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In-situ analysis of the ring current and adjacent FACs

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The in-situ ring current (RC) morphology and dynamics, and the role and operation of the (region 2) field aligned currents (FACs), which are understood to connect from the ring current and close through the ionosphere, forms the dominant external influence on the measured Geomagnetic field. Furthermore, the widely used Dst index is often not good indicator of the changing ring current strength and omits the influence of FACs, so that space-based indicators of RC behavior are needed. These externally induced magnetic signals have significant effect at low Earth orbit (LEO) so that coordinated measurements of the current systems from ground to the (inner) magnetosphere are highly desirable. The imminent launch of the 3 Swarm spacecraft into low, polar Earth orbits; the planned coordination of Swarm with the 4 Cluster spacecraft through joint operations, and the further possible coordination with the recently launched 2 spacecraft RBSP spacecraft, provides an unprecedented, distributed space dataset of 'clustered' multi-point measurements. In anticipation of the direct comparison of Swarm and Cluster, preliminary study of the influence of the RC using Cluster has produced a full-circle determination of the in-situ RC and associated FACs directly from the 4-spacecraft perigee observations. The results confirm that the in situ average measured current density (in the radial range 4–4.5RE) is asymmetric in MLT and are consistent with the operation of region-2 FACs (but other factors such as the radial distribution of the RC may be significant). Comparison of magnetic signals seen at LEO and those measured directly within the central RC region, however, shows a discrepancy between near-Earth and in-situ behaviour, as seen both under storm and non-storm conditions. We report here further investigations of the RC morphology and the significance of the FACs using comparative analysis techniques derived from the calculation of curl B and magnetic gradients and investigate the consequences for future spacecraft constellations at Cluster and Swarm.