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Tiivistelmä ) Referat ) Abstract

The one-dimensional method of characteristics is a forward method for determining ionospheric currents from electric and magnetic field measurements. In this work the applicability of the method was studied with respect to polar electrojet and shear flow events as these are the predominant ionospheric current situations and are often one-dimensional, the fields thus having only dependence on the latitude.

In this work the characteristic equations are derived from Maxwell's equations and Ohm's law. A program was developed with an algorithm applying the one-dimensional method of characteristics to ionospheric electric field measurements by the STARE radars and ground- based magnetic field measurements by the IMAGE magnetometer network. The magnetic field was upward continued to the ionospheric horizontal current altitude (100km).

The applicability of the one-dimensional method of characteristics was shown by analyzing the results from three electric current events. The length of these events varied between 10 and 40 minutes and the study area was limited to STARE and IMAGE measurement area over Scandinavia and part of the Artic Ocean. The results were accurate and relatively detailed and gave insight to e.g. the origin of the features of the field-aligned currents.

The estimated ratio of the Hall and Pedersen conductances, or the alpha parameter, is needed in the method. It was shown that the alpha dependence follows the theoretical predictions, and thus the Hall conductance and the East-West component of the horizontal currents (the Hall current, that dominated the horizontal currents) have practically no depen- dence on alpha. Also the general features of the conductance and current profiles were not dependent of alpha.

Field-aligned current (FAC) results obtained during one of the events were compared with concurrent Cluster satellite measurements at a high altitude orbit above the area of study. Two maxima and a minimum of FAC occurred simultaneously in the results with very comparable numerical values after the mapping down of the results from the satellite.

The one-dimensional method of characteristics was found very successful in determining ionospheric conductances and currents in detail from ionospheric electric and magnetic field measurements when the assumption of the one-dimensionality of the event is valid. It seems quite feasible to develop the algorithm for application of the method during longer time periods, where as here only singular events were studied.

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