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Cluster and DMSP observations of SAID electric fields

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We report on magnetically-conjugate Cluster and the Defense Meteorological Satellite Program (DMSP) satellite observations of sub-auroral ion drifts (SAID) during moderate geomagnetic activity levels on April 8, 2004. To our knowledge, the field-aligned separation of DMSP and Cluster ($\approx$ 28,000 km) is the largest separation ever analyzed with respect to the SAID phenomenon. Nonetheless, we show coherent, sub-auroral magnetosphere-ionosphere (MI) coupling along an entire fieldline in the post-dusk sector. The four Cluster spacecraft crossed SAID electric field channels with meridional magnitude $E_M \simeq 25$ mV/m *in situ* and latitudinal extent $\Delta\Lambda \approx 0.5^\circ$ in the southern and northern hemispheres near 07:00 and 07:30 UT, respectively. Cluster was near perigee ($R \approx 4\ R_E$) and within 5° (15°) of the magnetic equator for the southern (northern) crossing. The SAID were located near the plasmapause, within the ring-current-plasmasphere overlap (RCPO) region. Downward field-aligned current (FAC) signatures were observed across both SAID crossings. The most magnetically and temporally conjugate SAID field from DMSP F16A at 07:12 UT was practically identical in latitudinal size to that mapped from Cluster. Since the DMSP ion drift meter saturated at 3000 m/s (or $\sim$ 114 mV/m) and the electrostatically mapped value for E_M from Cluster exceeded 300 mV/m, a magnitude comparison of E_M was not possible. Although the conjugate measurements show similar large-scale SAID features, differences in substructure highlight the physical and chemical diversity of the conjugate regions.