Using the Lyon-Fedder-Mobarry (LFM) global MHD magnetosphere model we explore the formation and evolution of fast, narrow flow channels in the earth’s plasma sheet. The flows appear in both the standalone MHD simulations and when the global magnetosphere code is self-consistently coupled with the Rice Convection Model (RCM) that describes energy-dependent drifts in the inner magnetosphere. The flows are intensified in the latter case, and are associated with low-entropy flux tubes that eventually lead to the ring current injection. We describe how the properties of the flow channels depend on the simulation resolution, as they tend to intensify and occur more often as the resolution is increased. The ionospheric signatures of these flows include considerable meso-scale perturbations in the field-aligned current pattern, and are associated with increases in particle precipitation and convection electric fields.