Comparison of wind speed against station observations

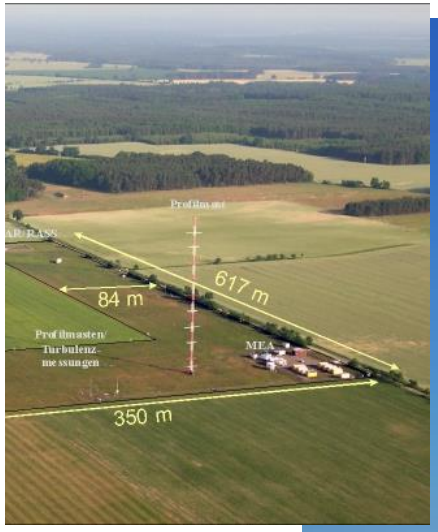
Deborah Niermann, Michael Borsche, Andrea K. Kaiser-Weiss, Frank Kaspar, (DWD)

UERRA evaluation workshop, 01.12.2017,

Tarragona, Spain

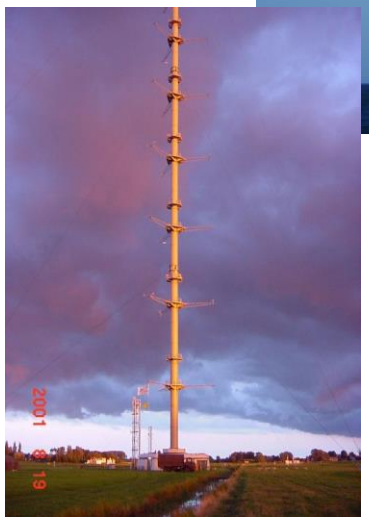
Data base

- Comparison against point measurements, including dependent measurements (German station observations) and independent measurements (wind masts)
- Analysis of reanalyses includes:
  - COSMO-REA6 (1-hourly analysis)
  - HARMONIE (6-hourly analysis and 1-hourly forecasts)
  - MESCAN (1-hourly forecasts)
  - UM and UM ens. (6-hourly analysis and 1-hourly forecasts, 20 members)
  - COSMO-REA12 and COMSO-REA12 ens. (1-hourly analysis, 20 members)



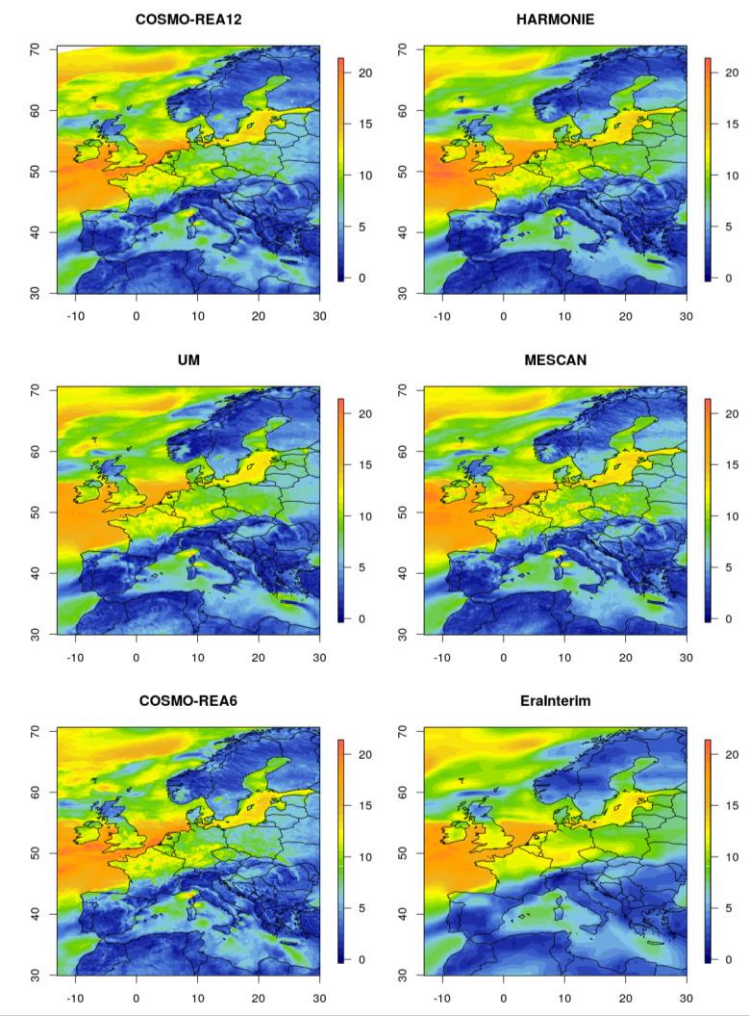
Leiterer et al., 2002

www.fino-offshore.de

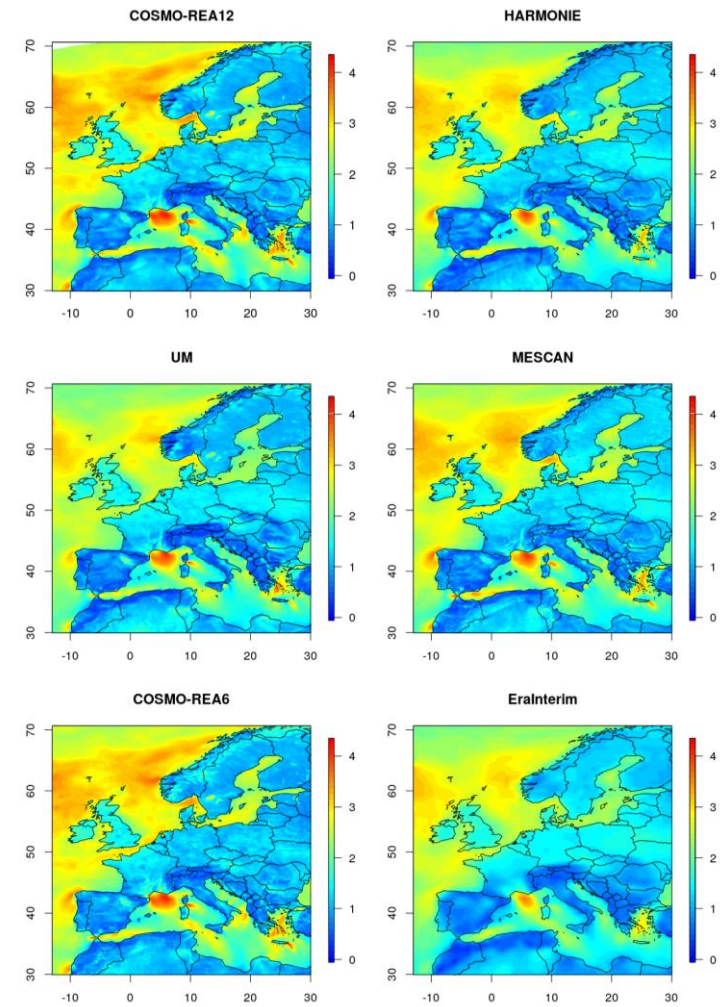


www.cesar-database.nl

Synoptic scale



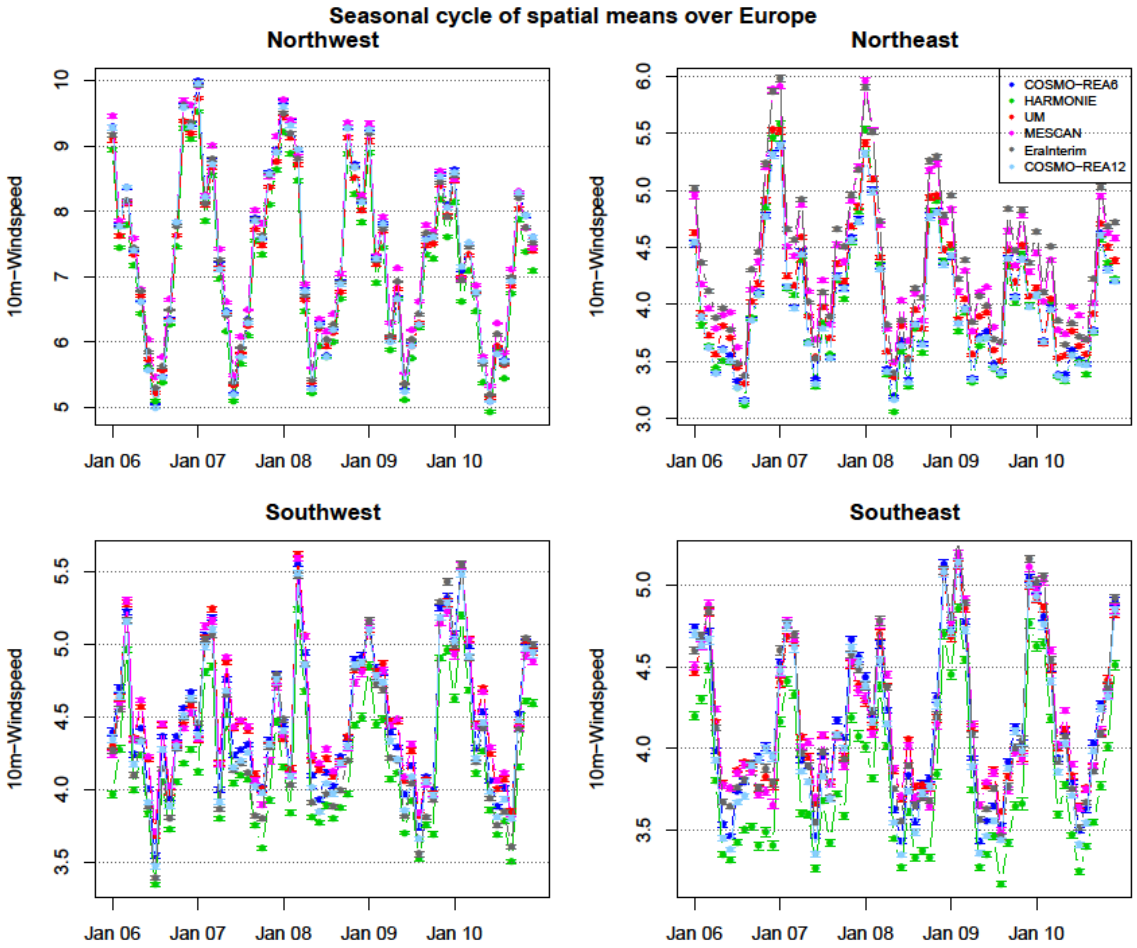
Daily mean 18.01.2007



Daily standard deviation 2006-2010

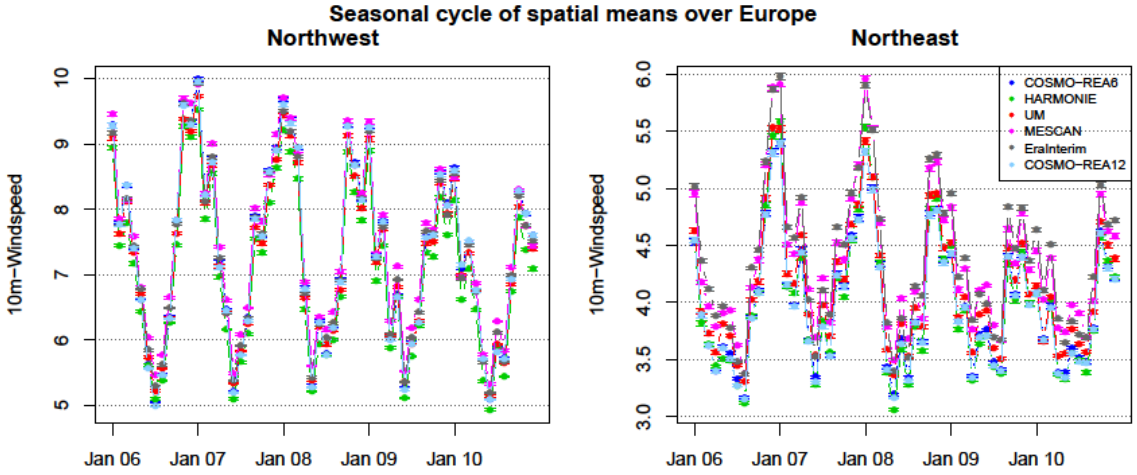
- RA's are remapped to same output field with 0.11° resolution
- Accordance of 6 model systems on daily and monthly scale
- Day to day variability shows typical regions of local wind systems (e. g. Mistral)

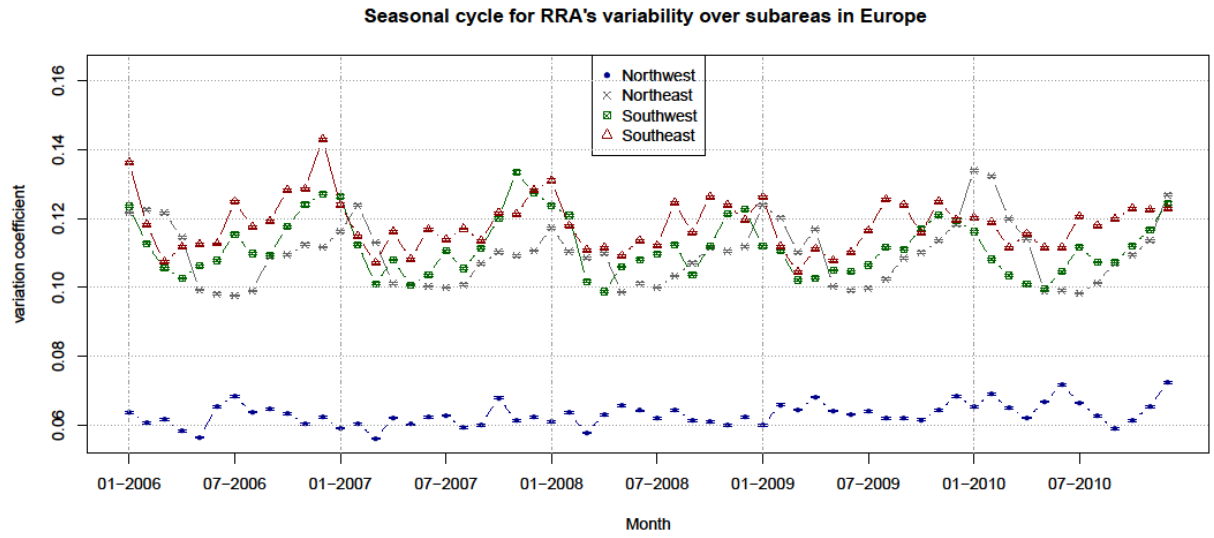
Model similarity in Europe



- Strongest Accordance over Sea
- For Northeast Mescan and Era-I about 0.3 m/s more than other
- Over Southeast Harmonie 0.25 less than other
- model variability over sea is half as much as over land

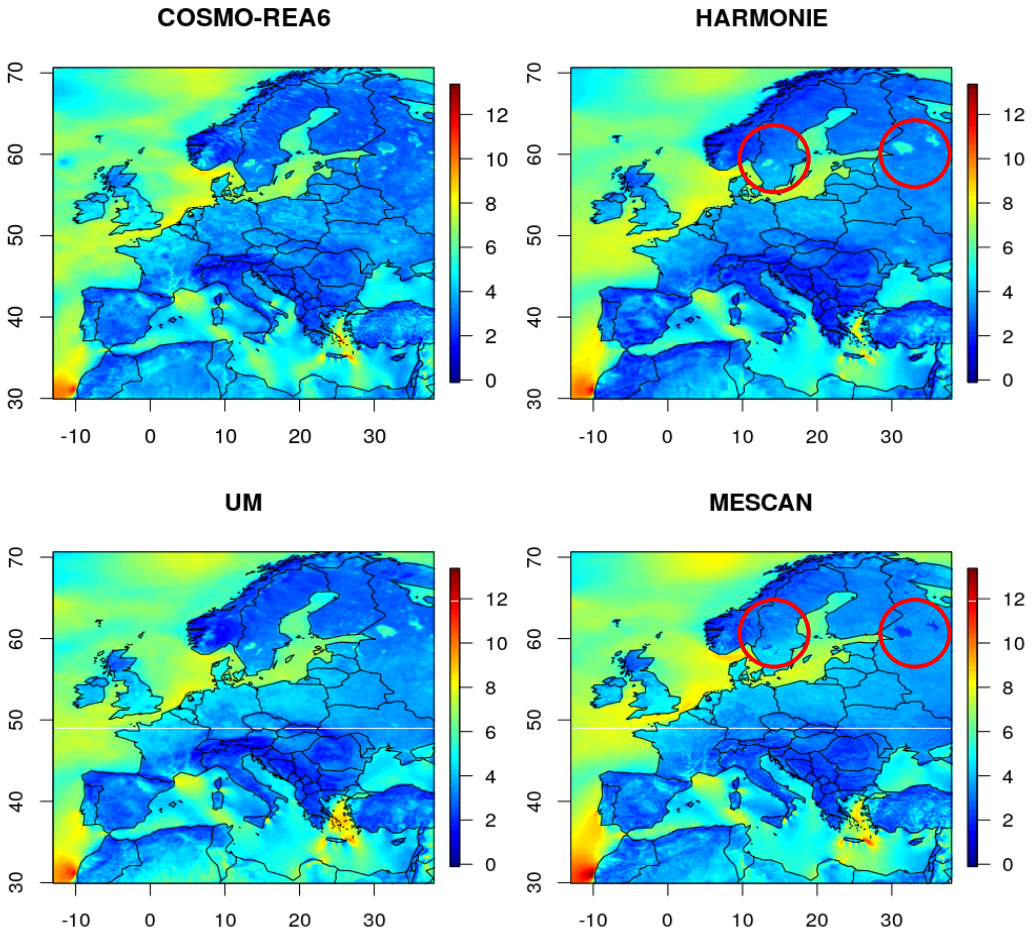
Model similarity in Europe





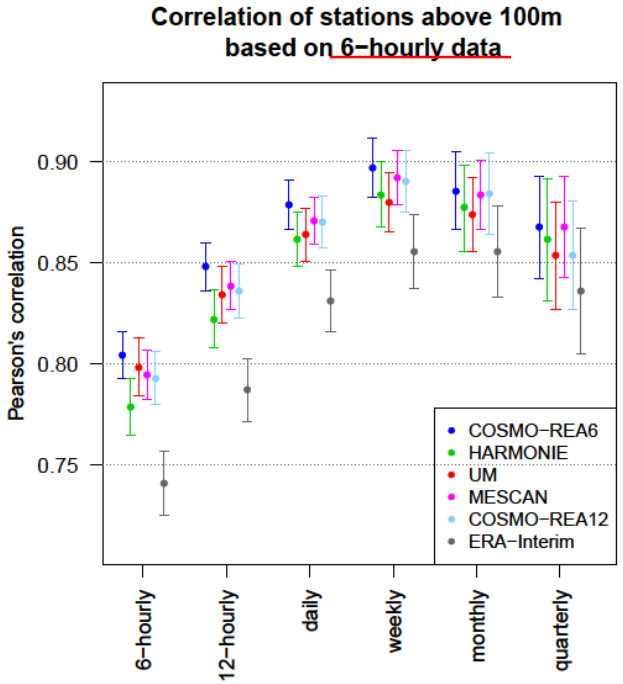
- Strongest Accordance over Sea
- For Northeast Mescan and Era-I about 0.3 m/s more than other
- Over Southeast Harmonie 0.25 less than other
- model variability over sea is half as much as over land

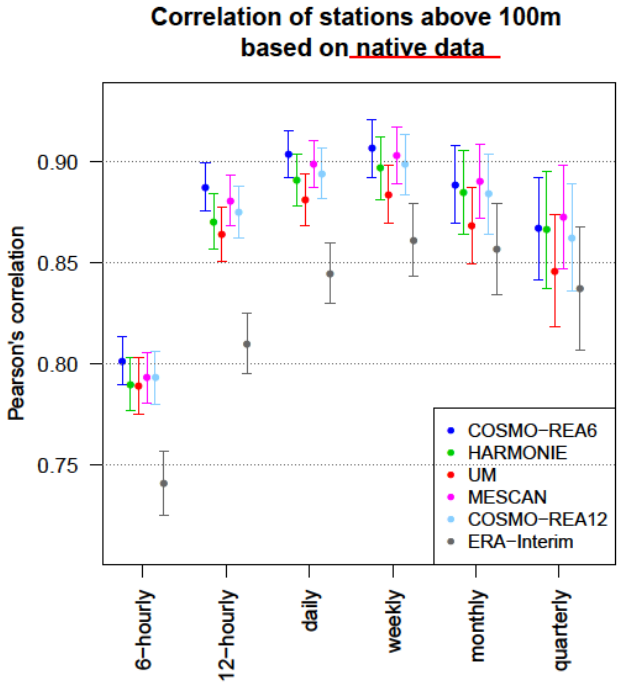
Mescan anomaly



10m wind speed monthly mean July 2007

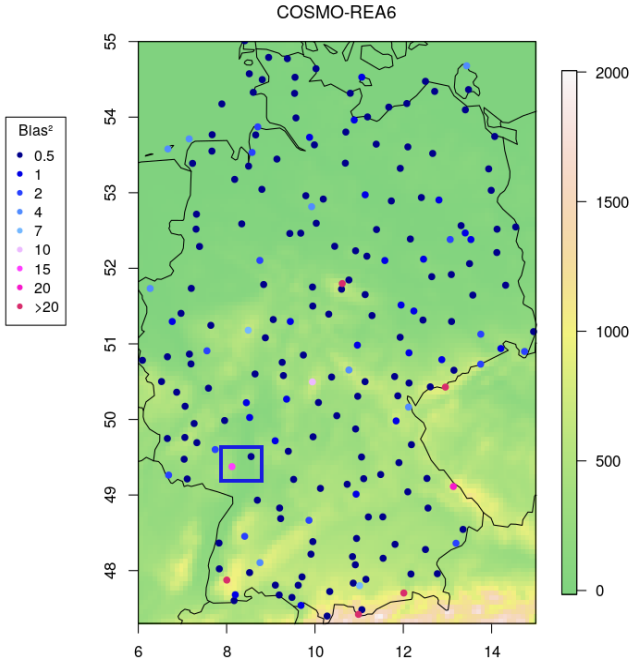
- For Mescan 10m wind speed over inland lakes is reduced, while other models show increase
- Due to various roughness length or surface adaption?





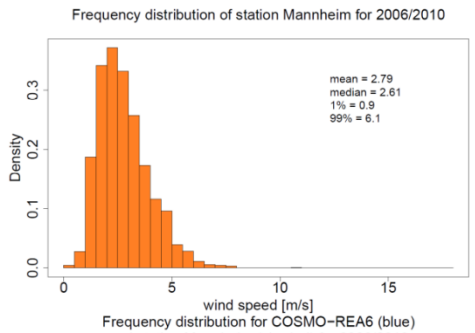
- ➔ Clear added value of regional reanalyses on hourly and daily scale
- ➔ Maximum peak at weekly timescale
- ➔ The use of hourly instead of six hourly reanalysis and observation data can improve the results significantly

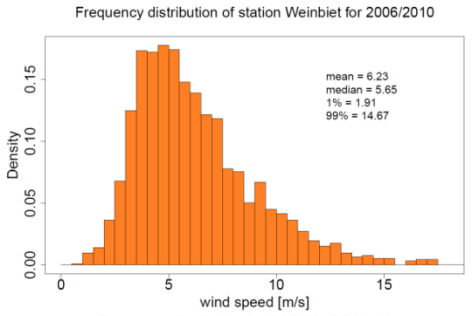
Spatial variability

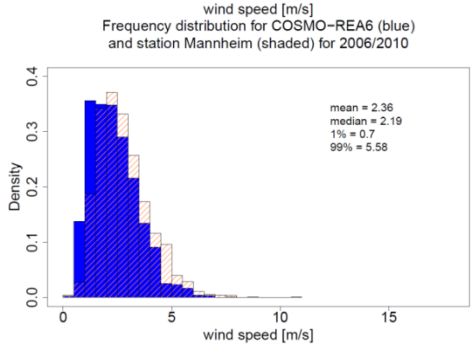


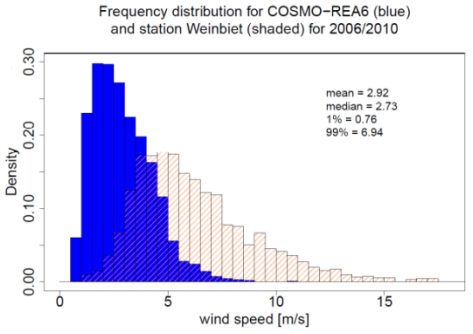
Station height (reality):
Weinbiet 553m
Mannheim 96m

Model height in COSMO-REA6:
Weinbiet 269m
Mannheim 82m



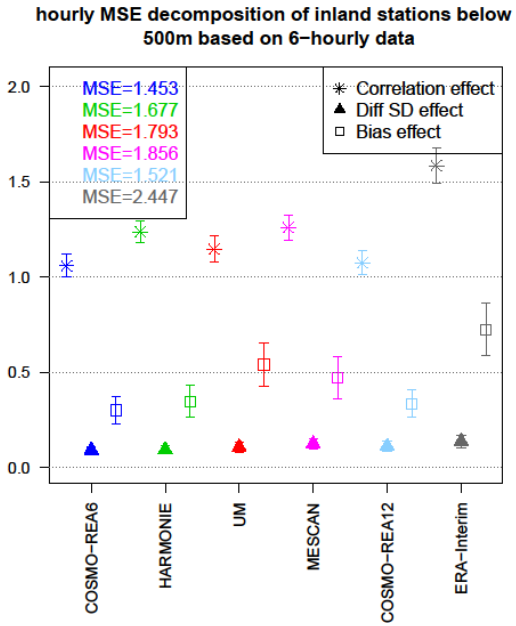




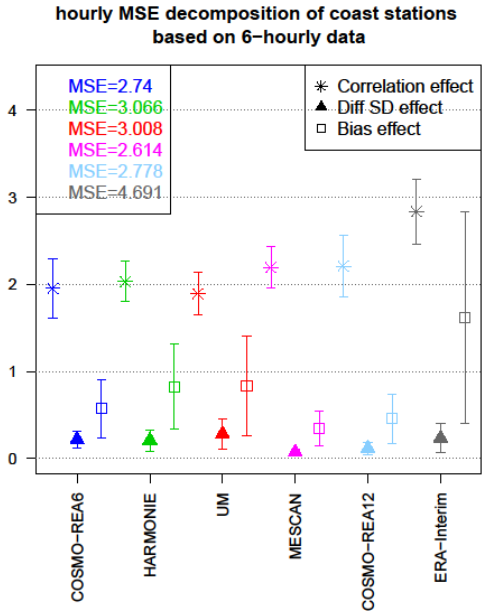


- ➔ Bias has strong local effects
- ➔ Bias depends on model system and wind speed as well

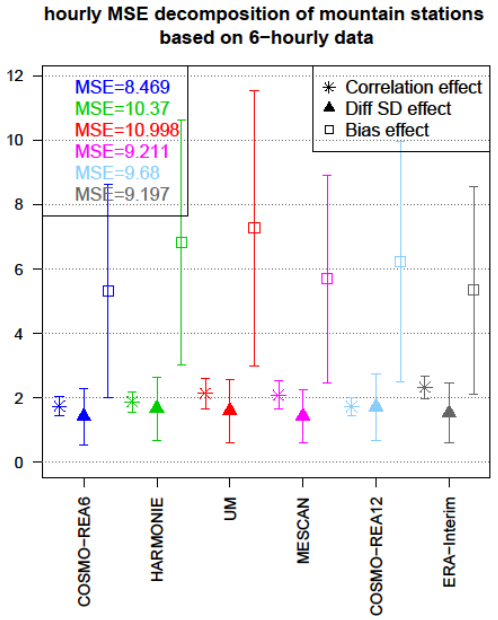
Spatial variability



Inland stations



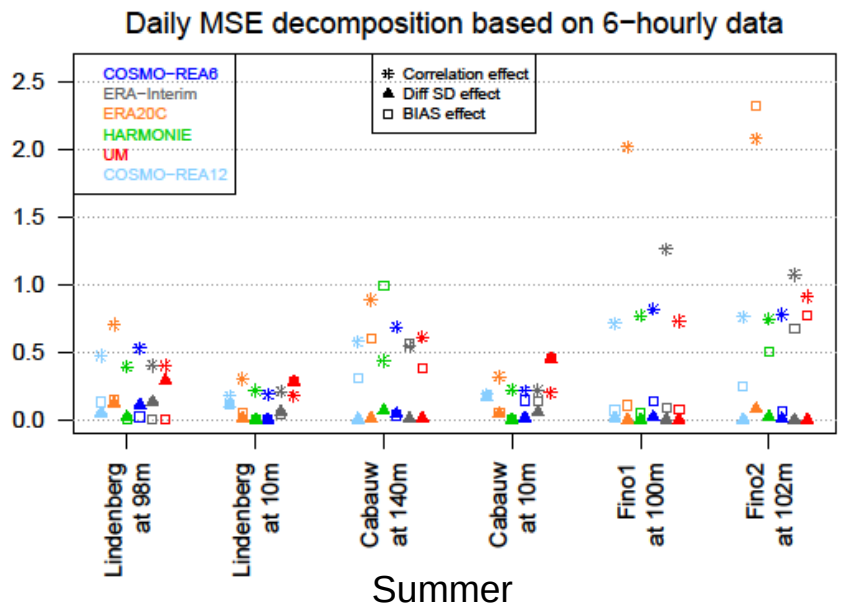
Coast stations

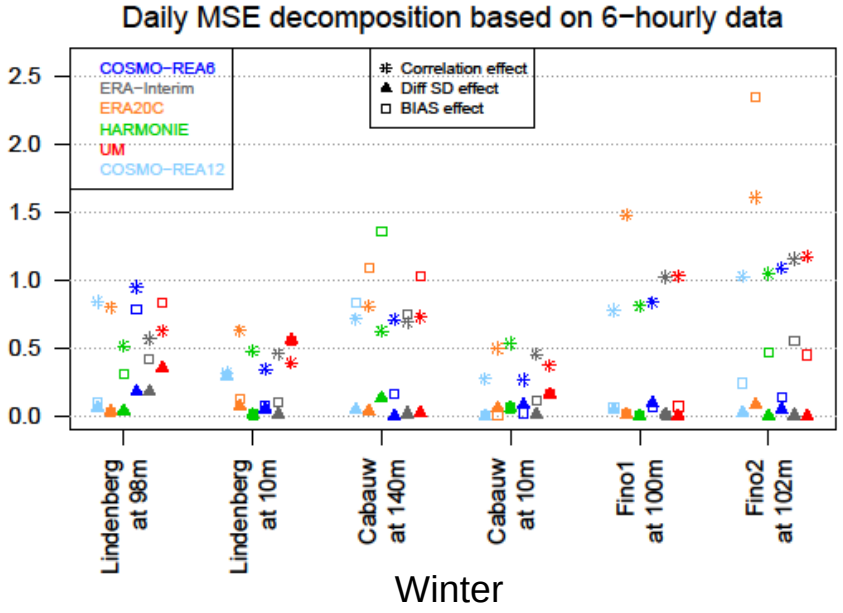


Mountain stations (above 500m)

- MSE decomposition identifies source of error: $MSE = 2\sigma_{rea}\,\sigma_{obs}(1-\rho) + (\sigma_{rea}-\sigma_{obs})^2 + (\mu_{rea}-\mu_{obs})^2$
- Correlation effect dominates on hourly scale and bias effect is larger on monthly scale (except mountain regions)
- MSE increases at the coast (due to higher deviations **σ**) and at mountainous regions (due to bias)

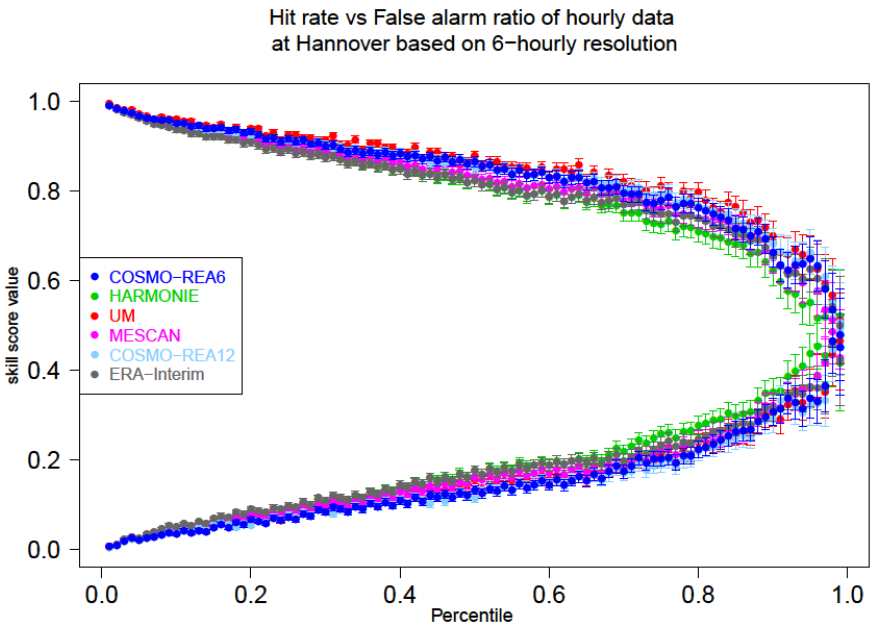
Seasonal variability

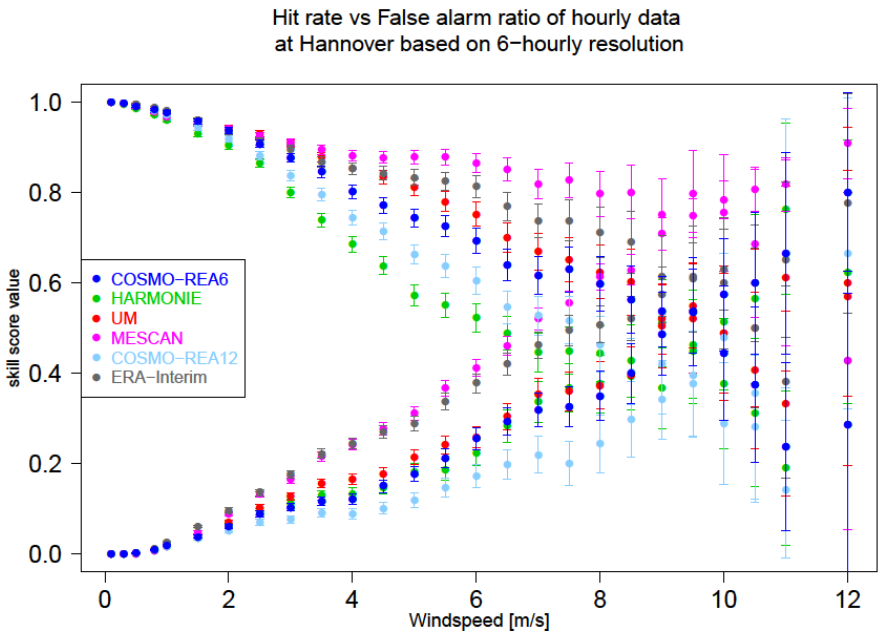




- Correlation of mast data in different heights averaged over JJA and DJF respectively
- Correlation and bias increase in winter season (valid for station data as well)

Absolute values and percentiles





- ➔ Hit rate (HR) and False alarm ratio (FAR) are plotted for various thresholds
- ➔ Differences between RRA's increase for absolute thresholds due to individual model bias
- ➔ HR and FAR intersect for absolute thresholds higher than 8 m/s and less than 9 m/s

Summary

- All RRA's show good performance relating to wind speed from 10m to 100m height at hourly, daily and monthly scale
- For each model one can find locations where it outperforms the other reanalyses
- On hourly and daily scale the regional models show an added value against ERA-Interim
- The bias depends on model system, wind speed and local effects
- The use of percentiles instead of absolute threshold improves the results of various scores, based on the contingency table