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Plate dynamical mechanisms as constraints on the likelihood of earthquake precursors in the ionosphere

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In my oral(?) contribution to this session [1] I use my studies of the fundamental physics of gravitation to derive a reason for expecting the vertical gradient of electron density (= radial electric field) in the ionosphere to be closely affected by another field, directly associated with the ordinary gravitational potential (***g***) present at the Earth's surface. I have called that other field the Gravity-Electric (G-E) field.
A calibration of this linkage relationship could be provided by noting corresponding co-seismic changes in (***g***) and in the ionosphere when, for example, a major normal-fault slippage occurs.
But we are here concerned with precursory changes. This means we are looking for mechanisms which, on suitably short timescales, would generate pre-quake elastic deformation that changes the local (***g***). This poster supplements my talk by noting, for more relaxed discussion, what I see as potentially relevant plate dynamical mechanisms.

Timescale constraints. If monitoring for ionospheric precursors is on only short timescales, their detectability is limited to correspondingly tectonically active regions. But as our monitoring becomes more precise and over longer terms, this constraint will relax. Most areas of the Earth are undergoing very slow heating or cooling and corresponding volume or epeirogenic change; major earthquakes can result but we won't have detected any accumulating ionospheric precursor.

Transcurrent faulting. In principle, slip on a straight fault, even in a stick-slip manner, should produce little vertical deformation, but a kink, such as has caused the Transverse Ranges on the San Andreas Fault, would seem worth monitoring for precursory build-up in the ionosphere.

Plate closure – subducting plate downbend. The traditionally presumed elastic flexure downbend mechanism is incorrect. 'Seismic coupling' has long been recognized by seismologists, invoking the repeated occurrence of 'asperities' to temporarily lock subduction and allow stress to build for a major earthquake. My 2008 paper [2], concerned with the building by subduction of UHP- metamorphic belts, finds that downbend must actually be by progressive escalator-like step-faulting. This is firmly prescribed by the need to produce the very characteristic rocks of which such belts are constructed. From that paper I will illustrate the step-faulting downbend, its mechanical properties for belt construction and some of the diagnostically resulting rocks. I will also show my constructed transect of the evolution of the NE Honshu system since the late Oligocene, which illustrates this action and could be pertinent to the Tohoku-Oki/Fukushima 2011 earthquake and tsunami.
Seismologically, the step-faulting mode results in two kinds of subduction earthquake; one when there is a quasi-vertical increment of the step, the other when the resulting interface offset ('asperity') is sheared through. We will be able to discuss the ways in which associated deformation might, or might not, generate a warning in the ionosphere.

Plate closure – collision tectonics. This, finally, is likely to be the most precursor-generating situation, but could demand good horizontal resolution within the ionosphere. Thrusting raises some rocks and depresses what it has overridden, changing ***g*** and G-E field of each. L'Aquila 2009 and Sichuan 2008 as examples. (Haiti 2010 was more complex.) So it appears that ionospheric changes over such regions should be taken very seriously.

[1] Osmaston M (2013) Earthquake precursors in the ionosphere: electrical linkage provided by the fundamental physics of gravitation. *Geophys. Res. Abstr.* **15**, EGU2013-2392.
[2] Osmaston MF (2008) Basal subduction tectonic erosion (STE), butter mélanges and the construction and exhumation of HP-UHP belts: the Alps example and some comparisons. *International Geology Review* **50**(8), 685-754 DOI: 10.2747/00206814.50.8.685.