R008-07
Zoom meeting D ：11/4 AM1 (9:00-10:30)
9:00〜9:15

A new global multifluid MHD model with the cubed sphere focusing on Martian ionosphere and magnetosphere

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It is a controversial question how presence of an intrinsic magnetic field affects escape of the ionized atmosphere, i.e., ion escape. In particular, the intrinsic magnetic field of ancient Mars suggested by crustal magnetic fields on the surface might have played a crucial role in atmospheric loss and climate change. Sakata et al. (2020) pointed out that the effects of an intrinsic magnetic field are pronounced in ion escape from the ionosphere which is the main escape process of molecular ions such as O_2^+ and CO_2^+. On the other hand, the effects on O^+ are milder due to the contribution of ion pickup on the neutral oxygen corona. This indicates that different ion species or escape processes have different dependences on the intrinsic magnetic field. However, the study was based on multispecies magnetohydrodynamics (MHD) simulations which assume the same velocity on all ion species and cannot depict behaviors of each ion species sufficiently.

To investigate different dynamics and the intrinsic magnetic field's effects among ion species, we developed a new global multifluid MHD model with semi-discrete central scheme. The multifluid MHD model solves the continuity, momentum, and energy equations of four ion species (H^+, O^+, O_2^+, CO_2^+) and the induction equation of the magnetic field. The electron pressure equation is also solved independently. We adopted the gnomonic cubed sphere grid which has nearly uniform grid and lacks singular points. The simulation domain is set to be from the ionosphere (100 km altitude) to the magnetosphere (several planetary radii) because the presence of an intrinsic magnetic field affects such a wide range of the magnetic configuration. It includes chemical reactions, photoionization, and collisions (ion-ion, ion-electron, ion-neutral, electron-neutral) necessary for the ionosphere. We will show some simulation results for the validation of the model.

References

Sakata, R., et al. (2020). Effects of an intrinsic magnetic field on ion loss from ancient Mars based on multispecies MHD simulations. J. Geophys. Res., 125, e2019JA026945. doi:10.1029/2019JA026945