Bubble phenomenon in the topside ionosphere

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There are the indications that plasma bubbles, produced by Rayleigh-Taylor instability at the bottomside of ionosphere, could rise up to the topside ionosphere and plasmasphere. Maryama and Matuura (1984), using ISS-b satellite data (high solar activity period, 1978-79), have seen the plasma bubbles in Ne density over equator at 1100 km altitudes in 46 cases in 1700 passes. That is $\sim$3% only. However, there is distinctly another picture in He^+ density depletions (subtroughs). According to ISS-b data He^+ density subtroughs occur in the topside ionosphere over equatorial and low-latitudinal regions (L$\sim$1.3-3) in 11% of the cases (Karpachev, Sidorova, 2002; Sidorova, 2004). The detailed statistical study of the He^+ density subtrough peculiarities was done. The subtrough depth (depletion value) as function of local time (evening–night hours) was compared with the vertical plasma drift velocity variations, obtained for the same periods from AE-E satellite and IS radar (Jicamarca) data. Striking similarity in development dynamics was revealed for the different seasons. It was noted also that the He^+ density subtroughs are mostly observed in the evening-night sector (18-05 LT) from October till May. It was like to the peculiarities of the equatorial spread-F (ESF), usually associated with plasma bubble. The monthly mean He^+ density subtrough occurrence probability, plotted in local time versus month, was compared with the similar plots for ESF occurrence probability, derived by Abdu and colleagues (2000) from ground-based ionograms obtained over Brazilian and Peruvian regions for the same years. The comparison shows good enough correlation (R=0.64). It was concluded that: (a) He^+ density subtroughs like ESF are controlled by prereversal enhancement electric field (vertical drift); (b) He^+ density subtroughs and ESFs may be considered as phenomena of the same plasma bubble origin; (c) it seems, plasma bubbles, reaching the topside ionosphere altitudes, are most easily observable in He^+ density as depletions.

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