

NUMERICAL SIMULATION OF ELECTROMAGNETIC COUPLING IN THE LITHOSPHERE-ATMOSPHERE-IONOSPHERE (LAI) SYSTEM ASSOCIATED WITH THE SEISMOGENIC PROCESS

Lanbo Liu¹, Qinghua Huang², Yanbin Wang², and Qiao Wang²

¹School of Engineering, University of Connecticut, 261 Glenbrook Road, Storrs, CT 06269, USA
Lanbo.Liu@UConn.edu, <http://www.engr.uconn.edu/~lanbo>

²School of Earth and Space Sciences, Peking University, 5 Yiheyuan Road, Beijing 100871, China
huangq@pku.edu.cn, <http://web5.pku.edu.cn/sess/>

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The lithosphere-atmosphere-ionsphere (LAI) system formed an electromagnetic (EM) cavity that hosts the EM field excited by electric or magnetic sources generated or induced by a variety of mechanisms inside the LAI system. For example, lightning in the lower atmosphere is the major cause for the excitation of the Schumann Resonance (SR). There have also been numerous reports on variations of the EM field existing in the LAI system prior to some significance earthquakes (e.g., Ohta et al, 2006; Hayakawa et al, 2008).

We have simulated the EM field variations associated with the seismogenic process in the LAI waveguide with a whole-earth model using a curvature coordinate by the hybrid pseudo-spectral (PS) and finite difference time domain (FDTD) method. The seismogenic process is considered and modelled in four stages: inter-seismic, pre-seismic, co-seismic, and post-seismic. For the inter-seismic stage, we can model the EM field by considering only the excitation of the Schumann Resonance (SR) as the background generated by randomly placed electric-current impulses within the lowest 10 kilometres of the atmosphere. The diurnal variation and the latitude-dependence in ion concentration in the ionosphere are included in the model.

For the pre-seismic stage we model the EM material property variation in the seismogenic volume caused by rock dilatancy and incorporate the effect into the LAI EM field computation. For the co-seismic process we have an electric impulse introduced in the shallow lithosphere to mimic the seismogenic rupture and assess the possible effects on SR strength and frequency. For the post-seismic process we will couple the mechanic wave propagation along earth's solid surface and its effect to LAI EM field through the generation of internal gravity in the atmosphere. We are working on implementing the modelling capacity to include more realistic mechanic and EM material properties and more mechanic-EM coupling mechanisms.

REFERENCES

- [1] K. Ohta, N. Watanabe and M. Hayakawa, Survey of anomalous Schumann resonance phenomena observed in Japan, in possible association with earthquakes in Taiwan, *Physics and Chemistry of the Earth, Part A/B/C*, Vol. **31(4-9)**, pp. 397-402, 2006.
- [2] M. Hayakawa, A. Nickolaenko and M. Sekiguchi, Anomalous ELF phenomena in the Schumann resonance band as observed at Moshiri (Japan), in possible association with an earthquake in Taiwan, *Natural Hazards and Earth System Science*, Vol. **8**, pp. 1309-1316, 2008.