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Models for Callisto's Plasma Interaction: Implications for the satellite's Atmosphere and Interior

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We present results from a MHD-model for the sub-Alfvénic interaction of Callisto with the surrounding magnetospheric plasma taking into account the influence of Callisto's neutral CO_2 and O_2 atmosphere on the plasma flow and magnetic fields induced in a possible subsurface liquid water ocean. The existence of a subsurface ocean was proposed e.g. by Neubauer [1998], Kivelson et al. [1999] and Zimmer et al. [2000] based on magnetometer data analysis. However, none of these previous studies included detailed modeling of Callisto's plasma interaction. We present the first 3D-MHD-models for the plasma interaction considering several flybys of Galileo at Callisto. We compare the magnetic signatures predicted by the plasma interaction model including an induced interior dipole with Galileo magnetometer data. We further use our models to investigate the structure of Callisto's atmosphere-ionosphere system for two cases: Static plasma conditions ($v_0 = 0$) with an ionosphere in chemical and radiative equilibrium and for the corresponding dynamic plasma flow conditions. The ionospheric structure is then compared to radio occultation measurements by Kliore et al. [2002]. The final goal of this study is to deduce information about possible temporal variations and the overall structure of Callisto's atmosphere and ionosphere and eventually about the interior ocean layer from the magnetic field data.