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Modeling of the global Distribution of ionospheric electric Fields based on realistic Maps of field-aligned Currents

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A new approach for modeling the global distribution of ionospheric electric potentials utilizing high-precision maps of FACs derived from measurements by the Ørsted and Champ satellites as input to a comprehensive numerical scheme is presented. The boundary conditions provide a correct treatment of the asymmetry of conductivity and sources of electric potential between the northern and southern hemispheres. Based on numerical simulation the basic convection patterns developed simultaneously in both hemispheres for equinox and summer/winter solstices are obtained. A rather complicated dependence of the convection patterns on season linked with the sign of IMF BY is found. In particular, the combinations of BY$>$0/summer and BY$<$0/winter produce the highest circular flow around the pole in comparison with the combinations of BY$<$0/summer and BY$>$0/winter. The model predicts that the summer cross-polar potentials are smaller than the winter potentials. The value of the ratio depends on the combination of season/IMF BY sign. The ratio is found to be greater for the combination of BY$>$0/southern summer and BY$<$0/northern summer. The smallest value is obtained for the combination of BY$<$0/southern summer and BY$>$0/northern summer under northward IMF conditions. At middle latitudes the main features of the MLT-profile of the westward and equatorward electric field components are reproduced. The model predicts that during solstice the equatorward component of the mid-latitude electric field is negative at all local times for BY$<$0 and positive for BY$>$0.