Spatial distribution of the polar thermospheric wind acceleration and importance of the 2D measurement with SDIs

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Understanding the flow of energy and mass throughout the magnetosphere-ionosphere-thermosphere coupled system is a fundamental goal of solar-terrestrial physics. Since substantial energy accumulated in the substorm growth phase in the magnetospheric tail flows into the polar ionosphere immediately after the substorm onset, investigating the energy dissipation process at high latitudes around the time of substorm onset can contribute significantly to achieving that objective. The energy dissipation generates acceleration and heating of the ionosphere and thermosphere, but this might occur not only near aurora but also far from it by hundreds kilometers equatorward or even in the mid-latitude ionospheric trough. We analyzed ionospheric and thermospheric measurements in the northern Scandinavian area (65-80 N) during periods of considerably low geomagnetic activity but with some aurorae monitored from Longyearbyen with an all-sky camera (75-80 N). Thermospheric winds measured with a Fabry-Perot interferometer (FPI; 630.0 nm) at Tromsø, Norway (69.6 N) showed westward accelerations coinciding with auroral brightening at the Svalbard area at the dusk sector though the relative distance from Tromsø to the aurora was 200-500 km in some cases. Moving into the dawn sector with the earth's rotation, the acceleration direction turned to southeastward through stagnation area or period seen at magnetic local midnight. The acceleration pattern represents well thermospheric responses to the ionospheric convection, but of particular interest is its location, in which the thermospheric wind have been obtained at the sub-auroral region far from the main auroral oval. In this analysis, we cannot infer to horizontal patterns of the wind acceleration because we have only a point measurement from the Tromsø FPI. While this result suggests the importance of two-dimensional measurements of ionosphere and the thermosphere, we need a new configuration of the observation network to infer horizontal winds and accelerations. In this presentation, we will introduce "SDI-3D" project, which aims at developing 3 Scanning Doppler Imagers (SDIs) and deploying them at the same area as for the EISCAT_3D, which may start in operation in 2022.