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Defining and Resolving Current Systems in Geospace

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Electric currents flowing through geospace support a highly nondipolar magnetic field topology, and their time-varying dynamics change particle drift paths and create a nonlinear feedback on the currents themselves. A number of current systems exist in the magnetosphere, most commonly the dayside magnetopause Chapman-Ferraro currents, high latitude “region 1” field-aligned Birkeland currents, lower-latitude “region 2” field-aligned currents connected to the partial ring current, magnetotail currents, and the symmetric ring current. In the near-Earth nightside, however, several of these current systems flow in close proximity to each other and it is very difficult to identify a local measurement as belonging to a specific system. Such identification is important, however, because how the current closes and how these loops change in space and time governs the magnetic topology of the magnetosphere and therefore controls the physical processes of geospace. Furthermore, many methods exist for identifying the regions of near-Earth space carrying each type of current. This study presents a robust collection of these definitions of current systems in geospace, particularly in the near-Earth nightside magnetosphere, as viewed from a variety of observational and computational analysis techniques. The influence of definitional choice on the resulting interpretation of physical processes governing geospace dynamics is presented and discussed.