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Dual SuperDARN radar observations of the time delay for the high-latitude nightside ionosphere to respond to solar-wind discontinuities arriving at the magnetopause

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We report measurements of the time delay for large-scale convection changes to appear in the high-latitude nightside ionosphere after an initial dayside response to various solar-wind discontinuities arriving at the magnetopause, as characterised using measurements made onboard the ACE, WIND, IMP8, and GEOTAIL spacecraft. The initial response of the dayside ionosphere was usually measured using the Halley SuperDARN radar, strategically located to monitor the behaviour of the ionospheric footprint of the greater cusp. The subsequent response of the nightside ionosphere was measured with the Tasman International Geospace Environment Radar (TIGER) located opposite the corrected geomagnetic pole to the Halley radar, and at a lower latitude suitable for monitoring the behaviour of ionospheric substorms in the austral auroral oval. We have examined three case studies (01 Apr., 12 Feb., 24 Sep., 2000) using high-time resolution (~6 sec) "camping" beam measurements. During all events there were fairly sharp southward turnings of the IMF B_z component accompanied by generally weaker B_y transitions. Basically, the time delays for the nightside ionosphere to respond were >20 mins (01 Apr.), 6 mins (12 Feb.), and 0 mins (24 Sep.), but other time delays were also deduced. The growth phase of a substorm was the most significant response during the sluggish, 01 Apr. event. The 12 Feb. event was a fairly unambiguous convection change proceeding at a moderate speed. Finally, a single, large-scale *instantaneous* response was observed on 24 Sep. when B_z turned southward, B_y turned positive, and a significant dynamic pressure pulse occurred (–4.8 nPa in 7 mins). This rapid response may have been communicated by fast-mode waves propagating in the magnetospheric cavity, the ionospheric duct, or the Earth-ionosphere wave guide. The complex history of solar-wind conditions were also an important consideration, but many more examples need to be studied to reliably separate the effects of different IMF and dynamic pressure pulse histories. We conclude that overall our results suggest that the majority of IMF-driven convection changes propagate at finite speeds in the order of 10 km s^{-1} throughout the high-latitude ionosphere (i.e., in agreement with Cowley and Lockwood, 1992).