

#### A wind-wave coupled mesoscale modelling system for coastal extreme wind and wave conditions

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### A wind-wave coupled mesoscale modelling system

# for coastal extreme wind and wave conditions

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# We are

**DTU WIND** (Xiaoli Larsén, Jianting Du, Mark Kelly, Andrea Hahmann, Søren Larsen, Merete Badger, Ioanna Karagali, Joakim Nielsen)

DHI (Rodolfo Bolaños, Henrik Kofoed-Hansen, Ole Petersen, Jacob T. Sørensen, Nikhil Garg)

Bergen University (Alastair Jenkins, Angus Graham)

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# We aim at

- Exploring the full potential of the different model components (atmospheric, wave and ocean model)
- Improving the physics and numerical descriptions for fast developing weather conditions
- Providing a coupled system that uses the strength of each model component for the challenging storm and coastal conditions
- Reducing uncertainties and therefore risk and cost for offshore, port or coastal development



# **Offshore challenges**

--Toward lower risk ar



4



### Kystnære havmøller i Danmark

Screening af havmølleplaceringer indenfor 20 km fra kysten Juni 2012

UDKAST til offentlig høring



# **Air-sea interaction - Actions**



# **Air-sea interaction - Actions**



# **Air-sea interaction - Actions**





# **MIKE functions and strength**

DTU Wind Energy, Technical University of Denmark





# WRF functions and strength



WRF model domain 18 km – 6 km – 2 km – 666.7 m – 222.3 m ~ 100 m (WRF-LES)

# Actions



We have been examining coupling techniques:

**One-way offline, two-way offline,** 

### two-way online

The results on the wind outputs could be very different!

# Actions

When modeling a storm, we examine Domain, initial time

to best reserve the large scale storm structure



### CFSR large scale forcing





#### WRF outer domain



We have been examining the coastal, storm, issues, including

# Actions

ospheric forcin

# model resolution, input data, fetch effect



#### We have been examining the air-sea interaction physics



ss)



We have been examining the oceanic impact

# Including SST, current and water level

#### MIKE 3 Model doma







We have been examining the oceanic impact

Including SST, current and water level



We are examining the Spray effect...

# Actions



# **Actions - Validation**

We have been validating the model results through various kinds of measurements

Mean meteorological measurements Turbulence Mean wave data Cloud pictures QuikSkat (wind, temperature, Hs) SAR wind











# We have been **validating** the model results through

# **Action - Validation**

various kinds of measurements in many ways

- Time series
- Distribution

0.50

0.10 0.05

0.01

- **Spatial distribution**
- **Spectral analysis**

0.001

0.010

**Compared to literatures** 





# What we can offer

- Wind and wave data in the coastal zones
  - high resolution
  - from advanced modeling
  - Long term statistics vs time series
  - For siting, design, O&M

#### • Tools

- A modeling system, particularly for storm conditions, suitable for coastal zones
- Post-processing program for assessing, evaluating and applying the data for particular use
- Improved knowledge, in technology, science and application



# **Final remarks**

•Better understanding and modelling of the challenging conditions: Storms, coastal zone

# Targeted at issues relevant for offshore (open sea and coastal) applications

# Useful input for existing systems