

AN INVERSION APPROACH FOR THE RETRIEVAL OF ATMOSPHERIC REFRACTION INDEX PROFILES FROM GROUND-BASED GPS MEASUREMENTS

R. Notarpietro*(1), M. Gabella (1), and G. Perona (1)

(1) Electronics Dept., Politecnico of Turin, Turin, Italy

An alternative remote sensing technique for the retrieval of atmospheric refraction index profiles is presented. It is an optimization procedure for the inversion of ground-based GPS phase measurements collected at low elevation angles.

Since the Abel inversion, usually adopted to infer atmospheric profiles from space-based radio occultation observations, can not be applied to the inversion of ground-based measurements, the technique we propose iteratively looks for the refraction index profile which minimizes a cost function depending on several measurements of signal times-of-flight, provided that the correspondent real signal arrival angles could be known with sufficient accuracy. Although different optimization procedures could be used, in this first attempt an unconstrained Newton-modified algorithm has been adopted. Starting from different first guess profile, the refractivity profile, that is the output of the retrieval method, is in good agreement with the reference one, used to derive the observables (signal times-of-flight and arrival angles).

As far as the arrival angles are concerned, two different measurement techniques are adoptable. The first one, described by Sokolovskiy et al. (Radio Science, 36, 2001), allows their indirect evaluation from the frequency Doppler shifts observed from a ground-based GPS receiver in a topocentric reference system. Since this approach depends on the adoption of the Snell's law for spherically distributed media, it could bring to erroneous evaluations of these angles, because of their high sensitivity to the not uniformly distributed water vapour fields characterizing a real troposphere, especially when the signal is received at low elevation angles. The alternative approach we propose is an interferometric technique based on phase measurements collected by two GPS receivers opportunely separated in height, to at least discriminate the real arrival angles from the correspondent satellite elevations.

A theoretical sensitivity analysis, which demonstrates the feasibility of such a kind of inversion in a way that is independent to the methodology adopted, is also performed. This result, together with the effectiveness of the technique proposed, points out the extremely good scenario that could be followed considering the atmospheric profiles obtainable from space through the use of occulted data (good vertical resolution) and complementing them with the profiles evaluated from ground measurements (good horizontal resolution), with an improved global coverage.