

# 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



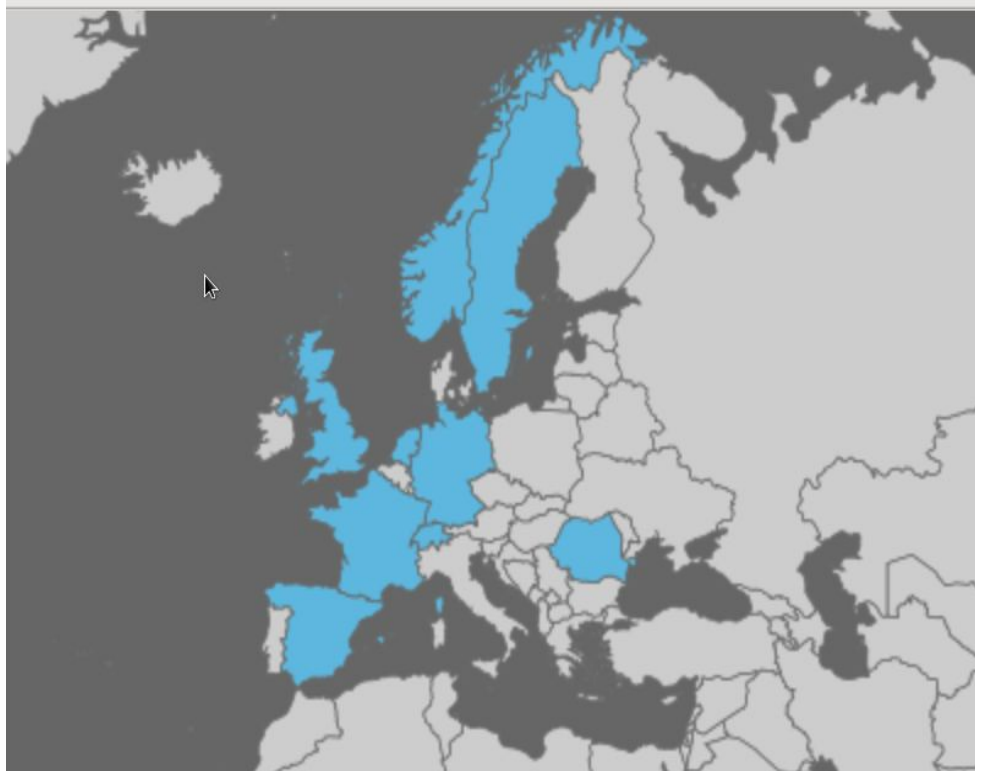
Meteorologisk  
institutt



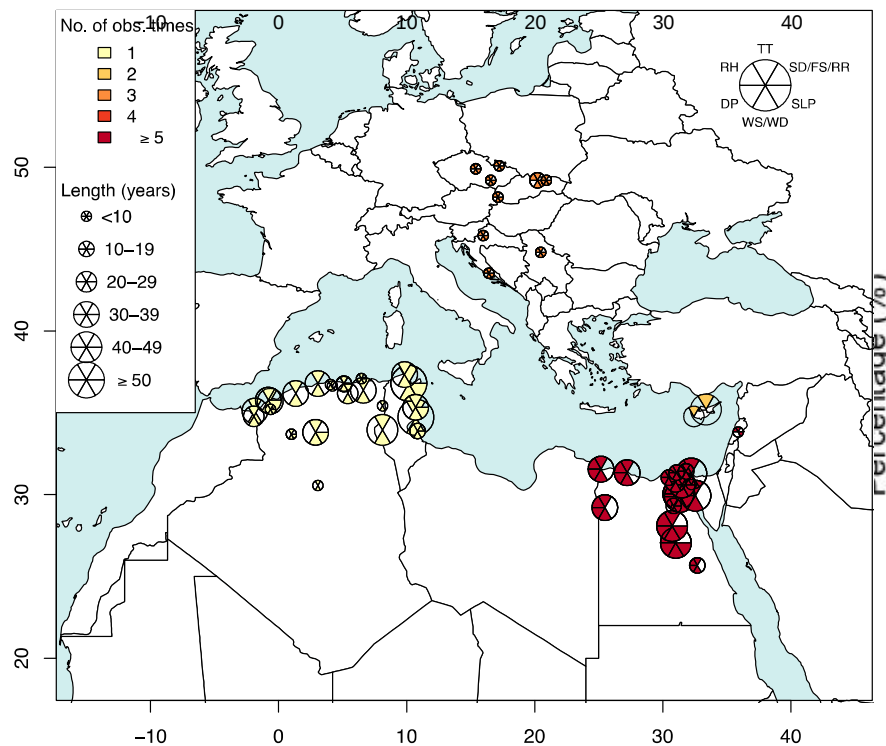
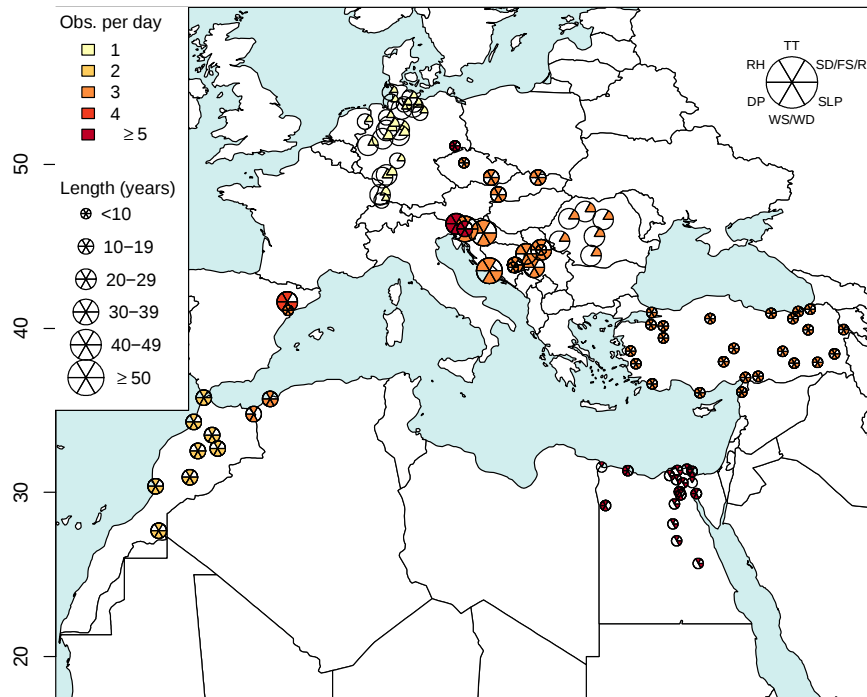
UNIVERSITAT  
ROVIRA I VIRGILI

**METEO  
ROMANIA**

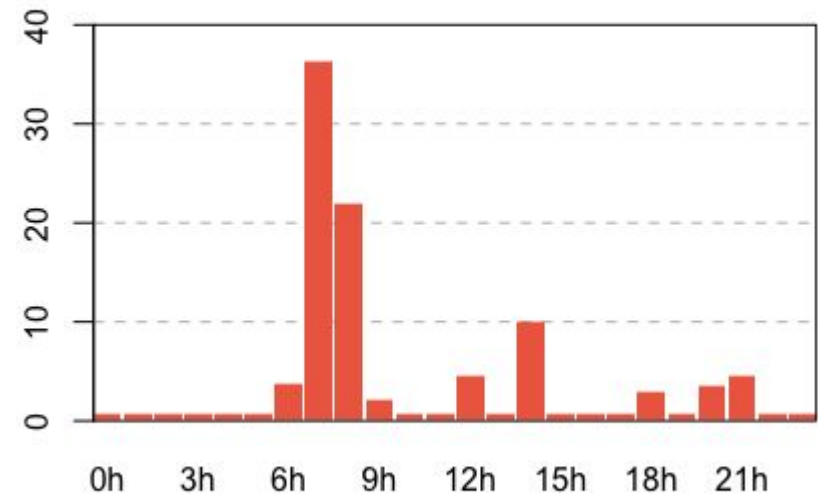
**universität bonn**  
Rheinische  
Friedrich-Wilhelms-  
Universität Bonn



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



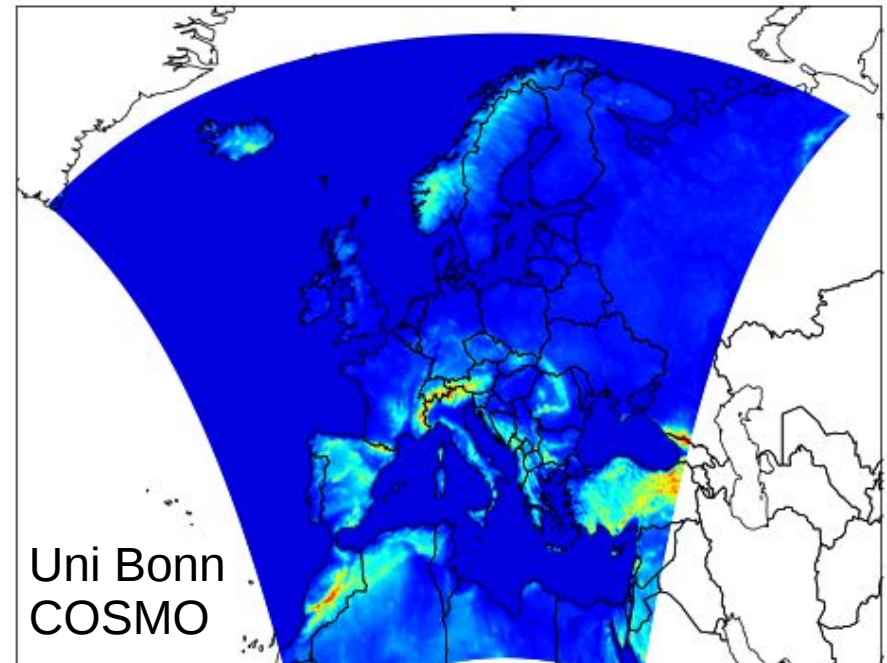
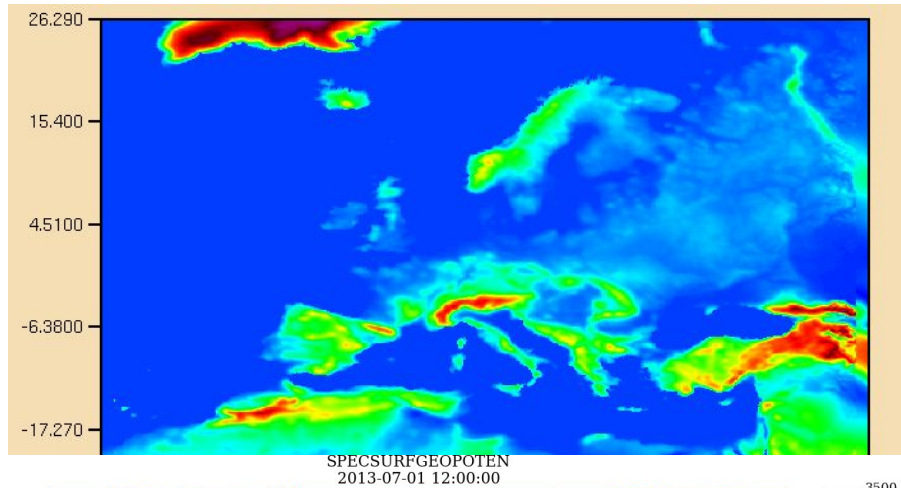
# Data delivered

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

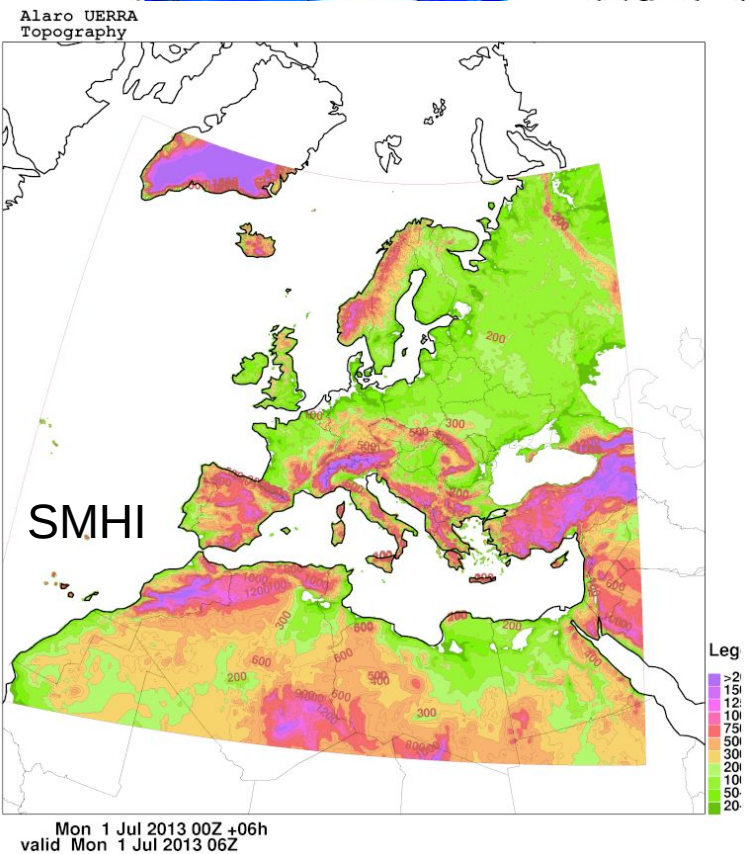
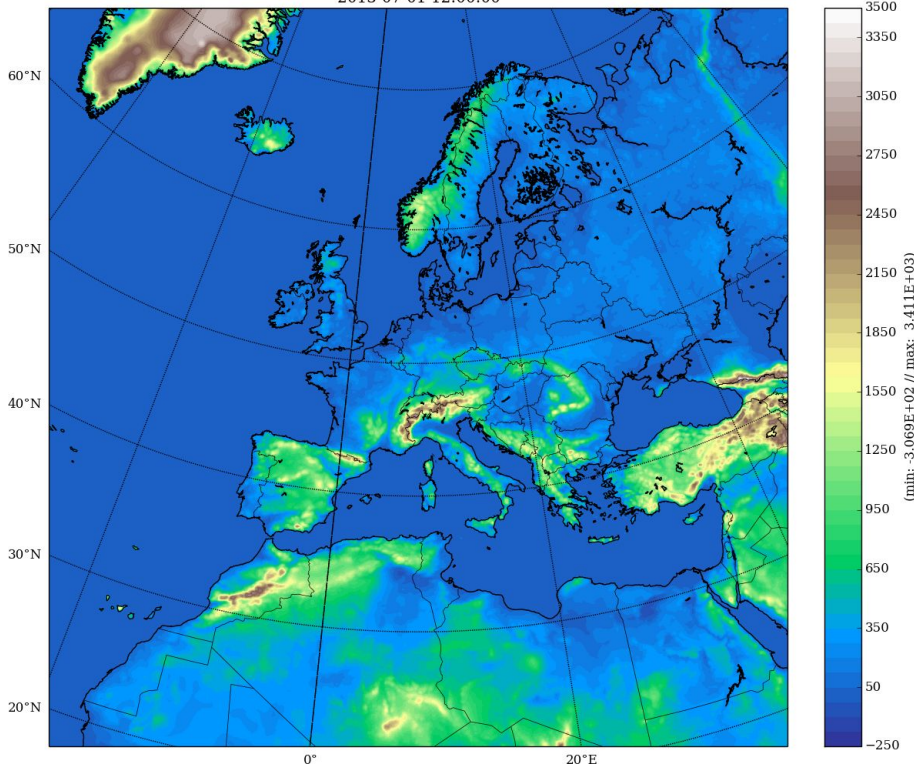


# UERRA Domain & projections

Met Office  
CORDEX  
EU 11 km



MF



# 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	2005-2010 <sup>1</sup>	T, RH, u, v, clouds, Geop, Precip, surf etc
COSMO ensemble	20	12	40	2005-2010 <sup>1</sup>	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	2005-2010	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)	Total cloud cover
MESCAN	1	5	1	(1961)1981-2015	T2m, RH2m, Precipitation
MESCAN ensemble	8	5	1	2005-2010	T2m, RH2m, Precipitation
UM 4D-VAR	12	12	70	1979-2015 <sup>2</sup>	T, RH, u, v, clouds, Geop, Precip, surf etc
UM Ens 4D-VAR	36	20	70	1979-1990, 2005-2010 <sup>2</sup>	T, RH, u, v, clouds, Geop, Precip, surf etc

1) Intermediate years only partial e. o. August  
(1961-1980 will be filled in September, MESAN V2 in September

2) 2000-2004 only partial, 2011-15 October, 1991-99 Dec

**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:**

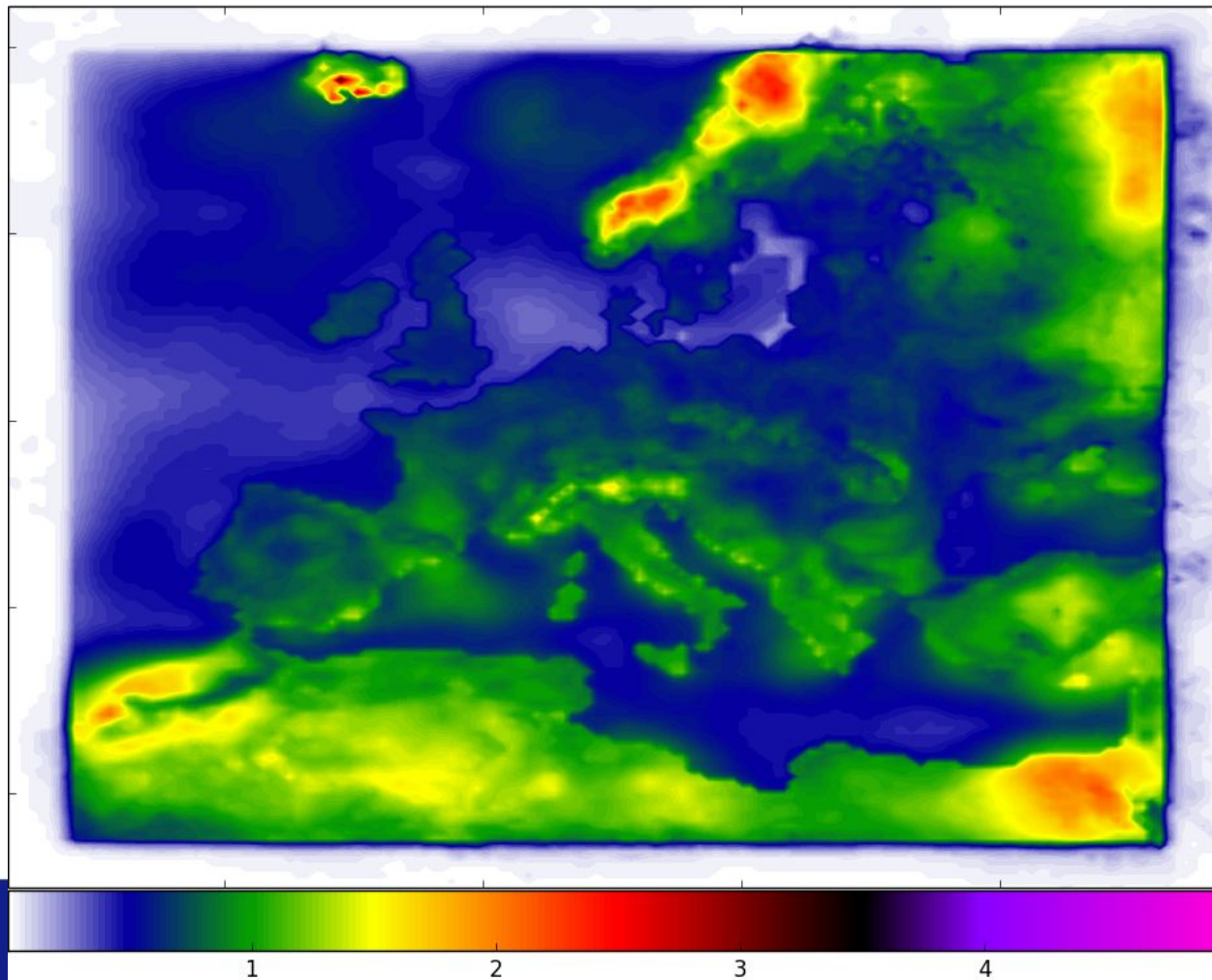
Temperature, wind, clouds, fluxes of sensible  
and latent heat, radiation fluxes, snow, rainfall

## **Soil levels**

Temperature and soil wetness

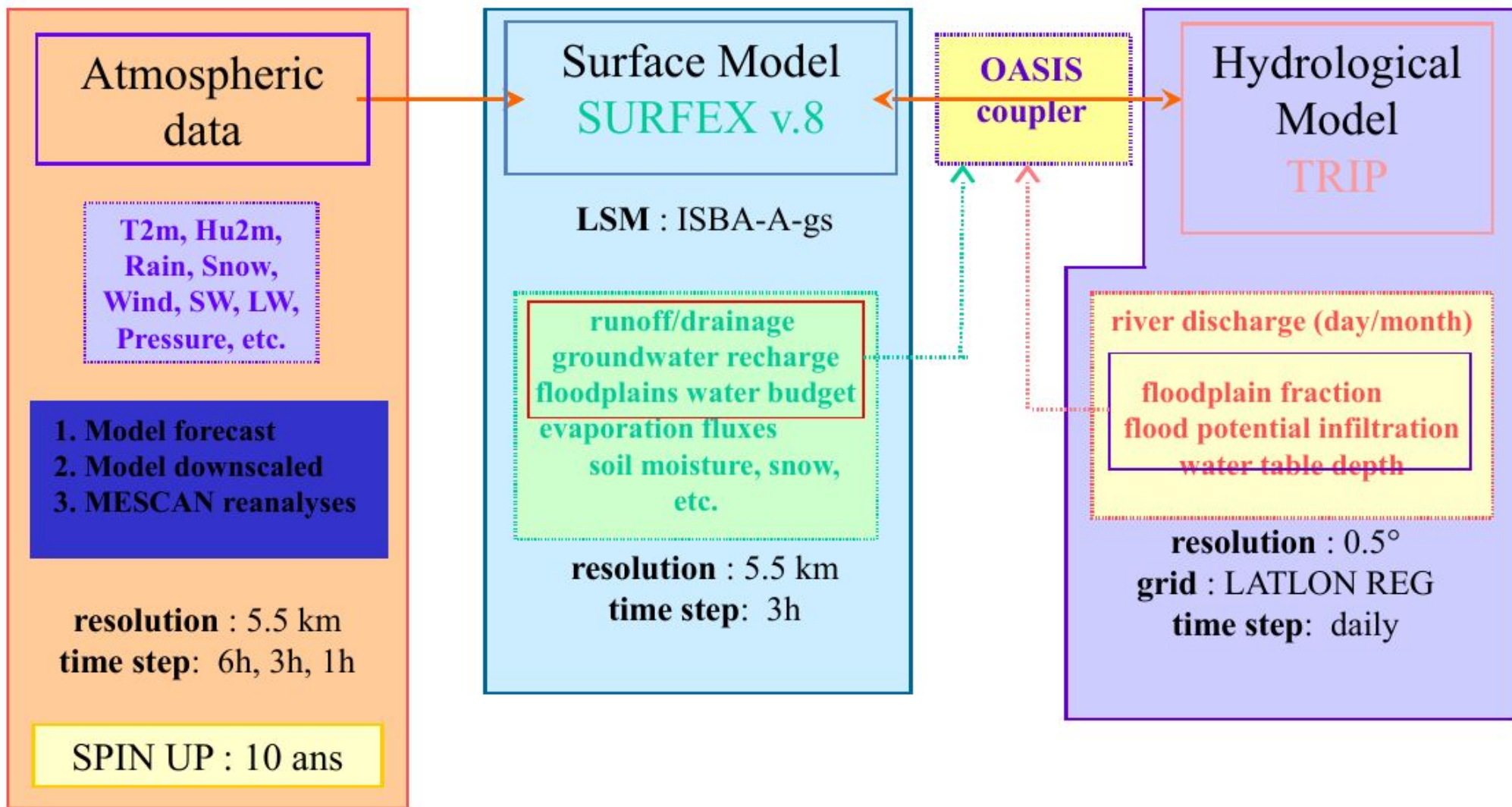


Spread of 2m temperature for March 1979 from the Met Office system Ensemble 4D-VAR reanalysis





# 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)



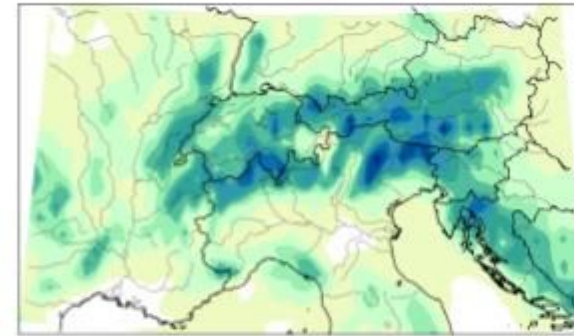
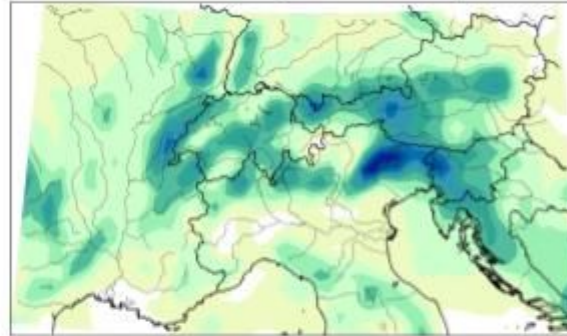
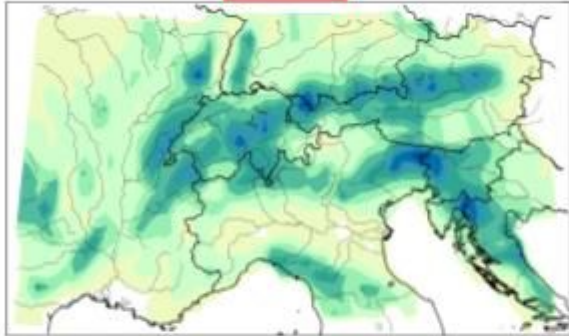
# Mean annual precipitation

2005-2008  
25 km grid

**APGD**

**MESAN (EURO4M)**

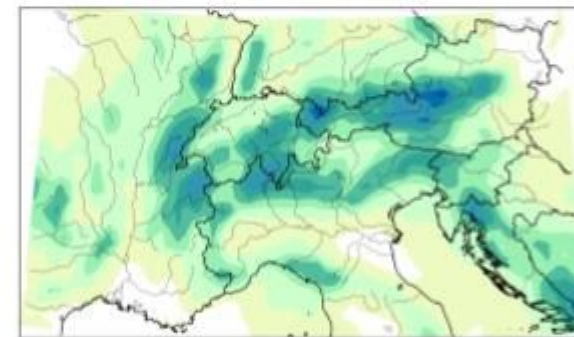
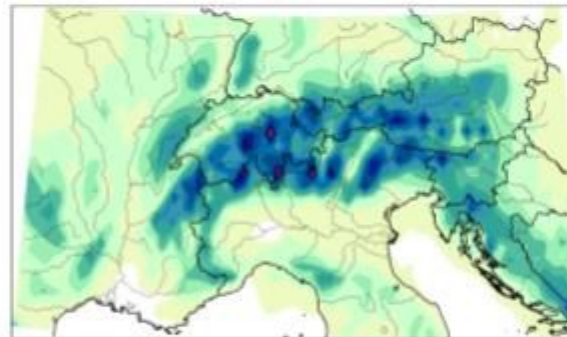
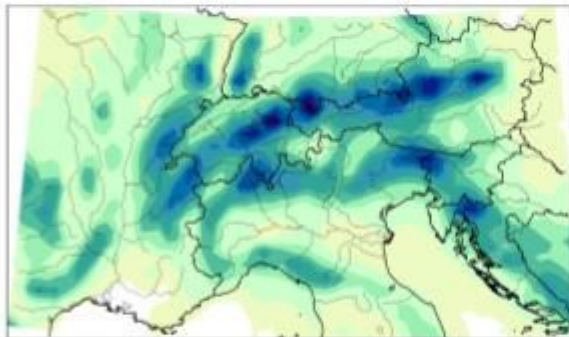
**MESCAN**



**UKMO det**

**HARMONIE v1**

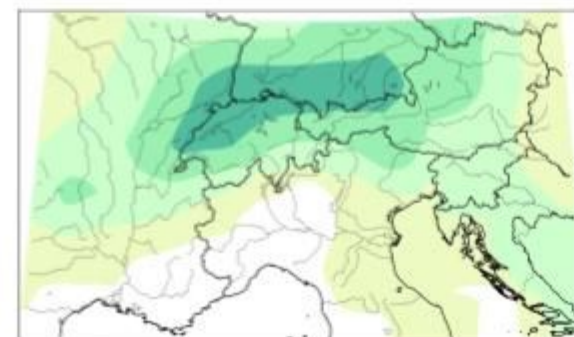
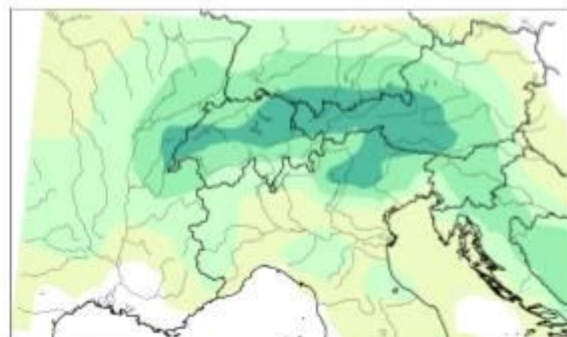
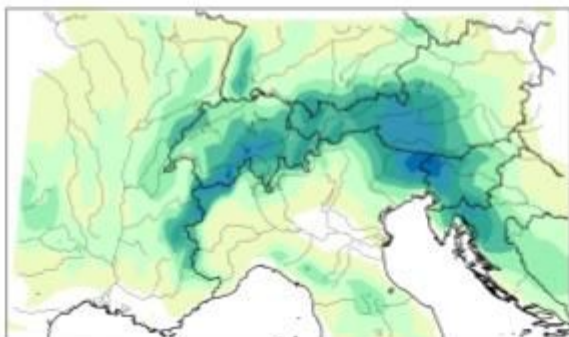
**COSMO6-REA**



**E-Obs**

**ERAINT**

**ERA20C**

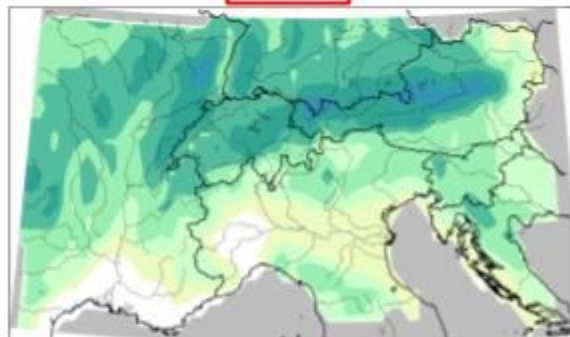




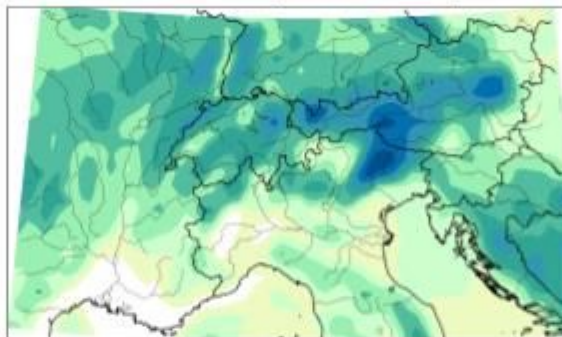
# Wet-days frequency $\geq 1\text{mm/d}$

2005-2008  
25 km grid

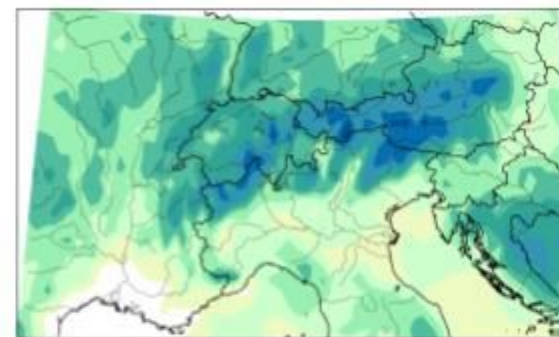
**APGD**



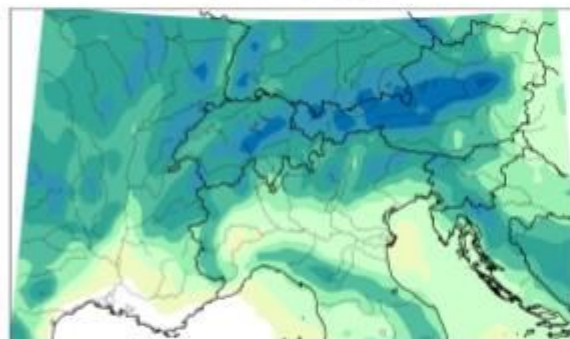
**MESAN (EURO4M)**



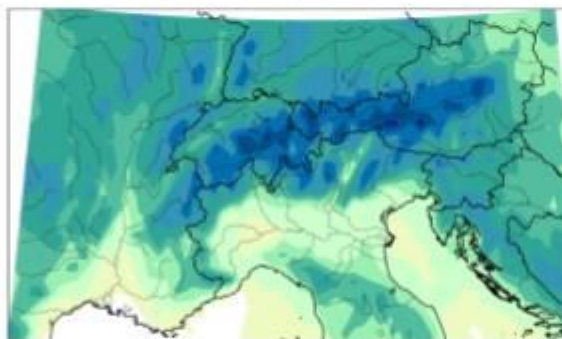
**MESCAN**



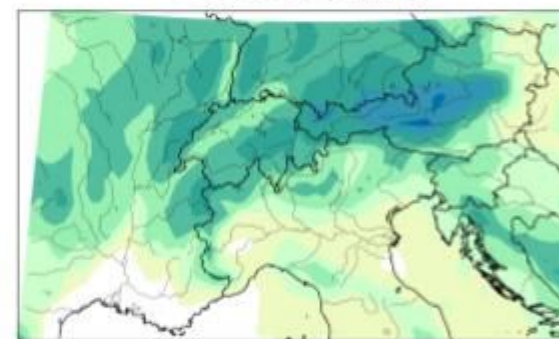
**UKMO det**



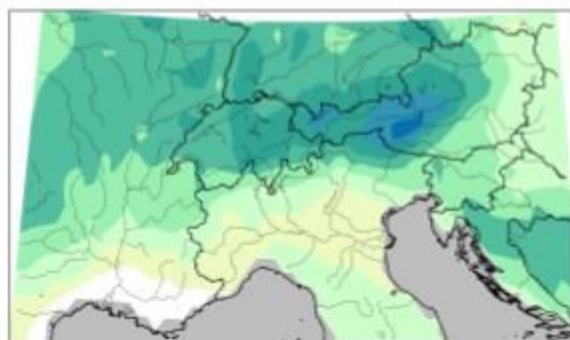
**HARMONIE v1**



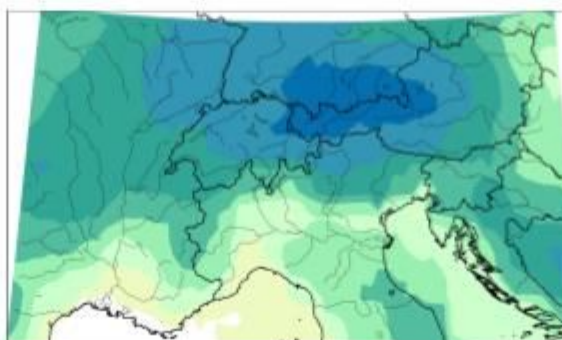
**COSMO6-REA**



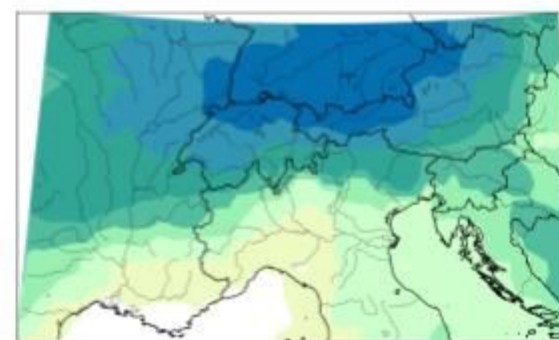
**E-Obs**



**ERAINT**



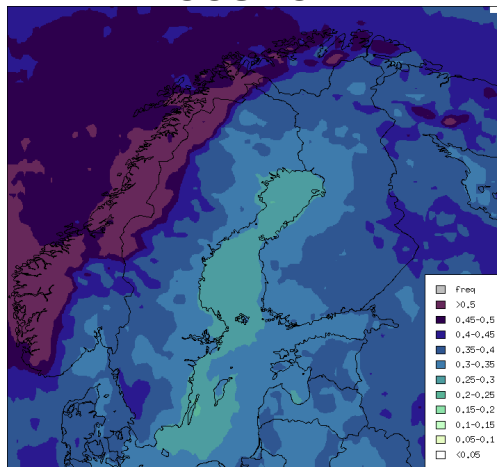
**ERA20C**



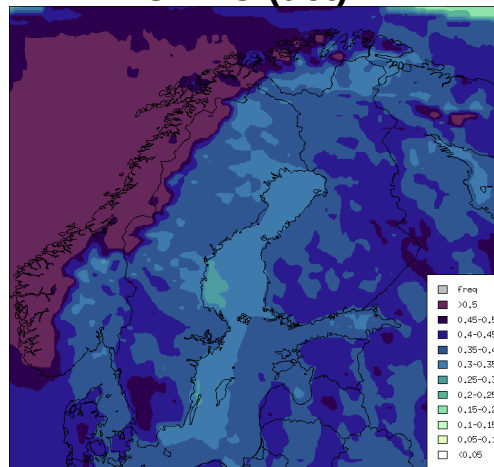
0.7  
0.65  
0.6  
0.55  
0.5  
0.45  
0.4  
0.35  
0.3  
0.25  
0.2



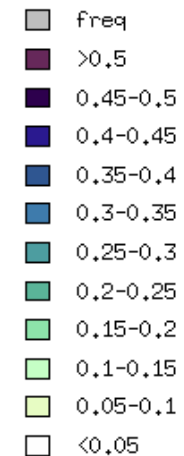
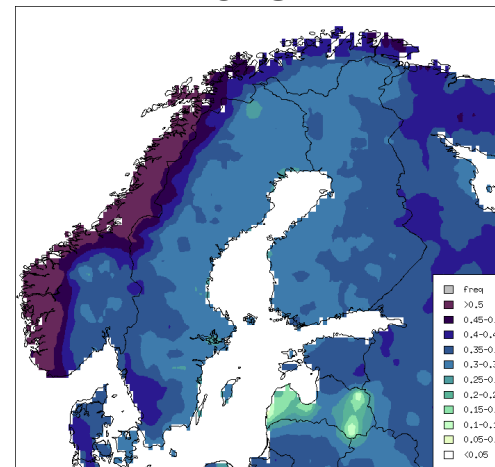
COSMO



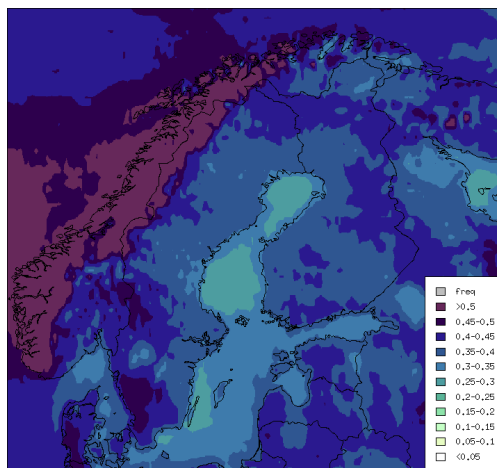
UKMO (det)



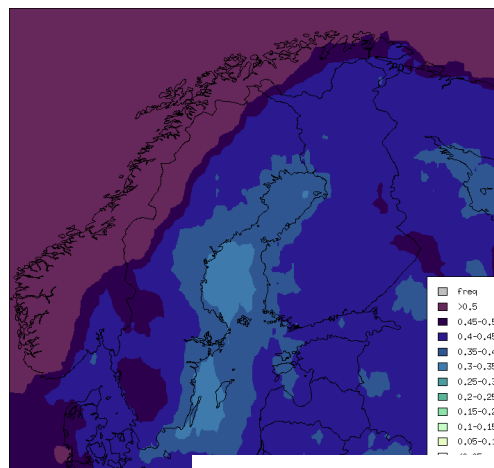
EOBS



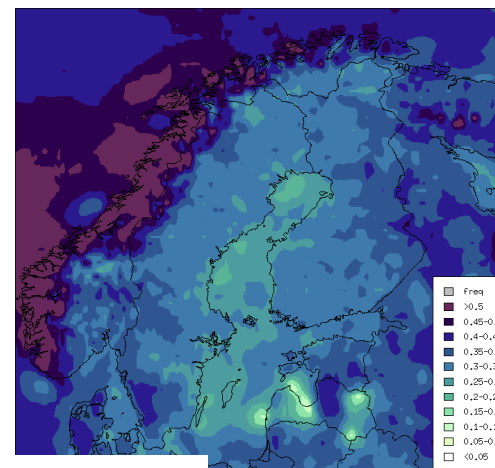
HARMONIE V1



ERA INTERIM

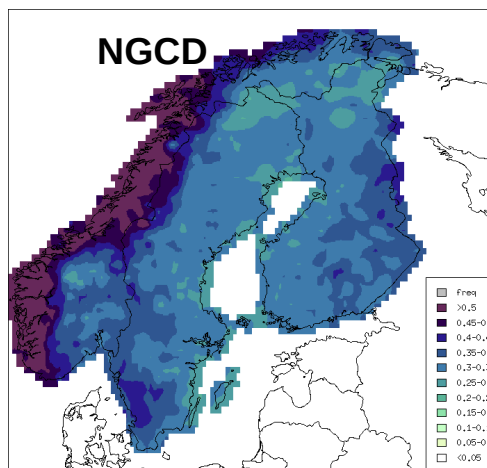


MESCAN SURFEX



Nordic Gridded Climate Dataset  
as one reference

NGCD

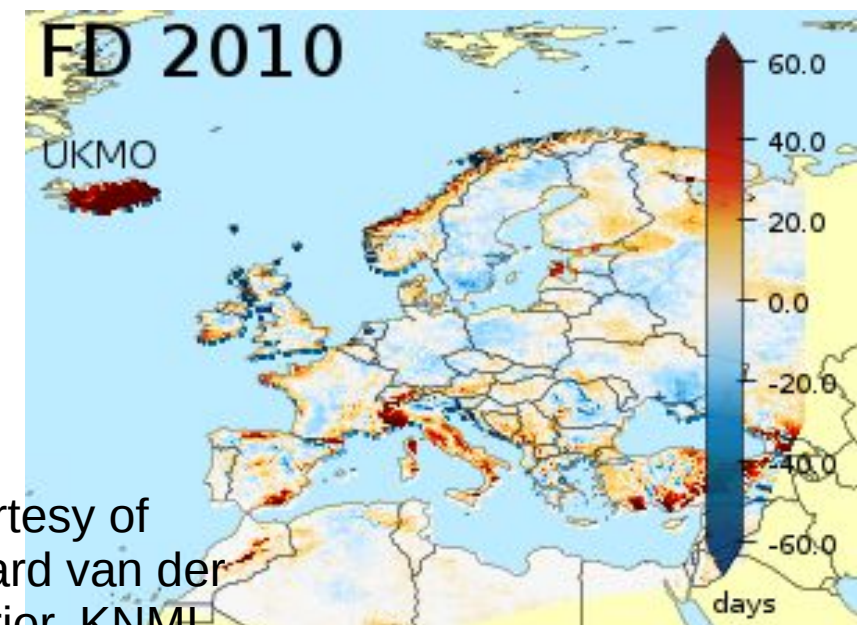
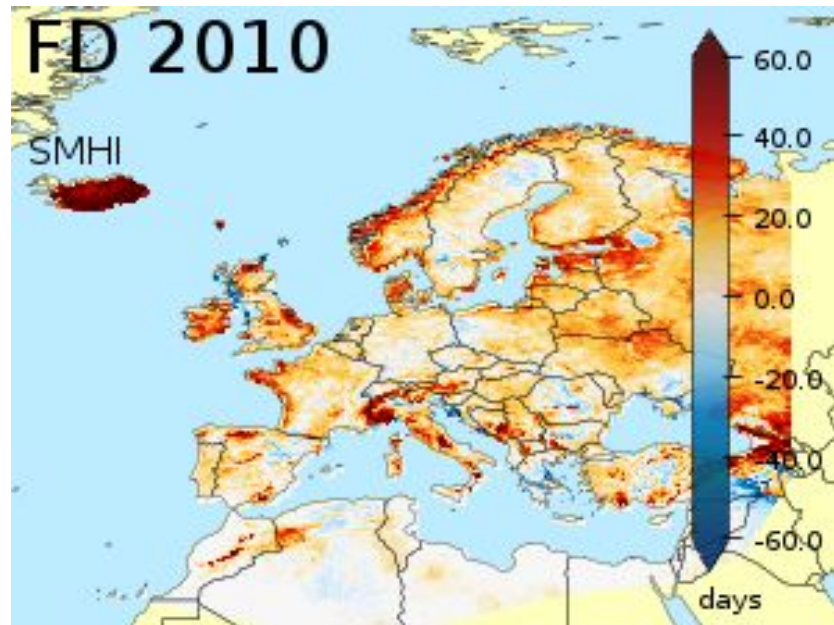
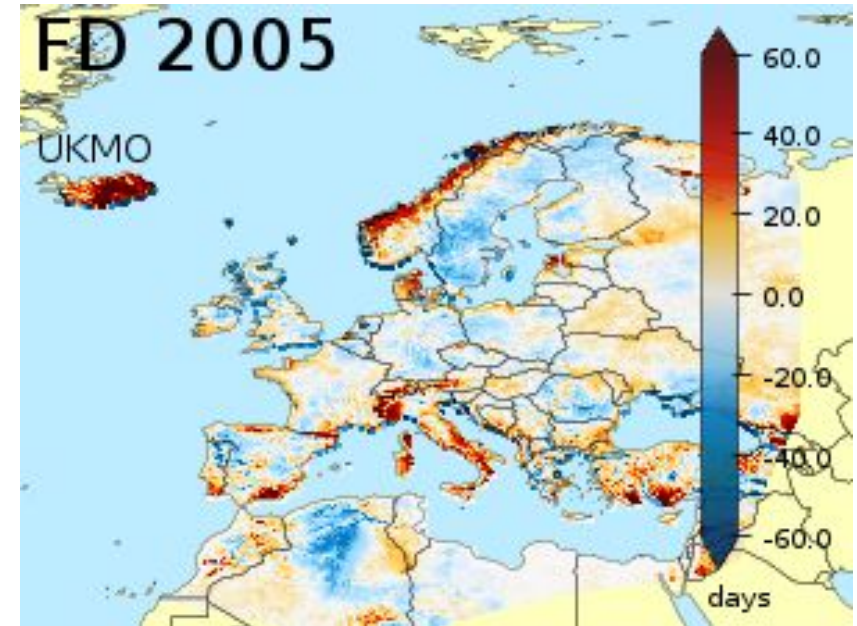
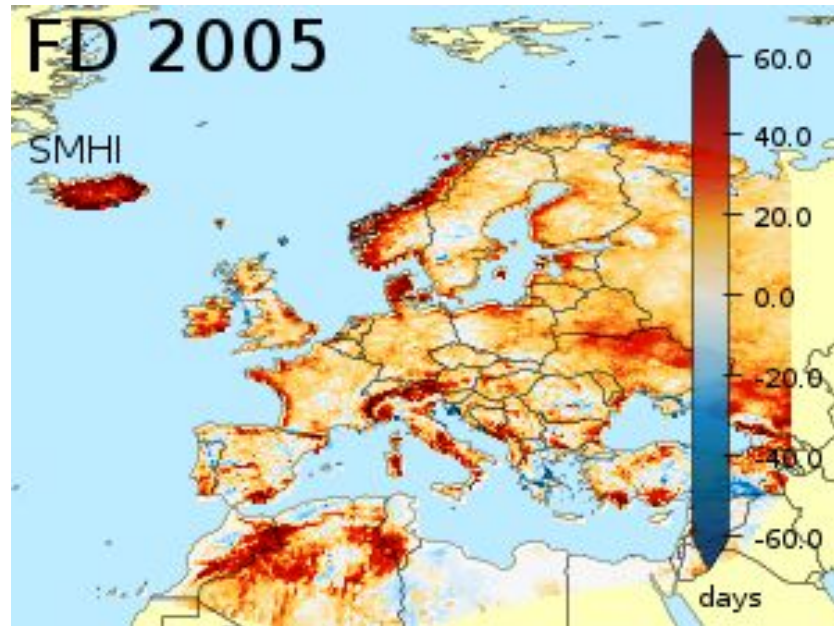


Courtesy Cristian  
Lussana (MET Norway)

Frequency of wet days  
(>1 mm)

# Climate indices – number of frost days

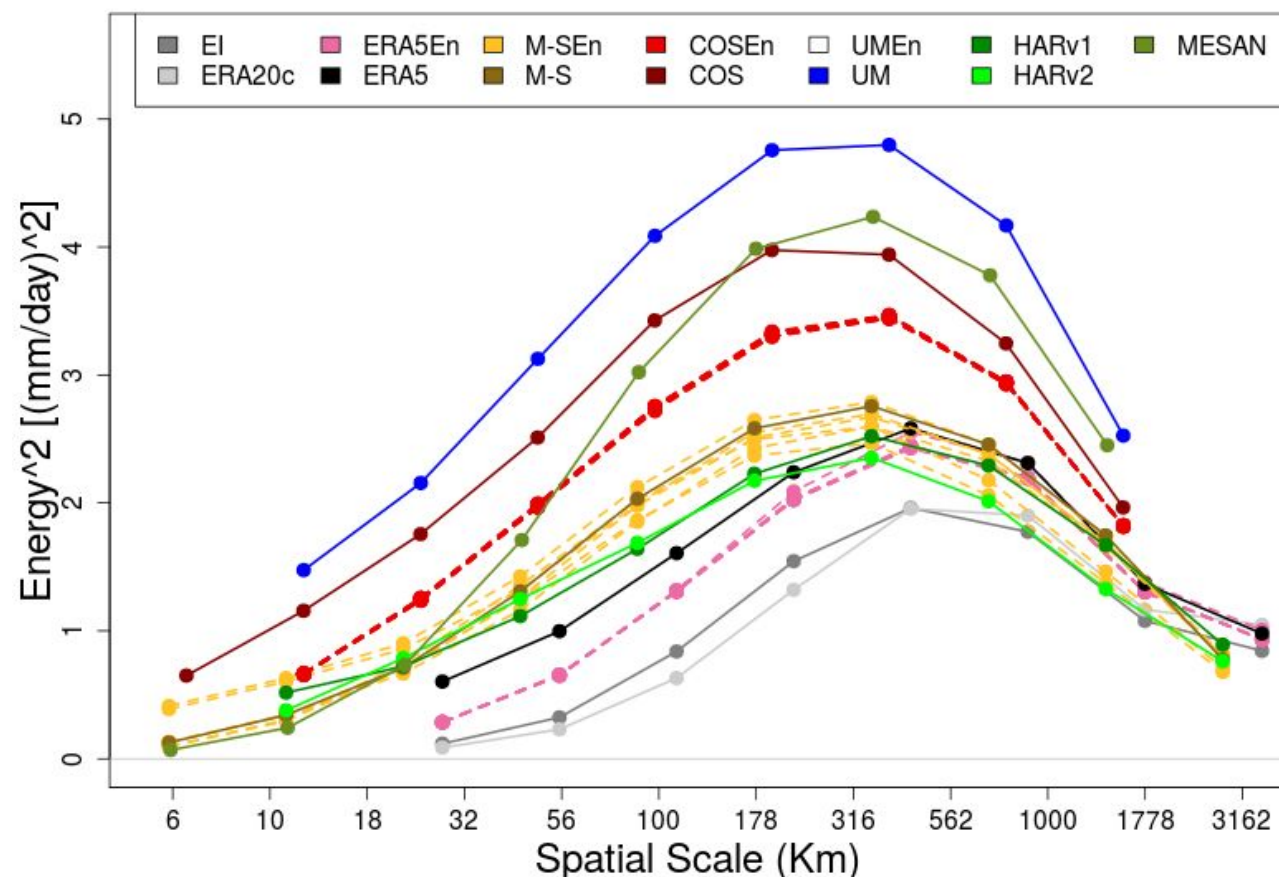
## SMHI or Met Office minus E-OBS



Courtesy of  
Gerard van der  
Schrier, KNMI



# mean Energy<sup>2</sup> as a function of the spatial scale (i.e. resolution) for different reanalyses



- Variable: 24h precipitation (06-06 UTC)
- Time period (model-dependent): 2000 - 2016
- Each model has been considered on its original grid (spatial domain: Europe; no regridding).
- El, ERA20c and ERA5 are global RAs (GRAs), the other models are RRAs
- Only days with more than 5% of the domain with precipitation > 1 mm/day have been considered

## Added value of RRAs:

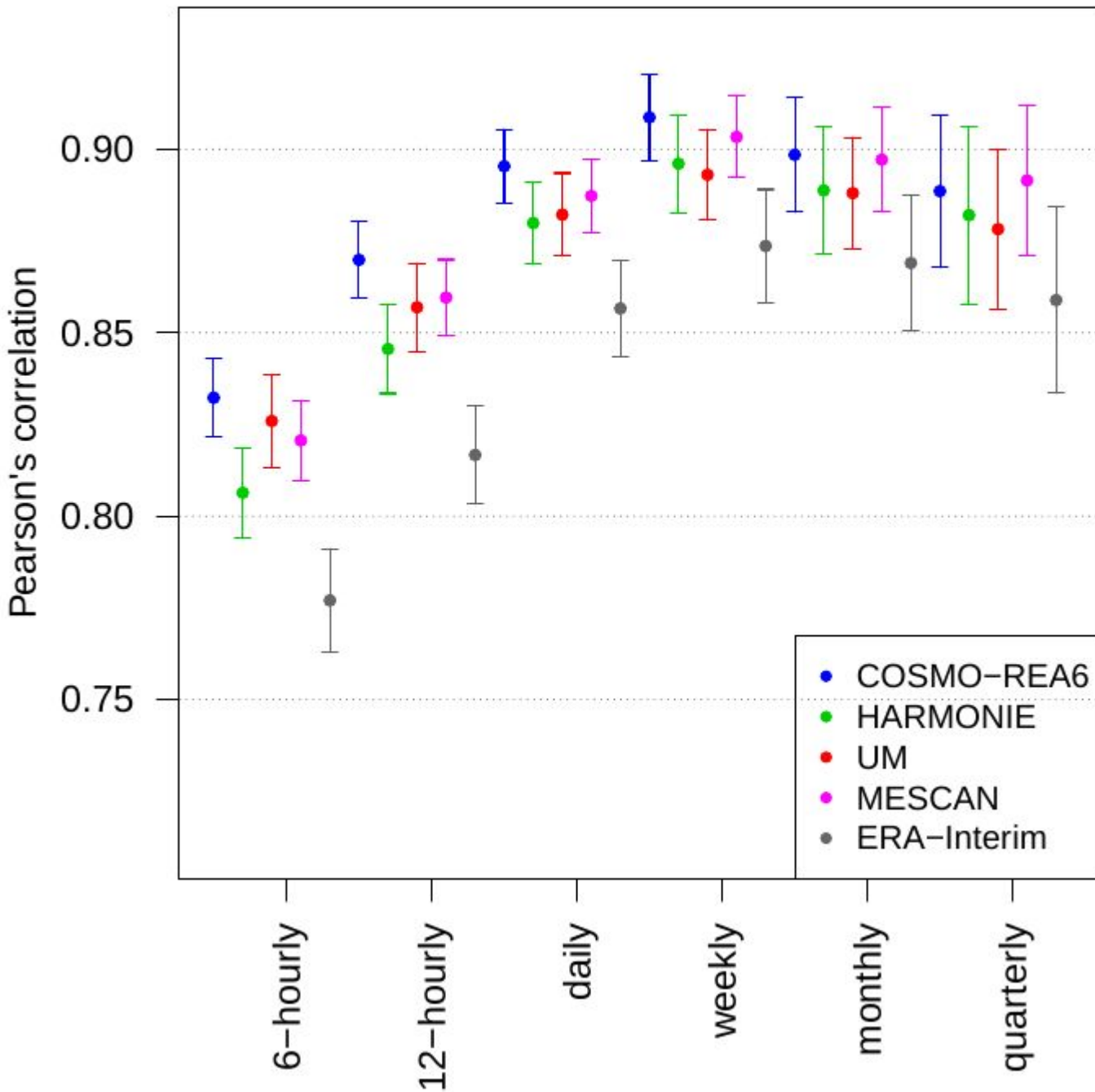
- RRAs simulate a broader range of scales than GRAs
- RRAs have more energy than GRAs (especially for spatial scales less than 100 Km)
- The mode for RRAs energy distributions is on smaller spatial scales than GRAs



Courtesy Cristian Lussana (MET Norway and Francesco Isotta (Meteo-Swiss)



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



Correlation of  
wind speed with  
station data

Courtesy of  
Deborah  
Nierman(DWD)





Announcement

# UERRA Evaluation and User workshop

Bringing together the users and providers of European reanalysis



30 November to 1 December 2017 **at El Seminari** (Carrer de  
**Topics:** **Sant Pau, 4, Tarragona, Spain)**

- Principles of reanalysis systems used in UERRA
- Strengths & weakness of the different datasets
- Assessing of uncertainties and fitness for purpose
- Demonstrating data access and visualisation
- Lessons learned & recommendations

Everybody interested in using UERRA regional reanalyses is invited. Registration begins Thursday at 8:00. **3 coffe breaks, two lunches and** an icebreaker, planned on Thursday night to facilitate discussions, are included. The workshop ends Friday at 13:00. There is no registration fee. More details on the programme, registration, and additional practical information will soon be published on <http://www.uerra.eu>.



# 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)



# UERRA : Grant Agreement 607193 EU FP7 SPACE 2013-1

---

## One of 5 pre-operational Copernicus Projects

ERA-CLIM2	European Reanalysis of the Global Climate System
UERRA	Uncertainties in Ensembles of Regional ReAnalyses
QA4ECV	Quality Assurance for Essential Climate Variables
CLIPC	A Climate Information Portal for Copernicus
EUCLEIA	European Climate and weather events: interpretation and attribution

# Preliminary Workshop Programme

## Thursday morning

- Principles of reanalysis systems (general overview)
- User experiences and requirements
- UERRA reanalysis methods and products  
(including evaluation of the variability, the uncertainty in relation to spatial scale and time scale,  
  
the representation of extremes, and user-oriented climate indices)

## Thursday afternoon

- UERRA reanalysis methods and products (cont.)
- Methods to assess uncertainty and fitness for different purposes
- Overview of the strengths & weakness of the different datasets

## Friday morning

- Demonstrating data access and visualisation
- Recommendations to users and users' requirements - dialogue
- Lessons learned & remaining challenges



# Global data centres

GPCC:	Global Precipitation Climate Centre (DWD)
ISPD:	International Surface Pressure Databank
(ISPD),	
ISTI:	International Surface Temperature Initiative
STFC/CEDA:	Science and Technology Facilities
Council/Centre for Environmental Data Analysis (UK)	
NCEI:	National Center for Environmental Information
UK-MO HadISD:	UK Meteorological Office Hadley Centre
Hourly dataset	
MARS:	Meteorological Archival and Retrieval System
ECA&D:	European Climate Assessment & Dataset

Courtesy of Joan Ramon et al. Del. 1.8



# Production and MARS archiving at ECMWF

SMHI HARMONIE ALADIN

1961-2015 Done and archived in MARS

2nd physics (ALARO)

2006-2010 Done and archived in MARS

Météo-France MESCAN

2006-2010 Ensembles of MESCAN in MARS test

1981-2010 Done and in Mars

All 1961-2015 to be completed in September – to be copied to MARS oper for September

SMHI MESAN cloud analysis 2004-2008 done (not yet in MARS), 1991-2004 in August

Met Office UM 4D-VAREnsemble 4D-VARs

1979-1990 Done and in MARS

2005-2010 Complete and in MARS

2000-2004 partial will be completed in September

2011-2016 eo October

1991-1999 eo December

Uni Bonn COSMO Ensemble 5 years

2008 , 2006-2010 to be completed and archived in August - early September