REFAG 2022 THESSALONIKI - GREECE
17-20 October 2022

Reference Frame and Identifying Localized vs Regional Deformation: Examples from Hawaii and the North Atlantic

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Abstract. Separating multiple sources of deformation can be difficult in places like Hawaii and Iceland. In both cases, there are time-dependent signals from multiple active volcanoes, and active faulting. In Iceland, ongoing glacier mass loss and glacial isostatic adjustment produce large signals, also time-dependent. In Hawaii, all GPS sites show an additional subsidence signal likely caused either by ongoing flexural loading under the growing volcanic load, or dynamics of the deep magma system. Because some of the deformation signals are longer wavelength than the islands themselves, an accurate regional or global reference frame is critical for analyzing the geophysical causes of these motions. In turn, if any sites from these places are included in a regional or global reference frame model, it is important to understand the time-dependence of the geophysical signals affecting those sites, so that their coordinate model is estimated appropriately.

In this study, I analyze continuous GPS data from the Pacific and the North Atlantic to assess plate motions and vertical reference. Each daily GPS solution is constructed by combining point positioning solutions (done with GIPSY goa-6.4) into a global solution, which is then aligned with ITRF globally. Velocities are estimated from the time series for those cases where a linear velocity (with offsets, if needed) is an appropriate description of the motion. The horizontal velocities can then be compared to models for plate motion, and the vertical velocities to a combination of loading models, or to co-located tide gauge data, to identify localized and regional sources of deformation.