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Assessing the impact of non-tidal atmospheric loading on a Kalman filter-based terrestrial reference frame

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The International Terrestrial Reference Frame (ITRF) adopts a piece-wise linear model to parameterize regularized station positions and velocities. The space-geodetic (SG) solutions from VLBI, SLR, GPS and DORIS used as input in the ITRF combination process account for tidal loading deformations, but ignore the non-tidal part.
As a result, the non-linear signal observed in the time series of SG-derived station positions in part reflects non-tidal loading displacements not introduced in the SG data reduction.
In this analysis, we assess the impact of non-tidal atmospheric loading (NTAL) corrections on the TRF computation. Focusing on the a-posteriori approach, (i) the NTAL model derived from the National Centre for Environmental Prediction (NCEP) surface pressure is removed from the SINEX files of the SG solutions used as inputs to the TRF determinations; (ii) adopting a Kalman-filter based approach, two distinct linear TRFs are estimated combining the 4 SG solutions with (corrected TRF solution) and without the NTAL displacements (standard TRF solution).
Linear fits (offset and atmospheric velocity) of the NTAL displacements removed during step (i) are estimated accounting for the station position discontinuities introduced in the SG solutions and adopting different weighting strategies. The NTAL-derived (atmospheric) velocity fields are compared to those obtained from the TRF reductions during step (ii).
The consistency between the atmospheric and the TRF-derived velocity fields is examined. We show how the presence of station position discontinuities in SG solutions degrades the agreement between the velocity fields and compare the effect of different weighting structure adopted while estimating the linear fits to the NTAL displacements.
Finally, we evaluate the effect of restoring the atmospheric velocities determined through the linear fits of the NTAL displacements to the single-technique linear reference frames obtained by stacking the standard SG SINEX files. Differences between the velocity fields obtained restoring the NTAL displacements and the standard stacked linear reference frames are discussed.