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Is there utility in moving to VMF3?

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We present an improved approach for modeling the time delay of electromagnetic signals such as from VLBI or GNSS, arising during their passage through the lowest atmosphere layer, the troposphere, which is one of the main error sources in space geodesy. The new model is referred to as VMF3 (Vienna Mapping Functions 3) and serves as the successor of VMF1 which is commonly used in GNSS and VLBI analysis nowadays. Using the new ray-tracer RADIATE, we computed ray-traced delays for 10 years of ECMWF ERA-Interim re-analysis data on a global grid in order to re-determine empirical mapping function coefficients 'b' and 'c' and equipping them with temporal as well as spatial dependency components. On this basis, new discrete coefficients 'a' are determined from ray-traced delays for selected epochs and locations on Earth. This is done in a least-squares adjustment for a set of azimuths and elevations as well as by strict tuning for the specific elevation 3.3°. The idea here is that mapping errors shall thus be minimized over the whole range of elevation angles. The user can consequently model slant tropospheric delays for arbitrary elevation angles with VMF3 just as is done with VMF1. Analyses show that slant delays modeled with VMF3 have the potential to get closer to the ray-traced delays in terms of bias and standard deviation and resulting station heights change by up to 1 mm.