



Supplement of

A derecho climatology (2004–2021) in the United States based on machine learning identification of bow echoes

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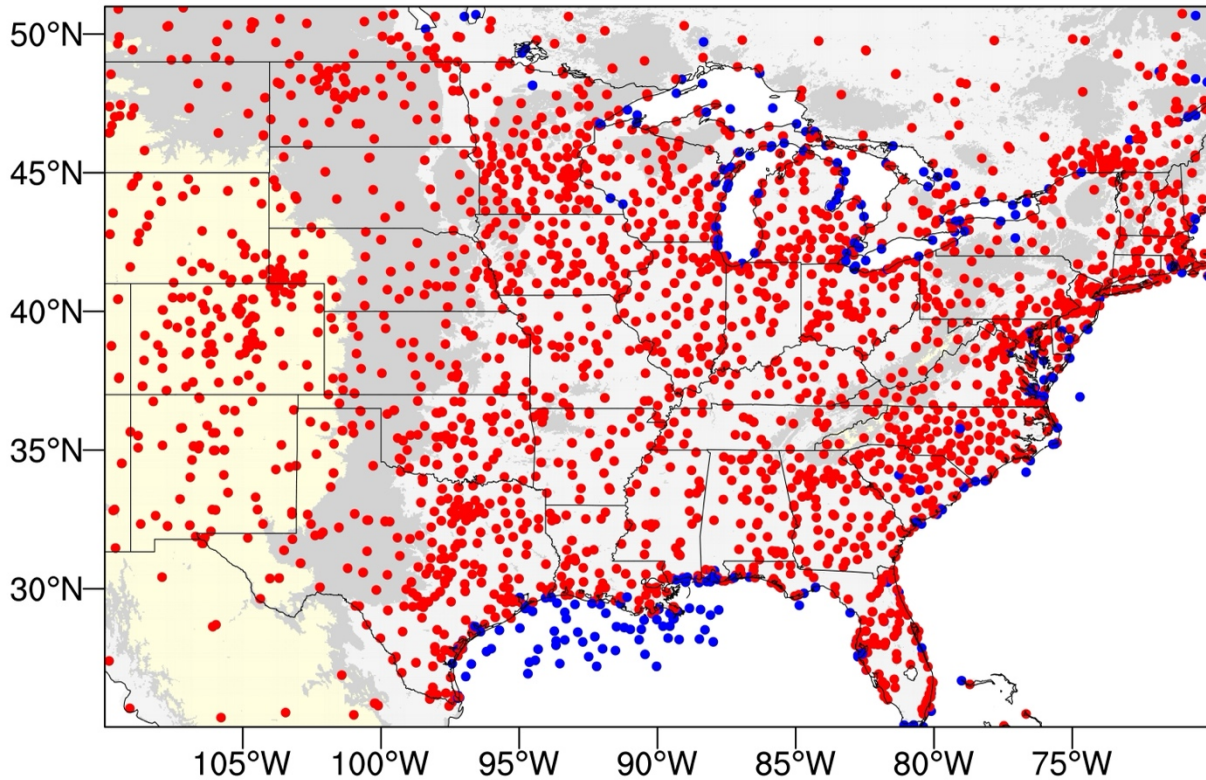


Figure S1. Locations of ISD gust speed observational sites used in the study. There are 4,260 sites, 3,954 of which are over land (red points), while the rest are over the ocean or lakes (blue points). We use the Advanced Research Weather Research and Forecasting (WRF) Preprocess System (WPS) to generate a 4-km land cover map to determine the land type associated with each observational site. Light-yellow shading denotes an elevation greater than 1000 m; light-gray shading denotes an elevation between 400 m and 1000 m; and smoke-white shading denotes an elevation less than 400 m. Background white is for the ocean and lakes.

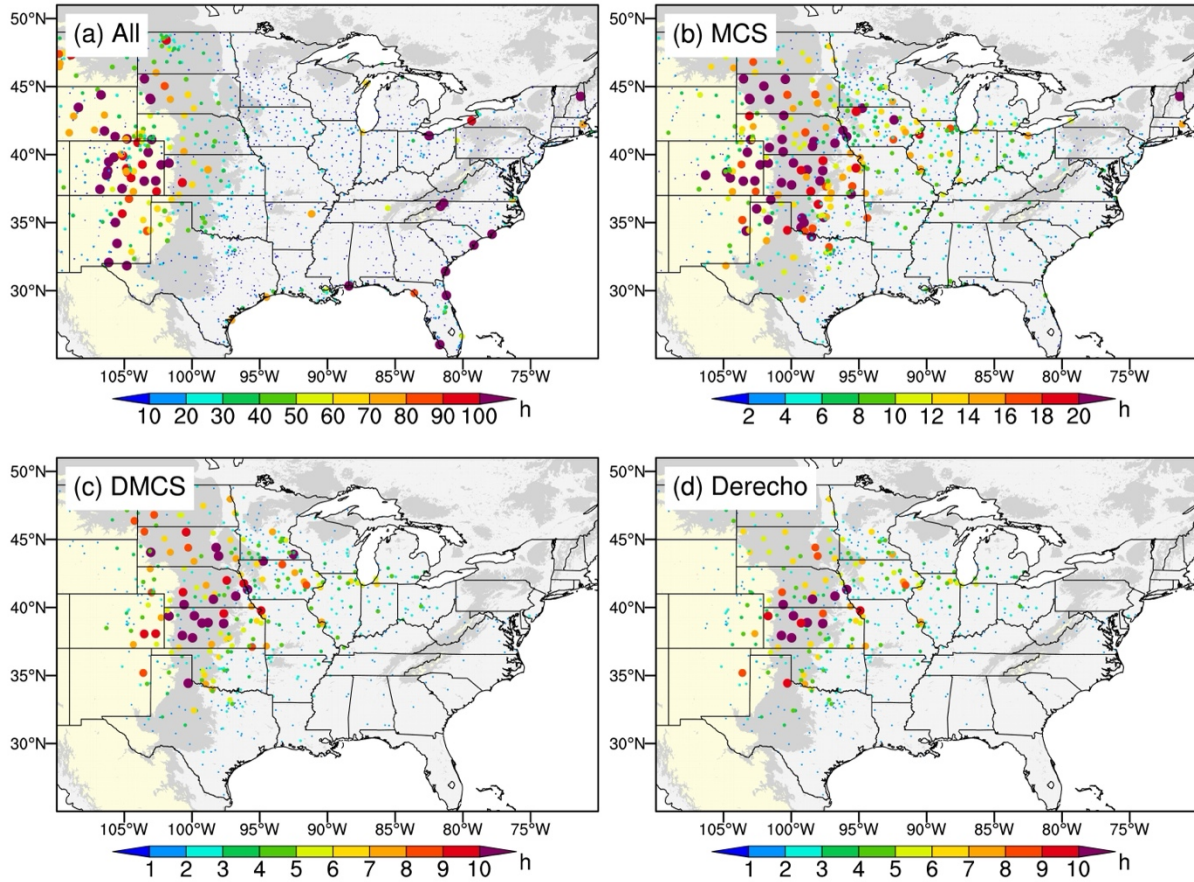


Figure S2. Same as Figure 12, but the frequencies of damaging gust occurrences from mesoscale convective system (MCS), derecho-producing MCS (DMCS), and derecho are shown in (b), (c), and (d) instead of fractions. Non-derecho-producing MCS events overlapping with tropical cyclones (TCs) are excluded in (b).

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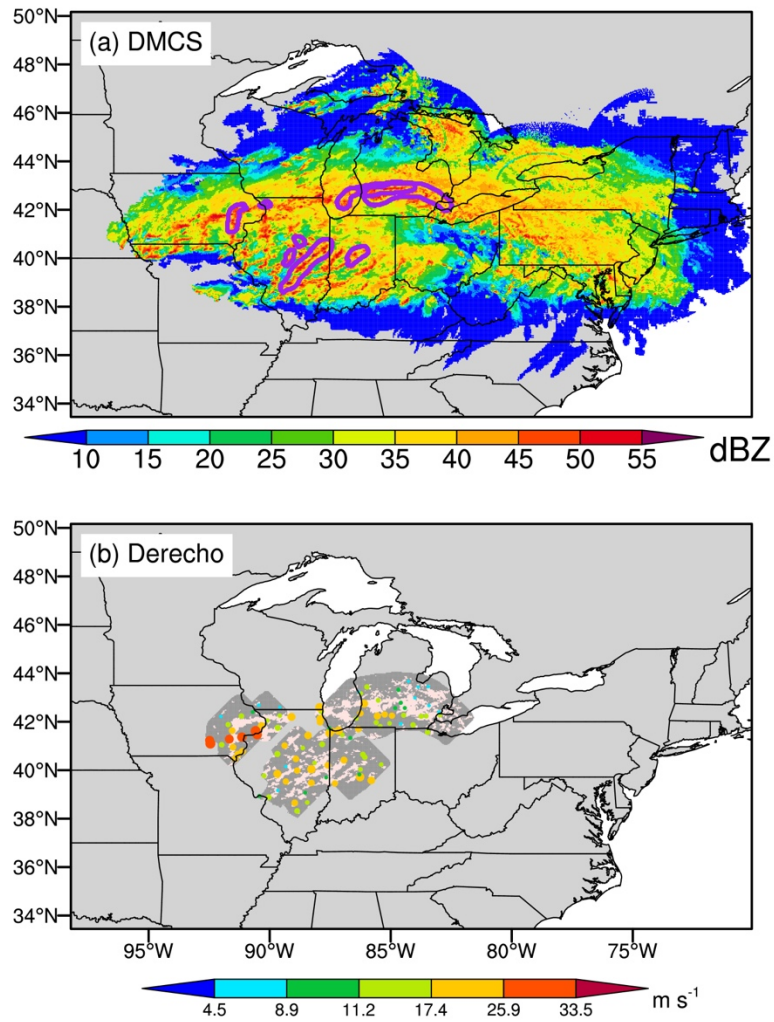


Figure S3. Same as Figure 7 but for an MCS that occurred on 19-21 June 2009. The automated detection algorithm falsely classifies the MCS as a DMCS due to the false identification of bow echoes by the segmentation CNN. The figure title refers to the MCS timing range.

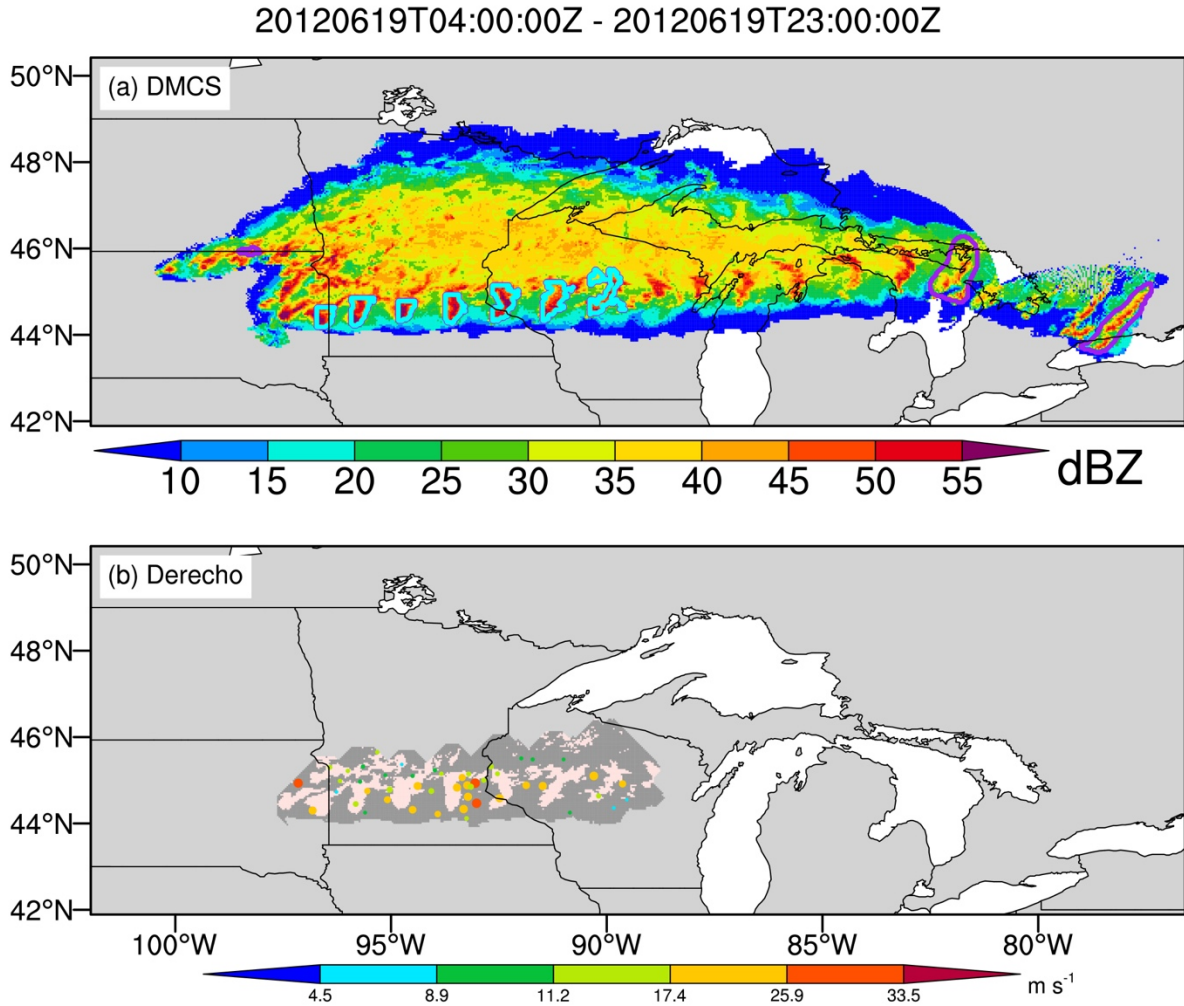


Figure S4. Same as Figure S3 but for a DMCS that the automated detection algorithm misses due to a failure in bow echo identification. In (a), purple contours denote CNN-identified bow echoes, while cyan contours refer to bow echoes labeled manually.

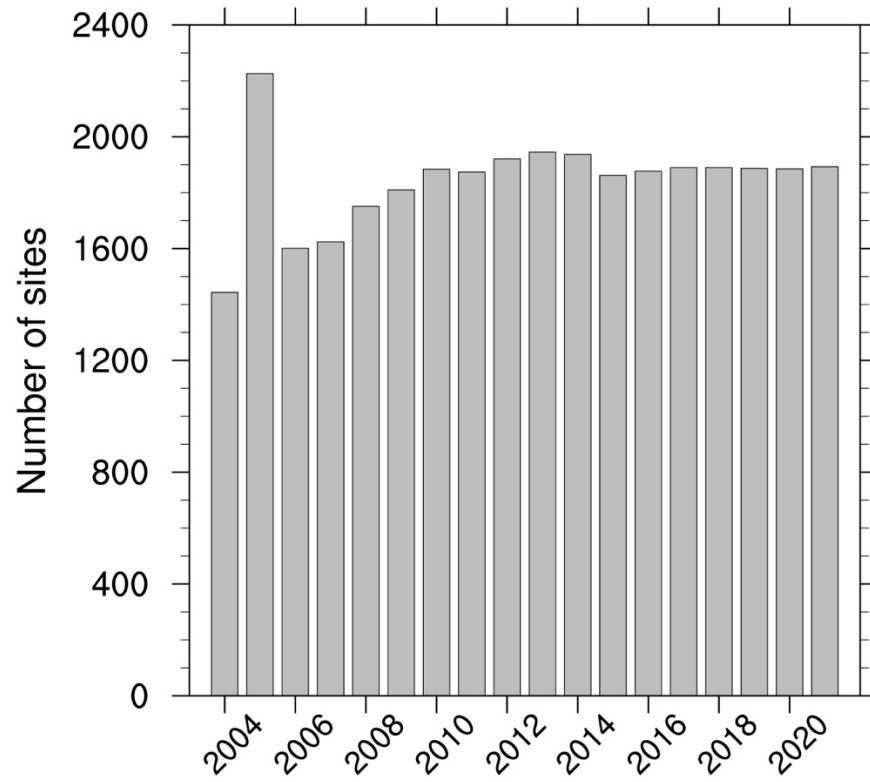


Figure S5. The annual number of ISD gust speed observational sites used in the derecho identification between 2004 and 2021.

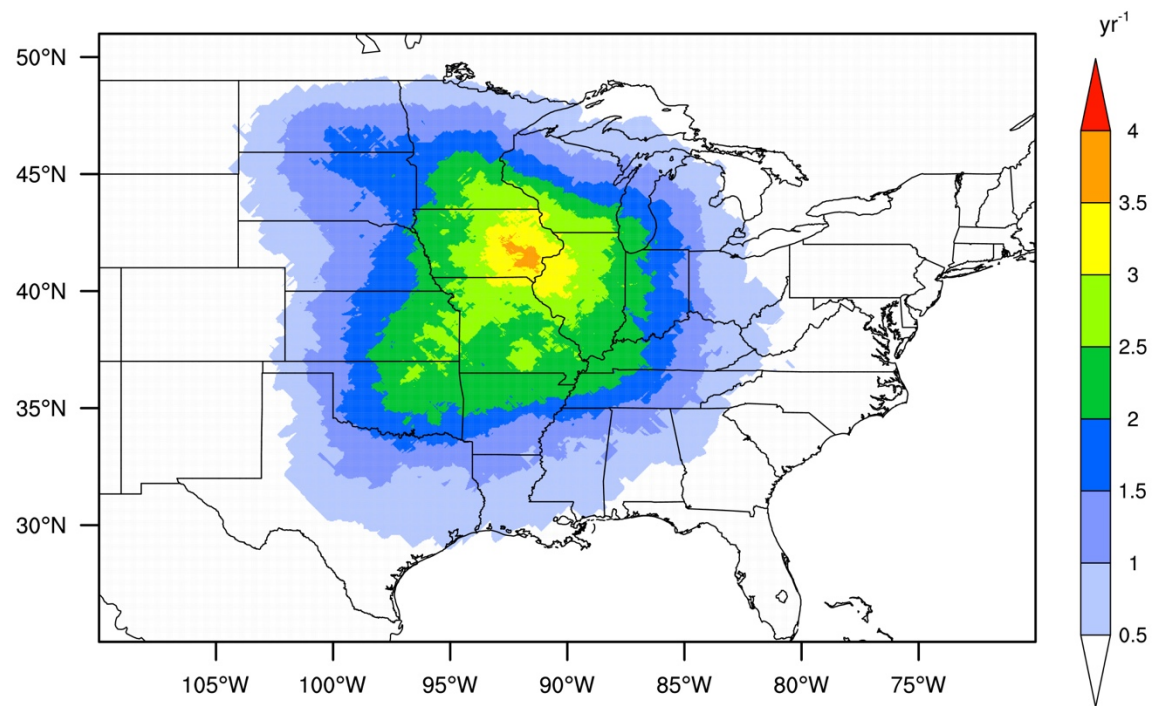


Figure S6. Same as Figure 9 but for the SED-based dataset.

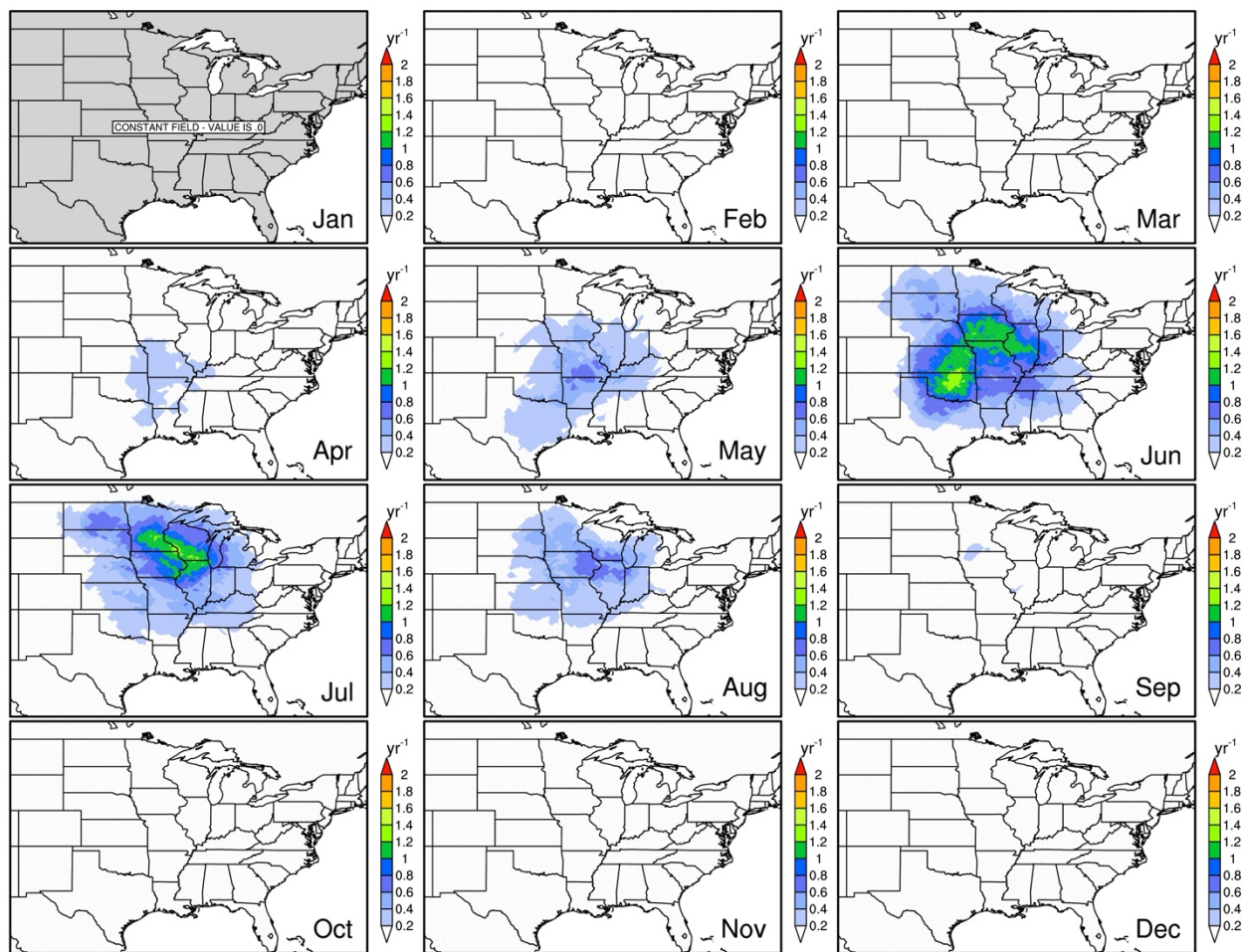


Figure S7. Same as Figure 11 but for SED-based derechos.

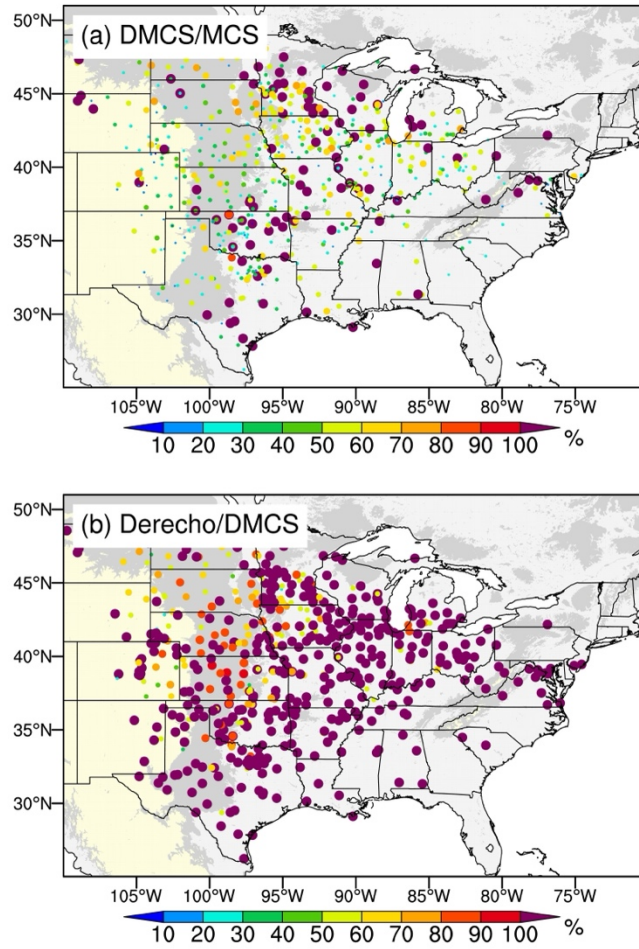


Figure S8. (a) Relative contributions of DMCS-associated to MCS-associated ISD damaging gust occurrences between 2004 and 2021 at weather stations over the United States east of the Rocky Mountains. (b) is the same as (a) but for relative contributions of derecho-associated to DMCS-associated damaging gust occurrences. We exclude non-derecho-producing MCS events overlapping with TCs in (a).

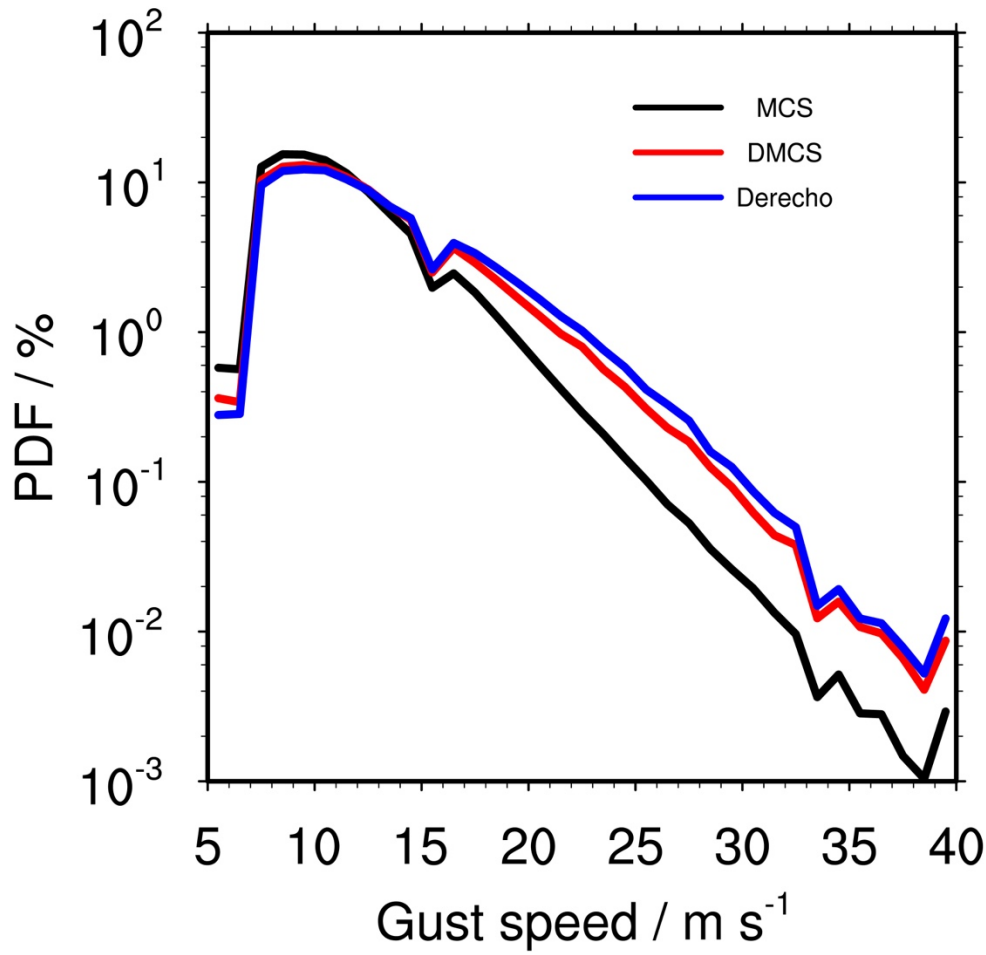


Figure S9. PDFs of land ISD gust speeds associated with MCSs, DMCSs, and derechos in the United States east of the Rocky Mountains. We exclude non-derecho-producing MCS events overlapping with TCs.

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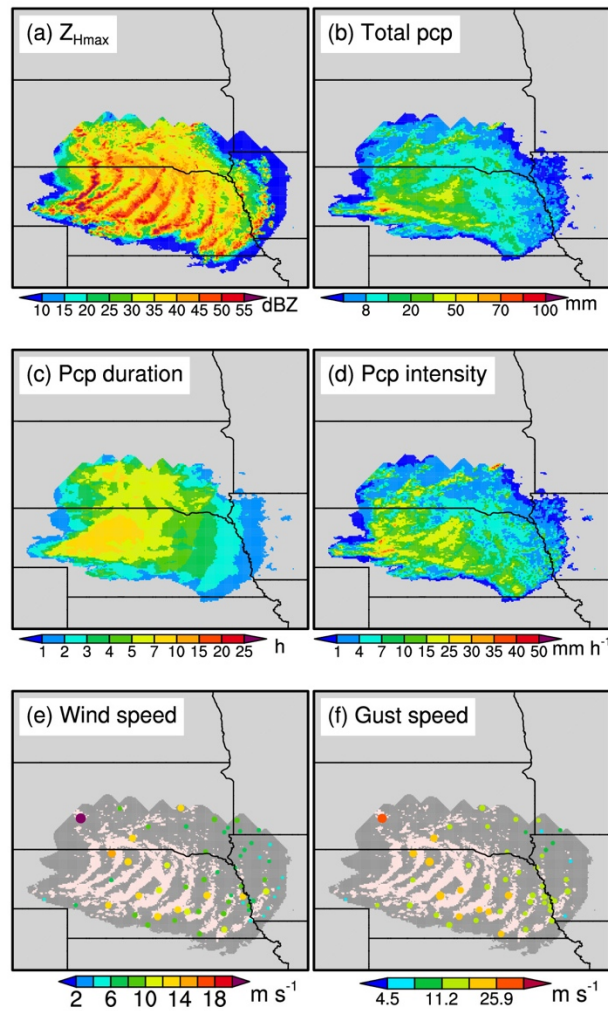


Figure S10. Same as Figure 13 but for the spatial evolutions of the accompanying derecho. The figure title refers to the derecho timing range.