TEMA L1-3 Present deformation pattern in the prospective of temporal and spatial Inter-seismic locking from GNSS and seismological data in the Maule Earthquake 2010 rupture and neighboring region

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We look for a highly research-oriented Ph.D. candidate to join in our FONDAP Research Center CIGIDEN program dedicated for natural hazards from subduction earthquake. The subduction earthquakes are the world?s greatest geophysical process of natural hazards. The subduction earthquakes (Mw>8) are thought to follow the non-periodic seismic cycle, which is simply described as a repetitive series of interseismic (accumulation energy), coseismic (release of elastic energy), and postseismic (complex relaxation period in the years to decades following a great earthquake) phases. Modern geodetic technique (GNSS and InSAR) and seismological data offer the potential to characterize a variety of processes associated with earthquakes. It can improve our understanding of the mechanics of the seismic cycle. As part of this advancement, I propose to study the latest and best observed megathrust earthquakes occurred in Chile, the 2010 (Mw 8.8) Maule earthquakes. It is intended to investigate, how a large seismic event and its postseismic transients impact during the relocking phase change the local and regional stress field at the subduction interface and deformation in the utmost detail. Models of recent large subduction-zone earthquakes have revealed first-order spatial relations between pre-seismic highly locked zones on the interface and seismic asperities (areas that release large slip during earthquakes) (e.g., Chlieh et al., 2008, Moreno et al., 2010). These observations suggest that the distribution of locking may be used to indicate the size and location of seismic asperities. Therefore, understanding the physical nature of locking and asperities has become a topic of prime interest. In recent years, modern geodetic observations (e.g., Dragert et al., 2001, Rogers and Dragert, 2003, Ruiz et al., 2014, Melnick et al., 2017) have shown temporal variations in the pattern of inter-seismic deformation, indicating that the patterns of strain accumulation may vary in both temporal and spatial.

However, the origin of transients and their impact on the stress field in the seismo-genic zone (advancing or delaying a future large earthquake) are still puzzling. Furthermore, additional observational and conceptual research is needed to better understand the mechanical basis of transient deformation at subduction zones. Identification of transients is difficult, as the time series may contain other deformation signals or be contaminated by hydrological effects, instability of monuments or reference frame errors, and thus requires sophisticated signal processing techniques (e.g., McGuire and Segall, 2003). Increasing resolution of the plate interface processes through densification of existing instrumental networks, together with the implementation of algorithms to detect low-signal transient deformation from GNSS time-series (e.g., Riel et al., 2014) and time-dependent slip inversions, are improving the detection of transient seismic and aseismic slip at subduction zones. Exploring how transient seismic and aseismic deformation patterns precede and/or immediately follow large and medium sized (more frequent) earthquakes, and the correlation of this behaviour with crustal structure and rock properties, should provide a more direct insight on the nucleation of earthquakes and thus improve the physical model of earthquake cycle phenomena.

To achieve this, my project is designed in an interdisciplinary framework integrating geodesy, seismological and numerical modeling for slip along the plate interface after the 2010 Maule earthquakes, and to characterize regional variations on the deformation field and relocking degree. In particular, these will include (1) Processing of GPS time series of surface deformation in the pre- and postseismic phases, (2) Detection of low magnitude transient deformation signals, (3) Numerical modeling of subduction zone mechanisms that are responsible for the observed transient deformation field during the interseismic, coseismic and postseismic periods. These results will quantify and provide better understanding of deformation processes associated with the seismic cycle, such as the relation between interseismic and coseismic deformations, and the temporal and spatial distribution of postseismic deformation and relocking processes.

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CONTACTO

Los postulantes interesados deber?n hacer llegar una carta de inter?s adjuntando su Curriculum Vitae a [mahesh.shrivastava@cigiden.cl]

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