Ionospheric climatology derived from long-term ionosonde measurements (1959-2002) at Syowa Station, Antarctica

Tetsuo Motoba[1]; Maho Nakamura[2]; Takashi Maruyama[2]; Kenro Nozaki[2]

[1] Nagoya Univ.; [2] NICT

We have analyzed the long-term ionosonde dataset at Syowa Station, Antarctica (69.0S, 39.6E; local time = UT+3 hours, magnetic local time = ˜UT), in order to identify ‘characteristic’ or ‘average’ features (climatology) in the high-latitude ionosphere, displaying a marked variation with local time (LT), season, and solar activity, and a secular change (long-term trend) for the F2-layer critical frequency (foF2). This climatological variation results from the couplings, time delays, and feedback mechanisms that are inherent in the system as well as from the effects of solar, interplanetary, magnetospheric, and mesospheric processes. The ionosonde dataset used in this study is available over the period 1959-2002, but there are unfortunate data gaps between 1963 and 1968. First, we use only foF2 data during quiet geomagnetic conditions (ap index less than 10) in order to avoid ionospheric storm and energetic particle precipitation effects on foF2 variations. The daily foF2 values increase with daily F10.7 index, but saturate (or increase with a much lower rate) for higher F10.7 index values. The mean LT variation in foF2 for equinox and winter months is characterized by the post-noon (14-15 LT) peak in its diurnal variation. The post-noon foF2 peak for high solar activity tends to be slightly delayed (within a few hours), compared with that for low solar activity. In summer the day-night change in foF2 is much smaller than that in winter because most of the local ionosphere is sunlit. Although the winter anomaly can also be found in daytime foF2 values, the winter foF2 values are either slightly larger or smaller than the summer foF2 values for high solar activity. For low solar activity, on the other hand, the winter foF2 values are always smaller than summer foF2 values. The mean seasonal variations in foF2 indicate the well-known equinoctial peaks, which are remarkable in 11-19 LT sector for high solar activity. The equinox foF2 values are larger than those in either winter or summer by a factor of 1.2-2.0. In contrast, the equinoctial peaks weaken or disappear for low solar activity. These foF2 variation features under the quiet geomagnetic conditions are compared with previous observations and numerical predictions, and we discuss the possible causes. In addition, the long-term foF2 trend will also be presented.