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New mechanisms of thermospheric mass density anomaly around the dayside cusp region

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CHAMP satellite observations have revealed that the thermospheric mass density statistically enhances in the cusp region. In this presentation we provide new mechanisms of the density anomaly. A numerical model of nonhydrostatic and compressible atmosphere coupled with ionosphere is used to investigate the response to a 2-cell convection pattern in ion distribution produced by only solar EUV. It is found that vertical upwelling and horizontal compression of neutral air around the cusp at 400 km altitude result in the neutral density anomaly. The upwelling is caused by heat transfer from ions to neutrals. Distribution of ion drift velocity and ion density naturally confines the region of the highest heating rate to the cusp. The compression is caused by horizontal momentum transfer from ions to neutrals. Ion drag and the resultant neutral flow converge at terminator near the cusp. Both of the mechanisms provide a causal explanation of seasonal variation, solar wind and solar EUV dependences of the density anomaly.

Keywords: cusp, thermospheric mass density anomaly, CHAMP satellite