

Magnetic field model of Jovian magnetosphere

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Europa, Ganymede, Callisto are the Jovian icy satellites called Galilean moons, and are possibly with internal oceans each. While ice is almost an insulator electrically, water including ions has high electrical conductivity, and existence of internal oceans can be verified using electromagnetic (EM) induction methods. In this study, we updated the necessary model of the external magnetic field to the icy satellites for the EM induction studies. Namely, parameters of the Euler potential model of the Jovian magnetosphere (Khurana, 1997) were renewed by adding magnetic data from both Galileo and JUNO spacecrafts.

The configuration of the Jovian current sheet was modeled by Khurana [1992] using three parameters, while the Jovian magnetospheric magnetic field modeled by Khurana [1997] was characterized by 14 parameters. We applied a non-linear optimization technique, i.e., the steepest descent method, to the parameters by newly adding magnetic data from Galileo and Juno spacecrafts. We minimized the root mean squared between the model and the data by exploring the parameter space around several initial sets of the parameters.

As a result, time-varying model parameters for each spacecraft orbit were obtained. Their temporal variation may reflect that of both magnetic field and electric current system in the Jovian magnetosphere. The changes of the parameters can be attributed to the interaction between the Jovian magnetosphere and the solar wind. It, therefore, preferable that the temporal variation of the model parameters is incorporated when the updated magnetic field model of the Jovian magnetosphere is applied to the EM induction studies in search for the internal oceans of the icy satellites.

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