Numerical simulation of the convective plasma dynamics stage at the ionosphere motion by means of 3D MHD equations

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It was developed the 3D numerical MHD model meant for the simulation of the plasma cloud expansion into nonuniform partly ionized ionosphere with magnetic field. The plasma cloud has high energy density and was formed by the strong explosion. The MHD equations was written down in the divergence form of one-speed and one-temperature approach by using eulerian coordinates. The diffusion of magnetic field and the angle between the vectors of vertical atmospheric density gradient and magnetic field also was taken into account. As the initial condition was used the data from the initial stage of the plasma deceleration found by the solution of 1D problem in Lagrange statement.

The numerical method is based on the high order accuracy (second and higher) monotonic predictor-corrector difference scheme. Since the strong discontinuities can be formed in the plasma flows, as a predictor was used the exact solution of Riemann problem like in Godunov's scheme [1]. The corrector was taken in the characteristic-based form like in the scheme [2].

It was done the computation of two strong explosions on the essentially different heights above ground level: 150 [km] and 1000 [km]. First of all, these heights differ one from other by the air density influence on the plasma dynamics. The air density influence brings to the inherent difference of the explosion dynamics for these heights.

References

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