Variations of the thermosphere and the ionosphere associated with auroral arcs

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Very large vertical velocities (10 - 100 m/s) and wave structure are sometimes driven in the vicinity of auroral arcs. We constructed a nonhydrostatic thermosphere-ionosphere model in order to quantitatively study the vertical wind in the thermosphere. Ionospheric parameters obtained by EISCAT observations are used for inputs for our numerical model of the thermosphere and the ionosphere. Using this model, variations of the thermosphere and the ionosphere associated with a moving auroral arc have been studied. We will present recent results of this analysis, and discuss effects of background wind and interaction between gravity waves.

Recent optical and radar observations have shown that very large vertical velocities (10 - 100 m/s) and wave structure are sometimes driven in the vicinity of auroral arcs. For most events, however, the temporal and spatial behavior of the thermospheric vertical wind is quite complicated, suggesting that variations of the thermosphere and the ionosphere are controlled by combination and/or interaction of various processes such as temporal and spatial variation of auroral heating rate, effects of background thermospheric/ionospheric wind, and interaction between gravity waves. We constructed a nonhydrostatic thermosphere-ionosphere model in order to quantitatively study the vertical wind in the thermosphere. Ionospheric parameters obtained by EISCAT observations are used for inputs for our numerical model of the thermosphere and the ionosphere. Using this model, variations of the thermosphere and the ionosphere associated with a moving auroral arc were studied. Our previous studies showed the following results: (1) when an auroral arc passes above the EISCAT radar site, field-aligned ion motion with a period of 15 - 40 min. and an amplitude of 10 - 30 m/s is often observed by the EISCAT radar; (2) the numerical model shows that field-aligned ion motion with a period of 15 min. is generated associated with a moving auroral arc; (3) the model also predicts that propagating gravity waves with a period of 30 - 40 min. are generated when sudden heating occurs; (4) the model tends to give somewhat smaller field-aligned ion velocities than the observed ion velocities. We will present recent results of this analysis, and discuss effects of background wind and interaction between gravity waves.