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Modelling of polar field-aligned current systems

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The Oersted and CHAMP satellites have since 1999 provided quite complete coverage of the polar regions with respect to local time and geophysical conditions. With data from Oersted and CHAMP it has been possible to investigate the important high-latitude field-aligned current (FAC), which provide coupling and energy transfer between the outer magnetospheric regions exposed directly to the variable solar wind conditions and the ionospheric current systems which in addition are strongly dependent on daily and seasonal variations and on energetic charged particle precipitation. The good local time coverage has enabled a rather complete determination of the local time dependencies of field-aligned current systems like the region 1 and region 2 high-latitude field-aligned current systems and the cusp currents. With the abundance of high-quality data the comprehensive statistical basis has now enabled the development of sophisticated models for the current distribution and intensities in dependence of solar wind and magnetospheric parameters and on the ionospheric daily and seasonal variations. Three models for the polar FAC distribution based on different procedures for relating the observed magnetic perturbations to FAC's shall be presented and their predictions will be compared to each other and to actual observations. There are still large uncertainties involved in using the new models primarily due to the lack of precise knowledge of the temporal development of the currents in relation to the highly variable solar wind parameters and the still unpredictable effects of magnetospheric substorms.