

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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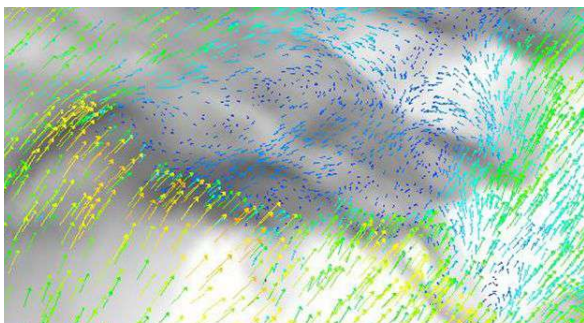


CFD CALIBRATION NUMERICAL SITE CALIBRATION

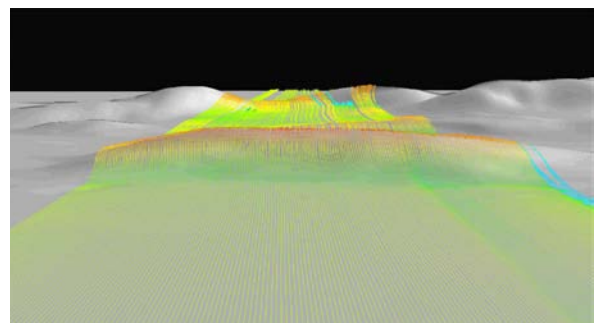


CENER offers numerical site calibrations (NSC) according to a validated CFD methodology, as part of the power performance test:

- NSC method avoids the installation of a meteorological mast in the position of the wind turbine for the calibration of the site.
- CFD CALIBRATION can be calculated when the wind turbine is already installed
- Estimation of wind speed components at the location of the reference mast and the wind turbine position.
- Estimation of flow distortion factors induced by terrain for each wind speed and wind direction bin.
- Estimation of average wind turning angles induced by terrain for each wind speed and wind direction bin.

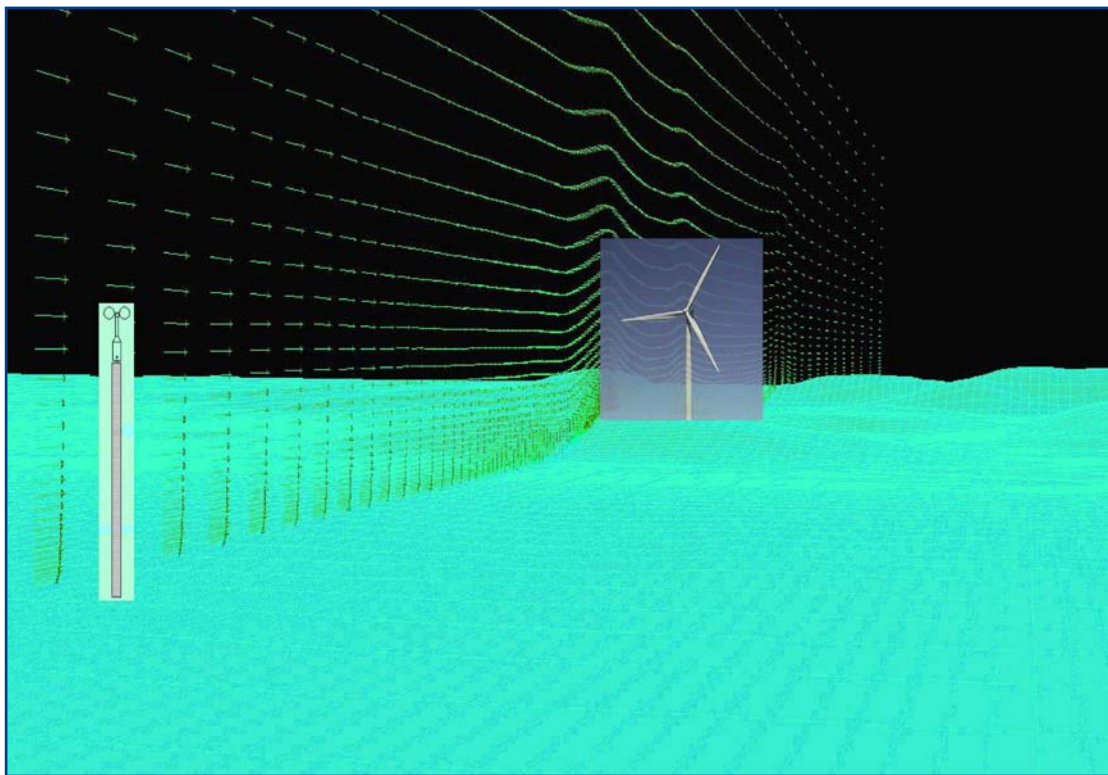


Wind speed vectors at the position of reference mast and wind turbine



Flow pathlines over complex terrain areas

- Customized services focused on the solution to specific problems
- Highly qualified and experienced staff in atmospheric boundary layer analysis
- Similar requirements to conventional wind resources assessment studies
- Uncertainty estimation
- Optimized turbulence model parameterization for atmospheric boundary layer
- Specific validations can be done if local measurements are available Successfully validated model in complex terrain
- Any customized analysis demanded by customers
- CENER participates in the development of the IEC 61400-12-2 standard for the adaption of CFD models to NSC



Wind speed vectors between reference met mast and wind turbine position

References:

- Sanz J., Cabezón D., Lozano S., Martí I., 2009, Parameterization of the atmospheric boundary layer for offshore wind resource assessment with a limited-length-scale k- ϵ model, Proceedings of the European Wind Energy Conference EWEC-2009, Marseille (France)
- Sanz J., Cabezón D., Martí I., Patilla P., van Beeck J., Numerical CFD modelling of non-neutral atmospheric boundary layers for offshore wind resource assessment based on Monin-Obukhov theory, Scientific Proceedings of European Wind Energy Conference (EWEC), Brussels (Belgium)
- Cabezón D., Martí I., A new methodology for estimating wind farm production through CFD codes, Proceedings of European Wind Energy Conference (EWEC), Milan, May 2007
- Cabezón D., Sanz J., van Beeck J. Sensitivity analysis on turbulence models for the ABL in complex terrain, Scientific Proceedings of European Wind Energy Conference (EWEC), Milan, May 2007