
Von vorwettbewerblicher Unterstützung bis zum Betrieb von Prüfständen für die Industrie

Dr. Stephan Barth

ForWind - Zentrum für Windenergieforschung



Forschungsverbund Windenergie

- 11 Standorte in 6 Bundesländern
- ca. 600 MitarbeiterInnen
 - DLR (6 Institute)
 - ForWind (30 Institute)
 - IWES Nordwest
- Kooperationsrahmenvertrag



Internationale Windenergieforschung Mitgestaltung von Roadmaps und Forschungsstrategien



Strategic Research Agenda /
Market Deployment Strategy
(SRA/MDS)

March 2014

IRPWind
Integrated Research Programme on Wind Energy

Project acronym: IRPWIND
Grant agreement n° 609795
Collaborative project
Start date: 01st March 2014
Duration: 4 years

Title: EERA JP Wind Strategic Action Plan 2014-2017
Work Package: WP2 Integration Activities
Deliverable number:

Lead Beneficiary: DTU
Delivery date:
Dissemination level: PP

Revised template for SP milestones etc: JOT 8 June 2015

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eawe WIND ENERGY SCIENCE
european academy of wind energy

**Long-term research challenges in wind energy –
a research agenda by the European Academy of
Wind Energy**

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⁷National Renewable Energy Laboratory, Golden, USA
⁸Aalborg University, Aalborg, Denmark
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¹⁰Technische Universität München, Munich, Germany
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Published: 9 February 2016

Abstract. The European Academy of Wind Energy (eawe), representing universities and institutes with a significant wind energy programme in 14 countries, has discussed the long-term research challenges in wind energy. In contrast to research agendas addressing short- to medium-term research activities, this eawe document takes a longer-term perspective, addressing the scientific knowledge base that is required to develop wind energy beyond the applications of today and tomorrow. In other words, this long-term research agenda is driven by problems and curiosity, addressing basic research and fundamental knowledge in 11 research areas, ranging from physics and design to environmental and societal aspects. Because of the very nature of this initiative, this document does not intend to be permanent or complete. It shows the vision of the experts of the eawe, but other views may be possible. We sincerely hope that it will spur an even more intensive discussion worldwide within the wind energy community.

Published by Copernicus Publications on behalf of the European Academy of Wind Energy e.v.

**LONG-TERM RESEARCH AND
DEVELOPMENT NEEDS FOR WIND ENERGY**
FOR THE TIME FRAME 2012 to 2030

Herausforderung

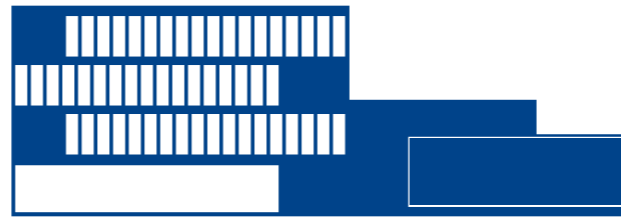
geschlossene Modellierungskette über viele Skalen

Simulation



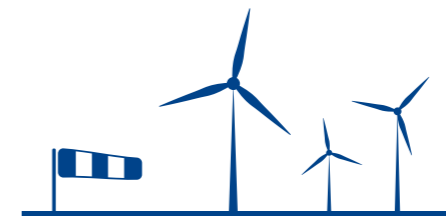
Großrechner

Experiment

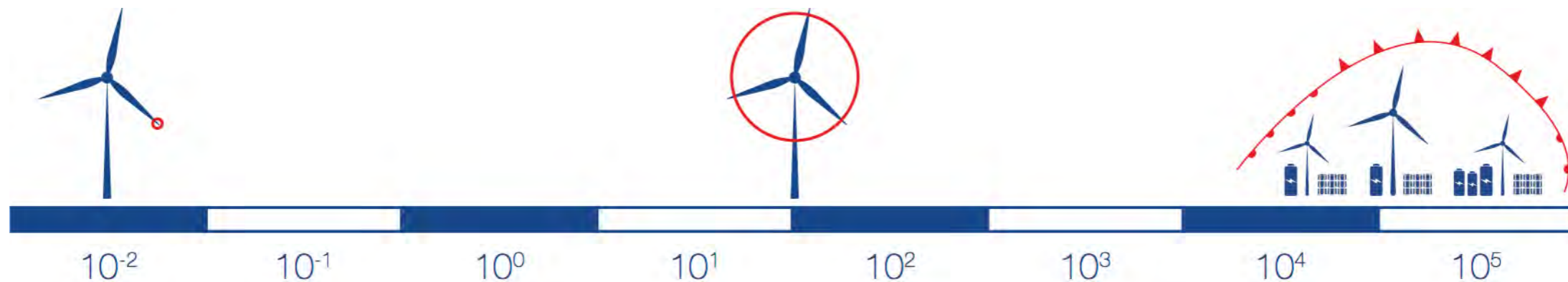


Testzentren

in situ



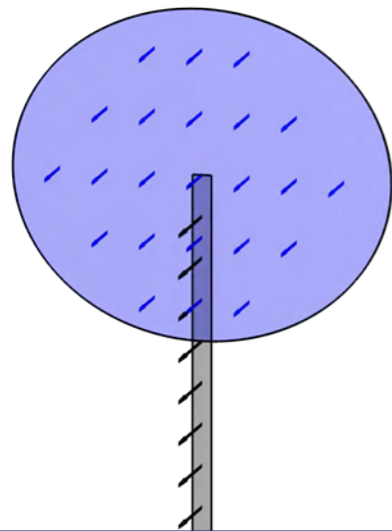
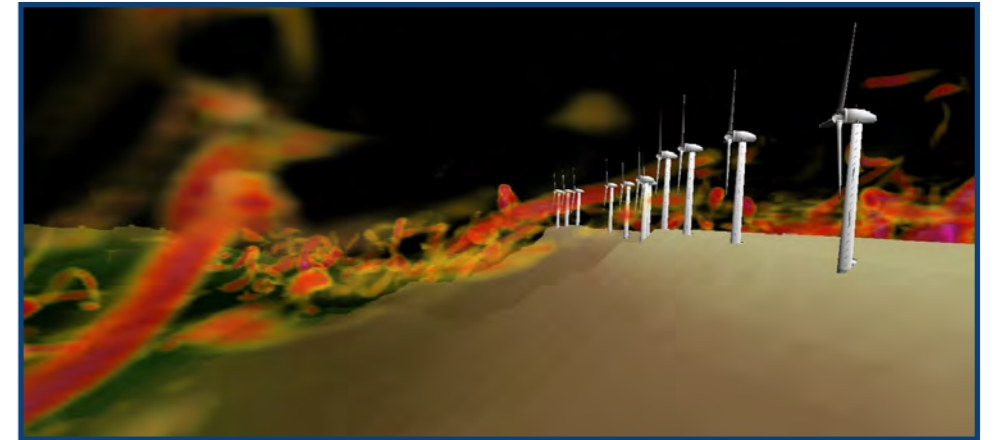
Freifeld



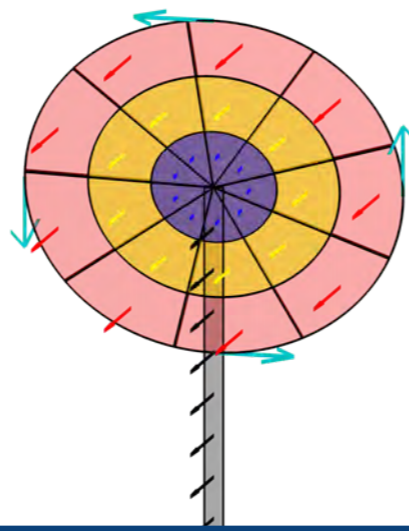
Strömungssimulation auf unterschiedlichen Skalen



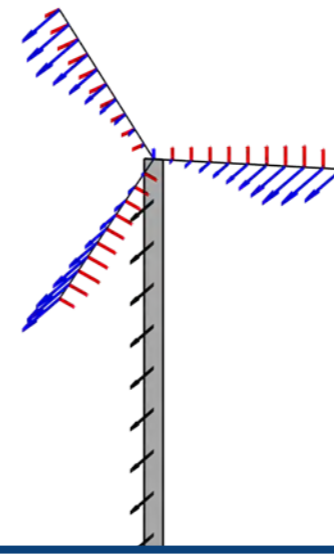
- Betrieb und Entwicklung des PArallelierten Large-Eddy SimulationsModells PALM
- Betrieb und Priorisierung eigener Hochleistungsrechner
- Expertise in der CFD-Modellbildung und Anpassung an HPC-Architekturen



Actuator disk model
(ADM)



improved ADM
(ADM-R)

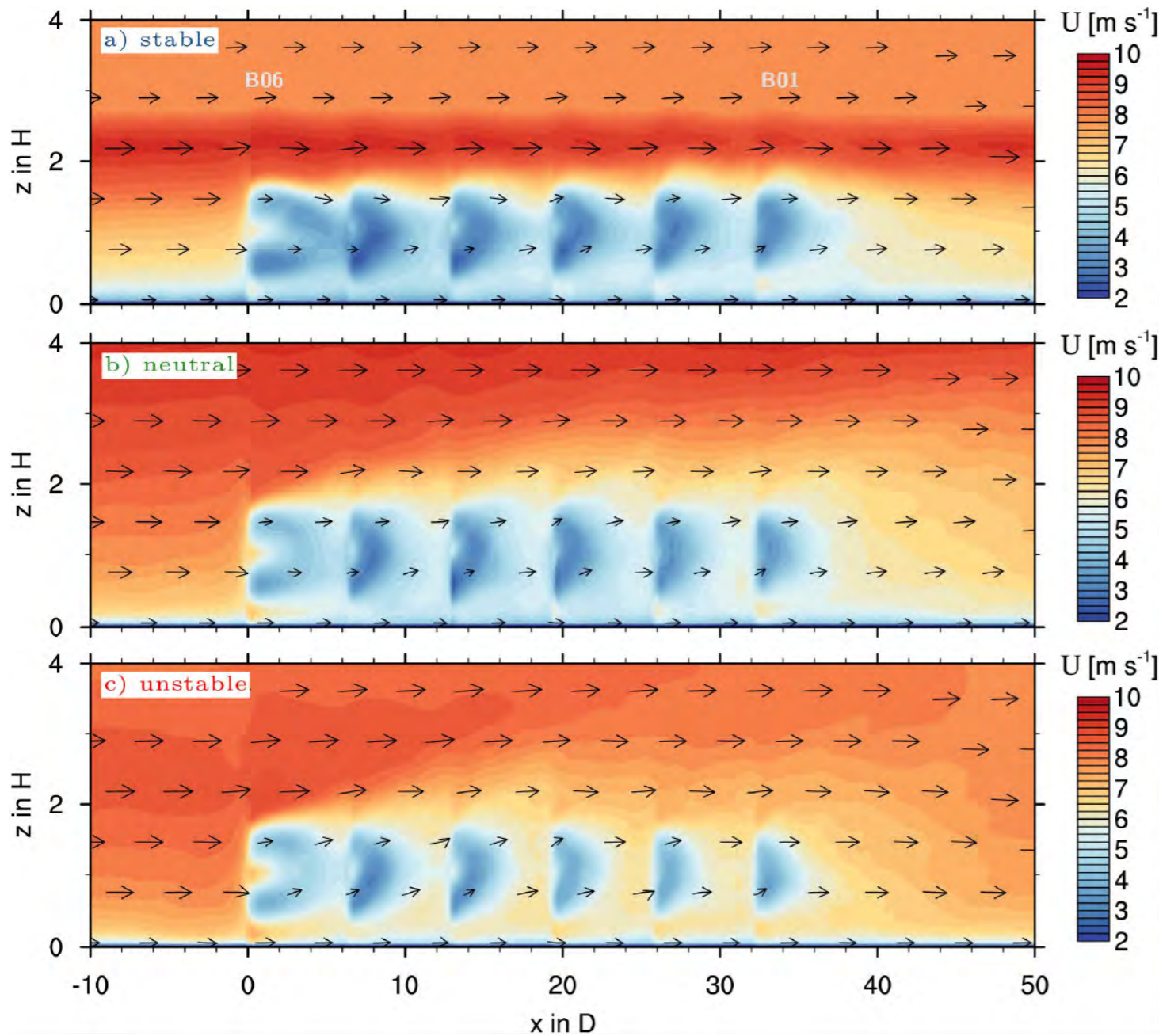


Actuator line
model (ALM)

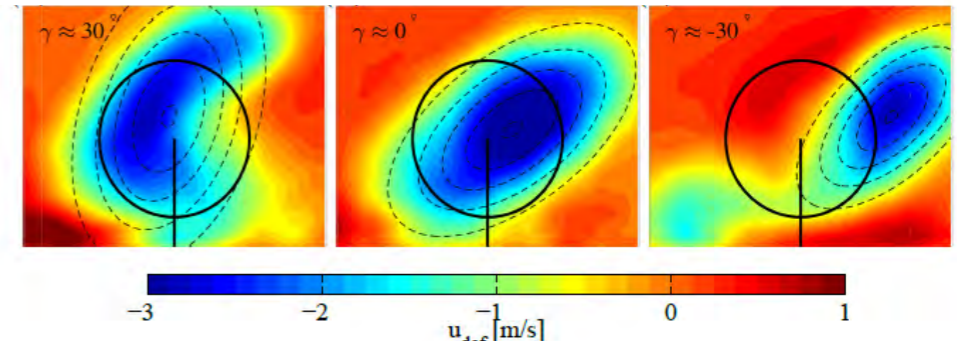
Wind turbine:
FAST

Atmospheric
flow: PALM

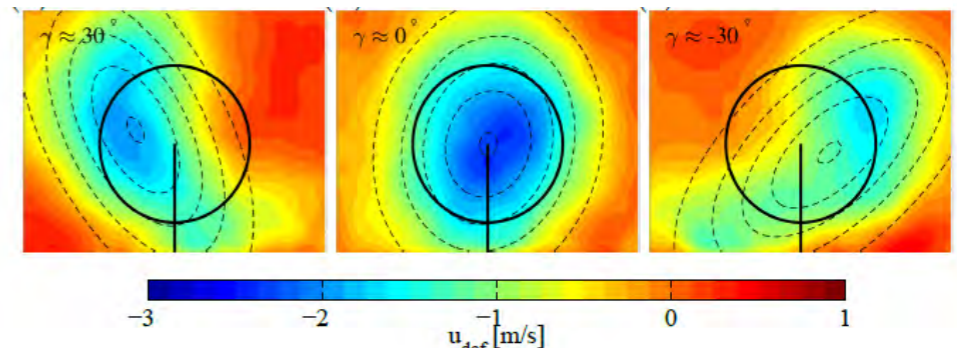
Kopplung von Meteorologie und CFD



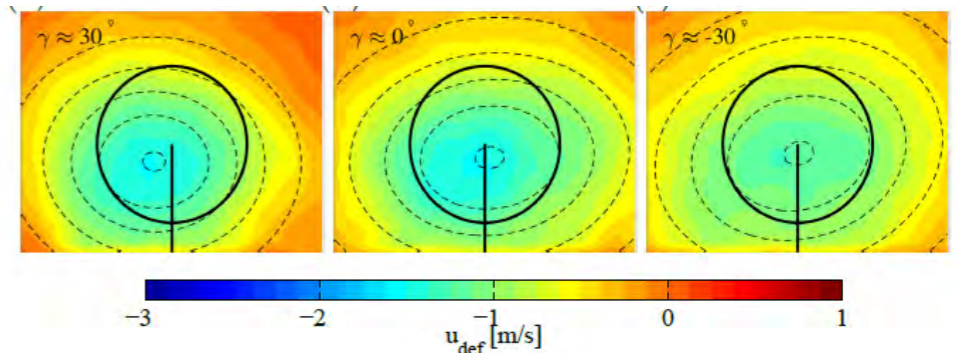
stabil



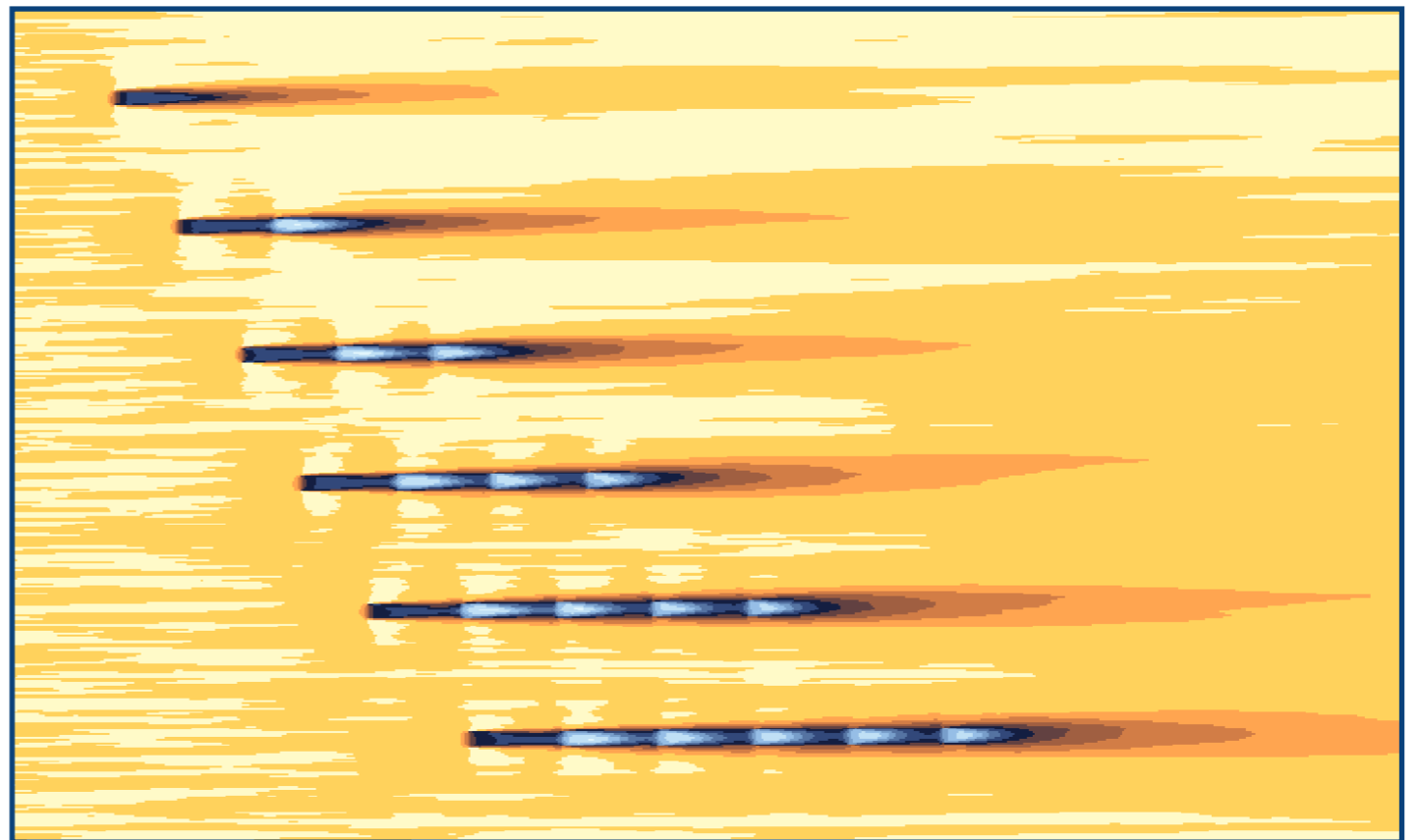
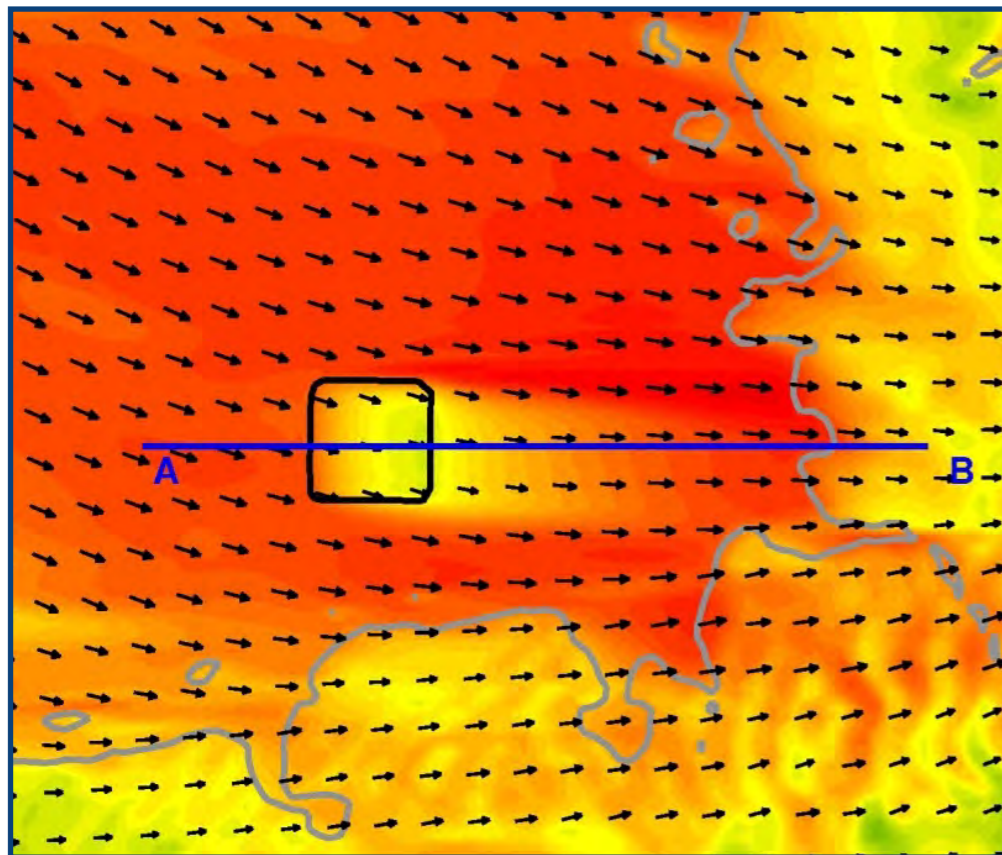
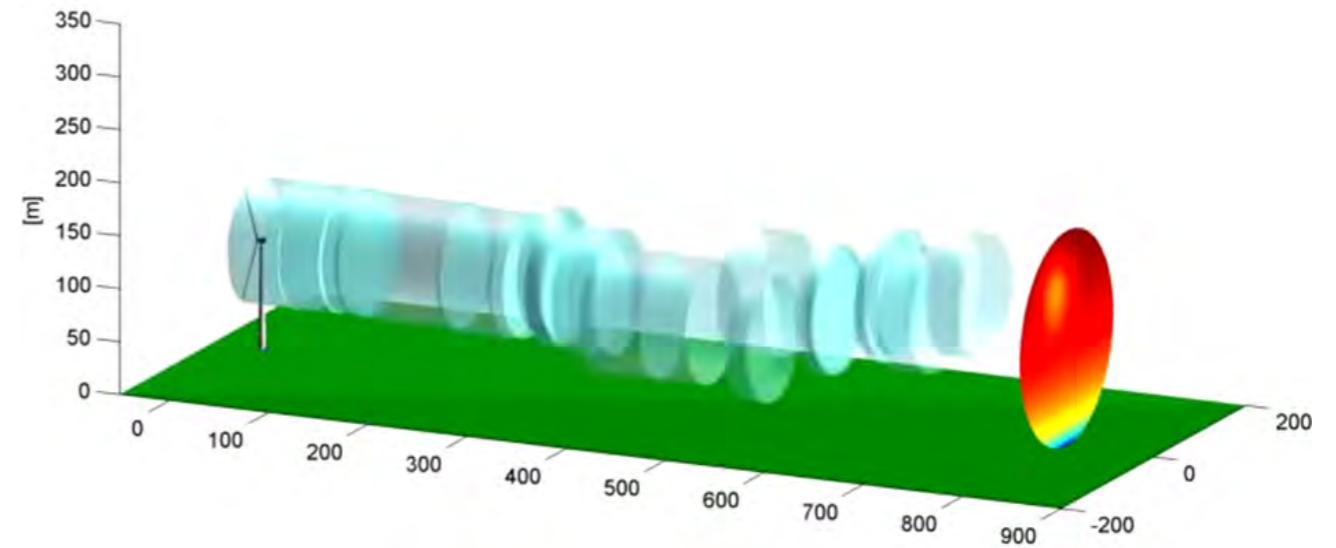
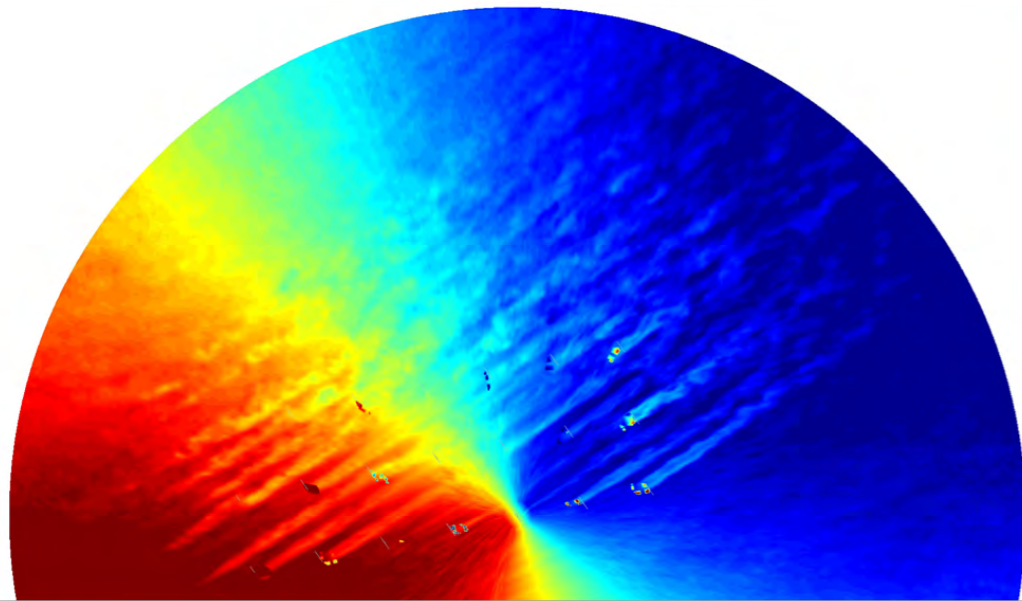
neutral



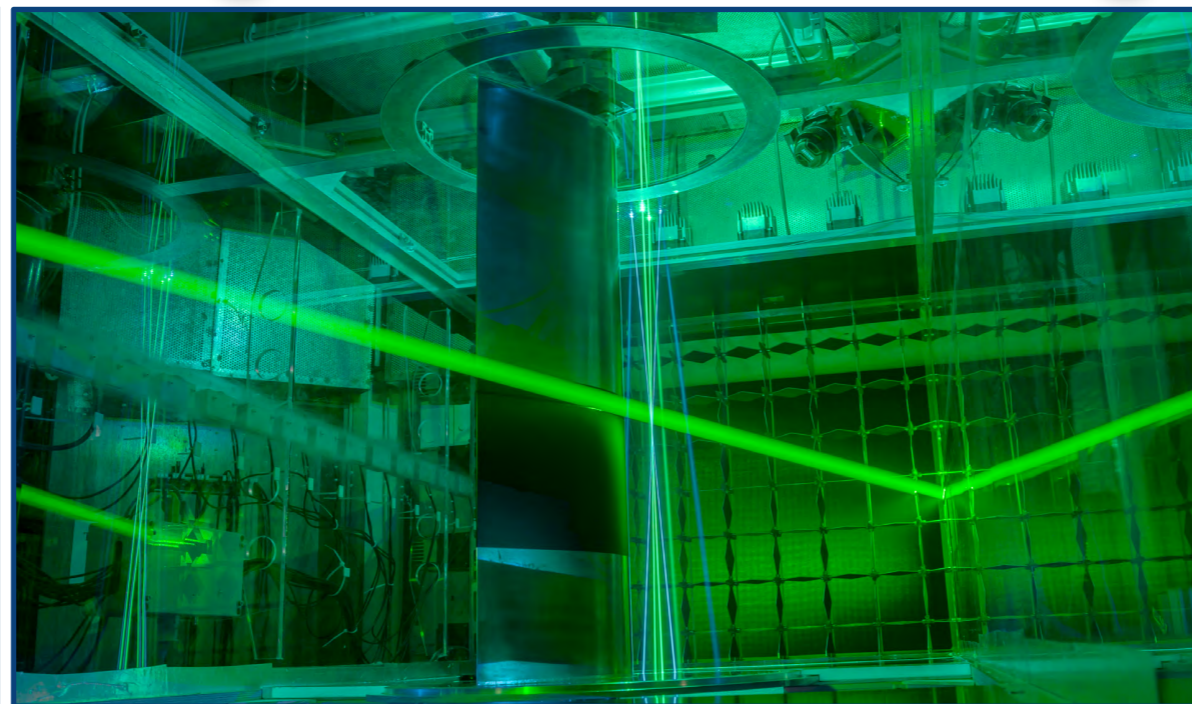
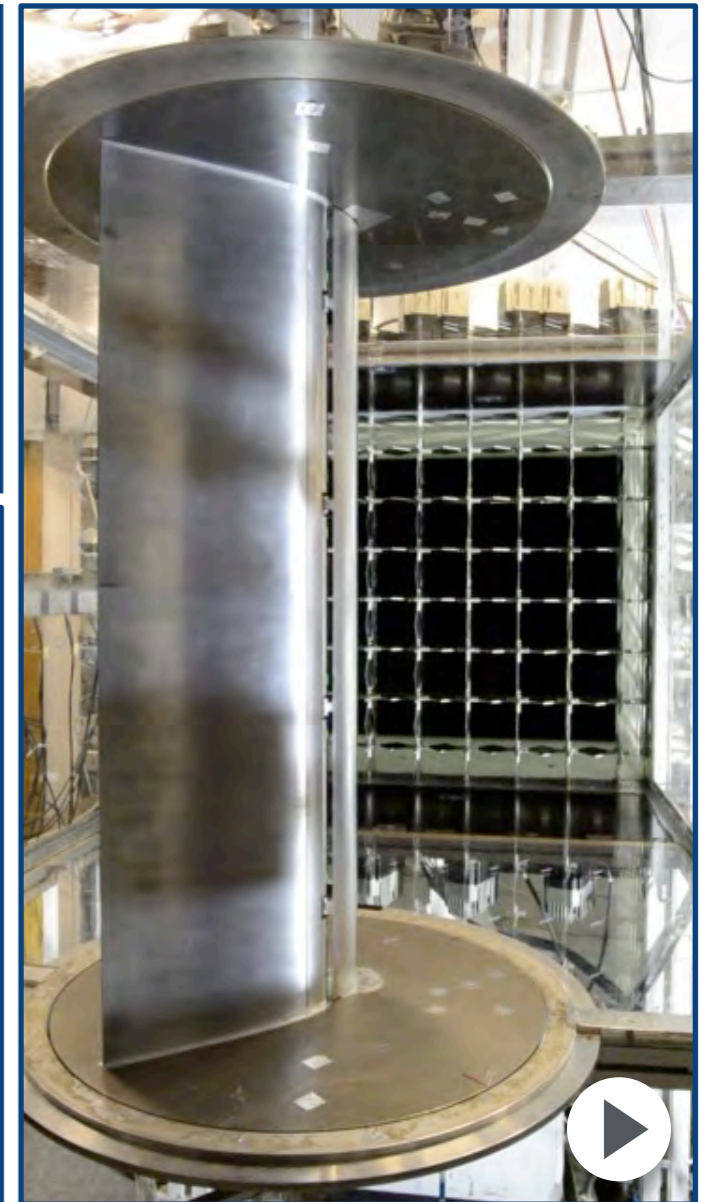
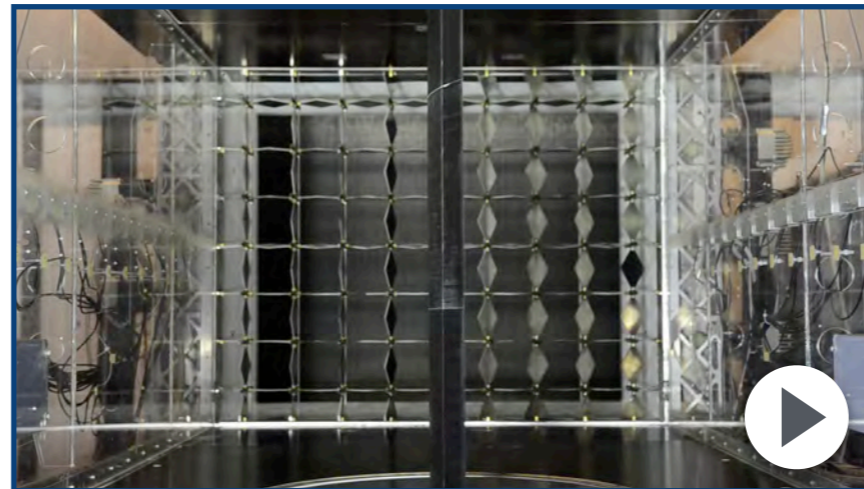
instabil



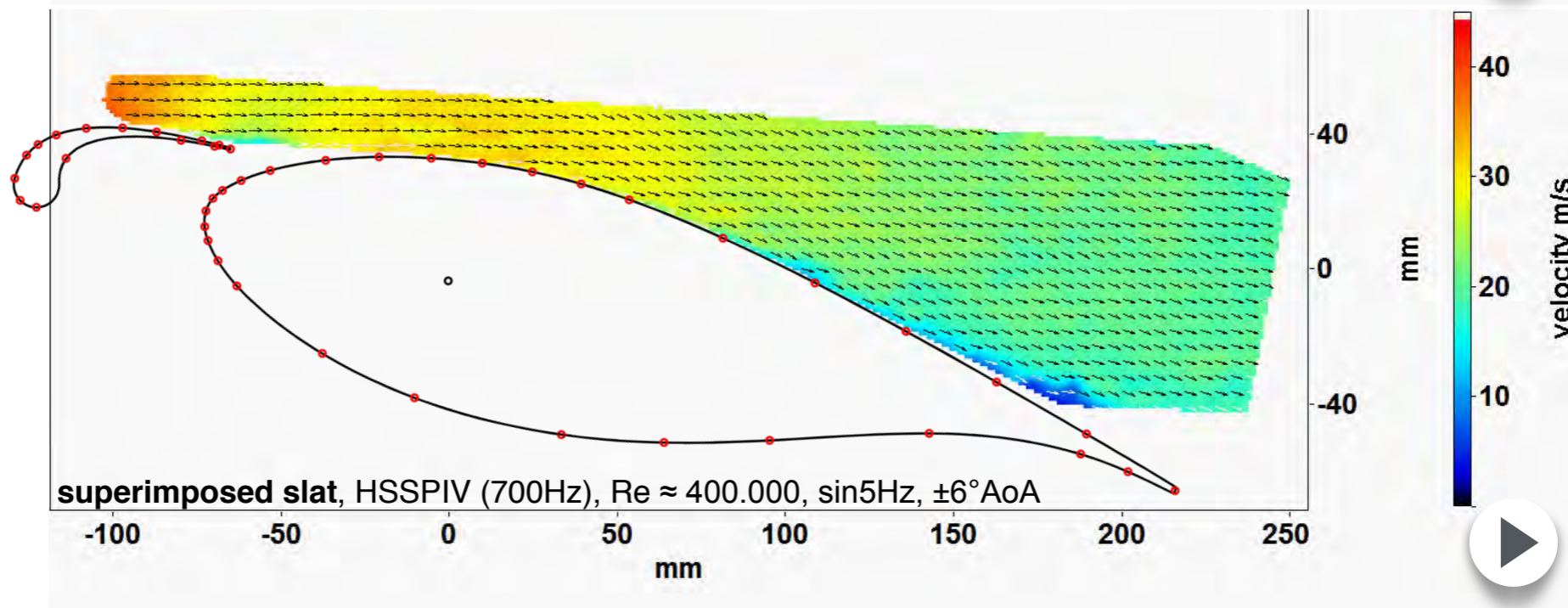
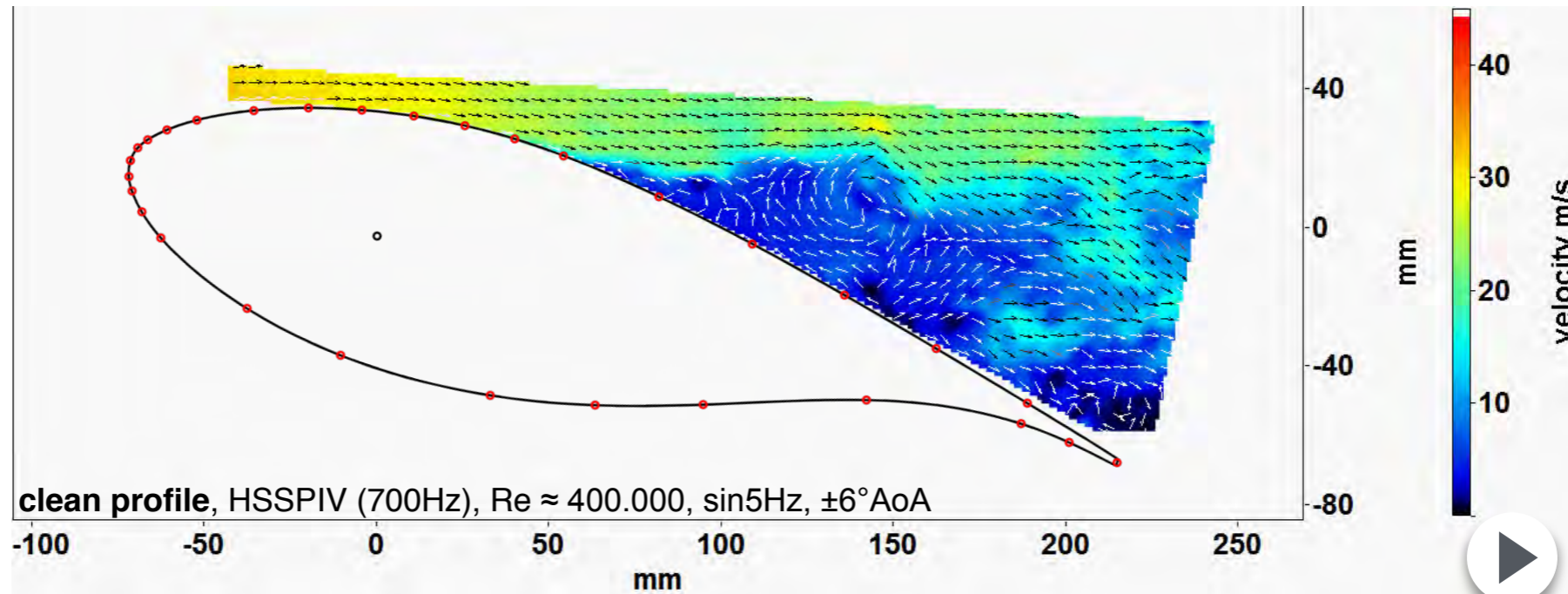
Modellierung von Windparkströmungen



Windkanäle mit optischer und akustischer Messtechnik, Turbulenzkontrolle und Modellwindenergieanlagen



High-Speed Stereo Particle Image Velocimetry

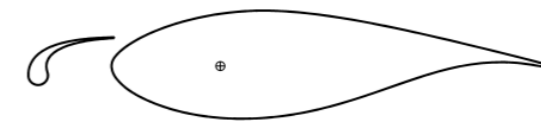
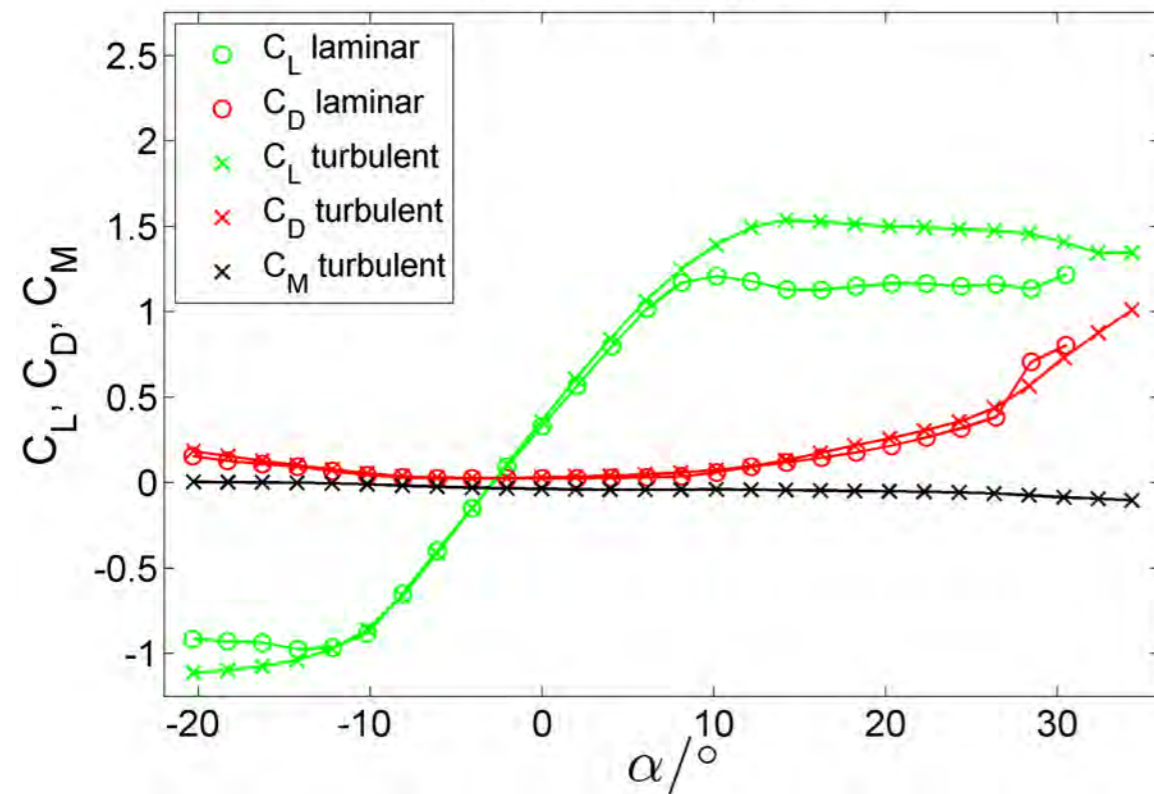


Polaren bei laminarer und turbulenter Anströmung

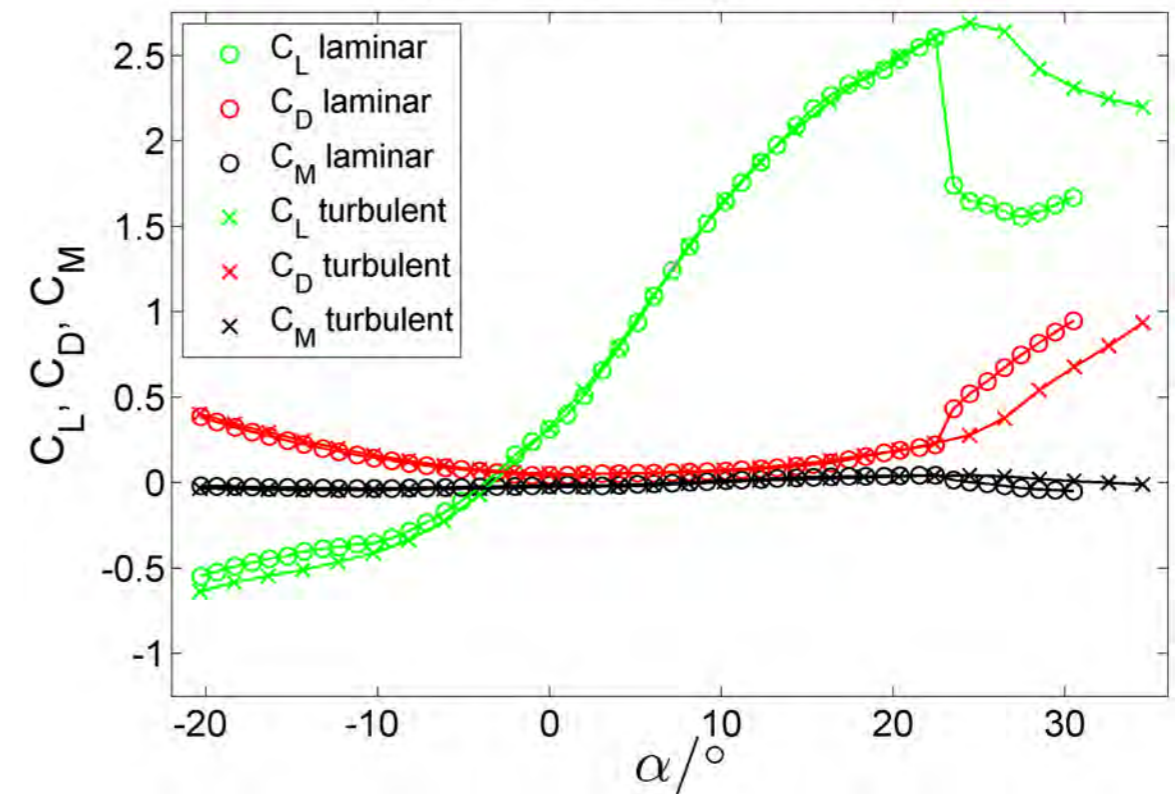
Re \approx 600,000



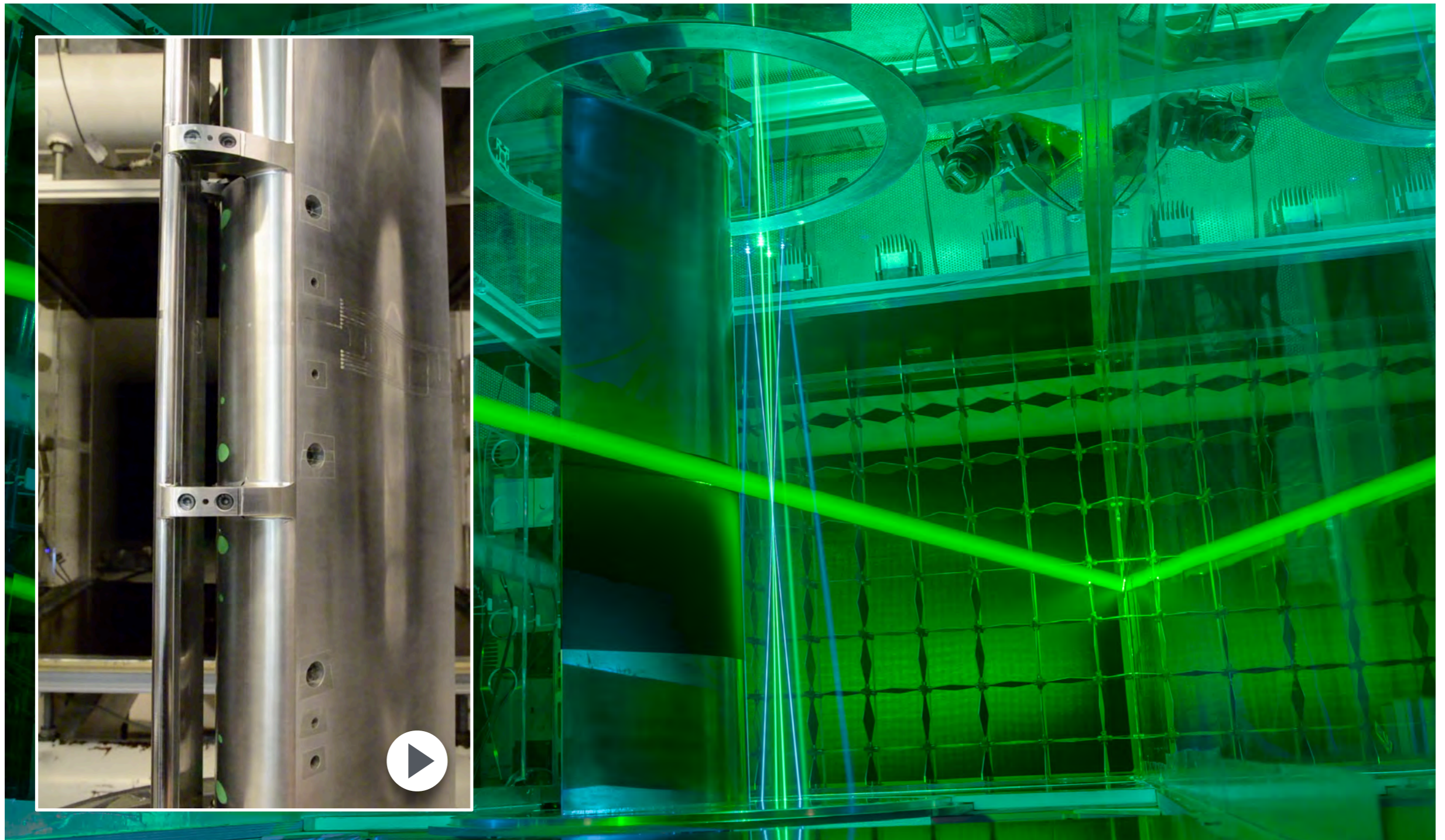
polars clean profile



polars superimposed slat

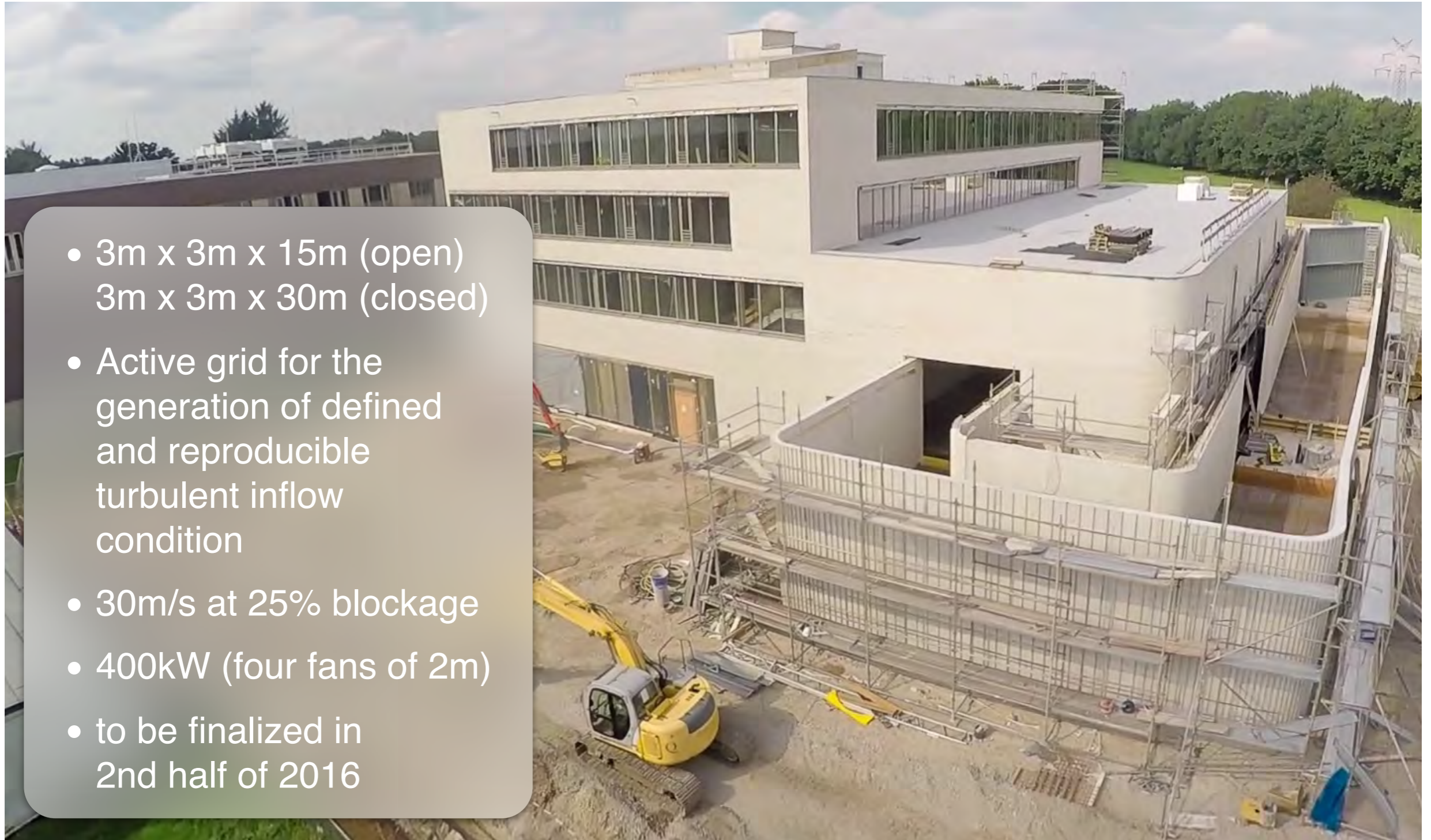


Potentiale und Machbarkeit von Smart Blades

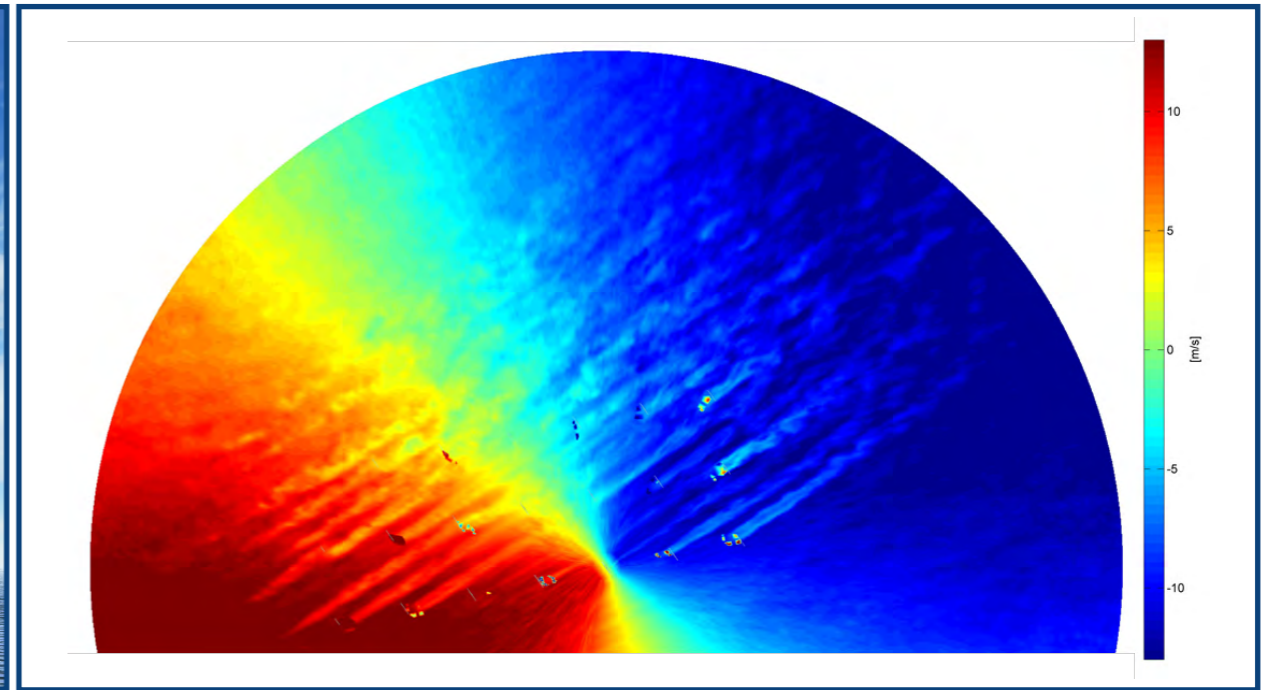
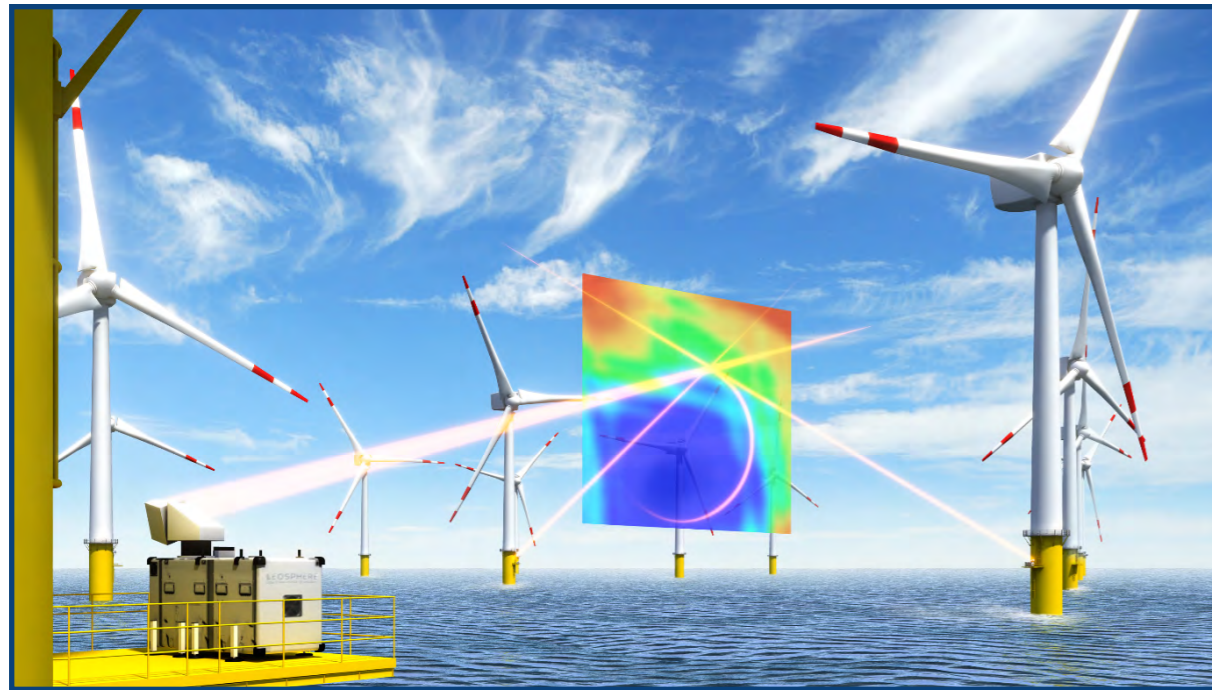
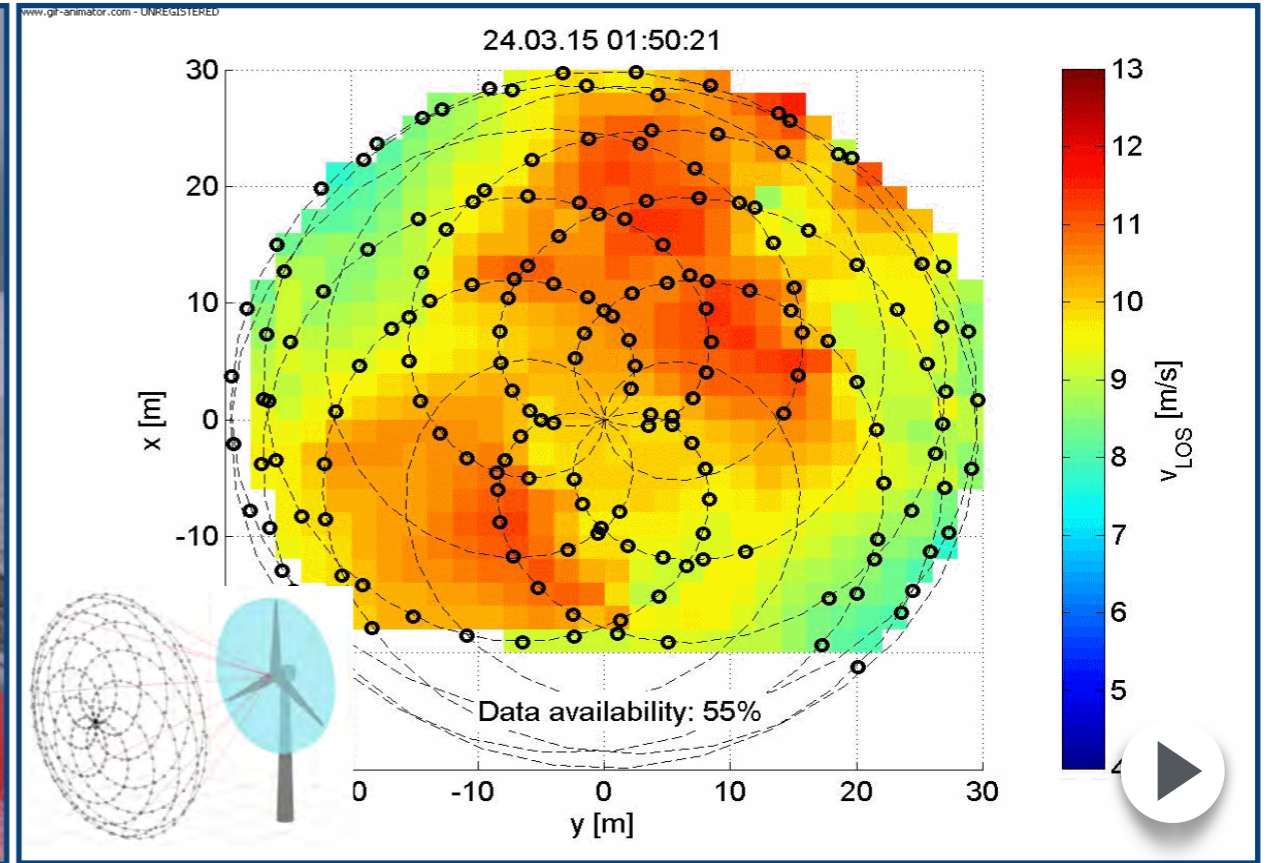
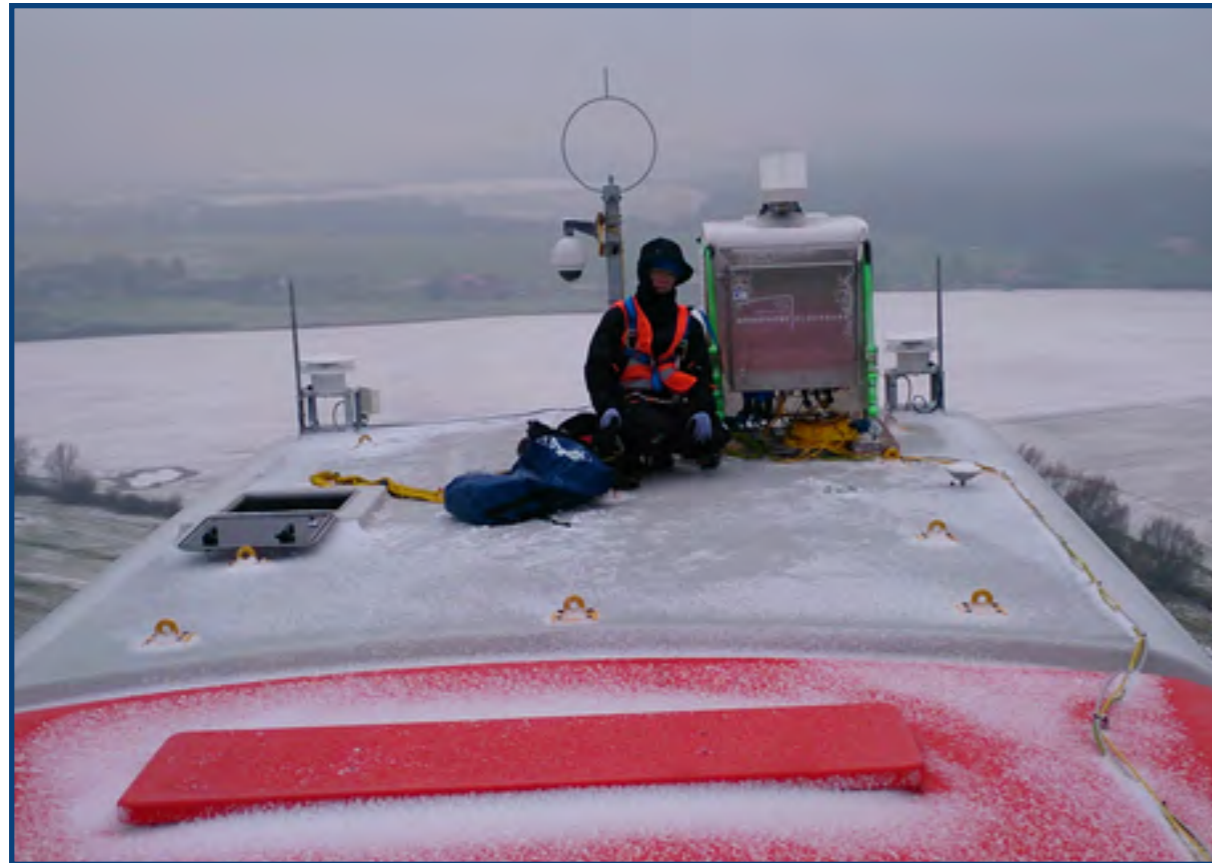


WindLab Oldenburg: Inbetriebnahme September 2016

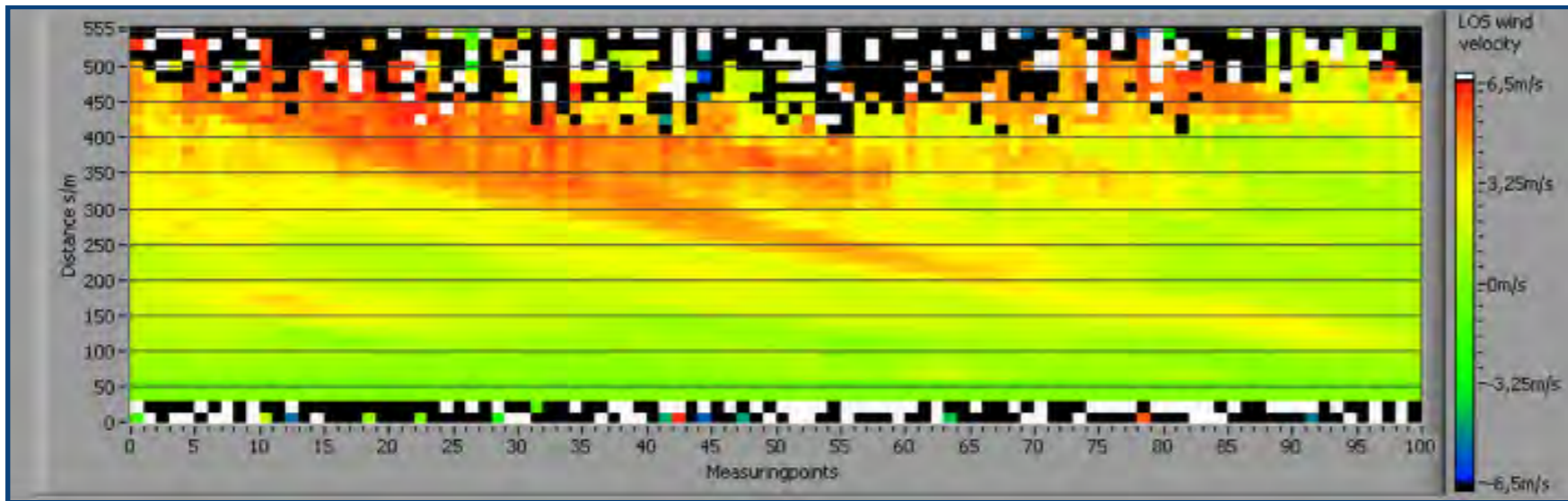
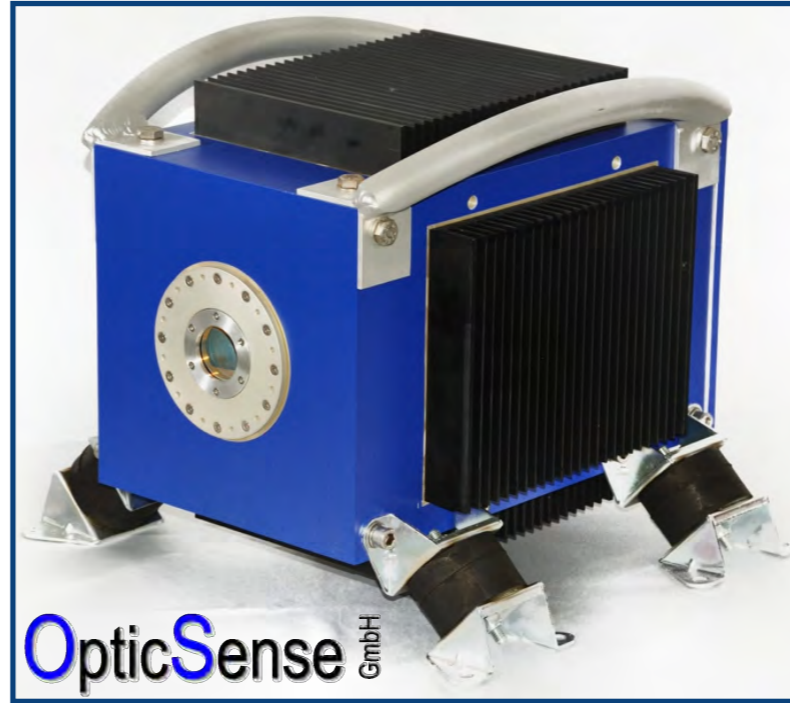
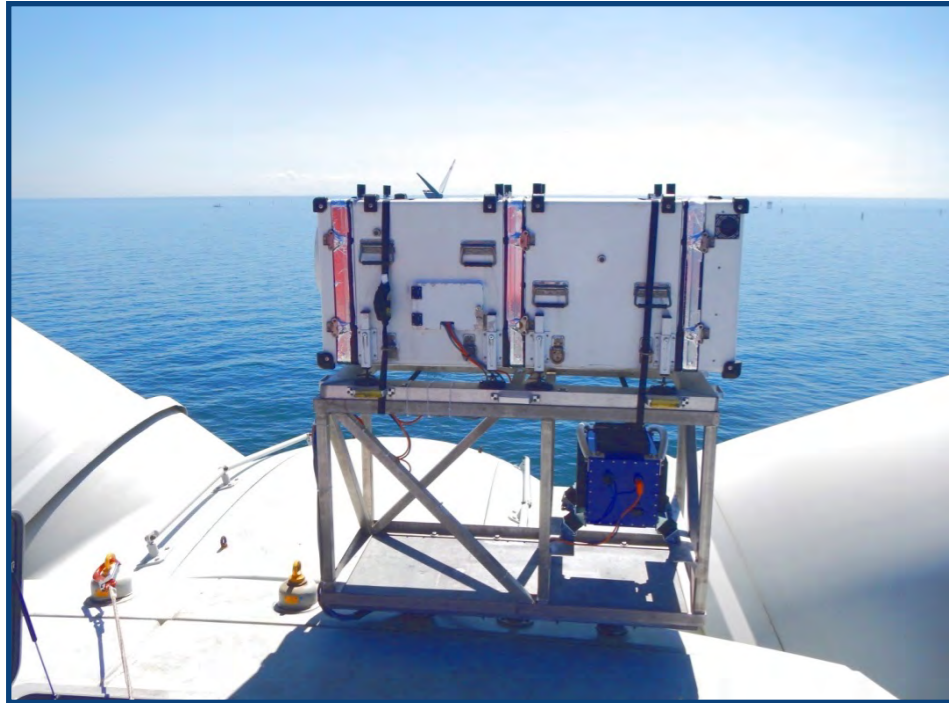
- 3m x 3m x 15m (open)
3m x 3m x 30m (closed)
- Active grid for the generation of defined and reproducible turbulent inflow condition
- 30m/s at 25% blockage
- 400kW (four fans of 2m)
- to be finalized in 2nd half of 2016



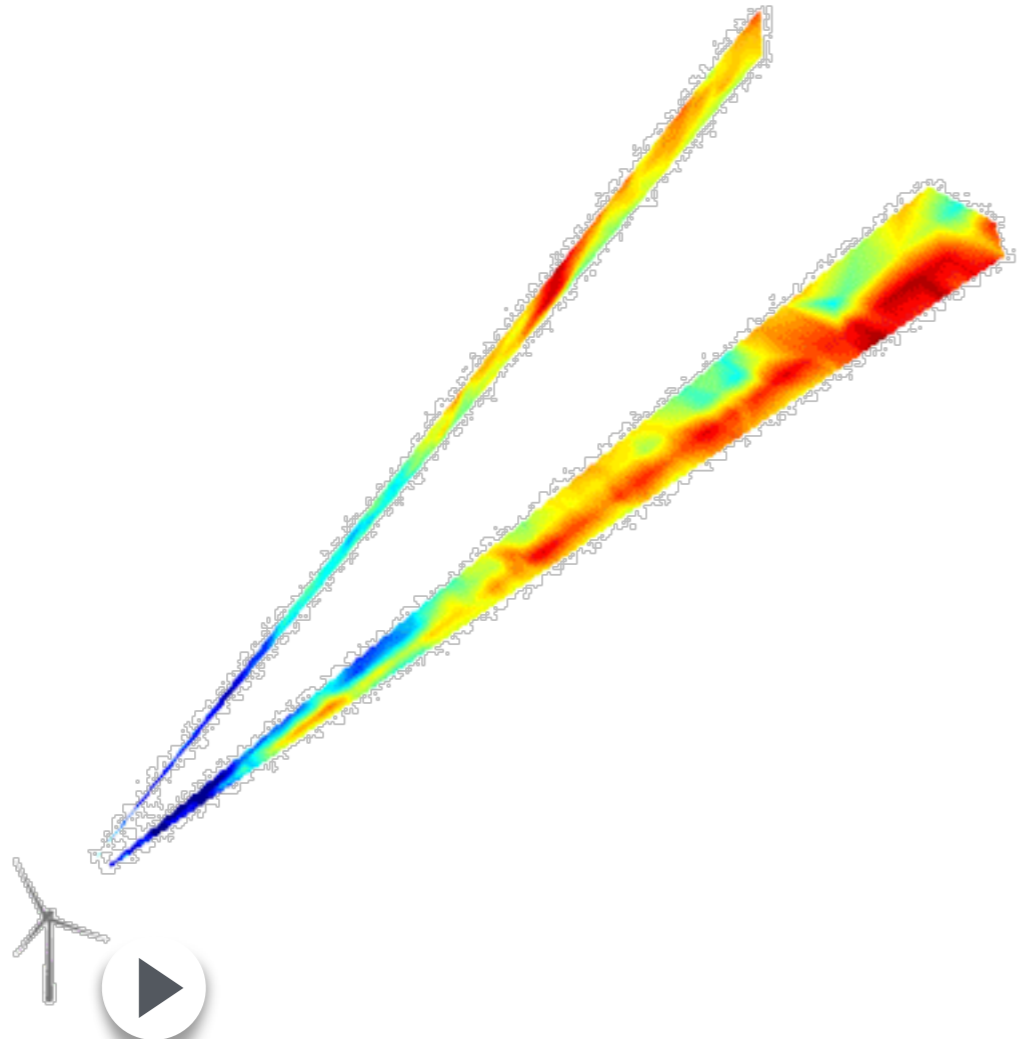
Short- und Long-range WindScanner



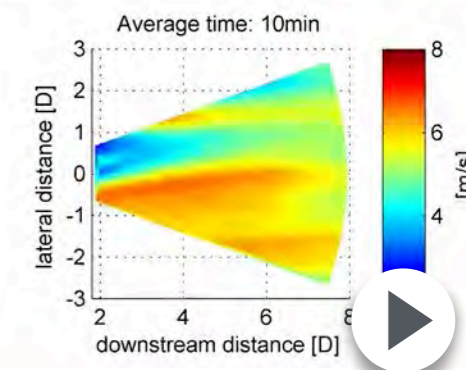
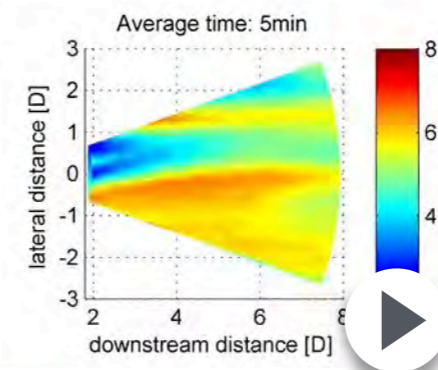
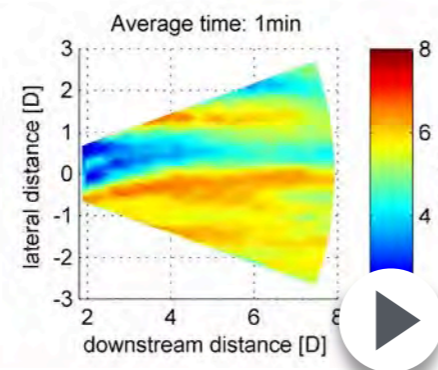
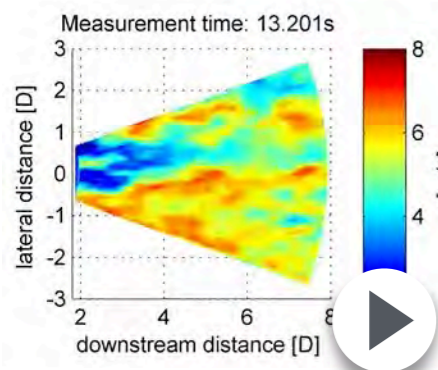
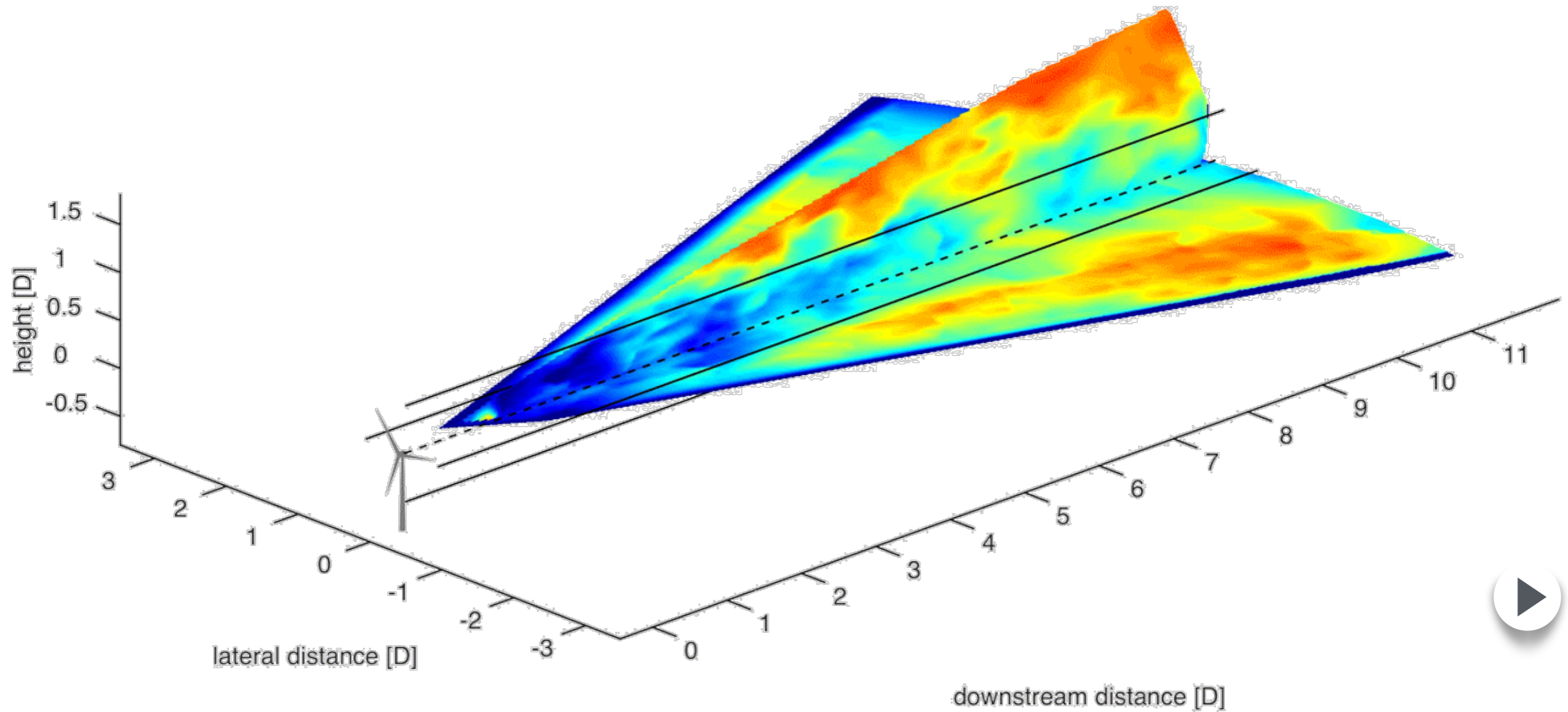
Entwicklungen für die industrielle Anwendung



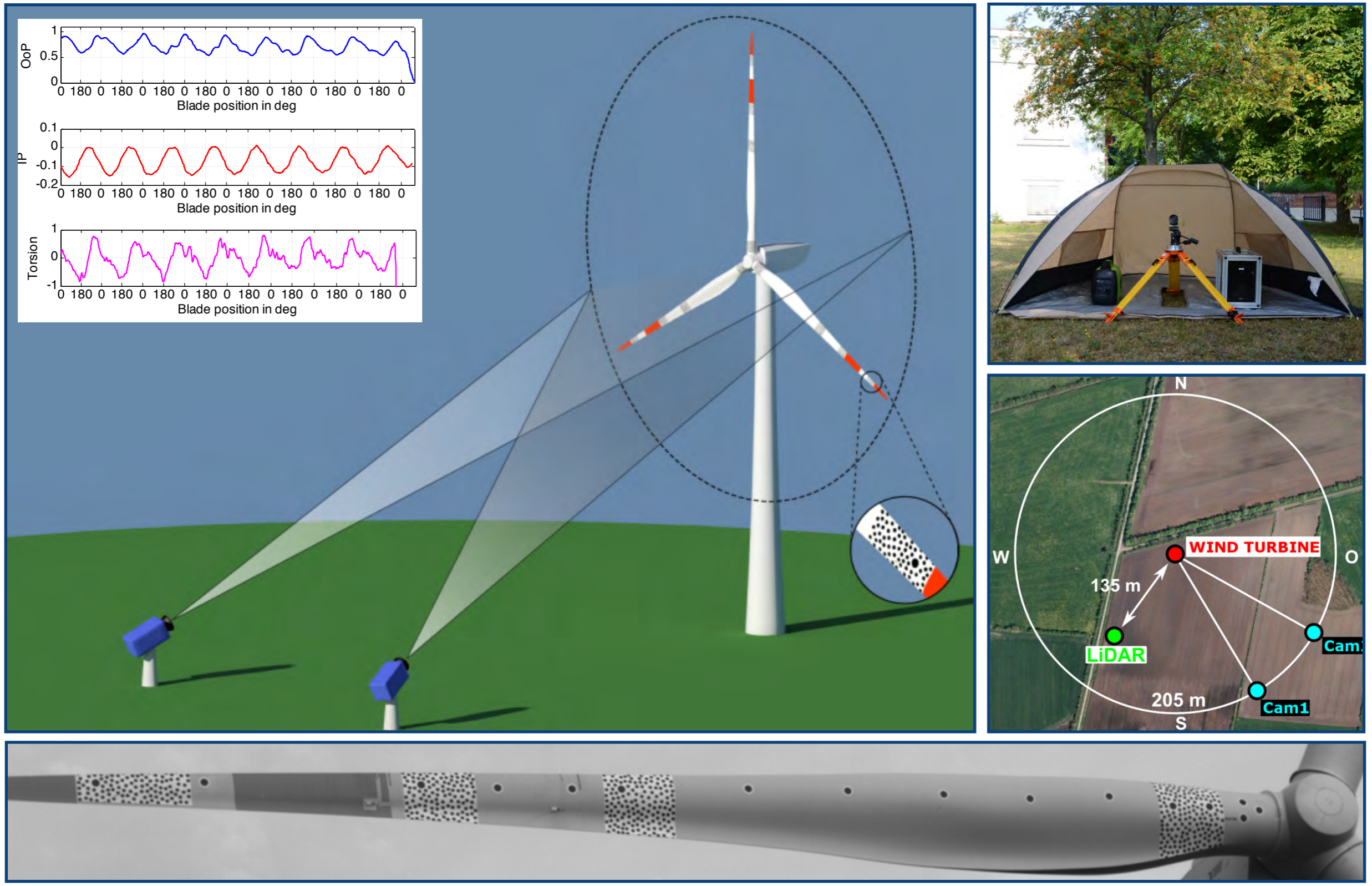
Von den Messdaten zum Windfeld



Von den Messdaten zum Windfeld



Optische Feldmessungen von Rotorblattverformungen

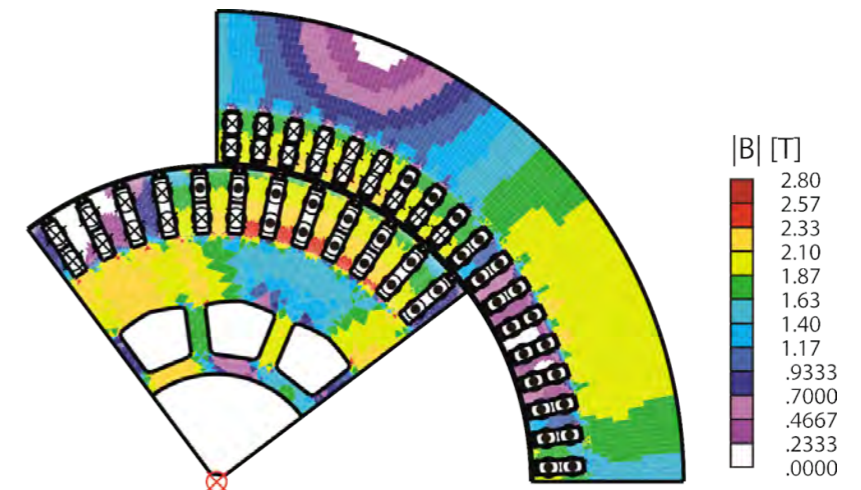


Antriebssysteme und Leistungselektronik

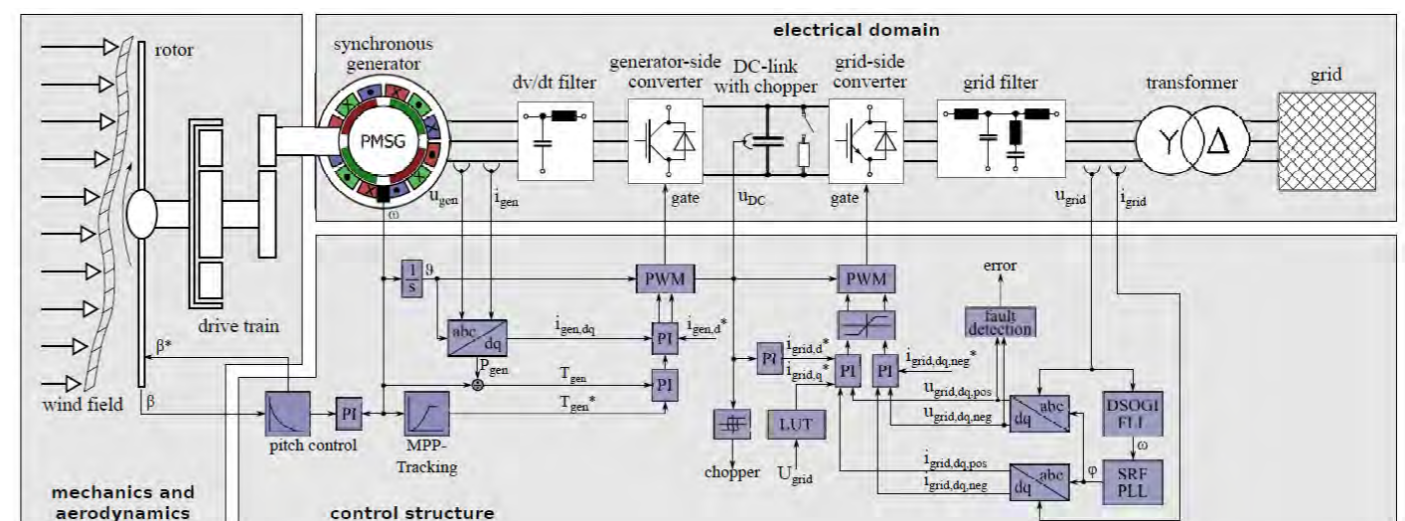
GeCoLab Generator-Umrichter-Prüfstand



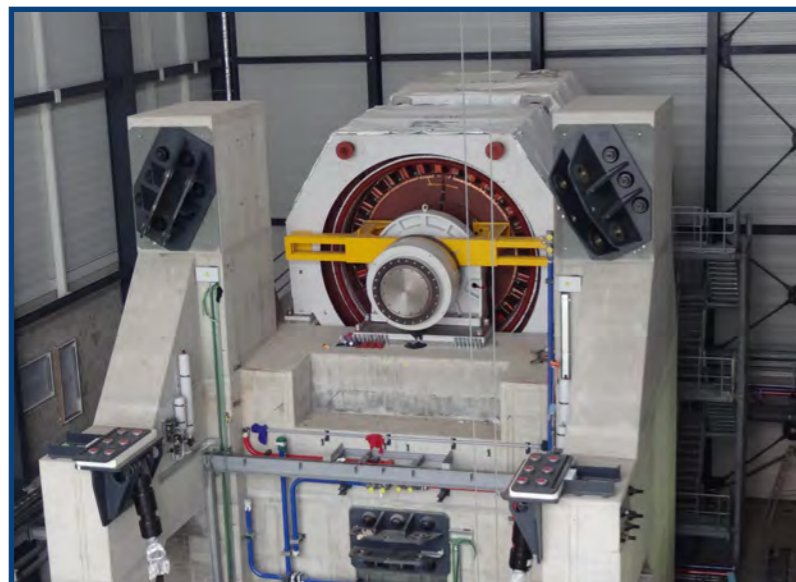
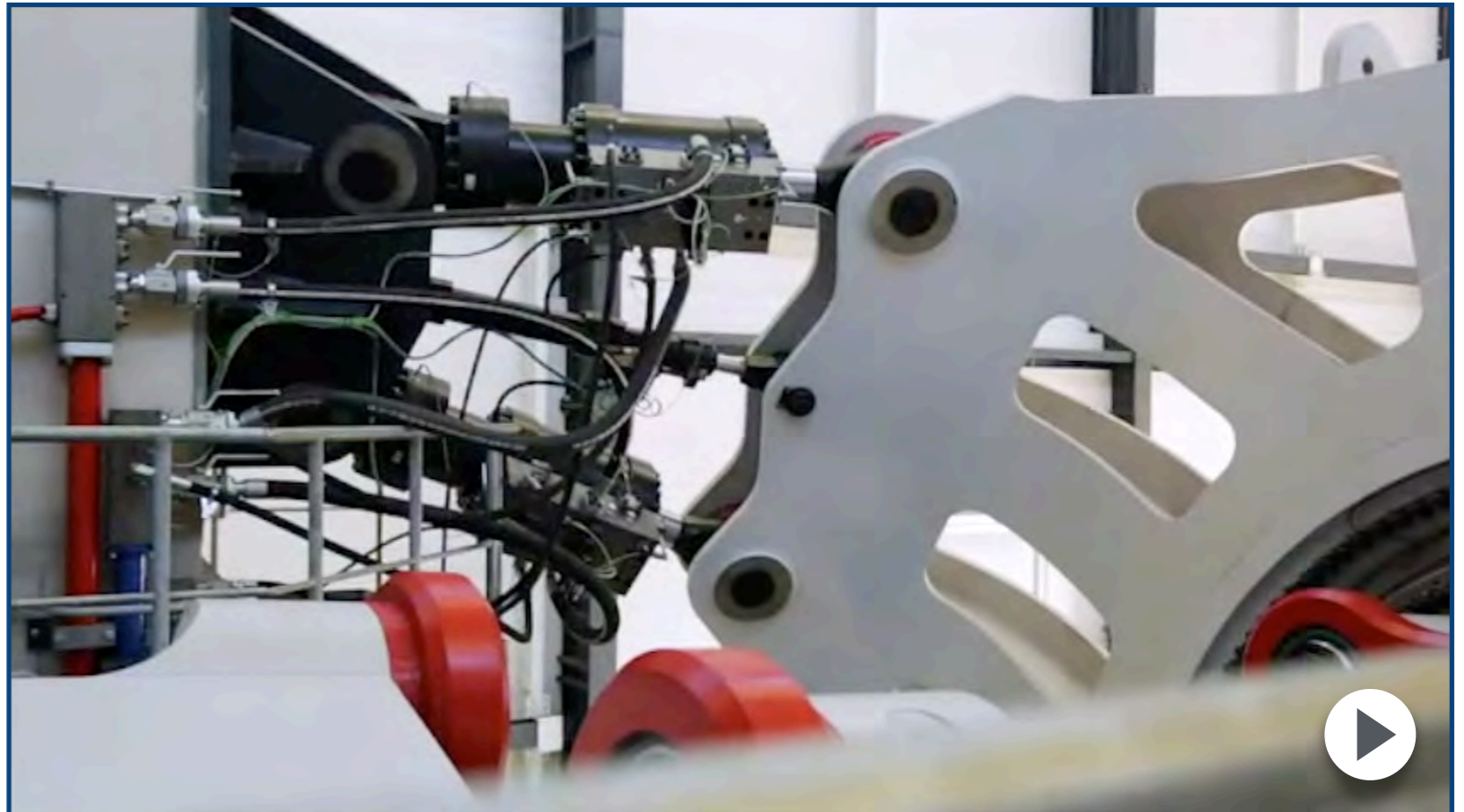
- Bemessungsspannung 690V
- Permanenterregte Synchronmaschine mit zugehörigem Vollumrichter [PN = 1,2 MW, nN = 375 rpm (0-750 rpm)]
- Doppeltgespeiste Asynchronmaschine mit zugehörigem Windumrichter [PN = 2,08 MW, nN = 1780 rpm]
- Umrichterbasierte Netznachbildung [SN = 4,4 MVA, fs = 5kHz]



- Entwurf von elektrischen Maschinen, Methoden und Software
- Messungen im Labor und im Feld
- Umrichter für Windenergieanlagen incl. Regelung
- Zuverlässigkeit der Leistungselektronik
- Modellierung WEA-Gesamtsystem



DyNaLab: 10 MW Antrieb / 44 MVA künstliches Netz



Testzentrum Tragstrukturen Hannover

Sandgrube

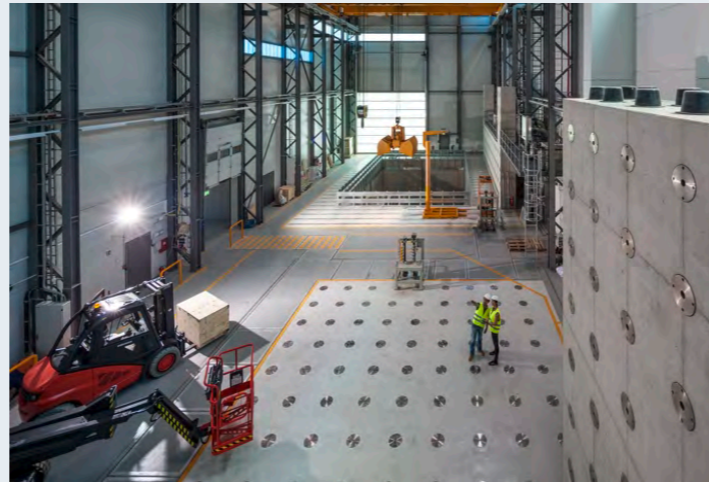
Testzentrum Tragstrukturen Hannover



- Dimensions: 14 x 9 x 10 m (L x W x D)
- Vertical loads: max 2 MN tension, max 700 kN pressure
- Horizontal load: max 0.5 MN tension/pressure load
- Test frequency: up to 50 Hz depending on cylinder
- Anchor points (vertical span): 0.5 MN tension/pressure load and 270 kN shear load

Spannfeld

Testzentrum Tragstrukturen Hannover



- Maße Horizontalfeld: 18,5 m x 9,5 m (L x B)
- Maße Vertikalfeld: 9,5 m x 10 m x 8 m (L x B x H) Winkelkonstruktion
- Last: bis zu 8 Zylinder á 2 MN
- Prüffrequenz: bis zu 5 Hz
- Ankerpunkte: 1 MN Zug- und Drucklast und 420 kN Schubkraft
- Raster: 1 m x 1 m

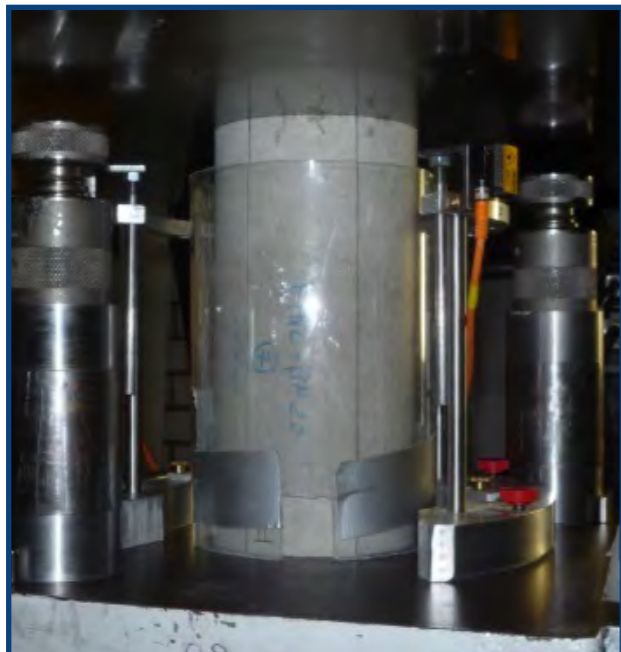
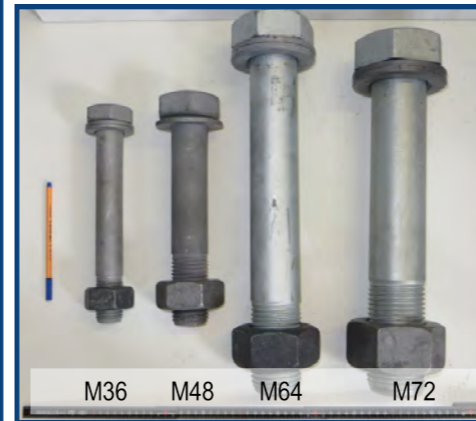
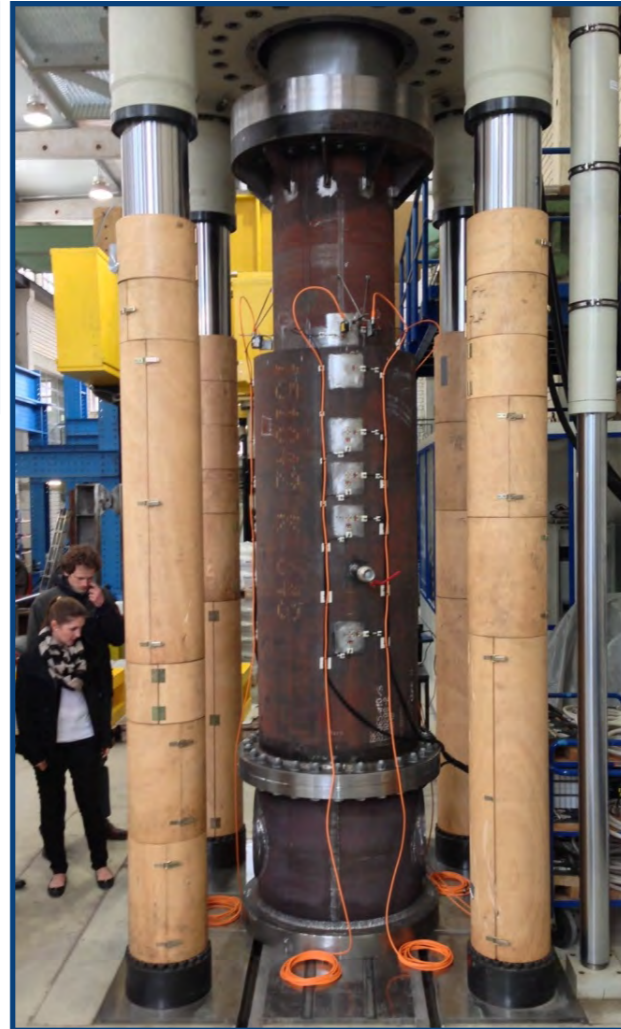
Speziallabore

Testzentrum Tragstrukturen Hannover

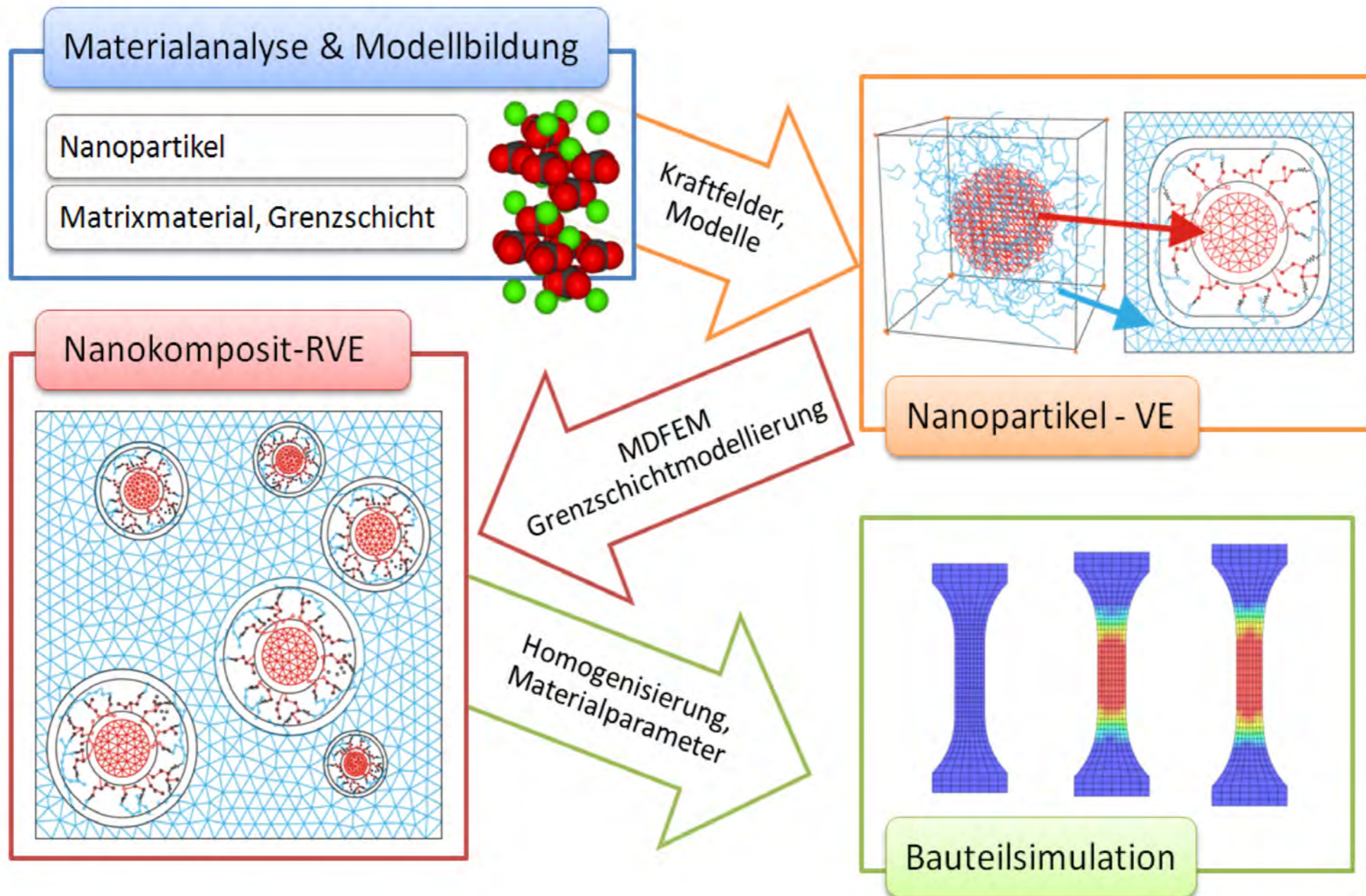


- Klimakammer: 4,2 m x 2,8 m
- Autoklave
- Speziallabore für
 - Bodenmechanik
 - Beton
 - Komposit
 - Generator-Umrichter
 - Resonanzprüfungen

(Hybrid-)Materialentwicklung und -prüfung

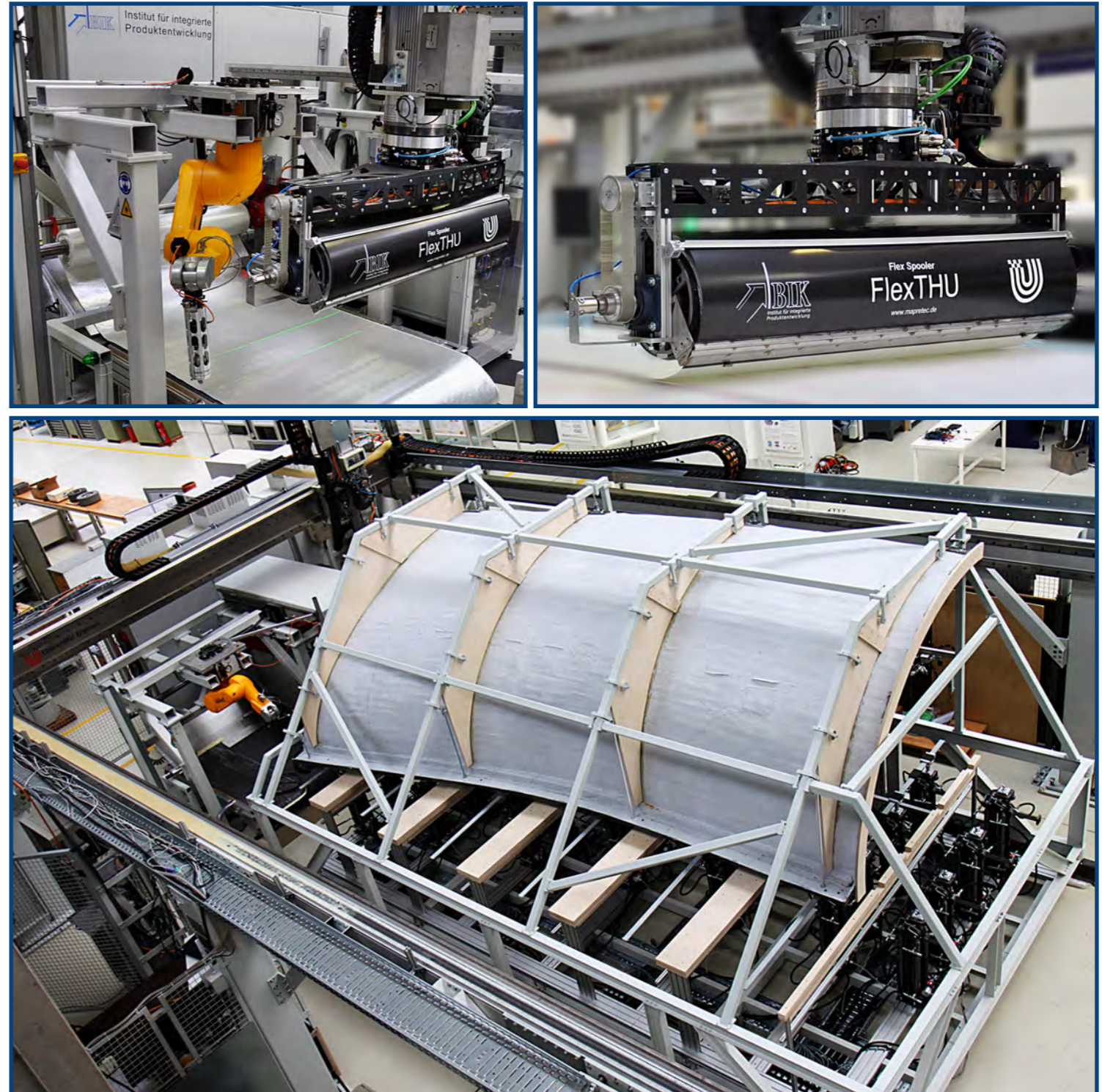


Nanomodifizierte und hybride Werkstoffsysteme im Rotorblatt



Automatisierte Fertigung

- Handhabungstechnologien für biege- und schubweiche Materialien (z.B. techn. Textilien)
- Modellierung und Simulation von Produkten und Fertigungsprozessen
- Messung von Qualitätsparametern während des Prozessablaufs
- Entwicklung und Test von ganzheitlichen automatisierten Prozessen von der Materialbereitstellung bis zum fertigen Rotorblatt
- Kombination intelligenter und flexibler Automatisierungstechnik, adaptiver Materialumgang sowie Einsatz von innovativer Sensor- und Informationstechnologie



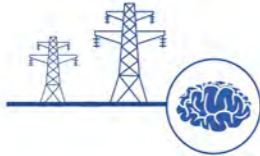
Systeme und Financial Decision Support Tool (FDSS)



Energiewandlungssysteme
Windenergie, Solar, KWK & Speicher



Ökologie
Klima und Umwelt



Netze
Intelligenter Betrieb



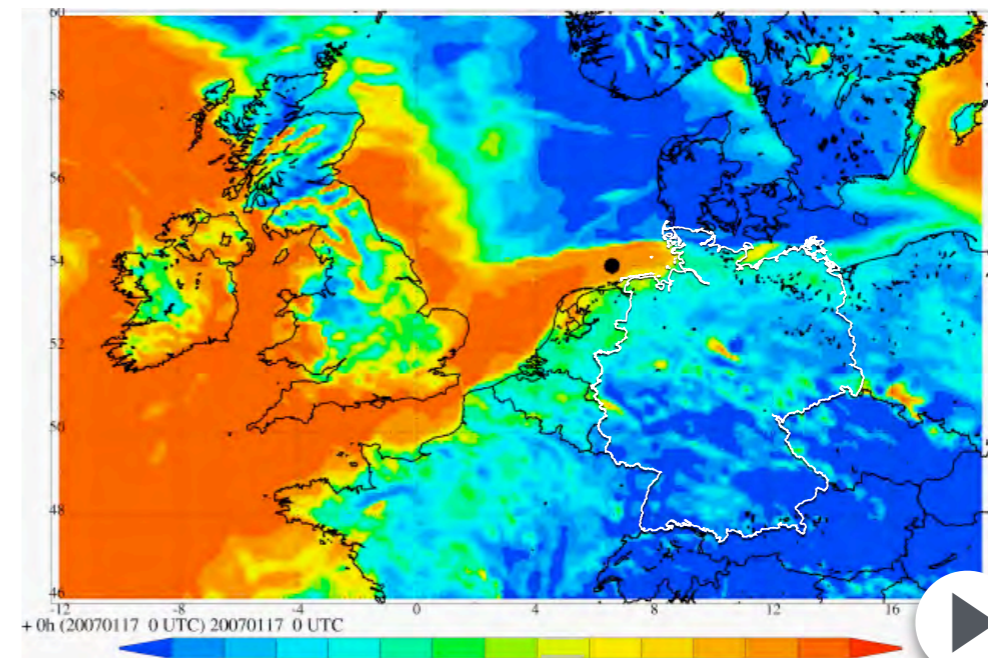
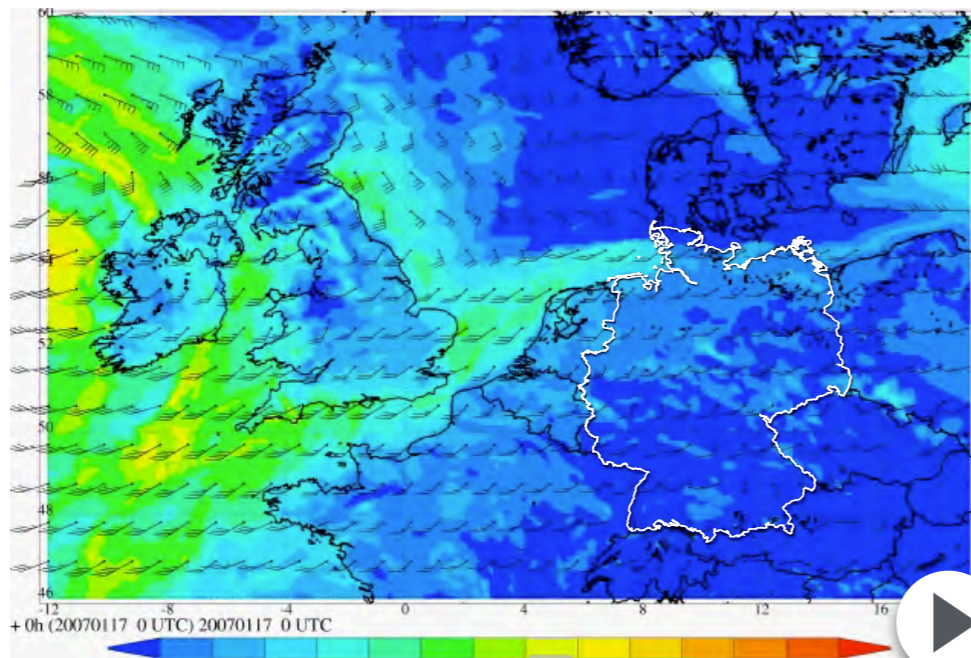
Betriebswirtschaft
Geschäftsmodelle



Szenarien
Vorhersagen & Architekturen



Volkswirtschaft
Energiepolitik & -märkte



Berufsbegleitende Qualifizierung

Wind *Studium*

**Für Ihren Aufstieg
in der Windenergie:**

Weiterbildendes Studium
Windenergietechnik und -management



Studienjahr 2016/2017

ForWind  Zentrum für Windenergieforschung
wab  windenergie
agentur

■ Projektarbeit
Teamsitzungen
Präsentationen

- 
- ■ 1. Auftaktseminar
 - 2. Windpotential
 - 3. Planung und Errichtung
 - 4. Anlagenkonzepte und maschinenbauliche Komponenten
 - 5. Planungs- und Energierecht Vertragsrecht
 - 6. Aerodynamik und Rotor Lastannahmen und Dynamik
 - 7. Finanzierung von Windenergieprojekten Zwischenprüfung
 - 8. Turm und Fundament Offshore
 - 9. Elektrisches System Stromnetze und Netzintegration
 - ■ 10. Kaufmännische Geschäftsführung Windparks
 - 11. Technische Betriebsführung
 - ■ 12. Abschlusseminar Prüfungen Projektpräsentation

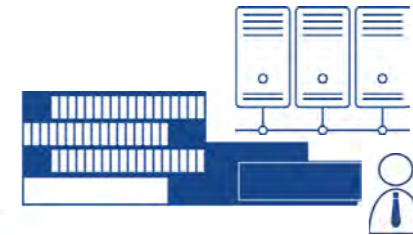
Vorteile einer Partnerschaft von FuE mit der Industrie



- Absolventen
B.Sc. / M.Sc.
- Windenergie-
Ingenieurwesen
- European Wind
Energy Master
- WindStudium



- Senior Experts
M.Sc. / Ph.D.
- Thematische
Schwerpunkte
durch Projekte
- Karriereoption
Uni2Industrie



- Nutzung der
Ressourcen: HR
und Infrastrukturen
- Definition von
Bedarfen an
Testzentren und
FuE-Möglichkeiten

Interesse?

ForWind – Center for Wind Energy Research

Dr. Stephan Barth

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26129 Oldenburg

GERMANY

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