



# Les re-analyses sur l'Europe: UERRA puis Copernicus

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18 Décembre 2017  
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# Un peu d'histoire

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- EURO4M 2010-2013 : re-analyse sur l'Europe à 22km (SMHI) avec le modèle HIRLAM (1980-2010) et analyse de surface à 5.5km (2007-2010) Météo-France avec développement de l'analyse de précipitation.
- UERRA 2014-2017 : plusieurs re-analyse atmosphérique sur l'Europe : UKMO, DWD, SMHI avec le modèle ALADIN ! + une analyse de surface à 5.5km (1961-2015) Météo-France. Mise à disposition de l'ensemble des données au CEP sur l'archive MARS.

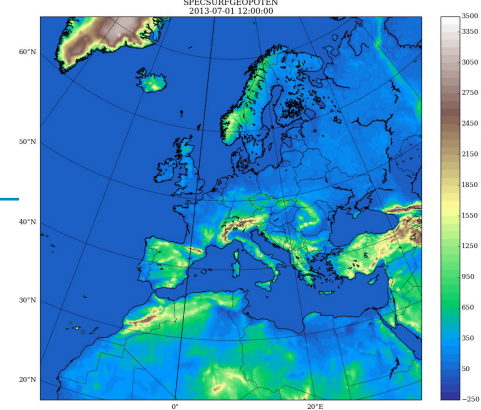


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# UERRA : Uncertainties in Ensembles Regional ReAnalysis (2014-2017)

## Per Uden SMHI



Données disponibles sur MARS (ECMWF) en GRIB2 ou NetCdf

SMHI  
HARMONIE - ALADIN  
11 km  
65 levels  
3D-Var

UK MetOffice  
12 km  
70 levels  
4D-Var  
Including satellite info.  
20 ens. members  
36 km

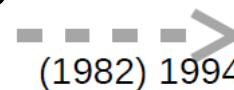
University of Bonn  
Hans Ertel Centre  
12 km  
40 levels  
Nudging (LETKF prepare)  
20 ens. Members  
12 km



**1961-2015**

Météo-France  
MESCAN  
Surface  
6-8 en. Members  
OI MESCAN  
5 km

**1979-2015**



SMHI  
MESAN  
Cloud Analysis

**2006-2010**

SMHI  
HARMONIE-ALARO

[www.uerra.eu](http://www.uerra.eu)



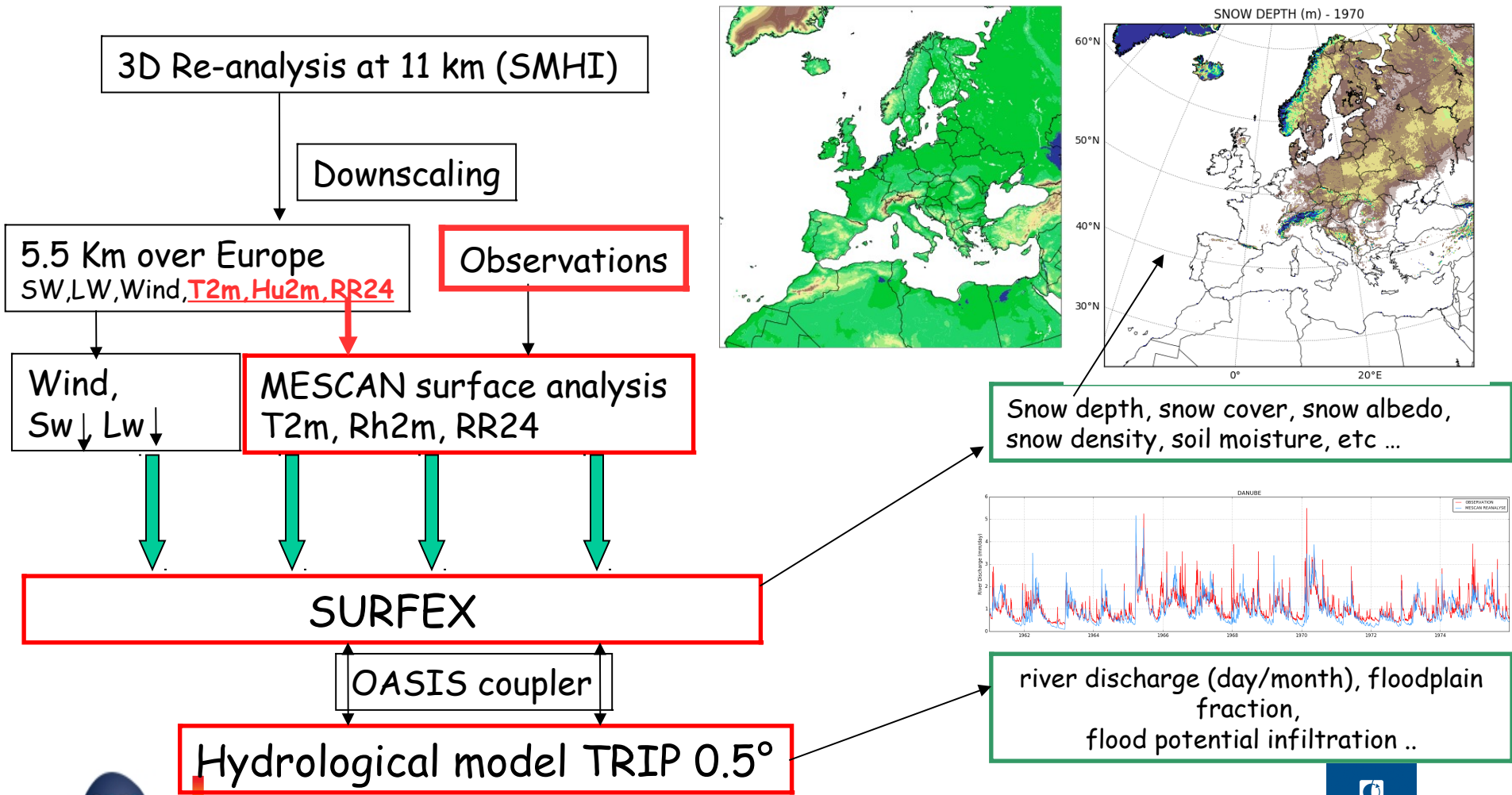
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# UERRA surface re-analysis 1961-2015 : MESCAN-SURFEX-TRIP

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



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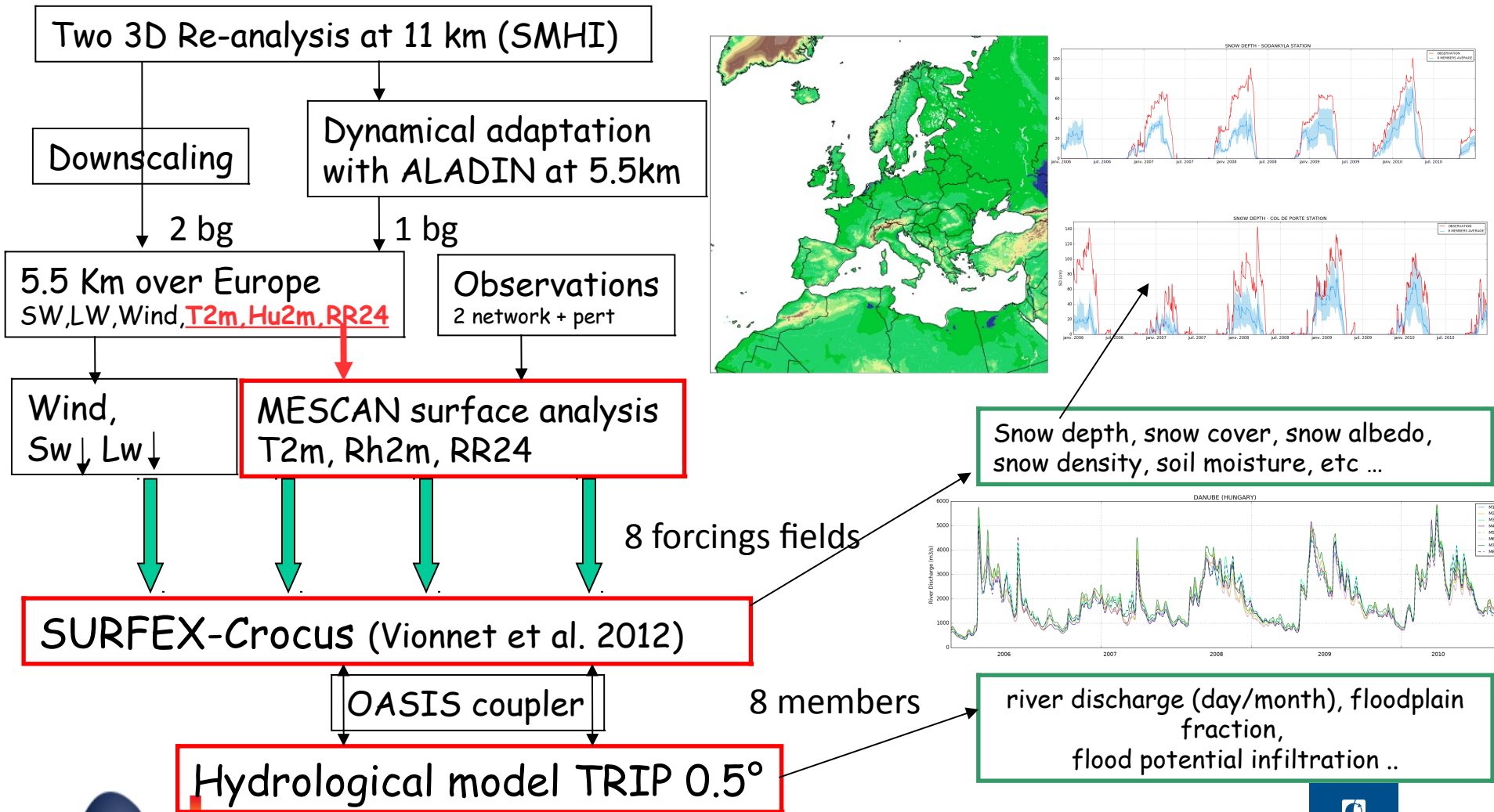
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# Ensemble with 8 members

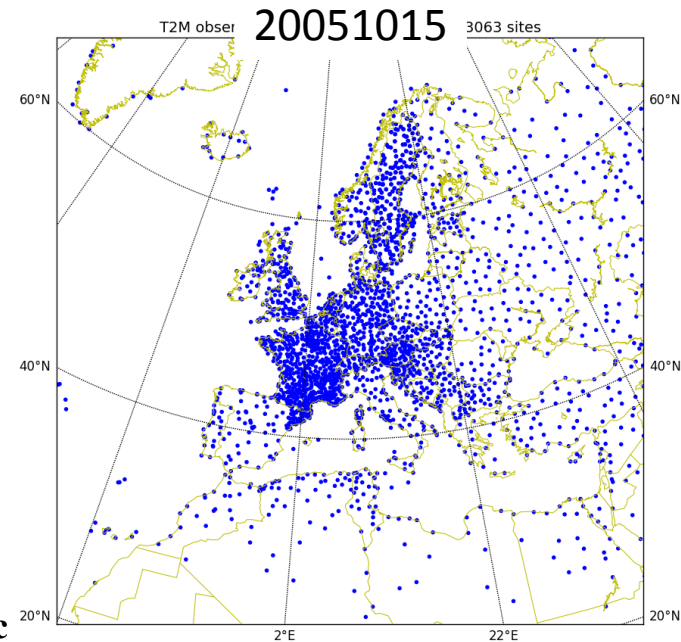
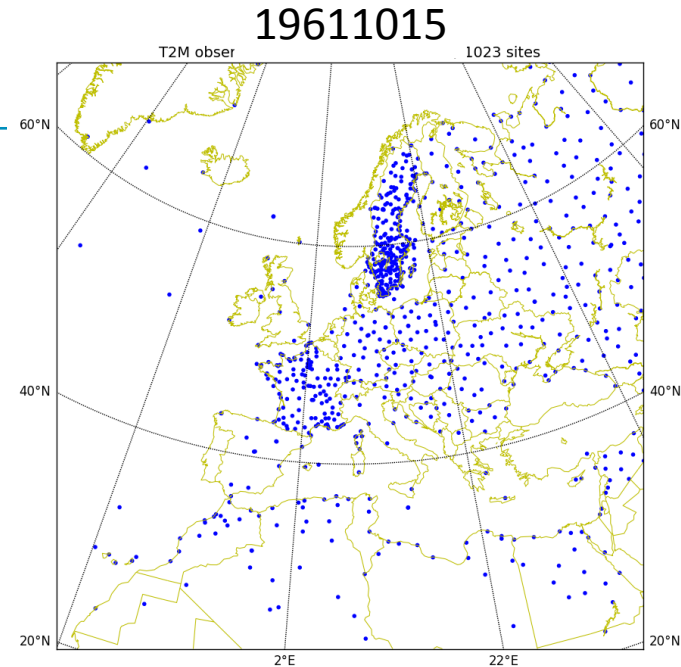
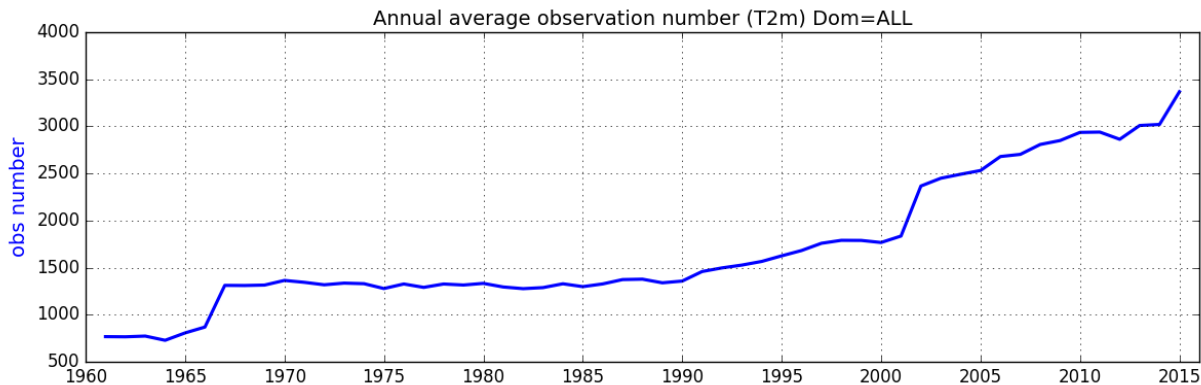
## ONLY 2006-2010 (UERRA report D2.9)



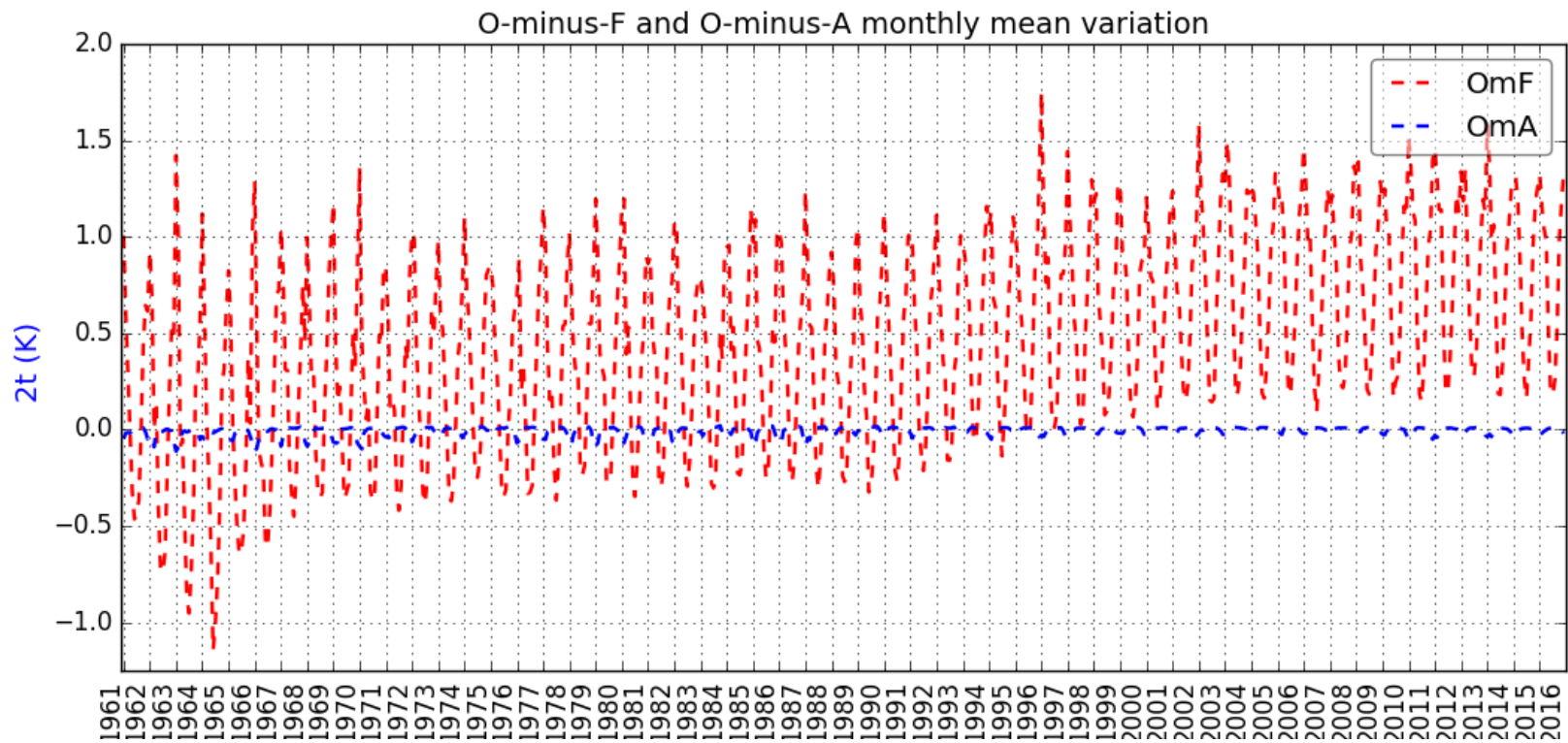
# T2m, Rh2m observations

- # 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) + some input from WP1

## Obs T2m used in UERRA surface re-analysis



# MESCAN verification T2m

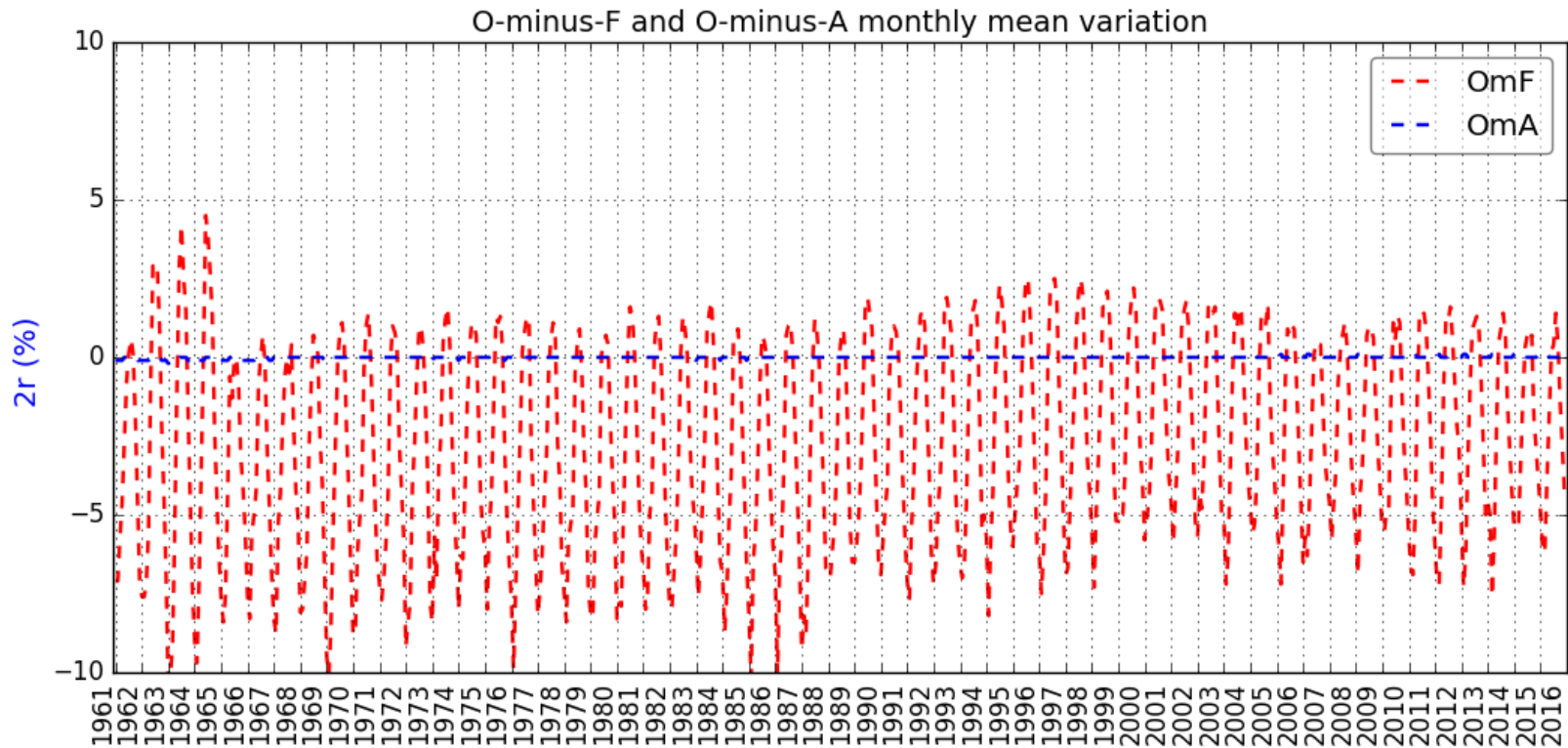


A slight increase of the O-G after 1992 due probably to a denser observation network in the Eastern part of Europe and over the Alps.

**Nevertheless the impact on the O-A is very small**

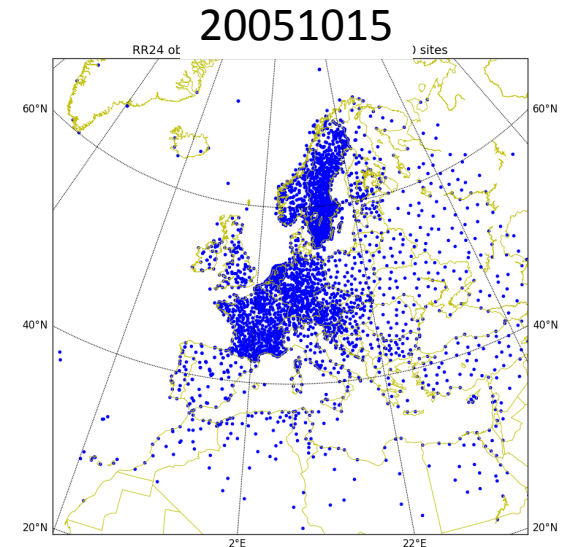
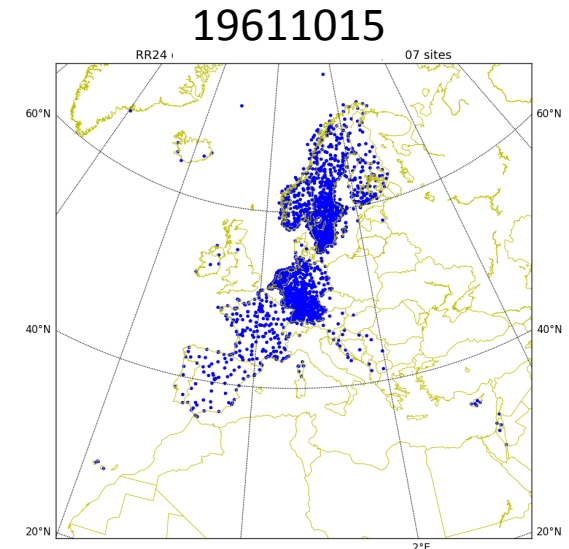
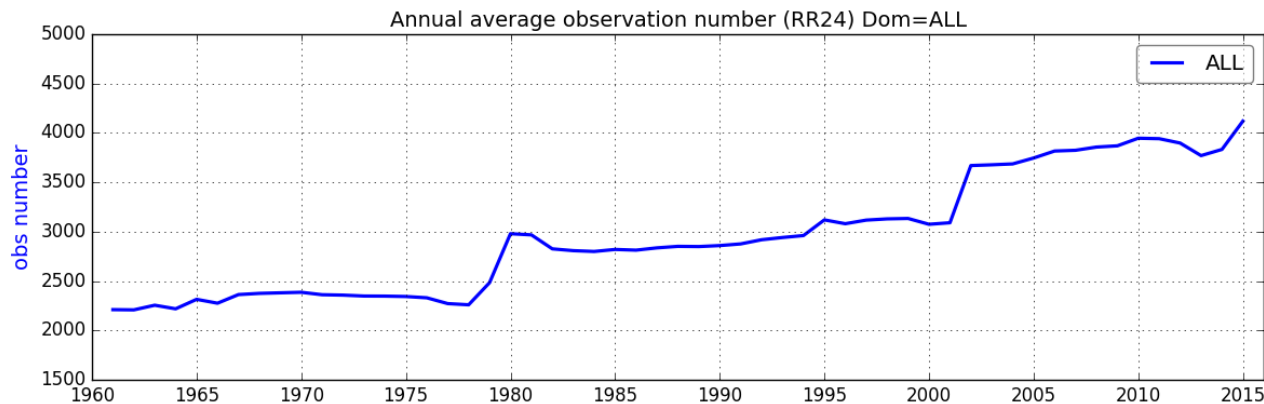


# MESCAN verification Rh2m



# Rainfall observations

- # Before 1978 no observations available or used over north Africa and East Europe !
- # Observations from national database (France, Sweden & Norway), ECA&D and ECMWF but ...
- # From the MARS archive only two 12h accumulated RR were used

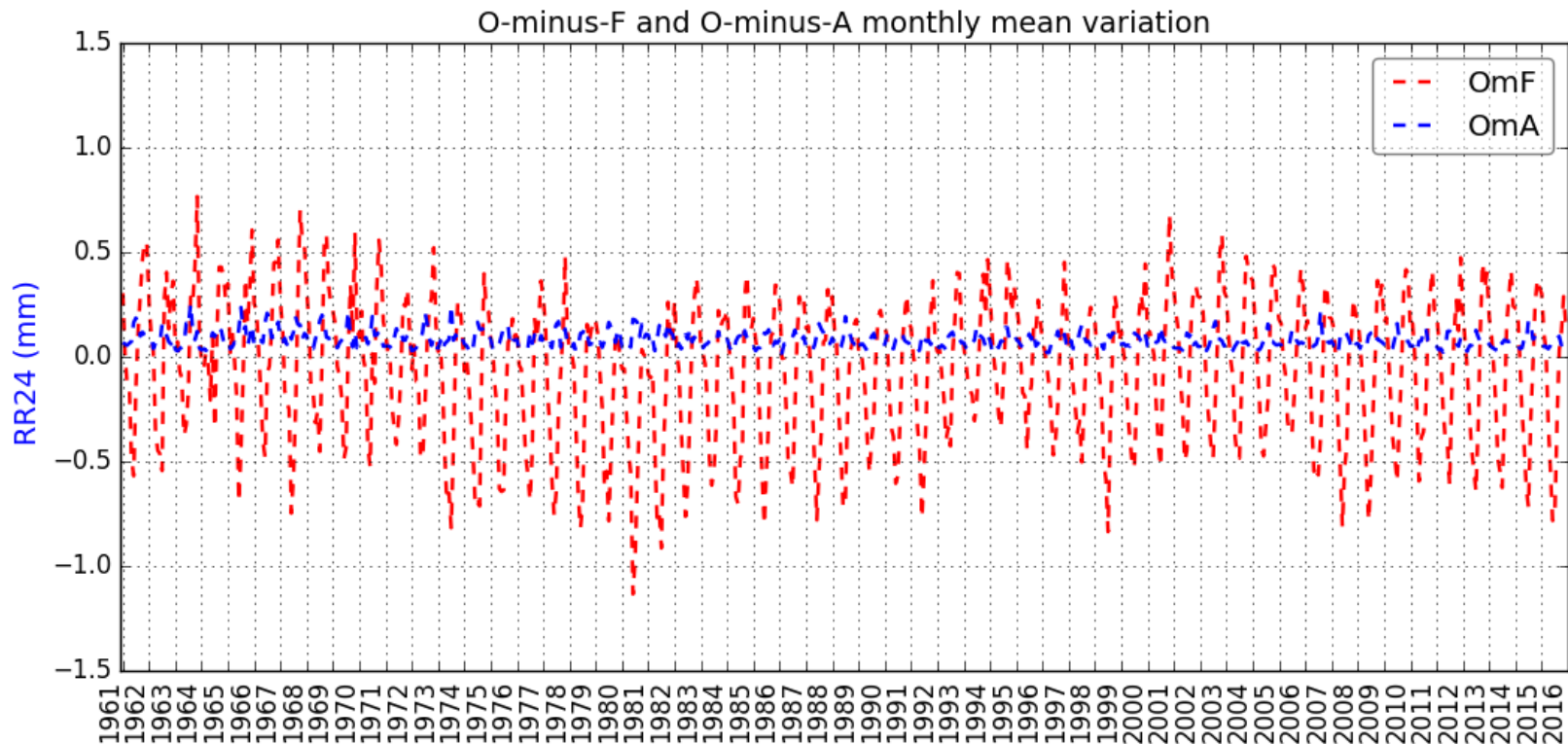




# MESCAN verification : RR24

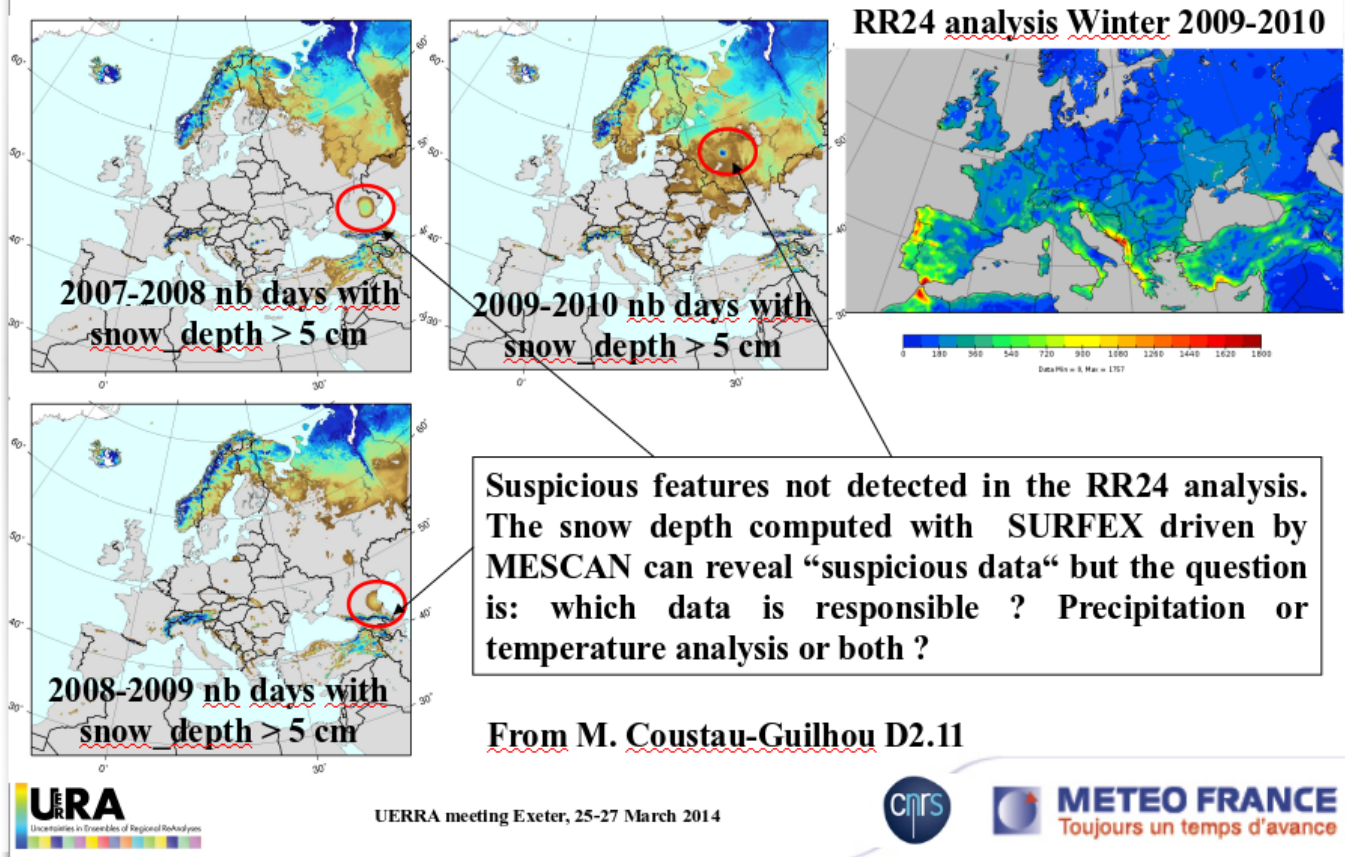
New tunings for the statistical errors for the precipitation analysis with a variable  $\sigma_o$  instead of  $\sigma_o = 5\text{mm}$  to reduce the problem of overestimation of wet days

$RR_{\text{obs}}=0. \rightarrow \sigma_o=0.001$  ;  $RR_{\text{obs}}<50\text{mm} \rightarrow \sigma_o=0.7+RR*0.1$  ;  $RR_{\text{obs}} \geq 50\text{mm} \rightarrow \sigma_o=5.7$

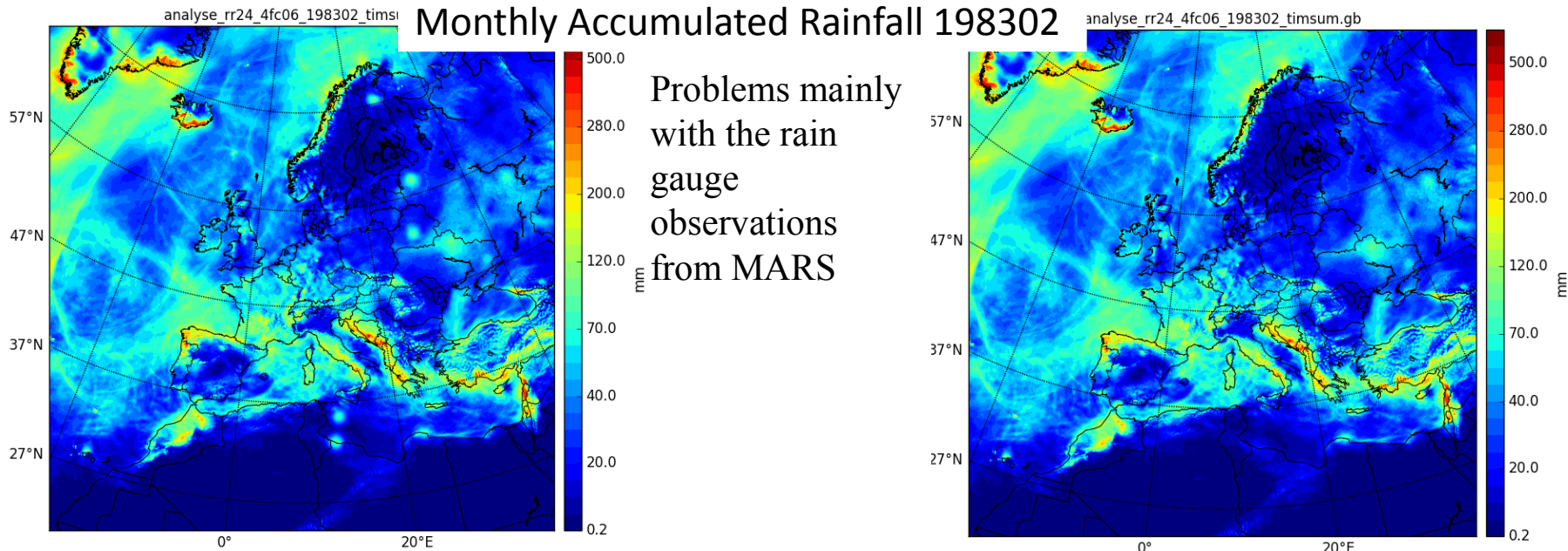


# Problems with the precipitation observations

## Lessons from Euro4M



# Quality of the precipitation observations



- QC done with Obs-FG impossible to optimize: to keep the extreme convective events and to reject all the suspicious obs → finally manual correction and re-run the analysis ! → take a lot of time → for the future need to develop a «clever » and specific QC for the precipitation

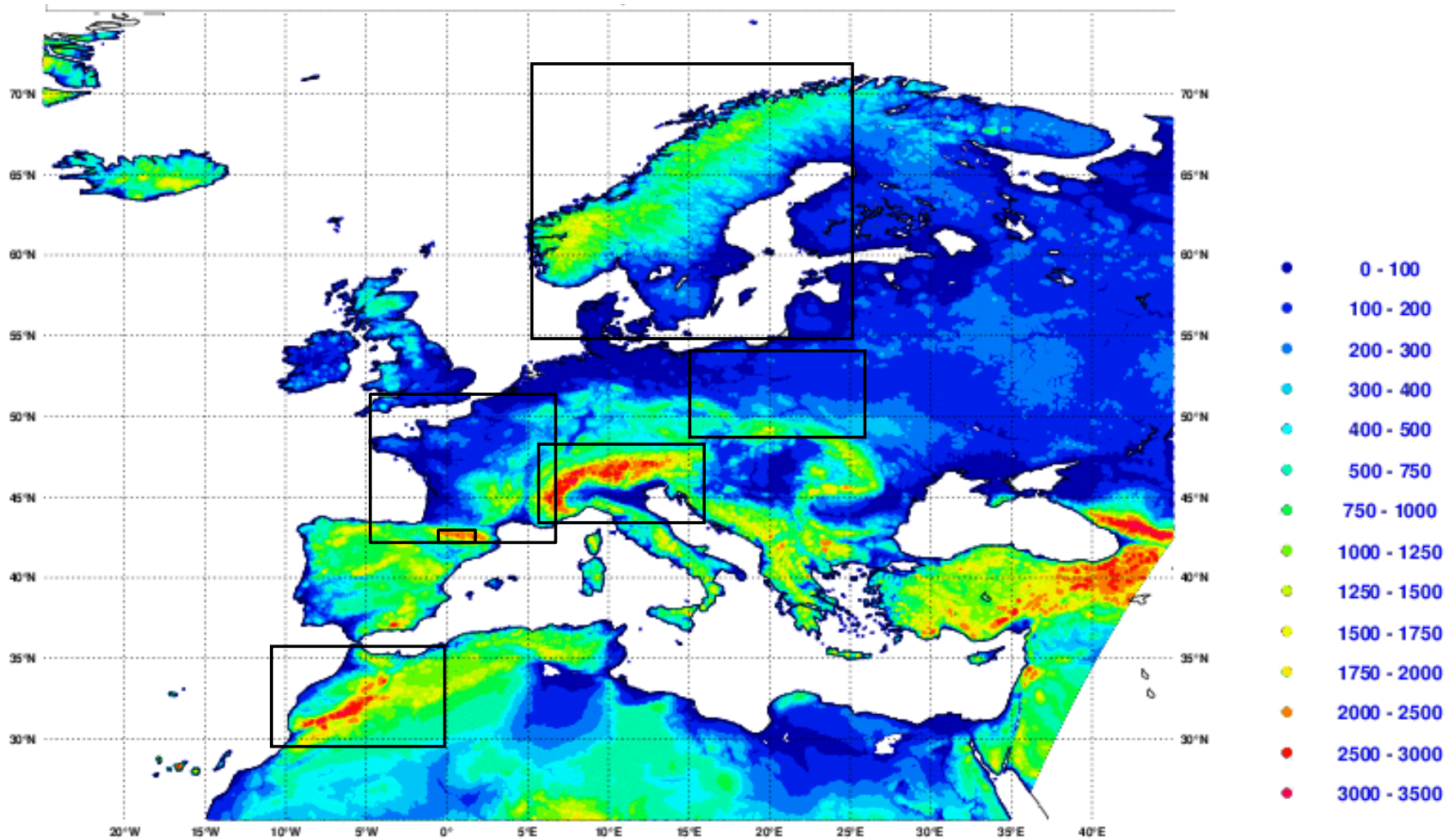
- Observation rejection criterion (NOT ACTIVATED):  $\frac{(O - G)^2}{\sigma_o^2 + \sigma_b^2} > T$  (= threshold)

Ex: O=400 mm, G=50mm,  $\sigma_o=5.7$ ,  $\sigma_b=13$  => T ≈ 26

With T=26, RR\_obs=100mm,  $\sigma_o=5.7$ ,  $\sigma_b=13$  => 25mm ≤ G ≤ 175mm



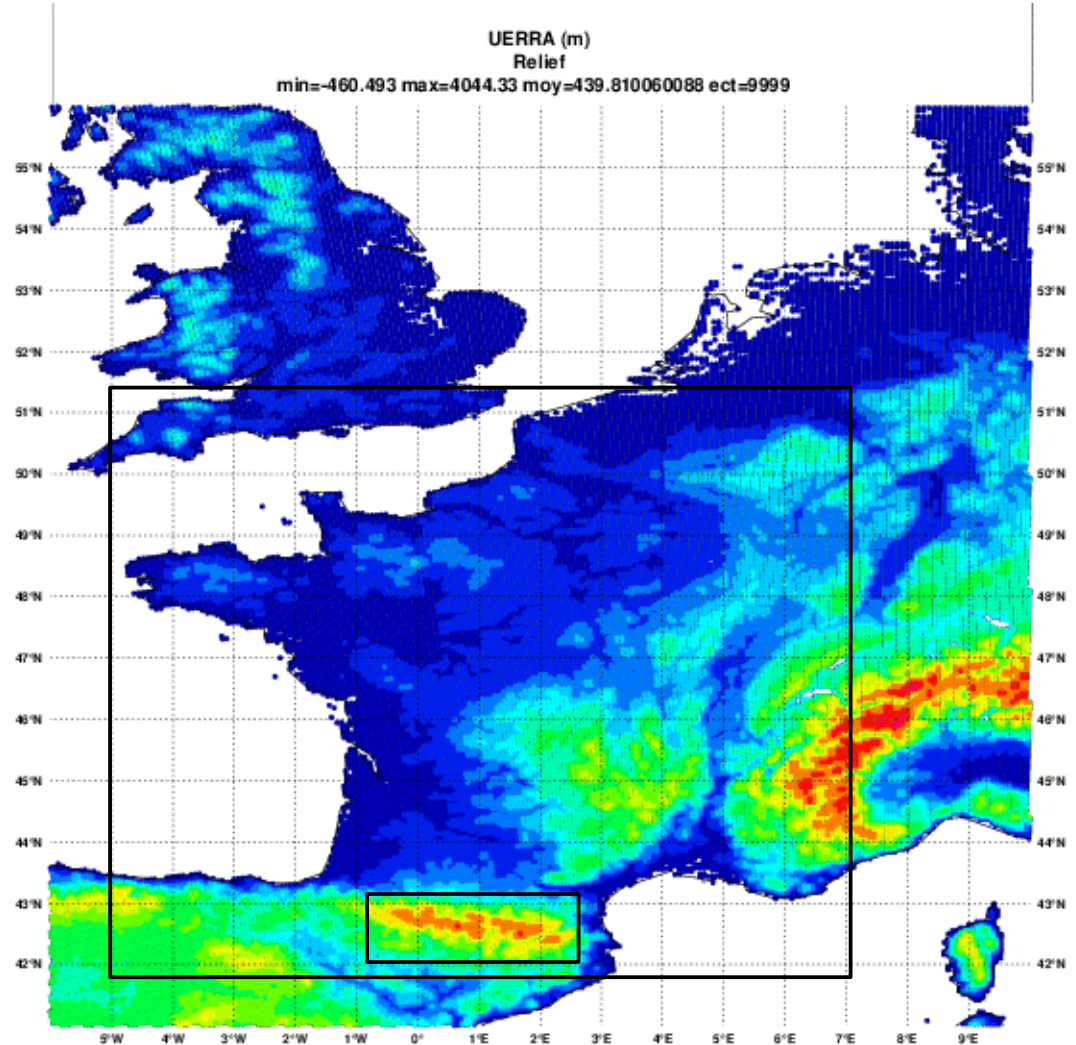
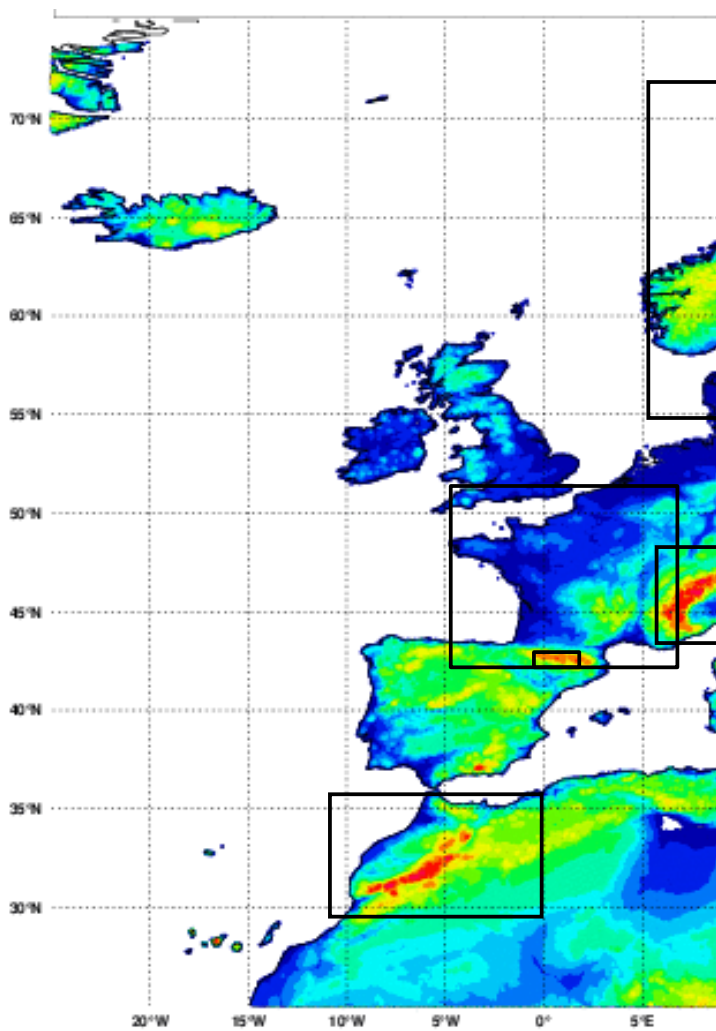
# Some preliminary results for several domains



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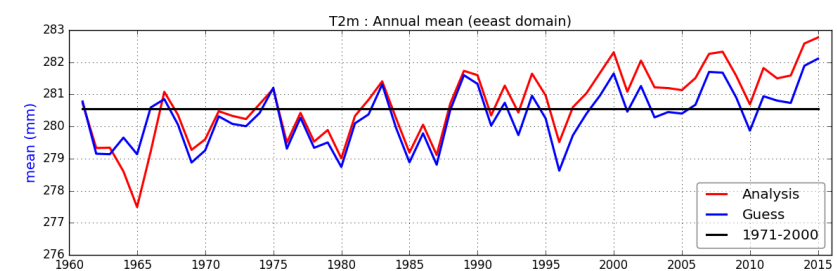
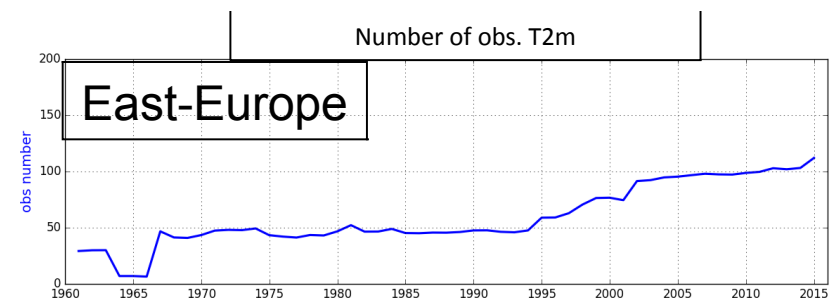
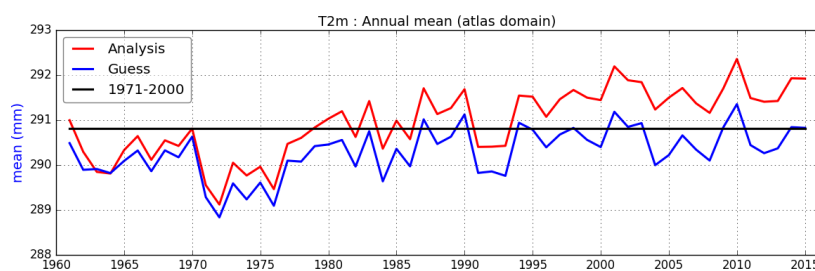
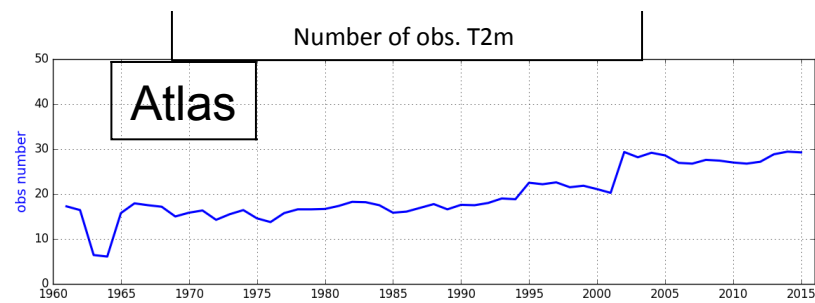
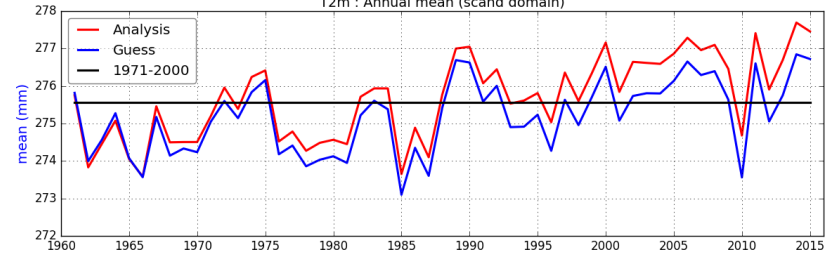
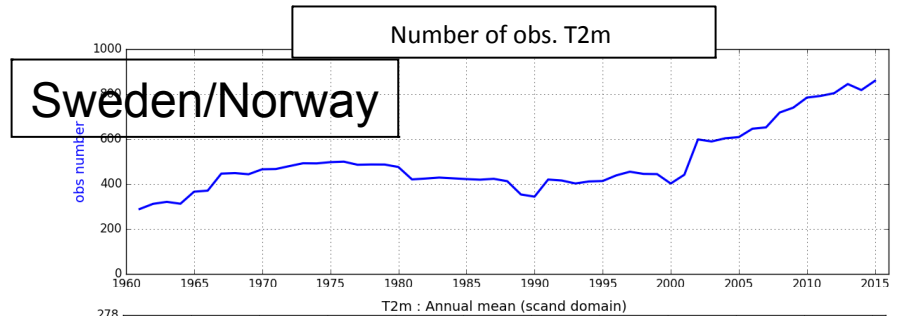
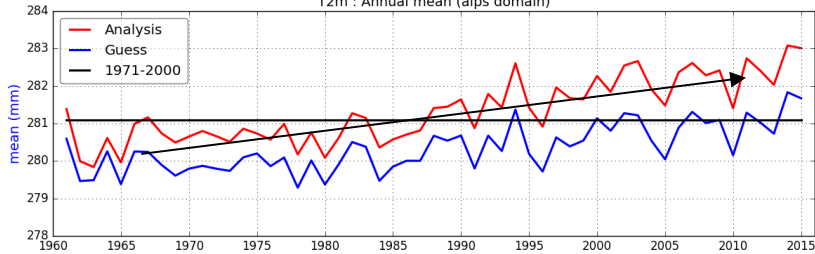
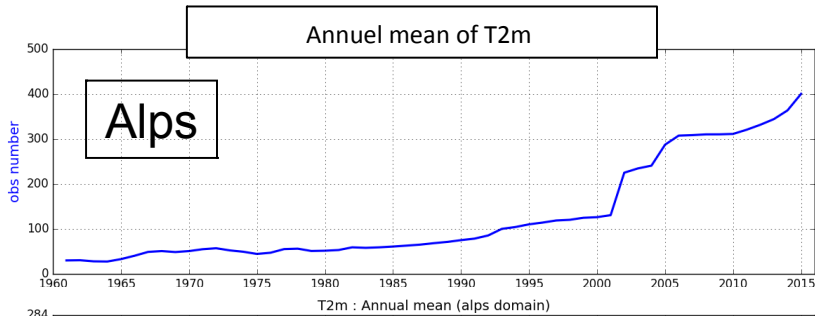
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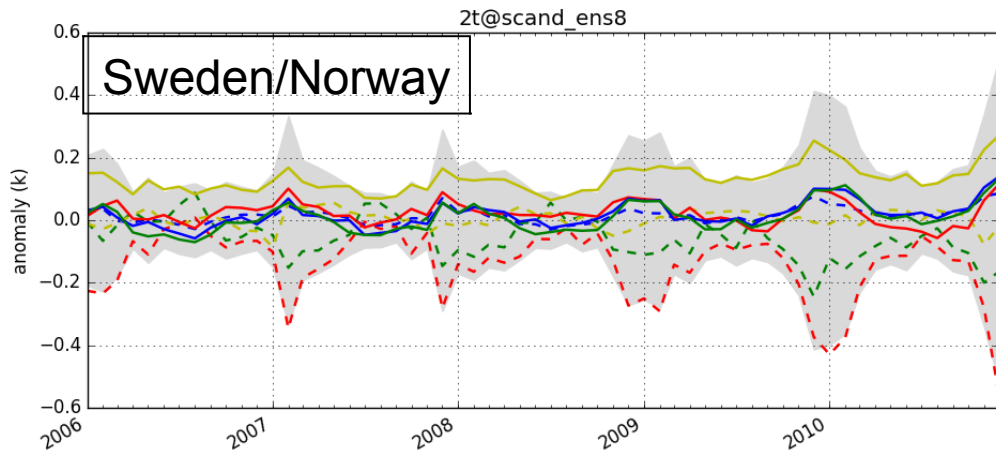


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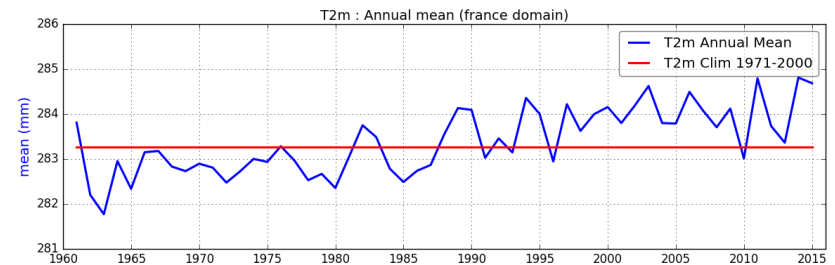
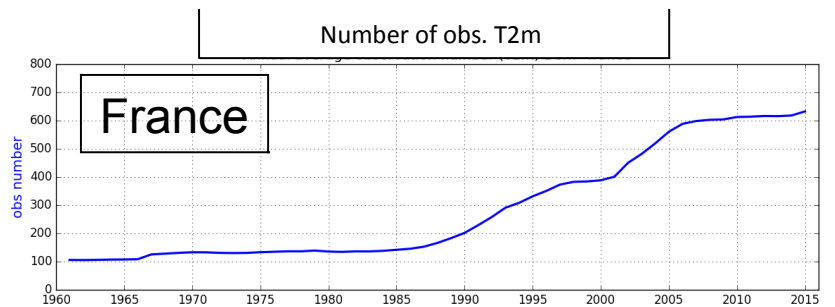
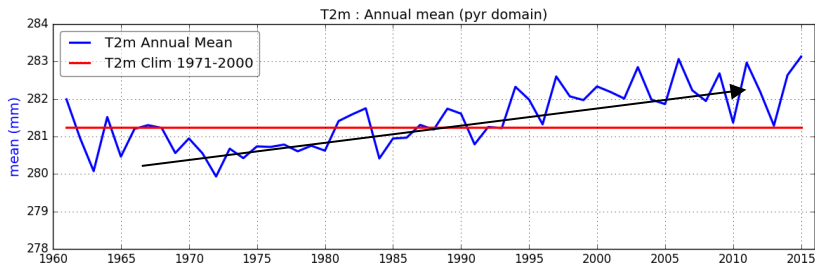
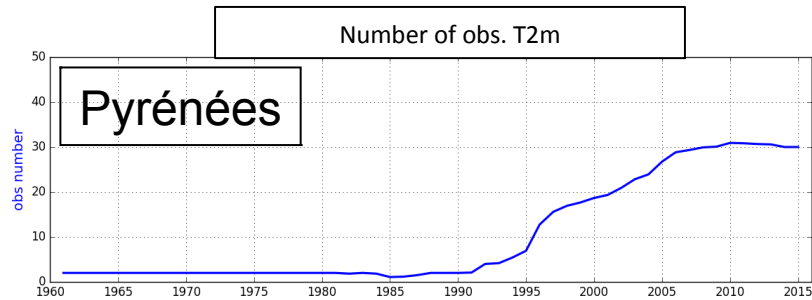
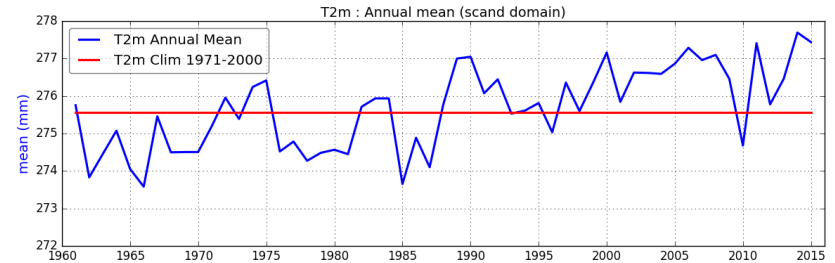
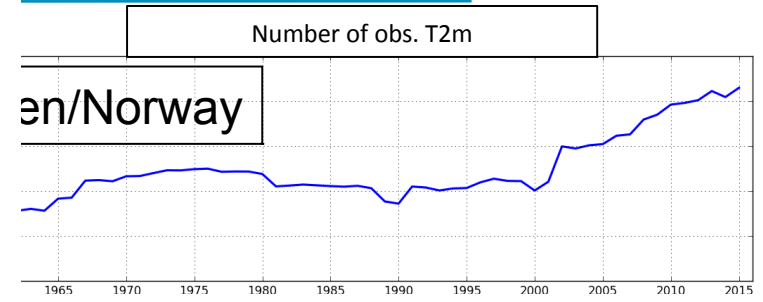


# Annual mean 2m temperature: 1961-2015

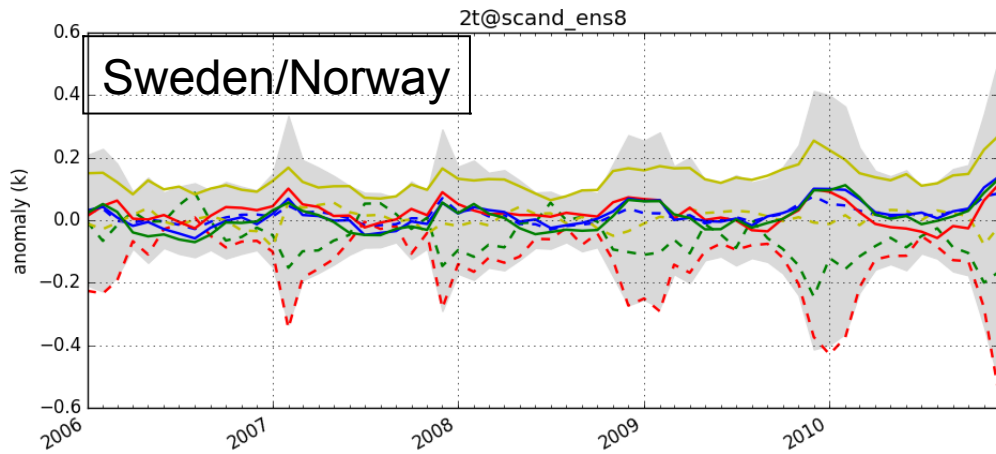




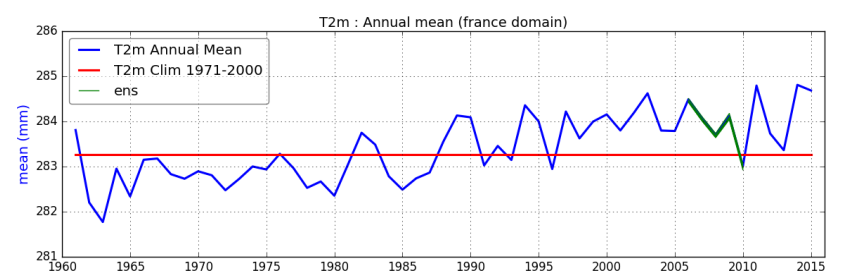
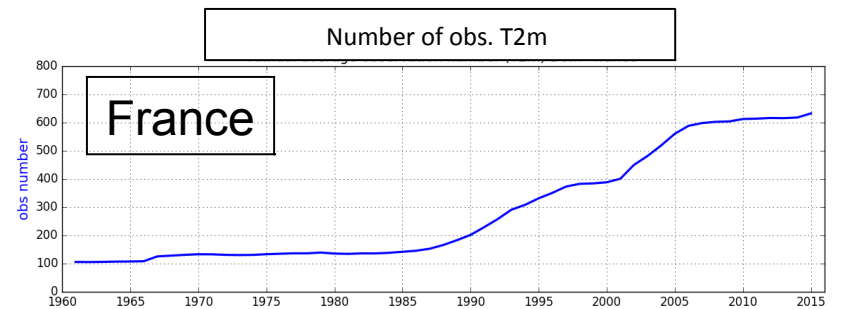
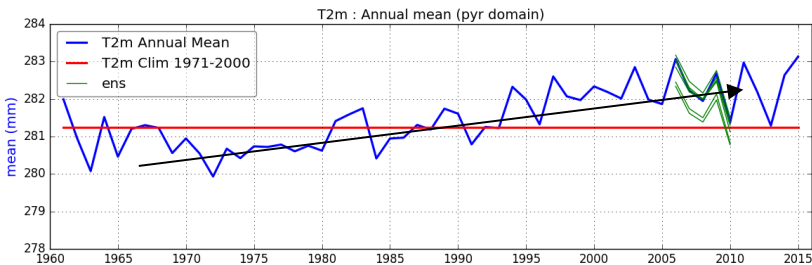
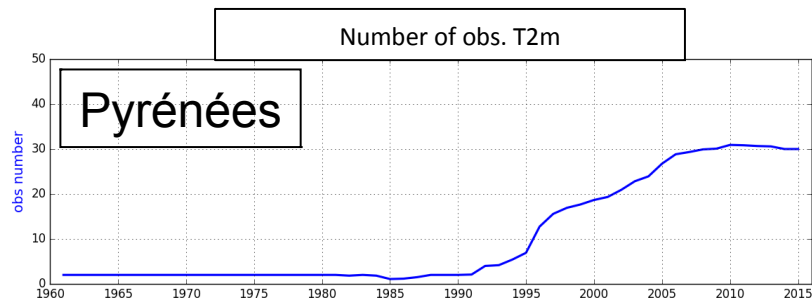
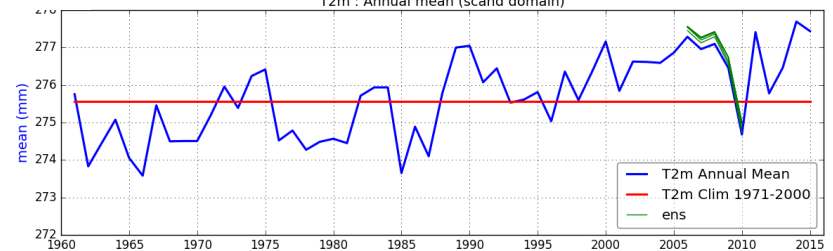
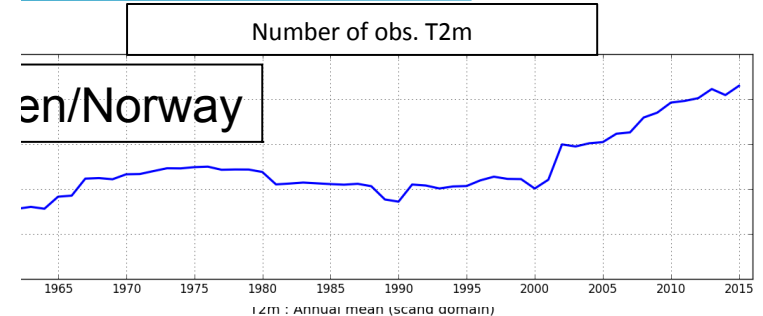
# Temperature: 1961-2015







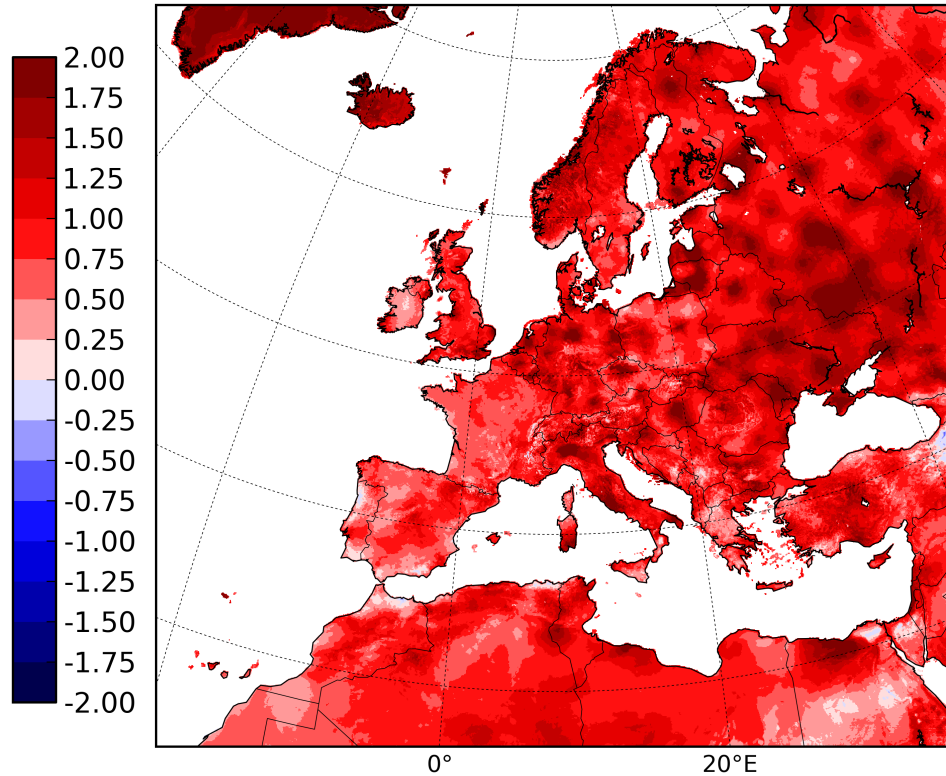
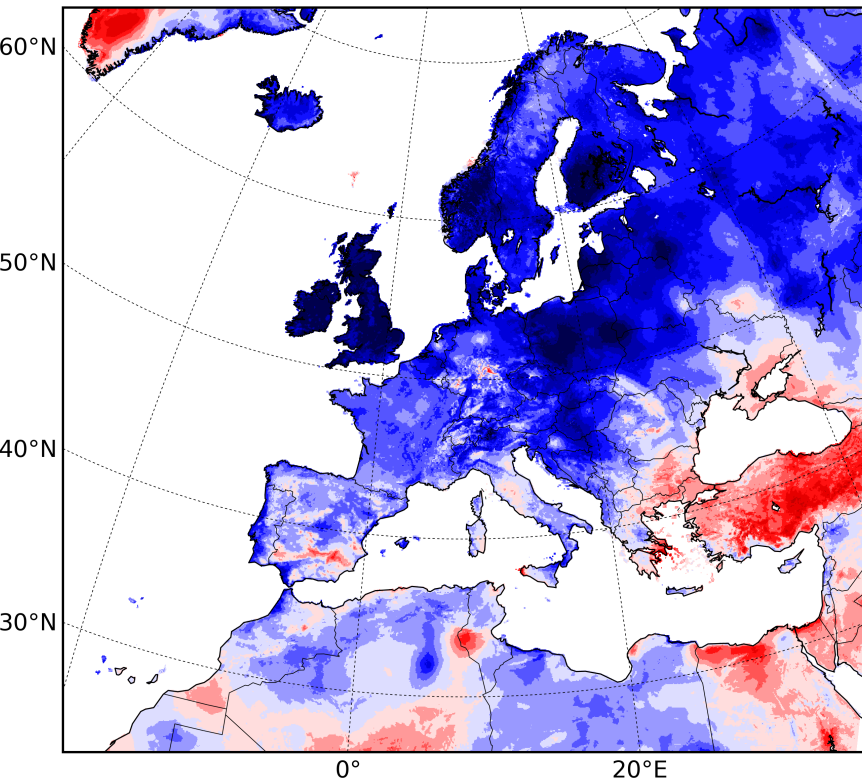
# Temperature: 1961-2015



# Surface temperature anomaly vs 1971-2000

1962-1970

2001-2009



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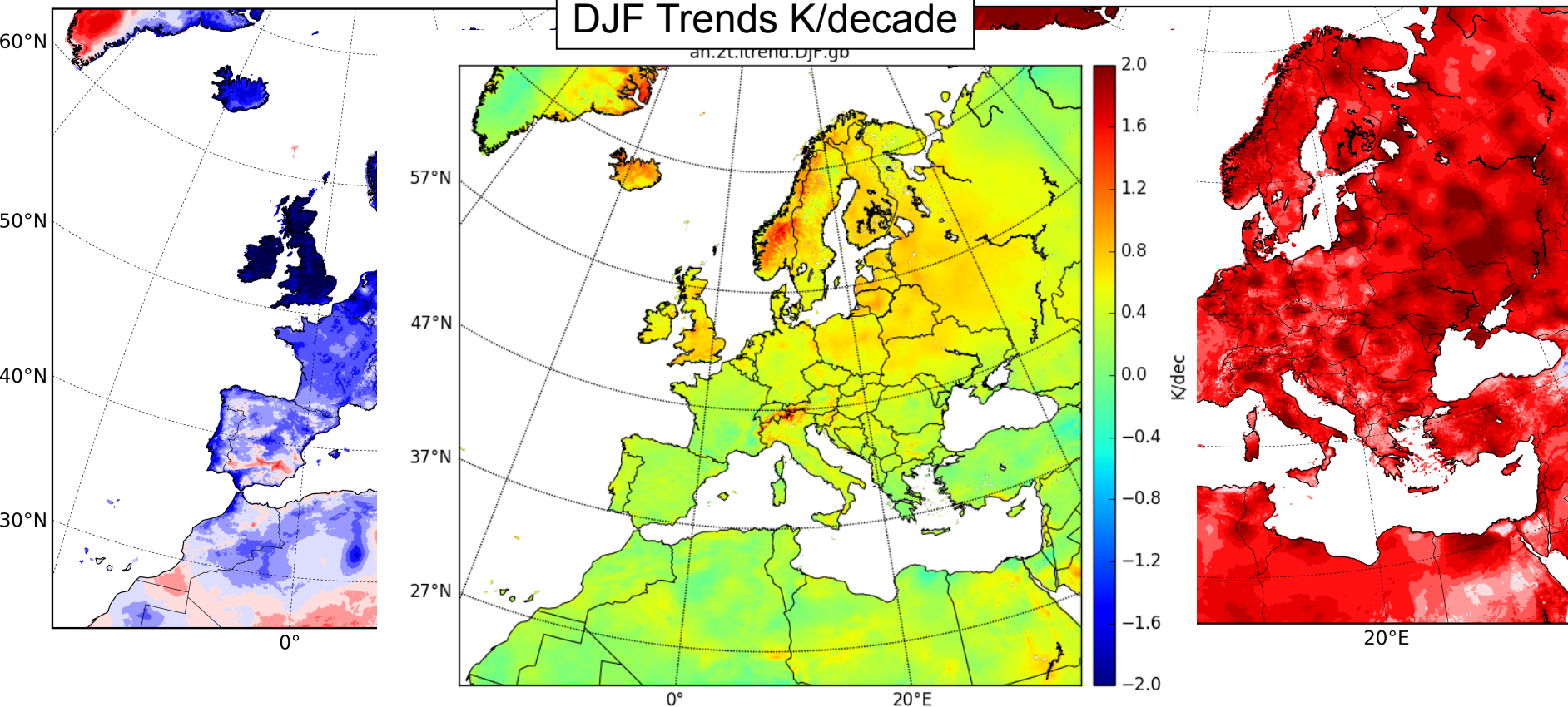


# Surface temperature anomaly vs 1971-2000

1962-1970

2001-2009

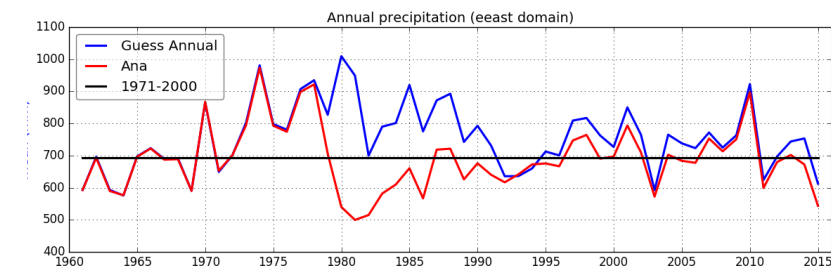
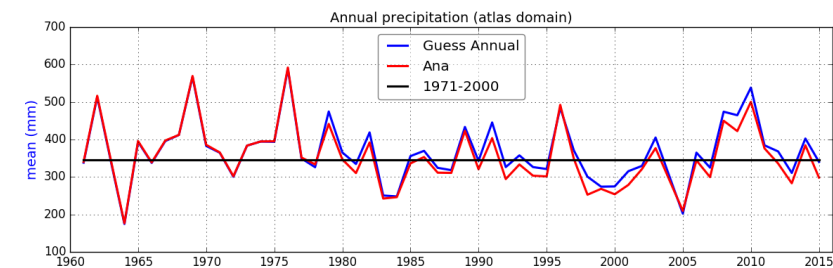
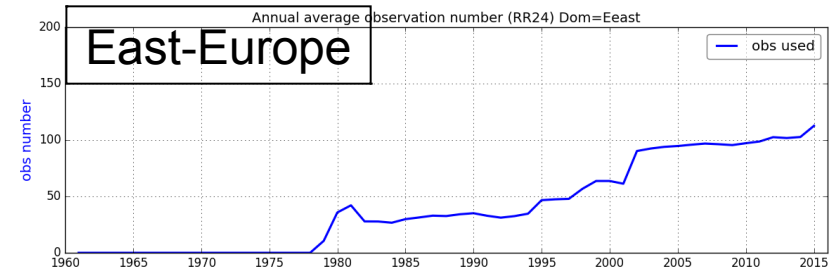
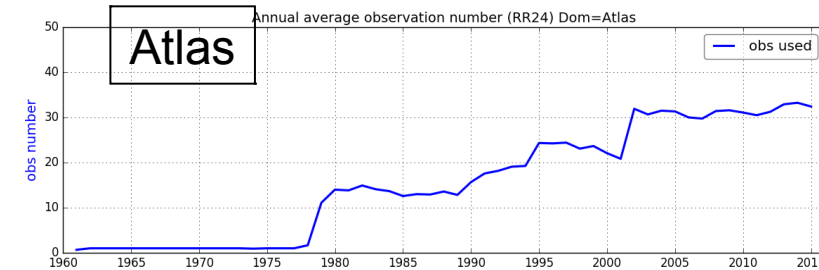
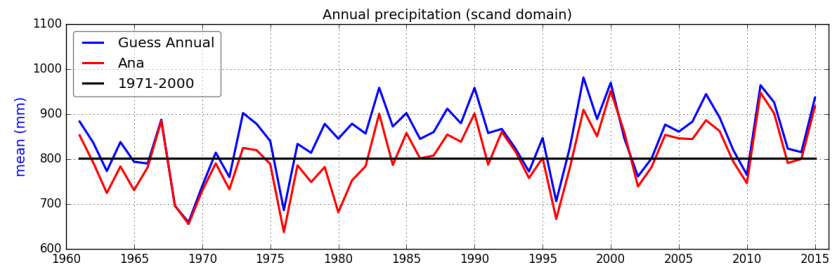
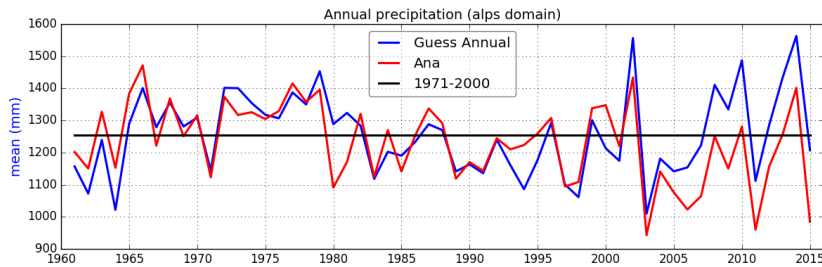
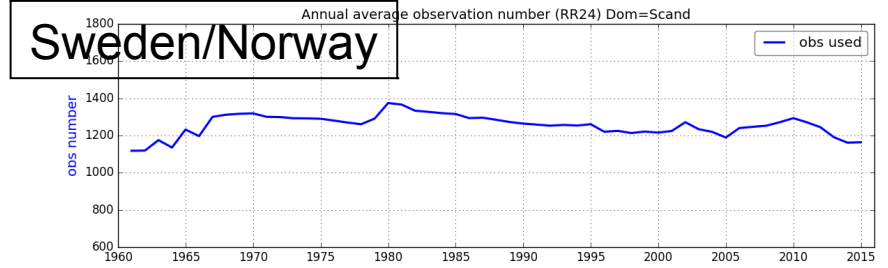
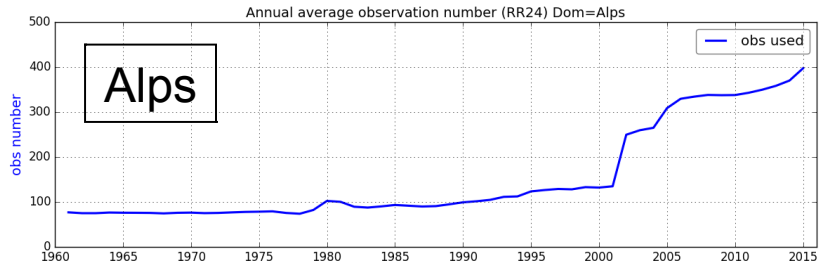
DJF Trends K/decade



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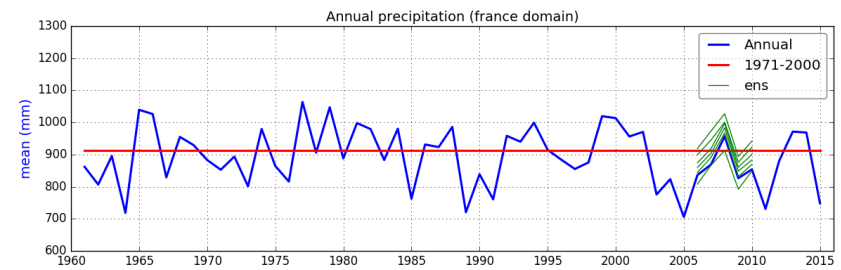
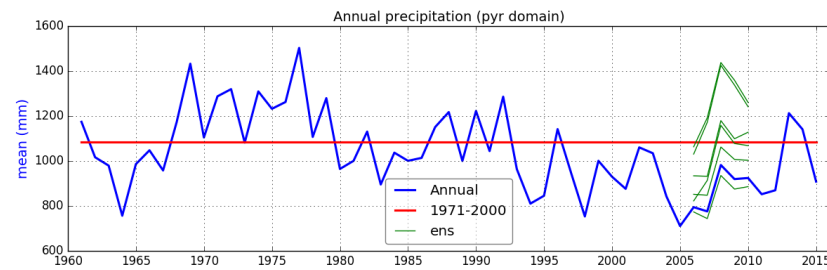
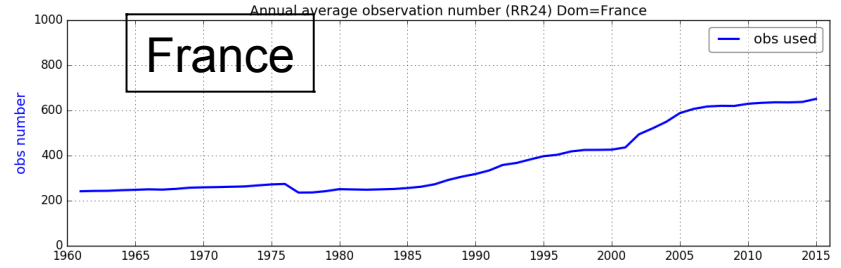
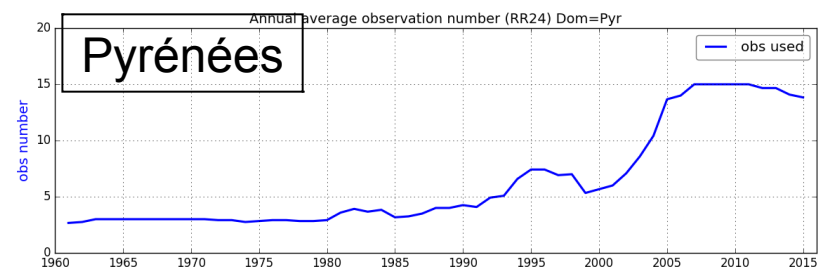
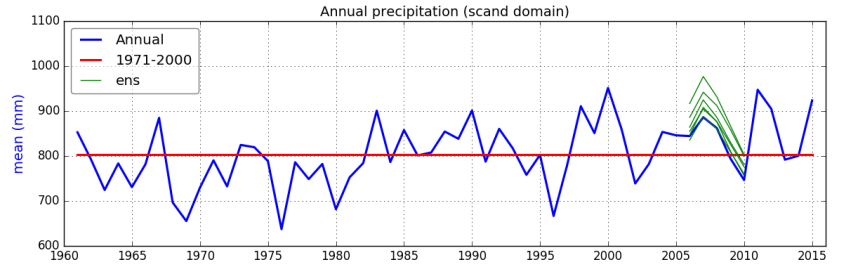
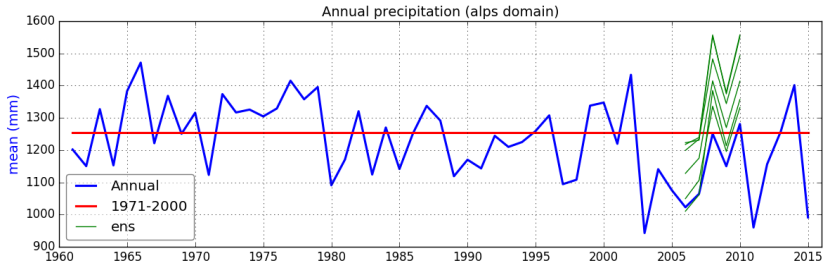
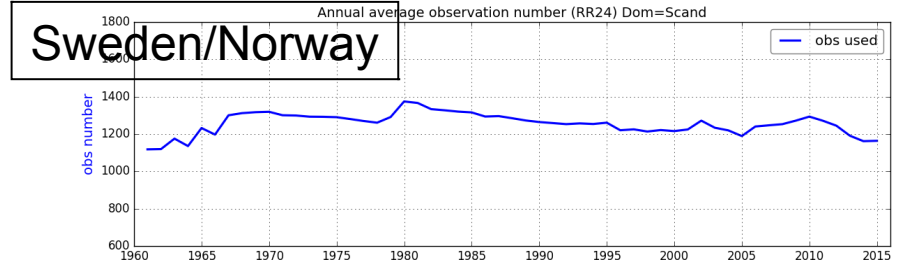
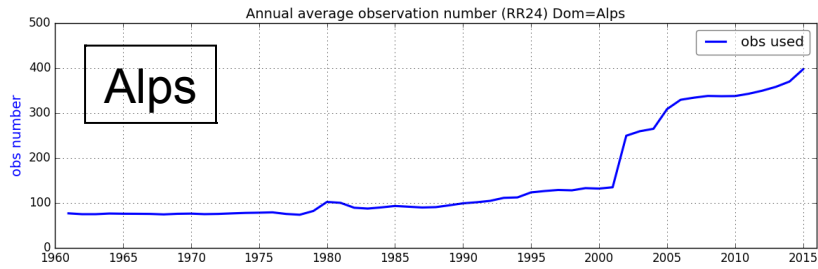


# Annual rainfall 1961-2015

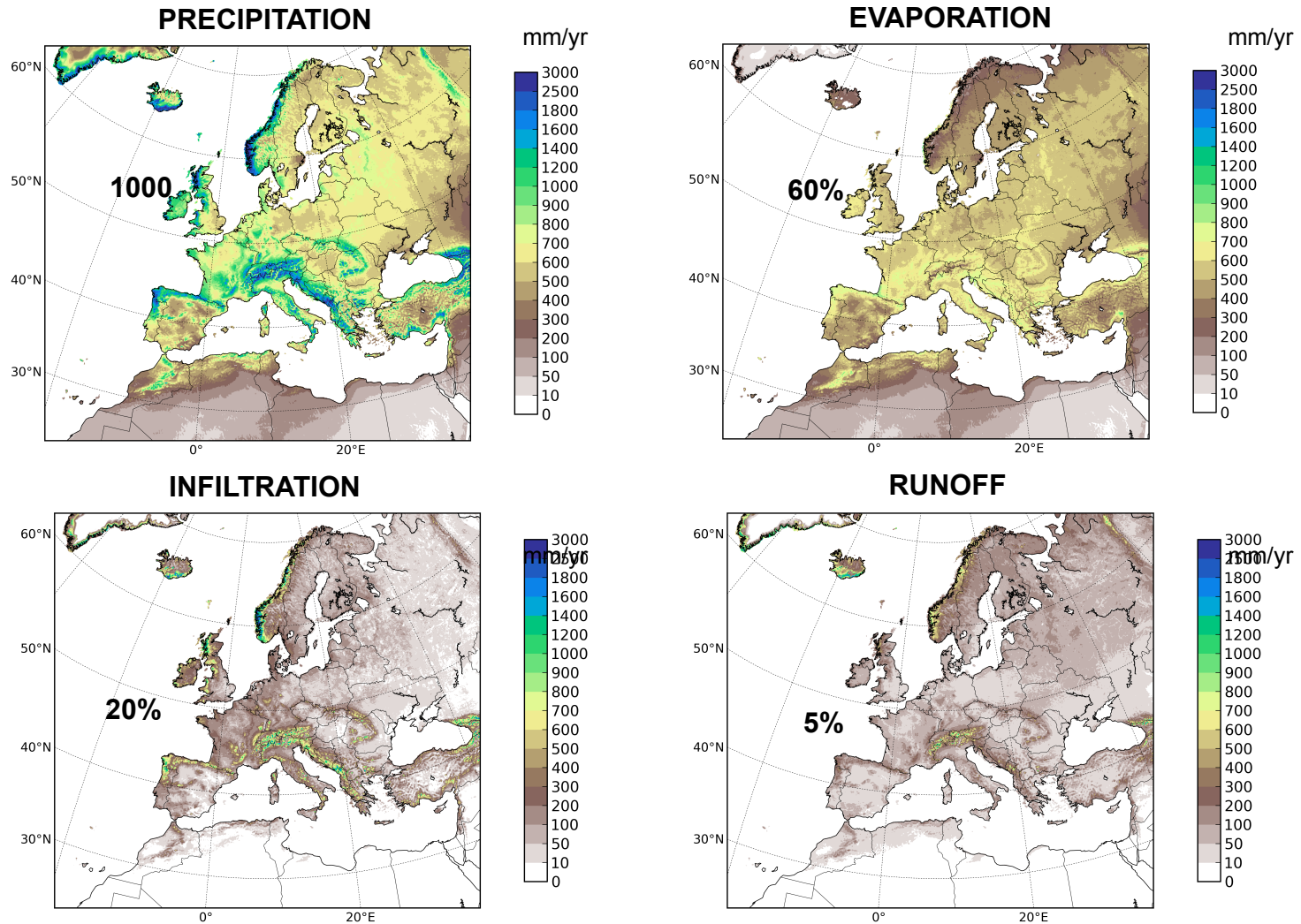




# Annual rainfall 1961-2015



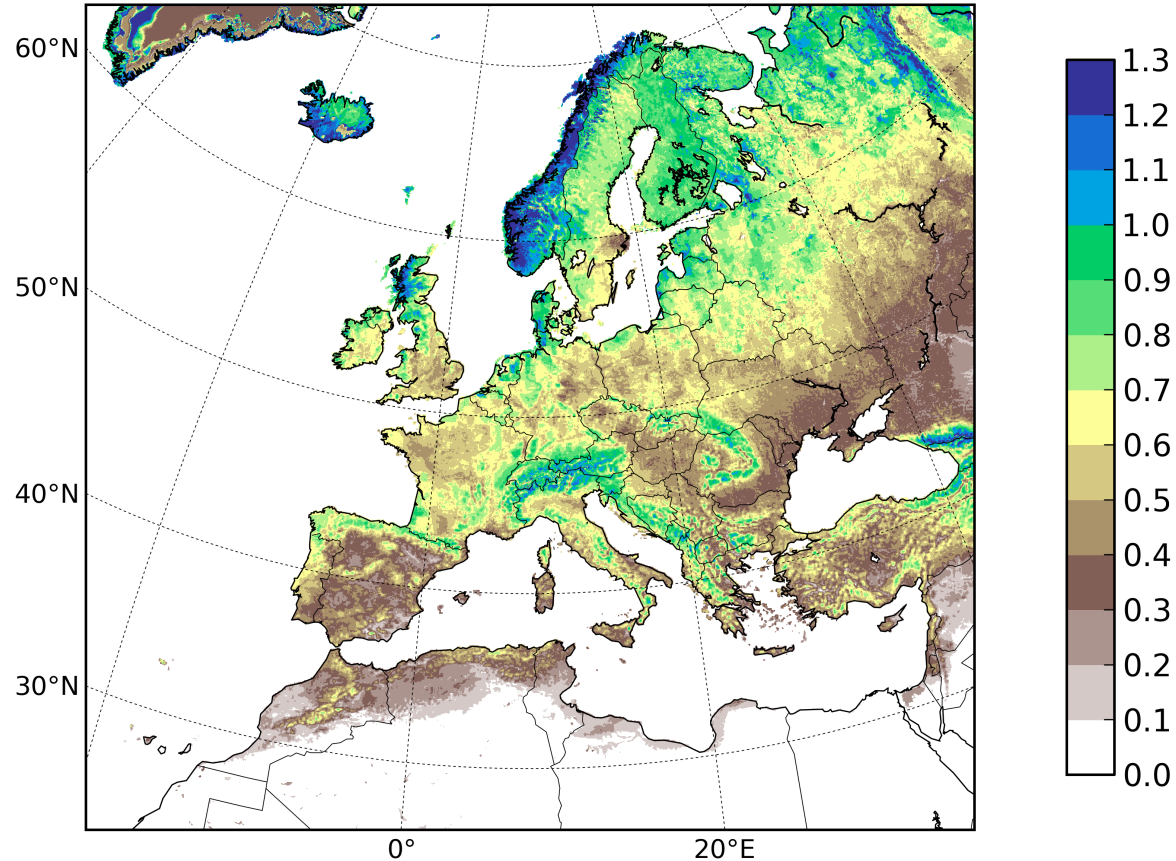
# Water Balance Components: 1961-2010



# Soil Wetness Index: 1961-2010

Water storage = Precip – Evap – Runoff – Infiltration

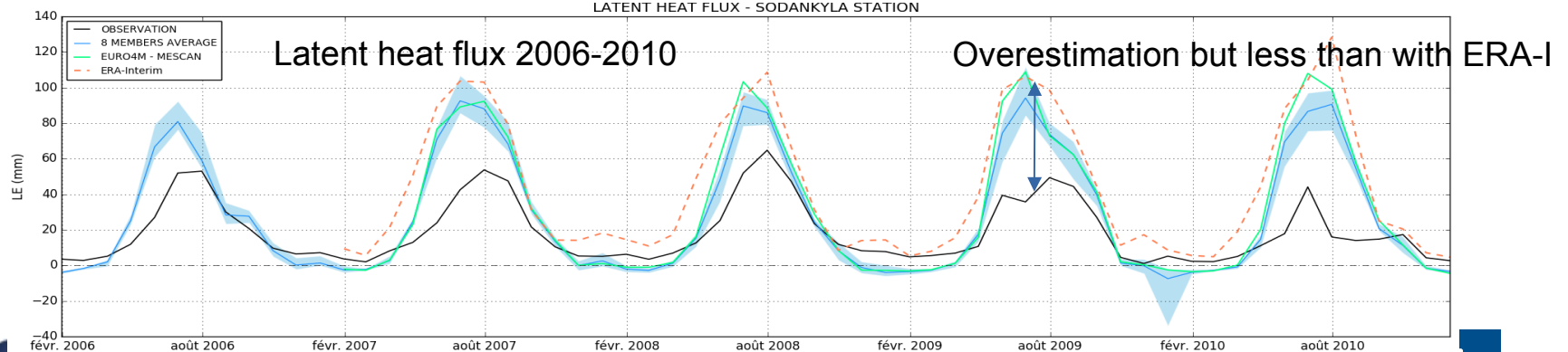
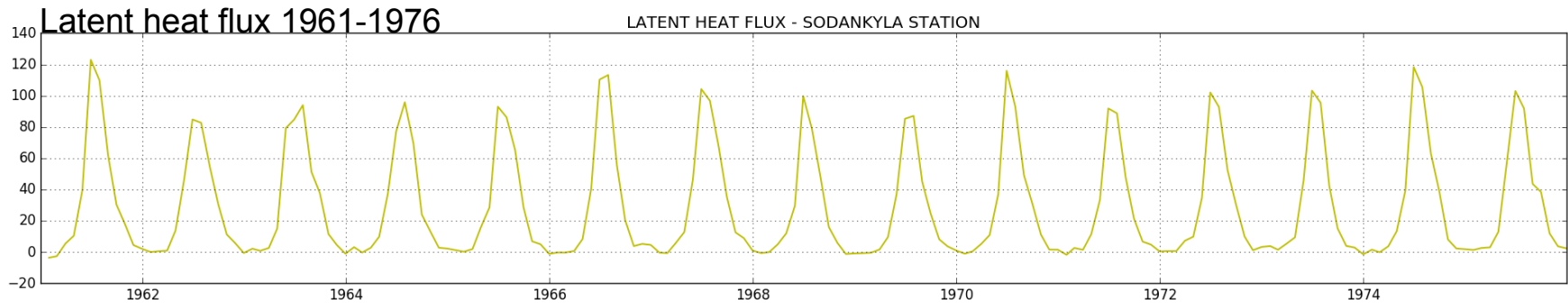
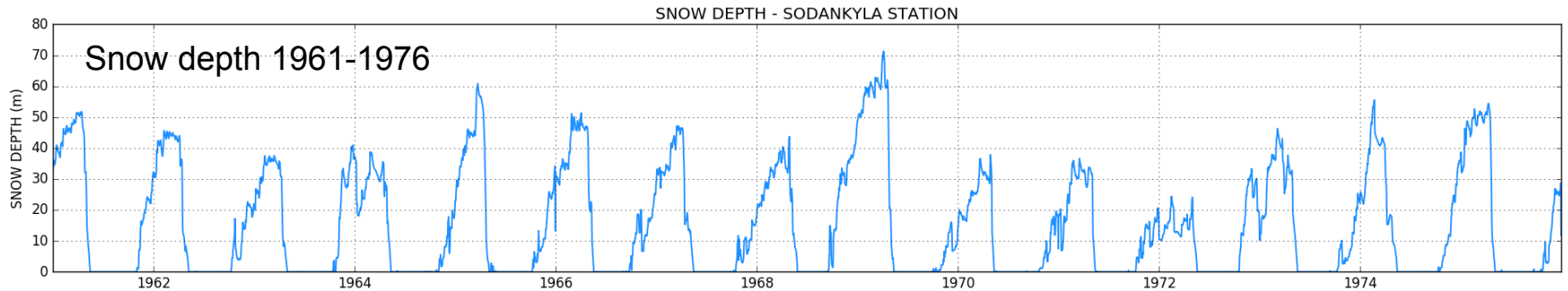
$$SWI = (Wg - Wwilt) / (Wfc - Wwilt)$$



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# Preliminary results with SURFEX/TRIP at Sodankyla



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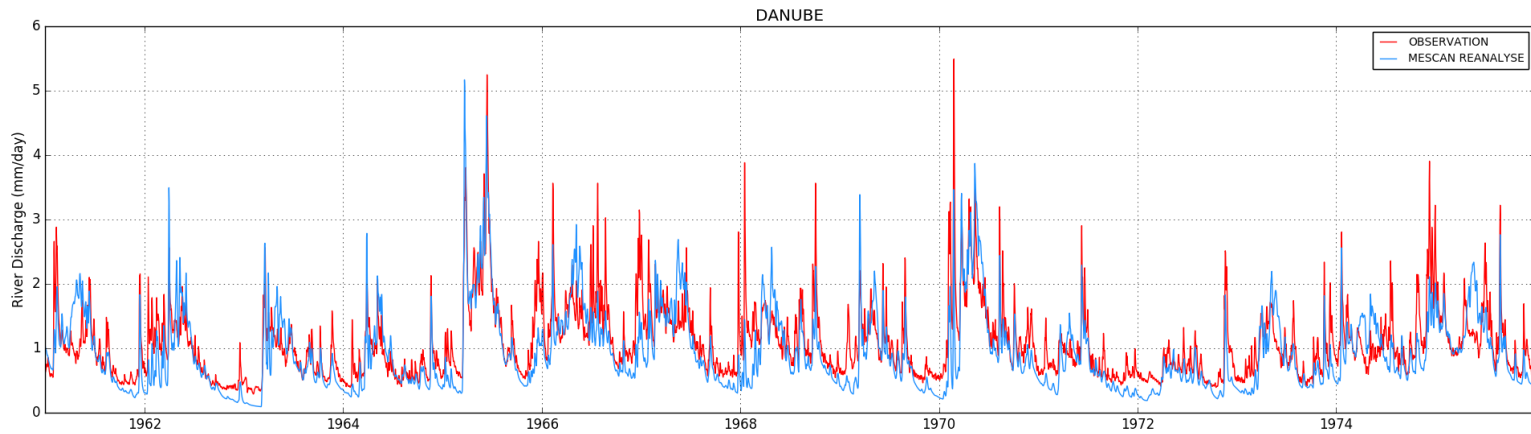
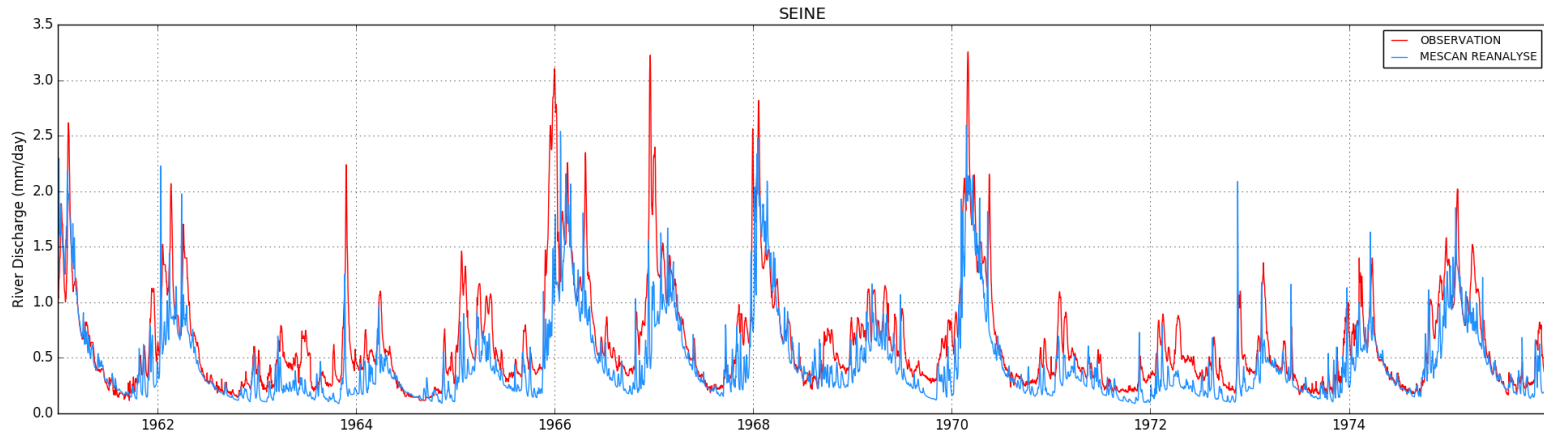
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METEO FRANCE

# Preliminary results with SURFEX/TRIP

## River discharge

More details in  
P. LeMoigne talk

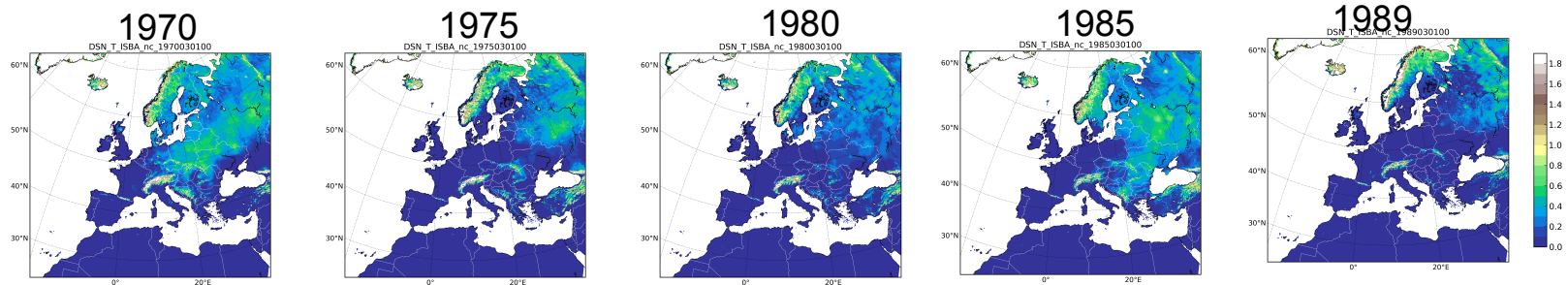
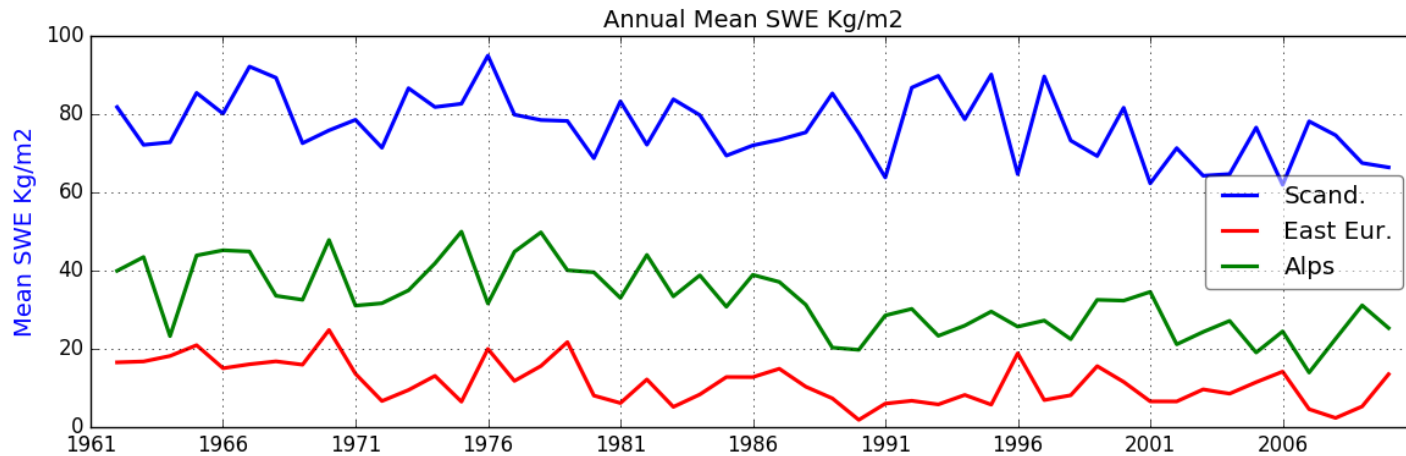
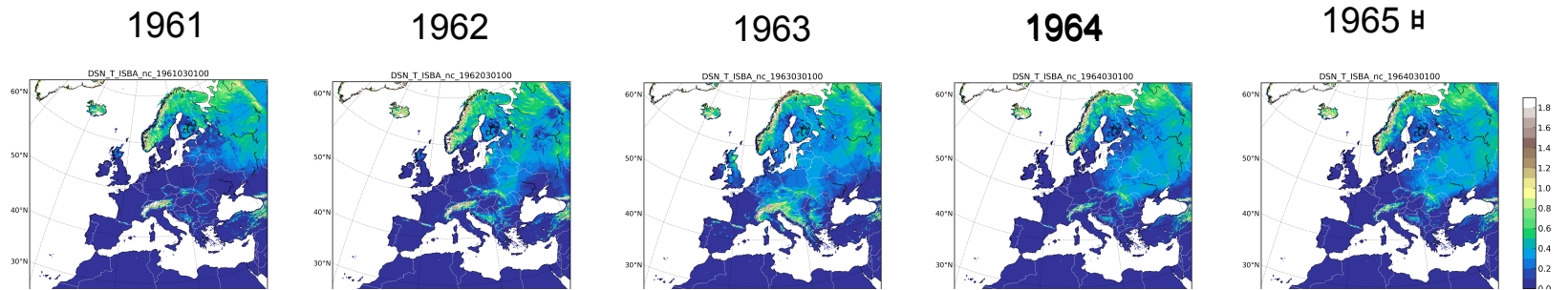


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# Snow height and SWE from MESCAN-SURFEX



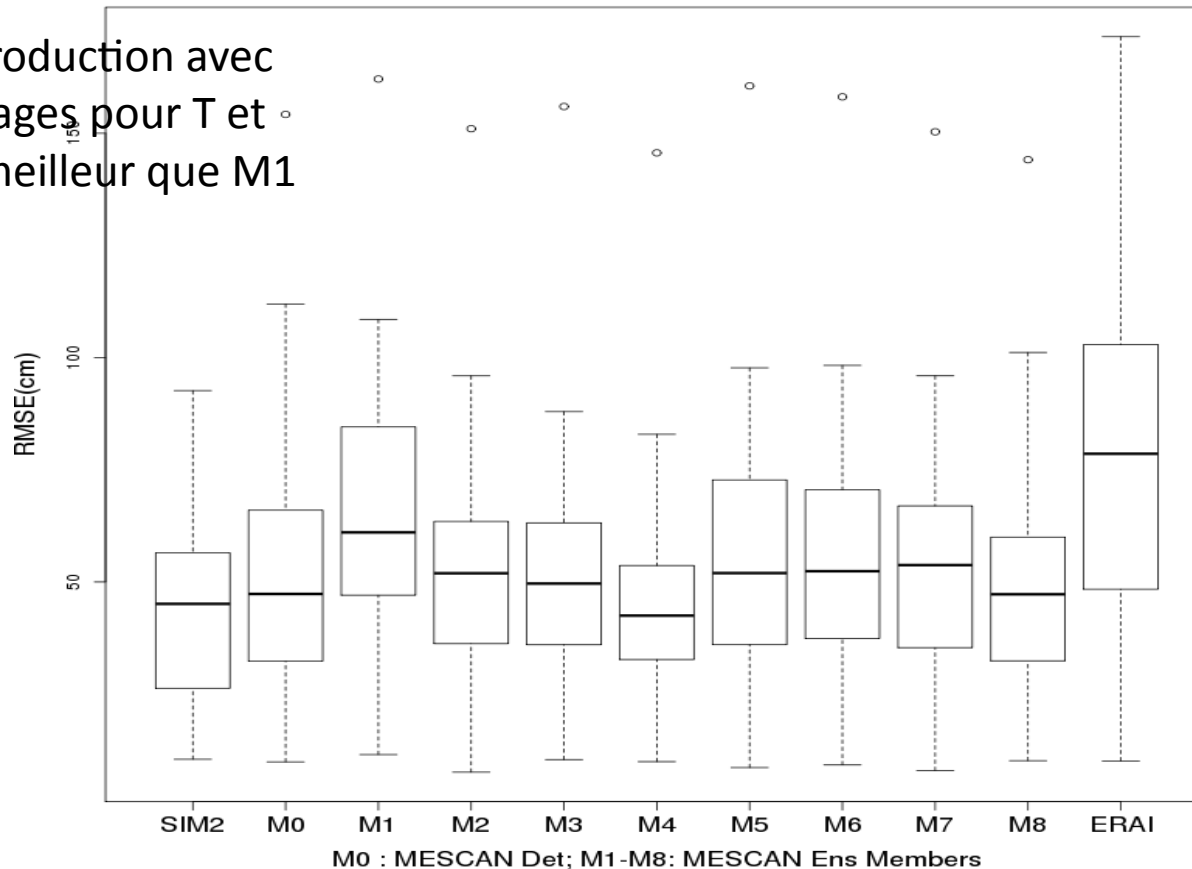
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# Hauteur de neige sur la France ref=Nivose

More details in F. Besson

RMSE boxplot per experiment - ALL



M0=AldDSH Production avec nouveaux réglages pour T et précipitation meilleur que M1

M1=AldDSH M2=AlrDSH M3=AldDSL M4=AlrDSL  
M5=AldDSHp M6=AldDSHp M7=Ald5H M8=Ald5L

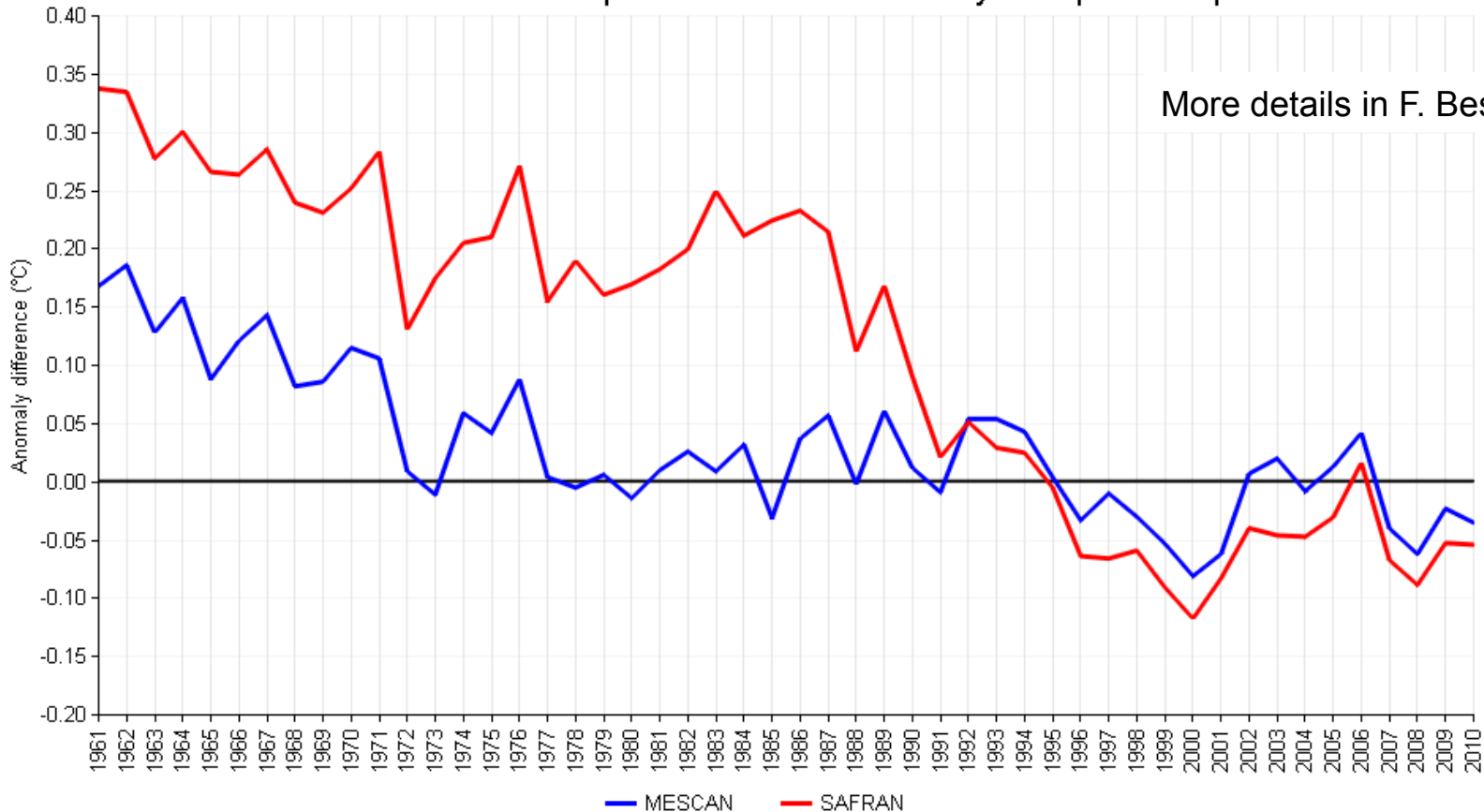
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# Temperature anomalies over France

Difference of annual mean temperature anomalies : Reanalysis - Operational product





# UERRA data: @ ECMWF MARS archive

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**Variable 3D:** Niveau pression, niveau  $z < 500\text{m}$ , Sortie horaire, 4 réseaux en GRIB2 pour 3 re-analyses HARMONIE-ALADIN 11km (55ans), UKMO 12km (35ans), DWD 12km (5ans)

**Variable de surface @ 5.5km période 1961-2015 : MESCOAN-SURFEX (Météo-France)**

- Analyse T2m, Rh2m, Ws10m, Wd10m toutes les 6h et analyse de précipitation (1/jour)
- horaire: Ts, hauteur, densité, albédo de la neige, albedo, SWE, SWd, SWnet, LWd, LWnet, flux d'évaporation, chaleur sensible, ruissellement, flux dans le sol, etc ...
- horaire: pour les 14 couches du sol : température, eau liquide et eau totale.

**Les données MESCOAN-SURFEX sont probablement les premières données de surface “cohérentes” et homogènes produites à 5.5km sur l'Europe en utilisant une analyse de précipitation sur une longue période 1961-2015**

**Ne pas oublier:**

- Une analyse dépend du réseau d'observation (variable dans le temps et dans l'espace)
- Utiliser si possible l'information des ensembles → idée de l'incertitude.



18 Décembre 2017  
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# Après 2017: Copernicus C3S\_322 lot1 & lot2

- **Lot 1 : Europe. Lead : SMHI avec Météo-France (CNRM) et Met-Norway (PRECISE):**
  - Continuation de la production du SMHI et de Météo-France d'UERRA pour 2016-2018
  - **Re-analyse atmo 3DVar à 5.5km sur l'Europe même domaine que UERRA avec la physique d'ARPEGE au moins 100 niveaux verticaux.**
  - Analyse de surface et de precipitation avec MESCAN puis SURFEX offline comme dans UERRA.
  - **Probable rétroaction de l'analyse de precipitation MESCAN dans la re-analyse 3D**
  - **Assimilation d'ensemble ~ 12km**
  - Nouveau système opérationnel en 2019 Periode 1979 → 2019 puis temps réel.
  - 3 postes sur 3.5 ans ( 2 au GMAP et 1 au GMME)
- **Lot 2 : Arctique Lead : MetNorway avec SMHI, DMI, Météo-France (CNRM) (CARRA)**
  - 2 domaines avec HARMONIE-AROME à 2.5km et 65niveaux 1979 →2018
  - Météo-France tres peu impliqué (1 poste -1 an)



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