Effects of pickup ions on the lunar plasma environment: 3D hybrid modeling

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The hybrid kinetic model used here supports comprehensive simulation of the interaction between different spatial and energetic elements of the moon-solar wind-magnetosphere of the Earth system. There is a set of MHD, kinetic, hybrid, drift kinetic, electrostatic and full kinetic modeling of the lunar plasma environment [1]. However, observations show the existence of several species of the neutrals and pickup ions like Na, He, K, O etc., (see e.g., [2,3,4]). The solar wind parameters are chosen from the ARTEMIS observations [5]. The O^+, Na^+, He^+ lunar exosphere's parameters are chosen from [6,7]. The hybrid kinetic model allows us to take into account the finite gyroradius effects of pickup ions and to correctly estimate the ions velocity distribution and the fluxes along the magnetic field, and on the lunar surface. Modeling shows the formation of the asymmetric Mach cone, the structuring of the pickup ion tails, and it presents another type of lunar-solar wind interaction. We shall investigate the effects of wave-particle interactions and a weak conductivity of the lunar core on the Mach cone structure. We shall compare the results of our modeling with observed distributions.

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