

Reply to Comment on "Preseismic Lithosphere-Atmosphere-Ionosphere Coupling"

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A number of electromagnetic candidates of earthquake precursors have been reported, but Rodger and Clilverd (Comment on "Preseismic Lithosphere-Atmosphere-Ionosphere Coupling," *Eos*, this issue) comment that their statistical significance has not been verified. Since most of the proposed mechanisms of reported earthquake precursors are controversial, it is true that the first requisite for verification should mainly rely on statistical analysis, as these authors rightly point out. The statistical analysis, in fact, is exactly what concerned researchers are continuously challenging. It is a difficult goal largely because of the limited number of large earthquakes.

In an *Eos* article [Kamogawa, 2006], some recent promising results that had been statistically studied were reviewed. Pioneering works by Gokhberg *et al.* [1989] and Molchanov and Hayakawa [1998] were also mentioned even if they were lacking in elaborate statistical analysis. In their comment, Rodger and Clilverd stress that the existence of preseismic subionospheric anomalies is contro-

versial, citing some papers such as those by Michael [1996] and Clilverd *et al.* [1999]. Although I did not refer to these papers due to the space limitation of the *Eos* article, I agree with their point.

However, it should be pointed out that Michael [1996] and Clilverd *et al.* [1999] tried to deal only with the pioneering works, not with the more recent works mentioned by Kamogawa [2006]. In my view, in addition to the small number of large earthquakes at the pioneering stage, the inadequacy of the pioneering works may be attributed to insufficient criteria to discriminate earthquake-related anomalies and other anomalies. Moreover, the complex mutual dependence of parameters associated with criteria such as the threshold values of signal amplitude, lead time, and focal distance should be more carefully investigated to avoid biased sample selection. More recently, Maekawa *et al.* [2006] made a further advance, though slight, in the statistical verification of the existence of preseismic subionospheric anomalies. Though step by step, some steady progress is being made. In any case, continued research for establishing a robust corre-

lation between earthquakes and anomalies will be needed to adequately respond to scientific criticisms like this comment.

References

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N E W B O O K S

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This column lists recently published books that have been received by *Eos*.

Biogeochemistry of Estuaries, Thomas S. Bianchi, Oxford University Press, ISBN: 978-0-19-516082-7, \$124.50.

Contaminated Rivers: A Geomorphological-Geochemical Approach to Site Assessment and Remediation, Jerry R. Miller and Suzanne M. Orbock Miller, Springer, ISBN: 978-1-4020-5286-6, \$99.

Environmental Disasters, Natural Recovery and Human Responses, Roger del Moral and Lawrence R. Walker, Cambridge University Press, ISBN: 978-0-521-67766-1, \$48.

Gamma-Ray Bursts: Prospects for Glast, Magnus Axelsson and Felix Ryde (Eds.), American Institute of Physics, ISBN: 978-0-7354-0413-7, \$83.

Groundwater: Resource Evaluation, Augmentation, Contamination, Restoration, Modeling and Management, M. Thangarajan (Ed.), Springer, ISBN: 978-1-4020-5728-1, \$169.

Human Impacts on Weather and Climate, William R. Cotton and Roger A. Pielke Sr., Cambridge University Press, ISBN: 978-0-521-60056-9, \$55.

Introduction to Applied Geophysics: Exploring the Shallow Subsurface, H. Robert Burger *et al.*, Norton, ISBN: 978-0-393-92637-8, \$66.

Introduction to Planetary Science: The Geological Perspective, Guter Faure and Teresa M. Mensing, Springer, ISBN: 978-1-4020-5233-0, \$99.

Radiation in the Atmosphere: A Course in Theoretical Meteorology, Wilford Zdunkowski *et al.*, Cambridge University Press, ISBN: 978-0-521-87107-7, \$135.

Rock Damage and Fluid Transport, Part II, Arno Zang *et al.* (Eds.), Birkhäuser, ISBN: 978-3-7643-7993-3, \$49.95.

Surviving Armageddon: Solutions for a Threatened Planet, Bill McGuire, Oxford University Press, ISBN: 978-0-19-280572-0, \$17.95.

Sustainability or Collapse? An Integrated History and Future of People on Earth, Robert Costanza *et al.* (Eds.), Dahlem University Press, ISBN: 978-0-262-03366-4, \$38.

Thrust Belts and Foreland Basins: From Fold Kinematics to Hydrocarbon Systems, O. Lacombe *et al.* (Eds.), Springer, ISBN: 978-3-540-69425-0, \$199.

Trace Fossil Analysis, Adolf Seilacher, Springer, ISBN: 978-3-540-47225-4, \$69.95.

Waves in Geophysical Fluids: Tsunamis, Rogue Waves, Internal Waves and Internal Tides, John Grue and Karsten Trulsen (Eds.), Springer, ISBN: 978-3-211-37460-4, \$99.