Geophysical Research Abstracts
Vol. 14, EGU2012-2636, 2012
EGU General Assembly 2012

Do we need to consider dispersive troposphere delays for current and next generation space-geodetic instruments?

T. Hobiger, P. Baron, and R. Ichikawa

National Institute of Information and Communications Technology (NICT), Applied Electromagnetic Research Institute, Tokyo, Japan (hobiger@nict.go.jp)

Space-geodetic microwave techniques like GNSS or VLBI work under the assumption that the only dispersive, i.e. frequency dependent delay contribution is caused by the ionosphere. In general, the refractivity, even for the troposphere, is a complex quantity which can be denoted as N = N0 + (N'(f) + i N"(f)) where N0 is a frequency independent term, and N'(f) and N"(f) represent the complex frequency dependence. Thereby, the imaginary part can be used to derive the loss of energy (absorption) and the real part can be assigned to the changes in the propagation velocity (refraction) and thus describes the delay an electromagnetic wave which propagates through that medium. Liebe et al. (1989 and 1993) describe in detail how to derive the constituents based on laboratory measurements of the most important absorption lines. By the use of this model it is possible to compute the complex refractivity based on atmosphere quantities like pressure, temperature and relative humidity. Although the frequency dependent delay contribution appears to be of small order, one has to consider that signals are propagating through few kilometers of troposphere at high elevations to hundredths of kilometers at low elevations. Thus, it is investigated whether such an effect has an impact well below the noise floor of current space-geodetic instruments and if it can be safely neglected. The analysis is based on simulations of the real part of the dispersive refractive index given a large set of altitude dependent atmospheric states which are representative for real conditions. Such atmospheric states are described by temperature, pressure and humidity profiles which can be extracted from numerical weather models. It is shown that dispersive troposphere delays grow inverse proportional to the cosine of the zenith distance (like any other troposphere delay) and will be absorbed into the estimated zenith delays during post-processing. Thus they should not affect the geodetic results on a significant level. In addition, we present a study about future space geodetic instruments concerning their sensitivity w.r.t. dispersive troposphere delays will be presented. Moreover, we are going to discuss the basic question to which level troposphere products from space geodetic techniques are comparable when a frequency dependent troposphere contribution is neglected.

References:
Liebe, H.J., 1989, MPM-An atmospheric millimeter-wave propagation model, Int. J. Infrared and Millimeter Waves, 10, 631-650.
Liebe, H.J.et al, 1993, AGARD 52 meeting, Palma de Mallorca, Spain.