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Supplement of

Mesoscale weather influenced by auroral gravity waves contributing to conditional symmetric instability release?

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Supplementary material for Section 3.2 Winter storms in the eastern U.S.

Case 5: 30 January – 3 February 2021

In the context of solar wind, this storm developed following the impact of high-density plasma (HDP) (January 30/31) at the leading edge of HSS/HCS/CIR (February 1/2) (Figure 3d in the paper). The snowstorm ranked as category 3 on the NESIS and RSI scales. Although the low pressure developed at the end of January as a Colorado Low moving eastward over the Midwest and Ohio Valley, it weakened as it moved towards the Atlantic coast (Figure S1). On February 1, a secondary cyclogenesis occurred and developed into a strong secondary low pressure just off the mid-Atlantic coast (https://www.weather.gov/phi/EventReview20210201) with the central pressure deepening from 1009 to 995 hPa in 12 hours. The cyclone developed a cloud head that produced the bulk of the snow precipitation in the north-east (https://www.ncei.noaa.gov/access/monitoring/rsi/nesis). The assessment of CSI and slantwise convection in Figure S2 displays characteristics similar to the other cases discussed in the paper: SCAPE exceeding CAPE in the frontal zones and the highest values of VRS and precipitation in the warm frontal sector.

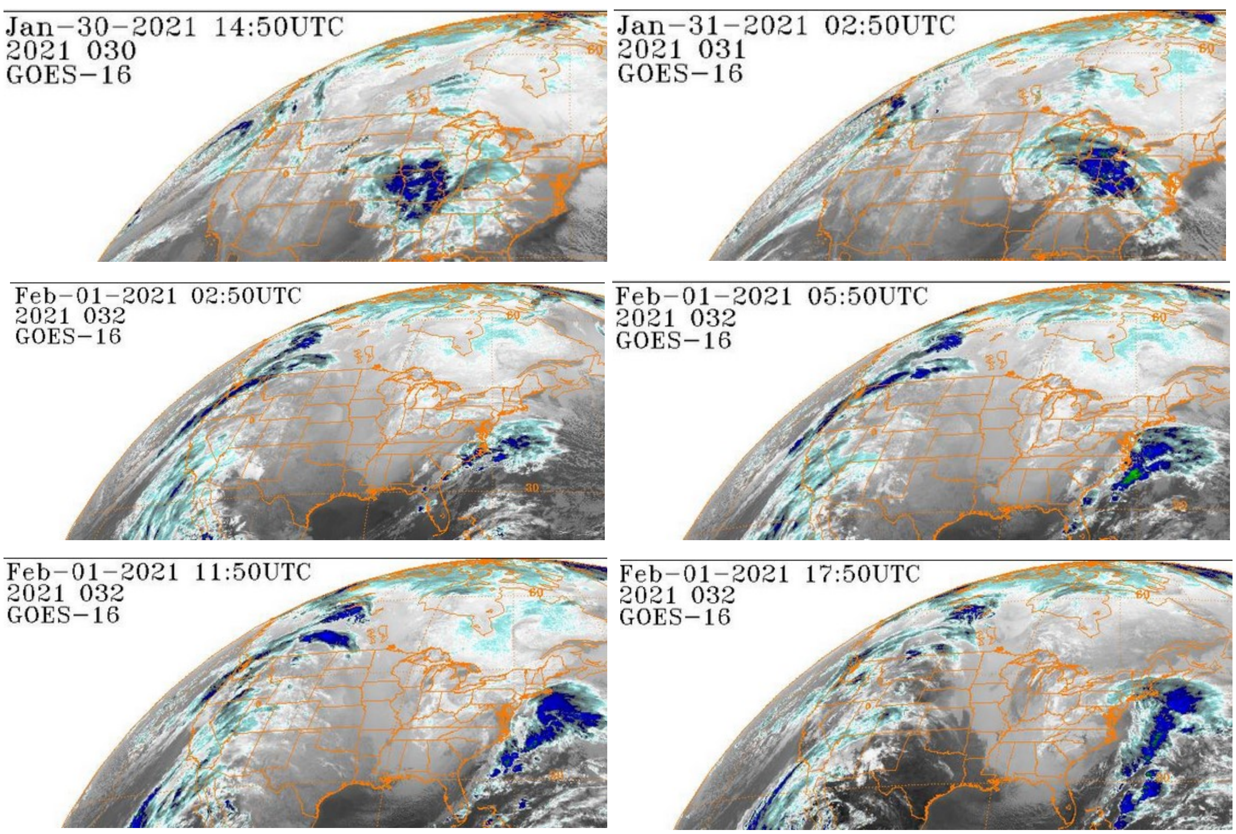

Figure S1. The GOES-16 infrared images during winter storm on 30 January – 1 February 2021**.**

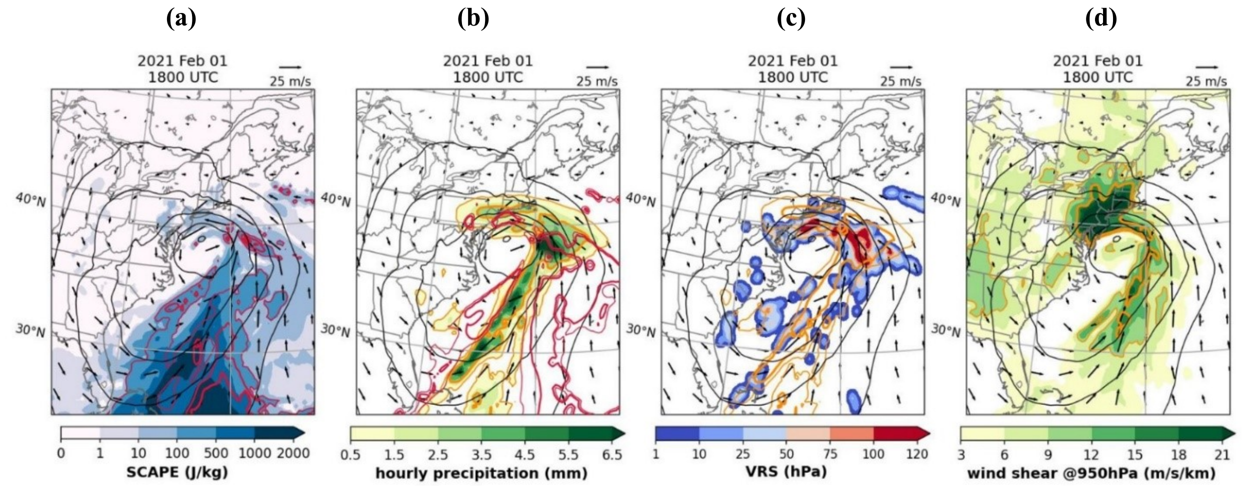

Figure S2. **(a)** SCAPE (shaded) and SCAPE–CAPE (red contours; 100, 300, and 500 J/kg), **(b)** 1 h accumulated precipitation (shaded) and f_s (red contours; thin for 0.5 and thick for 0.8), and **(c)** VRS (shaded) and precipitation (orange contours; 0.5 and 2.5 mm), **(d)** low-level wind shear (orange contour; 9, 15 m/s/km). **(a–d)** All overlapped with 950 hPa wind (vectors; m/s) and 950 hPa geopotential height (black contours; m; at intervals of 50 m).

Case 6: 16–17 January 2022

This snowstorm that ranked as category 1 on the RSI scale developed in the south-east U.S. following the arrival of HSS/CIR on January 15 (Figure 3e in the paper). Similarly to Case 1 and 2 discussed in the paper, the storm developed striated delta cloud (Figure S3a) on January 16, the central pressure deepened to 980 hPa the next day, as the cyclone developed strings of 'back-building' convective cells in the warm and cold frontal zones (Figure SF3b). Figure SF4 shows the presence of CSI and slantwise convection with SCAPE exceeding CAPE, high values of VRS and precipitation, as well as low-level southerly winds and wind shears that favour over-reflection of AGWs.

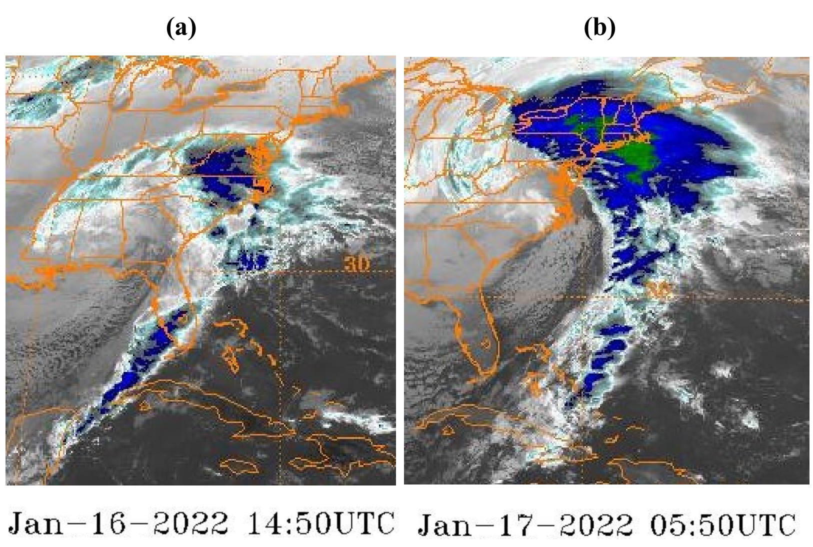

Figure S3. The GOES-16 infrared images during winter storm on 15–16 January 2022**.**

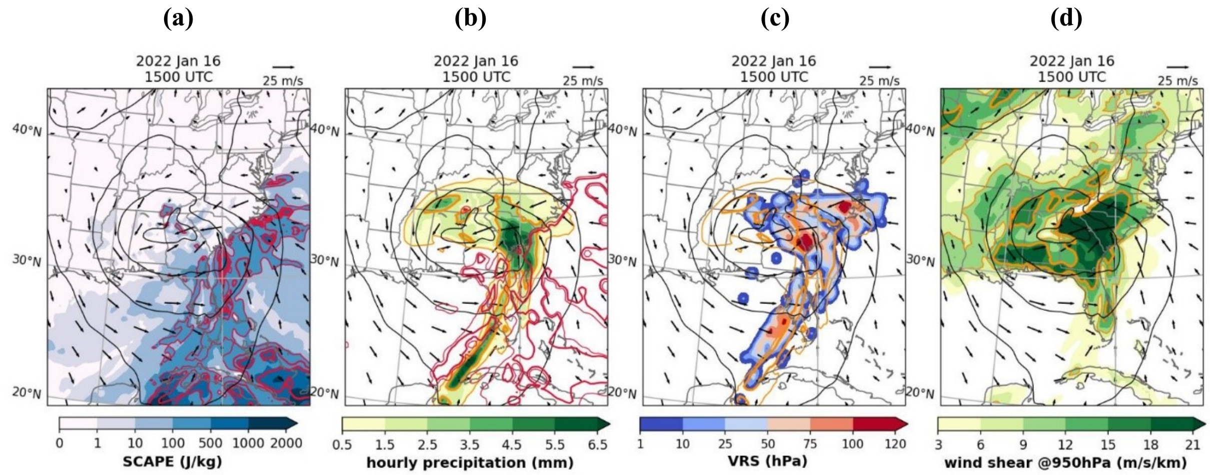

Figure S4. The same as Figure S2, but for the winter storm on 16 January 2022.

Striated delta clouds and cloud heads

The first identified striated delta clouds by Feren (1995), and several cases of cloud heads that were discussed by Dixon et al. (2002) and Browning and Wang (2002), are shown in the context of solar wind in Figures S5 and S6. All these cases were associated with arrivals of HSS/HCS/CIRs or ICMEs, when solar wind - MIA coupling generates large-amplitude globally propagating AGWs.

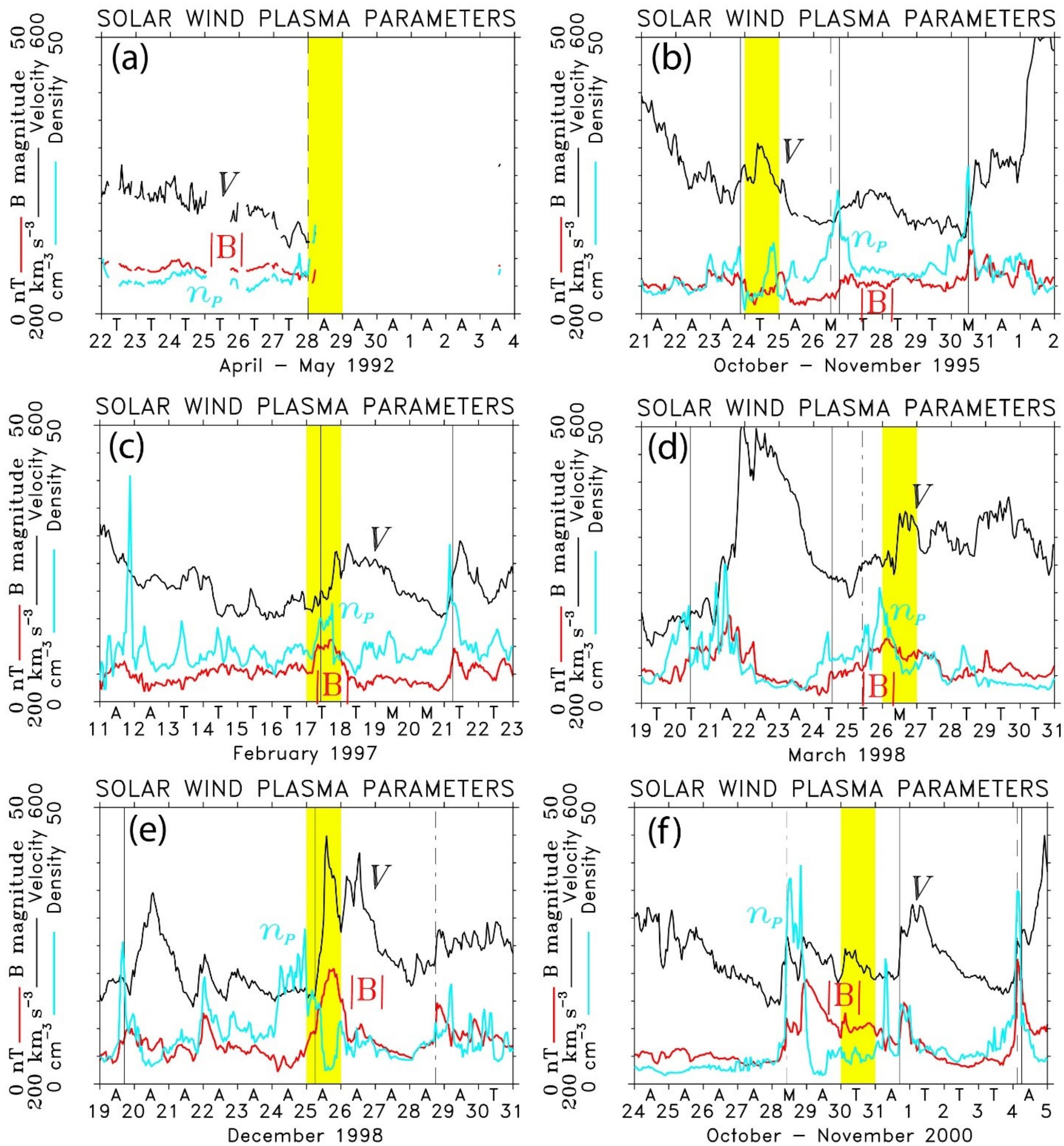

Figure S5. Solar wind plasma parameters showing HSS/CIRs, HCSs, and ICMEs (vertical solid, dashed, and dash-dot lines). The proxy interplanetary magnetic field sectors (A: away, T: toward, M: mixed). The yellow shaded rectangles indicate days of striated cloud heads cases (Dixon et al., 2000; Browning and Wang, 2002) on **(a)** 28 April 1992, **(b)** 24 October 1995, **(c)** 17 February 1997, **(d)** 26 March 1998, **(e)** 25 December 1998), and **(f)** 30 October 2000.

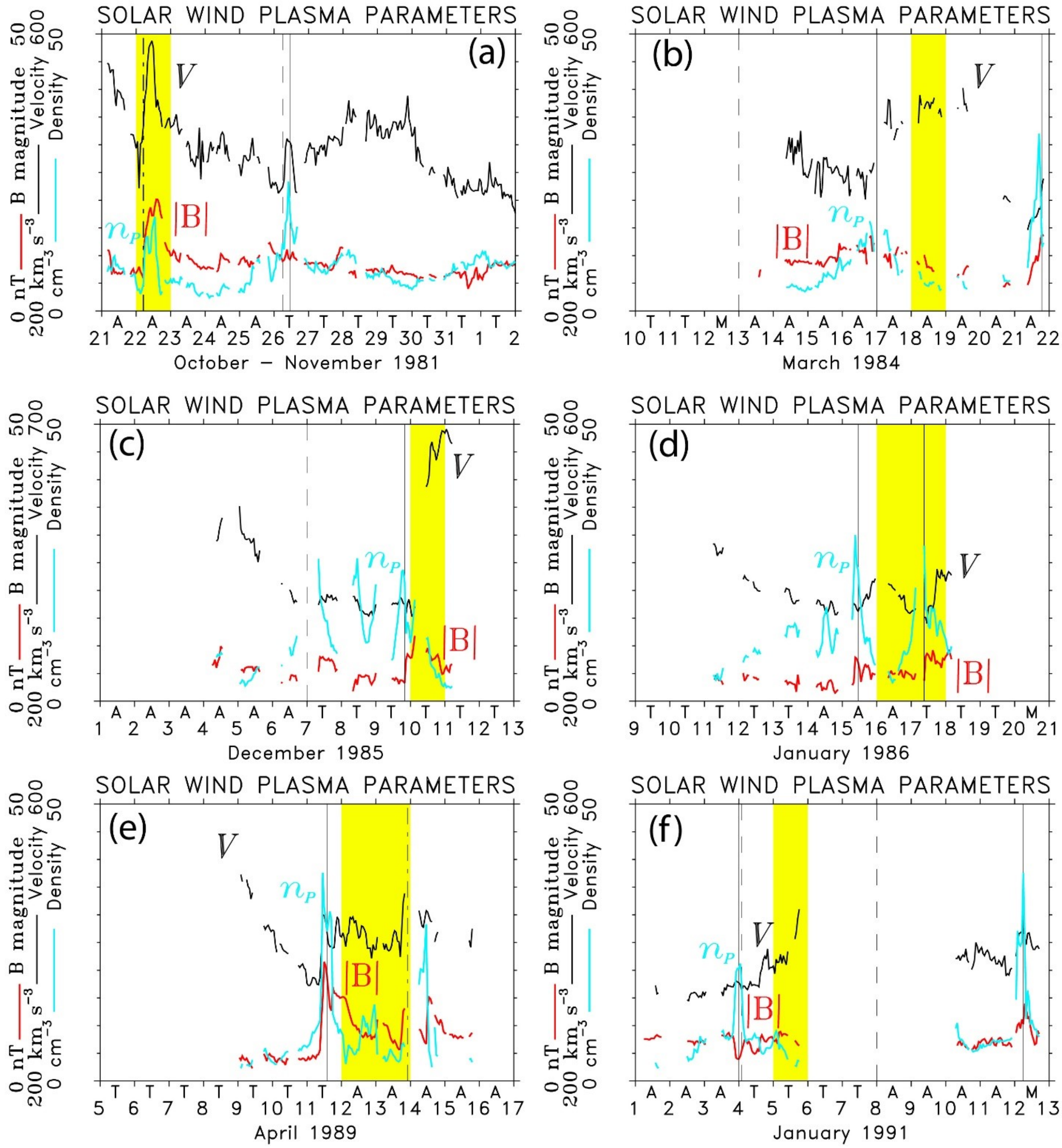

Figure S6. Solar wind plasma parameters showing HSS/CIRs, HCSs, and ICMEs (vertical solid, dashed, and dash-dot lines). The proxy interplanetary magnetic field sectors (A: away, T: toward, M: mixed). The yellow shaded rectangles indicate days of striated delta clouds cases (Feren 1995) on **(a)** 22 October 1981, **(b)** 18 March 1984, **(c)** 10 December 1985, **(d)** 16-17 January 1986, **(e)** 12-13 April 1989, and **(f)** 5 January 1991.