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Climatology of ionospheric TEC derived from TOPEX/POSEIDON mission

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In the present work the TOPEX/POSEIDON TEC data were used to construct TEC maps (TEC vs. magnetic local time MLT, and magnetic latitude MLAT) in the interval from 1993 to 2004. For investigating the ionospheric climatology from these TEC maps, we modeled the yearly TEC variation as, $TEC=A_0\{1+A_1\cos[2\pi(t-t_s)/Y]+A_2\cos[4\pi(t-t_e)/Y]\}$, where A_0, A_1 and $A_2$are respectively the yearly mean TEC and the relative annual and semiannual amplitude, as functions of MLT and MLAT; t_s and t_e respectively denote the solstice (December solstice are chosen) and equinox time, and Y is the length of a year. As indices represent the global annual and semiannual variation of the TEC, the relative amplitude A_1 and A_2, as well as the symmetrical and asymmetrical annual amplitudes A_1, $A'=(A_1(MLAT)+A_1(-MLAT))/2$ and $A''=(A_1(MLAT)-A_1(-MLAT))/2$, were estimated from the construct TEC maps and discussed in detail. Thus plentiful properties for the ionospheric TEC climatology were found in these index maps as follows.

(1) At most latitudes excluding the tropic region (within $\pm 15^{\circ}$) and most local time excluding the noon interval (10-16 MLT), A_1 may maintain negative and reach to -50% in north hemisphere, and maintain positive and reach to 60% in south hemisphere, indicating maximum TEC appears in summer solstice. At noon time tend to appear the case that A_1reverse to an opposite sign, which is coincident with the “seasonal anomaly” that TEC at higher mid-latitudes is greater in winter than in summer. In the tropic region, A_1 takes small value and cannot remain in unique sign. In addition, the A_1maps do not change very much with the solar activity.

(2) The asymmetrical annual index is the dominant part of A1, thus A" manifests most behaviors of A1, such as maintaining opposite signs in different hemispheres

and tending to reverse around noon time. A" reaches to $\pm$50% in the two hemisphere, exceeding 80% of A1.

(3) The symmetrical annual index A’ is positive at tropic and mid-latitude (with $\pm 60^{\circ}$) and all the local time excluding the sunrise period. This implying that TEC behaves as the F-region “annual anomaly” or that ionization is stronger in December solstice than in June solstice. The 20-25%.peak values of A’ occur in the near outsides of the equatorial crests. The A’ crests extend polarward with the increase of solar activity.

(4) The semiannual index A2 is positive in daytime at all the latitudes, with value from 10% to 15% decreasing with solar activities, and goes higher (up to 20%) in evening and midnight at tropic latitudes. In daytime at all the latitudes and at tropic latitudes in evening and midnight, the positive A2 index, indicates that the TEC value may larger at equinoxes than at solstices, this is just the “semiannual anomaly” in ionosphericF2-region.

It is concluded from the above discussion that the TEC maps from TOPEX/ POSEIDON data may present, in global scale, most of the ionospheric climatology such annual anomaly, the seasonal anomaly and semiannual anomaly.