UERRA Regional reanalysis systems

Uncertainties in Ensembles of Regional ReAnalyses

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FP7 SPACE 2013-1

UERRA
Uncertainties in Ensembles of Regional ReAnalyses

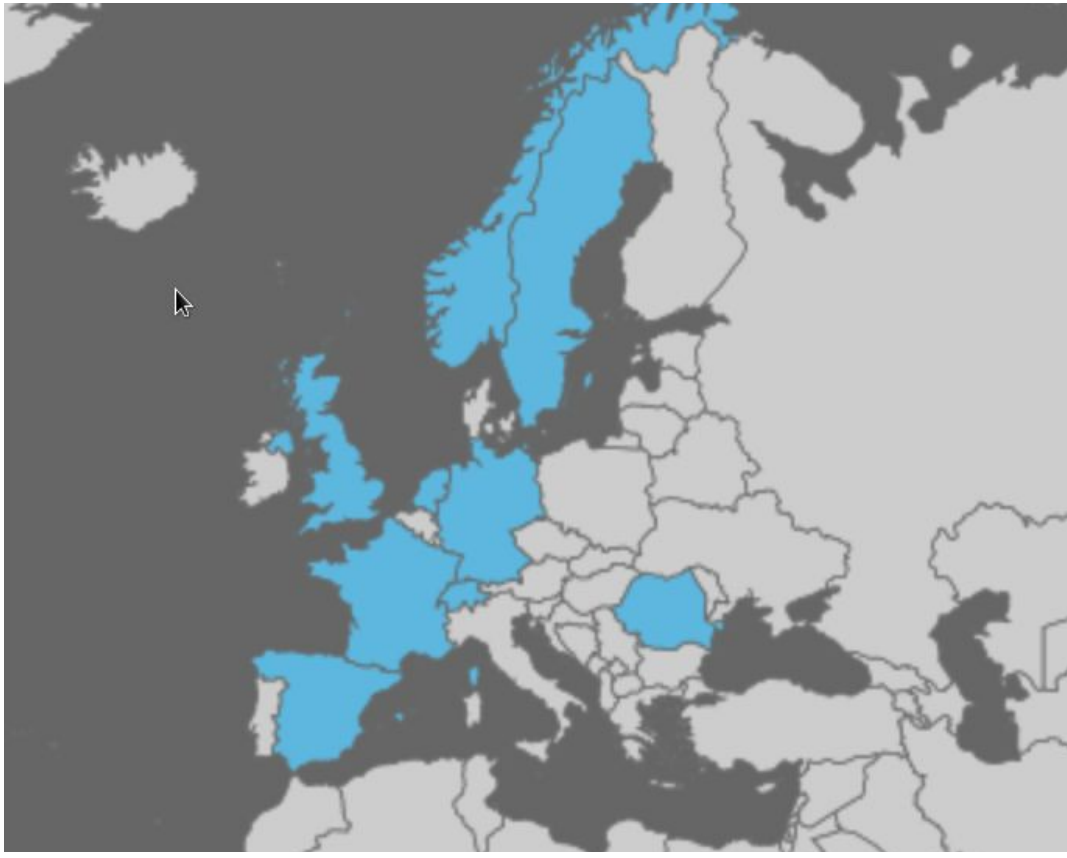
Project Partners

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

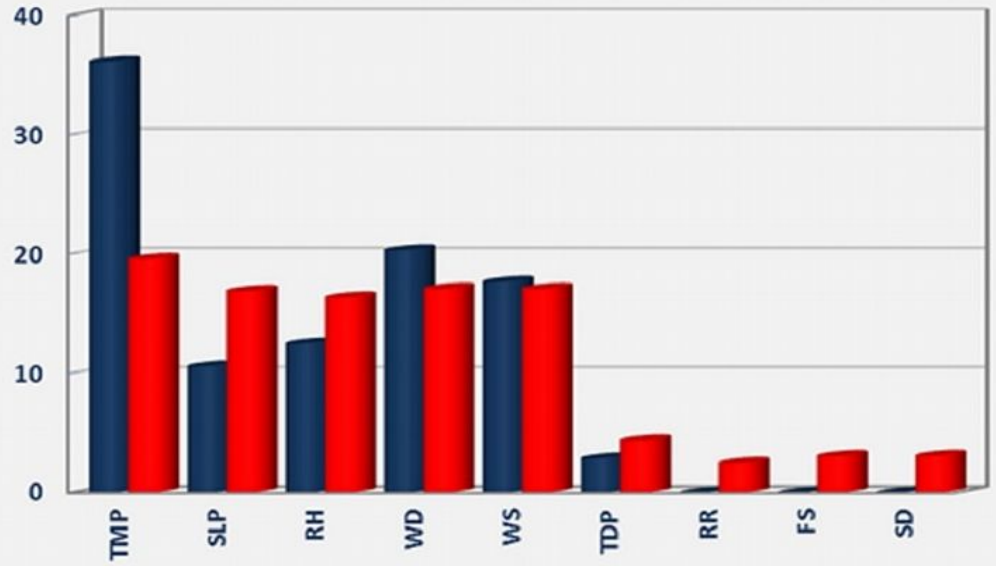
Data rescue of historical observations

+ *More than 8 M data recovered*

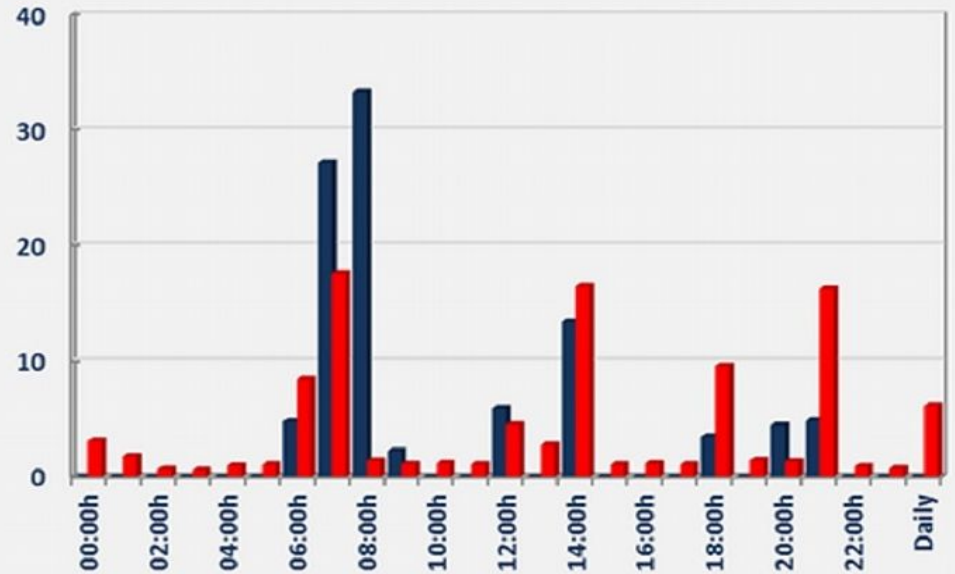
+ *Emphasis on sub-daily scale → observation stream for reanalyses*

+ *Comprehensive quality control and data development (correction, homogenisation)*

a) Percentage of digitised values by variable for pre-1961 (blue) & post-1961 (red) periods: ~1M & ~5M station values, respectively



b) Digitised values by observing times for pre-1961 (blue) & post-1961 (red) periods: ~1M & ~5M station values, respectively



TMP: hourly temperature; SLP: Sea Level Pressure; RH: Relative Humidity; WD: Wind Direction; WS: Wind Speed; TDP: Temperature Dew Point; RR: precipitation; FS: Fresh Snow; SD: Snow-depth

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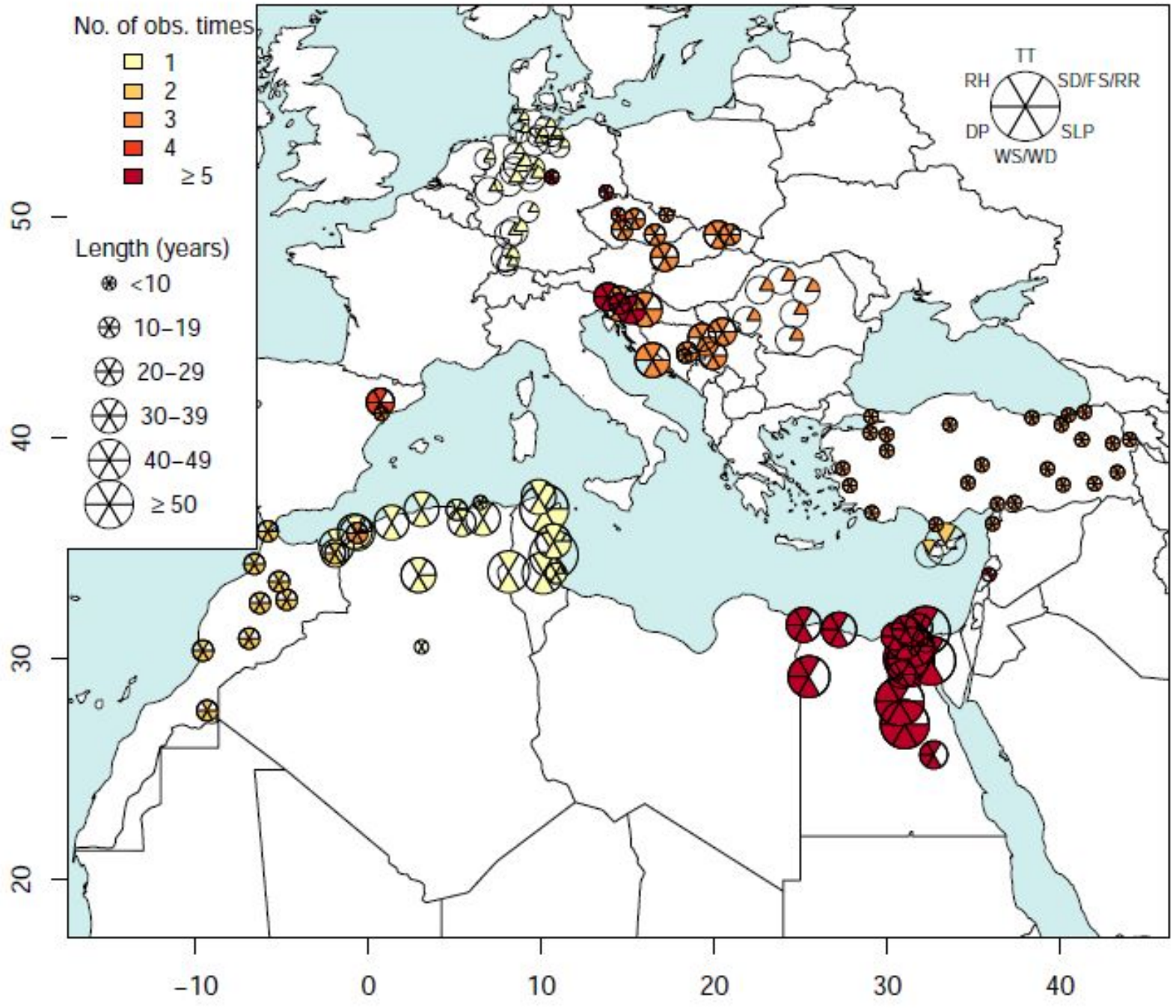
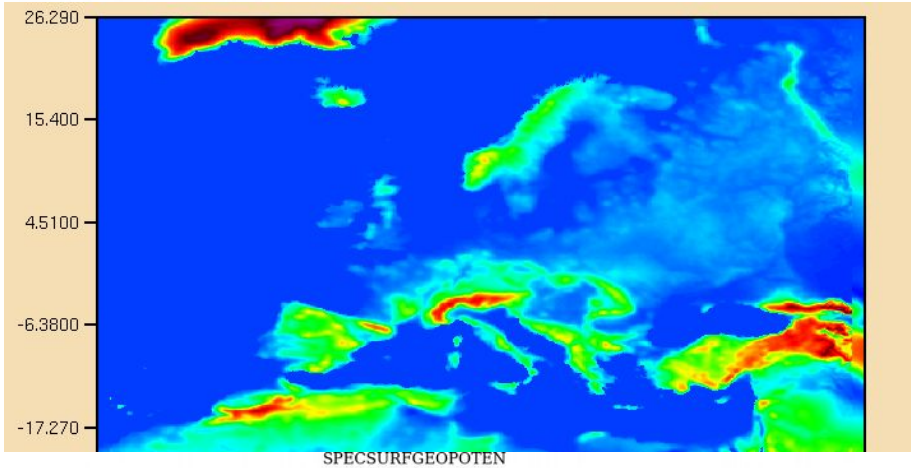
UERRA data sources 1879–2012



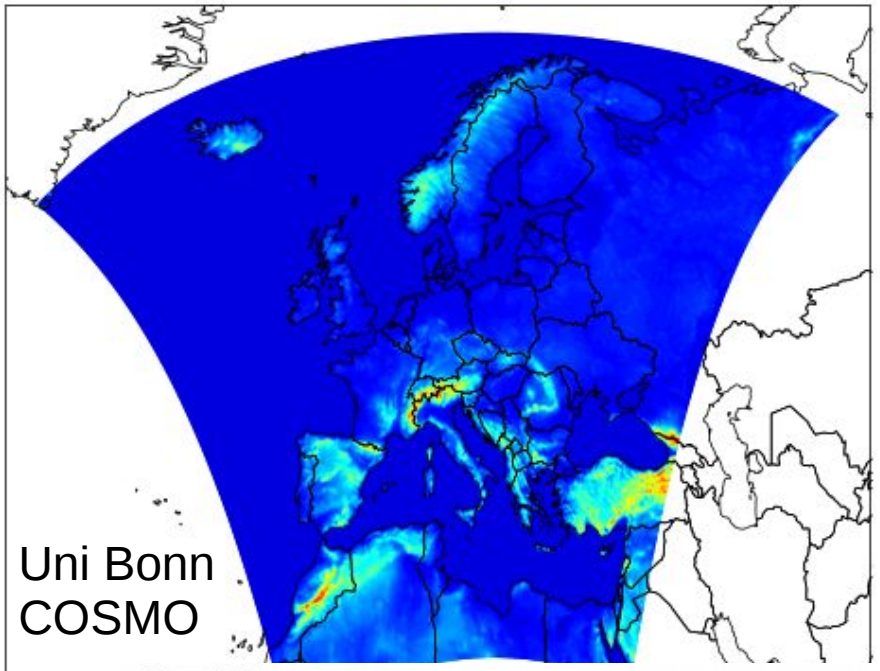
UERRA Domain & projections

Uncertainties in Ensembles of Regional ReAnalyses

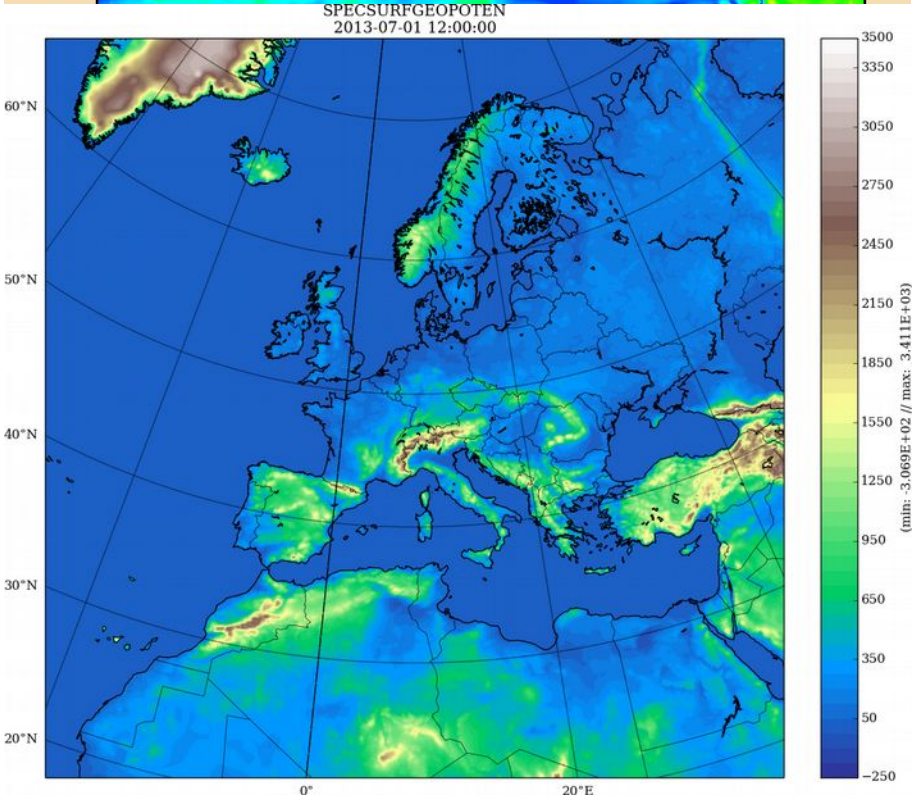
Met Office CORDEX EU 11 km



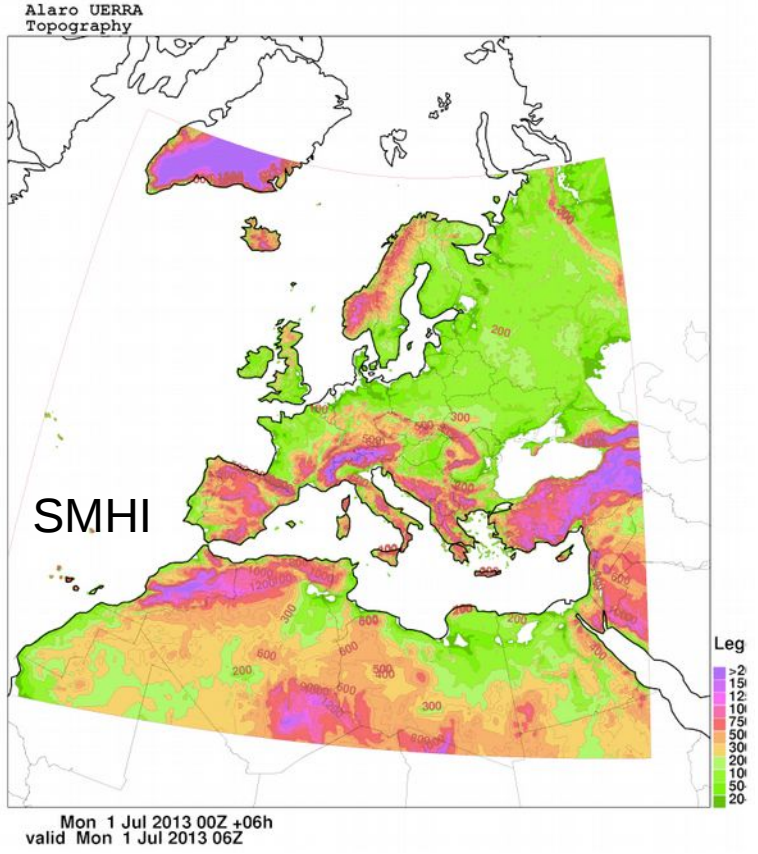
Uni Bonn COSMO



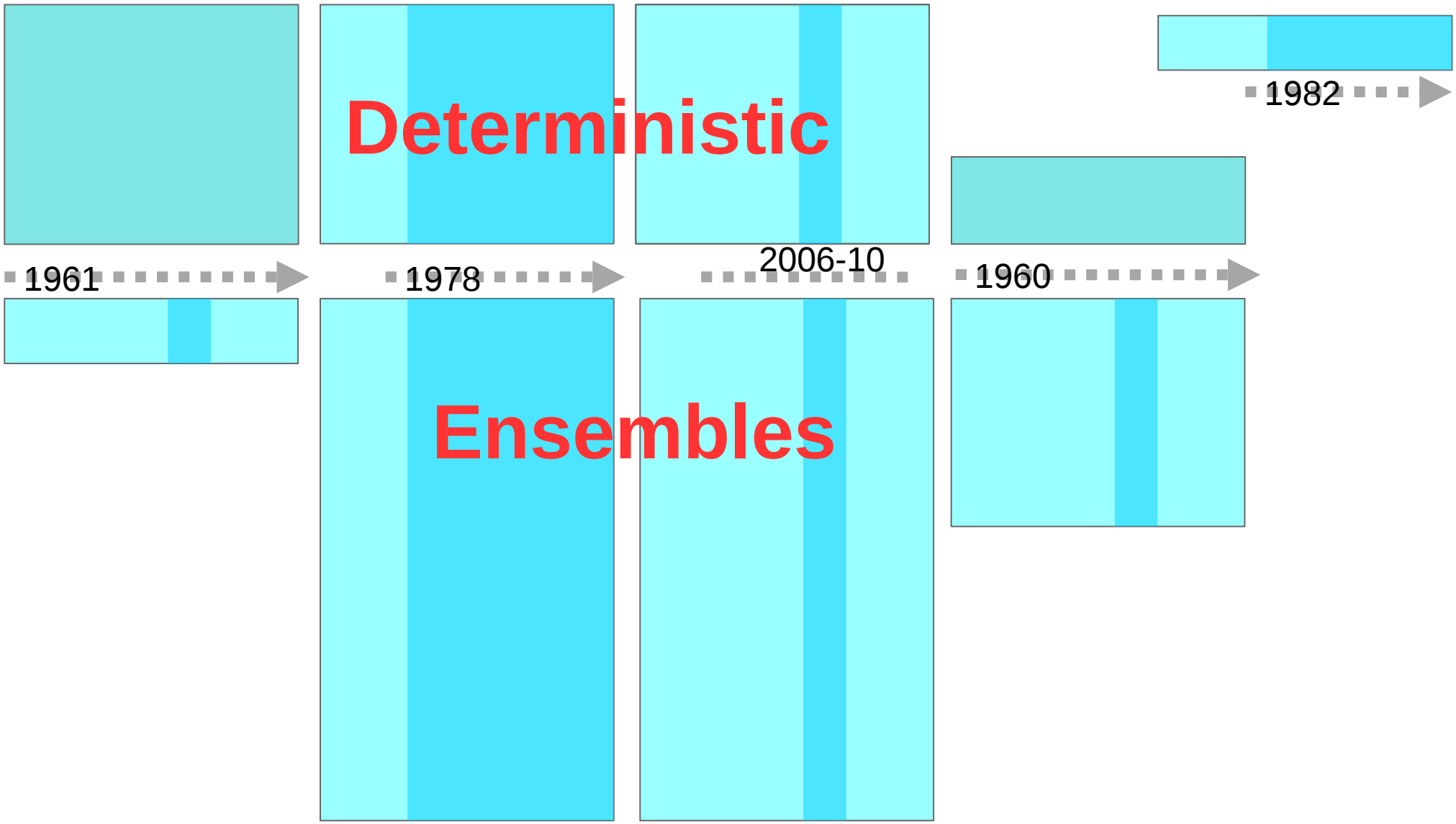
MF



SMHI



European Area 11 | 5 km || Multi-model || 2, 6, 20 Ensembles || 55 | 35 | 30 | 5 y



European Area 11 | 5 km || Multi-model || 2, 6, 20 Ensembles || 55 | 35 | 30 | 5 y

SMHI 3D-VAR
HARMONIE
ALADIN
12 km 65 levels

1961

2 Physics 5 y

Met Office 4D-VAR satellite era Using ensemble Information
12 km, 70 levels

1978

20 ensembles
4D-VAR 24 km

University of Bonn
Hans Ertel Centre
COSMO nudging
Assimilation
(LETKF prepare)
12 km, 40 levels

2006-10

20 ensembles
Nudging 12 km

SMHI MESAN cloud Analysis METEOSAT

1982

Météo-France 5km
MESCAN surface

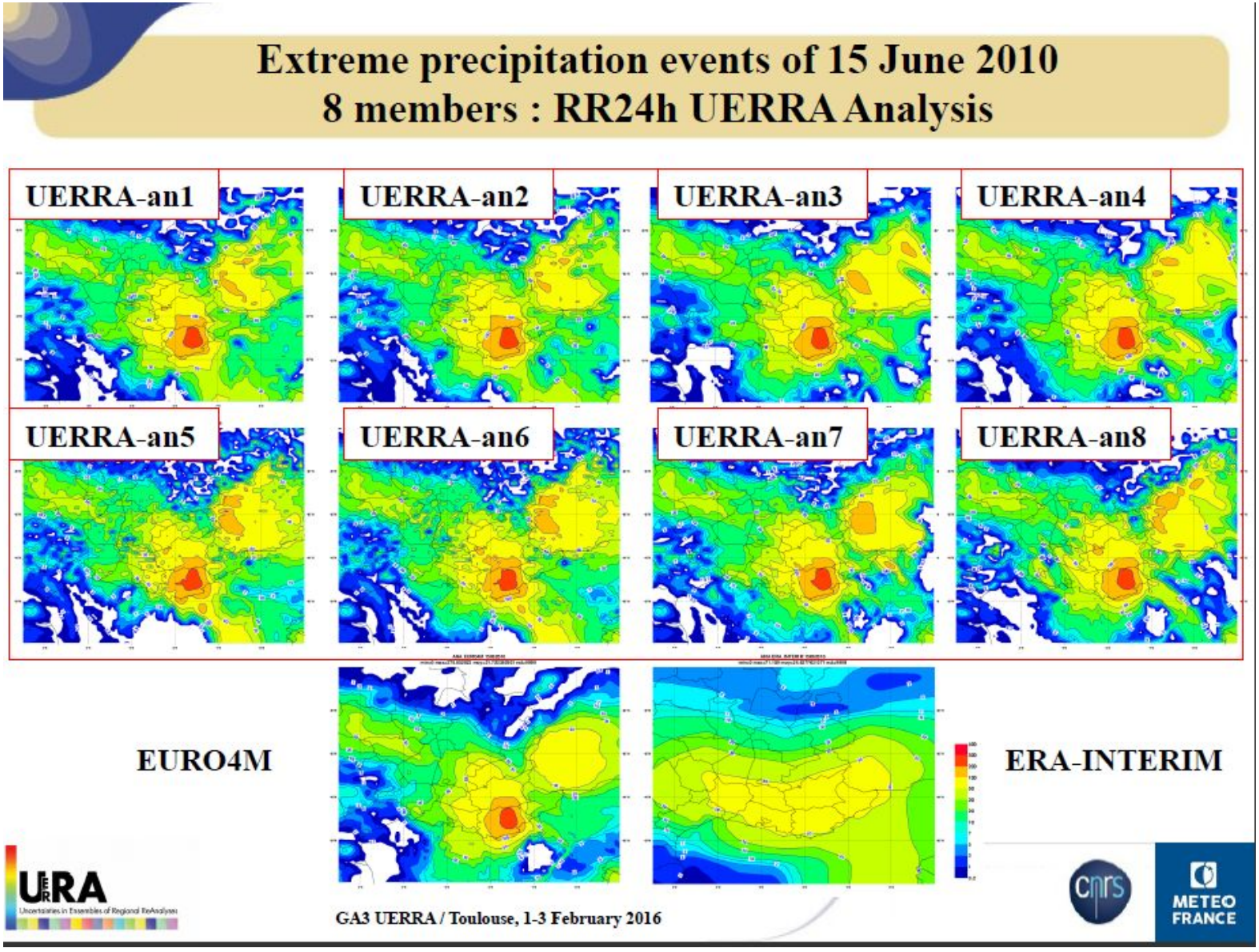
1960

6-8 ensembles
OI MESCAN
5 km

2-D surface fields analyses driven by 3D reanalyses

MF/SMHI MESCAN	SMHI MESAN	SMHI HYPE	MF SURFEX and TRIP
2D advanced Statistical Interpolation	2D advanced Statistical interpolation	Hydrological physical model	Surface flux model Hydrological physical model
Downscaled ALADIN model background	Downscaled 3D HIRLAM model Climatological adaptation background	ERA, EURO4M and UERRA reanalyses Precipitation and temperature forcing	MESCAN atmospheric variables and precipitation
Surface and climate stations T, Td, precipitation	AVHRR, METEOSAT SEVIRI and MVIRI	No input observations Validation against discharge data	No input observations Validation against discharge data
5 km Europe T2m, RH, 24 h precipitation	5 km Europe Cloud fraction hourly	River discharge 35000 catchments Europe, median 215 km^2	River discharge 25 km -> rivers
1961 - ~2016	~1982 - 2013	~1979 - 2010	~1981 - 2010

Ensemble members due to different model backgrounds



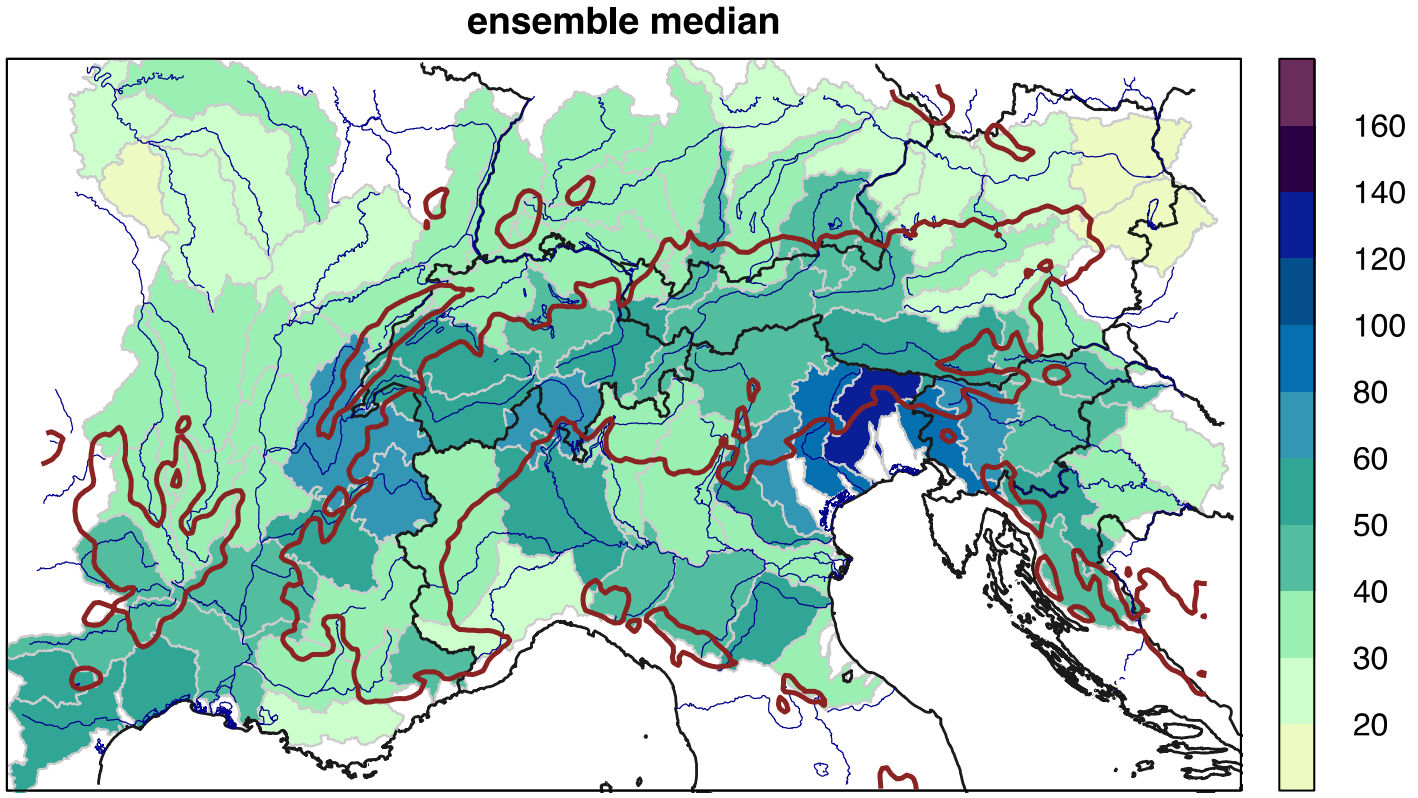
• Evaluation of reanalyses and uncertainties

Errors, scales of errors in space and time, exceedance etc.

- Point measurements
  - SYNOP and TEMP data
  - Mast measurements → independent !
- Data assimilation (feedback) statistics
  - Background (forecast) fits to data
- Gridded data sets often at high resolution
  - E-OBS (25 km)
  - Alpine and Nordic (MET Norway) data sets 2 km
  - GPCC (global precipitation)
- Satellite products (SAF and CCI)
- Ensemble renalyses spread

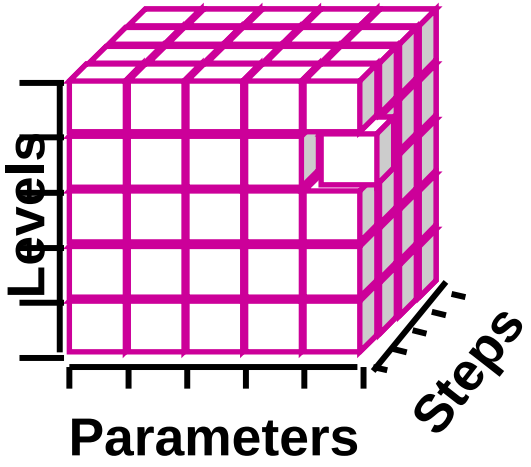
Uncertainty and Station Density

Scale B, largest event per catchment in 1990



ARCHIVING IN MARS
Data Services

+ *The common UERRA archive is MARS at ECMWF*
  Common set of parameters chosen for all models
  GRIB2 (some new definitions)
+ *Data services from MARS and ESGF interface*
+ *Web Map Servers*
+ *Visualisation through Metview and WMS*



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Model levels

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

Pressure levels

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

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Pressure levels

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

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

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Height levels

WP3 suggestion [m]
15
30
50
75
100
150
200
250
300
400
500

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Uncertainties in Ensembles of Regional ReAnalyses

Surface levels Analysis:
00 UTC, 06 UTC, 12 UTC, 18 UTC
hourly for COSMO, MESAN, SURFEX
Forecast: T+1,2,3,4,5,6,9,12,15,18,21,24,27,30
00 UTC and 12 UTC, T+1,2,3,4,5,6 06 UTC and 18

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						

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Surface levels

Many more parameters:

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

Soil levels

Temperature and soil water

UERRA user workshop

Participants statistics:
48 participants from 12 countries *(18 from France)*
19 working on applications of re-analyses data
10 not related to UERRA

Applications:
Energy (wind, solar, demand), Insurance,
Transport, Agriculture, Defense, Hydrology,
Climate Impacts, Model evaluation,
Atmospheric physics

UERRA user workshop

- Participants presented their applications and requirements
- About 50% had some experience with re-analyses data
- The list of UERRA data products seems fairly complete
- Time and spatial resolution requested for was very variable; some cannot be provided by UERRA
- Most users were not familiar with ‘Feedback’ information provided by the re-analyses systems,
- Easy access to re-analyses data is the most important requirement
- Evaluation tools and visualization tools are of interest to a significant number of users

Link to agenda, presentations and full workshop report: http://www.uerra.eu

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Timeline

2015 – HARMONIE 5 years 2 physics

- HARMONIE
- MF MESCAN (5 year 6 member ensemble)
- UM Ensemble 4D-VAR start test only
- MESAN cloud analysis 0 years test

2016 – HARMONIE another 20 y -> 25-30 y 5 streams @ 4-5 years

- MESCAN -> 5 + 25 years
- MESAN cloud analysis 25 years
- UM Ensemble 4D-VARs 20-30 years
- UBO COSMO Ensemble 5 years

2017 – HARMONIE 25 years -> 55 years

- MESCAN 25 years -> 55 years
- UM Ensemble 4DVAR -> 36 years, Hybrid 4D-VAR 36 years
- UBO COSMO diagnostics

End

Read more on www.uerra.eu

www.uerra.eu