Effect of solar wind high-speed streams on the high-latitude ionosphere

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The Sun and the solar wind are sources of space weather disturbances in the geospace environment. During the declining phases of solar cycles, the solar wind high-speed streams (HSSs) are a dominant phenomenon, even though they appear at all phases of the solar cycle. HSSs originate from the coronal holes on the Sun and during their travel in the interplanetary space, HSSs interact with the slow solar wind, generating co-rotating interaction regions (CIRs). The effect of HSS/CIRs on the terrestrial ionosphere is a complicated and poorly understood process, which involves flow of mass and energy from the Sun, interaction with the Earth’s magnetosphere, and final entry of energy into the ionosphere in different forms including particle precipitation and Poynting flux producing Joule heating.

In this talk, we will focus on the effects of HSS/CIRs on the high-latitude ionosphere. We will give a brief overview of the observed features and modeling effects in earlier studies and then we will focus on one specific event taking place in March 2016, for which we have an extensive set of measurements. The event was caused by two interacting HSS/CIR structures, which produced a moderate geomagnetic storm, which lasted for eight days. In specific, we have EISCAT Tromso and Svalbard (ESR) incoherent scatter radar measurements for this event, giving information of development of plasma parameters during several days of the storm. The radars were performing CP3 antenna scan patterns covering latitudes from the north of the radar site to the south. TomoScand ionospheric tomography provided electron densities from latitudes extending to the south of EISCAT Tromso radar field-of-view. IMAGE magnetometer network gave information of the substorms taking place locally; globally the AE index repeatedly exceeded 1000 nT. In specific, we are interested in the effects of this storm on the high-latitude F-region electron density behavior (long-duration decreases and increases in different MLT sectors) and the physical processes producing the observed changes, including ionosphere-thermosphere coupling.