

Evaluation of dynamical or dynamically influenced phenomena in RCMs

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Motivation

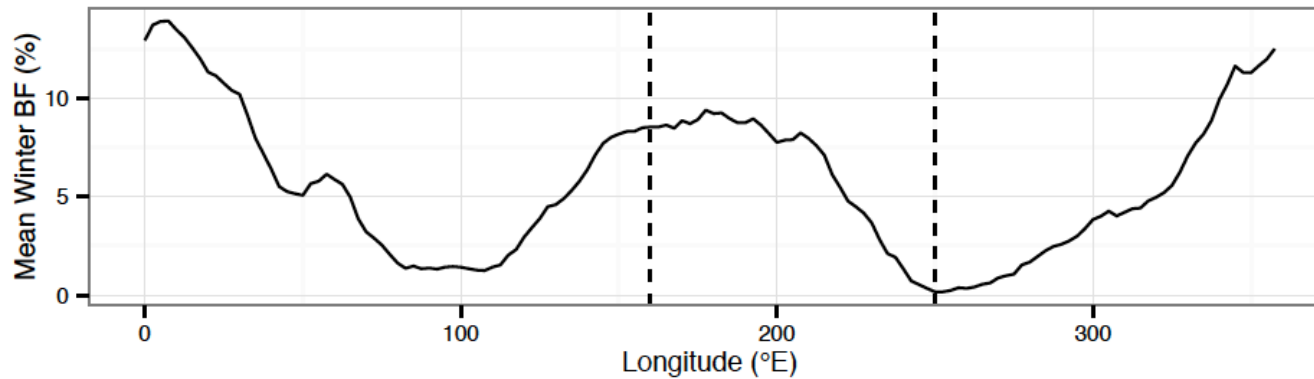
- The usual demonstrations of the added value from RCMs rely primarily on the impact of improved topographic forcing on surface climate
- Fewer studies have considered the influence of teleconnected variability outside the RCM domain, or whether RCMs “add value” to the representation of storms within their domains

Outline

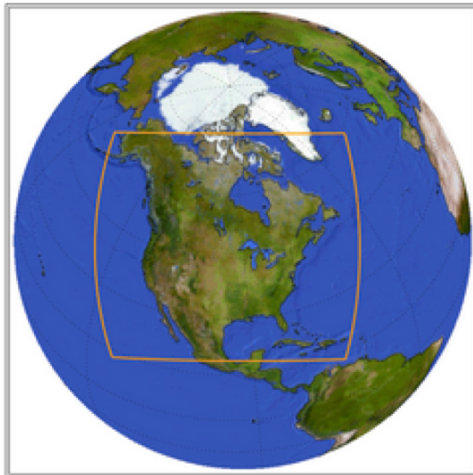
- Whan, Zwiers, Sillmann
 - Influence of upstream blocking on cold temperature (TNn) extremes in the RCM domain
- Seiler, Zwiers, Hodges
 - Explosive cyclones on the east coast of North America

Atmospheric Blocking

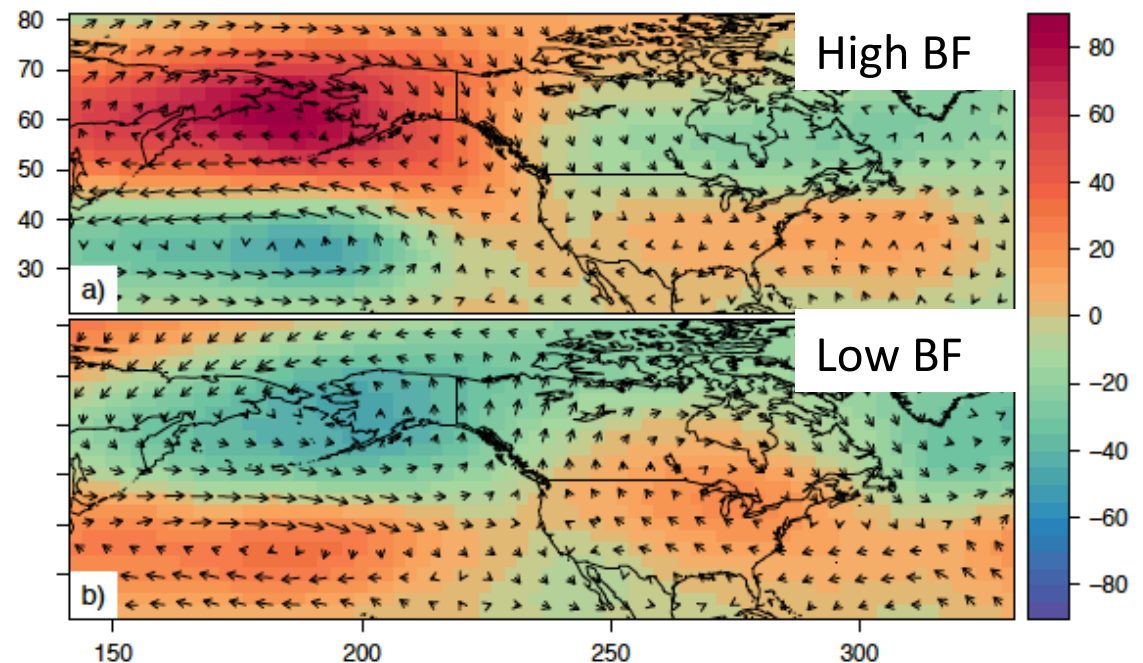
Mean DJF blocking frequency using Tibaldi and Montini (1990) blocking index



CORDEX-NA domain

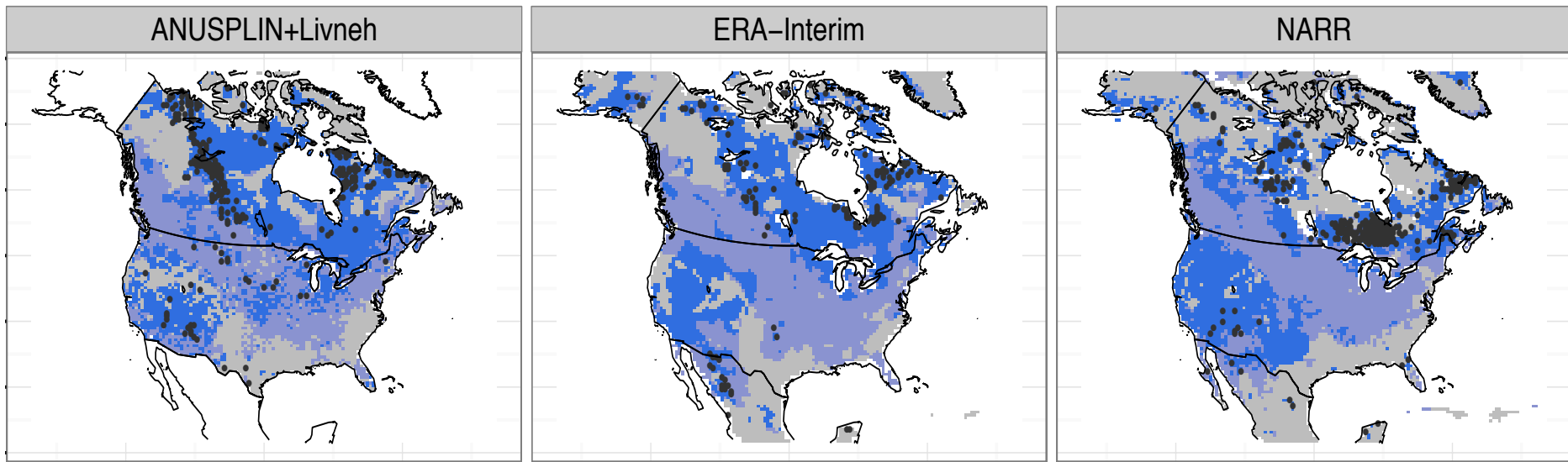


10 m/s **500 hPa GPH and Vector Wind Anomalies**

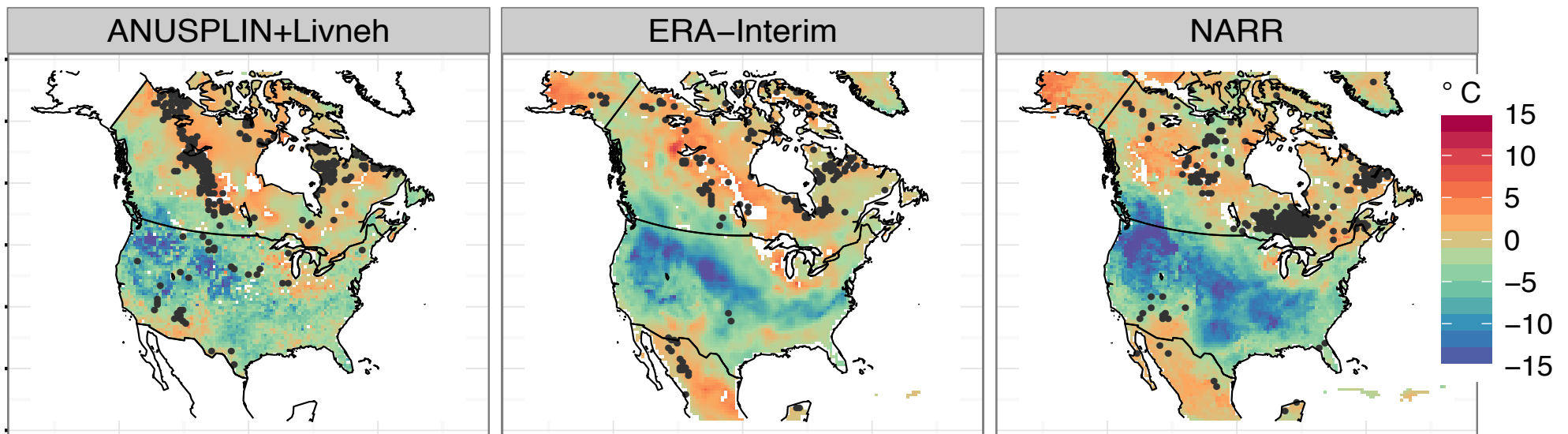


Influence of blocking: Observations

Locations where blocking has a significant influence on TNn

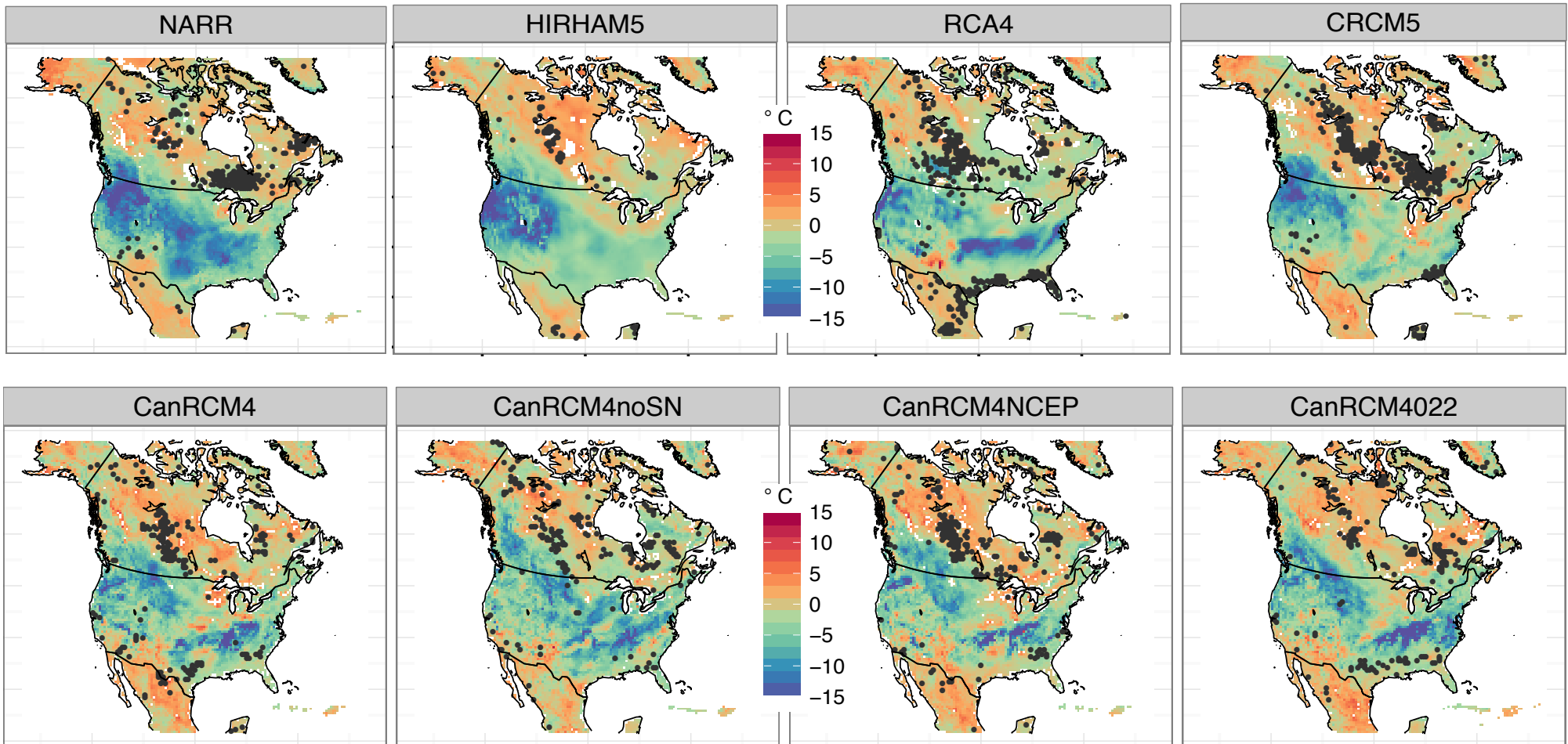


High vs low blocking index 20-year return values for TNn ($^{\circ}\text{C}$ per 10% diff in BF)



Influence of blocking: NARR and RCMs

High vs low blocking index 20-year return values for TNn ($^{\circ}\text{C}$ per 10% diff in BF)



Explosive Cyclones

- Global climate models underestimate the frequency of explosive cyclones.
- Can we solve this by using regional climate models?

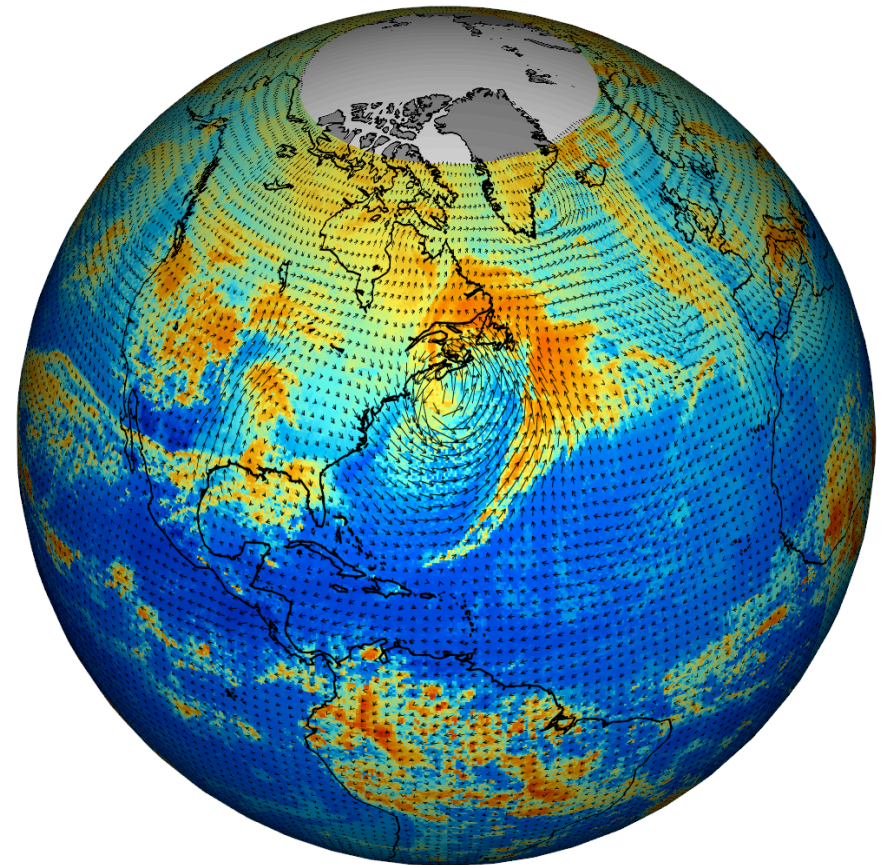


Figure : Explosive Cyclone of March 26, 2014, with hurricane force winds in the Maritimes.

Method

- Reanalysis: ERA-INT
- GCM: CanESM2
- RCM: CanRCM4
- 6h pressure (MSLP)
- Algorithm: TRACK

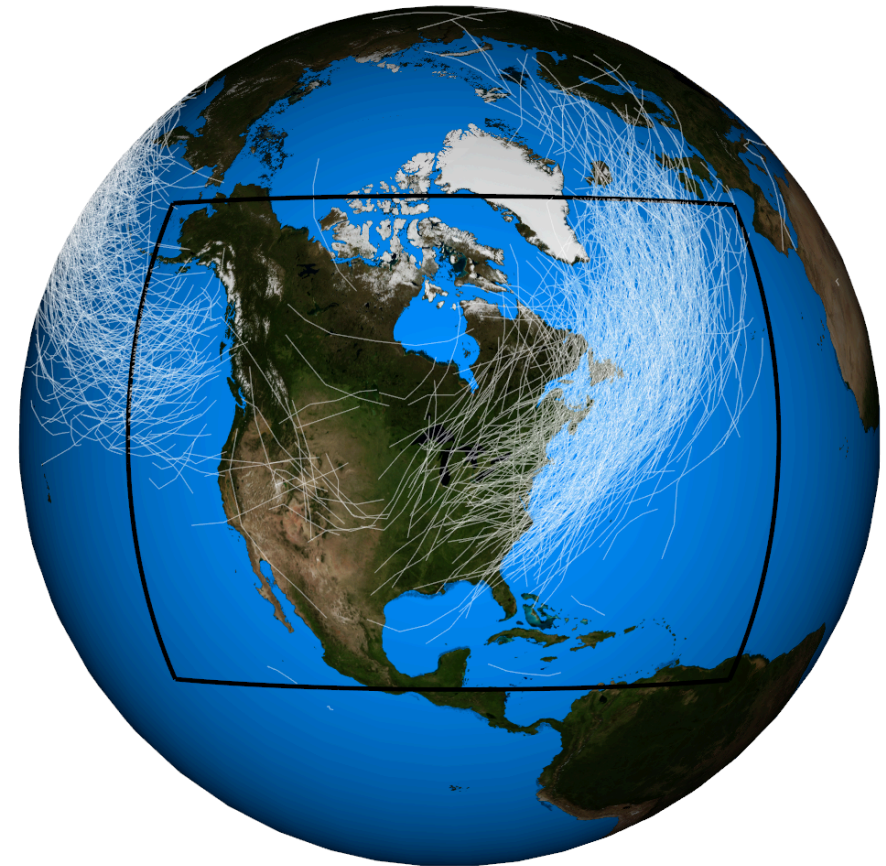
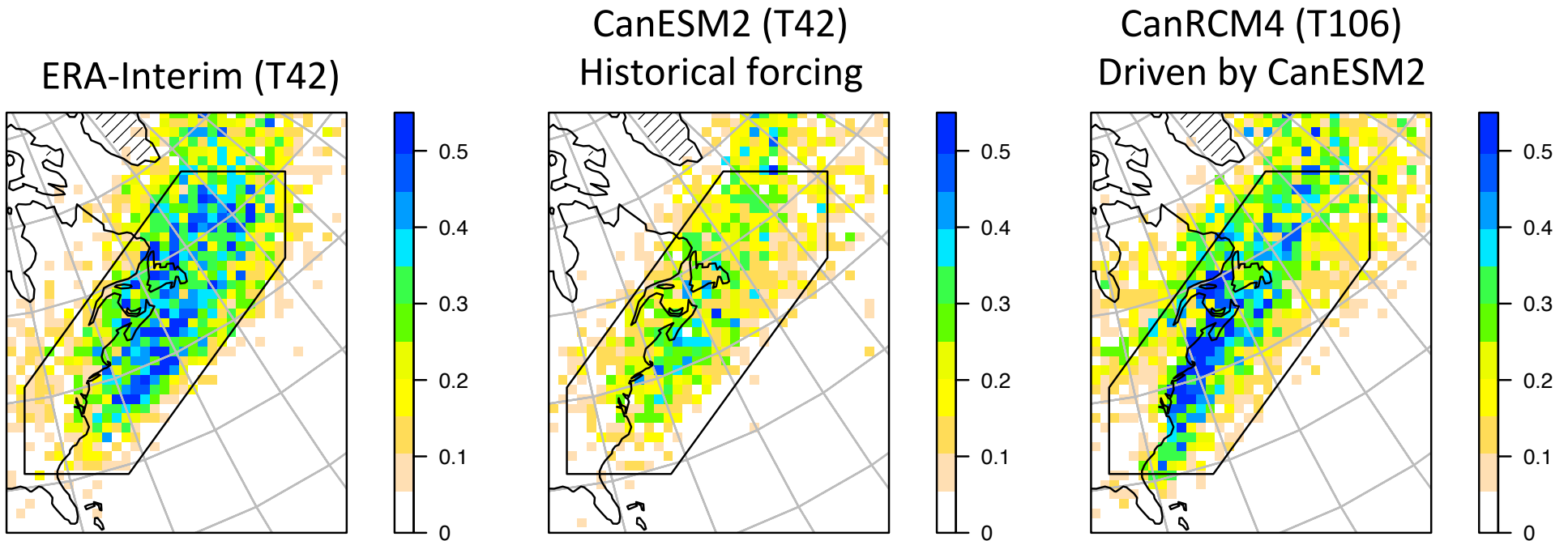


Figure : RCM domain, and explosive segments of cyclone tracks computed from reanalysis (ERA Interim).

Explosive cyclone frequency

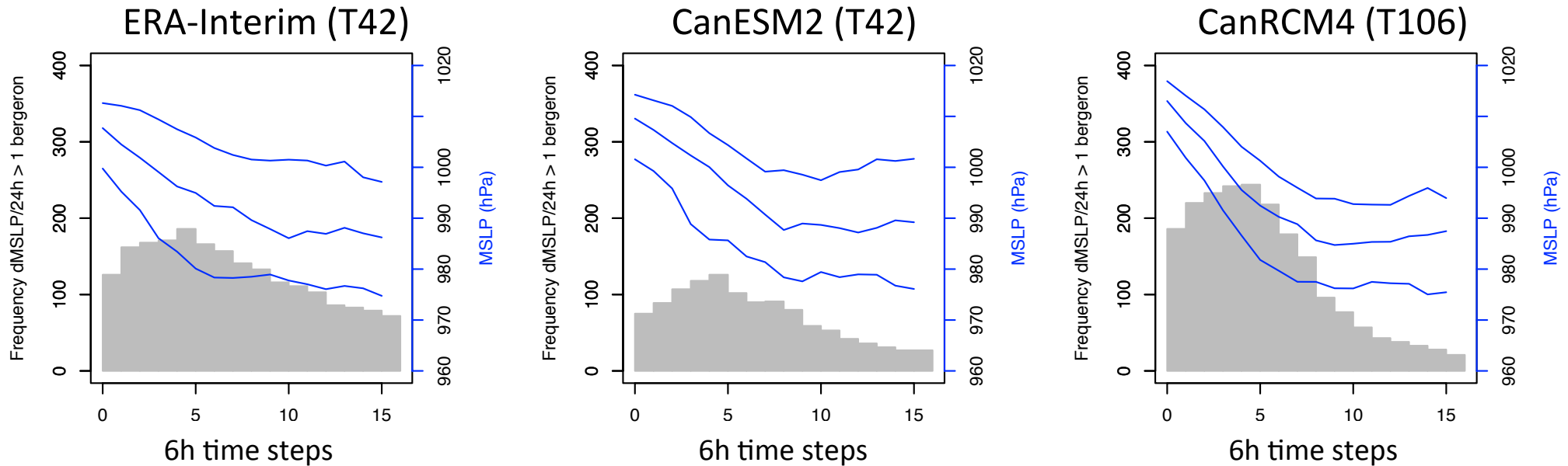


Units: annual mean number of 6h cyclone centres

- Domain average frequency bias reduced from -44% to a value statistically consistent with 0!

Explosive cyclone deepening rates

Frequency (grey) and central pressure (blue, interquartile range)



- CanESM2 produces too few explosive cyclones; deepening rates are realistic
- CanRCM4 produces too many short lived explosive cyclones; deepening early in the storm tends to be faster than in ERA-Interim
- Why?
 - Enhanced surface temperature gradients? Enhanced baroclinicity? More realistic orography?

Conclusions

- Frequent argument for using regional models is that they better represent extremes
- “Value added” depends in part on the extent to which RCMs are able to generate their own additional internal variability
- Evaluation should include whether they reflect large-scale circulation influences on extremes, and whether they improve biases in simulating intense storms
- RCMs appear to reflect the effects of blocking on extreme minimum temperature reasonably well over the large CORDEX-NA domain, particularly in the northern half of the domain
- Surprisingly, CanRCM4 appears to substantially improve the representation of explosive cyclones along the North American eastern seaboard (on the downstream side of the CORDEX-NA domain)