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The National Renewable Energy Centre of Spain -CENER- is a technology centre specialized in applied research and development as well as the promotion of renewable energies. CENER is divided into six departments: Wind Energy, Photovoltaic Solar Energy, Solar Thermal Energy, Biomass Energy, Bioclimatic Architecture and Renewable Energy Grid Integration.

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GLOBALWIND: HIGH RESOLUTION WIND RESOURCES MAPS AT REGIONAL SCALE

CENER has developed and validated a methodology to generate wind resources maps for any region on Earth, onshore and offshore, at a resolution of up to 10 m x 10 m without local measurements: **GlobalWind**.

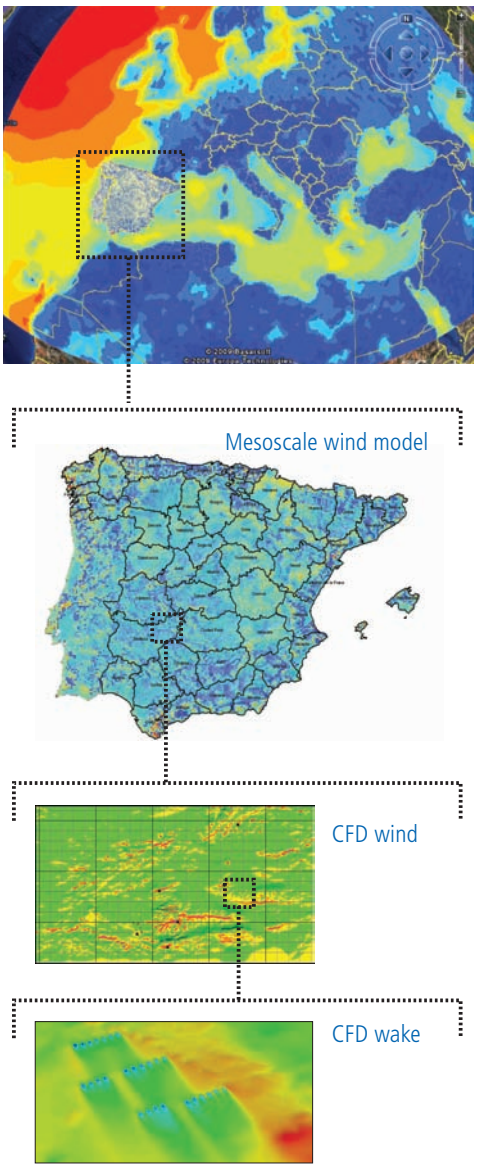
GlobalWind generates useful information for:

- Public Administrations for planning wind resources explotation and grids (municipalities, regional, national and trans national authorities).
- Utilities, transmission and system operators to help the development of wind energy penetration scenarios.
- Investors and wind project promoters to minimize the risk of installing meteorological stations or investing resources in areas without enough wind.
- Wind turbine manufacturers for developing market plans according to the level of wind resources and to determine the IEC class of wind turbines required in specific areas without measurements.
- Determining the energy production of small wind turbines (isolated systems or small scale network connected).

The method includes a non hydrostatic mesoscale model coupled with a CFD model (CFDwind). These two steps allow to take into account all relevant scales affecting the wind, from the synoptic scale to the local scale. The following maps can be produced for onshore and offshore sites:

- Average wind speed and wind power density (long term, yearly, seasonal, monthly and daily maps).
- Extreme wind speed (Vref).
- Wind speed vertical profile.
- Wind speed and power density variations (comparison of a time period with a reference period).
- Air density and temperature (including extreme temperatures that could affect wind turbine operation).
- Turbulence intensity with CFDwind.
- High resolution wind speed and vertical profiles with CFDwind.
- IEC wind turbine class with CFDwind.

Wind maps are integrated in a Geographic Information System (GIS) accessible online (see: www.globalwindmap.com) or in an offline package.



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Maps are calculated with a mesoscale model configured for optimal simulation of wind, specially in mountainous areas. Wind is simulated at the nodes of a 1km x 1km spatial resolution grid. Simulations are run for each hour in 5 year long backwards periods, producing time series of wind speed, direction, temperature, pressure, etc for every grid point providing similar information to measurement stations, allowing to calculate wind farm energy production.

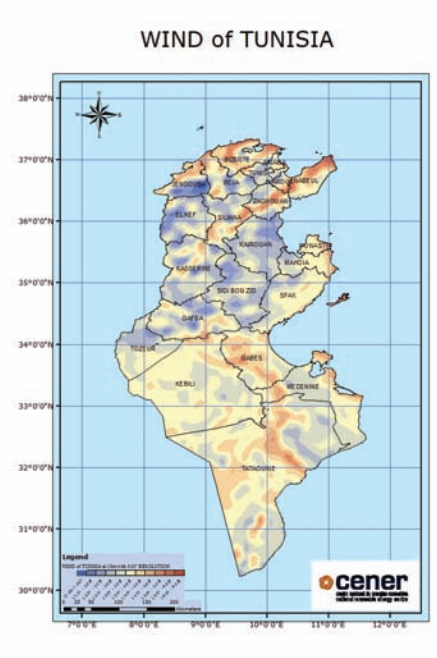
CFDwind can get coupled to the mesoscale model simulating the full boundary layer of regions or wind farm areas with high resolution. This provides accurate estimations of the variation of wind speed, turbulence intensity, vertical profile... due to topographic or roughness changes and thermal effects in onshore and offshore areas. In the latest step a non linear wake model, **CFDwake**, can be used to simulate the wakes including the interaction terrain-wake and a precise simulation of big offshore wind farms.

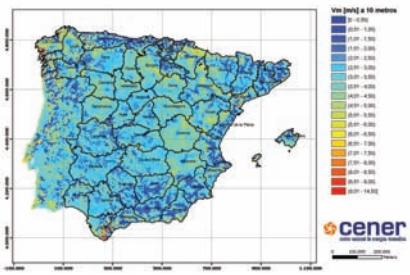
The methodology has been developed during 5 years by meteorologists, mathematicians and IT team of CENER in cooperation with the University of Athens and has been validated extensively in many different environments with meteorological stations, buoys and satellite images, providing excellent results onshore and offshore:

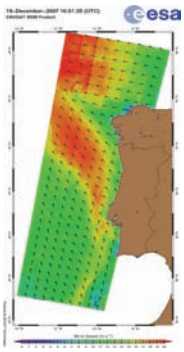
- 81 meteorological stations in Spain, central Europe and Tunisia.
- Fino 1 offshore meteorological station in Germany.
- 3 buoys and ESA SAR images in the Spanish coast. Better accuracy of the mesoscale model versus satellite images.

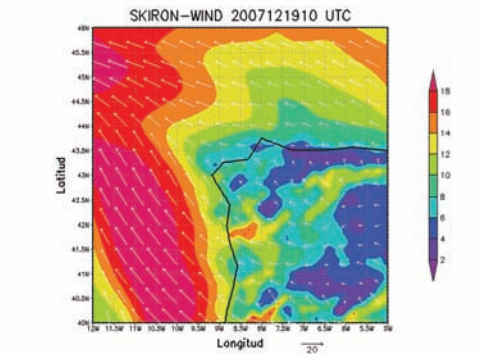
Additionally, static and dynamic electrical grid simulations can be produced covering various scales from the node to the country. The information of the wind resources and the grid analysis can be helpful to know:

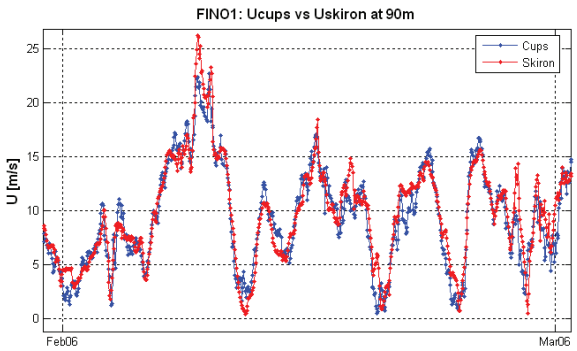
- The capacity of the grid and the effect of wind energy.
- The penetration limits of wind energy related to the grid.
- Possible scenarios of wind energy development according to the wind potential and grid conditions.











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