HDSM, un modèle hydrologique multi-échelle, dédié aux environnements tropicaux (Lac Tchad) et montagneux (Himalaya)

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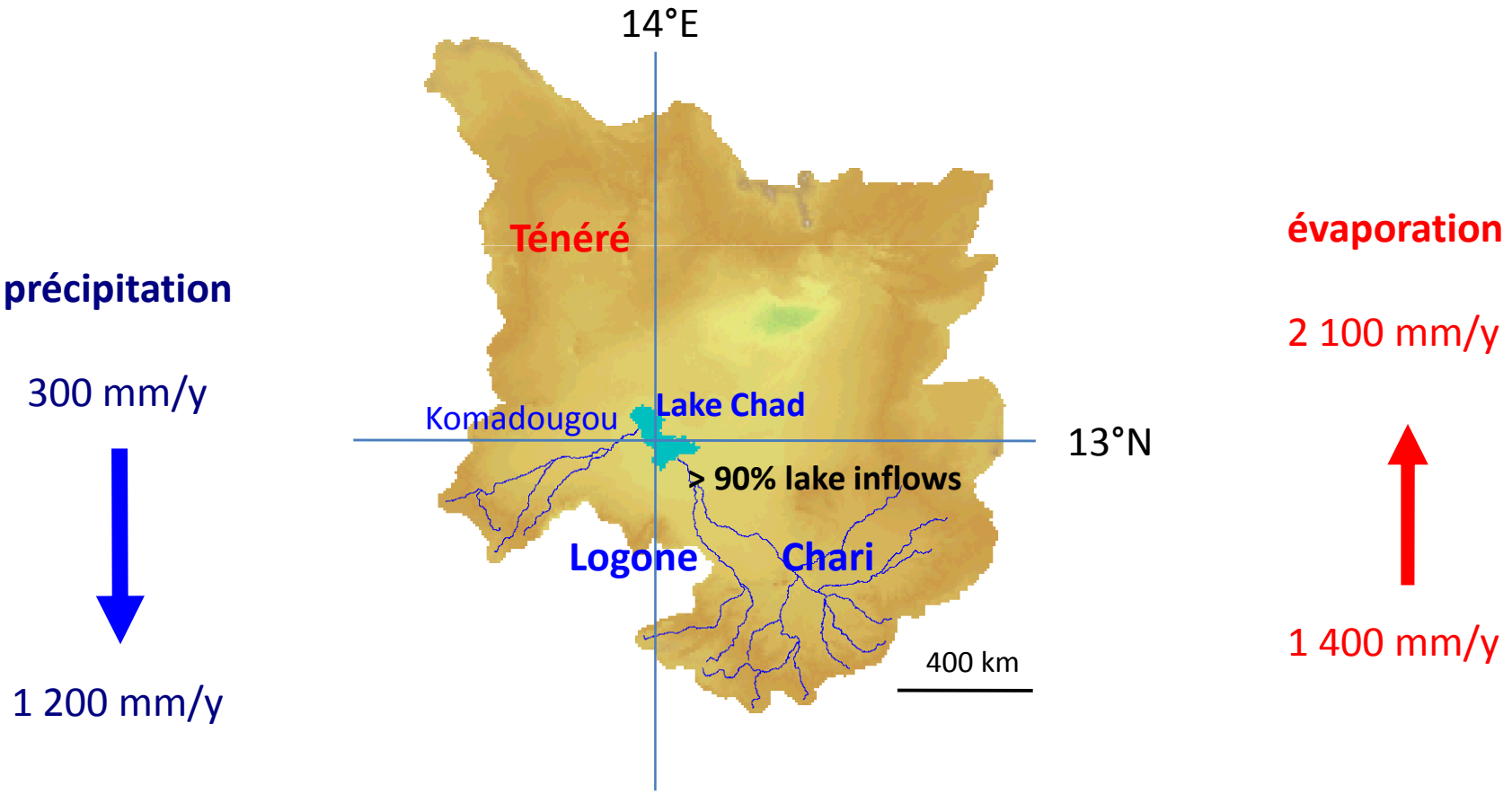
HydroSciences Montpellier
CNRS - IRD - UM1 - UM2

Un nouveau modèle hydrologique ?

2006… : projet(s) Bassin du Lac Tchad

✓ Surface bassin: 2.5 MKm^2 surface hydrologique active: 1 MKm^2

✓Fort gradient climatologique



✓ dynamique du lac

350 000 Km² (6000 BP)

25 000 km²

5 000 km²

✓ dynamique du lac

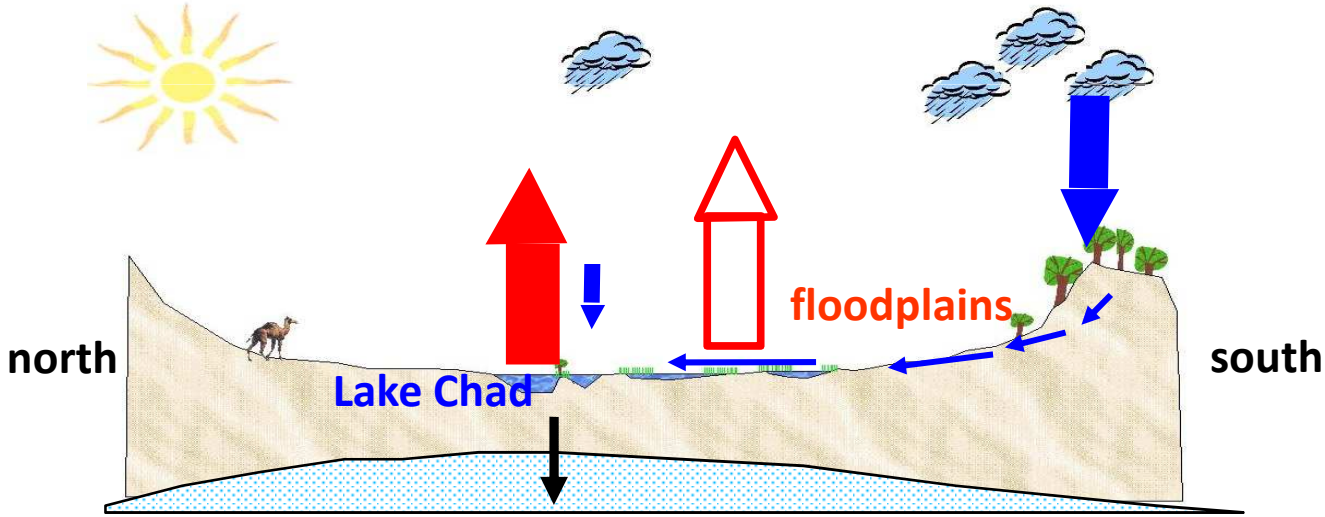
350 000 Km² (6000 BP)

25 000 km²

5 000 km²

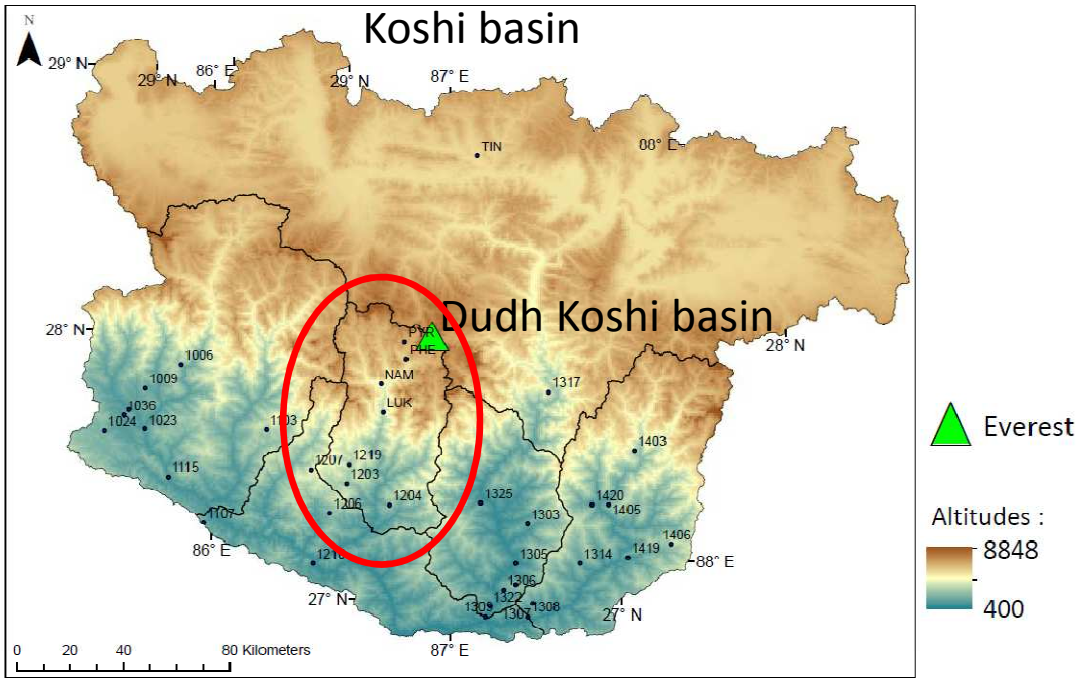
✓ plaine inondation

133 000 Km²
~ 80% volume lac



Un nouveau modèle neige-glace-eau ?

2009… : projet Bassin Dudh Koshi (Everest)



Surface : 3 700 km²

Précipitations 1200 mm/y

Hiver : Flux d'ouest

Eté : Mousson (80%)

Altitudes (400 – 8 848 m)

Glace : 500 km²

Neige : 250 ↔ 2 500 km²

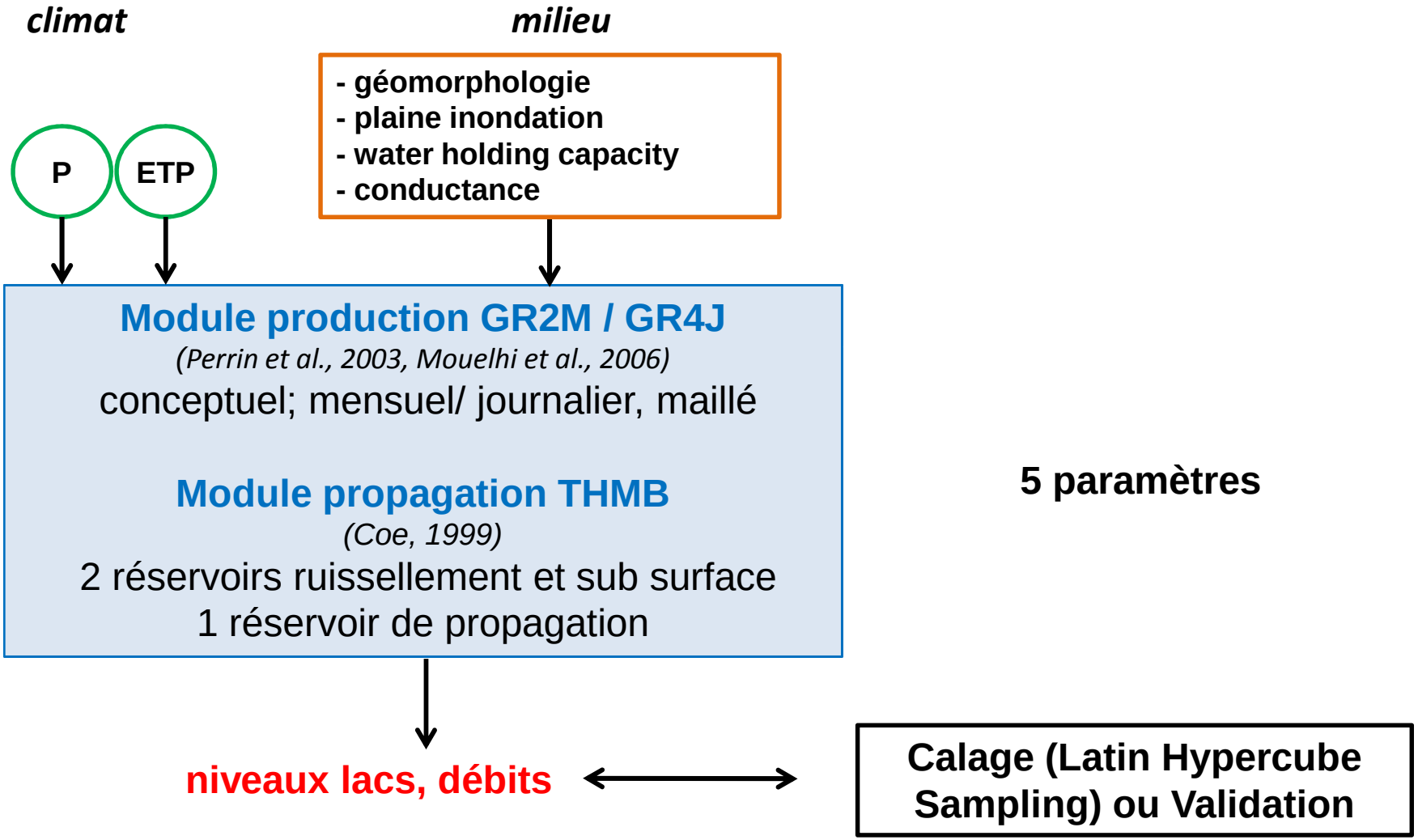
✓ Contributions pluie/neige/glace ➔ débit ?

✓ Comparaison de la perception du changement climatique par populations locales et l'évolution indicateurs climatiques : couvert neigeux simulé

Contraintes "neige" du modèle

- ✓ **hypothèse : bonne représentation des débits implique simulation correcte du couvert neigeux**
- ✓ **paramètres fonte neige calibrés avec couvert neigeux satellite**
- ✓ **forte hétérogénéité en altitude → spatialement distribué par mailles plutôt que bandes**
- ✓ **lacs sur plateau Tibétain → dynamiques lacustres**

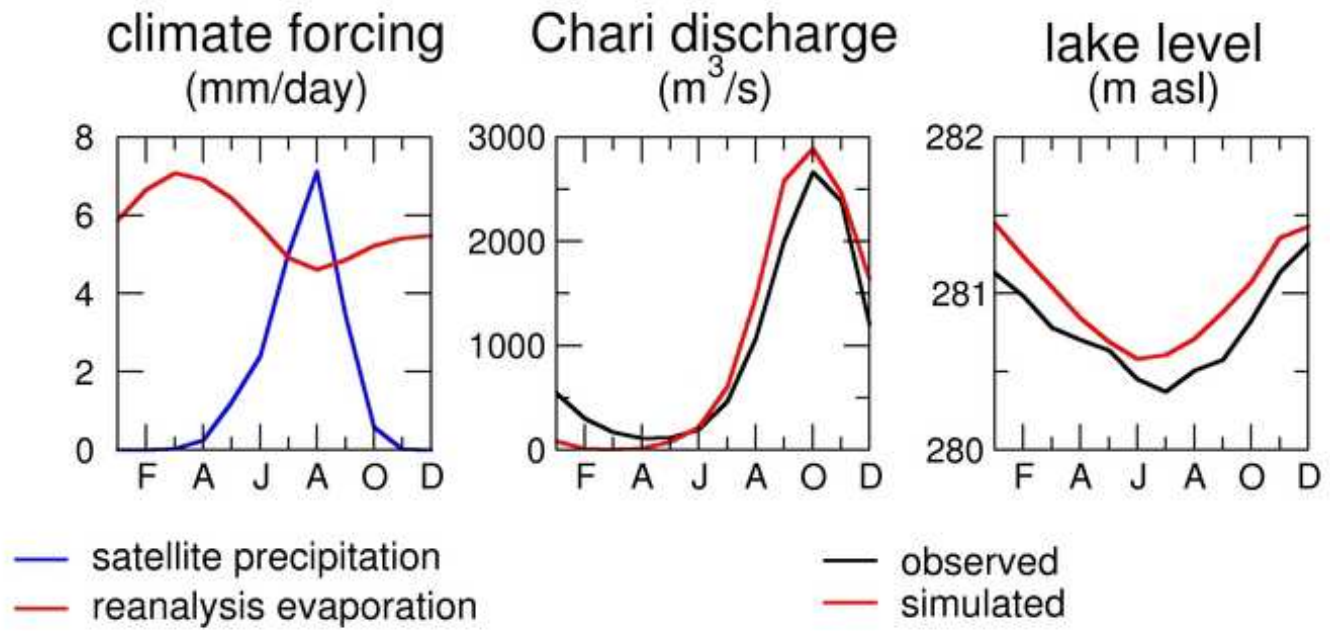
HDSM, Hydrological Distributed Snow Model : développements modélisation hydro



Validation du Bassin Lac Tchad à l'actuel

Forçage climat : P = CRU + (GPCP + TRMM)/2 — *Bastola et Delclaux, 2011*
ETP = Hargreaves(NCEP/NCAR)

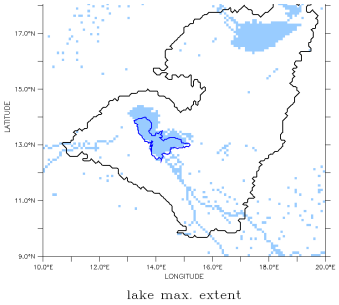
Milieu : Relief = SRTM 3 '' agrégé à 10km — *Lecoz et Delclaux, 2008*
WHC = LSP2 ECHAM — *Hagemann, 2002*



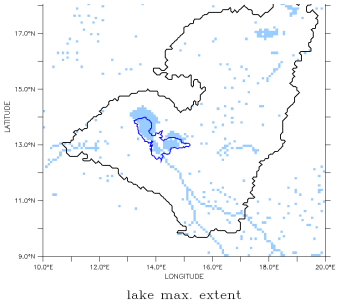
Simulation HDSM + PMIP2 du Lac Tchad à 6Ky BP (Mega Tchad)

Forçage climat : P, ETP = 11 modèles PMIP2

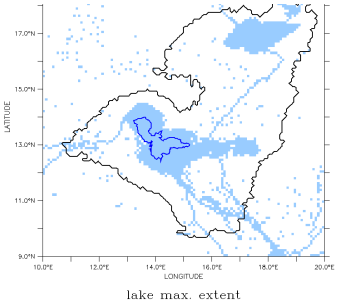
ccsm oa



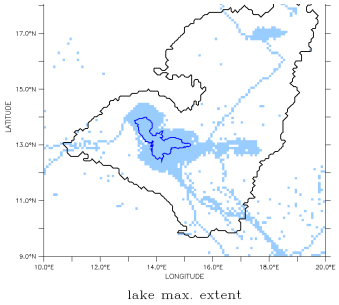
csiro1.1 oa



echam5



echam53 lpj oa



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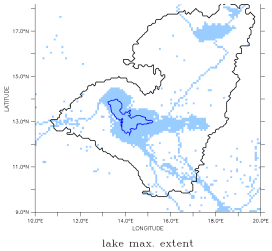
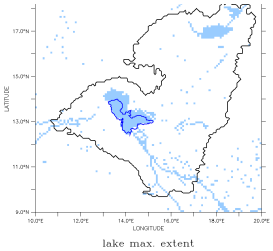
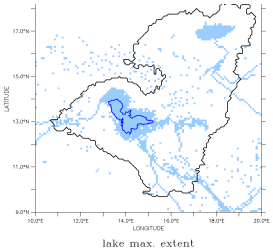


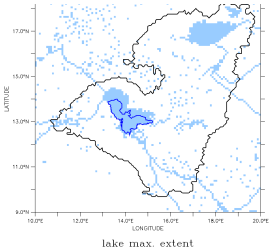
fgoals oa



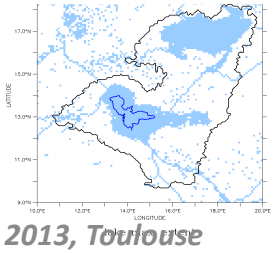
ipsl oa



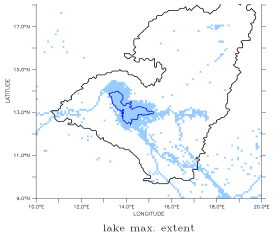
mrinfa oa



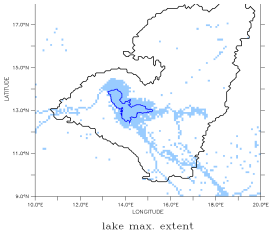
mrinfa oav



ubris oa



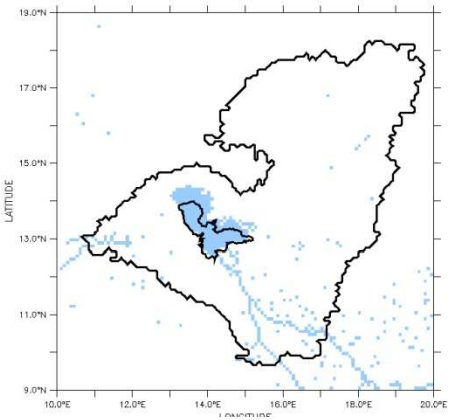
ubris oav



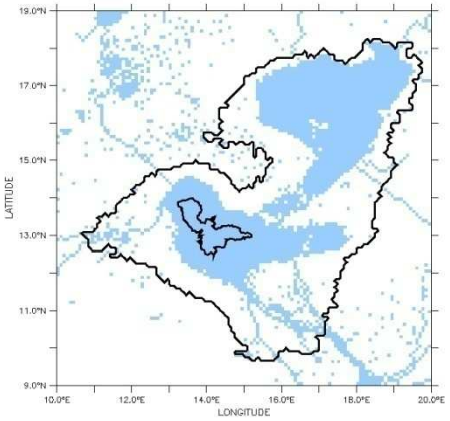
Simulation HDSM + LMDZ du Lac Tchad à 6Ky BP (Mega Tchad)

Forçage climat : P, ETP= LMDZ avec et sans rétroaction zones humides

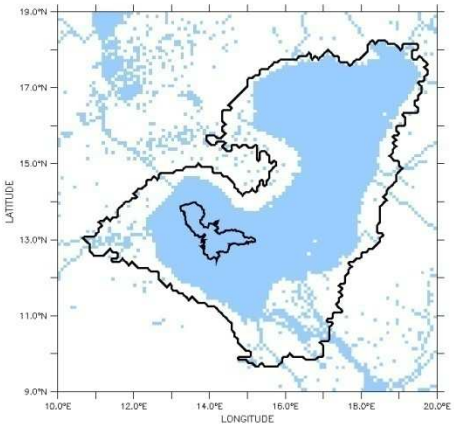
Krinner et al, 2012



present time

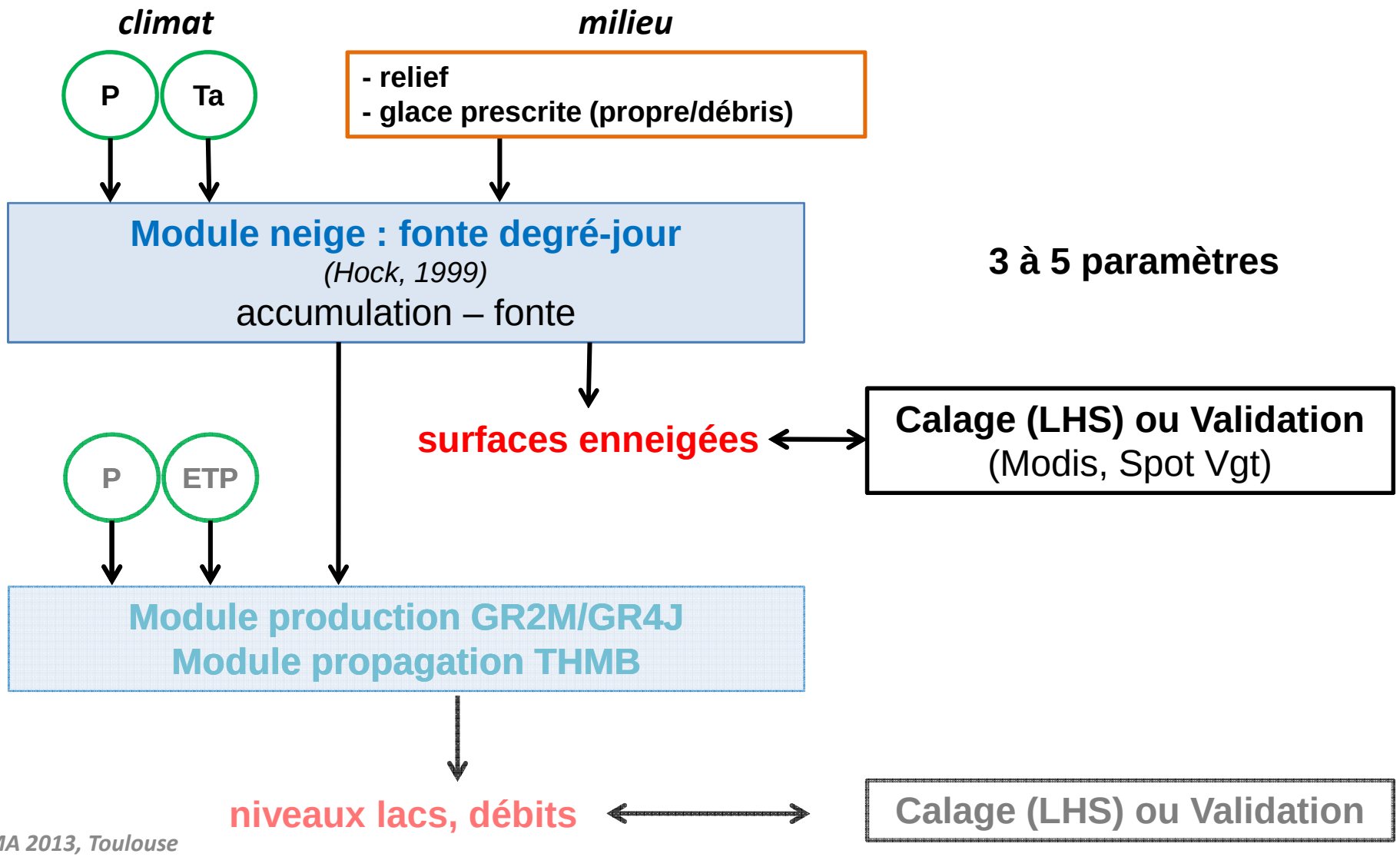


6 Ky BP, no retroaction



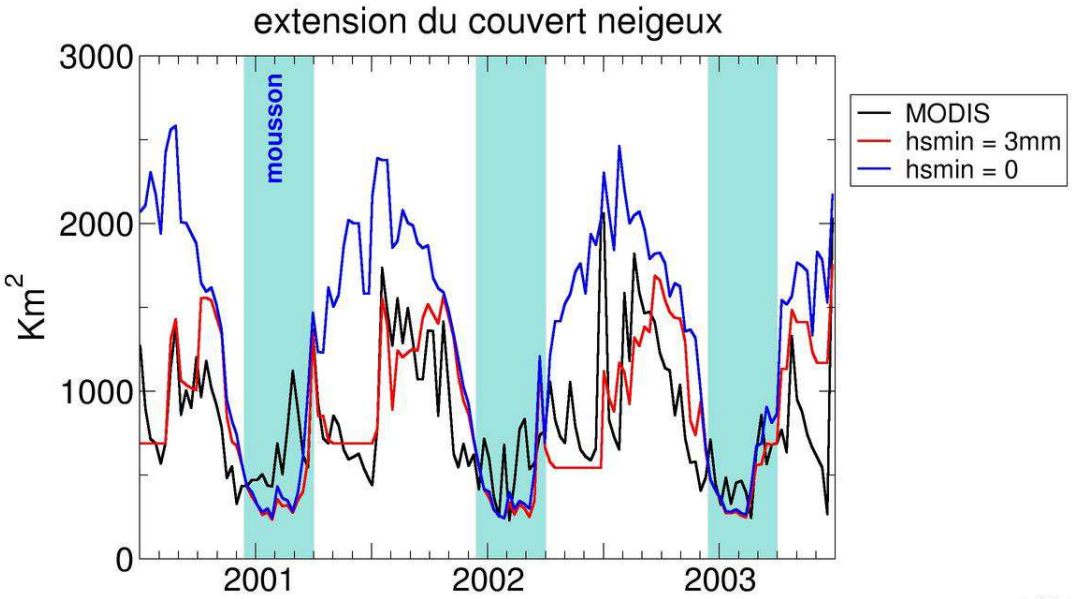
6ky BP, retroaction

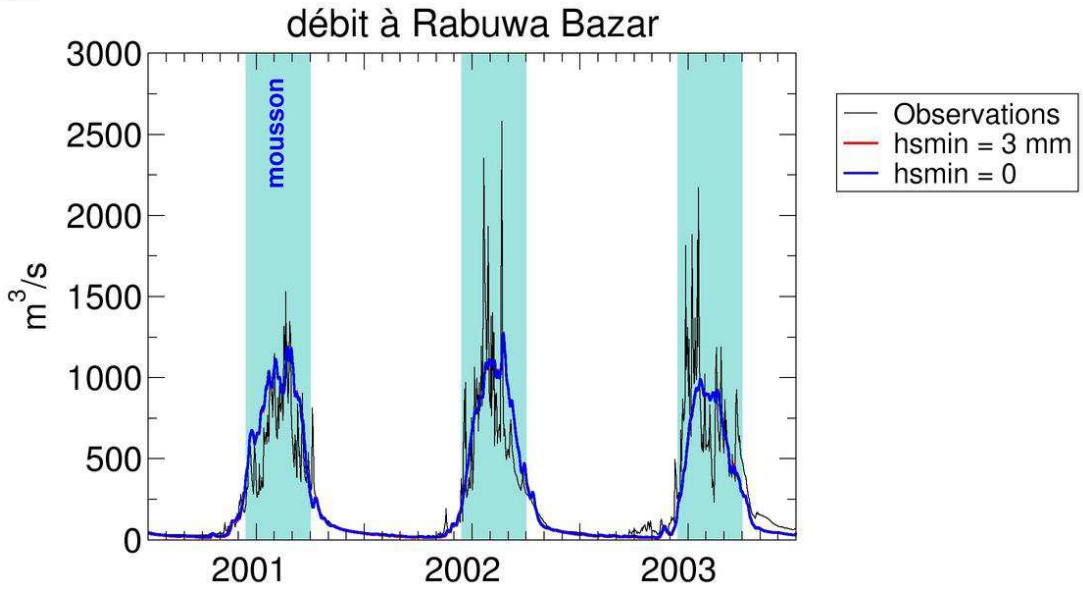
HDSM, Hydrological Distributed Snow Model : développements modélisation neige



Sensibilité de Snow Cover Area à la neige fugace

Si hauteur neige < hsmin : hauteur neige ➔ pluie





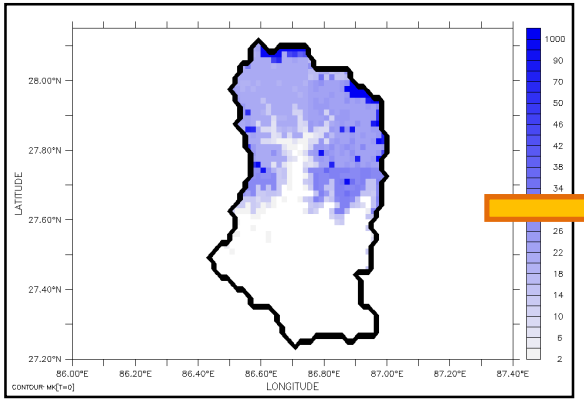
Variabilité spatiale du manteau neigeux

Snow Water Equivalent
(mm we)

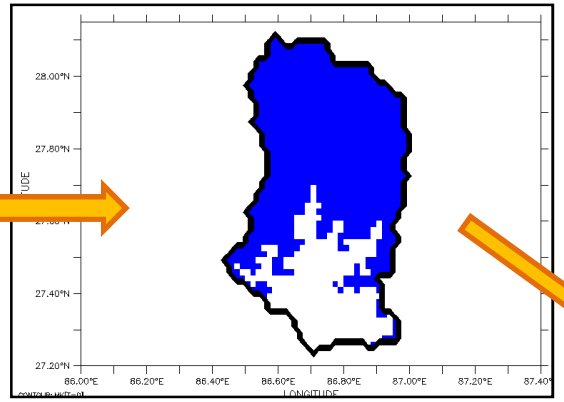
Surface enneigées
(absence / présence)

Comparaison spatiale

HDSM

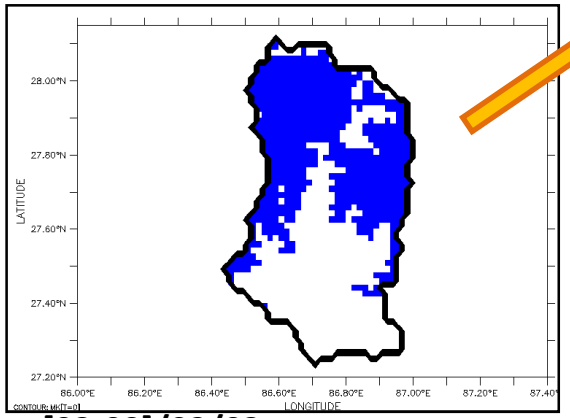


[02-09]/02/03



[02-09]/02/03

MODIS



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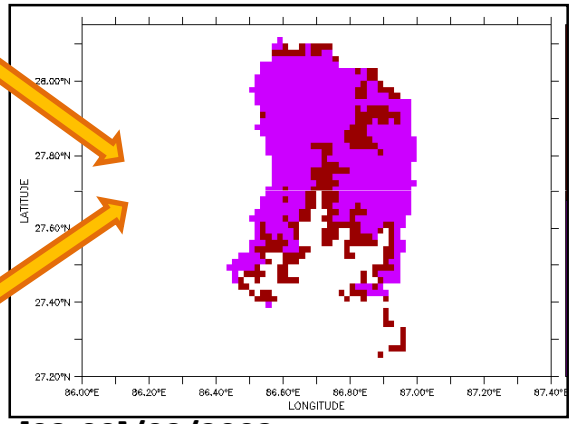


[02-09]/02/2003

HDSM = MODIS

HDSM > MODIS

Surfaces enneigées

Les limites du modèles sont autant de perspectives !

Hydrologie

✓ Amélioration du schéma de propagation : relief % plaine inondation

✓Paramétrisation du WHC pour prise en compte de la végétation et du sol

Neige

✓ Introduction de termes de ‘’pertes’’ : sublimation ? transport vent?

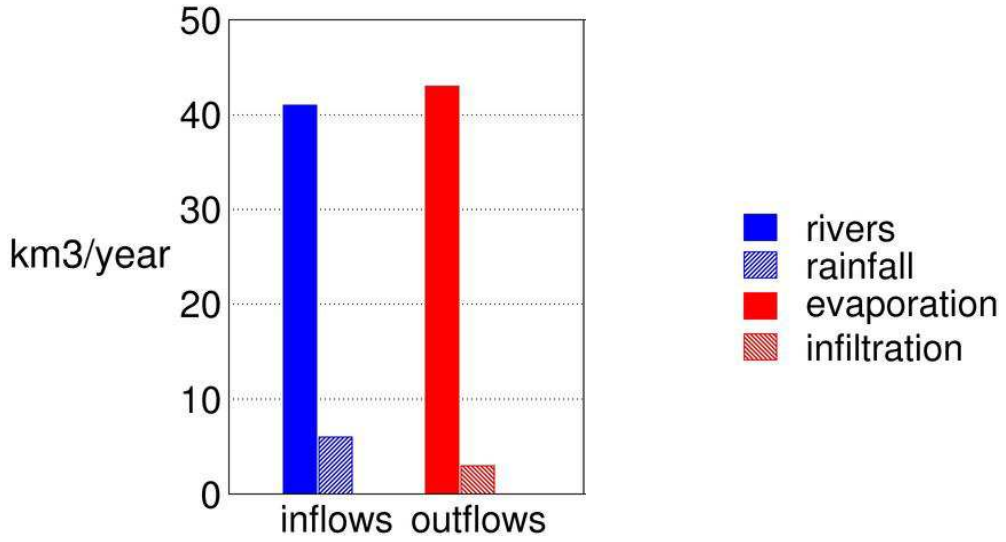
✓ Modélisation de la fonte par fonction(albédo, rayonnement)

✓Passage au MODIS et Spot Vgt journalier

Merci pour votre attention !

lake water budget is mainly controlled by evaporation and tributaries inflows

a) before 1970s drought

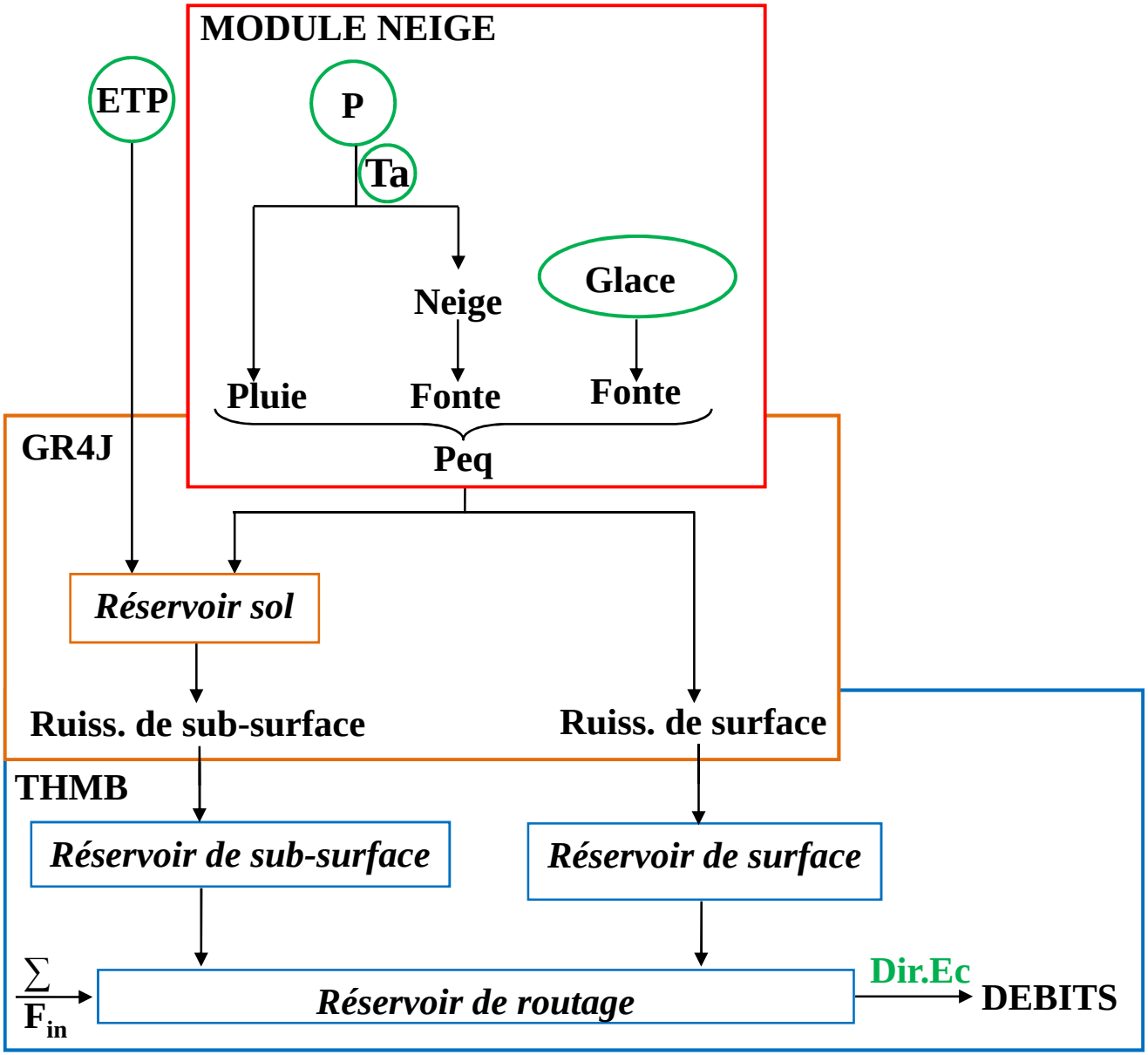


lake surface ~ 20 000 km^2

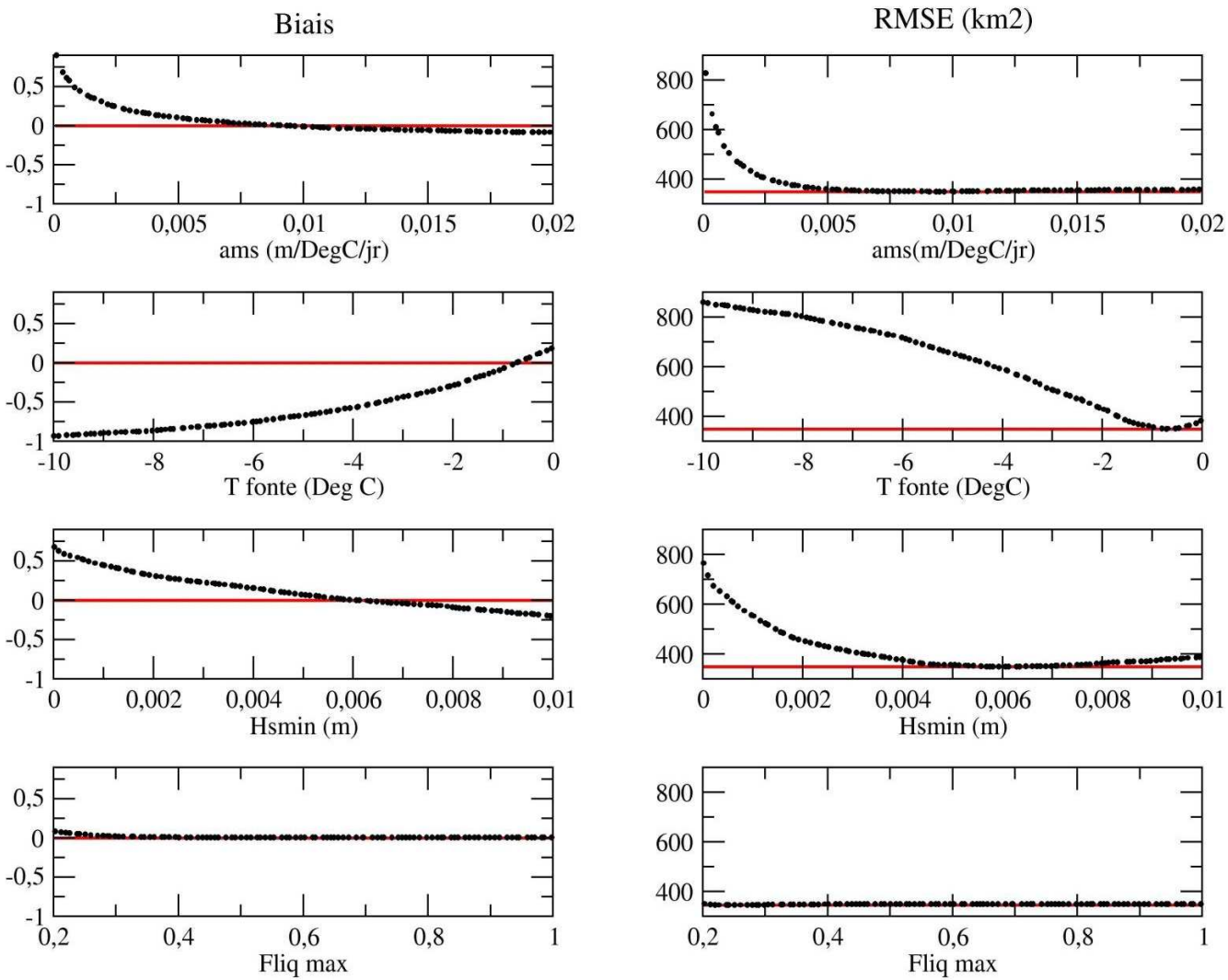
b) after 1970s

all the values are divided by 2

MODÈLE FINAL

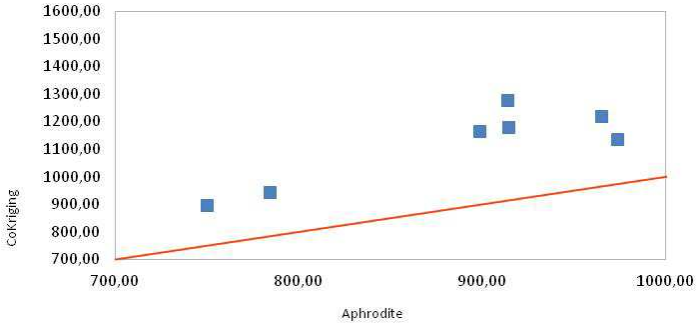


Sensibilité SCA à la paramétrisation "neige"

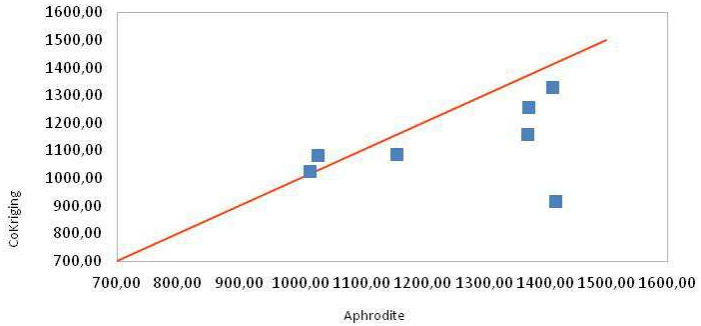


Comparison between Aphrodite and Cokriging precipitation

Koshi (57 850 km²)



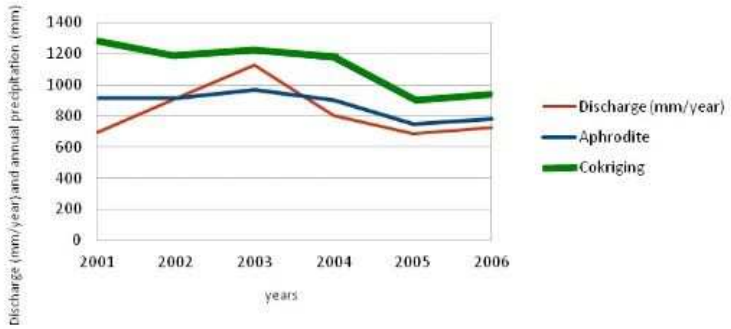
Dudh Koshi (3722 km²)



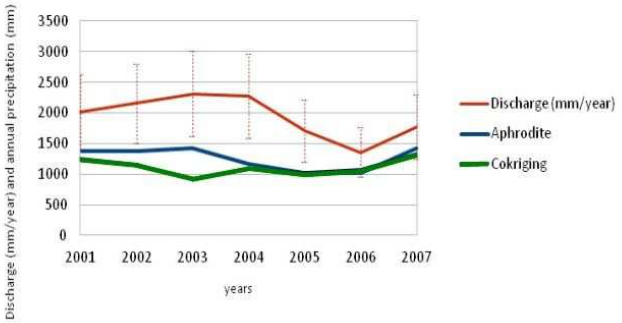
Mean annual precipitation (2001-2007)	Aphrodite mm/year	Cokriging mm/year
Koshi	886	1117 (+26%)
Dud Koshi	1253	1122 (-10%)

Comparison with annual discharge

Koshi (Chatara)



Dudh Koshi (Rabuwa Bazar)



Runoff coefficient overestimation due to snow ? Dudh Koshi = highest basin (3373 m)