

Centennial and Decadal Scale Changes of Synoptic Activity in 20CR Reliability and Evaluation



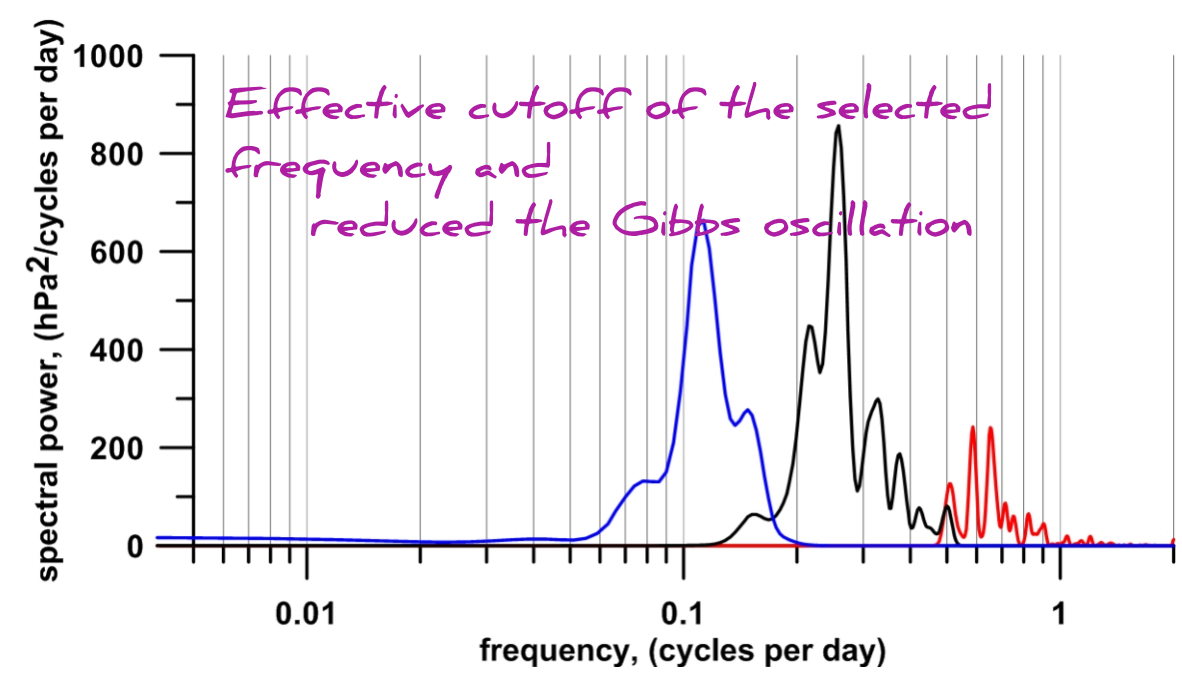
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Methods

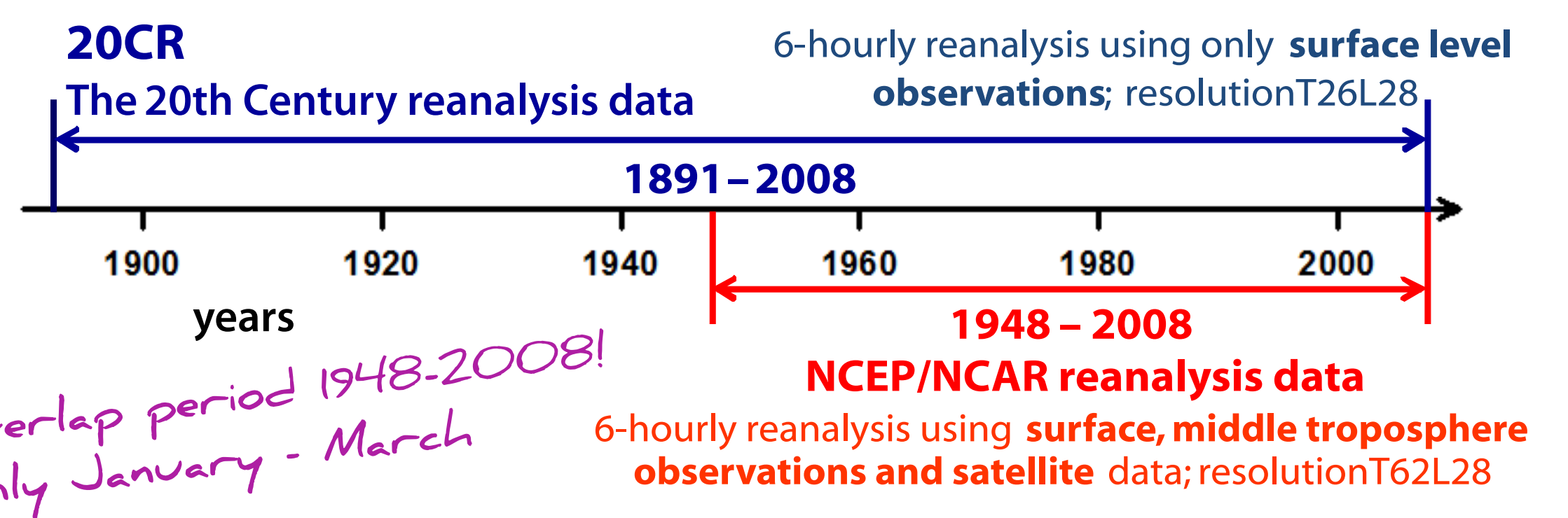
1 Bandpass statistics – general vision of the intensities of synoptic variability
 Lanczos filtering (Lanczos 1956, Duchon 1979)

Standard deviation as intensity!
 0–2 days ultra-high frequency variability
 2–6 days synoptic scale variability
 6–12 days low-frequency variability

2 Cyclone tracking – looking on the characteristics of individual cyclones
 numerical scheme numerical cyclone tracking scheme (Rudeva and Gulev 2007, 2010)

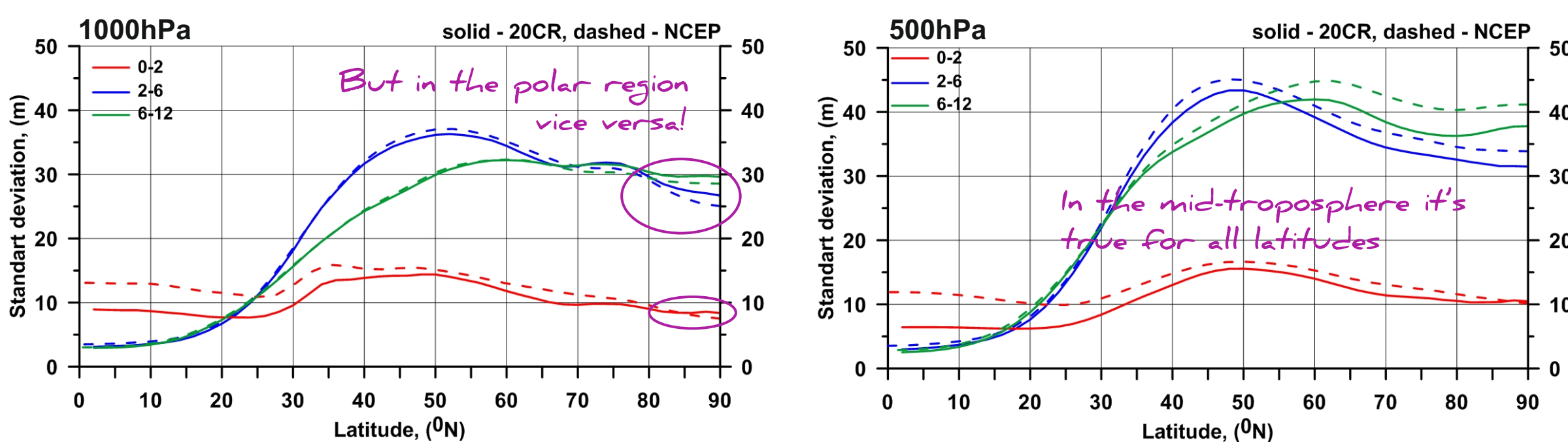


Data



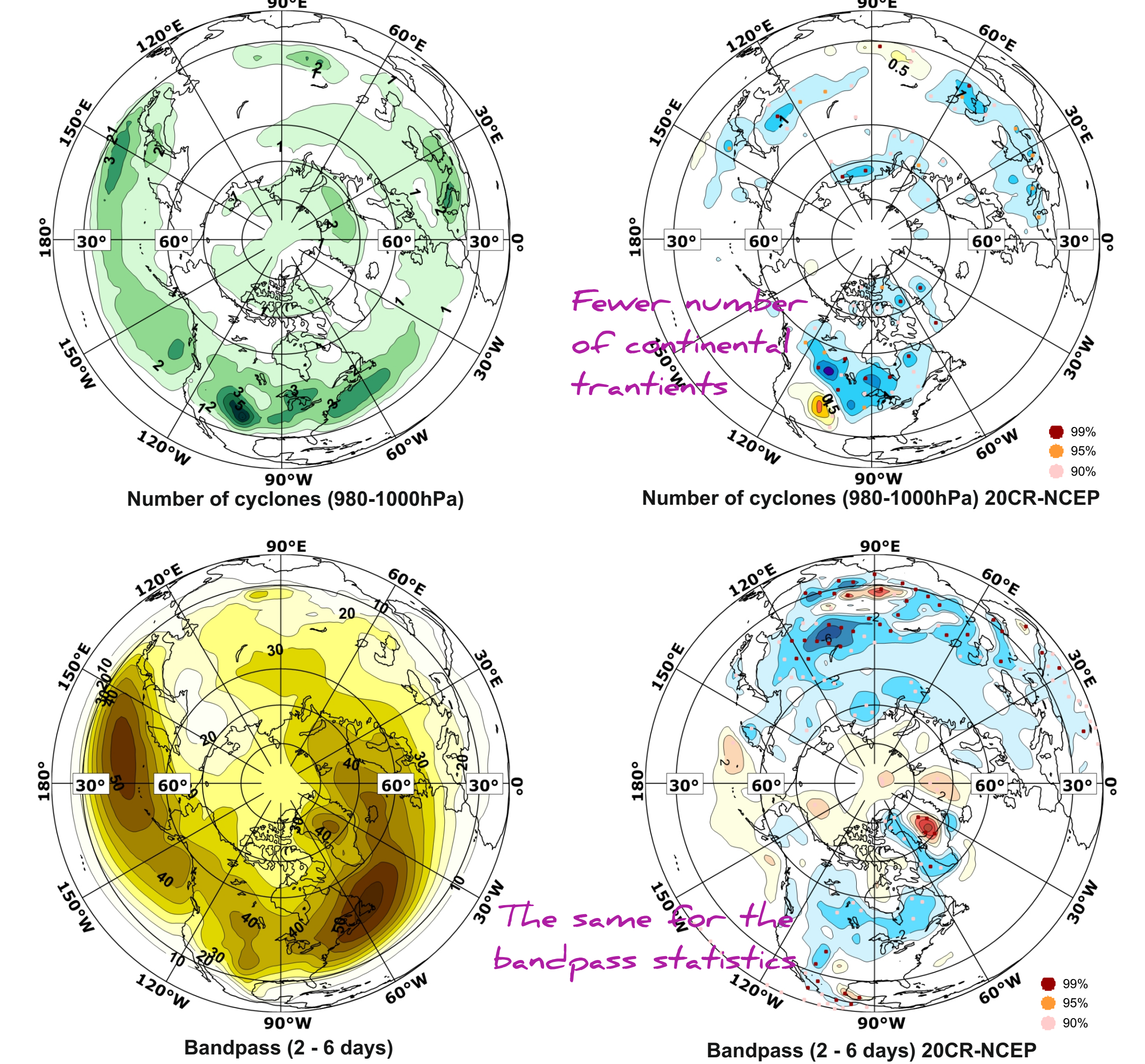
1. Synoptic variability in 20CR vs NCEP

Zonal means of the magnitudes of bandpass statistics JFM 1948-2008

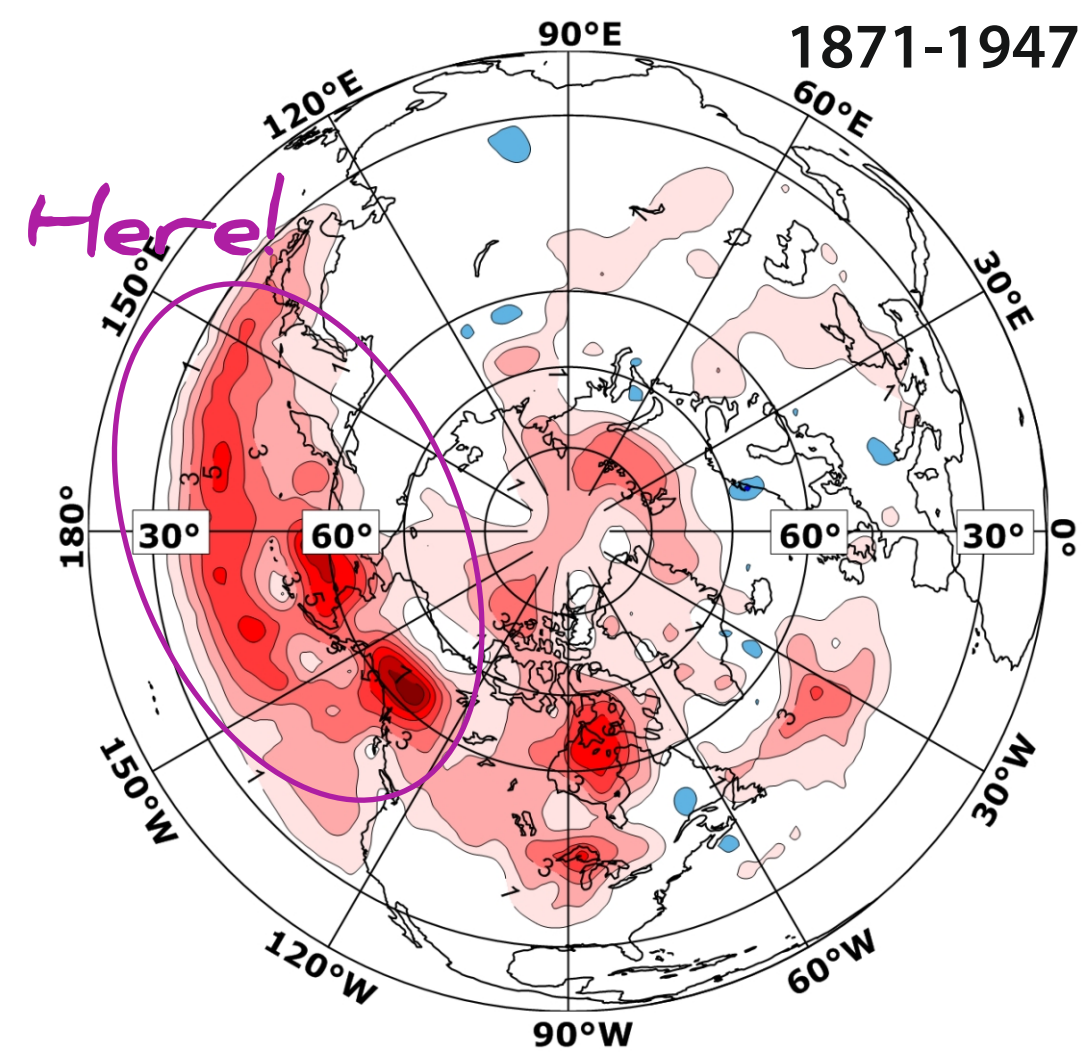


20CR: Climatology JFM (1948-2008)

Difference 20CR-NCEP (1948-2008)



4. Reliability of 20CR in the Late 19th- and Early 20th- Century

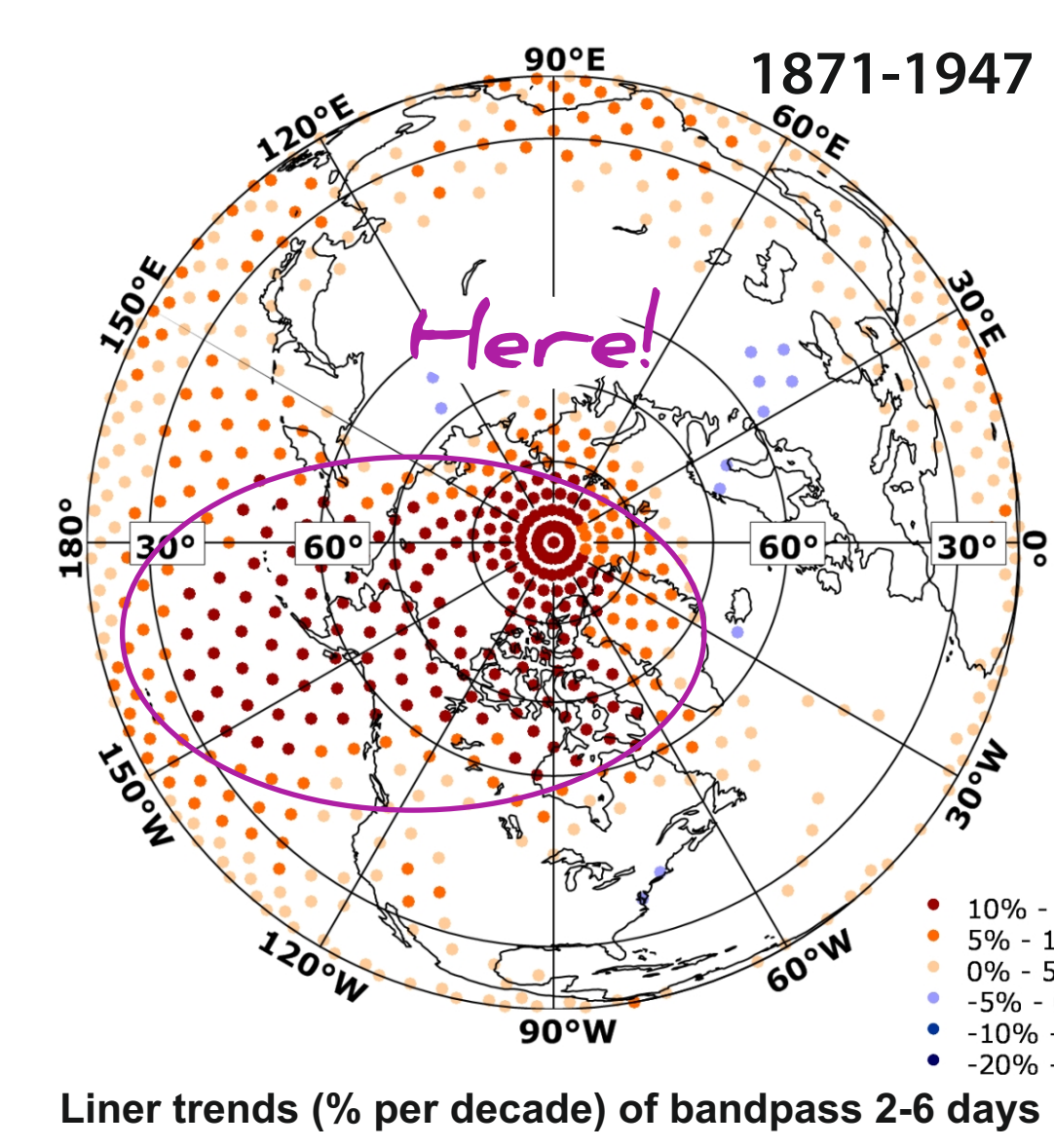


Late 19th and early 20th centuries (1871-1948) variability in 20CR for January-March in the Pacific and Arctic exhibits strong upward changes in all characteristics of the intensity of synoptic scale variability.

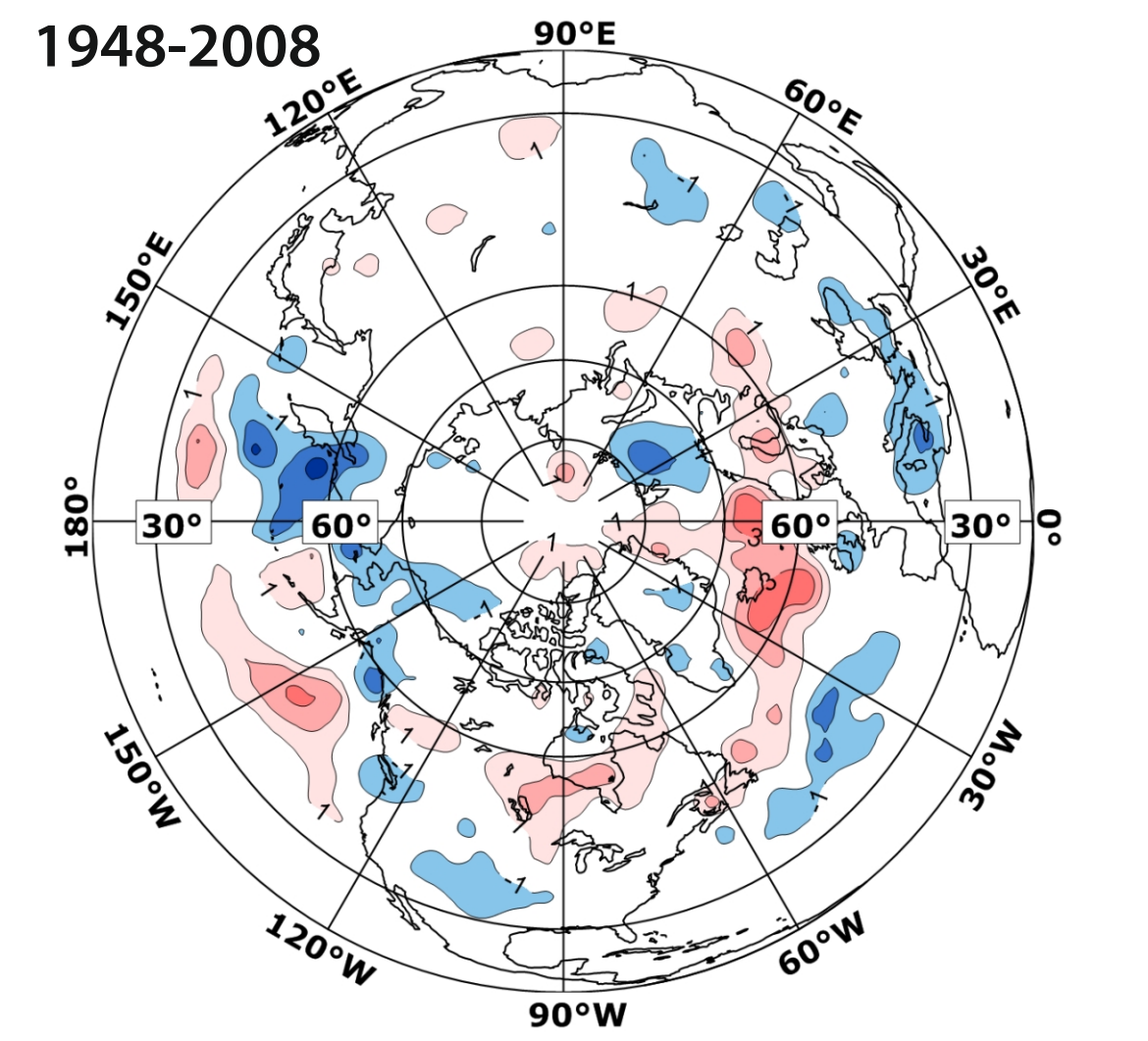
Thus, variability patterns in both cyclone counts and bandpass statistics should be taken with caution.

However over the Atlantic ocean and continents (North America, Eurasia) 1871-1947 variations are likely more reliable.

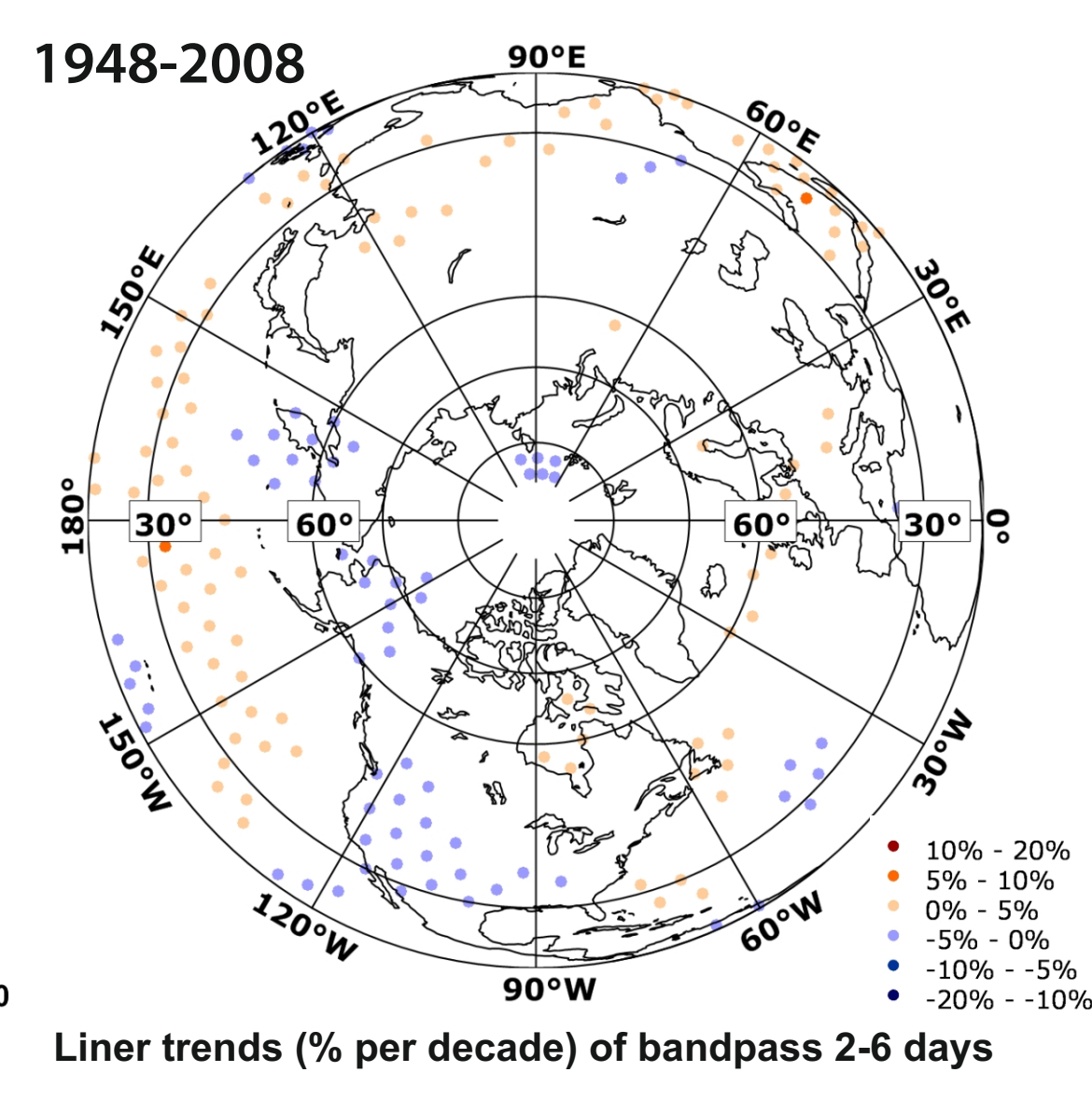
Liner trends (% per decade) of the number of cyclones



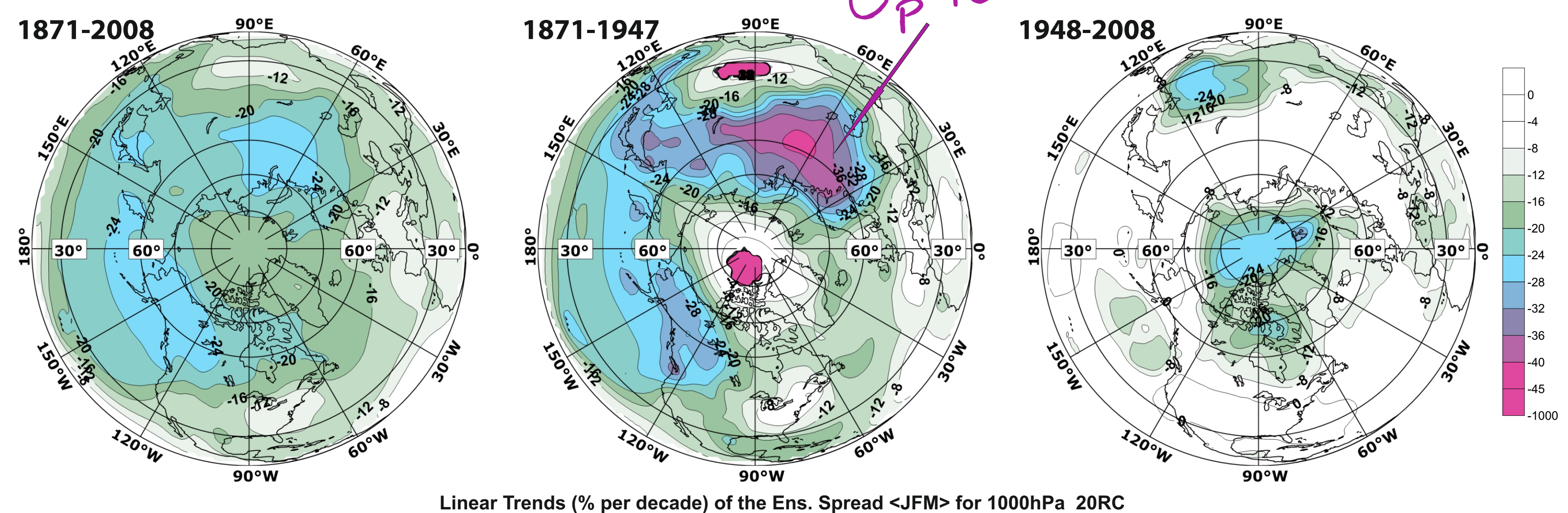
Trends are qualitatively consistent with NCEP, but quantitatively different



Liner trends (% per decade) of the number of cyclones



5. Ensemble spread in 20CR is potential reason for artifacts in long-term variability

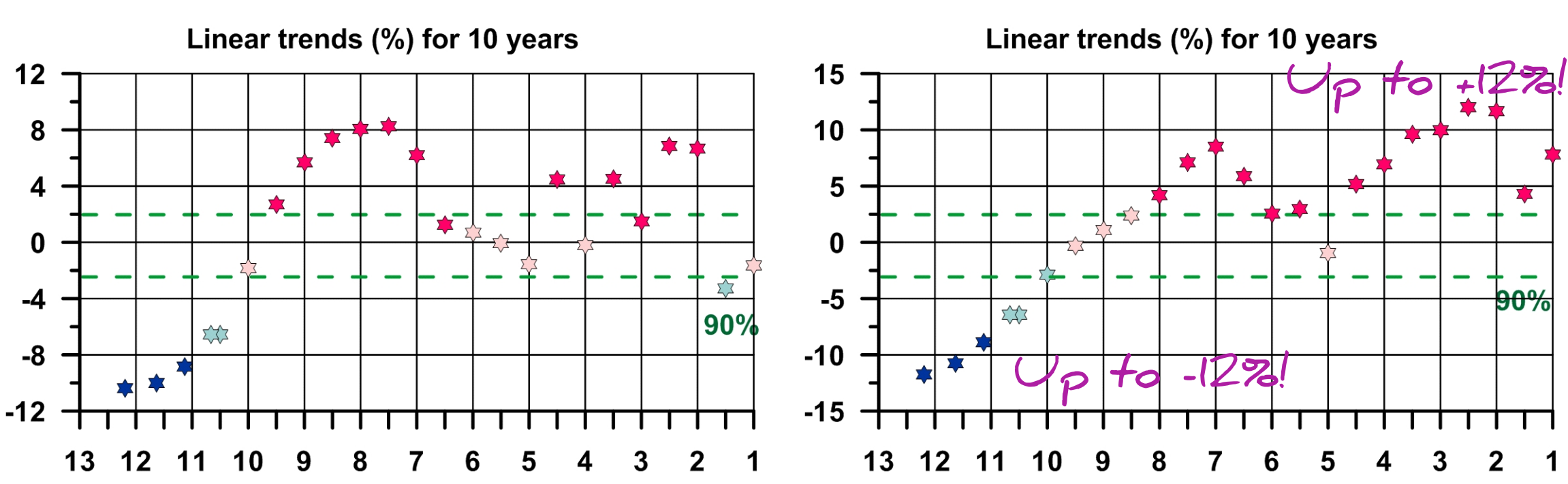


2. Spectrum analysis

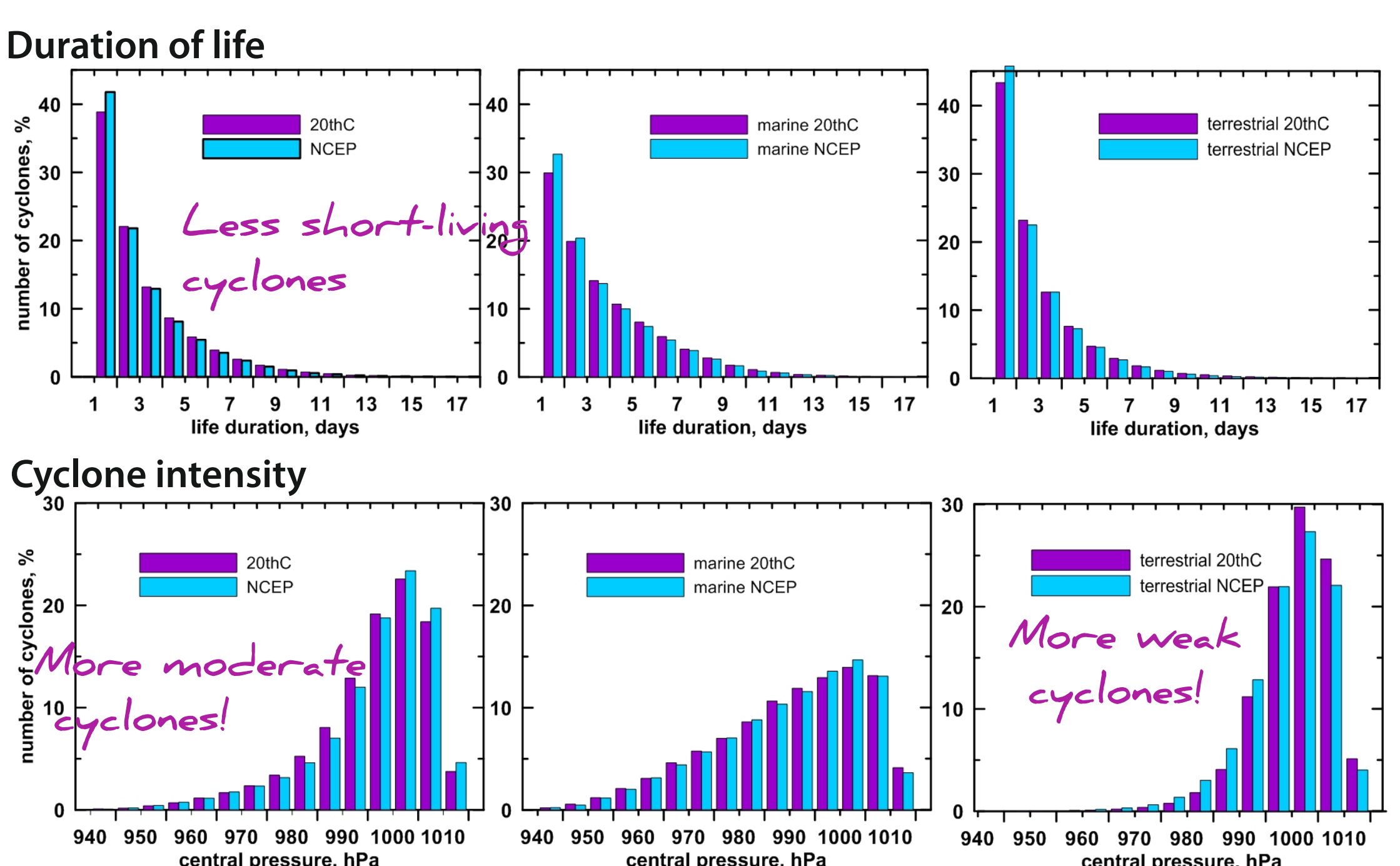
Analysis of the temporal evolution (linear trends) of synoptic scale spectra for period 1948-2008. In order to estimate the change in the spectral functions linear trends were computed for all frequencies. Both data sets show increasing magnitudes of shorter-period synoptic variability (1-4 days and 6-8 days) and weakening of the slow synoptic variability (11-13 days)

NCEP: 30-15W, 57.5-

20CR: 30-16W, 56-64N



3. Cyclone lifecycle 20CR vs NCEP

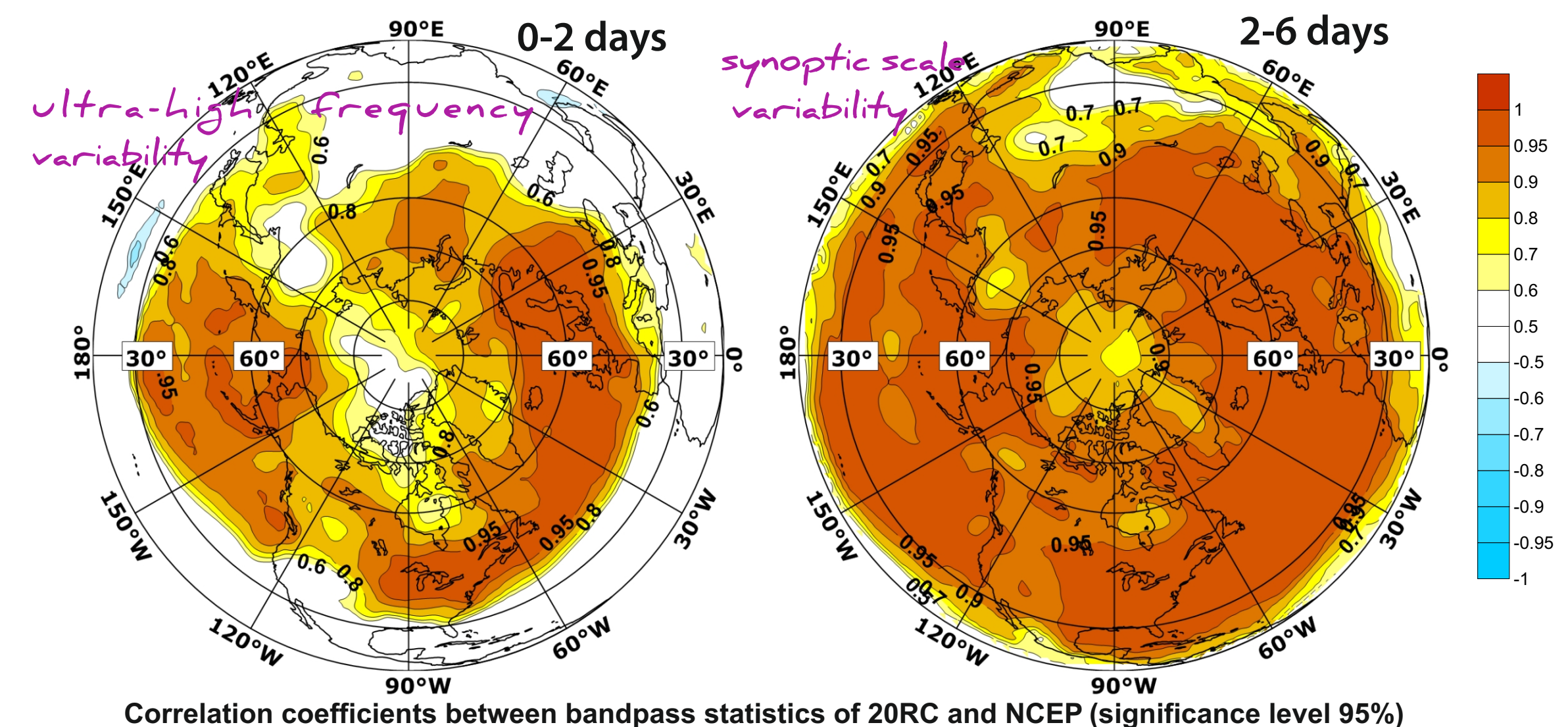


Life cycle characteristics are consistent, although the number of short-living cyclones in R20thC is smaller compared to NCEP.

At the same time the number of moderate cyclones is higher in 20CR. The average propagation velocity of 20CR cyclones is smaller. The stronger differences are observed for continental cyclones.

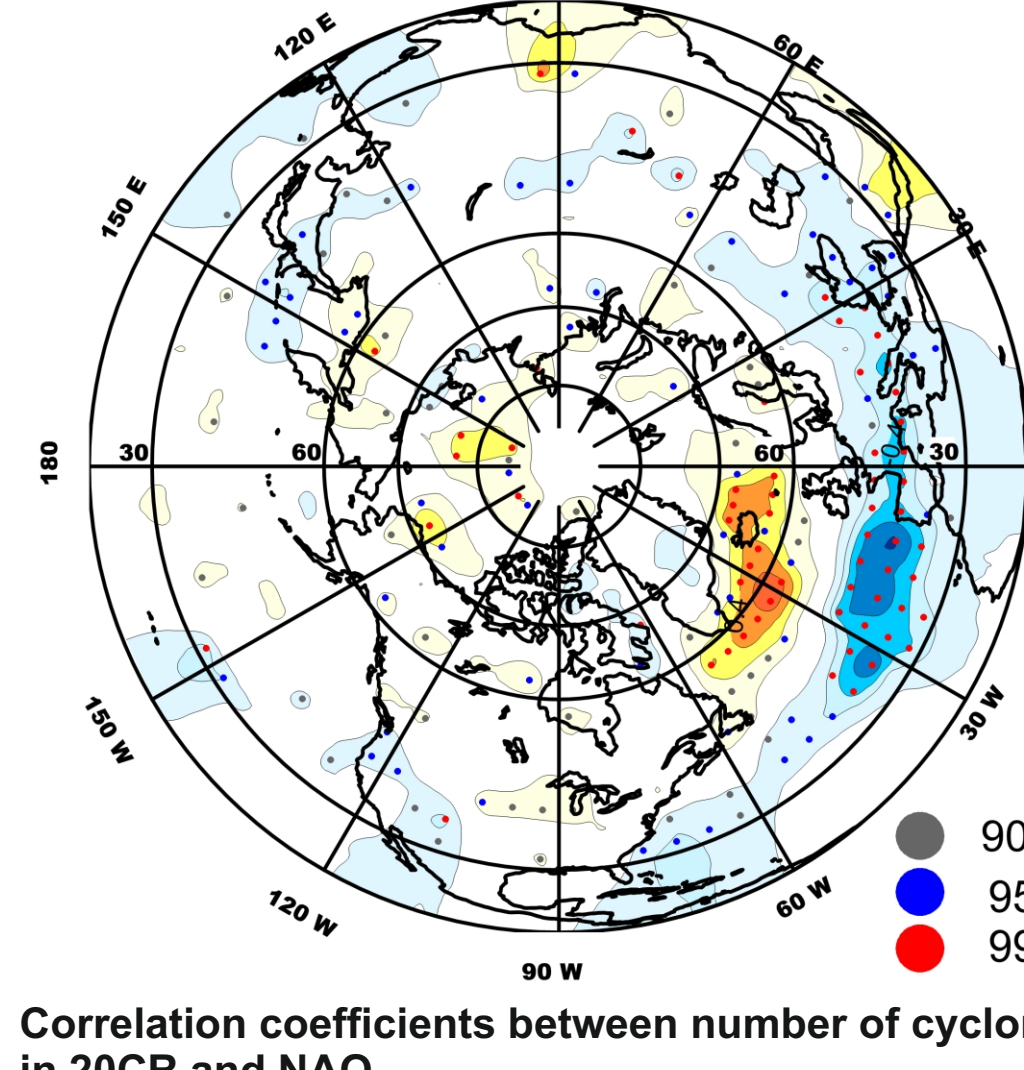
6. Correlation: 20CR with NCEP 1948-2008

Interannual variability for winter period (January-March) synoptic activity is more consistent in the 2 products over the oceans compared to the continents. Of the two oceans, Atlantic demonstrates higher correlation (more than 0,97) compared to the Pacific ocean. Magnitudes of the synoptic scale variability is correlated much better compare to ultra-high frequency variability.



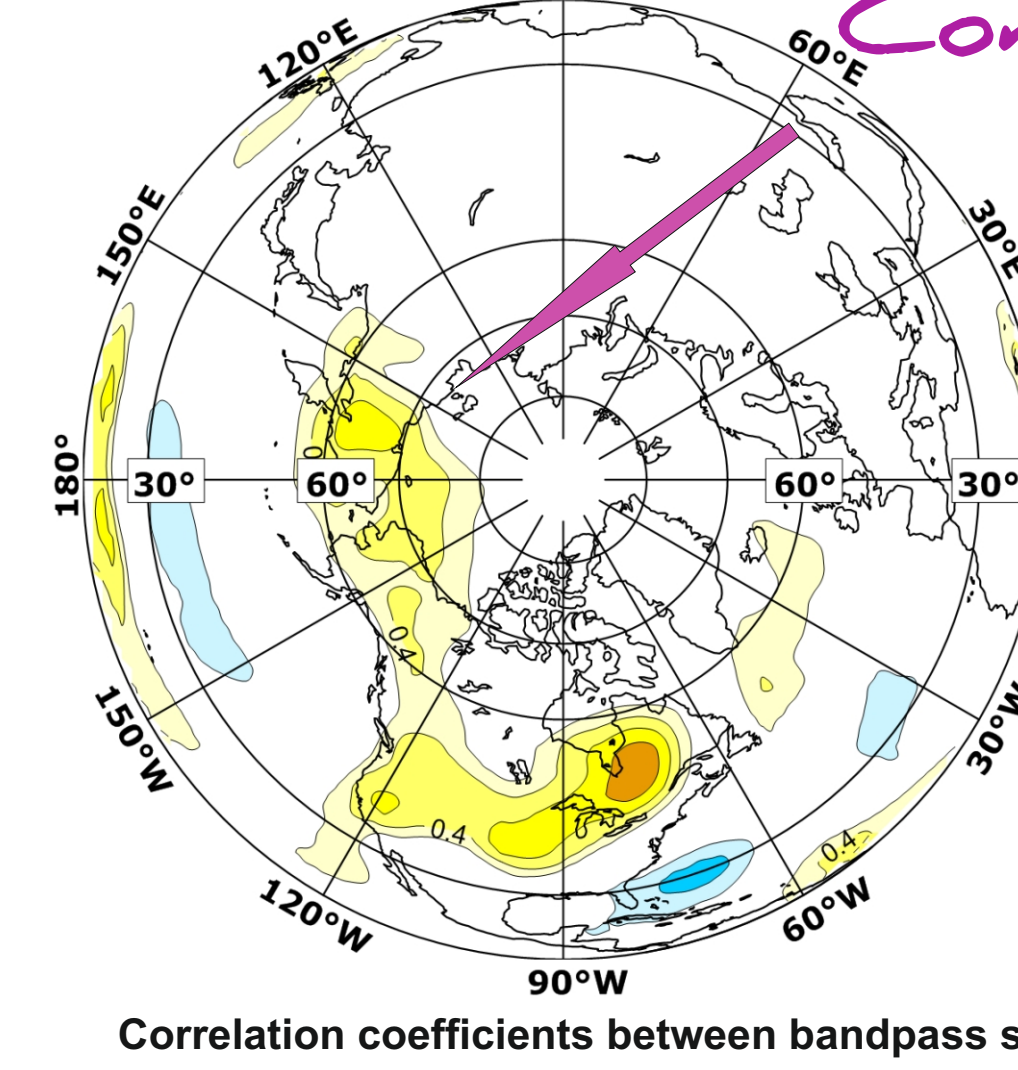
7. Capturing atmospheric circulation modes: NAO and NP

Associated correlation with NAO for 1948-2008



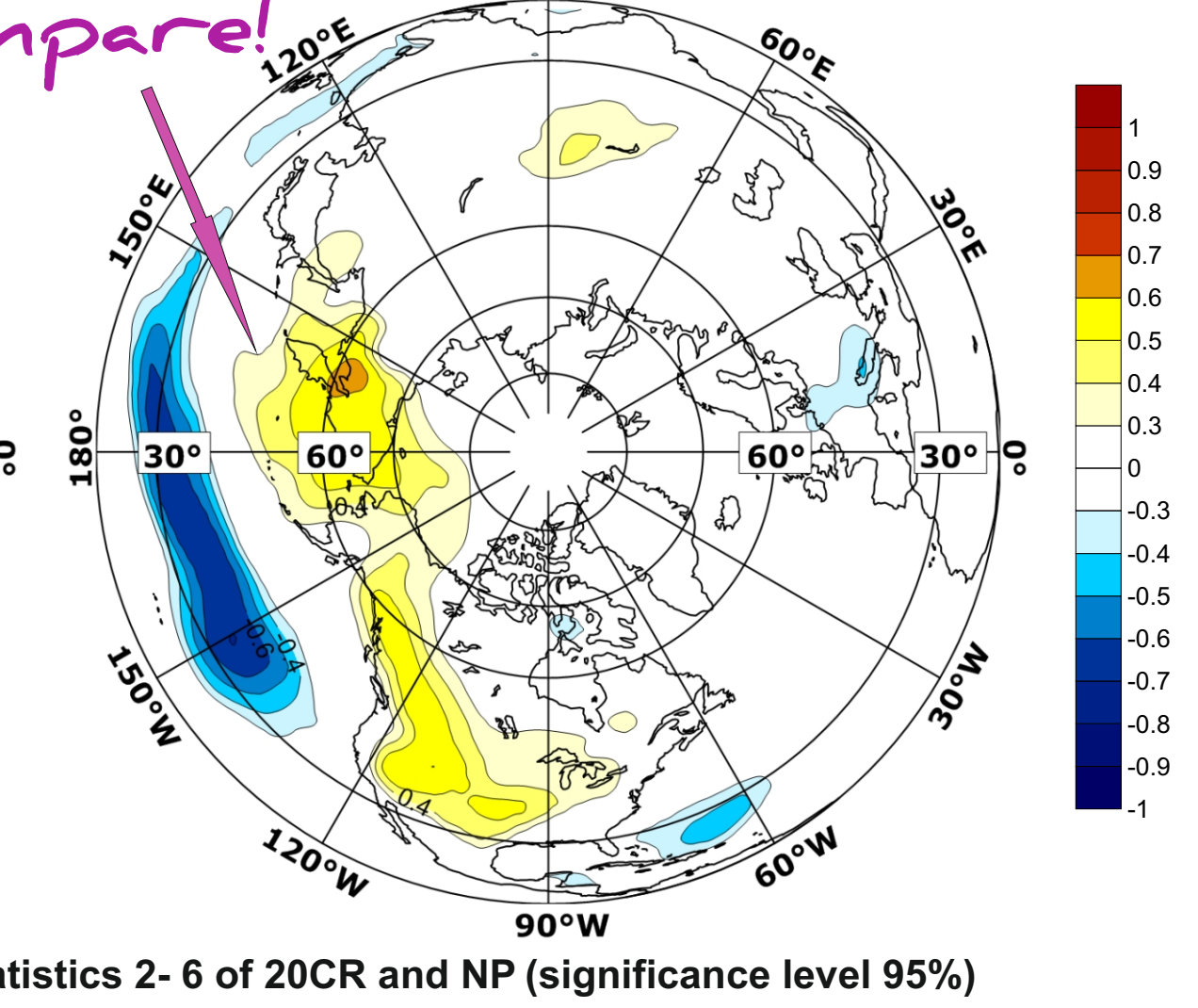
Correlation coefficients between number of cyclones in 20CR and NAO

Associated correlation with NP for 1871-1947



Correlation coefficients between bandpass statistics 2-6 of 20CR and NP (significance level 95%)

Associated correlation with NP for 1948-2008



Correlation patterns with NAO persist during both 1871-1947 and 1948-2008 periods, while the correlation with NP is clearly observed only after 1948.

