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Neutral wind and electric field calculation from monostatic IS radar measurements by means of stochastic inversion

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We present the principles of a new method that utilises stochastic inversion in determining the electric field and neutral wind from monostatic beam swing incoherent scatter (IS) radar measurements (Nygren et al., J. Geophys. Res., 2011). The method consists of two stages. In the first inversion of beam-aligned ion velocities from the F region, we get the two perpendicular electric field components and the field-aligned ion velocity profile together with their error estimates. The number of beam directions can be freely selected, as long as there are at least three non-coplanar directions. Typically, we use the best possible time resolution for electric field, which is about 6 min for the Tromso CP2 experiment. In the second stage, the input to the inversion problem consists of beam-aligned ion velocities from the E region as well as the calculated electric field components. The number of applied beam cycles for E-region winds is typically greater than in the first inversion problem, since the neutral wind usually changes more slowly than the electric field. The solution of the second inversion problem gives the most probable values of the three neutral wind components and their errors.

In the method described above, a stationary and horizontally homogeneous ionosphere has been assumed. These assumptions are not necessarily valid during a single beam cycle or within the whole measurement region. Disturbances in the receiver may also cause errors. Thus the results may contain errors, which are not of statistical nature. A method has been developed that finds and rejects such measurements from the analysis described above (Nygrén et al., submitted). In consequence, more reliable results for electric fields and neutral winds are expected.