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Ionospheric electron enhancement ˜20 minutes before the 2015 Nepal earthquake

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Ionospheric electron enhancement, reported to have occurred ˜40 minutes before the 2011 Tohoku-oki (Mw9.0) earthquake by observing total electron contents (TEC) with global navigation satellite system (GNSS) receivers, has been repeatedly questioned due mainly to the ambiguity in the derivation of the reference TEC curves from which anomalies are defined. For a brief history of the debate on this matter, please see the reference list given at the end of the abstract. Here we propose an AIC-based numerical approach to detect positive breaks (sudden increase of TEC rate) in the vertical TEC time series without using reference curves. We demonstrate that such breaks are detected 25-80 minutes before the ten recent large earthquakes with moment magnitudes (Mw) of 7.8-9.2, including the 2015 Nepal Eq.. The amounts of precursory rate changes were found to depend upon background TEC as well as Mw. The precursor times also showed Mw dependence, and the precursors of intraplate earthquakes tend to start earlier than interplate earthquakes. We also performed the same analyses during the period of no earthquakes to evaluate the usefulness of TEC observations for short-term earthquake prediction.

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