Bayesian surface reconstruction of geodetic uplift rates: mapping the global fingerprint of GIA

Laurent Husson*[1], Thomas Bodin , Giorgio Spada[2], Gaël Choblet[3], and Corné Kreemer[4]

[1]Institut des sciences de la Terre (ISTerre) – CNRS : UMR5275, IFSTTAR, IFSTTAR-GERS, Université de Savoie, Université Joseph Fourier - Grenoble I, INSU, OSUG, Institut de recherche pour le développement [IRD] : UR219, PRES Université de Grenoble – BP 53 38041 Grenoble cedex 9, France

[2]Department of Pure and Applied Sciences, University of Urbino "Carlo Bo" – Italy

[3]Laboratoire de Planétologie et Géodynamique (LPGN) – CNRS : UMR6112, INSU, Université de Nantes – 2 Rue de la Houssinière - BP 92208 44322 NANTES CEDEX 3, France

[4]Nevada Bureau of Mines and Geology, Nevada Seismological Laboratory – University of Reno, Nevada, USA., United States

Abstract

We use a global compilation of geodetic (GPS) rates to reconstruct vertical land motion (VLM) using a Bayesian inference method. Trends of VLM are derived from almost 15,000 GPS position time-series retrieved from the Nevada Geodetic Laboratory. Our Transdimensional Regression (TR) method is based on Voronoi tessellation and self-adapts to the level of spatial structure contained in the database. It is thus suitable for our strongly heterogeneous data set, both in terms of the geographical distribution and level of uncertainties, and provides at each location a probability density function for the rate of VLM. We apply the TR method to a set of globally distributed regions. At high latitudes the signal is dominated by Glacial Isostatic Adjustment (GIA); fast uplift rates are observed across the previously ice-covered areas, while subsidence characterizes the surrounding peripheral forebulges. Other long-wavelengths processes, like dynamic topography, occasionally overprint and out-pace the GIA signal. Short- wavelength processes can be disentangled; remarkable examples are the sharp boundary between the uplifting Himalaya and subsiding foreland Ganges plain, the fast subsiding Central Valley of California, or the subsiding Galveston area (Texas) and Mississippi delta. In an attempt to visualize the global signature of GIA, we assembled the regional maps and filtered out the short-wavelength components. Comparison to independent models (dynamic model predictions of GIA) or data (relative sea level change along coastlines) reveals that our map of VLM is robust and dominated by GIA. Conversely, in regions where TR predictions are robust, departure between the two classes of models (dynamic predictions and TR) either reveals that other processes than GIA may locally contribute to the signal, or to incorrect model predictions. For example, on the edges of formerly ice-covered regions, TR predicts larger negative gradients of uplift rates than dynamical models, most probably due to the poor knowledge of the effective rheological structure of the Earth that is used in dynamic GIA models.

*Speaker