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Next Generation Global Geodetic Networks for GGOS

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We present simulation studies aimed at designing optimal global geodetic networks to support the Global Geodetic Observing System–GGOS. 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. These goals are based on extensive deliberations within the Earth science community. In particular, oceanographers, a prime user group that these products are intended for, require this level of accuracy and temporal stability in order to address sea level rise issues with confidence. 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. This insidious coupling between the product and the reference with respect to which the product is generated makes the problem extremely complex and sensitive to systematic errors. An uneven distribution of the stations realizing the ITRF results in biases and distortions in the combined product due to the dissimilarity of the combined networks and their de facto lopsided overlap. Poor geometry results in increased correlations between the similarity transformation parameters, leading again to biased and unstable results. In this first step, we are focusing on establishing the optimal SLR and VLBI network, since these two techniques

alone are sufficient, and they are also the most costly, necessitating a very conservative deployment of the minimum number of such systems. Using simulations of geodetic data that we expect to collect with the future geodetic networks, we provide various designs of several co-located networks and the resulting accuracy in the origin, scale and orientation definition of the realized ITRF.