Tomographic studies of F- and E- regions of low-latitude ionosphere

E.Andreeva (1), S. Franke (2) and V. Kunitsyn (1)

(1) M.Lomonosov Moscow State University, Russia, (2) University of Illinois at Urbana-Champaign, USA (Email: andreeva@phys.msu.su / Phone: +7-495-939-2089)

In recent years, radiotomography (RT) has undergone intense development because of its potential as a new tool for ionospheric observations. Methods of satellite RT have opened new possibilities for investigating structural and dynamic features of F- and E-regions of equatorial anomaly. A review of results obtained from a low-latitude ionospheric tomography network (LITN) between Manila and Shanghai is presented. Applying a phase difference method to data from the LITN receiver network we have been able to reconstruct ionospheric images spanning the northern crest of the equatorial anomaly region. The analysis of RT images allowed us to reveal some unprecedented details of the equatorial anomaly: (1) the crest core is tilted with an approximate alignment with the geomagnetic field lines; (2) asymmetry exists between the equatorward edge of the anomaly region; (3) the TEC crest is broader and occurs at a lower latitude than Nmax crest; (4) the ionospheric thickness changes with latitude and shows a rough two-cycle oscillation within the observed latitude range 15N - 30N; (5) a penetration of ionospheric plasma to the lower heights exists around the latitude range 26N - 28N and a bite-out or constriction in the lower ionosphere at around 28N - 30N. Quite often a post-sunset enhancement of electron concentration was observed. On many days the crest was observed to linger into the night with a smaller spread in latitude. Interpretation of these features of the structure and dynamics of the equatorial anomaly crest will be discussed within the framework of the effect of variable electric fields on the equatorial fountain mechanism. Reconstruction of the E-region ionosphere by RT methods is much more difficult since the E-region contribution into the measured data is significantly less than the F-region contribution. However, if the baseline of RT system exceeds 2000 km and the receiving chain is such that a system of rays intersecting in the F- and E-region ionosphere can be formed, reconstruction of E-region ionosphere is possible. LITN meets such requirements. "Sinking" of the lower boundary of the ionosphere and penetration of the plasma flow from the F-region to the E-region ionosphere are clearly seen in RT images. These phenomena of "sinking" and "penetration" are not the artifacts of reconstruction and do exist in reality, which has been confirmed by preliminary simulation. Studies results on the motion of the anomaly crest are presented. Comparison of the RT results with the ionosondes measurements demonstrated the high quality and efficiency of the developed RT methods. RT technique is suitable for providing not only 2-D sections of ionospheric plasma density but also plasma fluxes by analyzing time-successive RT

cross-sections. Examples are given of determination, from experimental data, of average vertical fluxes and two-dimensional plasma fluxes in the meridional cross section in the region of equatorial anomaly. In the future it seems promising to develop combinations of complementary approaches that are based on the analysis of experimental RT data and modeling studies with mutual verification. Tomographic images of equatorial anomaly are compared with the data of IRI-model. Possibility to correct IRI-model on the basis of tomographic investigations of equatorial anomaly is discussed.