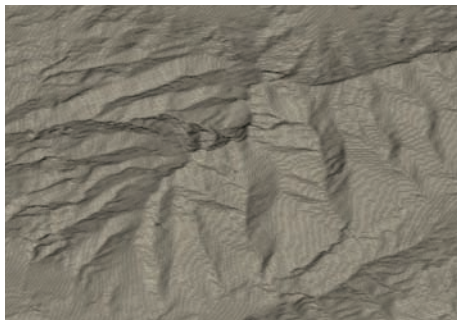


## CFD WIND 2.0: WIND RESOURCE ASSESSMENT FOR COMPLEX TERRAIN AND OFFSHORE WITH CFD

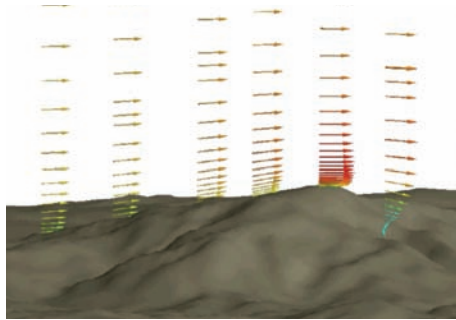


CENER offers to the wind energy sector a validated methodology based on Computational Fluid Dynamics (CFD) especially designed for complex terrain topographies as well as offshore environments and coastal areas, where linear models are less reliable. It will help you to reduce the uncertainty related to wind turbine siting, increasing wind farm profitability.

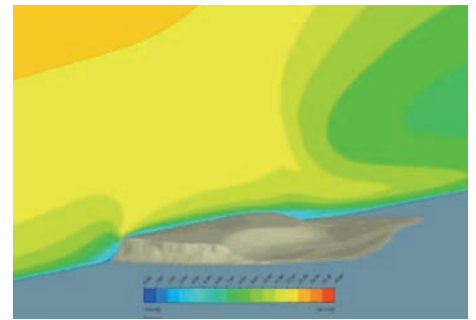
- High resolution wind maps in complex terrain and offshore (up to 5m x 5m resolution).
- Wind speed, turbulence intensity and upflow angle at any point in the wind farm.
- Long term annual energy production with measurements at one or several masts.
- Reliable vertical extrapolation of measurements to high hub heights.
- Significant cost reduction on installation of additional high meteorological masts. Better accuracy compared to linear models using less meteorological stations.
- Possibility of coupling to mesoscale models in areas without measurements (onshore and offshore).
- Any customized analysis demanded by customers.



3D high resolution  
mesh around wind farm



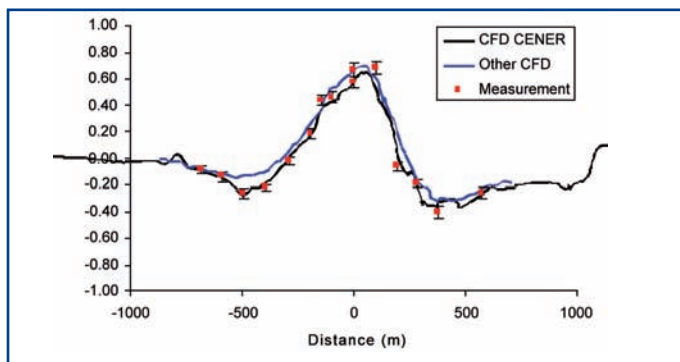
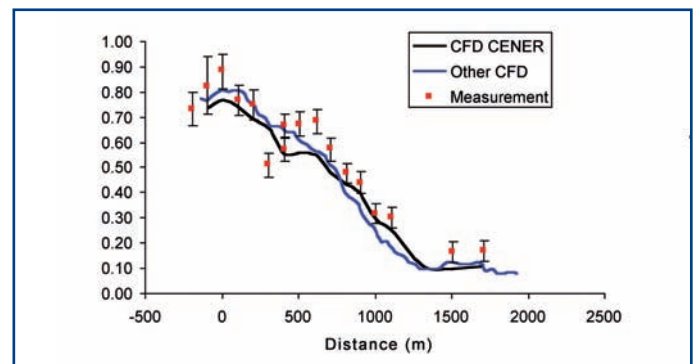
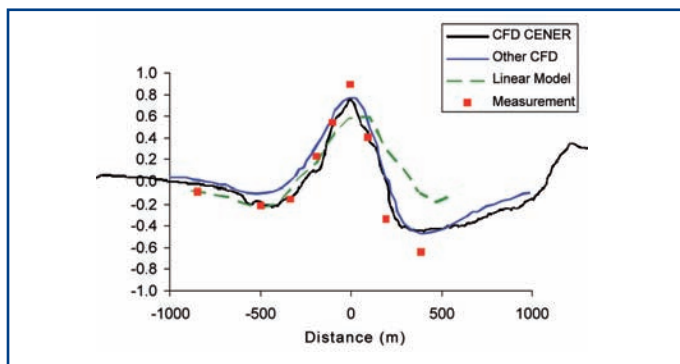
Vertical wind speed profiles modified  
by complex terrain



Wind speed distribution at highly  
complex terrain areas

Better accuracy with similar requirements to conventional wind resources assessment studies

- Uncertainty calculation
- Automatic generation of surface roughness maps
- Optimized turbulence model parameterization for atmospheric boundary layer
- Results according to IEC standards
- Highly qualified and experienced staff in atmospheric boundary layer analysis
- CFD calculations can be validated in specific cases if local measurements are available
- Successfully validated model in complex terrain and offshore cases (see references)
- Training adapted to the customer needs by specialised staff on wind flow modelling with CFD available.
- Customized services focused on the solution of specific problems



Validation of CFDWIND in Askervein hill (LINE A, LINE AA and LINE B)

## References:

- Sanz J., Cabezón D., Lozano S., Martí I. Parameterization of the atmospheric boundary layer for offshore wind resource assessment with a limited-length-scale k-É model, Proceedings of the European Wind Energy Conference 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, Proceedings of European Wind Energy Conference 2008, Brussels (Belgium)
- Cabezón D., Martí I., A new methodology for estimating wind farm production through CFD codes, Proceedings of European Wind Energy Conference 2007, Milan (Italy)
- Cabezón D., Sanz J., van Beeck J. Sensitivity analysis on turbulence models for the ABL in complex terrain, Proceedings of European Wind Energy Conference 2007, Milan (Italy)