Observation and model calculation of the F3 layer in Southeast Asia

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The occurrence probability, local time, solar and magnetic activity dependences of the F_3 layer have been clarified experimentally from ionosonde observations as well as model calculation, whereas some unexplained problems have remained. It has been reported that the F_3 layer was frequently observed in June solstice season at Fortaleza (geographic latitude -4 deg, geographic longitude 322 deg, and magnetic latitude -5.4 deg), although in this season (local winter season), frequently occurrences of the F_3 layer were not predicted from the model calculation with normal values of the **E** x **B** drift and meridional neutral wind and seasonal dependence of occurrences at Waltair (17.7 deg, 83.3 deg, 11.5 deg) shows a different tendency from that at Fortaleza. The latter problem could be explained by the magnetic latitudinal dependences of the F_3 layer. However, it was not examined in detail, since earlier observational studies of the F_3 layer have been performed using a single ionosonde data due to the lack of the ionosndes in the equatorial region. In order to clarify the mechanism of the F_3 layer, we are analyzing the ionosonde data of the South East Asian Low-latitude IOnosonde Network (SEALION) mainly provided by NICT. In this study, the ionograms observed at Chiang Mai (CMU; 18.8 deg, 98.9 deg, 13.0 deg), Chumphon (CPN; 10.7 deg, 99.4 deg, 3.3 deg) and Kototabang (KTB; -0.2 deg, 100.3 deg, -10.0 deg) are used. To date, it has been clarified from our data analysis that the F_3 layer shows a clear magnetic latitude dependence, and it was suggested that plasma diffusion along the magnetic field lines could play an important roll for generation of the F_3 layer in the magnetic low-latitude region. This process does not seem to be incorporated into the concept of mechanism of the F_3 layer, although it is expected that the plasma diffusion process has already been included in the earlier model calculation. In this presentation, we will report the results of comparison between the SEALION data, model calculations and also latitudinal plasma density structure observed from CHAMP on 10 April 2005.

On 10 April 2005, the F_3 layer was observed at 3 stations, although the F_3 layer observed at CPN was very weak compared with that at CMU and KTB. The F_3 layer at CPN started to form at 0845 LT and moved upward with shorter duration time, while at CMU and KTB, it started to form at 1000 LT and 0915 LT, respectively, and the cusp stayed close to the same altitude with longer duration time. On the other hand, the critical frequency in the magnetic CMU and KTB became higher than that CPN around 0930 LT. It means that plasma diffusion along the magnetic field lines associated with the equatorial anomaly started at least before 0930 LT. Moreover, it was found by comparing the plasma density structure observed from CHAMP with the vertical structures of plasma density that the F_3 layer over CMU and KTB were located on the magnetic field lines passing through the crest of the equatorial anomaly. The F_3 layer is then inferred to be associated with the equatorial anomaly, in other words, plasma diffusion along the magnetic field lines. As a result of model calculations using the SAMI2 code, the observed features of the F_3 layer were basically reproduced using the normal values of the **E** x **B** drift and neutral wind for the day of 10 April 2005, although the F_3 layer was not reproduced over CPN. It was found from the spatial variation of electron flux that plasma were transported from near the magnetic equator into the region of the F_3 peak in the magnetic low-latitude region. These model calculation results are consistent with those found from our data analysis. It is then concluded that plasma diffusion along the magnetic field lines plays an important role for generation of the F_3 layer in the magnetic low-latitude region.