Designing a Global Geodetic Network to Support GGOS

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Space geodesy is entrusted with the establishment and maintenance of reference frames that are widely used by the scientific and other user communities. Over the past decade, the burden of this task was primarily carried by the services of the International Association of Geodesy (IAG), led by IERS, the International Earth Rotation and Reference Systems Service. The new IAG initiative, the Global Geodetic Observing System, GGOS, places the utmost importance on the development, maintenance and wide distribution of an International Terrestrial Reference Frame (ITRF) of high accuracy and stability. At present, the goal is the definition of the origin accurate to 1 mm or better (at epoch) and a temporal stability on the order of 0.1 mm/y, with similar numbers for the scale and orientation components. The stability, integrity and applicability of the ITRF are directly related to how accurately we can account for mass redistribution during the analysis and reduction process of the data used for its development. Long wavelength variations of the gravity field driven by these mass redistributions produce geometric effects that are manifested as changes in the origin and orientation between the instantaneous and the mean reference frame. An uneven distribution of the stations that realize the ITRF on the globe generates biases and distortions in the combined product due to the dissimilarity of the combined networks and the de facto lopsided overlap of the combined networks. The poor geometry of the constituent networks results in increased correlations between the similarity transformation parameters, and they thus lead to biased and unstable results. The currently existing networks do not support high accuracy products and it is widely accepted that they are urgently in need of serious modernization and resource redistribution. Using simulations of geodetic data that we expect to collect with the future geodetic networks (SLR and VLBI), we provide preliminary options for the design of the complementary networks that will ensure the desired accuracy in the origin, scale and orientation definition of the ITRF..