

Spatiotemporal evolution of drought over Canada

Elvis Asong¹, Julio Herrera-Estrada², Howard Wheeler¹, John Pomeroy¹

¹Global Institute for Water Security, University of Saskatchewan, Saskatoon, SK

²Department of Earth System Science, Stanford University, Stanford, CA 94305

elvis.asong@usask.ca www.usask.ca/water



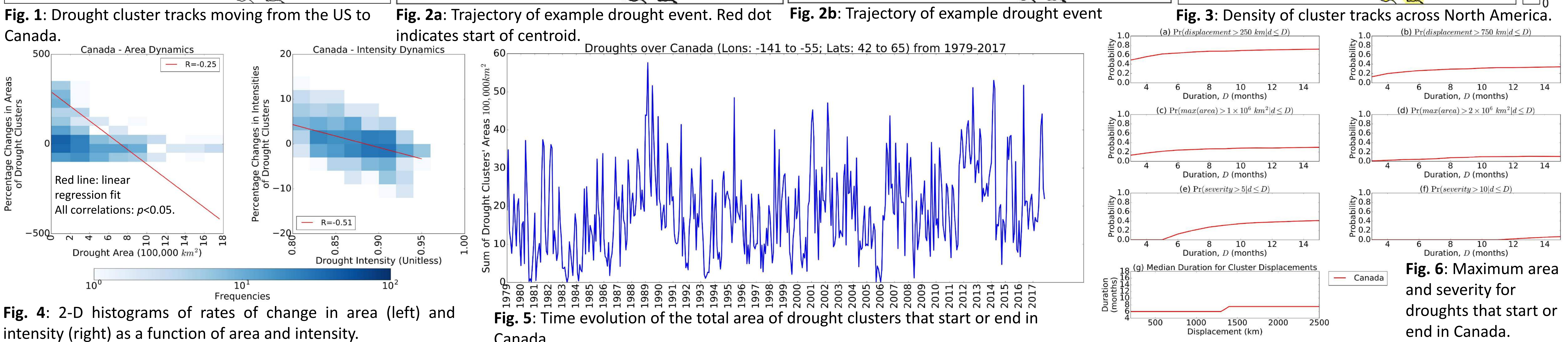
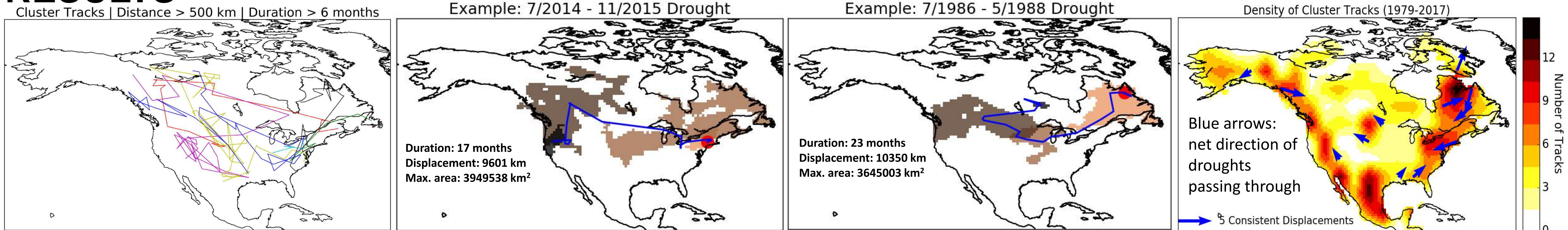
PROBLEM

- Drought studies have focused on time series analysis of area-averaged quantities of a fixed duration and extent (e.g. *Asong et al.* 2018)
- However, the simultaneous evolution of droughts in time and space has received limited attention and is critical to informing forecasting efforts

APPROACH

- To identify clusters, monthly volumetric soil moisture data from ERA-Interim (1979–2017) are utilized
- Clustering approach follows the block neighborhood algorithm in *Andreadis et al.* (2005), *Herrera-Estrada et al.* (2017)
- Drought is defined when a value is below the 20th percentile threshold
- Regions under drought are aggregated into clusters at each time step by a proximity criterion. Then their continuity through time is tracked
- Cluster characteristics examined include distributions of their duration, total distance traveled by the centroids, distance between start and end locations (i.e. monthly displacement), cluster areas, mean intensities and severity at each time step, and rates of change in area and intensity

RESULTS



- Several drought clusters in Canada originated in the US, lasted for more than 6 months and traveled at least 500 km (Fig. 1)
- There was a drought event over North America (NA) from July 2014 – Nov 2015. It originated in northeastern US, displaced across the Prairies and ended in northwestern US (Fig. 2a). ‘Hotspots’ of track densities concentrated mostly along the NA coastlines and the Prairies (Fig. 3). The rates of change in area and intensity are found to be non-linear functions of the clusters’ area and intensity (Fig. 4)
- Most events exhibit a sharp expansion in their areal extent at least once (Figs. 5 & 6). This suggests that longer-period droughts result from the merger of two or more shorter-period events
- To conclude, drought clusters that start or end in Canada are very dynamic, travel long distances while growing and shrinking on the way

REFERENCES

Andreadis, K. M., E. A. Clark, A. W. Wood, A. F. Hamlet, and D. P. Lettenmaier (2005), Twentieth-century drought in the conterminous United States, *J. Hydrometeorol.*, 6(6), 985–1001, doi:10.1175/JHM450.1.
 Herrera-Estrada JE, Satoh Y, Sheffield J. 2017. Spatiotemporal dynamics of global drought. *Geophys. Res. Lett.* 44(5): 2254–2263. <https://doi.org/10.1002/2016gl071768>.
 Asong, Z. E., Wheeler, H. S., Bonsal, B., Razavi, S., and Kurkute, S.: Historical drought patterns over Canada and their relation to teleconnections, *Hydrol. Earth Syst. Sci. Discuss.*, <https://doi.org/10.5194/hess-2018-122>, in review, 2018.