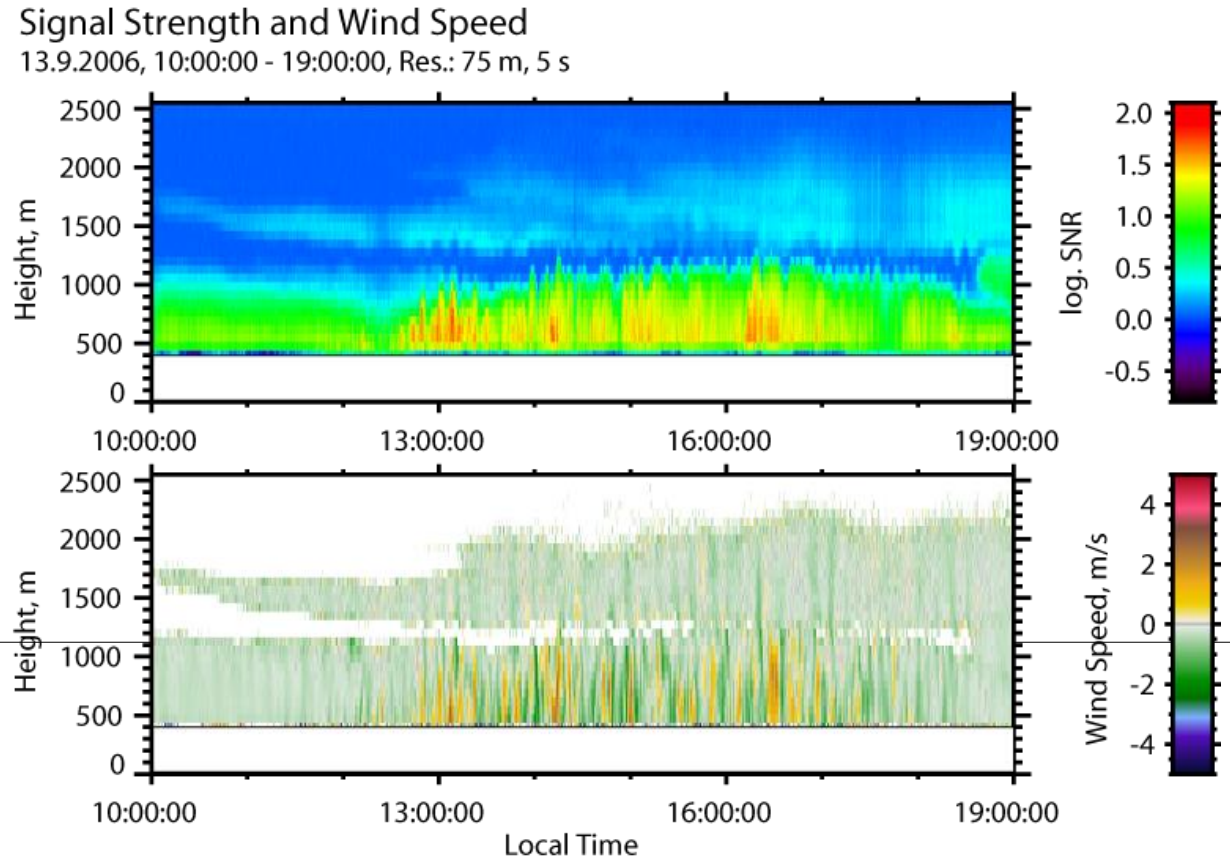
Erzeugung von 3-D Wetterdaten und deren Qualität

Ronny Petrik, Beate Geyer, Burkhardt Rockel (Helmholtz-Zentrum Geesthacht) + support from German Weather Service, Frank Beyrich, …



@TROPOS: Doppler Windlidar WiLi

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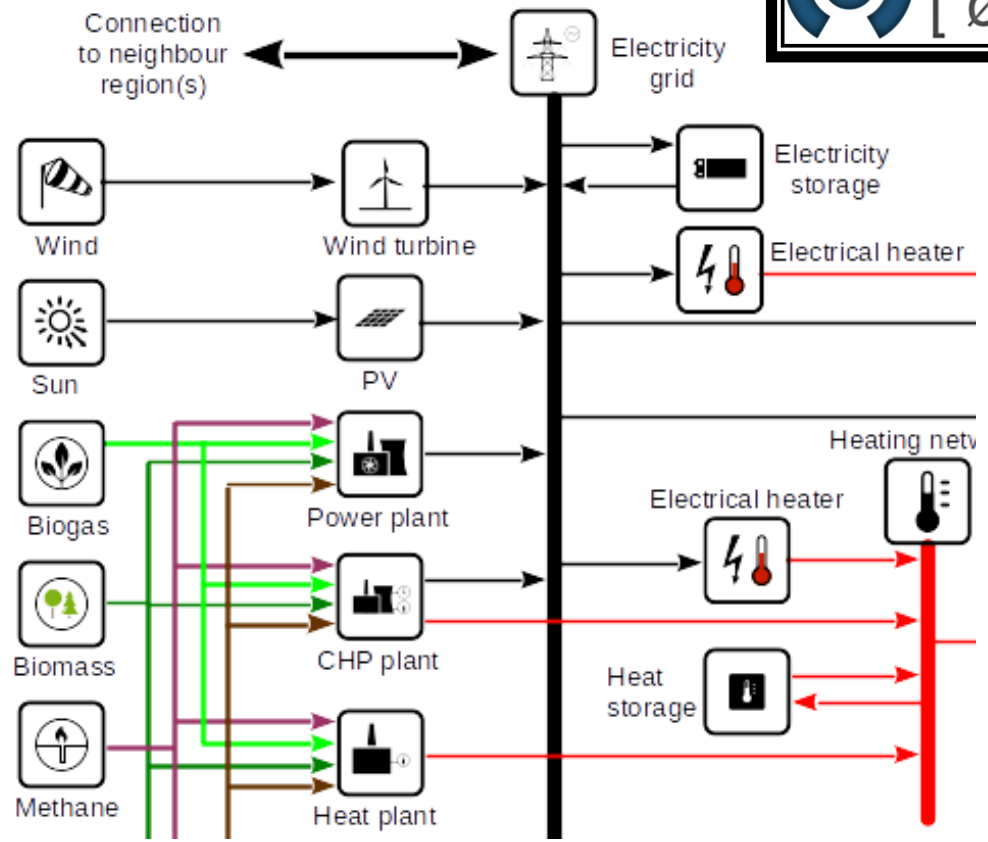
openFRED

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

- long-term feed-in time series based on a Renewable Energy Database
- philosophy: **all** input and result data published using open-data licenses

- openFRED provides input data for energy system models simulating the flow within the power grids
- scientific use of long-term model runs: determine a strategy for optimal grid and storage expansion (project open_eGO)



@RLI, modified

Energy system modelling and the planetary boundary layer

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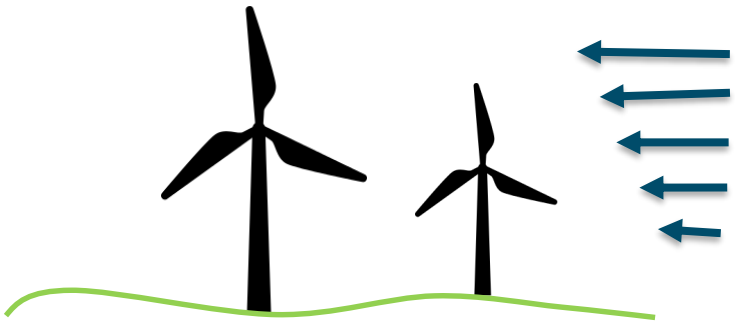
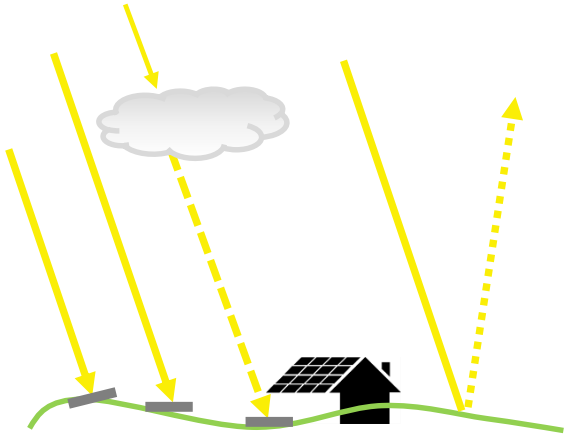
Centre for Materials and Coastal Research



@RLI, modified



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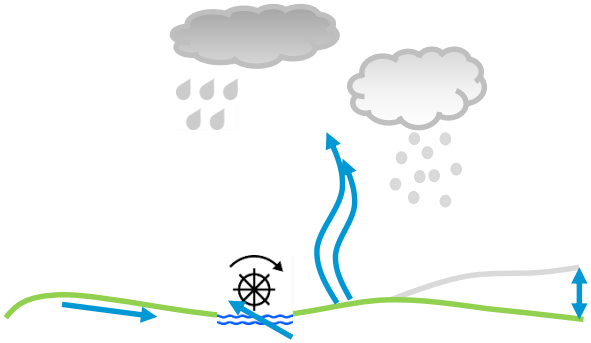

@RLI, modified

Demands: long-term and high-resolution data about

- atmospheric profiles up to 250 m
- solar radiation inputs
- hydrological discharge in drainage system

realistic information about planetary boundary layer + data compatible with the openData philosophy

Extraction of weather data – 4 pathes

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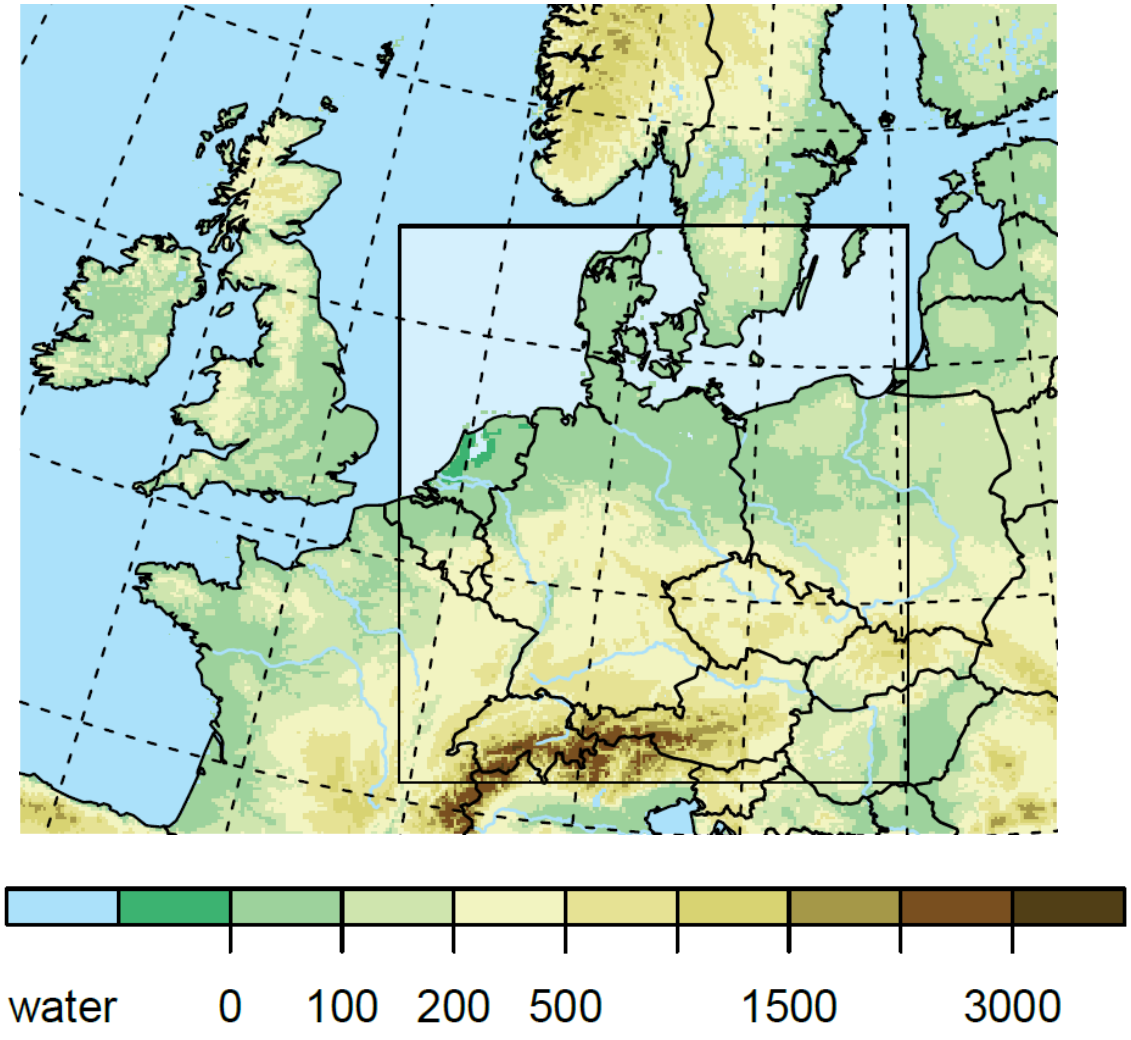

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Extraction of weather data – 4 pathes

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1. Vertical extrapolation / horizontal interpolation (model or station data)
2. Statistical downscaling (global or local ESM‘s + station data)
3. Statistical-dynamical downscaling (global ESM‘s)
4. Dynamical downscaling (global ESM‘s)

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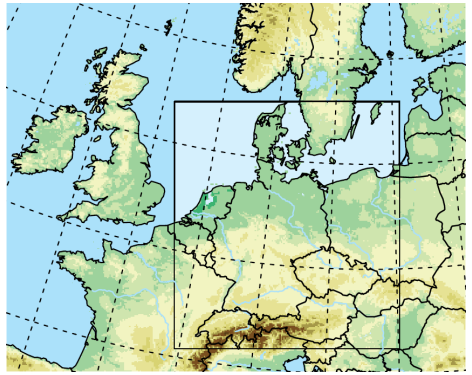
	VE/HI	Stat-D	StatDyn-D	Dyn-D
Spatial resolution	++	-	+	+
Vertical resolved information	++	-	+	+
Temporal / spatial coherency	--	+	--	+
Physical consistency	--	-	+	++



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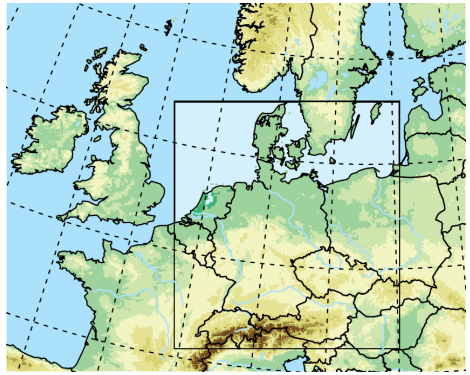

It‘s so easy – dynamical downscaling with Christian (27. – 29.10.2017)

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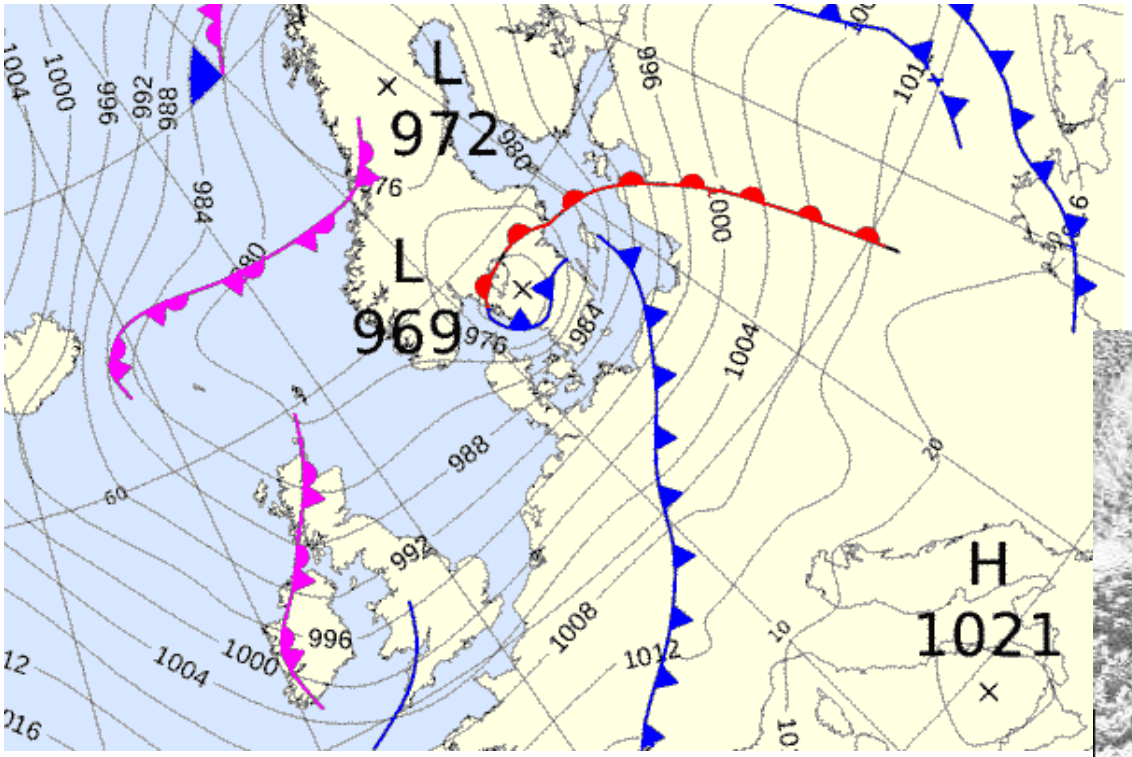
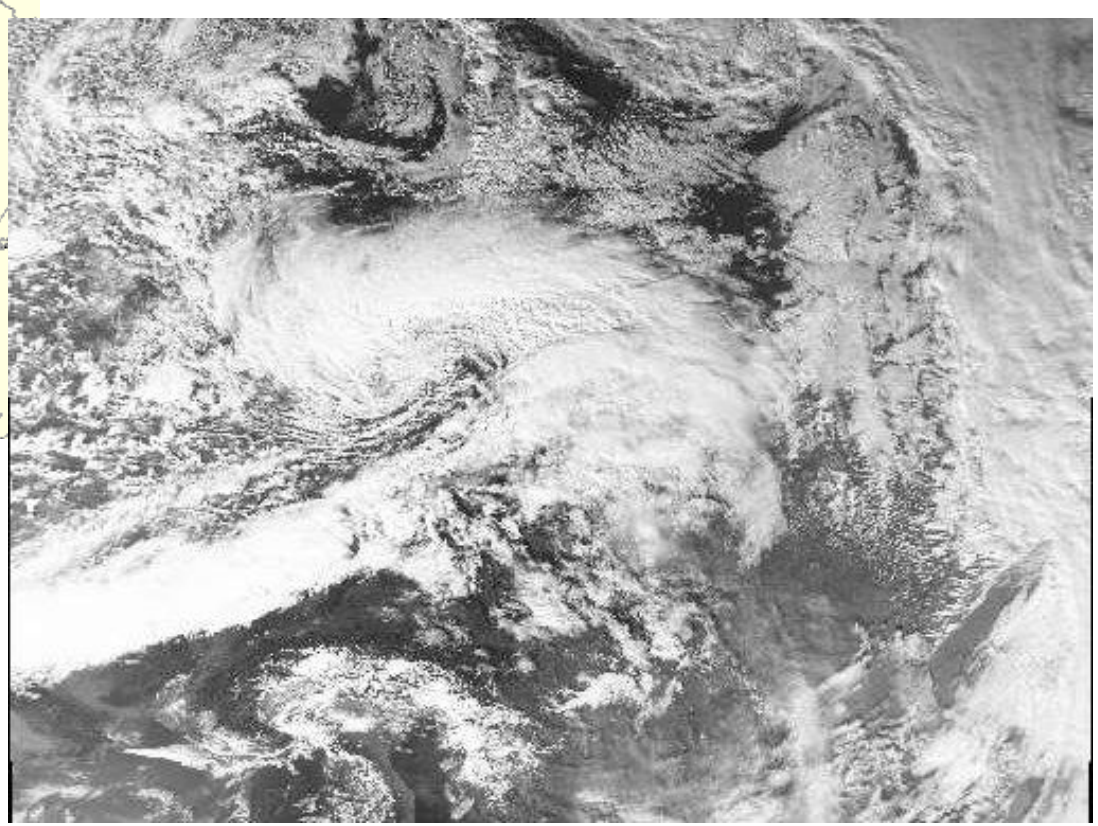
- Low ‚Christian‘ was passing Europe (sounding at 10113, 160 km/h at 500m height)



Quelle der Karte: Wetterzentrale

Bearbeitung: Mario Lehwald



Quelle: NOAA quicklook from NEODAAS/University of Dundee

It‘s so easy – dynamical downscaling with Christian (27. – 29.10.2017)

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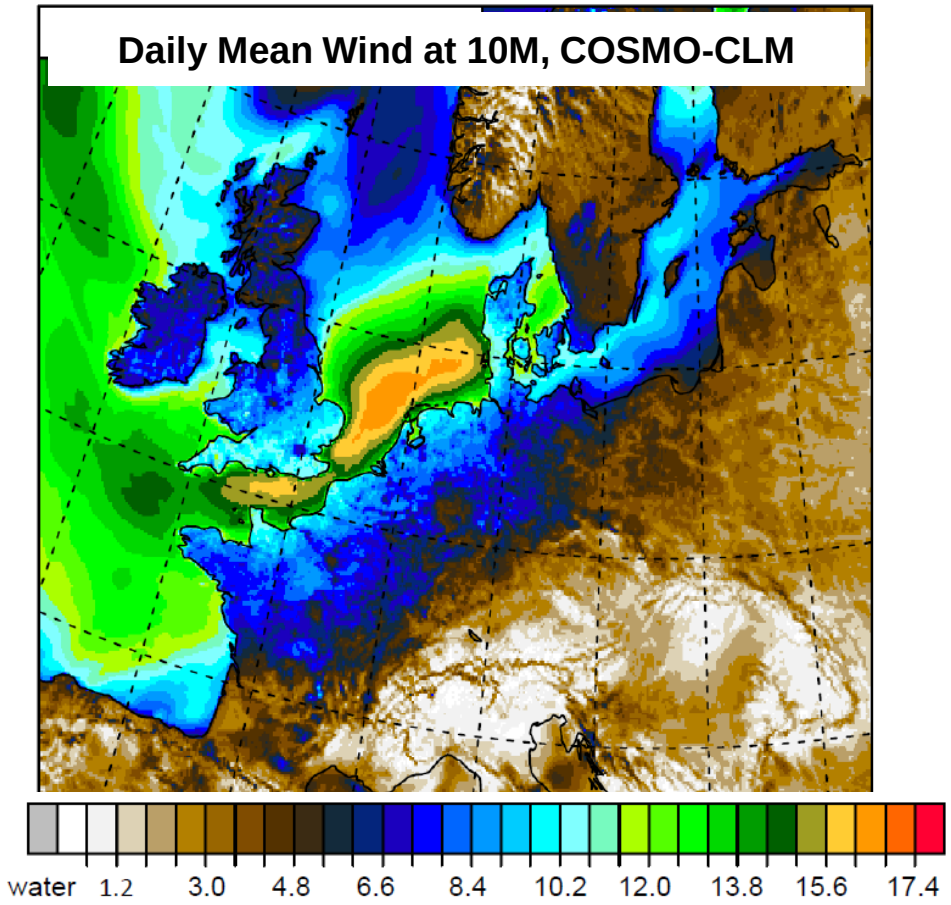
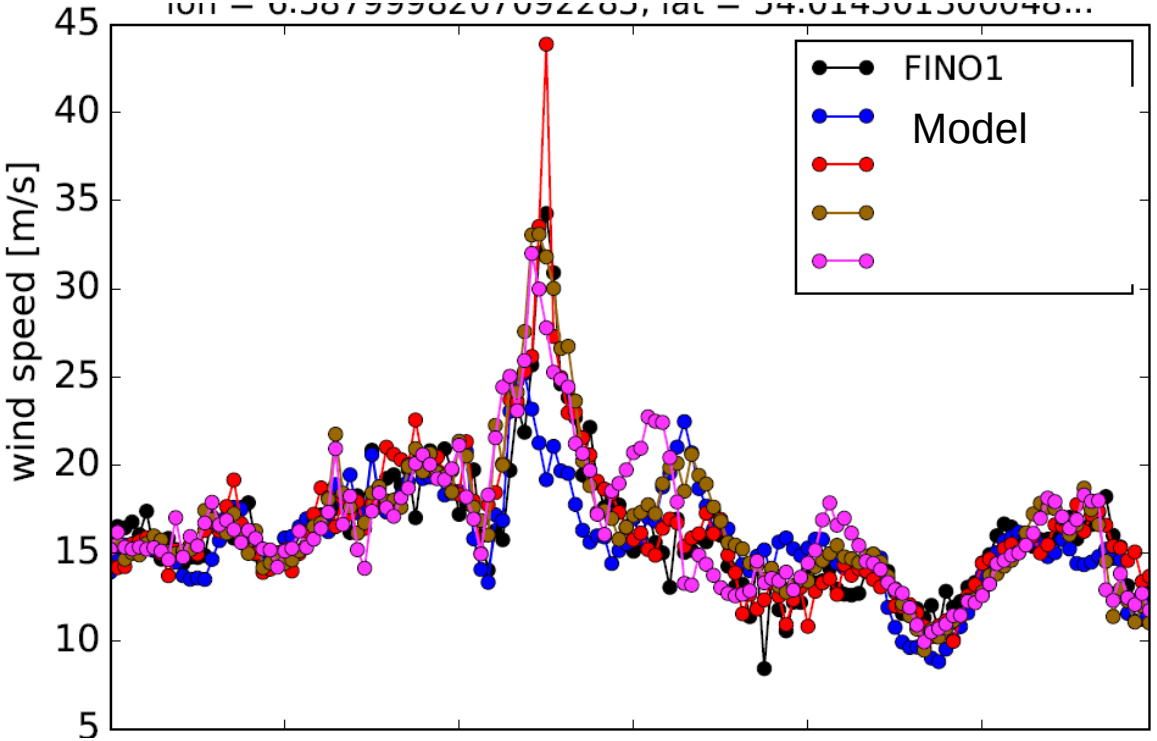
- Perfect boundary approach of Dynamical Downscaling





- Often used by wind companies
- Domain of Interest should be small
- High-Dependency of atmospheric variabilty on model settings (domain, time step, …)

Dynamical Downscaling – the assimilation approach

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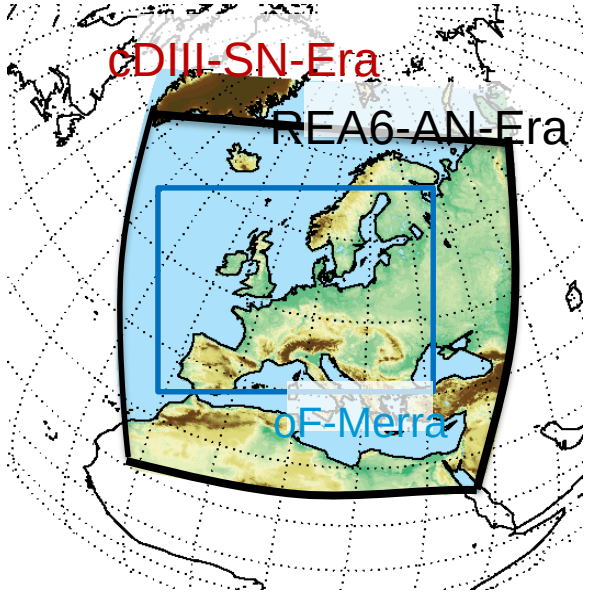
oF-Merra	COSMO-REA6	UERRA-Reanalysis project
Helmholtz-Zentrum G.	Deutscher Wetter-dienst / Uni. Bonn	European Meteoro-logical Services
Spectral nudging / No nudging	Continuous nudging of observations	Nudging / 3D-VAR / 4D-Var
DOF: ++ and +++	DOF: +	DOF: + - ++
MERRA2 / ERA inter	ERA inter	ERA inter
0.06°	0.06°	0.11°



- Temporal coverage differs significantly
- One global reanalysis is in the data production phase (ERA-5, non open-data)

Renewed Dynamical downscaling with Christian (27. – 29.10.2017)

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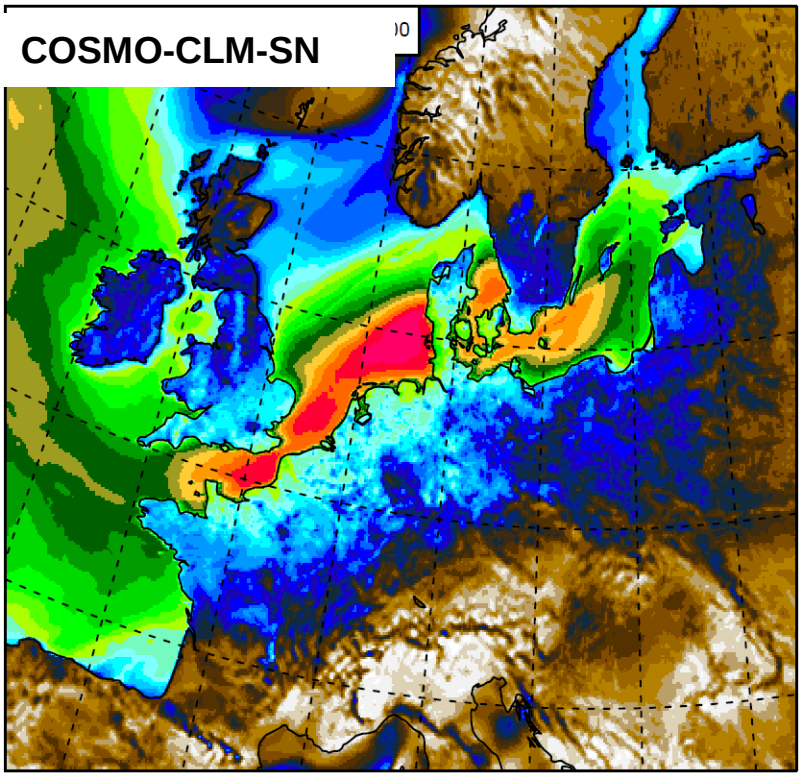
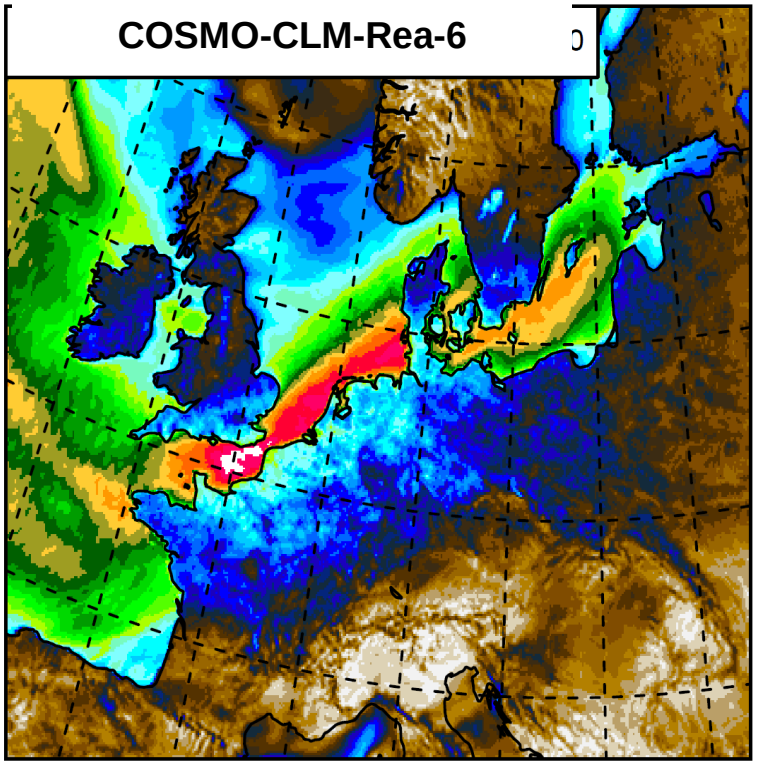
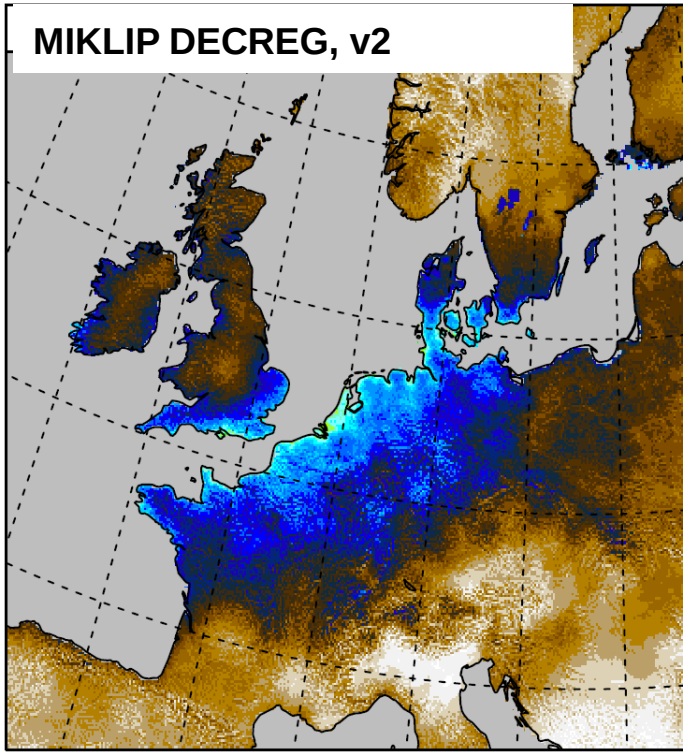
Daily Mean Wind at 10M, 28.10.2017







Renewed Dynamical downscaling with Christian (27. – 29.10.2017)

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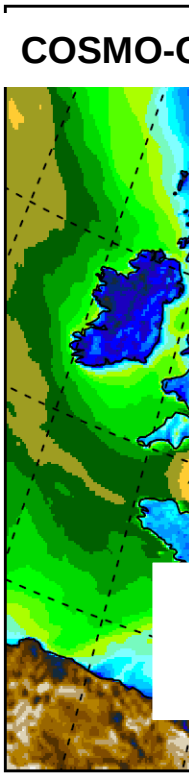
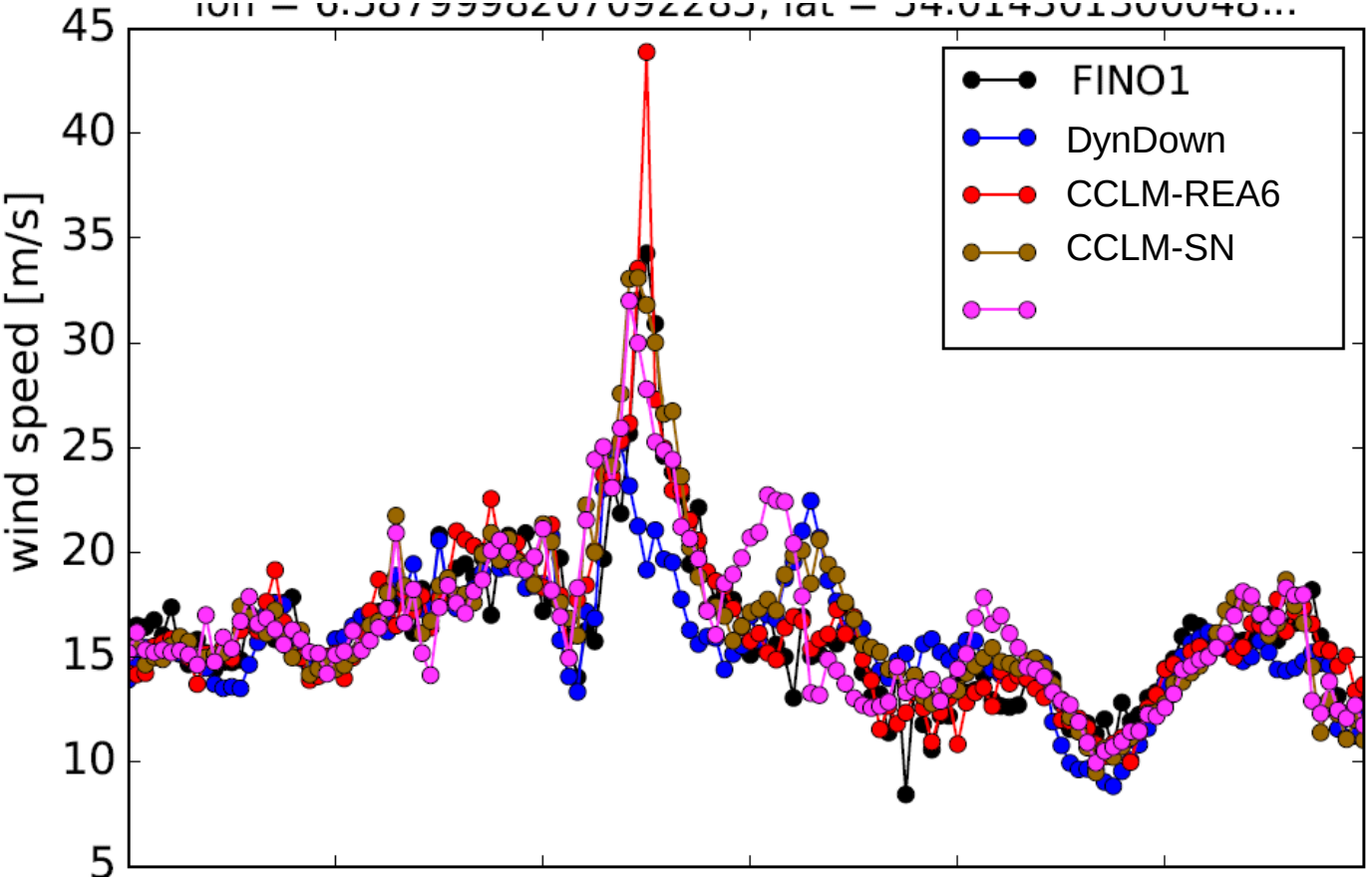
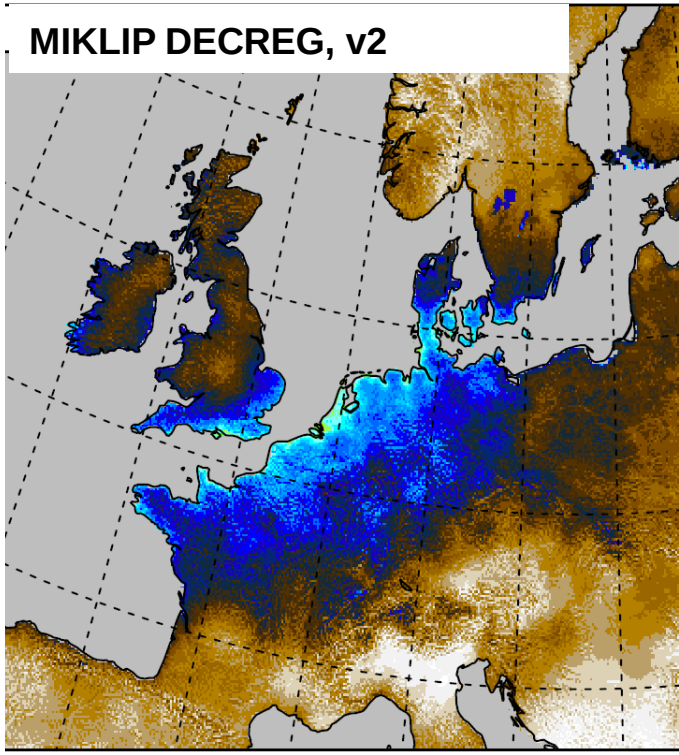
Centre for Materials and Coastal Research

Wind at FINO1 platform, 100M, mast corrected, 26.-30.10.2017







- At least for high temporal coherency follow the assimilation approach of dynamical downscaling
- for physical consistency??

And the wind farms?

They are not located at 10m height?

Availability of long-term reference data for the planetary boundary layer

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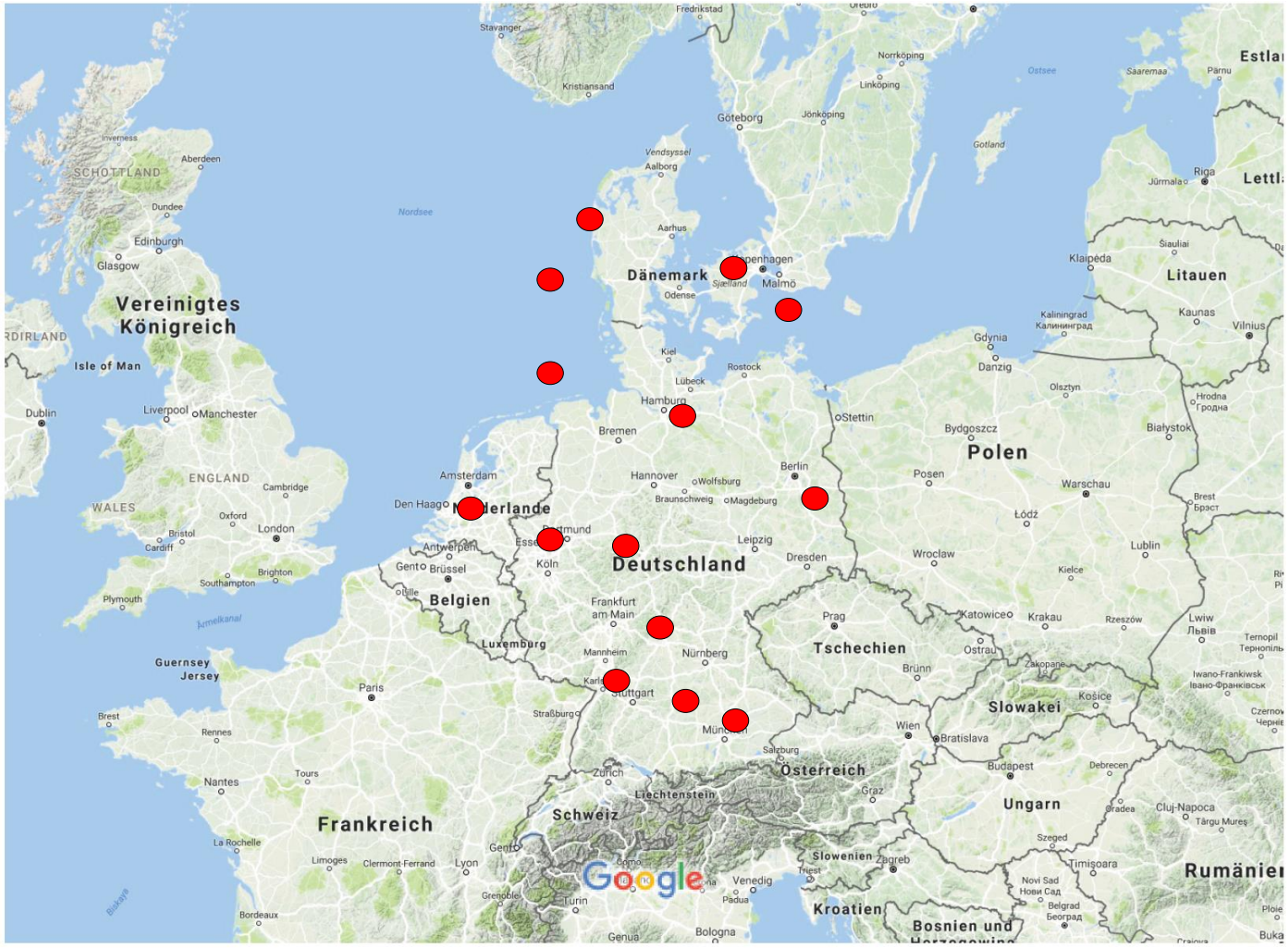

FINO1, wind speed at 100M, Oct - Dec 2013

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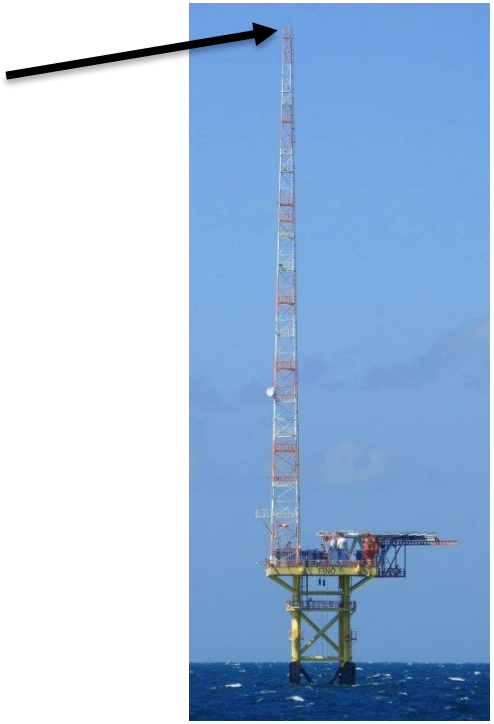

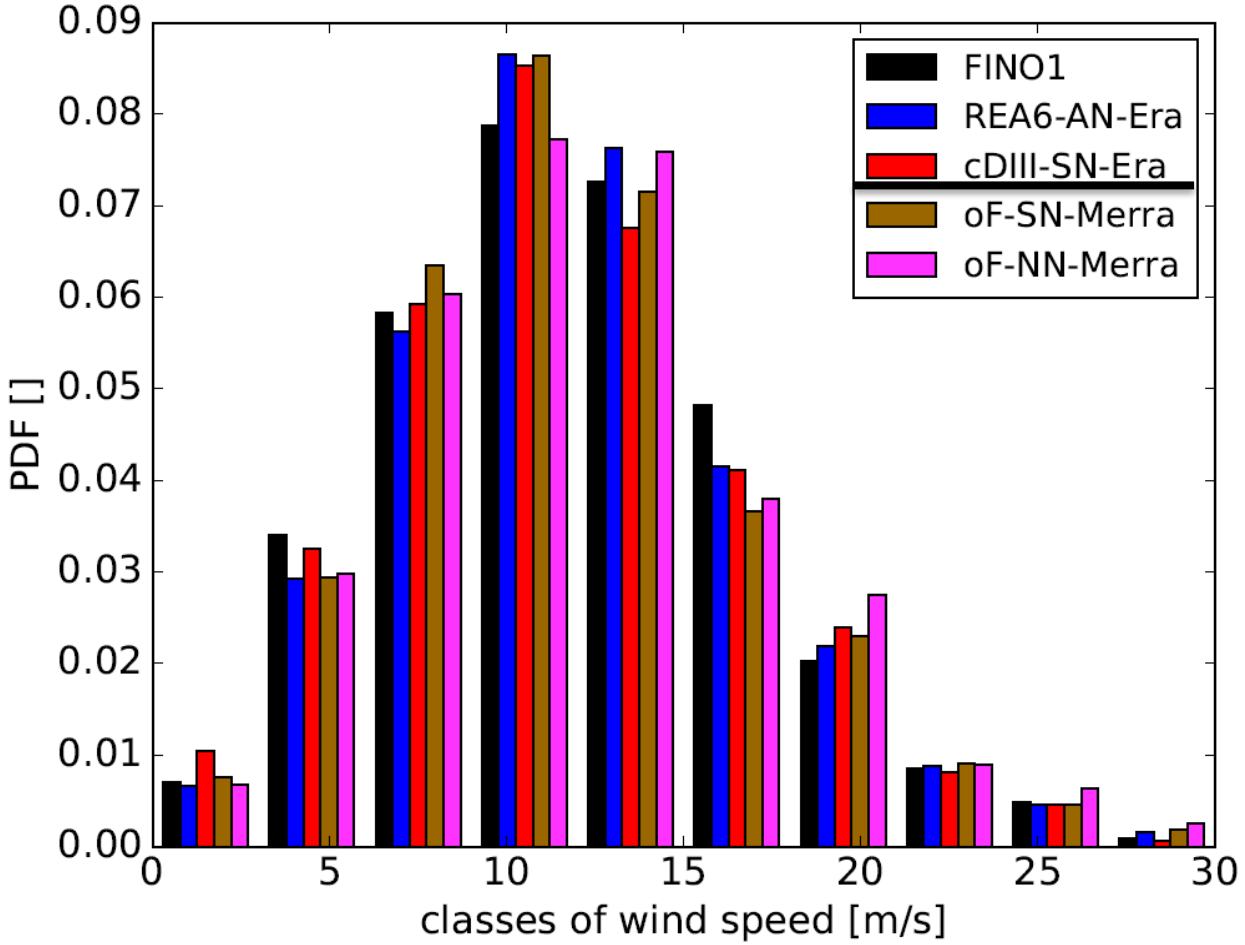

- measurements from the top anemo-meter (mast corrected) -> reselected all model results to one hour

IQD [*10^-3] + Correlation	REA-6-AN-Era	cDIII-SN-Era	oF-SN-Merra	oF-NN-Merra
Okt – Dez 2013	**0.42 (0.95)**	**0.42 (0.90)**	**0.67 (0.92)**	**0.59 (0.86)**
Okt 2013	1.3 (0.95)	1.3 (0.87)	0.85 (0.91)	0.49 (0.85)
Nov 2013	0.2 (0.91)	1.0 (0.84)	0.5 (0.86)	0.9 (0.78)

Boundary layer measurements at Falkenberg (MOL Lindenberg)

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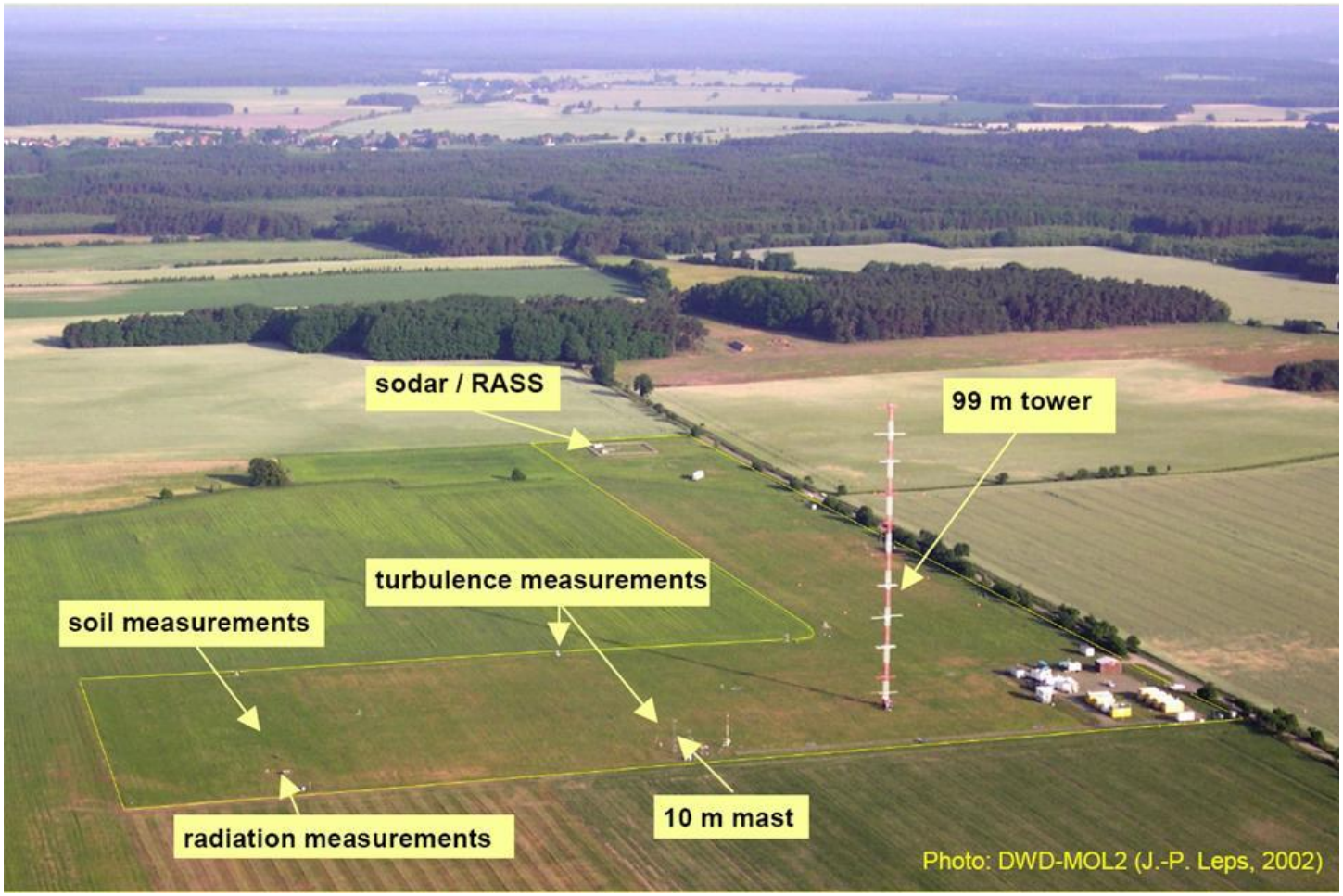

Tower Falkenberg – daily cycle error in PBL winds (Q1, 2015)

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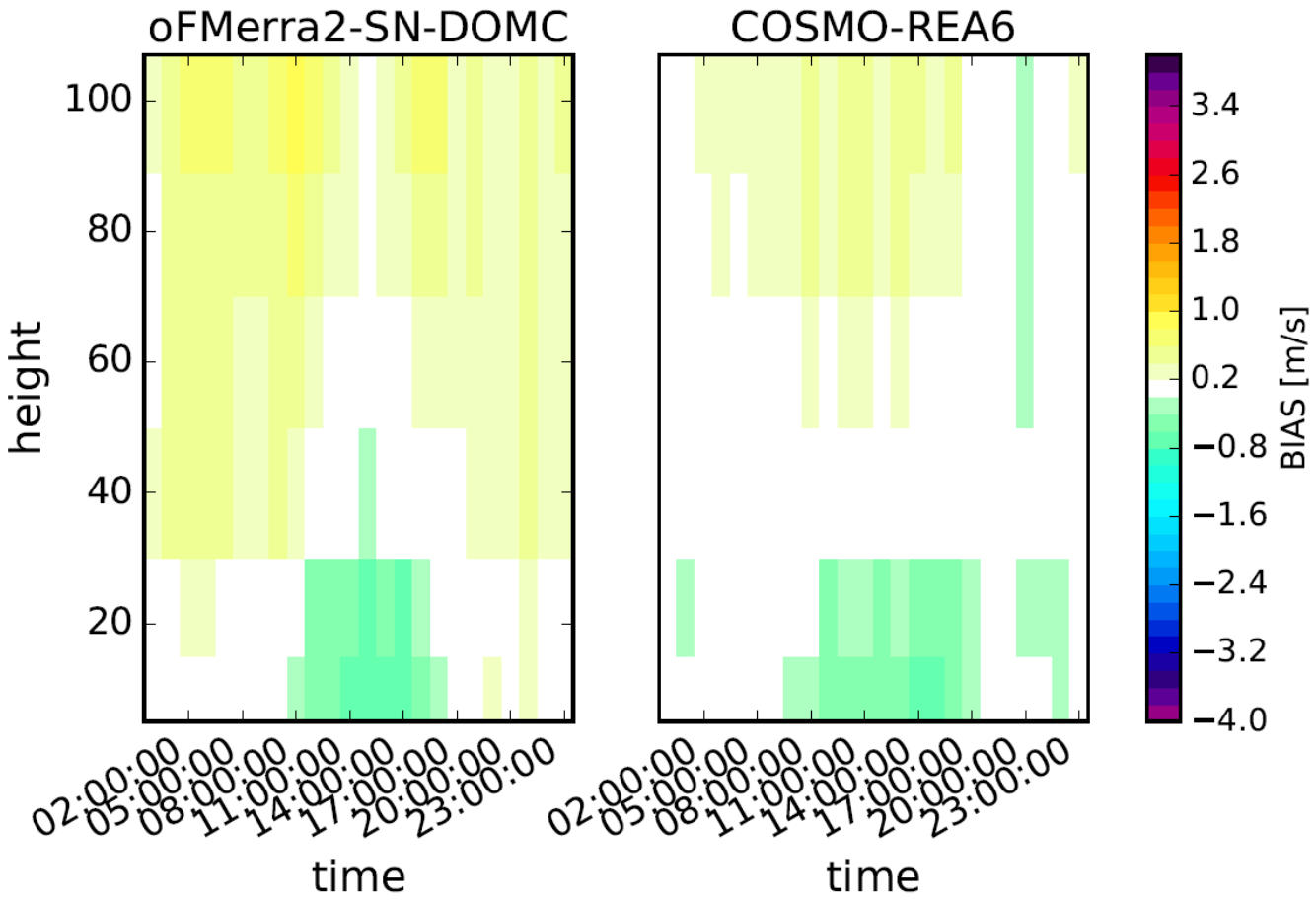
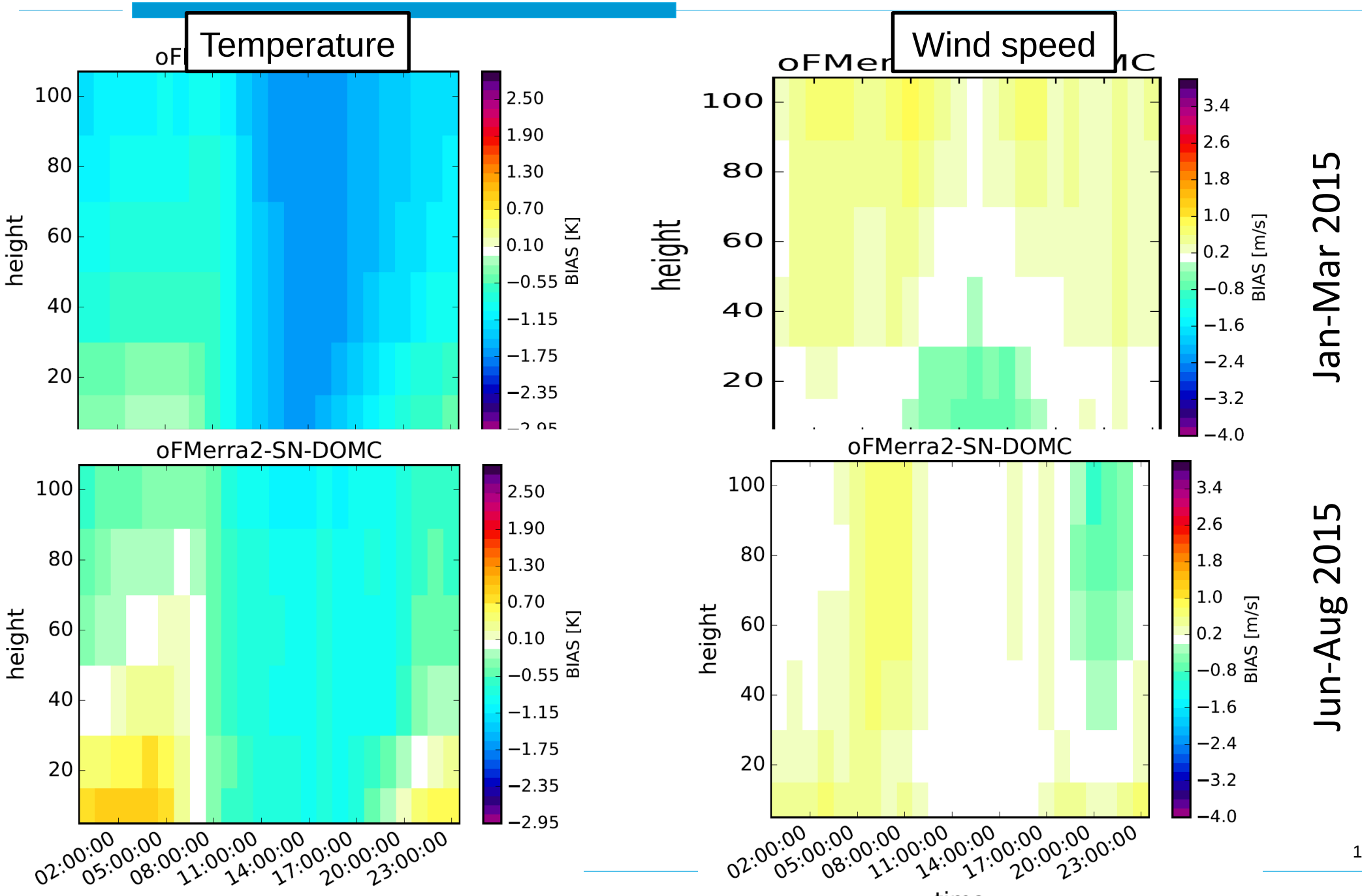
Centre for Materials and Coastal Research



Tower Falkenberg – Do not forget stratification!!

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research



Tower Falkenberg – Coherency of models and data (Q1, 2015)

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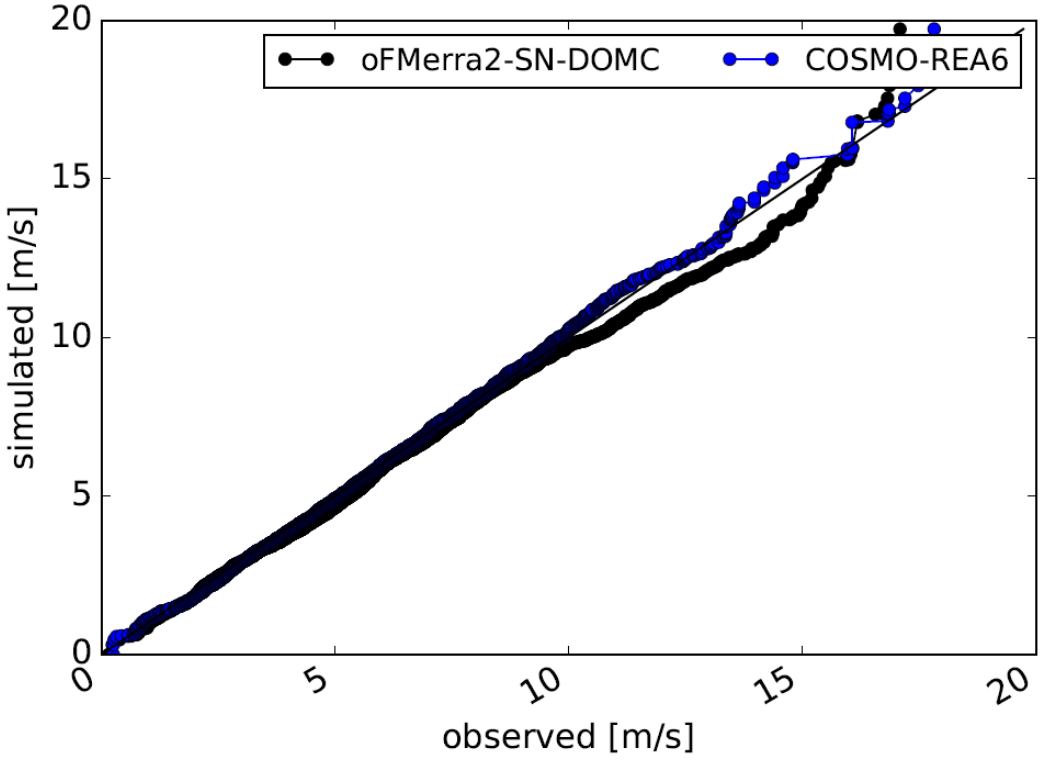
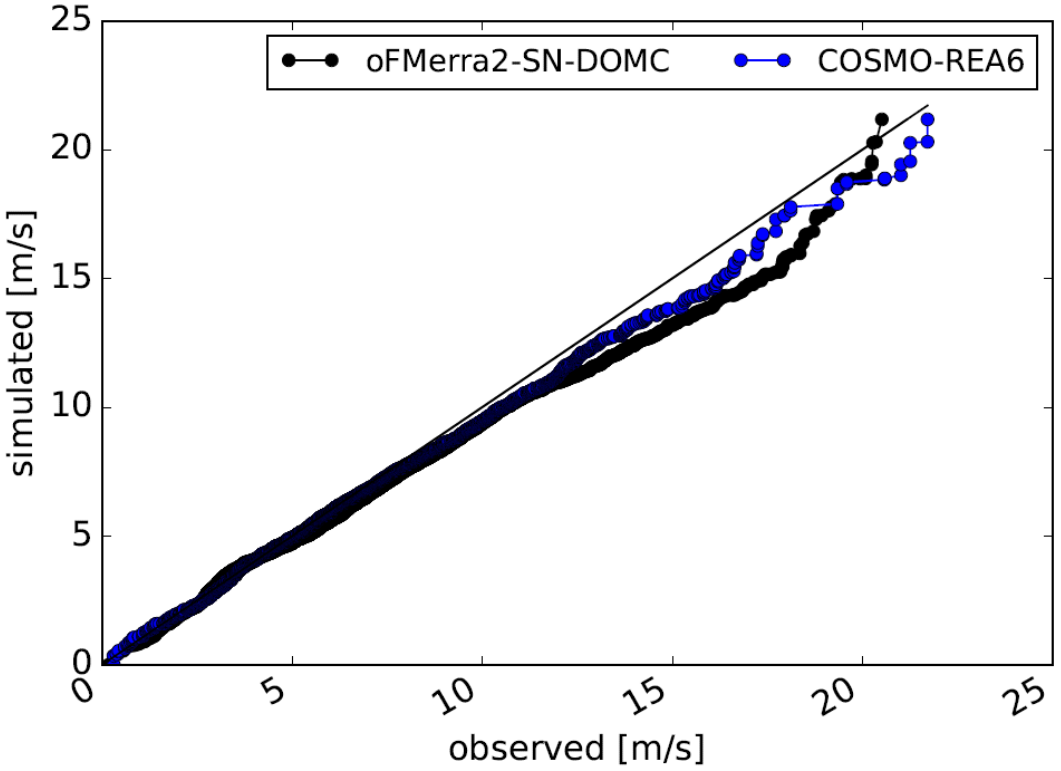
40m height



98m height



Tower Falkenberg – Wind roses at 80m height, 2015

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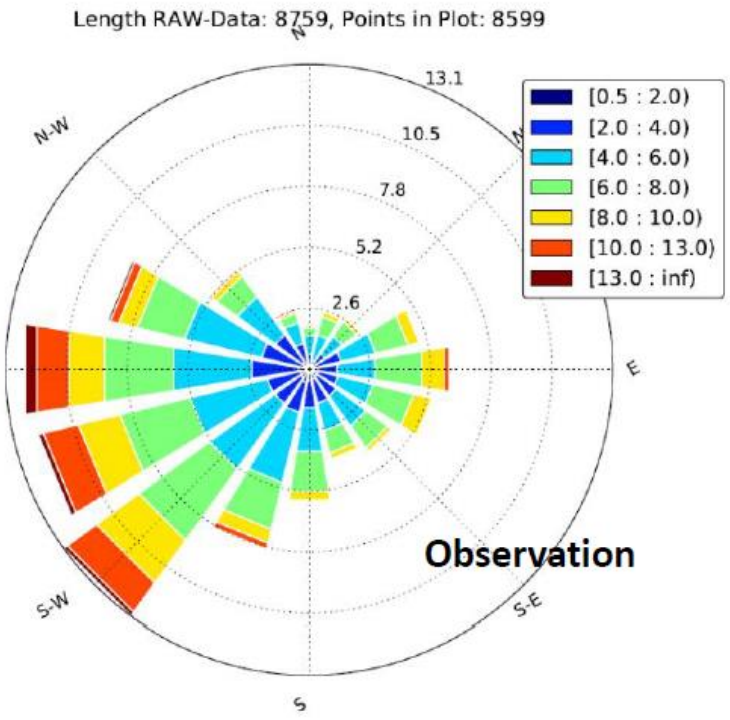

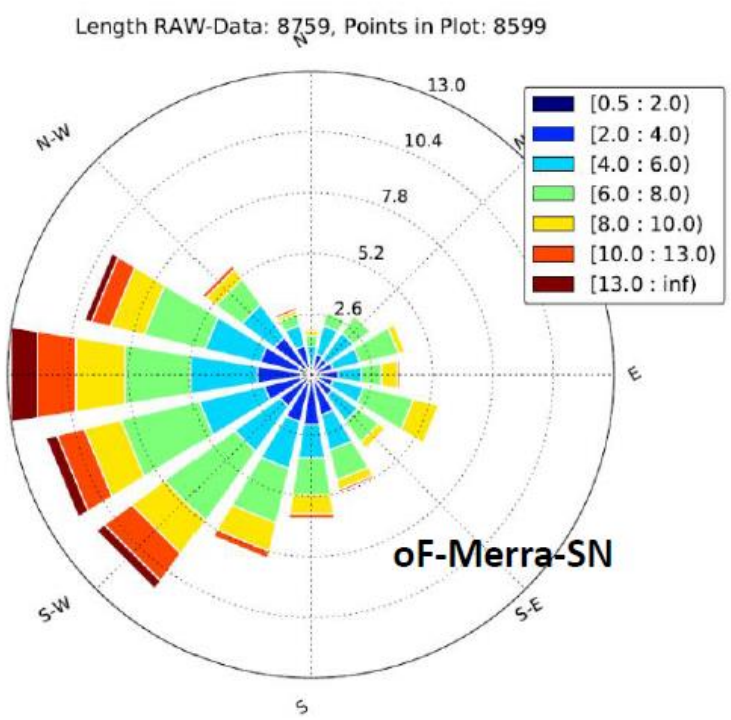

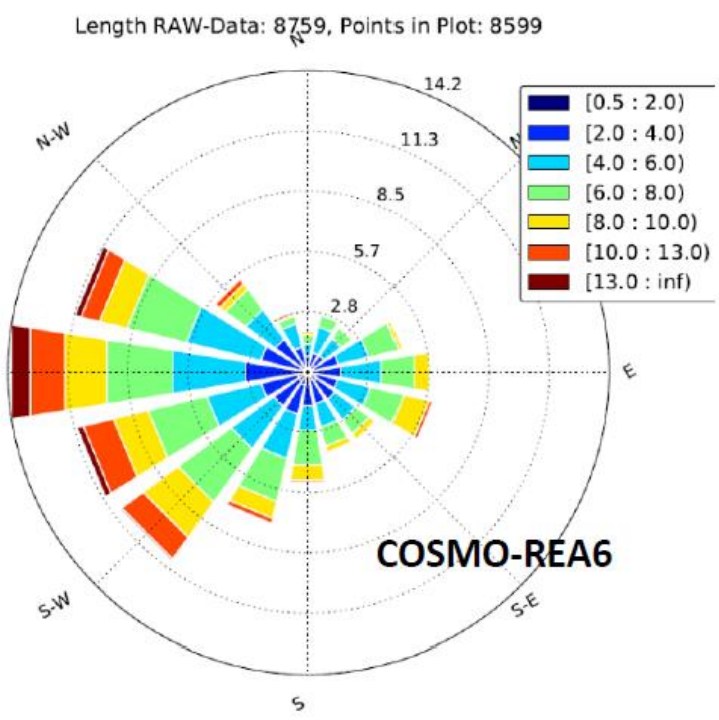

- Vertical coherency of the planetery boundary layer profiles seems to be not fulfilled in case of assimilation approaches

Conclusions

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- Dynamical downscaling turns out to be the path to go when high-resolved data on larger domains are required
- Dynamical downscaling: assimilation approach outperforms the perfect boundary approach with respect to temporal coherency
- !the physical consistency might be better with the perfect boundary approach!
- The evaluation is extended to longer time periods and more stations

- All weather data type for solar and wind energy as well as hydro-power will be part of the open energy platform and accessible using user-friendly interfaces
- Deadline: mid next year

https://oep.iks.cs.ovgu.de/