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Neutral air-upwelling in the cusp region - a response to solar and magnetospheric forcing

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The high-latitude upper atmosphere is subject to various interactions of plasmadynamic and aerodynamic forces. We focus on total mass density enhancements in the vicinity of the polar cusps which have been frequently sampled by the CHAMP satellite in about 400 km altitude. In a statistical analysis these cusp-related density anomalies are found to be a continuous phenomenon in the dayside auroral regions of both hemispheres which is partly driven by the strength of the solar activity (indicated by the solar flux index, P10.7), but more directly by the energy input of the solar wind (indicated by the merging electric field). A larger background density favors the formation of large anomalies. The neutral fountain effect in the polar cusp region is considered as the cause of the density anomaly. Its generation mechanisms are investigated in a combined CHAMP-EISCAT campaign, model studies on soft particle precipitation, and a periodicity analysis of the density anomaly and its controlling parameters. The following mechanism is suggested to cause the density anomaly: The energy input by the solar wind, as characterized by the merging electric field, provides the power for Joule heating of preferably neutral molecules. Soft particle precipitation in the cusp simultaneously enhances the altitude of maximal Pedersen conductivity, thus lifting up the heated layer in the cusp. The density anomaly is then caused by local composition changes in the upper atmosphere due to differential expansion of heavier particles.