Fast Preview

Note: This is not exactly what the published abstract will look like

Improving reference frame stability by modelling common modes of surface displacements using Empirical Orthogonal Functions

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For a number of scientific and non-scientific applications, monitoring of point motion with respect to a regional or global reference frame is fundamental. Applications include but are not limited to tectonic plate motion, displacements of the Earth surface due to atmospheric, hydrological and cryospheric loading, sea level variations, natural and man-made land subsidence, and stability of large infrastructure. The geodetic tool most widely used today for this is GPS, either in campaign mode where points are re-visited episodically, or with continuous GPS (CGPS) stations operated over a long time. Time series of point coordinates derived from GPS observations are affected by a number of perturbations due to reference frame instabilities, atmospheric and ionospheric mismodelling, orbital errors, unaccounted point displacements due to local to regional processes, and local processes at the GPS site. These perturbation result in actual and apparent point motions on widely varying spatial and temporal scales, which may mask the signals actually sought for in a particular application. The spatially coherent common modes in the 3-D displacement fields observed by regional CGPS networks (with examples from Europe and the Basin and Range Province, USA) are determined with the help of a Principal Component Analysis (PCA) leading to Empirical Orthogonal Functions (EOF). The main common modes are used to create a regional and local displacement field, respectively, which can be used to decontaminate GPS determined point coordinates for these larger scale displacement. This new methodology is compared to standard approaches of spatial filtering that use simple averaging [Wdowinski et al., 1997]. The common modes also allow to identify the contribution of different forcing factors to the observed displacements of the solid Earth's surface in order to separate unaccounted point displacement from other effect. As an example, the common modes due to atmospheric pressure loading are identified and quantitatively assessed.

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