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The substorm loading-unloading cycle as reproduced by community-available global MHD magnetospheric models

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In this study we investigate how well the three community-available global MHD models, supported by the Community Coordinated Modeling Center (CCMC NASA), reproduce the global magnetospheric dynamics, including the loading-unloading substorm cycle. We found that in terms of global magnetic flux transport CCMC models display systematically different response to idealized 2-hour north then 2-hour south IMF Bz variation. The LFM model shows a depressed return convection in the tail plasma sheet and high rate of magnetic flux loading into the lobes during the growth phase, as well as enhanced return convection and high unloading rate during the expansion phase, with the amount of loaded/unloaded magnetotail flux and the growth phase duration being the closest to their observed empirical values during isolated substorms. BATSRUS and Open GGCM models exhibit drastically different behavior. In the BATS-R-US model the plasma sheet convection shows a smooth transition to the steady convection regime after the IMF southward turning. In the Open GGCM a weak plasma sheet convection has comparable intensities during both the growth phase and the following slow unloading phase. Our study shows that different CCMC models under the same solar wind conditions (north to south IMF variation) produce essentially different solutions in terms of global magnetospheric convection.