Intraplate deformation in central-western Europe from GPS data

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Abstract

The possibility that earthquakes of significant magnitude strike western Europe, away from active mountain ranges such as the Alps or the Pyrenees, is a topic of academic interested that is fueld, in part, by the associated risk to large sensitive facilities. Here we use GPS data to search for potential surface deformation in central-western Europe that may be linked to on-going large-scale tectonic processes. The study area is centered on the Paris Basin and covers the Armorican Massif, the Ardenne, Vosges and Jura mountains in the mainland, and extends northwards beyond the English channel to the London Basin and the southern Cambrian Mountains. We retrieved freely and publicly available data for 518 continuously-operating GPS stations in the study area, 12 of which are reference sites of the International Service for Geodynamics (IGS). We processed the data using the GAMIT-GLOBK software package for the period 2000-2017. We combined the regional, loosely constrained, daily solutions with the global daily solutions for the whole IGS network available from the Massachusetts Institute of Technology IGS Data Analysis Center, to optimally tie our solution to the International Terrestrial Reference Frame (ITRF-2014). We then compute a cumulative position/velocity solution with uncertainties that account for site-dependent colored noise.
We use the resulting velocity field to search for departures from plate rigidity at regional and local scales, accounting for the velocity uncertainties. Overall, residual velocities with respect to a perfectly rigid behavior are very small, all less than 2 mm/yr, and are not showing regionally coherent departures from plate rigidity. There may be an exception in southern England and along the coasts of Belgium and Netherlands, that may be experiencing far-field effects of the present-day Fennoscandia glacial isostatic adjustment.

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