Long Term Variations in the Coronal Hole Distribution and Its Impact on the Geo-space Environment

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The long term variations in the Coronal Holes distribution on the solar disk have been studied using the SOHO/EIT, STEREO/EUVI, GEOS/SXI data for one complete solar cycle (SC 23). Large polar region holes which extend to mid latitudes, some times becoming isolated, are dominated during the declining phase and the solar minimum. Particularly during the solar minimum, the rigid and isolated coronal holes found to re-appear for several solar rotations, producing the recurrent high-speed streams at solar rotational (27-day) and its sub-harmonic periods (13.5-, 9-, 7-days and even lesser periods). In response, the Earth's upper atmospheric and geomagnetic properties are also found to ring with the same periodicities. The ionospheric response to these periodic forcing is quite complex because of various neutral, electro-dynamic and chemical processes involved and exhibits significant altitudinal and latitudinal variability. The topside ionosphere (above 350 km) exhibits global and coherent enhancements in the electron density with periodic forcing, primarily through the thermal expansion of upper atmosphere and subsequent changes in the plasma scale height. Whereas, the electron density response at F-region peak altitudes (200 to 350 km) is dominated by the changes in the neutral composition and exhibits significant latitudinal, local time and seasonal variations. Further, the ionospheric response below 200 km is dominated by the particle precipitation at high latitudes and exhibits coherent electron density enhancements. These results are further discussed in terms of various physical processes that include photoionization-chemistry, particle precipitation, dynamic and diffusion transport.