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Hemispheric asymmetries of plasma environments of Venus and Mars in a hybrid model

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We study the asymmetries of planetary plasma environments at Venus and Mars in the global HYB-Venus and HYB-Mars hybrid simulations. The hemispheric asymmetry in the direction of the solar wind electric field (the Esw asymmetry) and the asymmetry between the magnetic dawn and dusk hemispheres, defined by the plane perpendicular to the Esw vector (the dawn-dusk asymmetry), have both been observed by in situ spacecraft particle and magnetic measurements. In ideal, single-fluid MHD simulations of planetary-solar wind interactions no Esw asymmetry rises provided that the inner boundary conditions and planetary ion sources are axially symmetric (i.e. depend only on the solar-zenith angle). But, the Hall JxB term of the electric field can break the Esw symmetry in ideal MHD. Further, kinetic effects of planetary ions and solar wind protons, such as finite gyro radii, can depend on whether the solar wind electric field is pointing towards the planet (-Esw hemisphere) or away from the planet (+Esw hemisphere). Thus, ion kinetics can contribute to the Esw asymmetry. In literature the origin of the Esw asymmetry of the magnetic field is traditionally attributed to planetary ion pick-up by the solar wind flow. Further, the flow-aligned component of the interplanetary magnetic field results in large scale dawn-dusk asymmetry of an induced magnetosphere. In this presentation we study the hemispheric asymmetries in a global hybrid simulation for Venus and Mars. We consider why the asymmetries arise in a hybrid model and we also discuss the importance of the asymmetries for particle and magnetic observations at Venus and Mars.