Long-term variations and trends of ionospheric temperatures observed with the EISCAT Tromsoe UHF radar

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Model calculations predict mesospheric and thermospheric cooling in response to rising greenhouse gas concentrations [e.g., Roble and Dickinson, *GRL*, 1989; Cicerone, *Nature*, 1990]. Data obtained with the EISCAT radars can potentially discover such signatures of long-term global changes. In order to investigate the long-term variations of polar ionosphere and thermosphere more precisely, we have been developing a complete and homogeneous EISCAT database.

Based on the database obtained from the EISCAT Tromsoe UHF radar observations (at 69.6 deg N, 19.2 deg E) between 1981 and 2011, long-term variations and trends of ion and electron temperatures have been examined. The ion temperature at 400 km altitude is higher during the solar maximum (˜1500 K) than during the minimum (˜1100 K). The electron temperature exhibits a clear seasonal variation, particularly during the solar maximum. In order to obtain a long-term trend of ion temperature, effects of the solar activity, seasonal variation, and geomagnetic activity in the ion temperature variation are removed. An initial result shows a cooling trend of about -2 K/year at altitudes between 200 and 350 km, which is close to the trend found with the Millstone Hill IS radar in the middle latitude (46.2 deg N, 288.5 deg E) [Zhang *et al., JGR*, 2011].

In this paper we explain our analysis method for the long-term variations and trends of ionospheric temperature in the polar ionosphere, and discuss the plausible mechanisms.