Deutscher Wetterdienst
Wetter und Klima aus einer Hand

EWeLiNE and ORKA:

Improving Model Physics for Renewable Energy

Andrea Steiner, Carmen Köhler, Jonas von Schumann



Outline

➔ Motivation / Modelling Challenges:

Wind:

- Frontal passage (low pressure systems)
- Diurnal cycle
- Winter positive bias

Solar:

- Convective events
- Subscale clouds after cold front passage
- Low stratus clouds

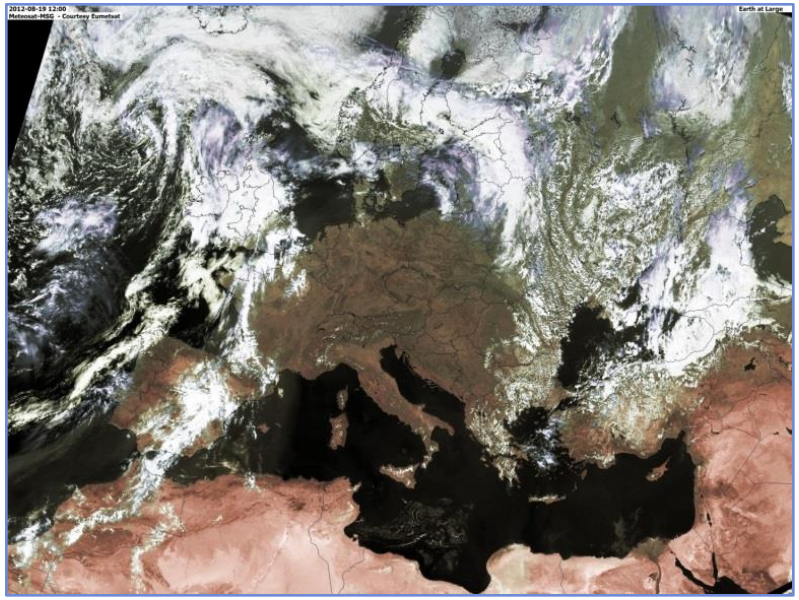
➔ Testcase in August 2012

➔ **Wind:**

- Nocturnal low level jet (LLJ)

➔ **Solar:**

- Solar irradiance on a clear sky day



19. Autust 2012, 12:00 UTC

Problem concerning wind speed

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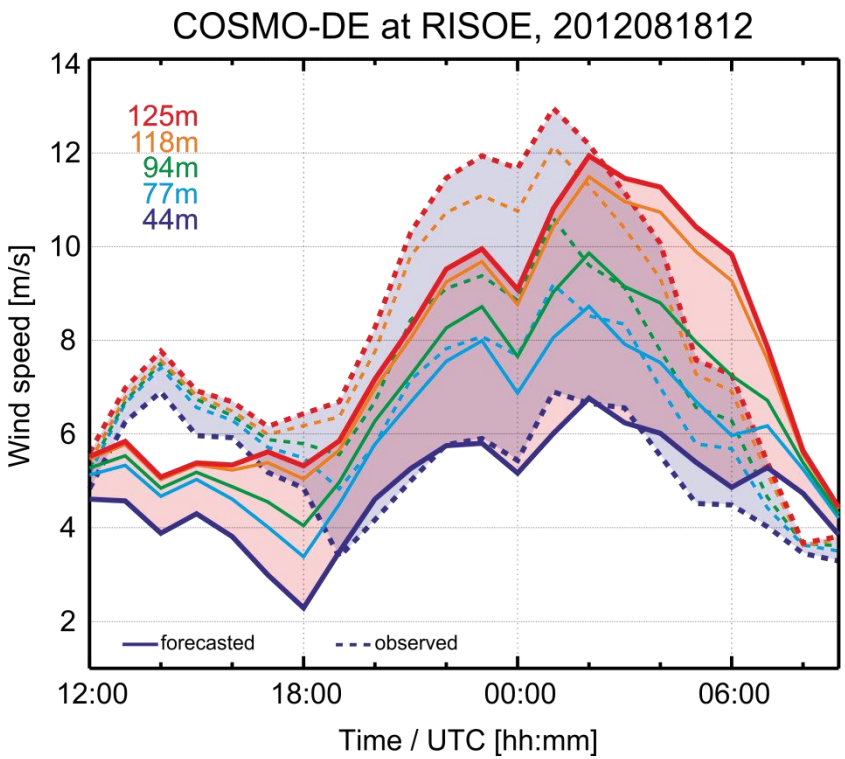
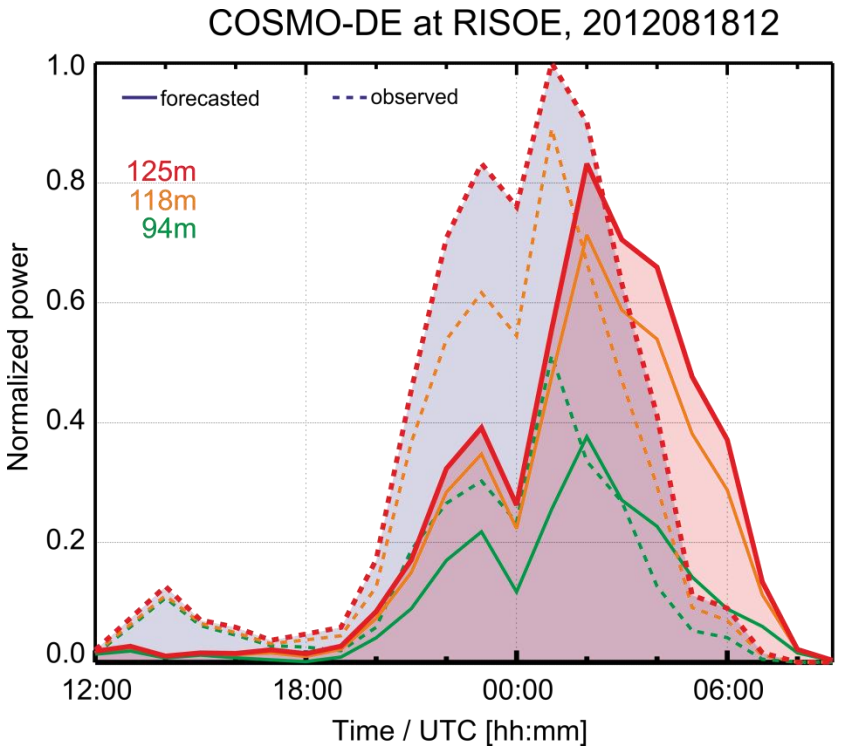
➔ Low Level Jets are underestimated

Wind Speed



Power



Sensitivity Tests

Vertical resolution:

➔ Increased (ke = 60, 62, 85)

Turbulence model:

➔ Stability was increased

- less TKE production: patlen = 0
- lower minimal diffusion coefficient: tk[h/m]min = 0.001
- smaller turbulent length scale: turlen = 150 & astab = 1
- combination of several setting (“turb_mod”): patlen = 200, rlammom = 0.7, tk[h/m]min = 0.01, turlen = 150, astab = 1

Soil model:

➔ Heat conductivity, heat capacity, soil moisture were tested

- itype_heatcond=2
- itype_root=2,
- w_so=0, 0.01*zalam, 100*zalam

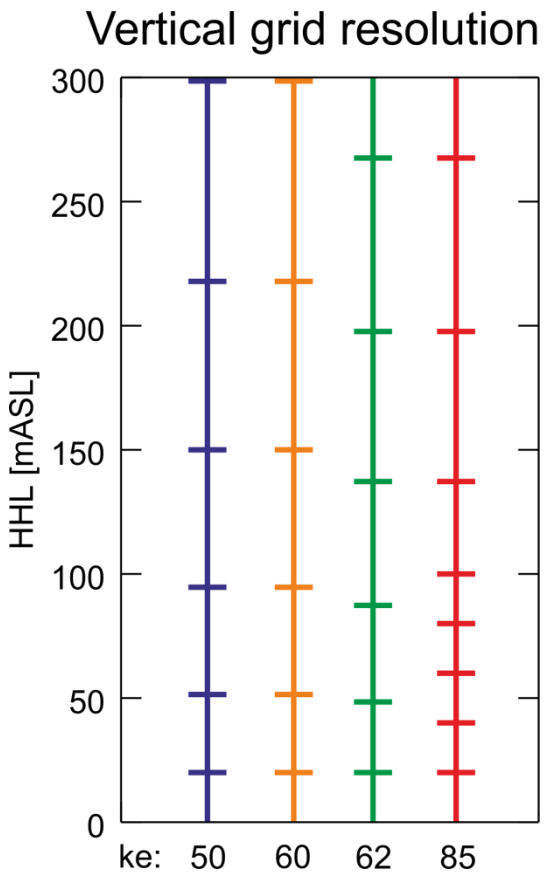
External parameters:

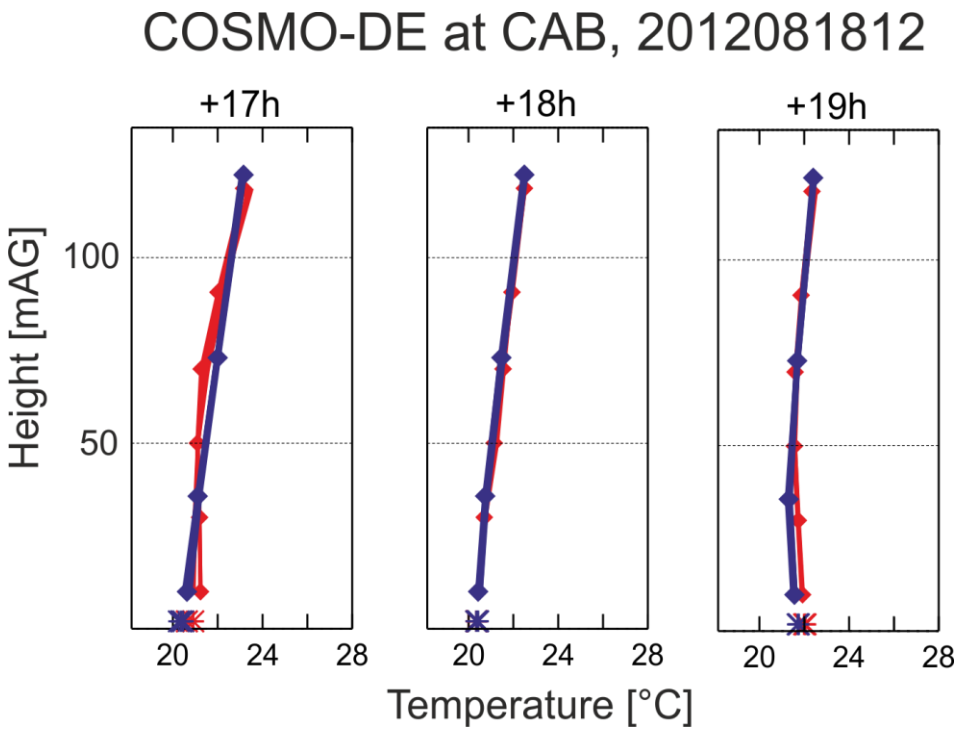
➔ Optimized for Lindenberg

- soiltype: 5 -> 3
- z0 = 0.1 -> 0.03

Sensitivity Test: Vertical resolution

➔ Almost no sensitivity to higher vertical resolution





Sensitivity Test: Turbulence parameters

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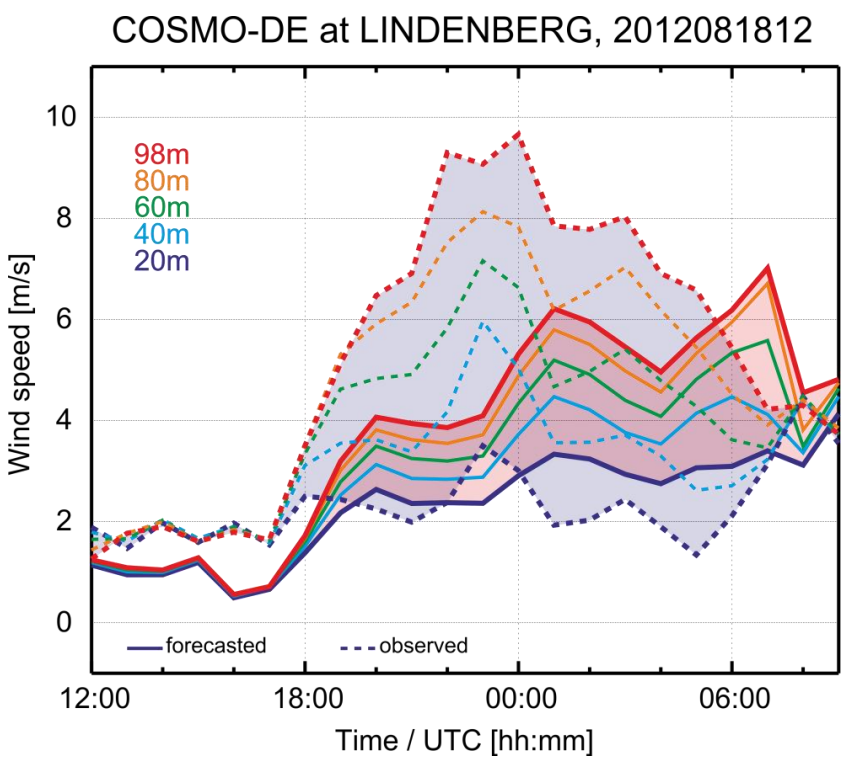
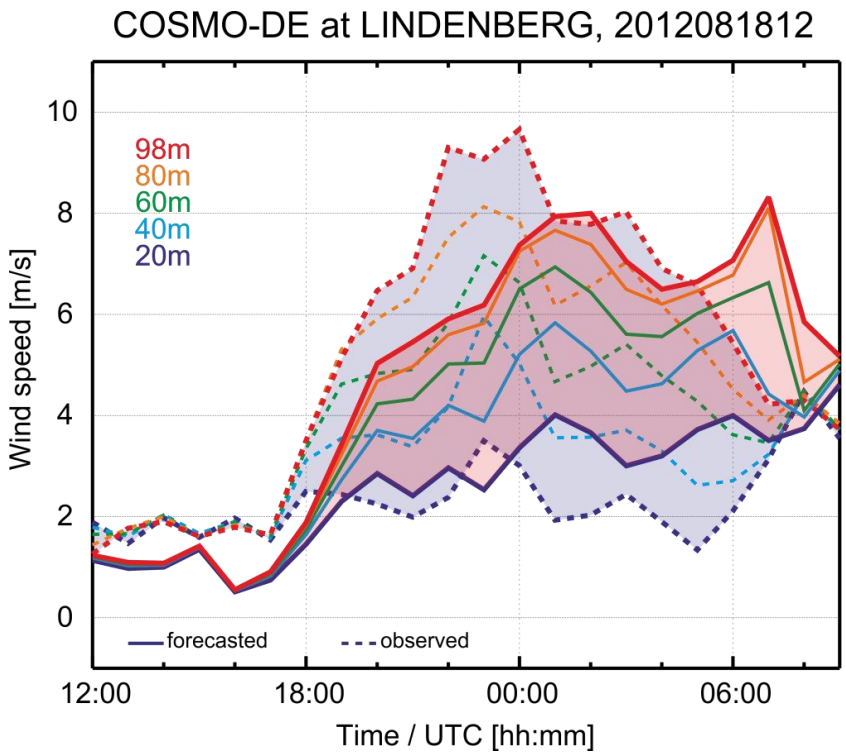
➔ Modified turbulence parameters allow for higher nocturnal wind speeds

Operational



"turb_mod"



patlen=200, rlammom=0.7, tk[h/m]min=0.01,turlen=150, astab=1

Sensitivity Test: LLJ at CABAUW

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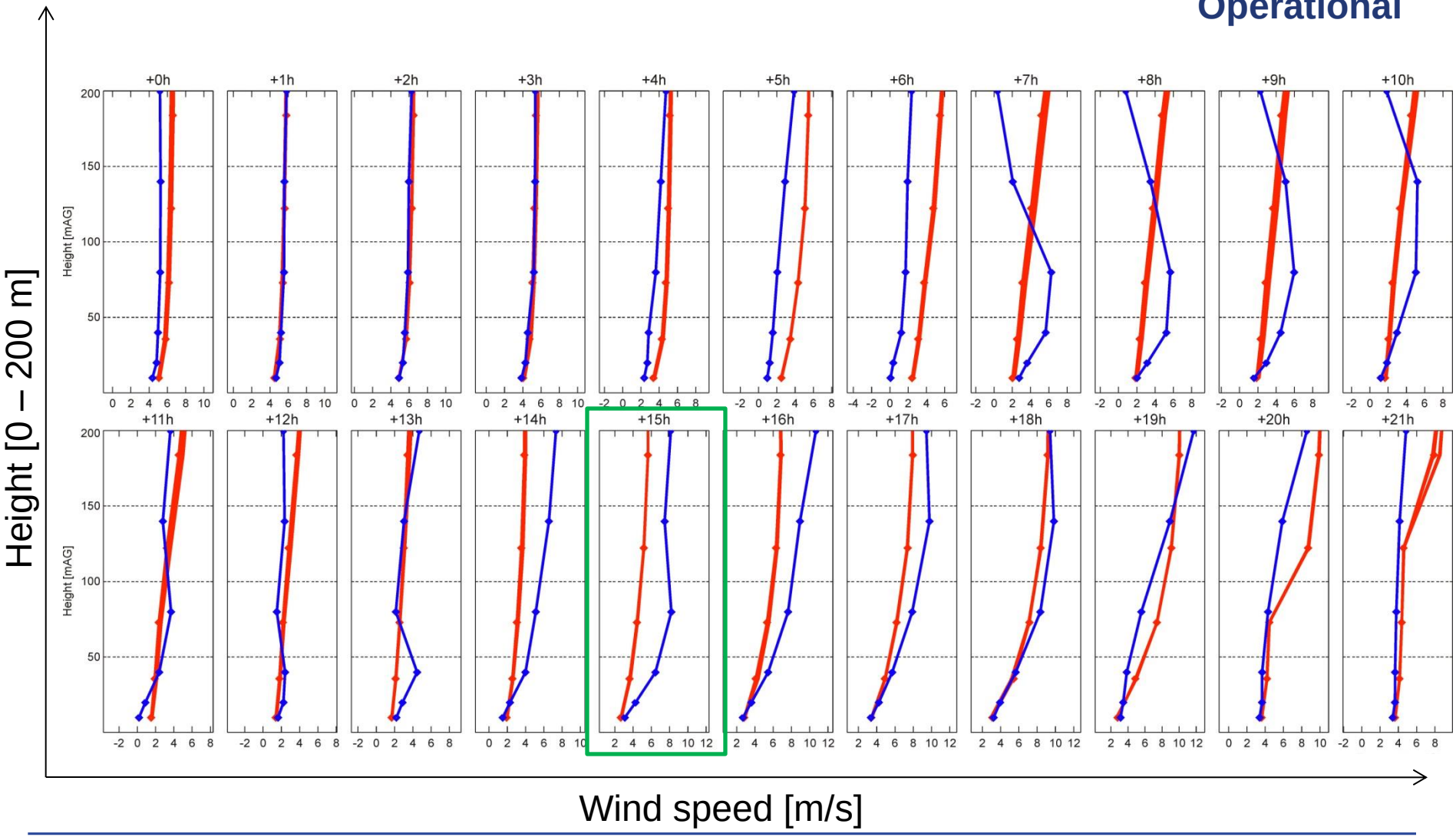
DWD

Operational



Sensitivity Test: LLJ at CABAUW

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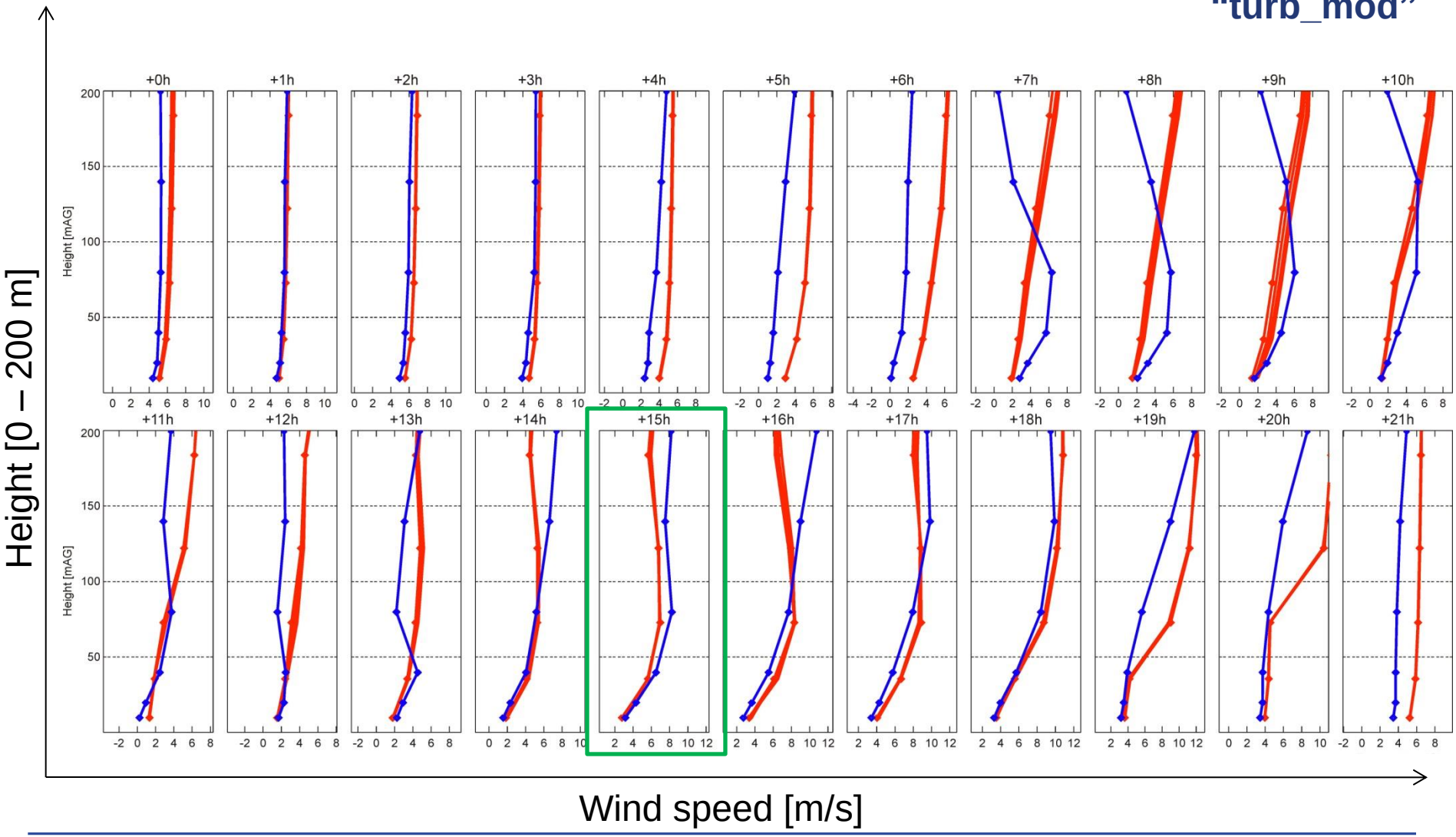
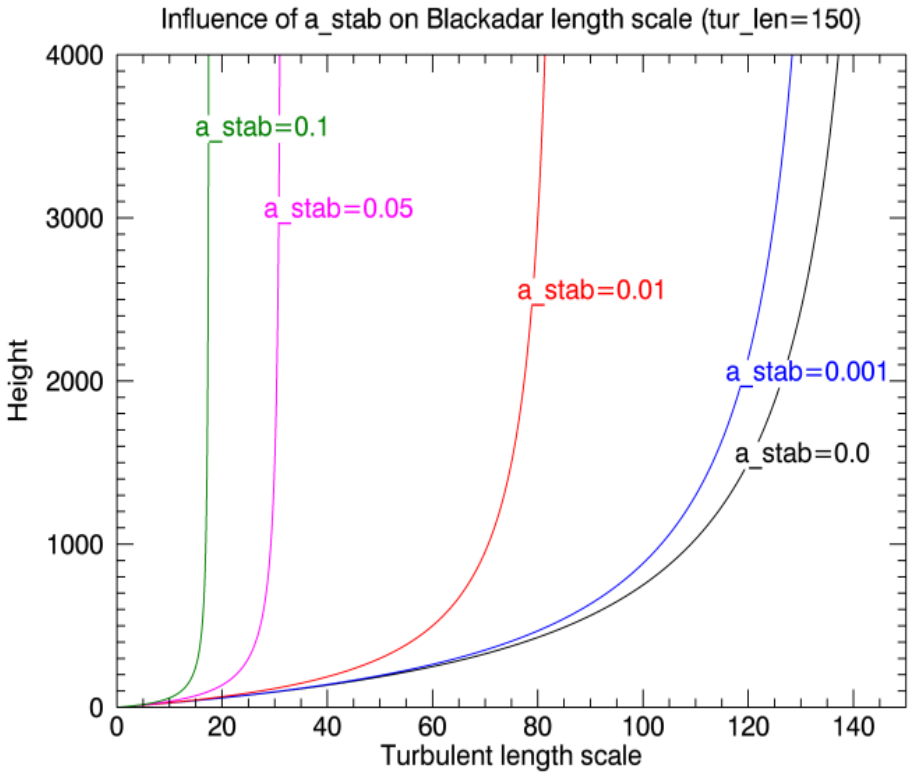
DWD

"turb_mod"



Sensitivity Test: Turbulence parameters

- Chosen turbulence parameters helped to better represent the nocturnal LLJ and the stable conditions (but: not for all measurement sites)
- A good combination of turbulence parameters needs to be chosen carefully
- A location or stability dependent reduction of diffusion might help (a_stab)



Sensitivity Tests

Vertical resolution:

➔ Increased (ke , 85)

Low impact

Turbulence model:

➔ Stability was increased

- less TKE production
- lower minimal c coefficient: tk[h/m]min = 0.001
- smaller turbulent length scale: turlen = 150 & astab = 1
- combination of several setting (“turb_mod”): patlen = 200, rlammom = 0.7, tk[h/m]min = 0.01, turlen = 150, astab = 1

High impact

Soil model:

➔ Heat conductivity, heat capacity, soil moisture were tested

- itype_heatcond=2
- itype_root=
- w_so=0, 0.0 zalam, 100*zalam

Medium impact

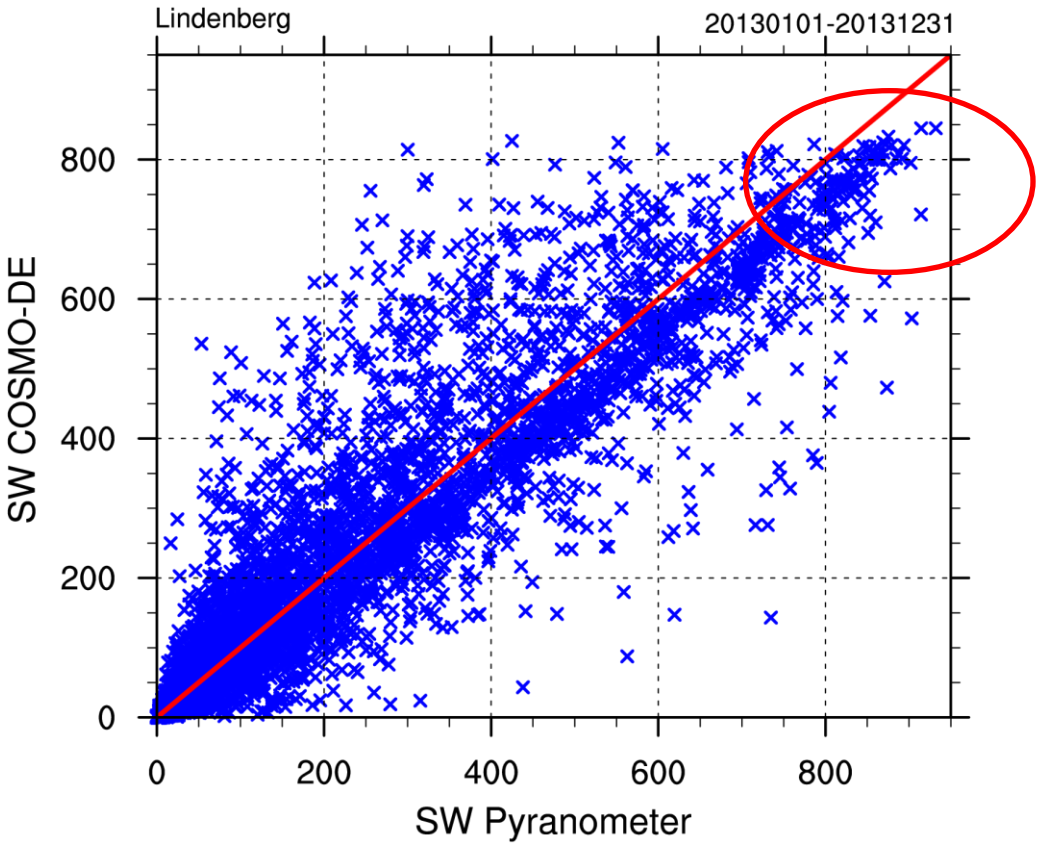
External parameters:

➔ Optimized for Lindenb

- soiltype: 5 -> 3
- z0 = 0.1 -> 0.03

Low impact

Comparison of Aerosols

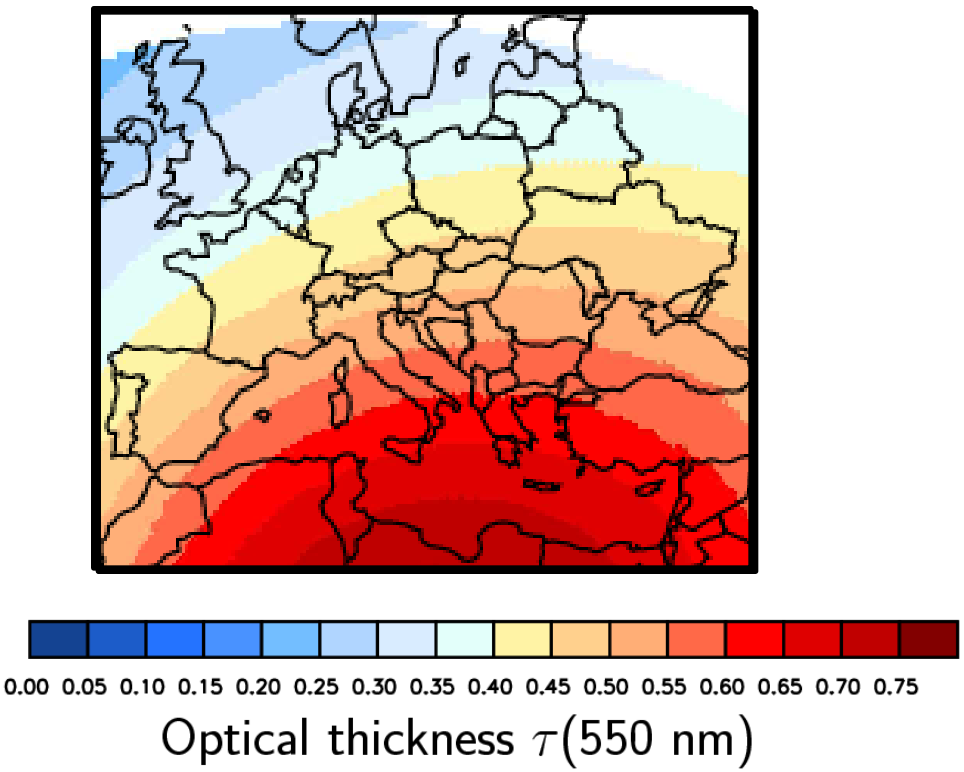


Operational aerosols are from Tanré et al. 1984

- ➔ Constant in time
- ➔ On clear sky days the shortwave radiation COSMO-DE model forecasts is too low

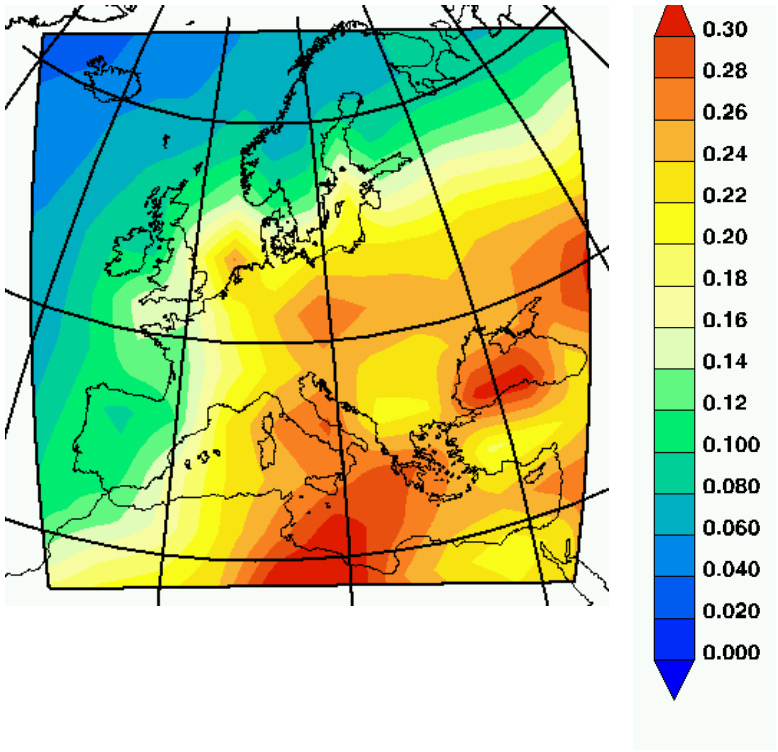
Aerosol Optical Thickness

Aerosols from Tanré, 1984 (operational)



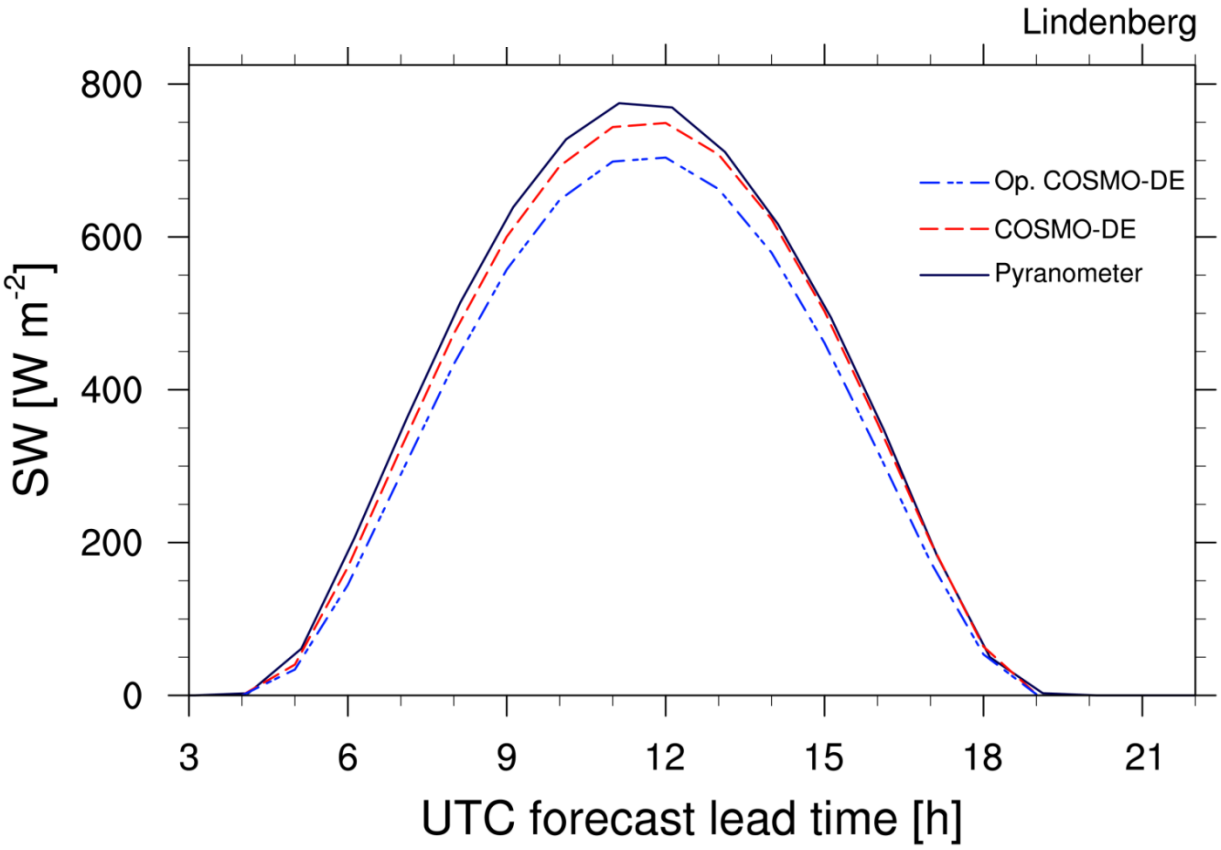
Helmert et al. (2007)

Aerosol climatology from Tegen, 1997



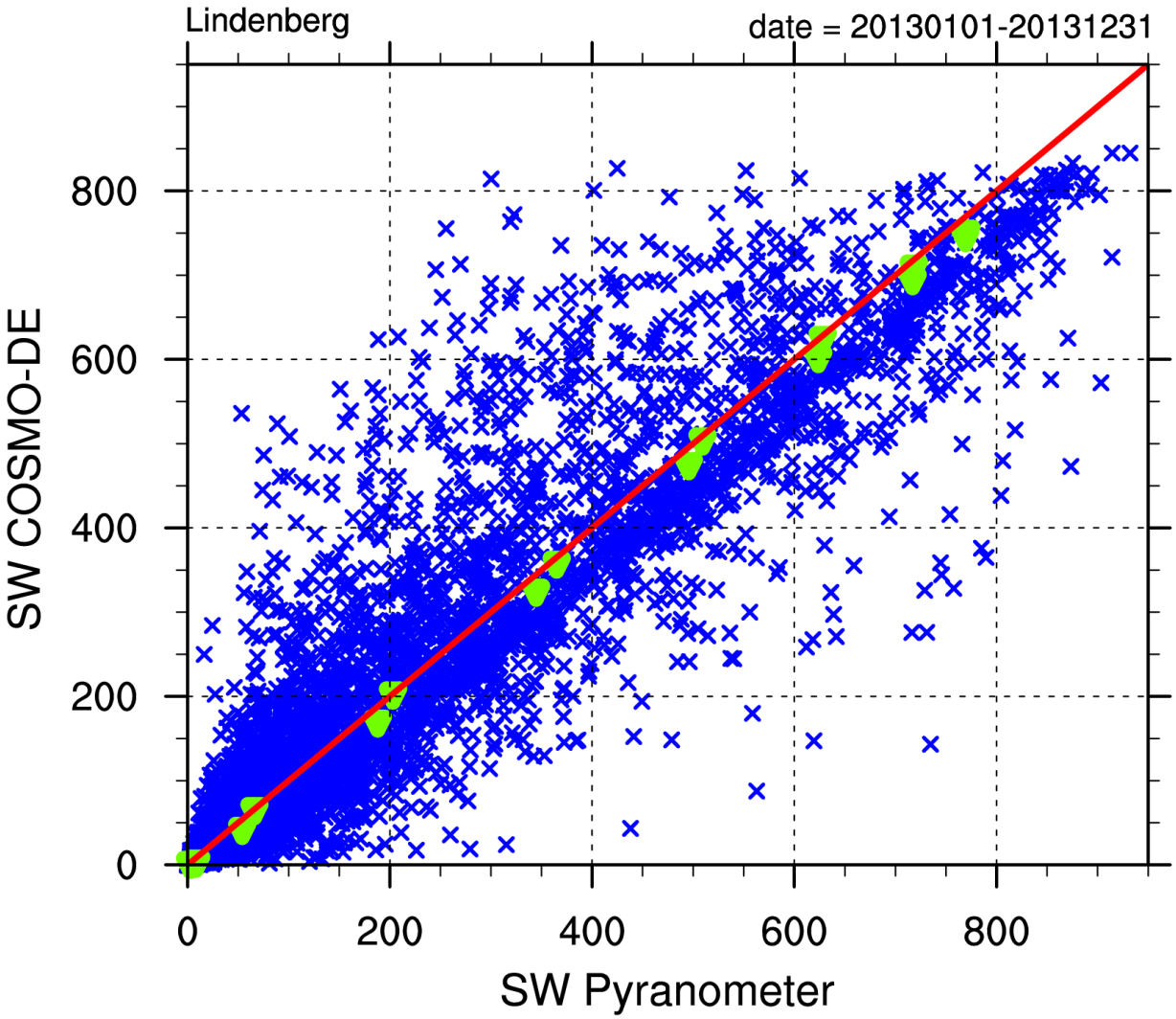
Jürgen Helmert (DWD)

Clear Sky Day – 19.08.2012



- Hourly averages of the shortwave radiation
- Tegen aerosol climatology shows improvement due to more transparent atmosphere

Clear Sky Day – 19.08.2012



Thank you!

Questions?

Observations operated by:
Meteorologisches Observatorium Lindenberg
DTU Wind Energy
Royal Netherlands Meteorological Institute