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Magnetosphere preconditioning by the formation of a cold-dense plasma sheet under northward IMF

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Motivated by recent observations and simulations of the formation of a cold and dense plasma sheet in the tail of the magnetosphere under northward interplanetary magnetic field (IMF) and of the direct influence of the plasma sheet density on the ring current strength, this study aims at (1) highlighting how the coupling of these effects may lead to a preconditioning of the magnetosphere under northward IMF and (2) performing first tests of the validity of this hypothesis. We performed both parametric kinetic ring current simulation studies to investigate how the density and temperature of the plasma sheet affect the ring current strength during geomagnetic storms, and superposed epoch analysis of various parameters to investigate the response of the magnetosphere (as indicated by the Dst index) to the passage of Coronal Mass Ejections (CMEs) and Corotating Interaction Regions (CIRs). The results all suggest that solar wind structures may be more geoeffective if preceded by a northward IMF interval, and they are consistent with the hypothesis of a preconditioning by a cold, dense plasma sheet. A colder and denser plasma sheet may lead to a stronger ring current when that plasma is convected inward during the main phase of an ensuing storm.