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Determination and Validation of the Vienna Atmospheric Pressure Loading Corrections

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Loading of the Earth's crust due to variations of global atmospheric pressure can displace the positions of geodetic sites by more than 1 cm, both vertically and horizontally, on annual to sub-diurnal time scales. Such atmosphere pressure loading (APL) effects have been observed in high-precision space geodetic data, e.g., from Global Navigation Satellite Systems (GNSS), Very Long Baseline Interferometry (VLBI), or Satellite Laser Ranging (SLR). In order to develop the Vienna-APL model, we generate the pressure anomaly data by subtracting reference pressure values from surface pressure data, and we then convolve these anomaly data with the Green's functions. The accurate definition of the reference pressure is an important aspect to achieve un-biased APL corrections. For this purpose, we define reference pressure values according to the newly developed Global Reference Pressure (GRP) model (Schuh et al., 2010). We use operational analysis as well as re-analysis data sets from the European Centre for Medium-Range Weather Forecasts (ECMWF) with a horizontal resolution of 1°. The full APL displacements are divided into tidal and non-tidal components, and six-hourly radial and horizontal corrections are provided for all VLBI sites as well as for the nodes of a global 1° grid. The displacements are determined in the Center of Mass (CM) and in the Center of solid Earth (CE) frames.

We validate the Vienna-APL model by long-term VLBI observations (1990-2009) and by comparison with the corrections provided by Petrov and Boy (2004). VLBI data processing shows that the use of both models, Vienna-APL and Petrov and Boy (2004), reduces the baseline repeatability and improves the accuracy of the position, in particular because the un-modeled corrections do not propagate into other parameters. Users can freely access the Vienna-APL correction values at http://ggosatm.hg.tuwien.ac.at/.