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Design of next generation global geodetic networks to support GGOS

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The Global Geodetic Observing System–GGOS places the utmost importance on the development, maintenance and wide distribution of an International Terrestrial Reference Frame (ITRF) with very stringent attributes. At present, our goal is an origin definition at 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. Using simulations of geodetic data that we expect to collect with the future geodetic networks, we provide some preliminary investigations of the design of the complementary networks that will ensure the desired accuracy in the origin, scale and orientation definition of the ITRF.