Scientific Planning and Design of the Southern German Wind Energy Test Site in Complex Terrain

PO.262

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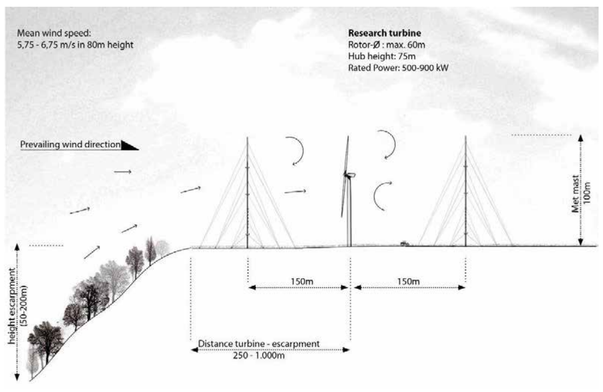
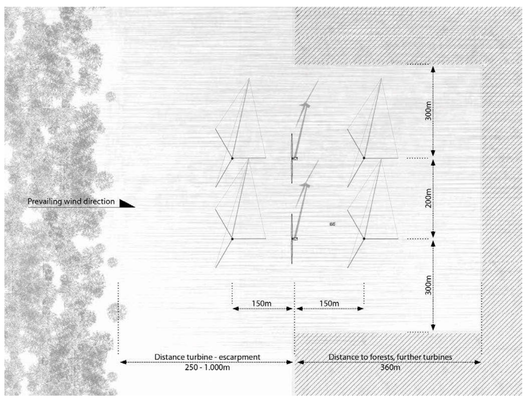
Motivation

- Lack of facilities in complex terrain with full accessible research turbines
- Basic and application-oriented research
- Consideration of site-specific features
- Dissemination of knowledge in research and development
- Technology testing platform for enterprises

Characteristics

- Close to an escarpment with Δh=100m
- Loading on wind turbines due to higher turbulence and inclined flow
- Wind acceleration due to escarpment overflow
- Designed site layout under landscape architectural point of view

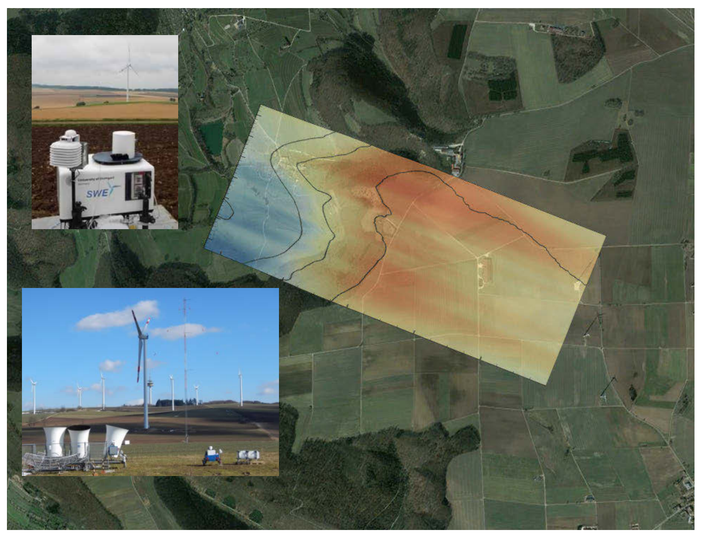




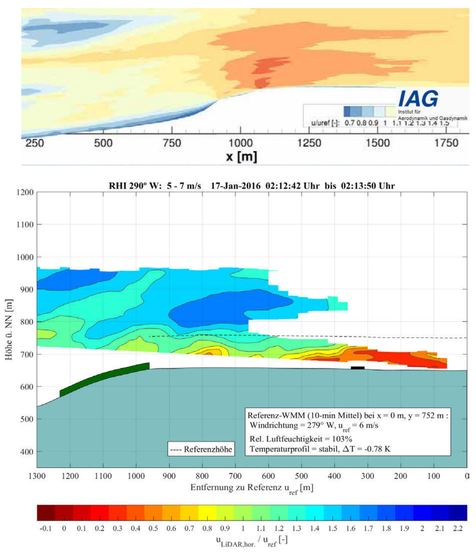
Two full accessible wind turbines (reference and research turbine), both fully equipped with load sensors. Four met masts and additional devices (e.g. remote sensing, Eddy-Covariance)

Developing the site

The nationally funded research project “KonTest” (2013-’15) aimed to develop the design for a wind energy test site in complex terrain.



Site overview – measurements performed by met mast, LiDAR, RASS and UAV as well as CFD simulation

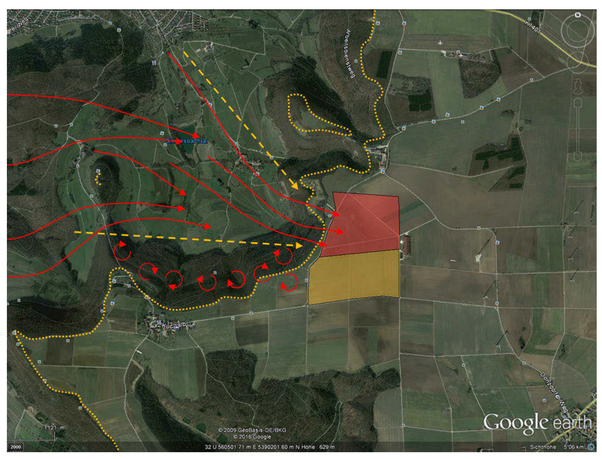


Comparison of long-range lidar measurements against CFD simulation

Test site description

- **Two open-access, modifiable research wind turbines** in complex terrain downstream of an escarpment
- **Access to all design data as well as to the controller** of the two research wind turbines
- **Extensive measurement instrumentation** for the detection of **electrical**, **acoustic**, **mechanical and seismic** parameters
- **Meteorological parameters** are gathered by **four** meteorological **masts** and additional devices (remote sensing, Eddy-Covariance, etc.)

Results



- Wind acceleration close to escarpment up to 1.6 higher
- Wide range of different flow characteristics at different wind directions
- First perceptions about influenced microclimate due to escarpment and topography
- Investigated area fits test site requirements

Future research objectives

- Testing and validation of new technologies
  Design, aerodynamics, aero-acoustics, aero-elasticity, manufacturing engineering, operation and control, measurement sensors, monitoring, noise reduction, rotor blades …
- In-depth basic research in meteorology for wind energy use in mountainous complex terrain
- Development and verification of simulation software for
  - the design of wind turbines as a complete system
  - wind field modeling in mountainous, complex terrain (incl. meso-microscale coupling)
- Energy storage technologies (e.g. Power-To-Gas) and grid connection
- Landscape architectural planning to improve social acceptance
- Ecological research

Outlook

- Realization of test site within follow-up projects in the next 3.5 years.
- Sub-project “Mikroklima” focuses on the detailed characterization of the site, which is monitored regarding the wind conditions, eddy covariance, soil-air interaction, agricultural use and ecological implications before and after the installation of the turbines.
- In the sub-project “FoWEA”, wind turbine models will be created at different levels of accuracy and validated with measured data. The current wind turbine controller will be replaced by a new baseline controller which will be open to any research institution.
- Open-access data base for wind energy research.

Supported by:

Acknowledgement
The project KonTest (No. 0325656A-D) was funded by the German Federal Ministry for Economic Affairs and Energy.

Federal Ministry for Economic Affairs and Energy
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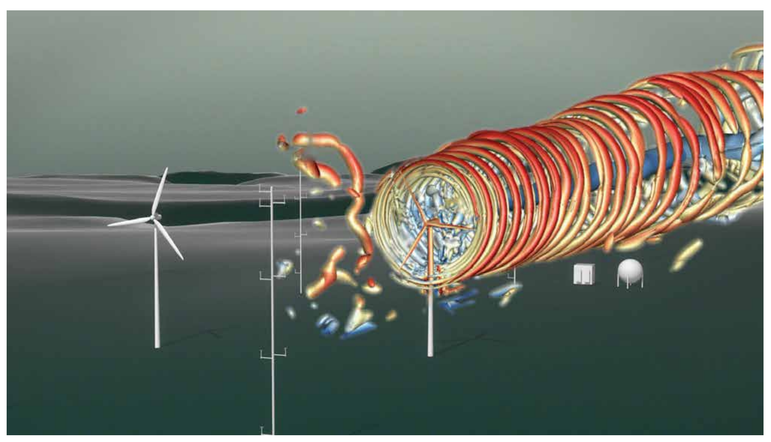

See video

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