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Two classes of earthward plasma sheet fast flows

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In this study we first identify earthward plasma sheet fast flows from Geotail plasma and magnetic data. We then estimate rates of change of nightside auroral power over the courses of the fast flows using Polar Ultraviolet Imager auroral images. It is found that 52 fast flows observed at $|Y| < 4\ R_E$ can be classified into two categories. One category of the fast flows was often observed near $X = -10\ R_E$ and the other category of all fast flows was found at $X < -15\ R_E$. The auroral power rates for the first category of the fast flows are found to be high, indicating the auroral brightness on the nightside was significantly increasing over the courses of these fast flows. The auroral images show an apparent substorm bulge developed at premidnight. The auroral power rates for most of the fast flows in the second category are low. The auroral features, such as poleward boundary intensifications and pseudobreakups, are found to be associated with these fast flows. The first category of the fast flows can be interpreted by the current disruption or near-Earth neutral line theory while the second category of the fast flows can be interpreted by the bubble theory.