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Statistical study of high-latitude plasma flow during magnetospheric substorms.

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We have utilised the near-global imaging capabilities of the Northern hemisphere SuperDARN radars, to perform a statistical superposed epoch analysis of high-latitude plasma flows during magnetospheric substorms. The study involved 67 substorms, identified using the IMAGE FUV spaceborne auroral imager. A substorm co-ordinate system was developed, centred on the magnetic local time and magnetic latitude of substorm onset determined from the auroral images. The plasma flow vectors from all 67 intervals were combined, creating global statistical plasma flow patterns and backscatter occurrence statistics during the substorm growth and expansion phases. The commencement of the substorm growth phase was clearly observed in the radar data 18-20 minutes before substorm onset, with an increase in the anti-sunward component of the plasma velocity flowing across dawn sector of the polar cap and a peak in the dawn-to-dusk transpolar voltage. Nightside backscatter moved to lower latitudes as the growth phase progressed. At substorm onset a flow suppression region was observed on the nightside, with fast flows surrounding the suppressed flow region. The dawn-to-dusk transpolar voltage increased from ˜40 kV just before substorm onset to ˜75 kV 12 minutes after onset. The low-latitude return flow started to increase at substorm onset and continued to increase until 8 minutes after onset. The velocity flowing across the polar-cap peaked 12-14 minutes after onset. This increase in the flux of the polar cap and the excitation of large-scale plasma flow occurred even though the IMF Bz component was increasing (becoming less negative) during most of this time. This study statistically proves that nightside reconnection excites high-latitude plasma flow in a similar way to dayside reconnection and that dayside and nightside reconnection are two separate time-dependent processes.