



Climate Change

Copernicus Regional Reanalysis for Europe

User workshop, Toulouse, 20/11/2018

Semjon Schimanke and the C3S_322_Lot1 team





Climate
Change

What's the service about?

- Operational production of a regional reanalysis (RRA) for Europe in near real-time
- Long series of freely available RRA
 - Starting 1961 with a horizontal resolution of 11km (available)
 - From the early 1980 with a horizontal resolution of 5.5km (under development)
- User support and guidance



Copernicus
Europe's eyes on Earth



SMHI

ON BEHALF OF
ECMWF
FOR THE EUROPEAN COMMISSION



Climate
Change

C o p e r n i c u s / C 3 S

- Copernicus is the European Union's earth observation program (<http://www.copernicus.eu/>)



Atmosphere
(CAMS)



Marine
(CMEMS)



Land
(CLMS)



Climate
(C3S)



Emergency
(EMS)



Security

- Copernicus Climate Change Services (C3S) (<http://climate.copernicus.eu/>)



Climate
Change

Service facts

- Copernicus regional reanalysis for Europe
The service is part of the Copernicus Climate Change Services (C3S_322_Lot1).
- The service lifetime is 4 years.
- Onset was on 1/9/2017.
- The service is operated by

SMHI





Climate
Change

Time line of service and system details

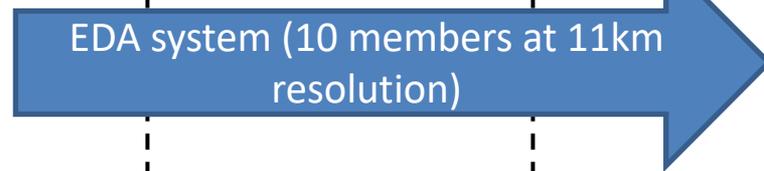
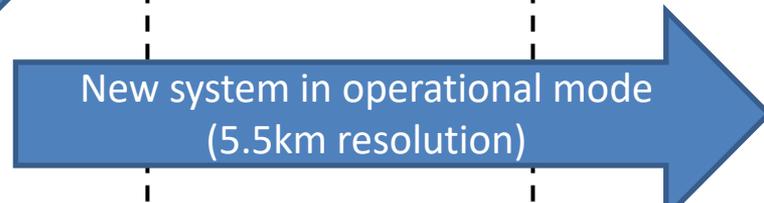
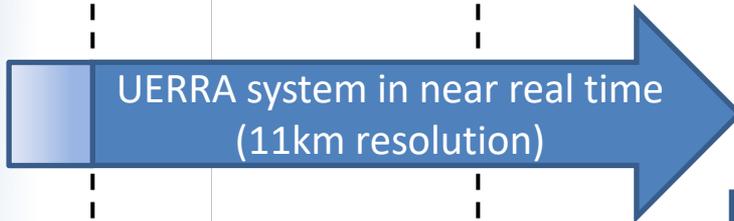
2017

2018

2019

2020

2021



- 11 km (565x565 grid points), 65 levels
- Surface downscaling analysis at 5.5 km (MESCAN-SURFEX)
- Start in 1961 and operational since 2/2018

- 5.5 km (1100x1050 grid points), 106 levels
- Surface analysis at 5.5 km – no downscale
- Plus 10 ensemble members at 11km
- Will start in the early 1980s



Copernicus
Europe's eyes on Earth



SMHI

ECMWF
FOR THE EUROPEAN COMMISSION



Climate
Change

Objectives of the service

- Operational production of the RRA for Europe in near real-time
- Develop an enhanced system which should provide data from the early 80's
In addition, an ensemble at lower resolution
- A comprehensive set of output parameters and ECVs for upper air, surface and soil
- Collaboration and coordination with other reanalysis activities, e.g. Arctic reanalysis (C3S_322_Lot2) and ERA5 (ECMWF)
- User guidance and support



Copernicus
Europe's eyes on Earth



SMHI

ON BEHALF OF
ECMWF
FOR THE EUROPEAN COMMISSION



Climate
Change

The pre-operational FP7 project

- UERRA: Uncertainties in Ensembles of Regional ReAnalysis
- 12 European partners
- Three different RRA plus ensembles

- UERRA-HARMONIE and MESCOAN-SURFEX data was produced for 1961-2015 and it is available through this Copernicus service.



www.uerra.eu



Copernicus
Europe's eyes on Earth



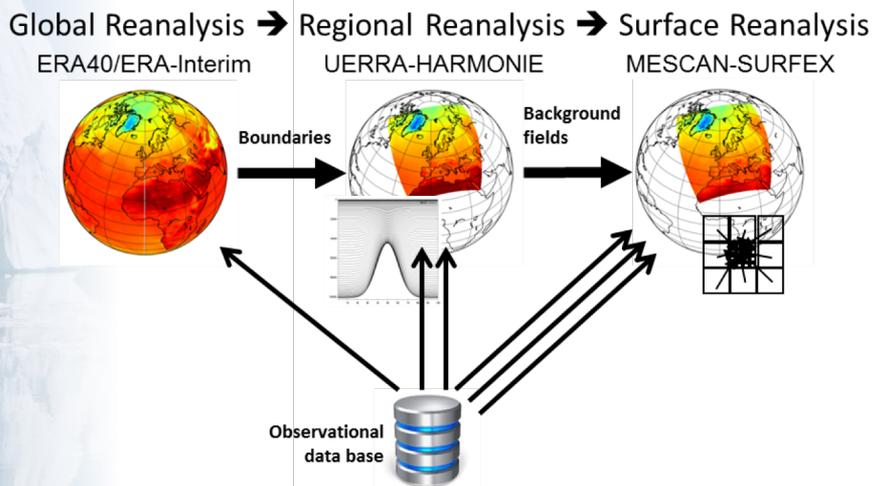
SMHI

ON BEHALF OF
ECMWF
FOR THE EUROPEAN COMMISSION



Climate
Change

The system



- UERRA system
 - HARMONIE cycle 38h1, ALADIN physics
 - ERA40/ERA-interim as lateral boundary
 - Assimilation of conventional observations
 - 4 cycles per day, forecast lengths 6h and 30h
 - 11km resolution (565x565) and 65 vertical levels
- MESCAN-SURFEX
 - Optimal interpolation (OI)
 - 5.5km resolution



Climate
Change

Data access – MARS

<http://apps.ecmwf.int/>

ECMWF Home Chart dashboard Contact Search ECMWF Semjon Schimanke | Sign out

About Forecasts Computing Research Learning

Navigation

- Home
- MARS Catalogue
- MARS Activity
- Job list

See also...

- FAQ
- Accessing forecasts
- GRIB decoder

MARS Catalogue

1961

Choose the month:

- ▶ [January](#)
- ▶ [February](#)
- ▶ [March](#)
- ▶ [April](#)
- ▶ [May](#)
- ▶ [June](#)
- ▶ [July](#)
- ▶ [August](#)
- ▶ [September](#)
- ▶ [October](#)
- ▶ [November](#)
- ▶ [December](#)

Current selection:

year: [1961](#), [1962](#), [1963](#), [1964](#), [1965](#), [1966](#), [1967](#), [1968](#), [1969](#), [1970](#), [1971](#), [1972](#), [1973](#), [1974](#), [1975](#), [1976](#), [1977](#), [1978](#), [1979](#), [1980](#), [1981](#), [1982](#), [1983](#), [1984](#), [1985](#), [1986](#), [1987](#), [1988](#), [1989](#), [1990](#), [1991](#), [1992](#), [1993](#), [1994](#), [1995](#), [1996](#), [1997](#), [1998](#), [1999](#), [2000](#), [2001](#), [2002](#), [2003](#), [2004](#), [2005](#), [2006](#), [2007](#), [2008](#), [2009](#), [2010](#), [2011](#), [2012](#), [2013](#), [2014](#), [2015](#)

type: [an](#), [fc](#)

stream: [enda](#), [oper](#)

origin: [edzw](#), [egrr](#), [eswi](#)

expver: [prod](#), [test](#)

class: [at](#), [be](#), [ch](#), [co](#), [cs](#), [de](#), [dk](#), [dm](#), [dt](#), [e2](#), [e4](#), [ea](#), [ei](#), [el](#), [em](#), [en](#), [ep](#), [er](#), [es](#), [et](#), [fr](#), [ie](#), [it](#), [la](#), [mc](#), [me](#), [ms](#), [nl](#), [no](#), [nr](#), [od](#), [pt](#), [pv](#), [rd](#), [rm](#), [s2](#), [se](#), [te](#), [ti](#), [to](#), [tr](#), [uk](#), [ur](#), [yp](#), [yt](#)

- All data is freely available! (1961- July 2018)
- All you need is to register!
- UERRA data 480 TB

▲ Top of page

copyright © ECMWF





Climate
Change

Data access – CDS

[Home](#) [Search](#) [Datasets](#) [Applications](#) [Toolbox](#) [Help & support](#)

UERRA regional reanalysis on pressure levels from 1961 to present

[Overview](#) [Download data](#) [Documentation](#)

The UERRA-HARMONIE regional reanalysis of the climate in Europe combines model data with observations from across the world into a complete and consistent dataset using the laws of physics. This principle, called data assimilation, is based on the method used by numerical weather prediction centres, where every so many hours (6 hours in the UERRA-HARMONIE system) a previous forecast is combined with newly available observations in an optimal way to produce a new best estimate of the state of the atmosphere, called analysis, from which an updated, improved forecast is issued. Reanalysis works in the same way, but at reduced resolution to allow for the provision of a dataset spanning back several decades. Reanalysis does not have the constraint of issuing timely forecasts, so there is more time to collect observations, and when going further back in time, to allow for the ingestion of improved versions of the original observations, which all benefit the quality of the reanalysis product.

The assimilation system is 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 initially much sparser networks will lead to less accurate estimates. UERRA-HARMONIE data is available from 1961 and is updated once a month with a delay to real-time of 3-4 months. The system provides four analyses per day at 0 UTC, 6 UTC, 12 UTC, and 18 UTC. Between the analyses, forecasts of the system are available with hourly resolution. Hence, estimates of the status of the atmosphere are available for every hour since 1961. Moreover, forecasts up to 30 hours are available from the analyses at 0 UTC and 12 UTC though the output is not stored hourly after forecast hour 6 but only every third (sixth) hour.

In addition to observations in the model domain, a regional reanalysis needs information at its lateral boundaries. For the UERRA-HARMONIE system, this information is taken from the global reanalyses ERA40 (until the end of 1978) and ERA-interim (from 1979). The improvement over global products comes with the higher horizontal resolution that allows incorporating more regional details, e.g. topography. Moreover, it enables the system even to consider more observations at places with dense observation networks. The UERRA-HARMONIE regional reanalysis is produced at a horizontal resolution of 11km.

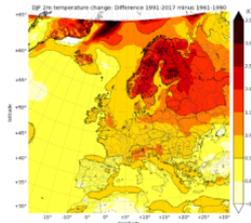
Variables are produced at the surface and on model levels (65 levels) but are also interpolated to two other level types: pressure levels (24 levels between 1000-10hPa), and height levels (11 levels between 15m-500m). The output of height levels were introduced with special focus on the

wind energy sector and their needs. The number of available parameters varies between the different level types.

In order to make data access more manageable, the UERRA-HARMONIE dataset has been split into 5 records. The present record is the UERRA-HARMONIE regional reanalysis on pressure levels from 1961 to present.

More details about the product are given in the Documentation section.

DATA DESCRIPTION	
Horizontal coverage	Europe
Horizontal resolution	11km x 11km
Temporal coverage	1961 to present
Temporal resolution	6-hourly



Contact

copernicus-support@ecmwf.int

License

[Licence to Use Copernicus Products](#)

Publication Date

1975-09-06

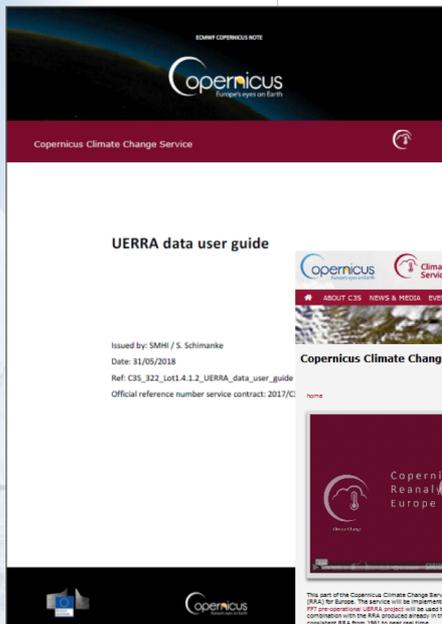
Soon, data will be
available via Copernicus
Climate Data Store (CDS)





Climate
Change

User support



UERRA data user guide

Issued by: SMHI / S. Schimanski
Date: 31/05/2018
Ref: C3S_322_Lot1.4.1.2_UERRA_data_user_guide
Official reference number service contract: 2017/C

Copernicus Climate Change Service regional reanalysis for Europe

NEWS

- 22 May 2018: Rain returns in force to Spain and Portugal
- 21 May 2018: Europe's warmest April since 1879
- 21 May 2018: Copernicus contributes to warmer city living through UTR measuring aspect
- 18 May 2018: Copernicus to launch operational service for energy sector
- 11 May 2018: Member States prepare to use Copernicus climate data

EVENTS

- 18 Jun 2018: COP24 (C45): Industry information videoconference
- 09 Jun 2018: Workshop: Innovate with Copernicus Data
- 22 May 2018: C3S at the ICJW 2018

Global Reanalysis → Regional Reanalysis → Surface Reanalysis

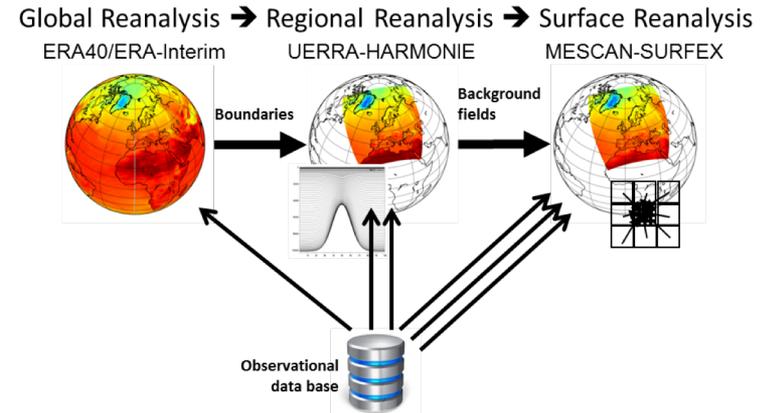
Figure 1: Three different stages of reanalysis: (left) the Global Reanalysis BRAS will be used at boundary condition, (middle) a 3D Regional Reanalysis, and (right) a 2D Reanalysis for the near-surface. The amount of observational data used for the final analysis will increase from the global to the surface reanalysis as indicated by the arrows.

- Contact copernicus-support@ecmwf.int
- User guide
- Homepage <https://climate.copernicus.eu/regional-reanalysis-europe>
- Git server with example scripts https://git.smhi.se/C3S_322_Lot1/C3S_322_Lot1_user_examples
- Training material will be produced for Copernicus user learning services.





- The service offers:
 - Based on the RRA from the FP7 UERRA project, hourly data at 11km/5.5km resolution from 1961 to near real time for Europe
 - A comprehensive set of output parameters for the surface, the upper air, and the soil
 - User guidance and support (copernicus-support@ecmwf.int)

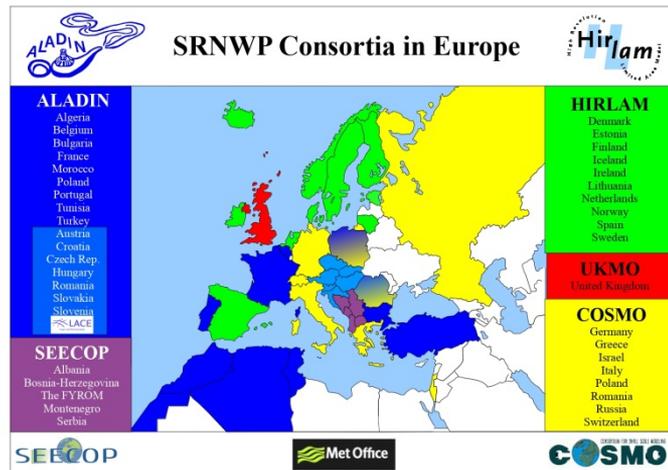
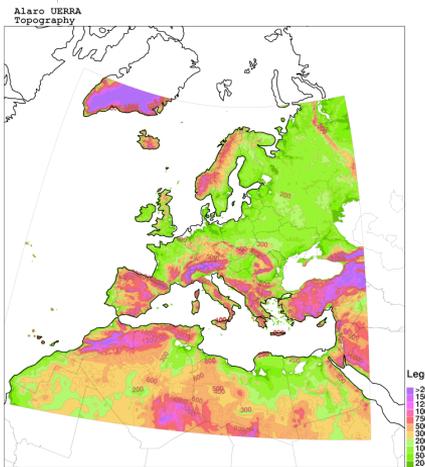




Climate
Change

Model systems: common base

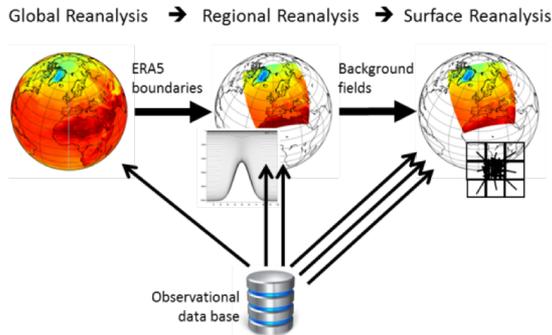
- HARMONIE-ALADIN system
- 3D-VAR data assimilation
- Large scale constraint (J_k)
- Incremental digital filter initialization





UERRA system

- 11 km (565x565 grid points)
- 65 levels (10hPa)
- Surface downscaling analysis 5.5 km (MESCAN)



New system

- 5.5 km (~1100x1050 grid points)
- ~100 levels (1hPa)
- Surface analysis at 5.5 km as part of the system
- Plus 10 ensemble members at 11km and coupling to data assimilation



Climate
Change

Model systems: differences

UERRA system	New system
HARMONIE cycle 38h1 (ALADIN physics)	HARMONIE cycle 40.1h/42 (ALADIN physics)
SURFEX 7.3	SURFEX 7.3 with updates or SURFEX 8.0
ERA40 and ERA-interim as LBC	ERA5 as LBC
4 cycles per day	8 cycles per day
No satellite data	Satellite radiances, e.g. IASI, SEVERI, MSU, AMSU
---	Usage of ERA5 ODB files, e.g. blacklisting information
---	More obs-data, e.g. GBGNSS



Climate
Change

Challenges for operational production

- More automatization, e.g.
 - Checks of input data (LBC and observations)
 - Checks of output data (number of files, quality controls, etc.)
 - Automatic job submission
 - Notifications via mail in case of abnormality
- Continual quality control
 - Monthly quality checks, e.g. visual check of verification scores, observation usage, bias corrections, etc.
 - Team of 3-4 people will be involved in checks and production



Climate
Change

Total HPC needs

- UERRA system 8 MSBU
 - PRECISE system 626 MSBU
 - Ensembles 286 MSBU
-

Total 920 MSBU ==> ~700.000 Euro
(~57 M core hours)

- Testing/developing 100 MSBU
 - Spin-up periods 36 MSBU
- } In-kind contribution