



Mass redistributions of the 2011 Mw 9.0 Tohoku-oki earthquake from GRACE

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Large-scale gravity variations associated with the deformations surrounding giant earthquakes are one way to probe the rheology of the Earth's upper mantle. They can be described from the GRACE mission data at temporal scales of months to years, and spatial scales inbetween those of local and global plate dynamics. Here, we consider the case of the 2011 Mw 9.0 Tohoku-oki earthquake and perform a space-time analysis of the GRACE geoid time series in a wide domain surrounding the event. In addition to the near-epicentral signals, we evidence regional-scale gravity variations starting a few months before the rupture, and propagating far within the Pacific and Philippine Sea plate interiors after the event. The gravity signals suggests that the earthquake is part of a broadscale deformation migrating from depth to surface across the entire subduction system, involving precursory slab extension at mid-upper mantle depths. We discuss the implications of these results, which provide unique evidence for episodic mass transfers at timescales of months in-depth of the plates boundaries.