Comment on “Preseismic Lithosphere-Atmosphere-Ionosphere Coupling”

On Ionospheric Earthquake Prediction

The enormous economic and social disruption caused by large earthquakes drives many researchers towards the goal of better seismic understanding, with the hope of improving the forecasting of destructive events. A 2006 *Eos* article describes preseismic "lithosphere-atmosphere-ionosphere coupling" [*Kamogawa*, 2006], giving the strong impression that the ionospheric signatures could indeed be used to provide early warning of imminent shocks. On the basis of the literature discussed in that article, this would indeed be true.

In many of the cases outlined, however, the high correlations described occur in small case studies, and no mention is made of follow-on statistical studies that have drawn totally opposite conclusions, i.e., that the proposed coupling does not exist. Two clear examples come from the description of earthquake precursors reported in the propagation behavior of very low frequency (VLF) electromagnetic waves beneath the lower ionosphere.

In the first case, the original *Eos* article describes anomalies in the amplitude and phase of VLF transmissions, reported when major earthquakes lie near the great circle path linking transmitter and receiver. Such studies were also published earlier [e.g., Gokhberg et al., 1989]. However, a U.S. Geological Survey statistical examination of the phenomena concluded that the precursory relationship reported is not statistically significant [*Michael*, 1996]. In the second case, a similar situation holds with the VLF propagation "Terminator Time" method described in the original *Eos* article. While initially this technique appeared to offer "high correlations" between earthquakes and propagation anomalies, a follow-on study, using considerably more data concluded that the occurrence rate of successful earthquake predictions using the Terminator Time method cannot be distinguished from that of chance [Clilverd et al., 1999].

It is possible to criticize the Clilverd study for not replicating the exact propagation conditions of the "successful" Terminator Time method case studies, other than having earthquakes occurring on the propagation path. Thus we cannot, as yet, conclude that the Terminator Time method is totally flawed. However, the excitement and importance of this field must not blind us to the value of the scientific method, and at this stage there are significant doubts as to the validity of the preseismic lithosphere-atmosphere-ionosphere coupling phenomena. We urge the wider *Eos* readership to examine the complete literature as to such preseismic phenomena, taking the recent *Eos* article as representing one side of the scientific argument.

References

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