

子午面イオノゾンデ観測網による低緯度電離圏ダイナミクス : Ionospheric Ceiling Low-latitude ionosphere dynamics as deduced from meridional ionosonde chain: Ionospheric ceiling

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Peculiar ionospheric features at low latitudes originate in the earth's magnetic field configuration that has a shape of arch. Near the magnetic equator, the daytime eastward electric field raises the ionosphere to high altitudes where the ion-neutral collision frequency reduces. The ionospheric plasma slips down over off-equatorial latitudes along the arch-shaped magnetic field line by the earth's gravity acceleration and the reduced ion-neutral drag, which is called the fountain effect. As a consequence, the latitudinal distribution of ionospheric critical frequency (foF2) forms two crests at low latitudes and a trough above the magnetic equator, which is well-known equatorial anomaly in foF2 distribution. As for the diurnal variation of the ionosphere above the magnetic equator, foF2 once increases in the morning and decreases before noon along with the development of the equatorial anomaly, which is called noon bite-out. Another feature at the magnetic equator, associated with the fountain effect, is the relatively steady ionospheric peak height (hmF2) around noon, even though the EXB drift is upward throughout the daytime. However, not much attention has been paid to hmF2 except for the time rate of change of it in connection with the vertical plasma drift velocity.

Interest in the equatorial anomaly has been focused mostly on foF2 (or NmF2), and there have been a few studies on hmF2 variations associated with equatorial anomaly development. In this paper, we revisit the equatorial anomaly in terms of height variations. For this purpose, we analyzed scaled ionogram parameters from three stations located along the magnetic meridian that is a primary component of Southeast Asia low-latitude ionospheric network (SEALION); one at the magnetic equator and the others at conjugate off-equatorial latitudes near 10 degrees magnetic latitude.

The daytime hmF2 was investigated for each season during the solar minimum period, 2006-2007 and 2009. The peak height increased for approximately 3 hr after sunrise at all locations, as expected from the daytime upward EXB drift. The apparent upward drift ceased before noon at the magnetic equator, while the layer continued to increase at the off-equatorial latitudes, reaching altitudes higher than the equatorial height around noon. The noon time restricted layer height at the magnetic equator did not depend on the season, while the maximum peak height at the off-equatorial latitudes largely varied with season. The daytime specific limiting height of the equatorial ionosphere was termed ionospheric ceiling. Numerical modeling using the SAMI2 code reproduced the features of the ionospheric ceiling quite well. Dynamic parameters provided by the SAMI2 modeling were investigated and it was shown that the ionospheric ceiling is another aspect of the fountain effect, in which increased diffusion of plasma at higher altitudes has a leading role.

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