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Seasonal variations of Uranus magnetosphere: magnetohydrodynamic simulation

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Based on the ratio of the planetary rotation period to the Alfven speed relaxation time of the inner magnetosphere, Uranus and Neptune must be considered as fast-rotators. So are Saturn and Jupiter. However, in terms of impact on the global magnetospheric structure, the major difference between the two groups of planets is that, while the angle between the rotation axis and the magnetic axis is small for Saturn and Jupiter (0 and 10 degrees, respectively), it is large for both Uranus (59 degrees) and Neptune (47 degrees). The immediate consequence is that the interaction of the solar wind with the magnetospheres of Uranus and Neptune is violently modulated by rotation whereas it is quasi steady for Jupiter and Saturn (apart from sporadic reconnection events). In addition, for both Uranus and Neptune (unlike Saturn and Jupiter), the orientation of the rotation axis with respect to the solar wind flow direction varies over a large angular range during a planetary year causing considerable seasonal changes of the global magnetospheric structure. We present MHD simulations of Uranus at solstice and equinox to highlight the seasonal variation of the magnetotail for different orientations of the IMF. In order to emphasize the effects of rotation we increase the angular velocity of the planet beyond its real value taking care not to enter into the regime of an ultra fast rotator where major qualitative changes occur.