RADIATE VLBI (FWF P25320)

Tropospheric delay modeling is the major error source in the analysis of geodetic Very Long Baseline Interferometry (VLBI) observations, and in order to comply with the ambitious accuracy goals of 1 mm in position and 0.1 mm/year in velocity for the terrestrial reference frame set for the Global Geodetic Observing System (GGOS), it is imperative to improve the tropospheric correction models. The determination of slant delays by ray-tracing through high-resolution data from numerical weather models is the most rigorous approach possible today, and their application in VLBI data analysis is on principle suited for replacing the common strategy of using mapping functions and horizontal tropospheric gradients.

In project RADIATE VLBI we will determine ray-traced delays for the whole history of about five million geodetic VLBI observations since 1979 from operational analysis and re-analysis data of the European Centre for Medium-range Weather Forecasts (ECMWF) as well as for all upcoming VLBI observations from forecasting data to have the delays available in real-time. In order to avoid the download of huge datasets with meteorological information, the ray-traced delays will be computed on the supercomputers of the ECMWF with ray-tracing algorithms that have been developed at the Vienna University of Technology in the last years. The ray-traced delays are then used in global VLBI solutions to assess the impact on terrestrial and celestial reference frames as well as on Earth orientation parameters, and the ray-traced delays will be made freely available to the scientific community. Furthermore, ray-traced delays from forecasting data of the ECMWF will be used in near real-time applications, in particular for the analysis of Intensive sessions.
For a limited time span of three years, we will calculate ray-traced delays which are uniformly distributed over the sky above all geodetic VLBI sites with a six-hourly time resolution. These delays will then be used to improve tropospheric delay models, e.g. by adding an azimuth-dependence to the mapping function coefficients or higher order spherical harmonics to the horizontal tropospheric gradients. All these new models will again be applied in global VLBI solutions, and the results will be compared to those from standard approaches and from the solutions with ray-traced delays for every observation.

With its rigorous approach of applying ray-traced delays through numerical weather models for every observation and with improved tropospheric delay models, project RADIATE VLBI will deliver innovative and unique VLBI results of highest accuracy for the terrestrial and celestial reference frame as well as for the Earth orientation parameters.