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Plasma Interaction and Induction Signatures at Callisto: Preparations for JUICE

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The interaction of the Jovian magnetospheric environment with an atmosphere and induced dipole at Callisto is investigated by applying a hybrid (kinetic ions, fluid electrons) simulation code. Callisto is unique among the Galilean satellites in its interaction with the ambient magnetospheric plasma as the gyroradii of the impinging plasma and pickup ions are large compared to the size of the moon. A kinetic representation of the ions is therefore mandatory to adequately describe the resulting asymmetries in the electromagnetic fields and the deflection of the plasma flow near Callisto. When Callisto is embedded in the magnetodisk lobes of Jupiter, a dipolar magnetic field is generated via induction in a subsurface ocean. This field creates an obstacle to the impinging magnetospheric plasma flow at the moon. However, when Callisto is located near the center of the Jovian current sheet, local magnetic perturbations due to the magnetosphere-ionosphere interaction are more than twice the strength of the background field and may therefore obscure any magnetic signal generated via induction in a subsurface ocean. Our simulations demonstrate that the deflection of the magnetospheric plasma into Callisto's wake cannot alone explain the plasma density enhancement of two orders of magnitude measured in the wake of the interaction region during Galileo flybys of the moon. However, through inclusion of an ionosphere around Callisto, modeled densities in the wake are consistent with in situ measurements.