New results in ionospheric research at ISU on the formation and prediction of Es layer and possible collaboration with HZDR

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Theoretically and by corresponding numerical simulations it is shown that the formation and localization of sporadic E (Es) layer at its mainly observable mid-latitude lower thermosphere heights can be determined by homogeneous horizontal wind velocity direction and value. In the suggested theory, differently from 'windshear' theory, the wind direction and value, in addition to geomagnetic field and vertically changing ion-neutral collision frequency, determine the minimal negative value of the divergence of heavy metallic ions drift velocity, which in turn causes ion convergence into Es type horizontal thin layer. Here, in the upper heights of the lower thermosphere, the Es layer peak density and thickness are also controlled by ion ambipolar diffusion.

The important contributions of the directions and magnitudes of the meridional and zonal wind (using the HWM14 data), its shear and electric field (using four different polarizations) to the vertical drift velocity of ions and, accordingly, the maximal total ion vertical convergence rate-MTotIVCR (about 10^{-3}–10^{-4} s^{-1}) are shown during the formation of Es layers in typical equatorial (with magnetic inclination I = 0 and 0.5° N; 195° E), between equatorial and mid-latitude (BEML) (I = 30°; 16° N; 195°E) and mid-latitudes (I = 60°; 45° N, 195° E) regions. For the considered zonal wind data and zonal and vertical components of electric field the important role of electric field in the increase of TotIVCR and correspondingly in formation and localization of the Es.

ISU and HZDR could efficiently collaborate in MHD numerical simulations and developing theoretical and numerical model of ion ionospheric global distribution under influence of arbitrary winds and electromagnetic fields.

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