

CRGA-CNRS UMR 5600

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Key-words: Highs and Lows features, surface level, precipitation, Western Europe.

Abstract: In this study, a Highs and Lows tracking algorithm, applied from NCEP-NCAR Sea Level Pressure daily Data, determines the characteristics of Highs and Lows at surface level from 1950 to 2000. The time series at different time scales (monthly, seasonal and yearly) established in a second time are compared with the evolution of WMO stations precipitation data of the western coast of Europe from Norway to Mauritania. The results suggest that there are two different regions (north and south to 45-50°N) where specific features of Highs and Lows permit to explain the evolutions of amount of precipitation along the period.

1- DATA and METHOD.

The data are extracted from NCEP-NCAR Reanalysis (<http://cdc.noaa.gov/cgi-bin/njph-nc/Datasets>) and from WMO (<http://www.WMO.ch>). The computations were done using the free statistical package R, (<http://cran.r-project.org>).

Working from National Center for Environmental Prediction-National Center of Atmospheric Research, Sea Level Pressure daily records from 01/01/1950 to 12/31/2000, we have retraced, using a method developed by A. Favre, A. Gershunov (2003, 2006) the trajectories of the Highs - whose leave southwards the Arctic area with more or less eastwards component and Lows.

This method is divided into two successive automated stages:

- Recognition of the maxima (minima) of pressure on each map, concerning each day of the period,
- Connections between the different maxima (minima) during their movement, At all the measures of time (synoptic, seasonal, annual, for the whole period) with some of their characteristics: frequency, latitude (genesis, lysis, mean), longitude (genesis, lysis, mean), pressure (max, min, mean), speed of displacement, distance, duration, surface.

Figure 1. Example of trajectories of Highs (green) and Lows (blue) during the winter

JFM 1990. Background colours represent mean pressures during the period (purple for low pressures to blue-green for high pressures).

From these two Data Base (one concerning the Highs and the other about Lows), we extract a significant number of time series representing every aspects interested the variability of Highs and Lows tracks along the period:

- **the Frequency Index**: standard deviation (SD) of the frequency,
- **the Power Index**: mean standard deviation (SD) of Maximal Pressure (or Minimal for Lows), Mean Pressure and Speed of displacement,
- **the Covered Area Index (or Geographical Extension Index)**: mean SD of (Longitude genesis, Latitude lysis)*(Mean Longitude * Mean Latitude).
- **the Lows and Highs indices** : SD of (Frequency Index* Power Index* Covered Area Index)

Working from WMO stations precipitation data of the western coast of Europe from Norway to Morocco, we extract some monthly and seasonal (JFM, AMJ, JAS, OND) time series.

From that Data Base, we establish correlations (Bravais-Pearson method) between variations features of Highs and Lows and amount of rain in order to define which parameter is the most relevant for precipitation evolutions.

2- RESULTS AND INTERPRETATIONS.

For example, figure 1 a, b show the deep correlation between Highs and Lows features and the precipitation evolutions. It does clearly appear that there exists a “line” around 45°N which split the Western Europe in two parts:

- when Lows index is strongly positive (which means that Lows are frequent, deep and run northward), the amount of rain increase in the northern part of studied region,
- when Highs index is strongly positive (which means that Highs are less frequent, stronger and run southward), the amount of rain decrease in the northern part of studied region,

a b

Figure 2. Correlations between precipitation Lows index (a) and Highs index (b)

The results for the others seasons show the same kind of spatial separation with some differences. Especially, the “line” gets southward during spring and summer.

When using sub indices (frequency, power and covered space), it does appear that the most efficient features explaining the precipitations evolutions are firstly the covered space index, secondly the frequency index and finally the power index for both highs and Lows.

3-CONCLUSIONS.

It’s really trivial that it does existing a deep links between Lows and Highs and precipitations evolutions. But in this study, the analyse permit to find precisely which are the features that are the most involve and to describe the regionalisation of the evolutions.

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