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Site and Orbit Repeatabilities using Adaptive Mapping Functions

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The electromagnetic signals emitted by the satellite positioning systems travel at the speed of light in a straight line in a vacuum but are modified in their propagation through the neutral atmosphere by temporal and spatial changes of density, and composition and refractivity. These waves are slowed down and their trajectories are bent. This presentation summarizes the performances of the modeling of the tropospheric propagation by the ray tracing technique through the assimilations of the European Meteorological Centre (ECMWF) in the framework of realizing the geodetic reference frame. This goal is achieved by modeling the spatial variability of the propagation using the time variable three-dimensional physical parameters of the atmosphere. The tropospheric delays obtained by ray tracing in all directions throughout the meteorological model surrounding the geodetic site, are fitted by Adaptive Mapping Functions (AMF) parameterized by several tens of coefficients. The delays produced by the Horizon software are then experimented, kept unchanged or adjusted, when recovering a reference frame based on hundred sites using the GINS software. Without any adjustments of the tropospheric modeling, the subcentimetric performances of the AMF are demonstrated by the repeatability of sites positions and GPS satellites orbits. When some AMF coefficients are adjusted, the accuracy of orbits recovery in term of quadratic mean is 7 to 8 millimeters. This limit is imposed by the lack or deficiency of other models, such as non-tidal and tidal loading respectively. Hence the repeatability of the vertical position is not enhanced by changing the propagation model. At the contrary, the repeatability of the horizontal position of geodetic sites is greatly enhanced by accounting for the azimuthal variability provided by the realistic 3D shapes of the Atmosphere and the Earth and the rigorous interpolations of atmospheric parameters included in Adaptive Mapping Functions with respect to the standard approach.