Ionospheric state and parameter estimation using Ensemble Square Root Filter and global three-dimensional first- principle model.

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Abstract

In the present paper we discuss the results of a serie of numerical experiments, aiming to recover velocities of $\overrightarrow{E}\mathbf{x}\overrightarrow{B}$ drift and neutral winds using the Ensemble Square Root Filter technique and ionospheric model. One of the purposes for the current research was testing well- described ensemble state and parameter estimation techniques together with the operational ionospheric conditions estimation system. The second purpose was to improve accuracy of calculation of major driving forces in ionosphere and increase modeling reliability in real-data cases.

Modeling system background and setup are introduced. In the first section we present the underlying physics- based model, which was used during the simulation. The main assumptions of the model, as well as $\overrightarrow{E}\mathbf{x}\overrightarrow{B}$ drift and neutral wind zonal and meredional velocities calculation methods are discussed. Further we introduce the observations simulation system and describe the data we use for assimilation and recovery process. We also provide a brief description of the Ensemble Square Root Filter, as the data assimilation algorithm used. In the last few sections the results of the recovery experiment are introduced and discussed.

1 Underlying models

The core physics- based model, which was used in the current work with minor modifications was presented in [Khattatov et al.,2005]. The model solves three magnetic hydrodynamic equations: for densities, velocities and temperatures. All the equations are solved along the magnetic field lines. To reproduce Earth's magnetic field, we use tilted eccentric dipole reference frame with three independent coordinates: l for magnetic longitude, p for the altitude of the highest point of the flow tube, expressed in meters above