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# Multi-Instrument and Modelling Study of Small-Scale Upwelling and Density Changes in the Auroral Thermosphere-Ionosphere Region

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An unexpected persistent thermospheric density enhancement over the magnetic cusp was observed by the CHAMP satellite in low-Earth orbit at 400km. The density enhancement is caused by denser air from below being lifted into the increasingly rarefied air above. In contrast, the Streak satellite (in a highly elliptical orbit) showed density depletions of the thermospheric cusp at 250km altitude. Several heating mechanisms have been proposed which include auroral particle precipitation and Joule heating. Conventional modelling simulations required over a 100 times the typical measured values of ion-frictional heating in the cusp. Other model simulations could not provide a large enough density enhancement. Coordinated Fabry-Perot Interferometer and EISCAT radar observations are presented which show large vertical winds consistent with the density enhancements. The UCL Coupled Middle Atmosphere Thermosphere model (CMAT2) model is used to test various mechanisms. It is proposed that in-situ measurements of small-scale structures can be provided by the multi-cubesat mission QB50, due for launch in 2016.

The cusp upwelling is a persistent feature that does not appear in existing Global Circulation Models because it is below typical spatial resolution, but will have a systematic influence on satellite orbits and ionospheric signal propagation.