UERRA - Uncertainties in Ensembles of Regional ReAnalyses

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SEVENTH FRAMEWORK PROGRAMME

Preparing for Regional Operational Copernicus Climate Change Services

- Produce European regional meteorological reanalyses of **E**ssential **C**limate **V**ariables for several decades with data services and uncertainty estimation;
- At higher resolution than before and multimodel and ensemble data assimilation
- Provide observations for reanalyses
- User interaction and user driven archives and visualisation services

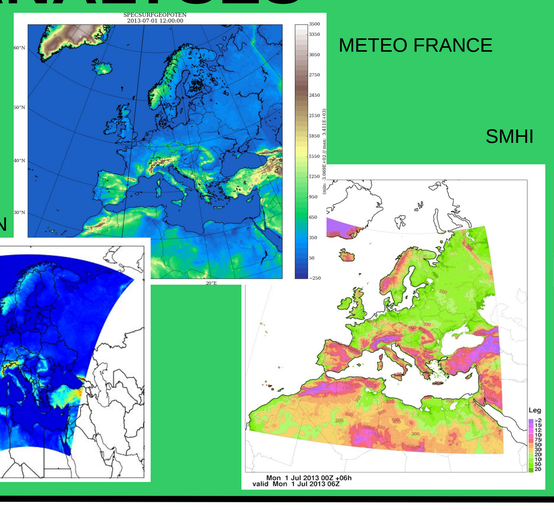
Building and running pre-operational pan-European multi-model ensemble reanalysis systems

Operational archiving and data services of Upper air model, pressure and height level parameters

Surface parameters and diagnostic parameters

REGIONAL REANALYSES

Domains & orography



3D reanalyses covering the full atmosphere

Met Office	SMHI/MF	HErZ-DWD
UM Hybrid 4D-Var, Ensemble of 3D-VARs	ALADIN-HARMONIE 3D-VAR	COSMO Ensemble Nudging
1 Control 12 km 70 levels 20 members 36 km ensemble	1 member 11 km 65 levels 2 members physics	1 Control 12 km 40 levels 20 members 12 km ensemble
Ensemble 1979 - 2015	deterministic 1961-2015 5 years mini ensemble	deterministic 2006-2010 ensemble 5 years
Conventional obs, satellite data, precip.	Conventional obs, Large scale constraint from ERA	Conventional obs

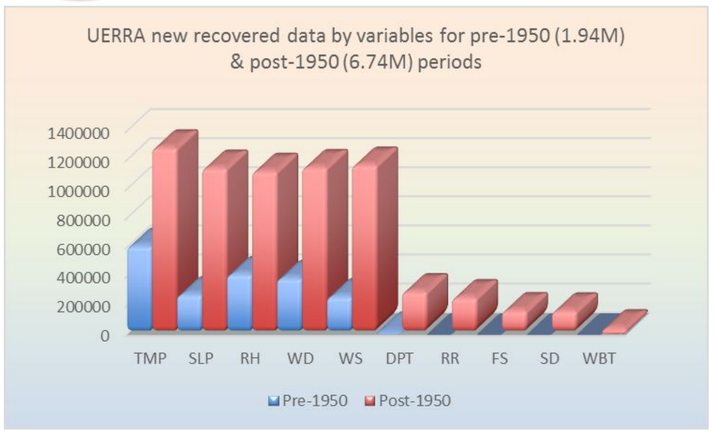
boundary forcing from global ERA reanalyses (ERA-40, -Interim,)

2D surface analyses driven by 3D

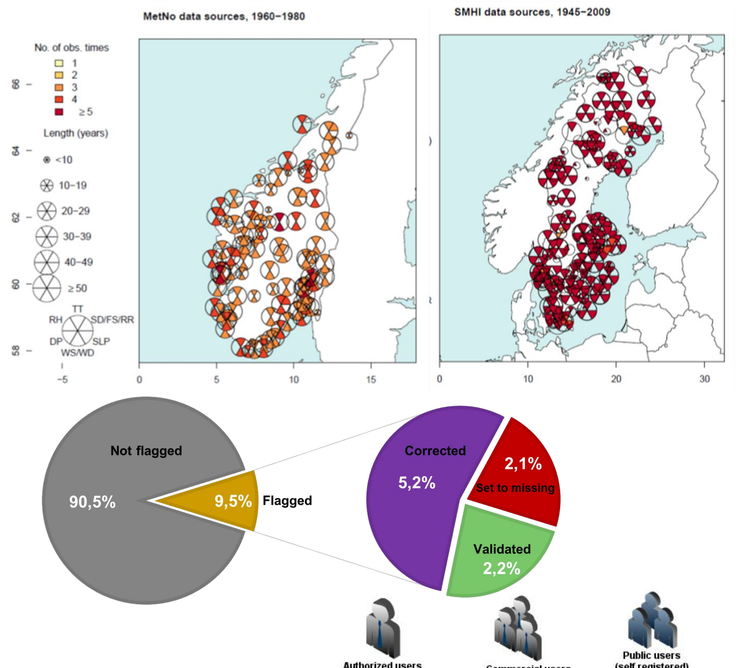
MF/SMHI MESCAN	SMHI MESAN
2D advanced statistical interpolation	2D advanced statistical interpolation
Downscaled ALADIN model background fromSMHI	Downscaled 3D HIRLAM climatological adaptation background
Surface and climate stations T, Td, precipitation	AVHRR, METEOSAT SEVIRI and MVIRI
5 km grid T2m, Td, precipitation	5 km Cloud fraction
1961 - 2015	~1994 - 2009

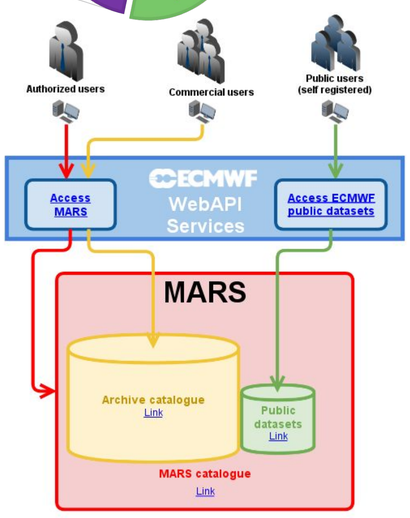
OBSERVATIONS
GLOBAL ANALYSIS
REGIONAL REANALYSIS

+ Regional reanalyses driven by global forcing and upper-air and surface observations using frozen systems
+ Multi-model and -technique ensembles of reanalyses
+ Surface and upper-air parameters



Distribution of the 8.2 M rescued observation data from URV. NMA-Romania has rescued additionally 300 k precipitation observations.Catalonia, Norway and Swedenhave provided some 170 M data from their already digitised open data which have not been available before.
The data are undergoing automatic and manual qualtiy control flags and some 9 % are flagged of which half can be corrected.





USERS

+ *Climate information*
+ *Bulletins for public*
+ *Information for policy makers*
+ *User interaction and evaluation*
+ *Downscaling*
+ *Model validation, climate*
+ *Energy wind and solar*
+ *Information and training*
+ *Agriculture and forestry season*
+ *Severe weather statistics*

ARCHIVING IN MARS

+ *The common UERRA archive is MARS at ECMWF*
+ *Data services from MARS and ESGF node at KNMI For E-OBS data and sub-set of reanalyses*
+ *Web Map Servers*
+ *Visualisation through Metview and WMS*

ECMWF ESGF Earth System Grid Federation

Height levels

15
30
50
75
100
150
200
250
300
400
500

Model levels

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

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

4.2.1 Precipitation and humidity

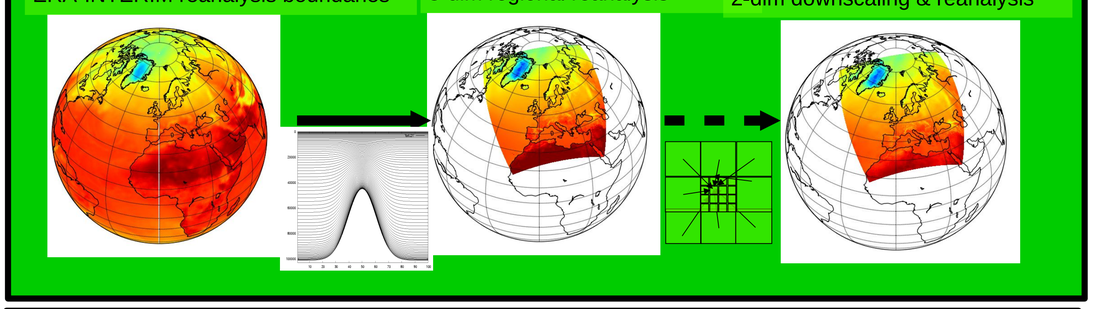
Parameter	MF	MESCAN (MF)	SURFEX (MF)	UM/4DVar UM/En4DVar (MO)		COSMO COSMO/En (HErZ/UB)		Harmonie/V1 Harmonie/V2 (SMHI)	
	For or Bg	Ana	For	Ana	For	Ana	For	Analysis	For
Accumulated total precipitation	X	X		X	X	X	X		X
2m relative humidity	X	X		X	X	X	X		X
Total column water vapour				X	X	X	X	X	X
runoff			X						
drainage			X						

Parameter	UM/4DVar UM/En4DVar (MO)		COSMO COSMO/En (HErZ/UB)		Harmonie/V1 Harmonie/V2 (SMHI)	
	Analysis	Fore-cast	Analysis	Fore-cast	Analysis	Fore-cast
cloud cover	X	X	X	X		X
cloud liquid water content (specific)	X	X	X	X		X
cloud ice content (specific)	X	X	X	X		X
geopotential height	X	X	X	X	X	X
relative humidity	X	X	X	X	X	X
temperature	X	X	X	X	X	X
U component of wind	X	X	X	X	X	X
V component of wind	X	X	X	X	X	X

Surface levels:
Temperature, wind, clouds, fluxes of sensible and latent heat, radiation fluxes, snow, rainfall
Soil levels
Temperature and soil wetness

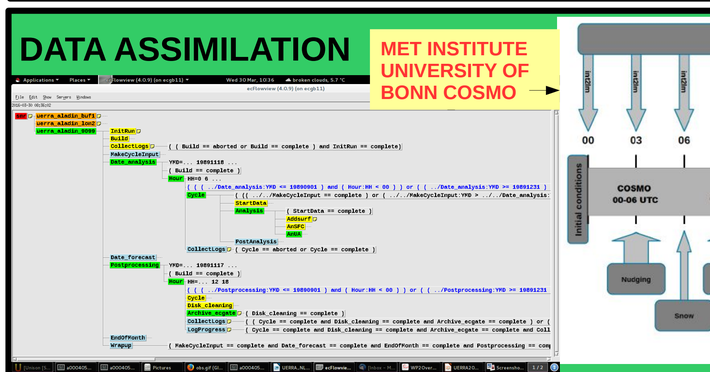
Analysis: six hourly at 00 UTC, 06 UTC, 12 UTC, 18 UTC (hourly for COSMO) Forecasts : T+1,2,3,4,5,6,9,12,15, 18,21,24,27,30 started at 00 UTC and 12 UTC T+1,2,3,4,5,6 started at 06 UTC and 18 UTC

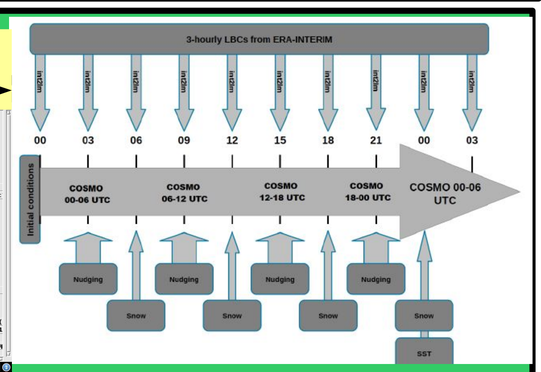
ERA-INTERIM reanalysis boundaries | 3-dim regional reanalysis | 2-dim downscaling & reanalysis



DATA ASSIMILATION

MET INSTITUTE UNIVERSITY OF BONN COSMO

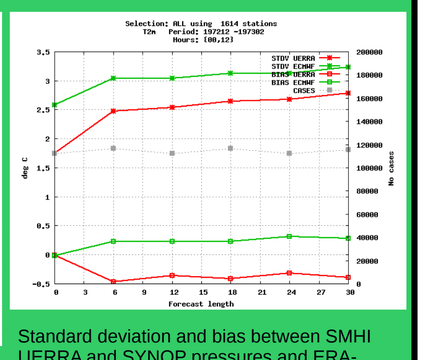




Finished reanalysis production and archiving

	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[1]	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[2]	T, RH, u, v, clouds, Geop, Precip, surf etc
UM Ens 3D-VAR	36	20	70	1979-1990, 2000-2014[2]	T, RH, u, v, clouds, Geop, Precip, surf etc

Number of observations used in SMHI UERRA and by type



Standard deviation and bias between SMHI UERRA and SYNOP pressures and ERA-Interim July-August 1961and for T2m

UERRA provides bases for uncertainty information both from the multi-model approach and through ensembles within each of the models/reanalysis systems.
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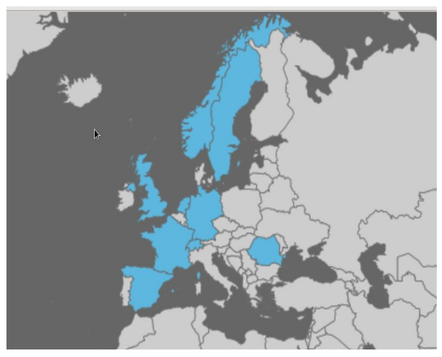
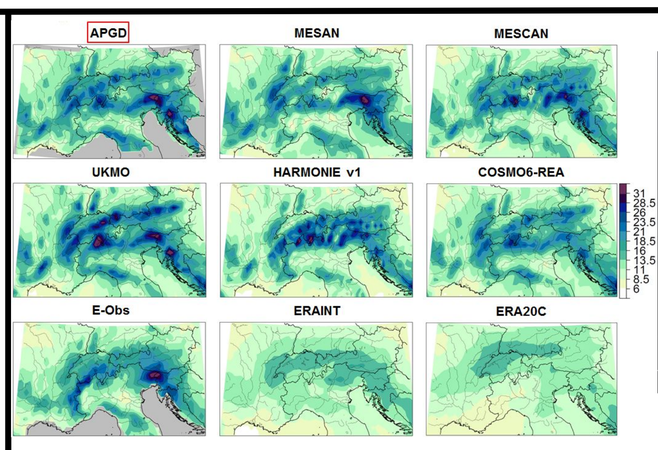
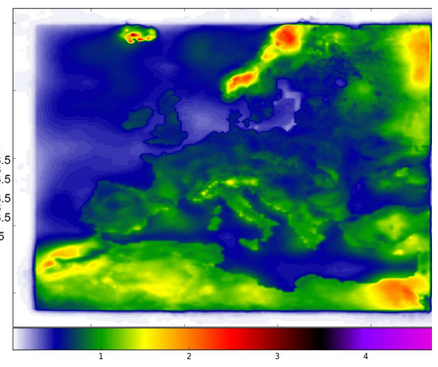
Project partners

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 · DWD · Meteorologisk institutt · Universitat Rovira i Virgili · METEO ROMANIA · universitätbonn Rheinische Friedrich-Wilhelms-Universität Bonn

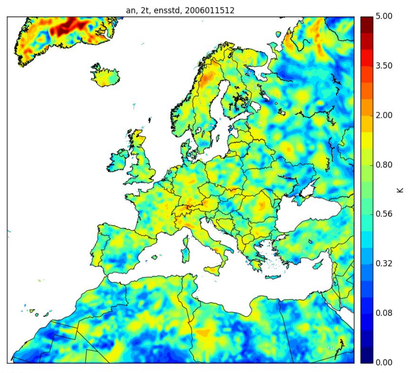




95% quantile of daily precipitation 2006-2008 for the different RAs and Alpine Precipitation Gridded Data Set



Spread of 2m temperature March 1979 from the Met Office ENS RA system.



MESCAN ensemble of perturbed observations and Networks T 2m standard deviation 15 Jan 2006 12

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