AGU
Become an AGU Member
Subscribe to AGU Journals
Home Publications

Full Article (Nonsubscribers may purchase for $9.00, Includes print PDF, file size: 4555993 bytes)

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 112, B02106, doi:10.1029/2006JB004447, 2007

Investigation of ionospheric electron content variations before earthquakes in southern California, 2003–2004

Thomas Dautermann
Department of Physics, Purdue University, West Lafayette, Indiana, USA

Eric Calais
Department of Earth and Atmospheric Sciences, Purdue University, West Lafayette, Indiana, USA

Jennifer Haase
Department of Earth and Atmospheric Sciences, Purdue University, West Lafayette, Indiana, USA

James Garrison
School of Aeronautics and Astronautics, Purdue University, West Lafayette, Indiana, USA

Abstract

It has been proposed that earthquakes are preceded by electromagnetic signals detectable from ground- and space-based measurements. Ionospheric anomalies, such as variations in the electron density a few days before earthquakes, are one of the precursory signals proposed. Since Global Positioning System (GPS) data can be used to measure the ionospheric total electron content (TEC), the technique has received attention as a potential tool to detect ionospheric perturbations related to earthquakes. Here, we analyze 2 years (2003–2004) of data from the Southern California Integrated GPS Network (SCIGN), a dense network of 265 continuous GPS stations centered on the Los Angeles basin, for possible precursors. This time period encompasses the December 2003, M6.6, San Simeon and September 2004, M6.0, Parkfield earthquakes. We produce TEC time series at all SCIGN sites and apply three different statistical tests to detect anomalous TEC signals preceding earthquakes. We find anomalous TEC signals but no statistically significant correlation, in time or in space, between these TEC anomalies and the occurrence of earthquakes in southern California for the 2003–2004 period. This result does not disprove the possibility of precursory phenomena but show the signal-to-noise ratio of a hypothetical TEC precursor signature is too low to be detected by the analysis techniques employed here. Precursors may still be revealed for future large earthquakes in well instrumented areas such as California and Japan, if the tests can be developed into techniques that can better separate external influences from the actual TEC signal.

Received 12 April 2006; accepted 18 September 2006; published 15 February 2007.

Keywords: ionosphere; total electron content; earthquakes.

Index Terms: 6929 Radio Science: Ionospheric physics (1240, 2400); 2439 Ionosphere: Ionospheric

irregularities; 7223 Seismology: Earthquake interaction, forecasting, and prediction (1217, 1242); 2494 Ionosphere: Instruments and techniques.

Full Article (Nonsubscribers may purchase for $9.00, Includes print PDF, file size: 4555993 bytes)

Citation: Dautermann, T., E. Calais, J. Haase, and J. Garrison (2007), Investigation of ionospheric electron content variations before earthquakes in southern California, 2003–2004, *J. Geophys. Res.*, *112*, B02106, doi:10.1029/2006JB004447.

Copyright 2007 by the American Geophysical Union.