Copernicus European Regional Reanalysis

Climate Change

BMIP workshop, 09/04/2021

Semjon Schimanke et al.

Copernicus Europe's eyes on Earth | European Commission | ECMWF | SMHI

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Overview

1. Introduction to the Copernicus service

2. UERRA – data and availability

3. UERRA – validation

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1. Introduction/Background

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Time line of service and system details

2017	2018	2019	2020	2021

UERRA — Uncertainties in Ensembles of Regional ReAnalyses

UERRA system in near real time (11km/5.5km resolution)

Development of the new system

CERRA-Land (5.5km resolution)

CERRA (5.5km resolution)

CERRA-EDA (10 members, 11km)

- 11 km (565x565 grid points), 65 levels
- Surface downscaling analysis 5.5 km (MESCAN-SURFEX)
- 1961 – July 2019

- CERRA: 1069x1069 grid points, 106 levels
- CERRA-Land: precipitation analysis and surface/soil analysis
- Starts in the September 1984

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2. UERRA – data and availability

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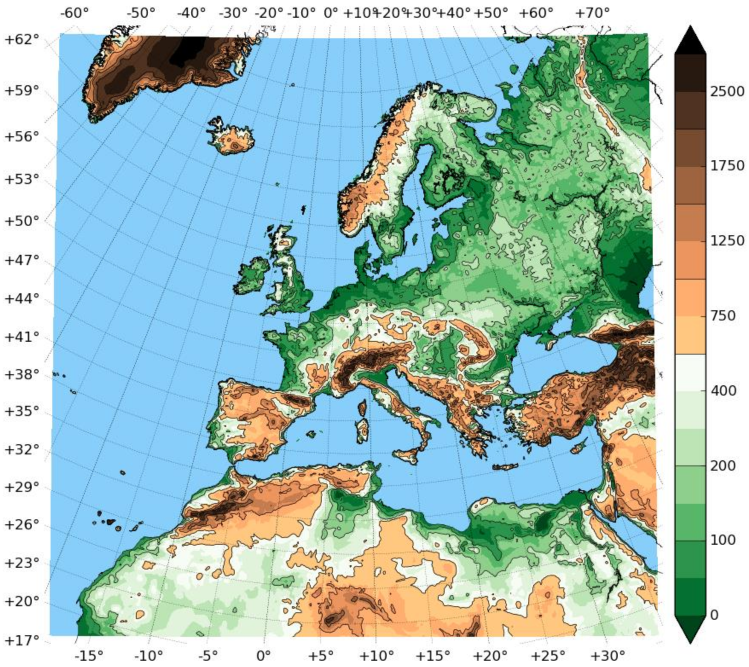
Available data

- Modell domain covers entire Europe
- Period 1961 – July 2019

- 31 surface parameters,
  9 parameters on pressure levels,
  7 parameters on height levels,
  4 parameters on model levels
  2 parameters on soil levels

- Additional output from MESCAN-SURFEX (surface and soil)



Model domain illustrated with model topography and land-sea mask

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Relevant data for ocean modelling

UERRA

- 10m wind speed
- 10m wind direction
- 2m temperature
- 2m relative humidity
- Short and long wave radiation
- Rain and snow
- Mean sea-level pressure
- (Cloud cover)
- Gustiness

CERRA

- Momentum fluxes
- More radiation parameters

Data access via CDS

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https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-uerra-europe-single-levels?tab=overview

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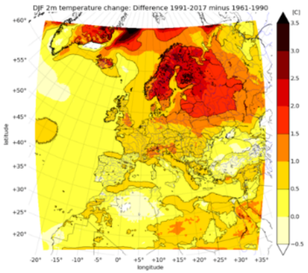
UERRA regional reanalysis for Europe on single levels from 1961 to present

Overview Download data Documentation

This UERRA dataset contains analyses of surface and near-surface essential climate variables from UERRA-HARMONIE and MESCAN-SURFEX systems. Forecasts up to 30 hours initialised from the analyses at 00 and 12 UTC are available only through the CDS-API (see Documentation).

UERRA-HARMONIE is a 3-dimensional variational data assimilation system, while MESCAN-SURFEX is a complementary surface analysis system. Using the Optimal Interpolation method, MESCAN provides the best estimate of daily accumulated precipitation and six-hourly air temperature and relative humidity at 2 meters above the model topography.



The land surface platform SURFEX is forced with downscaled forecast fields from UERRA-HARMONIE as well as MESCAN analyses. It is run offline, i.e. without feedback to the atmospheric analysis performed in MESCAN or the UERRA-HARMONIE data assimilation cycles. Using SURFEX offline allows to take full benefit of precipitation analysis and to use the more advanced physics options to better represent surface variables such as surface temperature and surface fluxes, and soil processes related to water and heat transfer in the soil and snow.

In general, the assimilation systems are able to estimate biases between observations and to sift good-quality data from poor data. The laws of physics allow for estimates at locations where data coverage is low. The provision of estimates at each grid point in Europe for each regular output time, over a long period, always using the same format, makes reanalysis a very convenient and popular dataset to work with. The observing system has changed drastically over time, and although the assimilation system can resolve data holes, the much sparser observational networks, e.g. in 1960s, will have an impact on the quality of analyses leading to less accurate estimates. The improvement over global reanalysis products comes with the higher horizontal resolution that allows incorporating more regional details (e.g. topography). Moreover, it enables the system even to use more observations at places with dense observation networks.

Contact

copernicus-support@ecmwf.int

License

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Publication Date

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Related data

UERRA regional reanalysis for Europe on pressure levels from 1961 to present

UERRA regional reanalysis for Europe on height levels from 1961 to present

- All data is freely available!
- All you need is to register!
- Almost 500 TB of data

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GitHub script

https://github.com/UserLearningServices-C3S/regionalreanalysis-UERRA

Create forcing data for NEMO-Nordic

These scripts are an example of how the UERRA data can be used for input to other model systems, in this case the NEMO-Nordic (a regional ocean model).

The objectives of the scripts

These scripts will:

1. download the needed,
2. extract the region needed for NEMO-Nordic,
3. convert the units as needed for NEMO-Nordic,
4. save the final files as netCDF.

Instructions

Basically, users have only to adopt the "Configure section" in the main script - Create_NEMO_forcing_from_UERRA.py

1. Set the dates your are interested in.
2. Define directories for downloaded data, the final data, and a directory for temporary files.

Then, all you have to do is to run the main script... Create_NEMO_forcing_from_UERRA.py

Good to know

The scripts need some time to run. Especially the downloading of data from the MARS archive takes time. Here, we are talking about days if you want to produce forcing data for longer periods (several years). A rough estimate is about six hours for each year. However, this depends

Conversions:

- Blend analyses and forecasts
- Change units
- Accumulated fluxes
- Compute specific humidity
- Compute wind components based on speed and direction

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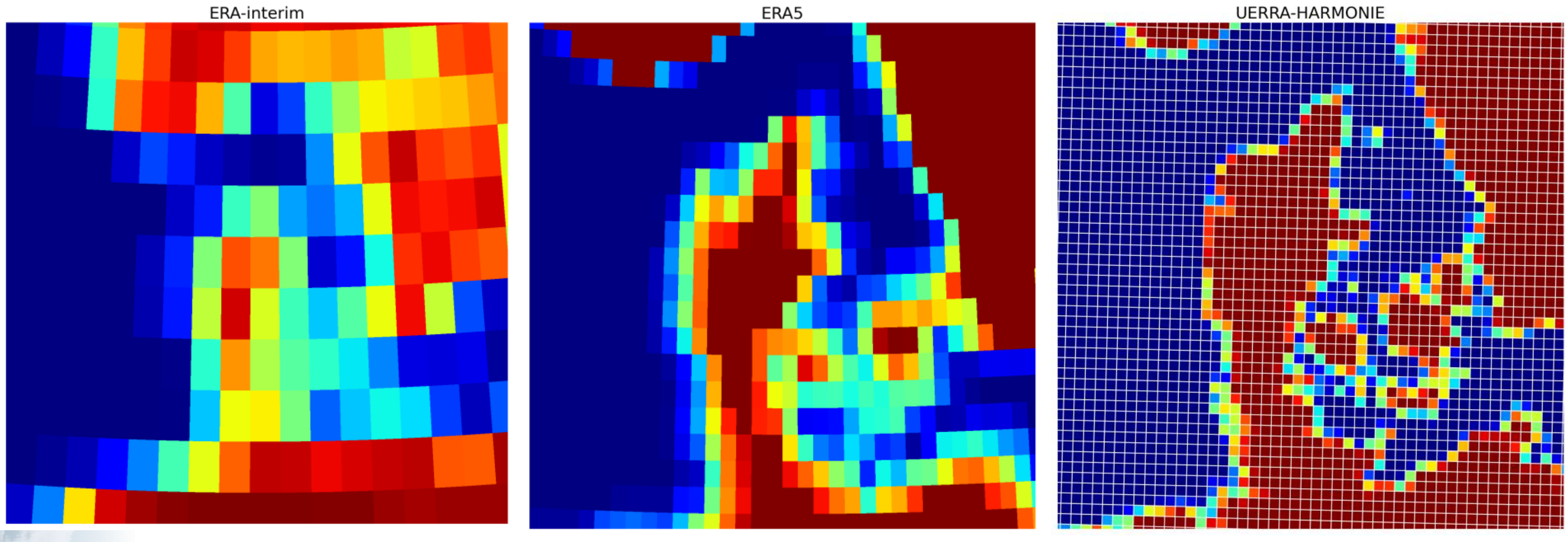
3. UERRA – validation

Added value compared to global RA

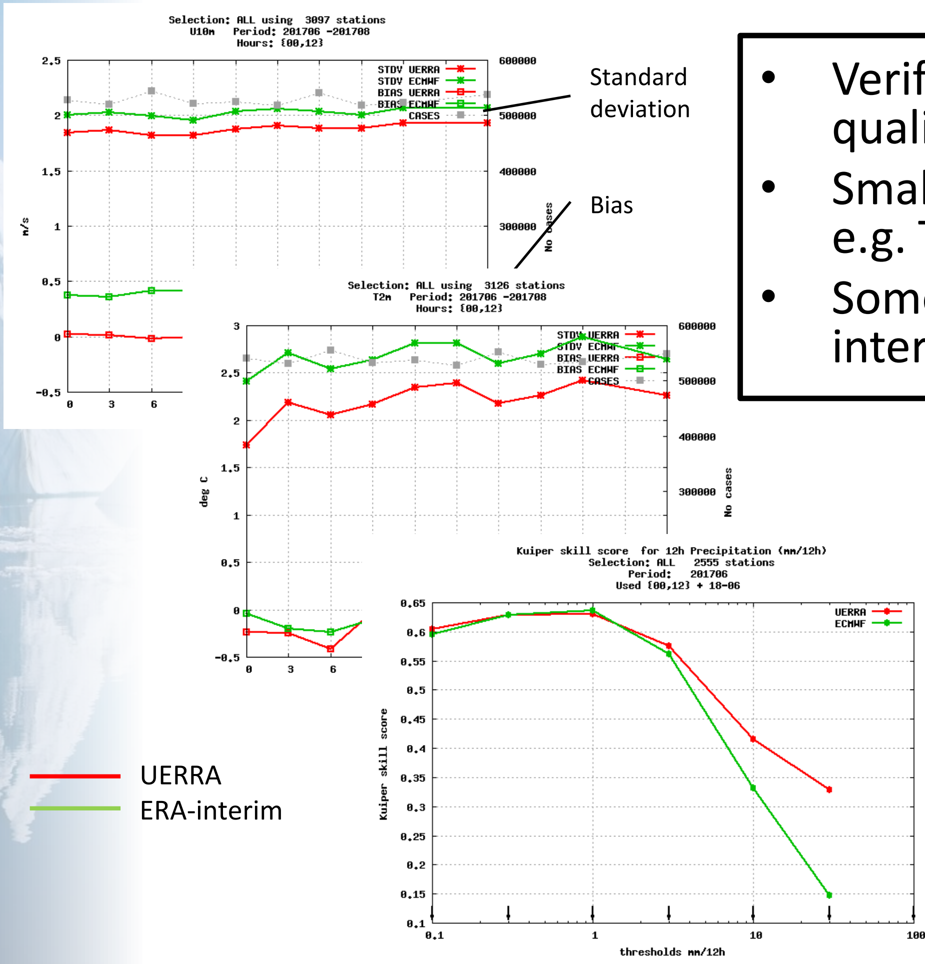
Land-sea masks

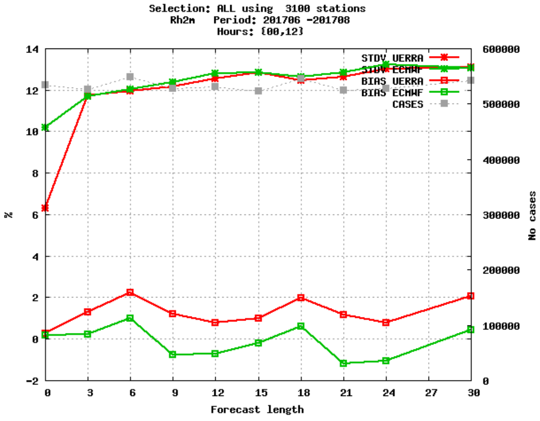


~80km ~31km 11km

Verification

- Verification tools are part of the quality control during the production
- Smaller bias and std than ERA-interim, e.g. T2m, wind speed, precipitation
- Some parameters not better than ERA-interim, e.g. RH2m





D J F w i n d s p e e d i n E R A 5 a n d U E R R A

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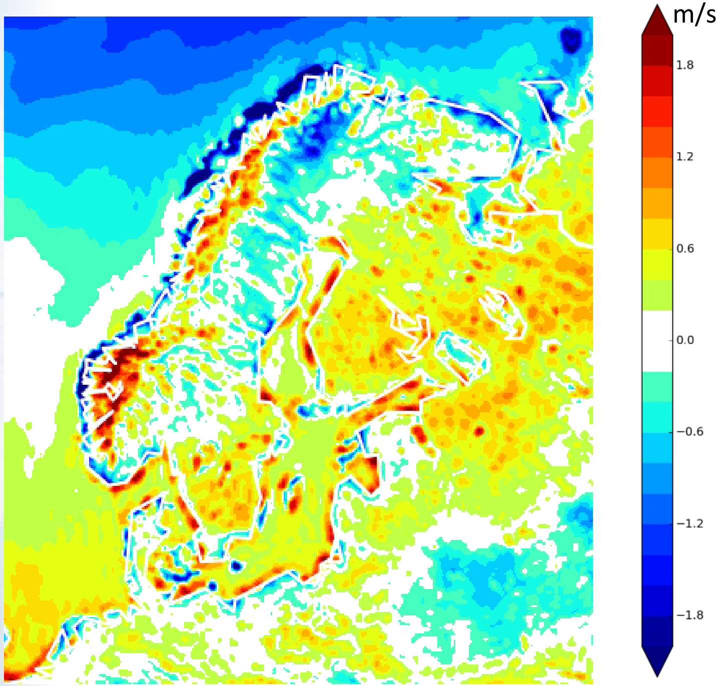
Wind speed differences between ERA5 and UERRA



- Differences mainly smaller than 1m/s
- Most differences are related to topography and thecoastline

Quality of wind speed

	ERA-interim	Downscaling with RCA	EURO4M	UERRA
RMSE	2.36	2.36	1.88	1.80
Correlation	0.79	0.75	0.83	0.85

Quality of wind speed based on 6 hourly data for a 10year period (1996-2005) at 24 Swedish coastal stations.

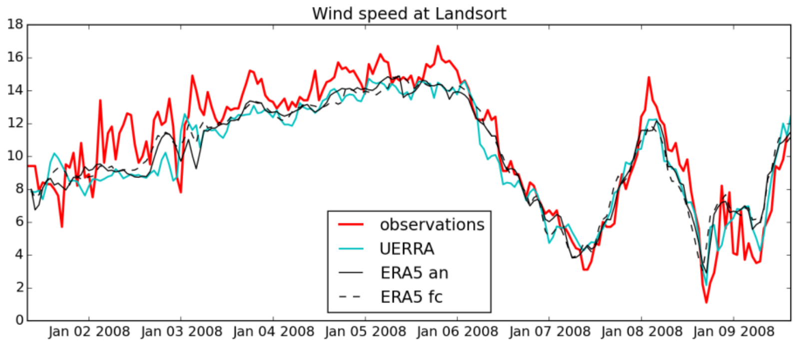
	Horizontal resolution	Resolution in time
ERA-interim	80 km	3 hourly
Dynamical downscaled with RCA	11 km	hourly
EURO4M	22 km	3 hourly
UERRA	11 km	hourly

Quality of wind speed

Comparison of wind speed at 24 Swedish coastal stations

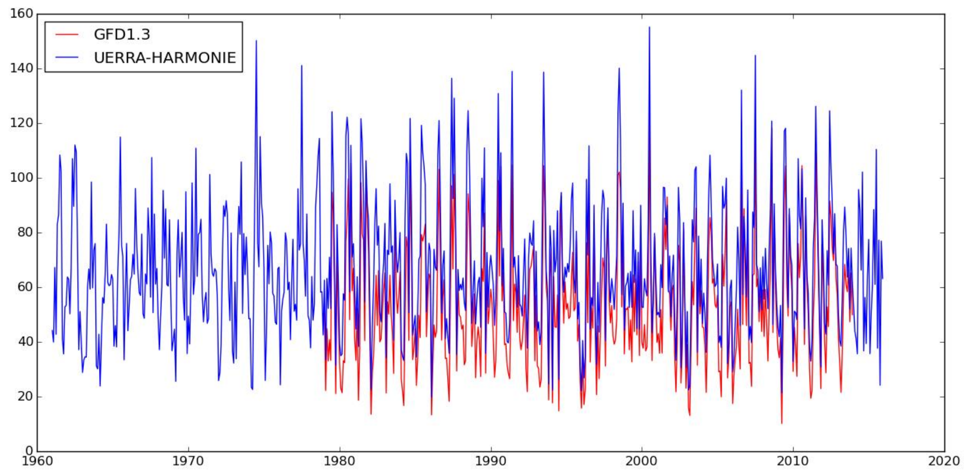
	UERRA	ERA5	ERA-int
Mean bias	-0.02	0.01	
Correlation	0.85	0.85	0.79
RMSE	1.83	1.97	2.36

Based on the period 2000-2015. Hourly data for UERRA and ERA5, 6hourly for ERA-interim



Series of a random sample for visual check.

Precipitation in the Baltic Sea area



	UERRA	GFD	E-OBS
Monthly mean	68 mm	54 mm	52 mm
Corr. with GFD	0.94		0.99
Corr. with E-OBS	0.96	0.99	

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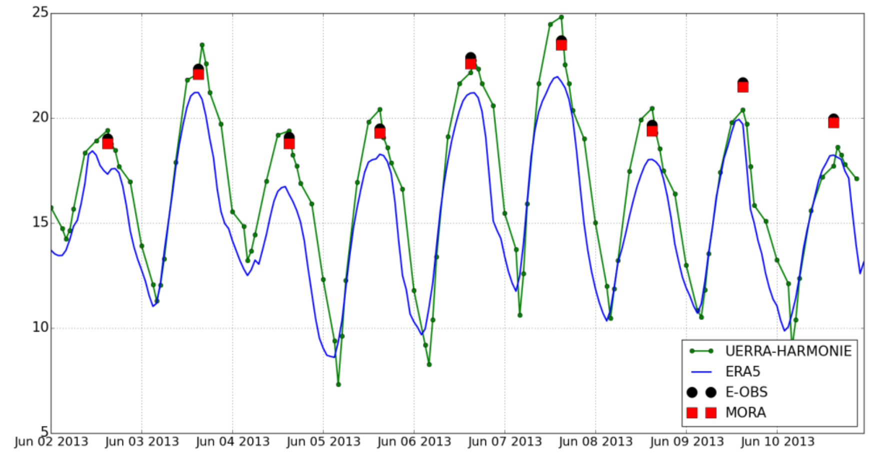
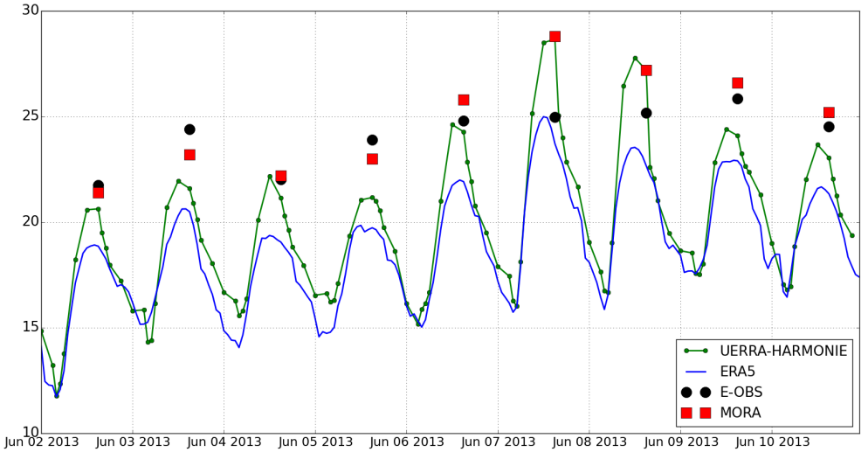
T2m: Daily cycle and maximum

Växjö (Sweden)



- Random sample, nine days in June 2013
- Växjö region is quite flat and homogenous
- UERRA-HARMONIE has general higher daily maximum temperatures than ERA5

Grazzanise (Italy)



- Grazzanise has a more complex terrain
- UERRA-HARMONIE has general higher daily maximum temperatures than ERA5
- Clear difference between gridded (E-OBS) data and direct measurements

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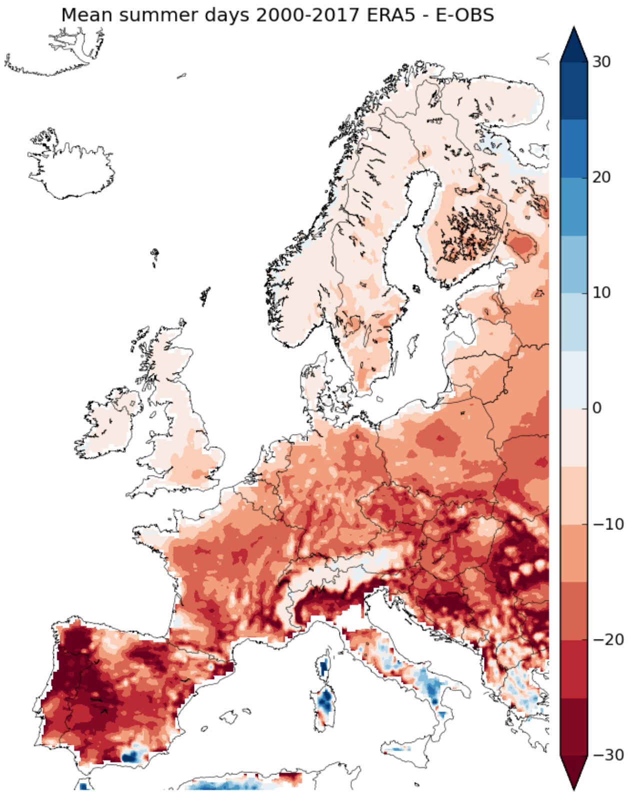
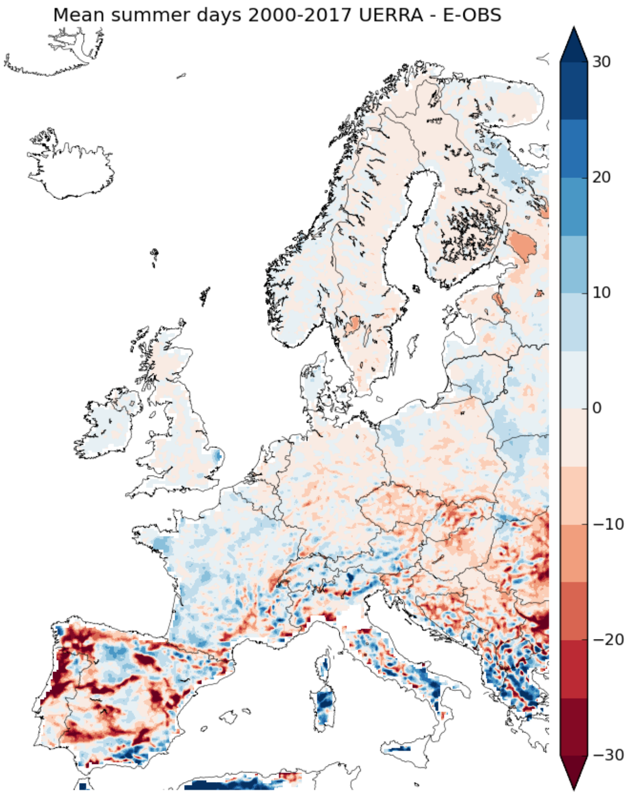
Summer days = Tmax > 25C





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H o m o g e n e i t y

Number of observations

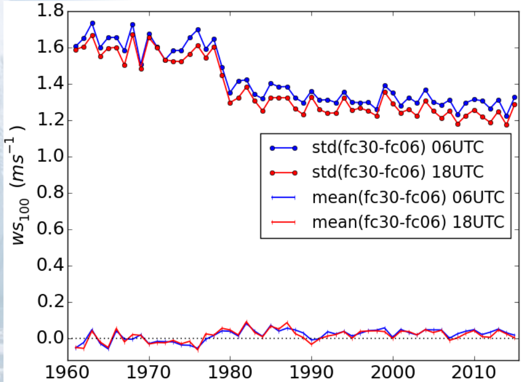
1969 1979 1989 1999 2009

Risks for inhomogeneity

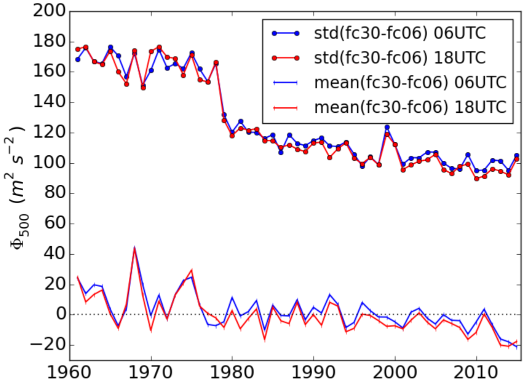
- Switch of lateral boundary data
  - 1961-1978 ERA40
  - 1979-2019 ERA-interim
- Increasing numbers of observations in time, especially aircraft data

Homogeneity

100m wind speed



500 hPa geopotential



Yearly averages of the standard deviation and mean of the forecast difference fc30-fc06 during winter (DJF).
Left: 100m wind speed. Right: 500 hPa geopotential. Curtesy Adam von Kraemer.

Investigations of the forecast skill (differences between fc30 and fc6):

- Forecast skill effects accuracy of the first guess and has herewith consequences on the data quality
- Increase of quality with the switch to ERA-interim and increasing numbers of observations (upper air)

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Summary

- The service offers:
  - Based on the RRA from the FP7 UERRA project, hourly data at 11km resolution from 1961 to July 2019 for Europe
  - A comprehensive set of output parameters for the surface, the upper air, and the soil
  - User guidance and support
- Data quality improves compared to global products
- Some inhomogeneity due to the change from ERA40 to ERA-interim