

# 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

**SMHI**

**METEO  
FRANCE**  
Toujours un temps d'avance



Koninklijk Nederlands  
Meteorologisch Instituut  
Ministerie van Infrastructuur en Milieu

**UEA**  
University of East Anglia



**Met Office**

**ECMWF**

**Deutscher Wetterdienst**  
Wetter und Klima aus einer Hand



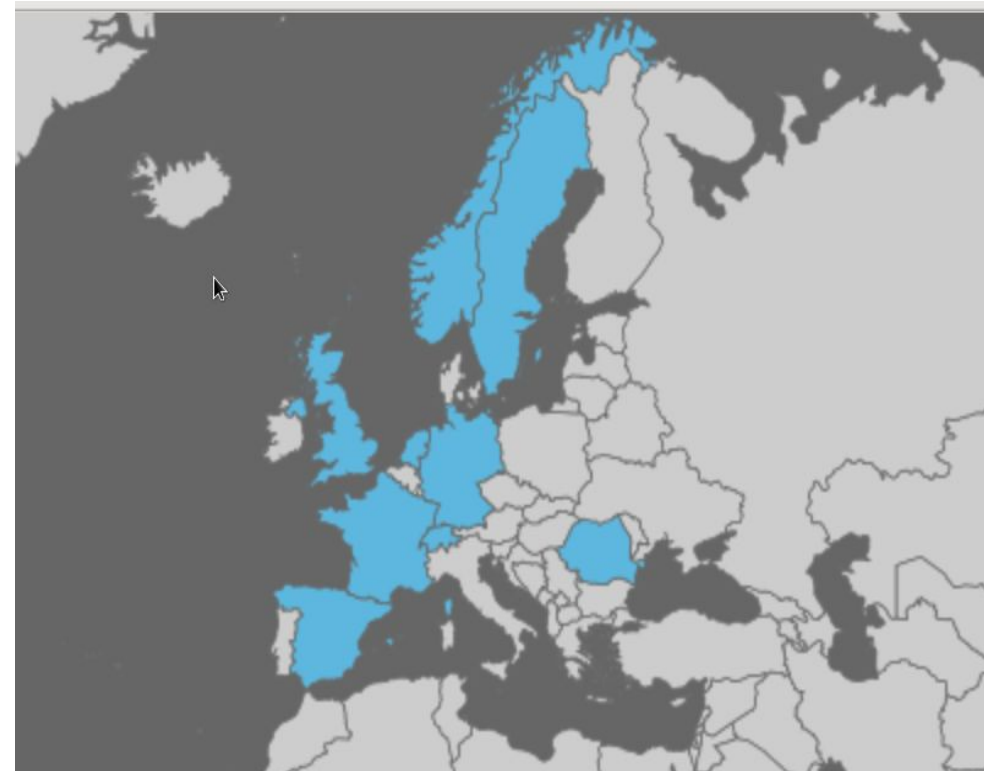
Meteorologisk  
institutt



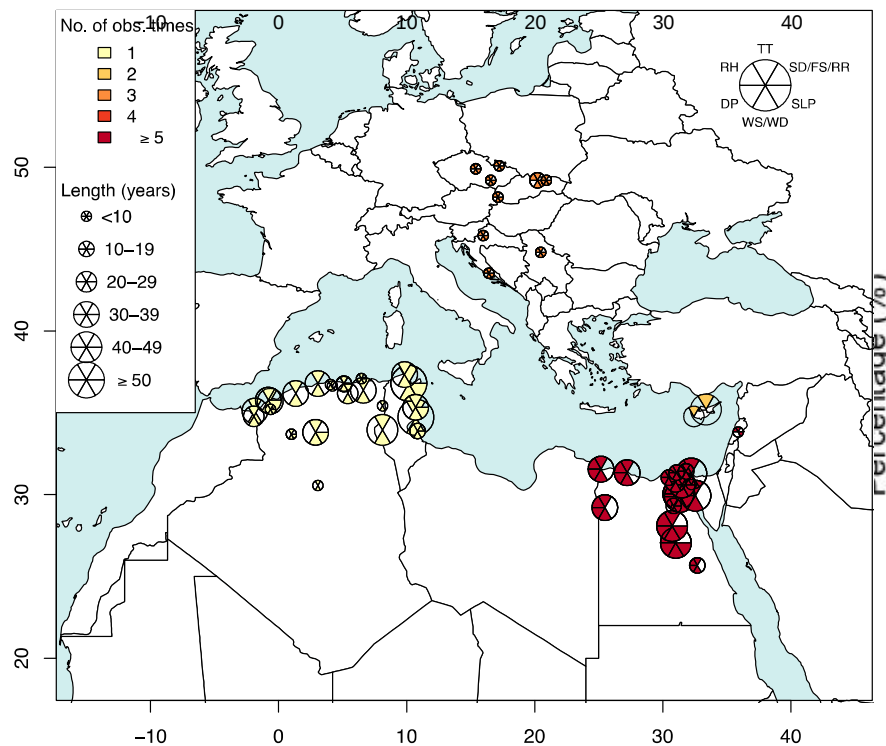
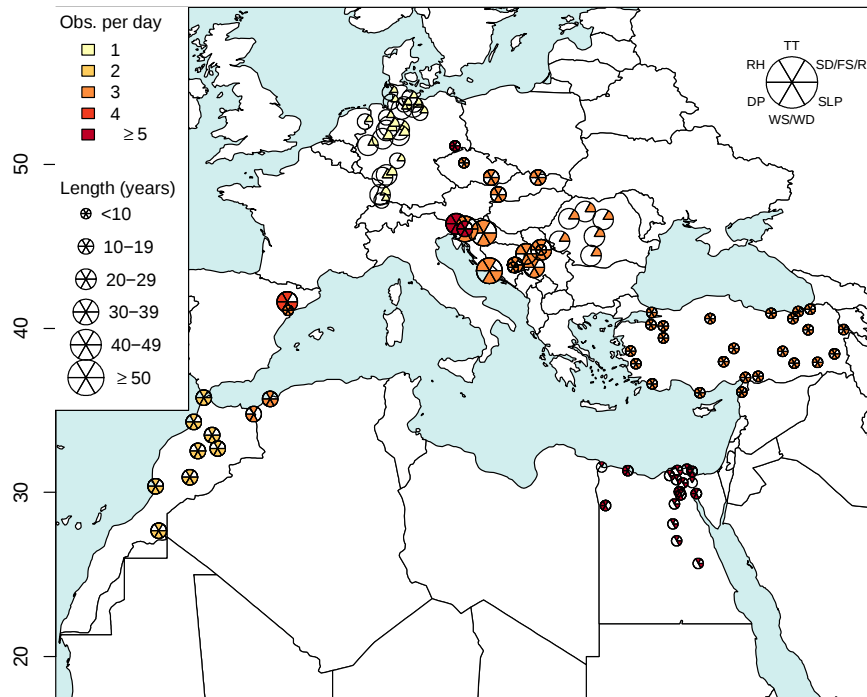
UNIVERSITAT  
ROVIRA I VIRGILI



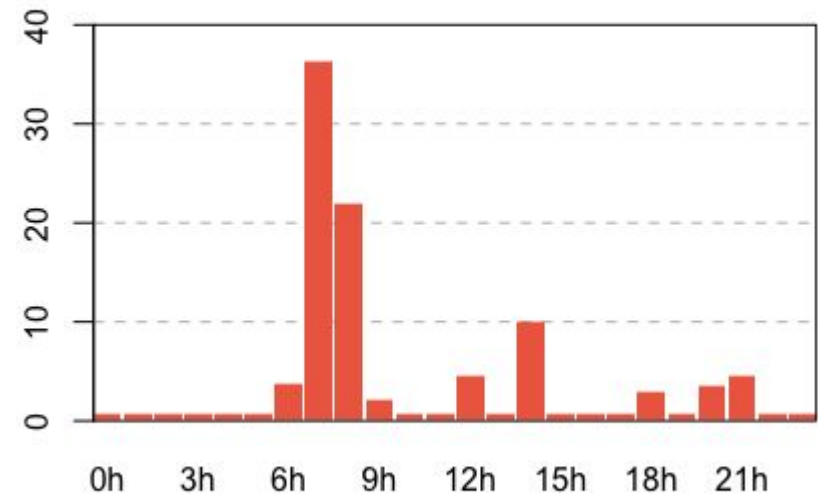
**universität bonn**  
Rheinische  
Friedrich-Wilhelms-  
Universität Bonn



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

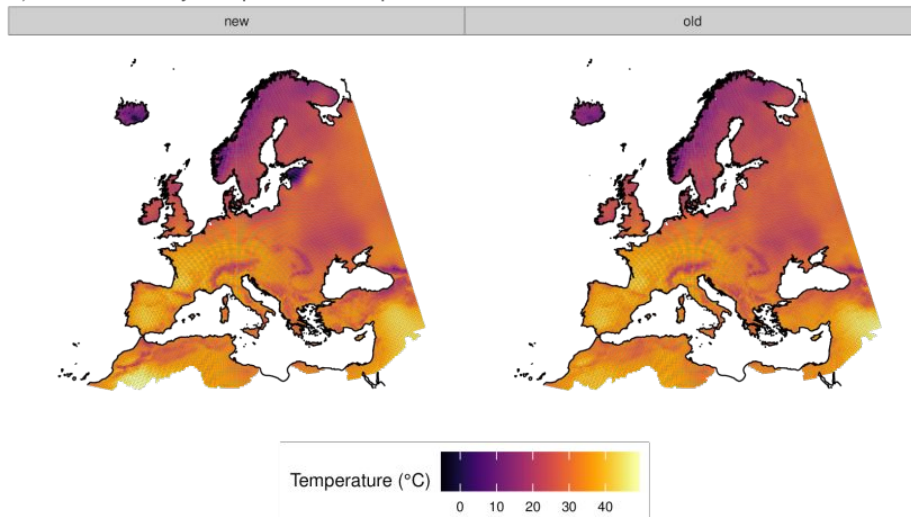


# Data delivered

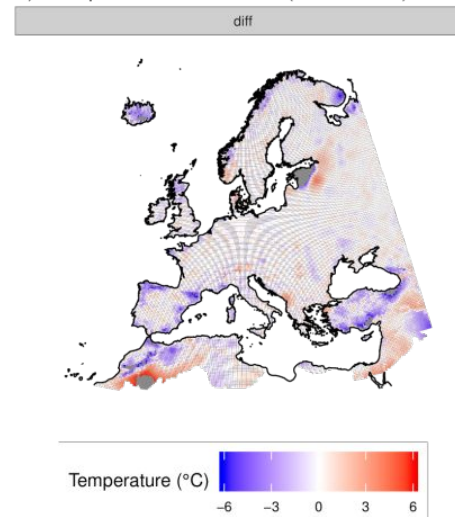
Recipient	Data delivered	Delivered
UERRA reanalysis	All available subdaily	√
UERRA evaluation	All available subdaily	√
UERRA climate indicators	All availables subdaily and daily averages and totals	√
GPCC	All available daily and subdaily precipitation data	√
ISPD	All available subdaily	√
ISTI & STFC/CEDA	- " -	√
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

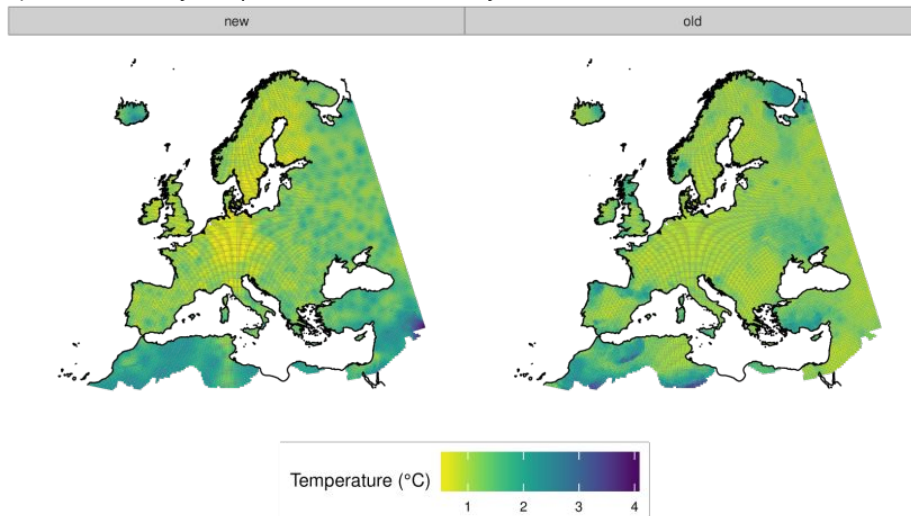
a) Maximum Daily Temperature Interpolation



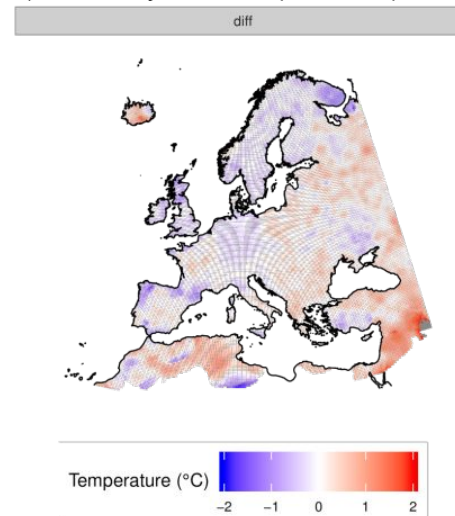
b) Interpolation Difference (New – Old)



c) Maximum Daily Temperature 95% uncertainty



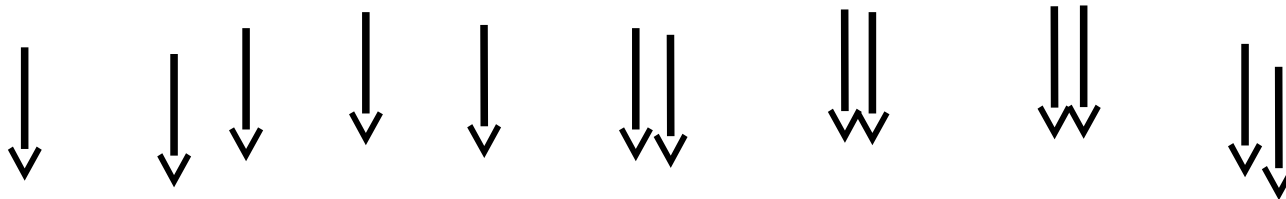
d) Uncertainty Difference (New – Old)



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

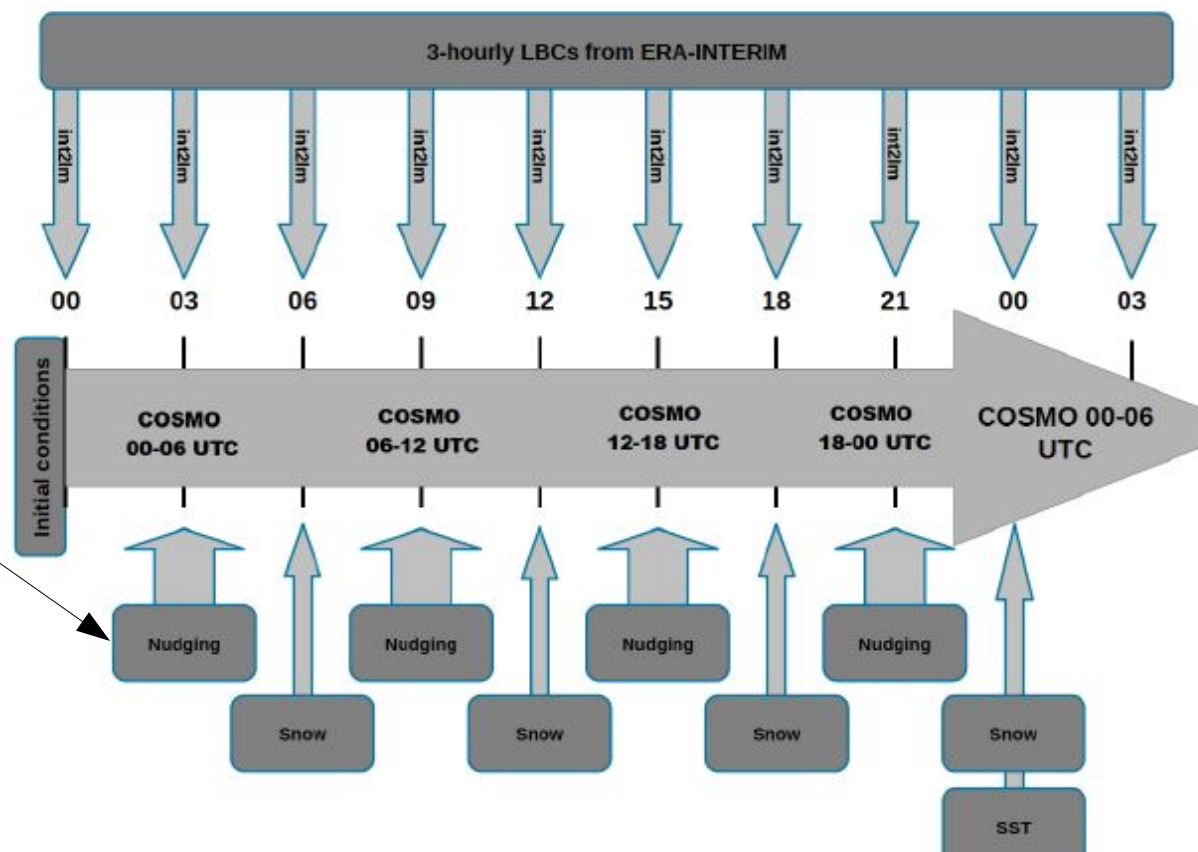
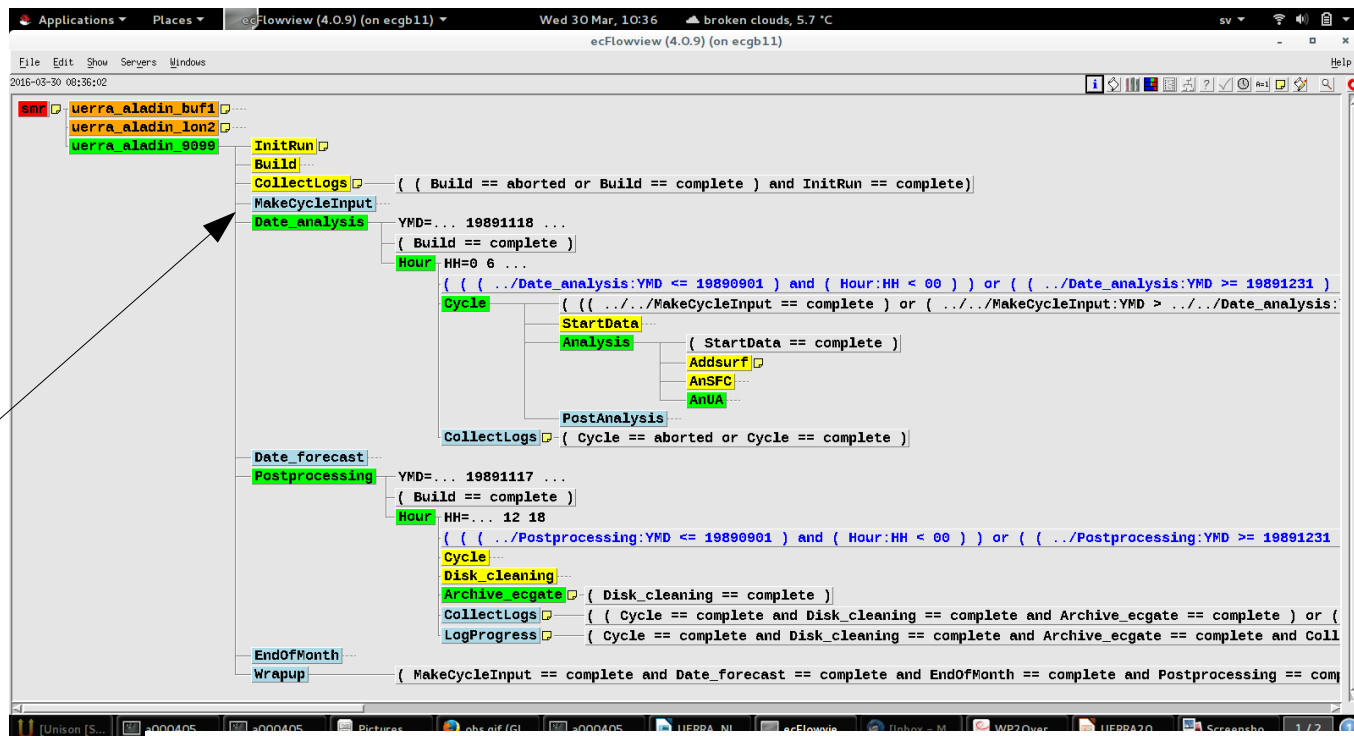
1961



2014<sup>6</sup>

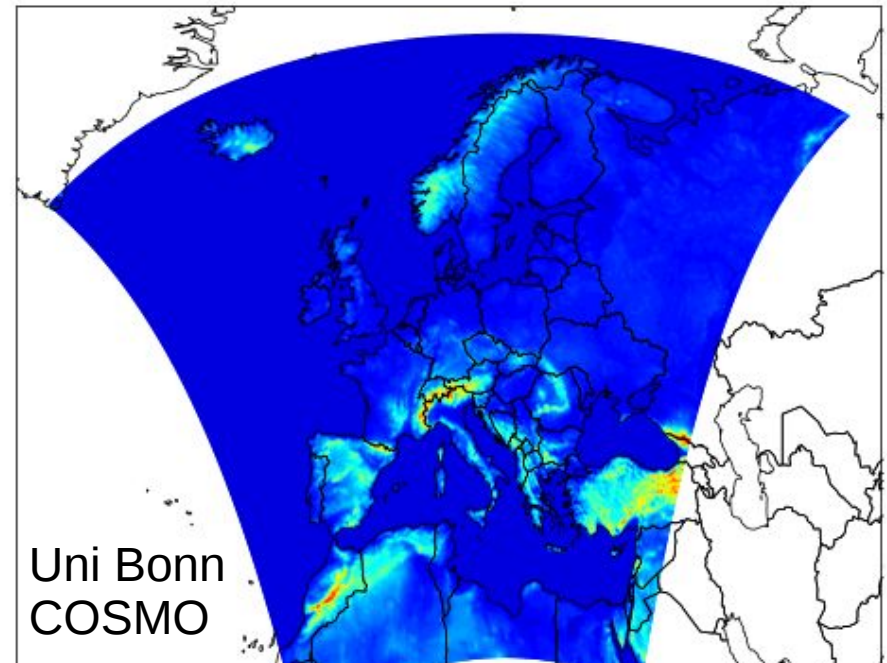
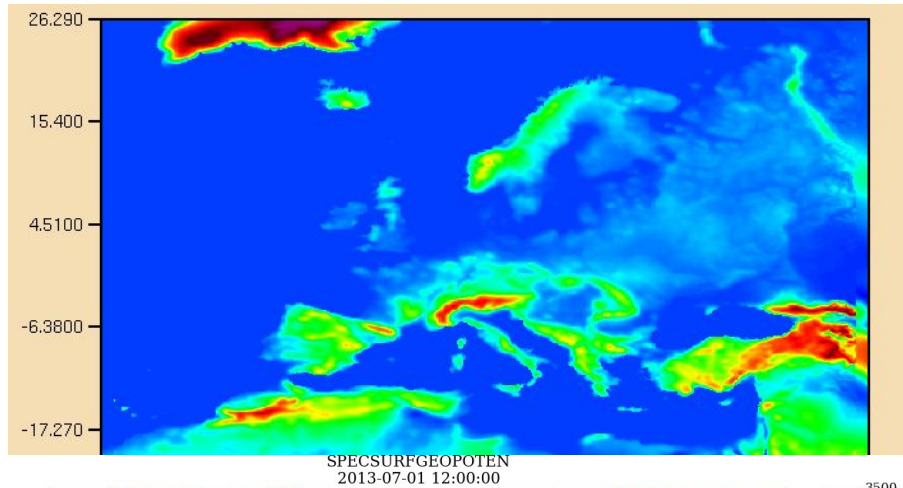


# Data assimilation of Observations

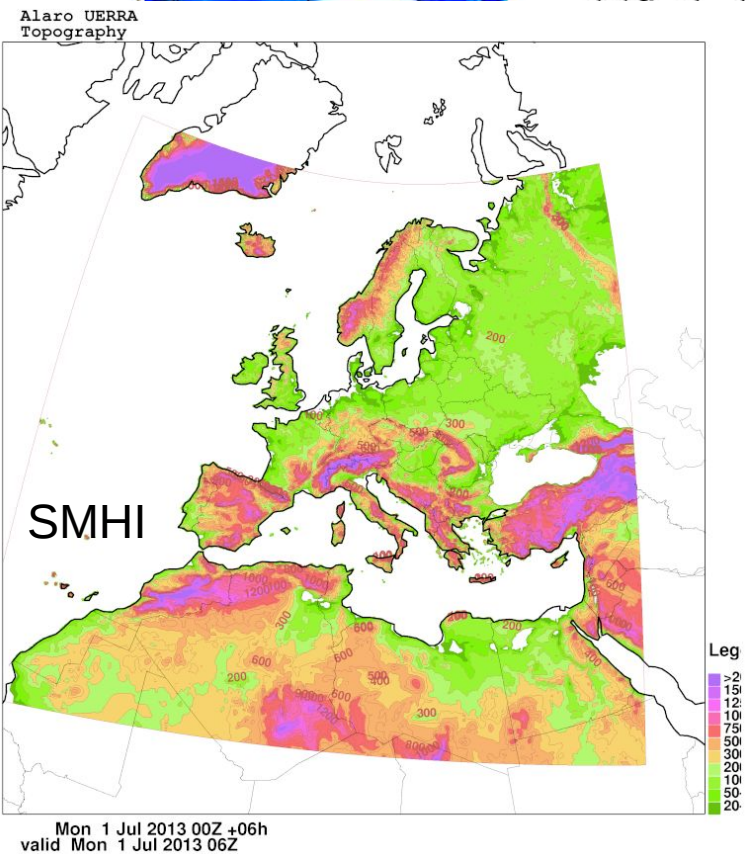
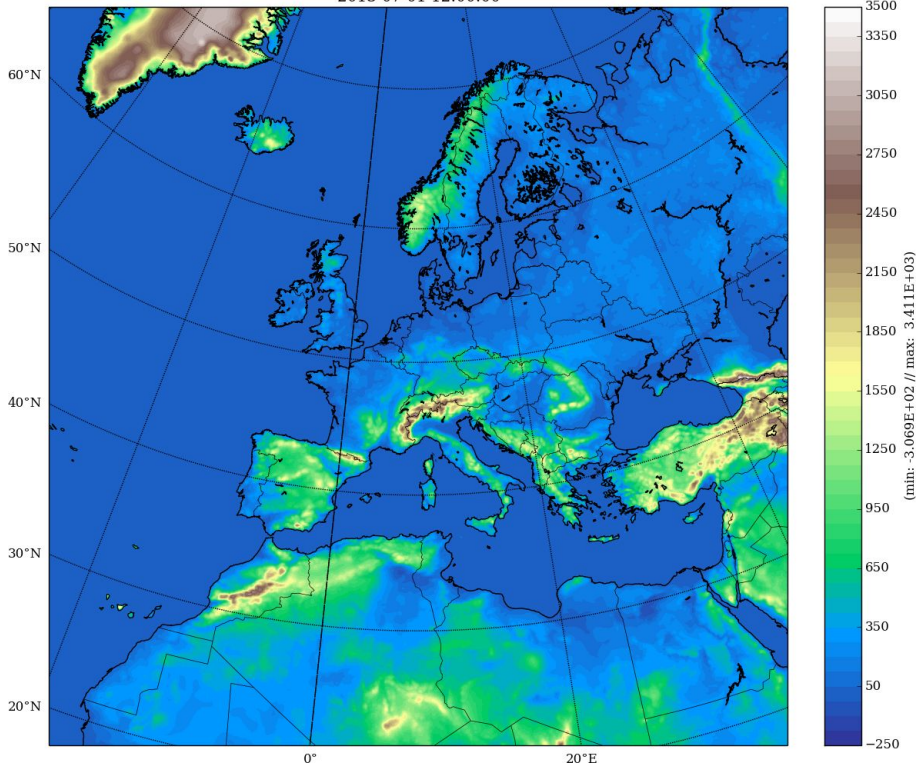


# UERRA Domain & projections

Met Office  
CORDEX  
EU 11 km



MF





## 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:**

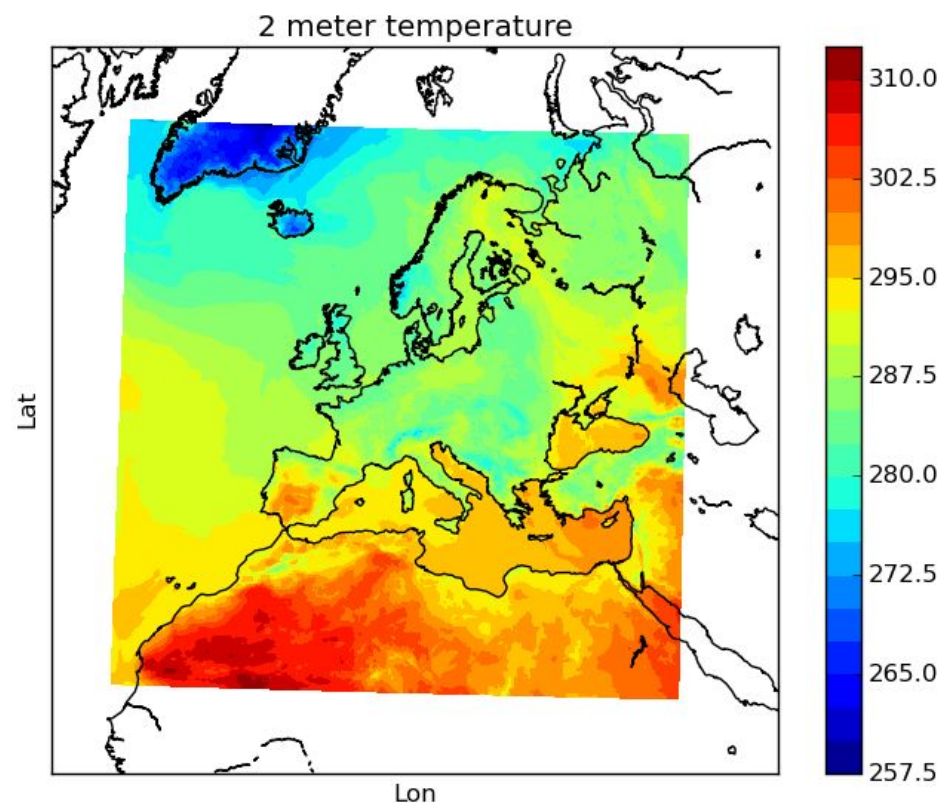
Temperature, wind, clouds, fluxes of sensible  
and latent heat, radiation fluxes, snow, rainfall

## **Soil levels**

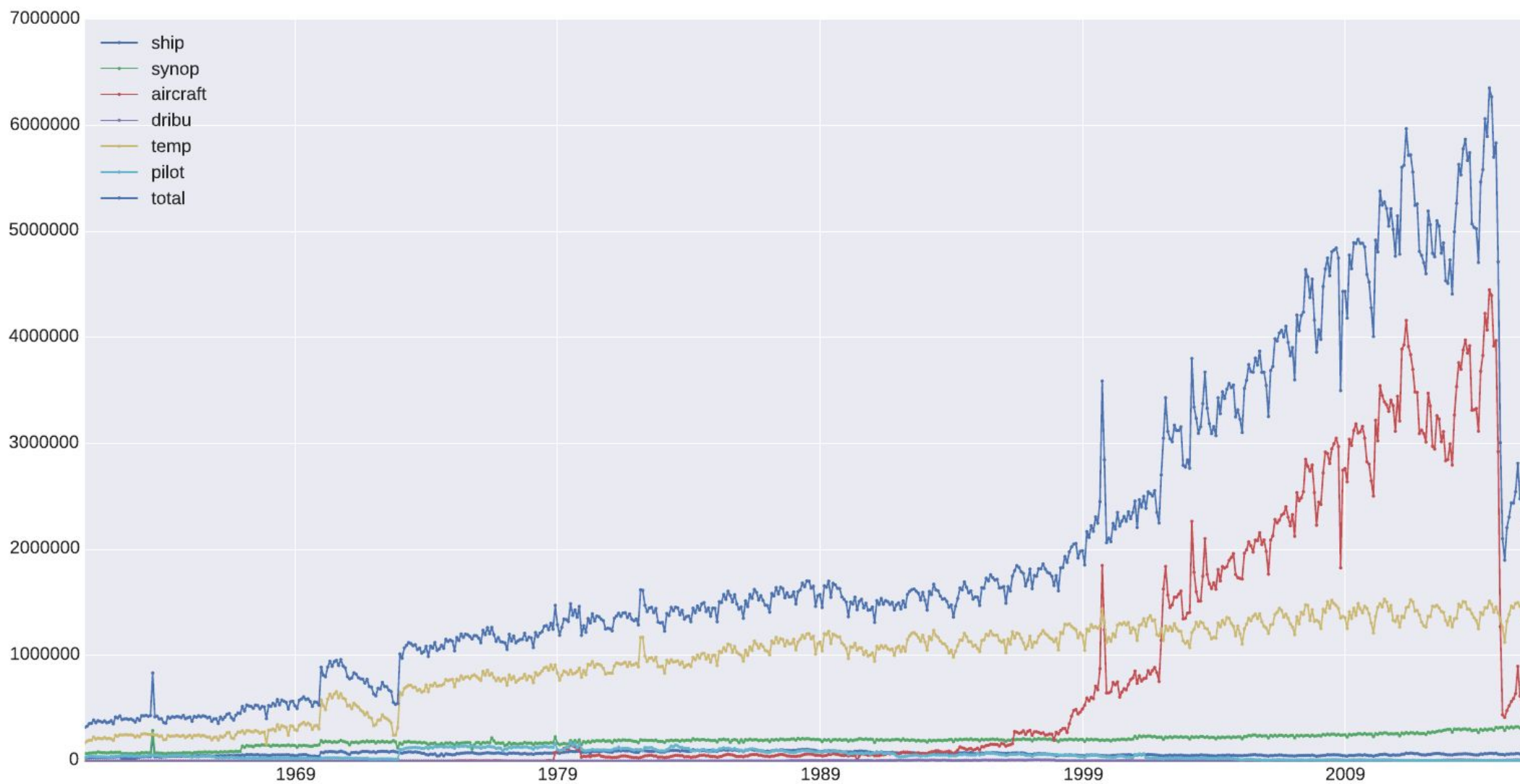
Temperature and soil wetness

## 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

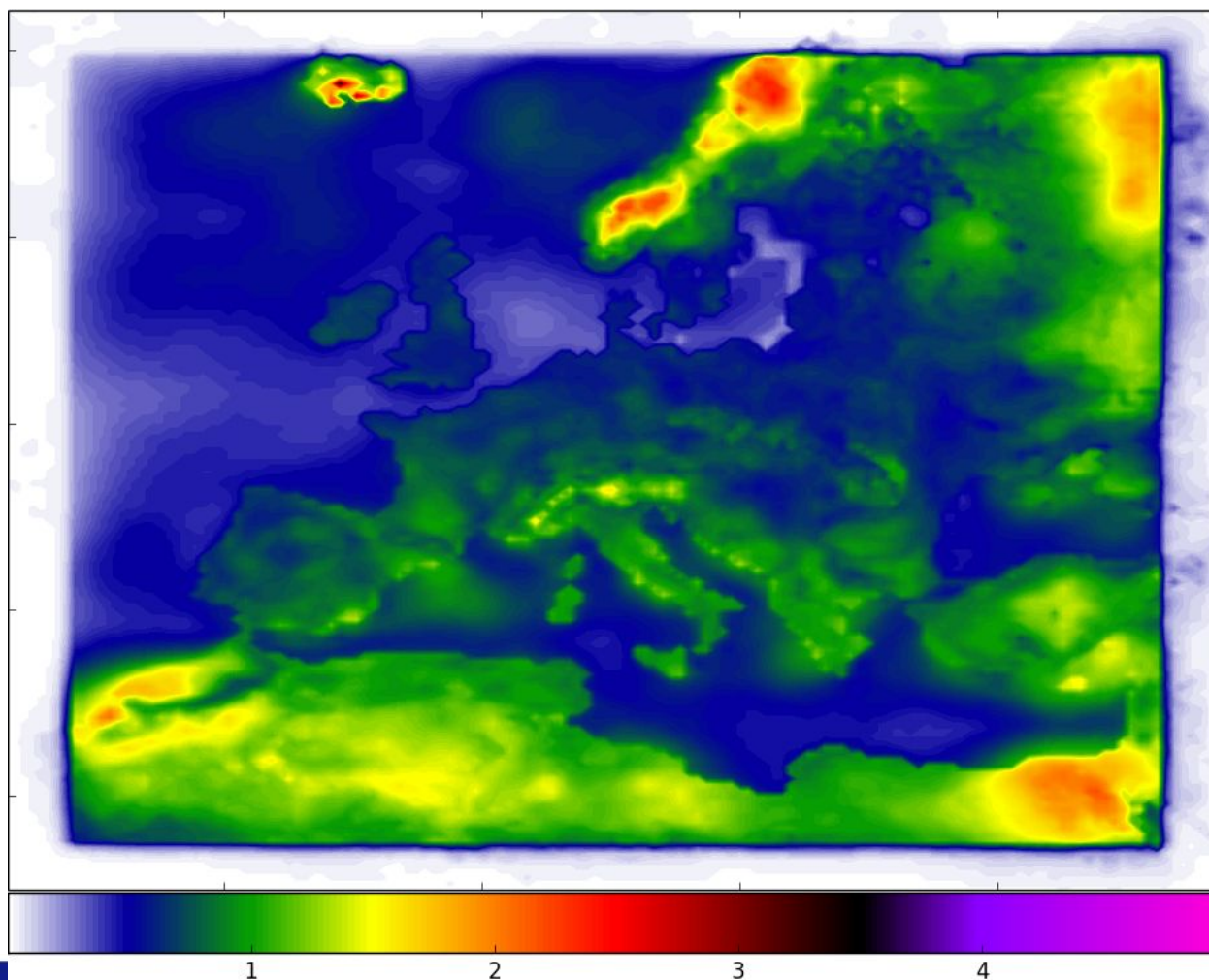


# All observations 1961-2015 (c.o. Klaus Zimmerman)

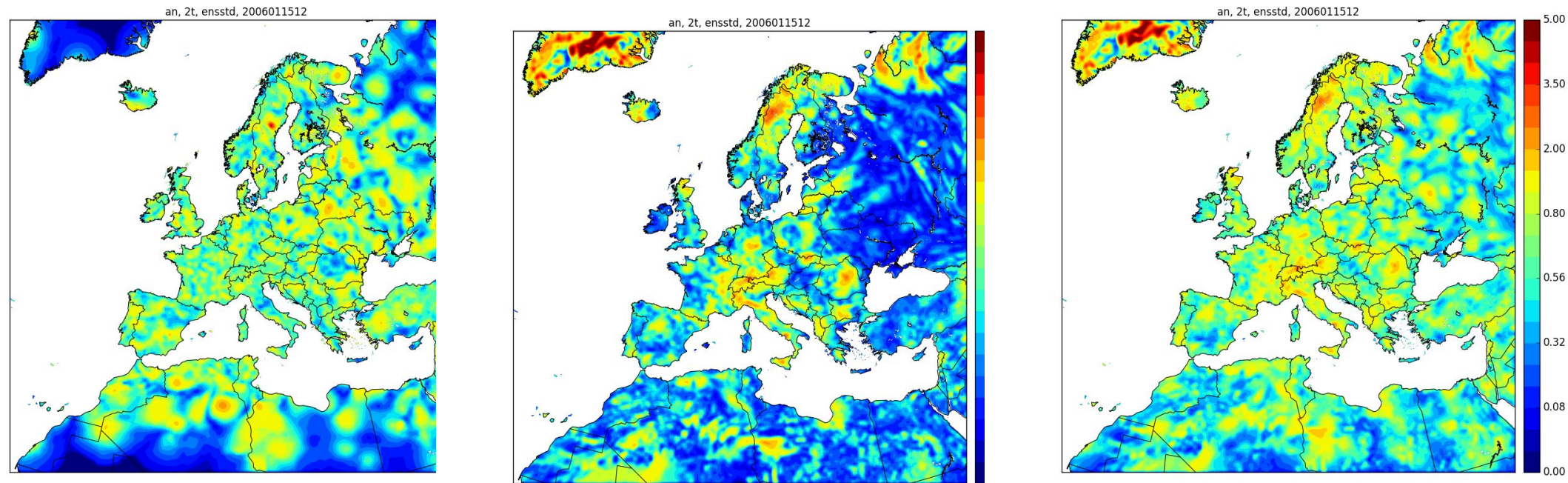




# Spread of 2m temperature for March 1979 from the Met Office system Ensemble 4D-VAR reanalysis



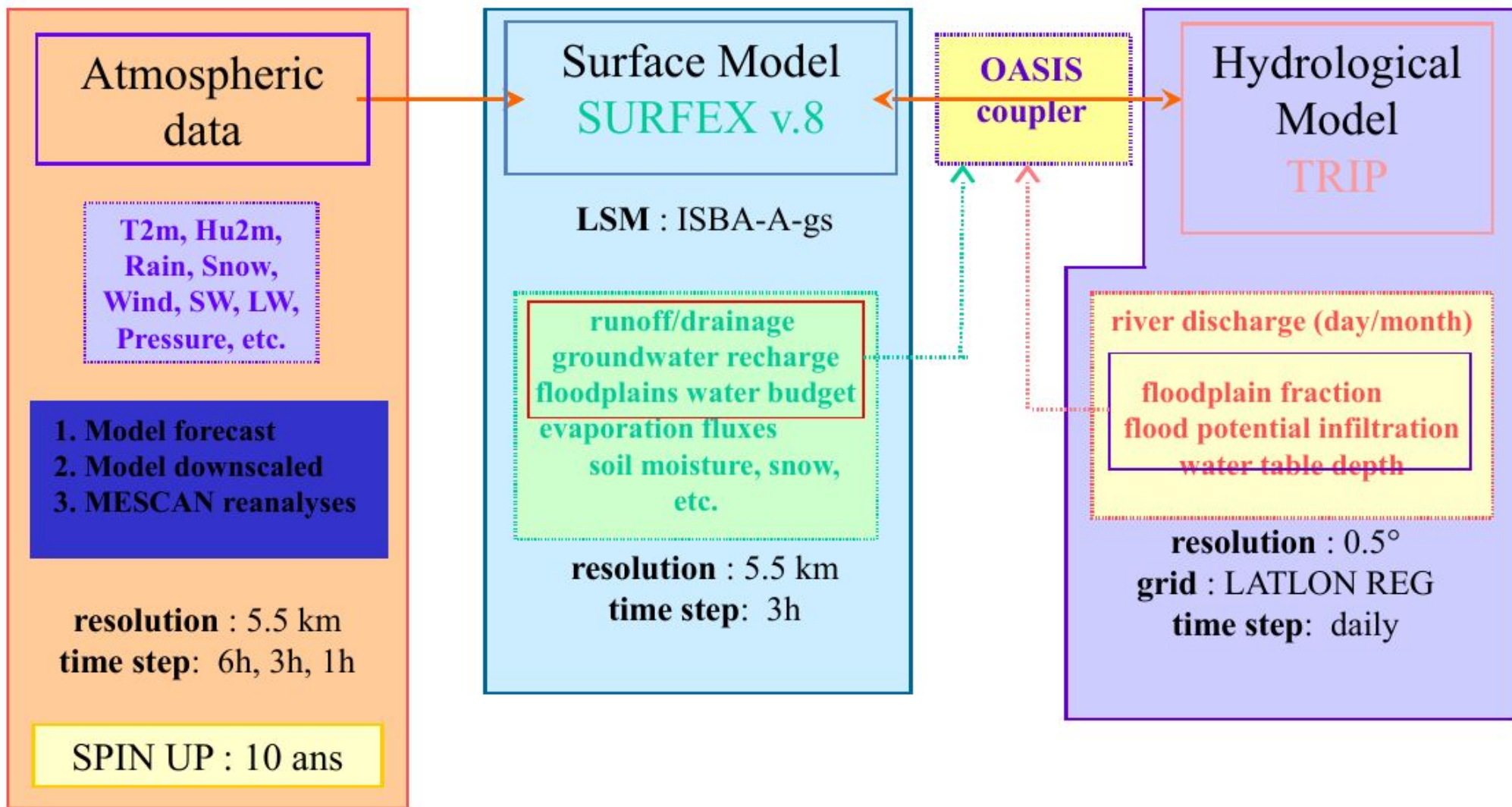
# MESCAN ensemble - T2m



T2m standard deviations 15 January 2006 12 UTC ,  
perturbed observations,  
different backgrounds 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)



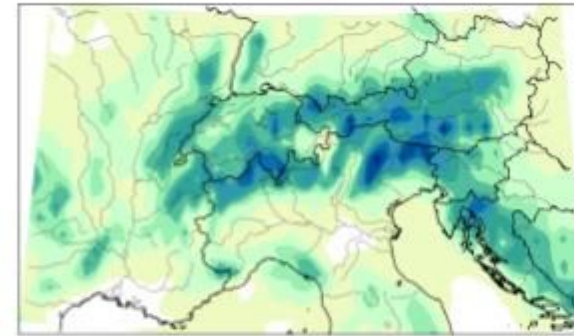
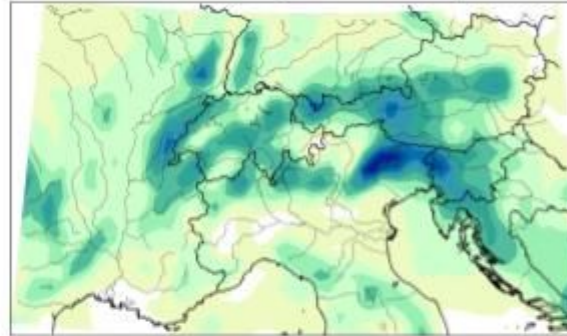
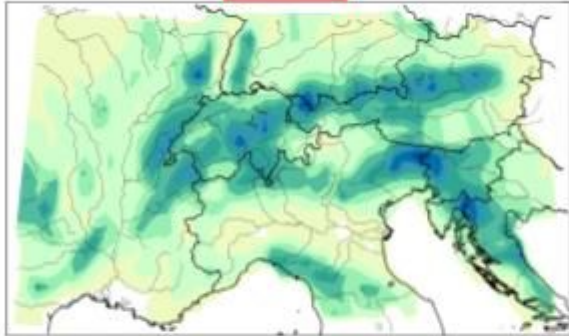
# Mean annual precipitation

2005-2008  
25 km grid

**APGD**

**MESAN (EURO4M)**

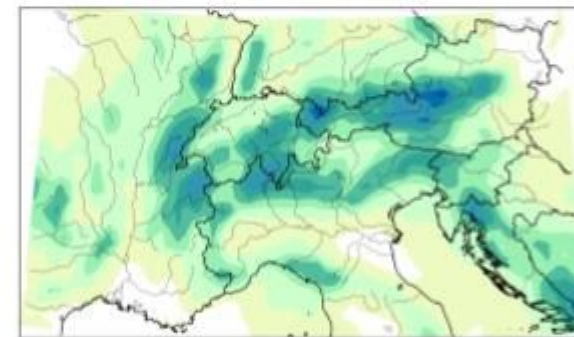
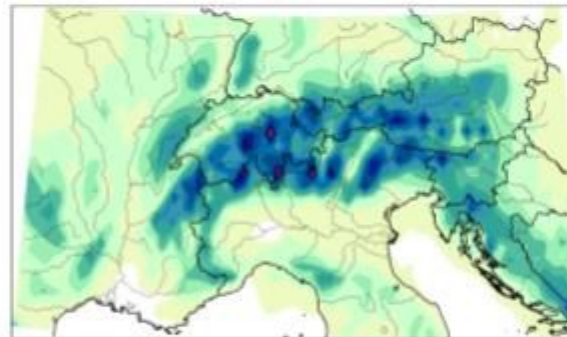
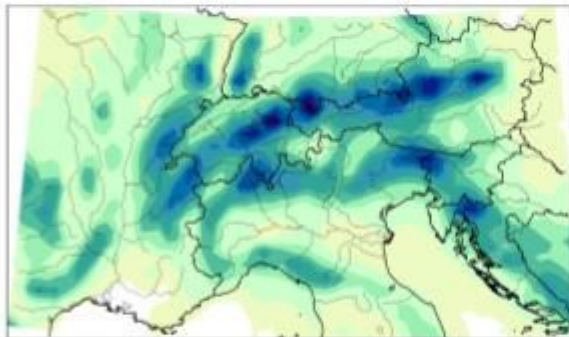
**MESCAN**



**UKMO det**

**HARMONIE v1**

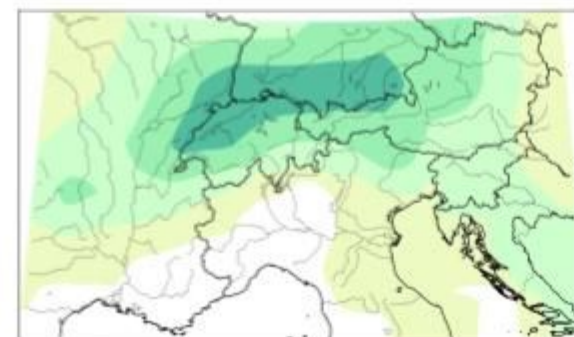
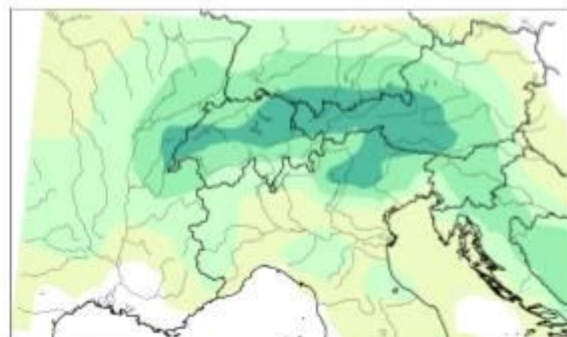
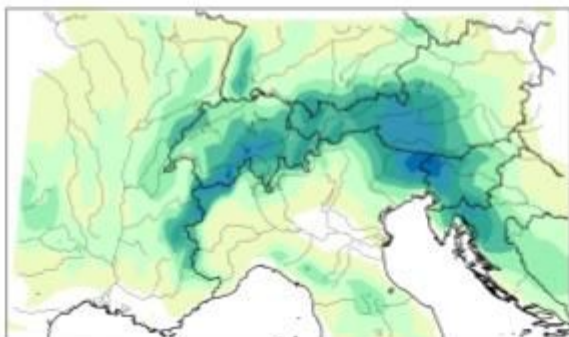
**COSMO6-REA**



**E-Obs**

**ERAINT**

**ERA20C**

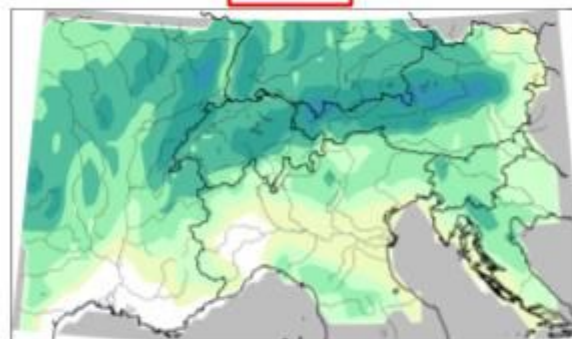




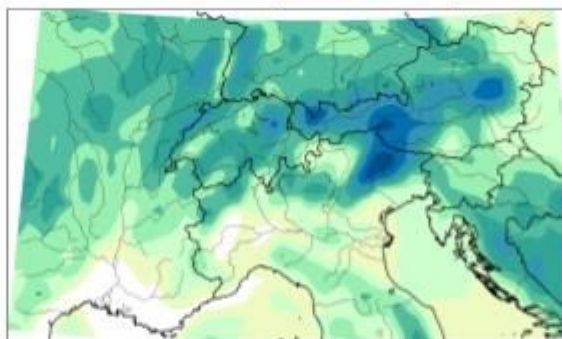
# Wet-days frequency $\geq 1\text{mm/d}$

2005-2008  
25 km grid

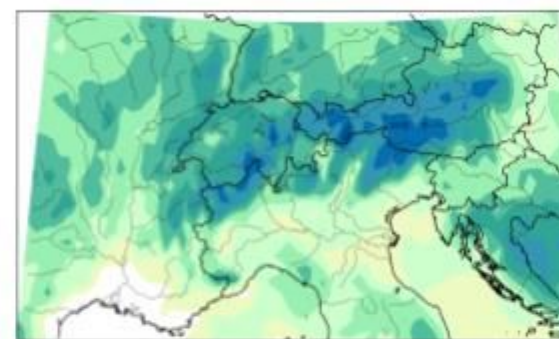
**APGD**



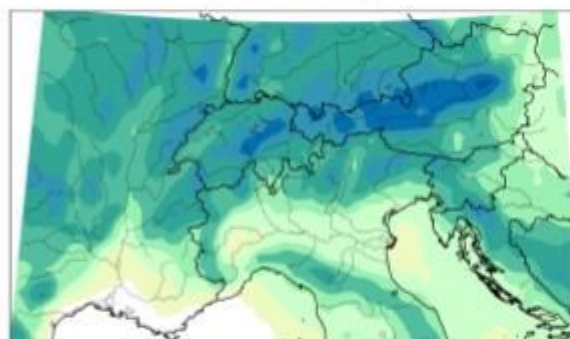
**MESAN (EURO4M)**



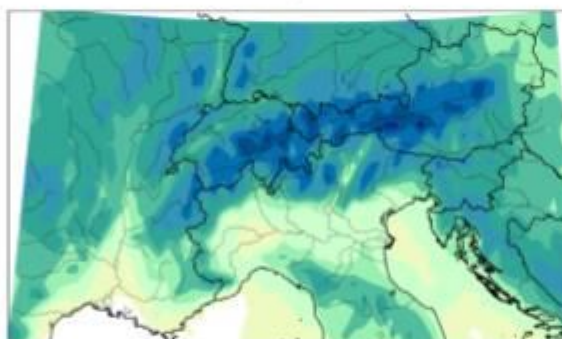
**MESCAN**



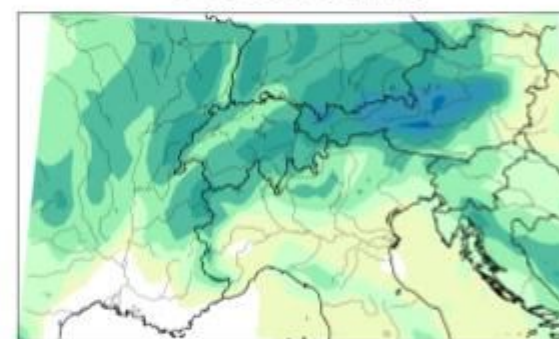
**UKMO det**



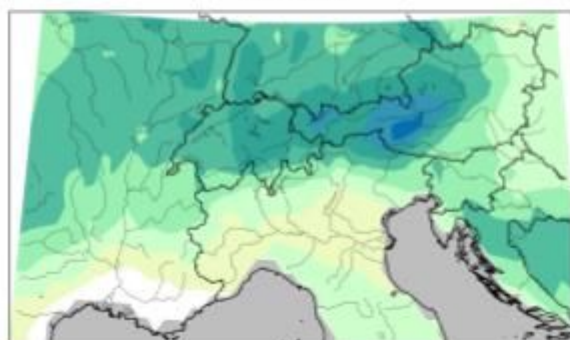
**HARMONIE v1**



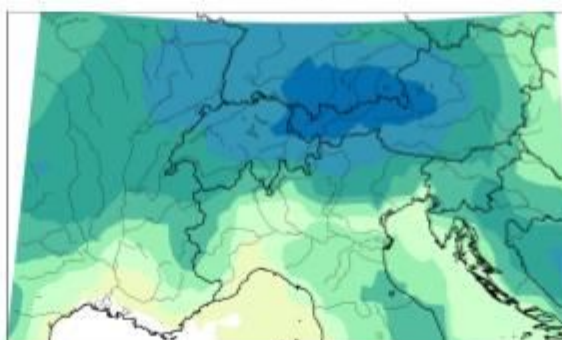
**COSMO6-REA**



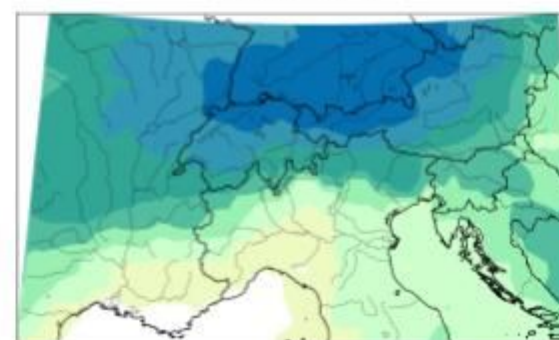
**E-Obs**



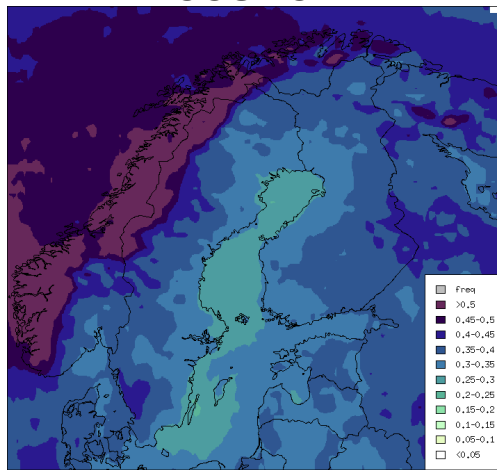
**ERAINT**



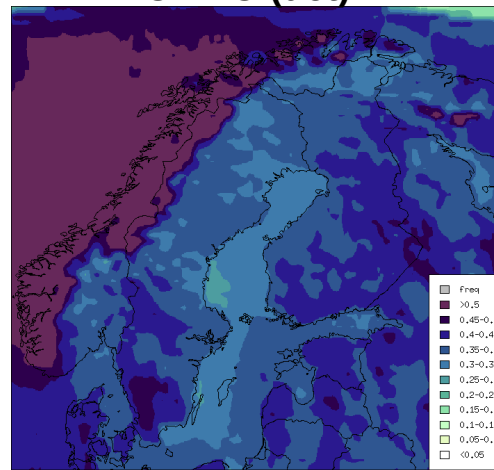
**ERA20C**



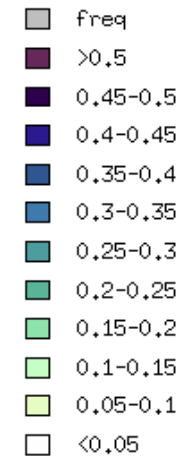
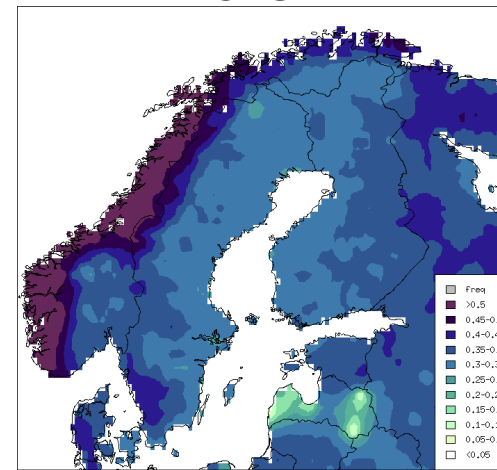
COSMO



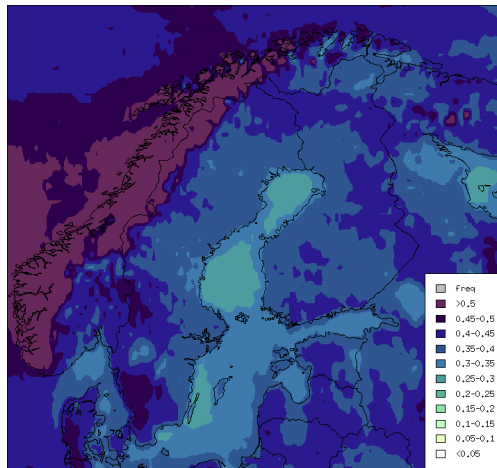
UKMO (det)



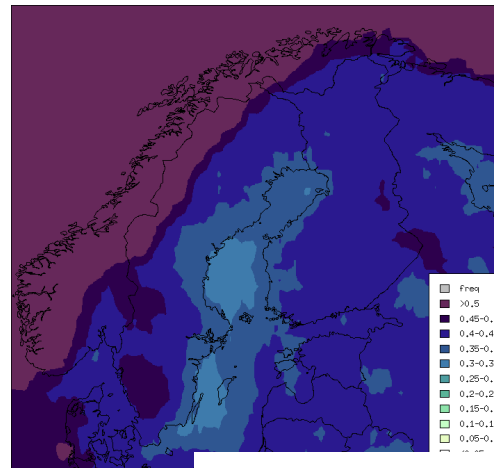
EOBS



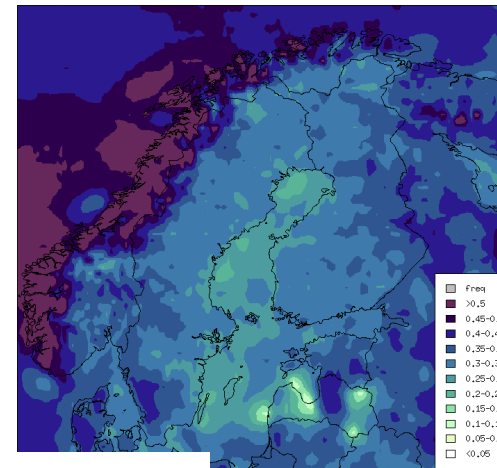
HARMONIE V1



ERA INTERIM

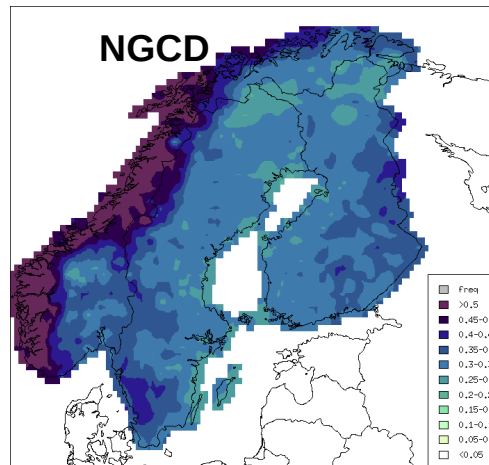


MESCAN SURFEX



Nordic Gridded Climate Dataset  
as one reference

NGCD



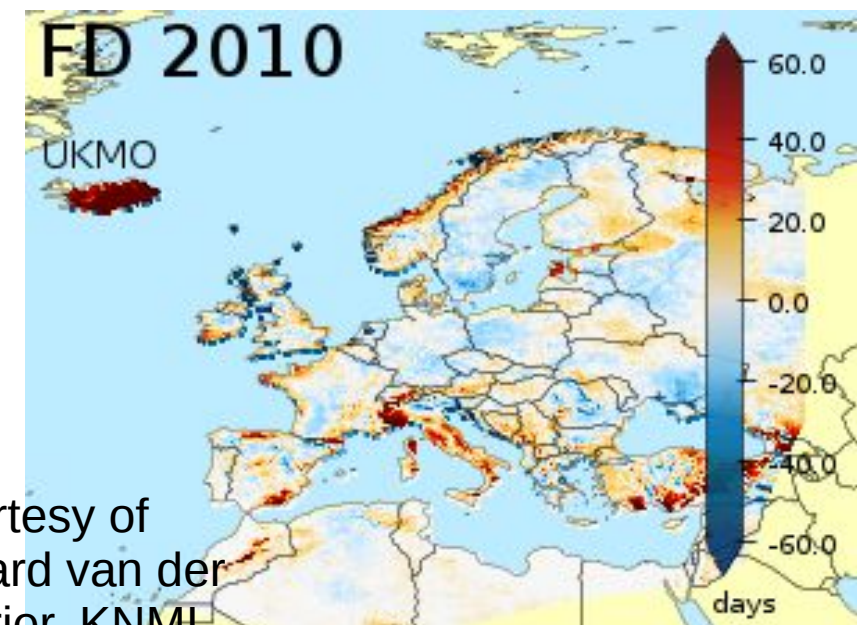
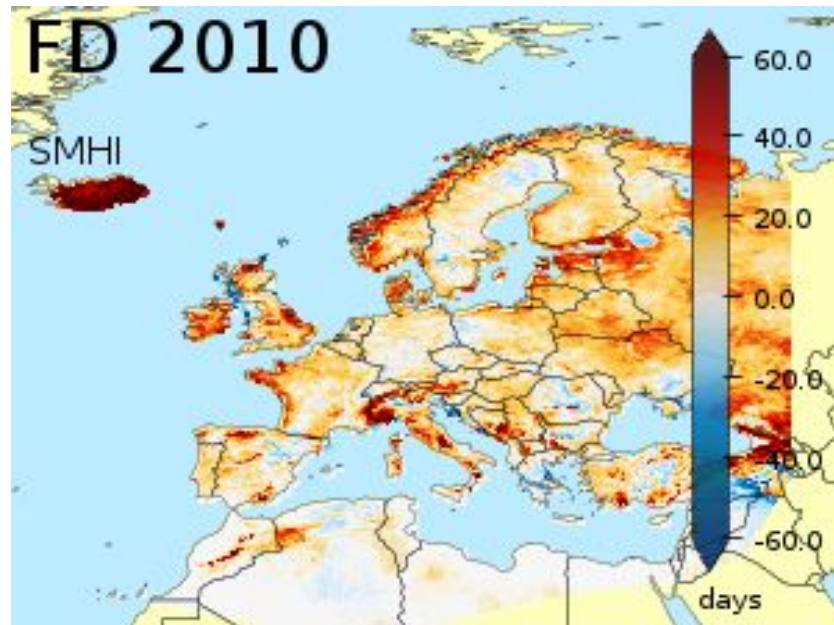
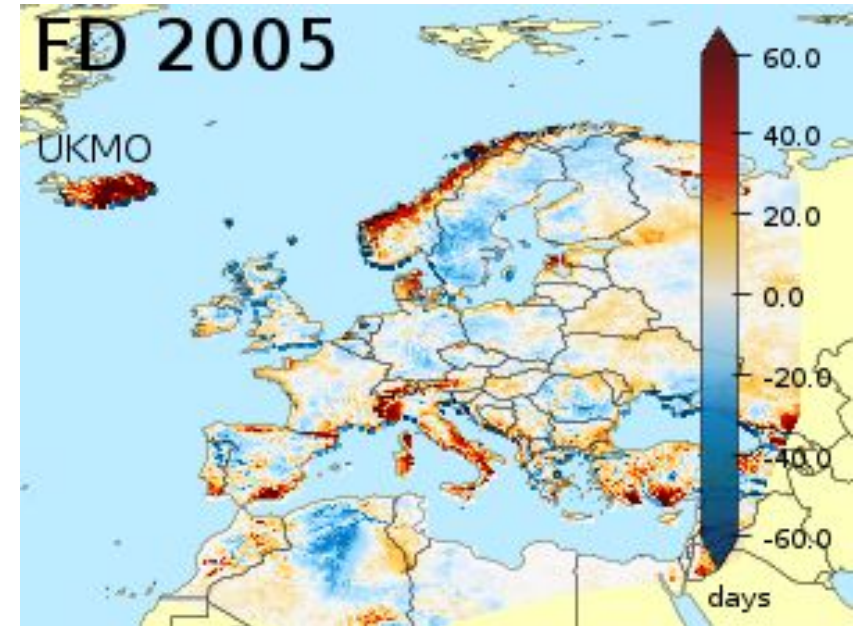
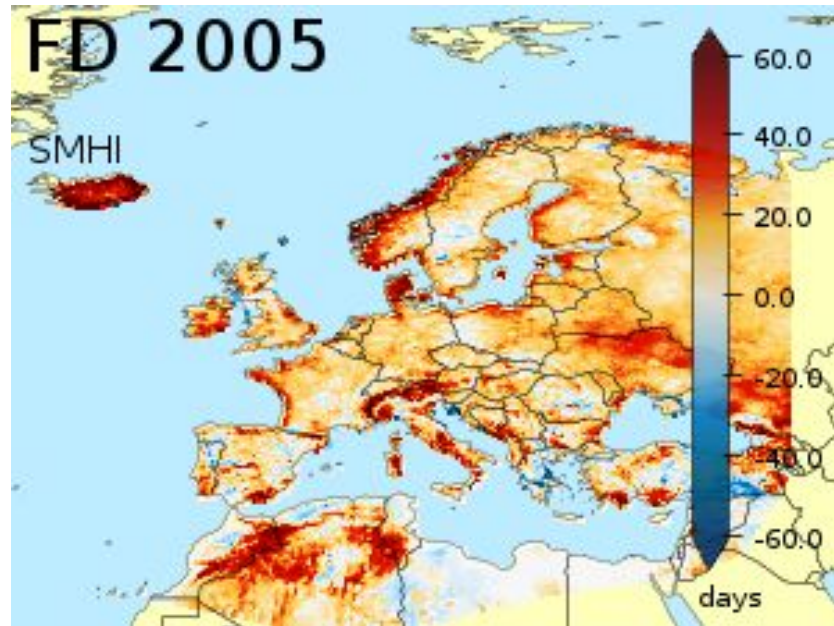
Courtesy Cristian  
Lussana (MET Norway)

Frequency of wet days  
(>1 mm)



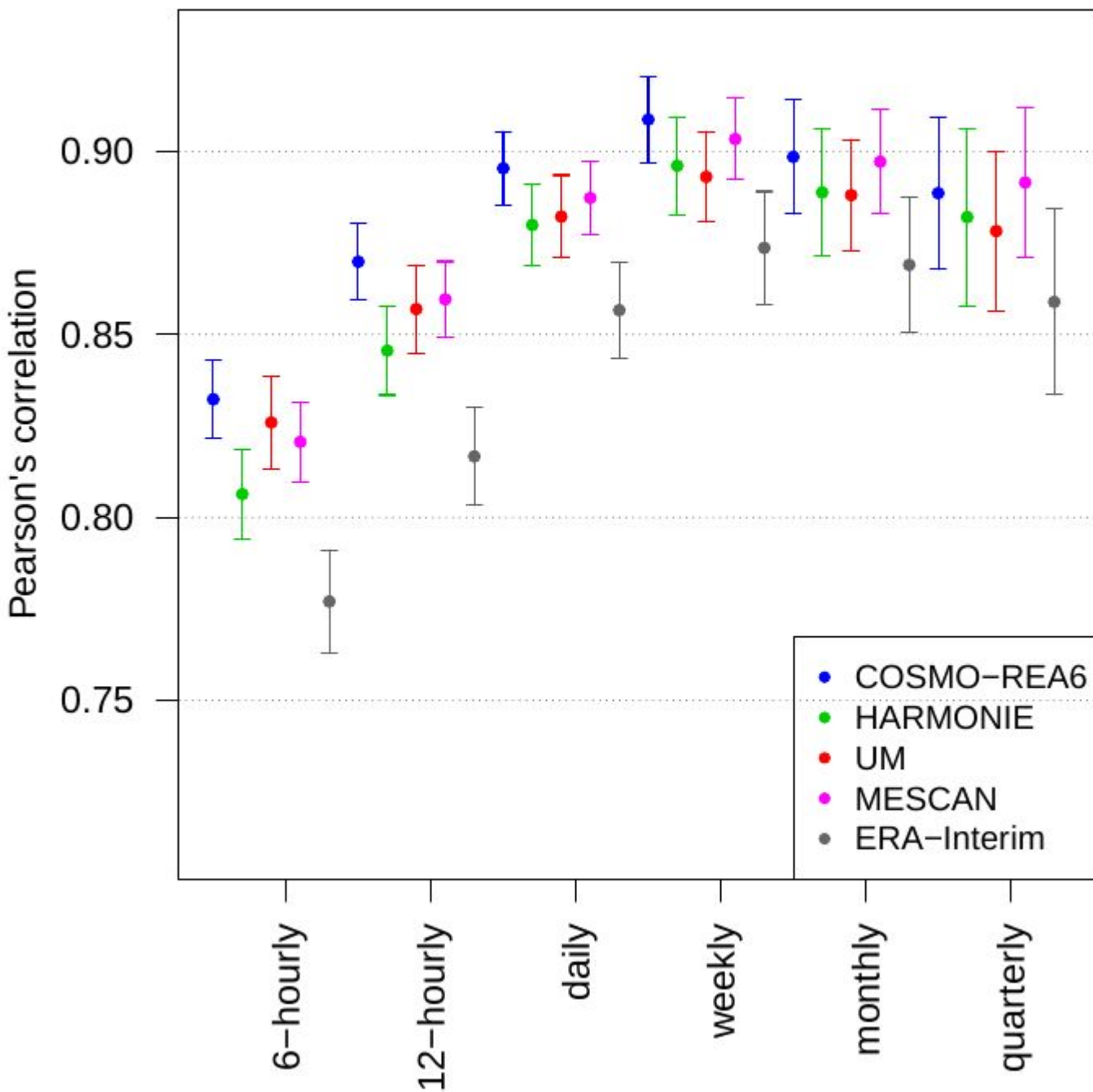
# Climate indices – number of frost days

## 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 is titled "UERRA - Home | ESGF-C" and the URL is "https://esgf-data.dkrz.de/projects/uerra/". The page features the UERRA logo, which is a stylized "UERRA" with a rainbow bar underneath. The text "Uncertainties in Ensembles of Regional ReAnalyses" is displayed below the logo. The page includes a navigation bar with links to Home, About Us, Users, Resources, and Contact Us. A sidebar on the left lists visitors and provides links to list all news, list all files, and list ESGF data groups. The main content area describes the UERRA project as a European FP7 reanalysis project of meteorological observations, including the 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. Social media links for Facebook and Twitter are provided. A right sidebar shows project browsing options, including parent, peer, and child projects, and a tag search function. The footer lists ESGF sponsors and partners, including DoE Office of Science, IS-ENES, NASA, NOAA, NCI, and NSF, and provides links to the ESGF P2P Version v2.3.8-master-release, the UERRA project page, and privacy policy/terms of use/impression.

The screenshot shows the is-enes website, which is the Infrastructure for the European Network for Earth System Modelling. The page is titled "is-enes Exploring climate model data". The navigation bar includes links to Home, Data discovery, Downscaling, Documentation, Help, About us, and Account. The main content area features a search bar and a list of project filters. The "Project" filter is selected, showing a list of projects with checkboxes and counts. The "uerra" project is selected, and the "Selected filters" section shows "Project : uerra". The page indicates that 2 datasets are found, displaying page 1 of 1. The datasets listed are "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 provided.

**UERRA**  
Uncertainties in Ensembles of Regional ReAnalyses



# Final points

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

UERRA HARMONIE (SMHI) and MESCAN (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)

