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Current Distribution and Magnetic Structure in Earth's Ring Current Region during Magnetic Storms Inferred from Cluster four Spacecraft Measurements

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The main characteristics of the magnetic storms are the ring current containing huge kinetic and magnetic energies and strong current and leading to the significant depression of the geomagnetic field on the ground. The geometry of the local geomagnetic field may be changed considerably during the storms. In this research, based on the multiple spacecraft magnetic measurements of Cluster, the current distribution and magnetic configuration in the ring current region during magnetic storms have been investigated. It is found that, there is east ward current inside of the westward current region, and the margin between them moves earthward with increasing strength of the magnetic storms. It is also revealed that, the magnetic geometry in the ring current region during storms may be changed considerably, and the radius of curvature of the magnetic field lines (MFLs) is reduced at all the local times. The stronger the storms, the more reduction of the radius of curvature of the local MFLs. And the alterations of the configuration of the MFLs are asymmetric with the local times. For the storms with the same strength, the radius of curvature of the local MFLs has the largest decrease at the nightside and duskside, medium at the dawnside, and the least at the daytside. The change of the geometry of the magnetic field in the ring current region may have significant influence on the spatial distribution of the particles with various energy in the radiation belt, ring current and plasmasphere. During the strong magnetic storms, the significant decrease of the magnetic strength and the radius of the curvature of the MFLs will lead to violation of the first adiabatic invariant of the previously existing >20MeV radiation belt protons in the ring current region, and the field line curvature pitch angle scattering process will cause the partial loss of these high energy protons.