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The impact of non-tidal surface loading deformation on GNSS coordinate time series

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Abstract. Time-dependent mass variations of near-surface geophysical fluids in the atmosphere, the oceans, and the continental hydrosphere lead to significant and systematic load-induced deformations of the Earth's crust. These deformations impact the space geodetic techniques, and thus, uncorrected deformations can be seen in the estimated parameters such as station positions and the terrestrial reference frame, mainly as periodic signals. Based on station coordinate time series it is possible to assess the impact of time-dependent mass variations on the Earth's surface geometry and, thus, to assess the impact of uncorrected deformations on station positions and terrestrial reference frame parameters. While these corrections were not applied in the recent third reprocessing campaign (IGS repro3) of the International GNSS Service, the subsequently derived ITRF2020 presents seasonal signals estimated for each time series. These signals cover therefore non-tidal loading effects but also other periodic coordinate variations.

To assess the seasonal signals given in the ITRF2020 release we compare them for each individual GNSS station in the IGS repro3 against the model-based surface deformation products provided by GFZ (ESMGFZ). These products contain deformations due to non-tidal atmospheric and hydrospheric loading. The comparison is done in terms of stations-wise amplitude differences and correlations, but also with respect to regional variations and patterns. In the second part of the contribution, we will present the differences between the official GFZ contribution to repro3 and a second solution derived by applying the ESMGFZ models at the observation level. While previous studies indicate improvements for around 80% of the considered stations, both investigations will help to further understand periodic components in station coordinate time series.