# XY0307 Wake modelling and measurements in Upwind

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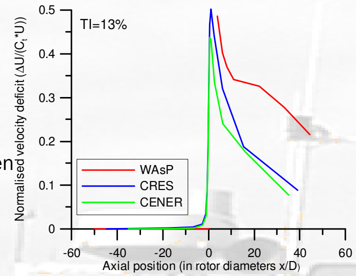
**Summary**

UpWind is a European Union Sixth Framework Integrated Project consisting of more than 40 partners. The project investigates design of very large wind turbines (8-10 MW), both onshore and offshore. www.upwind.eu The flow workpackage focuses on modelling and measurement of parameters relating to flow including wind speed, direction and turbulence particularly wakes in large wind farms in complex terrain or offshore. Wakes (interactions of flow between wind turbines and arrays) are a major cause of power losses and can potentially be reduced through optimisation of wind turbine siting and operation.

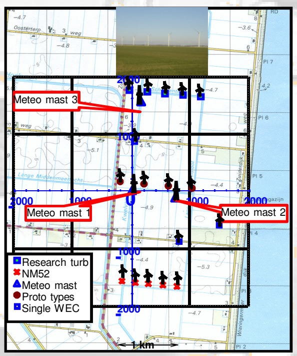
## 1. Wakes in complex terrain

1. Model evaluation: wind turbine top of Gaussian Hill:
   - CRES CFD
   - CENER Fluent
   - RISOE WAsP

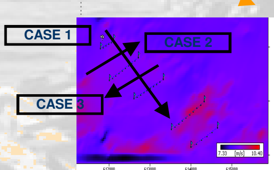
Main results
   - Good agreement between CENER & CRES models
   - Minor discrepancies attributed to surface parameterisation

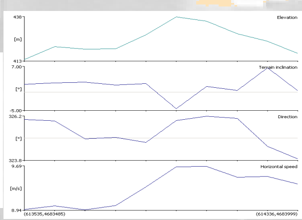



2. Model evaluation of multiple turbine interactions at research wind farm



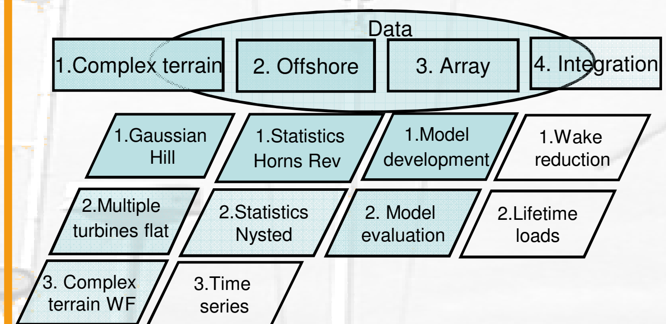

3. Complex terrain wind farm
   - Data 'cleaned' of topographic effects e.g. 8 m/s, direction 325º
   - Modelling in WAsP Engineering
   - Terrain induced ΔU~0.75 m/s (4th row)
   - Model evaluation to be performed



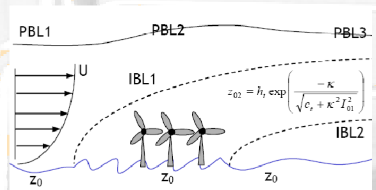

## Structure of the workpackage

(Shading indicates progress towards completion)



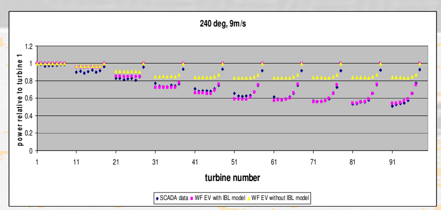

## 3. Array effects

Assess optimal spacing between wind farms. Evaluation includes; added roughness, canopy type, analytical, WAsP & Windfarmer models.




## 4. Integration

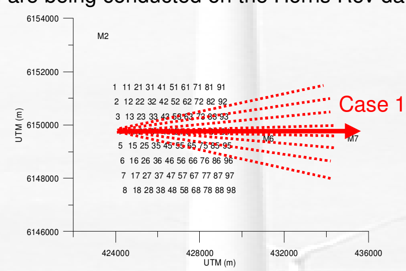
The last two tasks involve evaluating strategies to reduce wake losses and to consider lifetime loads on wind farms.

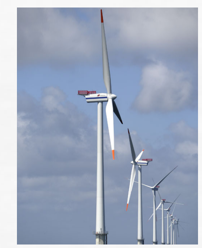



From Schlez et al. DEWEK 2006

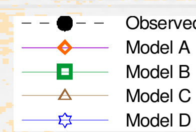
## 2. Wakes in offshore wind farms

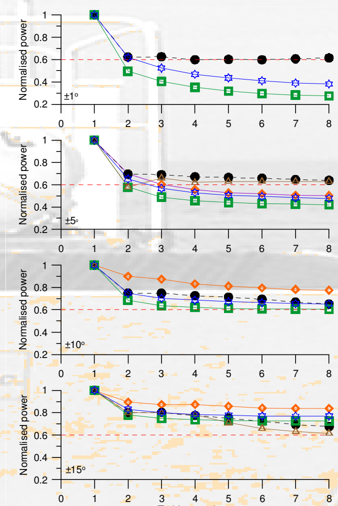
Wind farm models give reasonable predictions of wake losses for small offshore wind farms but not in large arrays. Our research aims to find the physical causes for this behaviour. Simulations are being conducted on the Horns Rev data.



Model results and obs. for 8 0.5 m/s, 270°, 7D spacing
   - Direct down the row wake losses are the largest esp. at low wind speeds
   - Defining narrow rows and wind sectors gives few obs.
   - Not representative for all wind speeds and directions
   - Further simulations underway

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SIXTH FRAMEWORK PROGRAMME