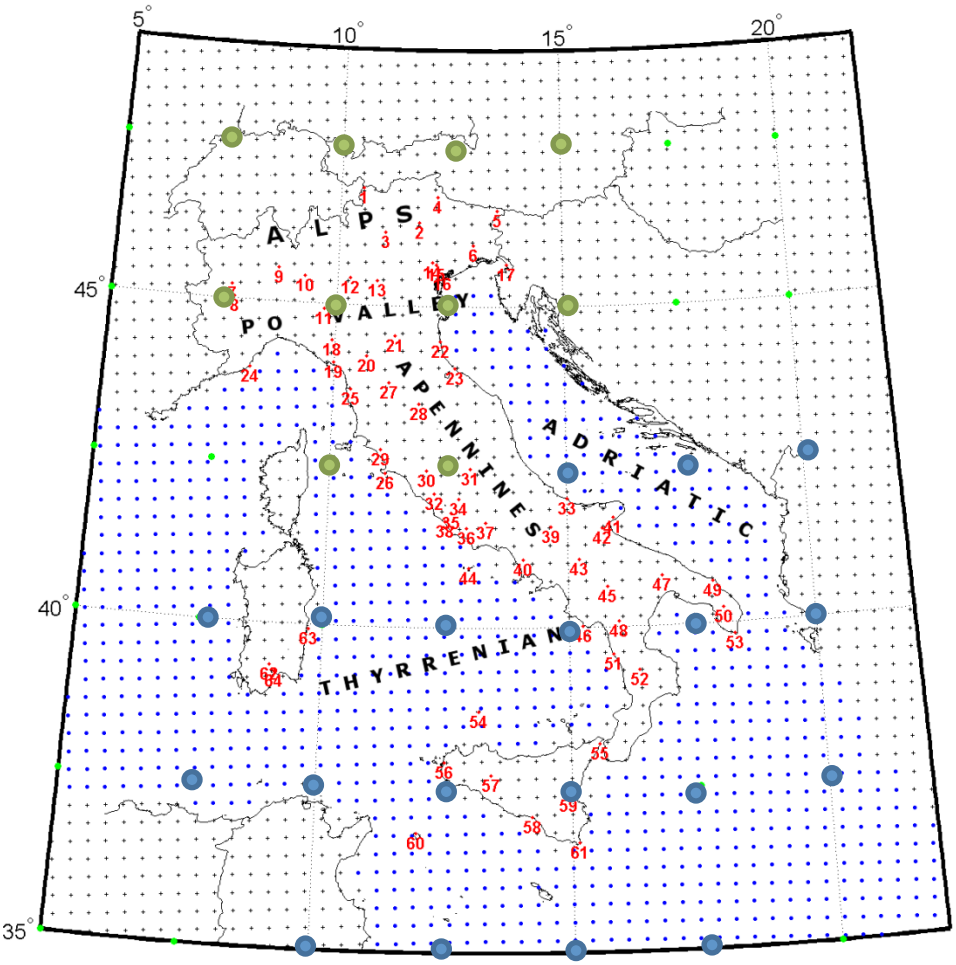


Evaluation of **climate patterns** in a **RCM** using long-term records from SYNOP **weather stations**.

S. Calmanti, A. Dell'Aquila, ENEA

F. Maimone, V. Pelino, CNMCA

in press
Climate Research

Cluster Analysis (Ward)

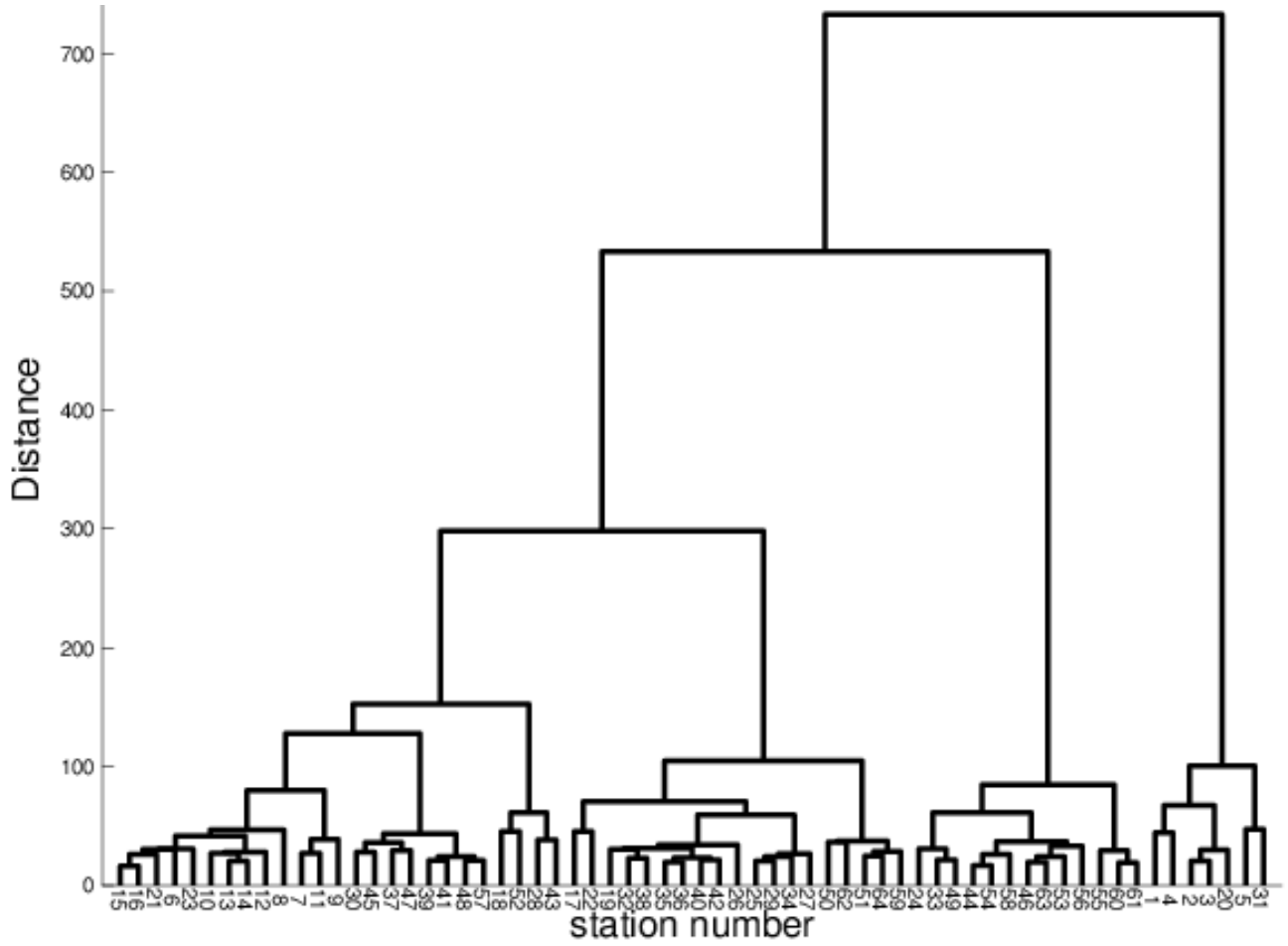
- **Euclidean** distance between two time-series

$$d_{ij} = \left[\sum_{k=1}^{p} \left(x_{ki} - x_{kj} \right)^2 \right]^{1/2} .$$

- **Weighted** distance between two clusters

$$d_{AB-C} = \left(N_A d_{AC} + N_B d_{BC} \right) / \left(N_A + N_B \right) .$$

Sample dendrogram

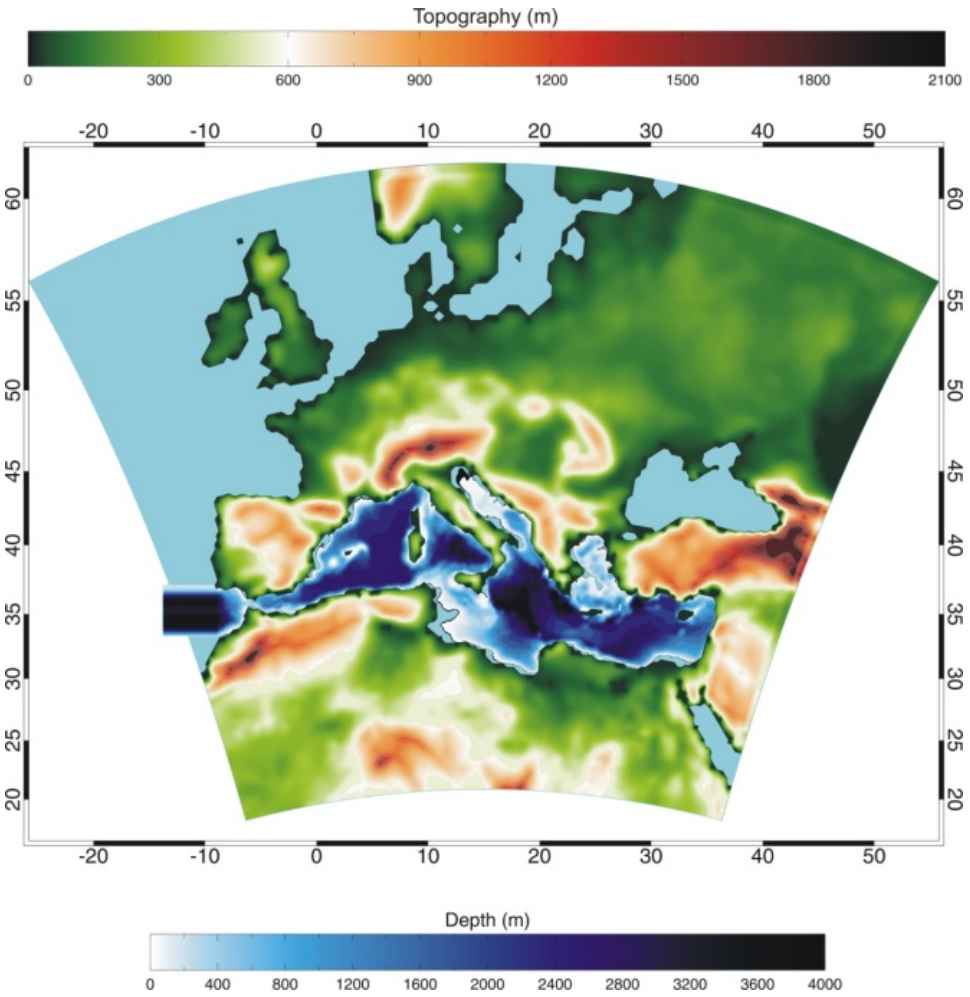


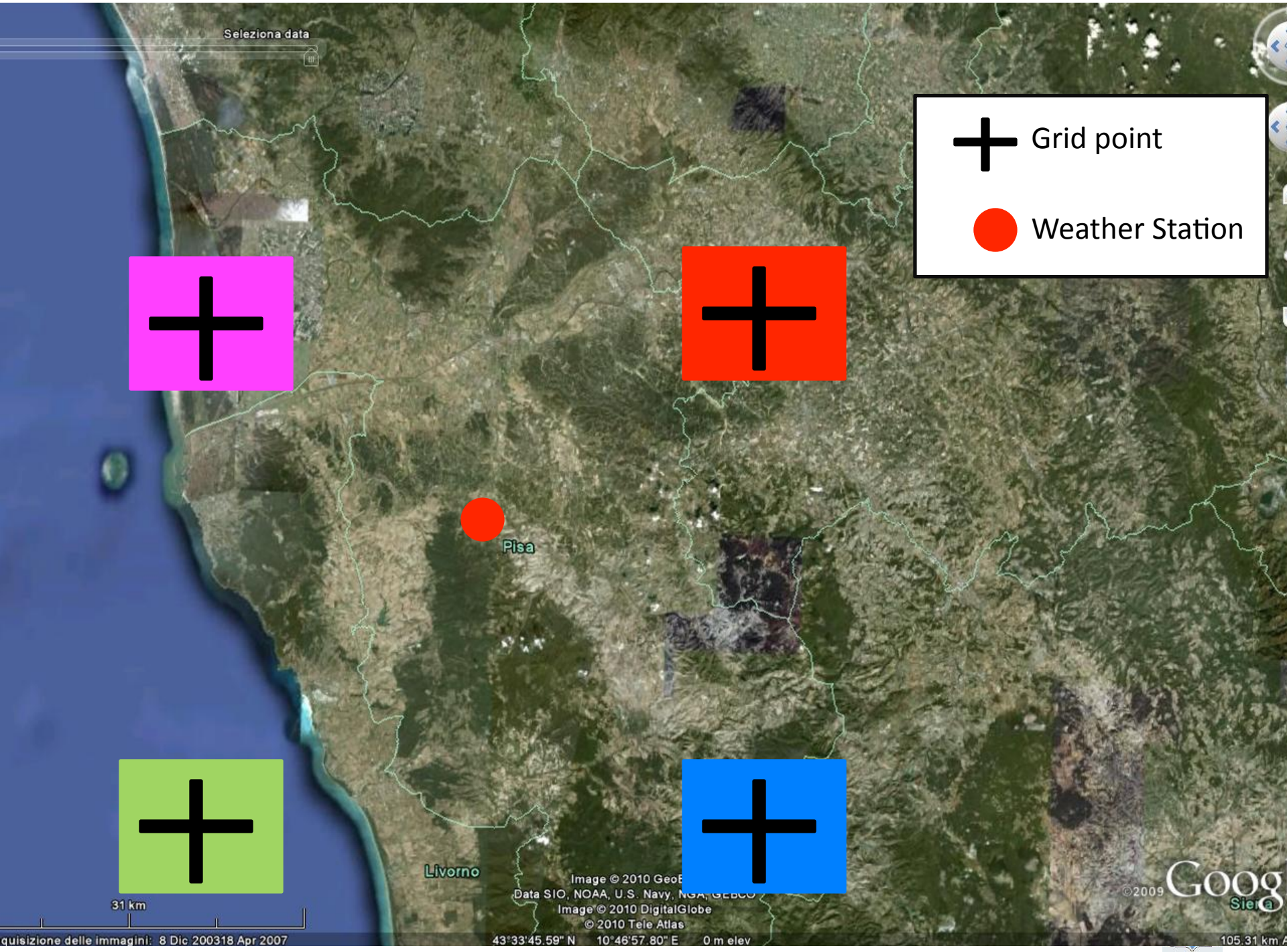
Data

- Daily temperature and precipitation records from **64 weather** stations of the Italian Air Force network from 1st January 1958 to 31th December 1999

- Coupled, ocean-atmosphere limited area model
  - atmospheric component has a uniform horizontal grid spacing of **30 km, 18 σ-levels**.
  - lateral boundary conditions provided every 6 hours by interpolating horizontal wind components, temperature, specific humidity and surface pressure from **ERA40** for the period 1958-2000

Model domain




Seleziona data
Grid point
Weather Station
Pisa
Livorno
31 km
Image © 2010 GeoE
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2010 DigitalGlobe
© 2010 Tele Atlas
©2009 Goog
Siena
quisizione delle immagini: 8 Dic 200318 Apr 2007
43°33'45.59" N 10°46'57.80" E 0 m elev
105.31 km A

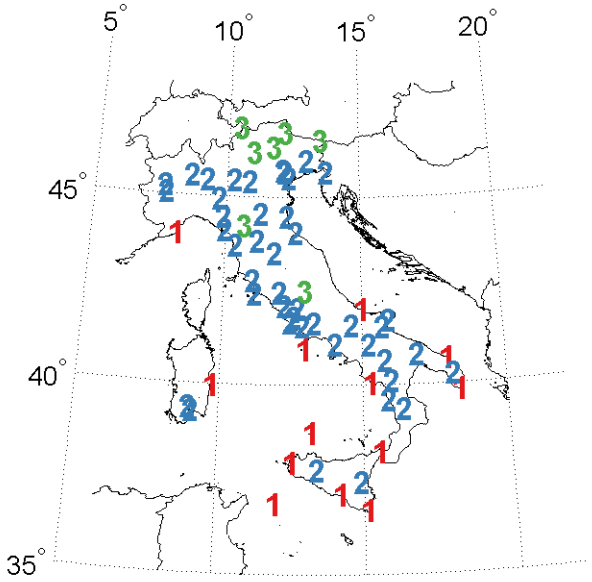
Coincidence Table

Var: Tmin

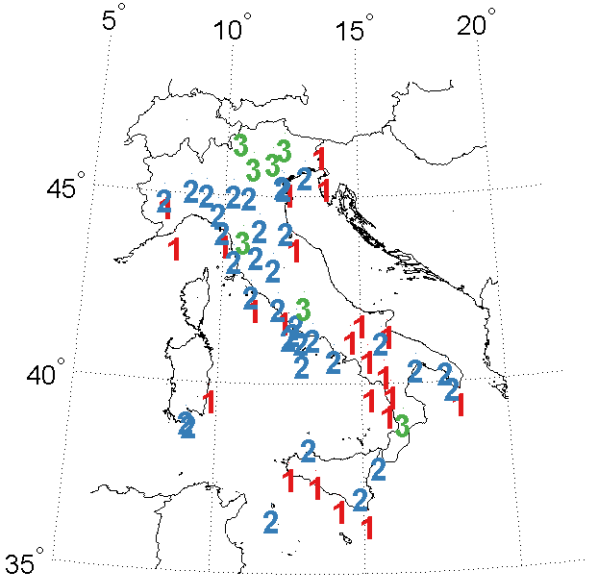
64%	Mod = 1	Mod = 2	Mod = 3
Obs = 1	6	6	1
Obs = 2	14	30	0
Obs = 3	1	1	5

Tmin

Observations



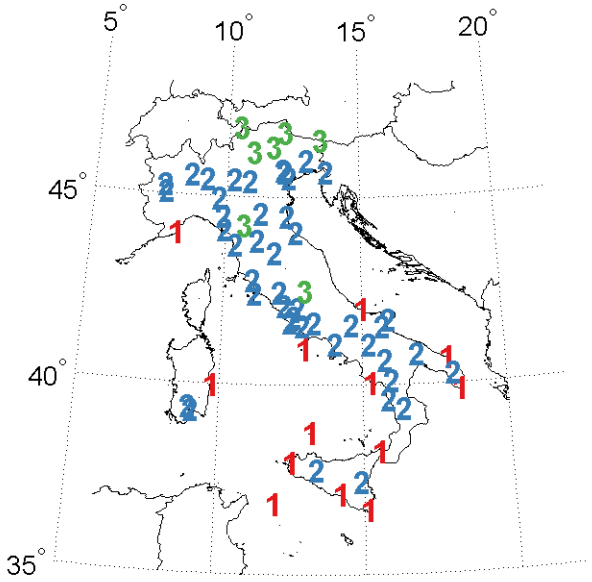
Model



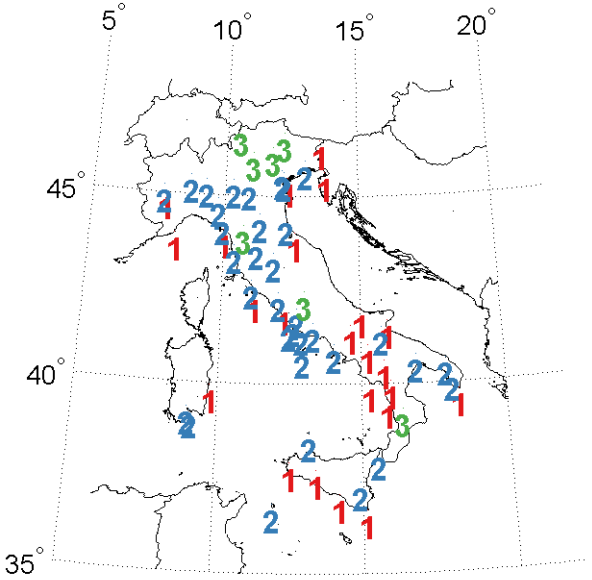
Coincidence 64%

Tmax

Observations



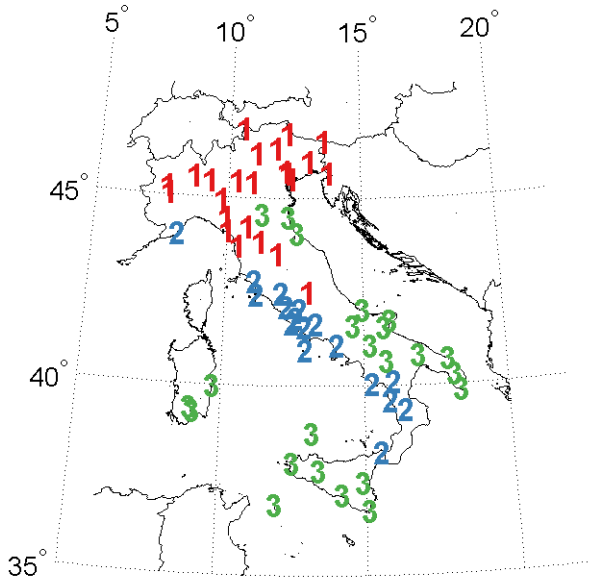
Model



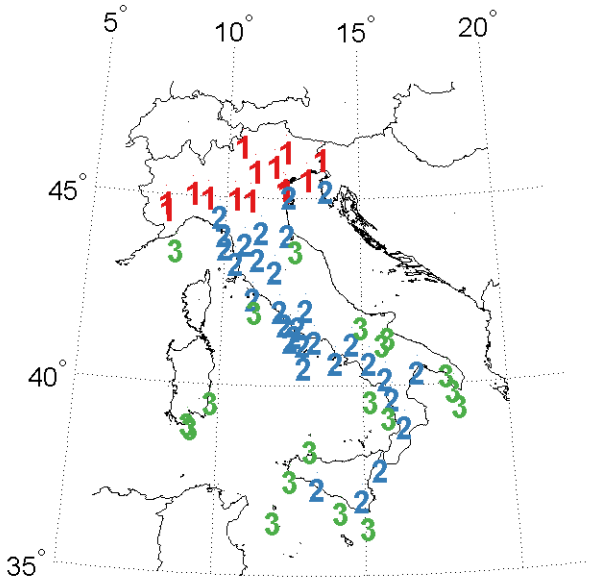
Coincidence 28%

Rainfall

Observations

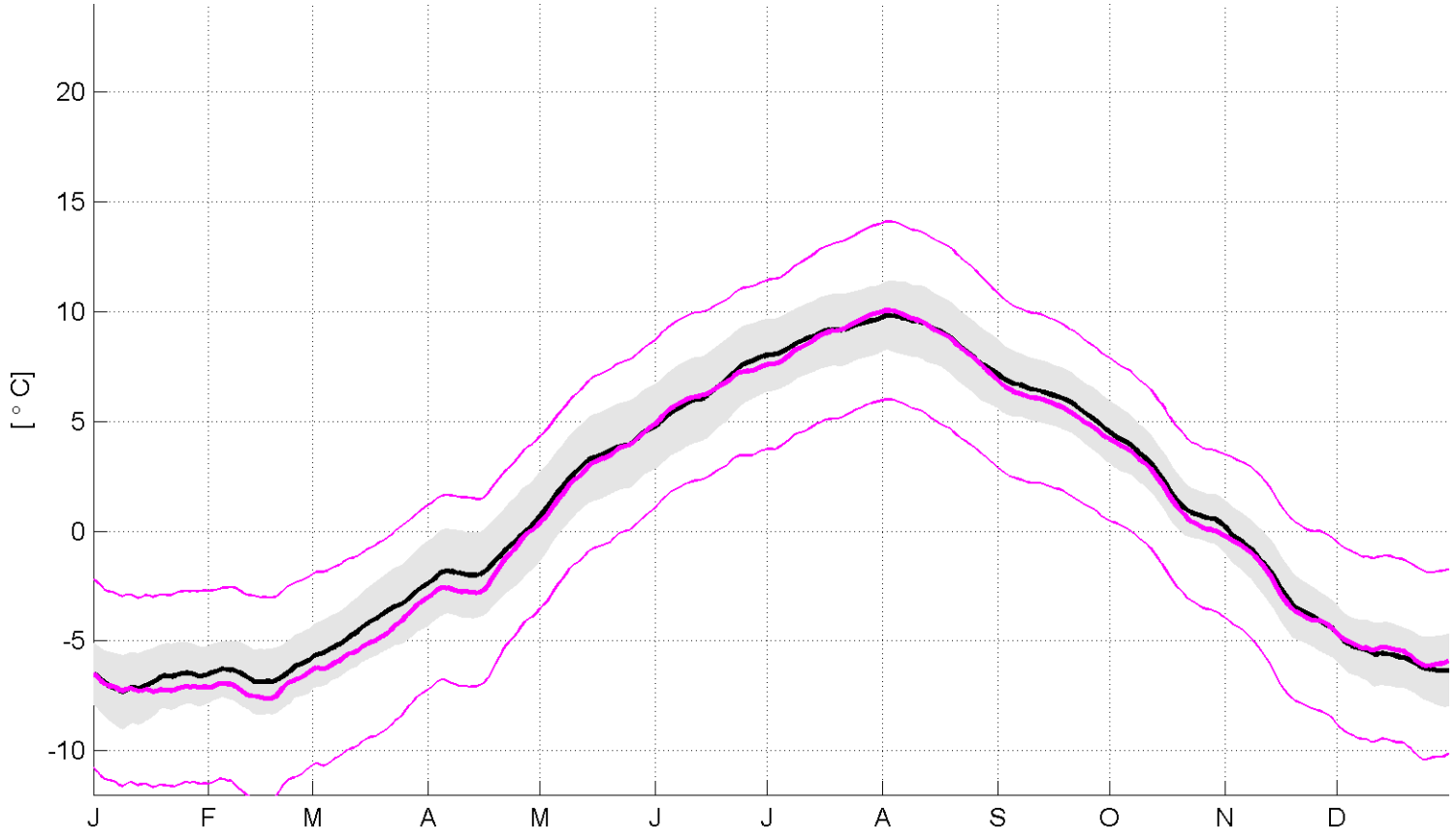


Model

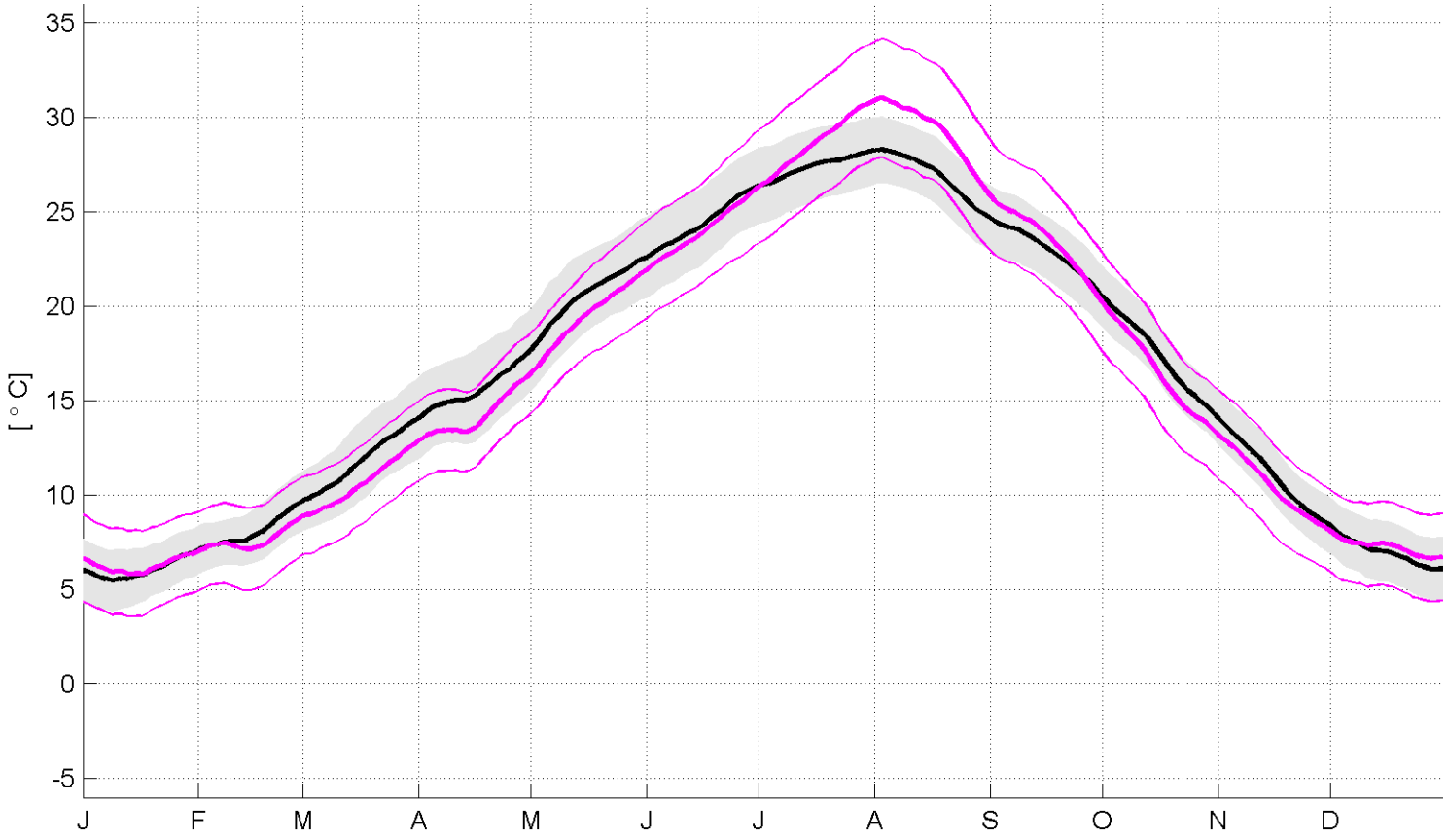


Coincidence 60%

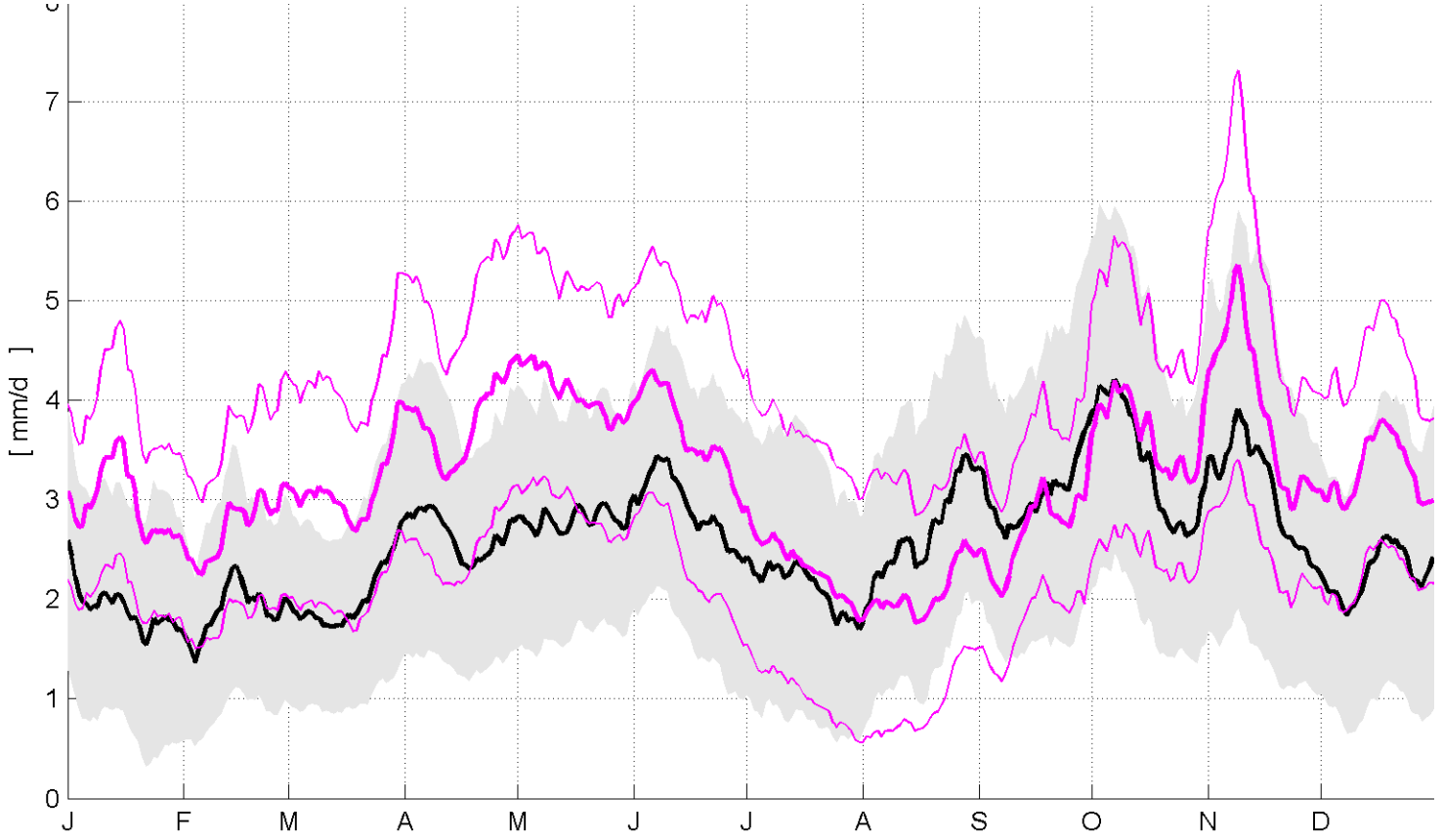
Tmin – Alpine Region cluster



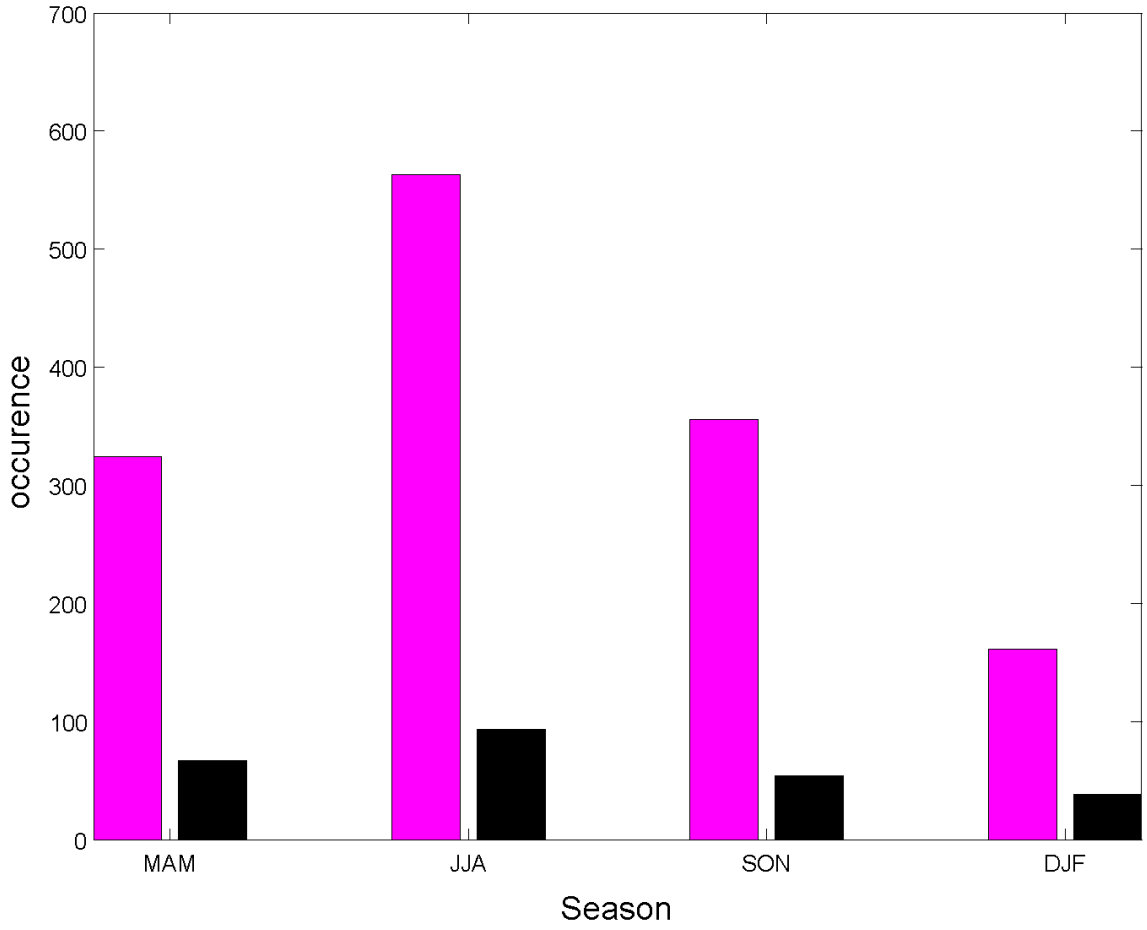
Tmax – Alpine Region cluster



Rainfall – Alpine Region cluster



Tmax extremes

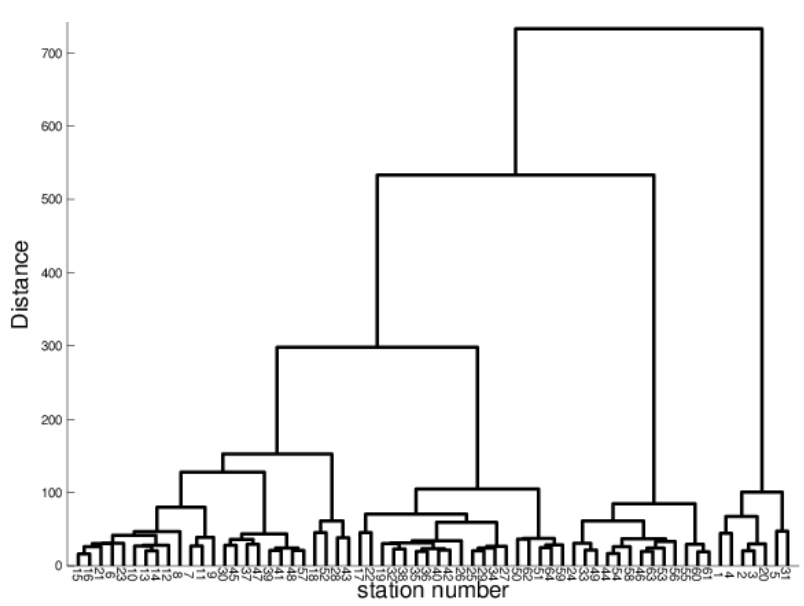


Conclusions

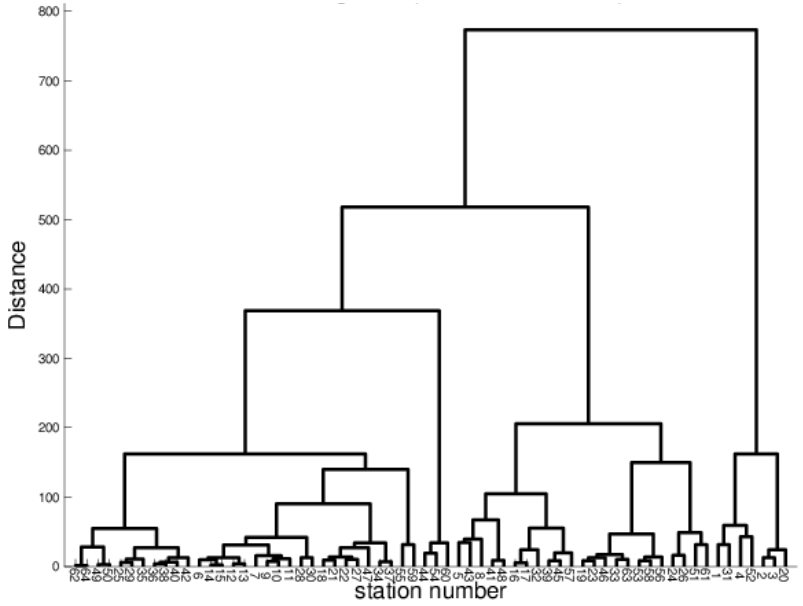
- Identified **homogenous climatic** zones by using the Ward's method
- Closest match between model and observations is for the case of daily minimum temperature
- Maximum temperature shows an unrealistic summer peak during summer over most part of the considered domain
- The model shows also a tendency to overestimate total rainfall especially during spring and early summer
- Late spring and summer mismatches may be corrected by locally adjusting land-atmosphere interactions through changes in the land-atmosphere **energy fluxes** and atmospheric **deep-convection**.
- During winter and fall, a large fraction of total rainfall is associated to well-characterized large scale circulation patterns. In this case, a model improvement is likely to require substantial testing of the ability to correctly describe the propagation of **synoptic scale circulation patterns.**

Tmin

Observations

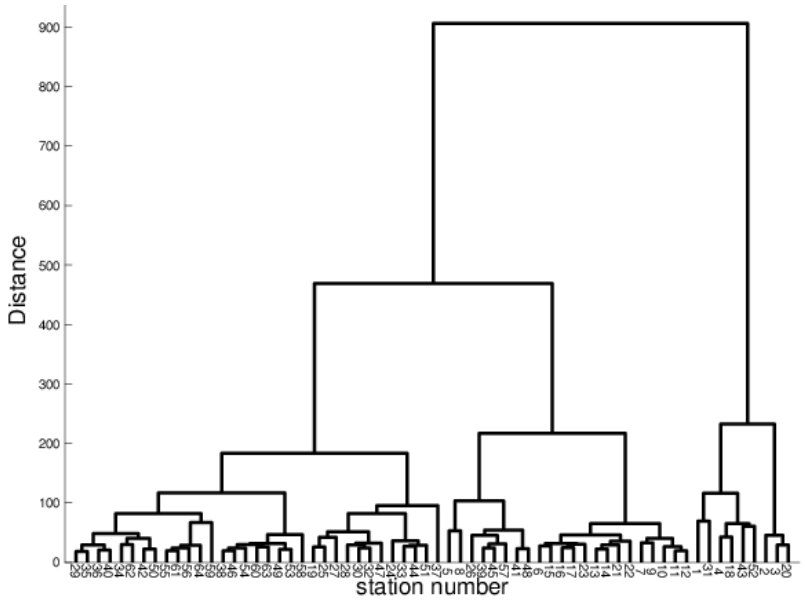


Model

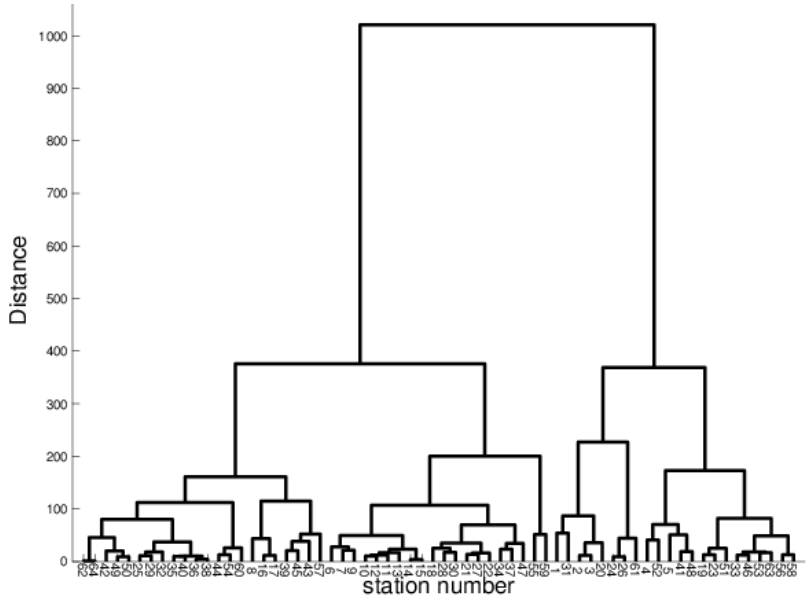


Tmax

Observations

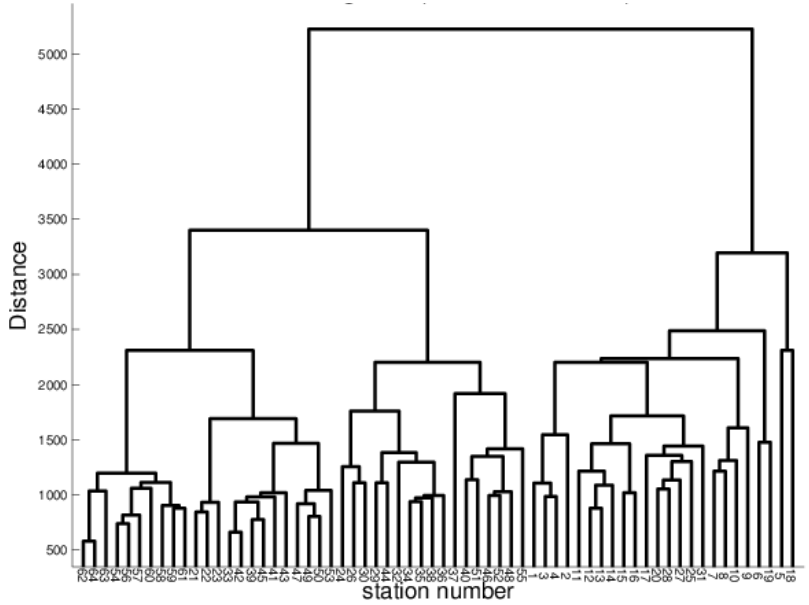


Model

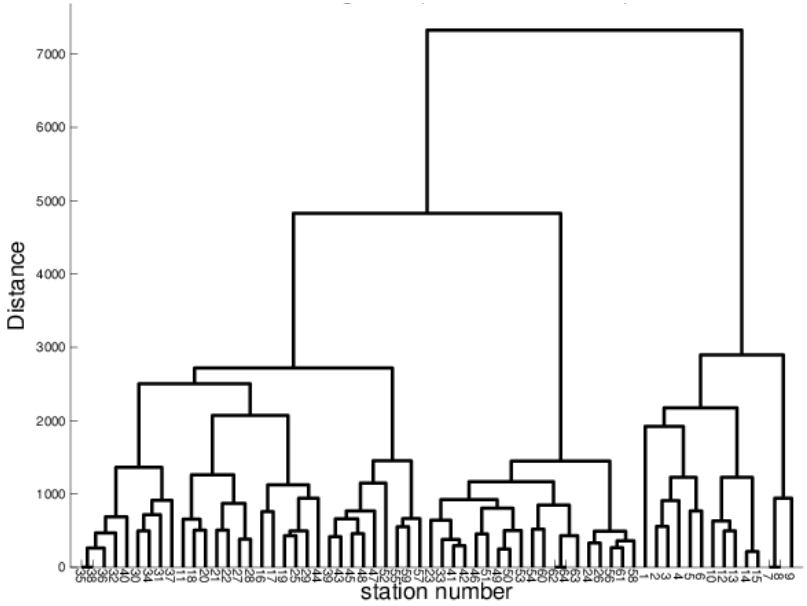


Rainfall

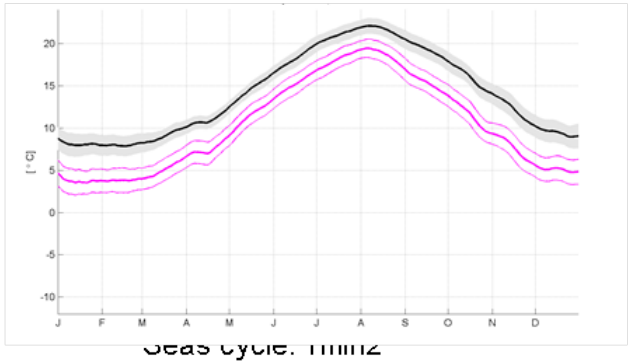
Observations



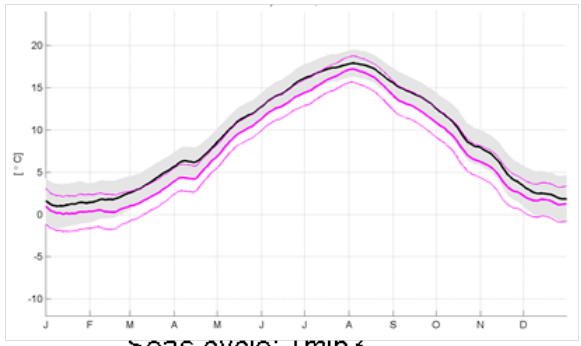
Model



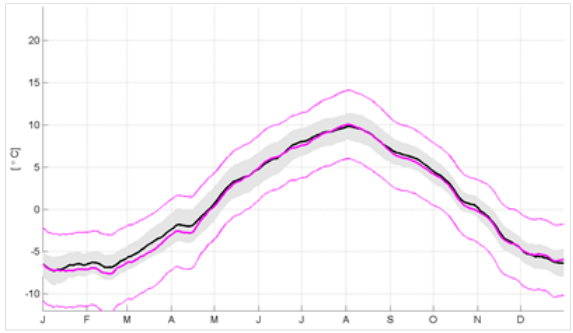
Seas cycle: Tmin1



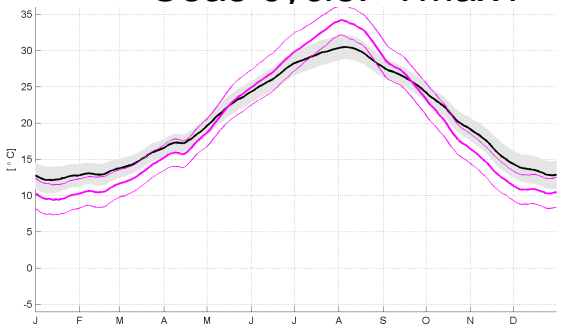
Seas cycle: Tmin2



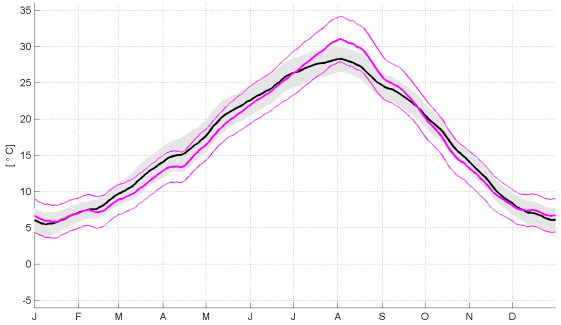
Seas cycle: Tmin3



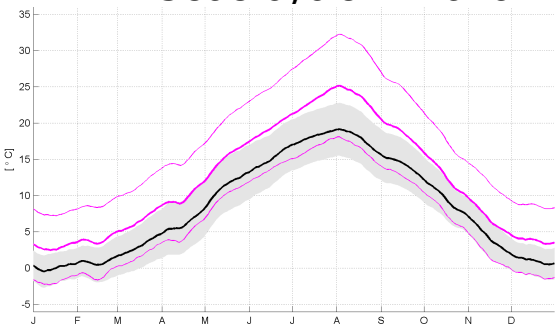
Seas cycle: Tmax1



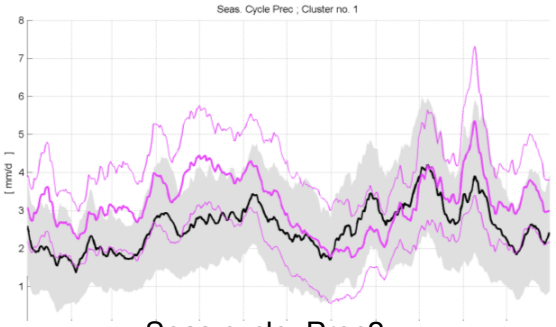
Seas cycle: Tmax2



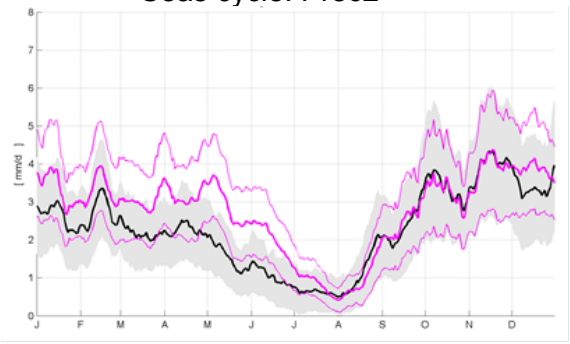
Seas cycle: Tmax3



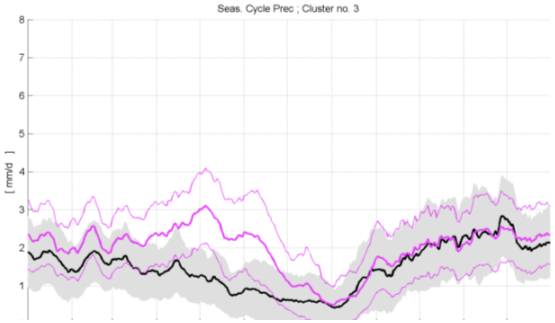
Seas cycle: Prec1



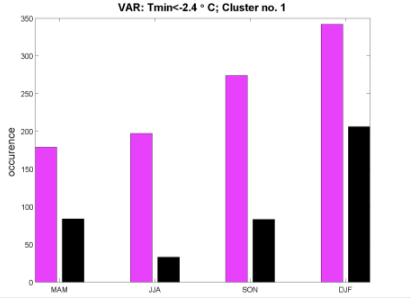
Seas cycle: Prec2



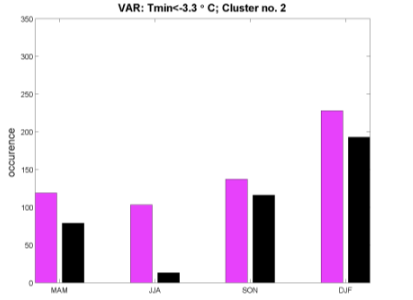
Seas cycle: Prec3



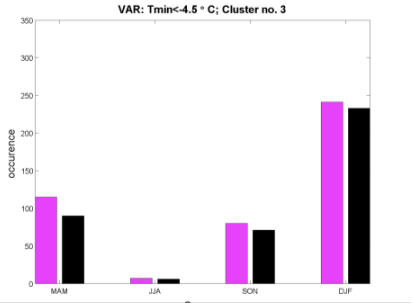
(a) Tmin<-2σ: cluster 1



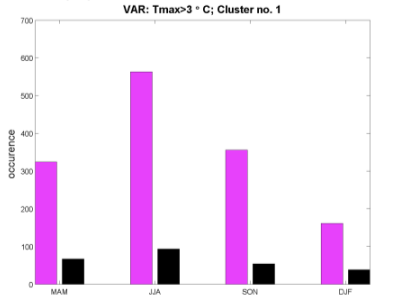
(b) Tmin<-2σ: cluster 2



(c) Tmin<-2σ: cluster 3



(a) Tmax> 2σ: cluster 1



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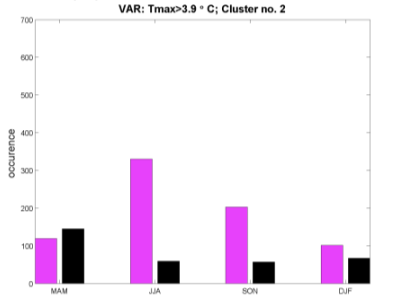
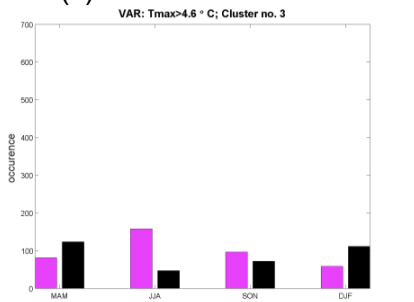
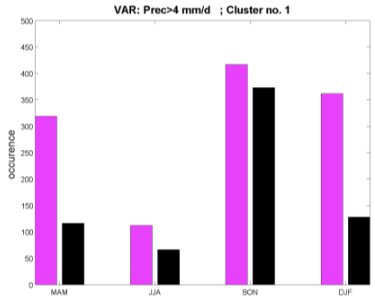
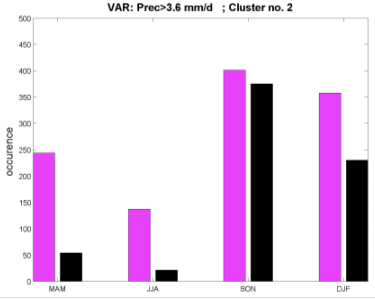


(c) Tmax> 2σ: cluster 3





(a) Prec> 2σ: cluster 2



(b) Prec> 2σ: cluster 3