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Application of ray-traced tropospheric slant delays for VLBI reference frame determination

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The effect of the troposphere on the observations of space geodetic techniques is one of the major error sources. In order to correct for this effect, slant delays need to be determined and applied to the observations. In the standard approach of analyzing the observations of Very Long Baseline Interferometry (VLBI) the estimation of the slant delays is done by estimating zenith delays and applying mapping functions for the projection of the zenith delays to the slant delays according to the elevation angles of the observations. A different approach for determining the slant delays is the use of the ray-tracing technique. Within this approach meteorological data from numerical weather models (NWM) are used for the direct retrieval of the slant delays, i.e. without the use of zenith delays and mapping functions. Thus, through the application of ray-traced delays in VLBI analysis an improvement in the analysis results can be expected if meteorological data along the slant path of each observation are used for the path and the delay retrieval. In this work the impact of ray-traced delays on VLBI analysis for reference frame determination is validated by using a large sample of VLBI sessions. For this assessment ray-traced delays for VLBI sessions covering a time span of ten years are determined using the ECMWF (European Centre for Medium-Range Weather Forecasts) operational NWM. By comparing the results of differently parameterized VLBI analysis solutions, i.e. from on the one hand a standard approach with the use of zenith delays and mapping functions and on the other hand an approach with applied ray-traced delays, the impact of the ray-traced delays is revealed by assessing baseline length repeatabilities and changes of global VLBI reference frames.