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Statistical downscaling of wind probability distributions over the western Mediterranean basin

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Trends in near-surface wind speeds are acknowledged as having particular importance for climate change impacts on society (e.g., the insurance industry, coastal erosion, forest and infrastructure damage, storm surges, and air-sea exchange). They also have relevance for applications such as wind energy resource estimation and construction issues.

Surface wind speeds exhibit variability at much smaller spatial scales than that resolved by general circulation models (GCM) and hence there is a need to develop tools for downscaling GCM projections to generate finer scale projections of near-surface wind climatologies.

Our study aims at inferring the small-scale near surface atmospheric circulation in the western Mediterranean basin associated with the main large-scale weather regimes over northern Atlantic and Europe. To achieve this goal, we: (1) classify the main weather regimes during winter between 1970 and 2001 using the 500 hPa geopotential of both the ERA-40 and NCEP reanalyses, (2) determine the relation between the large-scale weather regimes and the local circulation at the surface using the wind measurements from the Météo-France network of meteorological surface stations, (3) assess the ability of the mesoscale model (MM5) forced by the ERA-40 reanalysis to reproduce the observed wind statistics using an ensemble modelling approach (with respect to one specified weather regime).

The main results are: (1) the four identified large-scale weather regimes are very similar with both ERA-40 and NCEP reanalyses (zonal, atlantic ridge, blocking and Greenland anticyclone). The maximum discrepancy between ERA-40 and NCEP weather regimes and between the three decades (1970-1980; 1980-1990; 1990-2001) is found for the 1980-1990 decade. (2) the near-surface local circulation is strongly disrupted

by the orography (Pyrénées, Massif Central and Alps) inducing typical fine-scale circulation. So, for each large-scale weather regime, several "fine-scale regimes" exist. (3) this on-going work requires to simulate a "reasonable" number of cases associated with the four large-scale weather regimes. The "reasonable" number of simulations is set so that the wind probability distributions (obtained from the climatology of measured surface winds) are preserved when considering the selected cases.