



Euro-Atlantic Atmospheric circulation and variability since 1685

Javier Mellado-Cano (1), David Barriopedro (2), Ricardo García-Herrera (2,3), and Ricardo Trigo (1)

(1) Instituto Dom Luiz, DEGGE, Lisbon, Portugal, , (2) Instituto de Geociencias (IGEO), CSIC-UCM, Madrid, Spain, (3) Dto de Física de la Tierra y Astrofísica, Universidad Complutense, Madrid, Spain

Wind direction provided by ships' logbooks is a consolidated instrumental source, as it has been measured with a compass for many centuries, thus yielding daily observations for the world's oceans and seas. Nonetheless, ships' logbooks have still been poorly exploited to reconstruct climate variability.

We present four monthly indices of wind persistence, one for each cardinal direction: Northerly (NI), Easterly (EI), Southerly (SI) and Westerly (WI), based on daily wind direction observations taken aboard ships over the English Channel. These directional indices (DIs) are the longest observational record of atmospheric circulation to date, covering the 1685-2014 period.

We show that the DIs are informative about the mid-latitude atmospheric circulation over the Atlantic and play an important role in the climate conditions of Europe. They show strong climatic signals in terms of temperature and precipitation anomalies over large areas of Europe throughout the year, especially during cold seasons. Statistical models including all DIs are able to explain a considerable amount of climate variability, improving in most cases that accounted for by the North Atlantic Oscillation (NAO).

A Principal Component (PC) Analysis of the DIs reveals links with the main modes of atmospheric climate variability over the eastern Atlantic, namely the NAO and the Eastern Atlantic (EA) pattern. The combination of NAO and EA phases inferred from the DIs allows us to report periods dominated by "high-zonal" and "low-zonal" flow patterns during the last three centuries. These results show the potential of DIs to capture non-stationary signatures of the atmospheric circulation, characterize the European climate variability from monthly to multidecadal time scales. As such, they arise as powerful tools to explore the atmospheric circulation responses to slowly-varying climate drivers, as well as anthropogenic and natural forcings.

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