ModObs: A new Marie Curie Research Training Network in Europe

Atmospheric modelling for wind energy, climate and environment applications: exploring added value from new observation techniques

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MODELING:

Global-to-Meso Scale:

Field observations together with analytical and process oriented numerical models are used to study the interaction between the atmosphere and the ocean on a regional scale. The results indicate an interaction between the intensity of polar lows and the subsurface warm Atlantic water (11). The presence of waves, mainly swell, influence the marine atmospheric boundary layer (MABL) fluxes and turbulence structure. The regional and global wave effect on the atmosphere will be also studied and quantified (7)

Climate change of the near surface wind speed over the North Atlantic is studied. The significant increase of the near surface wind speed in the cold part of the year is found (2).

Meso-Scale:

Planetary boundary layer (PBL) parameterization in meso-scale WRF model is investigated. PBL parameterization is improved to better simulate the near-surface wind shear (2).

The effect of stable stratification on the wind profile is investigated in nature and in NWP models, which are used to build the wind atlas over Finland. Production of the wind atlas is based on downscaling runs of HIRLAM and AROME models, as well as on implementation of WAsP program and CORINE land use data. The final resolution of the wind maps is 250x250 meters (3).

We study the development of the MABL and surface layer turbulence during the LASIE experiment in the Ligurian Sea. We evaluate different methodologies to calculate MABL using Ceilometer and radio sounding data (12).

Micro-Scale:

Large Eddy Simulation (LES) is used to study the planetary boundary layer under different complex effects:

(a) *Forcing from general circulation model (GCM):*

LES diagnostics are performed to evaluate the cumuli parametrizations, due their impact on climate. The LES is forced by a GCM to directly compare the evolution of turbulence and cloud representation. Focusing on trade wind cumulus over the GPCI cross-section (5).

LES GROUP

A joint work involving participants of partners 1, 2, 4, 5, 6, 8 has been developed. In this research, the neutral boundary layer is studied using Large-Eddy Simulations. The model parameters, the inertial oscillations (Fig. 1), the effects of the boundary conditions, and the turbulence structure (Fig. 2) in the neutral boundary layer are among the approached subjects.

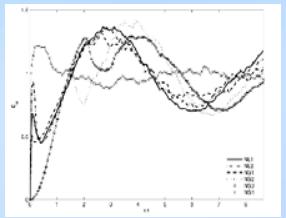

Figure 1. Inertial coefficient C_u, showing the deviation from steady state conditions in the x-component momentum equation. Labels refer to different simulations runs.

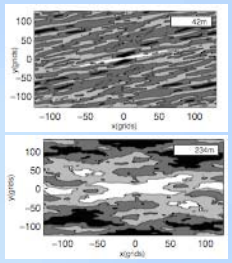

Figure 2. Two dimensional correlation function of the streamwise velocity in the transverse direction at two levels. Dark (light) colours inidcate negative (positive) correlation.

(b) *Heterogeneity of the Marine Surface Layer (MSL):*

Investigation of the air-sea turbulent exchange mechanisms, in both under homogeneous and under the effects of coastal discontinuity and horizontal gradient of temperature (6).

(c) *Heterogeneity of land surface:*

Neutrally-stratified turbulent flow over hills is studied using turbulence resolving simulations. Sensitivity studies of of the dependence of the results on different computational elements are used to generate guidelines for computing such flow (8).

(d) LES of the surface boundary layer for wind energy applications (offshore conditions):

Testing LES simulation performances against observations will help to understand better the observations within the PBL as well as to assess the applicability of LES in wind energy. Moreover a better understanding of the impact of organized or coherent inflow turbulence over the plane turbine rotor will be analysed (4).

OBSERVATIONS:

Satellite:

Contribution of satellite observations for the study and parametrization of marine boundary layer:

The aim is to find a MSG-SEVIRI based observable related to the moisture component of the latent heat turbulent flux focusing on the Mediterranean Sea. High temporal and spatial resolution maps of the difference between estimated near-surface water vapour mixing ratio and the saturation value corresponding to the estimated SST are produced. Qualitative analysis of results showed consistent structures and we investigate the connection of the intensity of these anomalies with other parameters (e.g. wind intensity, atmospheric surface pressure etc). (6).

LIDAR, SODAR:

Remote sensing techniques applied for wind energy:

Wind speed profiles measured with a LiDAR in front of a large wind turbine were used to calculate an "equivalent wind speed" taking the wind shear into account. This was found to reduce the scatter in power curve measurement. This work is used for the revision of the IEC standards 16400-12-1 (1).

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