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The terrestrial reference frame (TRF) consists of precise Earth-centered coordinates of hundred of surface sites, many of which anchor the orbit estimates of the global navigation satellites. TRF is the foundation for all space-based, airborne, and ground-based Earth observations. Positions of objects are determined within an underlying TRF, and the accuracy with which objects can be positioned ultimately depends on the accuracy of the reference frame.

The non-tidal deformation (NTD) due to loading from atmosphere, ocean, and ground water tends to seasonally modulate the space geodetic position data used in determination of TRF. Campaign to determine the International Terrestrial Reference Frame (ITRF) takes place approximately every 5 years (with a recent initiative to realize intra-campaign ITRF updates every year). Because of such latency in ITRF realizations, forecasts of the TRF positions are desired in a typical application, relying on the TRF velocity estimate to forecast the linear trajectory projection. Here, we examine how various models of NTD could affect the accuracy of such TRF position trajectory forecasts.

The current ITRF realization models the NTD empirically with a truncated Fourier series (having an annual and semiannual periods) via fit to the position data. Alternatively, the NTD can be evaluated externally using numerical models of geophysical dynamic processes (of atmosphere, oceans, ground water, etc). Here, we introduce an independent NTD proxy based on the global ground surface deformation data derived from the GRACE satellite measurements.

Use of the GRACE data were particularly effective in mitigating extremely large forecast errors at certain sites, out-performing the next-best NTD realization by an average of 3 mm. Also, no degradation of the forecasts due to addition of the GRACE data was observed. These warrant further consideration of using the GRACE data in reference frame estimation.
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