Deutscher Wetterdienst
Wetter und Klima aus einer Hand

User-oriented evaluation and post-processing of global and regional reanalysis

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To serve adequately the significant user interest (renewable energy, hydrological applications, agriculture and forestry) in reanalysis products, especially in high-resolution regional products, intermediate levels of post-processing are needed as well as evaluation of the products with focus on user-relevant parameters. This will enable the uptake and use of reanalysis products by a wider community of users which may not have the means to perform own research on suitability of reanalysis products for their particular application. At DWD there is long experience to satisfy a diverse group of users with different backgrounds, supplying suitable climate data, especially in-situ but also satellite products. Here we endeavor to bring the benefits of global and regional reanalysis to these users of traditional climate data by suitable evaluation, regionalization and post-processing of reanalysis. In our contribution to the UERRA project, we statistically assess the information content of the regional reanalyses and their uncertainties by comparison against independent or different ECV datasets at the user relevant scales. The reference datasets include satellite-derived data for climate monitoring, and gridded datasets based on high-density station series together with their uncertainty estimates.

A) Current and future reanalysis data used by DWD to meet end user needs:

Global reanalysis, e.g., ERA-Interim and ERA-20C and regional reanalysis, e.g, as produced in the UERRA project, and DWD's own **HErZ COSMO** reanalysis products are currently evaluated by DWD in international co-operation (CORE-CLIMAX, UERRA) for the suitability of reanalysis data to complement the traditional climate data DWD provides to a multitude of national end users, who lack the time and expertise to explore themselves.

The regional reanalysis system based on the COSMO-NWP-model of the German Meteorological Service (DWD) developed at DWD's Hans-Ertel-Center for Weather Research (HErZ) at University of Bonn

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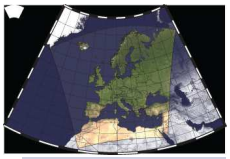


ERA-Interim

COSMO-REA6 (6.2 km)
- CORDEX EUR-11 Domain
- Data assimilation

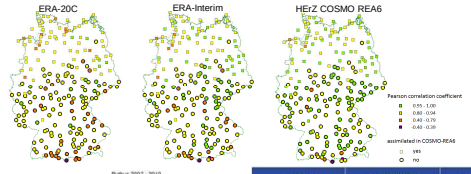
Soil moisture analysis (SMA)

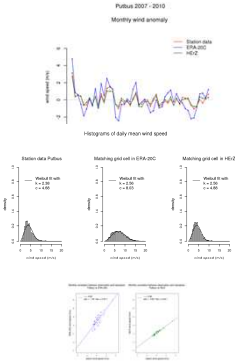
Continuous nudging
SYNOP, SHIP, PILOT, TEMP, AIREP, AMDAR, ACARS,...

SST analysis (daily)
Snow analysis (6-hourly)

UERRA archive on MARS (ECMWF)

B) Comparing reanalyses:





Example of 10m station winds showing advantage of regional reanalysis.

Core Climax

UERRA WP3 Uncertainties in Ensembles of Regional ReAnalyses

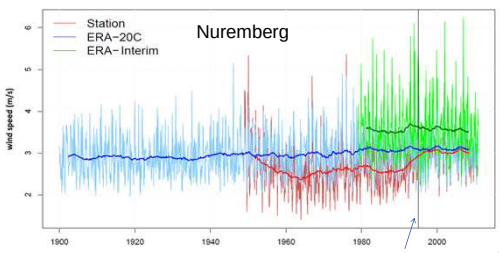
Purpose of the activitiy:
To derive user friendly skill scores and statistics at applicable temporal and spatial scales

Method	Data source	Parameter	Details	Scientific questions	User questions
A: feedback statistics	Radiosonde soundings	Temperature, wind speed, and relative humidity	Focus on lower troposphere; bias and RMSE of time series; store in ODB format	**How stable** are the regional reanalyses (RRAs) with respect to multi-annual trends on a spatial scale of roughly 100 km?	How well represented are **trends and climatologies** of wind speed relevant for wind energy?
B: point measurements	B1: (independent) mast station data; B2: (dependent, i.e., assimilated) station data	B1: wind speed B2: Tmin, Tmax, and number of days of threshold exceedance of temperature and precipitation	There are many more suitable observations available for B2 than for B1.	At which **time scales** can we find which **correlations** between reanalysis fields and station observations?	On which time scales of variability and parameters can we use the **RRAs similar to** the use of a **station measurements**?
C: gridded measurements	Gridded data products for the Nordic region and the UK; E-OBS, APGD	Precipitation; Tmin and Tmax	To consider whether a part of underlying station observations was assimilated into the reanalysis.	What differences do we get with different products when determining the **useful spatial and temporal scales** of the RRAs?	**Which scales** of the RRAs (temporal, spatial) **can be interpreted**?
D: satellite data products	Satellite data products of CM-SAF and CCI	Global radiation; total cloud cover; snow water equivalent		How well do the **RRAs** compare to the **satellite observations** - or exceed their quality?	Does the **RRA** or the **satellite** provide the better data product **for the user applications**?
E: Ensemble based comparison	WP1 created ensemble of gridded data with derived uncertainty estimates;	Precipitation; Tmin, Tmax, Tmean;	Ensemble based uncertainty estimates will be performed on (1) the newly (WP1) created data products.	Does the **ensemble** provide a **spatially and temporally better resolved** estimate of uncertainty compared to a deterministic reanalysis?	Which **uncertainty characteristics** can be interpreted from the ensembles **for user** relevant parameters?
	Products as in methods A through D	Parameters as in A through D	(2) the basis of methods A through D when available.		
F: User related models		Tmean; Tmax and Tmin pseudo analysis; wind speed; precipitation;	SURFEX by Météo France uses the reanalyses as input		Is the result of a **user model forced by RRAs** significantly better than with the original forcing?

C) DWD internal use of reanalysis for quality control:

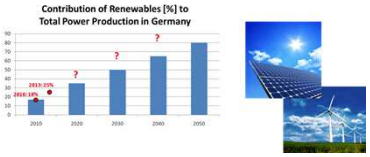
Use of reanalysis for purposes of quality control (within limits of reanalysis uncertainty) is in principle applicable to all historical climate data in the DWD archive (in-situ, remote sensing and satellite). If assimilated, access to reanalysis feedback is most desirable.

Example application, for the 10m station wind speeds of the last century:



Comparing 5yr running means exhibit change to automatic weather station in 1995

D) User needs: post-processing:



Due to the strong increase in renewable energy production in Germany the energy sector is highly interested in up-to-data climate products.

Results of the CORE-CLIMAX user survey on priorities of parameters:

Core Climax

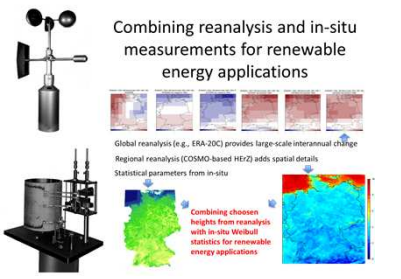
*"I work with this **variable** and use / do not use reanalysis data for this"*

TOP5

Atmospheric surface:	Air temperature	1212 (75%)	
	Wind speed and direction	1194 (73%)	
	Pressure	1115 (69%)	
Atmospheric upper air:	Temperature	929 (57%)	
	Wind speed and direction	923 (57%)	

TOP5

Atmospheric surface:	Precipitation	895 (55%)	282 (17%)
Oceanic surface:	Sea-surface temperature	691 (43%)	246 (15%)
Terrestial:	River discharge	134 (8%)	218 (13%)
Atmospheric surface:	Surface radiation budget	555 (34%)	210 (13%)
Atmospheric upper air:	Cloud properties	397 (24%)	199 (12%)



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