Monitoring in MedCOF: observed temperature and precipitation anomalies over the region

E. Rodríguez-Camino

AEMET

(with contributions of I. Mestre, E. Sánchez, F. Franco)

Outline

- Introduction
- Motivation
- Gridded versus station observational data
- Gridded/station data: weaknesses and strengths
- Observations: scales and representativeness
- Conclusions and recommendations
- Discussion on MedCOF step 1

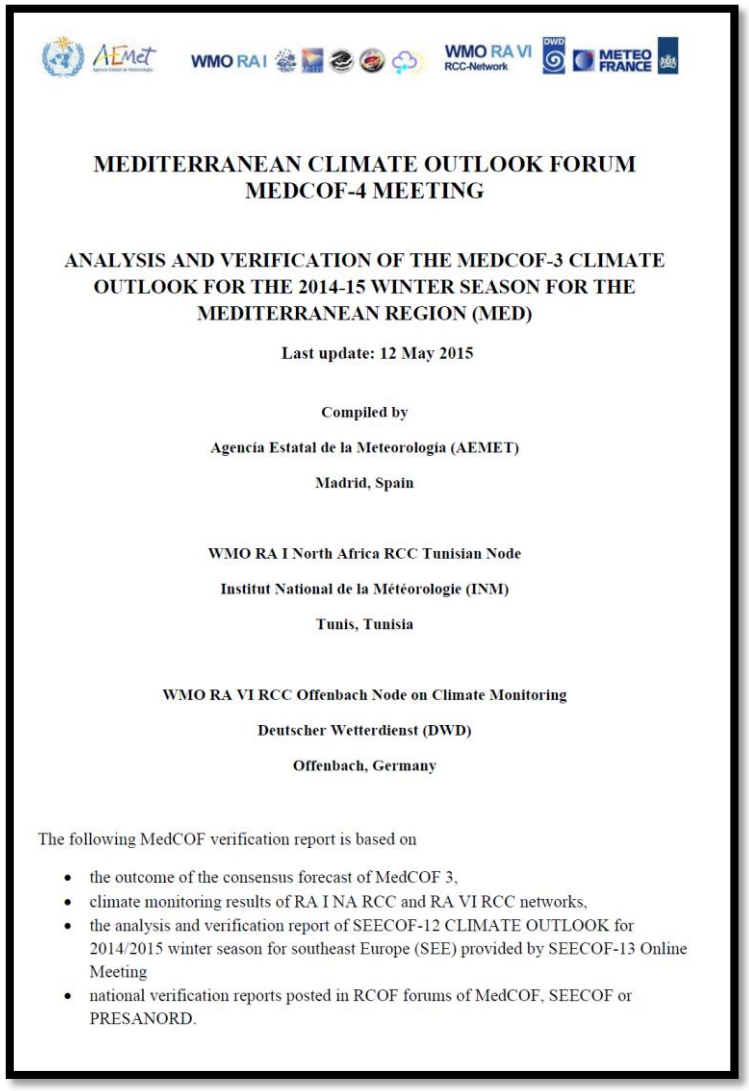
Introduction

- Main **objective** of this workshop: improvement of MedCOF procedures and products

- MedCOF –as many other RCOFs- follows three steps:
  - STEP-1: Verification of previous forecasted season
  - STEP-2: Assessment of the current state of climate
  - STEP-3: Building of the consensus statement

Motivation

STEP-1: Verification of previous forecasted season.



MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-4 MEETING

ANALYSIS AND VERIFICATION OF THE MEDCOF-3 CLIMATE OUTLOOK FOR THE 2014-15 WINTER SEASON FOR THE MEDITERRANEAN REGION (MED)

Last update: 12 May 2015

Compiled by

Agencia Estatal de la Meteorologia (AEMET)

Madrid, Spain

WMO RA I North Africa RCC Tunisian Node

Institut National de la Météorologie (INM)

Tunis, Tunisia

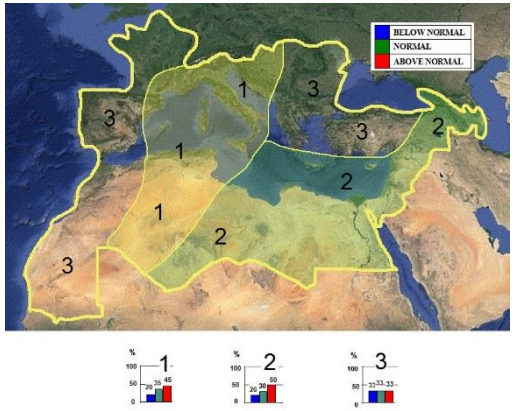
WMO RA VI RCC Offenbach Node on Climate Monitoring

Deutscher Wetterdienst (DWD)

Offenbach, Germany

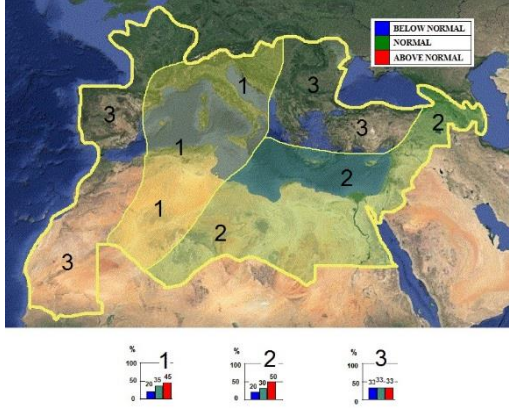
The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF 3,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- the analysis and verification report of SEECOF-12 CLIMATE OUTLOOK for 2014/2015 winter season for southeast Europe (SEE) provided by SEECOF-13 Online Meeting
- national verification reports posted in RCOF forums of MedCOF, SEECOF or PRESANORD.



Considerations:

- Based on products of RAI NA and RAVI RCCs and national verification reports.
- Many products and national verification reports are based on absolute values, anomalies, …
- Need to move to tercile based products more adapted to seasonal probabilistic outputs
- Need to move from subjective verification to objective computation of verification scores



Verification and monitoring in the format in which forecasts are presented.

- If forecasts are delivered in form of tercile-based categories → Verification/monitoring should fit to it!

Some considerations on observational data


- Observational data are frequently not publicly available


- Very different density of observations among regions

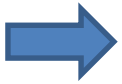

- Lack of data over uninhabited regions


- MedCOF comprises two WMO RAs with different databases/repositories for verification purposes


- Obs data at full resolution not needed → only terciles


- Probably terciles have not commercial restrictions


- Global gridded observational data and re-analysis available



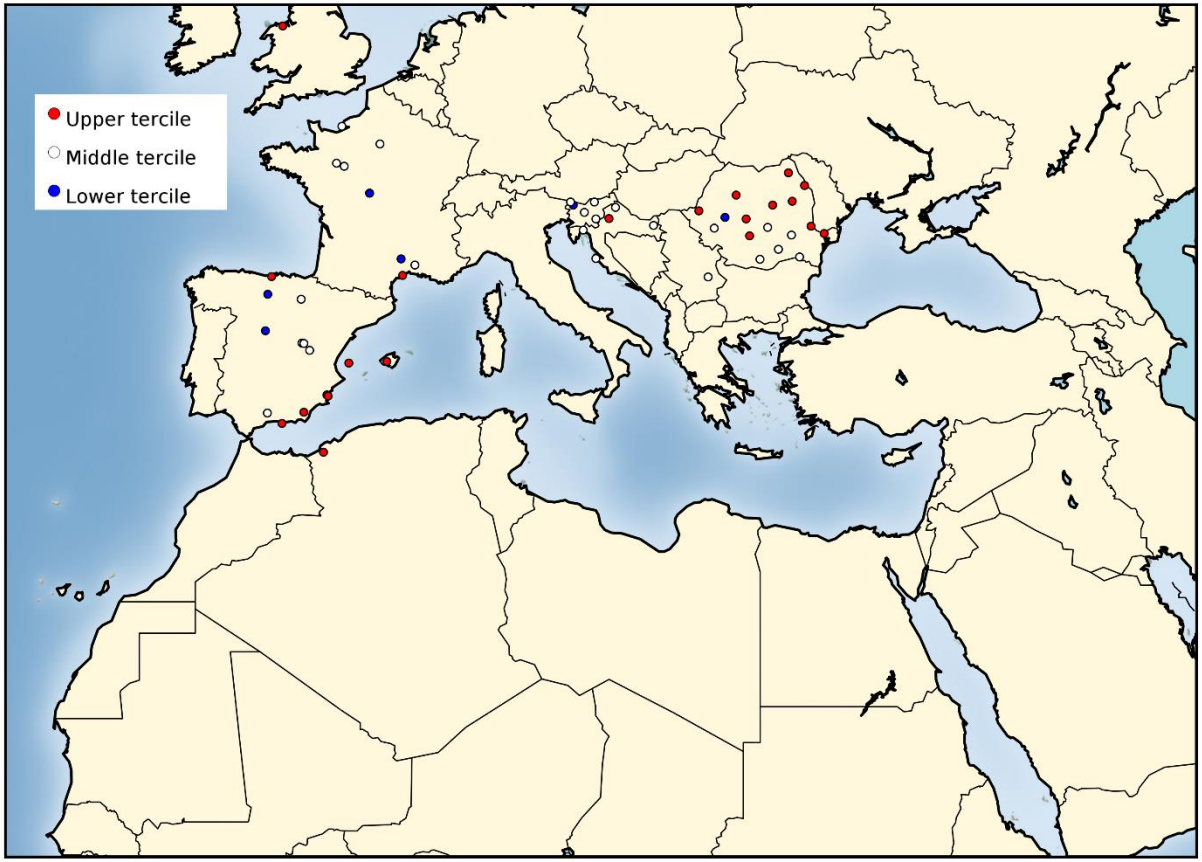
Verification of tercile-based forecasts only requires information of the obs. category → problems related data policy circumvected

Year	Observation	Below	Normal	Above
2001	B	0.45	0.35	0.20
2002	B	0.50	0.30	0.20
2003	B	0.35	0.40	0.25
2004	B	0.33	0.33	0.33
2005	N	0.25	0.35	0.40
2006	N	0.20	0.35	0.45
2007	A	0.20	0.35	0.45
2008	A	0.25	0.40	0.35

(back)

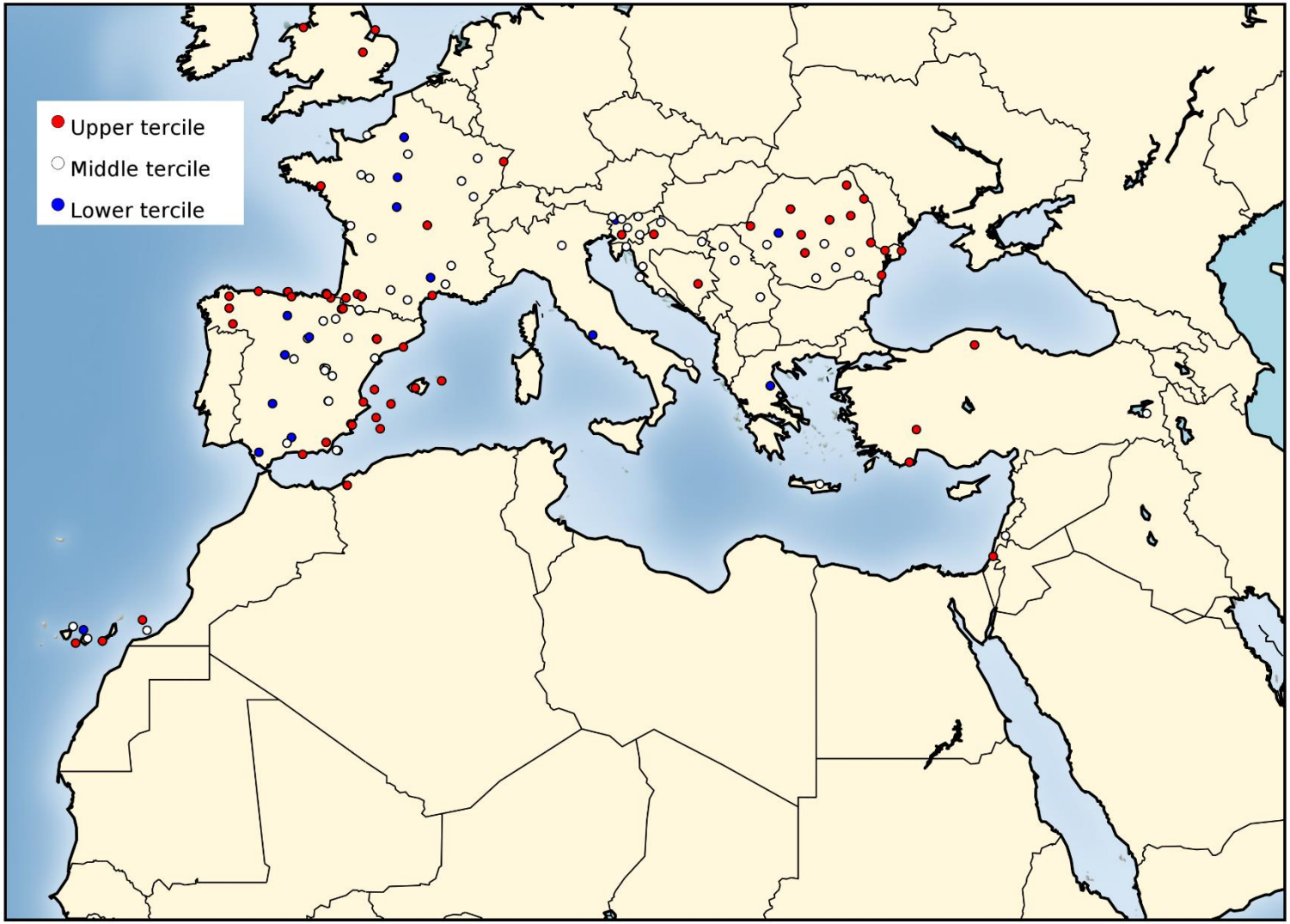
Verifying against what?

TEMPERATURE JJA 2014 (ECA&D data)
(reference period 1981-2010)



No gaps

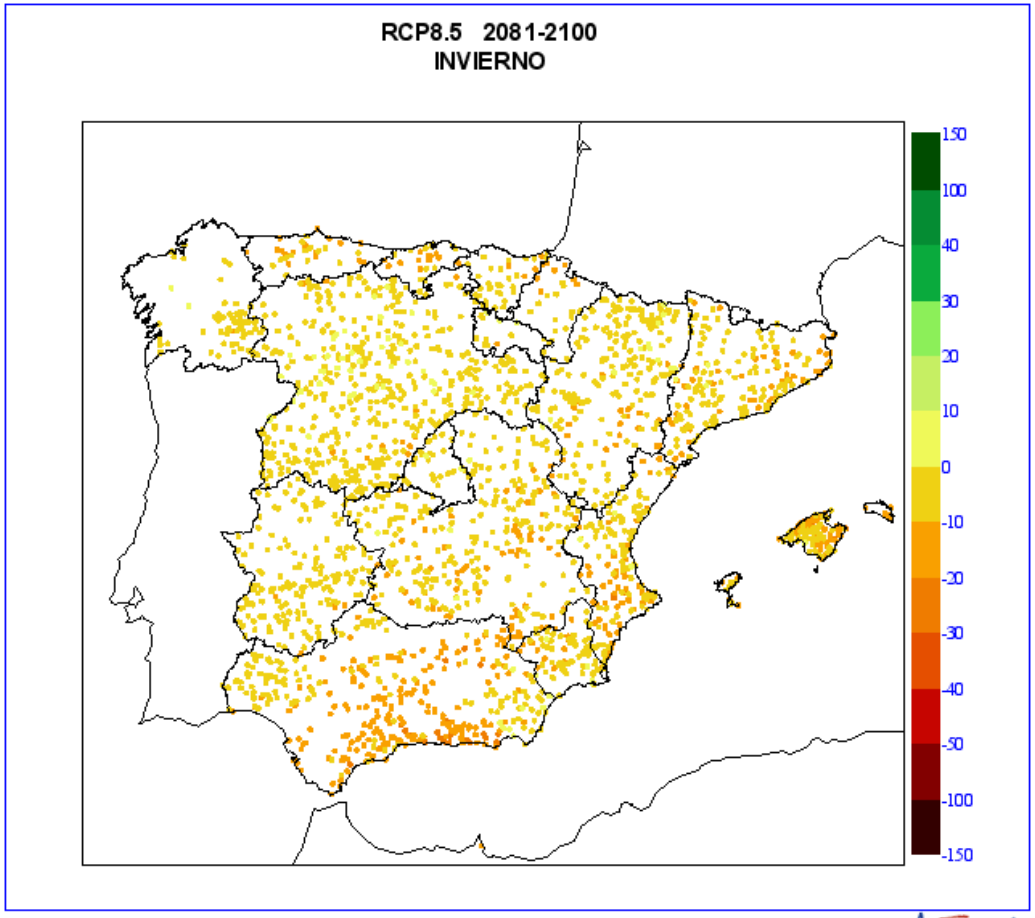
TEMPERATURE JJA 2014 (ECA&D data)
(reference period 1981-2010)



15% gaps

What else can we do?

- Use of available data from NMHSs?
- Regional data collection for monitoring and verification purposes?

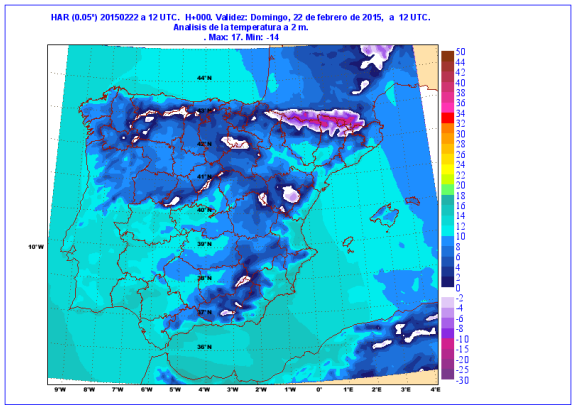


Data grids

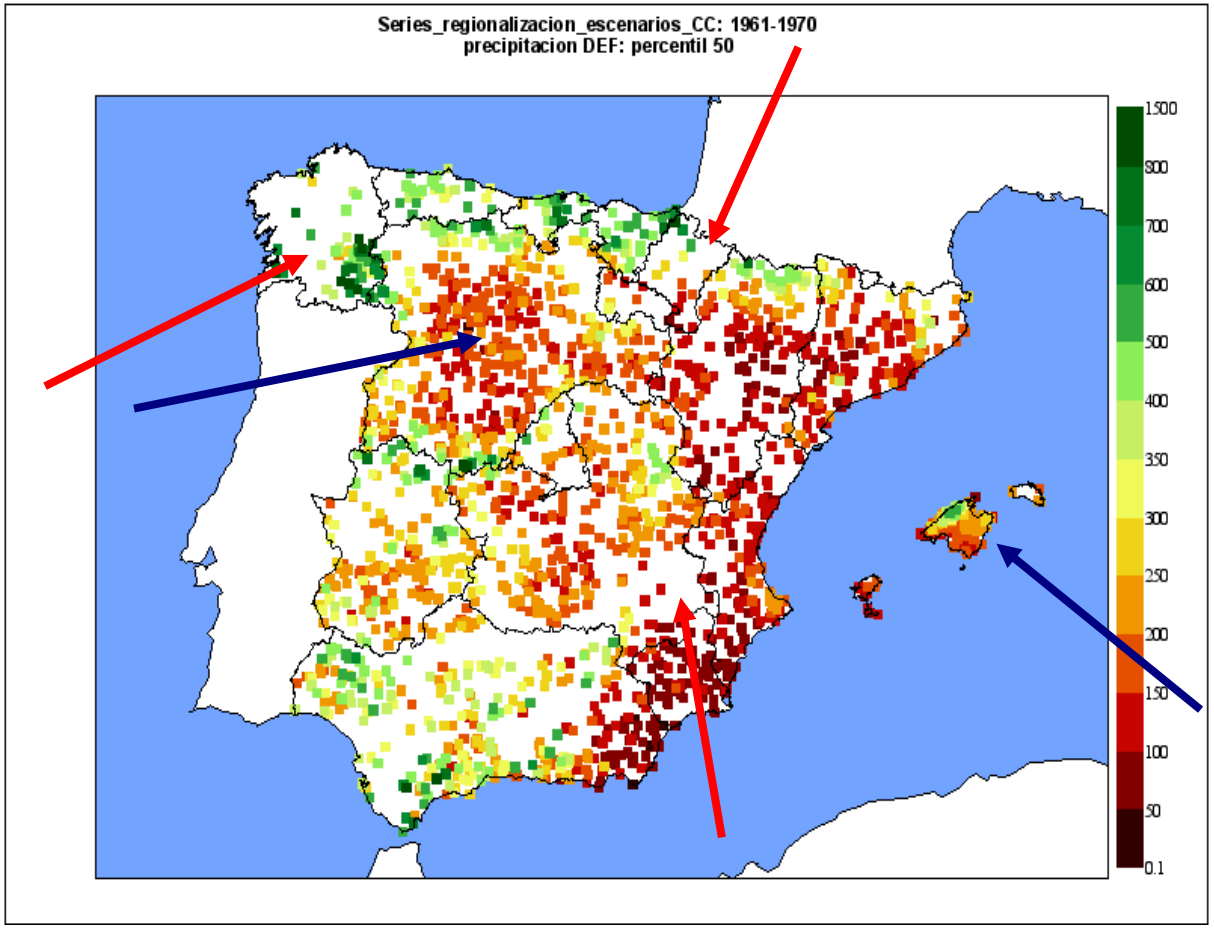
Historically, two separate worlds:

- World of climate → station data → grids

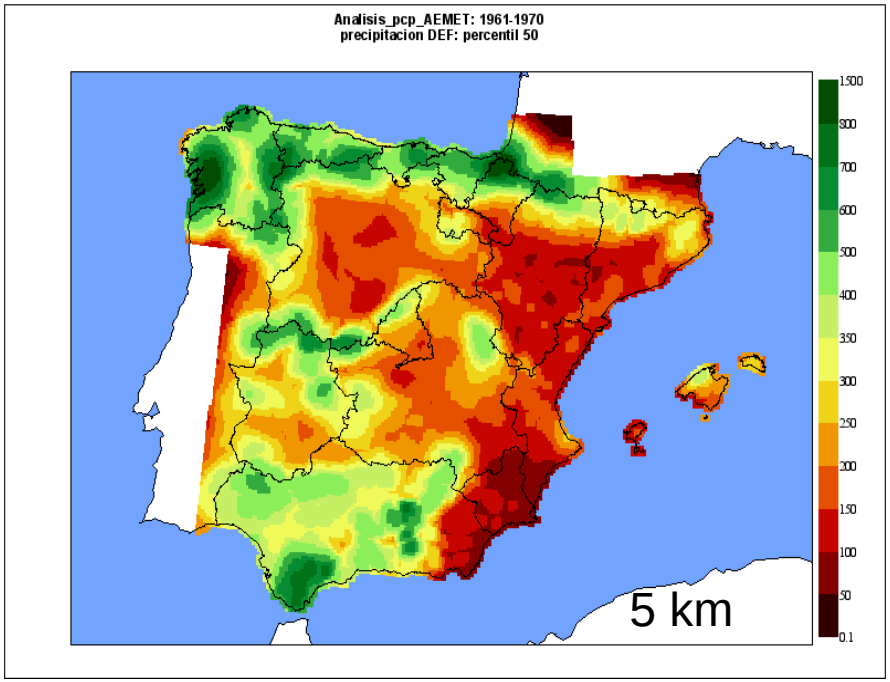
- World of prediction/models → data assimilation → grids

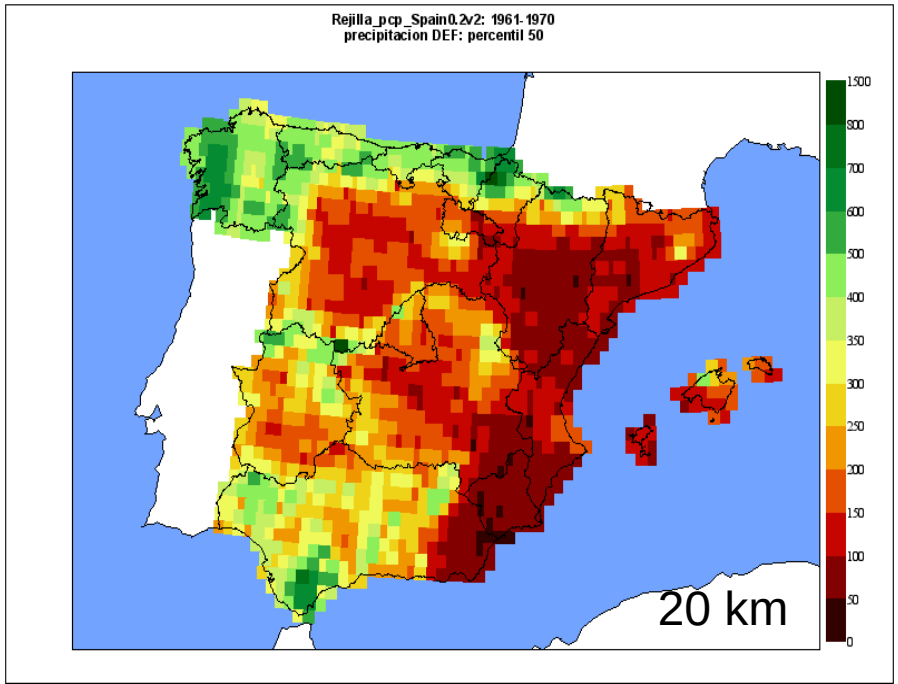


- Time series of quality controlled climate data
- Inhomogenous horizontal resolution of final observation dataset



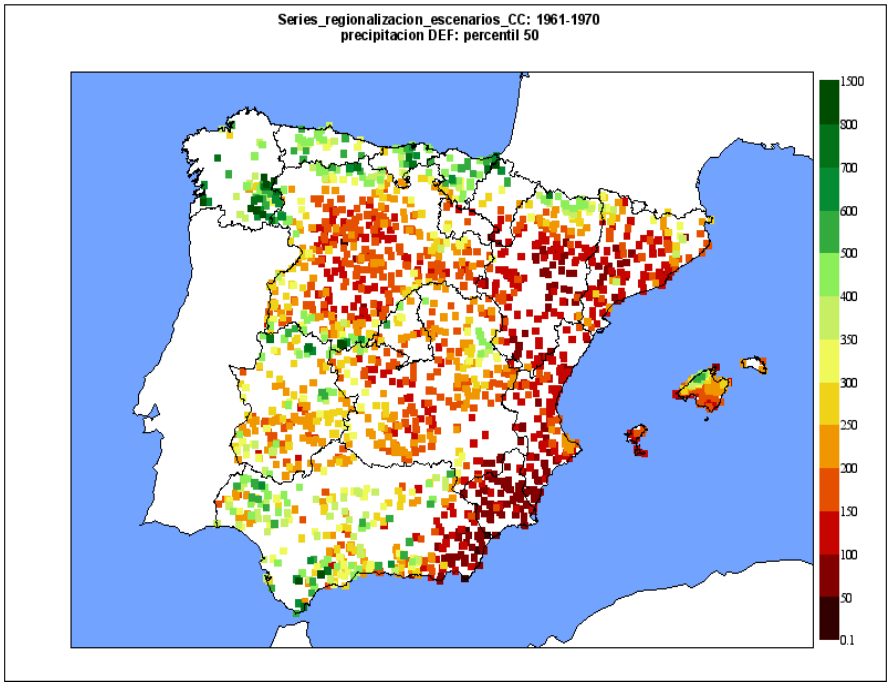
e.g. precipitation





Preliminary trial:

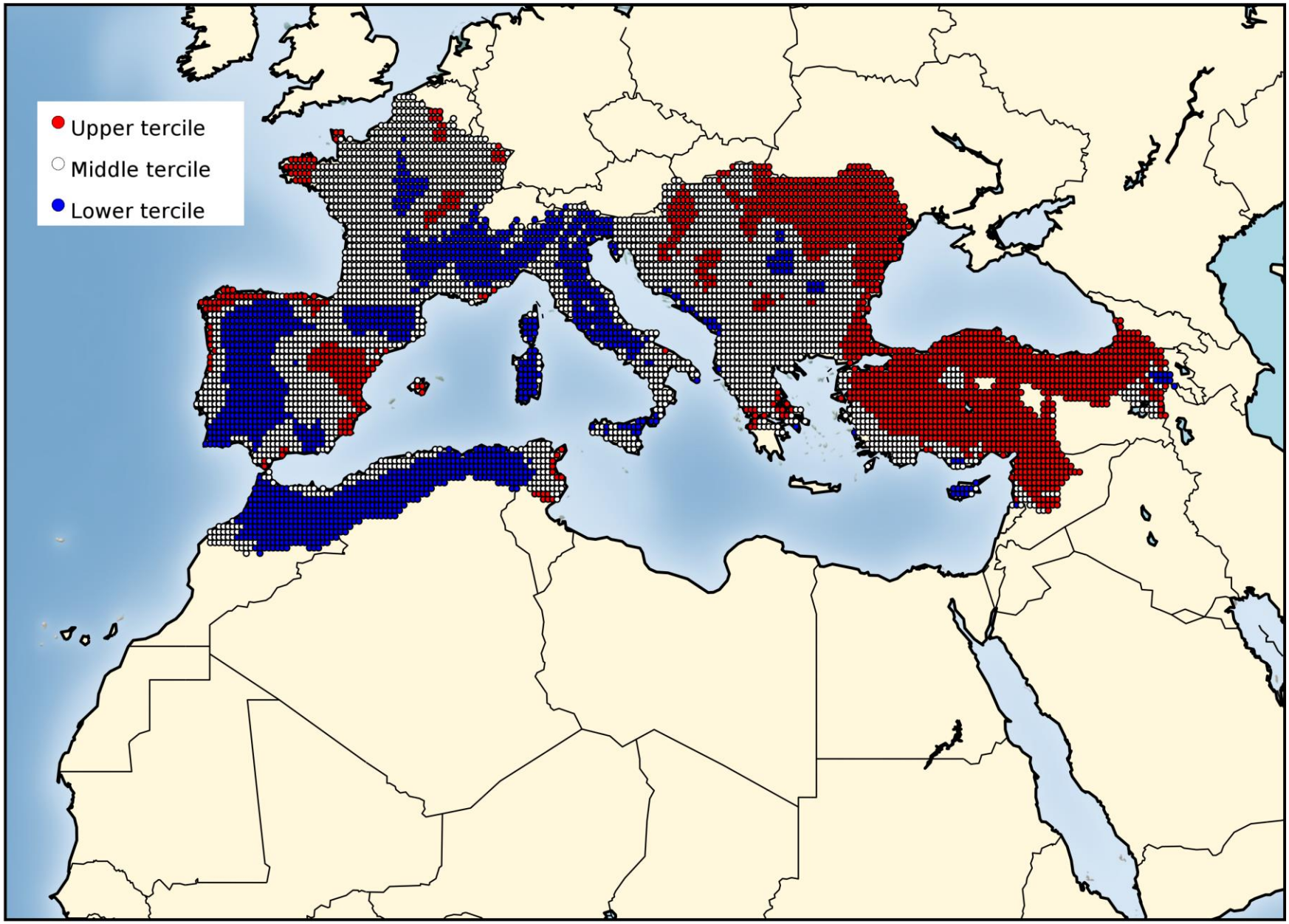
P50 DEF 1961-1970



The extraordinary art of monitoring /verifying without observations!

- Use observational grids as an alternative
- Problem of availability → 2-4 months processing time
- Mathematical artifacts to generate the grids (interpolations?)
- Robustness of a tercile-based description of pdf's

TEMPERATURE JJA 2014 (EOBS data)
(reference period 1981-2010)



A European daily high-resolution gridded data set of surface temperature and precipitation for 1950–2006

M. R. Haylock,[1,2] N. Hofstra,[3] A. M. G. Klein Tank,[4] E. J. Klok,[5]
P. D. Jones,[1] and M. New[3]

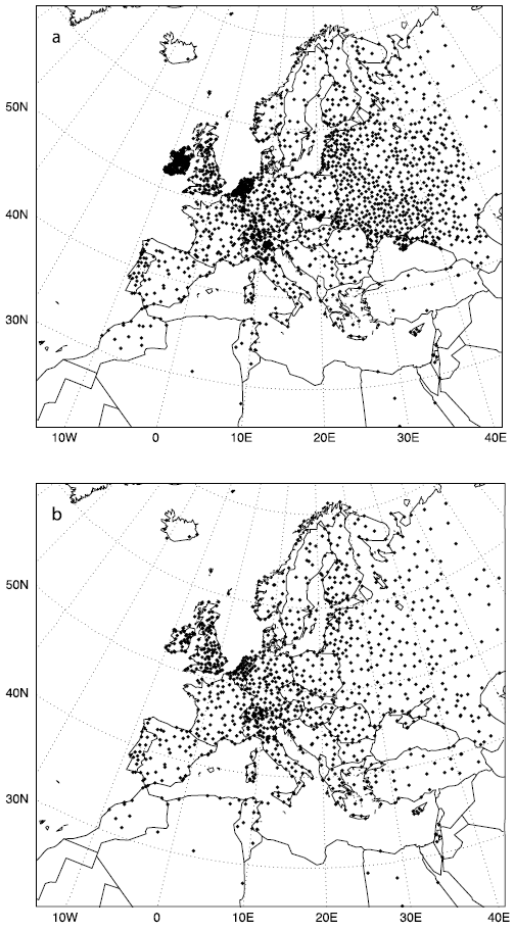


Figure 1. The complete gridding region (land-only), showing the station network for (a) precipitation and (b) mean temperature.

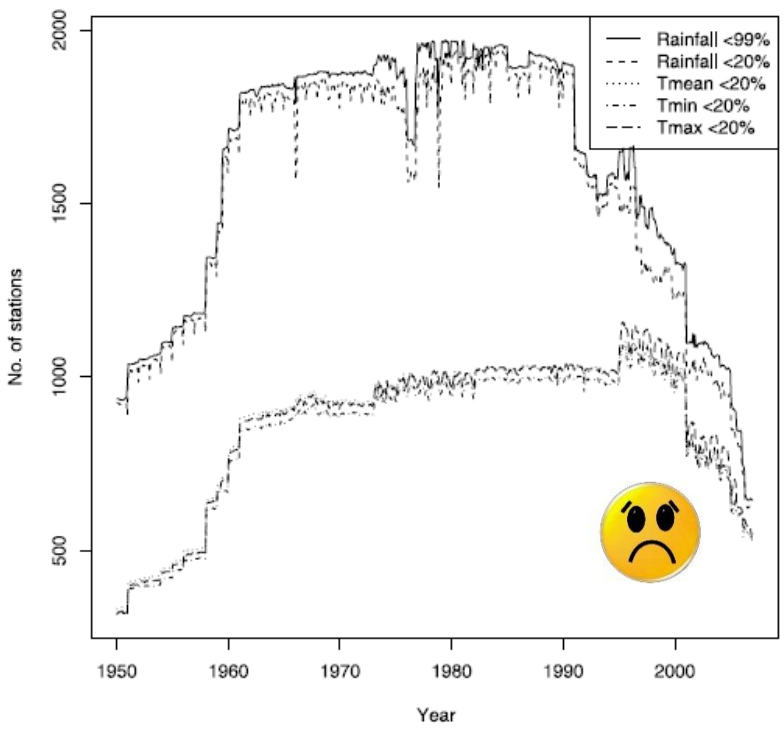


Figure 2. The number of stations with less than 99% and 20% missing observations for each month.

Types of gridded observational data

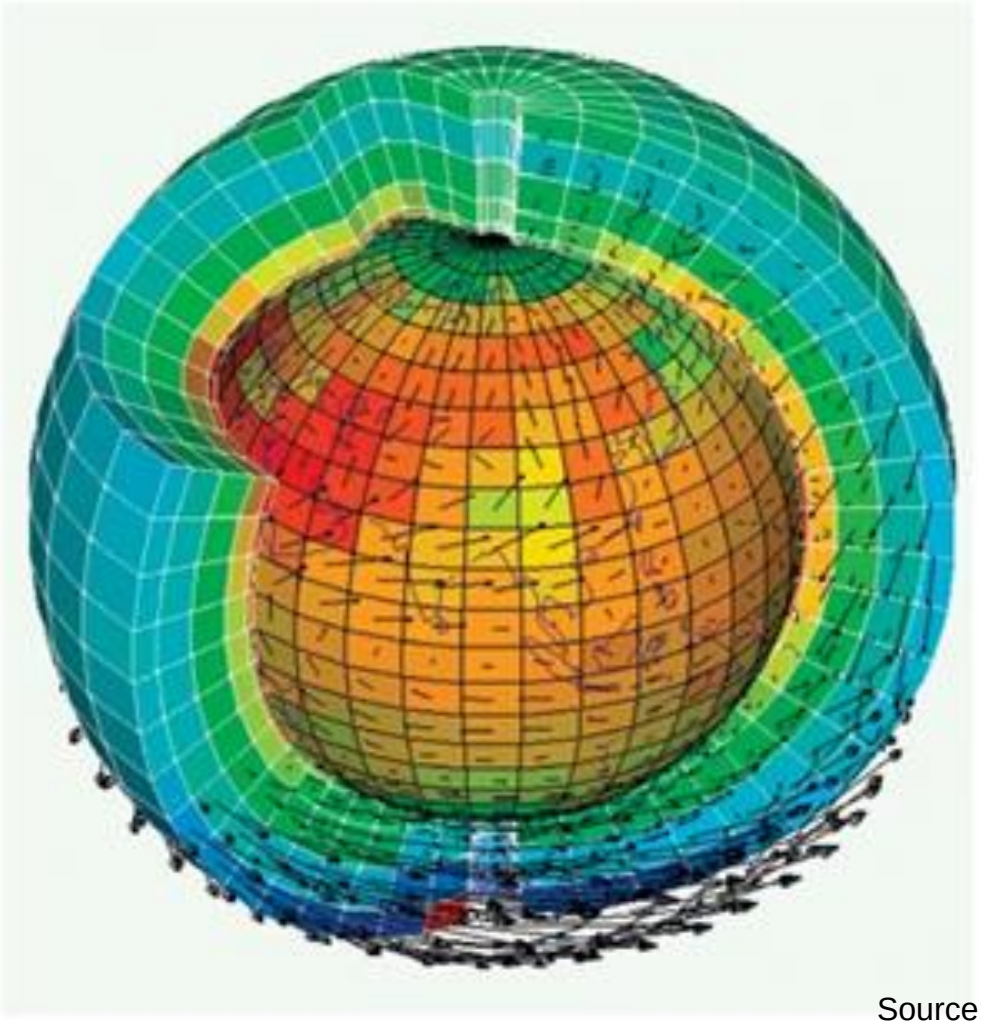
- Gridded data: 2-dimensional array of values (grid cells) which maps on to an area.
- Making use of:
  - only observations
  - Analysis → mixing obs with FG (model dependant)
  - Diagnosed → e.g. derived from model outputs

What to do when we do not have observations?

- Analysis → Mix obs and first guess
  - If no (or few) obs then analysis → model
  - If high density of obs then analysis → obs

ERA-Interim

ERA-Interim is a global atmospheric reanalysis from 1979, continuously updated in real time

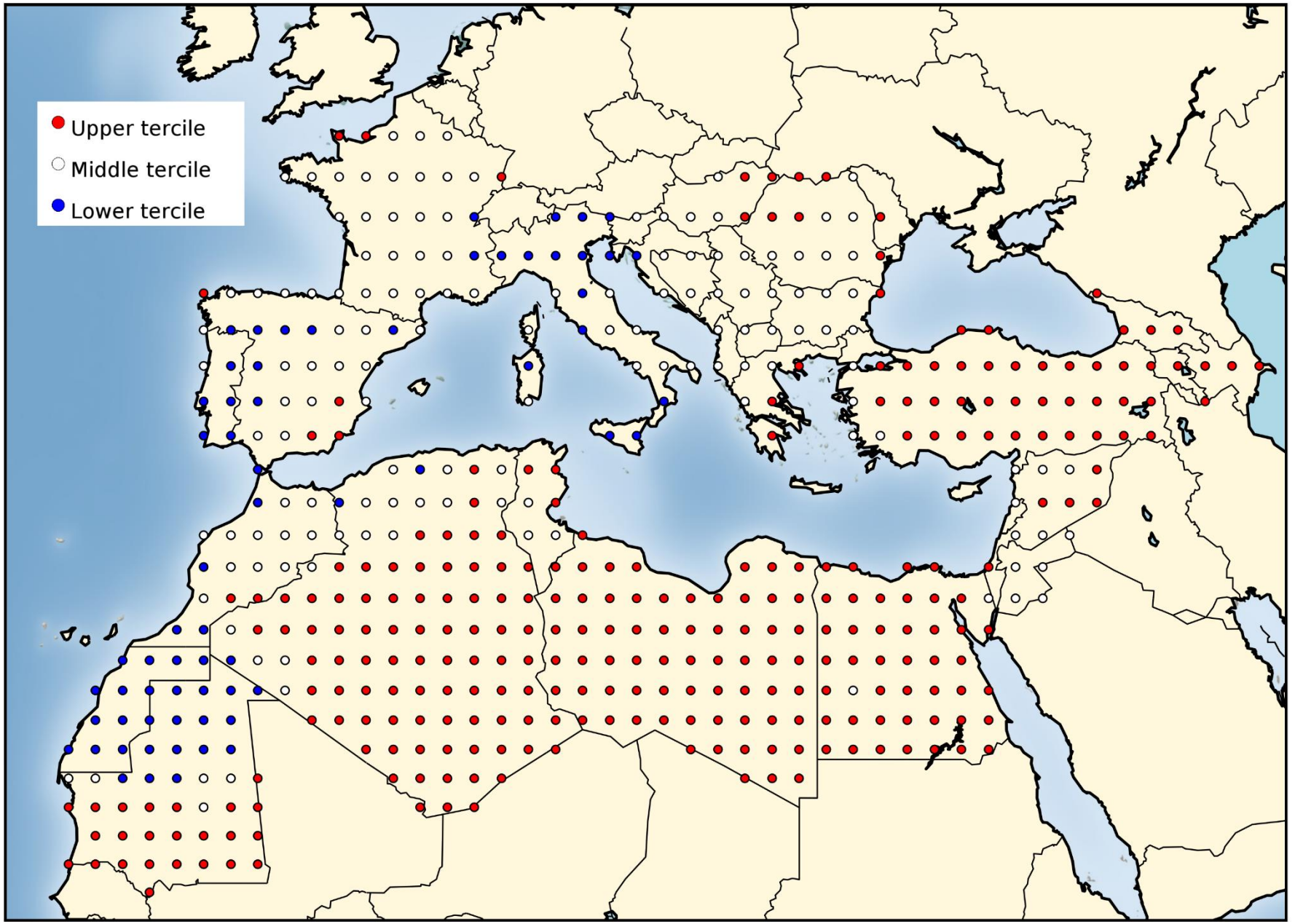


What is climate **reanalysis**?

A climate reanalysis gives a numerical description of the recent climate, produced by **combining models with observations**.

Source: L. Fairhead (IPSL/LMD)

TEMPERATURE JJA 2014 (ERA-Interim data)
(reference period 1981-2010)



Some considerations on ERA-Interim

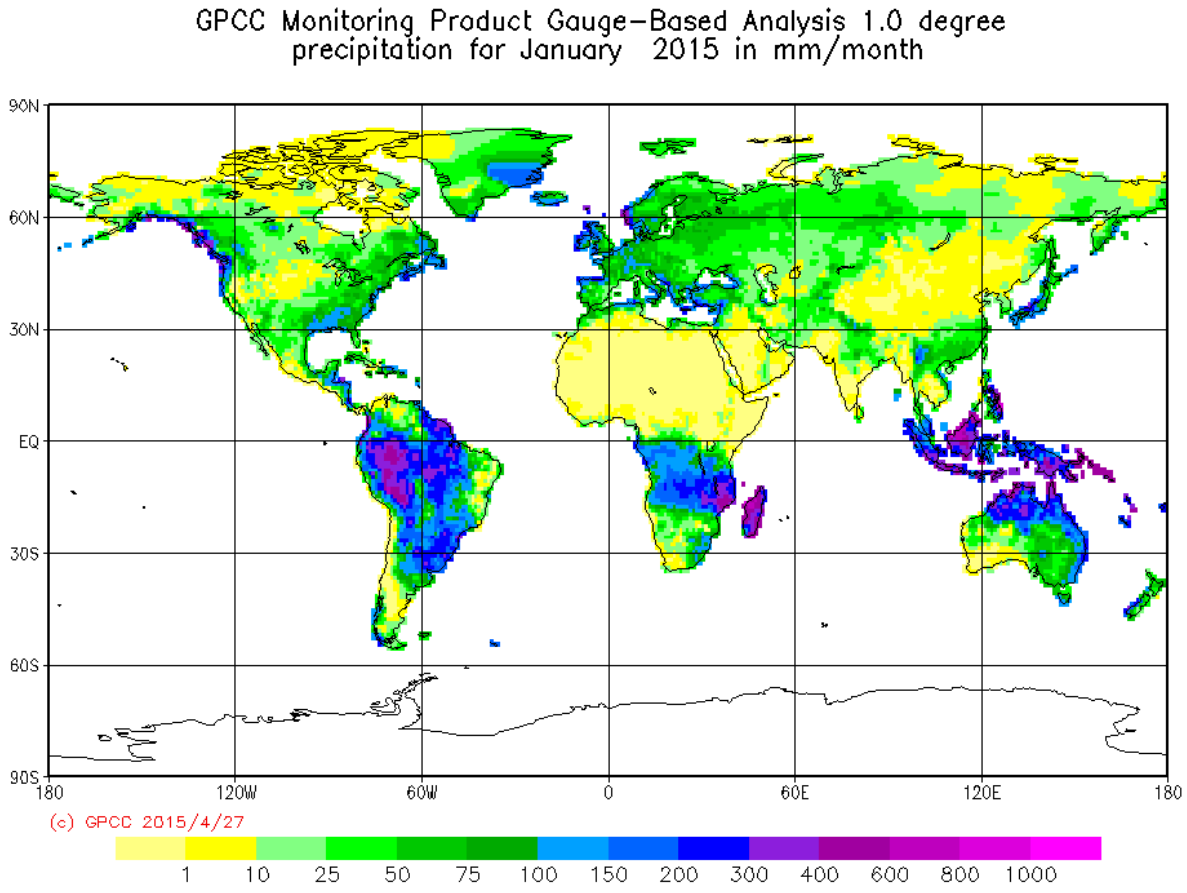
- Re-analyses are not exclusively based on observations (fg + obs mix)

- Some variables (e.g., precipitation) are not analysed but derived as model output product.

- Grids can inherit model deficiencies

- Global → Easy to see large scale patterns during monitoring/verification process

GPCC

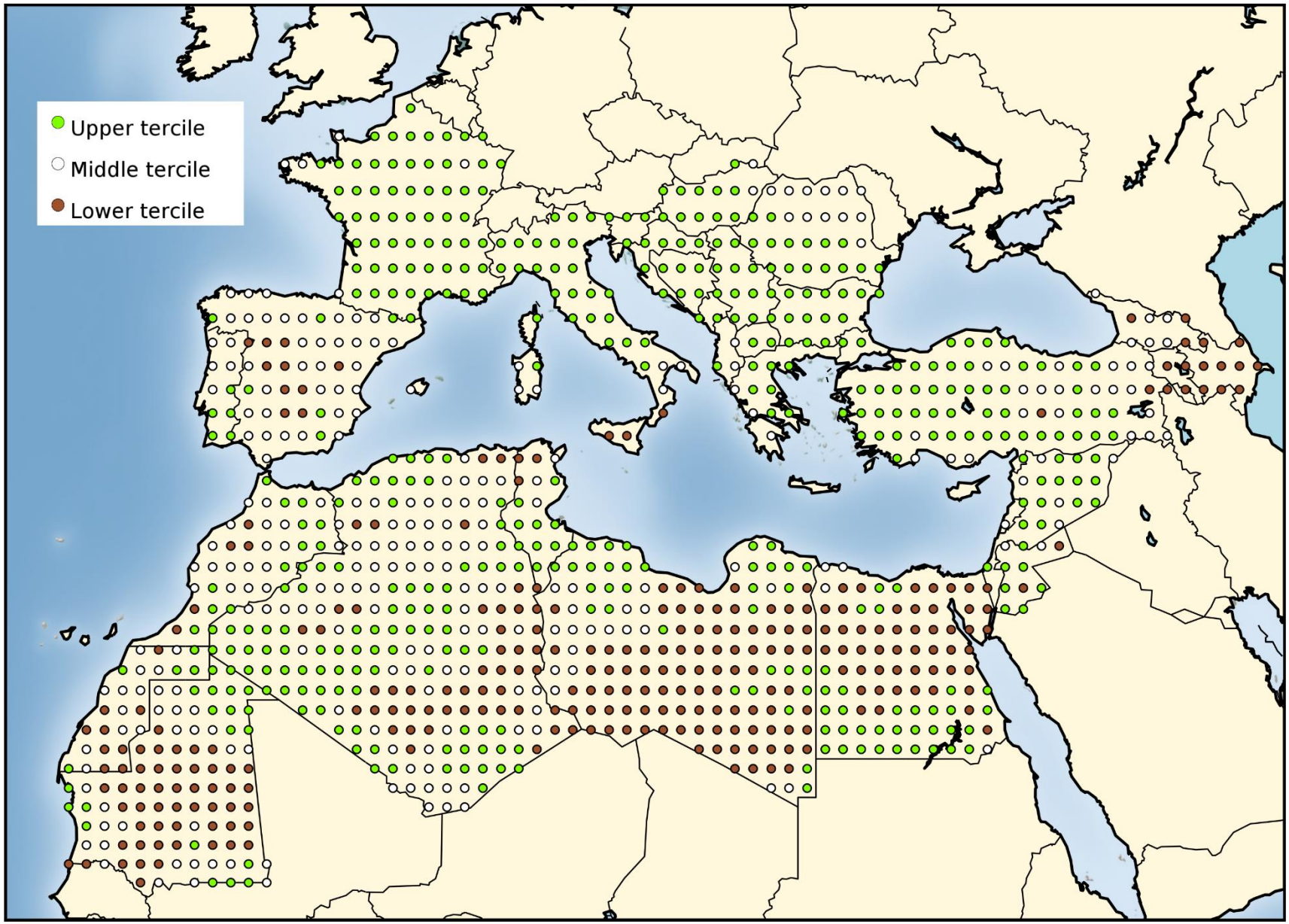


Near real-time First Guess of **monthly precipitation** anomalies based on **SYNOP** messages of meanwhile approx. 7,000 stations arriving with DWD (Offenbach). Data become retrievable within **5 days** after observation month

Ziese, Markus; Becker, Andreas; Finger, Peter; Meyer-Christoffer, Anja; Rudolf, Bruno; Schneider, Udo (2011): GPCC First Guess Product at 1.0°: Near Real-Time First Guess monthly Land-Surface Precipitation from Rain-Gauges based on SYNOP Data. DOI: 10.5676/DWD_GPCC/FG_M_100

http://www.dwd.de/EN/ourservices/gpcc/gpcc.html

PRECIPITATION JJA 2014 (GPCC data)
(reference period 1981-2010)



Some considerations on GPCC

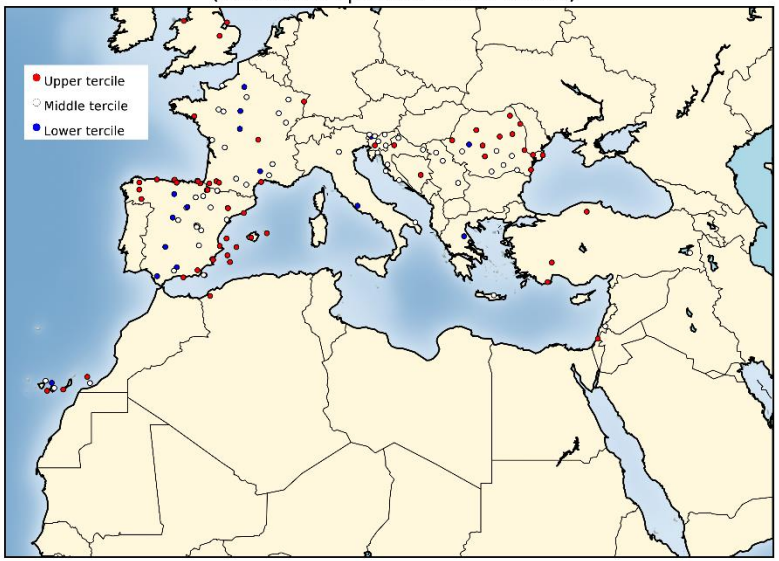
- Based on SYNOP messages.

- Very low observational density over less populated regions

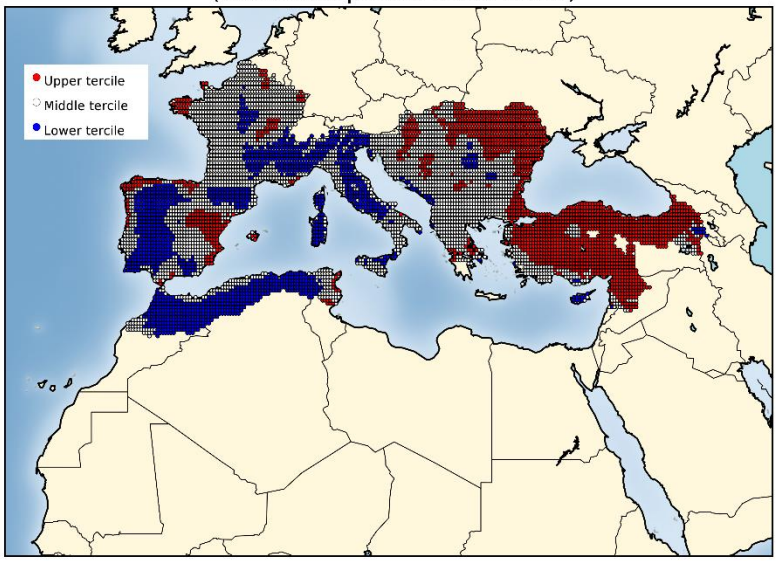
- Not dependent on models

- Global → Easy to see large scale patterns during monitoring/verification process

TEMPERATURE JJA 2014 (ECA&D data)
(reference period 1981-2010)



TEMPERATURE JJA 2014 (EOBS data)
(reference period 1981-2010)



TEMPERATURE JJA 2014 (ERA-Interim data)
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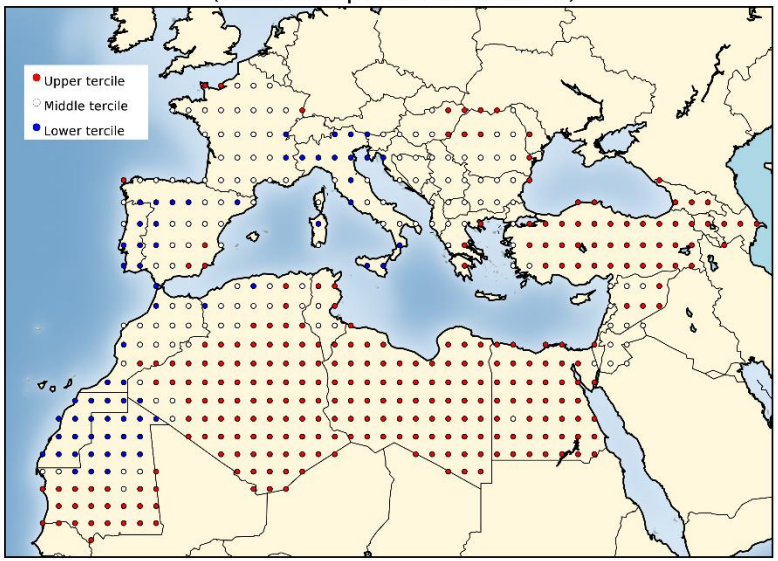

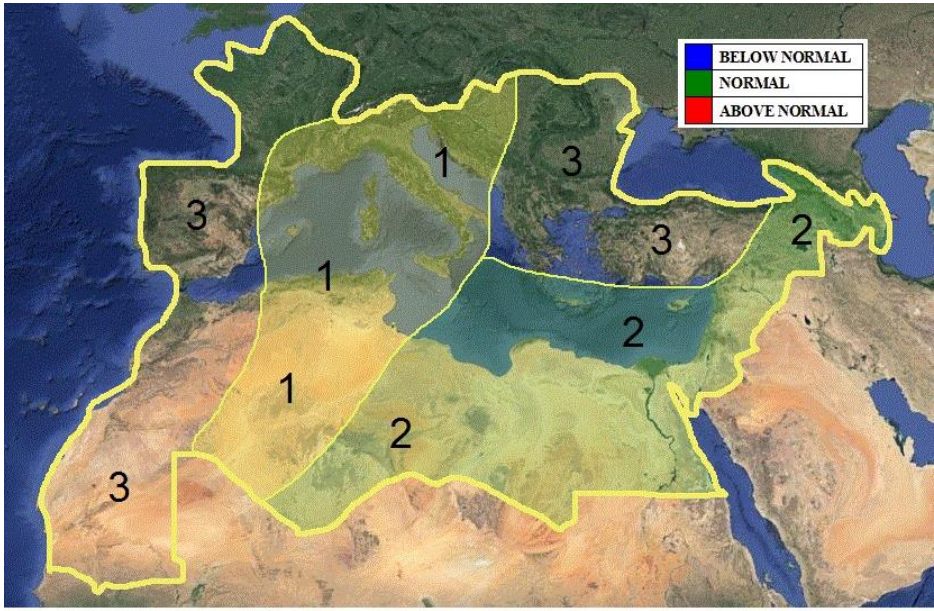

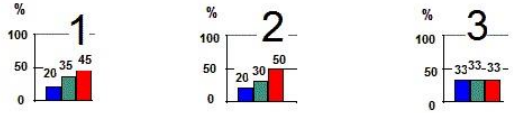

TEMPERATURE JJA 2014 (ERA-Interim data)
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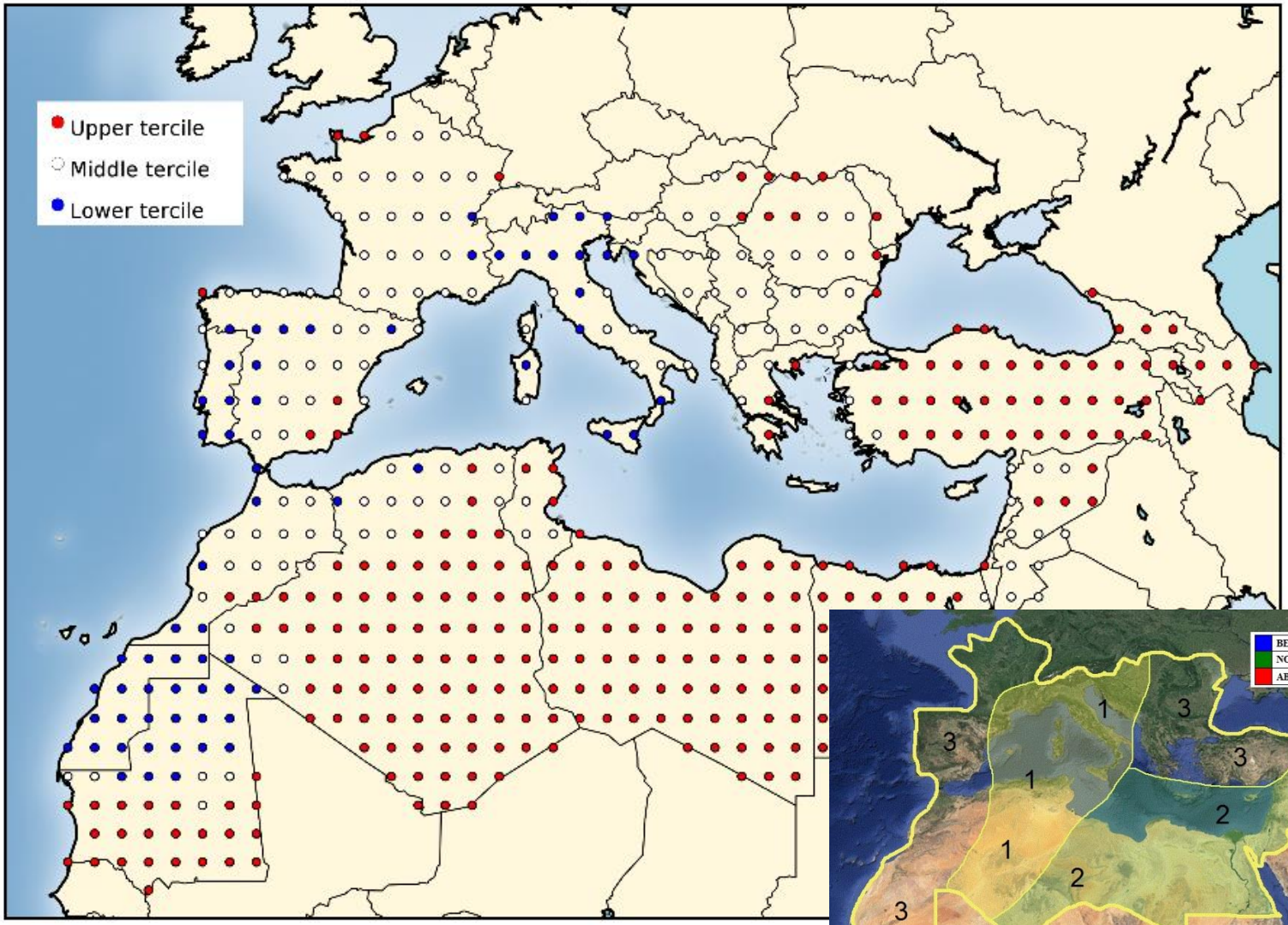
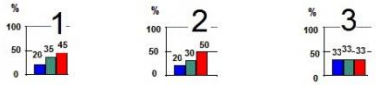
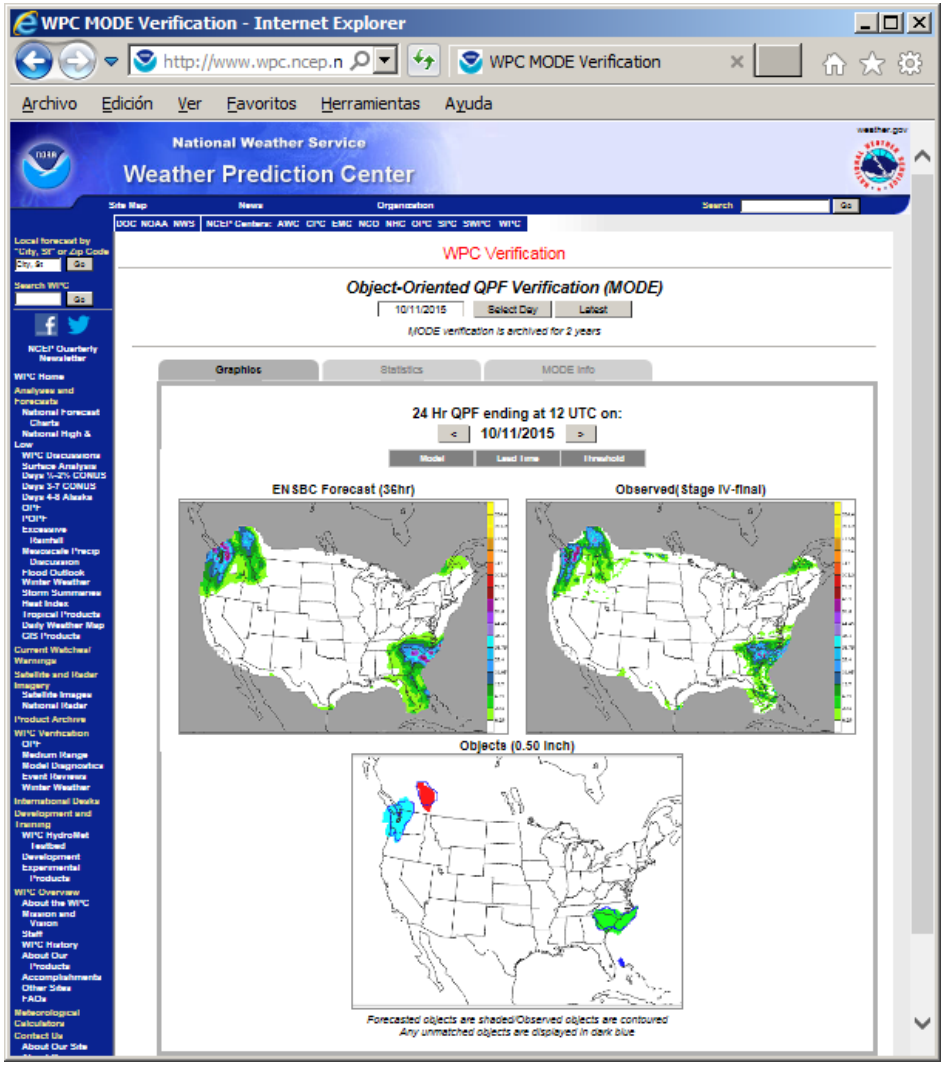




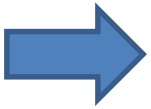
Comments

- Gridded data allow a better visualization of structures → object-oriented verification → existence, location, orientation, time
- Robustness of terciles (for 3 month periods) → relatively good coincidence of different gridded observational data
- Provide monitoring and verification data over observational sparse regions

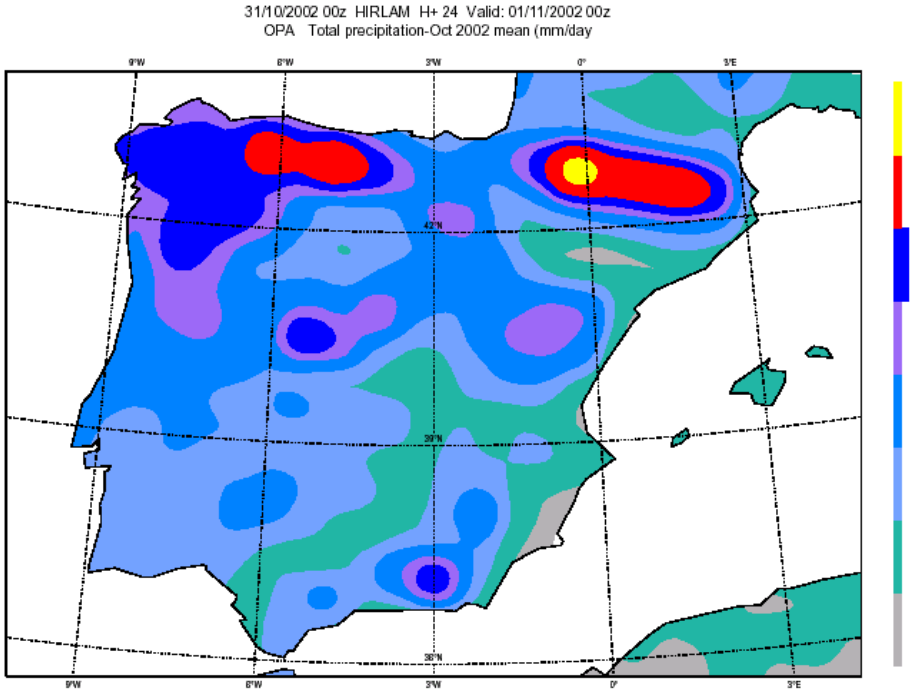


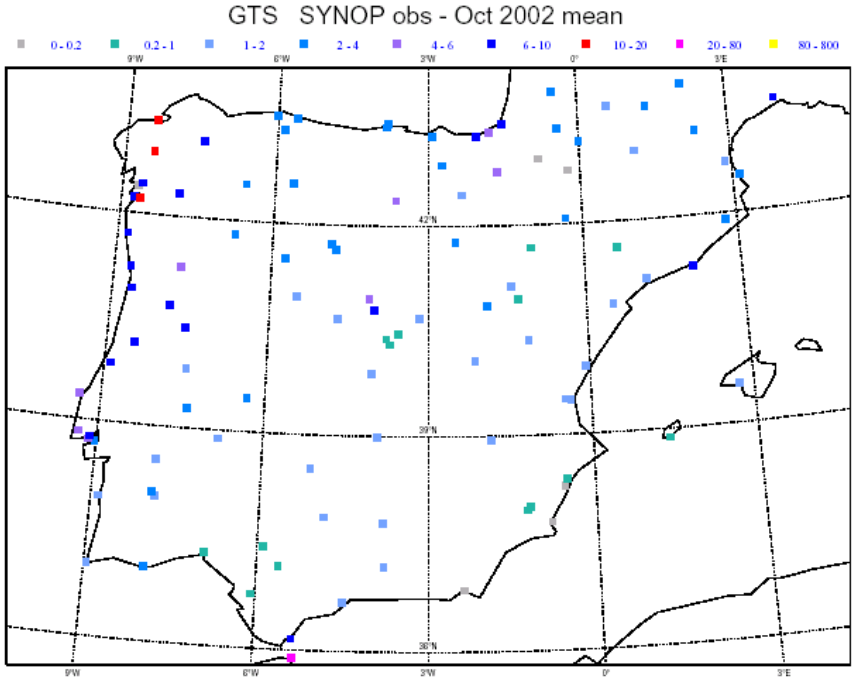
Monitoring and verification against observations

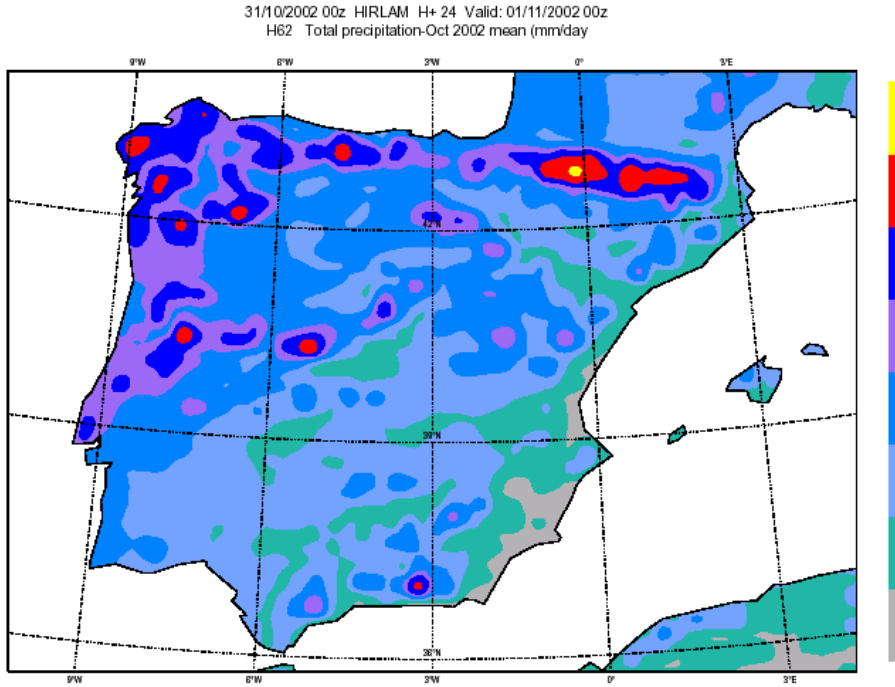
- Verification against observations is very much **conditioned by the represented spacial scales** of both forecasts and observation network.
- Model output is usually supplied in the form of grid-point values. However, those values should be considered as a grid box areal quantities when dealing with **variables that are implicitly areal**. This is the case of variables resulting from subgrid parameterizations like precipitation, radiation, etc.
- Observations, on the other hand, are frequently affected by the **problem of representativeness**. Some observed variables are representative of large areas and are not very much influenced by local conditions, whereas others show a remarkable horizontal variability.
- Usually, the variables close to the ground (like 2-metre temperature) inherit their big **horizontal variability from the high heterogeneity of the land surface**. Other variables, like precipitation, inherit their high horizontal variability from the scales of the intervening precipitating clouds.



Verification of precipitation using synoptic stations

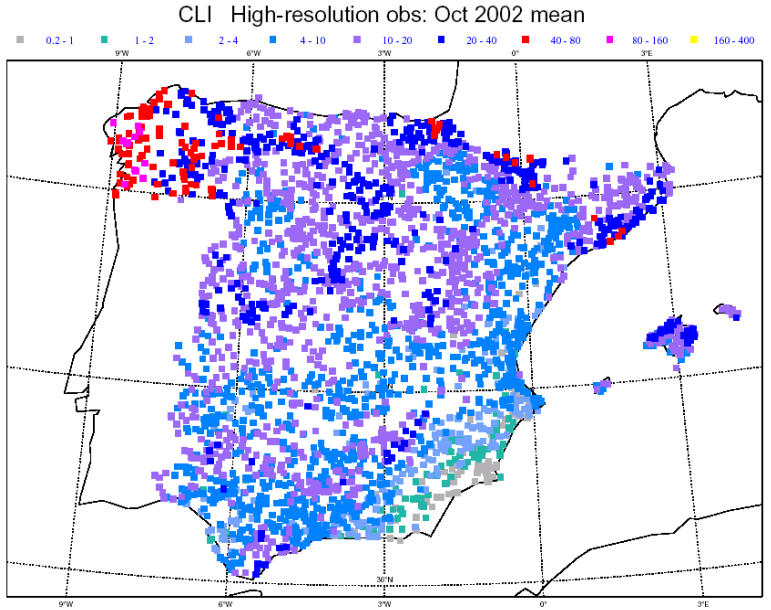


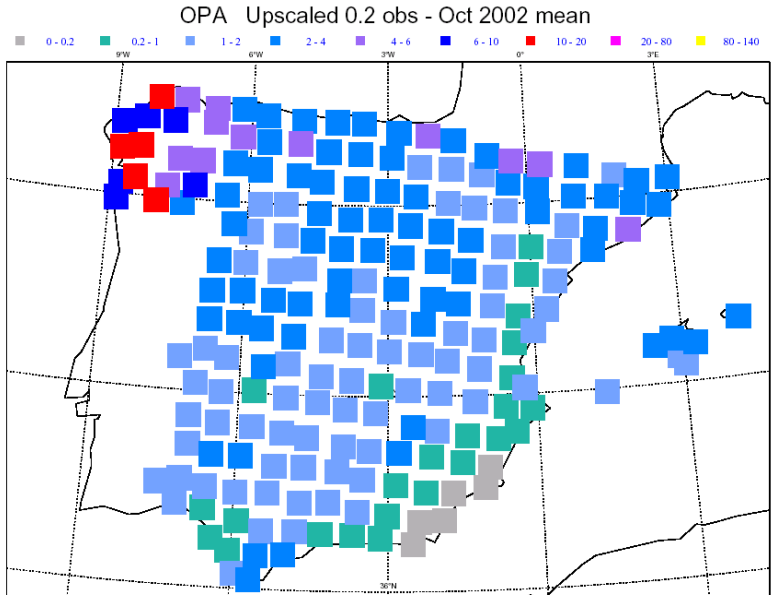




Verification of precipitation by scaling a very dense observation network (I)

- ECMWF model precipitation compares better with gridded analysis (Ghelly and Lalaurette, 2000; Cherubini et al., 2002; Ghelly, 2002).
- Model precipitation should be considered as an areal quantity
- Use of very dense obs. Network (ELDAS, MAP, ...) → representation problem
- Approaching of model and observation scales: up/downscaling





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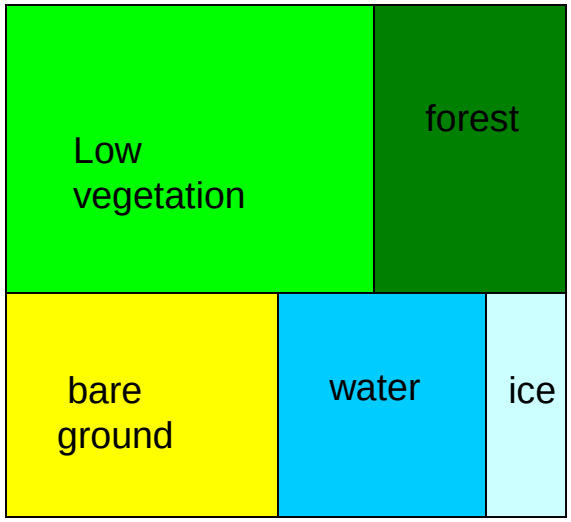
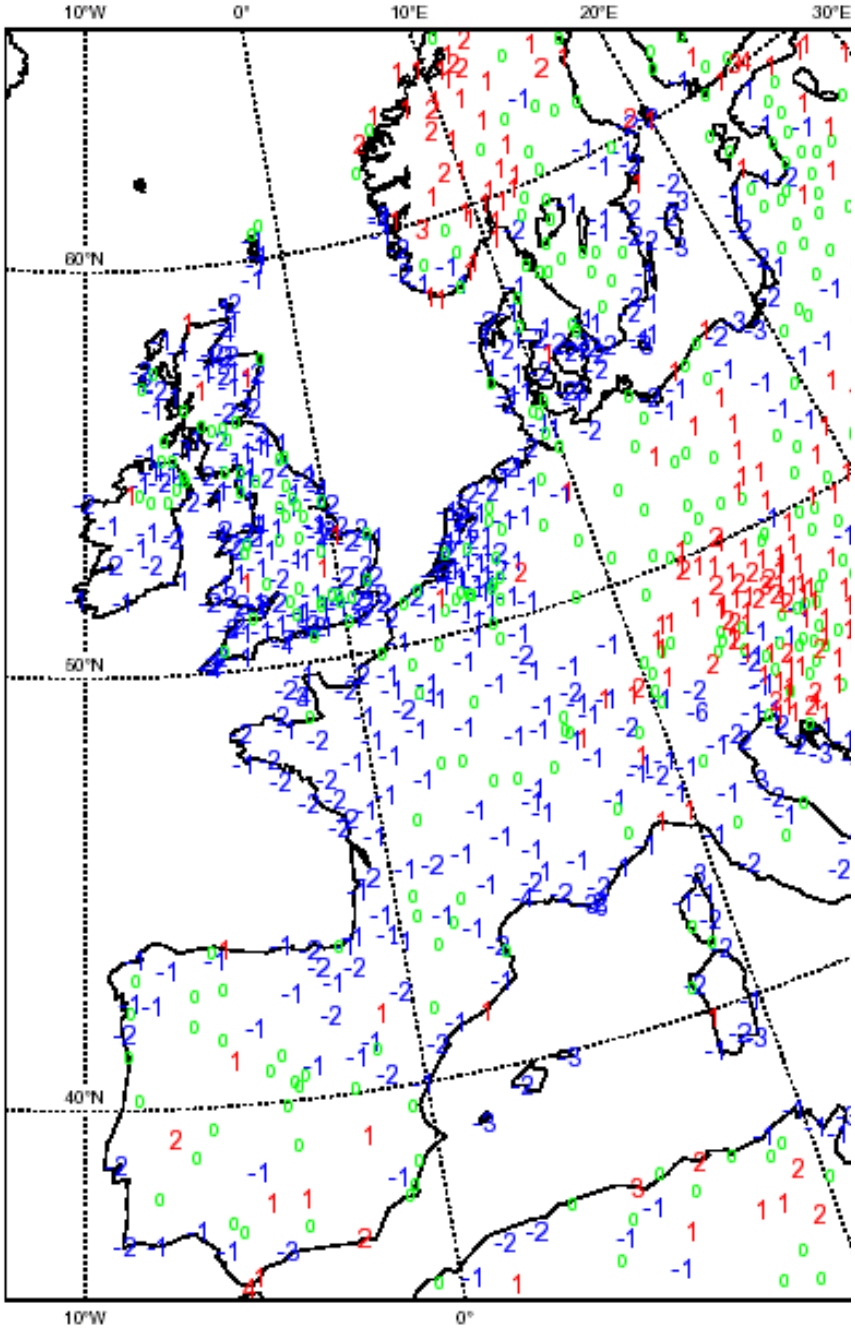
Subgrid structure in the surface model treatment



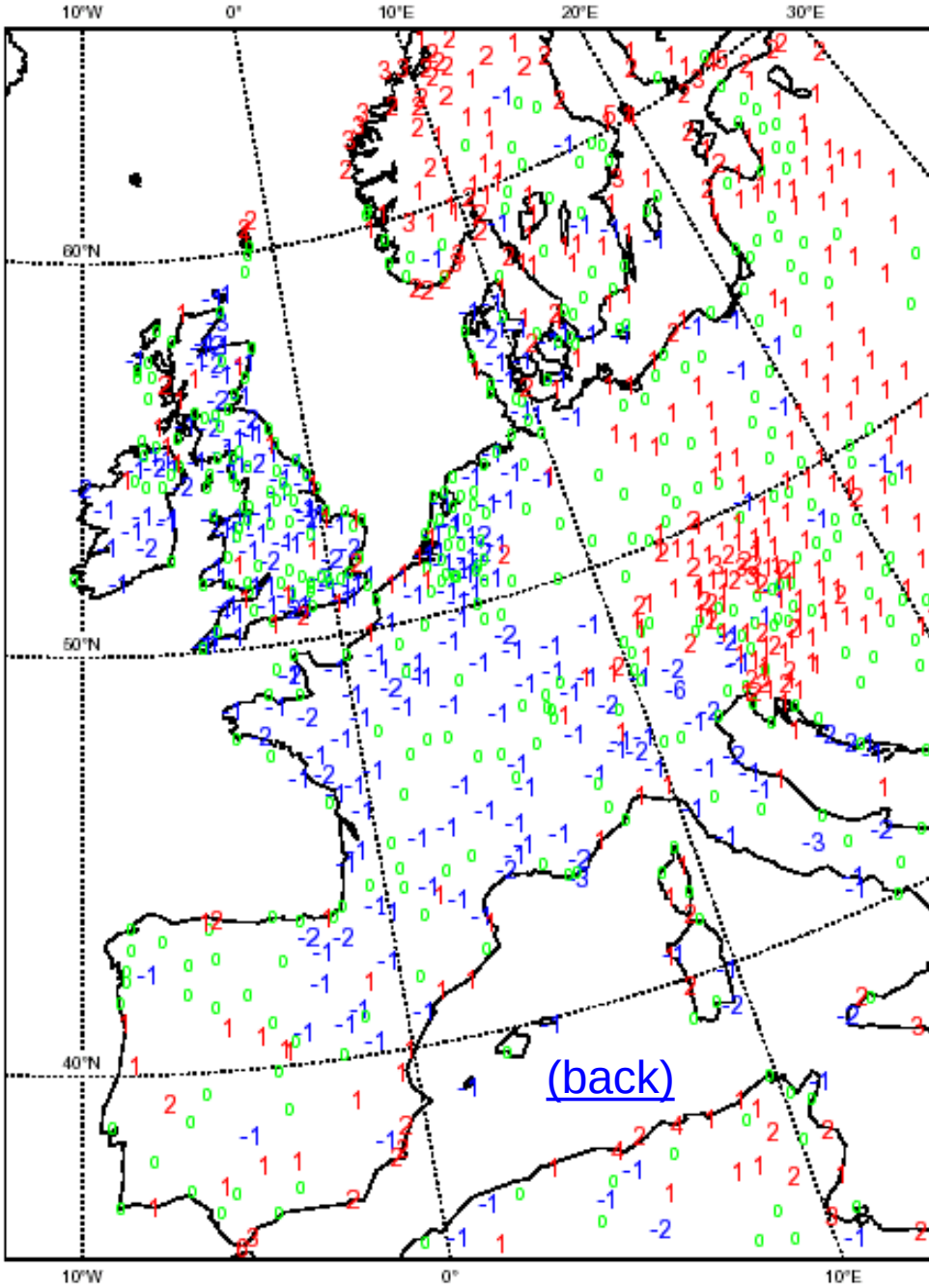
Which T2m?:

$$T_{2m} = \sum_{I=3}^{5} f_i T_{i2m} \qquad T_{2m} = \sum_{I=1}^{5} f_i T_{i2m} \qquad T_{2m} = T_{4_{2m}}$$

620 T2m BIAS(K) H+24 (agai



620 T2m BIAS(K) H+24 (against 14



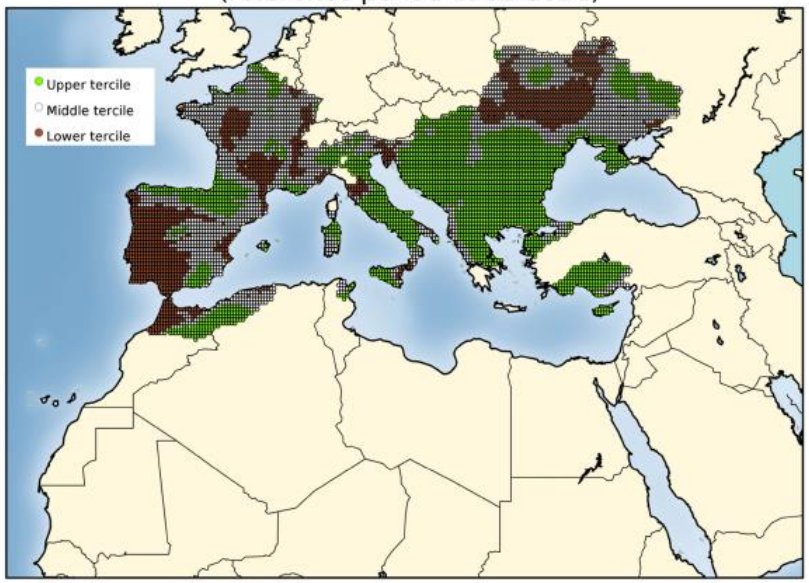
Ideal verification of model output against conventional observations

- The model variable is horizontally interpolated to the observation point.
- The model variable should be vertically corrected to account for the difference between model orography and the real height of the station.
- Some QC should be performed to disregard disparate values coming from incorrect observations.
- Approaching of model and observation scales

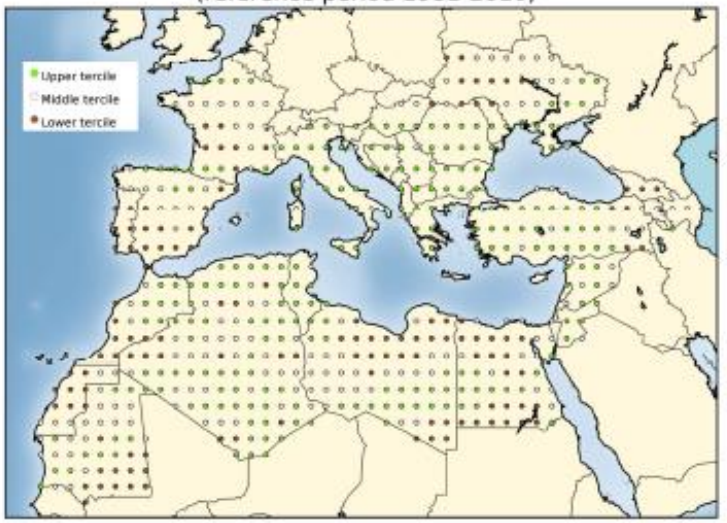
Comments

- Verification against observations is not so easy and straight forward as one initially could think
- Questions related with representativeness of observations
- Need to approach model and observation scales
- Need to approach model outputs and observations (e.g. tiles, altitud correction, etc)

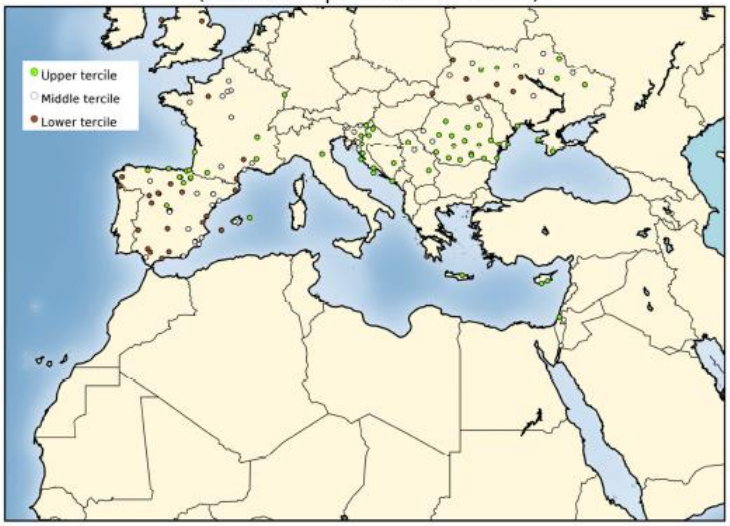
PRECIPITATION DJF 2015 (EOBS data)
(reference period 1981-2010)



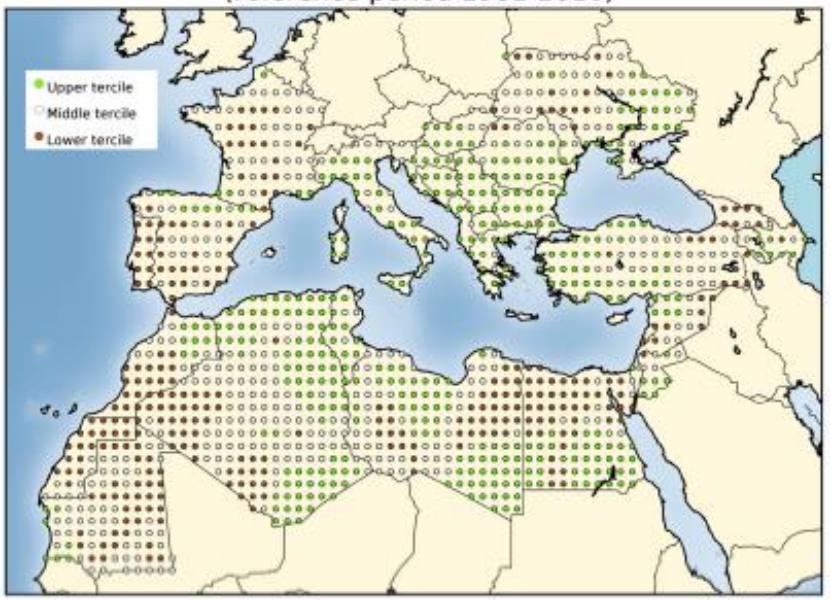
PRECIPITATION DJF 2015 (ERA-Interim data)
(reference period 1981-2010)



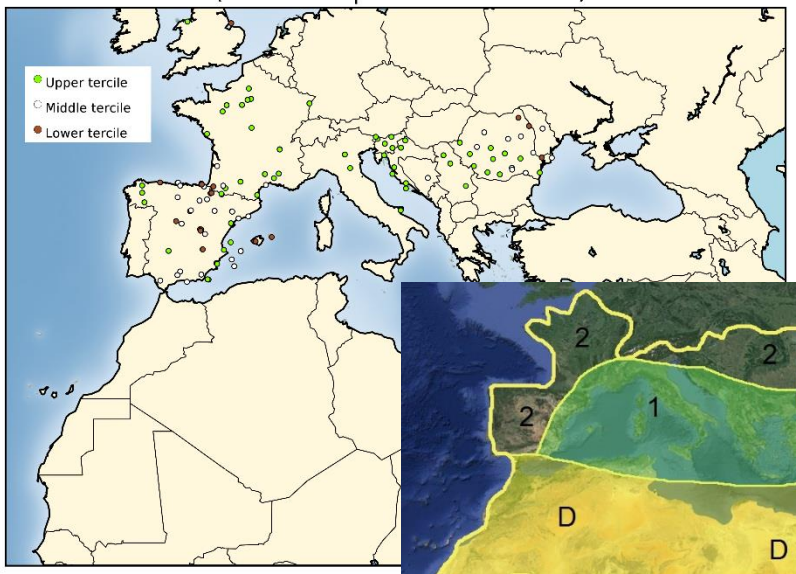
PRECIPITATION DJF 2015 (ECA&D data)
(reference period 1981-2010)



PRECIPITATION DJF 2015 (GPCC data)
(reference period 1981-2010)



PRECIPITATION JJA 2014 (ECA&D data)
(reference period 1981-2010)



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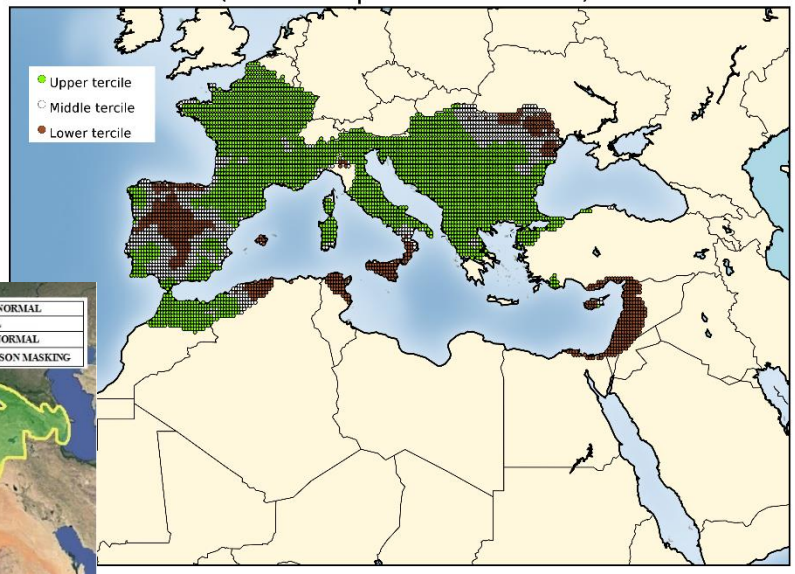
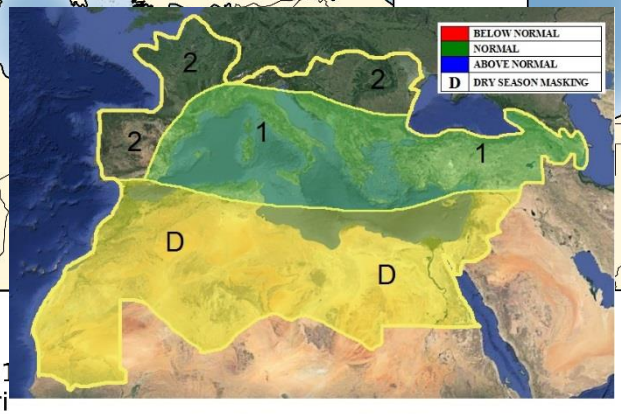
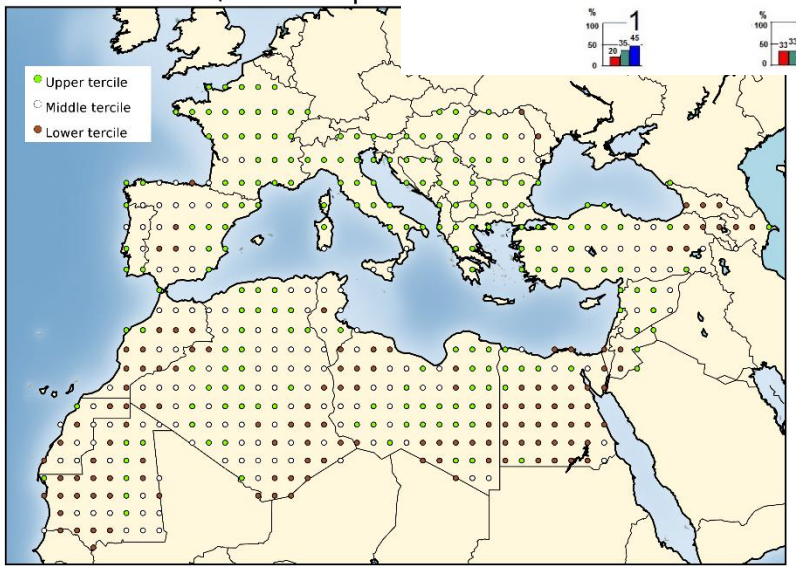
(reference period 1981-2010)

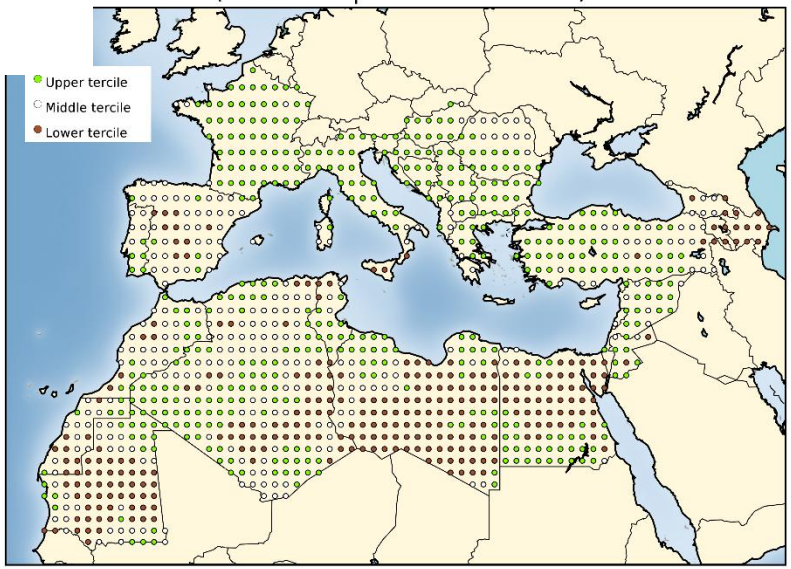




PRECIPITATION JJA 201
(reference peri



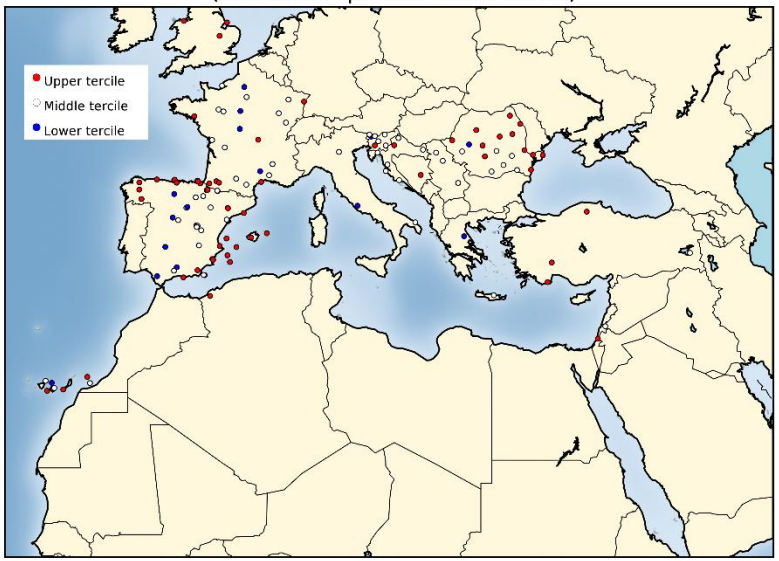
PRECIPITATION JJA 2014 (GPCC data)
(reference period 1981-2010)



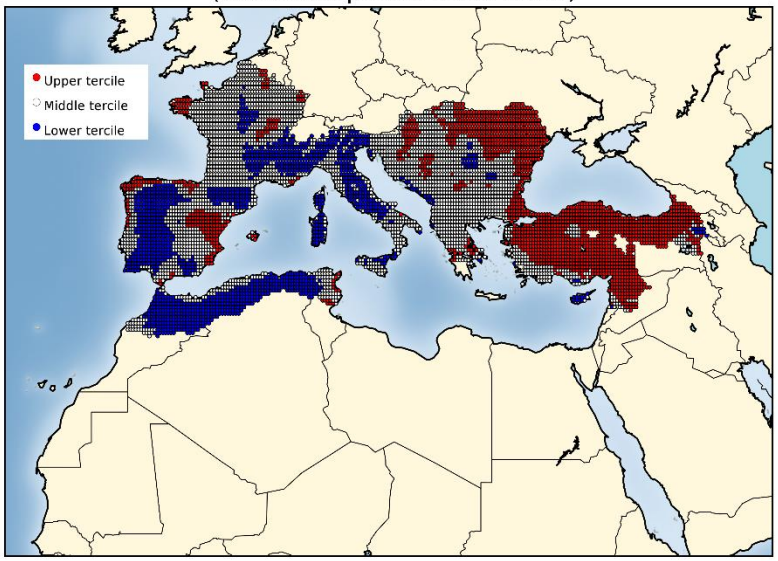
Probabilistic forecasts and forecast quality

- One reasonably common practice is to define probabilistic forecasts as “correct” if the category with the highest probability verified.
- How good are the different probabilistic forecast?
- Attributes of “good” prob. forecasts (Murphy 1993):
  - resolution (outcome conditioned by forecast),
  - discrimination (forecast conditioned by outcome),
  - reliability (observation as frequently as forecast implies),
  - sharpness (forecasts differing markedly from climatology),
  - skill (comparison with some metric)
- → Simon’s session

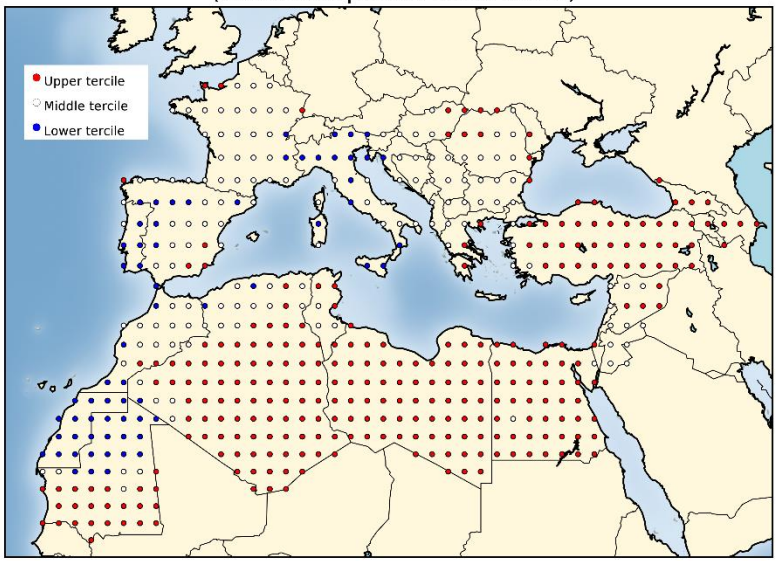
TEMPERATURE JJA 2014 (ECA&D data)
(reference period 1981-2010)

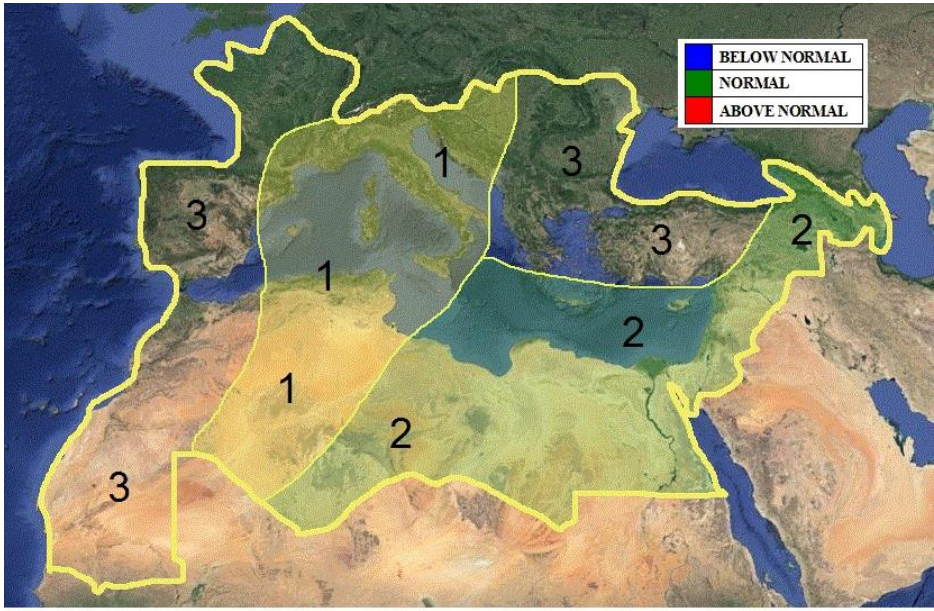


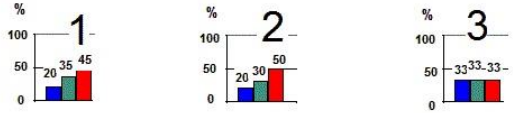
TEMPERATURE JJA 2014 (EOBS data)
(reference period 1981-2010)



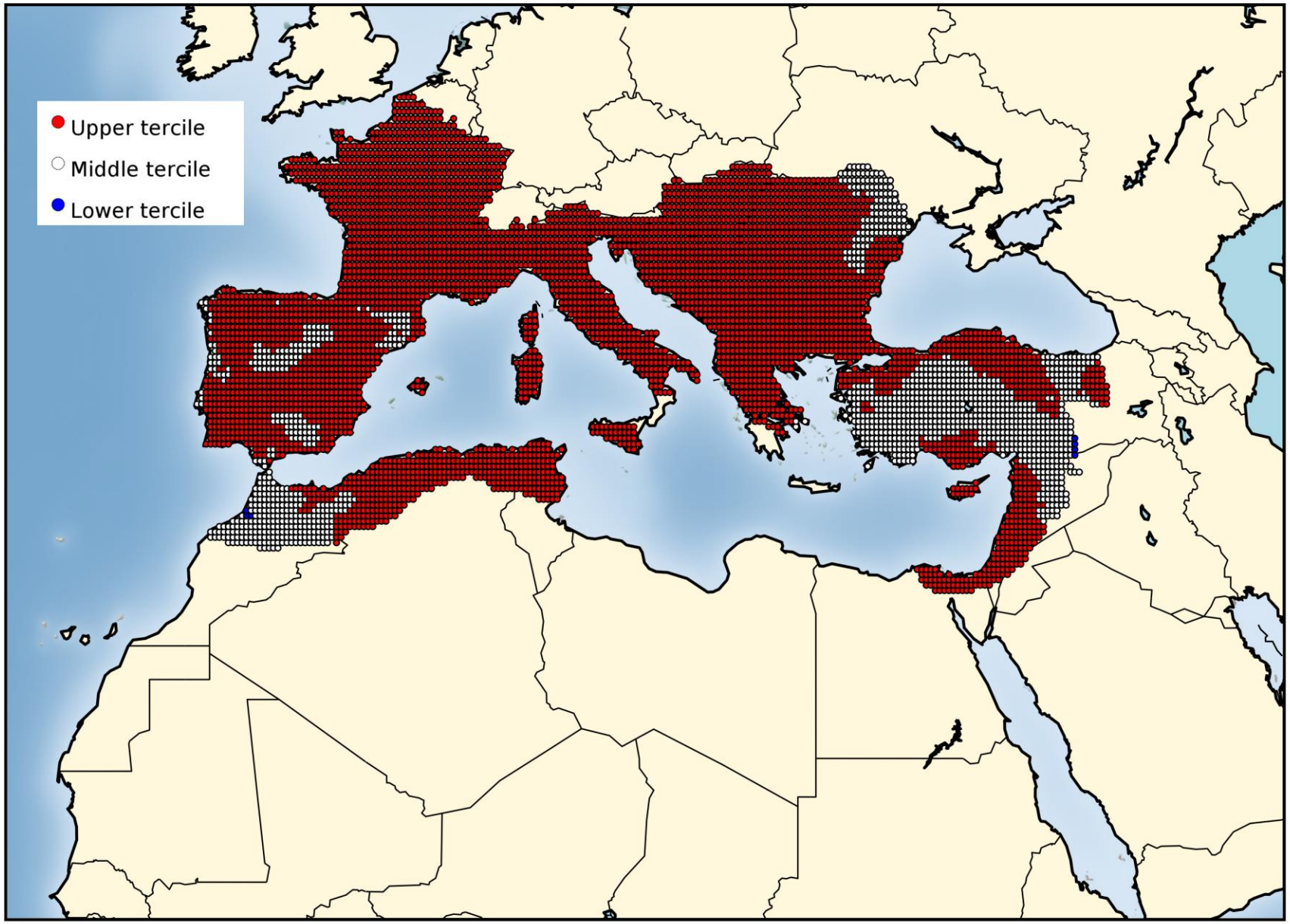
TEMPERATURE JJA 2014 (ERA-Interim data)
(reference period 1981-2010)



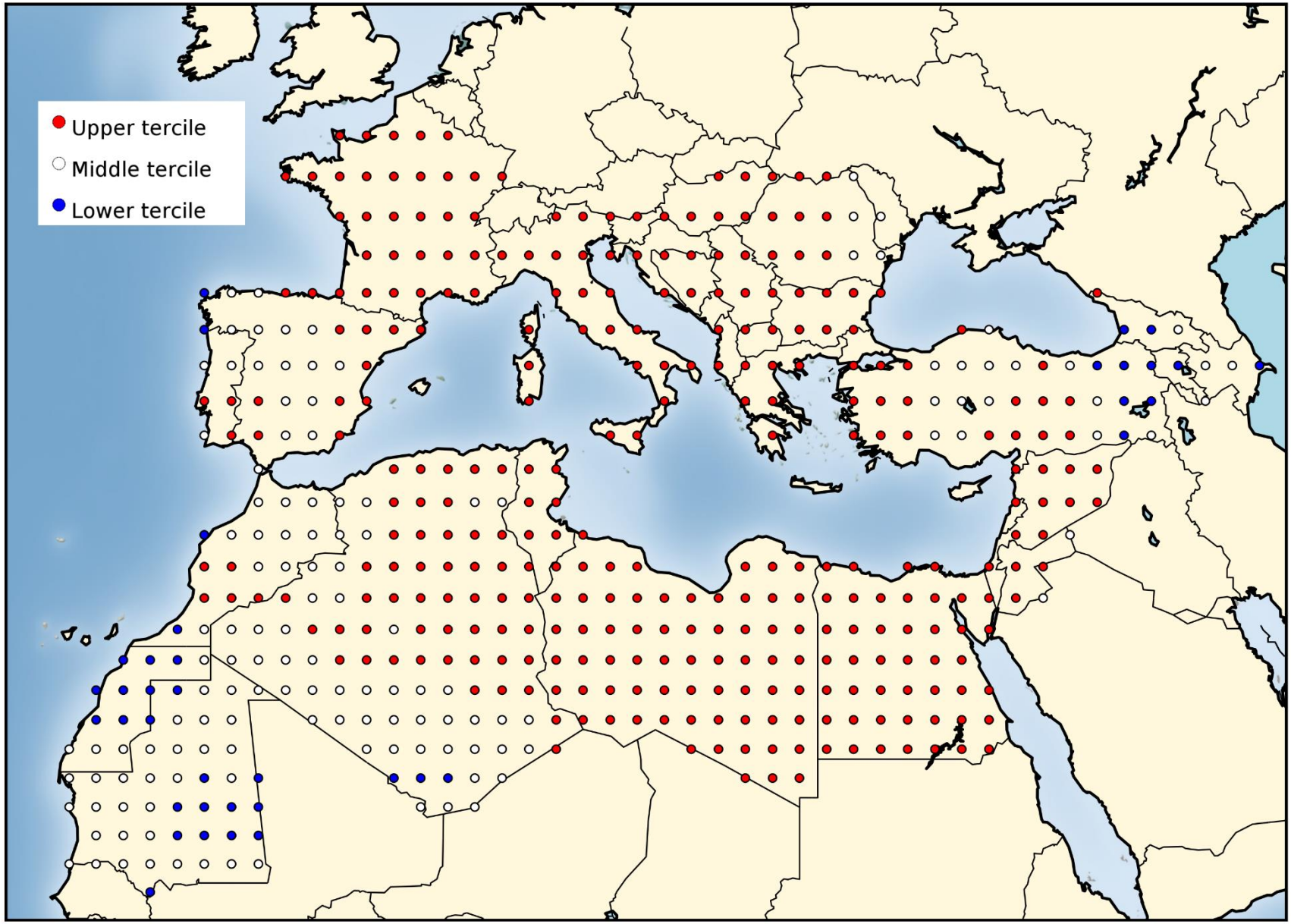




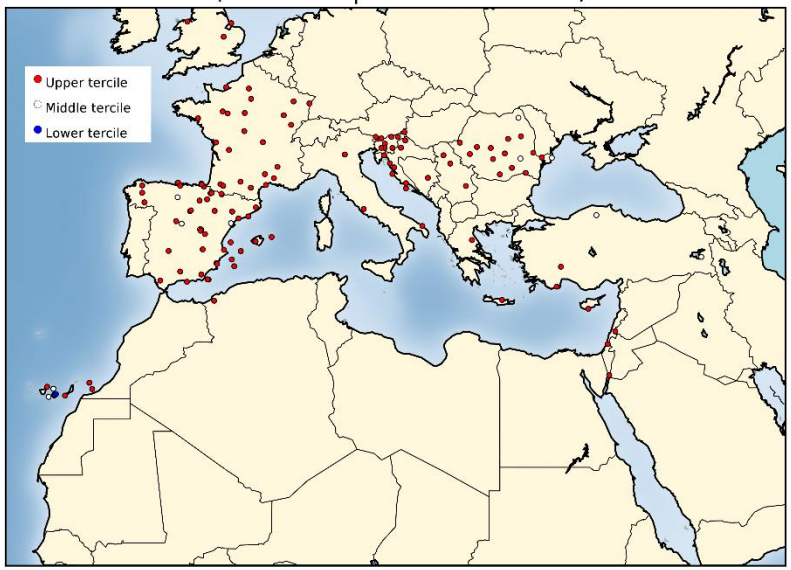
TEMPERATURE DEF 2014 (EOBS data)
(reference period 1981-2010)



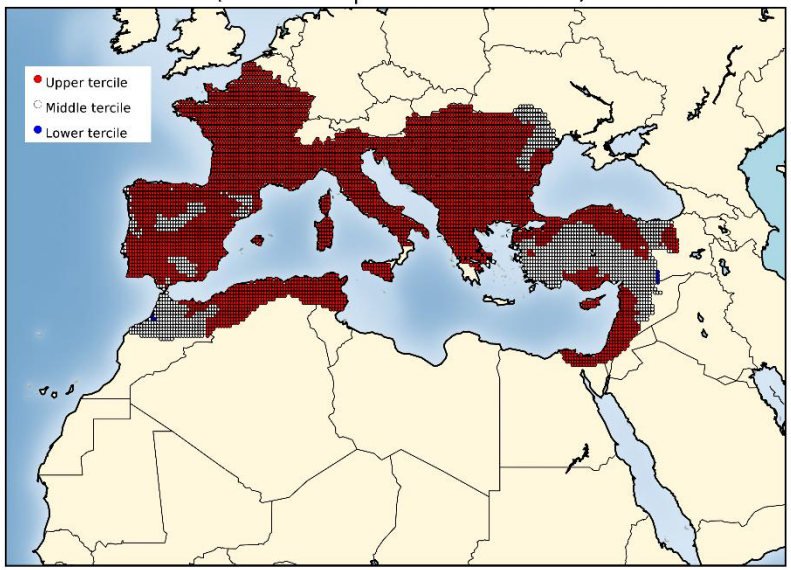
TEMPERATURE DEF 2014 (ERA-Interim data)
(reference period 1981-2010)



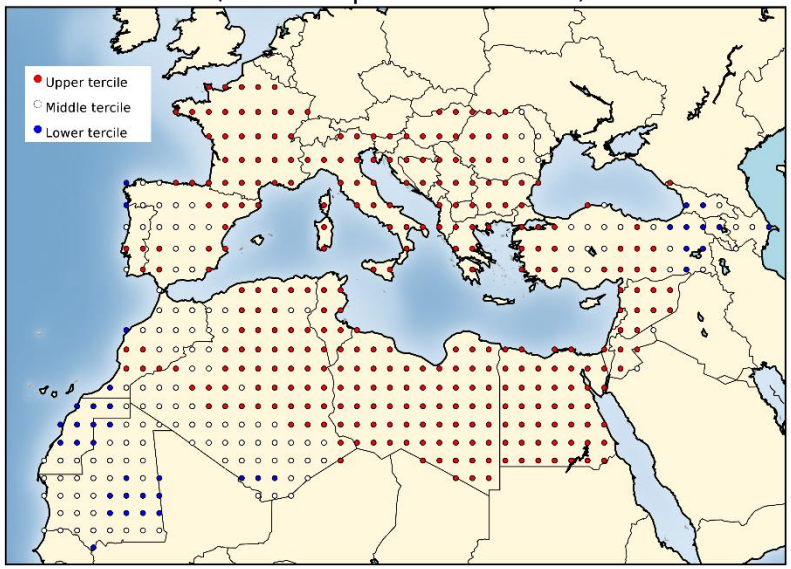
TEMPERATURE DEF 2014 (ECA&D data)
(reference period 1981-2010)

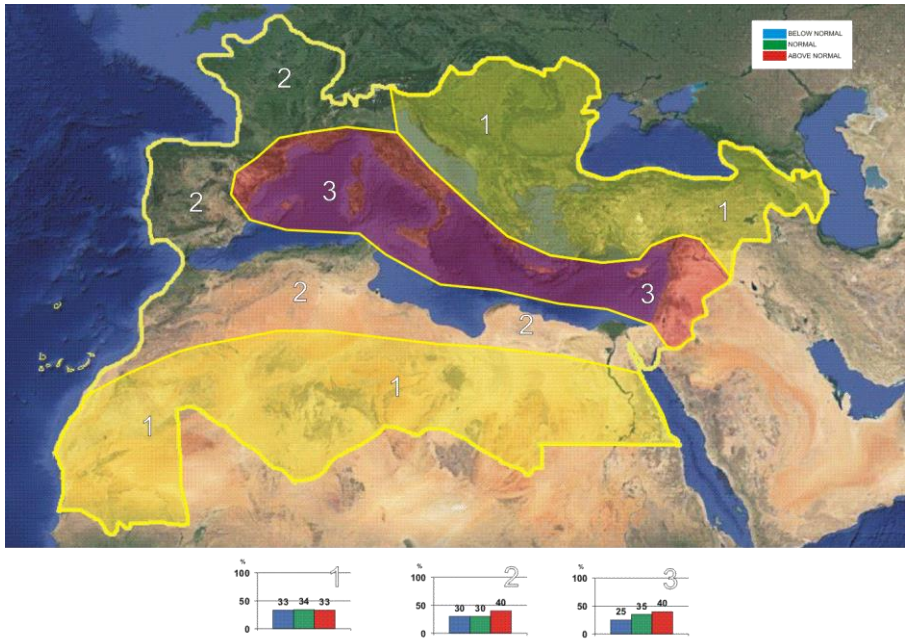


TEMPERATURE DEF 2014 (EOBS data)
(reference period 1981-2010)

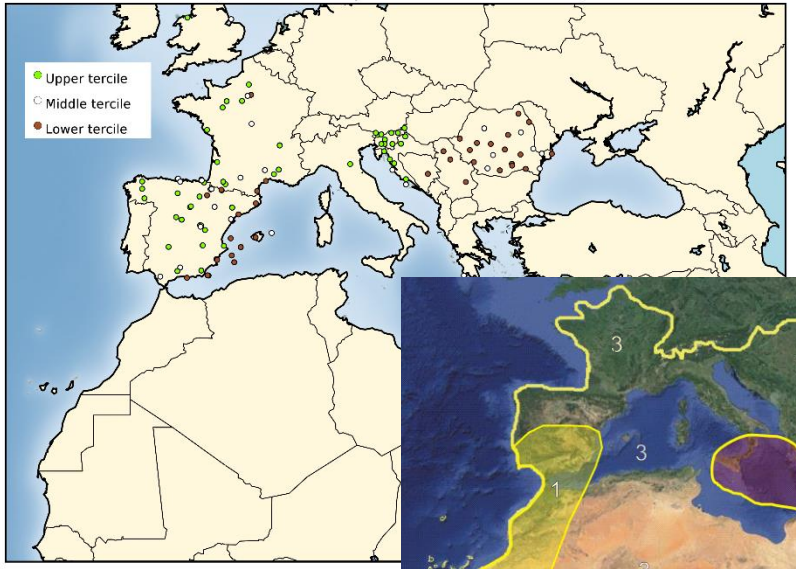


TEMPERATURE DEF 2014 (ERA-Interim data)
(reference period 1981-2010)

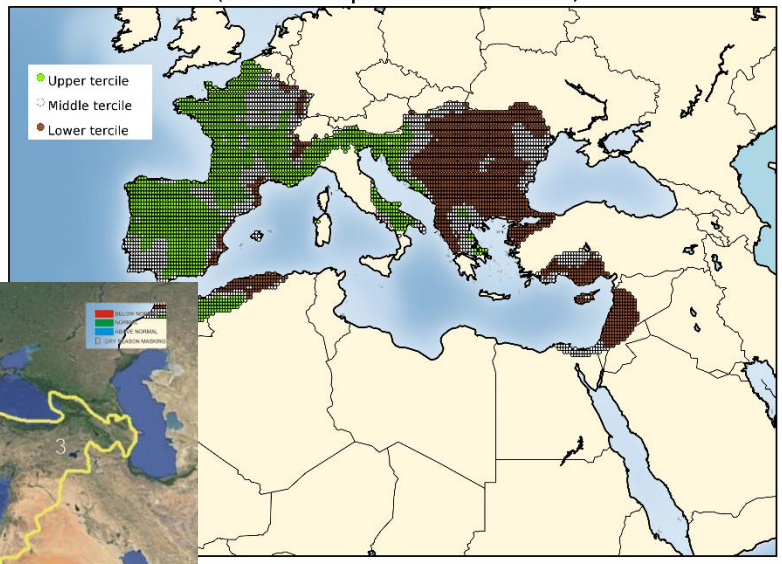


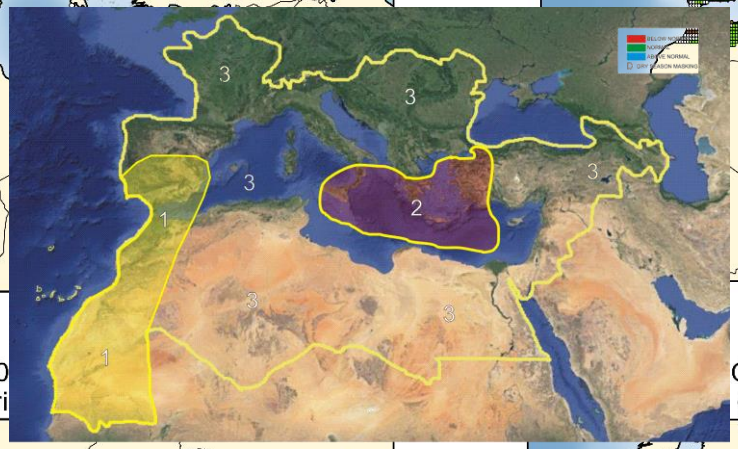


PRECIPITATION DEF 2014 (ECA&D data)
(reference period 1981-2010)

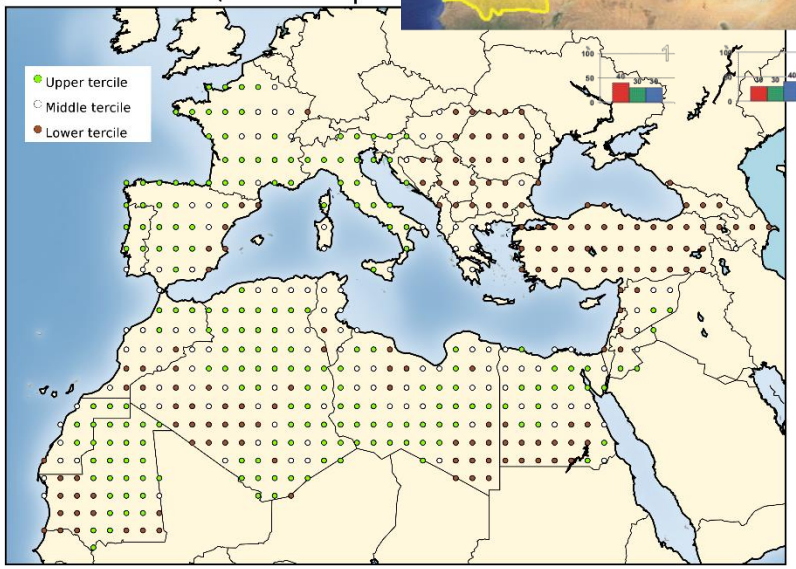


PRECIPITATION DEF 2014 (EOBS data)
(reference period 1981-2010)

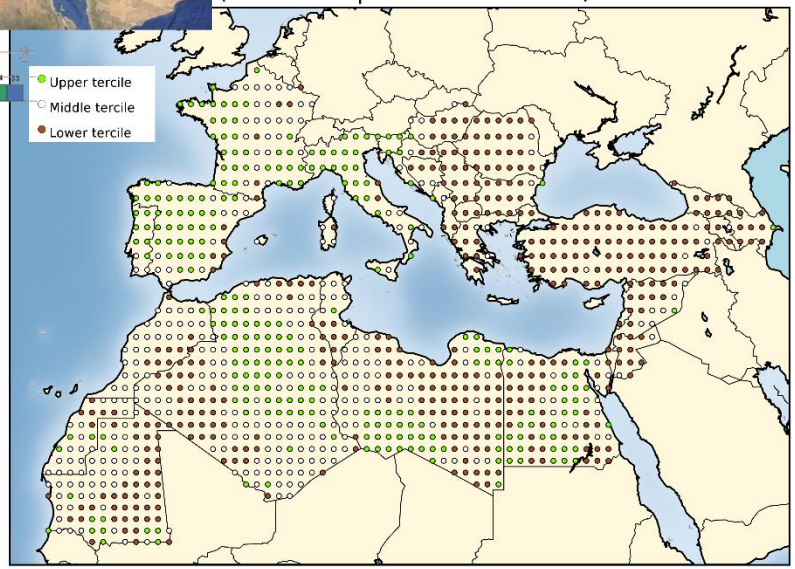




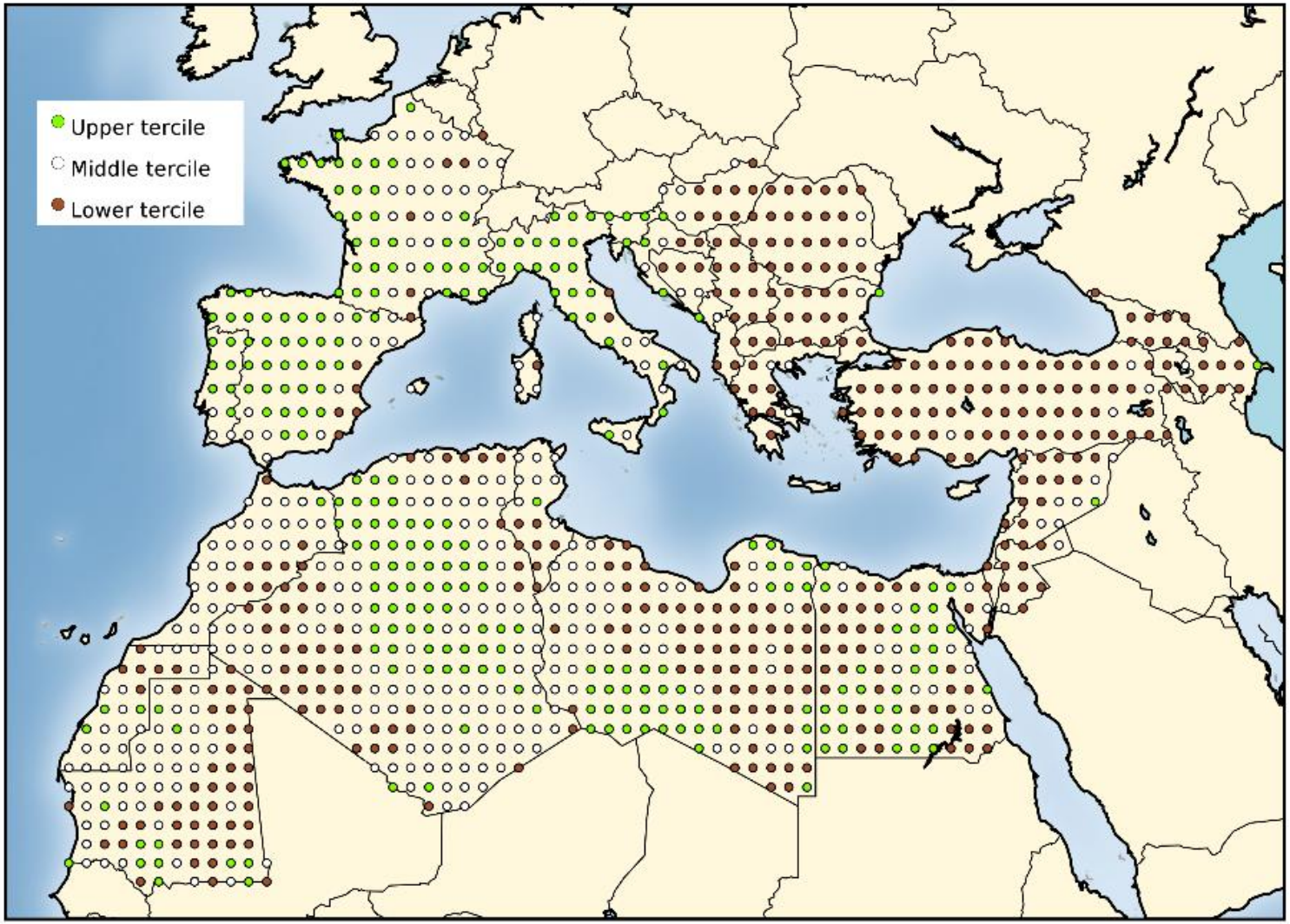
PRECIPITATION DEF 20
(reference peri



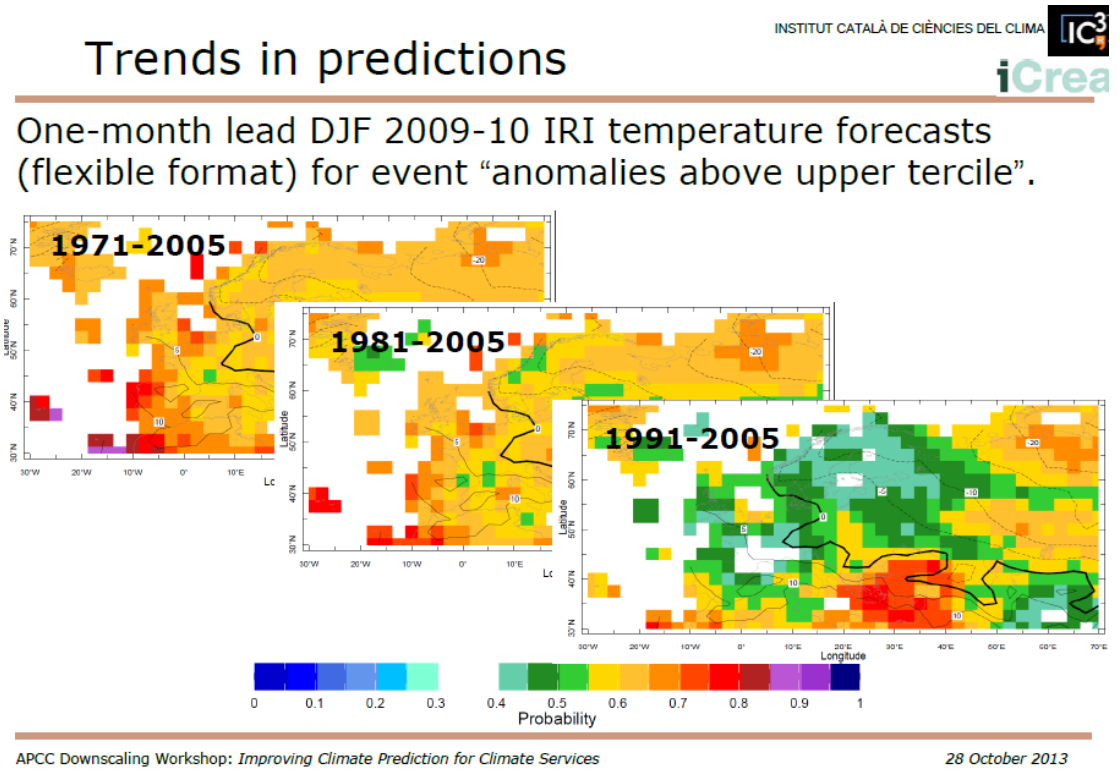
CIPITATION DJF 2014 (GPCC data)
(reference period 1981-2010)



PRECIPITATION DJF 2014 (GPCC data)
(reference period 1981-2010)



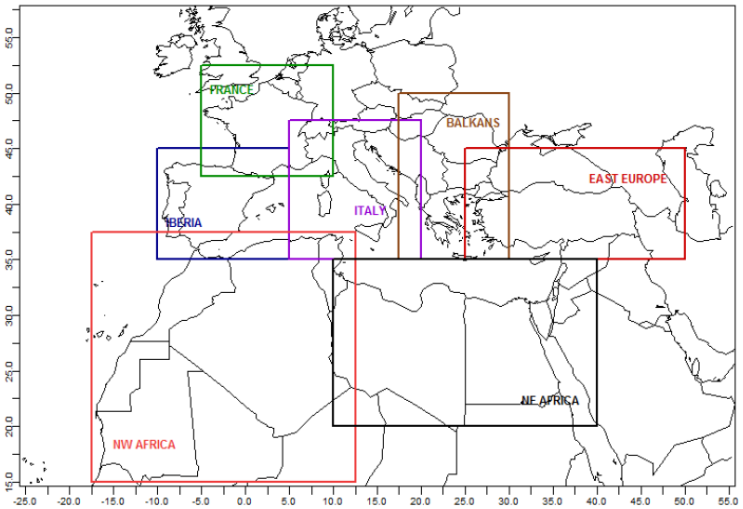
Reference climatology is relevant!

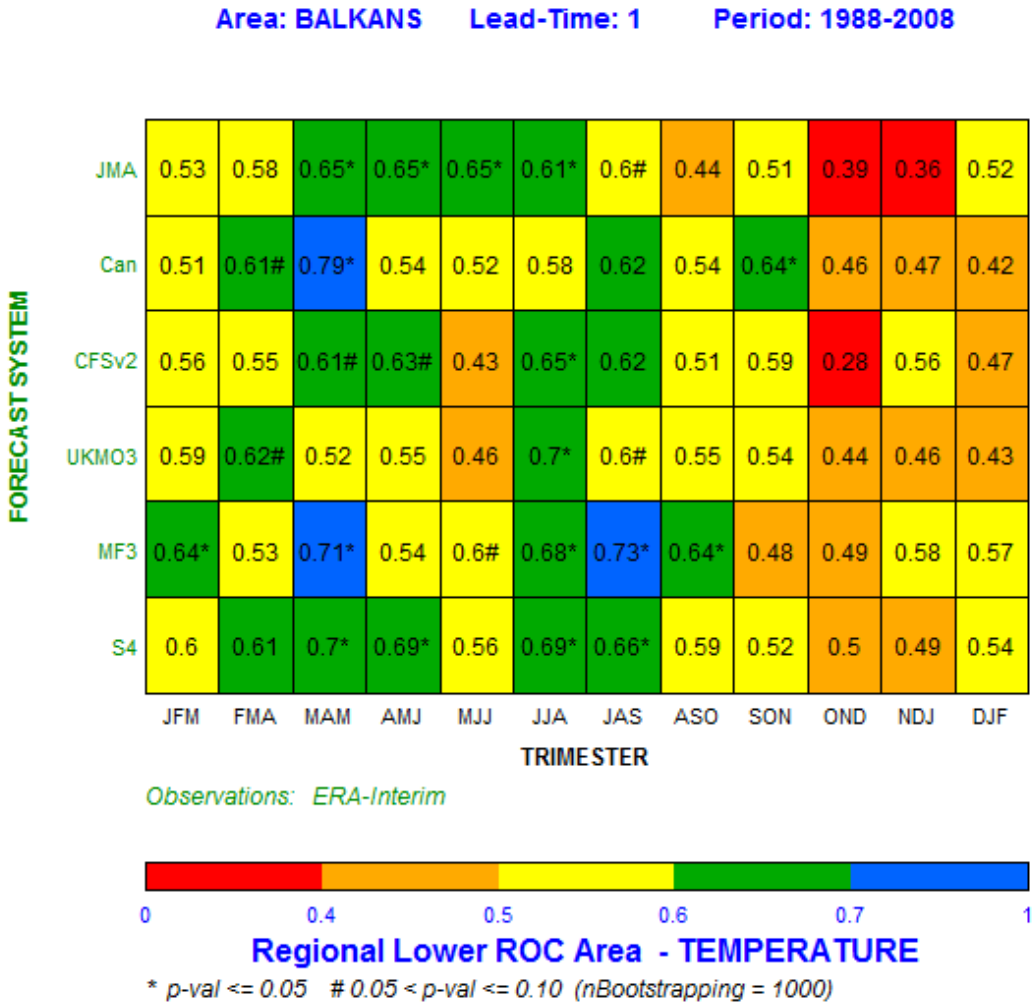


(Thanks to P. Doblas-Reyes)

- Tercile-based seasonal forecasts referred to a climatology
- Climatologist → long reference periods (30 y)
- Users → short (10 y) recient periods

A lot of experience verifying probabilistic outputs of seasonal models.



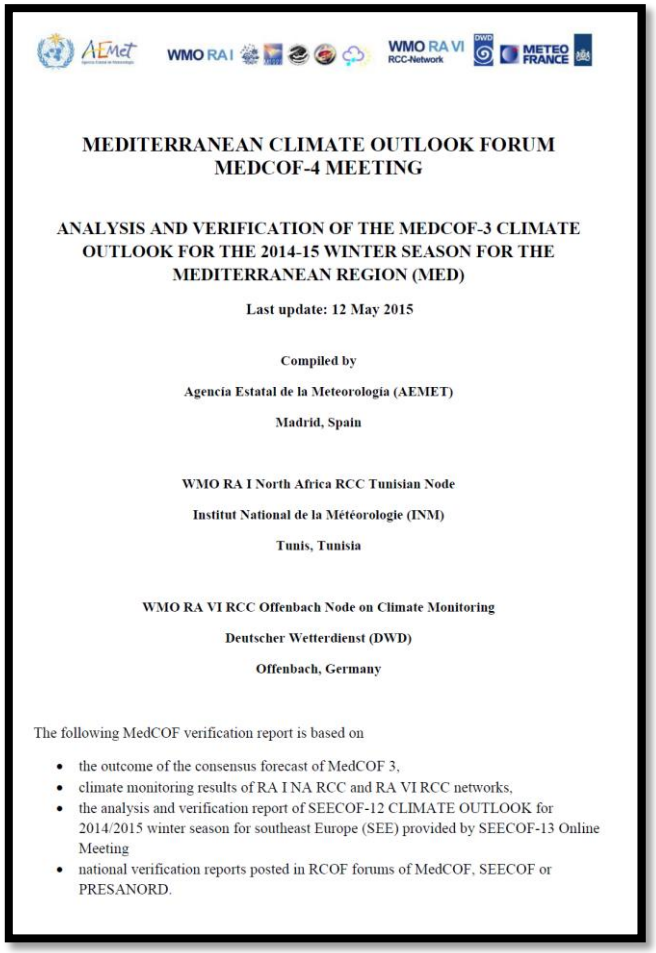


- Standardized Verification System for LRFs (SVSLRF) for GPC products.
- RCOFs → need move towards use of objective verif. scores!!
- Guidance on procedures published by WMO CCl

Conclusions and recommendations

- Monitoring and verification using stations and gridded observational data.
- Both station and gridded observational data have their own limitations and weaknesses.
- Monitoring also in terms of terciles
- Start with a minimum verification package (following WMO-CCI guidelines) verifying consensus forecast (tercile-based) → Simon's session
- Regional data collection for monitoring and verification purposes based on terciles to circumvent data policy restrictions
- Agree on a reference period to establish our tercile values
- Make all verification information (both from models and consensus forecasts) readily available (web?) for MedCOF exercises
- Scores to verify the consensus forecasts and scores to improve the consensus process

Discussion (I)



MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-4 MEETING

ANALYSIS AND VERIFICATION OF THE MEDCOF-3 CLIMATE OUTLOOK FOR THE 2014-15 WINTER SEASON FOR THE MEDITERRANEAN REGION (MED)

Last update: 12 May 2015

Compiled by

Agencia Estatal de la Meteorología (AEMET)

Madrid, Spain

WMO RA I North Africa RCC Tunisian Node

Institut National de la Météorologie (INM)

Tunis, Tunisia

WMO RA VI RCC Offenbach Node on Climate Monitoring

Deutscher Wetterdienst (DWD)

Offenbach, Germany

The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF 3,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- the analysis and verification report of SEECOF-12 CLIMATE OUTLOOK for 2014/2015 winter season for southeast Europe (SEE) provided by SEECOF-13 Online Meeting
- national verification reports posted in RCOF forums of MedCOF, SEECOF or PRESANORD.

Outline

- Climate outlook of previous season
- Analysis of previous season with all available information
- Verification of climate outlook of previous season
- User's perception of previous season climate outlook
- Appendix: Summary of national verification reports (NVRs)

Reception of NVR → Merge with RCC-CM products → 1st draft → comments → 2nd draft → discussion and approval

Discussion (II)

- Recent upgrades:
  - Verifying maps in terciles
  - Verifying maps using stations and grids
  - Products for the whole domain
- Considerations:
  - Small sample sizes (few years, few stations) typical of seasonal forecasts → large sampling errors
  - Format of consensuated forecasts → gridded product suitable for verification/ visualization/ applications ?

THANK YOU FOR YOUR ATTENTION!

and

discussion on MedCOF step 1 after lunch!!!