Searching beyond seismology for earthquake precursors

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Special Topics

The Global Earthquake Forecasting System:

Towards Using Non-seismic Precursors for the Prediction of Large Earthquakes

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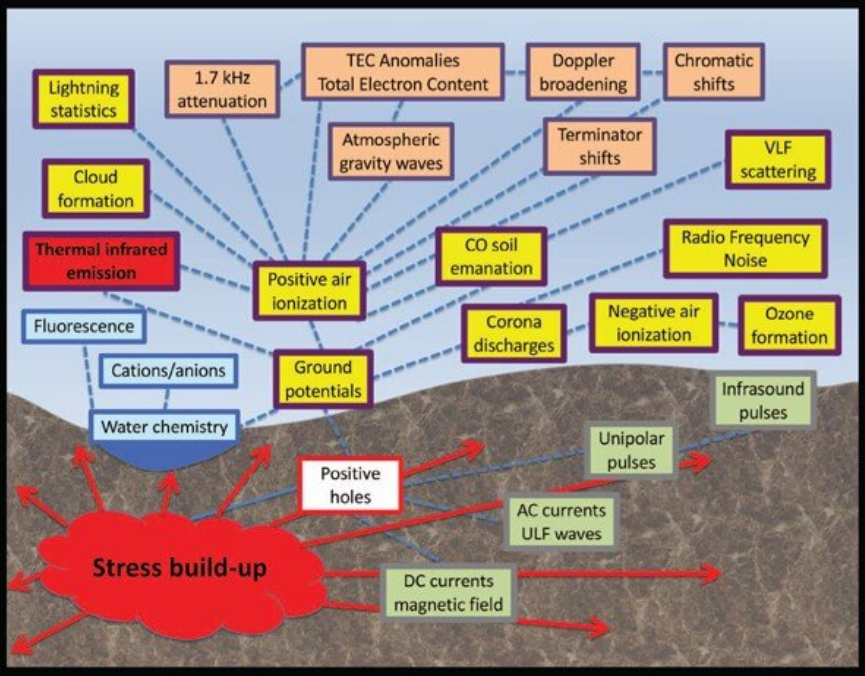

edp sciences Springer

Credit: *Eur. Phys. J.*

To predict when earthquakes are likely to occur, seismologists often use statistics to monitor how clusters of seismic activity evolve over time. However, this approach often fails to anticipate the time and magnitude of large-scale earthquakes, leading to dangerous oversights in current early-warning systems. For decades, studies outside the seismology field have proposed that these major, potentially devastating seismic events are connected to a range of non-seismic phenomena—which can be observed days or even weeks before these large earthquakes occur. So far, however, this idea hasn't caught on in the wider scientific community. In this special issue, *EPJ* Special Topics proposes the Global Earthquake Forecasting System (GEFS): the first collaborative initiative between multi-disciplinary researchers devoted to studying a diverse array of non-seismic earthquake precursors.

By promoting the integration of these ideas with existing theories in seismology, GEFS could lead to significant improvements of earthquake early warning systems; potentially saving lives and protecting critical infrastructures when future disasters hit. The initiative is rationalized via a subtle atomic-level defect-based mechanism for explaining a variety of earthquake precursors, building on decades of laboratory experiments in physical chemistry and solid-state physics. The theory suggests that, as stresses build up in tectonic plates prior to seismic activity, electron-hole pairs are generated in the Earth's crust. The electrons are confined to the stressed rocks, but the positively charged holes flow out into the surrounding, less stressed rocks, producing electrical currents that can travel over large distances. These currents in turn can trigger wide-

ranging secondary effects ranging from unusual low to ultralow electromagnetic radiation, to emissions of spectroscopically distinct thermal infrared from the Earth's surface, to changes in the atmosphere and ionosphere.

This special issue documents the findings of researchers around the world, who have used both ground- and space-based observations to link these non-seismic patterns to the occurrence of subsequent large earthquakes. The work creates a strong rationale for global efforts to continually monitor the Earth for key signs of these precursors, which are often intermittent and weak. If its aims are realized, GEFS could be the first step towards a widespread collaboration between different scientific communities, each with the shared goal of improving our ability to forecast large earthquakes in the future.

More information: Preface to the Global Earthquake Forecasting System (GEFS) Special Issue: Towards Using Non-seismic Precursors for the Prediction of Large Earthquakes, *Eur. Phys. J.* Special Topics, DOI: 10.1140/epjst/e2020-000242-4