Signatures of the midnight open-closed magnetic field-line boundary during balanced dayside and nightside reconnection

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Abstract. The geomagnetic conditions were moderately disturbed (IMF B_z ~ –3 nT) during magnetic midnight on 10 December 1999 when the Tasman International Geospace Environment Radar (TIGER), a southern hemisphere HF SuperDARN radar, observed a persistent, sharp latitudinal decrease (~90 km) in line-of-sight Doppler velocity and especially spectral width near –68°Λ. The region poleward of the Doppler boundary was characterised by bursty, meridional flows (>300 m s^{-1}) and high spectral widths (>200 m s^{-1}). This kind of scatter is often observed, and on this evening was associated with irregularities forming on the open (but soon to be reconnected) field lines threading the polar cap ionosphere to the southern tail lobe. The region equatorward of the Doppler boundary was characterised by slower, more zonal flows (<300 m s^{-1}) and very low spectral widths (<50 m s^{-1}). This kind of scatter is more transient, and was associated with irregularities forming on the closed field lines threading the discrete and diffuse auroral oval to the plasma sheet boundary layer (PSBL) and central plasma sheet (CPS). Hence the spectral width boundary was a reasonable proxy for the open-closed field line boundary, and the equatorward limit of the region with low spectral width was probably aligned with the poleward wall of the main ionospheric trough. The spectral width boundary was observed to contract poleward and expand equatorward on time scales of ~10 min, much as would be expected during balanced dayside and nightside reconnection. The relationships between familiar ionospheric and magnetospheric regions were inferred by comparing TIGER data with dynamic spectrograms of precipitating particles measured on board the Defence Meteorology Satellite Program (DMSP) F14 satellite. Total electron content (TEC) measurements made at Macquarie Is. (–65°Λ) and Hobart (–54°Λ), and ionograms recorded at the same stations and Bundoora (–49°Λ), also helped to validate the interpretation.