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Modeling the interaction between the solar wind and Saturn's magnetosphere by the AMR-CESE-MHDmethod

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The space-time conservation element and solution element (CESE) method ingeneral curvilinear coordinates is successfully applied to the three-dimensional magnetohydrodynamic (MHD) simulations of the interaction between the solar wind and Saturn's magnetosphere on a six-component grid system. As a new numerical model modified for the study of the interaction between the solar wind and saturn's magnetosphere, we obtain the large-scale configurations of Saturn's magnetosphere under the steady solar wind with due southward interplanetary magnetic field (IMF) conditions. The numerical results clearly indicate that the global structure of Saturn's magnetosphere is strongly affected by the rotation of Saturn as well as by the solar wind. The subsolar standoff distances of the magnetopause and the bow shock in our model are consistent with those predicted by the data-based empirical models. Our MHD results also show that a plasmoid forms in the magnetotail under the effect of the fast planetary rotation. However, somewhat differently from the previous models, we find that there are two flow vortices generated on the duskside under due southward IMF at Saturn. On the duskside, the clockwise one closer to the planet is excited by the velocity shear between the rotational flows and the sunward flows, while the anticlockwise one is generated from the velocity shear between the tailward flows along the magnetopause and the sunward flows.