Geophysical Research Abstracts
Vol. 12, EGU2010-9022-1, 2010
EGU General Assembly 2010


# A new raytracing algorithm to compute slant total delays in a mesoscale atmospheric model

Florian Zus, Michael Bender, Galina Dick, Zhiguo Deng, Stefan Heise, and Jens Wickert
Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany (zusflo@gfz-potsdam.de)

Ray-tracing is essential to accurately simulate Global Positioning System (GPS) Slant Total Delays (STD) in a mesoscale atmospheric model. A rigorous ray-tracing algorithm based on Fermat's principle was developed to simulate the propagation of radio signals in a gridded 3D refractivity field. The unique in the proposed algorithm is that the solution automatically involves the exact location of the receiver and the satellite, i.e. 'shooting' is not required. The structured non-linear system of equations, arising due to the applied finite difference scheme, is solved by Newton's iteration. For elevation angles as low as 5 degree at a ground-based receiver a single Newton iteration turns out to be sufficient. Subsequently the algorithm allows us to simulate about 1500 STDs per second on a single CPU. Having developed the forward operator for STDs, we constructed the tangent linear and adjoint code for sensitivity and variational data analysis.

First results from three potential applications of the proposed ray-tracing algorithm are presented: (1) monitoring STD data processed at the GFZ Potsdam against European Centre for Medium-Range Weather Forecasts (ECMWF) analysis, (2) vertical profiling, i.e. the retrieval of the refractivity profile above a ground based receiver from the STD data by using a least square adjustment, and (3) direct mapping.