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A new circulation type classification based upon clustering of lagrangian air trajectories

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Techniques for circulation types classification are usually based on a small number of meteorological fields like sea level pressure or geopotential height. In particular, they most often do not take into account the 3d-structure of the flow and are based only on a single day, i.e. neglect any kind of day-sequence classifications.

In this work we present a new classification method that can be applied for any region in the world. In this case, we analyze the backward trajectories arriving to our target area - the northwest of Iberia Peninsula. The final aim is to have a classification of the representative flow for each day.

The backward trajectories are computed with the 3-D Lagrangian particle dispersion model FLEXPART. Data from a global simulation were used, which contains 1,398,800 particle positions and their meteorological state properties recorded every six hours over a five-year period (1/12/1999 to 11/30/2004).
The methodology can be split in several steps:

a) an initial horizontal (based on latitude and longitude) cluster analysis was performed, followed by a second clustering focusing on the height of the trajectory, the distance to the target area, specific humidity and latitude;

b) some additional flow characteristics were computed (e.g.: curvature cyclonicity of the flow, and moisture evolution) for each cluster ; and based on physical grounds and on a correlation analysis, a subset of variables was selected to represent each cluster;

c) finally, each classifying variable was separated into several distinct classes (e.g. cyclonic or anticyclonic flow), hence enabling us to characterize each cluster with an “index” for each classifying variable.

As results, we get a daily catalog containing information about the air masses before they arrive to the target area (trajectory types). In order to analyze if the new classification method is able to distinguish the intra-seasonal variability in the region, a comparison between the frequency of the cluster for each season is examined. Moreover a comparison linking the trajectory classification to a "classical" circulation types method (Lamb weather types) for the northwest Iberia Peninsula will be made in order to assess if there are coherent and consistent between them.