of several recent earthquakes which show significant changes in the surface latent heat flux, chlorophyll concentrations, water vapor, total electron content, infrared thermal temperature. These parameters show anomalous behavior up to about two weeks prior to earthquakes due to the strong coupling between the land, ocean, atmosphere and ionosphere. The nature of the coupling and the effect are quite variable and dependence on the nature, location and focal depth of the earthquakes. Detailed analysis of about 400 earthquakes have shown that the earthquakes of magnitude 5.5 occurring with focal depth up to 33 km are characterized by the anomalous surface latent heat flux, water vapor, chlorophyll concentrations, total electron content and infrared thermal temperature. The anomalous behavior is seen up to five standard deviation in the case of recent deadly earthquakes (Gujarat and Sumatra) occur near the coast. Detailed analysis of various parameters showing anomalous behavior will be discussed in providing early information about earthquake and details of the integrated approach using high resolution with high temporal resolution will be presented in early warning of impending mega earthquakes. Few examples from the recent Sumatra and Pakistan earthquakes will be presented which show the use of multi sensor data in early warning of earthquakes.