

# UERRA - Uncertainties in Ensembles of Regional ReAnalyses

Grant Agreement 607193 EU FP7 SPACE 2013-1

Production data with quality evaluation and data rescue and gridded data



Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



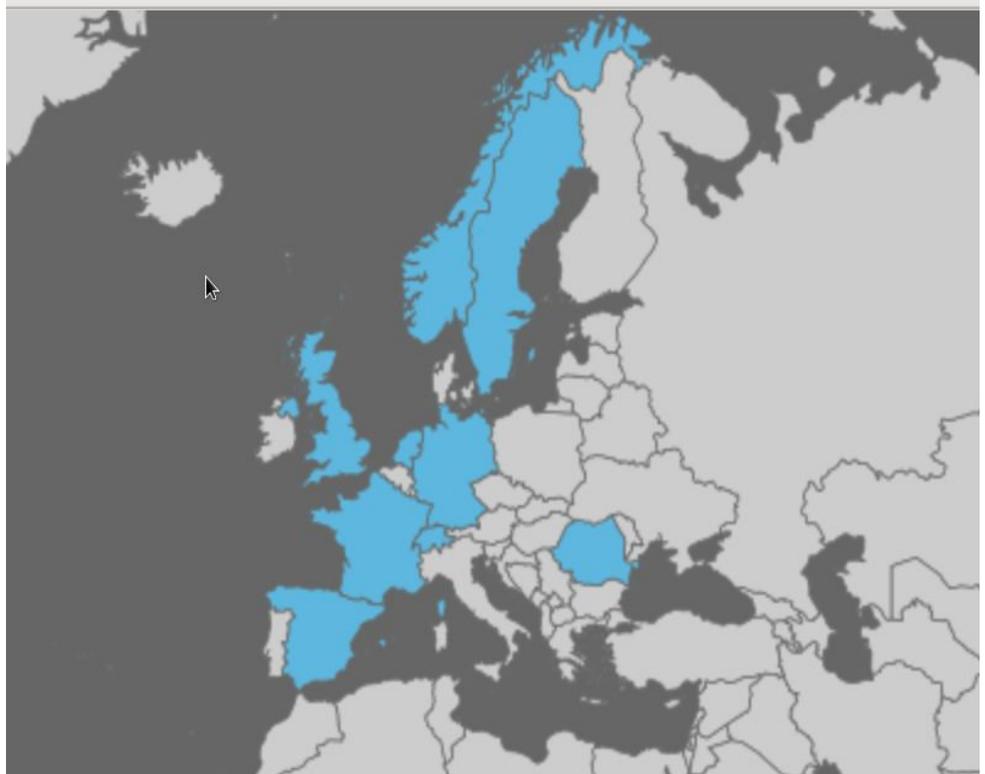
Meteorologisch  
institut



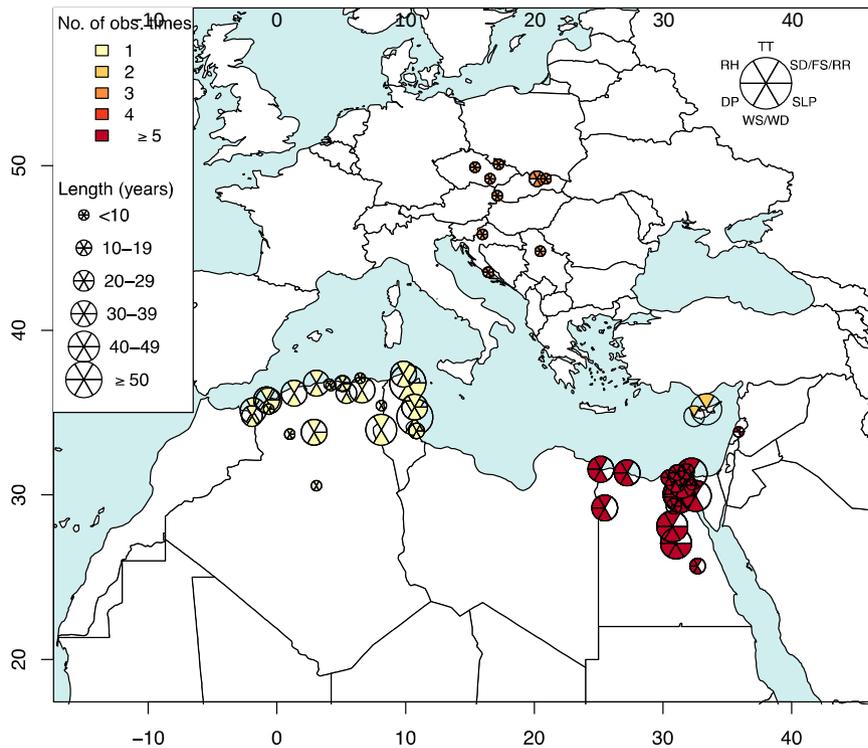
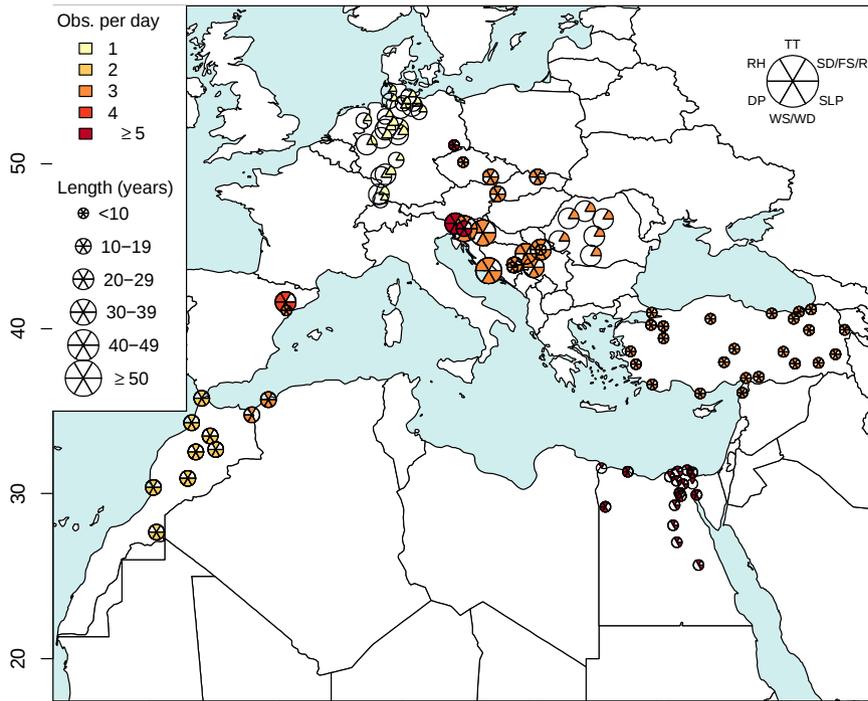
UNIVERSITAT  
ROVIRA I VIRGILI



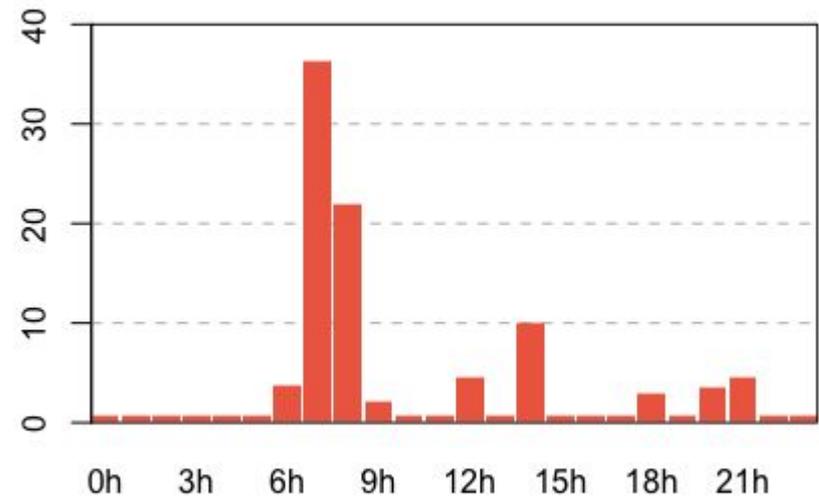
universitätbonn  
Rheinische  
Friedrich-Wilhelms-  
Universität Bonn



### Post-1950 data



**Infilling >1950  
and <1950**  
complemented by French  
and Swedish 60's data  
And Norwegian, Swedish and  
Catalonian data



# Observational data delivered

Provider	Period	Variable	Frequency	Amount
MET (Norway)	1960-1980	TT, WD, WS, RR	3-4 times a day or hourly	7.2 M
MET (Norway)	1981-2016	-"-	-"-	30.4 M
SMHI (Sweden)	1945-2009	TT, SLP, RR, RH, SD, CC	3-4 times a day, daily precip	41.1 M
MeteoCat (Spain)	1988 - 2015	TT, SLP, WD, WS, RR, RH	Hourly	63.6 M

Courtesy of Joan Ramon et al. Deliverable 1.8

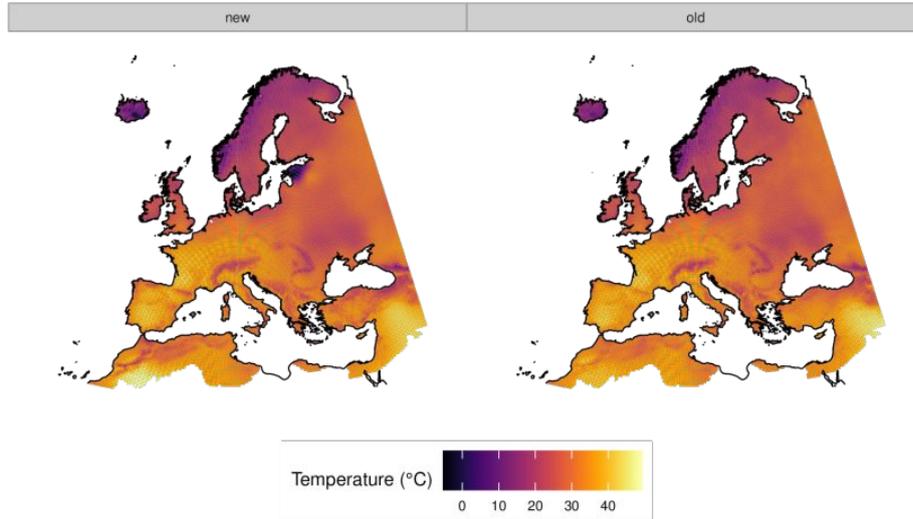


# Data delivered

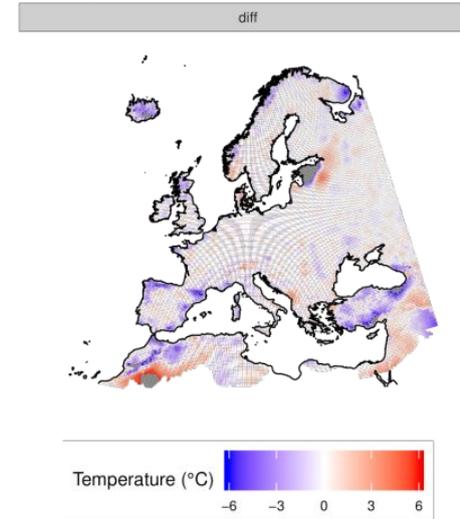
Recipient	Data delivered	Delivered
UERRA reanalysis	All available subdaily	√
UERRA evaluation	All available subdaily	√
UERRA climate indicators	All availables subdaily and daily averages and totals	√
GPCC	All available daily and subdaily precipitation data	√
ISPD	All available subdaily	√
ISTI & STFC/CEDA	- " -	√
NCEI	- " -	√
UK-MO HadISD	- " -	√
MARS archive	All available subdaily and quality-controlled data	Through STFC/CEDA
ECA&D system	All availables subdaily and daily averages and totals	√
NMS from which data have been rescued		

Courtesy of Joan Ramon et al. Del. 1.8

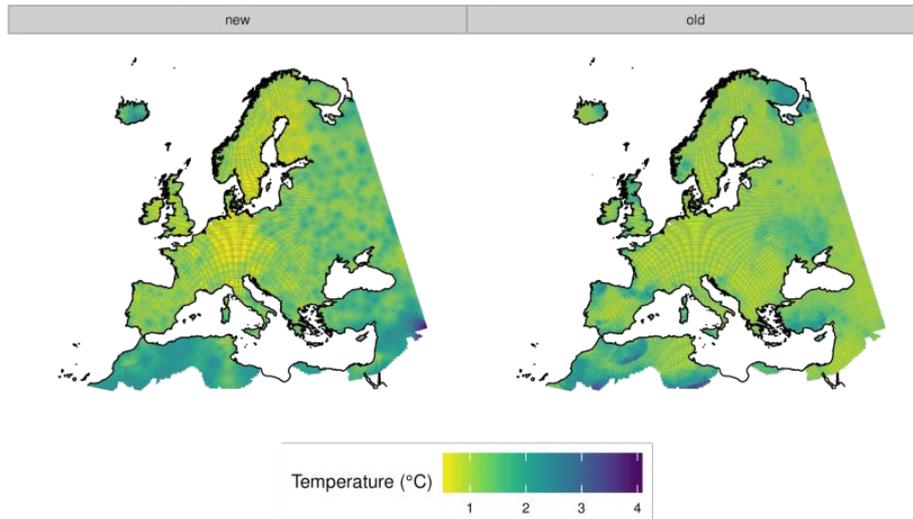
a) Maximum Daily Temperature Interpolation



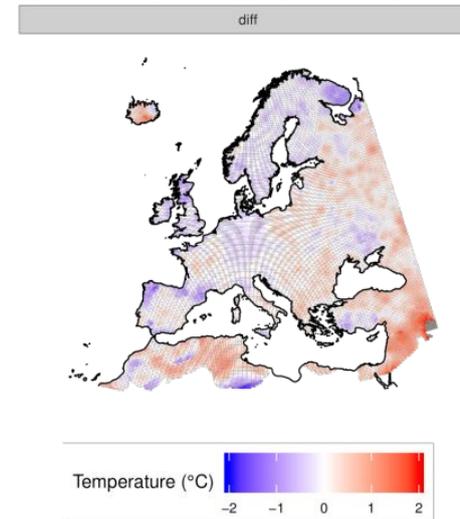
b) Interpolation Difference (New – Old)



c) Maximum Daily Temperature 95% uncertainty



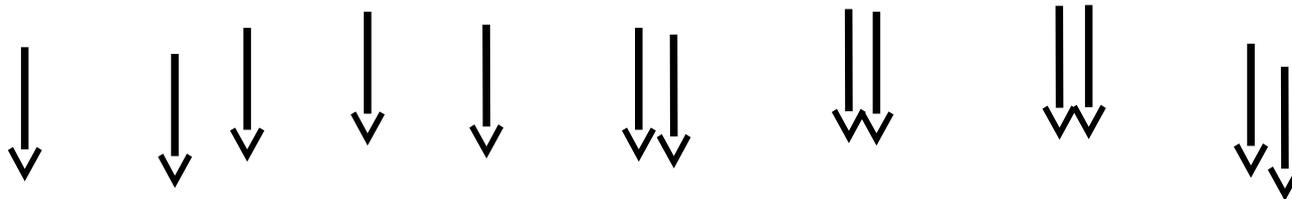
d) Uncertainty Difference (New – Old)



New E-OBS interpolation method  
 Random model parameters give different realisations  
 (4 Jan 2003, Courtesy of Richard Cornes, Del. 1.14)

# Reanalysis principle

Observations as complete as possible or improving



NWP model and analysis system remain fixed

Reanalysis quality remains the same or improving

1961



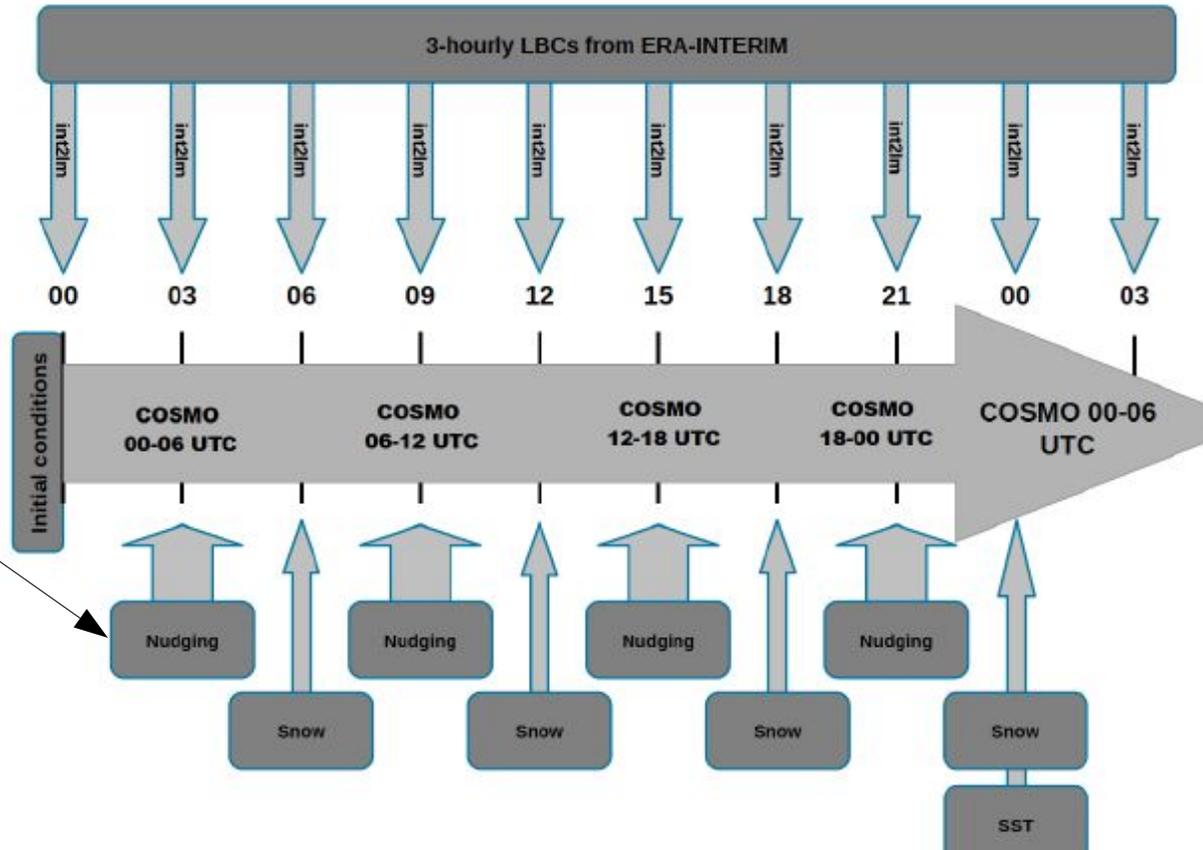
2014

# Data assimilation of Observations

```
File Edit Show Servers Windows
2016-03-30 08:36:02
ecFlowview (4.0.9) (on ecgb11)
Help

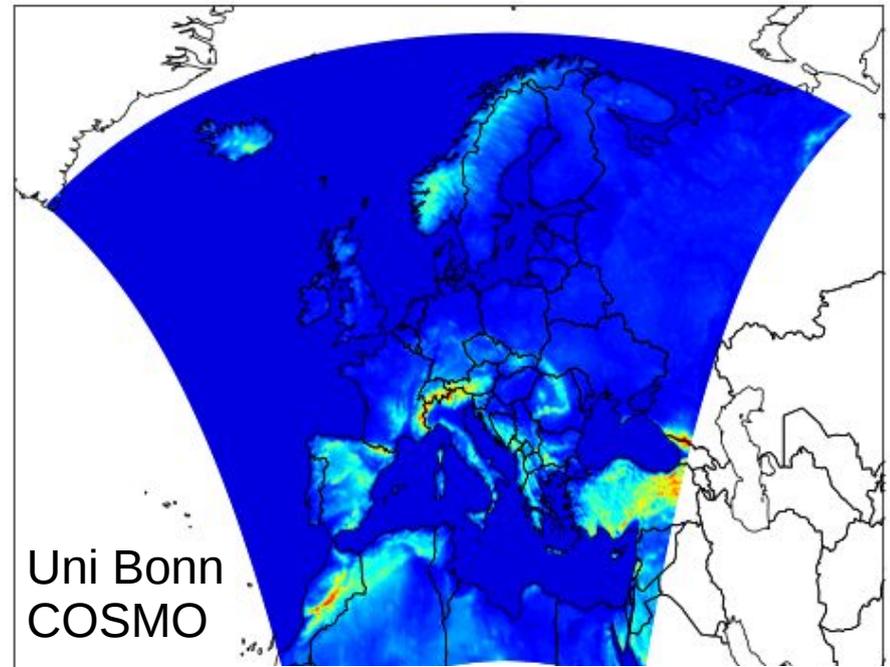
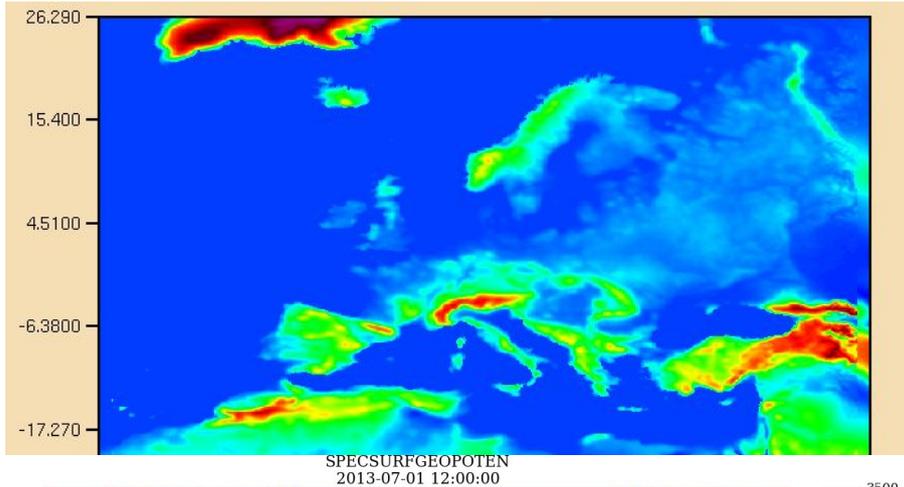
[env]
  uerra_aladin_buf1
  uerra_aladin_lon2
  uerra_aladin_9099

  InitRun
  Build
  CollectLogs { ( Build == aborted or Build == complete ) and InitRun == complete }
  MakeCycleInput
  Date_analysis { YMD=... 19891118 ...
                 ( Build == complete )
                 Hour HH=0 6 ...
                 Cycle { ( ( ../Date_analysis:YMD <= 19890901 ) and ( Hour:HH < 00 ) ) or ( ( ../Date_analysis:YMD >= 19891231 )
                        StartData
                        Analysis { StartData == complete }
                        Addsurf
                        AnSFC
                        AnUA
                        PostAnalysis
                        CollectLogs { Cycle == aborted or Cycle == complete }
                }
  Date_forecast
  Postprocessing { YMD=... 19891117 ...
                  ( Build == complete )
                  Hour HH=... 12 18
                  Cycle { ( ( ../Postprocessing:YMD <= 19890901 ) and ( Hour:HH < 00 ) ) or ( ( ../Postprocessing:YMD >= 19891231 )
                        Disk_cleaning
                        Archive_ecgate { Disk_cleaning == complete }
                        CollectLogs { ( Cycle == complete and Disk_cleaning == complete and Archive_ecgate == complete ) or (
                        LogProgress { Cycle == complete and Disk_cleaning == complete and Archive_ecgate == complete and Coll
  EndOfMonth
  Wrapup { MakeCycleInput == complete and Date_forecast == complete and EndOfMonth == complete and Postprocessing == comp
```



# UERRA Domain & projections

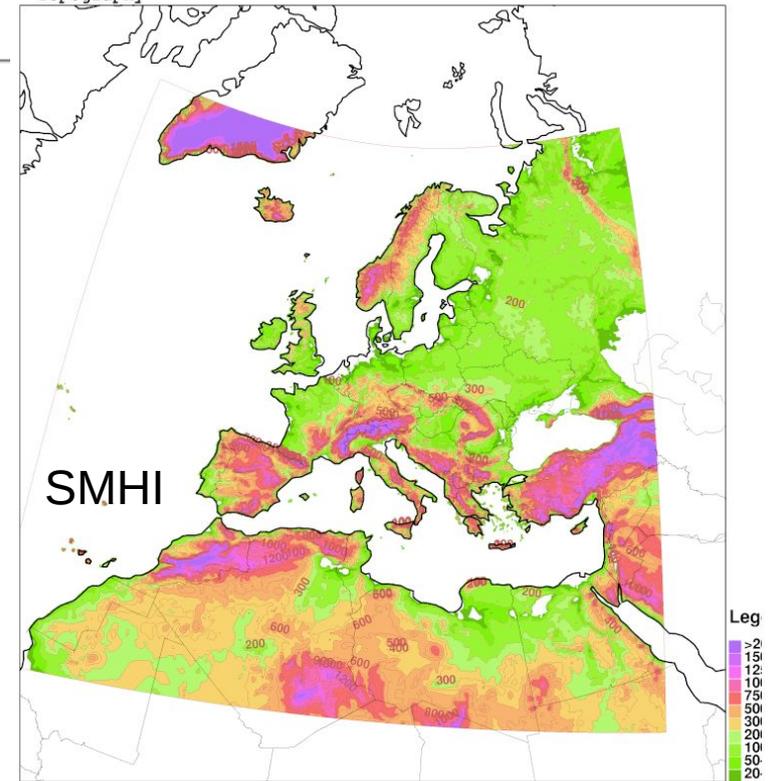
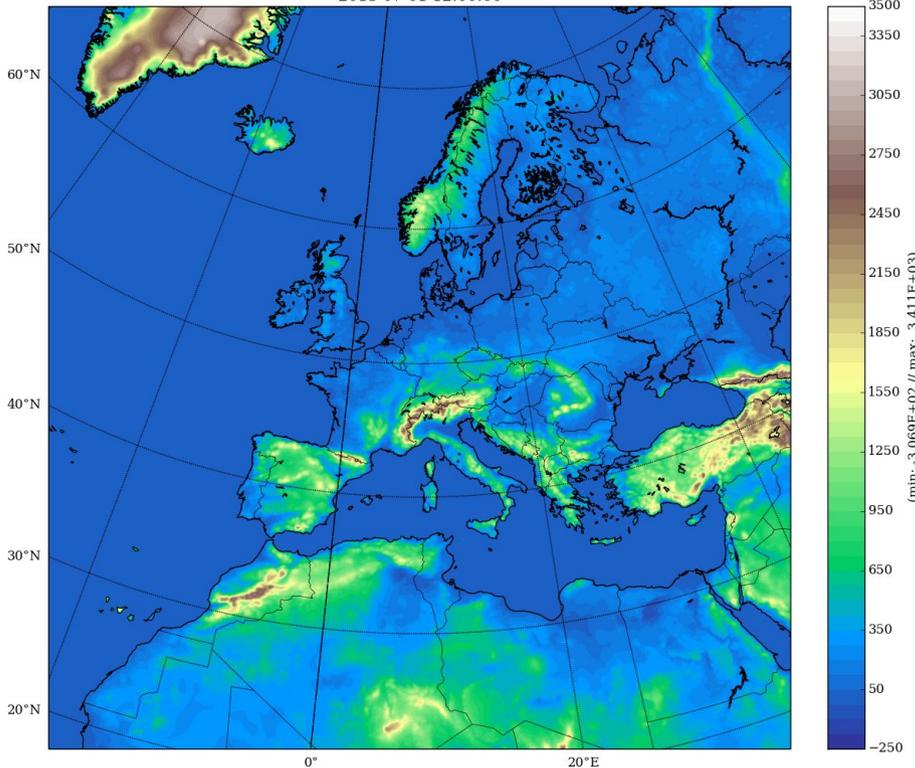
Met Office  
CORDEX  
EU 11 km



Uni Bonn  
COSMO

Alaro UERRA  
Topography

MF



Mon 1 Jul 2013 00Z +06h  
valid Mon 1 Jul 2013 06Z

# Reanalyses in UERRA

SMHI  
 HARMONIE - ALADIN  
 11 km  
 65 levels  
 3D-Var

UK MetOffice  
 12 km  
 70 levels  
 4D-Var  
 Including satellite info.  
 20 ens. members  
 36 km

University of Bonn  
 Hans Ertel Centre  
 12 km  
 40 levels  
 Nudging (LETKF prepare)  
 20 ens. Members  
 12 km

1961

1979

(1982) 1994

2006-10

Météo-France  
 MESCAN  
 Surface  
 6-8 en. Members  
 OI MESCAN  
 5 km

SMHI  
 MESAN  
 Cloud Analysis

SMHI  
 HARMONIE- ALARO

# UERRA data sets in MARS at ECMWF

	Members	Resolution	Levels	Period	Variables: 3D upper air: T, RH/q, u,v, (dir,speed), Geop/pressure, cloud, water and ice, precip, 2 and 10 m T, RH, wind, evaporation, radiation fluxes, snow etc.
COSMO (Univ Bonn)	1	12	40	2006-2010	T, RH, u, v, clouds, Geop, Precip, surf etc
COSMO ensemble	20	12	40	2006-2010	T, RH, u, v, clouds, Geop, Precip, surf etc
HARMONIE ALADIN	1	11	65	1961-2015	T, RH, u, v, clouds, Geop, Precip, surf etc
HARMONIE ALARO ensemb	1	11	65	2006-2010	T, RH, u, v, clouds, Geop, Precip, surf etc
MESAN cloud V1	1	11	1	2004-2008	Total cloud cover
MESAN cloud V2 ensemble	1	11	1	1991-2010 <sup>1</sup>	Total cloud cover
MESCAN	1	5	1	(1961-1990 (-2015	T2m, RH2m, Precipitation
MESCAN ensemble	8	5	1	2006-2010	T2m, RH2m, Precipitation
UM 4D-VAR	12	12	70	1979-1990 2000-2014 <sup>2</sup>	T, RH, u, v, clouds, Geop, Precip, surf etc
UM Ens 3D-VAR	20	36	70	1979-1990, 2000-2014 <sup>2</sup>	T, RH, u, v, clouds, Geop, Precip, surf etc

( ) will be filled in September-December and SURFEX forecast

1)MESAN V2 in October

2) 2011-15 October,

**Analysis: six hourly  
at 00 UTC, 06 UTC, 12 UTC, 18 UTC (hourly  
for COSMO)**

**Forecasts : T+1,2,3,4,5,6,9,12,15,  
18,21,24,27,30 started at 00 UTC and 12 UTC  
T+1,2,3,4,5,6 started at 06 UTC and 18 UTC**

## **Model levels**

**Store analysis output every  
six hours at  
00UTC, 06UTC, 12UTC,  
18UTC for all models.**

**ECMWF MARS  
Data services  
Open data**

## **Height levels**

15
30
50
75
100
150
200
250
300
400
500

## **Pressure levels**

1000
975
950
925
900
875
850
825
800
750
700
600
500
400
300
250
200
150
100
70
50
30
20
10

## **Surface levels:**

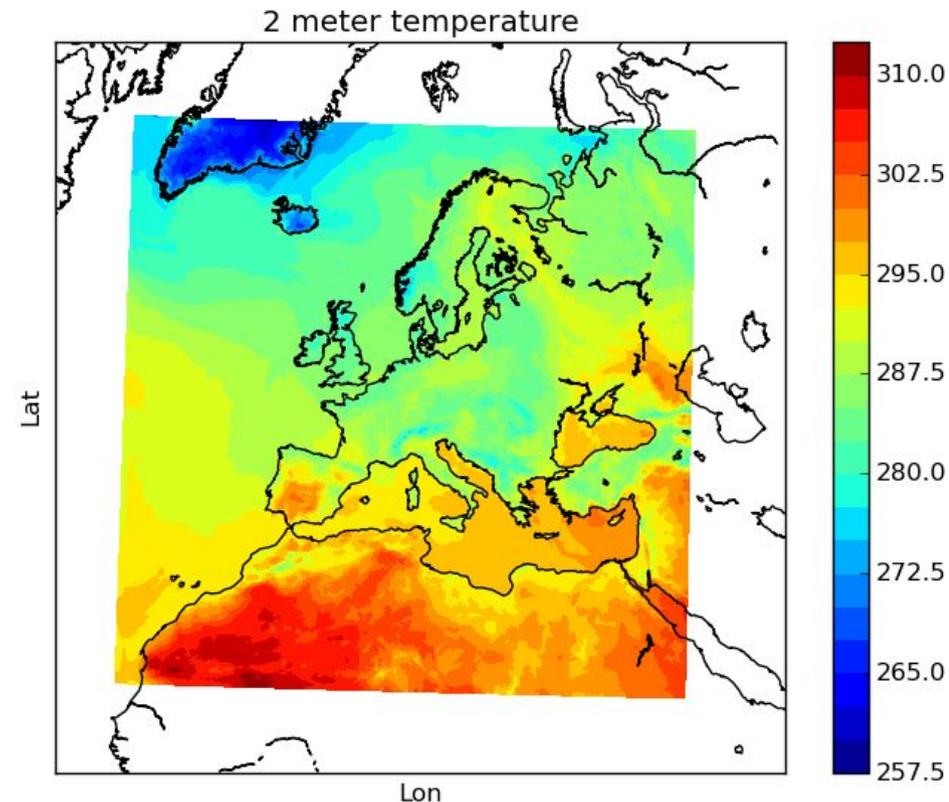
Temperature, wind, clouds, fluxes of sensible  
and latent heat, radiation fluxes, snow, rainfall

## **Soil levels**

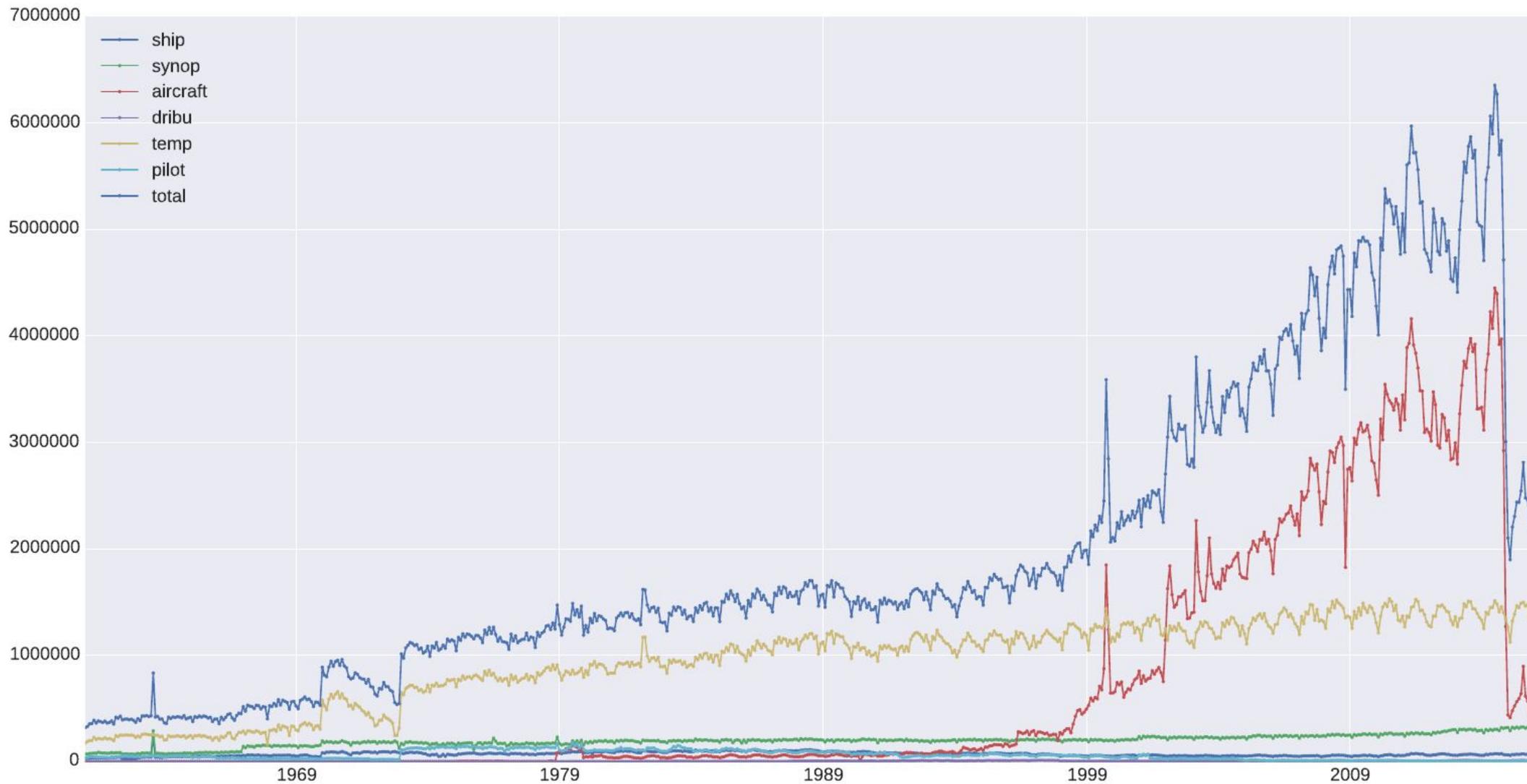
Temperature and soil wetness

## HARMONIE (HIRLAM ALADIN Regional/Mesoscale Operational NWP In Europe)

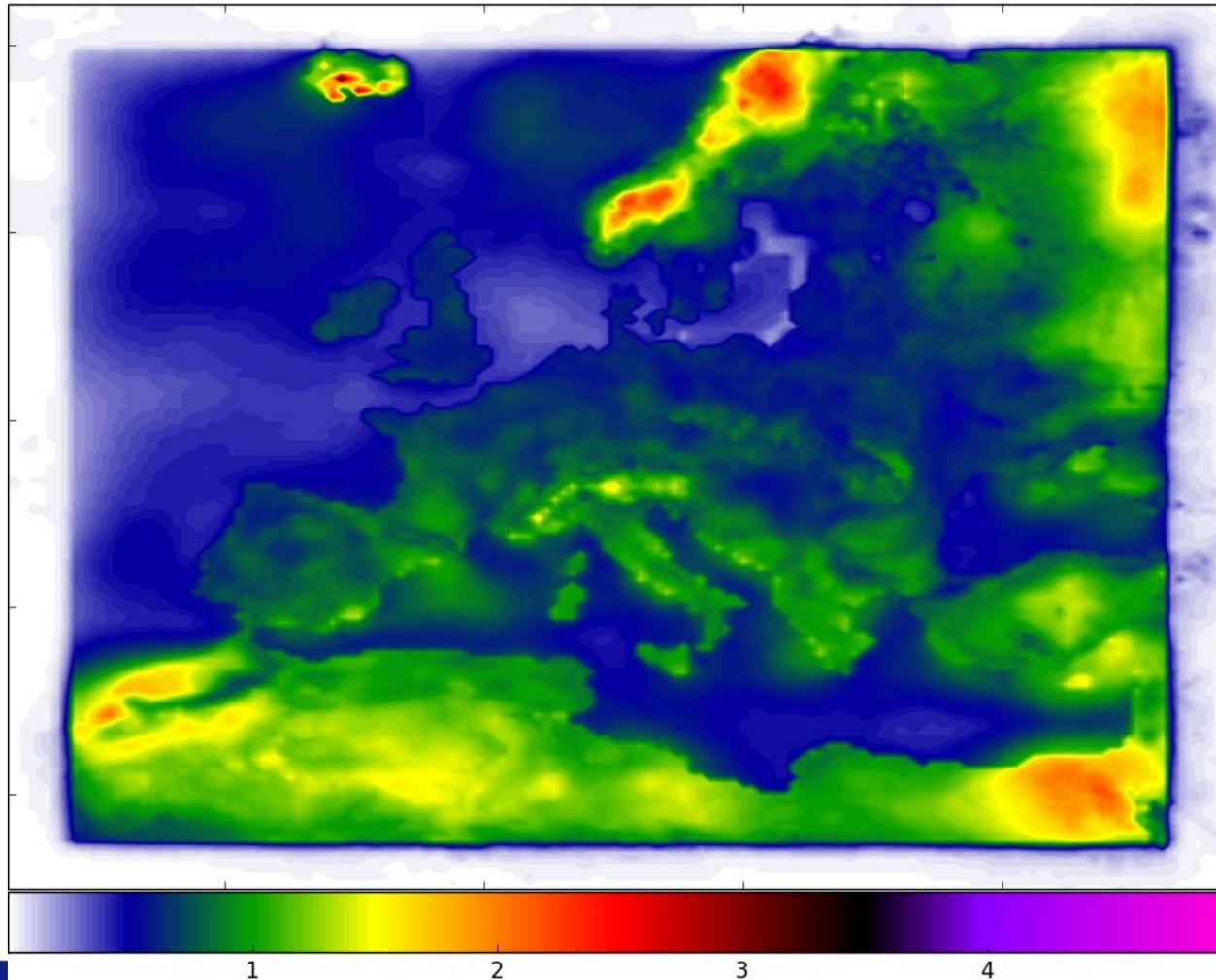
- Forecasts
  - 30 hour forecasts at 00 and 12
  - 1 hour resolution up to 6 hours, 3 hour resolution up to 30 hours
  
- Run at ECMWF
  - Several streams (5-10 years) with 4 months overlap
  - ~180 milj. SBUs
  - ~1200 Tb data of which ~350 Tb is stored in MARS
  
- 5 years with HARMONIE-ALARO
  - 2006-2010
  - Preparation for the longer re-analysis
  - Mini ensemble for uncertainty estimates



# All observations 1961-2015 (c.o. Klaus Zimmerman)

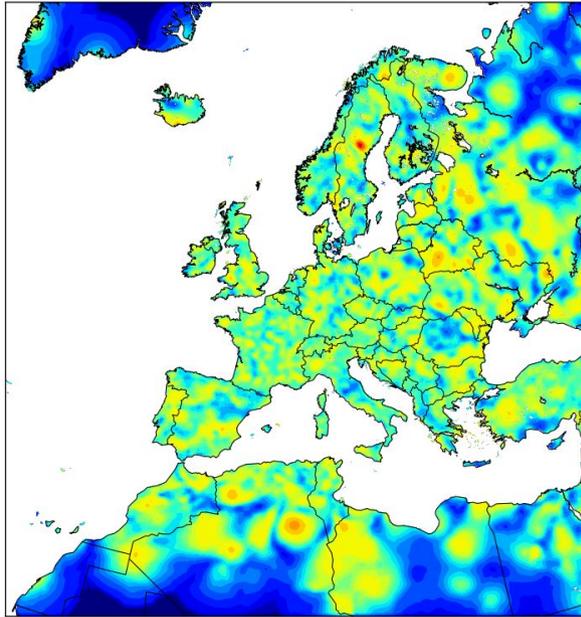


Spread of 2m temperature for March 1979 from the Met Office system Ensemble 4D-VAR reanalysis

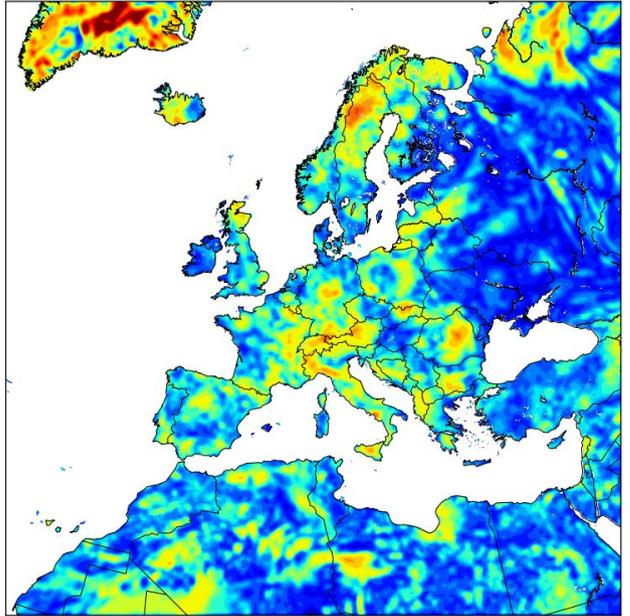


# MESCAN ensemble - T2m

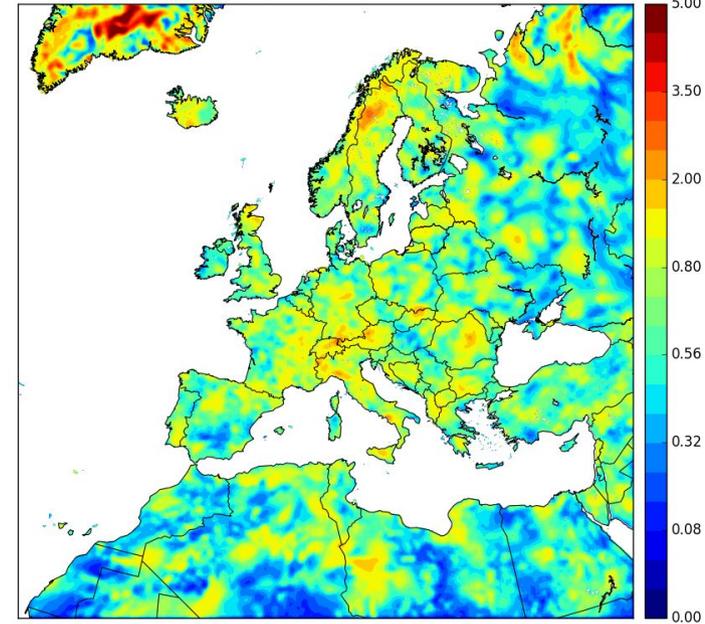
an, 2t, ensstd, 2006011512



an, 2t, ensstd, 2006011512

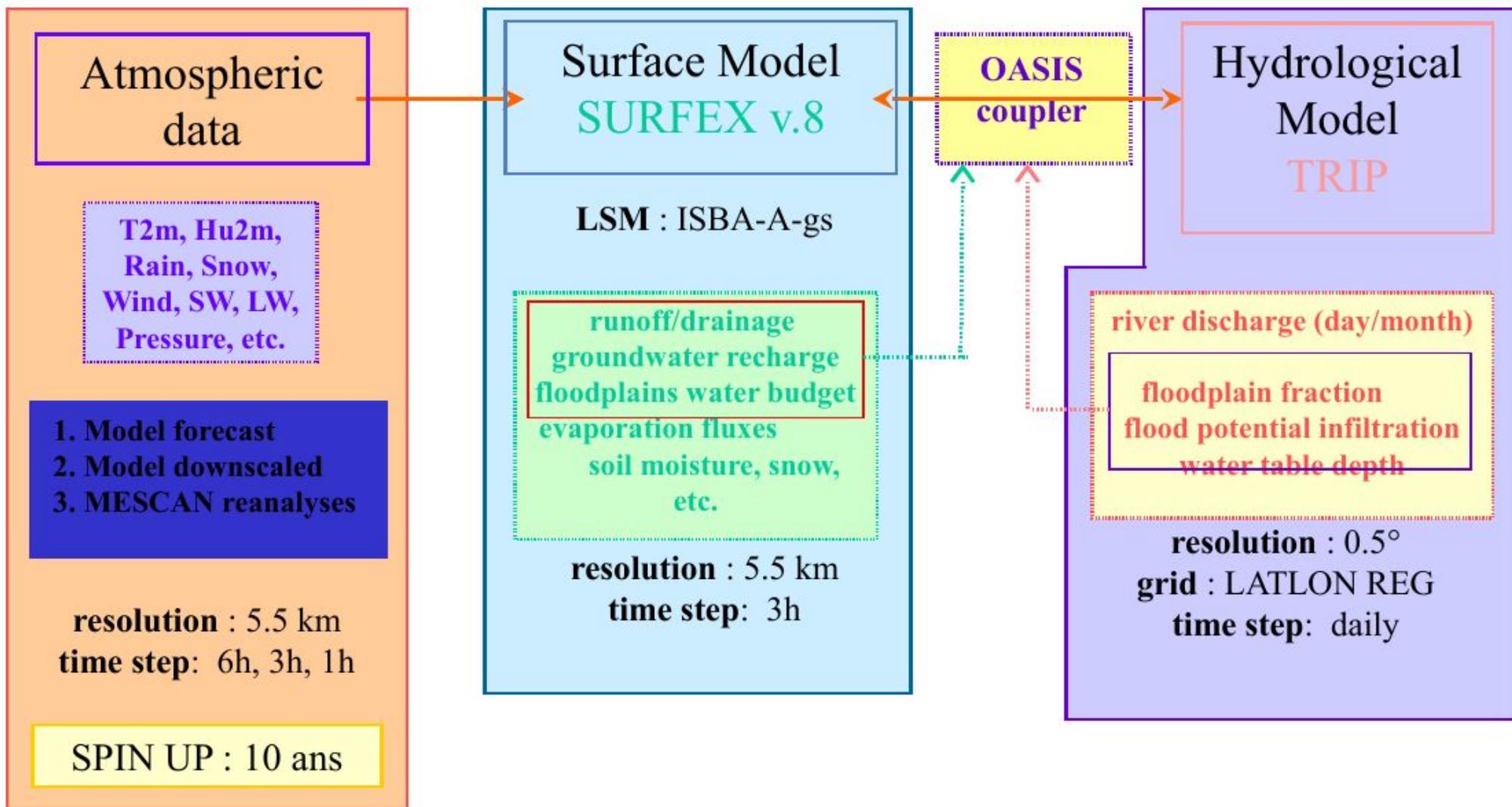


an, 2t, ensstd, 2006011512



T2m standard deviations 15 January 2006 12 UTC ,  
perturbed observations,  
different background and two networks  
and then combined

# The coupled hydro-meteorological modelling system



# Evaluation of quality and uncertainties

## Selected variables and measures of primary user interest :

Diagnostic package developed with statistics, computations and graphics

- in R, openly available

Winds - surface stations, mast measurements

- vertical profiles and diurnal cycle

Short wave radiation fluxes against satellite derived quantities

Precipitation against high resolution observation gridded data sets

Temperature against climate data set (E-OBS)

Climate indices and special phenomena

(e.g. frost days, vegetation period, drought index)

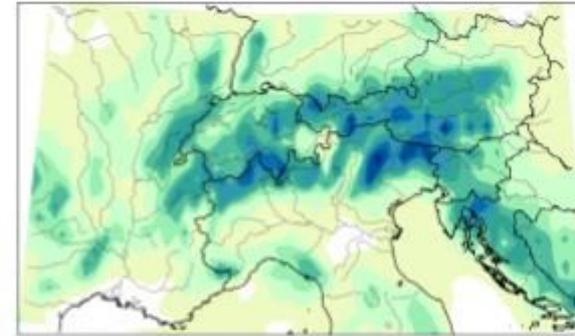
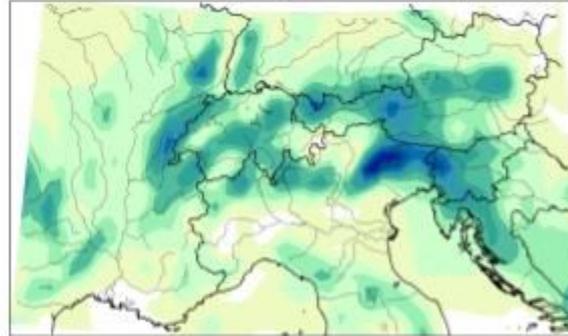
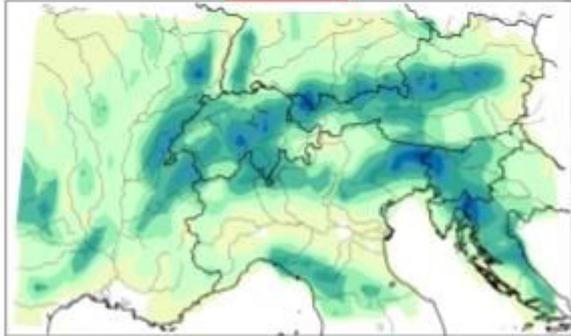
# Mean annual precipitation

2005-2008  
25 km grid

**APGD**

**MESAN (EURO4M)**

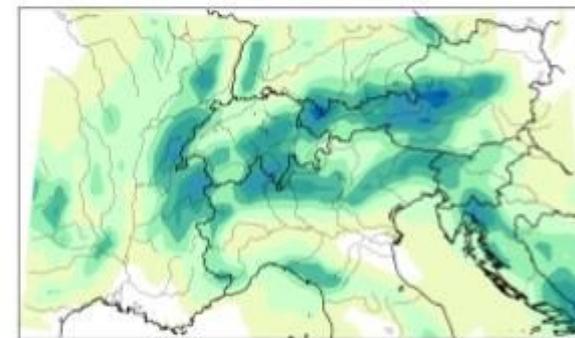
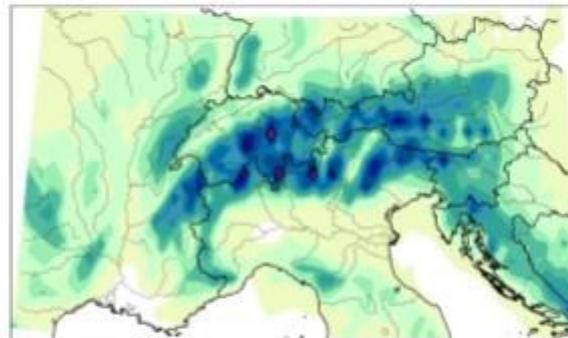
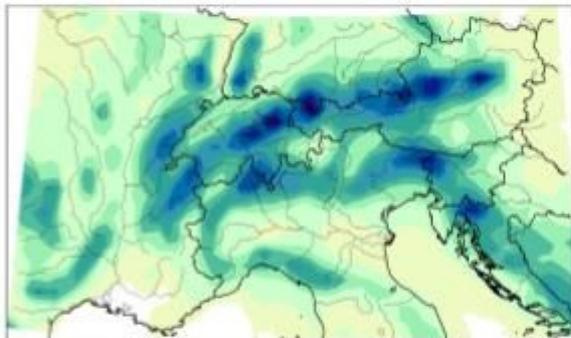
**MESCAN**



**UKMO det**

**HARMONIE v1**

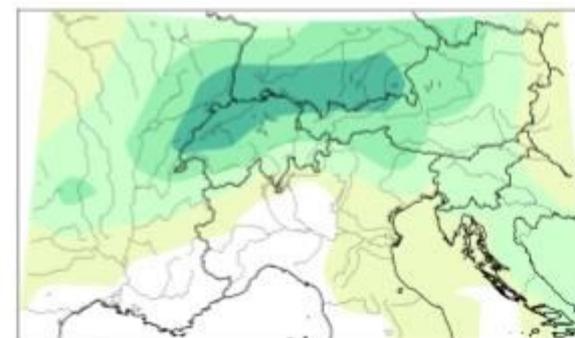
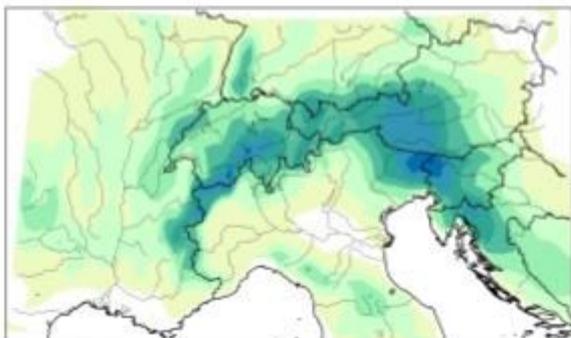
**COSMO6-REA**



**E-Obs**

**ERAINT**

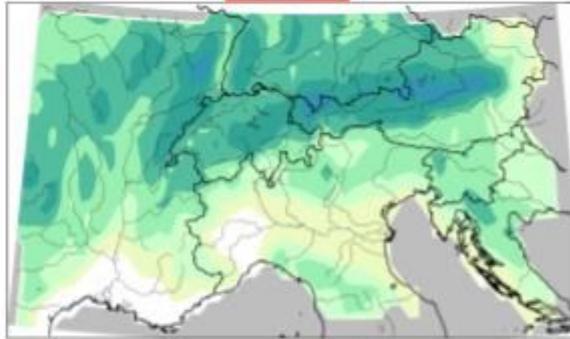
**ERA20C**



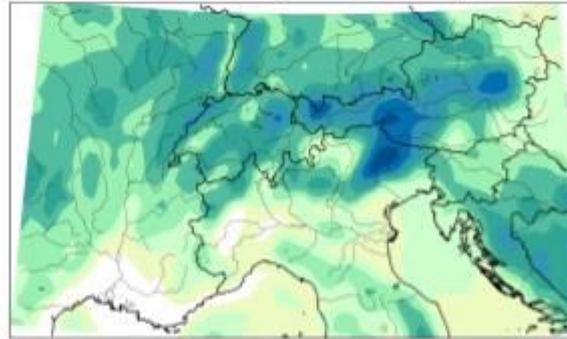
# Wet-days frequency $\geq 1\text{mm/d}$

2005-2008  
25 km grid

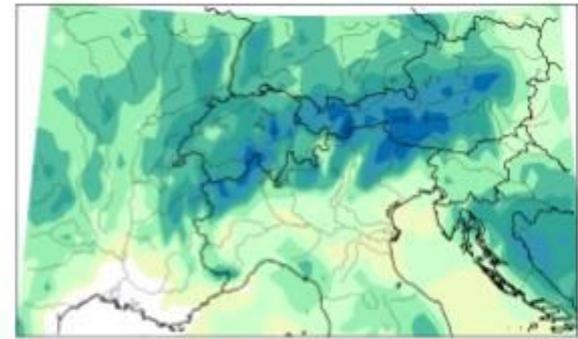
**APGD**



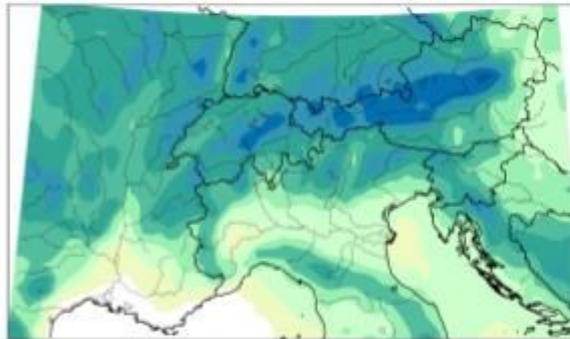
**MESAN (EURO4M)**



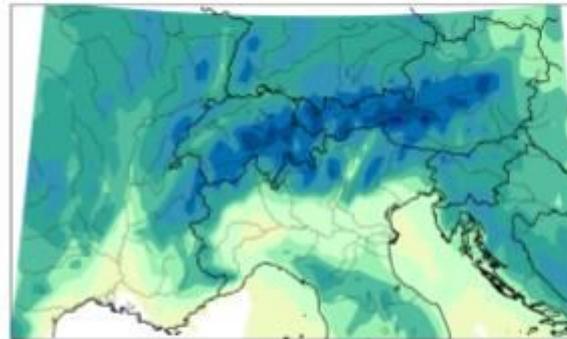
**MESCAN**



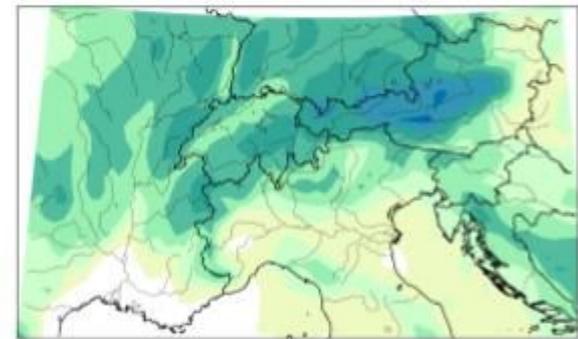
**UKMO det**



**HARMONIE v1**

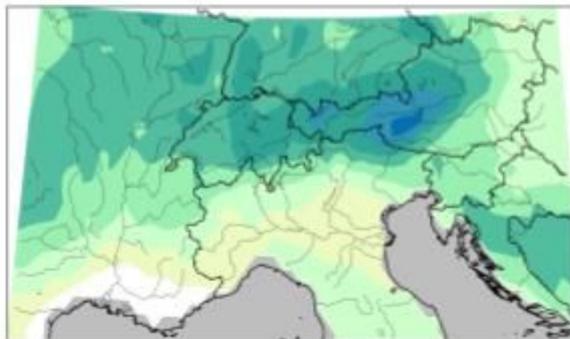


**COSMO6-REA**

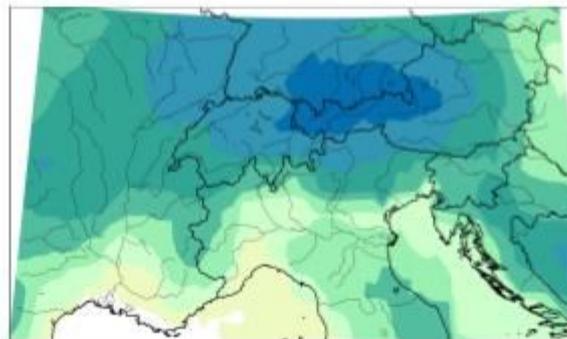


0.7  
0.65  
0.6  
0.55  
0.5  
0.45  
0.4  
0.35  
0.3  
0.25  
0.2

**E-Obs**



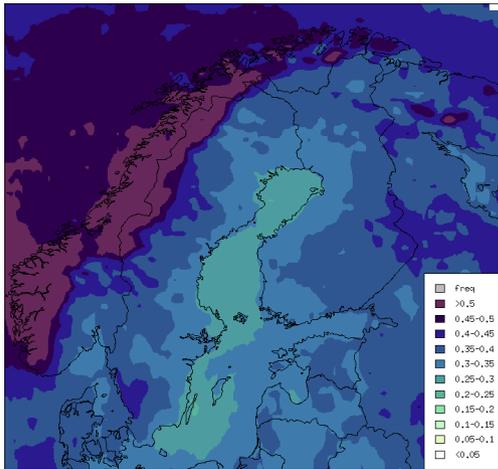
**ERAINT**



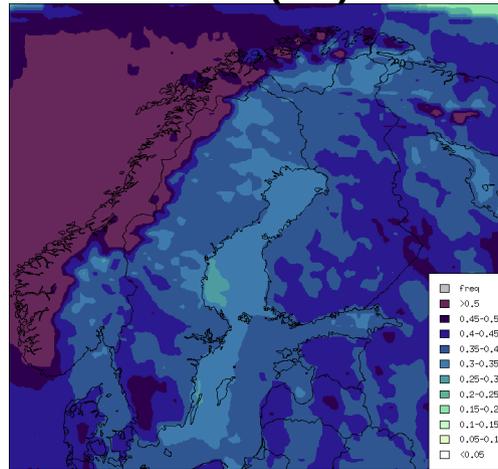
**ERA20C**



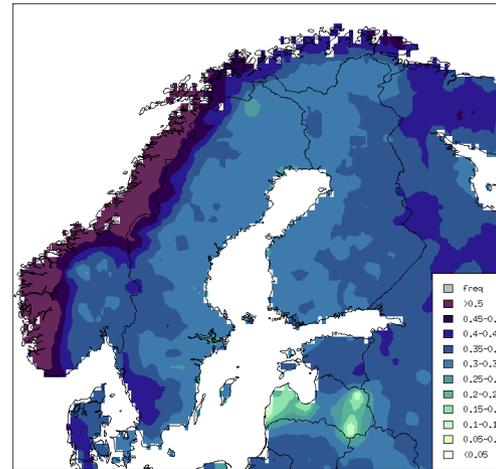
**COSMO**



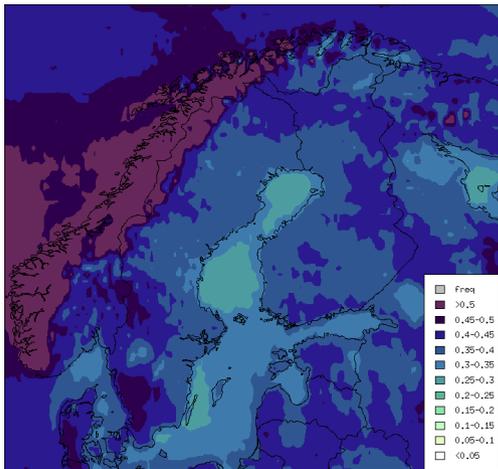
**UKMO (det)**



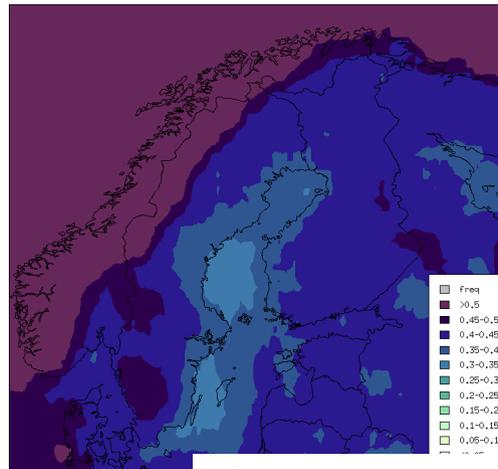
**EOBS**



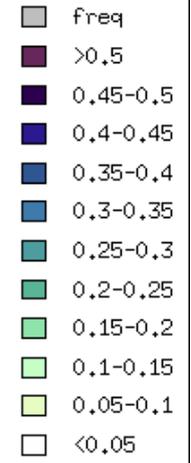
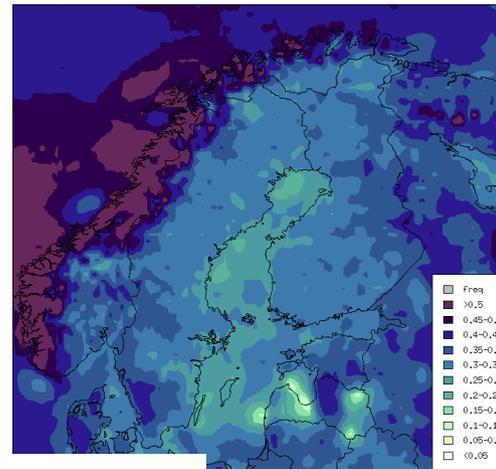
**HARMONIE V1**



**ERA INTERIM**



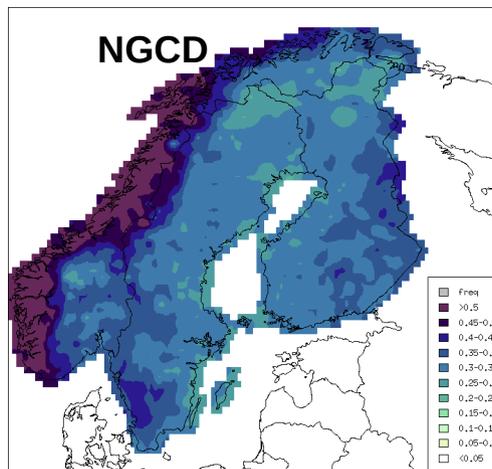
**MESCAN SURFEX**



Nordic Gridded Climate Dataset  
as one reference

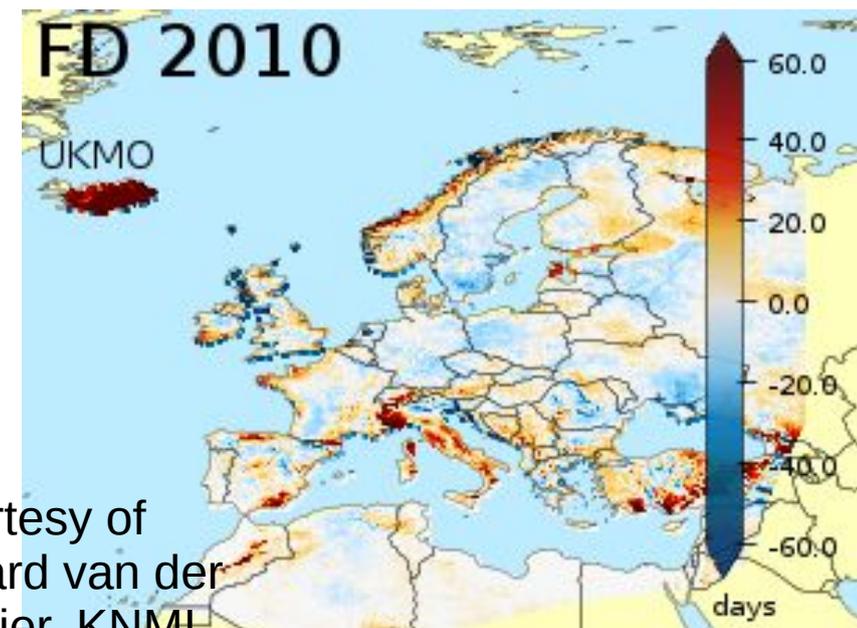
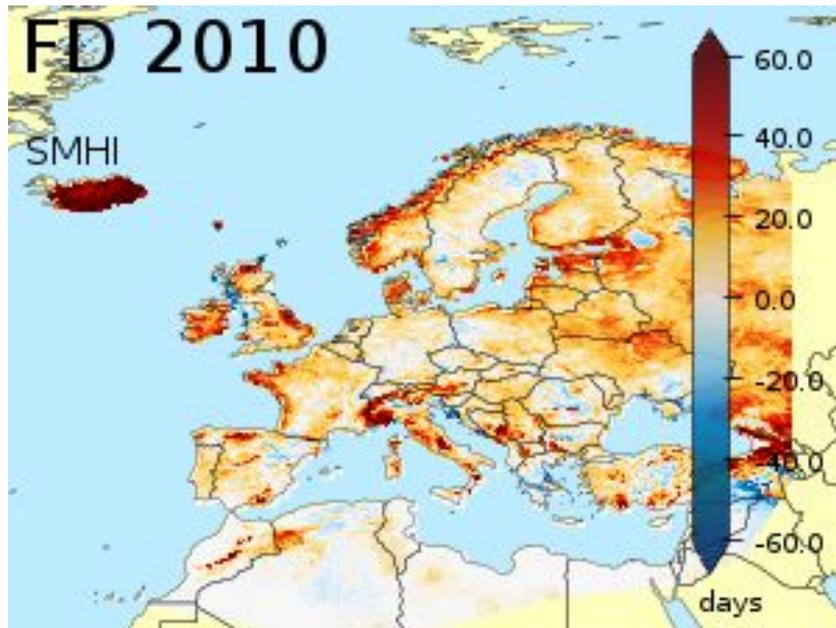
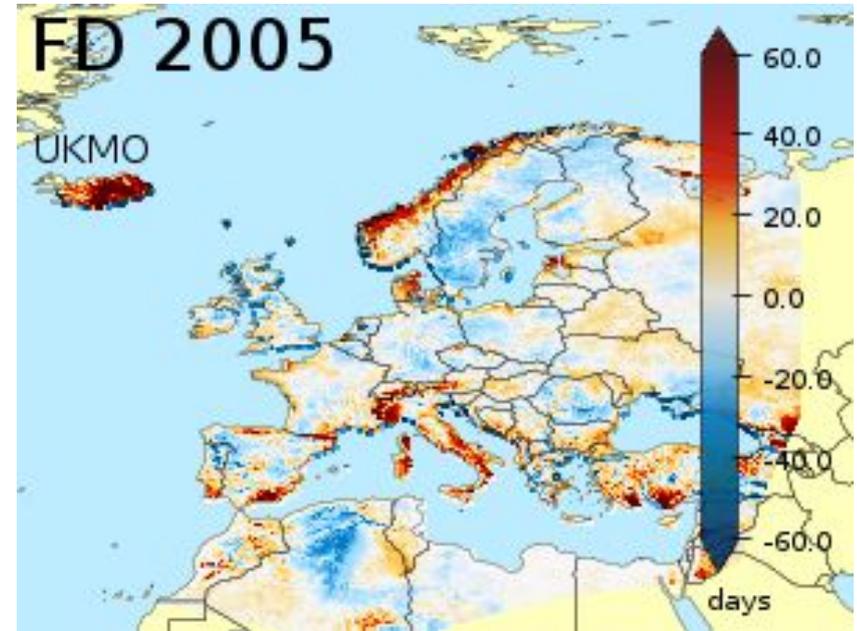
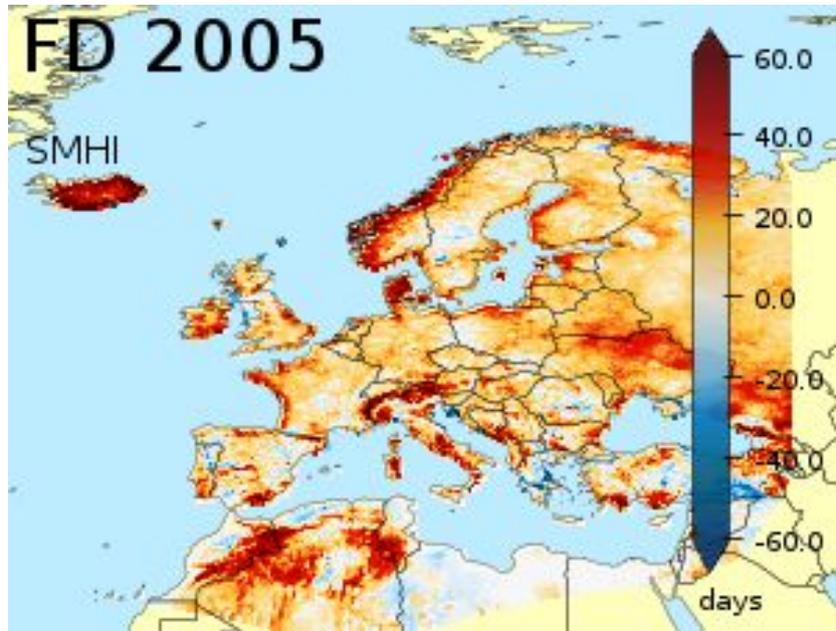
Courtesy Cristian  
Lussana (MET Norway)

Frequency of wet days  
(>1 mm)



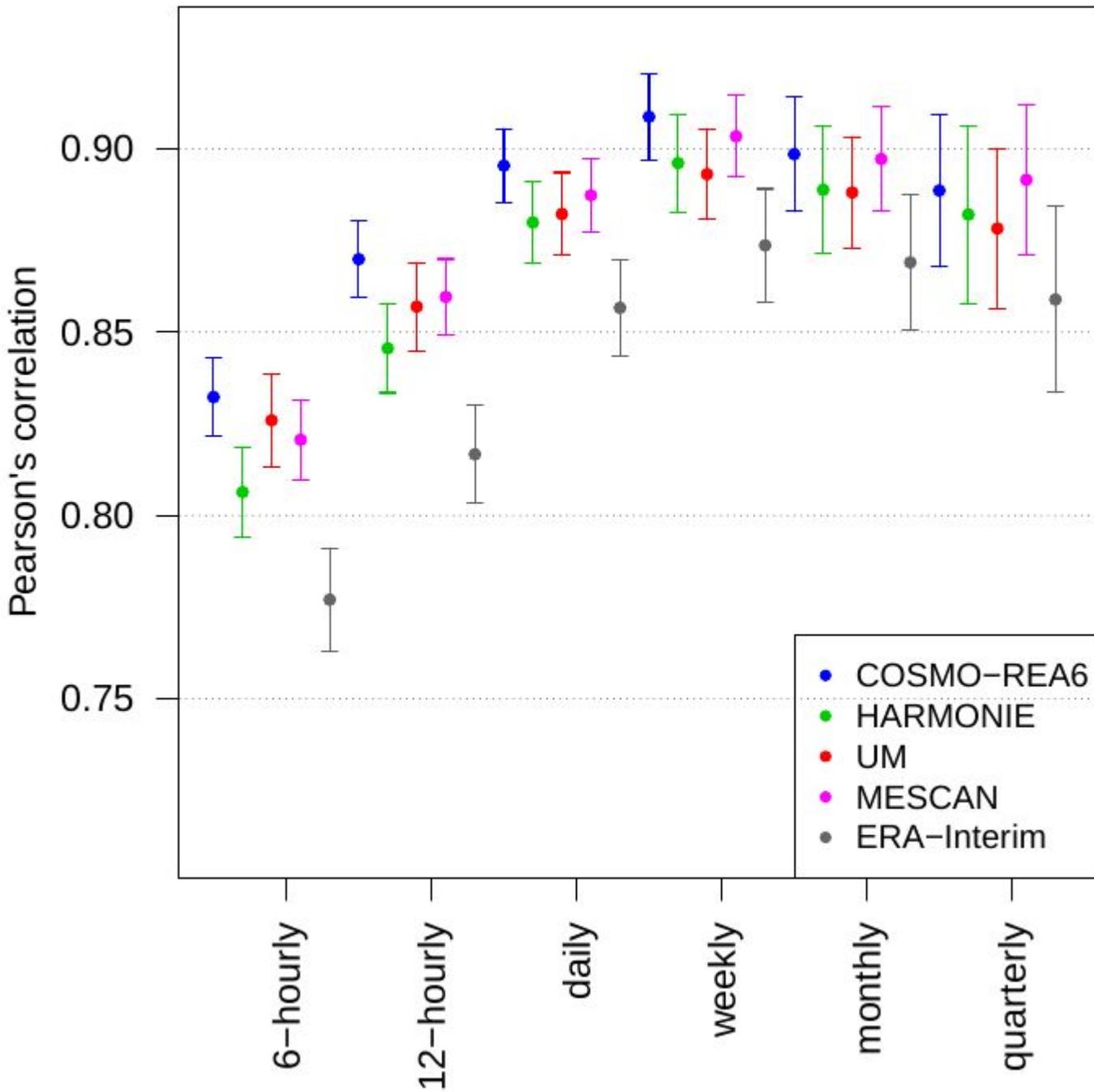
# Climate indices – number of frost days

## SMHI or Met Office minus E-OBS



Courtesy of  
Gerard van der  
Schrier, KNMI

## Correlation of all stations based on 6-hourly data



Correlation of wind speed with station data

Courtesy of Deborah Nierman(DWD)

# Earth System Grid Federation

The UERRA Project is  
Available on ESGF via  
<https://esgf-data.dkrz.de/projects/uerra>  
A 15 year temperature series

The screenshot shows the UERRA project page on the ESGF website. The page title is "UERRA - Home | ESGF-C". The URL is <https://esgf-data.dkrz.de/projects/uerra/>. The page is hosted by DKRZ and is-enes. The ESGF logo is visible in the top right corner. The main content area features the UERRA logo and the title "Uncertainties in Ensembles of Regional ReAnalyses". A description states: "UERRA is a European FP7 reanalysis project of meteorological observations. It includes recovery of historical (last century) data, estimating uncertainties in the reanalyses and user friendly data services. It aims to prepare for and contribute to a future Copernicus climate change service." The last update is noted as "Nov. 3, 2016, 7:21 a.m. by ESGFKNMI KNMI". There are social media share buttons for Facebook and Twitter. A sidebar on the right contains a "Browse Projects" section with filters for "This", "All", "My", and "Tags". The footer includes ESGF sponsors and partners (DoE Office of Science, IS-ENES, NASA, NOAA, NCI, NSF), CoG version 3.7.0, ESGF P2P Version v2.3.8-master-release, and Earth System CoG sponsors and partners (NOAA, NASA, NSF, DoE Office of Science, IS-ENES). Links for "Privacy Policy", "Terms of Use", and "Impressum" are also present.

The screenshot shows the is-enes data discovery interface. The header includes the is-enes logo and the tagline "Exploring climate model data". The navigation menu includes "Home", "Data discovery", "Downscaling", "Documentation", "Help", "About us", and "Account". The main content area is titled "Filters" and shows a list of project properties. The "Project" filter is selected, showing a list of projects with checkboxes. The "uerra" project is checked. Below the filters, the "Selected filters" section shows "Project : uerra". The results section displays "Found 2 datasets. Displaying page 1 of 1." and lists two datasets: "UERRA.observations.EOBS.EUR-25.KNMI.day.tg.0.25deg.v14.0.v1" and "UERRA.reanal.HARM.EUR-11.SMHI.HARM-REANALYSIS.6hr.tas.v20170626.v1". Navigation buttons for "Previous", "Next", and "Export to CSV" are visible.



# Final points

UERRA production, archiving and evaluation reports completing during the remainder of 2017

UERRA HARMONIE (SMHI) and MESCOAN (MF) will lead into C3S\_322 lot 1 European Regional operational Reanalysis

Higher resolution and ensemble from 1979 – starting 2019

UERRA will be continued from 2016 in the mean time

Also an Arctic Regional Reanalysis



[www.uerra.eu](http://www.uerra.eu)

