Ionospheric response at Tromsø location to the persistent solar wind forcing

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As one of the drivers of Earth's ionosphere, solar wind kinetic energy is of great importance. This energy source is always present and, particularly at high latitudes, transforms and dissipates in the polar atmosphere, modifying the background composition and circulations and therefore causing significant changes to the global thermosphere and ionosphere conditions. Our main objective is to investigate how the thermosphere-ionosphere system responds to solar wind variability at high latitudes and to provide an explanation for the possible mechanisms driving this continuous response.

Using a dataset covering more than twenty years of measurements of the high latitude ionosphere in Tromsø, Norway (70°N, 20°E), the variation of total electron content (TEC) with variability in the solar wind forcing is investigated on larger timescales such as days, weeks, months, and years. We use a 2-hour resampled Advanced Composition Explorer (ACE) solar wind magnetic field and plasma dataset, as well as 2.5°x5° degree spatial and 2-hour temporal resolution International GNSS Service (IGS) TEC maps. Applying a cross correlation analysis with moving 90-day window method, we generate a dataset illustrating the temporal variation of the correlation values. In addition, with an offset varying from 0 to 48 hours we apply to solar wind data in the cross correlation analysis, we derive the response time of TEC to the solar wind variations.

According to our preliminary results from the cross correlation analysis, there are moderate correlations detected (±0.8) between TEC and the merging electric field.There is a strong solar cycle, seasonal and local time dependence evident in the correlation values: 1) a positive correlation during winter nighttime, 2) a noontime anomaly throughout the year with a positive correlation, and 3) a negative correlation during summer. Additionally, we observe a shorter delay, ≈4 hours, in the response time during winter nighttime and a longer delay, ≈18 hours, in the response time during summer conditions. It is suggested that particle precipitation, Joule heating, and plasma convection are the driving mechanisms behind the response. The details will be discussed in the meeting with respect to thermosphere background conditions and possible participating processes.