# Analysis and modelling of tsunami-induced tilt for the 2007, *M*= 7.6, Tocopilla and the 2010, *M*= 8.8 Maule earthquakes, Chile, from long-base tiltmeter and broadband seismometer records

F. Boudin[1], S. Allgeyer[2], P. Bernard[3], H. H´ebert[4], M. Olcay[5], R. Madariaga[2], M. El-Madani[3], J.-P. Vilotte[3], S. Peyrat[1], A. Nercessian[3], B. Schurr[6], M.-F. Esnoult[3], G. Asch[6], I. Nunez[5] and M. Kammenthaler[7]

We present a detailed study of tsunami-induced tilt at in-land sites, to test the interest and feasibility of such analysis for tsunami detection and modelling. We studied tiltmeter and broadband seismometer records of northern Chile, detecting a clear signature of the tsunamis generated by the 2007 Tocopilla (*M* = 7.6) and the 2010 Maule (*M* = 8.8) earthquakes. We find that these records are dominated by the tilt due to the elastic loading of the oceanic floor, with a small effect of the horizontal gravitational attraction. We modelled the Maule tsunami using the seismic source model proposed by Delouis *et al.* and a bathymetric map, correctly fitting three tide gauge records of the area (Antofagasta, Iquique and Arica). At all the closest stations (7 STS2, 2 long-base tiltmeters), we correctly modelled the first few hours of the tilt signal for the Maule tsunami. The only phase mismatch is for the site that is closer to the ocean.We find a tilt response of 0.005–0.01 μm at 7 km away from the coastline in response to a sea level amplitude change of 10 cm. For theMaule earthquake, we observe a clear tilt signal starting 20min before the arrival time of the tsunami at the nearest point on the coastline. This capability of tilt or seismic sensors to detect distant tsunamis before they arrive has been successfully tested with a scenario megathrust in the southern Peru-northern Chile seismic gap. However, for large events near the stations, this analysis may no longer be feasible, due to the large amplitude of the long-period seismic signals expected to obscure the loading signal. Inland tilt measurements of tsunamis smooth out short, often unmodelled wavelengths of the sea level perturbation, thus providing robust, large-scale images of the tsunami. Furthermore, tilt measurements are not expected to saturate even for the largest run-ups, nor to suffer from near-coast tsunami damages. Tiltmeters and broadband seismometers are thus valuable instruments for monitoring tsunamis in complement with tide gauge arrays.