UERRA evaluation results overview

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Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu

METEO ROMANIA

Meteorologisk institutt

Met Office

Outline

1. Evaluated parameters
2. General remarks
3. Summary
4. How to proceed

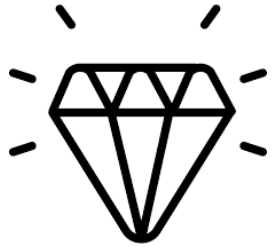
Evaluated parameters

- Precipitation
- Potential evapotranspiration
- Wind
- Radiation
- Temperature
- Climate indices

some examples, mean bias, correlation with obs, frequency distribution, usual NWP verification scores, daily cycle, annual cycle, interannual variability and long-term trends where possible.

http://www.uerra.eu/publications.html

How good? Product is better than ...?



- Scandinavia, Alps, Romania (precipitation, climate indices)
- Germany and Cabauw (wind)
- Europe where CM SAF data (radiation)
- Switzerland, where Heliomont data (radiation)
- Europe covered by E-Obs, ECA&D (temperature, climate indices)

Note: Results (scores) depend on chosen area, and time of year.

Users will have their own area of interest.

UERRA WP3 gives some leading examples (best practices).

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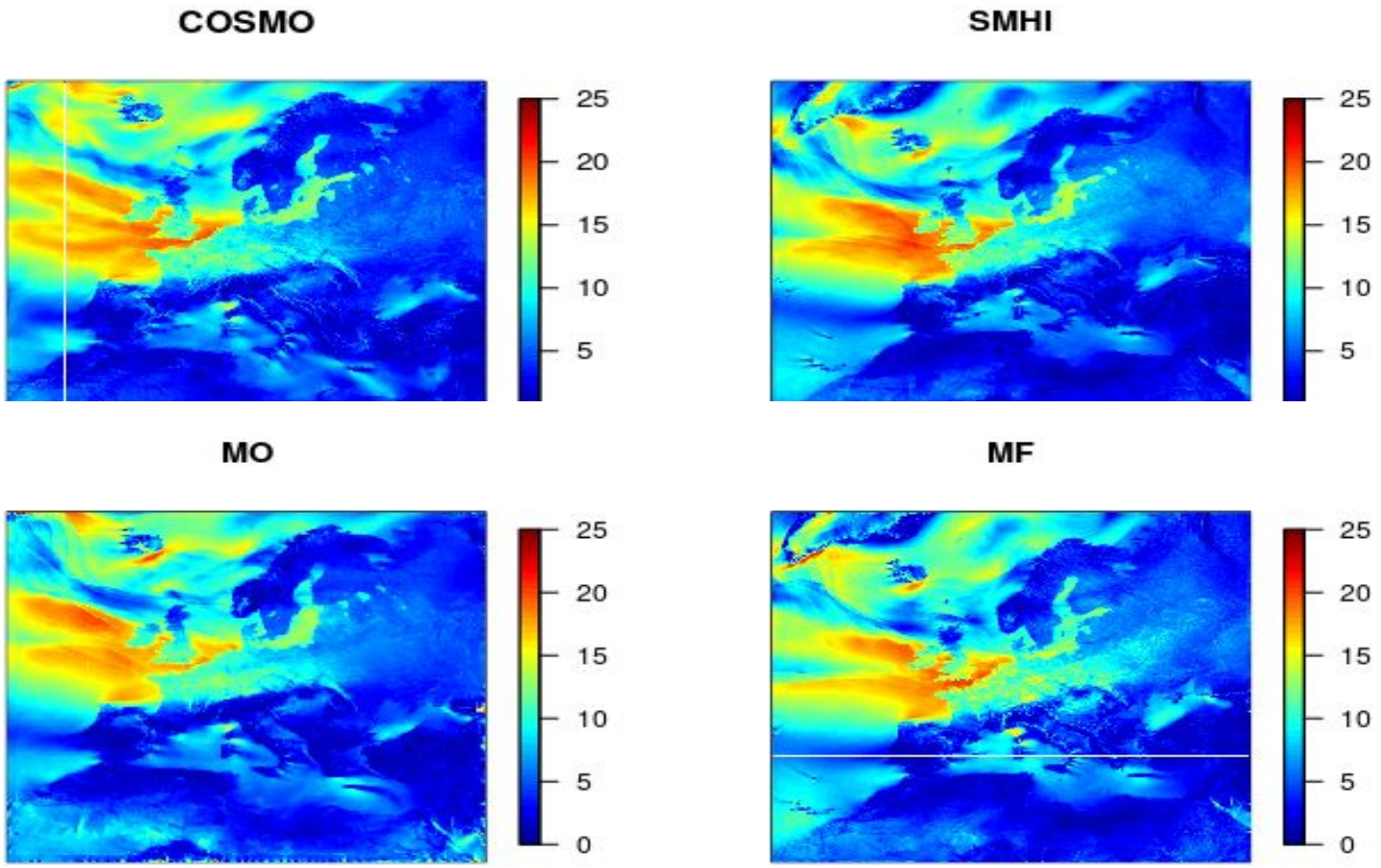
General Remarks

- Value of reanalysis most evident in data sparse areas
- Evaluation results differ with region, month of year, temporal and spatial scale
- No single winner among our UERRA regional reanalyes
- But they all add value to the global reanalyses
- Relative instead of absolute measures (e.g., based on percentiles) will score higher
- Representativity can be at larger scale than grid cell (nominal versus inherent resolution)
- Value is in coherence of parameters (wind, moisture, temperature, …)

All regional reanalyses with similar synoptic features.

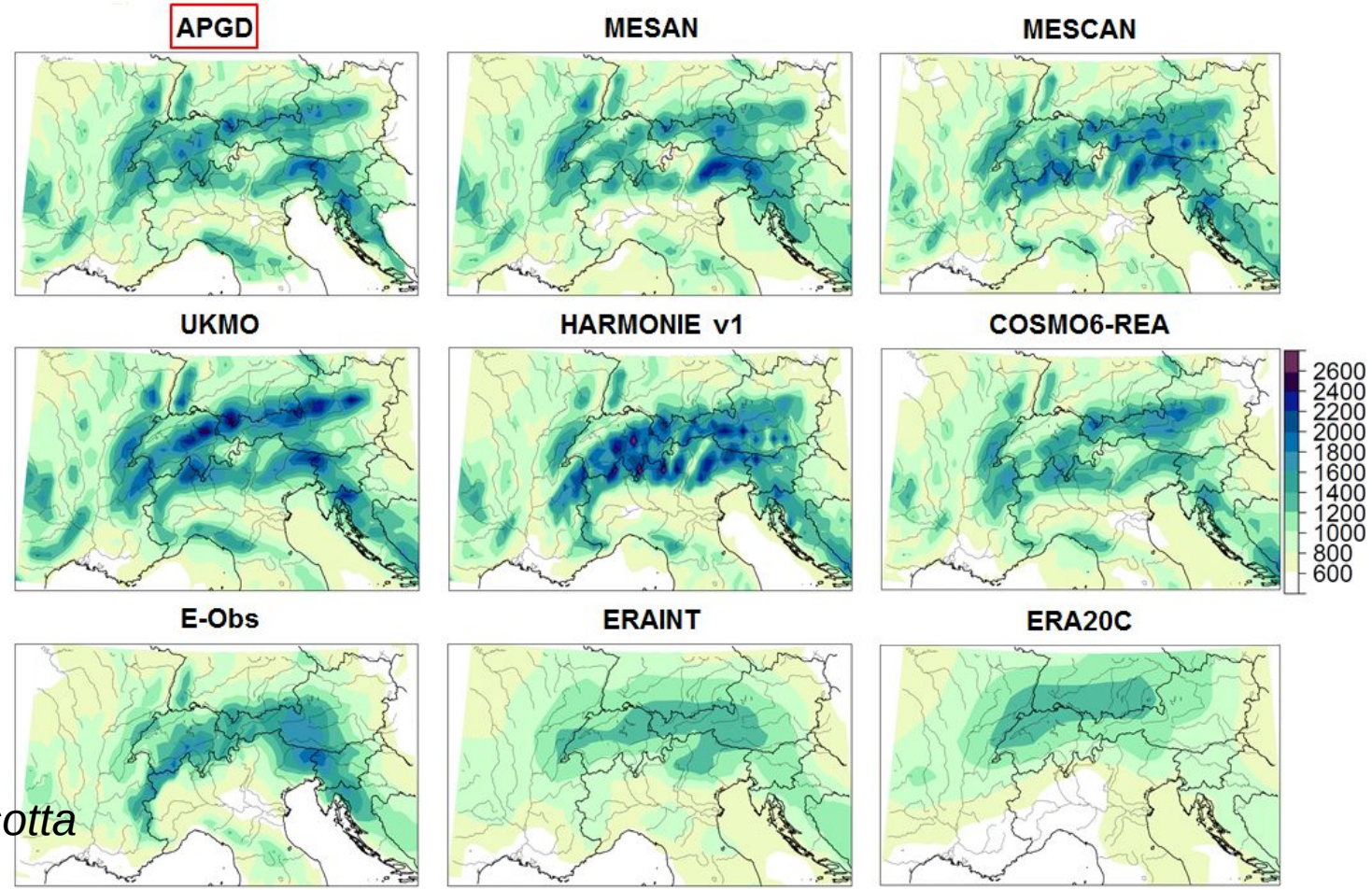
Wind speed in m/s, time slice during Kyrill storm



From Deborah Niermann (DWD)

Reanalyses show different climatological means.

Mean annual precipitation (mm per year, 2006-2008). Datasets rescaled to 0.25° regular grid. Reference: APGD.



From Francesco Isotta (MeteoSwiss)

Main results (Alpine Precipitation)

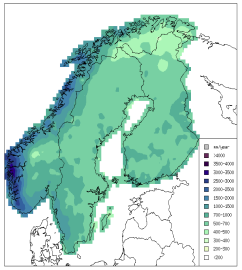
- **Regional reanalyses:**
  - **tendency to overestimate precipitation amounts and frequency, especially in complex terrain (Alps, Norway)**
  - **regional reanalysis shows better small scale structures and performance than observational gridded datasets in region of low station density (except wet-day frequency)**
  - **COSMO-REA6 and COSMO-ENS12 best performance.**

- **Downscaling:**
  - **additional value in regions with dense station network**
  - **improvement especially for fraction of wet days**

- **Model error mostly bigger than uncertainty of the reference dataset (especially for days >10mm/d precipitation and global reanalyses)**
- **Scale dependent analyses: more information about the performance of the datasets depending on the application/scale of interest. Biggest differences from the reference and the lowest Brier skill score are found in complex topography, small catchment sizes and for higher precipitation amounts.**
- **Annual cycle is mostly well reproduced in all datasets.**

Norwegian Meteorological Institute

Evaluation of daily precipitation
reference: Nordic (observational) Gridded Climate Dataset



Regional reanalyses (RRAs):
precipitation fields have spatial structure similar to obs. gridded datasets (better than global RAs)
Overestimation of precipitation amounts and frequency, especially in complex terrain.
HARMONIE shows the best performances (dry area of Lapland in the north).
COSMO-ENS provides satisfactory results both on precipitation and of its uncertainty (Brier skill-score).
UKMO-ENS problem with precipitation amount (see UERRA report D2.14, Jermey et al.)

Downscaling datasets:
Additional value wrt RRAs, especially in regions with dense station network (prec and wet-day-freq better).
Local station density is the most important factor for quality of the post-processed precipitation fields.
The spatial structures are similar to the observational gridded datasets, though the downscaling datasets reach a very high detail of the precipitation pattern even in complex terrain.
MESCAN-SURFEX most detailed.

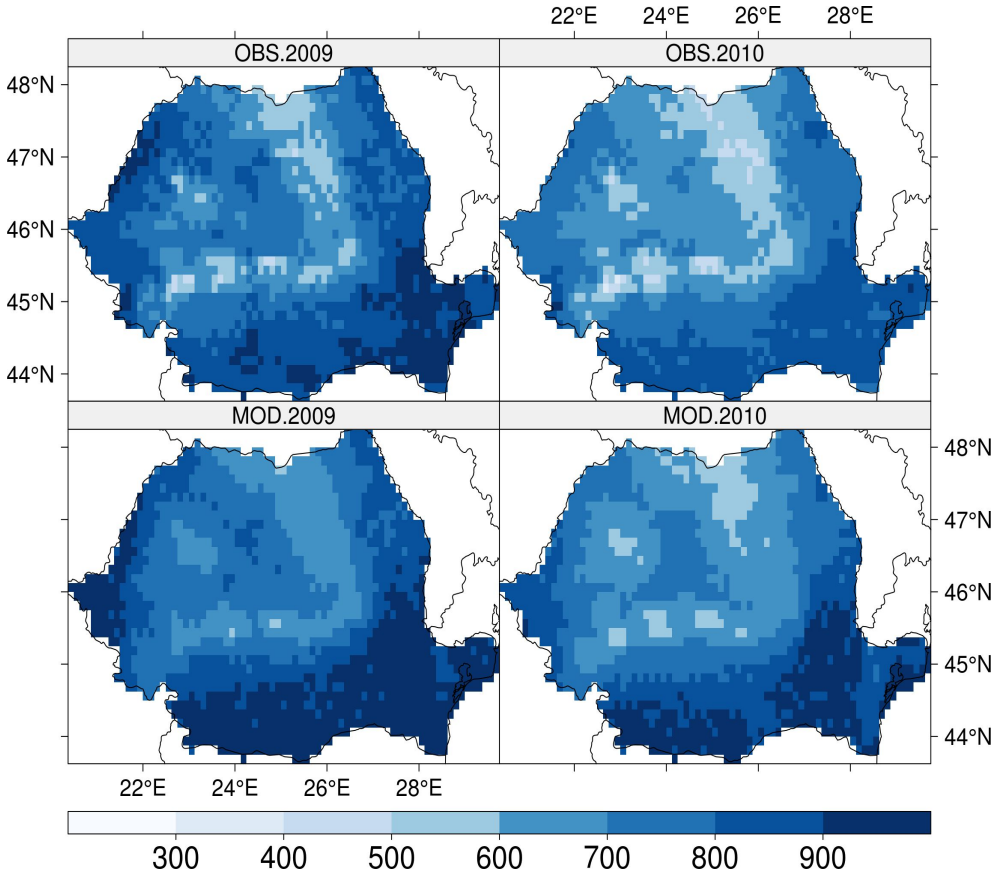
Generally: Most valuable contribution in data sparse regions. Largest differences found in complex topography, for higher precipitation amounts and in areas characterized by a sparse station network.
Annual cycle is mostly well reproduced in all datasets.
The spatial distribution of annual accumulated precipitation and the 95% quantile of daily precipitation are well reproduced by all datasets.

WP3 results (5):

The spatial pattern is captured.

Potential evapotranspiration from ROCADA (top) and UKMO (bottom)

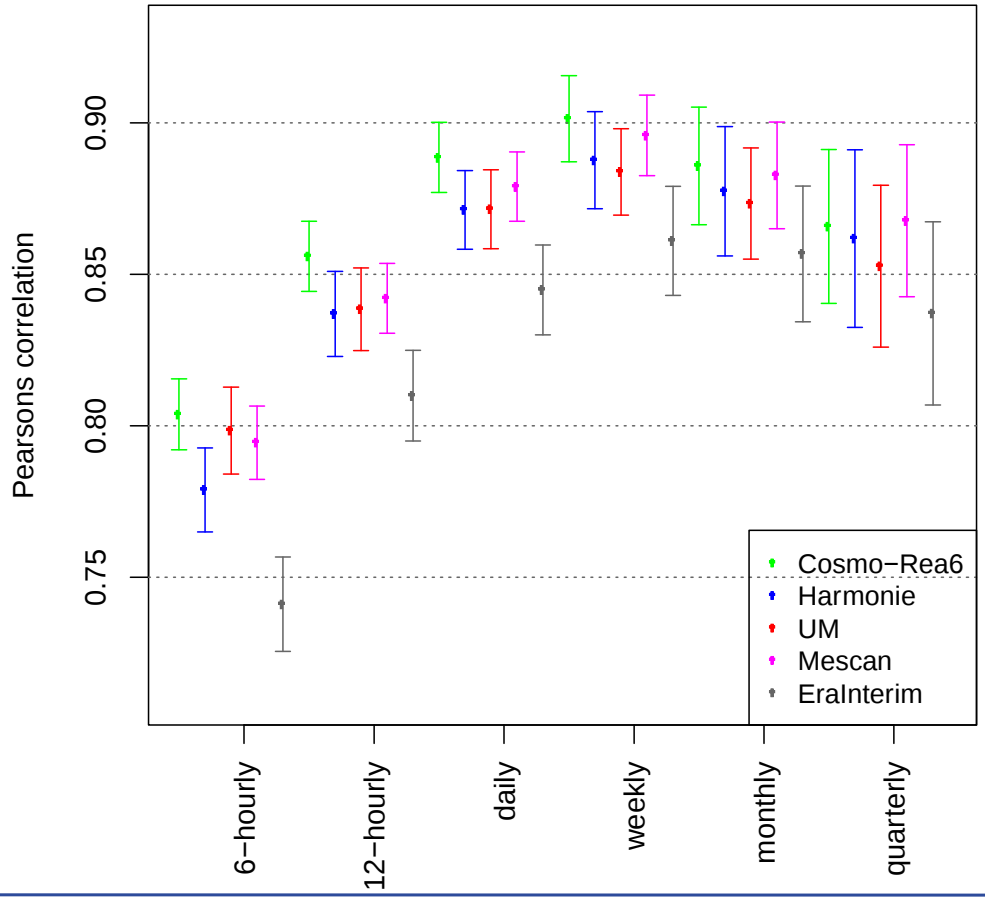
From Roxana Bojariu



WP3 results (3):

There are advantages over ERA-I.

Correlation of 10m wind speed (from German stations) is higher for the regional reanalyses.

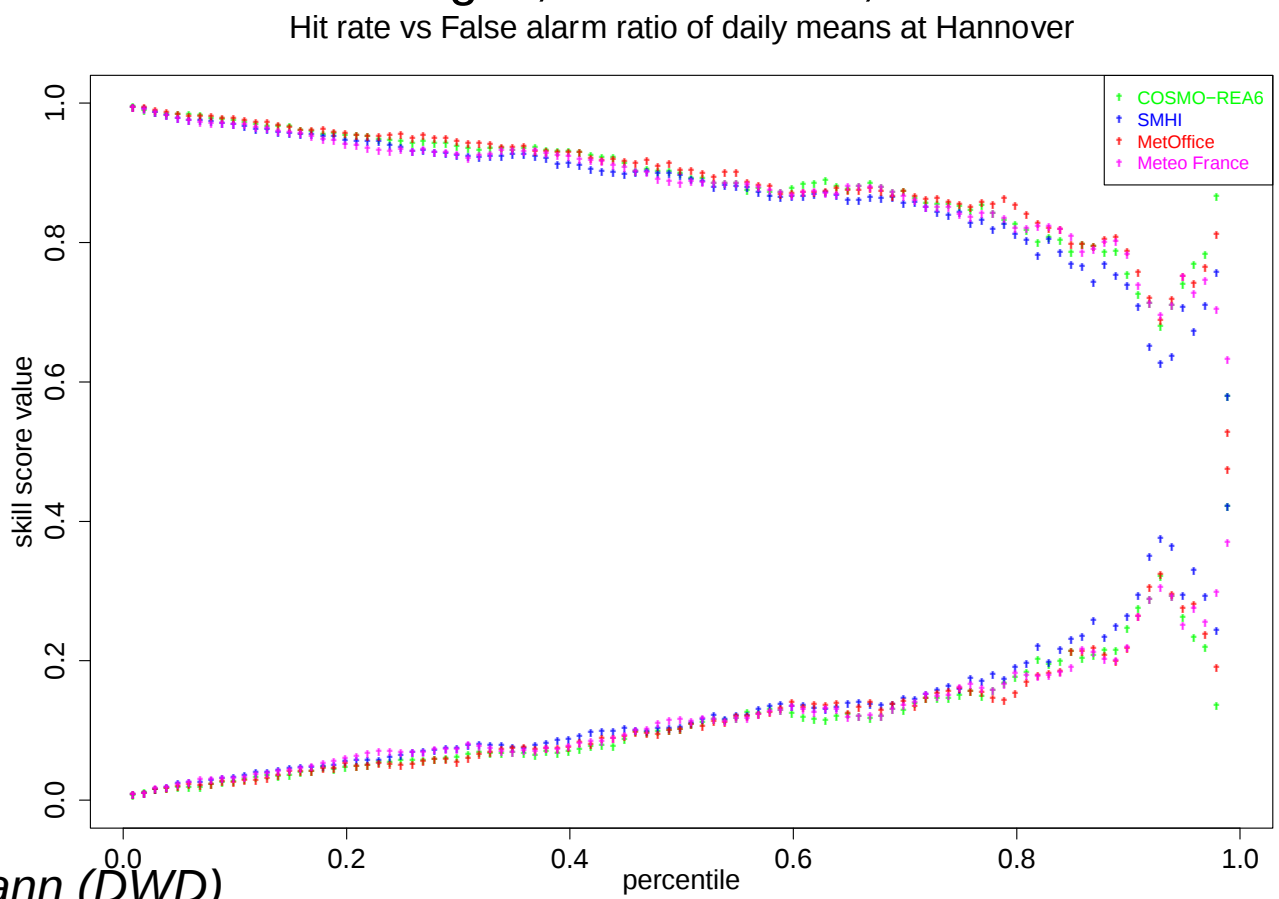


From Deborah Niermann (DWD)

WP3 results (6):

Relative change can be more meaningful, in this sense, extremes are captured.

10m wind speed contingency table

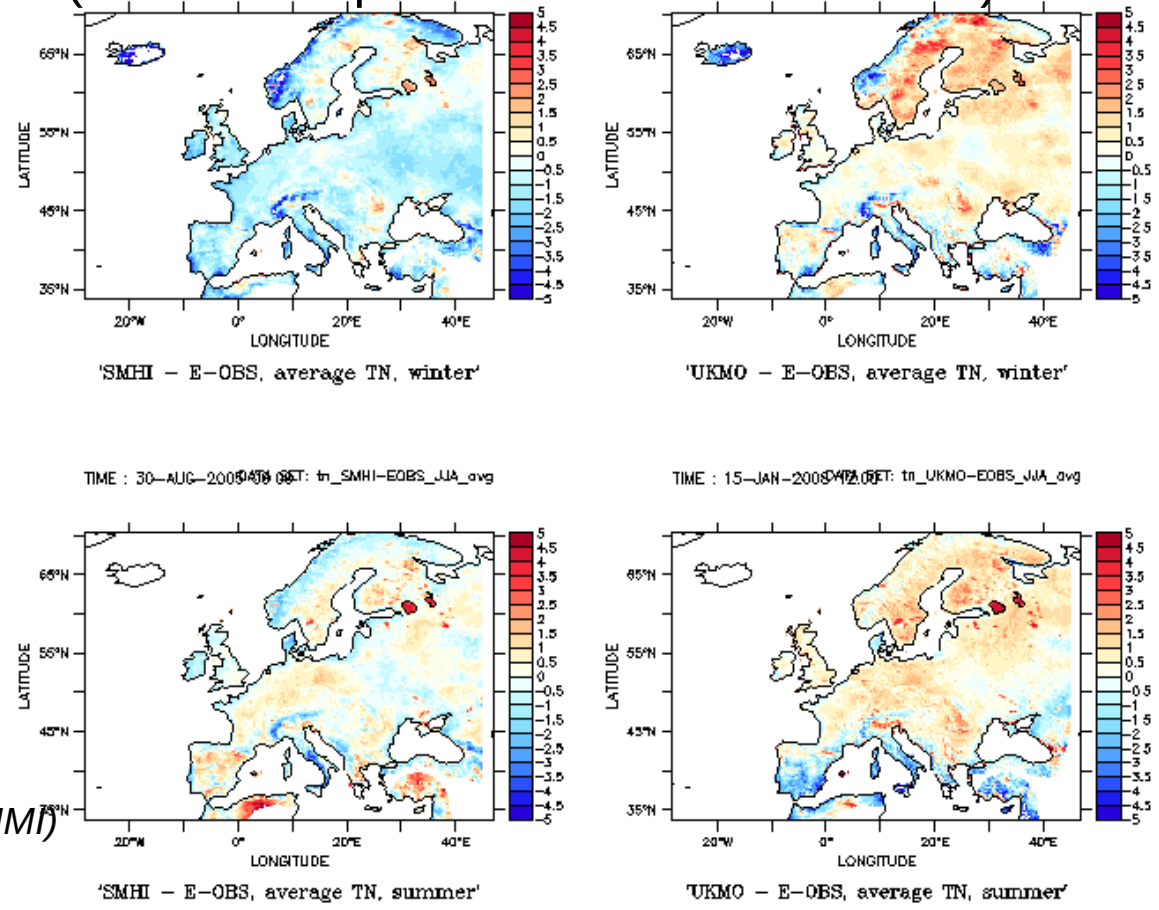


From Deborah Niermann (DWD)

WP3 results (4):

Bias can be a problem (with consequences for climate indices).

Difference in winter (top) and summer (bottom) in daily minimum temperature between the SMHI reanalysis (left) and UKMO reanalysis (right) versus E-OBS.



From Else van den Besselaar (KNMI)

UERRA
Uncertainties in Ensembles of Regional ReAnalyses

Koninklijk Nederlands Meteorologisch Instituut
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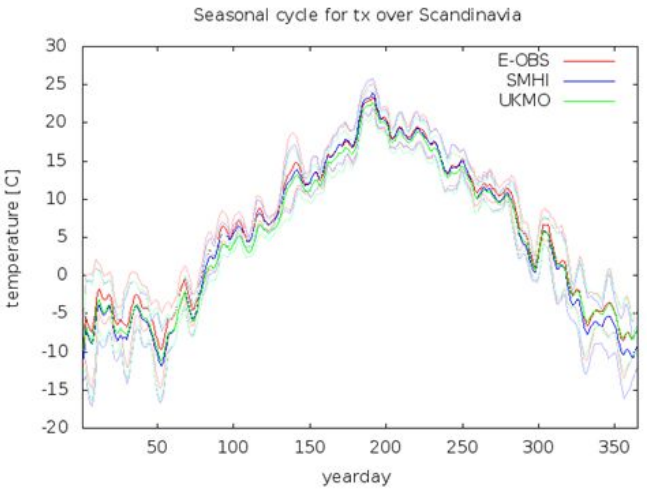
Comparing E-OBS against UERRA reanalysis:



They are tracing the variability remarkably good!

- Example: seasonal cycle of Tx over Scandinavia

•There is an issue with the extremes

- SMHI reanalysis' cold extremes in winter are too cold
- …while in summer, the warm extremes are too hot
- UKMO reanalysis often too warm in (both) extremes
- In terms of frost & summer days, these biases give differences of up to 40 days/year

•Spread in reanalysis too small to bridge the bias

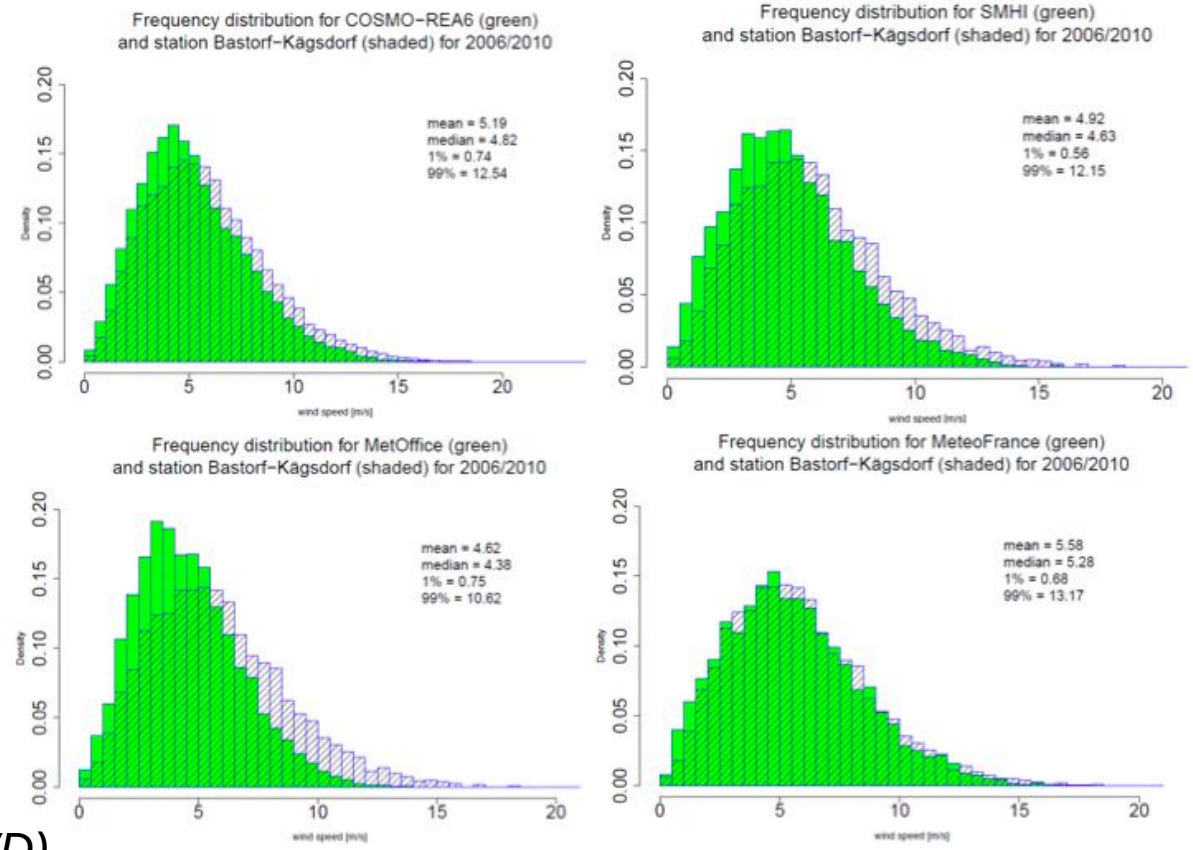
- Averaged over selected regions: no overlap between reanalysis spread of COSMO, UKMO & E-OBS

Advice: enjoy responsibly and use in moderation.

For many situations, reanalysis temperatures are good alternatives to observations, but beware of extremes

No clear winner of competition “which is the best regional reanalyses”, local effects sometimes / not captured.

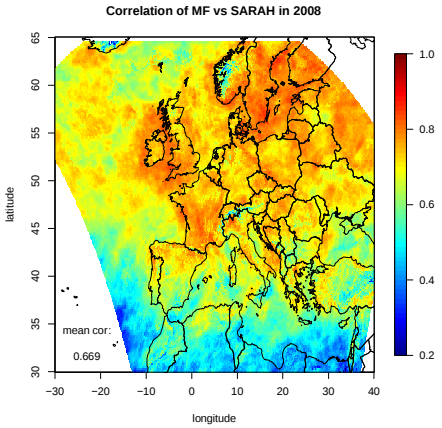
Frequency distribution of 10m wind (grid cell vs point obs)

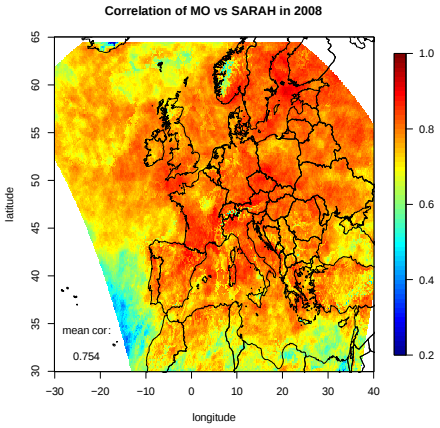


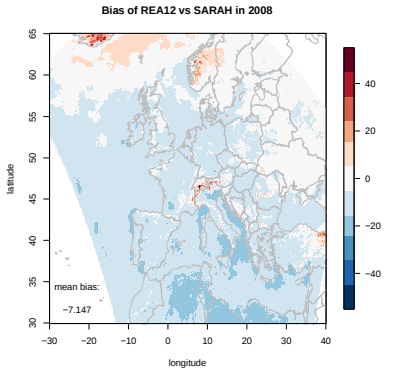
From Deborah Niermann (DWD)

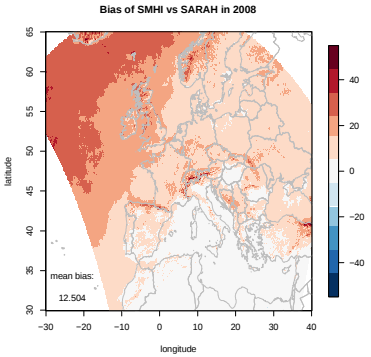
There are biases in radiation fields. But also the reference data set is biased: depending on region, time of year, …

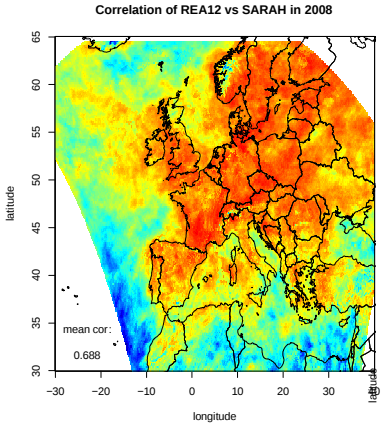
Bias of radiation

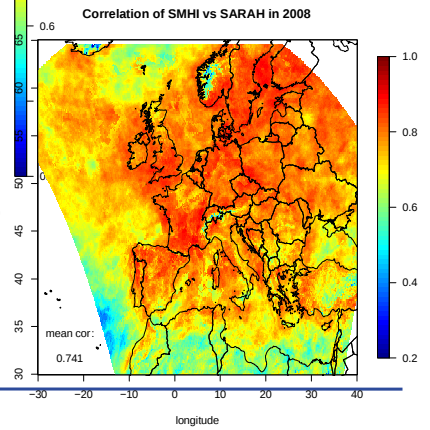












Correlation of radiation with CM SAF

From Michael Borsche (DWD)

Many details to take into account when working with radiation:

It is difficult do find an appropriate reference to properly evaluate global radiation over the European domain

It depends on the region which reanalysis is preferred over the other. On an annual basis:

- Harmonie and Aladin hit the satellite reference spot-on in the Mediterranean and southwards but over-estimate northwards and over the North Atlantic
- UKMO overestimates radiation with a decreasing gradient form Northeast to South
- COSMO-REA6 hits the satellite reference spot-on over the North Atlantic and underestimates it with an increasing gradient southwards

All reanalyses have an overall high correlation (>0.8) over land areas, except for Aladin which is less.

- UKMO and Harmonie also have a high correlation over parts of the Mediterranean and the North Atlantic

There is a difference between summer and winter

- UKMO overestimates more in summer than in winter
- COSMO-REA6 has an almost homogeneous underestimation in summer whereas there is over- and underestimation in winter
- Harmonie and Météo France overestimate radiation over the North Atlantic in both seasons

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Summary of application for radiation

- ➔ Regional reanalysis fields are in some areas (e.g., far North, Alps) better than the CM SAF products
- ➔ Model dependent bias, strongly dependent on region, month of year.

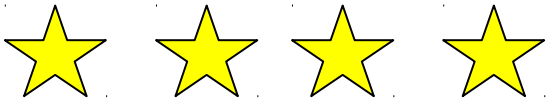
Summary of application for temperature

- ➔ Regional means of temperature are good for use – as long as no thresholds are involved
- ➔ Long-term evaluation still missing
- ➔ Model dependent bias, with consequences for climate indices

Summary of application for precipitation

- All regional reanalyses capture the spatial pattern of precipitation distribution
- There is a lot of small scale structure which is not easy to verify / falsify
- Different reanalysis vary in bias

Summary of application for wind speed



- All regional reanalyses are an attractive data source for wind speed from 10m to 100m height at daily, monthly, annual and inter-annual scale, adding resolution and accuracy to the global reanalyses
- The correlations show a maximum peak at weekly time scale
- Care should be taken with the daily cycle from 50m onwards, there are limitations in temporal resolution of boundary layer changes.
- The bias depends on model system, wind speed and local effects

How to proceed:

1. Pick the parameter, location, spatial scale, temporal scale and score which determines the quality of your application, and
2. look it up in the UERRA documentation.
3. Check whether you could use the free UERRA R-package:.
   https://github.com/UERRA-EVA/EVA_gridobs
   https://github.com/UERRA- EVAEVA_stationobs
4. Compare performances of various reanalysis products and choose most fitting one.
5. Alternative to 4.: use the multi-model ensemble (adds spread as first feeling for uncertainty).
6. Consider own post-processing.