Extratropical Cyclones over North Atlantic based on ERA-5 and NCEP/NCAR/DOE Reanalyses for 1979-2020

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The Goal of study:

The comparison of characteristics of **cyclone activity** in different regions of North Atlantic, calculated based on :

  1) *one method* and data of *different* reanalyses :

    NCEP/ NCAR/DOE   **and**   **ERA-5/ECMWF**

  2) *different* modifications of cyclone centers identification and

    data of *one reanalysis* - **ERA-5/ECMWF**

Cyclone activity parameters, (calculated for every region and every winter season from 1979 to 2021):

 - the integral number of generated cyclone tracks in region for season,

 - the integral number of cyclone centers in region for season,

 - cyclone activity index - the summa of pressure anomalies in cyclone centers in region for season.
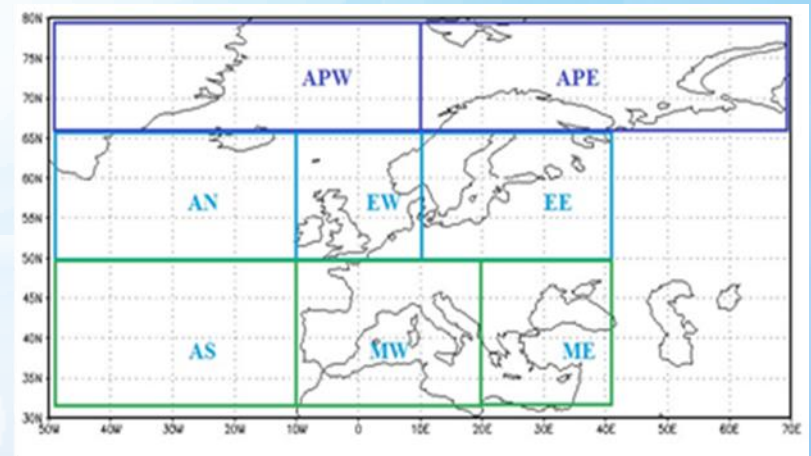
Method:

The cyclone centers and cyclone tracks were identified based on automated cyclone detection/tracking algorithm based in 6-hourly MSLP data in grid points.

Period of study   : 1979/1980 - 2020/2021.
Winter season : from October to March

Data:

NCEP/NCAR DOE reanalysis with step 2.5° x 2.5°
*ERA-5/ECMWF reanalysis with step 0.25° x 0.25°*

1 Realization: in both reanalyses, the cyclone centers were detected at the "closest" points at a distance of 2.5 degrees from the supposed cyclone center.
Taking into account additional conditions, this implementation allows detecting cyclones with a radius of at least 5 degrees.
2 Realization: The second implementation is focused on a grid step of 1.25 degrees of the ERA-5 reanalysis data and allows detecting cyclones with a radius much smaller than in the first case.
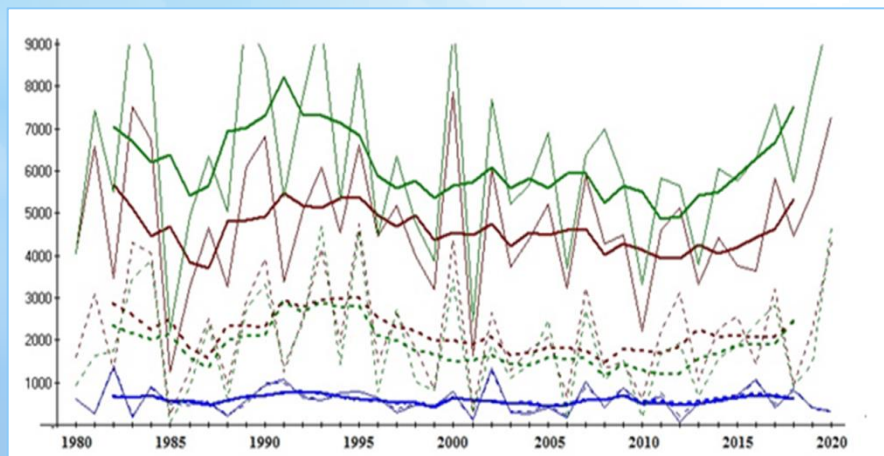
1. The number of cyclone tracks with start in different regions for all period of study
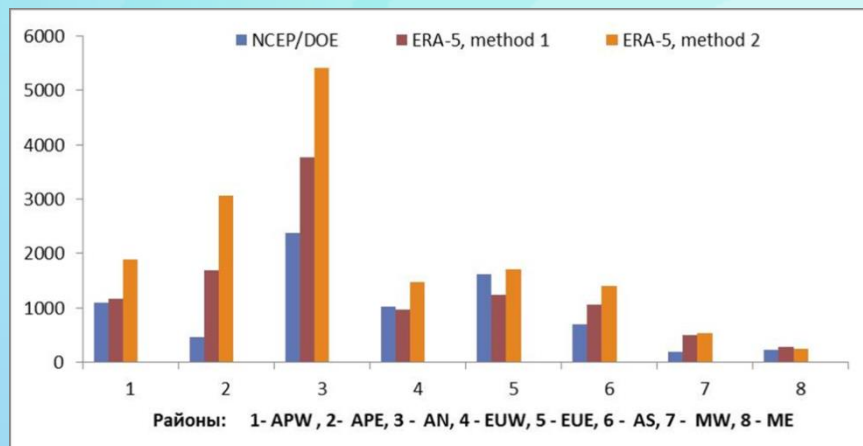
2. The number of cyclone tracks with different life (in days) for all period of study
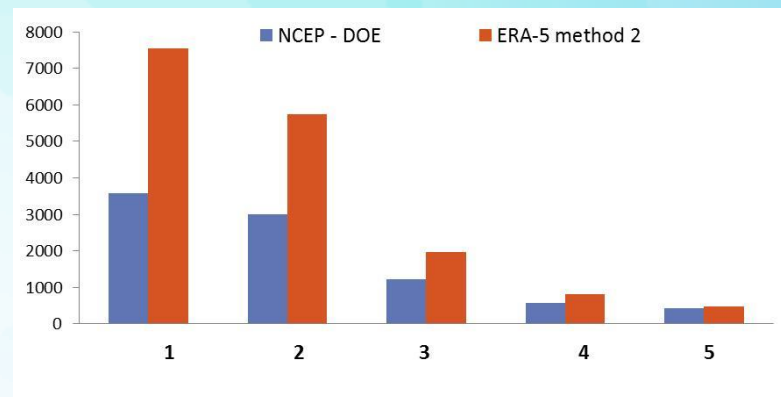
blue - NCEP - DOE
broun - ERA-5, 1 modification
orange – ERA-5, 2 modification.

3. Cyclone activity index (Barenz Sea)

blue - NCEP -DOE
broun - ERA-5, 1 modification
green – ERA-5, 2 modification.
      solid line - all cyclones
      point line - deep cyclones
      bold line - moving average over 5 years

Conclusions

1. The use of the ERA-5 reanalysis data and second version of the cyclone center identification method gives the highest number of generated cyclone trajectories in almost all areas of North Atlantic in the winter half of the year compared to reanalysis NCEP - DOE.

2. This increase is associated with an increase primarily in the number of short-lived cyclones.

3. The maximum differences in number of cyclone trajectories, number cyclones centers and cyclone activity index between reanalyses are observed in the subpolar latitudes of North Atlantic.

4. The comparison of two versions of cyclone identification according to one reanalysis data, ERA-5, shows, that the change in the conditions for identifying the centers of cyclones when using actually the same method and data from the same reanalysis determines only the differences in the annual values of the characteristics of cyclonic activity.   The course of the trend of variability of these characteristics in the selected regions of the North Atlantic from 1979 to 2020 independent of the selected cyclone identification criteria.

Thanks for
your attention !