

Far out!

Alpha Ventus – Pilot Project and Offshore Research Lab OWO 2011

June 16, 2011, Bergen, Norway



Dipl.-Ing. Michael Durstewitz
Fraunhofer-Institute for Wind Energy and Energy System Technology IWES,
Kassel, Germany

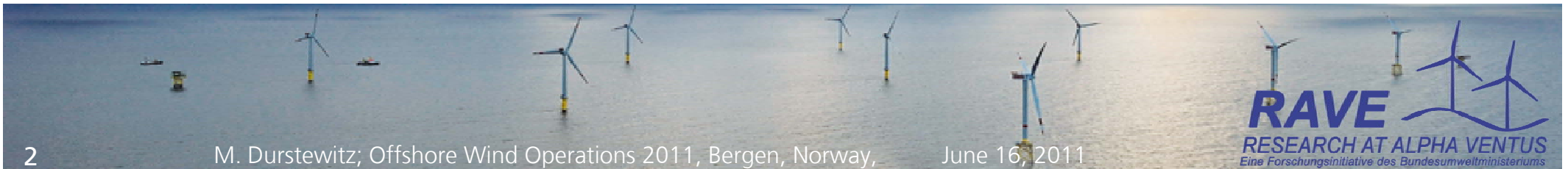
Funding Body

Supervisor

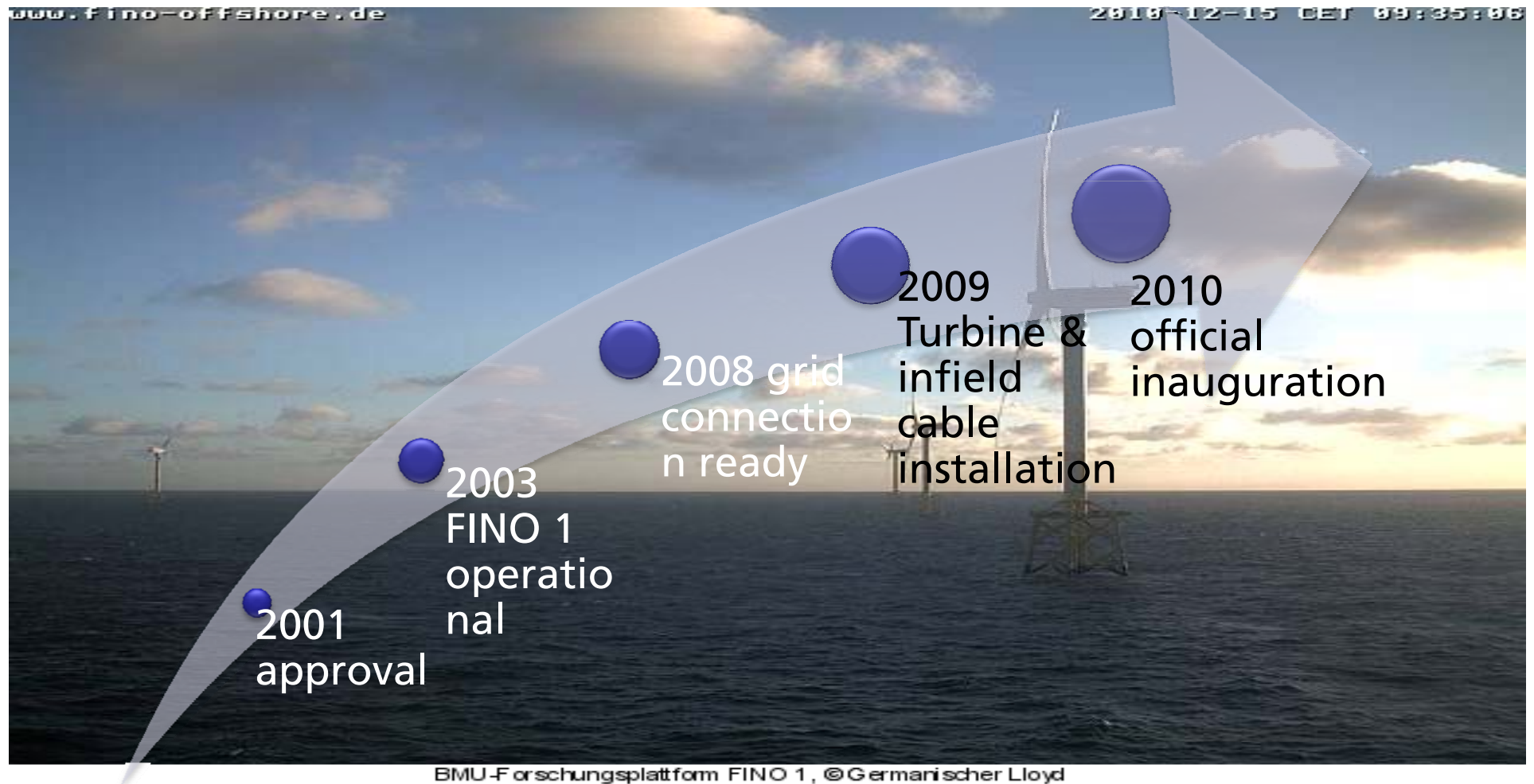
Coordination

Content

1. offshore wind farm alpha ventus
facts & lessons learnt
2. RAVE – the research initiative at alpha ventus
 - Objectives
 - Projects
 - Measurements
3. Outlook – next steps



Alpha ventus: selected milestones

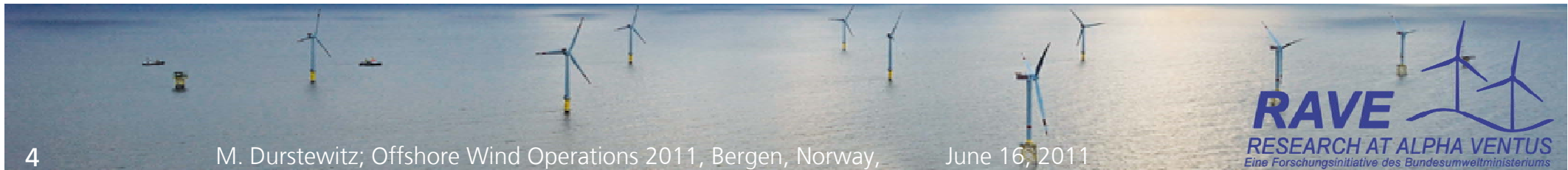


Alpha ventus: location and project details

- Demonstration project
- North Sea, 50 km north of Borkum
- 60 MW
- 12 WT, 5 MW each
- ~100m hub height
- ~120m diameter
- AC grid connection
- 30 m water depth
- FINO 1 nearby
- operated by DOTI



© DOTI



Project structure

Alpha ventus

Main project trades

substation

AREVA
Wind
M5000

Repower
5M

5M Jacket
foundations

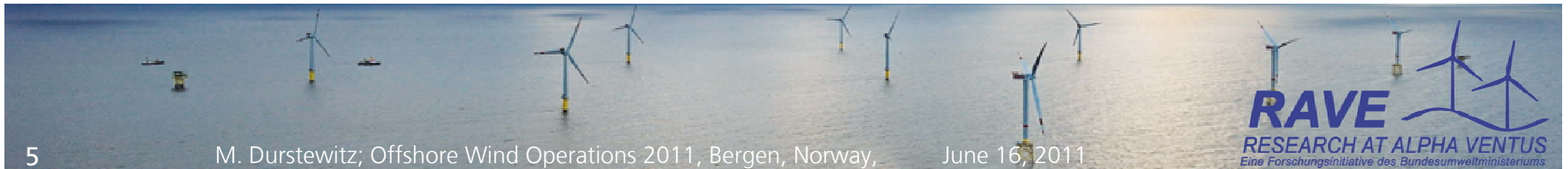
Infield
cabling

Control
system

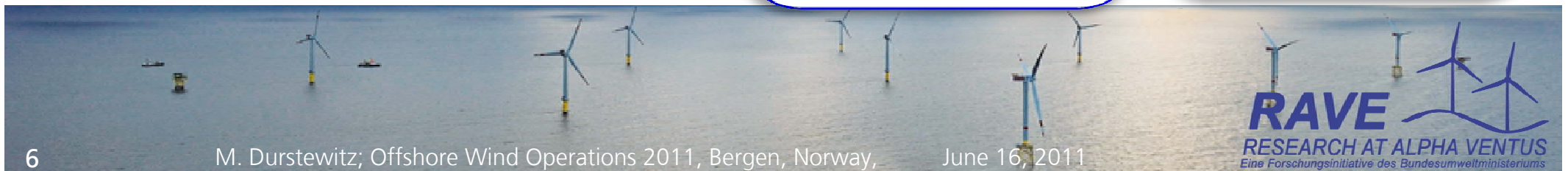
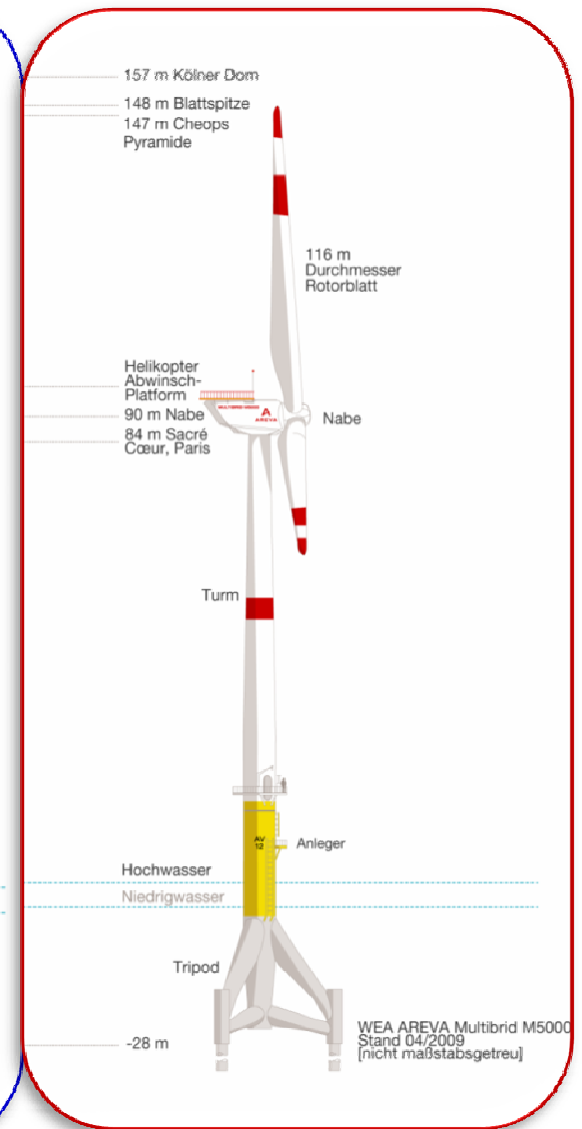
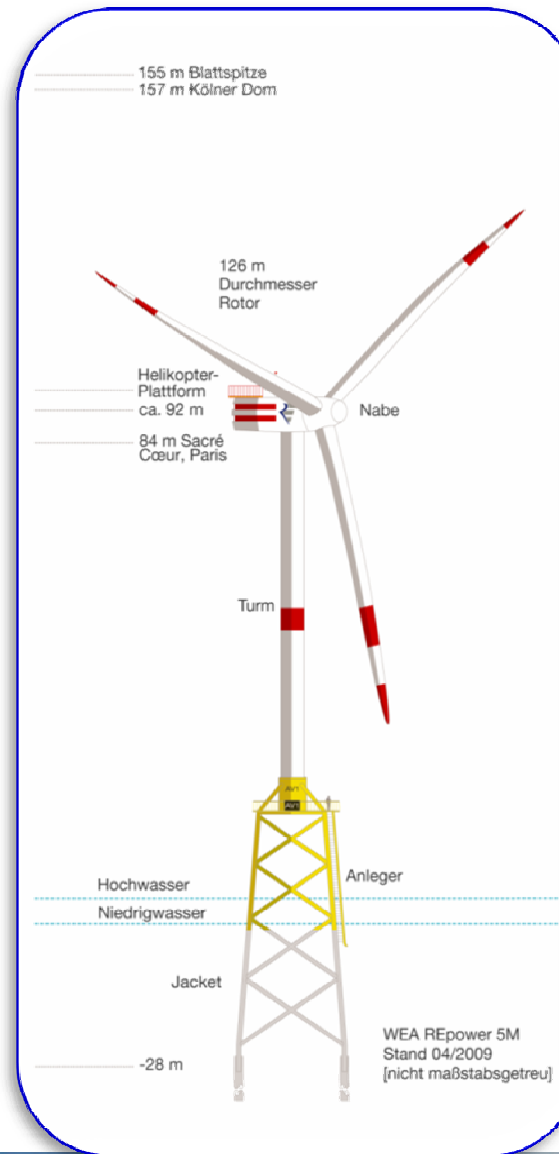
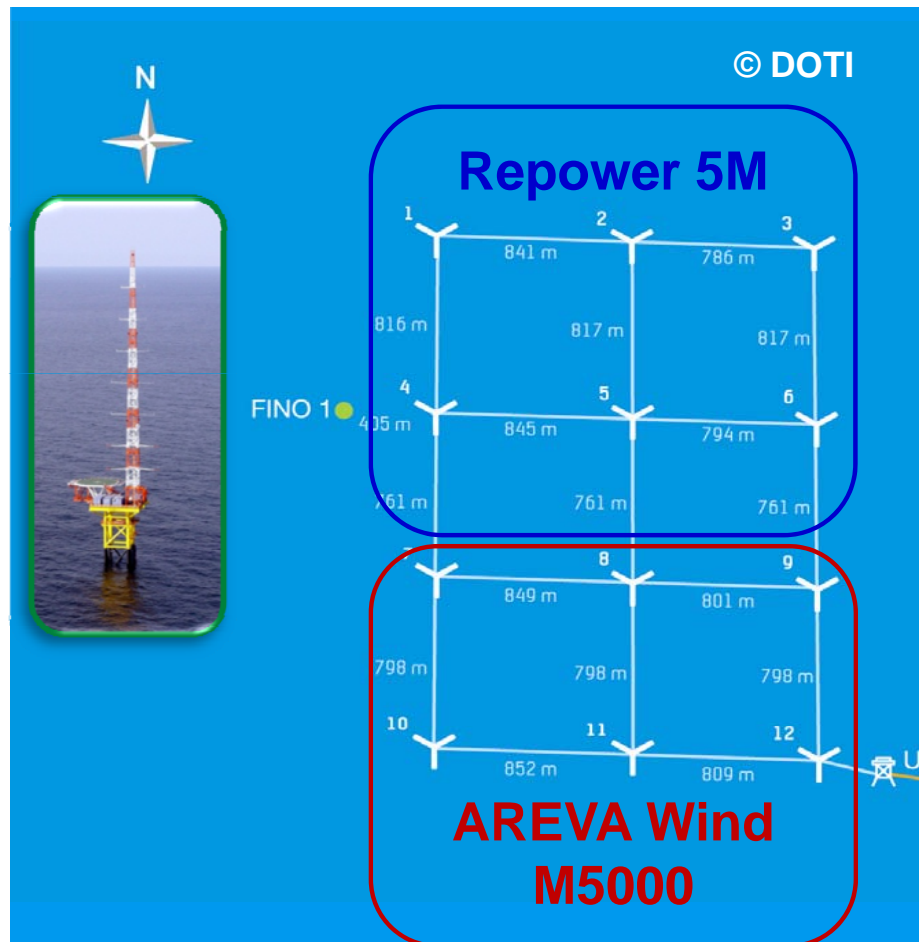
tripod

General
contractor

R
A
V
E

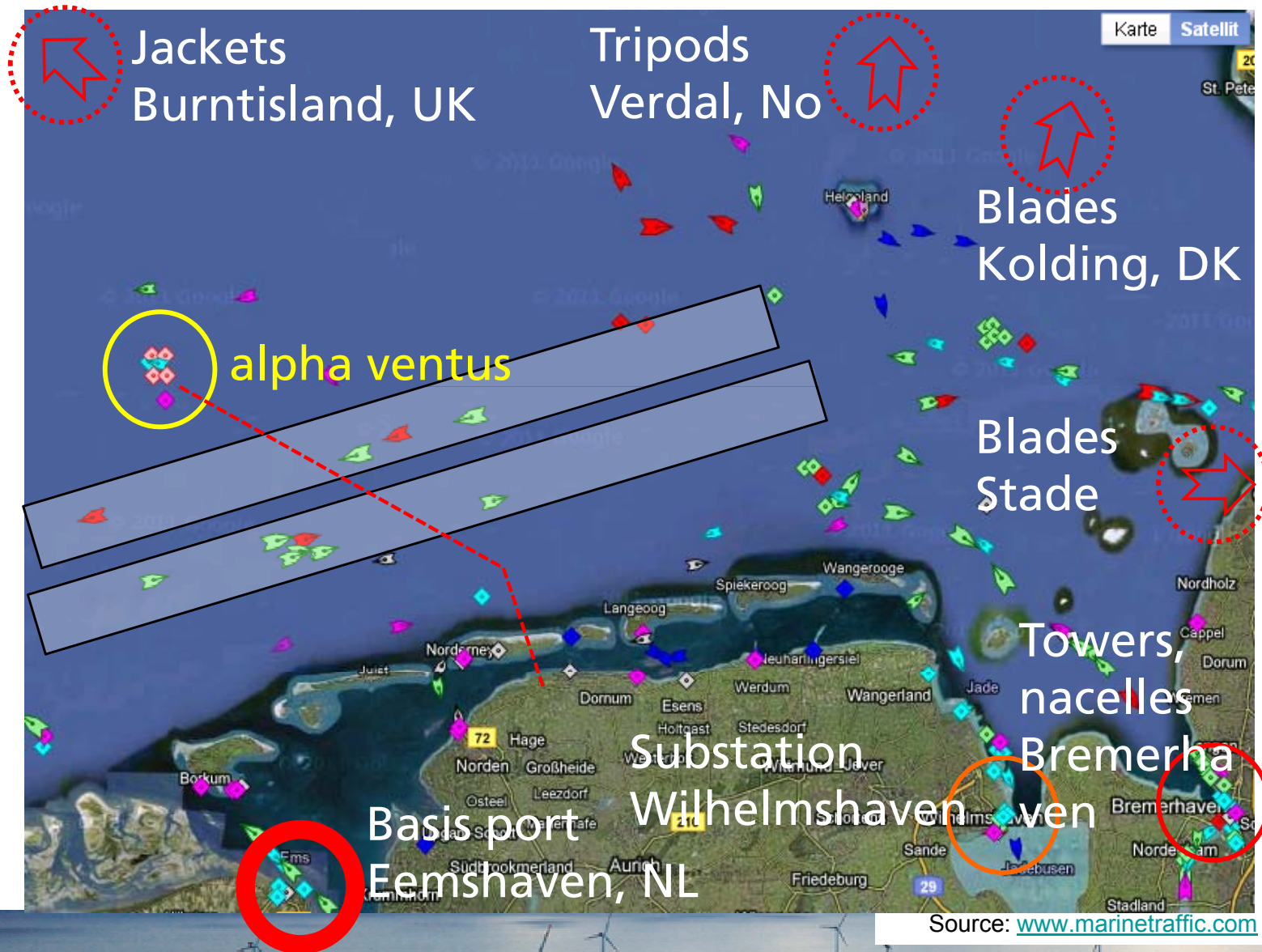


Layout of alpha ventus



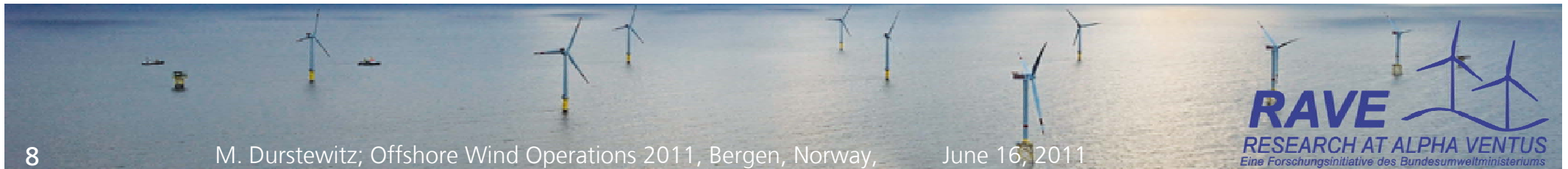
Installation logistics

Main component suppliers and locations



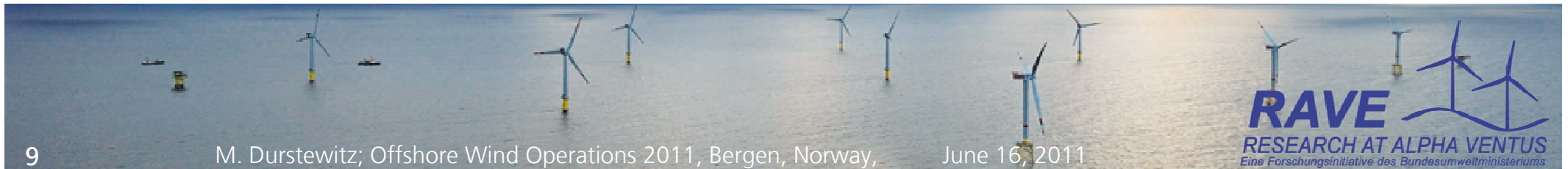
Alpha ventus: lessons learnt

- Many contractors
→ communication & scheduling
- Installation vessels: many limiting factors (weather limits, lifting capacity, tug demand, hire availabilities, etc.)
- Access to turbines
- HSE regulations
- working hours restrictions



Other experiences

- Replacement of six M5000 nacelle caused by over heating of bearings
- Damage of infield cable by inst. vessel
- Good turbine availability
- Satisfactory energy production

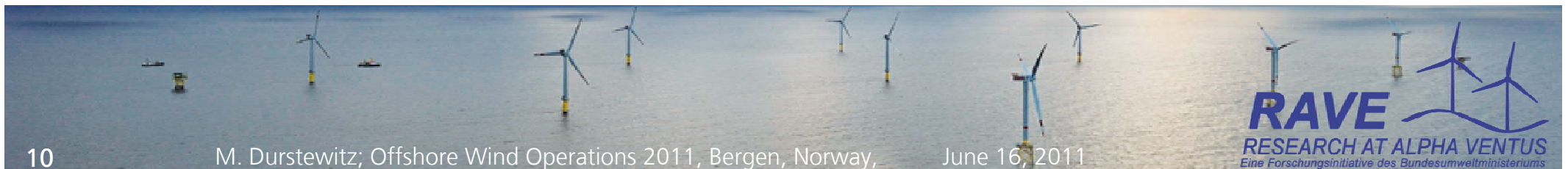


RAVE – Research at alpha ventus

- Accompanying research at the alpha ventus test wind farm
- initiative of the German Ministry for the Environment
- 2011: 25 projects
- More than 40 partners
- RAVE – steering committee:

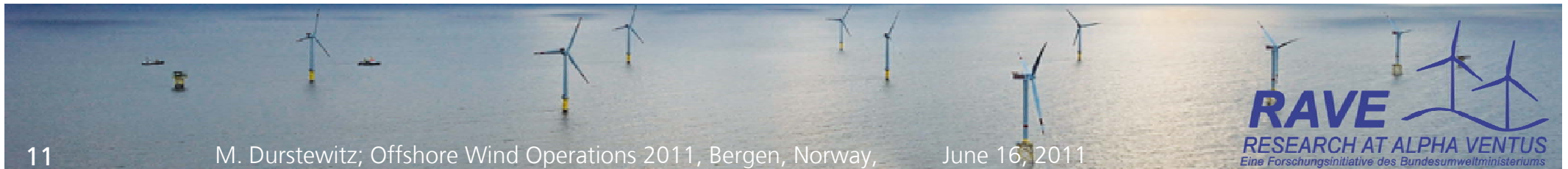


Universität Stuttgart
Germany



RAVE – Research at alpha ventus: objectives

- Provide evidence of the offshore-capability of the 5 MW turbine class
- Further development of turbine technology
- Investigation of outstanding questions on offshore wind energy utilization
- Expansion of the research potential in Germany



RAVE - Structure

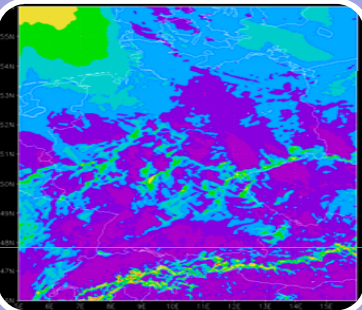


RAVE initiative



Cross sectional service projects

- RAVE coordination
- RAVE measurement service



Research project priorities

- Foundations & support structures (3)
- Turbine technology and monitoring (6)
- Ecology, environment and acceptance (6)
- Grid integration (1)

AKZEPTANZ



Interdisziplinäre Evaluation des Einflusses von Offshore-Windfarmen auf die soziale Akzeptanz der Windenergie bei Anwohnern und Touristen

Institut für Psychologie
Martin-Luther-Universität
Halle Wittenberg

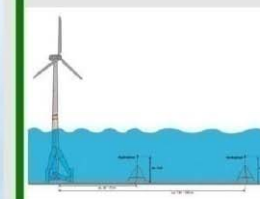
AREVA MULTIBRID M5000 OPTIMIERUNG



Entwicklung, Konstruktion und Test der M5000 unter Offshore-Bedingungen

AREVA Multibrid

BETRIEBSSCHALL



Messung der Unterwasser-Betriebsgeräusche von Offshore Windenergieanlagen

Fachhochschule Flensburg

GEOLOGIE



Erfassung und Bewertung der Kolkbildung im Bereich der Offshore-WEA sowie der sedimentdynamischen Prozesse im gesamten Windpark

Bundesamt für Schifffahrt und Hydrographie

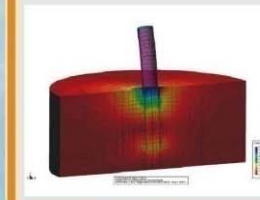
GIGAWIND ALPHA VENTUS



Wirtschaftliche Optimierung von OWEA-Tragstrukturen durch Reduktion von Material- und Entwicklungskosten

Leibniz Universität Hannover

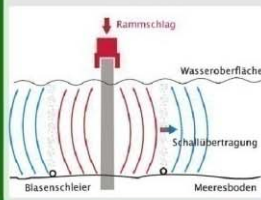
GRÜNDUNGEN



Entwicklung eines anwendungsorientierten Bemessungs- und Überwachungsmodell für Offshore Gründungsstrukturen unter zyklischer Belastung

Bundesanstalt für Materialforschung und -prüfung

HYDROSCHALL ALPHA VENTUS



Erforschung der Schallminderungsmaßnahme „Gestufter Blasen-schleier (Little Bubble Curtain)“ im Testfeld alpha ventus

Leibniz Universität Hannover

LIDAR



Entwicklung neuartiger laser-optischer Windmesstechniken (LIDAR) und ihre Anwendung in der Regelung, Leistungskurvenmessung und Nachlaufuntersuchung bei Windenergieanlagen

Universität Stuttgart

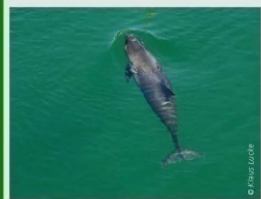
NETZINTEGRATION



Entwicklung, Implementierung und Demonstration von Strategien und Verfahren zur Integration von Offshore Windenergie in elektrische Übertragungsnetze

Fraunhofer Institut für Windenergie und Energiesystemtechnik
IWES Kassel

ÖKOLOGIE



Ökologische Begleitforschung am Offshore-Windpark alpha ventus für einen Erkenntnisgewinn zu Effekten auf Benthos (Bodenlebewesen), Fische, marine Säugetiere, Zug- und Rastvögel

Bundesamt für Schifffahrt und Hydrographie

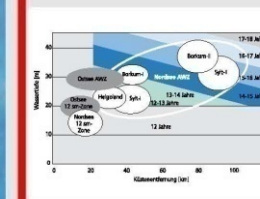
OWEA



Verifikation wesentlicher Schlüssel-aspekte von Offshore Windenergieanlagen zu den Themen Leistungskurven, Strömungsbedingungen und LiDAR-Messungen, CDF-Simulationen, Gesamtdynamik der WEA und Gründungsstrukturen.

Universität Stuttgart

OWMEP



Monitoring der Offshore-Windenergienutzung in Deutschland

Fraunhofer Institut für Windenergie und Energiesystemtechnik

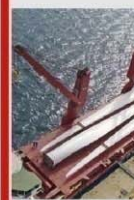
REPOWER KOMponenten



Weiterentwicklung von Offshore-WEA-Komponenten in Bezug auf Kosten, Langlebigkeit und Servicefreundlichkeit

REpower Systems AG

REPOWER ROTORBLATT



Entwicklung eines innovativen, ertragsoptimierten und kostengünstigen Rotorblatts für Offshore-Windkraftanlagen

REpower Systems AG

SONARTRANSPONDER

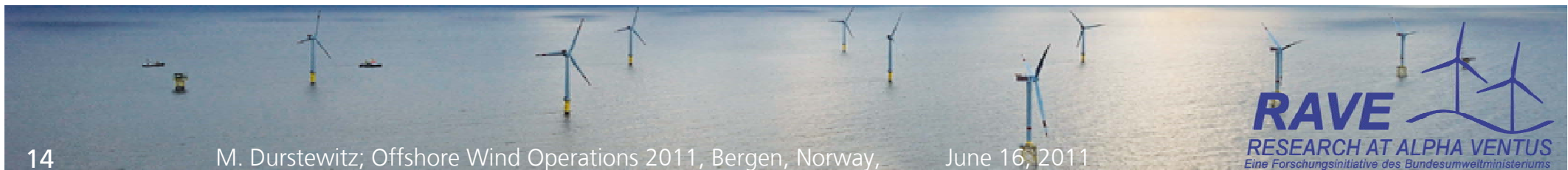
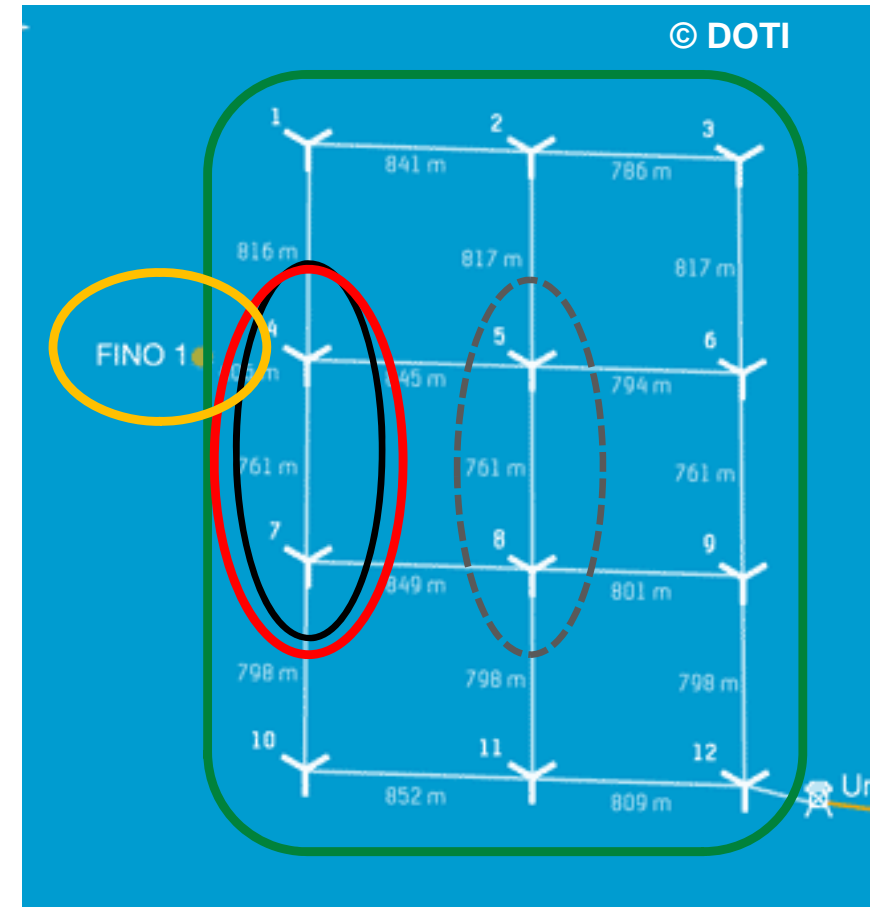


Erforschung von Sonartranspondern für Offshore-Windparks und technische Integration in ein Gesamtkonzept

Leibniz Universität Hannover

Overview of RAVE measurements

- Coordinated common measurements for all RAVE projects
- Detailed Load and turbine data from four wind turbines
- Scanning LiDAR System (upwind and downwind) on two turbines
- SCADA data of all turbines
- Geological, oceanographic and environmental data
- Electrical data from substations
- Meteorological data from FINO 1



RAVE – measurements

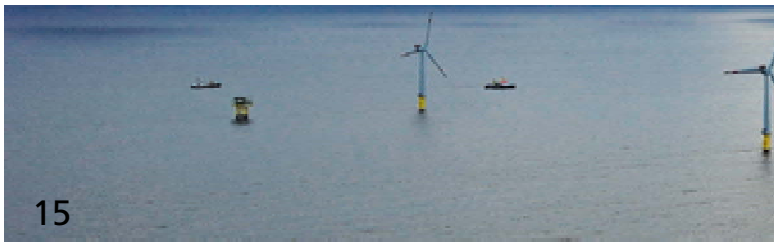
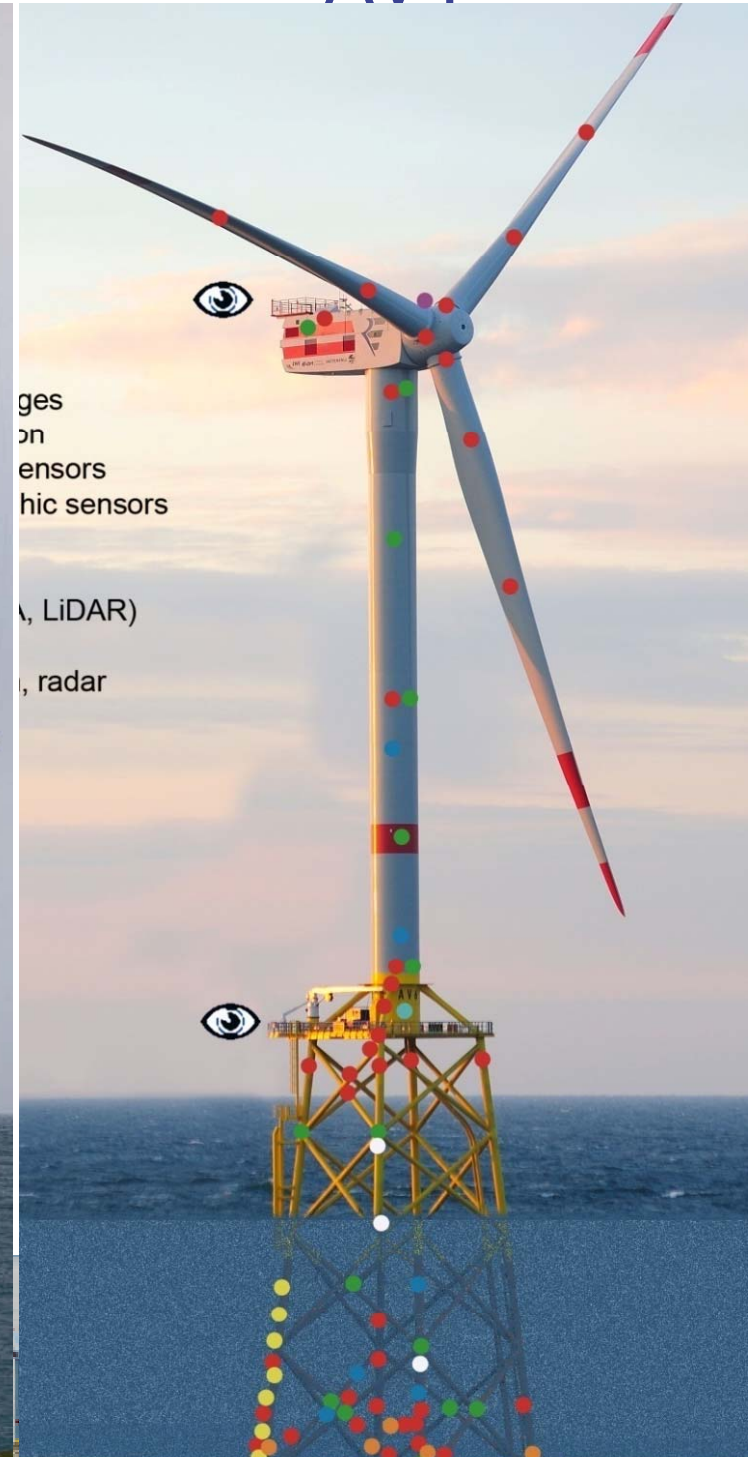
- ~ 1,200 sensors
- Available to accredited researchers

- strain gauges
- acceleration
- acoustic sensors
- hydrographic sensors
- met data (USA, LiDAR)
- sonars
- water pressure sensors
- SCADA
- corrosion
- 👁 video cam, radar

AV7



AV4



Sensors on AREVA Wind M5000 / AV07 structural dynamics and acoustics



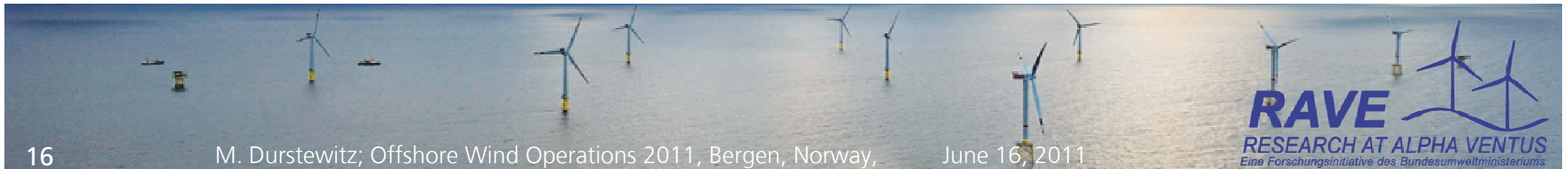
Strain gauges,
structural loading



Acceleration and
inclination sensor
(structural dynamics)



Acoustic sensor
(acoustic emissions
into the water)



Sensors on AREVA Wind M5000 / AV07 – hydrography and meteorology



Carbonmast for high-resolution wind measurement



Radar for wave height measurement



LiDAR (wind fields LUV and LEE of WEA)



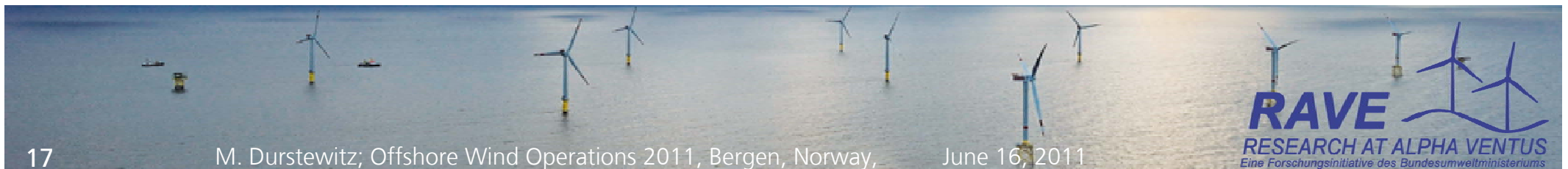
Water pressure measurement belt (wave inflow)



PTI00 (temperature profile of the water)

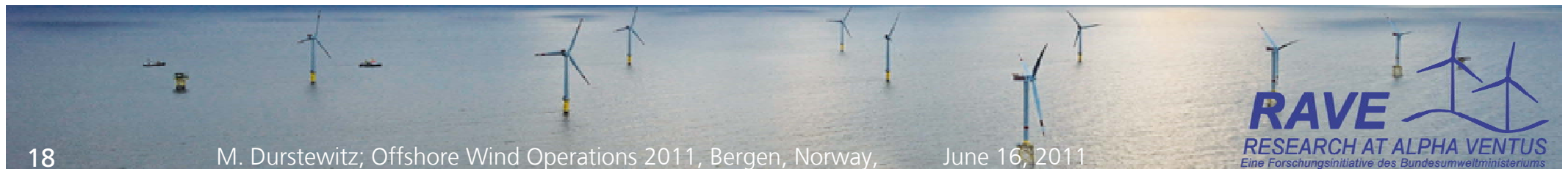
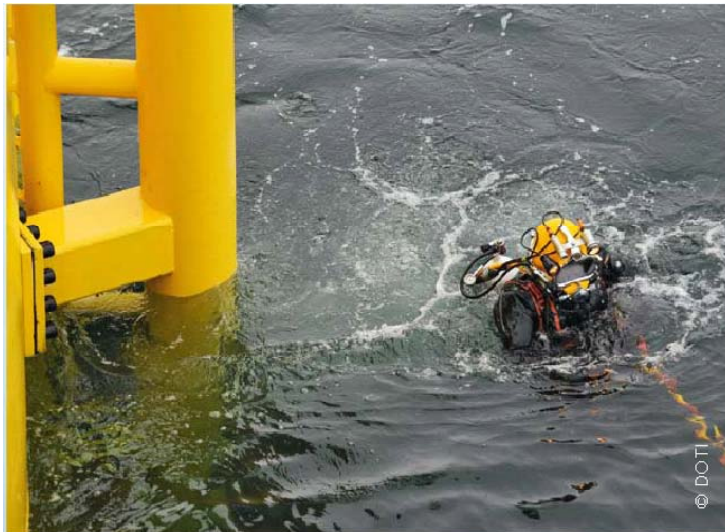


Sonars (sediment modification, scouring)



Oceanography, geology & ecological accompanying research

- Most of the installations finalised
- Regular service and maintenance of some sensor devices in the waters by divers in summer 2011



RAVE – Research: outlook

- Evaluation of data by research projects
- Analysis of results
- Presentation of first results
 - eow 2011, Nov. 2011, NL
 - RAVE International conference, May 2012, DE
- Next steps
 - Concept for test field #2, ...

