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Groundwater resources of the Pyrenees in the global change context -The PIRAGUA Project

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Present and future potential groundwater recharge from precipitations over France

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Future groundwater resource?

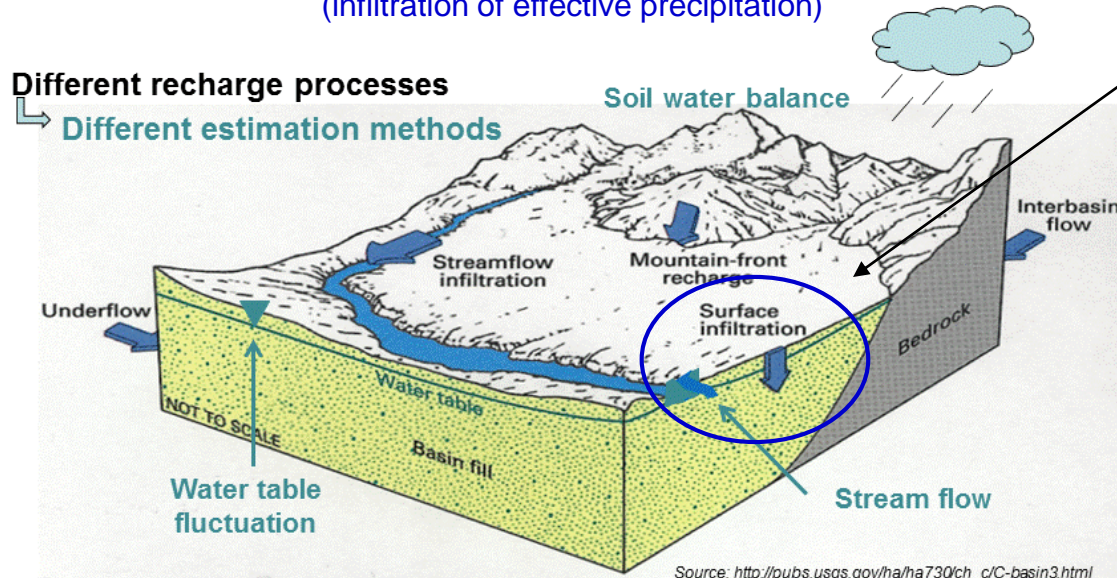
Renewable groundwater resource: Potential groundwater recharge by precipitation

(infiltration of effective precipitation)

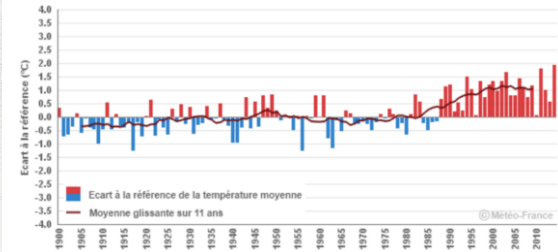
Different recharge processes

Different estimation methods

Soil water balance

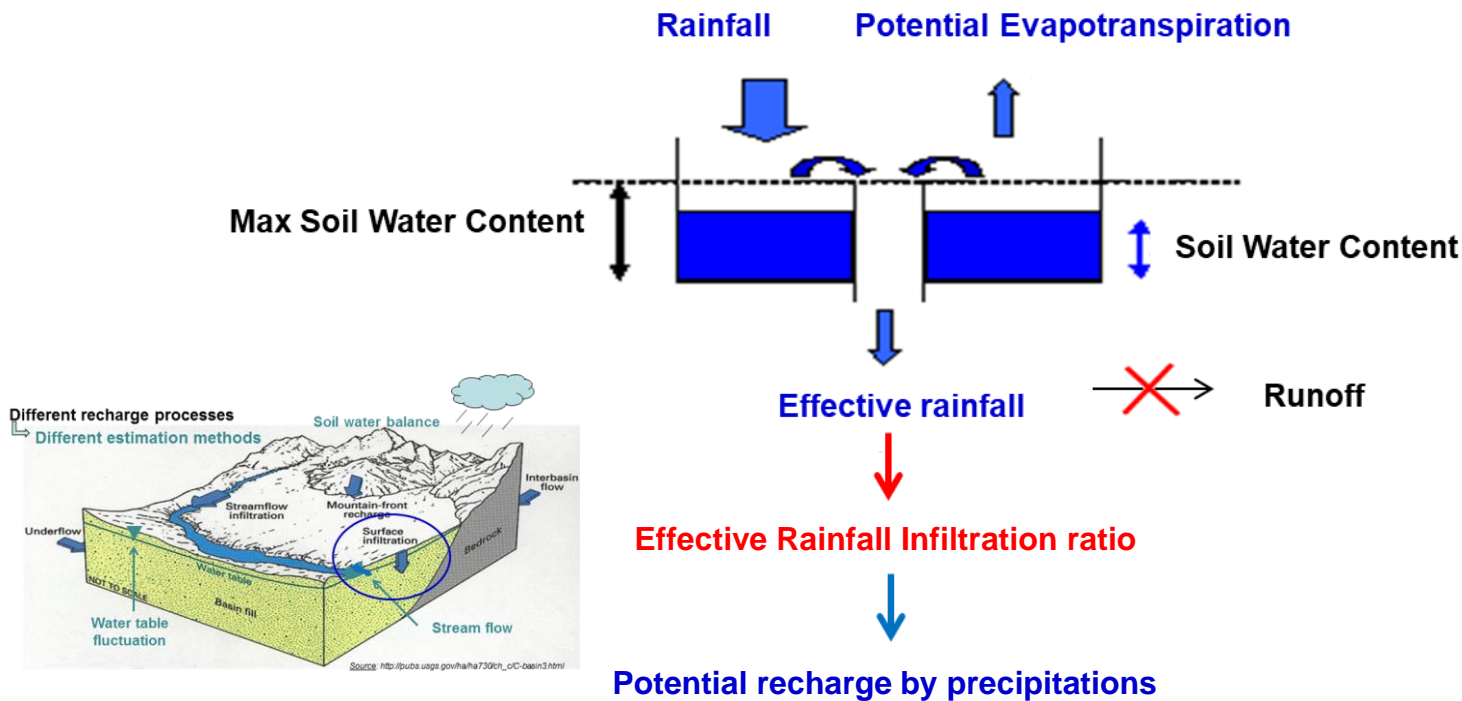


Projected impacts of Climate Change?
Future T° and Precip°
→ Adaptation

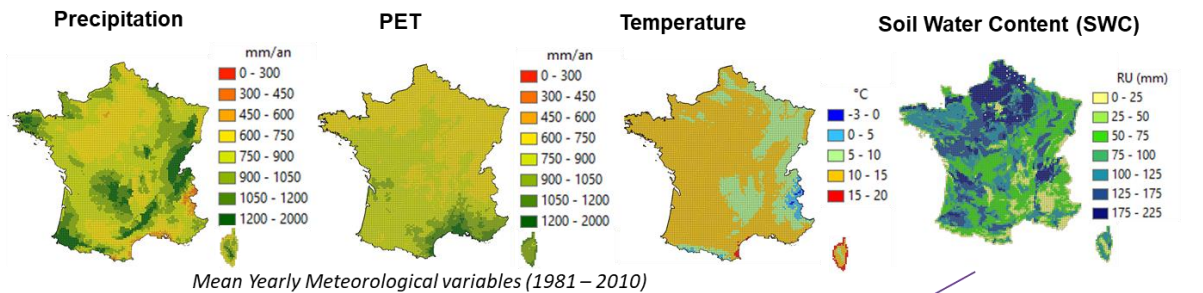


Using several recharge estimation methods provides more robust results with associated uncertainty (Scanlon et al., 2006)

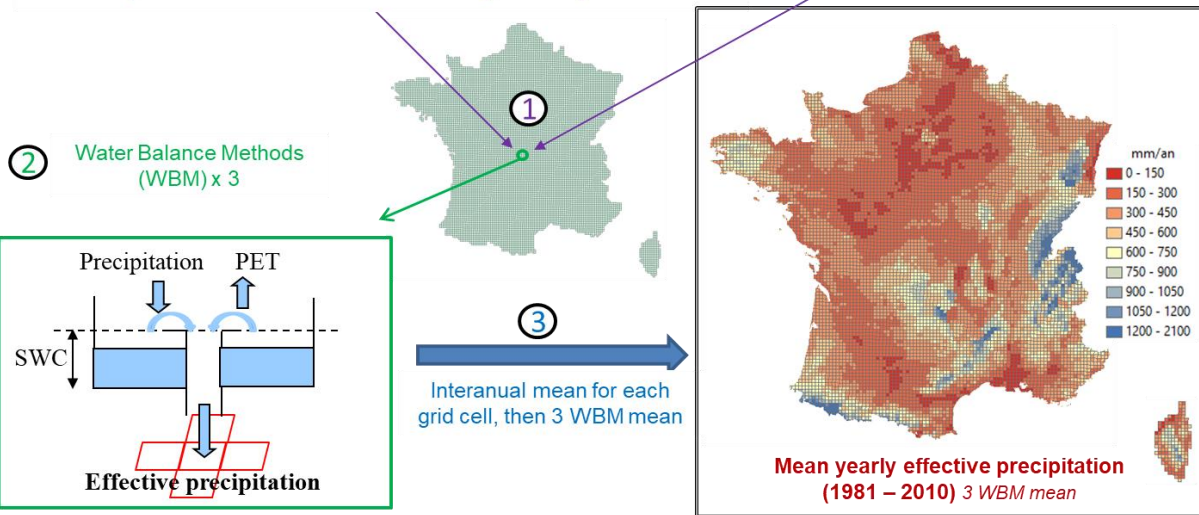
From effective precipitation → Potential recharge



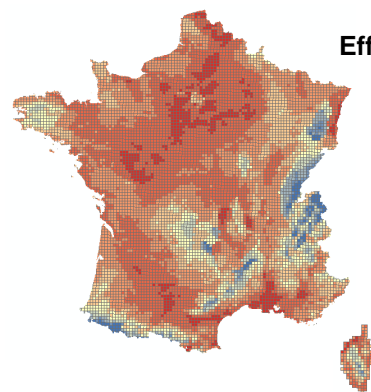
Effective precipitation computation



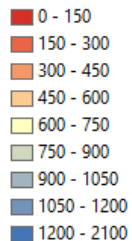
Daily time series for each SAFRAN grid cell (8*8 km²)



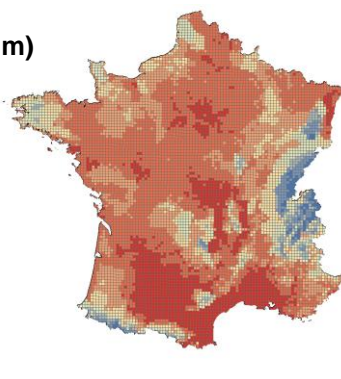
Effective precipitation computation quality



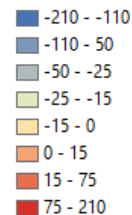
Effective precipitation (mm)



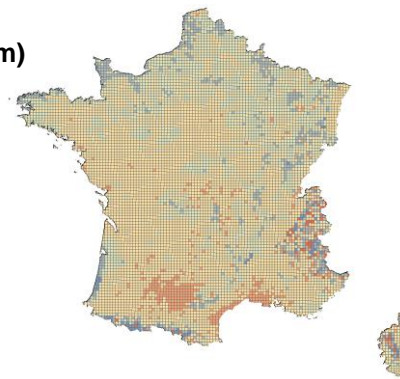
WBM Effective precipitation (2010)



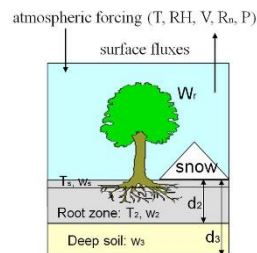
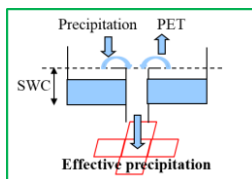
Surfex – WBM (mm)



Reference: Surfex (2010)
Soil Vegetation Transfer Scheme
(*Masson et al., 2013*)

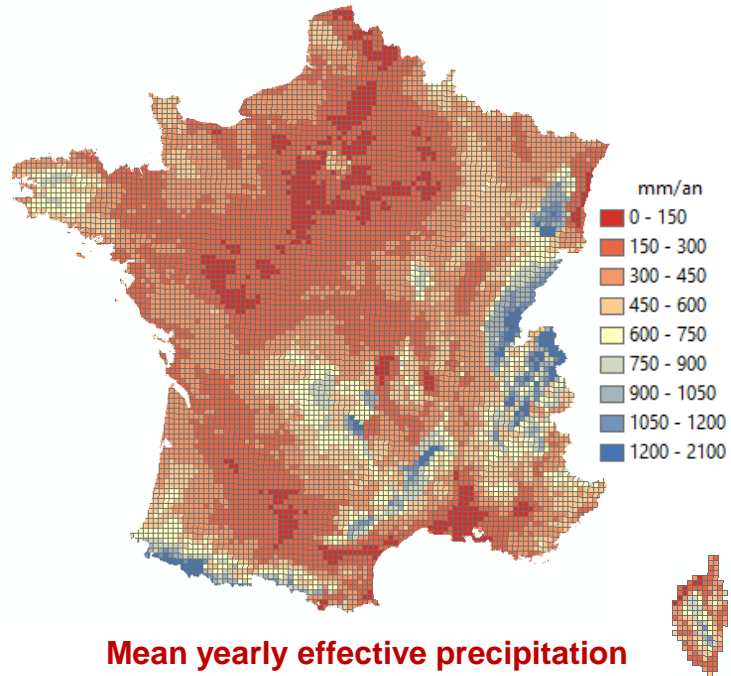


Difference
Surfex – WBM Eff Precip



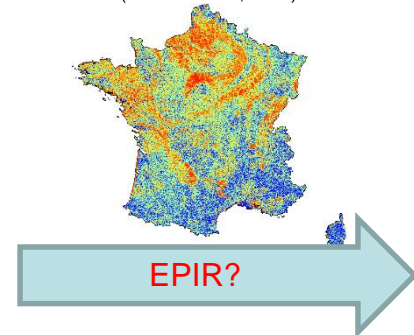
From effective precipitation → Potential recharge

> Effective precipitation infiltration ratio? (EPIR)



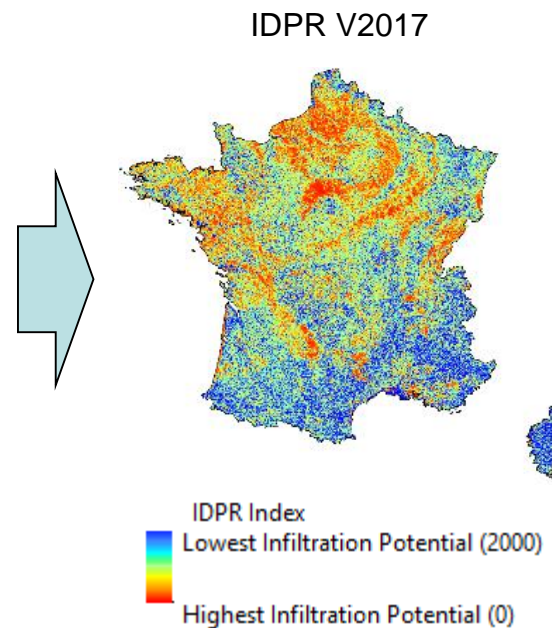
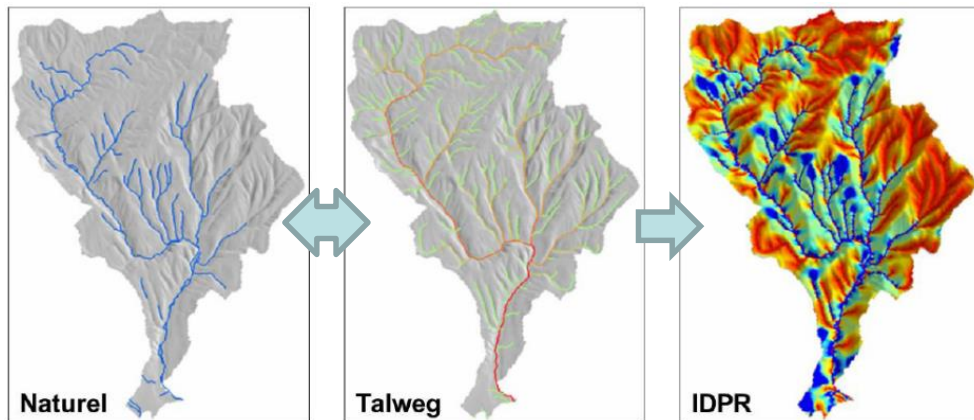
Mean yearly effective precipitation
(1981 – 2010) 3 WBM mean

IDPR V2017 Map
(Mardhel et al., 2004)



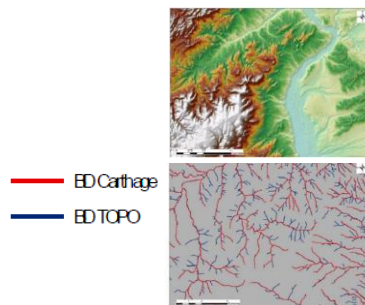
Potential recharge
by precipitation

IDPR V2017 concept



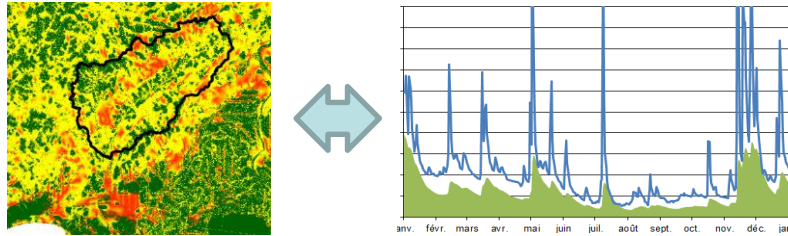
> V2017: New data:

- DEM 20 m (BD ALTI V2 IGN©)
- Hydrographic Network (BD TOPO IGN©)



From effective precipitation → Potential recharge

> IDPR / Base Flow Index (BFI) → EPIR



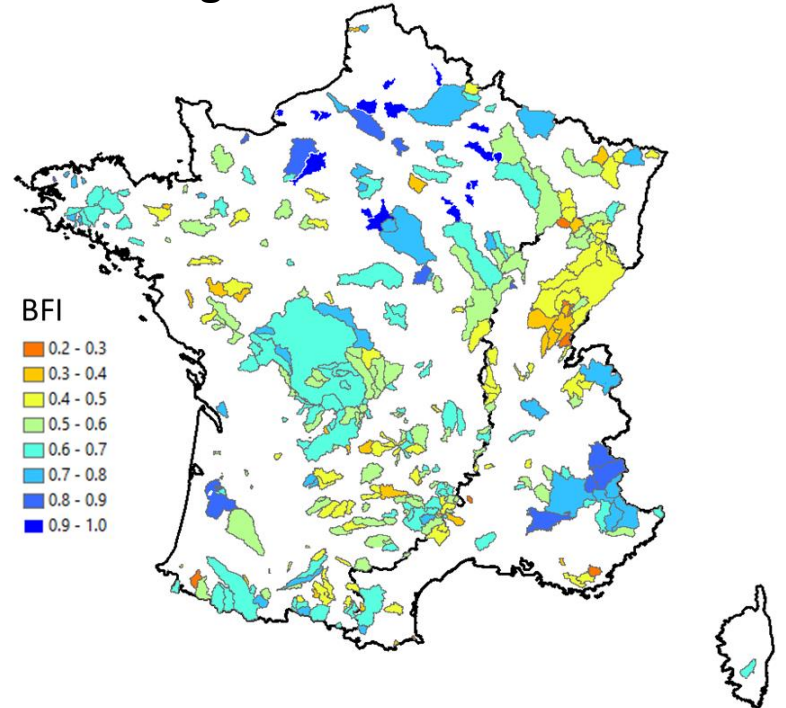
At yearly scale:

- « Natural » river basin
- No lateral nor vertical groundwater flux
- Negligible stock variation

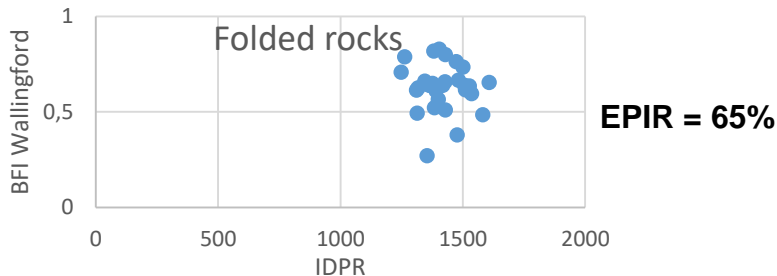
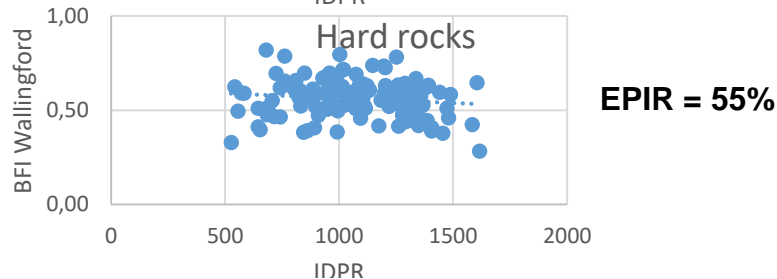
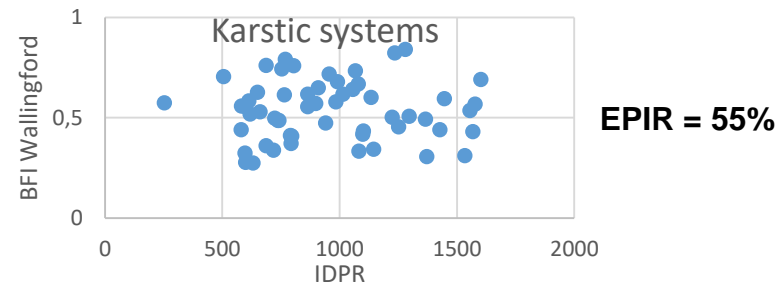
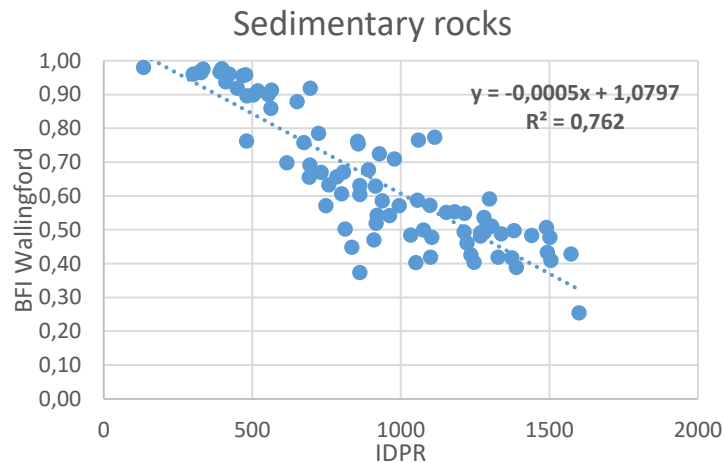
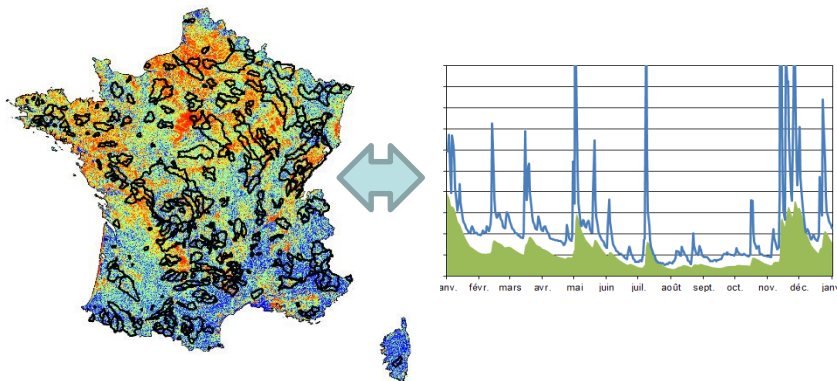
Recharge ~ base flow / Eff. Precip° ~ total discharge
→ EPIR = BFI

BFI computation over 350 river basins

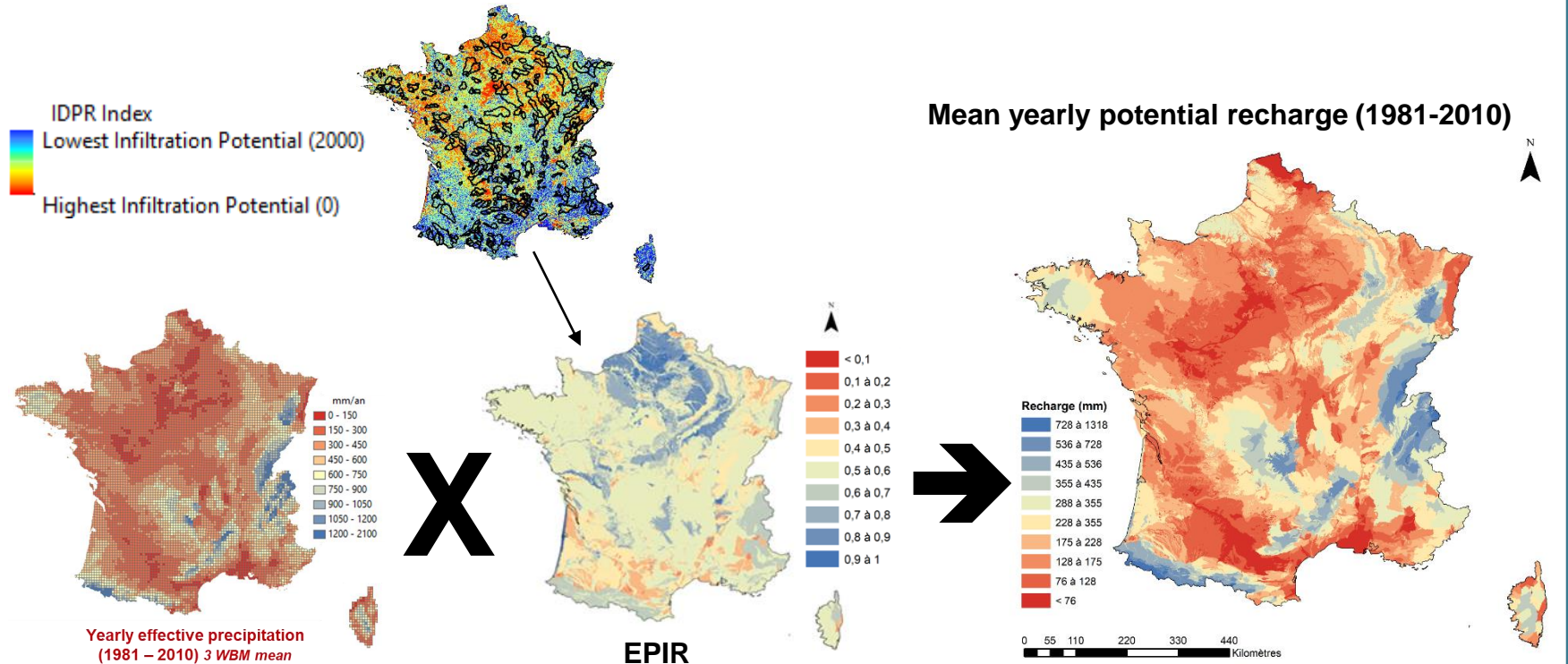
Wallingford method (Gustard et al., 1992)



From effective precipitation → Potential recharge



From effective precipitation → Potential recharge



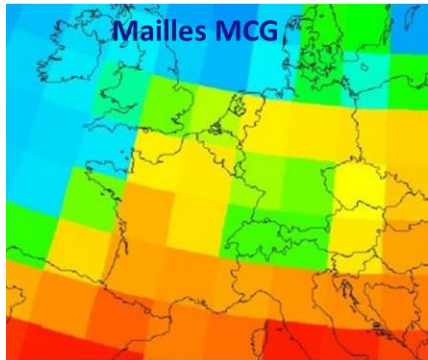
Future potential recharge?

Climate projections → Future effective precipitation

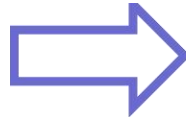
RCP Scenarios 2.6 (optimist) and 8.5 (pessimist)

5 GCMs: (NCAR CSM1, CanESM2, NorESM1, IPSL, CNRM-CM3)

2 downscaling methods: (DSCLIM / DAYON)



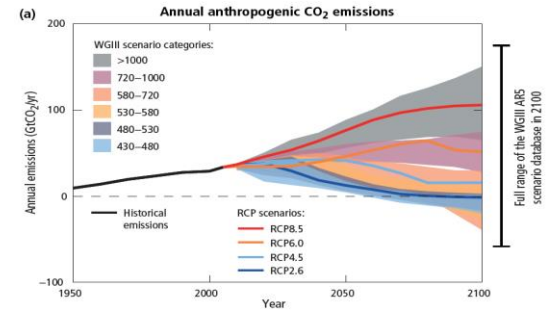
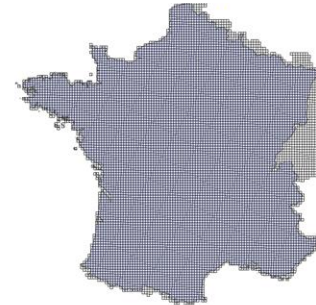
downscaling



DESCLIM
(Pagé et al., 2010)

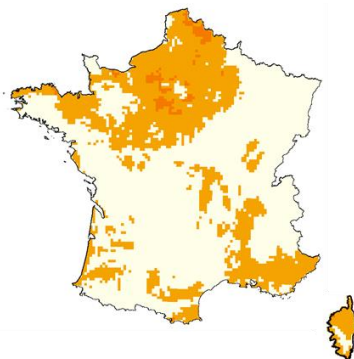
Analogs
(Dayon, 2016)

SAFRAN grid (8x8 km)

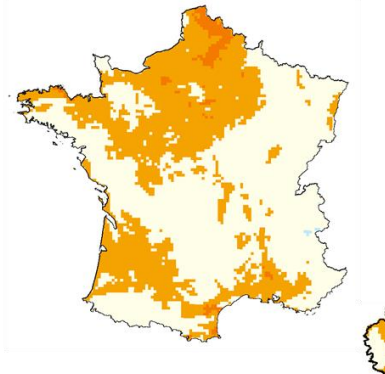


Future potential recharge?

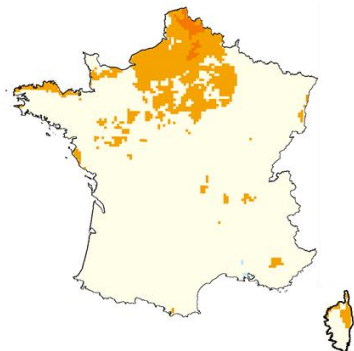
RCP2.6 - Horizon 2030



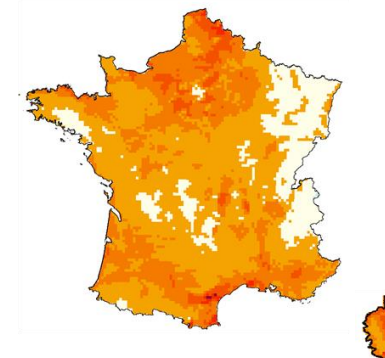
RCP8.5 - Horizon 2030



RCP2.6 - Horizon 2080



RCP8.5 - Horizon 2080



Conclusions



Towards a decreasing of the potential recharge by precipitations over France

- Method for large scale potential recharge estimation → to be assessed
- Probable decrease of the effective precipitations over France, with regional differences to be assessed (higher impacts in the northern regions at short term...)
- Necessary uncertainties assessment at the different levels of the computation and comparison of future / present variability

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