

Simulation de l'enneigement sur les massifs français par ISBA-ES / Projet SCAMPEI/

KITOVA N¹, MARTIN E¹, DEQUE M¹

¹ CNRM-GAME/GMME/MOSAYC, CNRS

Simulation de l'enneigement



Neige : ISBA-ES

Complexité intermédiaire (3 couches)

[température, eau liquide, masse, densité]

Sol :

Couvert de type prairie

10 couches de sol (flux du sol explicite)

Calcul sur la grille 8 km et par tranche d'altitude :

[hauteur de neige, équivalent en eau et fonte quotidiens]

Résultats présentés :

Hdmax : moyenne des hauteurs décadaires hivernales maximales

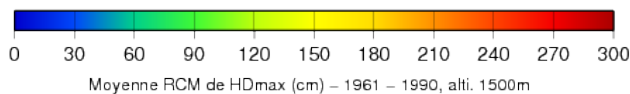
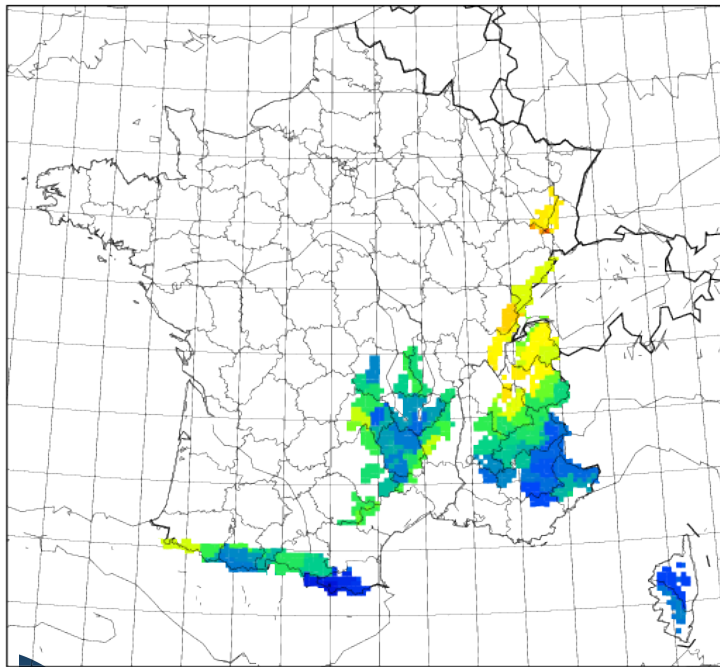
NJN5: Nombre de jours de neige > 5cm

HS100: hauteur de neige minimale pendant 100j le long de l'hiver

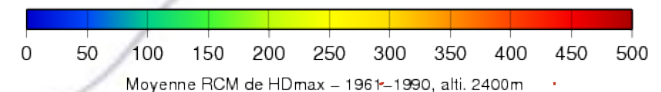
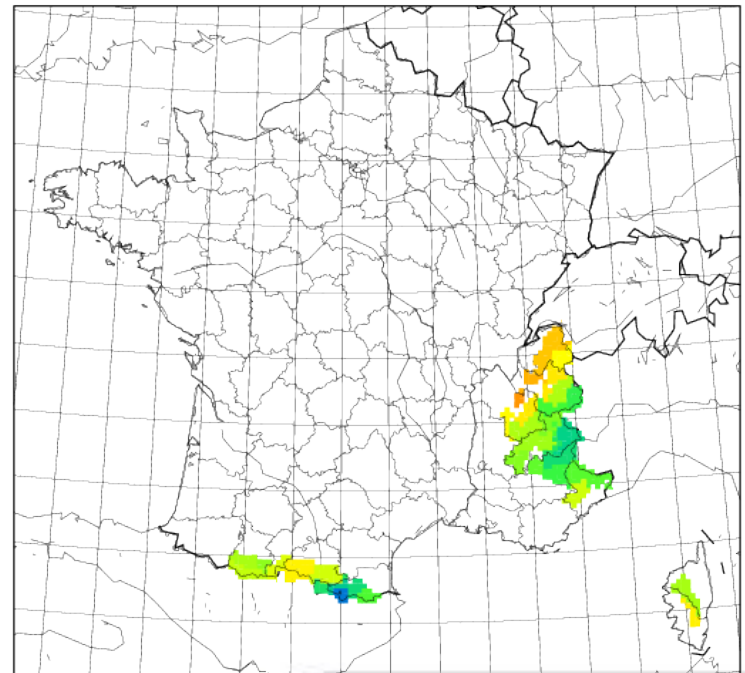
Simulations: RCM (A1B QQ), Scen (A1 TT), DSM(A1 TT/QQ A1B), CMIP (A1B QQ)

Bon accord avec une simulation de référence à partir de Safran
 Meilleure qualité à haute altitude

Moyennes RCM de HDmax à 1500m
 1961-1990



Moyennes RCM de HDmax à 2400m
 1961-1990



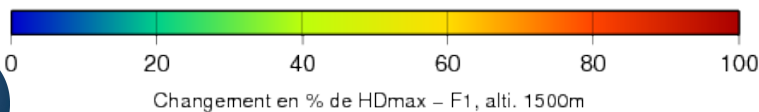
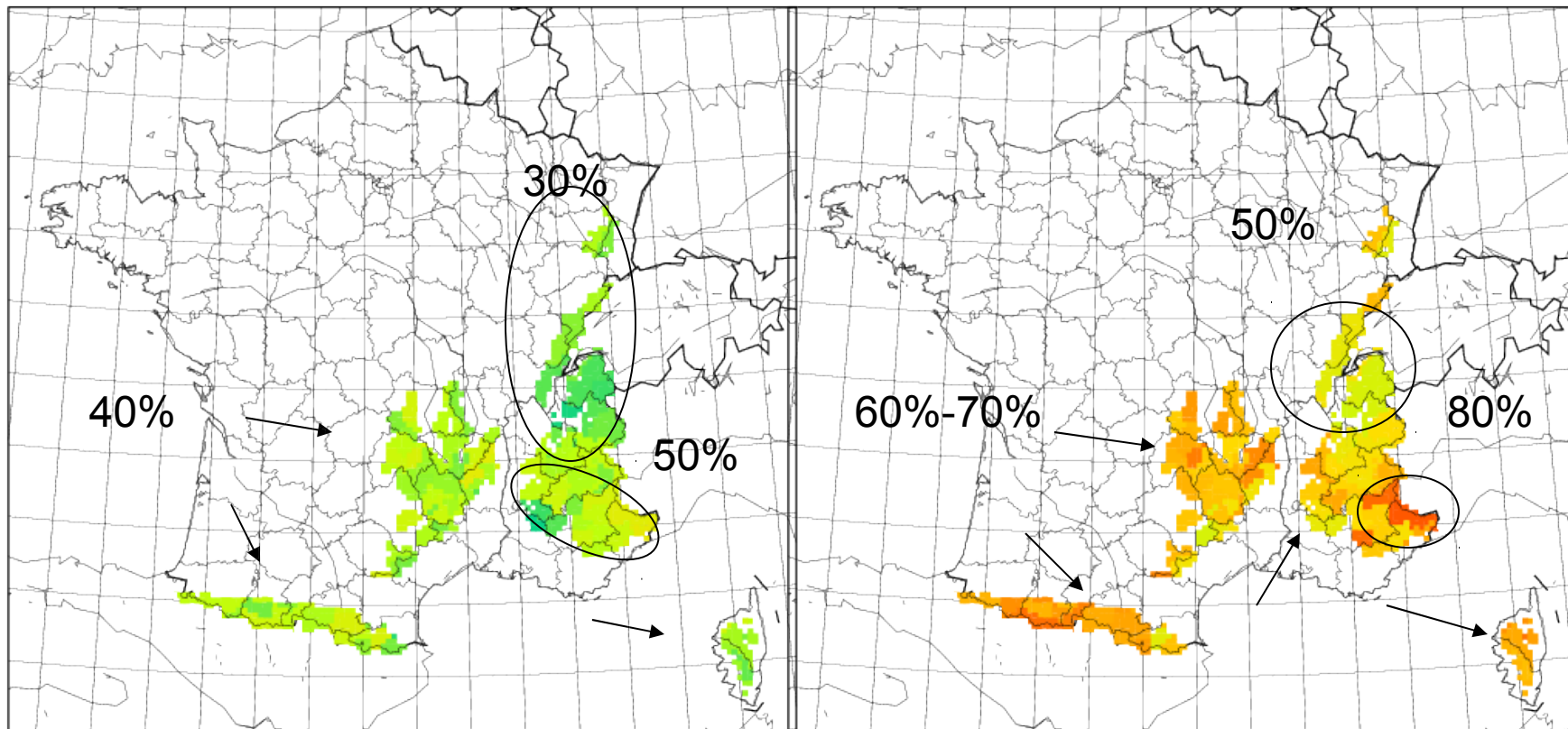
Impact du CC sur la neige

Changement le long du XXI^{ème} siècle

Changement en % de HDmax

Futur proche, 1500m d'altitude

Futur lointain, 1500m d'altitude

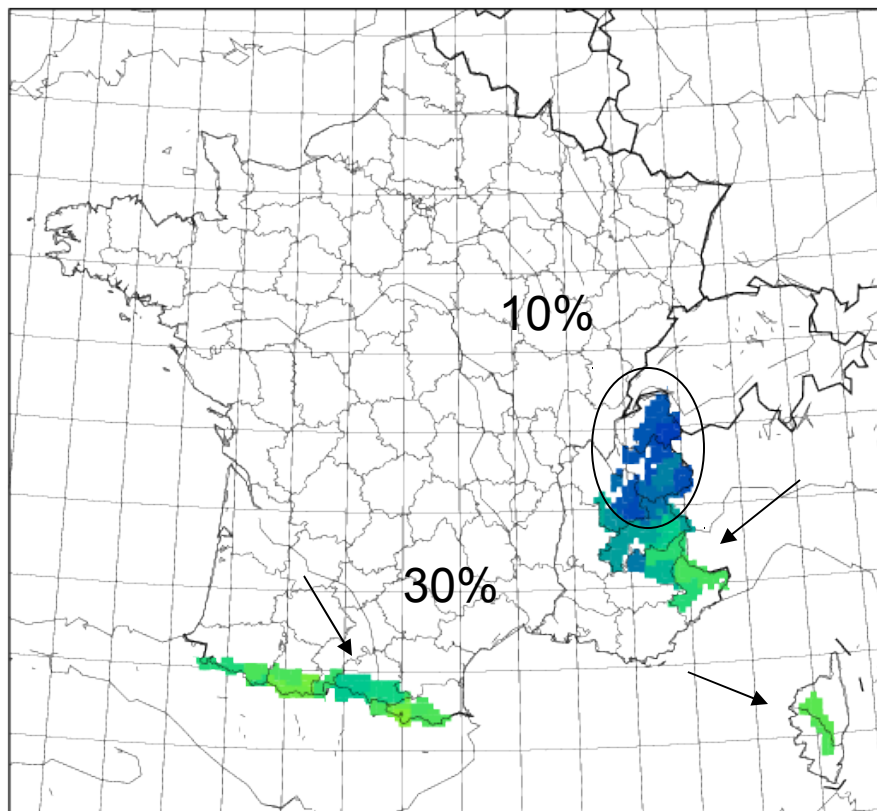


Impact du CC sur la neige

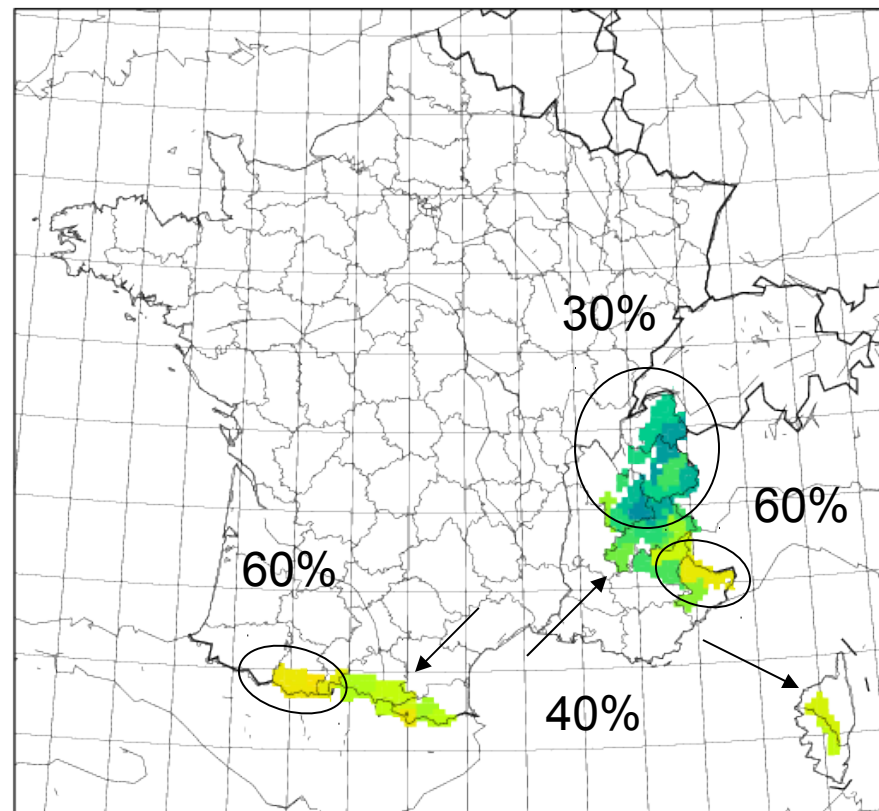
Changement le long du XXI^{ème} siècle

Changement en % de HDmax

Futur proche, 2400m d'altitude



Futur lointain, 2400m d'altitude



Changement en % de HDmax – F1, alti. 2400m

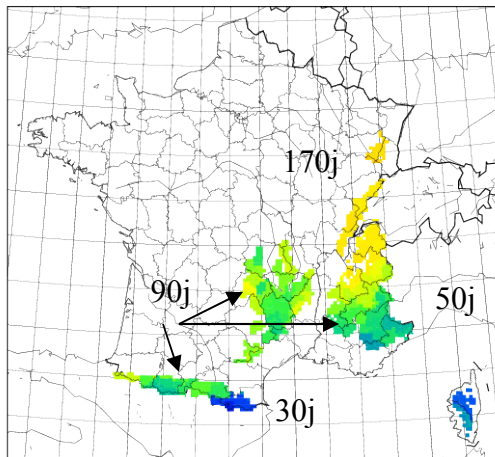


Changement en % de HDmax – F2, alti. 2400m

NJN5 1

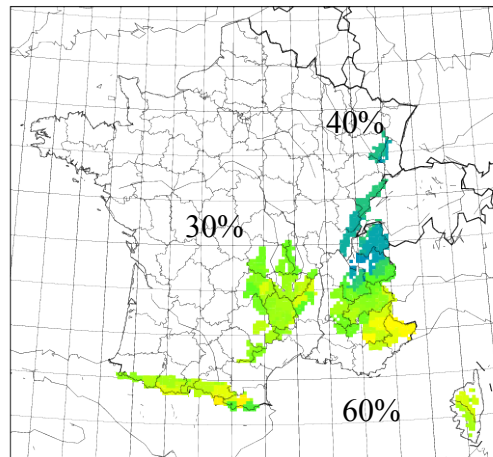
Evolution de NJN5 à 1500m le long du siècle

Moyenne RCM, 1500m
1961 -1990



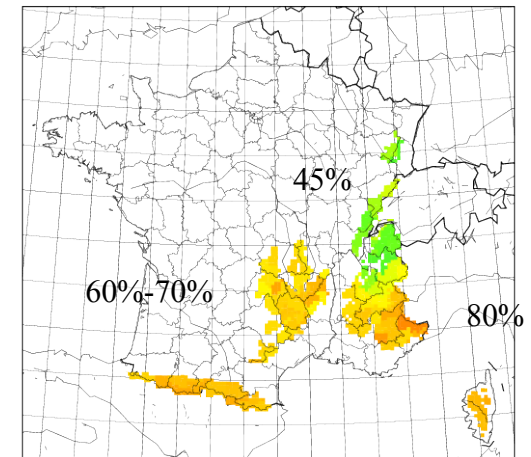
0 30 60 90 120 150 180 210 240 270 300
Moyenne RCM de NJN5 (days) - 1961 - 1990, alti. 1500m

Changement en % RCM, 1500m
F1



0 20 40 60 80 100 120
Changement en % de NJN5 - F1, alti. 1500m

Changement en % RCM, 1500m
F2

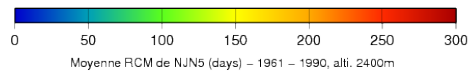
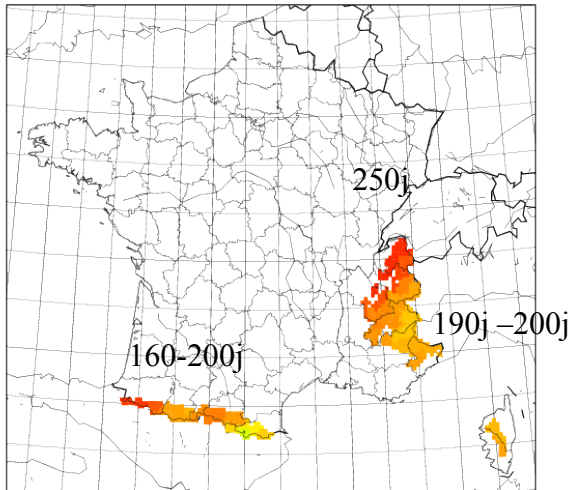


0 20 40 60 80 100 120
Changement en % de NJN5 - F2, alti. 1500m

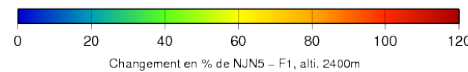
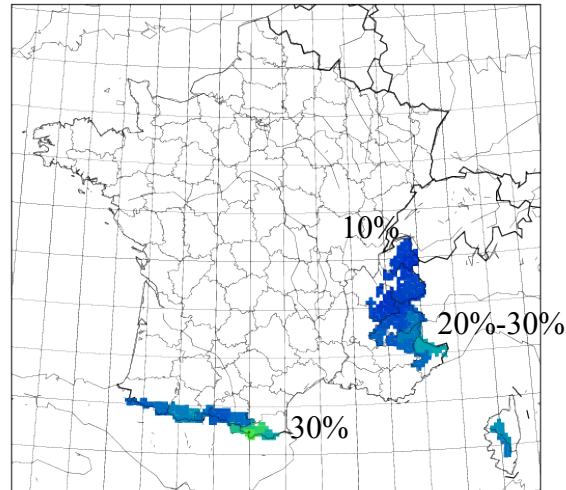
NJN5 2

Evolution de NJN5 à 2400m le long du siècle

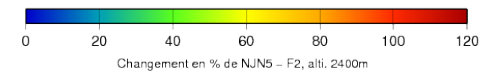
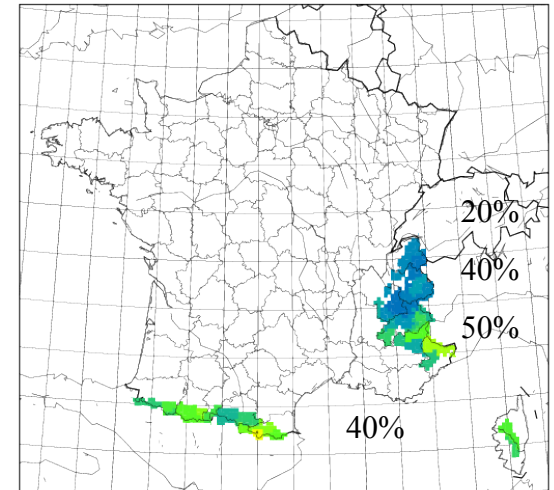
Moyenne RCM, 2400m
1961 -1990



Changement en % RCM, 2400m
F1



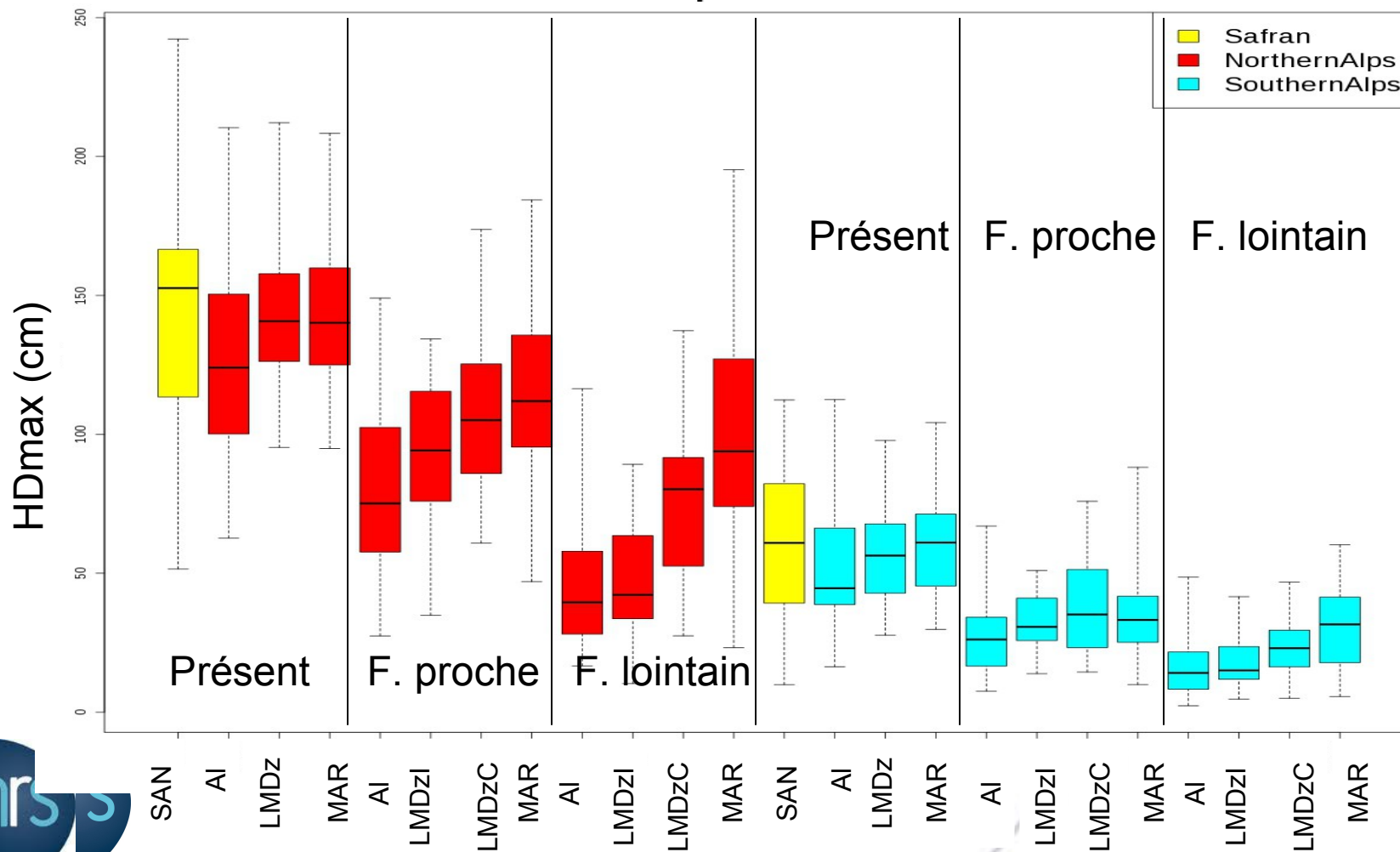
Changement en % RCM, 2400m
F2



Impact du CC sur la neige

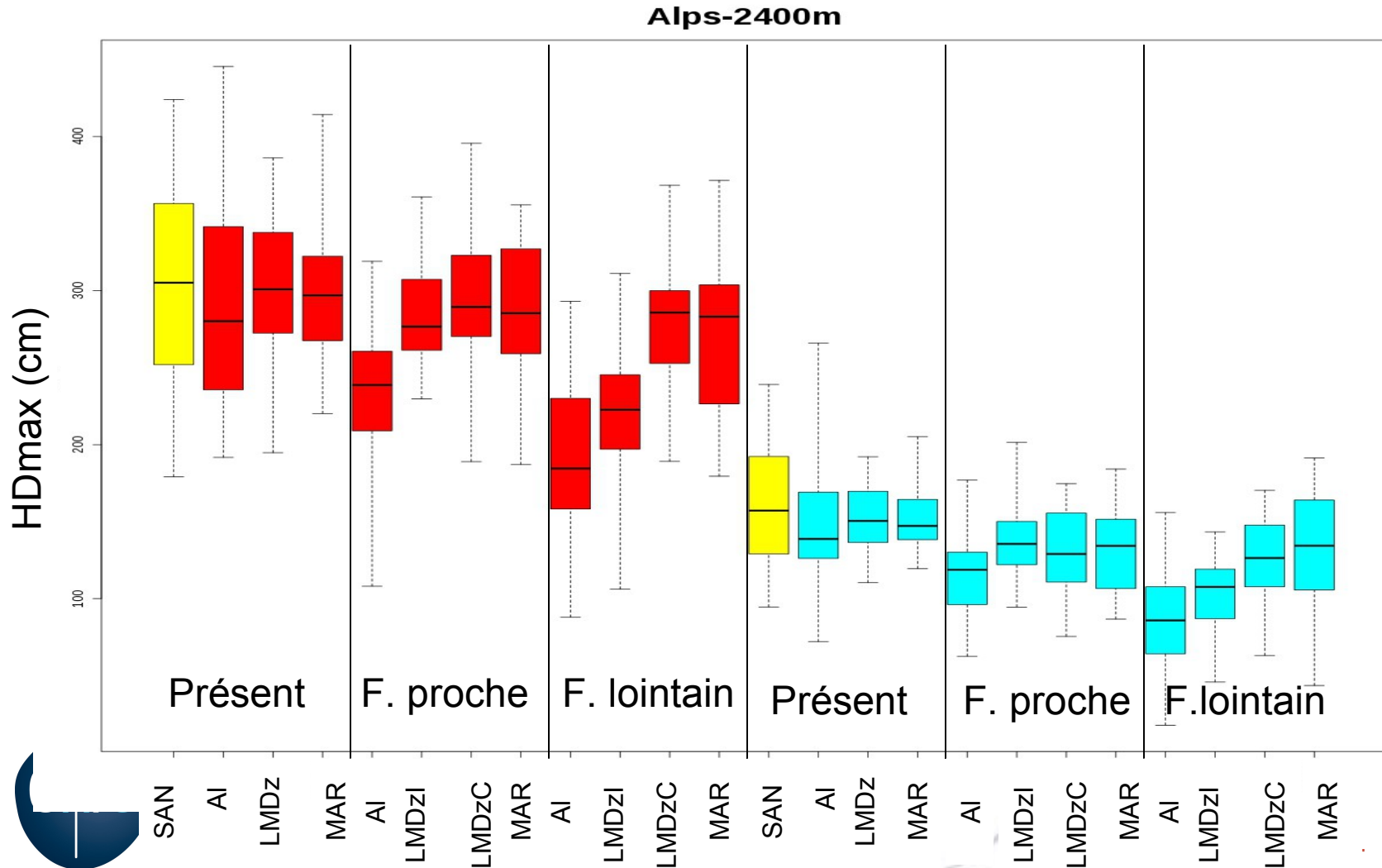
La variabilité temporelle le long du XXIe siècle de chaque des trois modèles régionaux – scénario A1B, correction des données météorologiques QQ

Alps-1500m



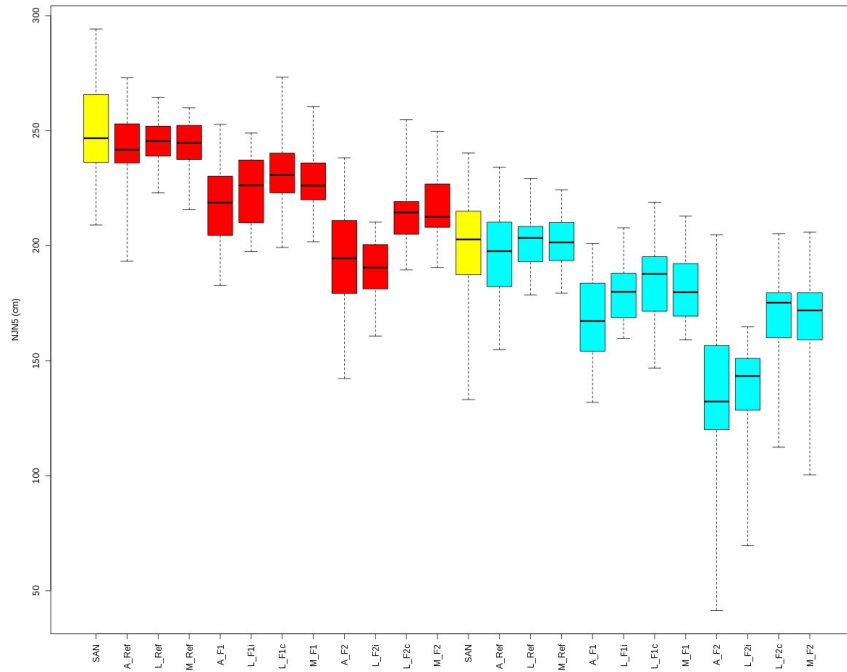
Impact du CC sur la neige

La variabilité temporelle le long du XXIe siècle de chaque des trois modèles régionaux – scénario A1B, correction des données météorologiques QQ

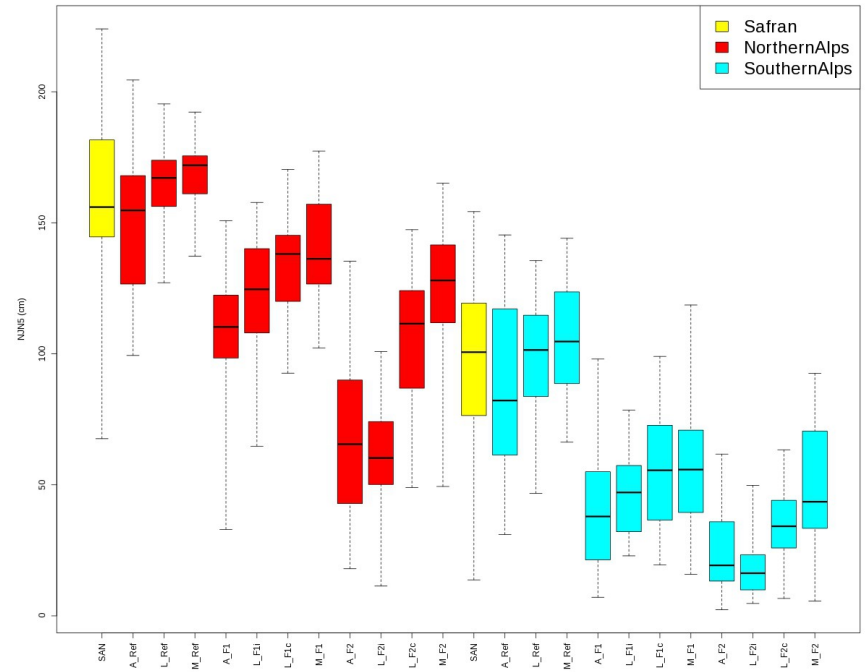


NJN5 RCM all sims

Alps-2400m

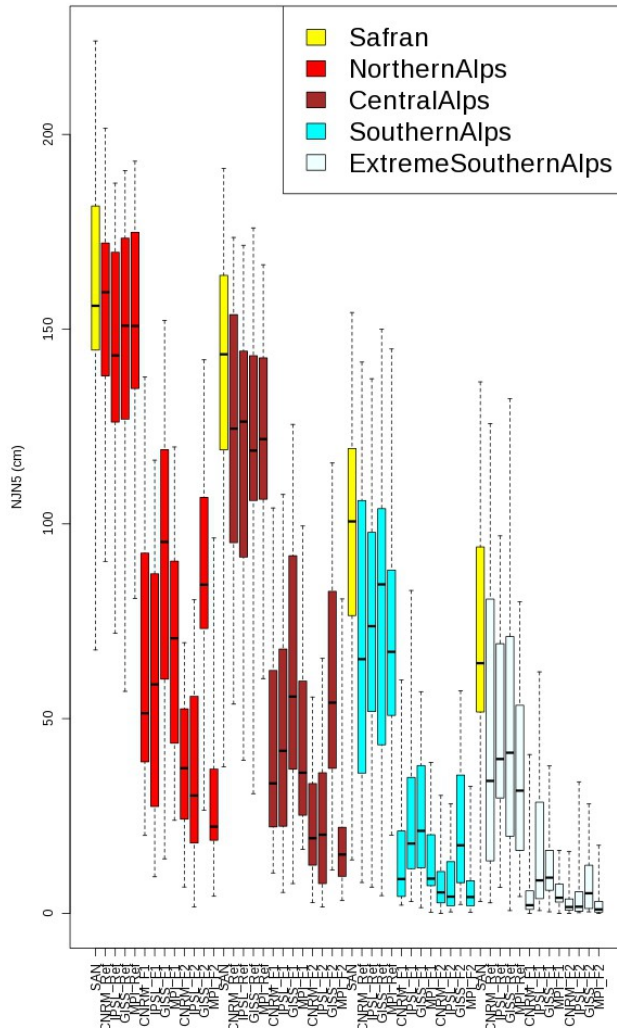


Alps-1500m

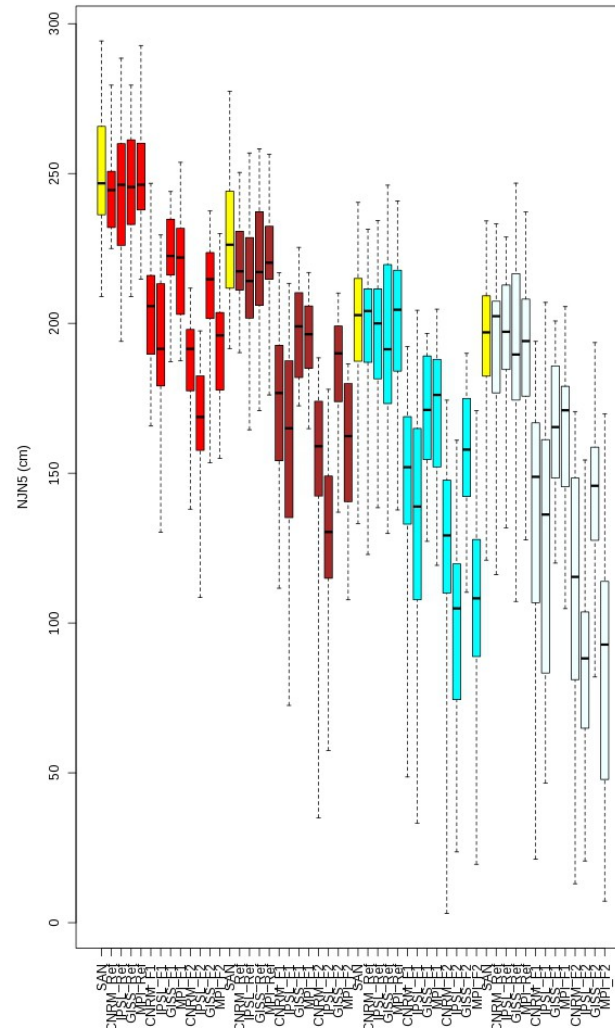


NJN5 CMIP – all sims

Alps-1500m



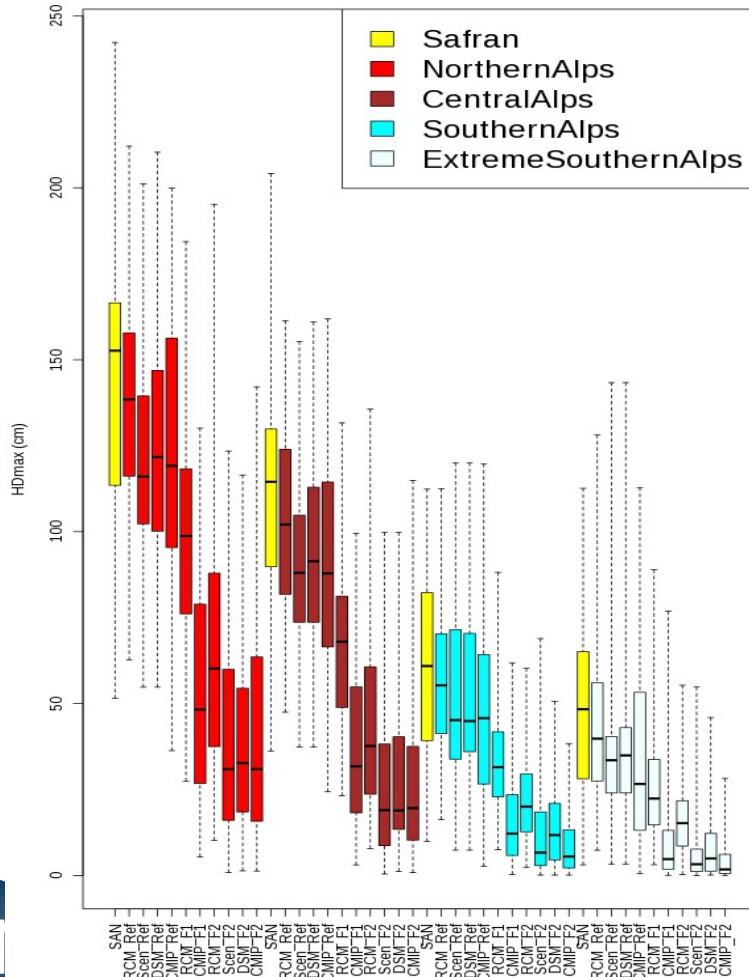
Alps-2400m



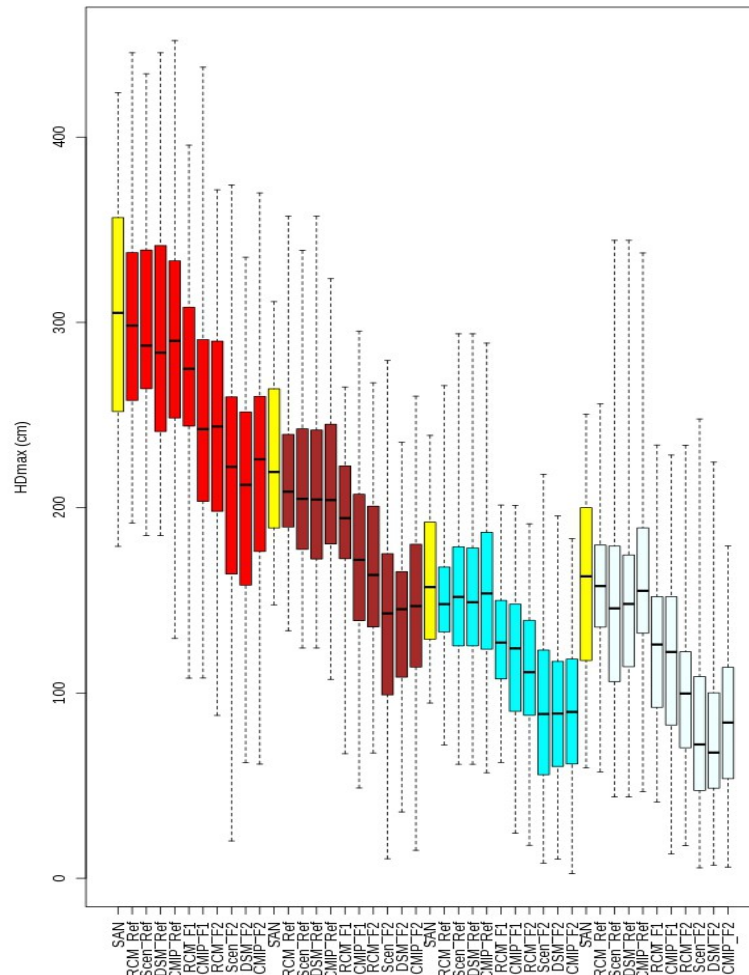
HDmax

Boxplot HDmax - Alpes, les 3 périodes, RCM, Scen, DSM, CMIP

Alps-1500m



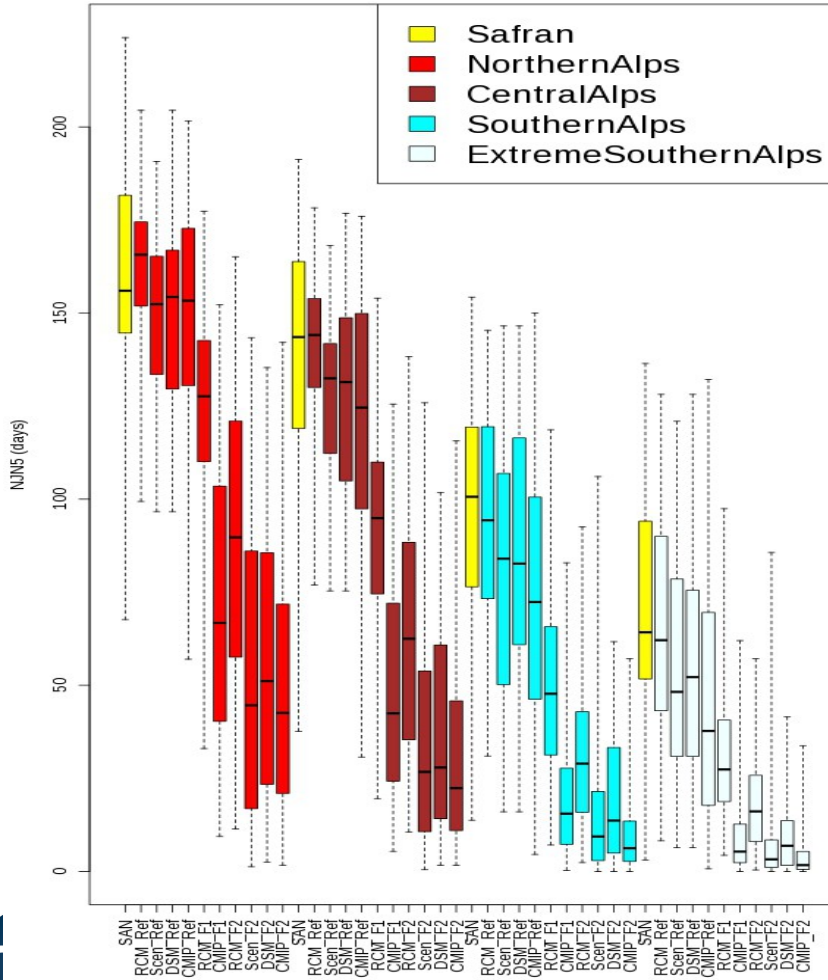
Alps-2400m



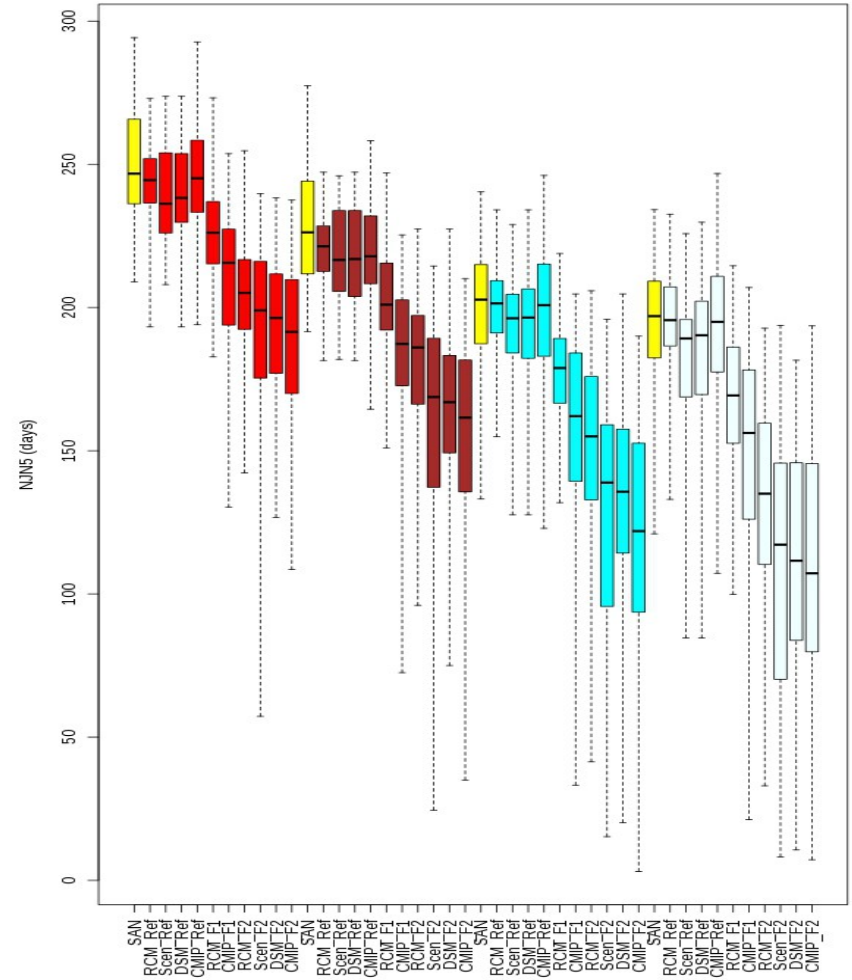
NJN5 3

Boxplot NJN5 - Alpes, les 3 périodes, RCM, Scen, DSM, CMIP

Alps-1500m

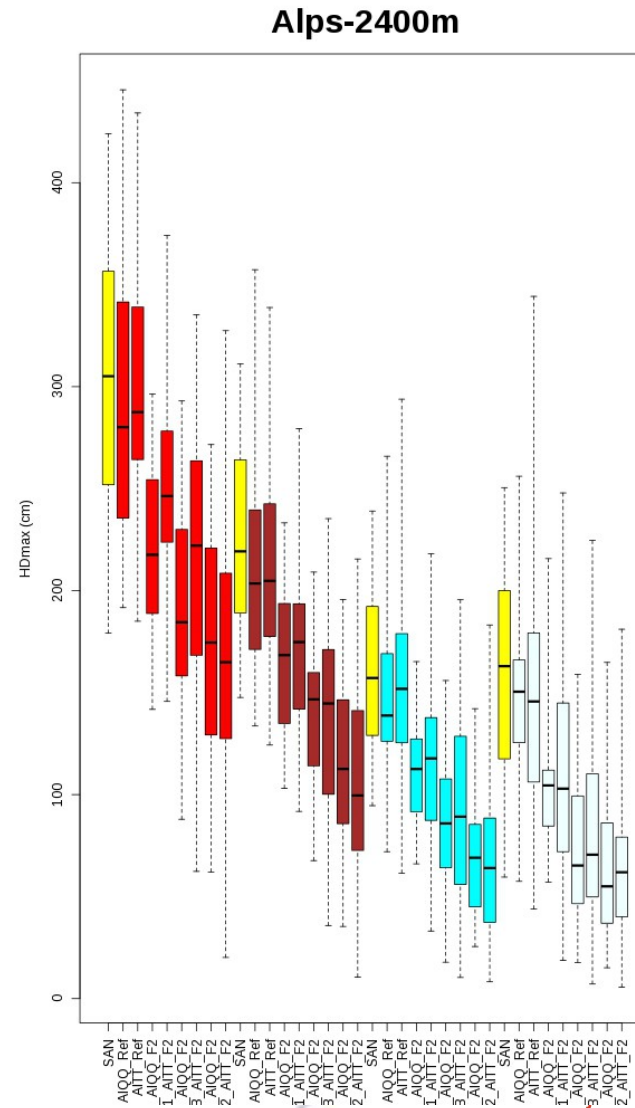
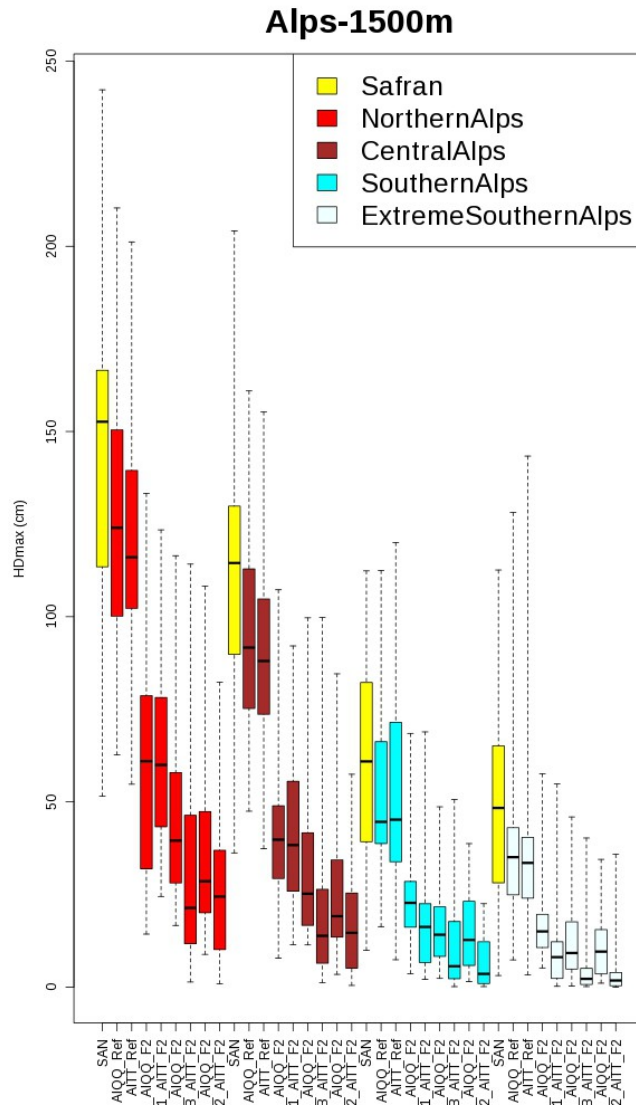


Alps-2400m



HDmax

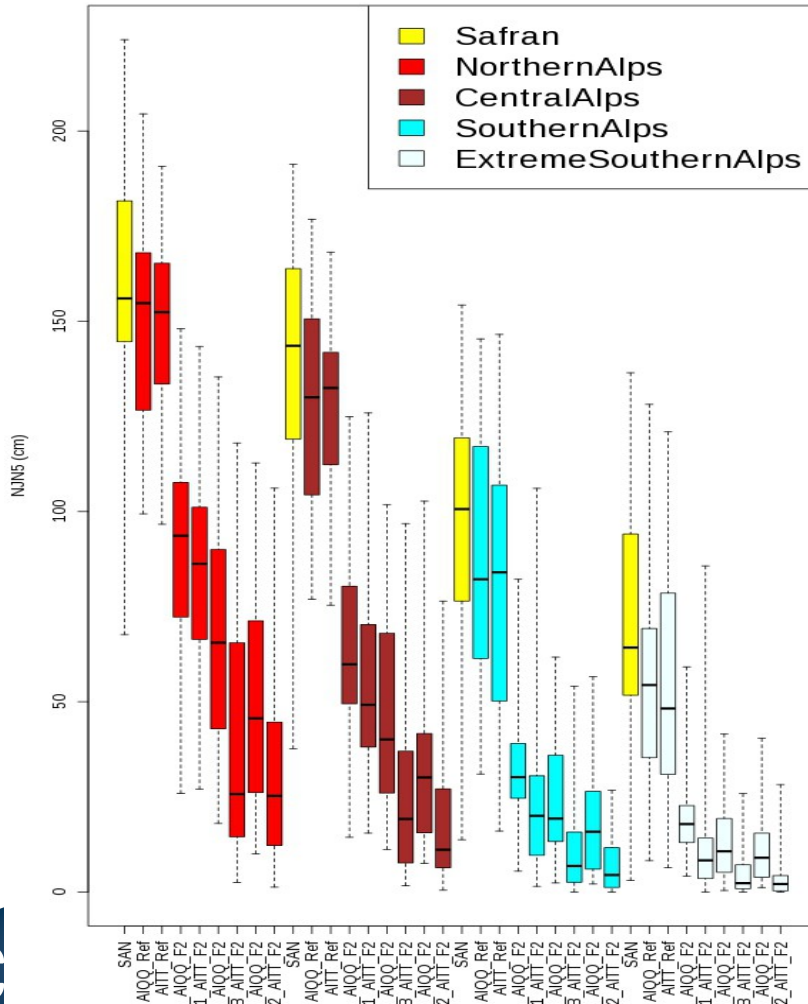
Boxplot Hdmax AIQQ et AITT(B1, A1B, A2) Alpes [Scen]



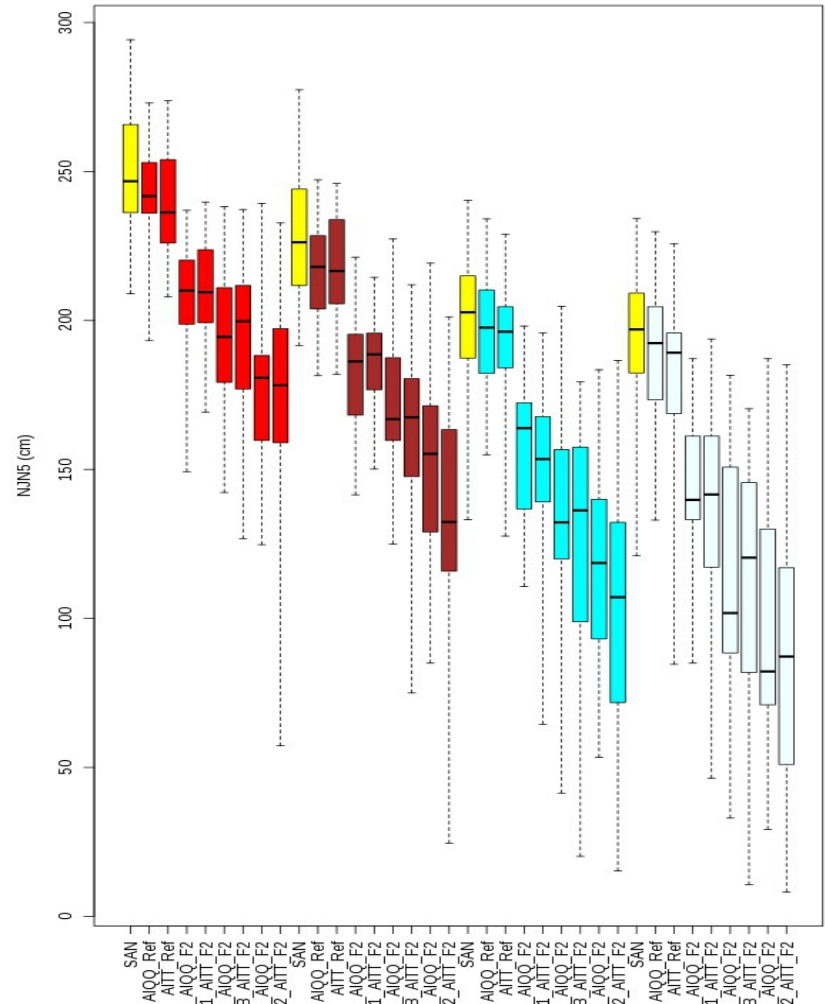
NJN5 4

Boxplot AIQQ et AITT(B1, A1B, A2) Alpes [Scen]

Alps-1500m

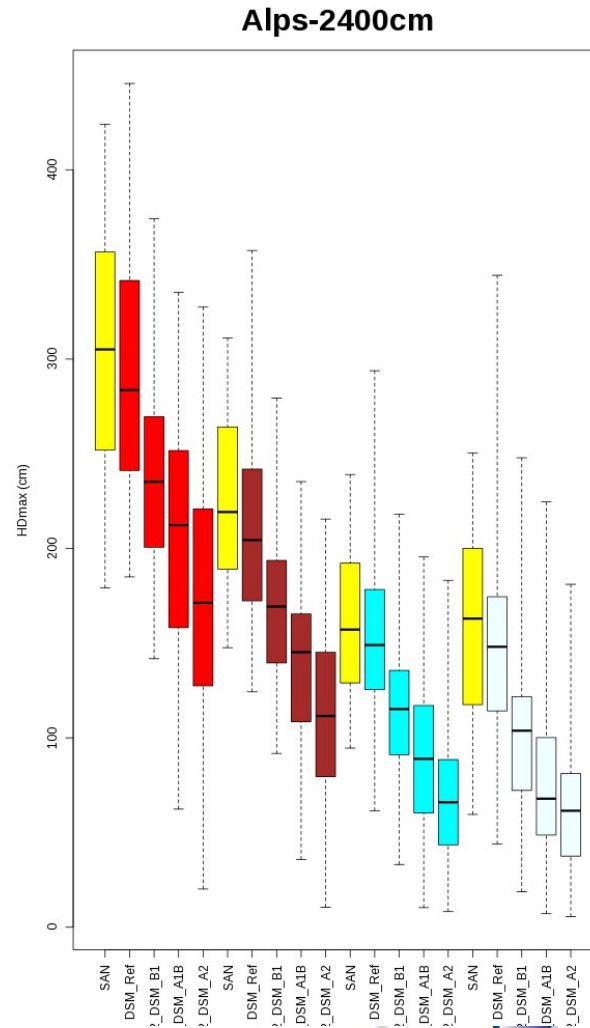
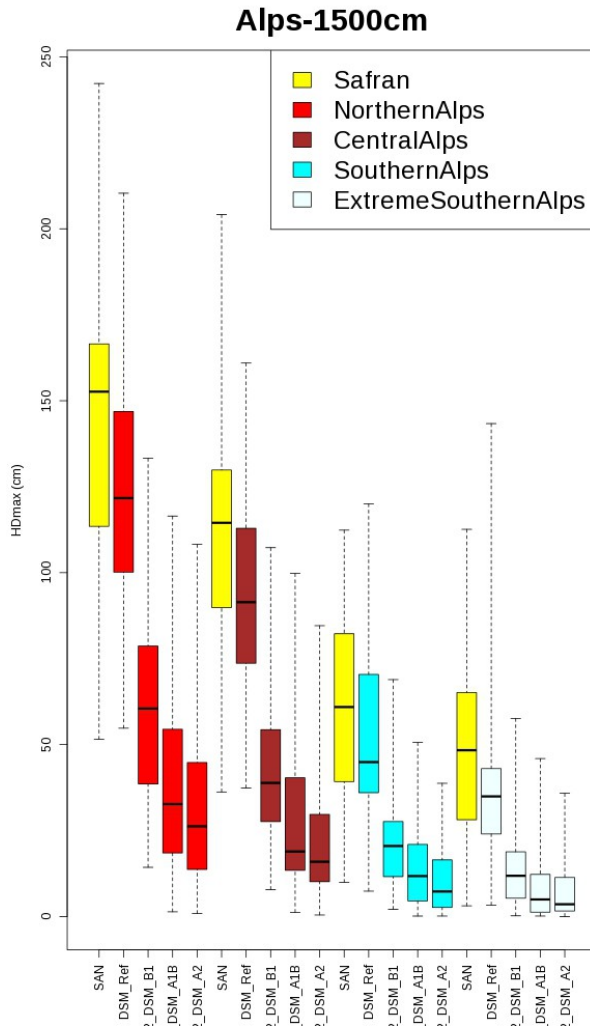


Alps-2400m



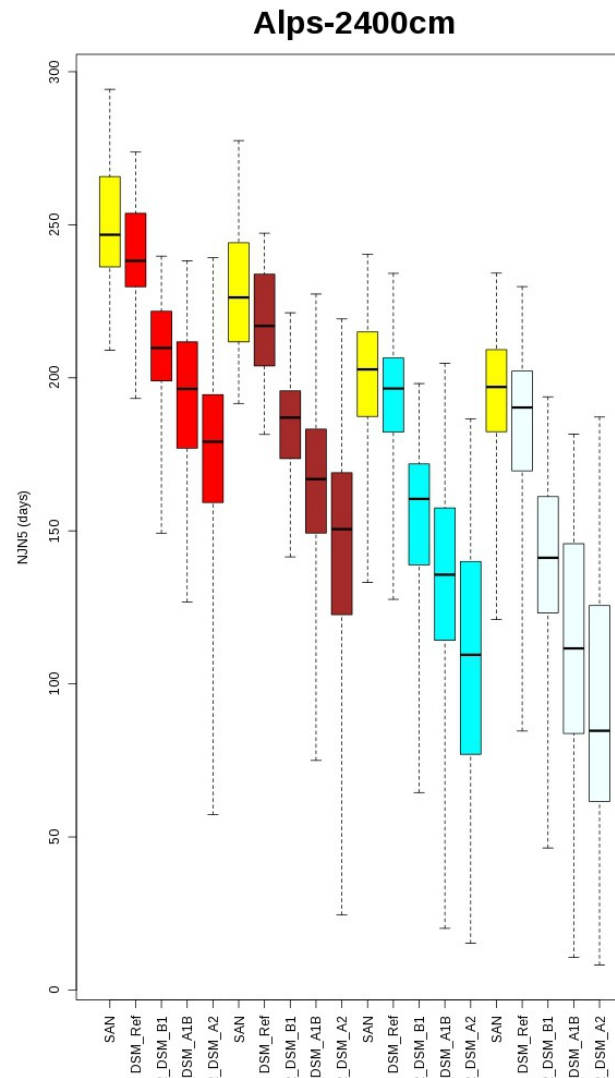
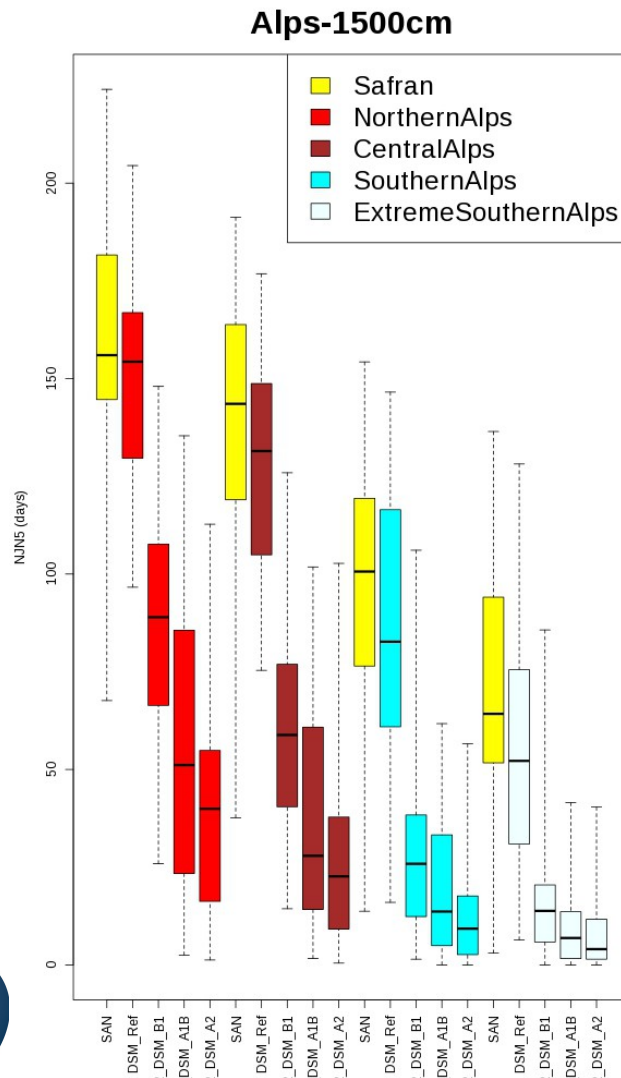
HDmax

Boxplot de HDmax Alpes AIQQ et AITT (A1B) [DSM]



NJN5 7

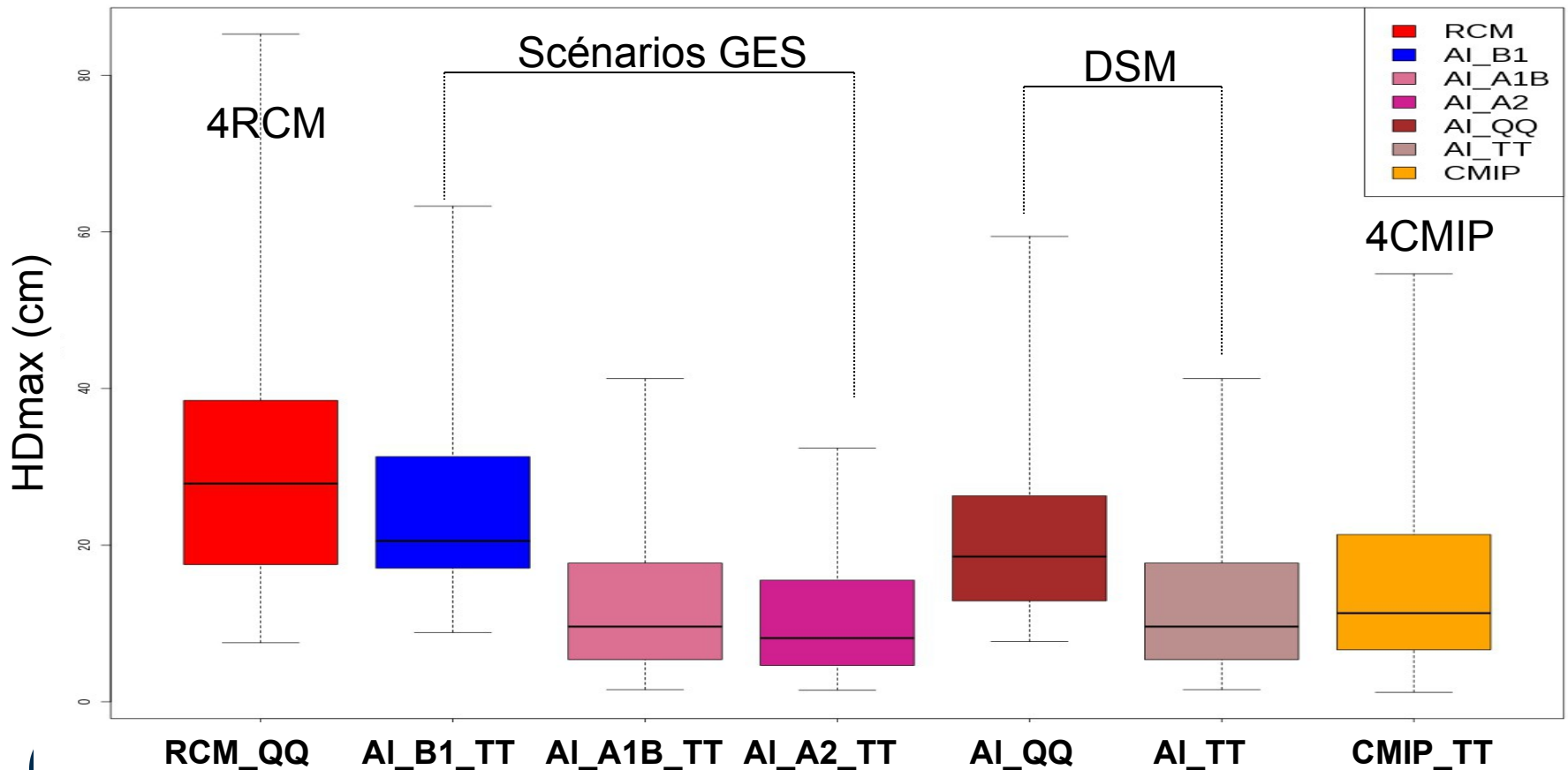
Boxplot AIQQ et AITT (A1B) Alpes [DSM]



HDmax Incertitudes

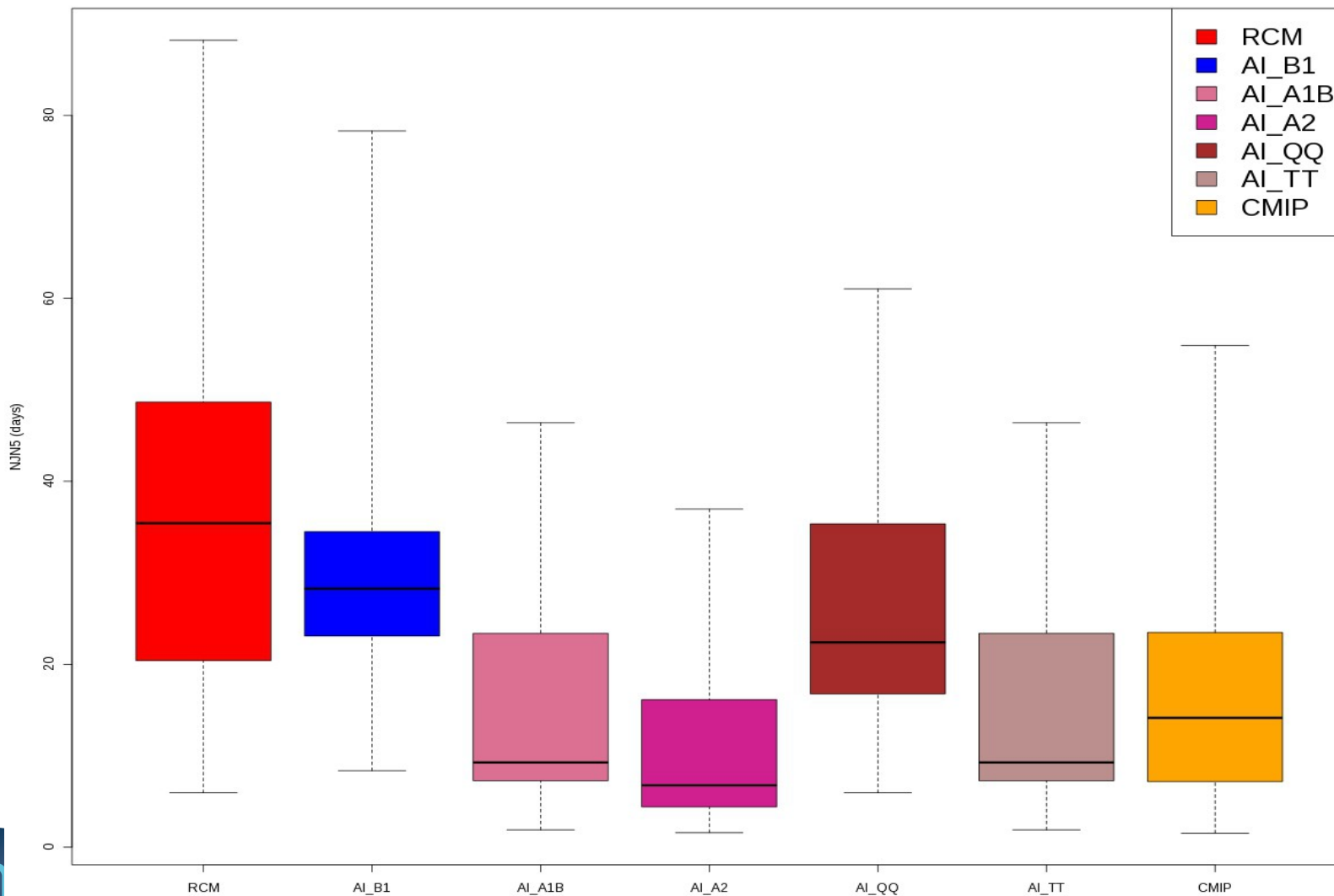
3 Scénarios de GES; les deux Méthodes de Descente d'Echelle [DSM] (A1B) et les 4 modèles de CMIP(A1B TT)

France, 1500m, Futur lointain



NJN5 Incertitudes

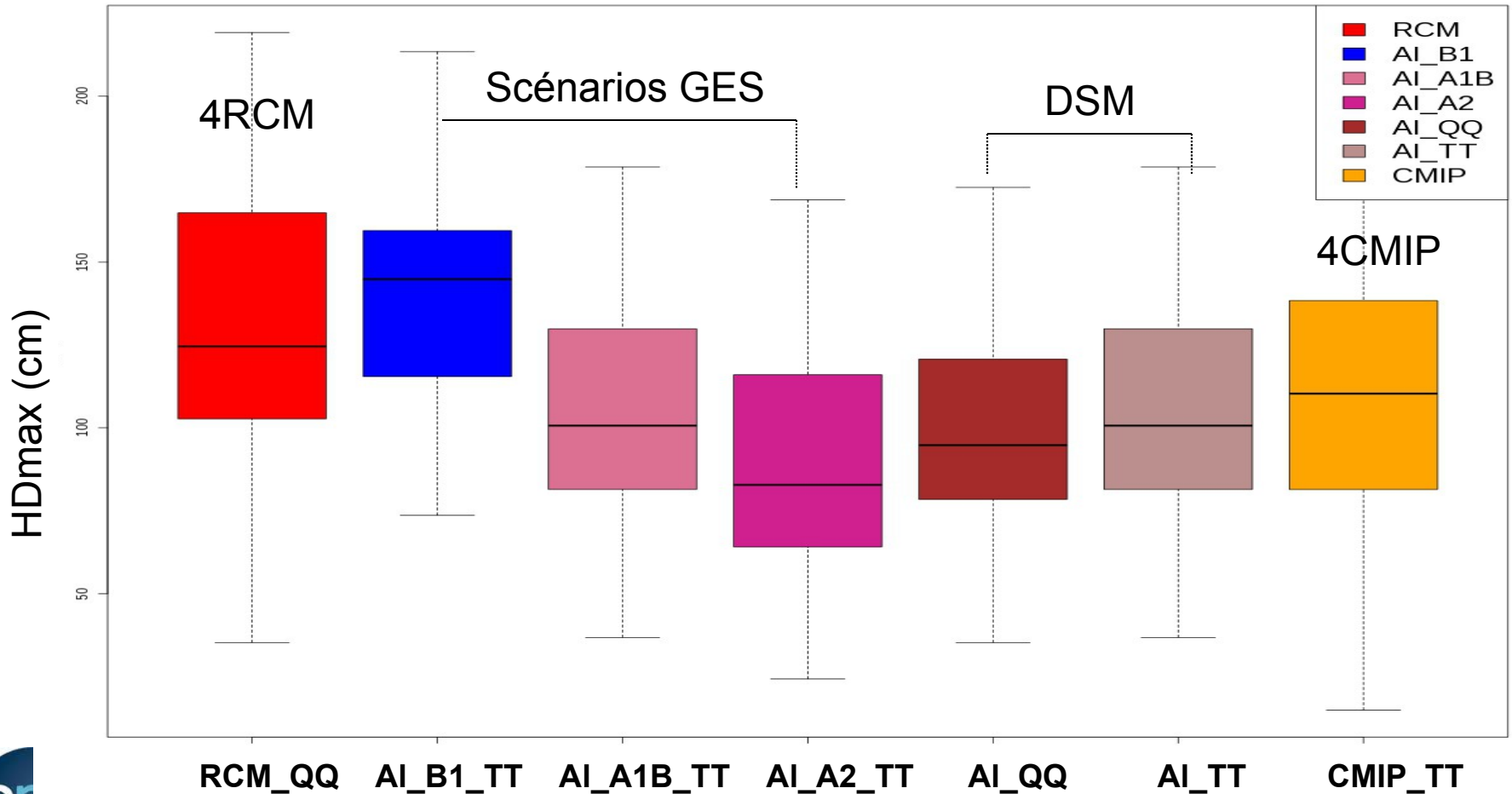
France,1500m, Fin du XXe siècle



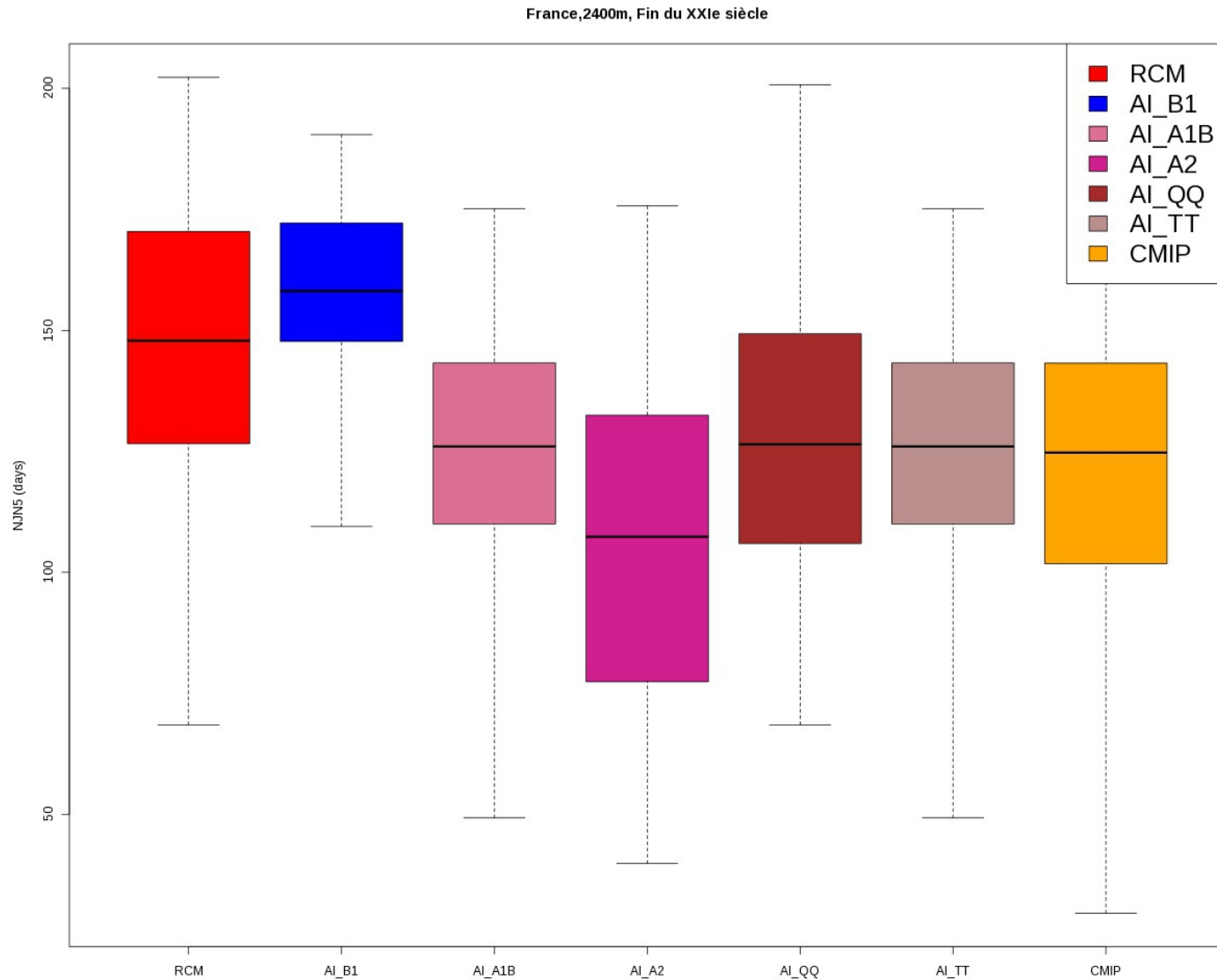
HDmax Incertitude (bis)

La même présentation qu'avant mais pour 2400m

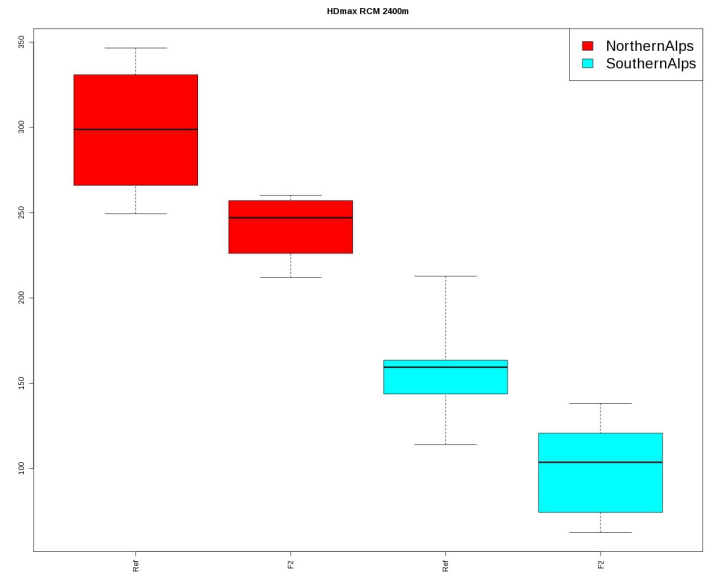
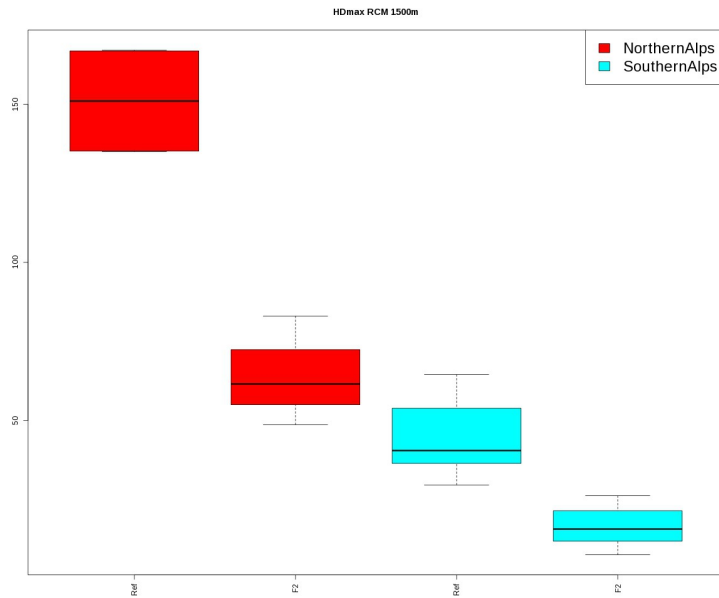
France, 2400m, Futur lointain



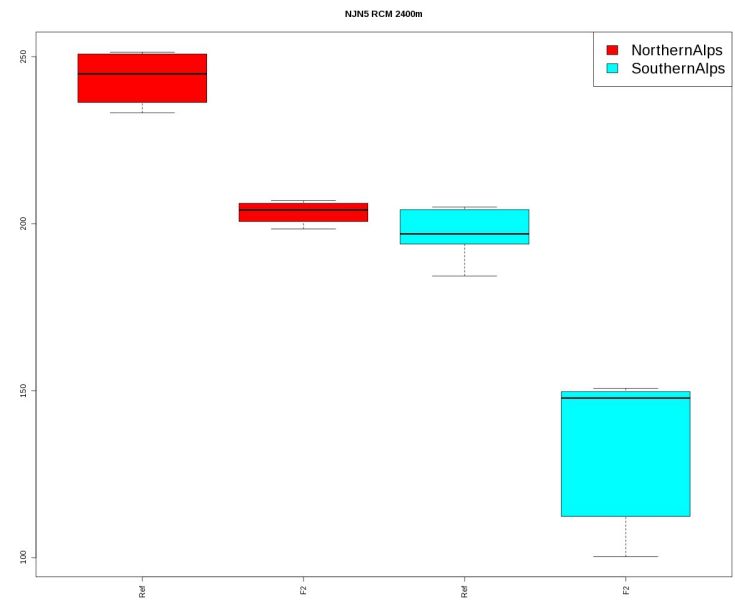
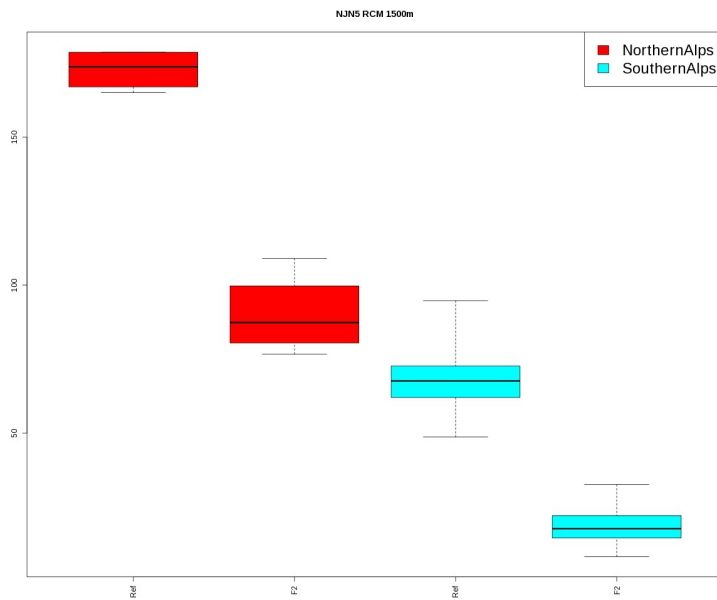
NJN5 Incertitudes (bis)



HDmax RCM change statial



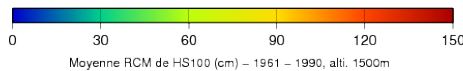
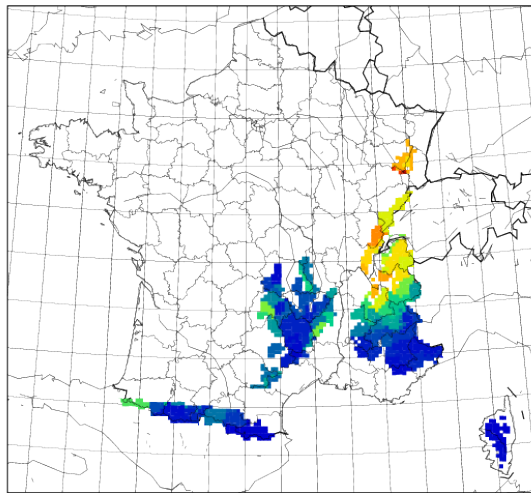
NJN5 RCM change statial



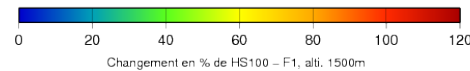
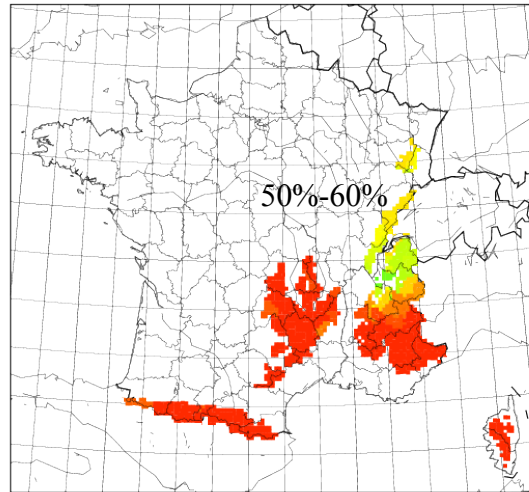
HS100

Evolution de HS100 à 1500m le long du siècle

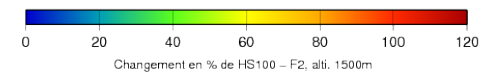
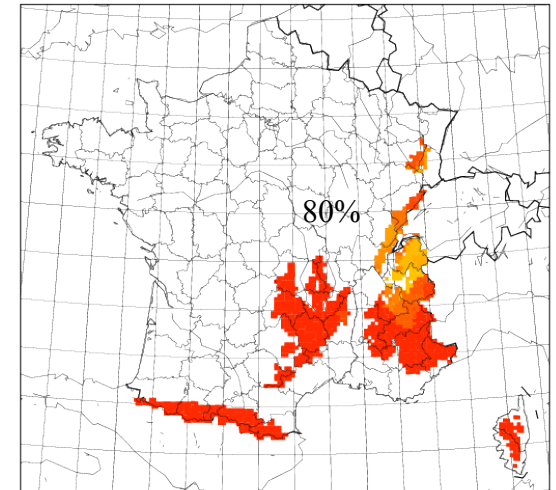
Moyenne RCM, 1500m
1961 -1990



Changement en % RCM, 1500m
F1



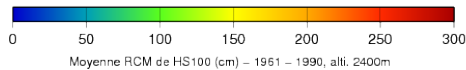
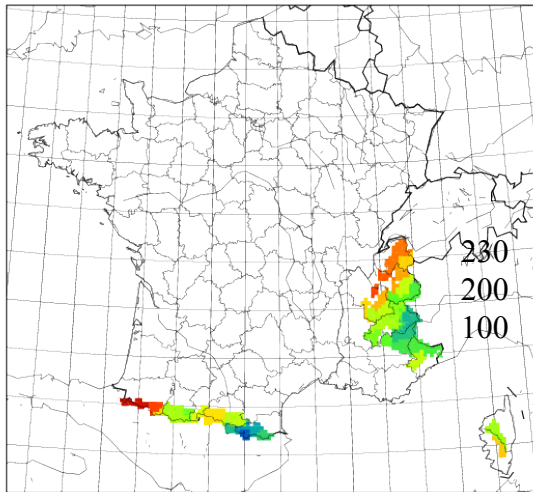
Changement en % RCM, 1500m
F2



HS100

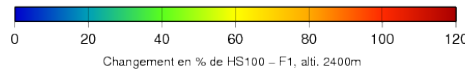
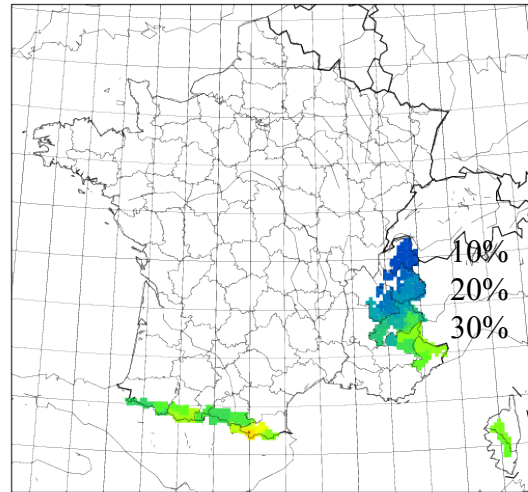
Evolution de HS100 à 2400m le long du siècle

Moyenne RCM, 2400m
1961 -1990



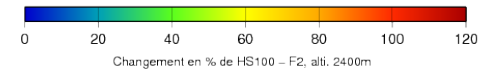
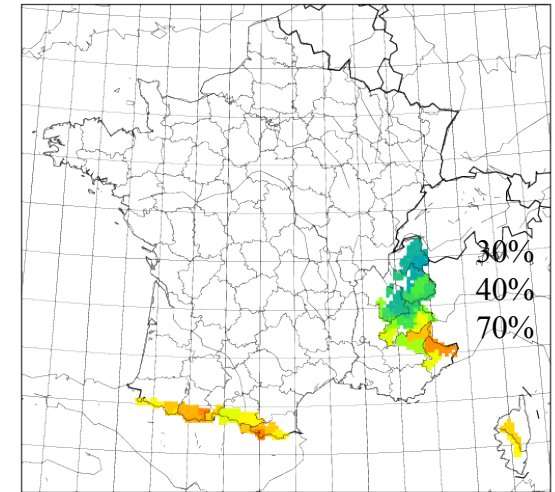
Moyenne RCM de HS100 (cm) – 1961 – 1990, alti. 2400m

Changement en % RCM, 2400m
F1



Changement en % de HS100 – F1, alti. 2400m

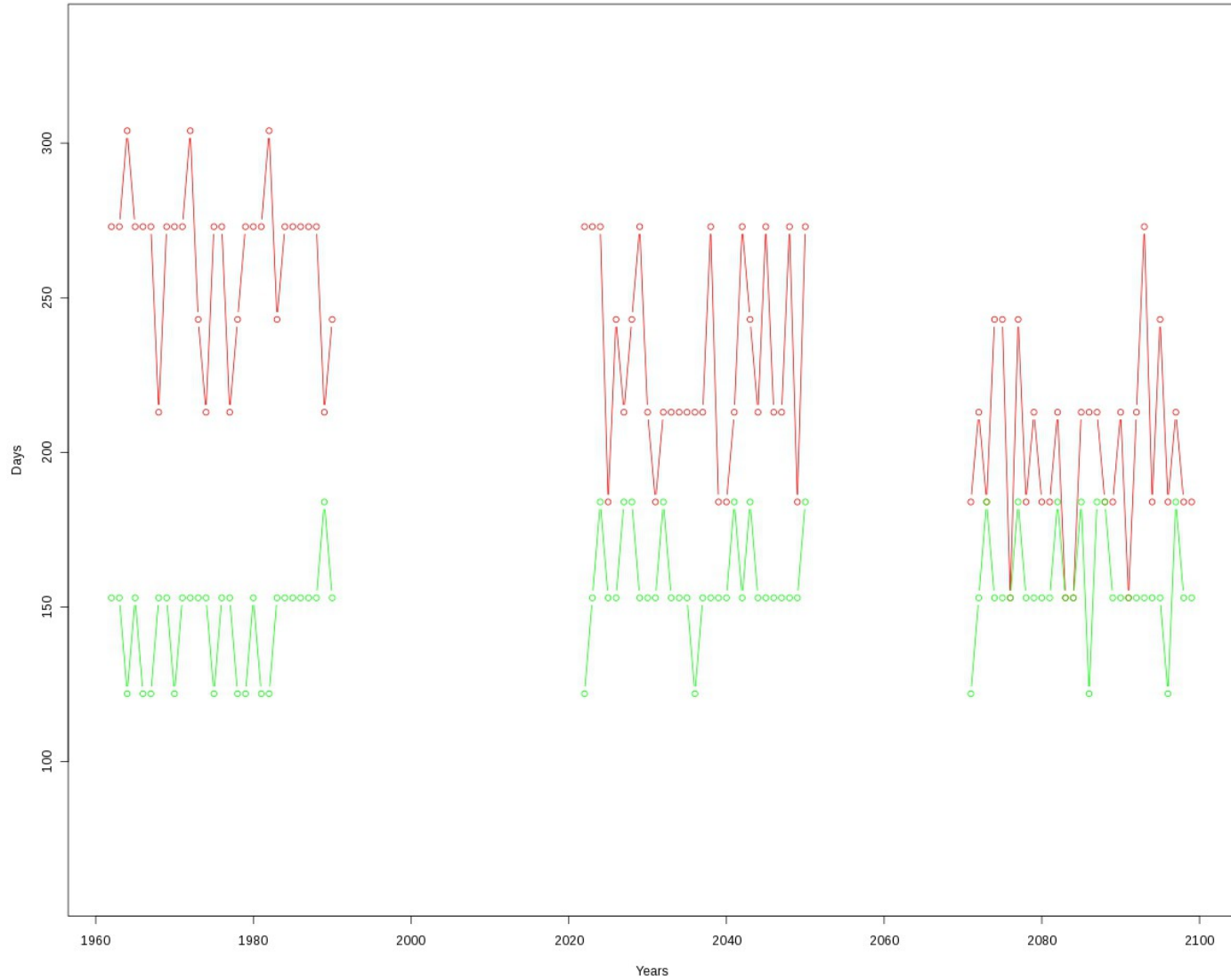
Changement en % RCM, 2400m
F2



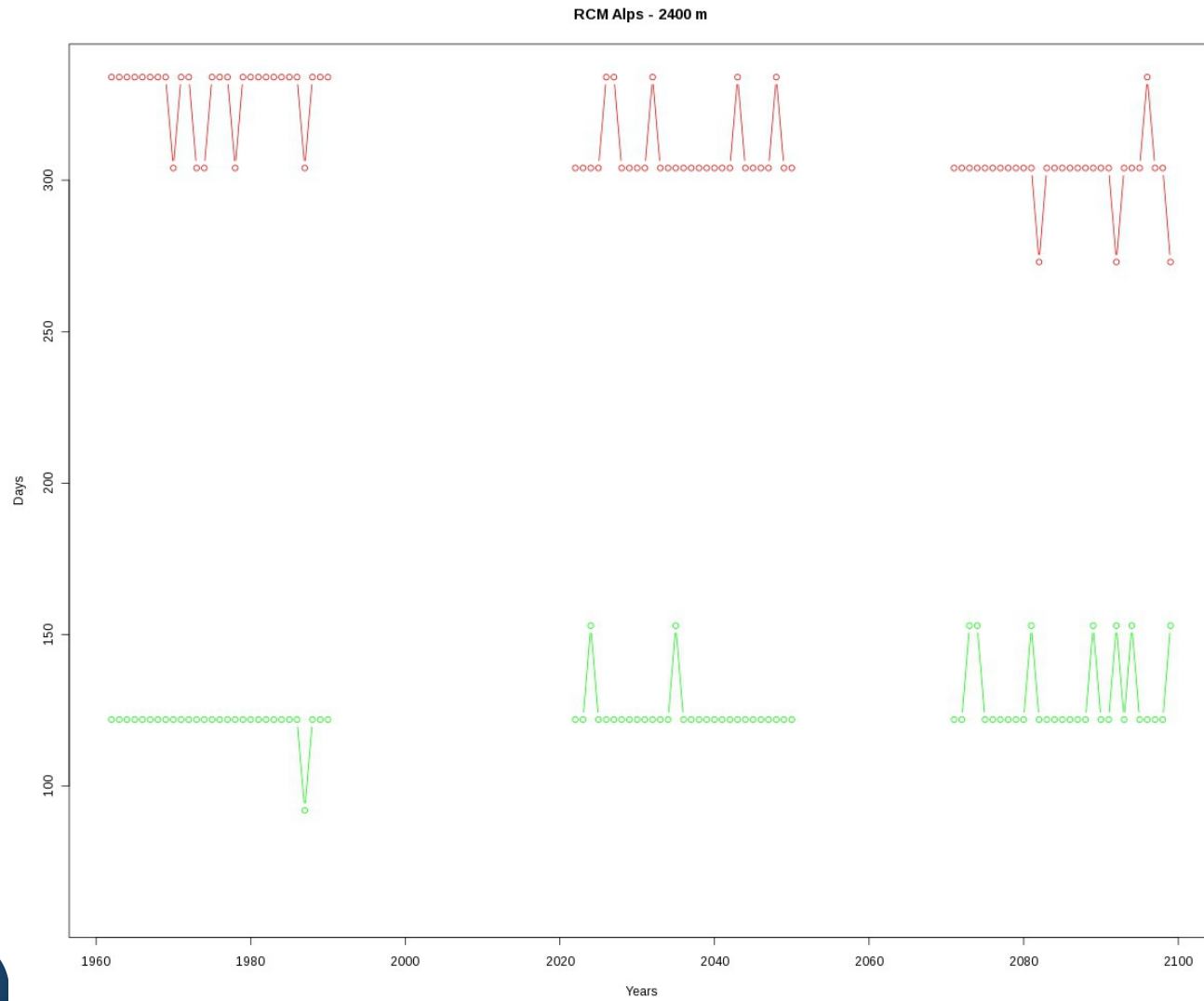
Changement en % de HS100 – F2, alti. 2400m

B5-E5

RCM Alps - 1500 m



B5-E5 2400m



Conclusions

- Bonne représentation de l'enneigement à partir des trois modèles régionaux
- 1500m : baisse de HDmax : 40/50% futur proche et 60/70% futur lointain
- 2400m : baisse de HDmax : 15% futur proche et 30% futur lointain
- Résultats cohérents sur la durée moyenne de l'enneigement
- Peu de différences en moyenne montagne (1500m) entre les scénarios A1B et A2 : impact très fort dans les deux cas
- L'incertitude liée aux modèles/scénarios/méthodes de descente d'échelle est surtout visible dans les zones de fort enneigement.