Norsewind wind atlas: Satellite derived wind atlas

Hasager, Charlotte Bay; Badger, Merete; Mouche, Alexis; Karagali, Ioanna; Driesenaar, M.L.; Berge, Erik; Hahmann, Andrea N.; Bredesen, Rolv; Costa, Paolo; Oldroyd, Andy

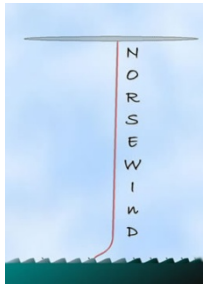
Publication date:
2013

Citation for published version (APA):
Hasager, C. B., Badger, M., Mouche, A., Karagali, I., Driesenaar, M. L., Berge, E., Hahmann, A. N., Bredesen, R., Costa, P., & Oldroyd, A. (2013). Norsewind wind atlas: Satellite derived wind atlas. Sound/Visual production (digital), European Wind Energy Association (EWEA). http://www.ewea.org/annual2013/

Norsewind wind atlas: Satellite derived wind atlas

Charlotte Hasager (1) Merete Badger (1) Alexis Mouche (4)
Ioanna Karagali (1) M.L. Driesenaar (5) Erik Berge (2)
Andrea Hahmann (1) Rolv Bredesen (2) Paulo Costa (6) Andy Oldroyd (7)

(1) DTU Wind Energy, Roskilde, Denmark
(2) Kjeller Vindteknik, Oslo, Norway
(3) Kjeller Vindteknik, Oslo, Norway
(4) CLS, Plouzane, France
(5) KNMI, de Bilt, The Netherlands
(6) LNEG, Lisboa, Portugal
(7) Oldbaum Services, Glasgow, United Kingdom



Introduction

The FP7 project Norsewind (2008-2012) focused on the offshore winds through observations with

- ground-based lidar
- offshore meteorological masts
- satellite remote sensing
- mesoscale modeling

One of the key products is wind atlas based on satellite data.

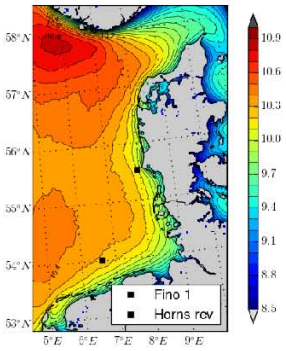
Rationale for satellite data

The NORSEWInD project (2008-12)

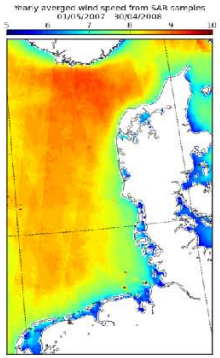
- Northern Seas Wind Index Database

- Combining the strengths of different data types to a state-of-the-art offshore wind atlas for the wind energy industry

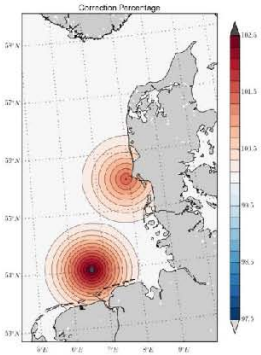
Numerical models



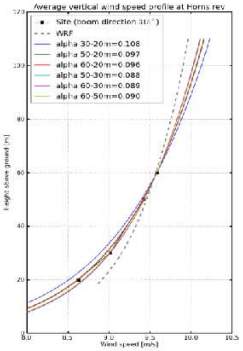
Satellite data



Measurements

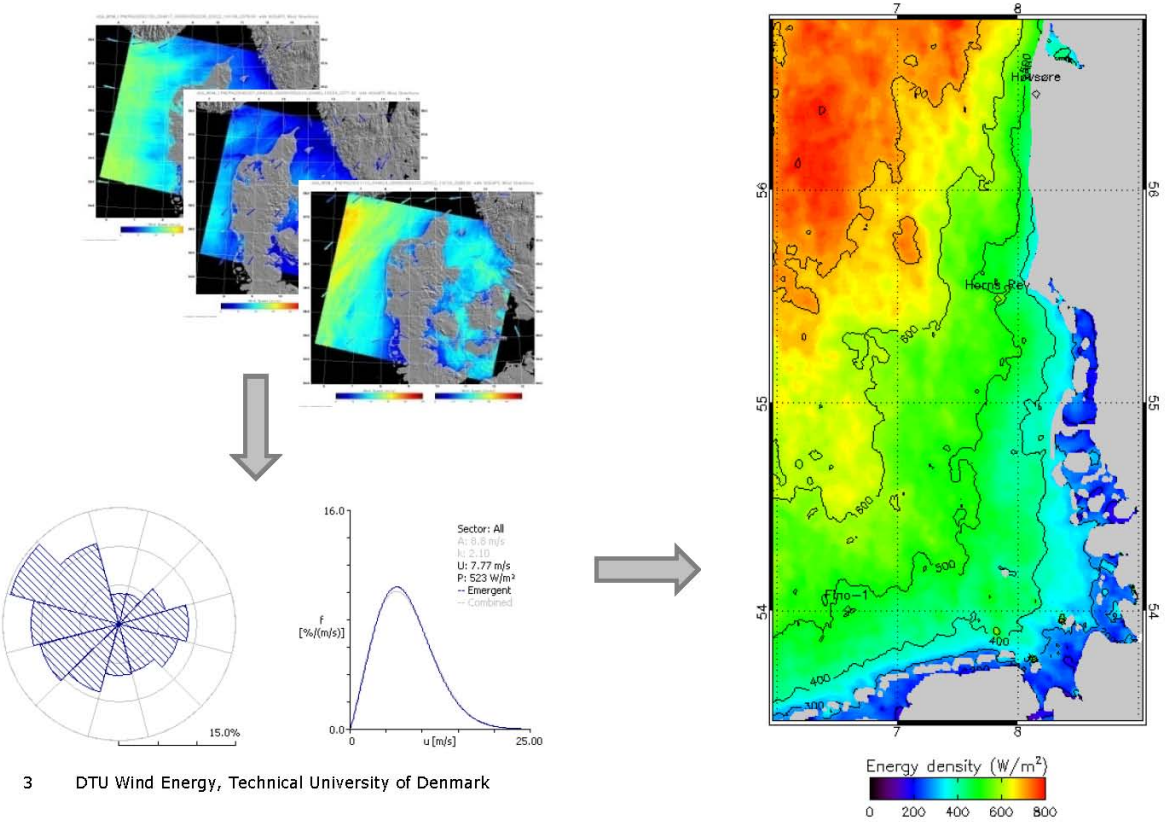


Vertical profiles

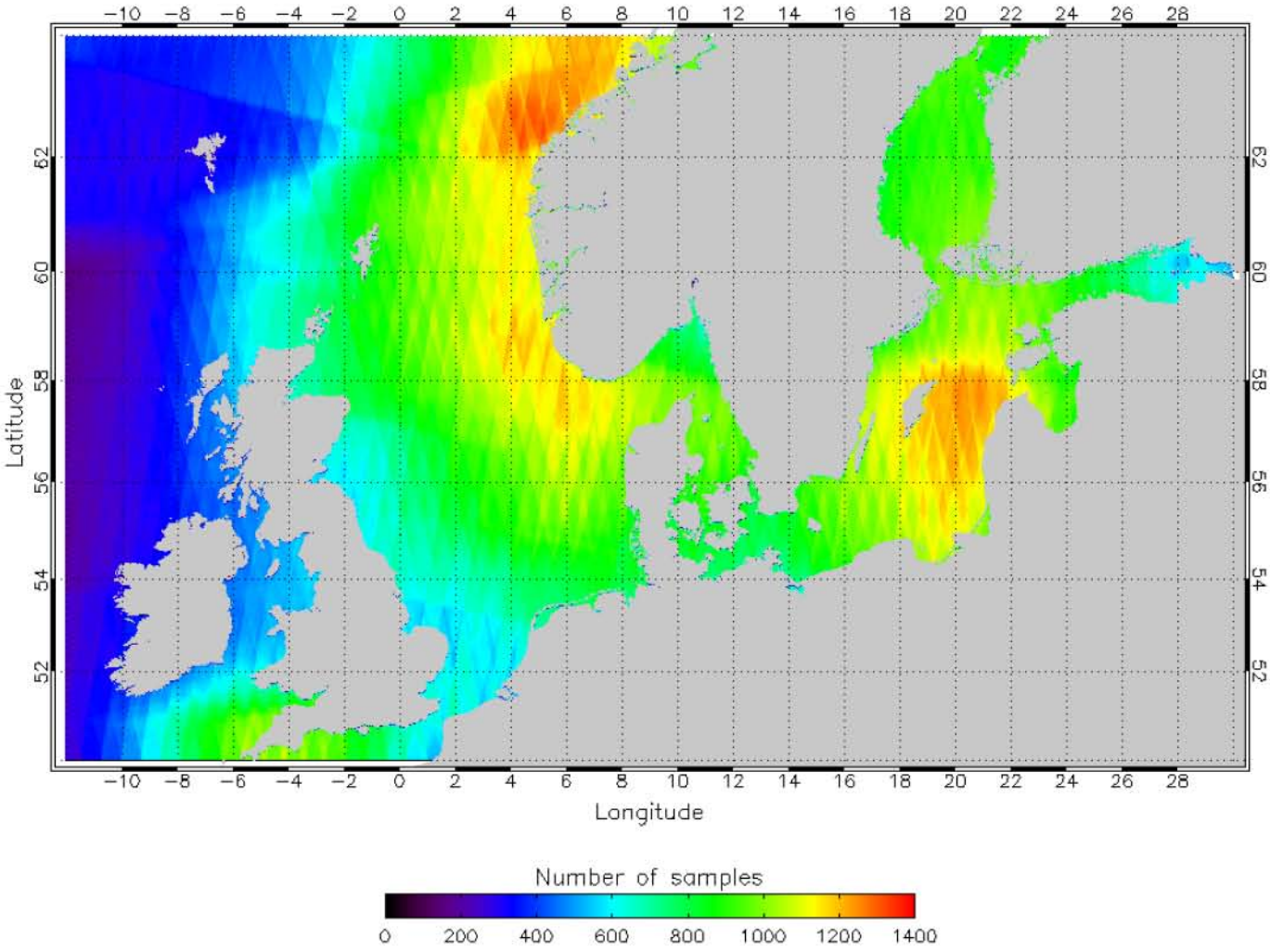


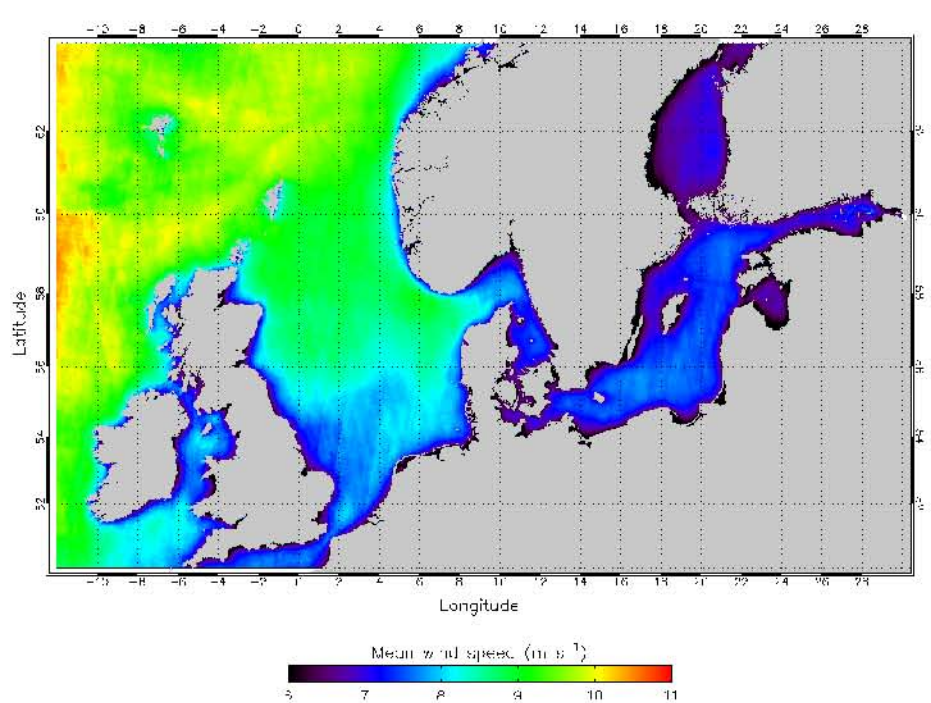
Satellite SAR – synthetic aperture radar

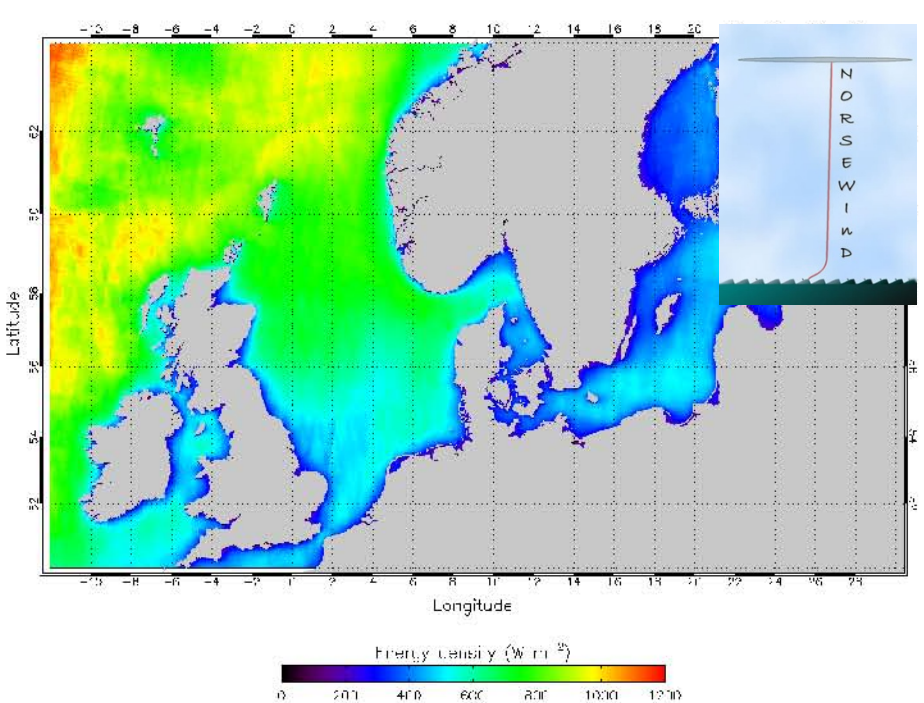
Wind resource mapping from satellite wind fields

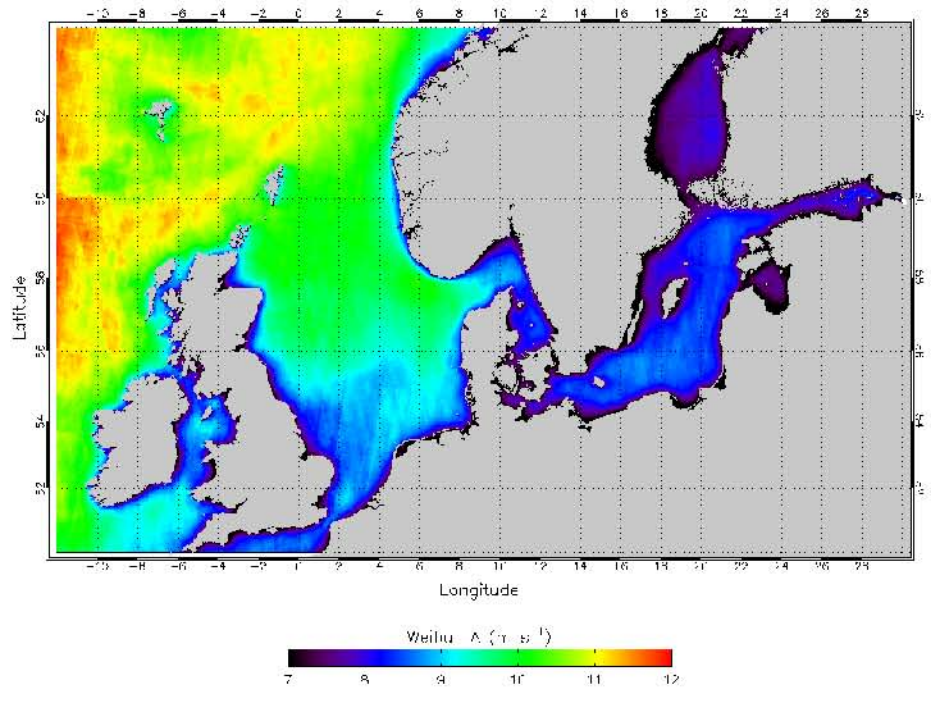


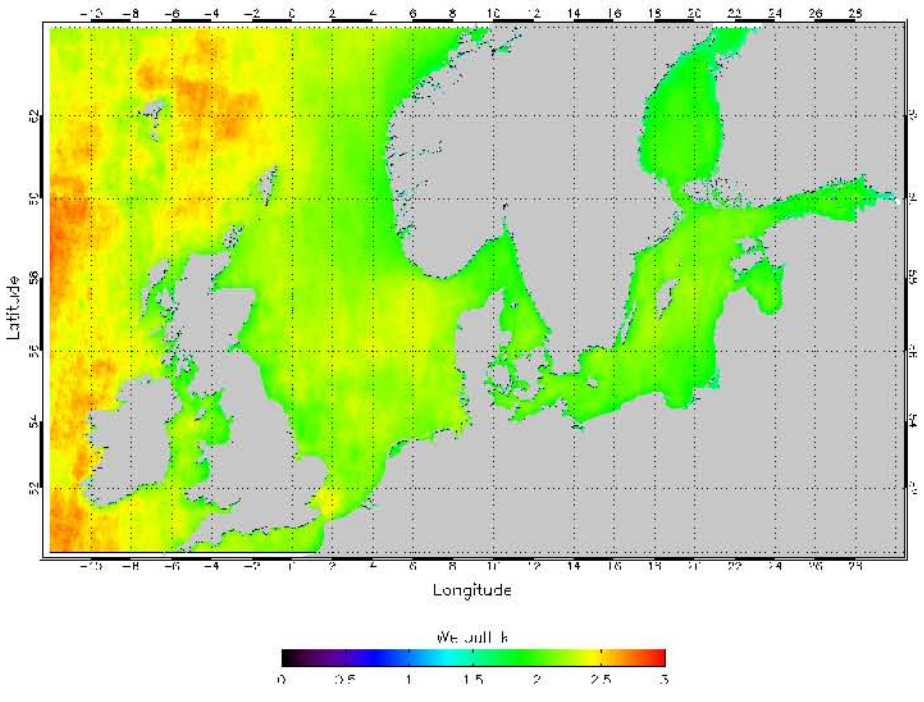
Envisat ASAR scenes in the NORSEWInD project - and the 10-m wind atlas from SAR



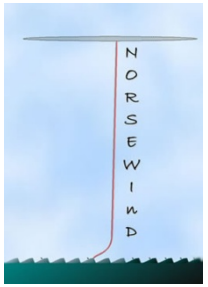

Latitude
Longitude
Mean wind speed (m s-1)
5
7
8
9
10
11

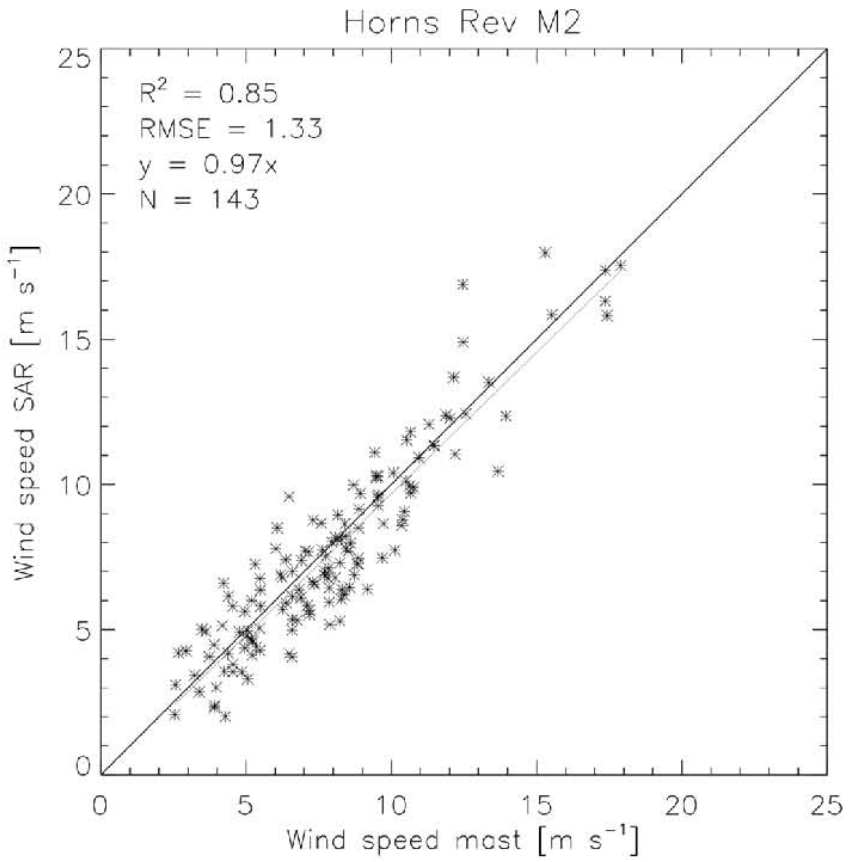

NORSEWIND
Latitude
Longitude
Energy density (W m-2)
0
200
400
600
800
1000
1200

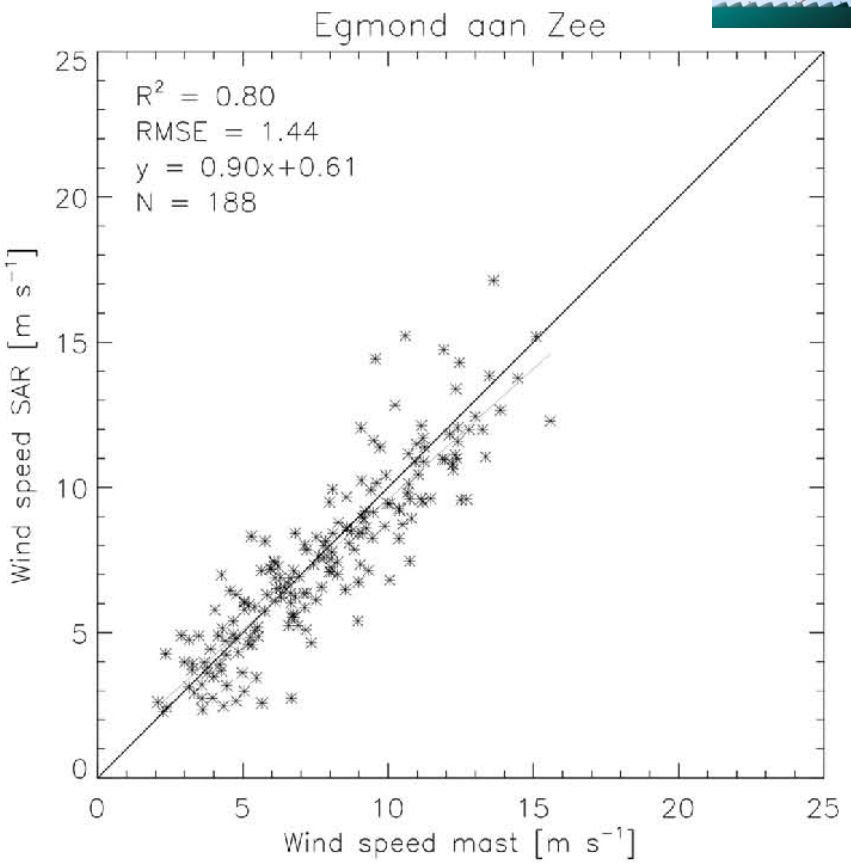

Latitude
Longitude
Weibull A (m s-1)
7
8
9
10
11
12


Latitude
Longitude
Weibull k
0
0.5
1
1.5
2
2.5
3

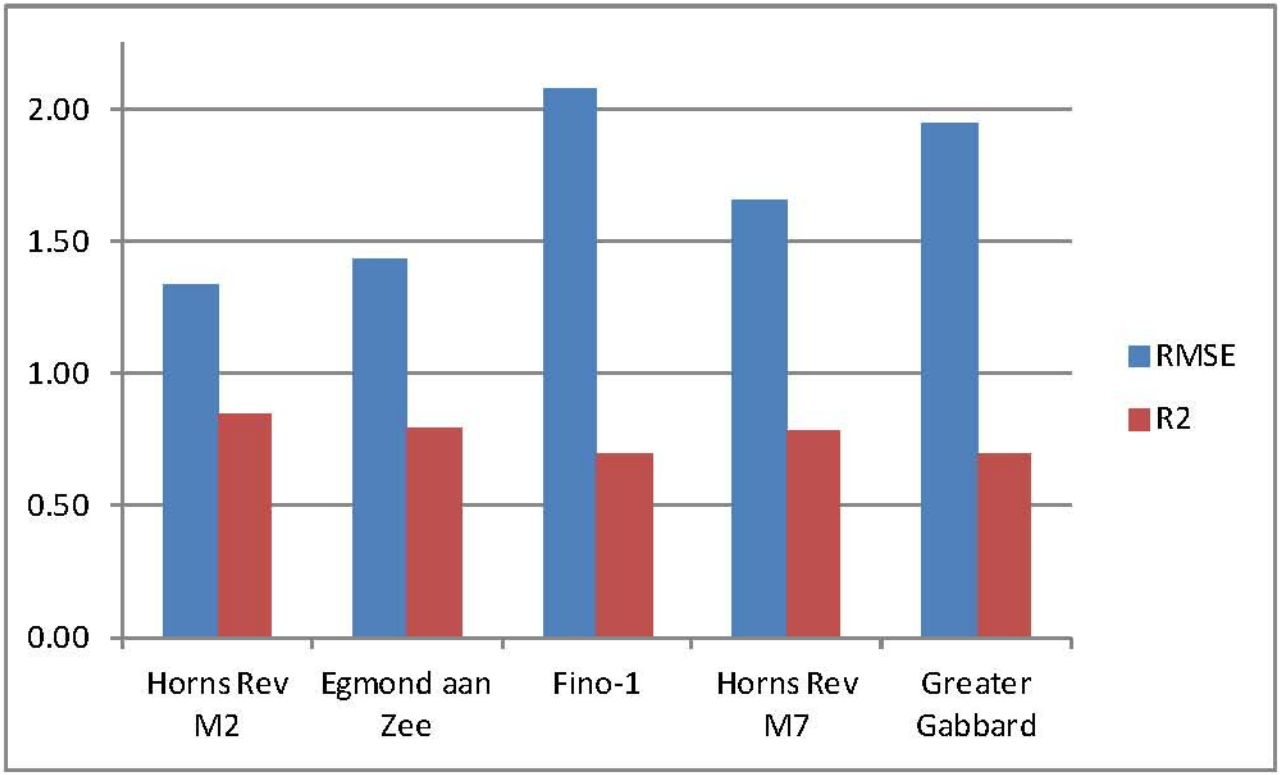
Comparison of SAR and mast winds at 10 m







Comparison of SAR and mast winds at 10 m

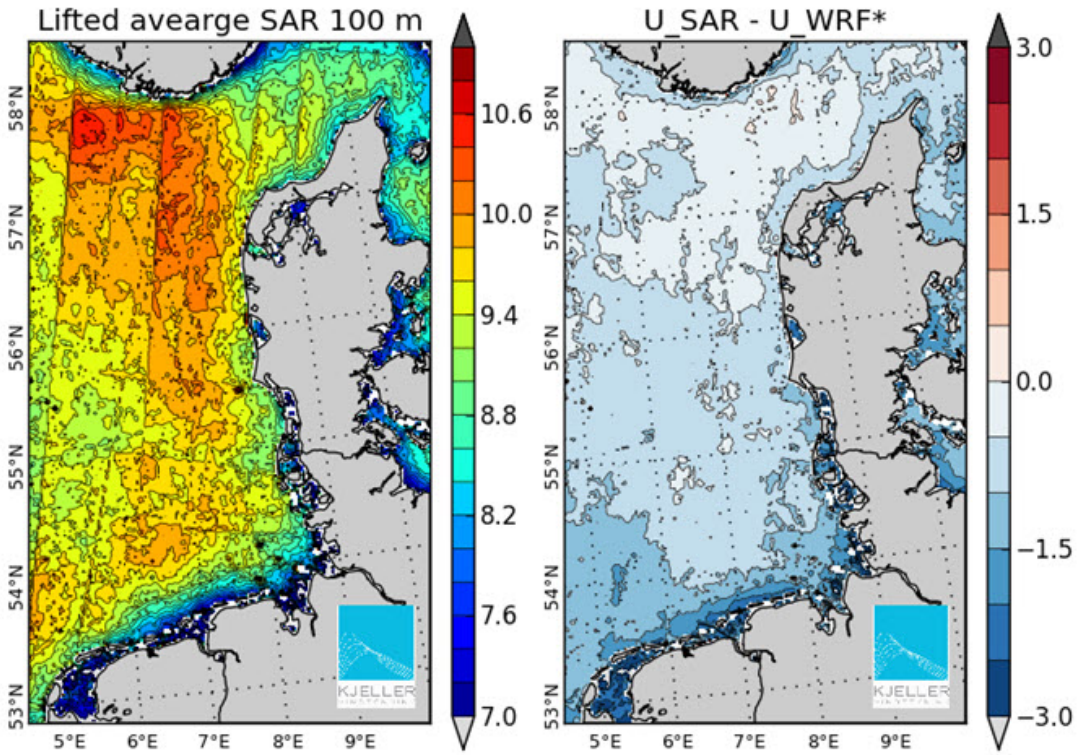


Wind speeds from SAR and 5 masts in the North Sea

Horns Rev M2 and Egmond aan Zee give stability dependent winds (SDW)

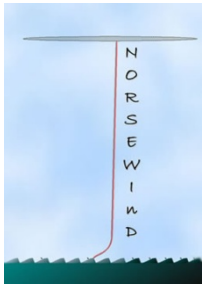
See also: Hasager et al. 2011, SAR-Based Wind Resource Statistics in the Baltic Sea. *Remote Sens.*, *3*(1), 117-144.

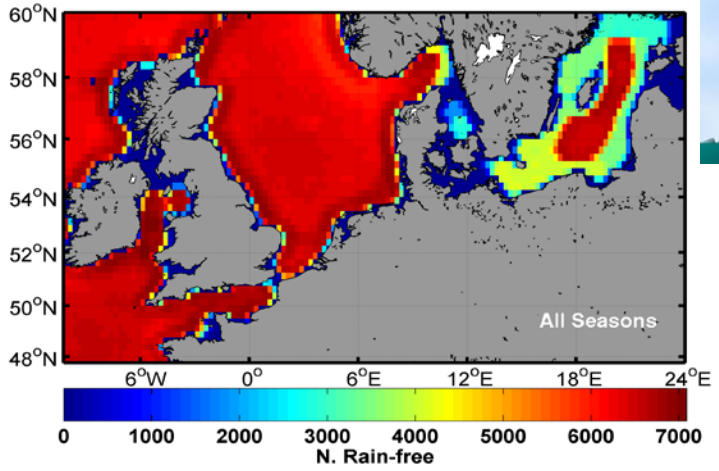
Spatial wind variability over the North Sea

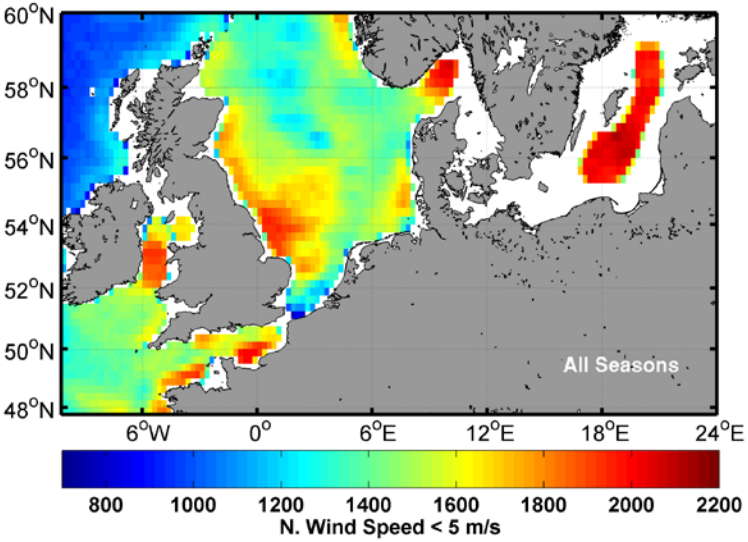


From : EWEA 2012 M. Badger, A. Peña, R. Bredesen, E. Berge, A. Hahmann, J. Badger, I. Karagali, C. Hasager, T.Mikkelsen, Bringing satellite winds to hub-height, Proceedings.

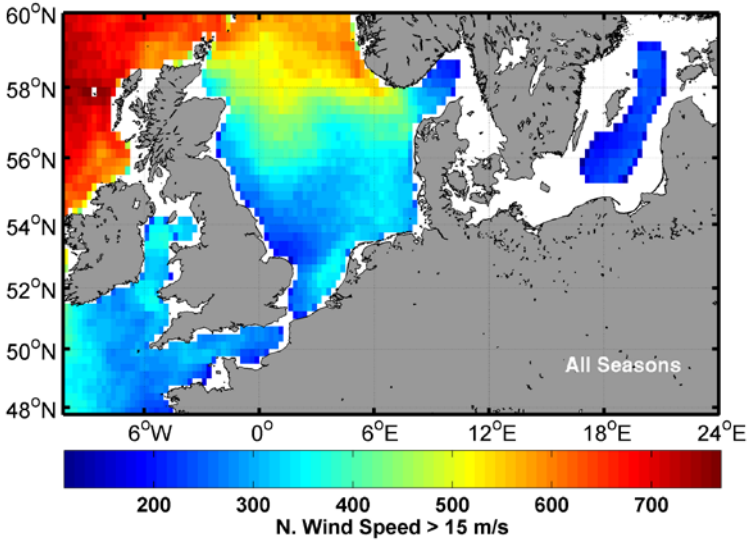
QuikSCAT





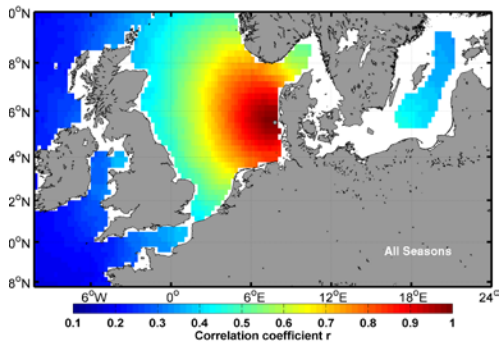


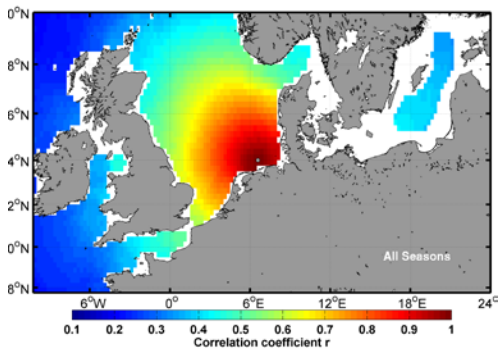
winds <5 m/s

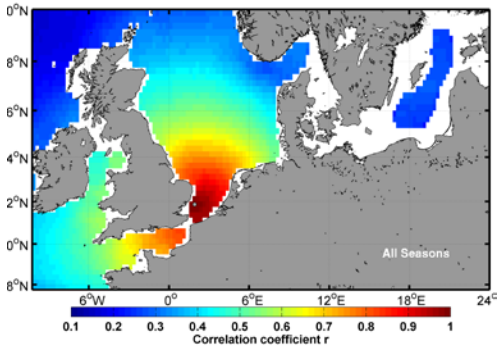


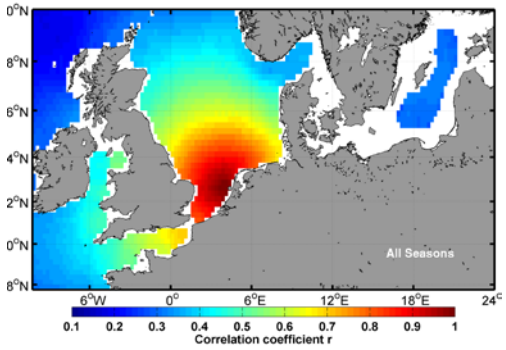
winds >15 m/s

QuikSCAT – spatial correlations









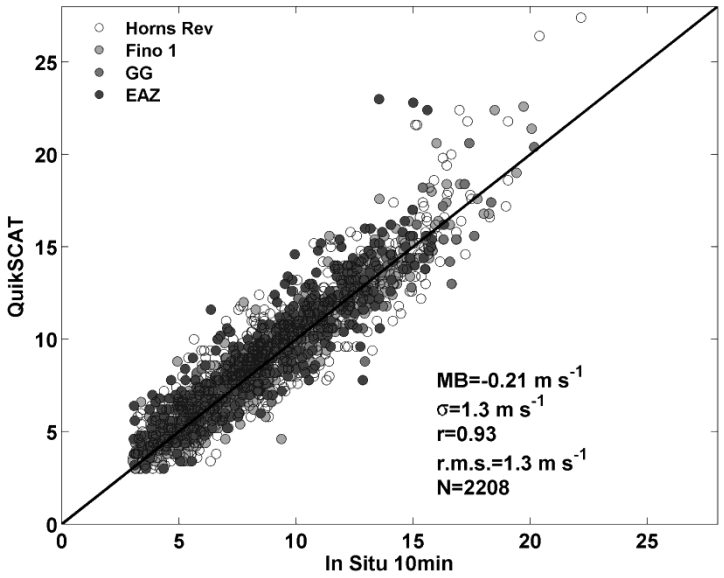
Horns Rev M2

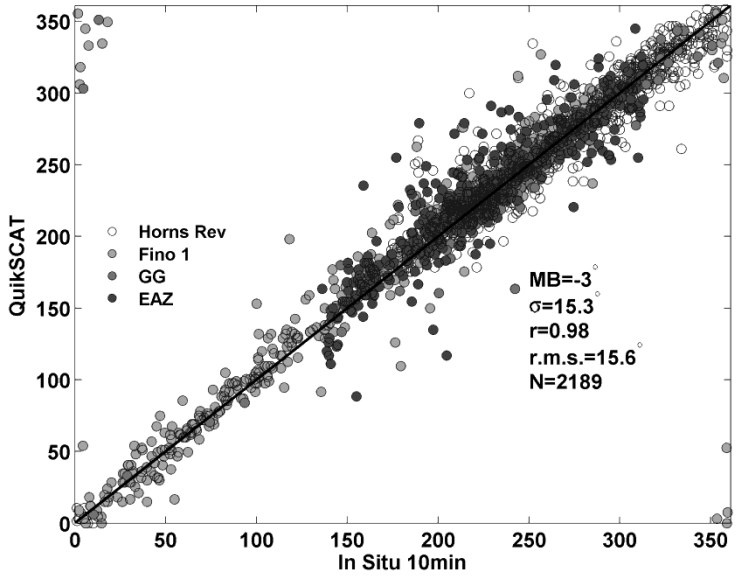
FINO-1

Egmond aan Zee

Greater Gabbard.

QuikSCAT versus four met-masts

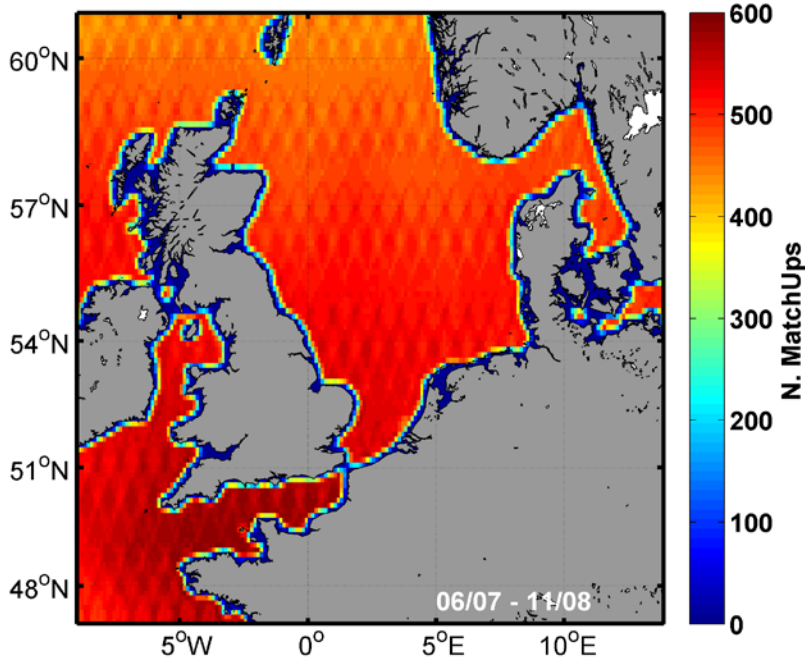


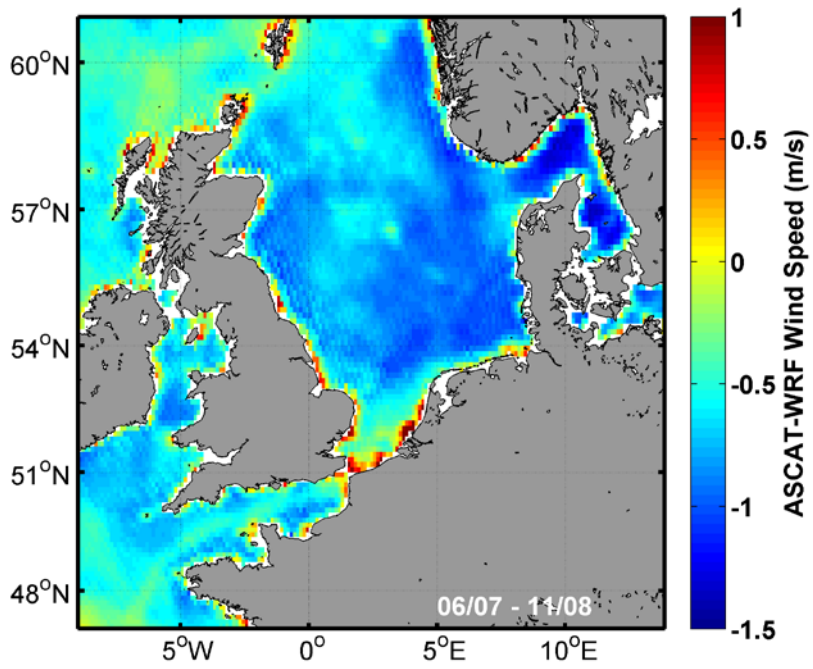


GG is Greater Gabbard
EAZ is Egmond an Zee

Karagali, I. (2012). Offshore Wind Energy: Wind and Sea Surface Temperature from Satellite Observations. PhD Thesis, DTU Wind Energy-PhD-003.

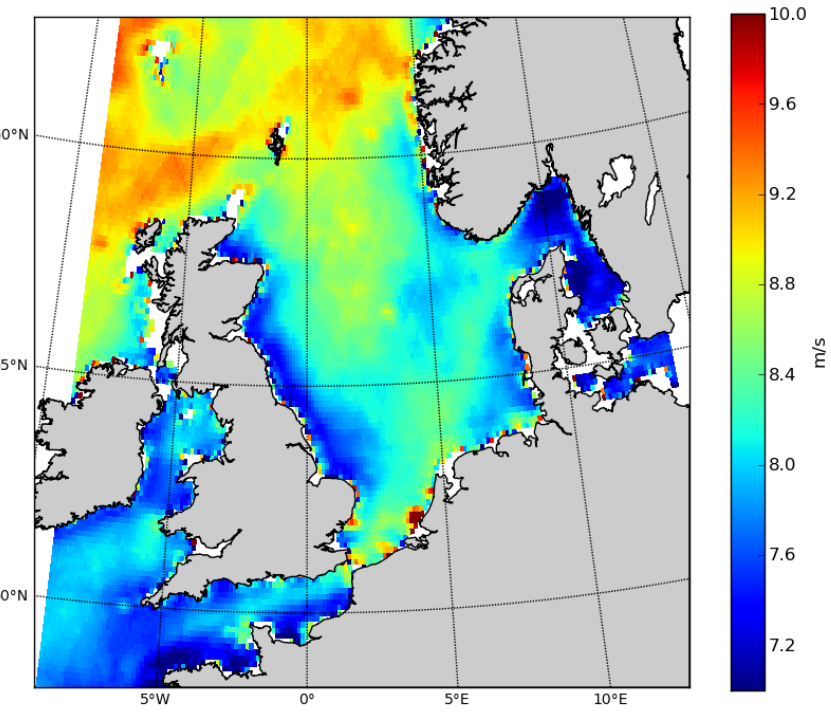
ASCAT versus WRF (wind speed)



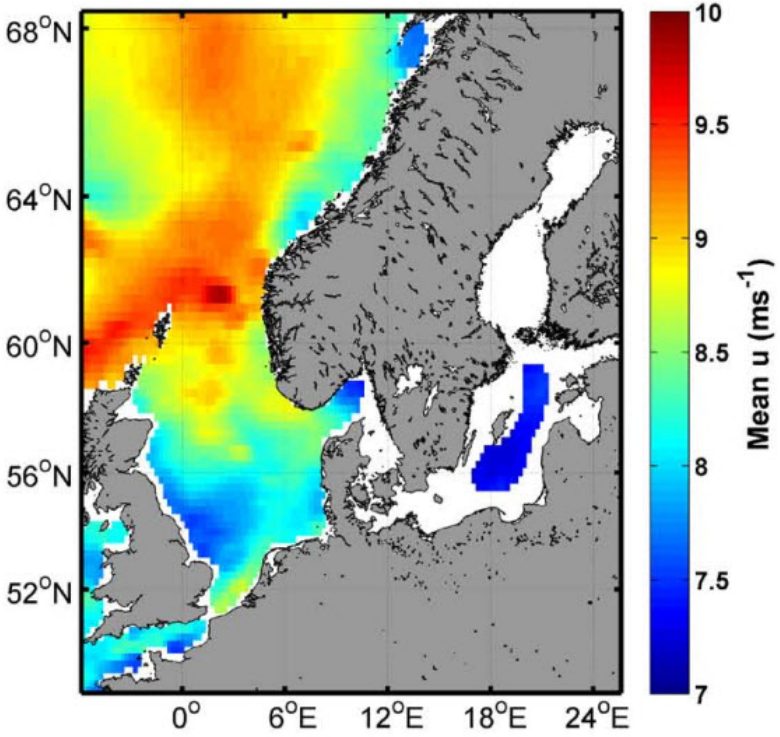


Number of ASCAT passes used for comparisons with the WRF model outputs (left) and mean bias between ASCAT and WRF.

ASCAT and QuikSCAT scatterometer mean wind speed

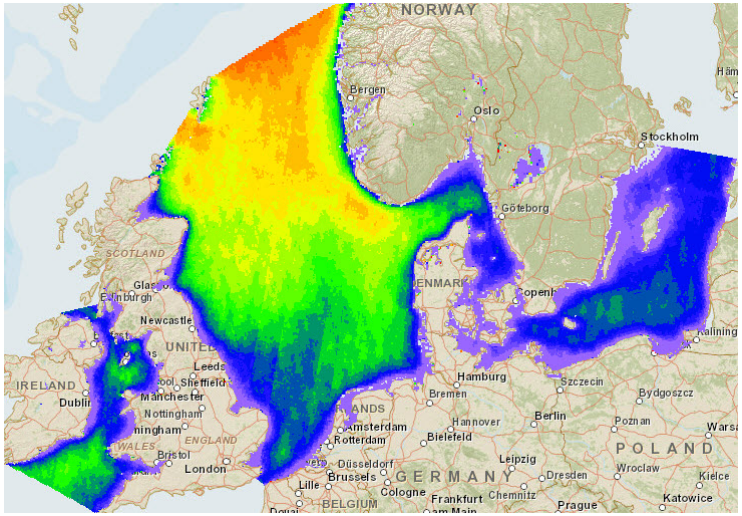


ASCAT coastal wind atlas (2007-08)



QuikScat wind atlas (1999-2009)

Access to wind ressource maps



The maps are
Number of samples
Mean wind speed
Weibull A parameter
Weibull k parameter
Energy density

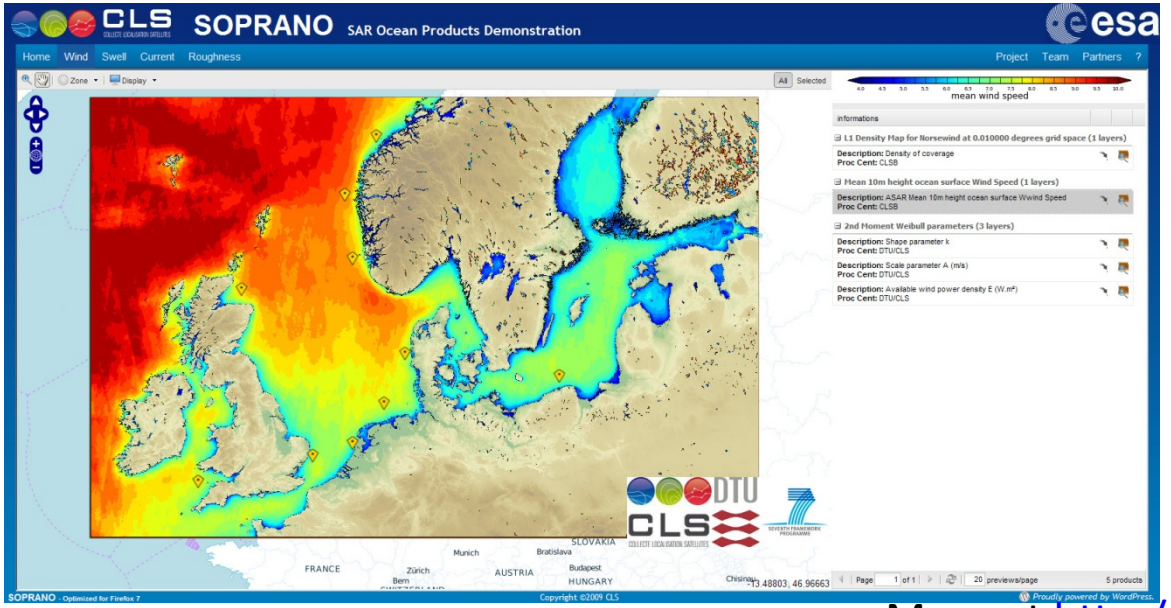
Maps at http://geoportal.lneg.pt//index.php?lg=en&state=Inicio.

The results are based on 9000 Envisat ASAR WSM wind maps collected and processed by CLS and DTU Wind Energy.

Also QuikSCAT and ASCAT maps are available and WRF results.

See www.norsewind.eu

Access to wind ressource maps

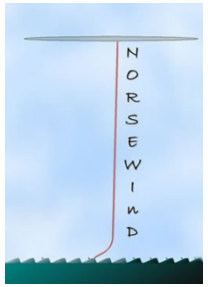


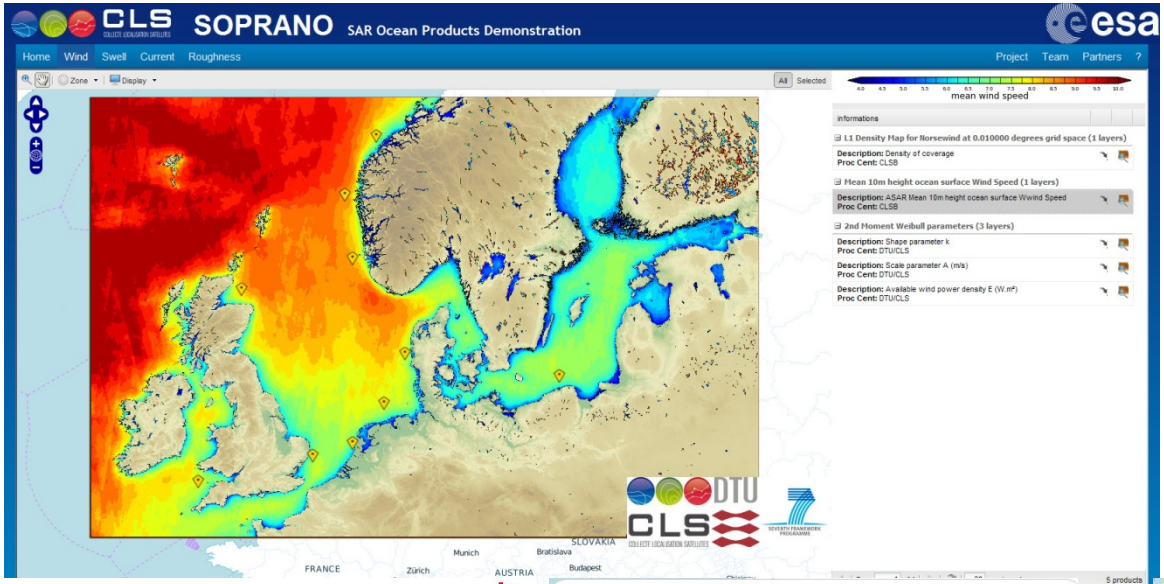
The maps are
Number of samples
Mean wind speed
Weibull A parameter
Weibull k parameter
Energy density

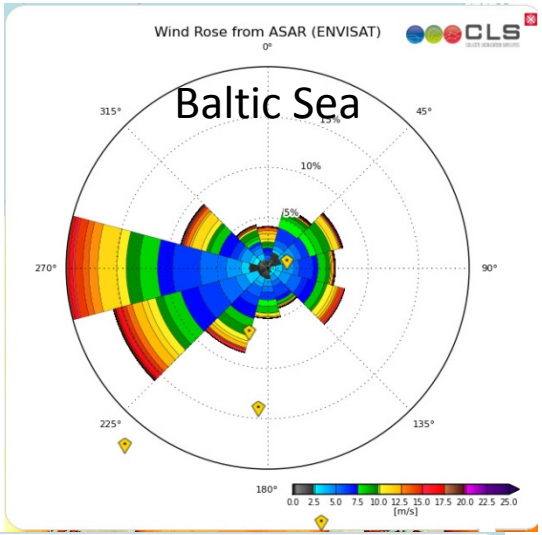
Maps at http://soprano.cls.fr
soprano/winds/statistics(L3)
select Norsewind.

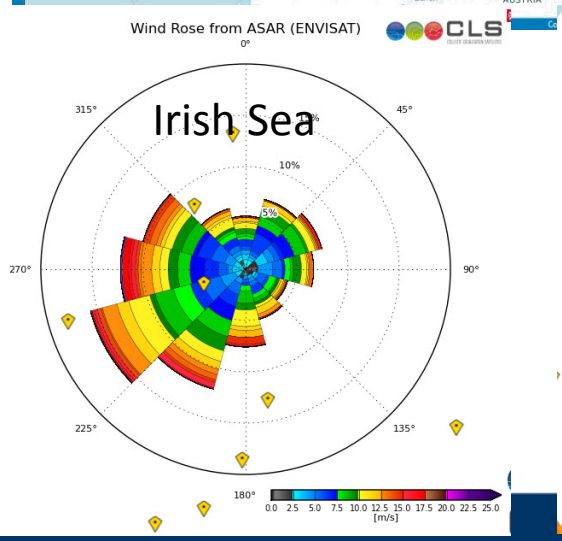
The results are based on 9000 Envisat ASAR WSM wind maps collected and processed by CLS and DTU Wind Energy.

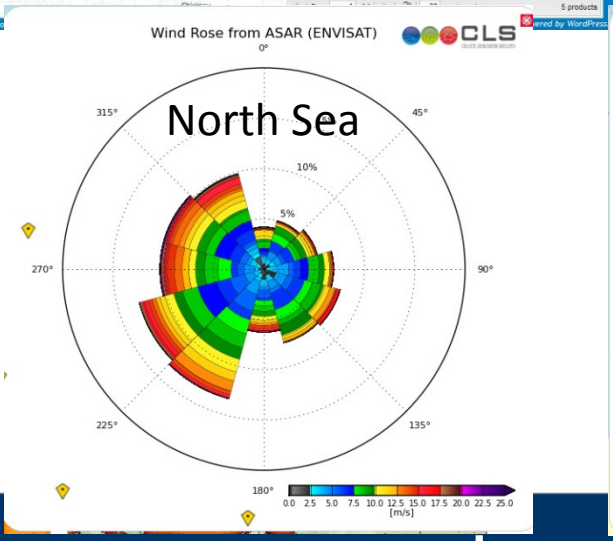
Access to wind ressource maps

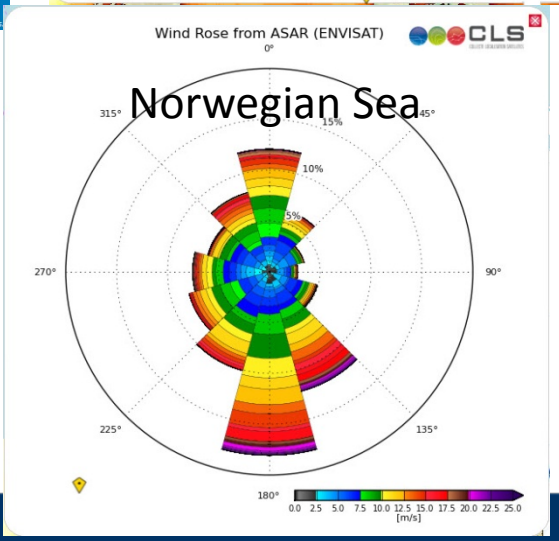




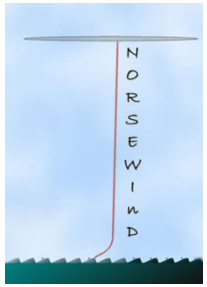








Conclusions



• Based on satellite SAR and scatterometer Earth Observations maps of many statistical parameters are calculated including mean wind speed, Weibull A and k, uncertainty estimates, spatial correlation, etc.

• Comparison to met-mast data and WRF results performed

• Lifting of satellite winds to hub-height is on-going (beyond the project)

• The satellite-based wind ressource maps for 10 m height are publically available at
http://soprano.cls.fr
http://geoportal.lneg.pt//index.php?lg=en&state=Inicio
www.norsewind.eu

Report: Hasager et al. 2012 Norsewind satellite wind climatology, DTU Wind Energy-E-0007(EN), Roskilde, Denmark