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Synoptic activity in 20C Reanalysis (1871-2008): reliability and evaluation.

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The recently produced 20C Reanalysis (20CR) provides a good prospect for spurring the advances of numerical weather prediction for studies of long-term (more than a century) changes in characteristics of synoptic scale variability of atmospheric processes. At the same time, 20CR may be also a subject of systematic and time dependent random biases and requires validation against the other reanalysis. In order to quantify synoptic scale activity in the reanalysis variables we use two major methodological tools. We analyze standard deviations of the band-passed for different synoptic ranges geopotential height. And we applied numerical storm tracking providing cyclone trajectories and the derived cyclone counts and characteristics of the cyclone life cycle. In the first instance, for the period 1948-2008, we performed a comprehensive validation and intercomparison of the characteristics of synoptic activity in 20CR against NCEP-NCAR reanalysis (NNR). For the period of overlap (1948-2008) NNR shows higher magnitudes of synoptic scale variability quantified through the band-pass statistics for all synoptic ranges as well as slightly higher cyclone counts. High frequency synoptic scale activity exhibits the strongest differences between NNR and 20CR in the low latitudes, while in the Arctic 20CR shows stronger magnitudes of high frequency variability. For the major synoptic scale range (2-6 days) NNR compared to 20CR indicates higher magnitudes over the continents and lower magnitudes over the midlatitudinal oceans. Time variability for this period in 20CR and NNR is highly correlated over the Atlantic with correlations over the Pacific being somewhat smaller than over the Atlantic. Analysis of cyclone counts and cyclone life cycle characteristics for this period generally confirm the findings revealed by the analysis of band-pass statistics. During the earlier period (1871-1947) both cyclone counts and magnitudes of the band-pass statistics demonstrate strong upward trends with the highest magnitudes in the Pacific. THese trends are likely implied by the impact of inhomogeneities in data assimilation input. In order to get the insights on the reliability of these trends we separately analyzed for 1871-1947 the results based on individual ensemble members and on the ensemble averages. Differences between magnitudes of synoptic scale variability derived from the individual ensemble members and from the ensemble means are very high in the period 1871-1947, being, however, close to each other in the latest decades. The largest inconsistencies are observed in the North Pacific. We conclude that the high upward trends in the magnitudes of synoptic scale activity have likely an artificial nature. This implies that characteristics of synoptic variability in 20CR, especially over the North Pacific, should be used with caution for the period from 1871 to 1947. A proper analysis requires the use all ensemble members to minimize the biases. Over the North Atlantic time variability for the same period looks more reliable than in the Pacific.