



Évolutions actuelle et future de la recharge naturelles des nappes souterraines du bassin Rhône Méditerranée Corse (RMC)

Enseignements du projet RECHARGE

Journée « Ressources en eau et changement climatique »

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4 février, 2021



Le contexte

SDAGE RM&C 2016-2021:

Les eaux souterraines, une ressource primordiale du bassin RM&C

Ressource?

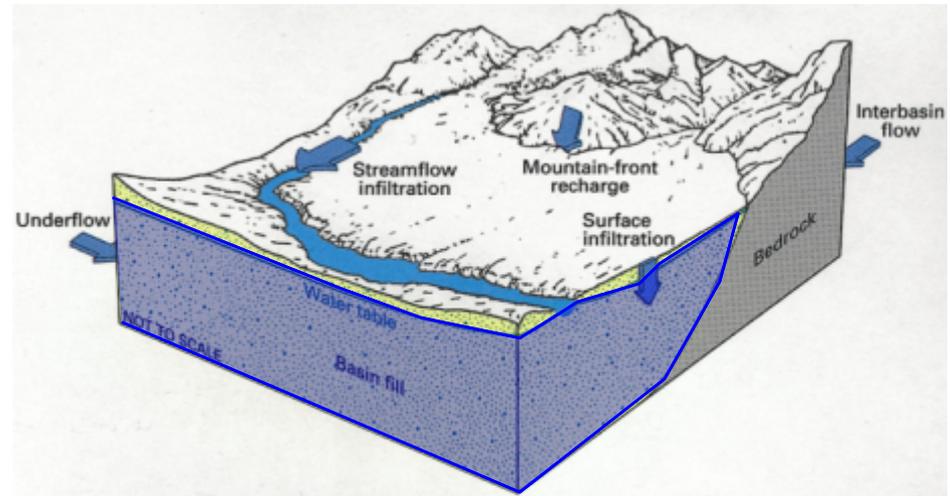


caractérisation de la recharge
(ressource renouvelable)

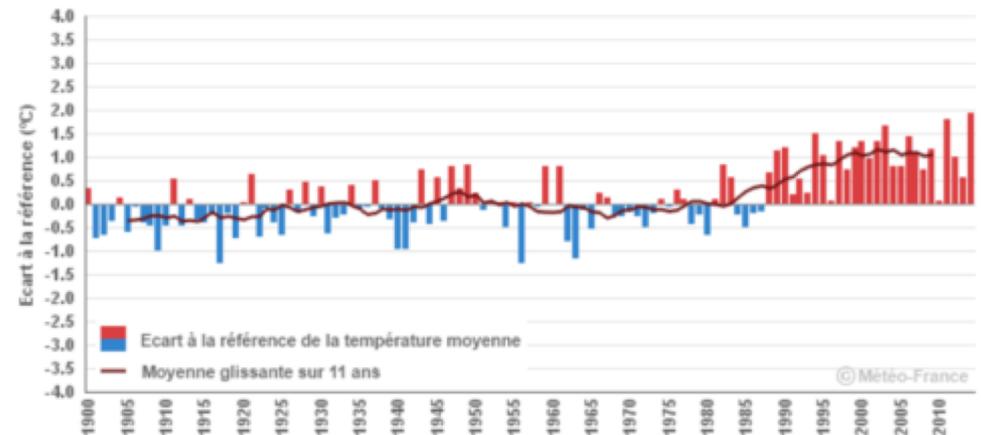
Rôle de l'eau souterraine sur soutien des cours d'eau

Quelle évolution future
%

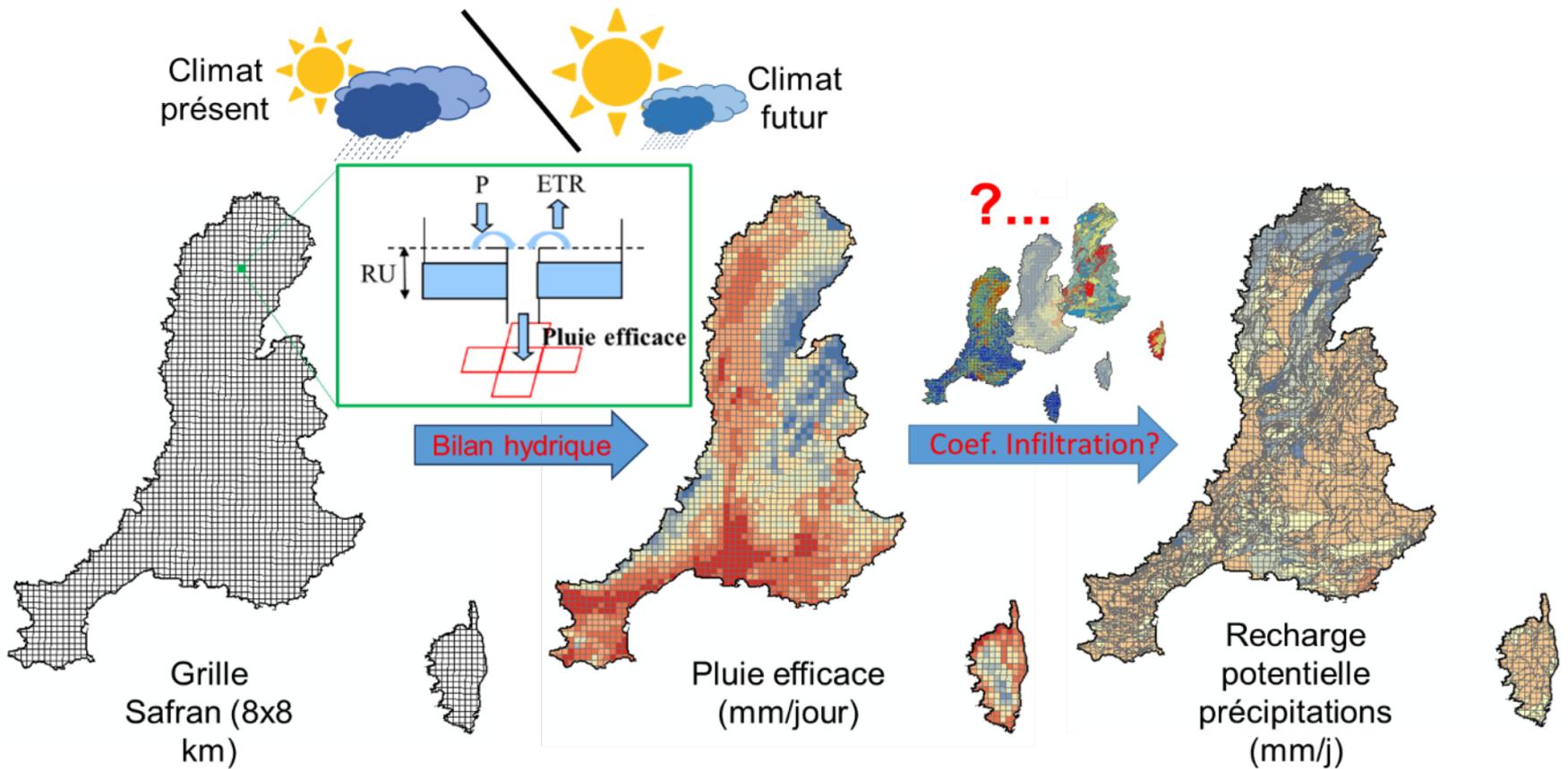
Changement climatique



Source: http://pubs.usgs.gov/ha/ha730/ch_c/C-basin3.html

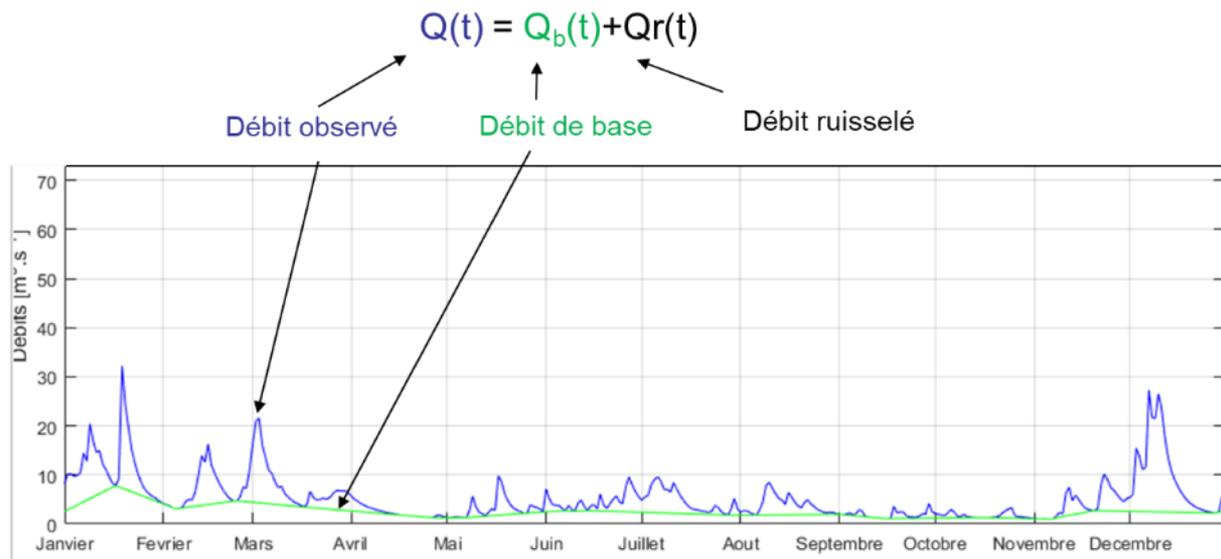
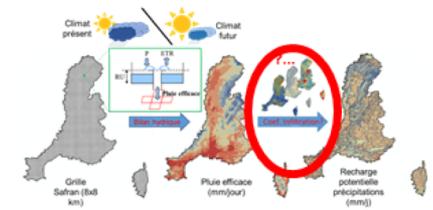


Démarche



Infiltration de la pluie efficace? → RIPE

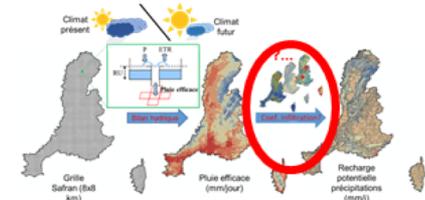
Débit de base : part du débit d'un cours d'eau qui provient du ou des aquifères qui lui sont hydrauliquement connectés



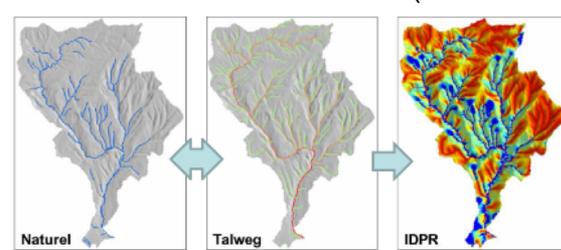
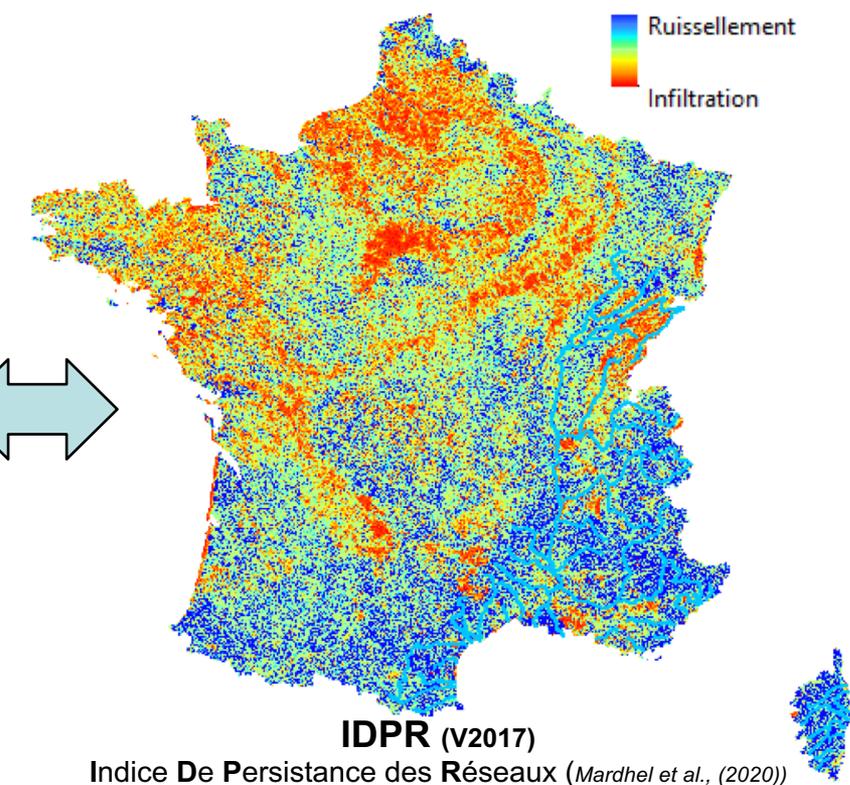
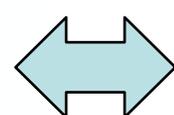
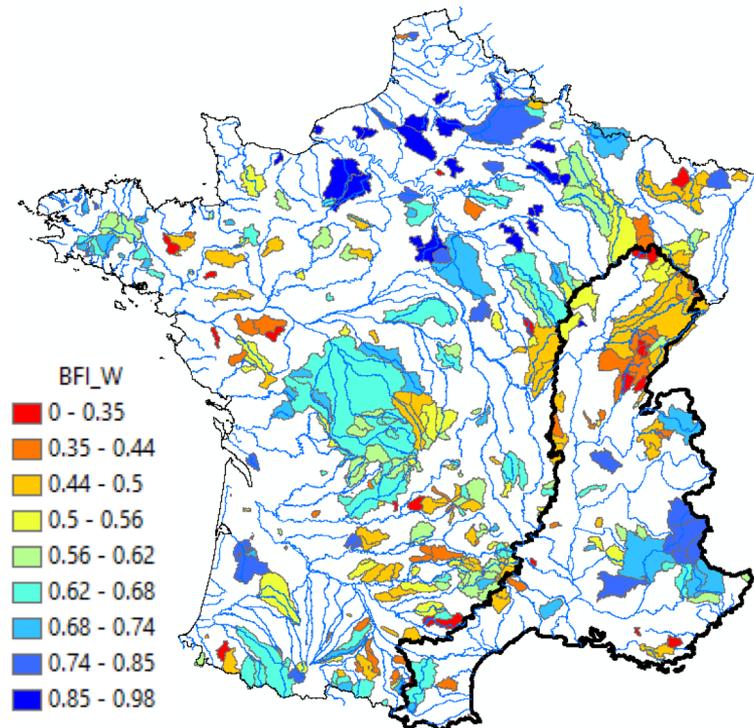
Si bassin non influencé, pas d'échange de flux latéralement ou par drainance, variation de stock négligeable, à l'échelle annuelle :

$$\frac{\text{Recharge "drainée"}}{\text{Pluie efficace}} = \text{RIPE} = \frac{\text{Débit de base}}{\text{Module débit}} = \text{BFI}$$

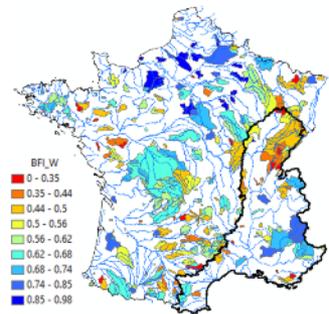
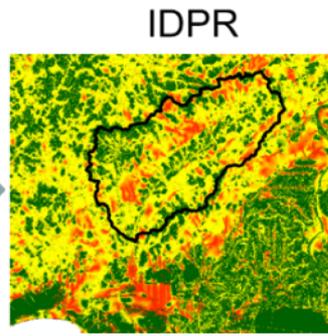
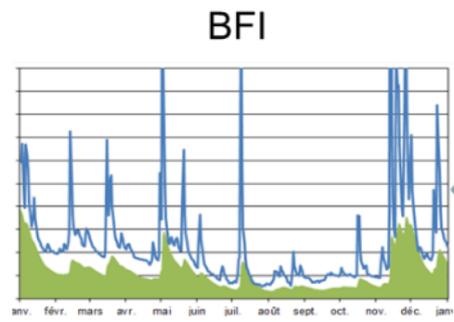
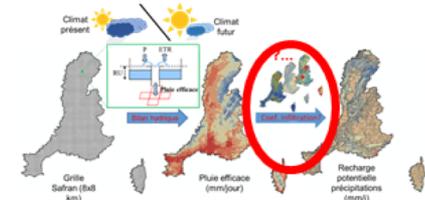
Caractérisation RIPE → Relation IDPR / BFI



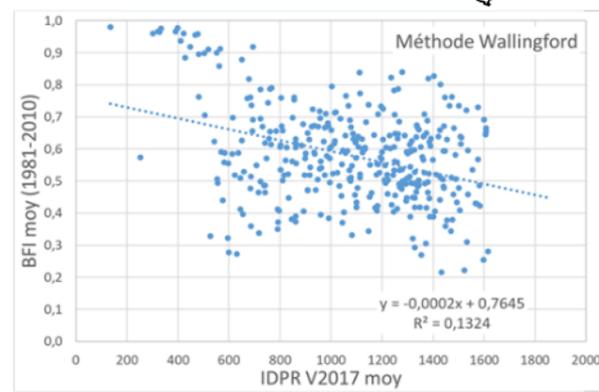
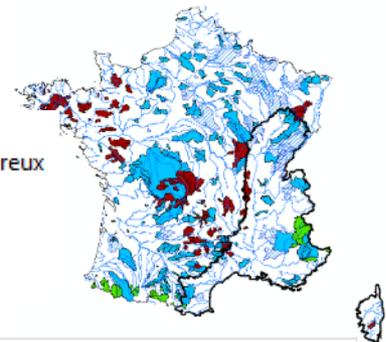
BFI pour 376 stations hydrométriques



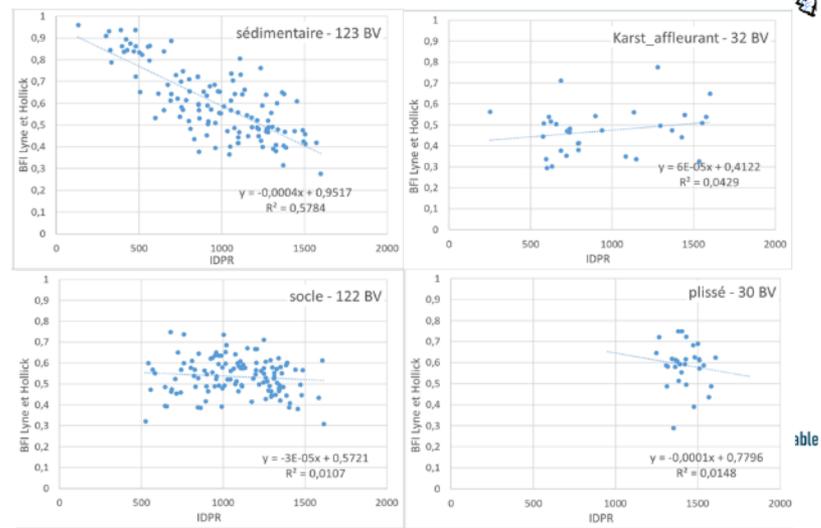
Caractérisation RIPE → Relation IDPR / BFI



- Lithologie dominante**
- sédimentaire ; milieu poreux
 - karst affleurant
 - volcanique; socle
 - formations plissées

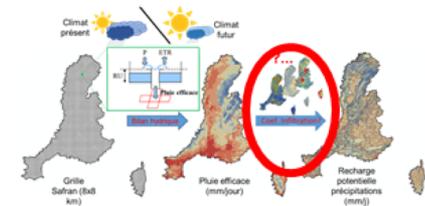


Relation globale



Relations thématiques

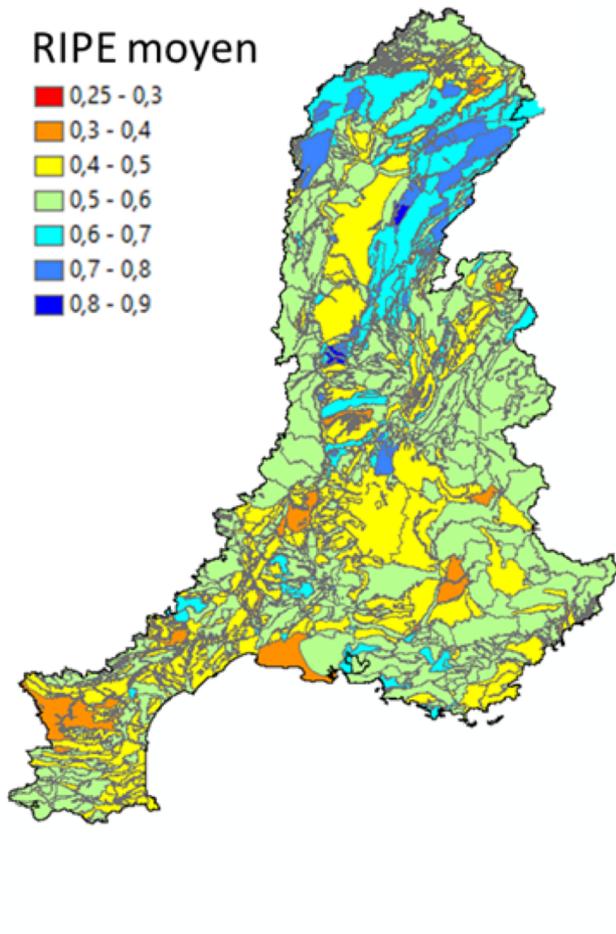
Cartes de RIPE finales et incertitudes



$$RIPE_{moyen} = \frac{(RIPE_{Hypothèse\ Haute} + RIPE_{Hypothèse\ Basse})}{2} \quad \Delta RIPE = \frac{(RIPE_{Hypothèse\ Haute} - RIPE_{Hypothèse\ Basse})}{RIPE_{moyen}}$$

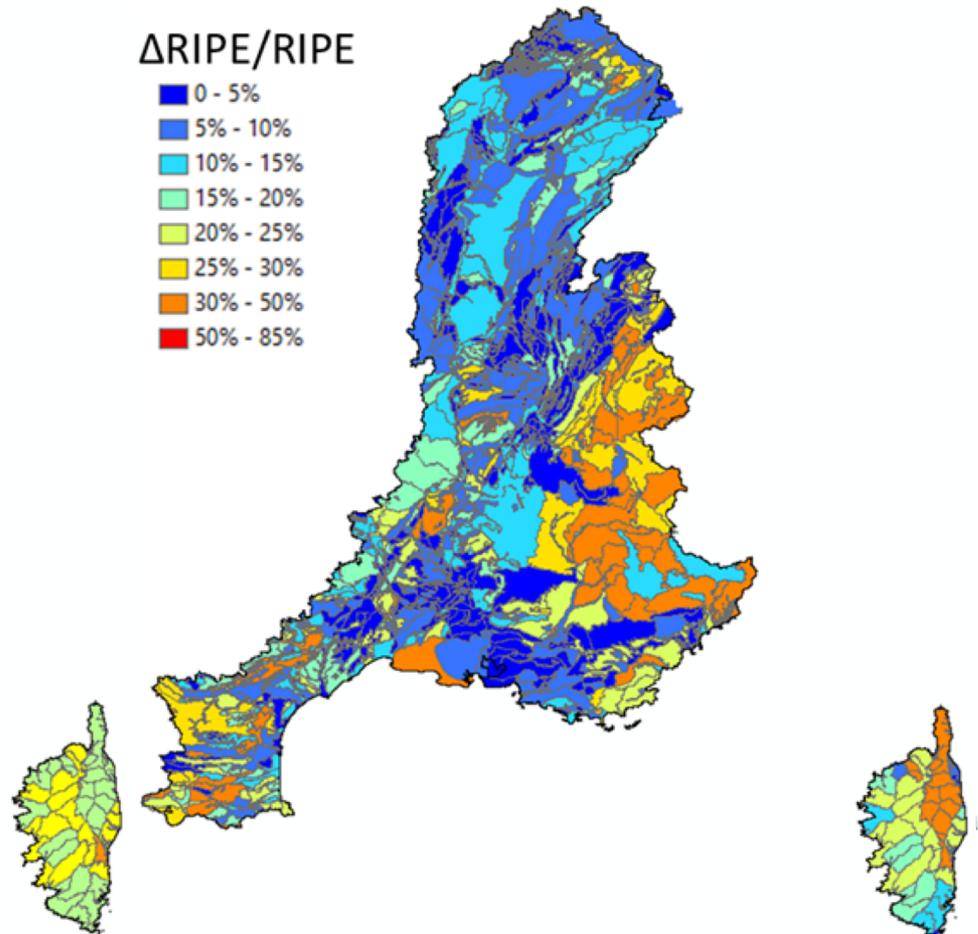
RIPE moyen

- 0,25 - 0,3
- 0,3 - 0,4
- 0,4 - 0,5
- 0,5 - 0,6
- 0,6 - 0,7
- 0,7 - 0,8
- 0,8 - 0,9

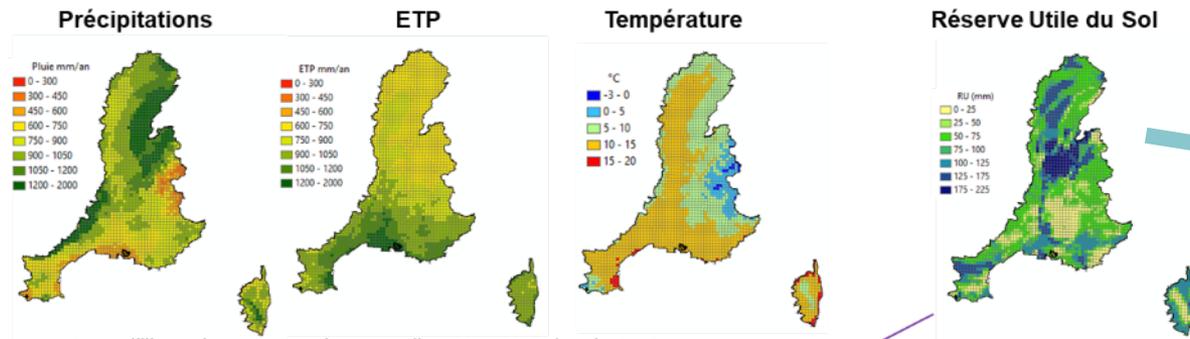
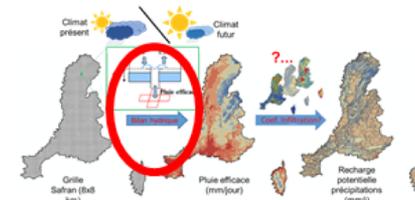


$\Delta RIPE / RIPE$

- 0 - 5%
- 5% - 10%
- 10% - 15%
- 15% - 20%
- 20% - 25%
- 25% - 30%
- 30% - 50%
- 50% - 85%

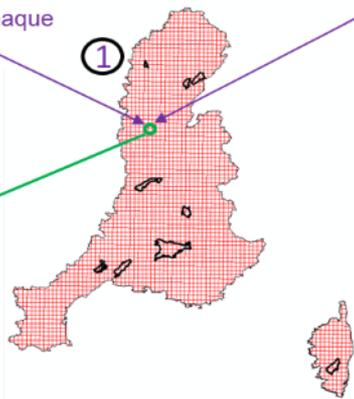


Pluie efficace à l'échelle du bassin RMC

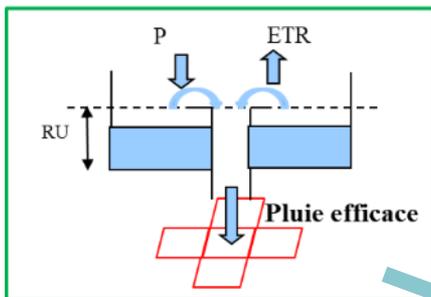


Cartes d'illustration : moyennes interannuelles 1981 – 2010, données SAFRAN

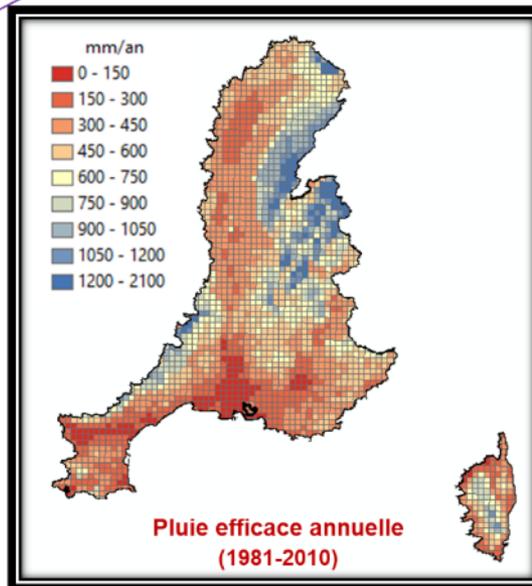
Données journalières pour chaque cellule de 8*8 km²



2 Bilan hydrique du sol pour chaque cellule

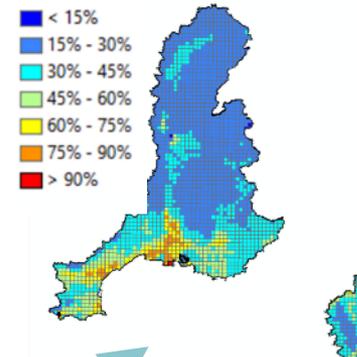


3 Moyenne interannuelle pour chaque cellule

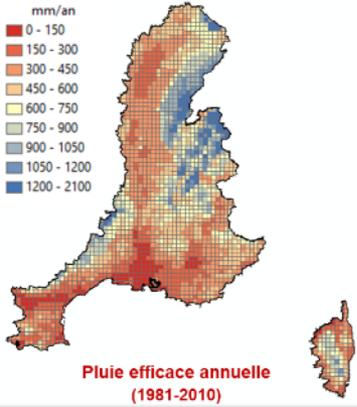
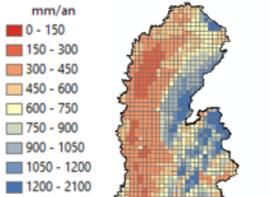
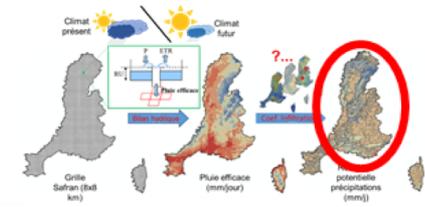


Pluie efficace annuelle (1981-2010)

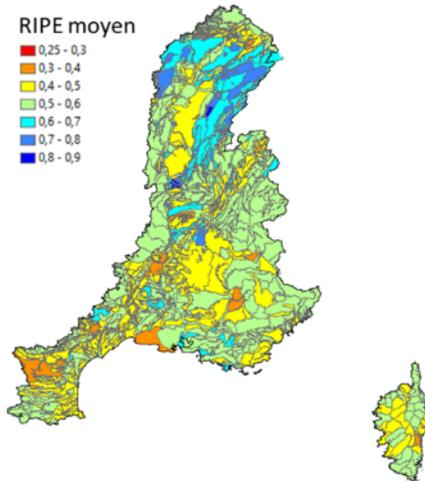
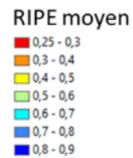
Incertitude



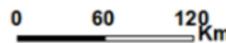
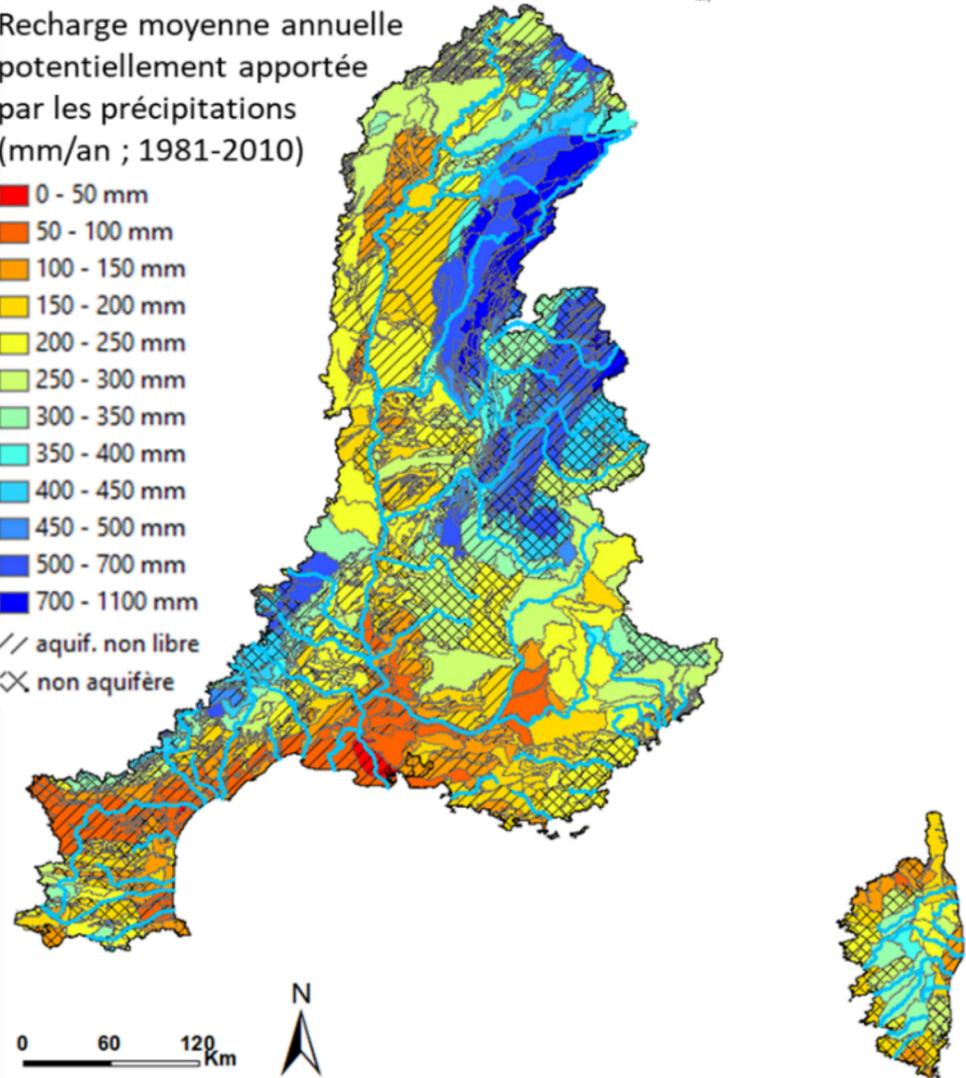
Recharge potentielle par les précipitations



X

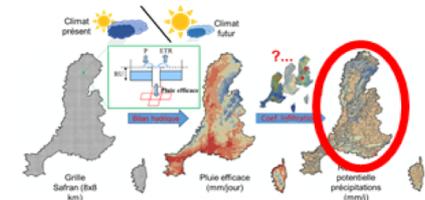


Recharge moyenne annuelle potentiellement apportée par les précipitations (mm/an ; 1981-2010)



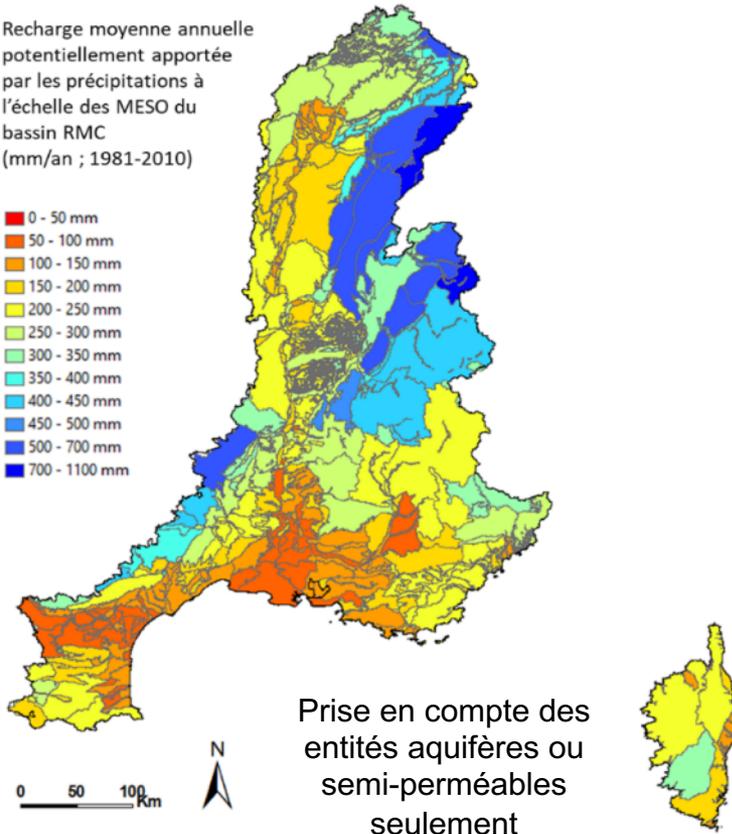
Recharge potentielle par les précipitations

Agrégation à l'échelle des Masses d'Eau Souterraine



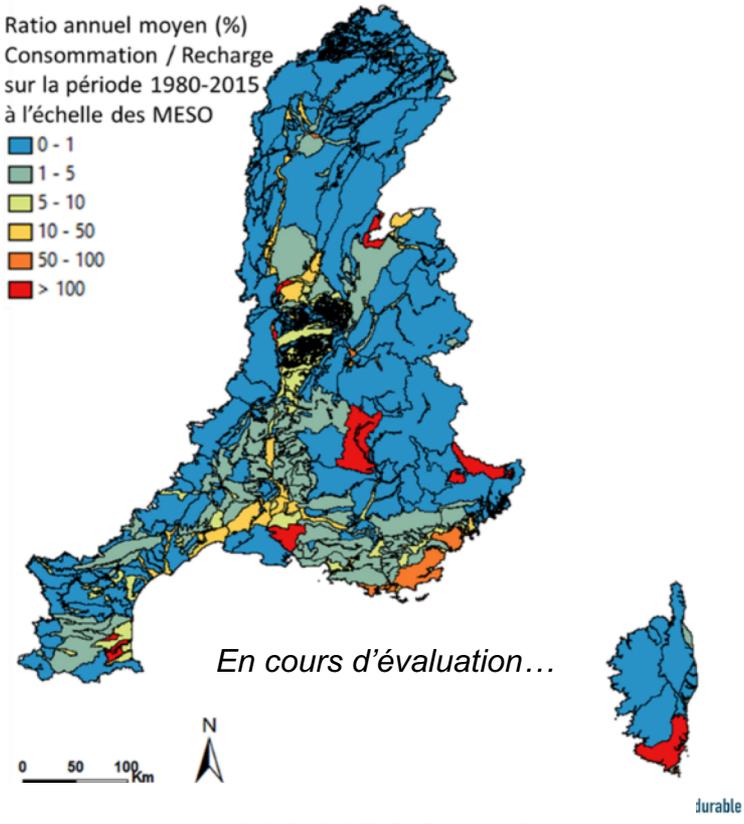
Recharge moyenne annuelle potentiellement apportée par les précipitations à l'échelle des MESO du bassin RMC (mm/an ; 1981-2010)

- 0 - 50 mm
- 50 - 100 mm
- 100 - 150 mm
- 150 - 200 mm
- 200 - 250 mm
- 250 - 300 mm
- 300 - 350 mm
- 350 - 400 mm
- 400 - 450 mm
- 450 - 500 mm
- 500 - 700 mm
- 700 - 1100 mm



Ratio annuel moyen (%) Consommation / Recharge sur la période 1980-2015 à l'échelle des MESO

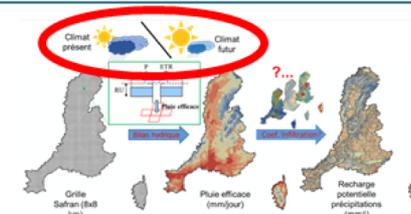
- 0 - 1
- 1 - 5
- 5 - 10
- 10 - 50
- 50 - 100
- > 100



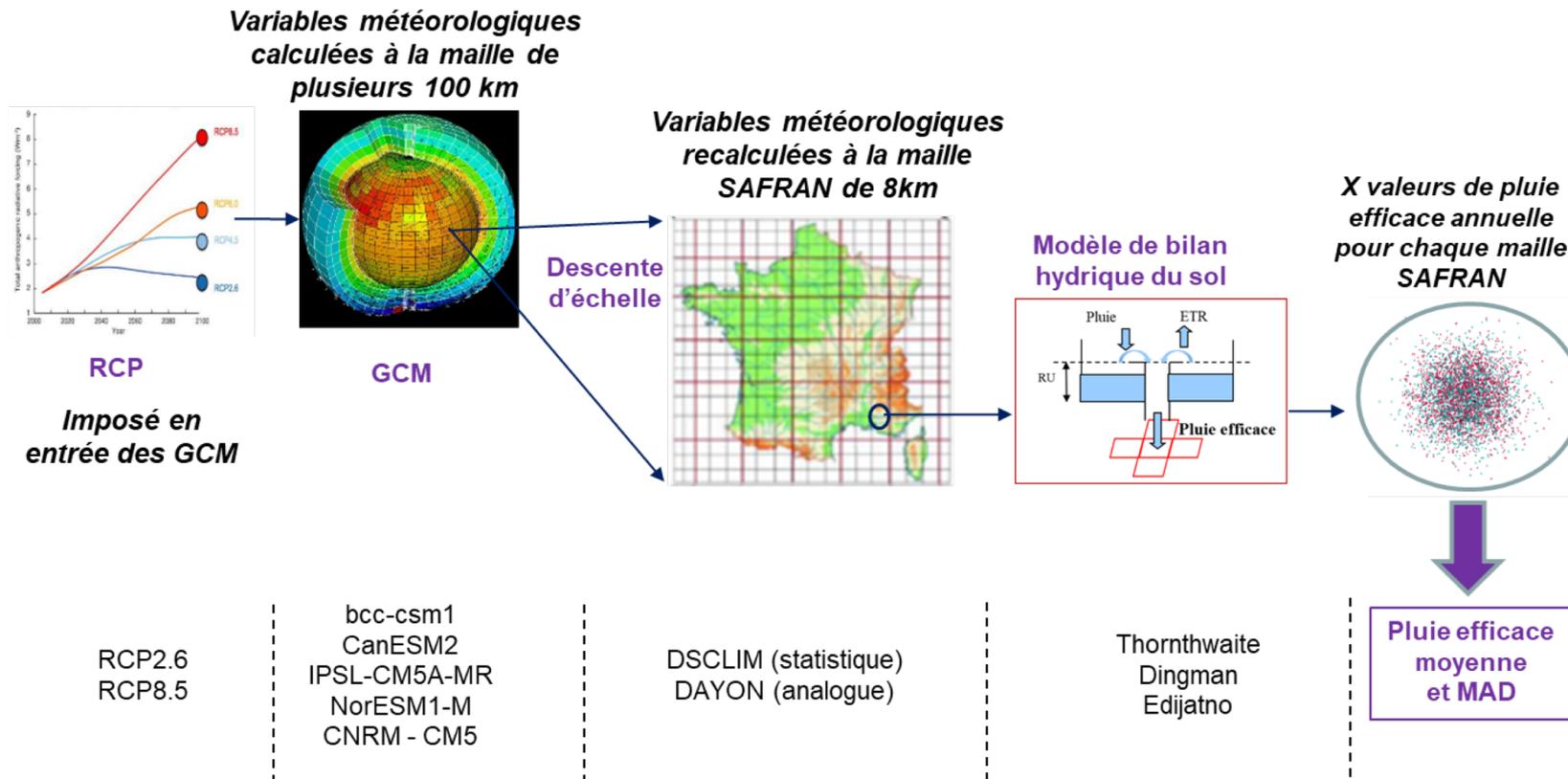
154 / 232 MESO < 5%

durable

Impact CC? → Démarche



Principe de la prévision d'ensemble de la pluie efficace future



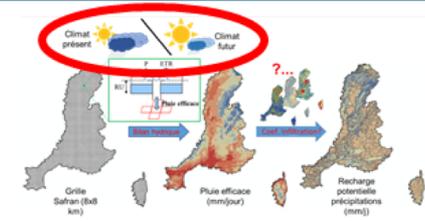
RCP2.6
RCP8.5

bcc-csm1
CanESM2
IPSL-CM5A-MR
NorESM1-M
CNRM - CM5

DSCLIM (statistique)
DAYON (analogue)

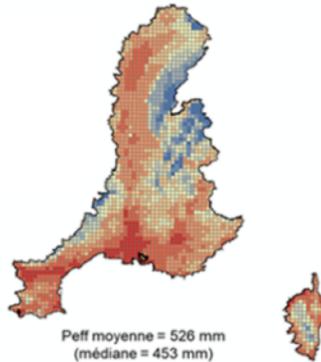
Thornthwaite
Dingman
Edijatno

Impact CC? → Pluie efficace future

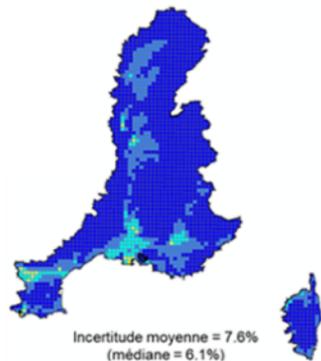


Incertitudes Pluies efficaces moyennes annuelles (1981-2010) SAFRAN < GCMs

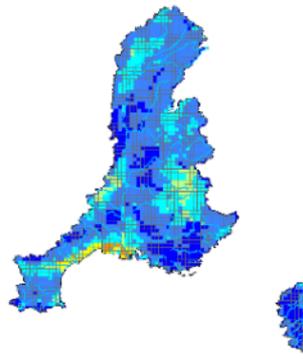
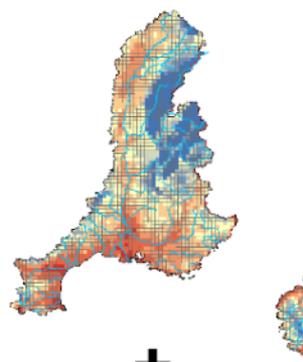
SAFRAN
Pluie efficace moyenne annuelle (1981-2010)



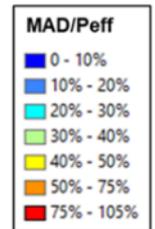
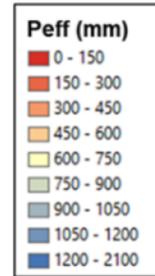
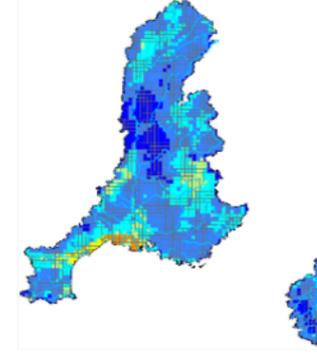
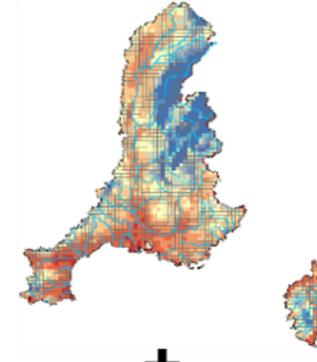
Incertitude globale associée (MAD/moy)



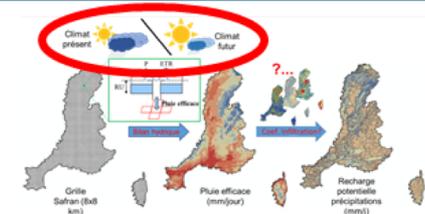
RCP 2.6
(5 GCM * 2 DD * 3 Méthodes bilan hydrique)



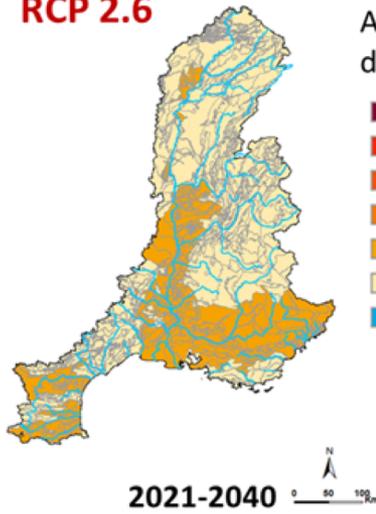
RCP 8.5



Impact CC? → Recharge potentielle future

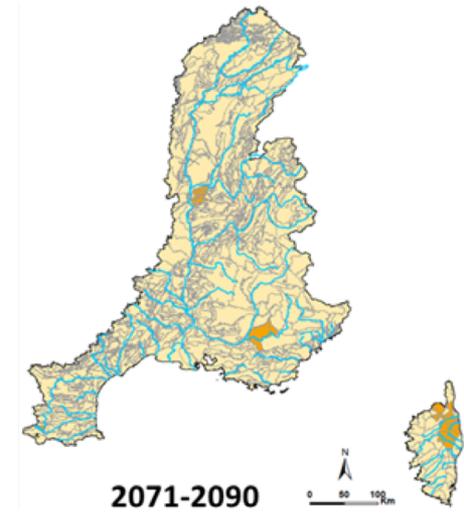
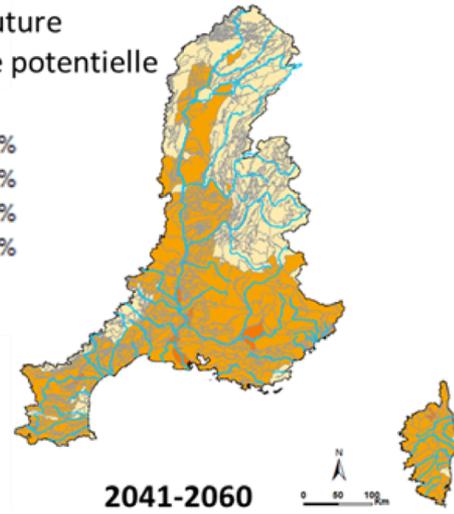


RCP 2.6

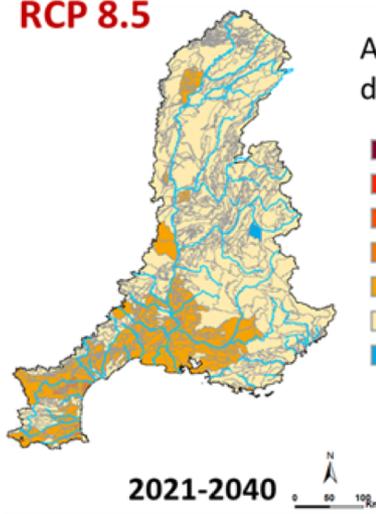


Anomalie future de recharge potentielle

- < -50%
- 50% - -40%
- 40% - -30%
- 30% - -20%
- 20% - -10%
- 10% - 0%
- 0% - 15%

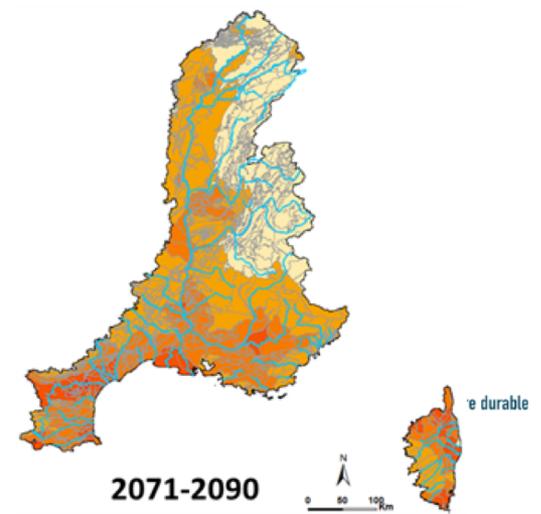
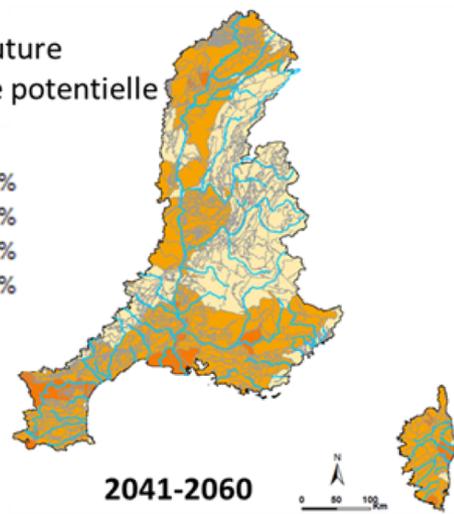


RCP 8.5



Anomalie future de recharge potentielle

- < -50%
- 50% - -40%
- 40% - -30%
- 30% - -20%
- 20% - -10%
- 10% - 0%
- 0% - 15%



Conclusions

- Une démarche pour calculer la recharge potentielle apportée par les précipitations sur le bassin RMC, applicable à d'autres territoires
- La démarche inclut calcul de la Peff, carte du RIPE et permet de se projeter pour explorer les impacts du CC
- Les apports:
 - Quantification de la ressource en eau souterraine potentielle actuelle du bassin RMC
 - Possibilité de l'utiliser pour évaluation ressources / besoins
 - Vision de l'évolution future de la ressource pour établir une stratégie d'adaptation (impacts fin siècle: [-10% ; - 40%])
 - Une moyen d'estimer l'apport futur des aquifères aux cours d'eau en étiage?