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Improving offshore wind resource assessments using a data assimilation technique

M. Fernandes; P. Costa; A. Estanqueiro

LNEG – Laboratório Nacional de Energia e Geologia

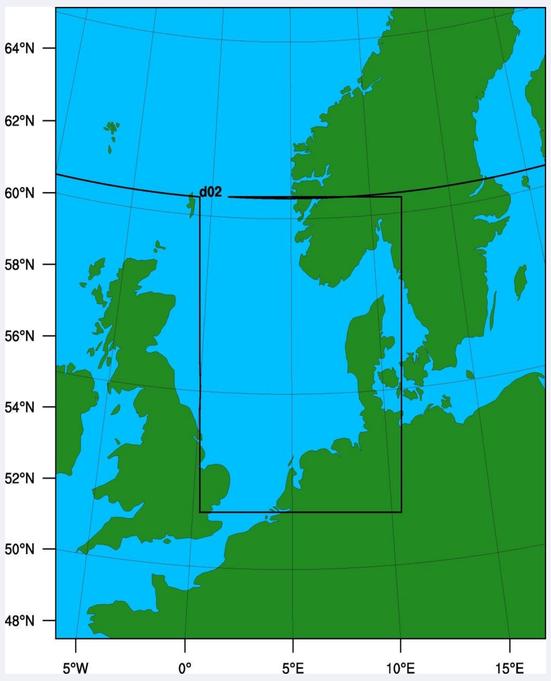
Abstract

Wind research and industry partners in collaboration with the EU have created the FP7 NORSEWInD project [1] with the main objective of delivering to the North, Baltic and Irish Sea areas high quality wind atlases for offshore wind resource assessment.

The state-of-the-art atmospheric mesoscale model WRF [2] is used to map the wind resource at 90m a.g.l. for the North Sea area. A model domain with a spatial resolution of 20x20 km is used to simulate a winter and a summer month (November 2008 and July 2009). It is coupled with a Newtonian relaxation assimilation technique to ingest surface wind data provided from QuikSCAT satellite [3] and sea surface temperature data from GHRSST Level 4 analysis [4].

Wind results from the model are validated against observational data from the anemometric mast FINO1. The spatial improvement of the average wind field is assessed with the QuikSCAT satellite data.

Methods

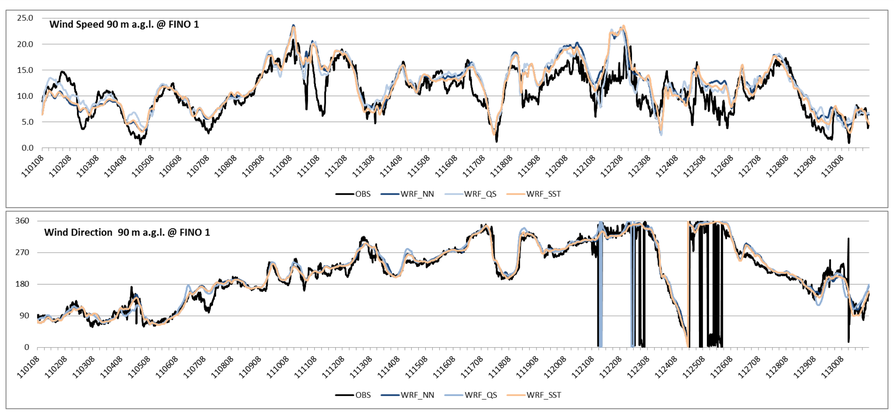


- *Simulate a summer month (July 2009) and a winter month (November 2008).*
- *Assimilate surface wind data from QuickSCAT and Sea Surface Temperature from ODYSSEA Global SST Analysis.*
- *Validate simulated wind speed, direction and vertical profile against met mast FINO 1.*
- *Validate average wind maps against QuickSCAT satellite observations.*

Results

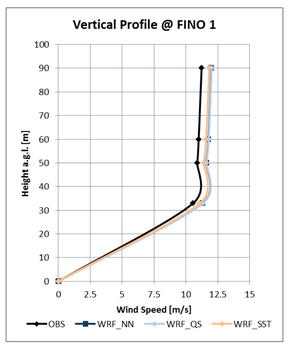
WINTER (November 2008)

Time Series

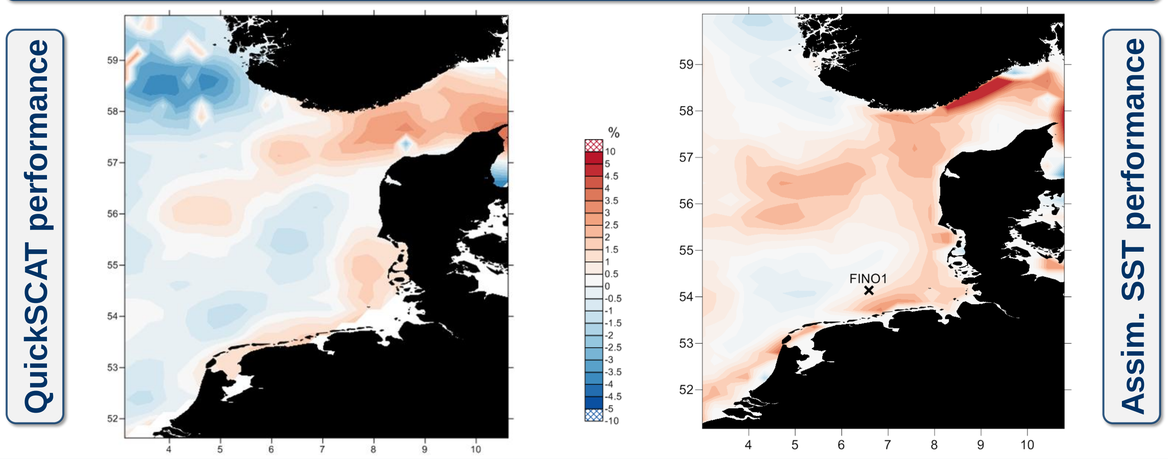


Statistics and Vertical wind profile

		90 m a.g.l. OBS	WRF_NN	WRF_QS	WRF_SST
WBL	AVG [m/s]	11.23	12.00	12.02	11.83
	STDEV [m/s]	4.53	4.43	4.20	4.40
	A [m/s]	12.62	13.46	13.45	13.20
	k	2.7	2.96	3.14	2.84
	CORREL	-	0.83	0.83	0.84
WSPD	MAE [m/s]	-	2.07	1.99	1.95
	RMSE [m/s]	-	2.82	2.65	2.62
WDIR	MAE [°]	-	12.39	12.96	11.83
	RMSE [°]	-	17.14	18.10	16.48

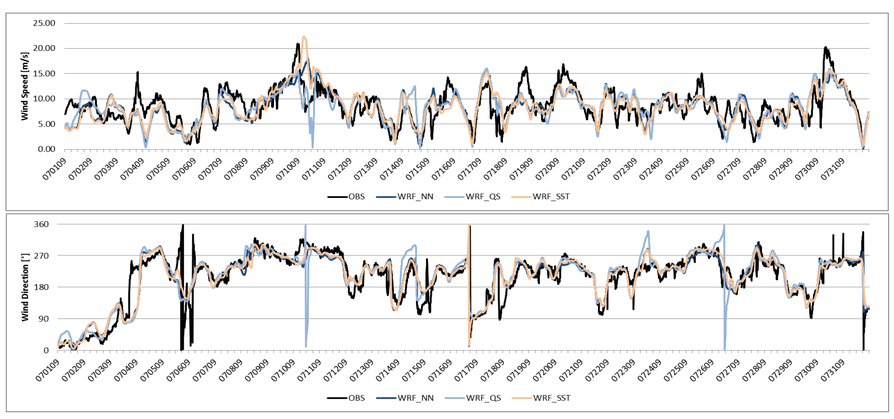


Spatial improvement @ 90 m a.g.l



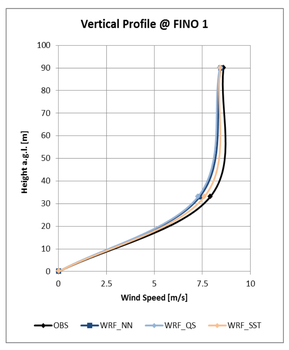
SUMMER (July 2009)

Time Series

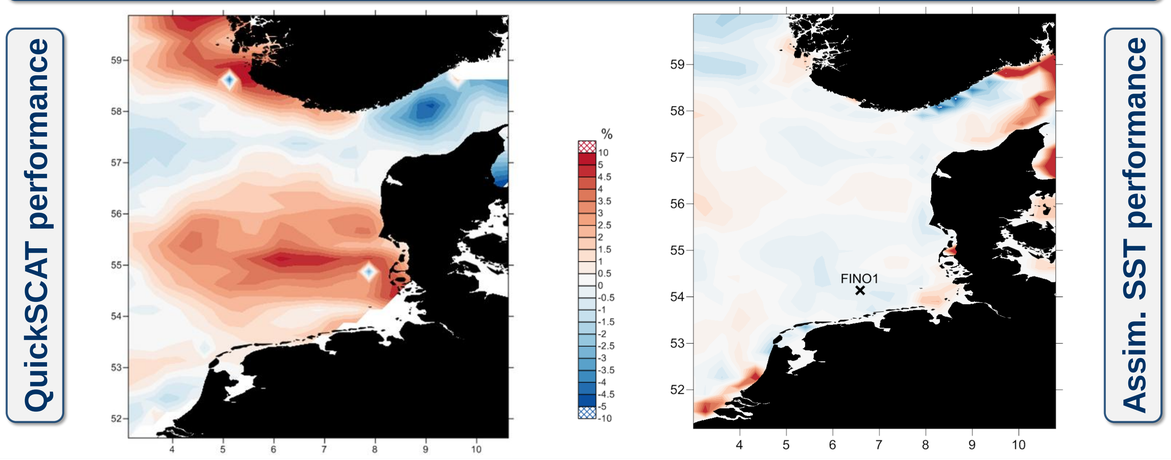


Statistics and Vertical wind profile

		90 m a.g.l. OBS	WRF_NN	WRF_QS	WRF_SST
WBL	AVG [m/s]	8.60	8.46	8.40	8.44
	STDEV [m/s]	3.36	3.08	3.05	3.25
	A [m/s]	9.65	9.47	9.38	9.60
	k	2.71	2.99	3.02	2.66
	CORREL	-	0.67	0.68	0.69
WSPD	MAE [m/s]	-	2.07	2.05	2.00
	RMSE [m/s]	-	2.62	2.59	2.63
WDIR	MAE [°]	-	19.98	23.93	19.35
	RMSE [°]	-	31.28	37.55	30.94



Spatial improvement @ 90 m a.g.l

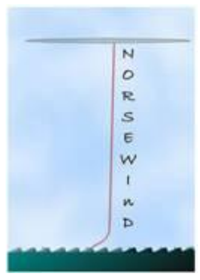


Conclusions

The assimilation of QuickSCAT (QS) data had an higher impact during the summer period. The assimilation of Sea Surface Temperature (SST) showed higher impact on the winter displaying a positive effect on wind speeds modeled at 90 m a.g.l.

At the FINO1 location the assimilation of SST data led to the improvement of the vertical profile on both occasions. The MAE and the RMSE statistical parameters were not significantly improved by the data assimilation technique.

References



[1] http://www.norsewind.eu
[2] W.C. Skamarock, J.B Klemp, *A time-split nonhydrostatic atmospheric model for weather research and forecasting applications,* J. Comp. Phys. 227 (2008), 3465-3485.
[3] K.L. Perry *et. al., SeaWinds on QuikSCAT level 3 Daily, Gridded Ocean Wind Vectors*, JPL Seawinds Project, California Institute of Technology, 1995.
[4] GHRSSTLevel 4 Sea and Baltic Sea Regional Foundation Sea Surface Temperature Analysis, available at http://podaac.jpl.nasa.gov

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