

## NASDA's Earthquake Remote Sensing Frontier Project (Recent Achievements)

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This report summarizes the recent achievements of NASDA's. Our main emphasis is to study the general view of the lithosphere-atmosphere-ionosphere (LAI) coupling, by means of different ways of monitoring methods: (a) Radio sounding of ionosphere, (b) ULF and AE emissions, (c) Satellite observation of plasma and waves, etc. We present a lot of results on the ionospheric perturbations associated with earthquakes including the initial Kobe result, 13 years' results and recent results from the newly established networks in Japan.

The fiscal year of 2000 is the last (5th) year of the NASDA's Earthquake Remote Sensing Frontier Project, so that we would like to summarize our recent achievements. Our main emphasis is to study the general view of the lithosphere-atmosphere-ionosphere (LAI) coupling, by means of different ways of monitoring methods. First of all, we will show a lot of results on the ionospheric perturbations associated with earthquakes (including the initial Kobe result, 13 years' results and recent results from the newly established networks in Japan (7 observing stations for VLF/LF subionospheric signals, and at each station we can receive at least a few transmitter signals simultaneously)). An important finding from this is that the atmospheric oscillation with period of 5 days or 9-11 days plays an important role in this LAI coupling. As the initial condition of this LAI coupled system and also its boundary condition, ULF emissions and acoustic emissions (AE) indicative of microfracturing have been investigated very extensively. So that, a network of ULF sensors has been established in Kanto area (Izu, Chiba, Kakioka, Chichibu and Matsushiro) in order to estimate the location of the ULF source. Especially, the differential arrays (with 3 or 4 closely spaced stations with spacing 5-10km) are adopted at Izu and Chiba, in order to make the direction finding of the source. Some interesting results are coming out. In parallel with this network observation, we have been working on the ULF data for large earthquakes taken place in the world, and our latest results for Biak earthquake in Indonesia will be reported, based on our polarization and fractal analyses. We have started the observation of AE at Matsushiro, which has indicated an interesting result of the precursors of earthquakes. Other works like the satellite observation of plasma and waves, remote sensing of Earth's surface temperature, GPS monitor of the ionosphere, etc. will also be described briefly.