# Simulations of the cusp neutral density enhancement in response to ion drag and frictional heating driven by ionospheric convection

Mitsuru Matsumura[1], Satoshi Taguchi[2]
[1]*Institute for Space-Earth Environmental Research, Nagoya University*
[2]*Graduate School of Science, Kyoto University*

The polar thermospheric mass density near 400-km altitude is known to have a local maximum in the dayside cusp region located around noon in magnetic local time and 75º in magnetic latitude [Liu et al., 2005]. A candidate to form the density anomaly is the local enhancement of frictional heating due to Poynting flux and soft particle precipitation [Deng et al., 2013]. The neutral mass density below 250-km altitude also has a local maximum in the cusp region, and it is localized by the neutral wind driven by the ionospheric two-cell convection, i.e. a clockwise circulation in the duskside and a counterclockwise circulation in the dawnside [Schoendorf et al., 1996]. The effect of the convection on the density anomaly near 400 km is still unknown.

In the present study, we investigate the response of the thenmospheric density to the convection using a three-dimensional coupled ionosphere-atmosphere model, in which we do not include any extra forcing in the cusp region. Our simulations show the following: The ionospheric plasma convection drives neutral wind circulations which have the similar pattern to the convection. Both plasma and neutral gas are carried by the flows to form a “tongue-like” structure extending from the dayside to the polar cap. The flow and density structures arrive at a steady state when the neutral density has a local maximum in the cusp located on the tongue. The friction between the ion and neutral gases imposes momentum and heating on neutrals and the former is effective to localize the mass density in the cusp. In a closed steady system, the total frictional heating rate is minimized with electric field responding to the fixed neutral wind conductivity and neutral wind distribution [Richmond and Fang, 2015]. We will investigate how the total frictional heating rate in the polar region is adjusted by the neutral wind and conductivity (dependent on neutral and plasma density) which respond to the fixed electric field driving the convection. Assuming the steady state of the polar thermosphere-ionosphere system is closed and independent of lower latitudes, we will discuss the role of the neutral density enhancement in the adjustment.

**References**

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