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Interpreting the damage from the 2022 Canadian derecho

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On 21 May 2022, a derecho occurred across parts of Canada. It travelled from south-western Ontario into Quebec. Along its 1000 km long and up to 100 km wide path, more than 40 % of the Canadian population have been affected by the storm. It has been one of the worst hazardous weather events in Canadian's history, killing 16, injuring 32, and causing power outages for 1.1 million people that lasted up to one month. The total estimated loss of 1.257 billion CAD is among the 10 highest recorded for a natural disaster in Canada.
The nature of the wind damage – specifically the damage mechanism responsible for extreme surface winds - can also help infer low-level storm dynamics and structure. Damage to buildings and infrastructure can indicate differences in wind speed gradients as well as other small scale storm structures which cannot be resolved using remote sensing data. In this event, these mechanisms likely spanned the full gamut of convective wind damage mechanisms (i.e., rear-inflow jet, meso- and miso-cyclones, downbursts/microbursts, and tornadoes), as inferred by wind damage survey data. The Northern Tornadoes Project did numerous damage surveys within the derecho's path, providing a detailed overview of the derecho's heterogenous wind damage occurrence. This included a quasi-continuous area of EF1 damage embedded within the derecho, and numerous downburst swaths of EF2 damage. Additionally, 4 tornadoes were confirmed.
Based on this detailed damage analysis, this work addresses the processes that influenced the development of the derecho, in particular according to its path and local intensity. Using radar data, model data, and data of observation networks, we analyse frontal lift, mesoscale lake-sea wind boundaries, the influence of vertical wind shear, and CAPE and CIN distribution in the pre-storm environment, and the location of the rear inflow jet, bow echoes, mesovortices, and pre-storm convection initiation to discuss the influence of these parameters to the derecho development.