## Trends and Variability of Extra-Tropical Cyclone Activity in the Ensemble of 20<sup>th</sup> Century Reanalysis

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# Outline

- Datasets & methodology
- Tracking ensemble mean SLP versus tracking SLP of individual runs
- Brief comparison of 20CR (v2) with NCEP1
  - Poster T236B (tomorrow) compares 20CR with five other reanalyses
- Long-term trends in <u>ensemble mean</u> seasonal cyclone <u>count</u> and mean <u>intensity</u>
  discontinuities in the ensemble mean series
- Summary

#### Datasets: Global 6-hourly MSLP fields

- 1. 20CR: (v2, each of the 56 runs & ensemble mean) for 1871-2008
- 2. NCEP1: NCEP/NCAR Reanalysis for 1948-2008
- 3. NCEP2: NCEP-DOE Reanalysis for 1979-2007
- 4. ERA40: WCMWF Reanalysis for 1958-2001
- 5. ERAint: ERA-Interim Reanalysis for 1989-2009.03.31
- 6. CFSR: NCEP CFS Reanalysis for 1979-2009 hly (6-hly used)

Different spatial resolutions:

20CR: 2.0°x2.0° lat-long grid NCEP1&2, ERA40: 2.5°x2.5° lat-long grid ERAint: 1.5°x1.5° lat-long grid CFSR: 0.5°x0.5° lat-long grid

50-km EASE grid Equal Area SSM/I Earth NH & SH, separately

Identification/tracking algorithm: Serreze et al. 1997 (Courtesy of Mark Serreze) MSLP is an extrapolated field  $\rightarrow$  Exclude areas of elevation > 1000 m; also the 20N-20S zone Also, we exclude cyclones/tracks of lifespan < 24 hours (4x6-hr), and those traveling < 500 km

6-hly



#### 20CR versus NCEP1:

Differences in 1958-2001 mean cyclone activity index (count \* mean intensity) 250-km EASE grid

In general, cyclone activity is weaker in 20CR than in NCEP1 over land, but stronger over oceans, especially in SH in summer

Black areas: elevation > 1000 m



#### In terms of hemispheric statistics, <u>both</u> cyclone <u>count & intensity</u> seem to have <u>increased significantly</u> in both hemispheres since 1871







#### **Ensemble mean** series of regional means of seasonal cyclone counts and mean intensity

Selected regions:



Strong cyclones: cyclones of intensity ≥ 45 units local Laplacian of pressure; unit: 10<sup>-5</sup> hPa/km<sup>2</sup>)

















![](_page_17_Figure_0.jpeg)

![](_page_18_Figure_0.jpeg)

### Major storm track regions – 85<sup>th</sup> percentile contour of long-term mean strong cyclone counts

### Summary

The 20CR ensemble mean 6-hourly SLP fields are not suitable for analyzing extremes such as cyclone activity, especially in data sparse areas/periods. e.g., the Arctic in the pre-1950 period

Good news: The 20CR shows <u>homogeneous</u> representation of cyclone activity over the <u>N. Atlantic & Europe</u>. In the SH, it is more homogeneous than NCEP1 (and ERA40) for the last half century.

In general, it is quite comparable to NCEP1&2, especially over oceans.

After the discontinuities being accounted for, the 20CR shows significant

increases in hemispheric cyclone count & mean intensity in both hemispheres, with regional & seasonal differences:

- The NH increases are mainly in High-lat NA, N.Europe, and Mid-lat. NP, with decreases in High-lat NP;
- Mediterranean: winter cyclone intensity has increased but count decreased, with a decrease in summer intensity
- Central-North USA: cyclone activity seems to have increased annually, with a decrease in winter count.
- Central-Eastern Canada: cyclone intensity has increased in both winter & summer, but decreased in winter count

Thank you very much!

![](_page_20_Figure_0.jpeg)

![](_page_21_Figure_0.jpeg)

#### Major <u>winter</u> storm track regions – <u>Strong</u> cyclone count > 85<sup>th</sup> percentile of <u>current</u> period

![](_page_22_Figure_0.jpeg)

The differences are smaller for extremes if cyclone intensity is measured by its center pressure

![](_page_23_Figure_0.jpeg)

For extremes, the CFSR-ERAint comparison is very dependent on what is used as intensity measure