

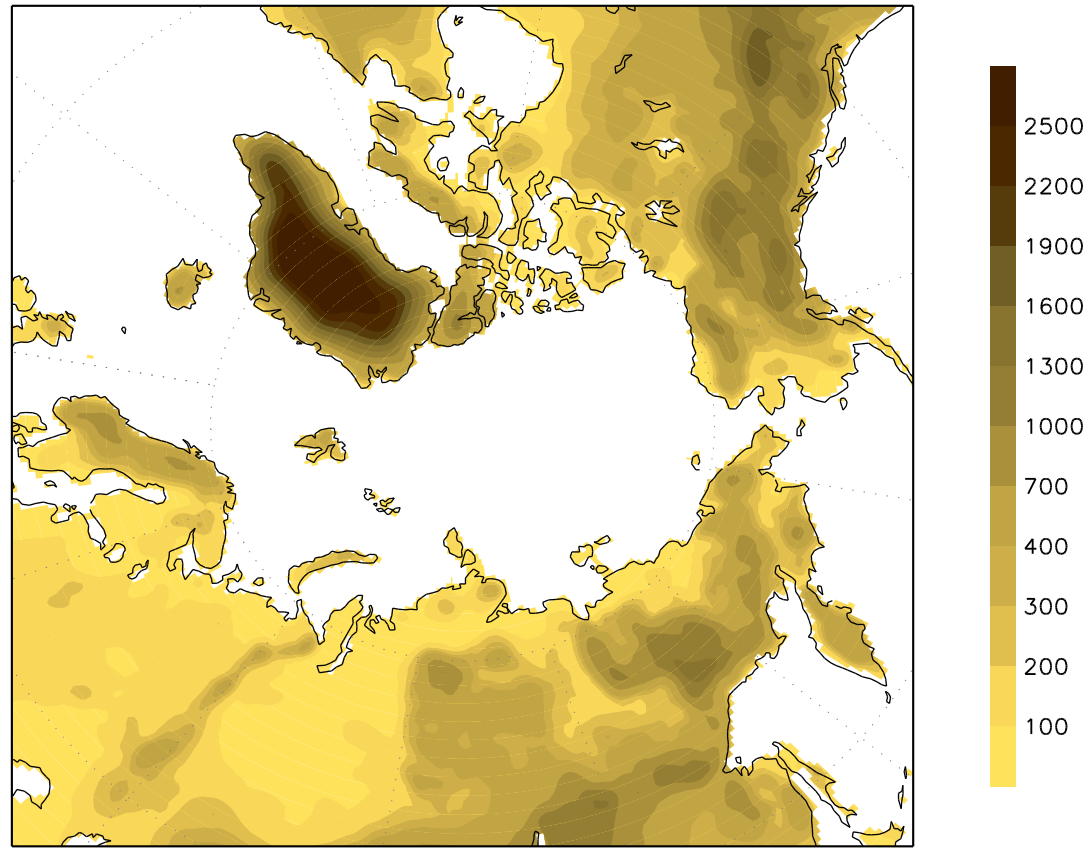
Atmospheric circulation over the Northern Eurasia and the Arctic: assessment of modeling performance and resolution issue

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Arctic RCM (50 km grid step)



Experiments

151×151 grid points in the horizontal (can be extended to 301×301 at 25 km resolution)

25 levels in the vertical

Full physical package from MGO AGCM

A series of simulations span 10yr slices (1981-1990)

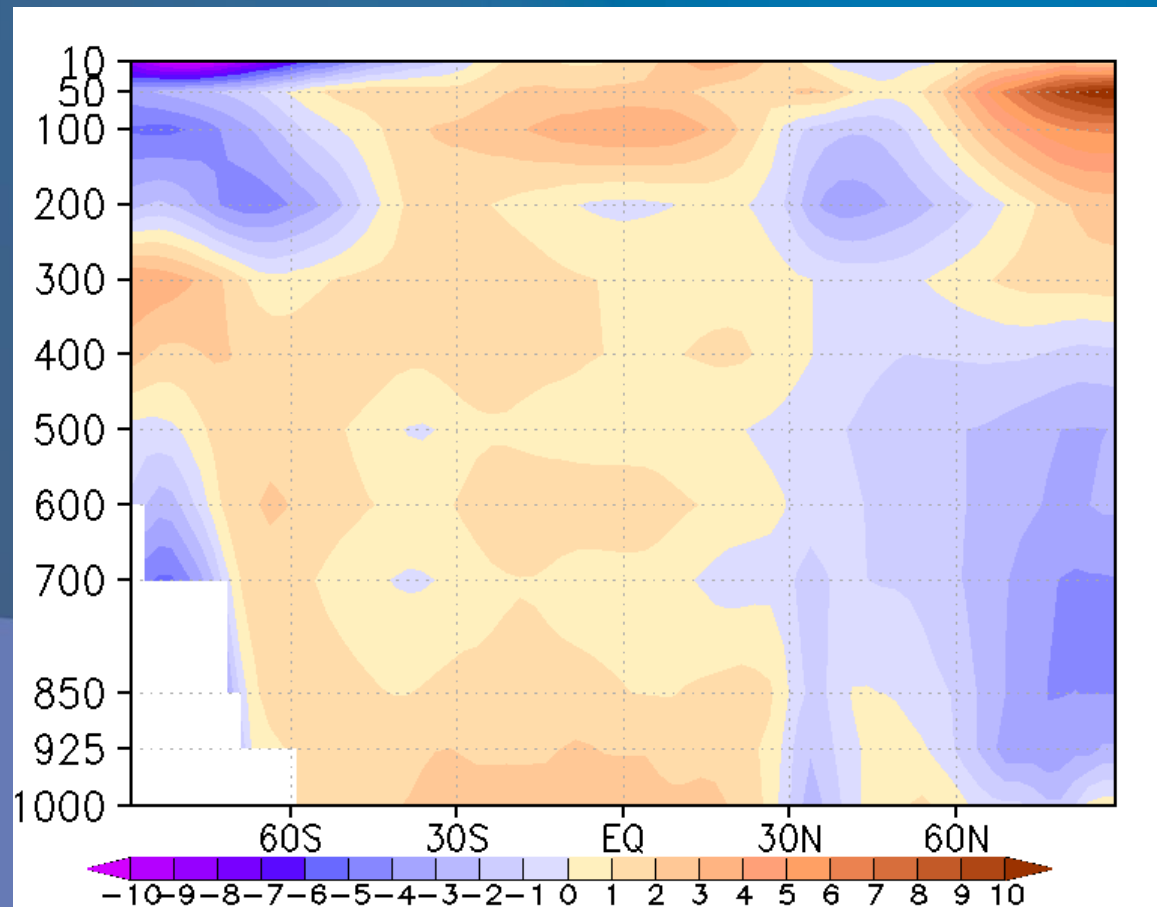
Driven by MGO AGCM T63L25, ERA-40 and quasiobserved SST/Ice variability

Focus on the value added resulting from GCM+RCM system as compared to GCM stand-alone simulation



Temperature bias latitude-altitude cross-section (DJF)

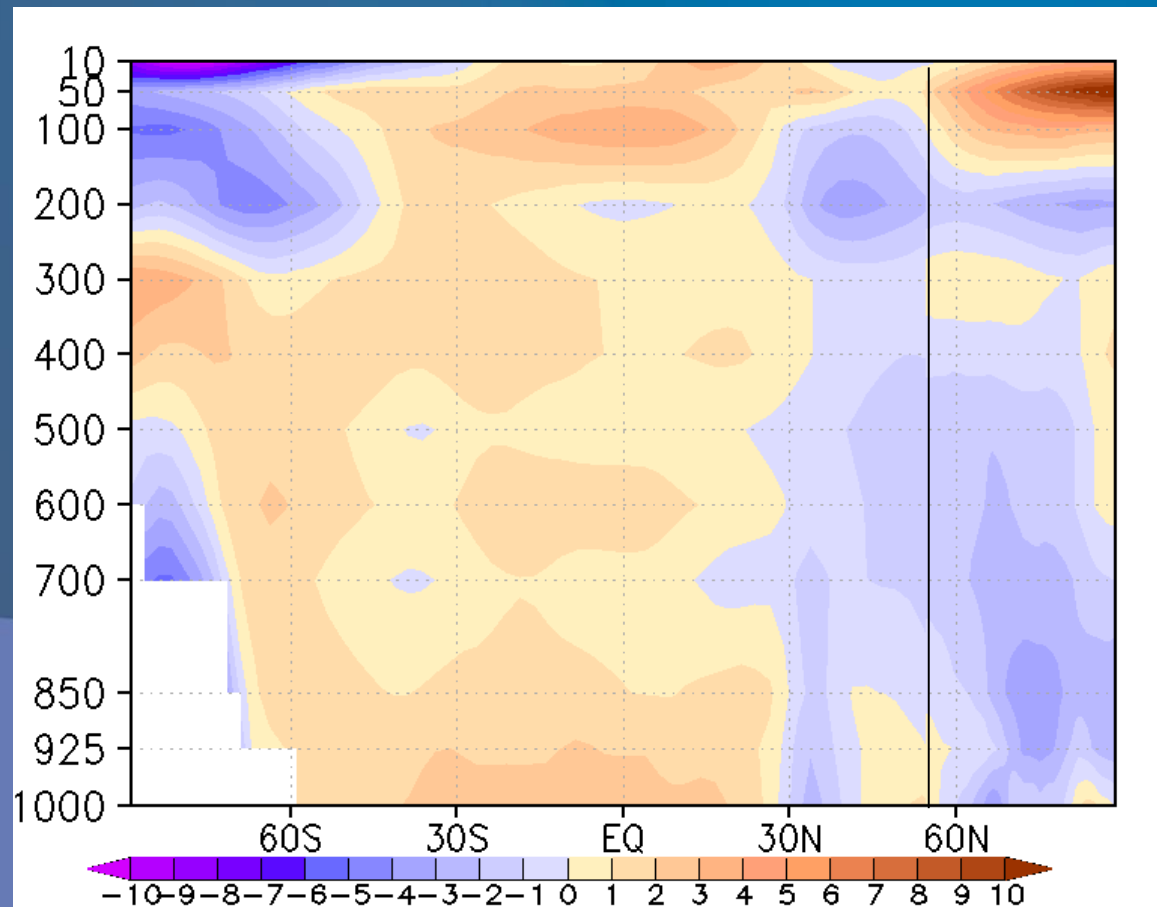
“GCM minus ERA40”





Temperature bias latitude-altitude cross-section (DJF)

“GCM+RCM minus ERA40”



“The Arctic must import heat from southerly latitudes due to the net radiation loss to space from the top of the atmosphere. Investigations have also shown that almost the entire deficit of energy is supplemented by atmospheric circulation.”

The climate of the Arctic (R. Przybylak, 2003)

Cyclone tracking

Sophisticated cyclone identification and tracking scheme developed at Univ. of Melbourne (Murray and Simmonds, 1991; Simmonds and Murray, 1999)

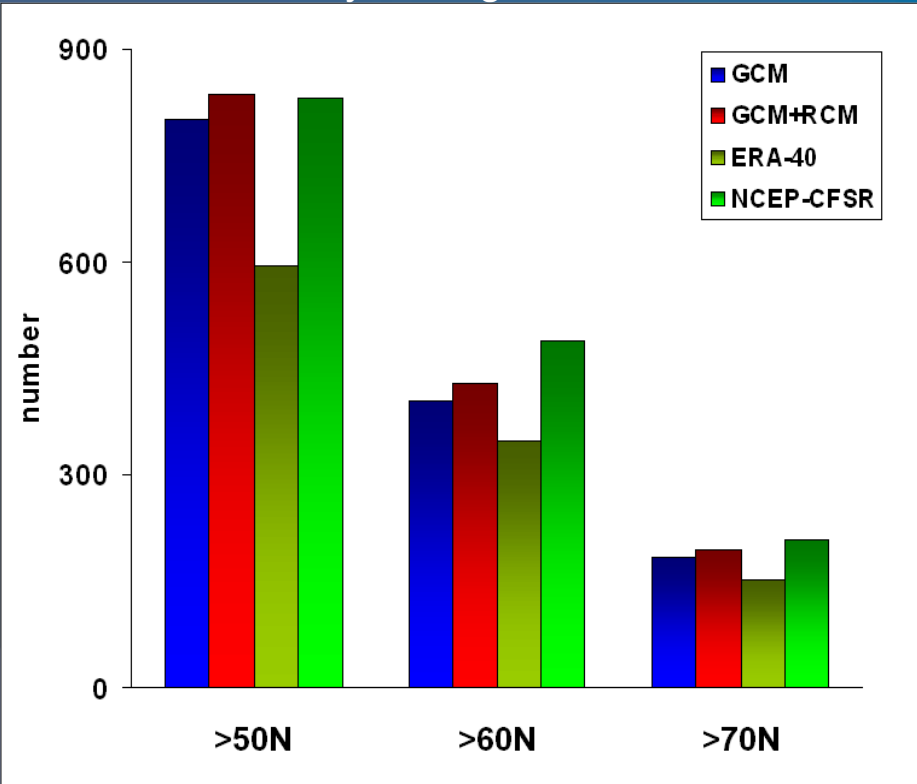
Cyclone statistics is based on 6hr mean sea level pressure output from GCM, RCM and reanalyses (ERA-40 and NCEP-CFS)

All datasets are interpolated onto unified $0.5^{\circ} \times 0.5^{\circ}$ grid that corresponds to RCM and NCEP CFSR resolution

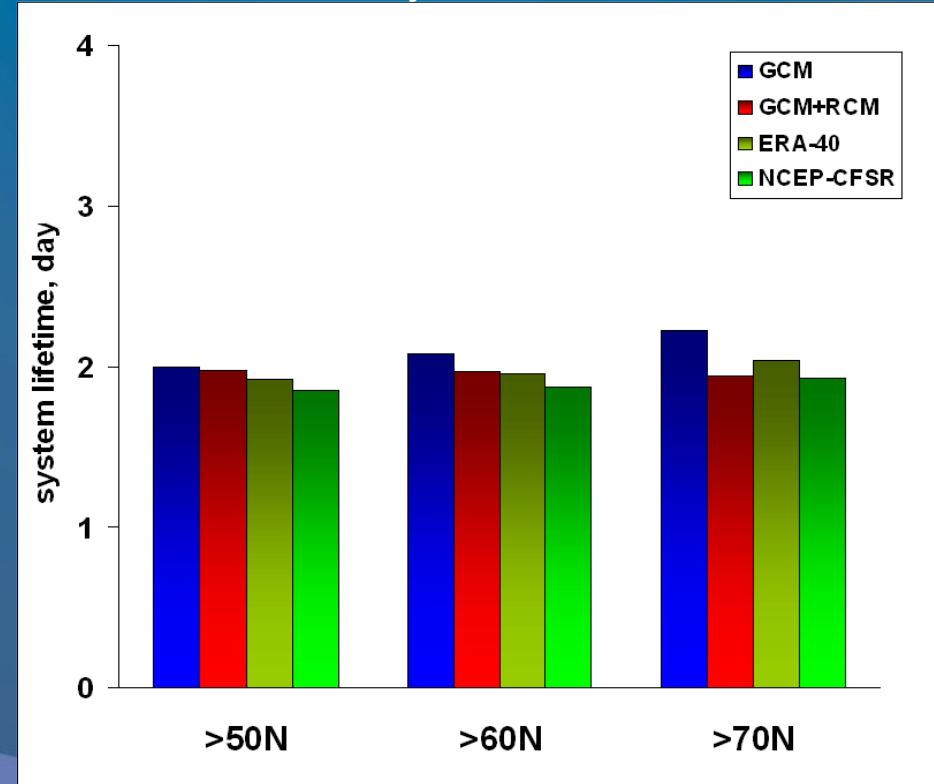
The RCM and GCM outputs are merged into one dataset to provide “seamless” tracking

All cyclones

Cyclone generation



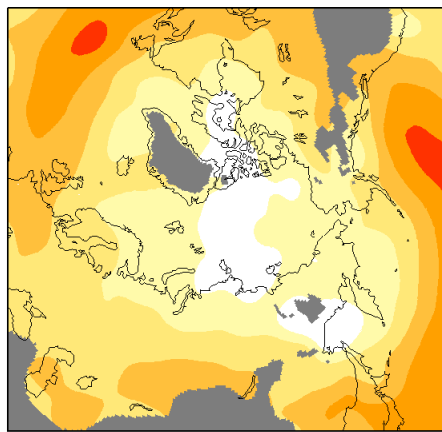
Mean cyclone lifetime



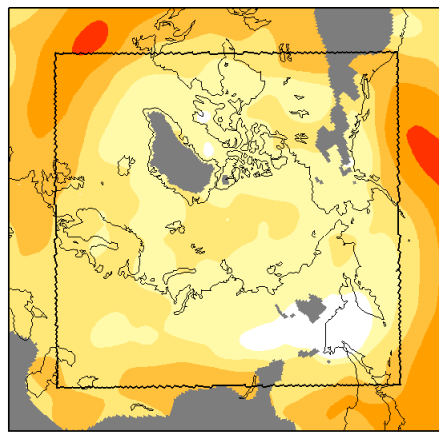


Average cyclone speed (km/hour)

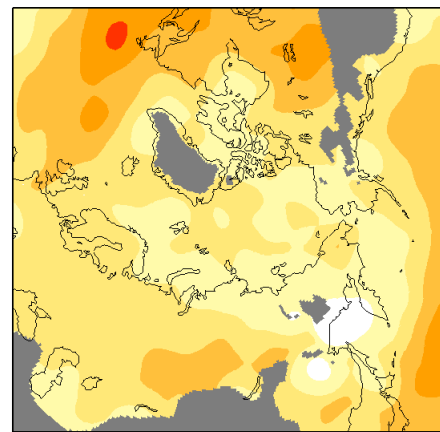
GCM



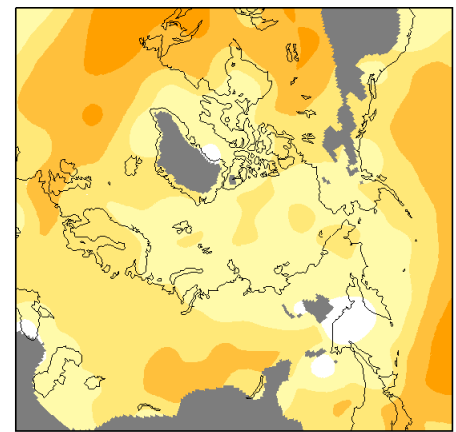
GCM+RCM



ERA-40

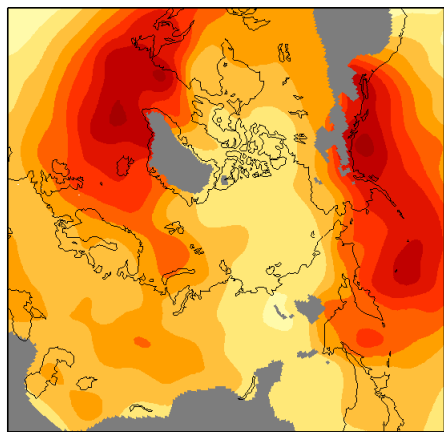


NCEP-CFSR

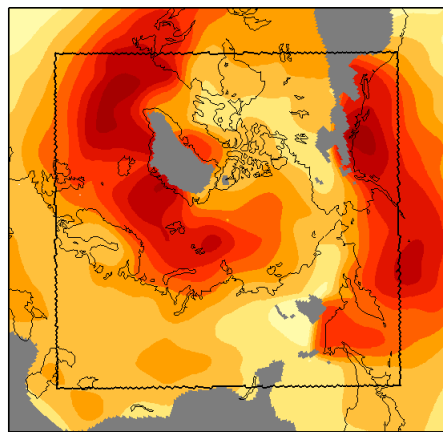


Average cyclone depth (hPa)

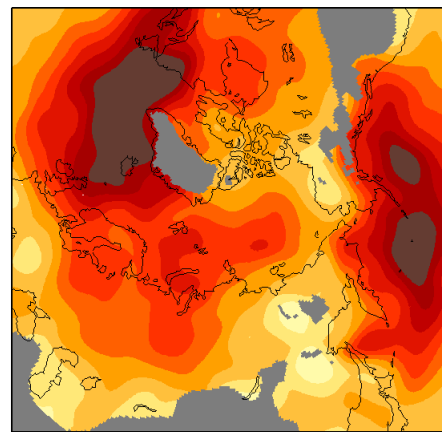
GCM



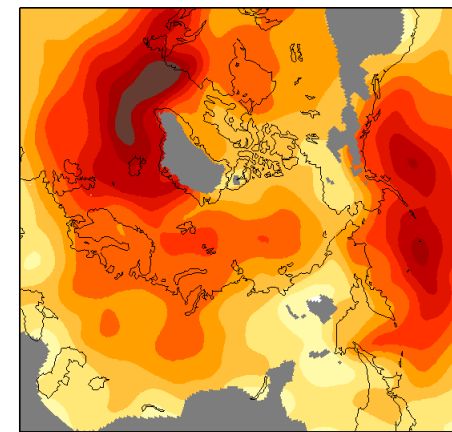
GCM+RCM



ERA-40

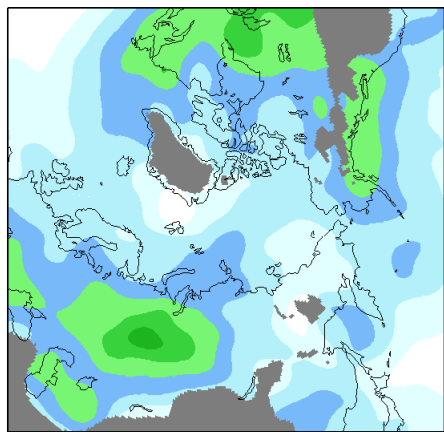


NCEP-CFSR

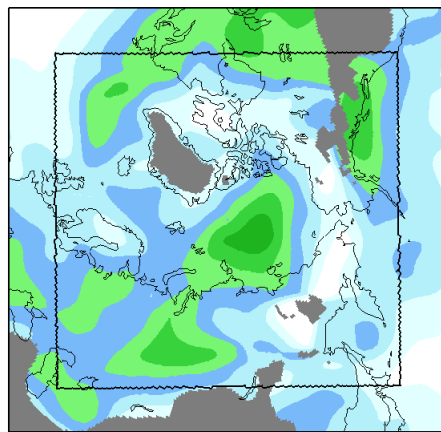


Average cyclone radius (deg lat)

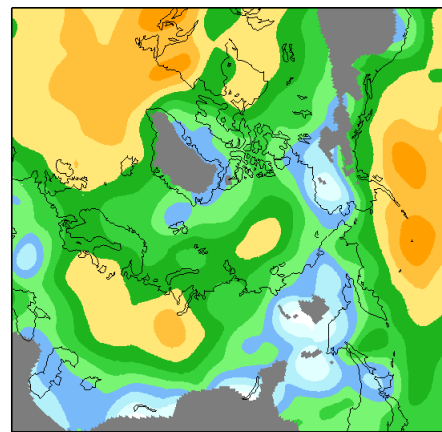
GCM



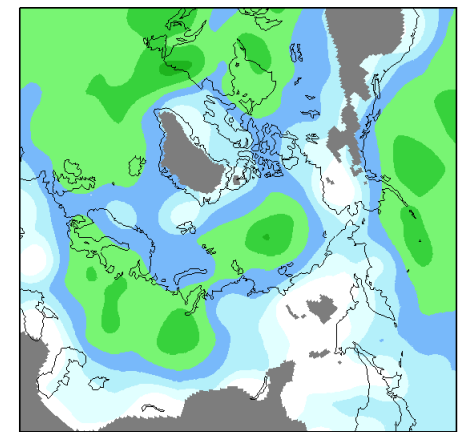
GCM+RCM



ERA-40



NCEP-CFSR



4 4.3 4.6 4.9 5.2 5.5 5.8 6.1 6.4

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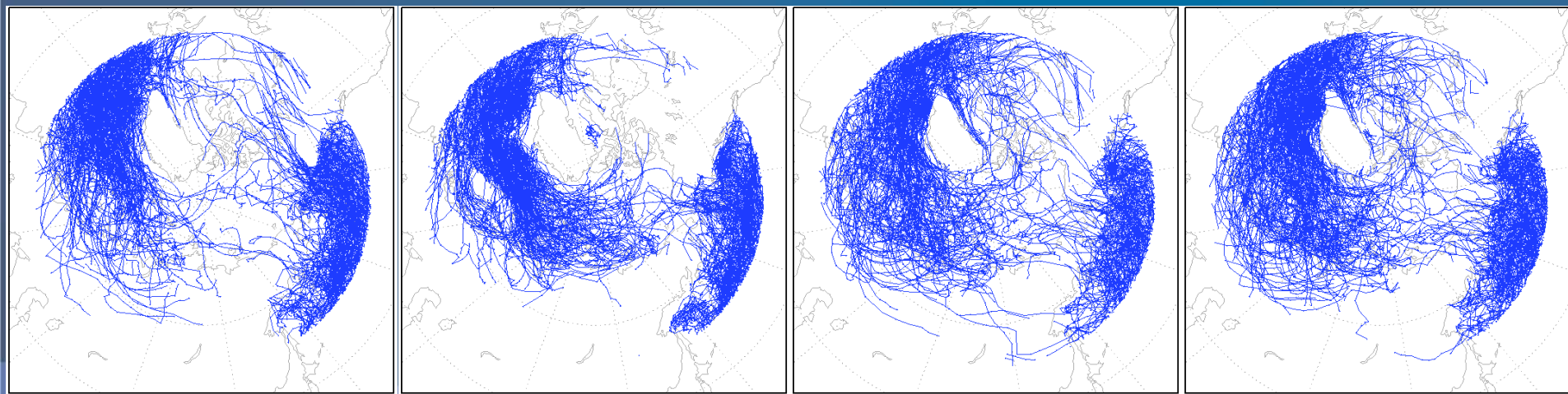
Tracks of “very deep” cyclones (central pressure <980 hPa)

GCM

GCM+RCM

ERA-40

NCEP-CFSR



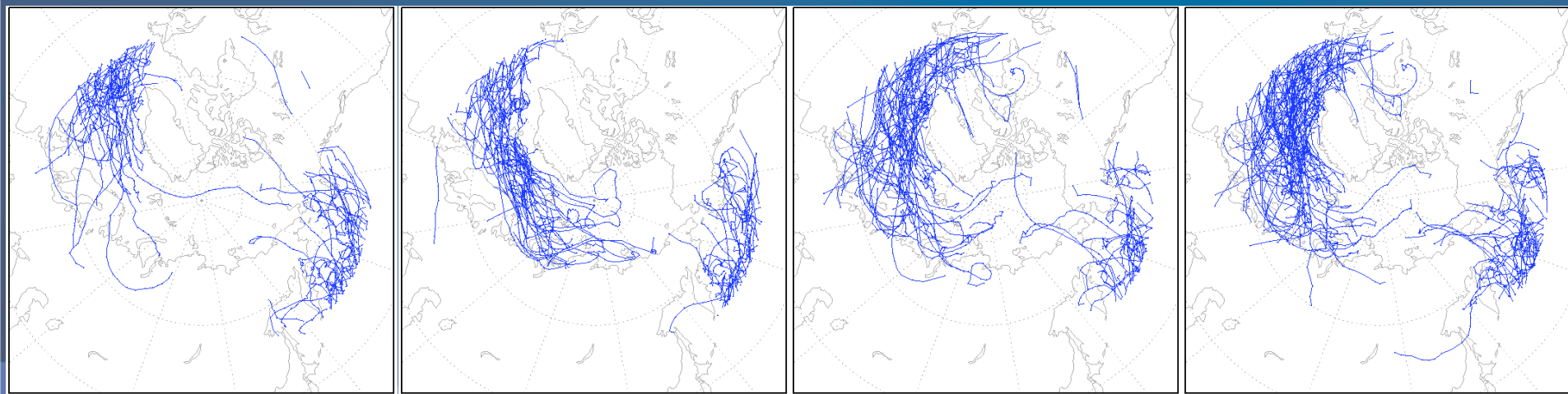
Tracks of “extremely deep” cyclones (central pressure <960 hPa)

GCM

GCM+RCM

ERA-40

NCEP-CFSR



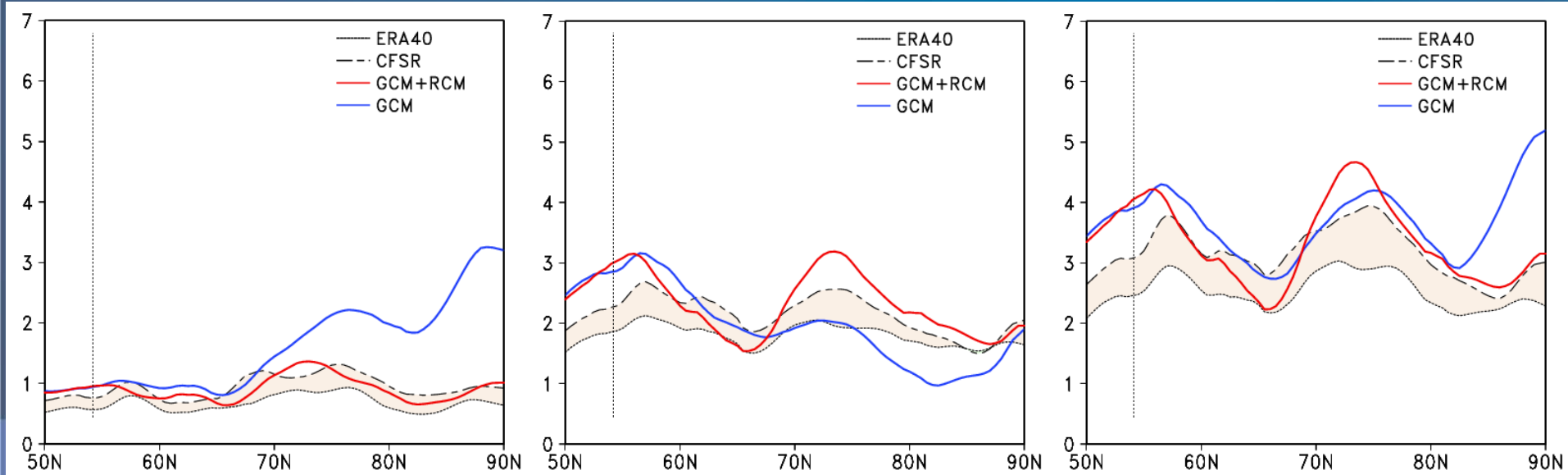
System density (mean cyclone number in a 1000×sq deg lat area)

zonally averaged cross-section

Central pressure >1000 hPa

Central pressure <1000 hPa

Total



Summary

- RCM tends to push GCM simulated baroclinic circulation patterns and statistical structure of cyclogenesis towards reanalyses, notably in high latitudes
- Reanalyses exhibit a considerable uncertainty representing some aspects of cyclone properties
- Further research is needed to order to assess future atmospheric circulation changes in the Arctic and associated changes in the extremes (polar lows, storm surges, frequency and intensity of heat/cold outbreaks in the Arctic, etc)