

# The 55 years UERRA surface re-analysis over Europe at 5.5km

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E. Bazile, A. Verrelle,  
P. Le Moigne, F. Besson.,

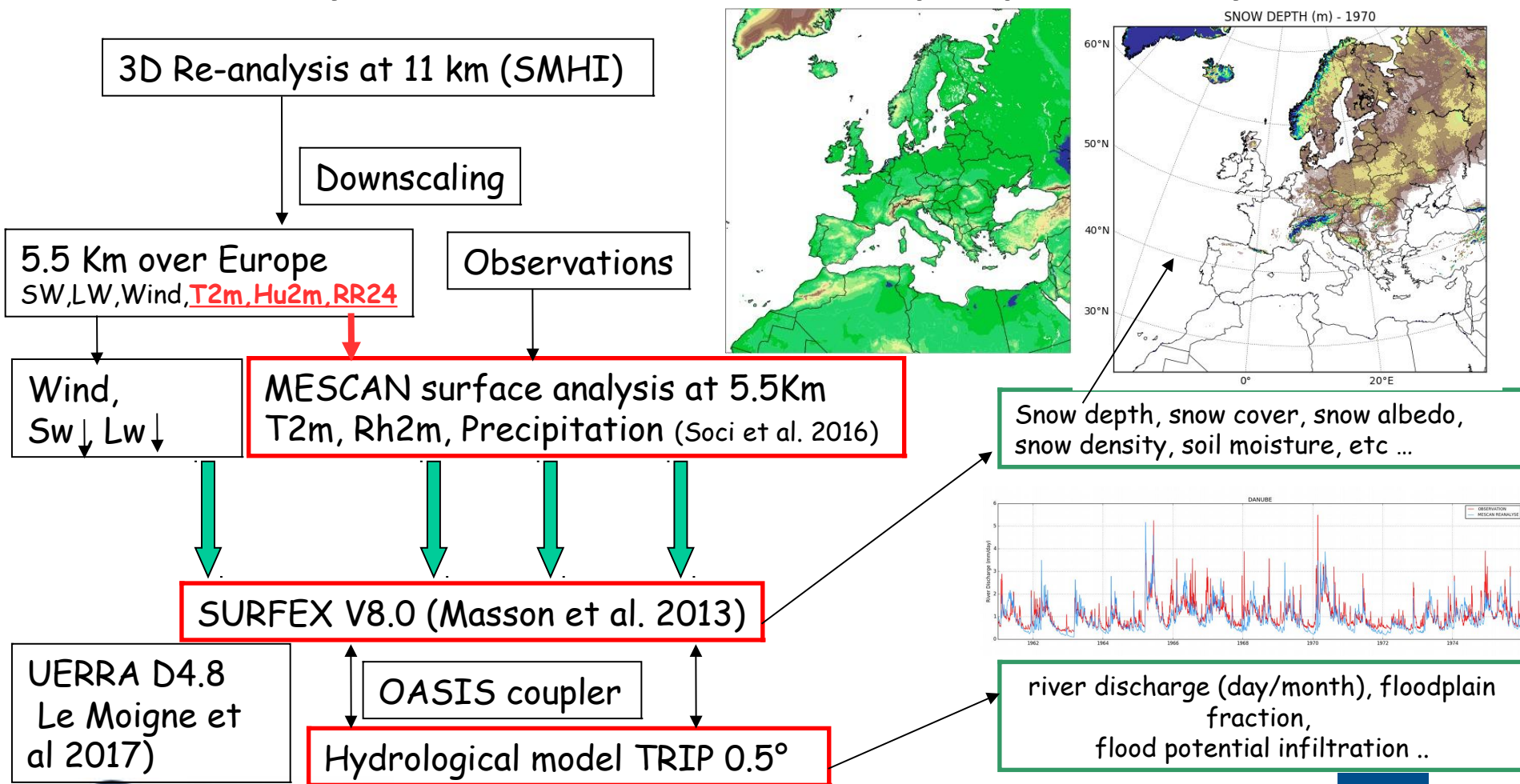
R. Abida(1), C. Szczypka(2), C. Soci(3)

(1) Météo-France -->12/2017, (2) Mercator Ocean Toulouse

(3) ECMWF

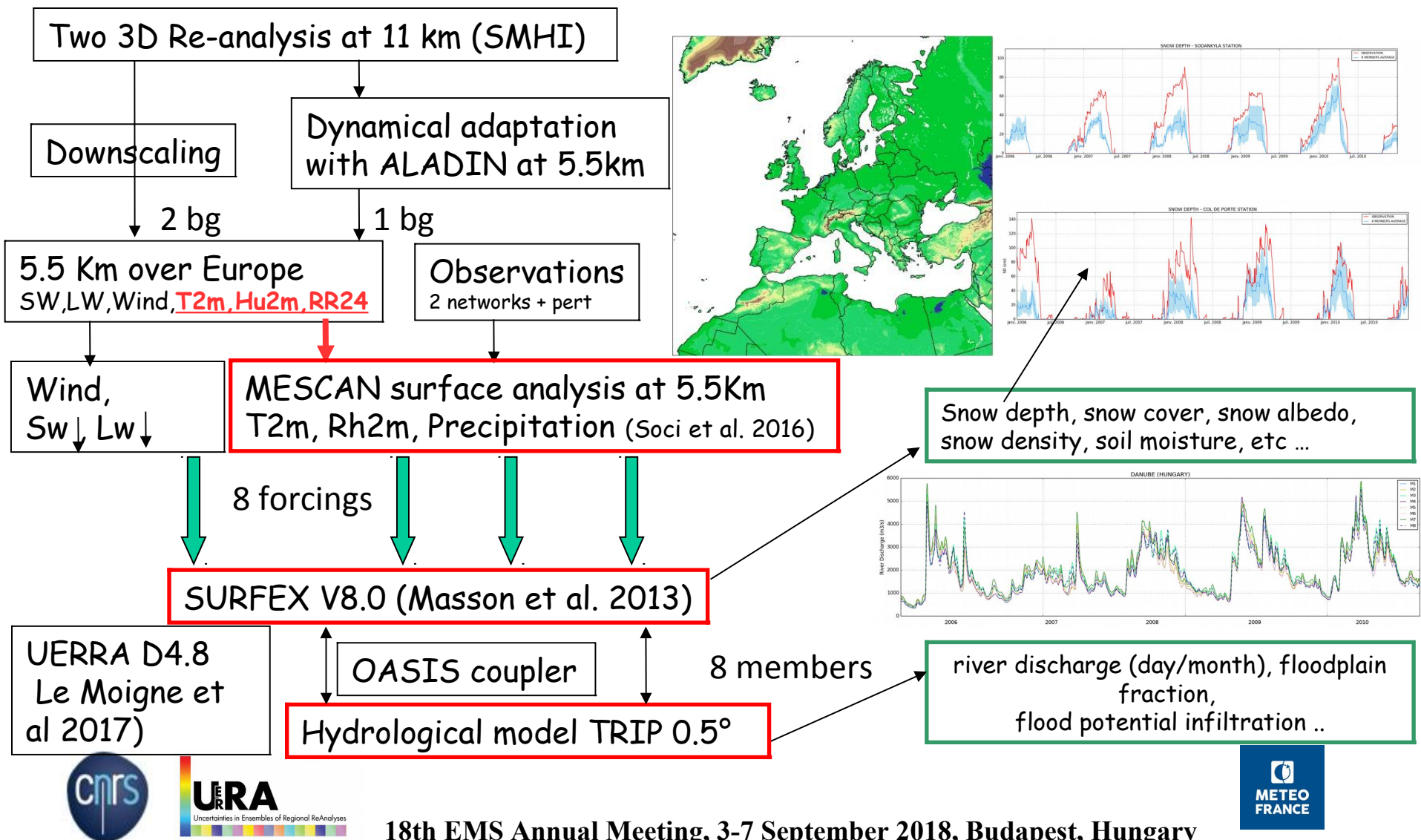
# UERRA surface re-analysis 1961-2015 : MESCAN-SURFEX (UERRA D2.8 Bazile et al. 2017)

-2D surface analysis at 5.5km for 1961-2015 with precipitation analysis



# Ensemble with 8 members

## ONLY 2006-2010 (UERRA D2.9 Bazile et al. 2017)

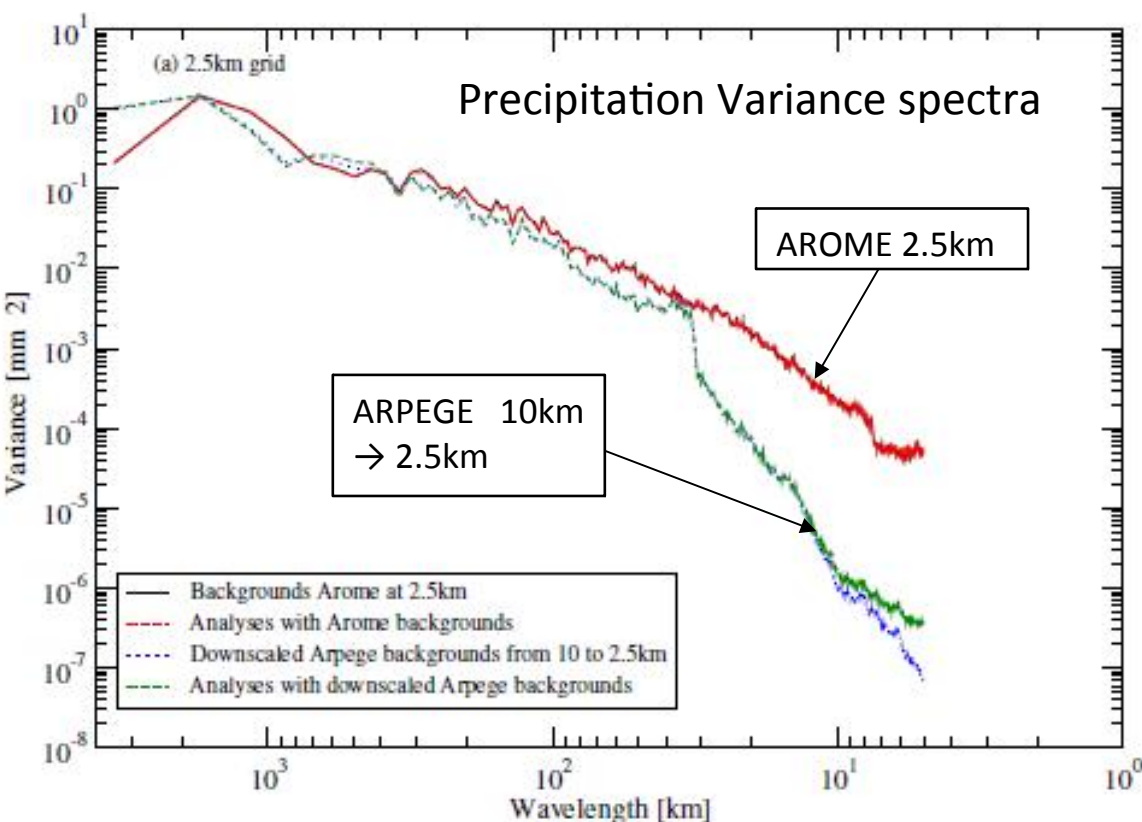


By Cornel Soci<sup>1\*</sup>, Eric Bazile<sup>1</sup>, François Besson<sup>2</sup> and Tomas Landelius<sup>3</sup>

<sup>1</sup>CNRM-GAME, Météo-France, Toulouse, France; <sup>2</sup>DCSC/AVH, Météo-France, Toulouse, France; <sup>3</sup>Swedish Meteorological and Hydrological Institute, Norrköping, Sweden

## MESCAN precipitation analysis based on OI

$$B_{ik} = \sigma_b^2 \left( 1 + \frac{r_{ik}}{L} \right) \exp \left( -\frac{r_{ik}}{L} \right)$$



## UERRA settings :

Sigma\_b=13mm and L=35km

RR\_obs=0.0mm →  $\sigma_o=0.001$  mm

RR\_obs<50mm →  $\sigma_o=0.7+RR*0.1$  mm

RR\_obs ≥ 50mm →  $\sigma_o=5.7$  mm

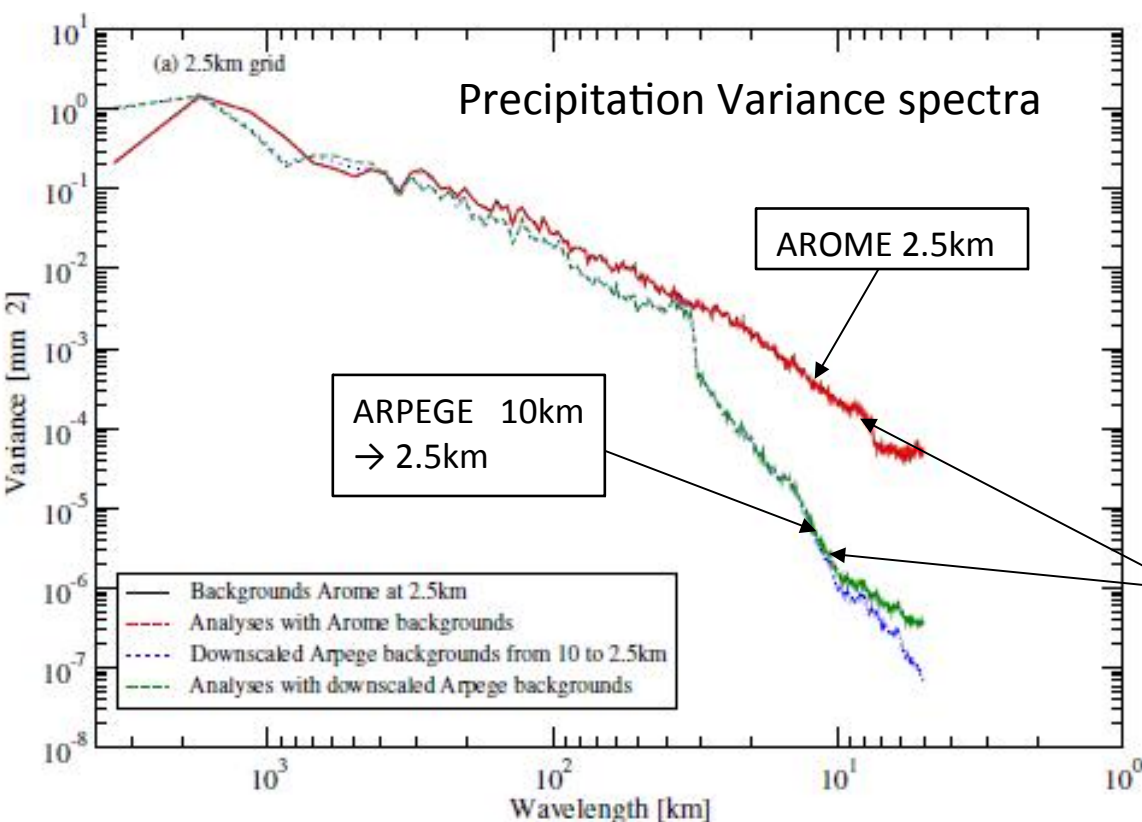


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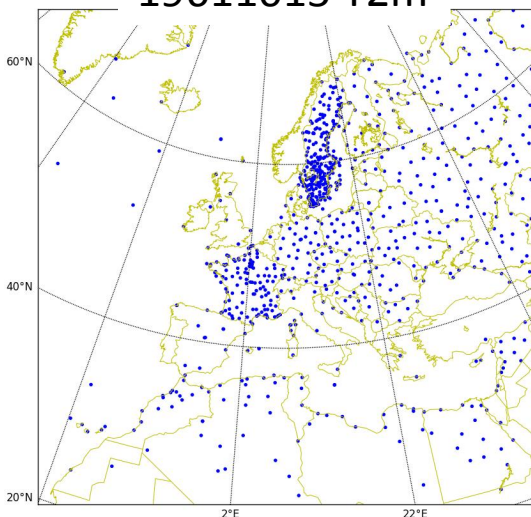
RR\_obs ≥ 50mm →  $\sigma_o=5.7$  mm

Analysis and observations (red and green) do not increase or improve the horizontal scale of the background (black and blue)

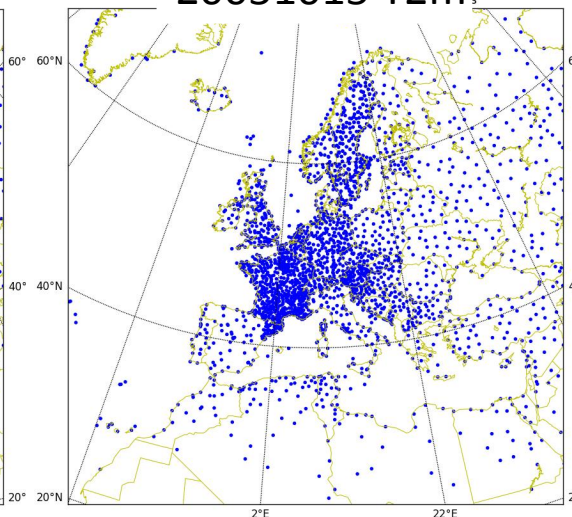
# T2m, Rh2m, Rainfall observations

- # Network density is not homogeneous in time and space
- # without enough observations the reanalysis tends to drift towards the model climatology.
- # A sharp increase in observation density might lead to misleading results. Particularly, for surface trend interpretation..
- # Observations (T2m, Rh2m) from ECMWF + some additional national database (France, Sweden & Norway)
- # RR24h: Observations from national database (France, Sweden & Norway), ECA&D and ECMWF however before 1978 no observations available over north Africa and East Europe !

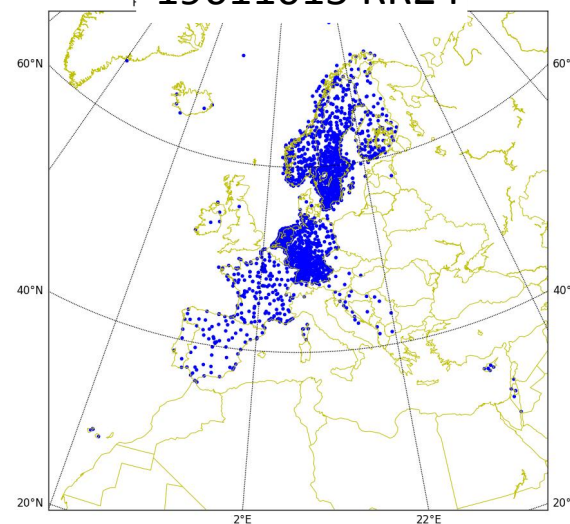
19611015 T2m



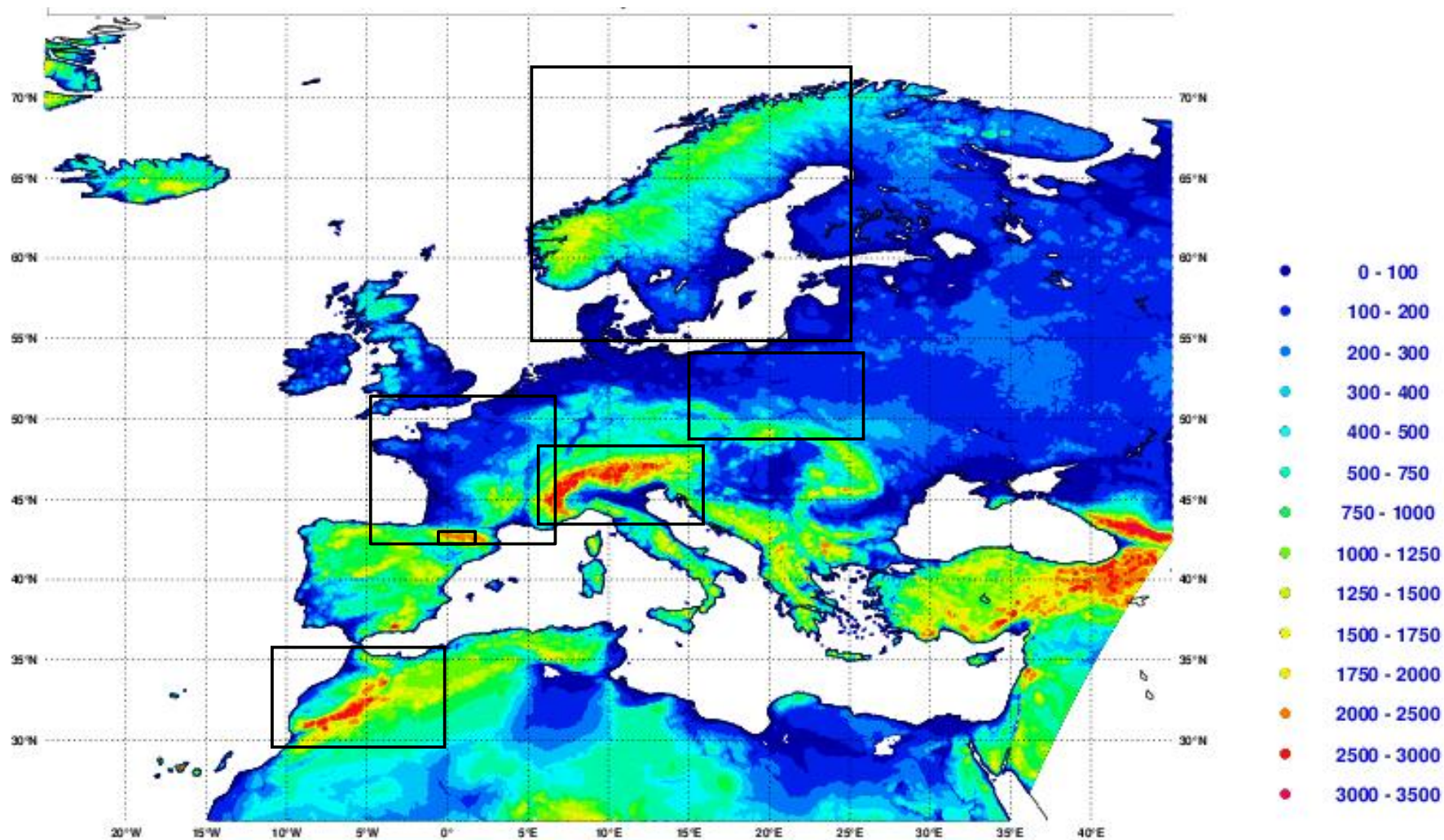
20051015 T2m



19611015 RR24

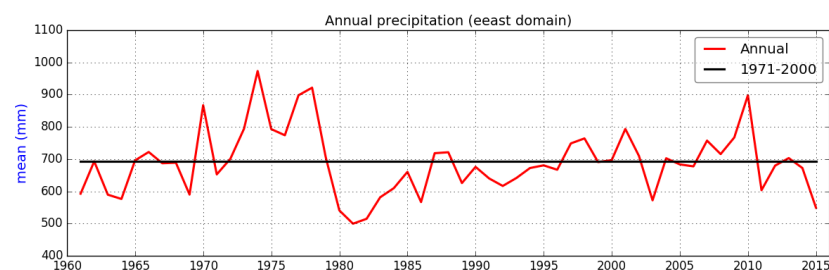
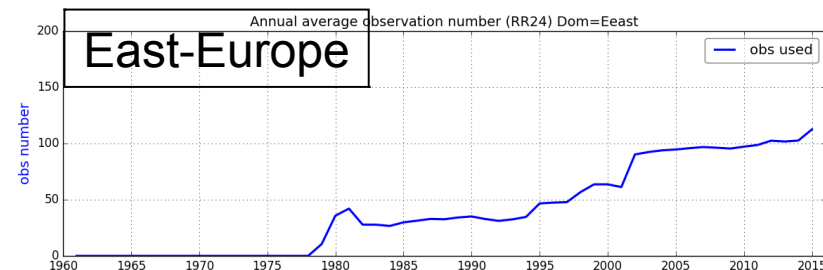
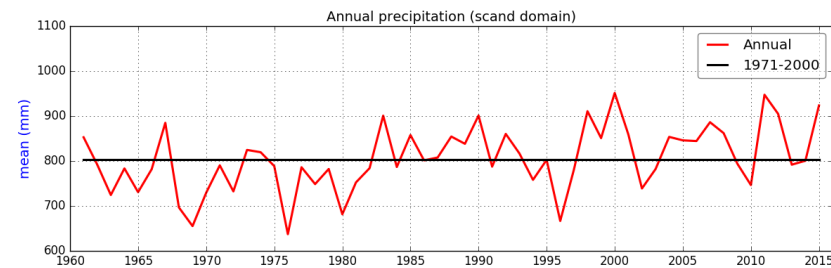
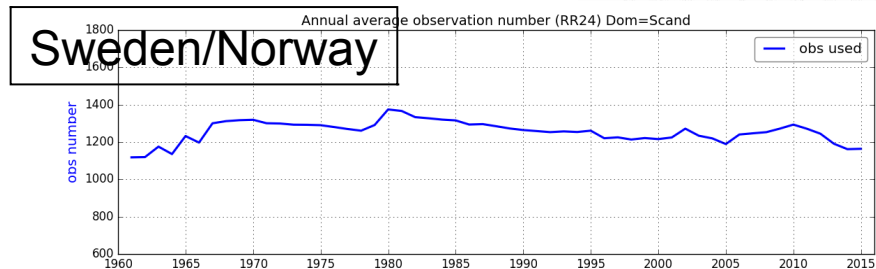
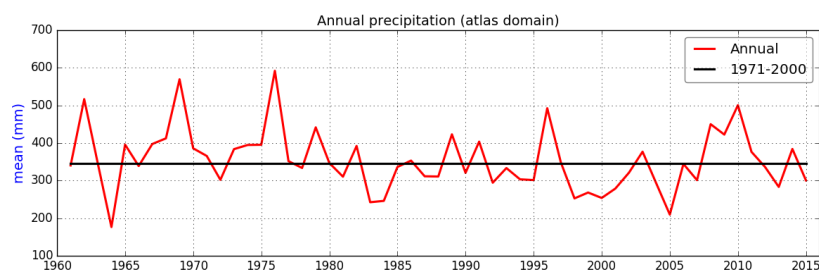
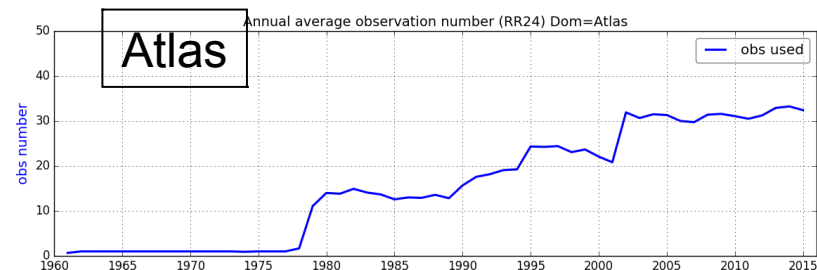
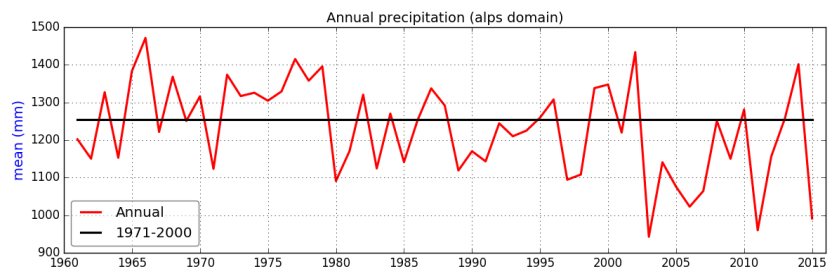
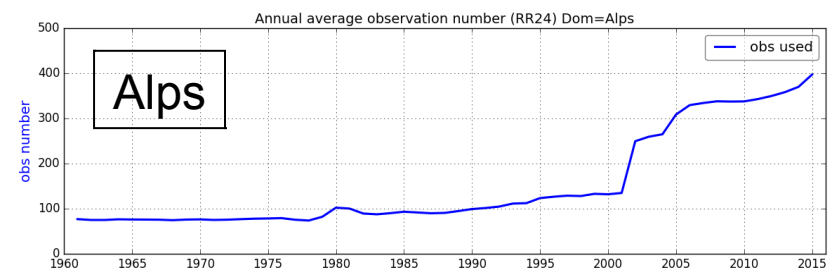
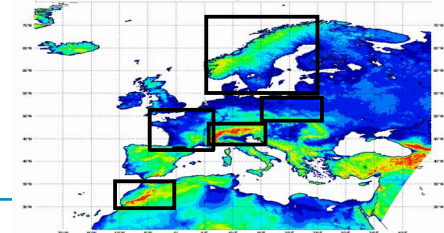


# Some preliminary results for several domains



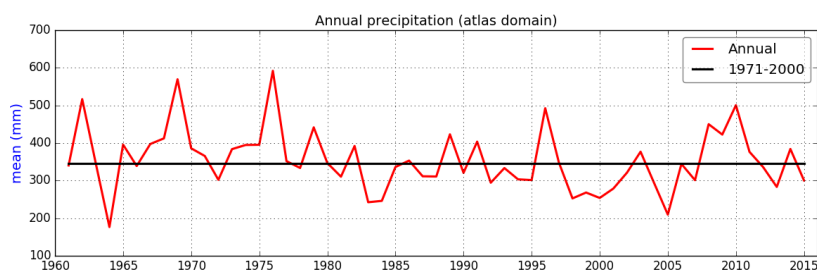
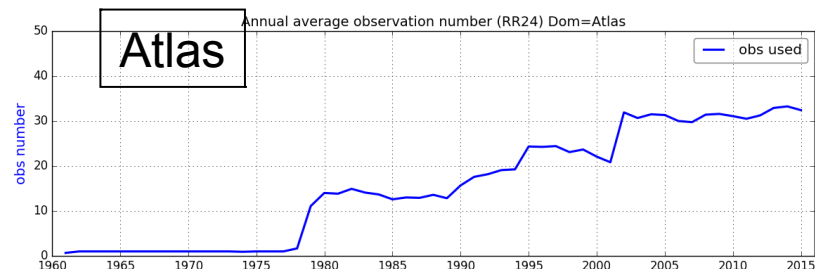
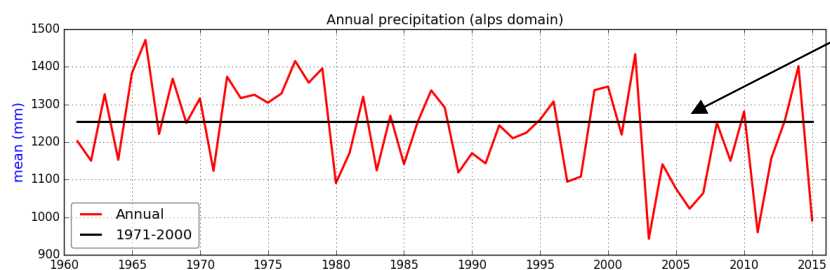
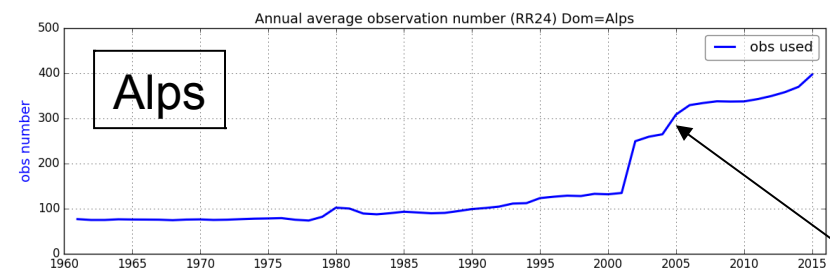


# Annual rainfall 1961-2015



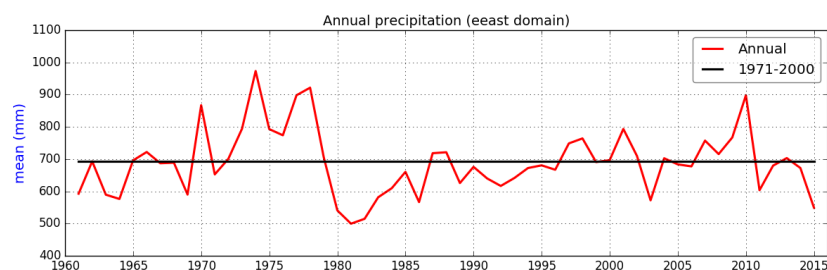
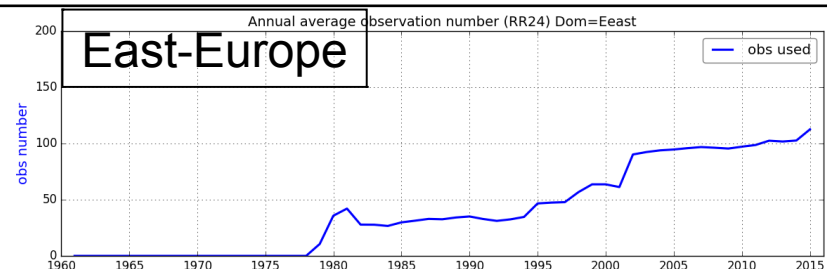


# Annual rainfall 1961-2015

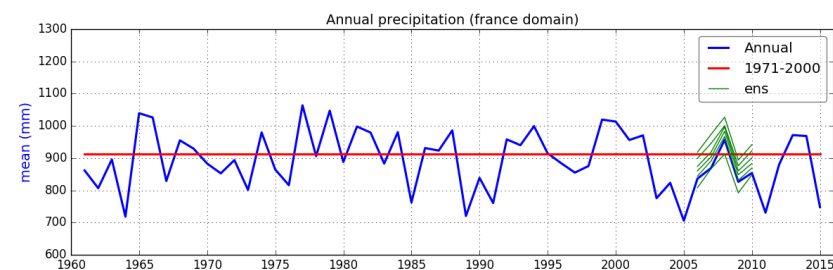
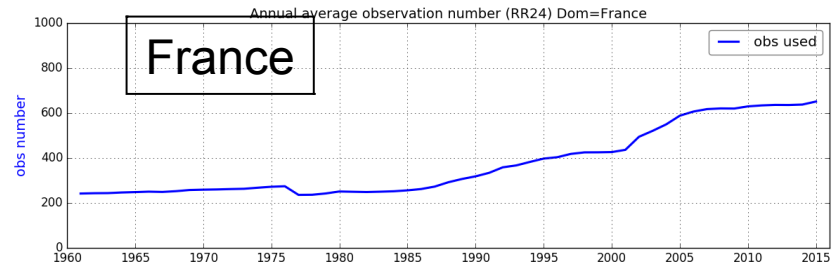
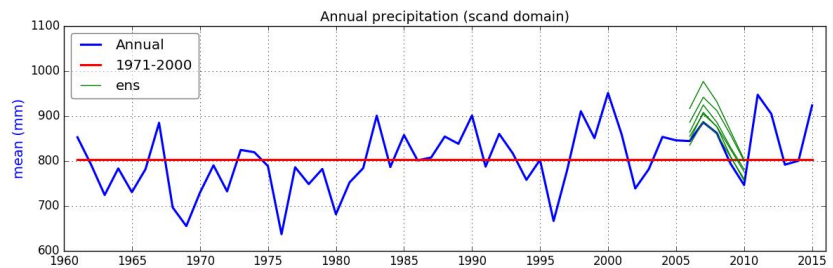
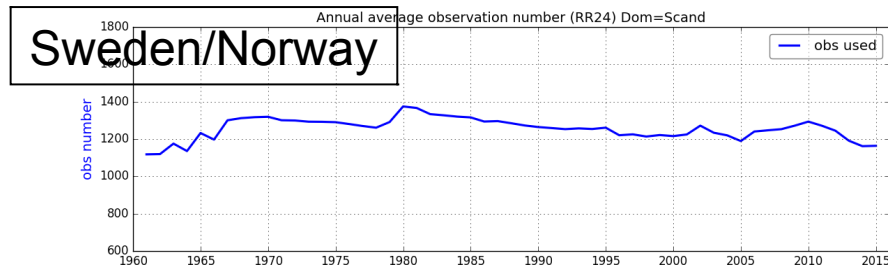
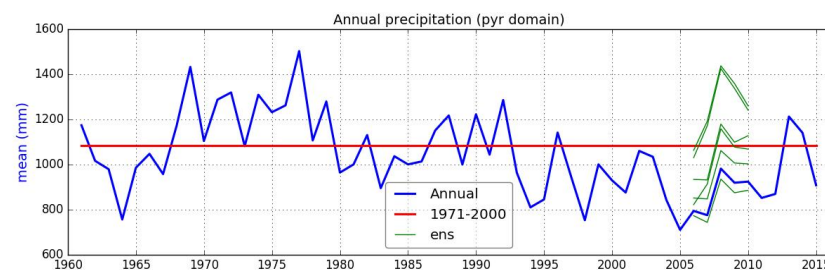
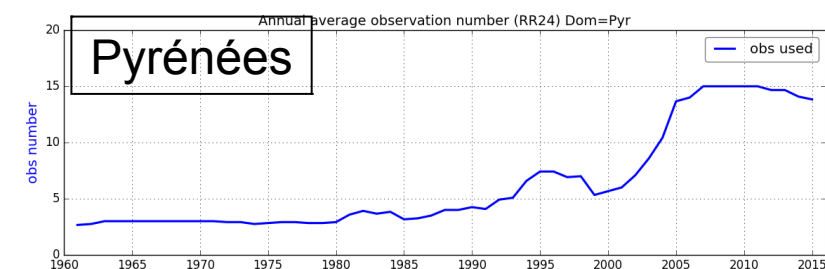
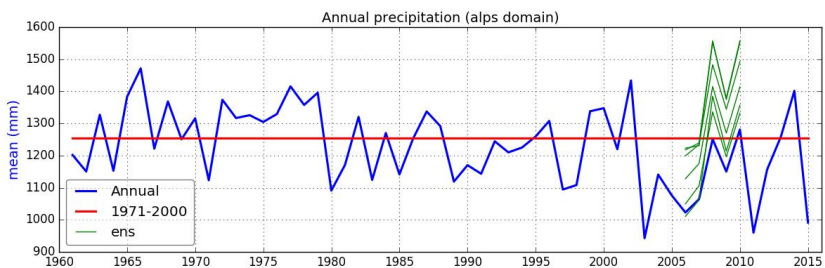
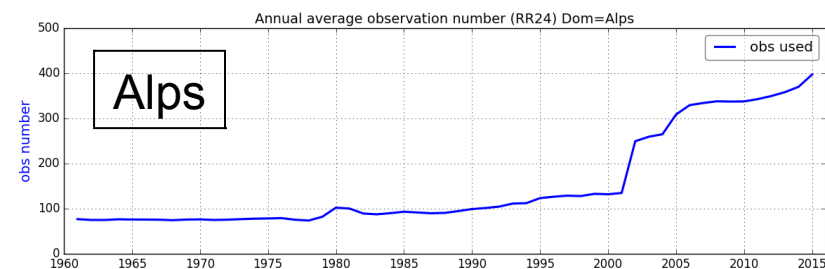


NWP models have a tendency to overestimate the precipitations over mountain. With more observations available → more corrections so less overestimation.

How the increase of the number of observations affect the trends of precipitation over the Alps ?



# Annual rainfall 1961-2015

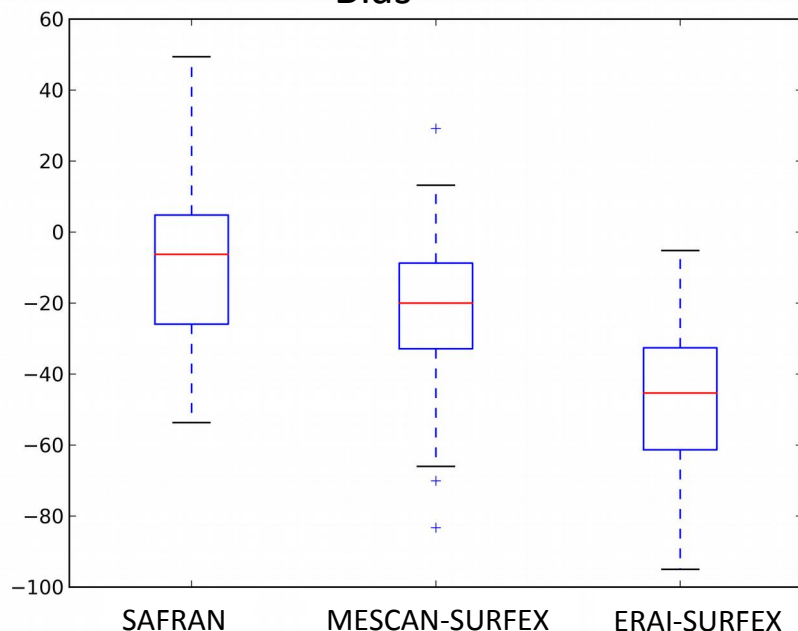


# UERRA-MESCAN-SURFEX

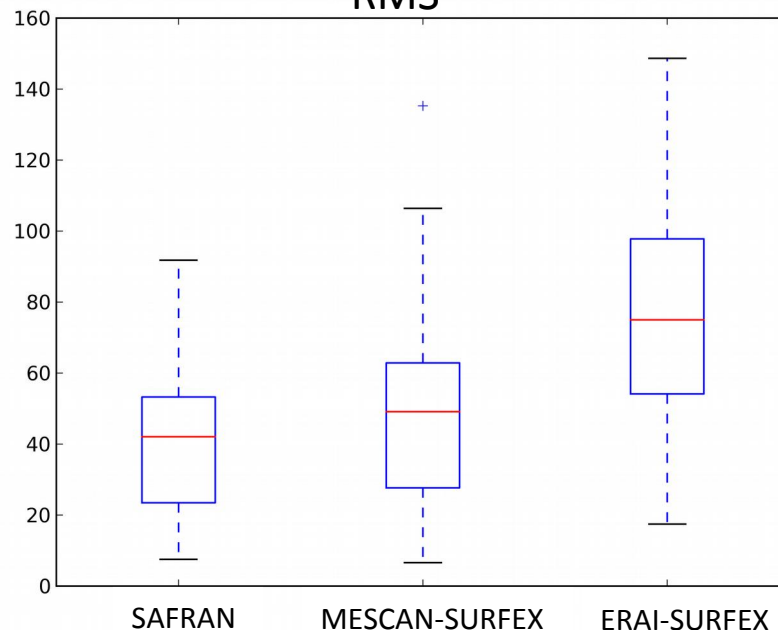
## Snow depth evaluation (2001-2011)

Snow depth measurement: independent observations for MESCAN-SURFEX but not for SAFRAN (operational Meteo-France system for snow avalanches). ERAI-SURFEX (Boisserie et al (2016)).

Bias



RMS

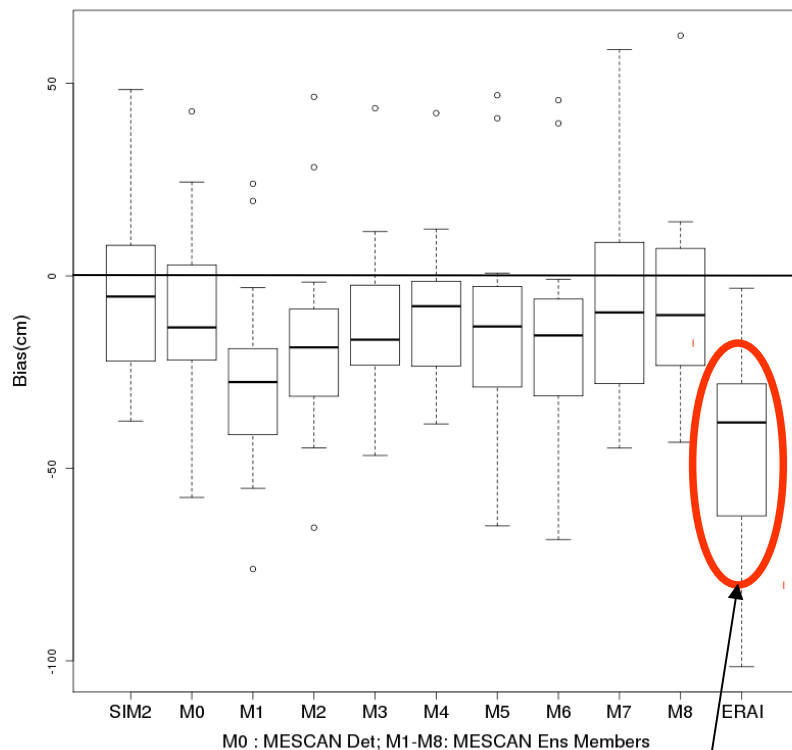


The MESCAN analysis improves the snow height computed by SURFEX ; thanks to the MESCAN precipitation analysis versus GPCC correction and a better horizontal resolution

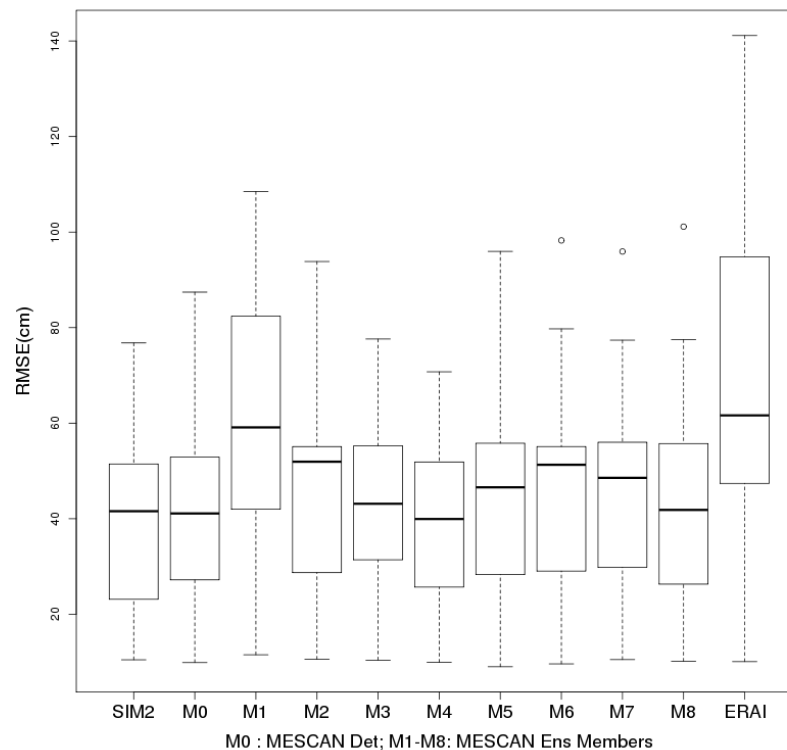
# UERRA-MESCAN-SURFEX-ENS

## Snow depth uncertainties (2006-2010)

BIAS boxplot per experiment - ALPES



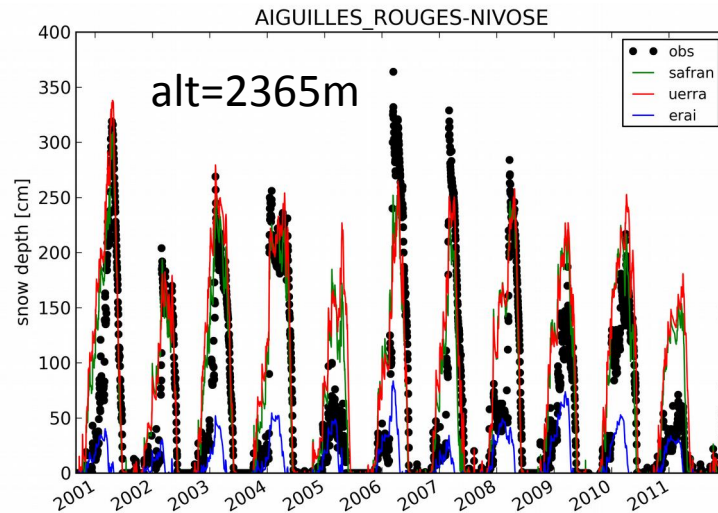
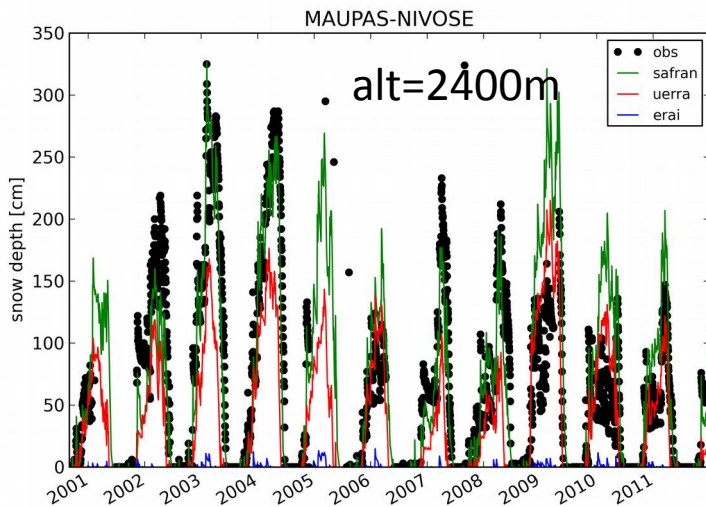
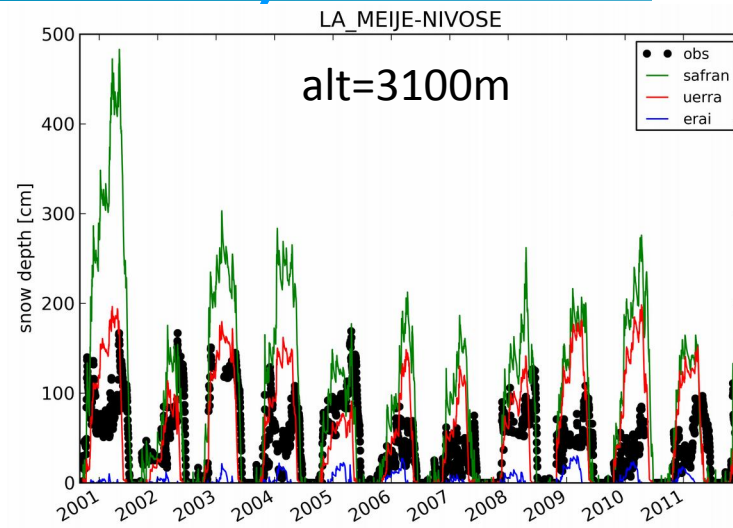
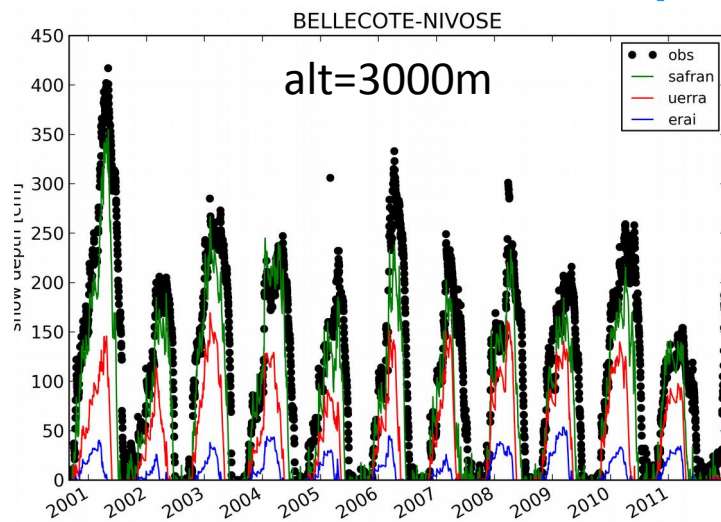
RMSE boxplot per experiment - ALPES



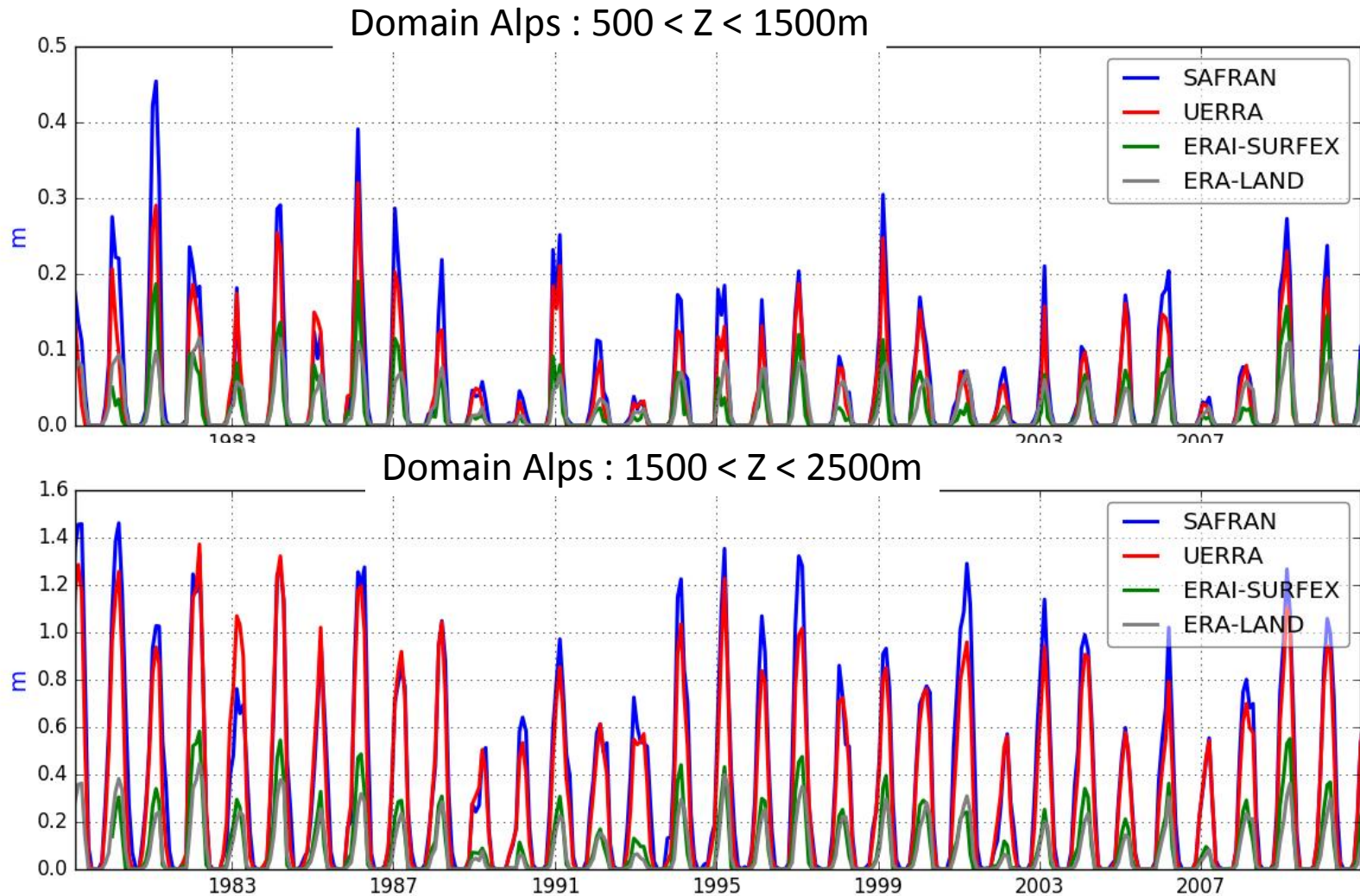
All the members underestimate the snow depth however in a less extend compared to ERAI-SURFEX



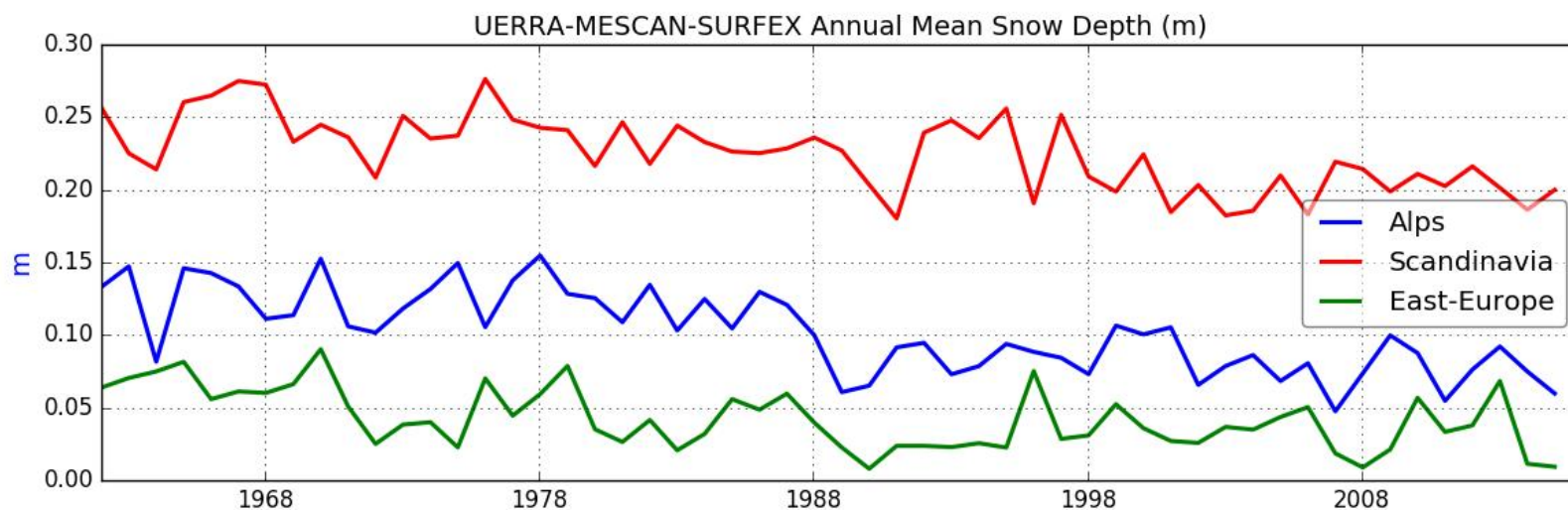
# MESCAN-SURFEX: Snow depth evaluation (2001-2011)



# Snow height comparison between SAFRAN, UERRA-MESCAN-SURFEX, ERA-Land & ERAI-SURFEX.



# MESCAN-SURFEX: Snow depth

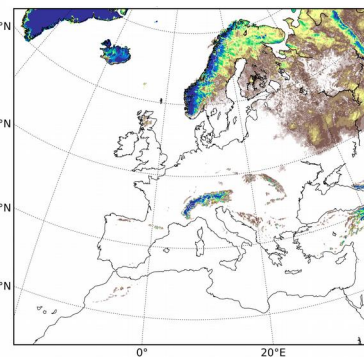
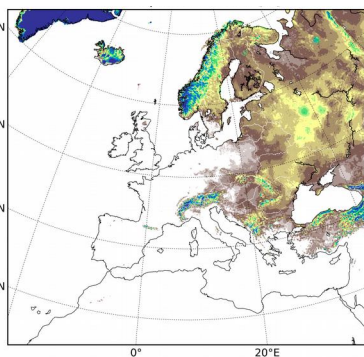
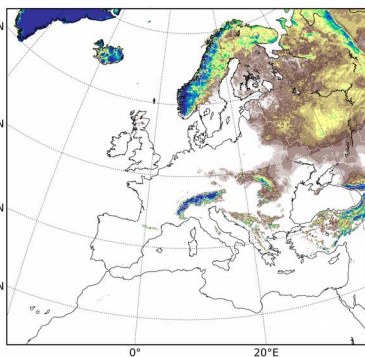
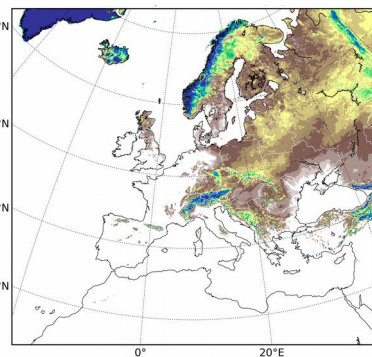


Snow depth 19650301

Snow depth 19750301

Snow depth 19850301

Snow depth 19950301





# Conclusions

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- The UERRA-MESCAN-SURFEX surface re-analysis at 5.5km over Europe is available for the period 1961-2015 from the MARS archive. 2016 and 2017 will be available soon...
  - Added value versus global re-analysis and/or other products such as ERA-Land or ERAI-Surfex
  - Snow depth are significantly improved thanks to the MESCAN precipitation analysis (versus GPCC bias correction used in ERA-Land) and a better resolution
  - Surface fluxes, river discharge, soil moisture are also improved (not shown)
  - Uncertainties are also available with 8 members for the period 2006-2010 and should be used by “users” especially for water budget, snow etc ..
  - More “users” → more “feedbacks” → more progress !
- Output surface variables @ 5.5km from the MARS archive:
  - T2m, Rh2m, Ws10m, Wd10m every 6h and 24h precipitation
  - Every 1h: Ts, Snow depth, snow density, albedo, SWd, SWnet, LWd, LWnet, LE, SH, surface run-off
  - Every 1h for all the 14 soil layers: soil temperature, total soil moisture , liquid soil moisture (non frozen)



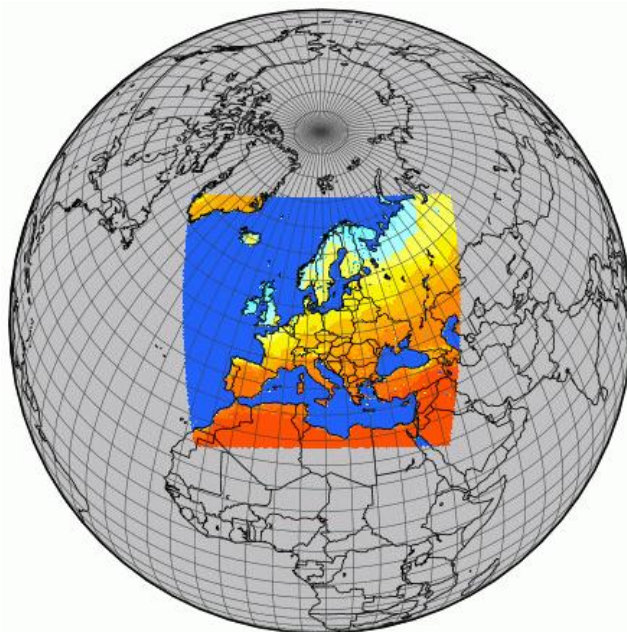
# For the future...

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- Do we need to increase the horizontal resolution ? 1Km ?
- Model horizontal resolution and “real scale” really useful for the users ?
- Precipitations are very important for snow, water management etc ...
  - precipitations are extremely variable in time and space
  - the observation network is not constant in time and in space → quality and uncertainties are also not constant in time and space !
  - Can we improve the MESCAN precipitation analysis by using the OPERA radar network ? Only available on a short period so useful ?
  - Need to develop a specific quality control for the precipitation, even if the additional data received from national weather service are supposed to be “verified”
- Uncertainties should include all the potential errors from the “full” system
  - Observations errors (perturbed method), impact of the density network
  - Model errors (background), surface and snow parameterization (perturbed parameters, multi-options or physics etc ..)
  - Settings (tunings) in the analysis scheme

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Thank you for your attention! Questions ?



### Acknowledgements

The research leading to these results has received funding from the European Union, Seventh Framework Programme (FP7-SPACE-2013-1) under grant agreement n° 607193.