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Improved atmospheric refraction modeling for Satellite Laser Ranging: Horizontal gradients' effects at optical wavelengths.

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Atmospheric refraction (AR) is an important accuracy-limiting factor in the use of satellite laser ranging (SLR) for high-accuracy science applications. In most of these applications, and particularly for the establishment and monitoring of the TRF, of great interest is the stability of its scale and its implied height system. The modeling of atmospheric refraction in the analysis of SLR data comprises the determination of the delay in the zenith direction and subsequent projection to a given elevation angle, using a mapping function. Mendes and Pavlis [2002] developed a new mapping function and concluded that current zenith delay models have errors at the millimeter level, which increase significantly at 0.355 micrometers, reflecting inadequacy in the dispersion formulae incorporated in these models. Recently, a more accurate zenith delay model was developed, applicable to the range of wavelengths used in modern SLR instrumentation (0.355 to 1.064 micrometers), [Mendes and Pavlis, 2004]. Using 3-D ray tracing and globally distributed satellite data from UMBC's AIRS instrument on NASA's AQUA platform, we have already assessed the new zenith delay models and mapping functions. To complete the improvements in the modeling of AR at optical wavelengths, we have now investigated the impact of horizontal gradients (HG) on SLR data collected at some of the core SLR sites around the globe. We discuss the effect of using different types of input data to drive our HG models, e.g. from NCEP, ECMWF and our AIRS instrument. We looked at the effects of seasonal changes, latitudinal dependence, topography and the proximity of the sites to large bodies of water. We will present the sensitivity of our models and give some recommendations towards an unification of practices and procedures in SLR data analysis, including sample analysis of SLR tracking data.