

# **Links between Highs and Lows features evolutions at surface level and (Low, medium and High) cloud cover in the North Atlantic Area from 1960 to 2000.**

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**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 1960 to 2000. The statistics established in a second time from monthly cycles and time series at different time scales (monthly, seasonal and yearly) are compared with the evolution of Cloud Cover (Low, Medium and High) from EMCWF ERA 40 monthly data. The results suggest that there are specific features of atmospheric circulation at small scale whose permit to explain the evolutions of Cloud Cover 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 EMCWF ERA-40 (<http://data.ecmwf.int/data/d/era40/daily>). 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: latitude (genesis, lysis, mean), longitude (genesis, lysis, mean), pressure (max, min, mean), speed of displacement, distance, duration, surface.

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.

Working from ECMWF ERA 40 monthly Cloud cover for the three different level, we establish some matrices for every time scales (monthly, seasonal and yearly).

From those Data Base, we had study the “impact” of variations of every features of Highs and Lows on the Cloud Cover fields using spatial correlations (Bravais-Pearson method).

## **2- RESULTS AND INTERPRETATIONS.**

We had already describe the characteristics of Lows and Highs at different thresholds for every time scales in previous studies (A. Pommier 2004a, b, 2005a,b,c).

In a second time we study the variations of Cloud Cover over few regions which are already recognize to be very important for the climate dynamic of the North Atlantic Region (North of North America, Azores, Gulf of Mexico, area between Greenland and Scandinavia. We find some very important variations. For example, between Greenland and Scandinavia, Low Cloud Cover (LCC) increase from 1960 to 1970 and strongly decrease after untill 2000 (figure 1).

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figure 1. LCC between Greenland and Scandinavia from 1960-2000.

In a third time, we establish some maps showing the spatial correlations between the evolutions of all the features of Highs and Lows with Cloud Cover. We find out that the most efficient features to explain the Cloud Cover variations are for Winter period (JFM):

- frequency of Highs and Lows, latitude of lysis of Highs, latitude of lysis of Lows, Pressure minimal of Lows, Longitude and latitude of genesis of Lows for LCC (figure 2),
- frequency of Highs and Lows and pressure maximal of Highs for Medium Cloud Cover (MCC),
- frequency of Highs and Lows for High Cloud Cover (HCC)

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figure 2. spatial correlation between latitude of genesis of Lows and LCC for JFM 1960-2000.

### 3-CONCLUSIONS.

It is quite trivial to study the relationships between Cloud Cover and Highs and Lows, because everybody knows even the very young children that High “means no clouds” and Lows “means lot of clouds”. But from those analysis we can provide the exact links between those elements for a long period (40 years).

### *References.*

- Deser C.,Walsh J.E, TimlinM.S., (2000). Arctic Sea Ice variability in the Context of Recent Atmospheric Circulation Trends. *Journal of Climate*: Vol. 13, No. 3, pp.617-633.
- Favre A., Gershunov A., (2006), Extra-tropical cyclonic/anticyclonic activity in North-Eastern Pacific and air temperature extremes in Western North America, *Cl. Dyn.*,
- Hurrell J., Y. Kushnir, G. Ottersen, and M. Visbeck (Eds) (2003), *The North Atlantic Oscillation : Climatic Significance and Environmental Impact*, *Geophys. Monogr. Ser.*, Vol. 134, AGU, Washington, D.C.
- Ellner S.P., (2001), Review of R, Version 1.1.1. *Bulletin of the Ecological Society of America*, 82, 127-128.
- Gentleman R., Ihaka R., (2000), Lexical Scope and Statistical Computing. *Journal of Computational and Graphical Statistics*, 9, 491-508.
- Kalnay E. (2001) The NCEP–NCAR 50-Year Reanalysis: Monthly Means CD-ROM and documentation, *Bulletin of the American Meteorological Society*, Vol. 82, No. 2, February 2001.
- Ihaka R., Gentleman R. (1996) R: a language for data analysis and graphics. *Journal of Computational and Graphical Statistics*, 5, 299–314.
- Leroux M. (1998), *dynamic analysis of weather and climate: general circulation, perturbations, climatic evolution*, SJ. Wiley ed., Praxis-Wiley series in Atmospheric Physics, London, New-York, Sydney, 365 p.
- Marshall J., Kushnir Y., Battisti D., Chang P., Czaja A., Dickson R., McCartney M., Saravanan R., Visbeck M. (2001), North Atlantic Climate Variability: phenomena, impacts and mechanisms, *Inter. Jour. Climatology*, vol.21, No.15, 1863-1898.
- Pommier A., Leroux M. (2004), POSTER: Relationships between surface and

frequency of Mobile Polar High (Highs) and Lows in the North Atlantic Aerological Space from 1950 to 2000. *European Meteorological Society Annual Meeting 2004*, Nice, France.

- Pommier A., Leroux M. (2004), POSTER: Relationships between the Features Variations of Highs and Lows in the North Atlantic Region and North Atlantic Oscillation from 1950 to 2000, *1st International CLIVAR Science Conference*, Baltimore, USA.

- Pommier A., (2005), *European Meteorological Society Annual Meeting 2004*, Utrechts, Netherlands

- Pommier A., (2005), Objective analyse of the atmospheric dynamic at surface layer over the North Atlantic region: mechanism and evolution from 1950 to 2000. Ph. D. of University of Lyon, France.

- Serreze M.C., Box J.E., Barry R.G., Walsh J.E (1993): Characteristics of Artic synoptic activity, 1952-1989, *Meteorol. Atmos. Phys*, 51.

- J.M. Wallace, W.J. Thompson (2002), Annular modes and climate prediction, *Physics Today*.