Winter windstorms in pseudo-global warming experiments

Objective

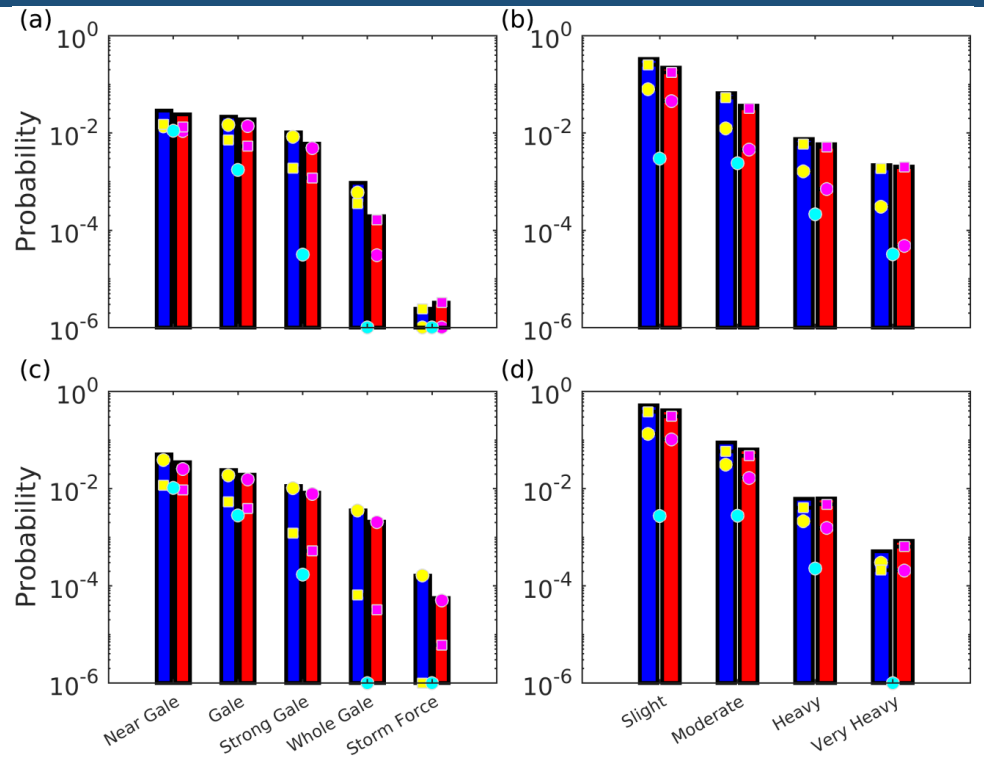
- Windstorms associated with intense synoptic-scale cyclones are an important natural hazard in the northeastern US. Here we provide a preliminary assessment of their response to global warming using a pseudo-global warming framework.

Approach

- Simulate two 14-day periods that contained two of the most powerful winter windstorms from the historical record and two more typical mid-latitude cyclones. Control simulations (CNTRL) are performed using WRF applied at 3.3 km. We evaluate the simulation fidelity relative to a range of observations. We re-simulate the periods with the initial and lateral boundary conditions warmed by 4K, specific humidity increased to hold relative humidity constant and with the Great Lakes deiced (PGW).

Impact

- Maximum wind speeds (WS) during the intense cyclones are slightly decreased in the PGW simulations. For example, the marginal probability (in space and time) of 10-m WS > 14.3 ms^{-1} over land drops from 6.6 to 5.3% for an intense Alberta Clipper and from 9 to 6.5% for a Colorado Low. However, there is spatiotemporal variability in the WS response, and localized increases in WS in the PGW simulations are also indicated.



Probability of 10-m WS; (1) Near Gale (14.31 - 17.43 ms^{-1}), (2) Gale (17.43 - 21.01 ms^{-1}), (3) Strong Gale (21.01 - 24.59 ms^{-1}), (4) Whole Gale (24.59 - 28.61 ms^{-1}) and (5) Storm Force (> 28.61 ms^{-1}) in CNTRL (blue) and PGW (red) simulations during (a) November 11-25, 2003 and (c) February 28 - March 13, 2018. (b) and (d) 3-hourly accumulated precipitation: (1) Slight rain (< 0.5 mm hr^{-1}), (2) Moderate rain (0.5 to 4.0 mm hr^{-1}), (3) Heavy rain (4 to 8 mm hr^{-1}) and (4) Very Heavy rain (> 8 mm hr^{-1}). Symbols: WRF output conditionally sampled for land (squares) and ocean (circles) in CNTRL (yellow) and PGW (magenta) simulations. Cyan dots = observations from 32 ASOS stations.

Sethunadh J., Letson F.W., Barthelmie R.J. and Pryor S.C. (2023): Assessing the impact of global warming on windstorms in the Northeastern United States using the pseudo-global-warming method. *Natural Hazards* 10.1007/s11069-023-05968-1

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