MULTIPLE OBSERVATIONS AND MODELING OF THE TINY GROUND MOTIONS ASSOCIATED WITH COSEISMIC GRAVITY CHANGES

Martin VALLÉE [1], ***Kévin JUHEL*** [1,2]

[1] Institut de Physique du Globe de Paris, Sorbonne Paris Cité, Université Paris Diderot, CNRS, Paris, France

[2] AstroParticule et Cosmologie, Université Paris Diderot, CNRS/IN2P3, Sorbonne Paris Cité, Paris, France

The recent first observations of the prompt elastogravity signals (PEGS) induced by the 2011 Mw=9.1 Tohoku megathrust earthquake generated interest in how these tiny signals might best be observed, especially for lower magnitude events. Simulations of these signals preceding the direct P wave, for different depths and focal mechanisms, first reveal that shallow strike-slip earthquakes offer a better detection potential than subduction megathrust earthquakes. Consistently, clear PEGS are observed at several broadband seismometers during the 2012 Mw=8.6 Wharton Basin earthquake. Due to their short source durations, large deep earthquakes are then shown to have an even larger detection potential, confirmed by the successful seismological observations for the 2018 Mw=8.2 Fiji and 1994 Mw=8.2 Bolivia earthquakes. Detection is even improved when an earthquake is recorded by a number of good-quality seismometers, allowing for stacking techniques. The PEGS of the 2018 Mw=7.9 Off-Alaska earthquake (strike-slip) and of the 2010 Mw=8.8 Maule megathrust earthquake are clearly revealed by such strategies. As a whole, we show new observations of the PEGS for five earthquakes in the [7.9 - 8.8] magnitude range. In all these cases, signals are shown to be accurately modeled when taking into account both the coseismic gravity changes and the ground motions induced by these gravity changes. These findings demonstrate that, even without considering promising future instruments, PEGS detection is not restricted to exceptional events, confirming their potential for magnitude and focal mechanism determination within the few minutes following a large earthquake.