

# A reference set of bias-corrected regional projections for hydrological impact studies over France

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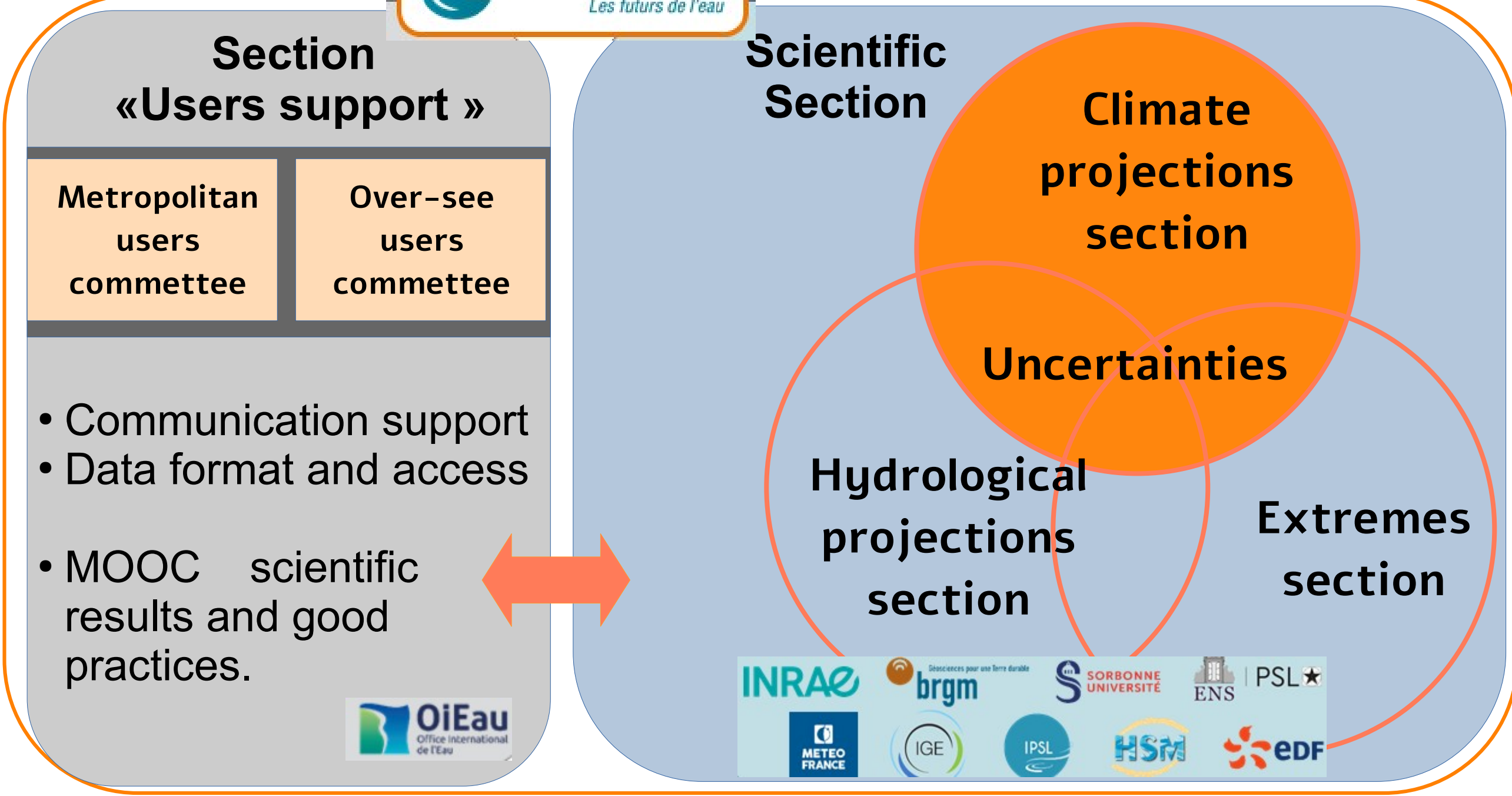
## The Explorez project

Scopes :

- Update the knowledge on the impacts of climate change on hydrology (surface and groundwater)
- Make publicly available reference climate data and climate information
- To support the users in the understanding and usage of the results

Climate Simulations

Hydrological Simulations



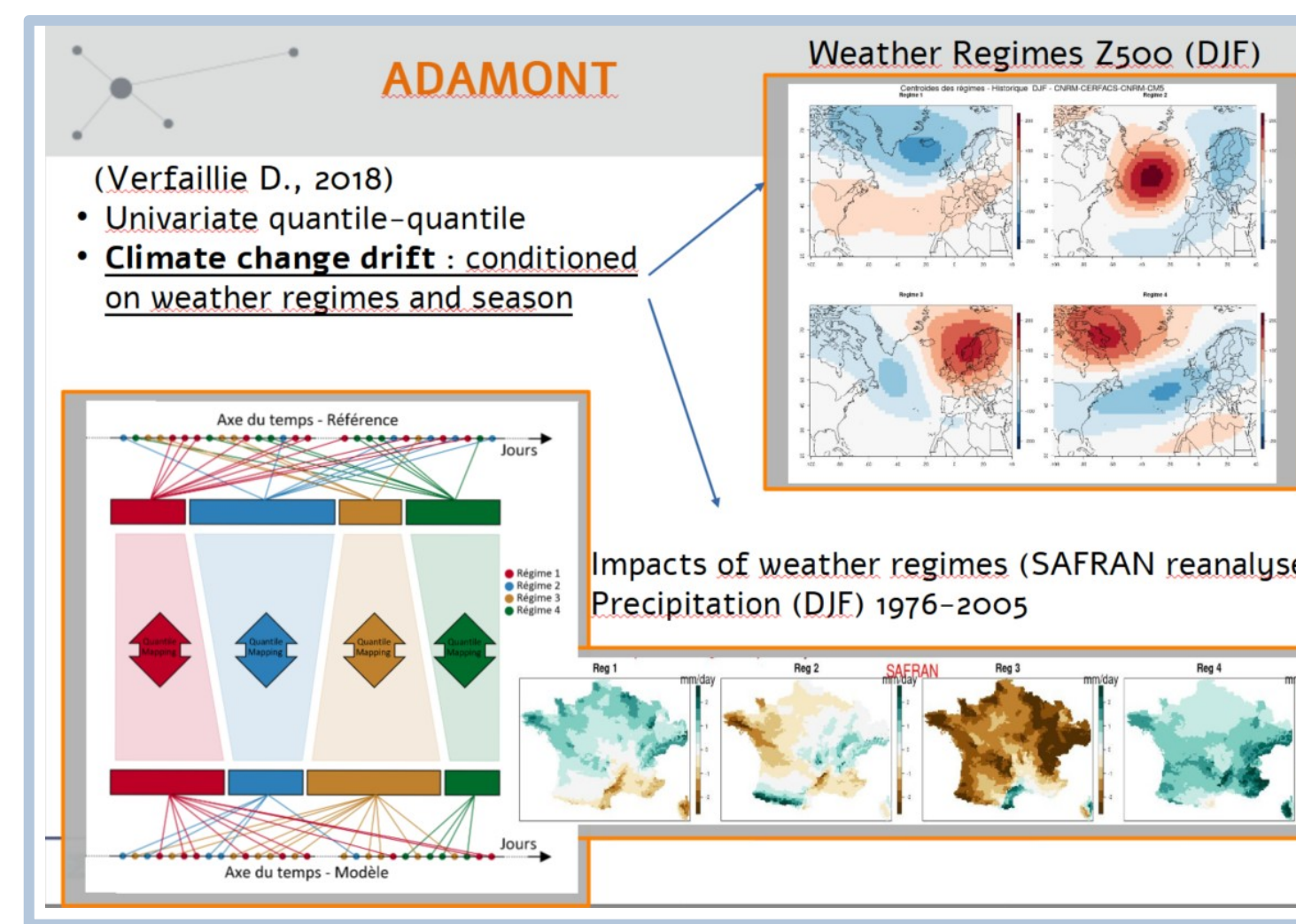
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## Climate projection section Ensemble members selection

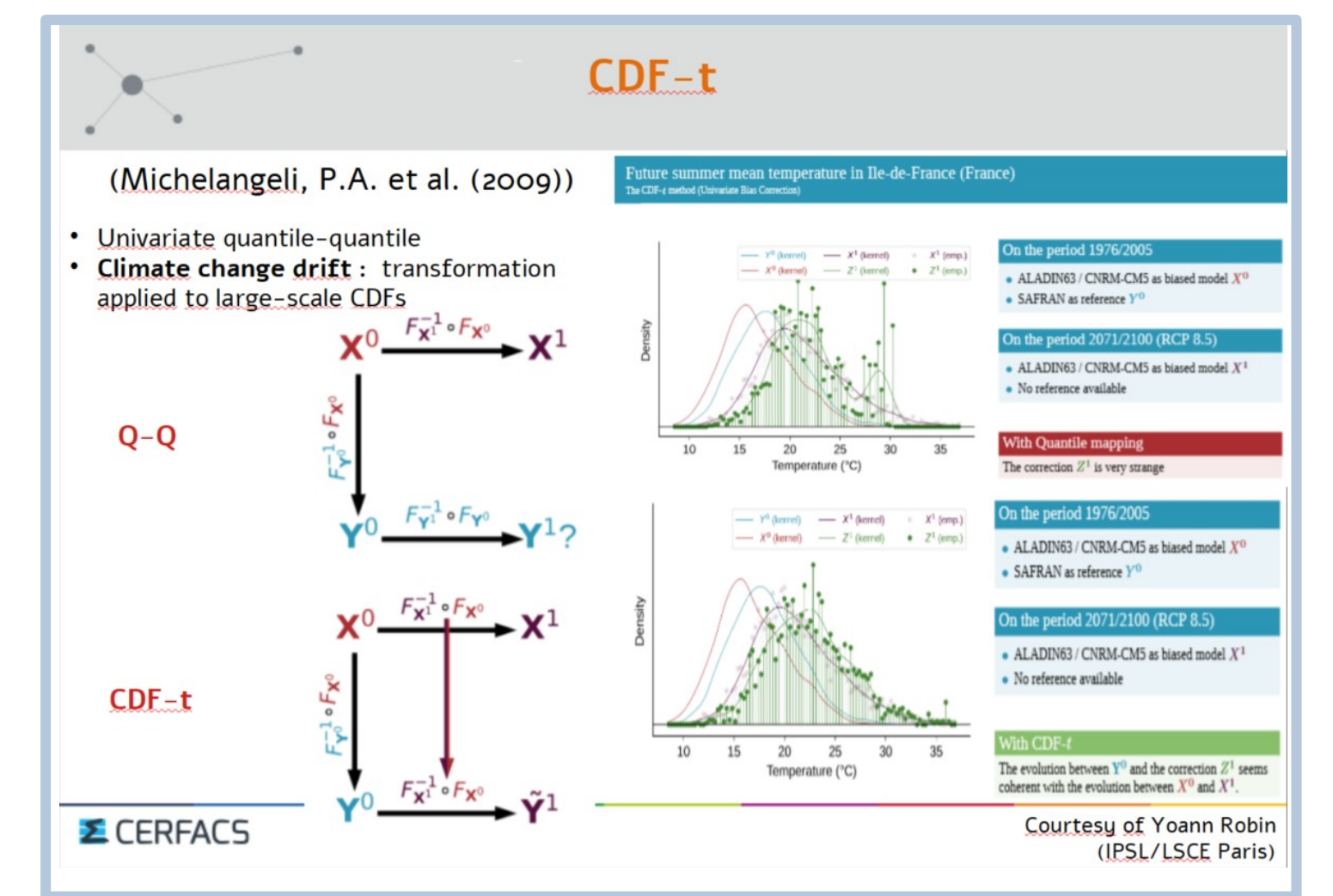
### Selection I – on raw models

Criteria for selection :

- ~ 10 couples per RCP scenario (RCP2.6, RCP4.5, RCP8.5)
- At least 2 RCP scenarios available per couple
- Realistic simulations over Europe only (McSweeney et al., 2015)
- Simulations from french insitutions must be included
- Couples with a physical coherence between GCM and RCM are to be favored
- The Euro-CORDEX ensemble dispersion must be preserved
- Latest simulations with evolutives aerosols must be included
- Each GCM and each RCM must appear more than once.



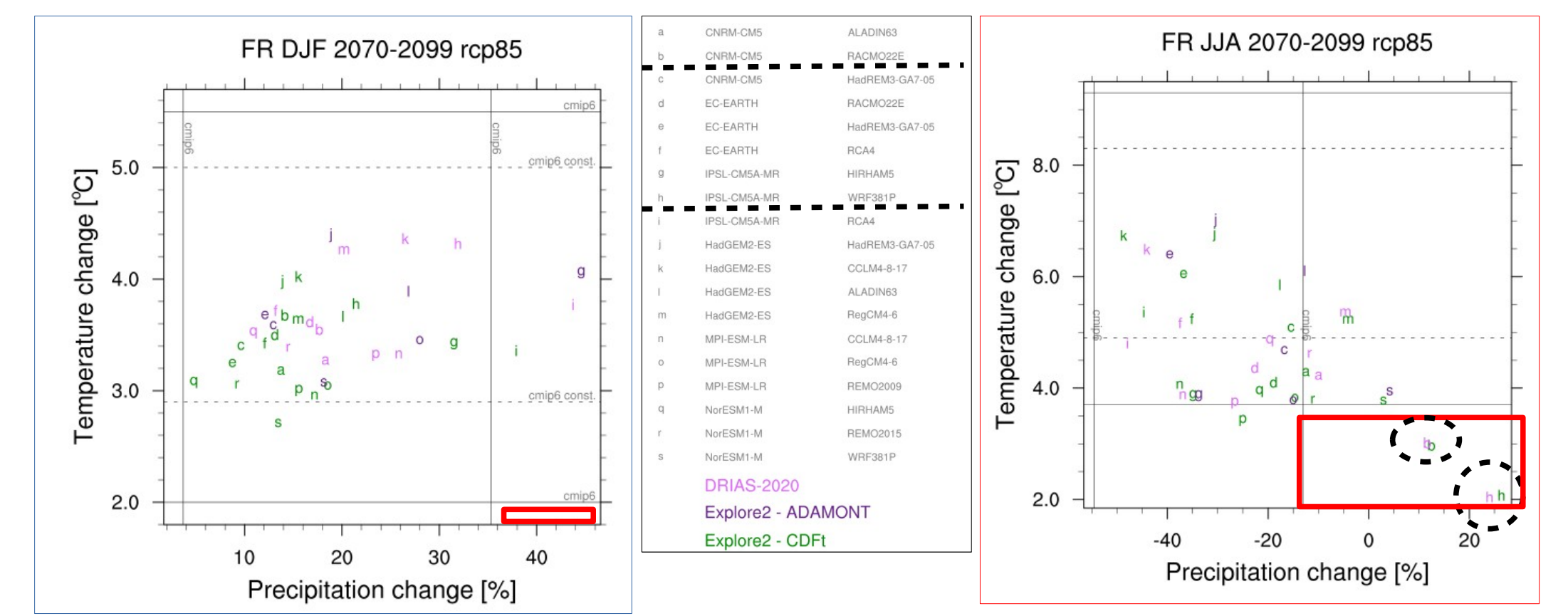
### Bias Correction (2 methods)



GCM	RCM	HISTO	RCP 2.6	RCP 4.5	RCP 8.5	
CNRM-CERFACS-CNRM-CMS	CNRM-ALADIN63	x	x	x	x	3
CNRM-CERFACS-CNRM-CMS	KNMI-RACMO22E	x	x	x	x	3
CNRM-CERFACS-CNRM-CMS	MOHC-HadREM3-GA7-05	x	o	o	x	1
ICHEC-EC-EARTH	KNMI-RACMO22E	x	x	x	x	3
ICHEC-EC-EARTH	SMHI-RC44	x	x	x	x	3
ICHEC-EC-EARTH	MOHC-HadREM3-GA7-05	x	x	o	x	2
MOHC-HadGEM2-ES	CNRM-ALADIN63	x	o	o	x	1
MOHC-HadGEM2-ES	CLMcom-CCLM4-8-17	x	o	x	x	2
MOHC-HadGEM2-ES	ICTP-RegCM4-6	x	x	o	x	2
MOHC-HadGEM2-ES	MOHC-HadREM3-GA7-05	x	x	o	x	2
IPSL-IPSL-CM5A-MR	DMI-HIRHAM5	x	o	o	x	2
IPSL-IPSL-CM5A-MR	SMHI-RC44	x	o	x	x	2
IPSL-IPSL-CM5A-MR	IPSL-WRF381P	x	o	x	x	2
MPI-M-MPI-ESM-LR	CLMcom-CCLM4-8-17	x	x	x	x	3
MPI-M-MPI-ESM-LR	ICTP-RegCM4-6	x	x	o	x	2
MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009	x	x	x	x	3
NCC-NorESM1-M	DMI-HIRHAM5	o	o	x	x	2
NCC-NorESM1-M	GERICS-REMO2015	x	x	x	x	3
NCC-NorESM1-M	IPSL-WRF381P	x	o	o	x	1
		19	11	11	19	

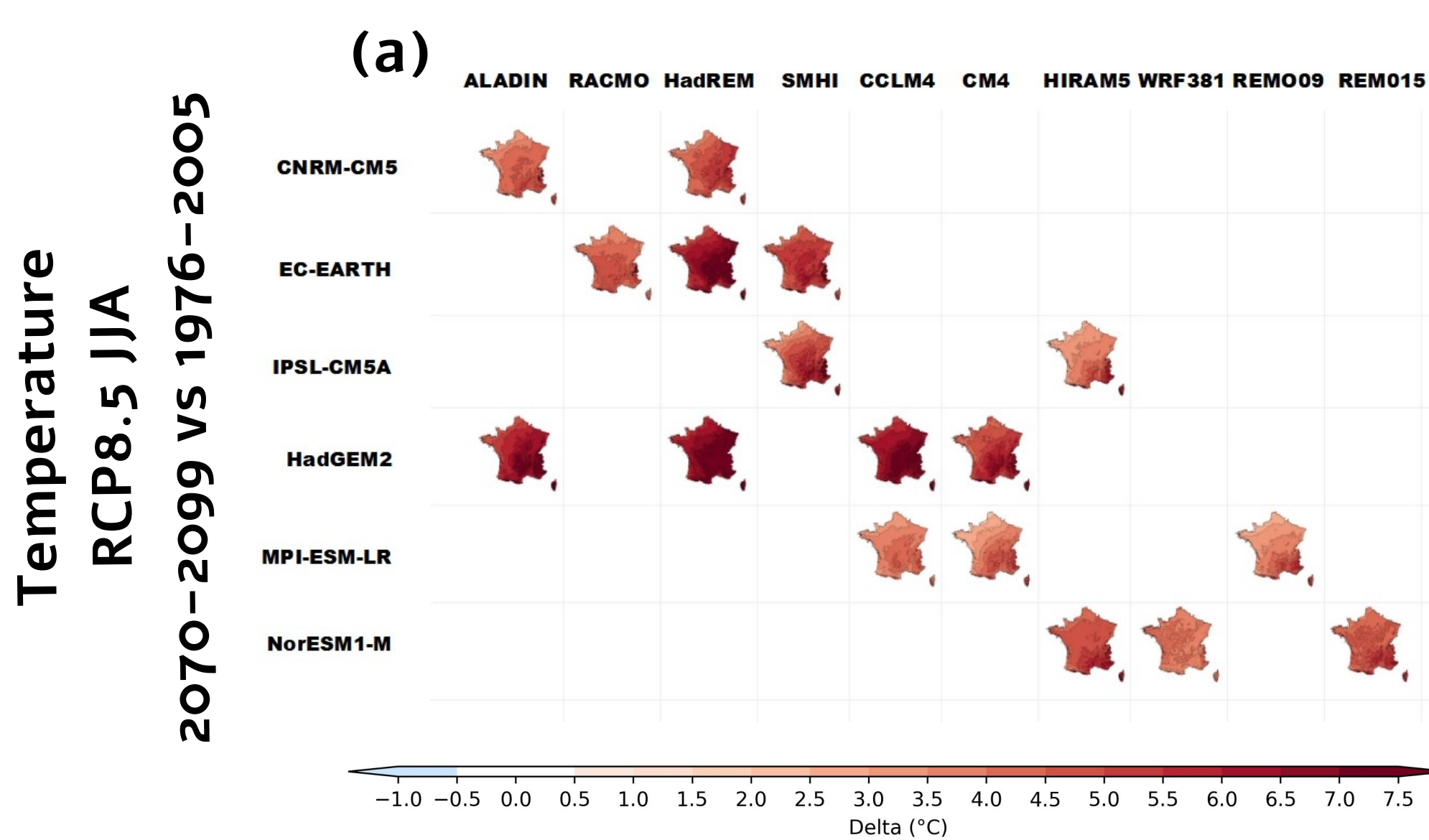
Set the ensemble from Euro-CORDEX in coherence with CMIP6 simulations over France  
Keep nevertheless a sufficient number of models

### Selection II – on corrected models



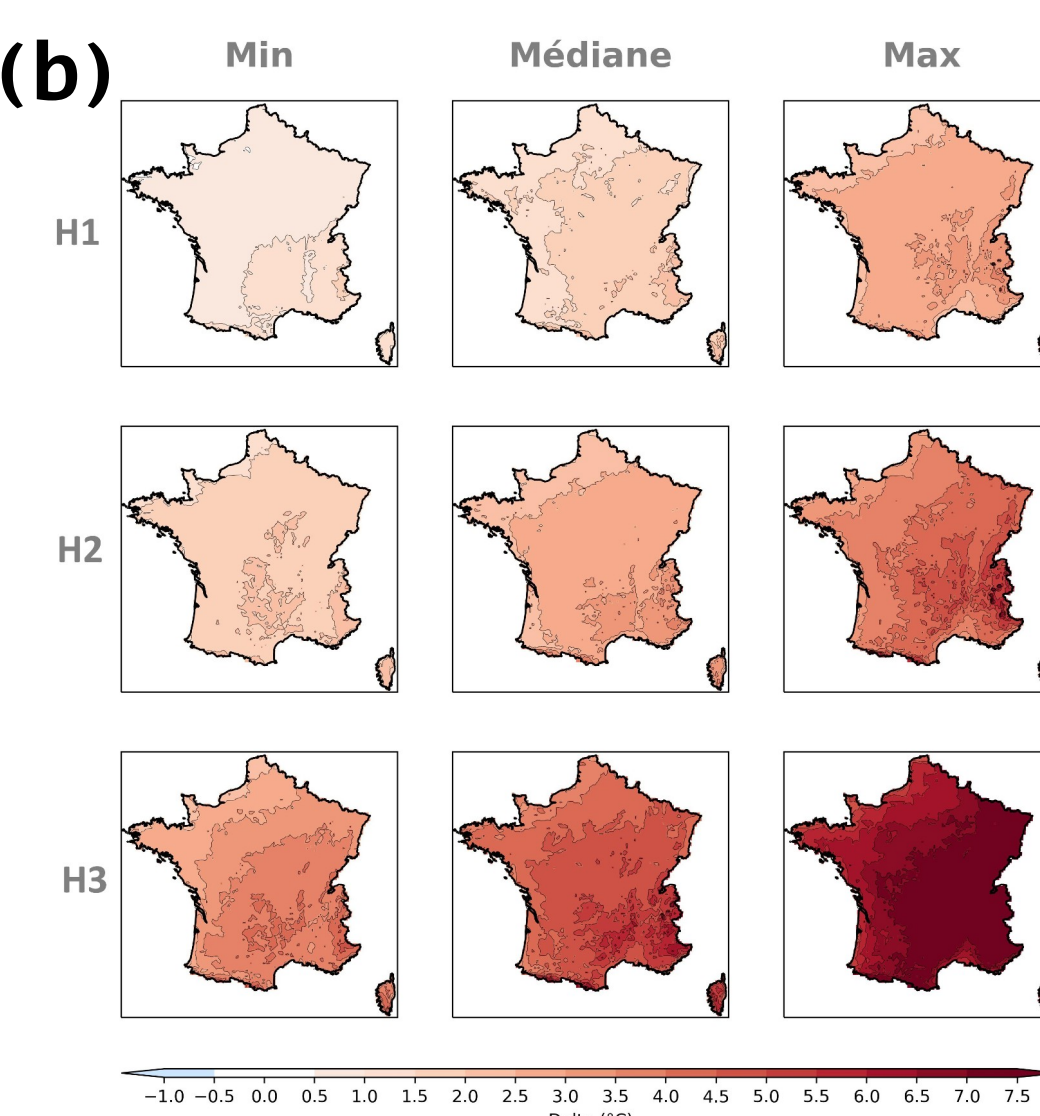
## Products from the ensemble

### Multi-model matrices



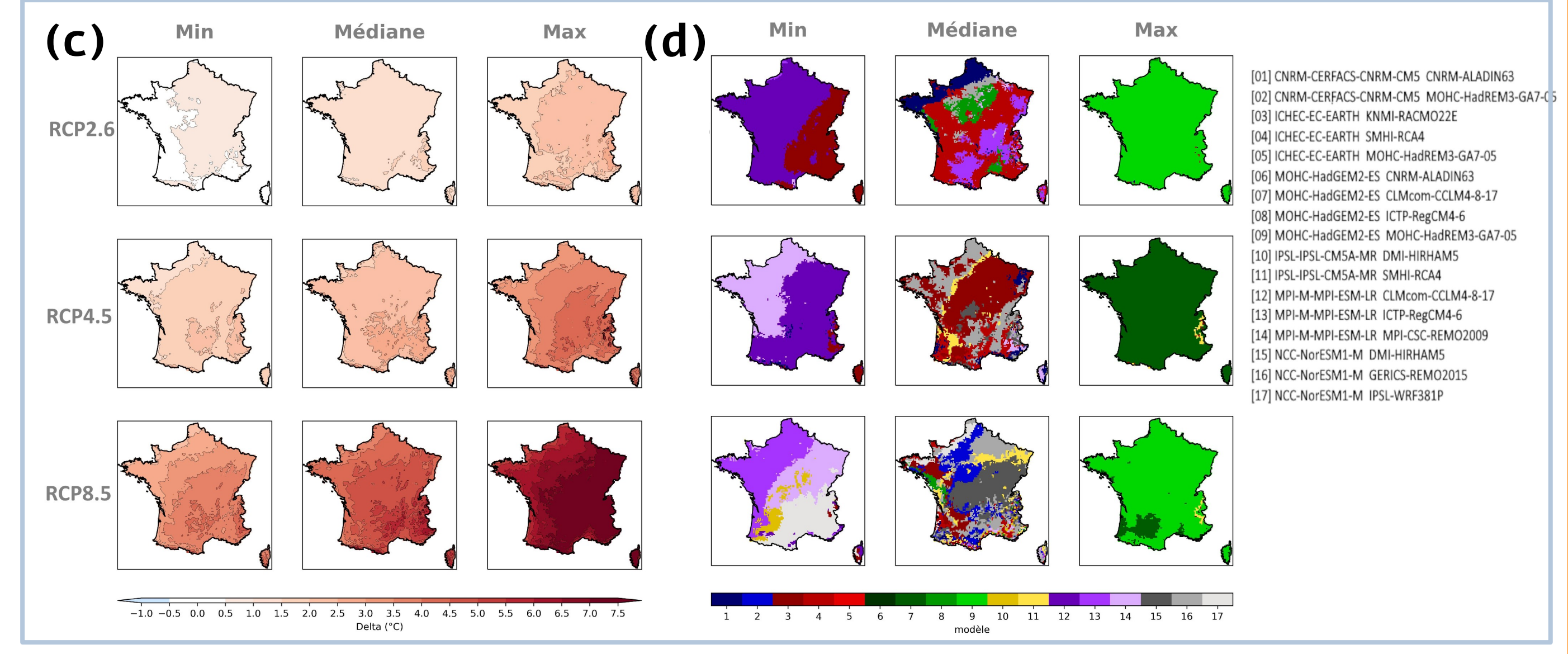
(a) These matrices show simultaneously the delta of all the selected GCM/RCM couples of the ensemble. This representation allows to see the dependences from GCMs or RCMs and the physically meaningful spatial structure from each couple.

### Multi-horizon matrices

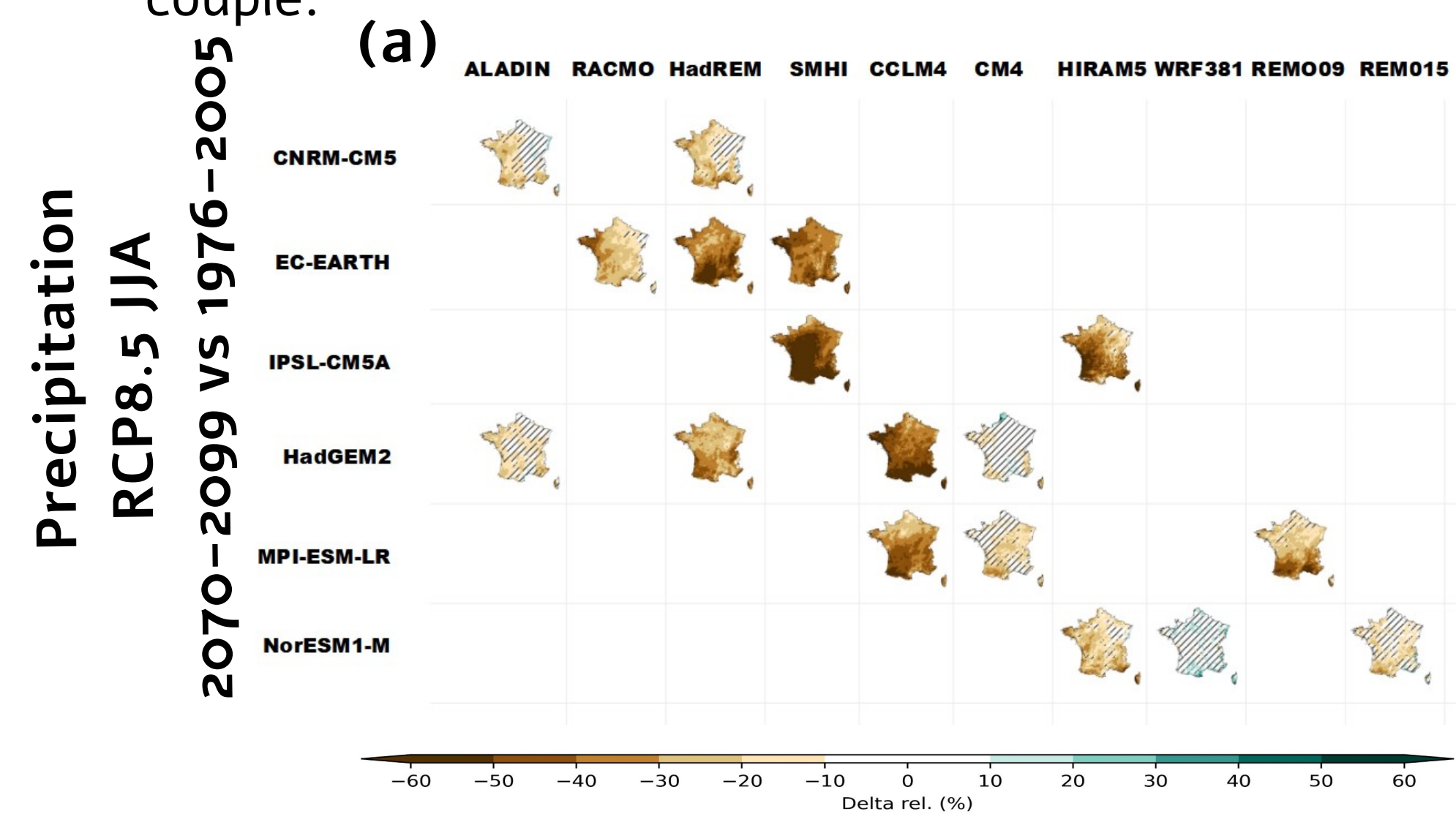


(b) Maps of minimal (left), median (center) and maximal (right) change in the ensemble per pixel. Rows : H1 : 2021-2050 ; H2 : 2041-2070 ; H3 : 2070-2099 ; RCP8.5.

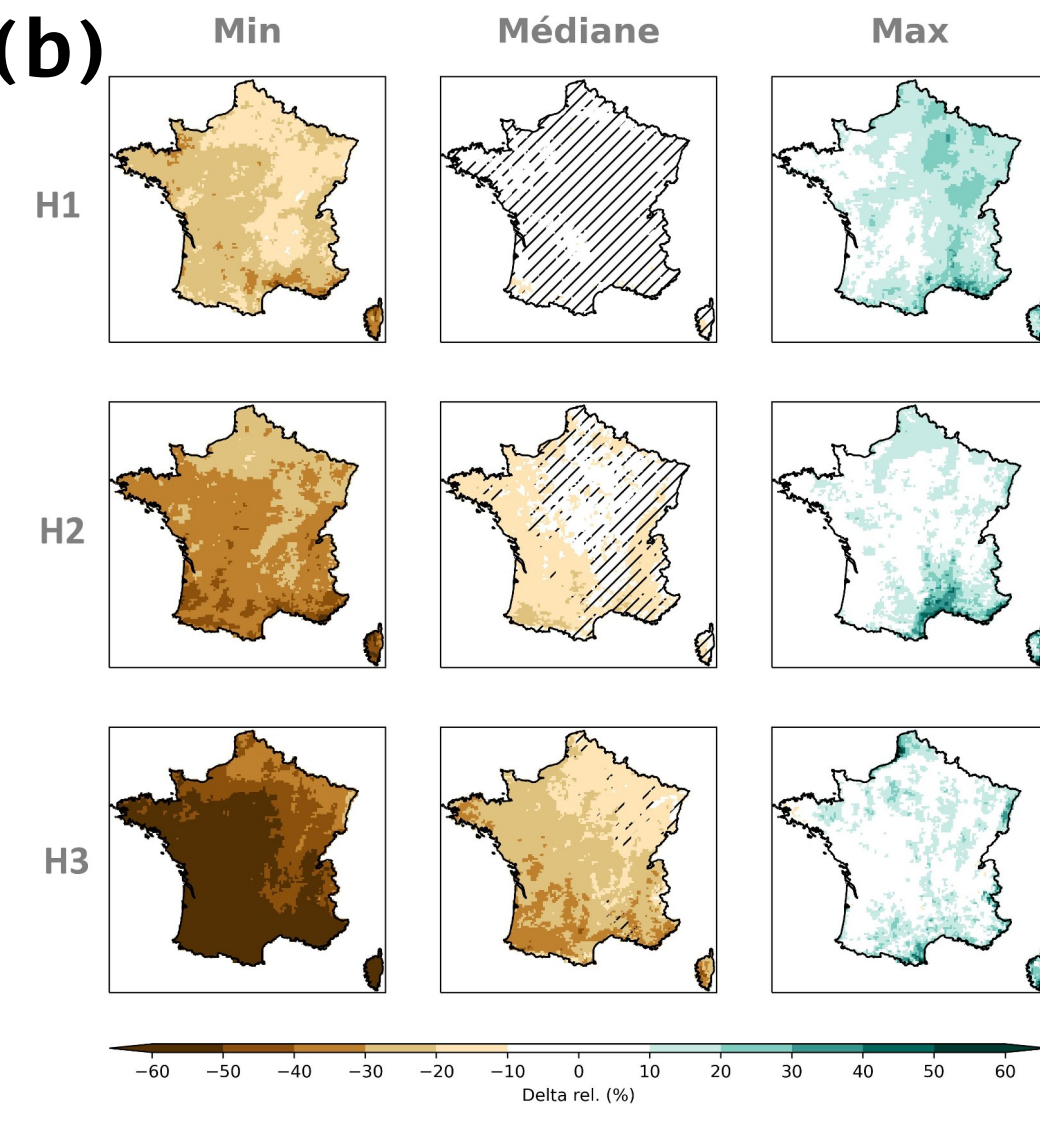
### Multi-scenario matrices



(c) Maps of minimal (left), median (center) and maximal (right) change in the ensemble per pixel. Rows : RCP2.6 , RCP4.5, RCP8.5. Horizon : 2070-2099.

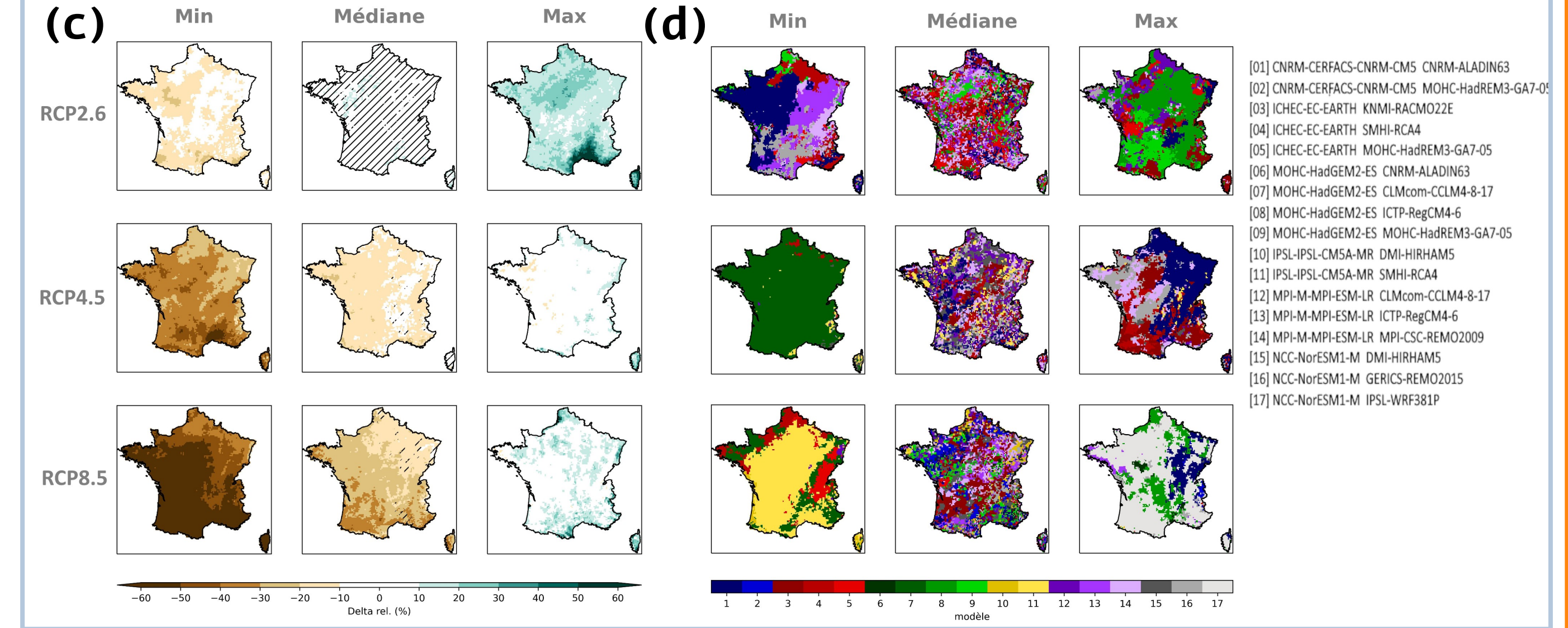


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## Hydrological projections

The bias corrected ensemble is used to feed hydrological surface and groundwater models to investigate the evolution of water resources in France along the XXIth century.  
<https://professionnels.ofb.fr/fr/node/1244>

## References

- McSweeney, C.F., Jones, R.G., Lee, R.W. et al. Selecting CMIP5 GCMs for downscaling over multiple regions. *Clim Dyn* 44, 3237–3260 (2015). <https://doi.org/10.1007/s00382-014-2418-8>
- Michelangeli P.-A. et al., 2009. "Probabilistic downscaling approaches: Application to wind cumulative distribution functions". *Geophysical Research Letters*, 36, L11708, doi:10.1029/2009GL038401
- Verfaillie, D. et al. (2017). "The method ADAMONT v1.0 for statistical adjustment of climate projections applicable to energy balance land surface models". In : *Geosci. Model Dev.* 10.11, p. 4257-4283. DOI : 10.5194/gmd-10-4257-2017