

How abrupt change in surface temperature impacts water balance over France?

A case-study of bread wheat cultivated areas.

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01/07/2022

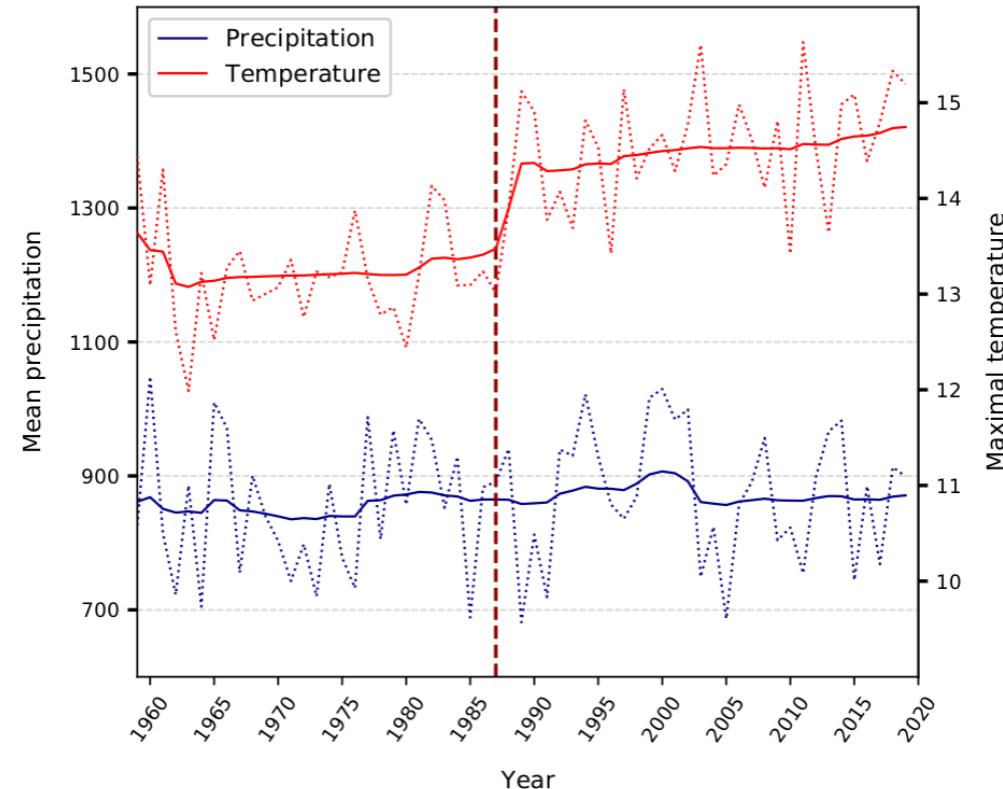
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Scientific context

Temperature warming and stationarity break



- Stationarity break for **Tmin** and **Tmax** in France in **1987/1988**
- No shift or significant trend in the yearly amount of rainfall

Seasonality

Period	Minimum temperature			Maximum temperature		
	% of stations	ΔT (°C)	95% HDI	% of stations	ΔT (°C)	95% HDI
YEAR	62	+0.92*	0.67–1.18	84	+1.1*	0.81–1.46
DJF	11	+0.64*	0.58–0.71	44	+0.92*	0.86–0.99
MAM	81	+1.13*	1.09–1.17	92	+1.55*	1.51–1.6
JJA	30	+1.1*	1.07–1.14	40	+1.31*	1.26–1.36
SON	4	+0.68	0.63–0.73	0	+0.48	0.43–0.52

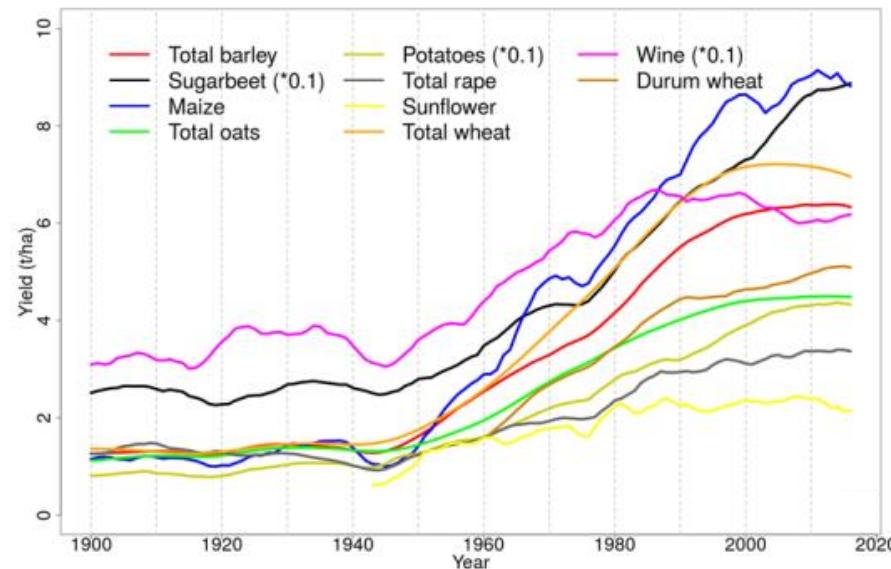
* Significant values are based on Bayesian analysis.

Brulebois et al., 2015.

- **Spring is the most impacted season**

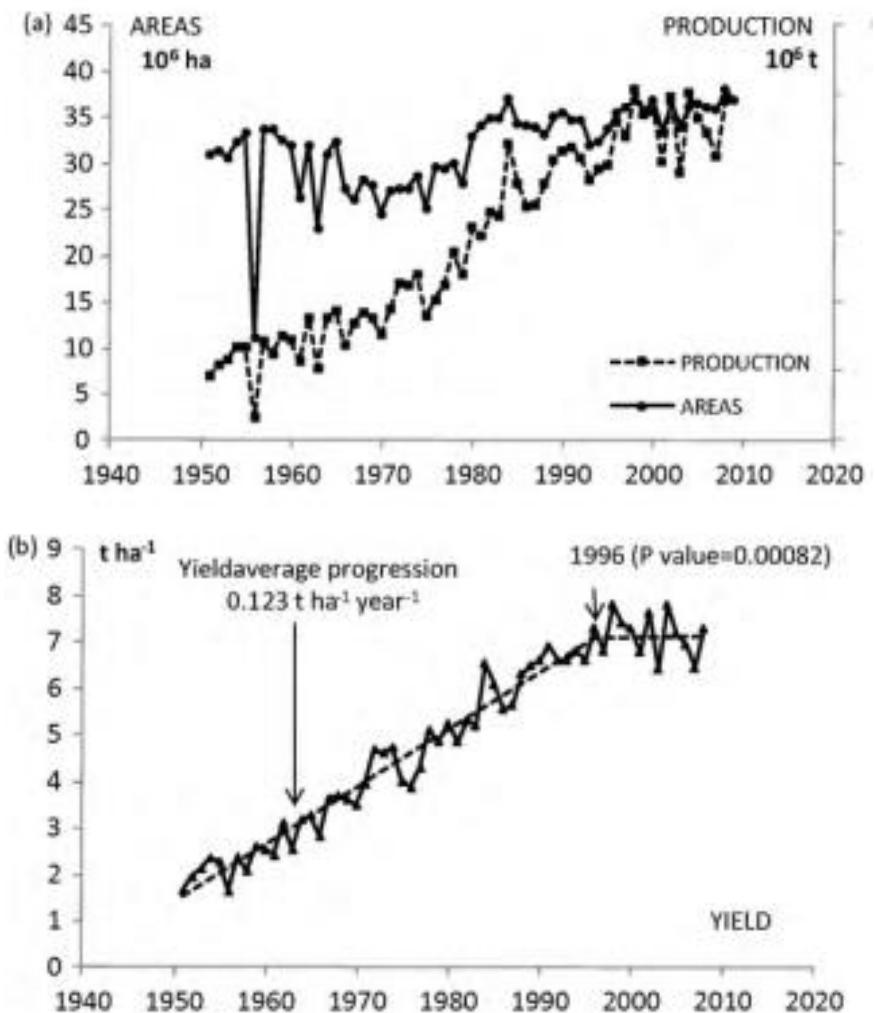
Scientific context

Yields stagnation



Schauberger et al., 2018.

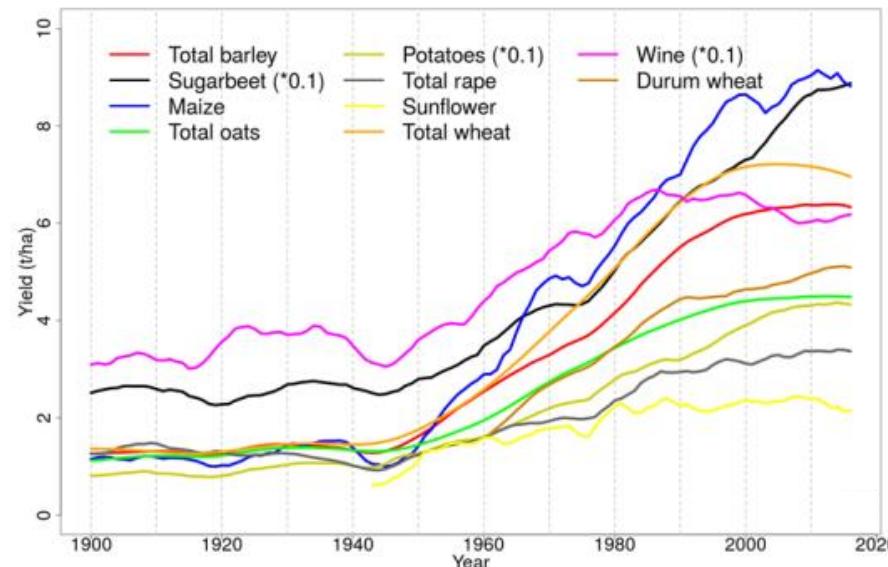
- Yields **stagnation** since ~ 1990 in France
- **Wheat** particularly impacted
- Several causes identified, including **climate change**



Data source: AGRESTE. Brisson et al., 2010.

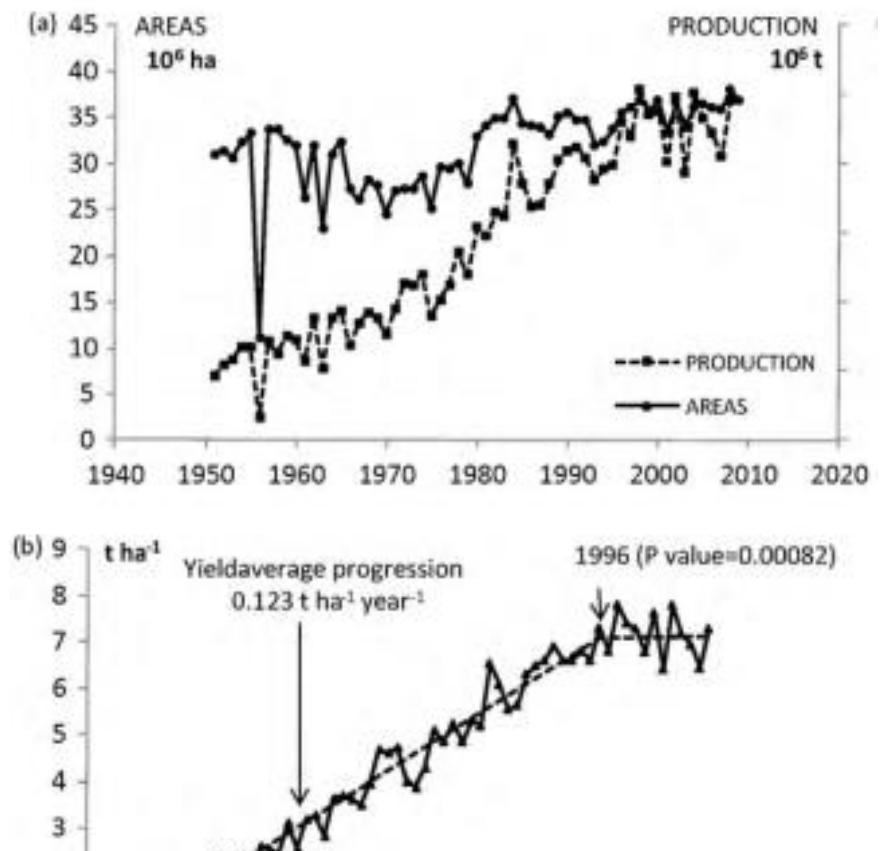
Scientific context

Yields stagnation



Schauberger et al., 2018.

- Yields stagnation since ~ 1990 in France

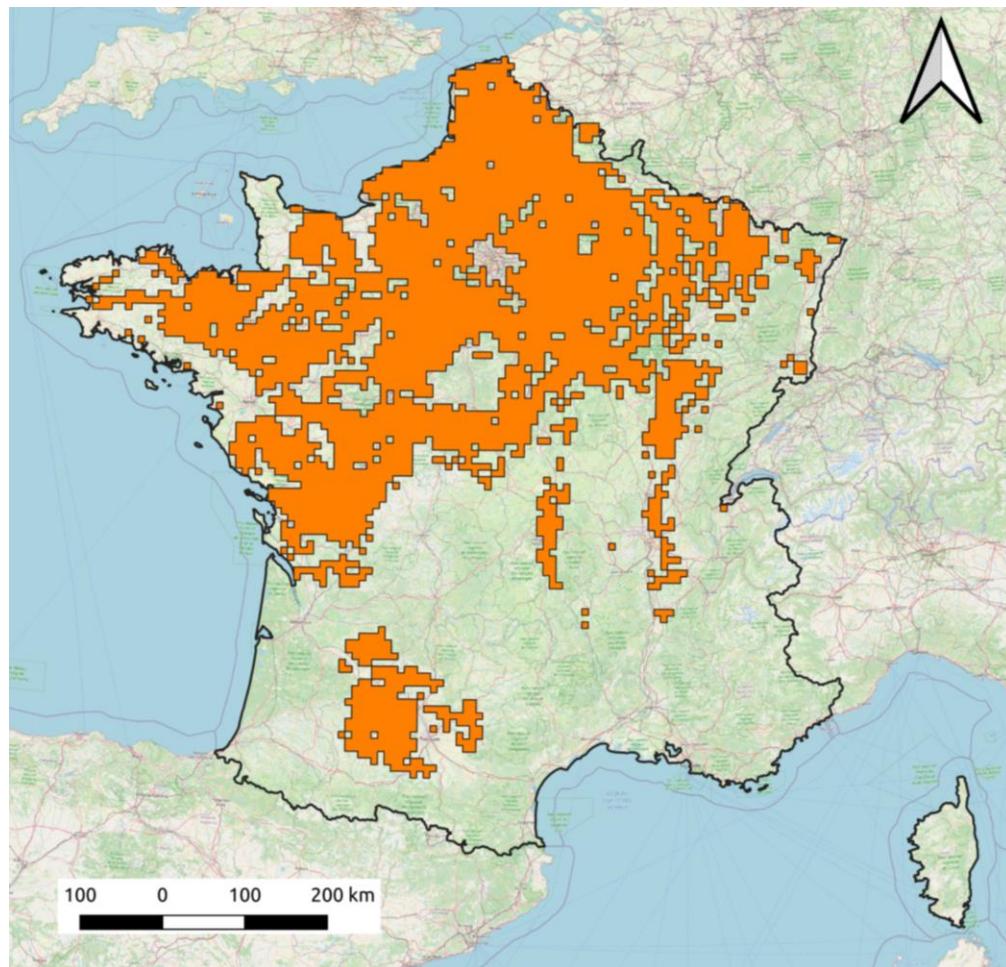


How abrupt changes in climate hazard impact soil water balance over winter bread wheat fields?

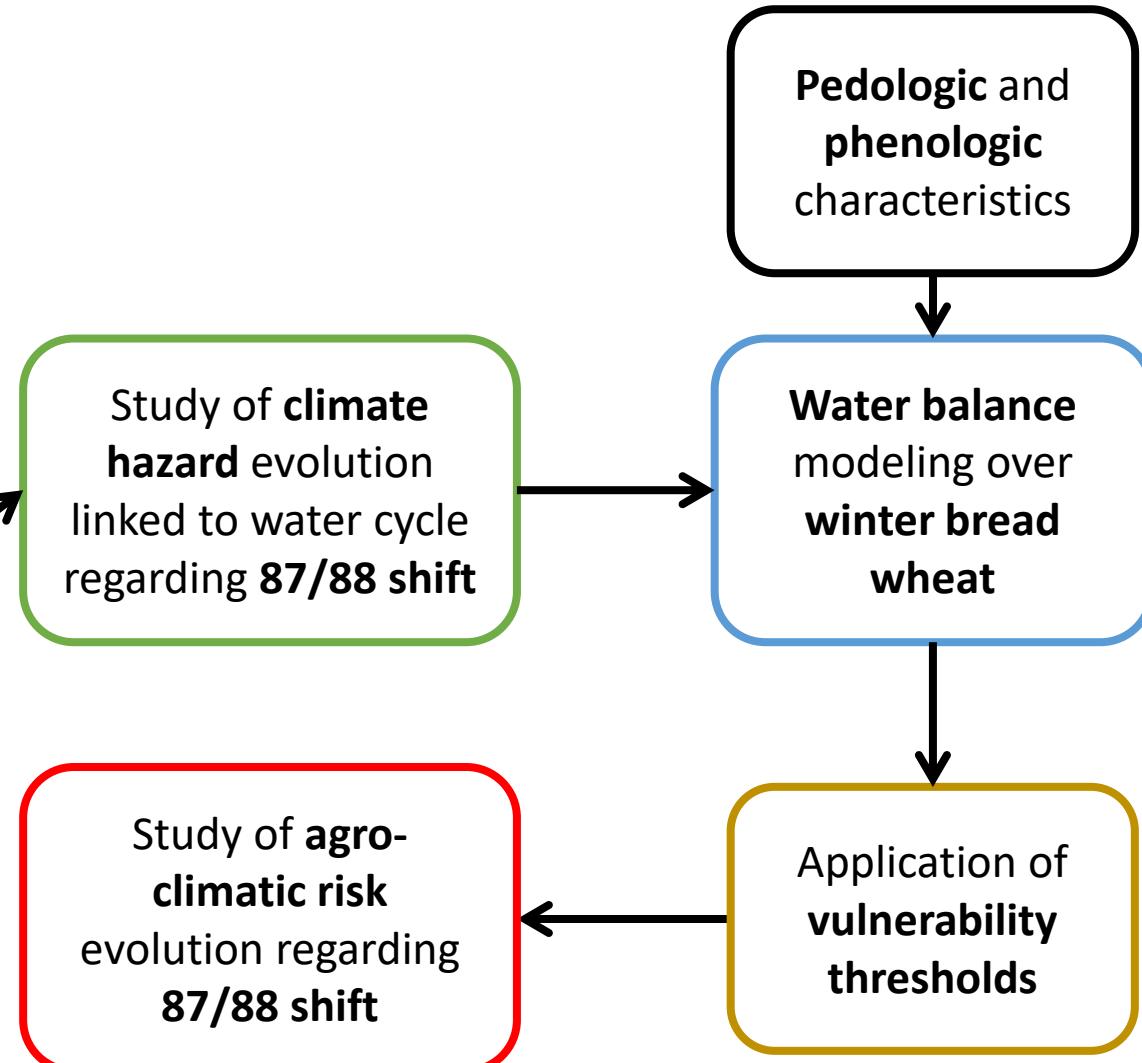
Several causes identified, including climate change

Data source: AGRETE. Brisson et al., 2010.

Study area and methodological approach

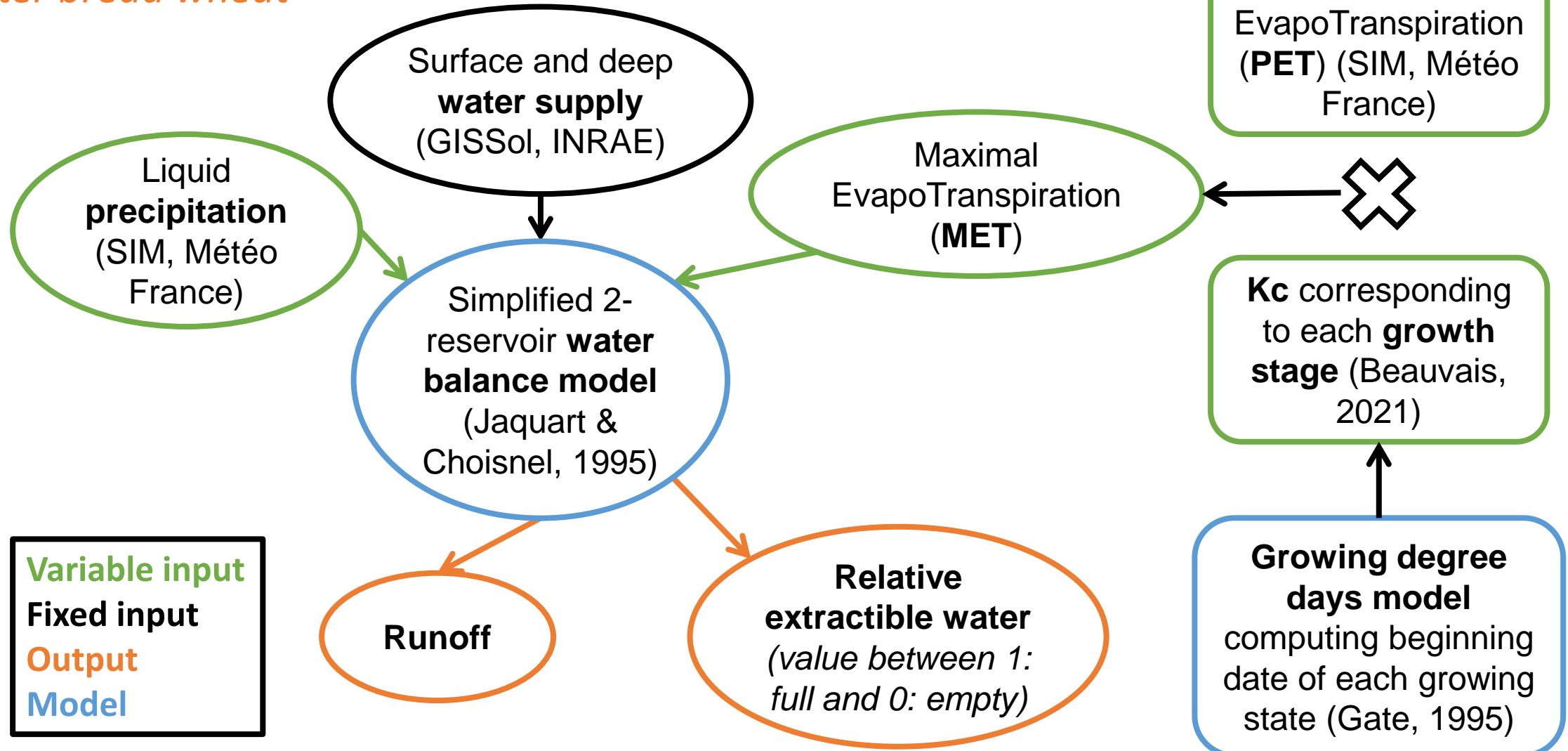


Safran-Isba-Modcou (SIM) grid points on which at least 10% of the area is covered by winter bread wheat crops.



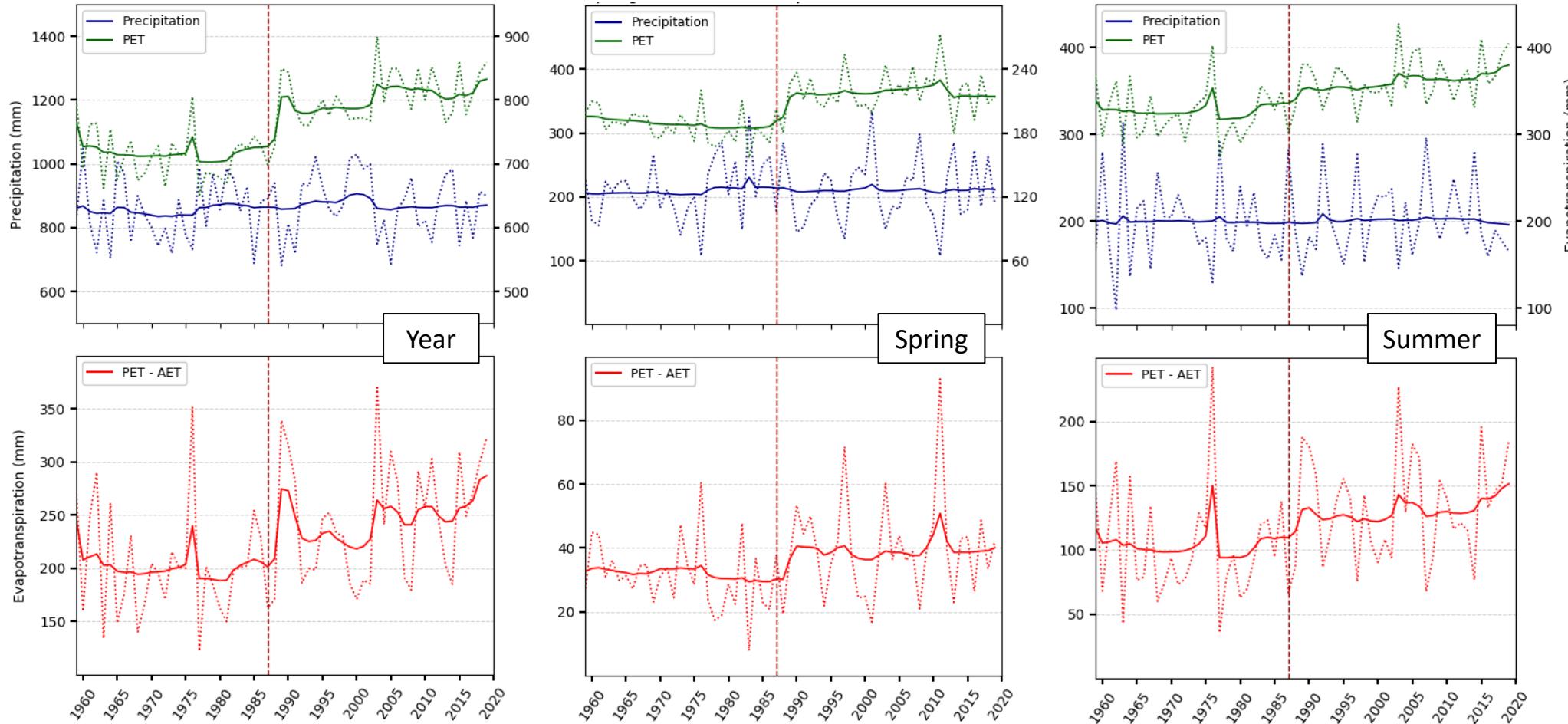
Data and water balance model

Winter bread wheat



Temporal evolution of climatic variables linked to water cycle

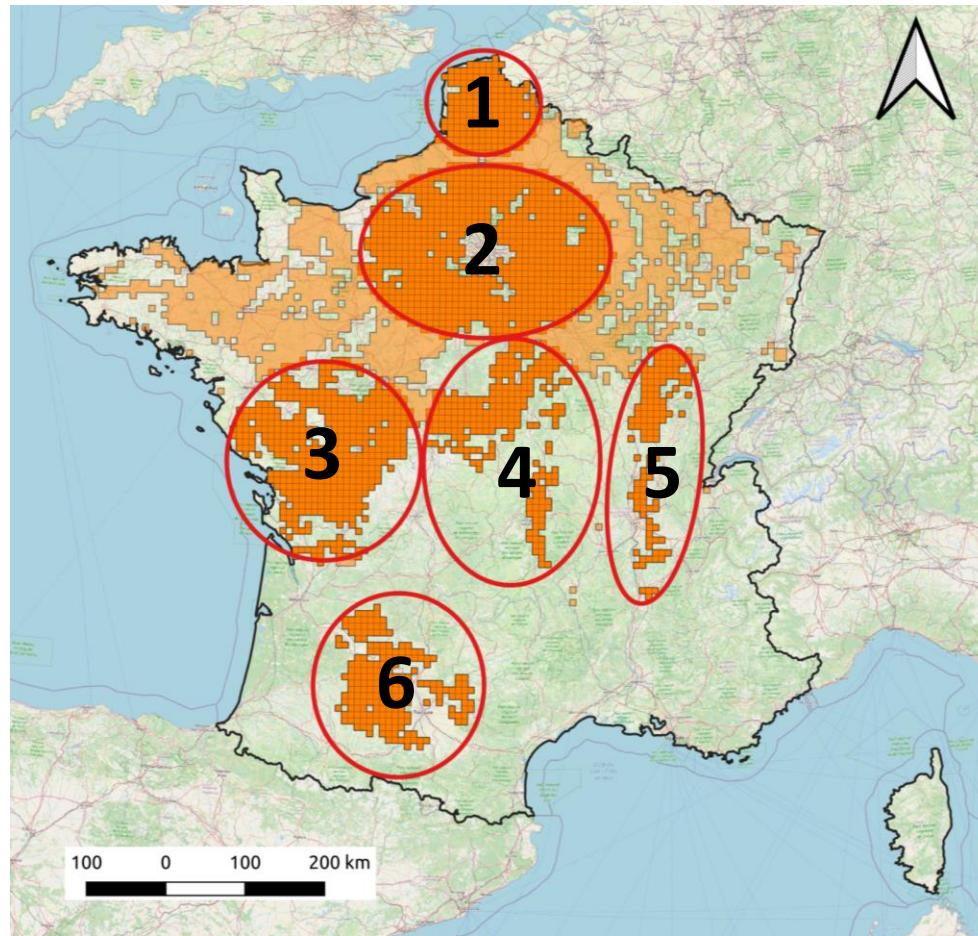
The role of evapotranspiration in the increase of water stress



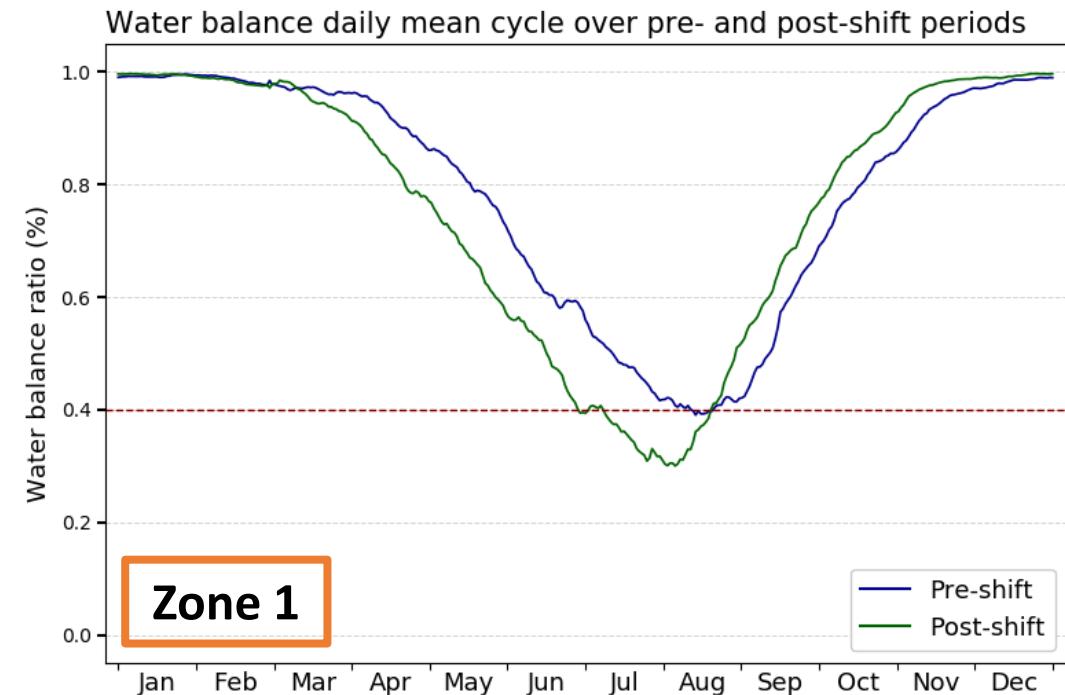
- Increase of water stress at the annual scale
- Seasonal disparities

Evolution of water balance of winter bread wheat

Temporal



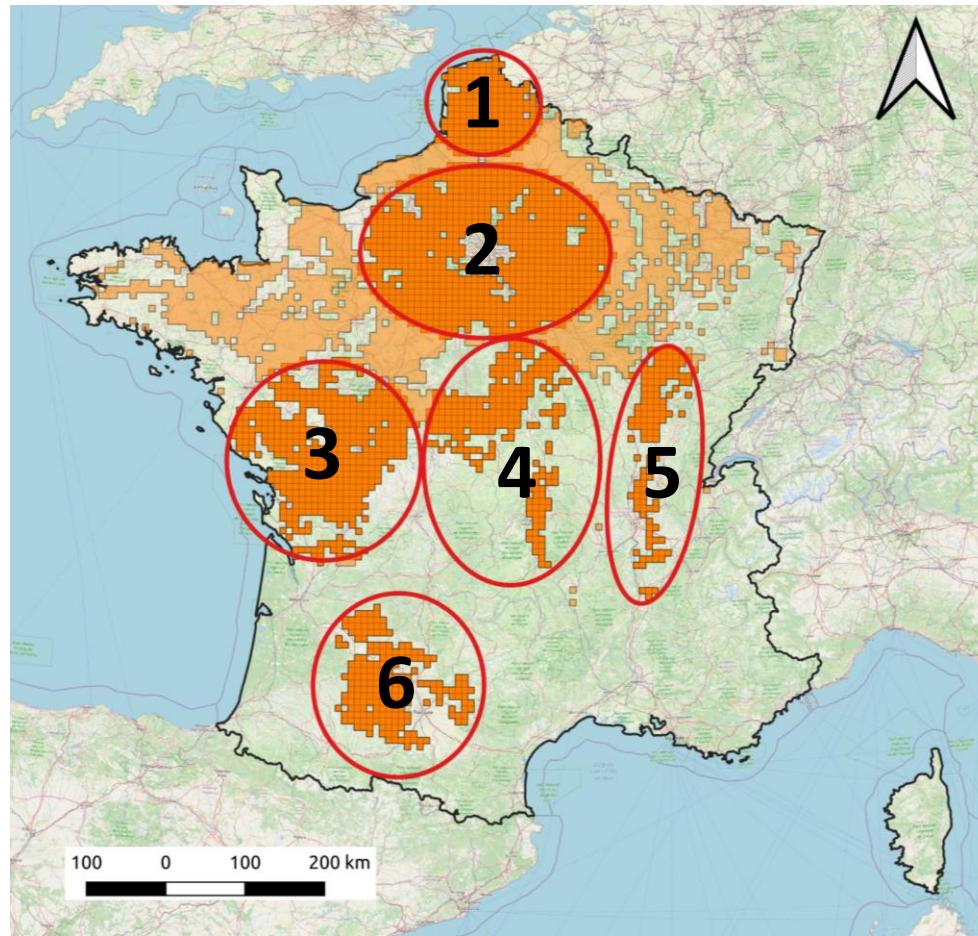
Main winter bread wheat production area



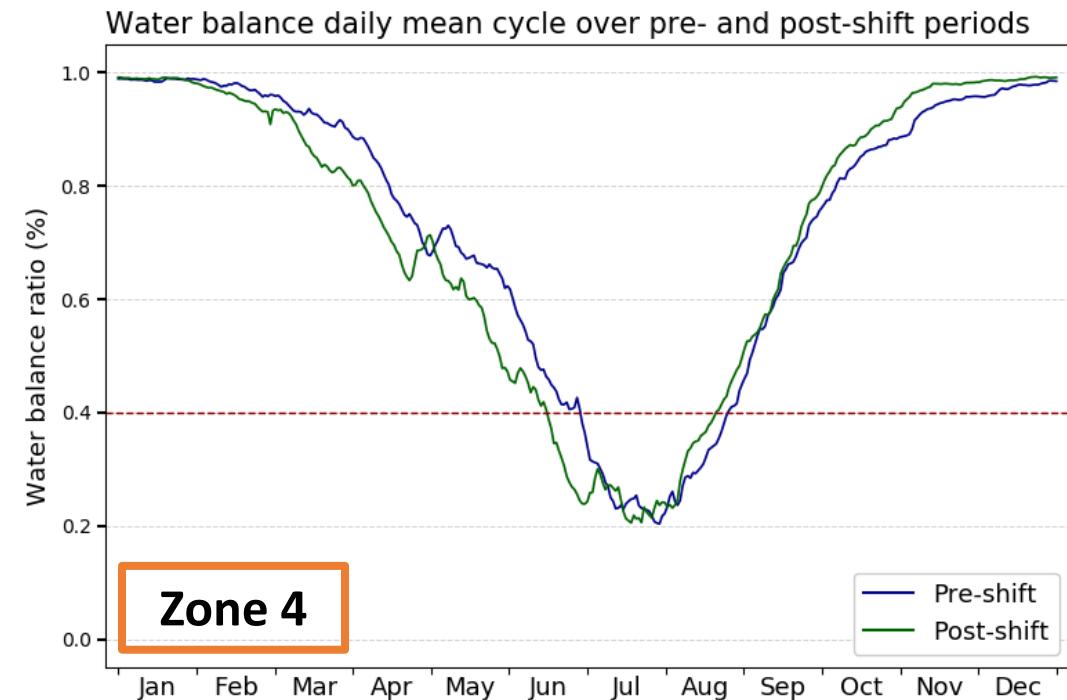
- **Spatial disparities** in the pattern of evolution of water balance
- **Apparition of hydric stress post-shift, longer and more intense event**

Evolution of water balance of winter bread wheat

Temporal



Main winter bread wheat production area

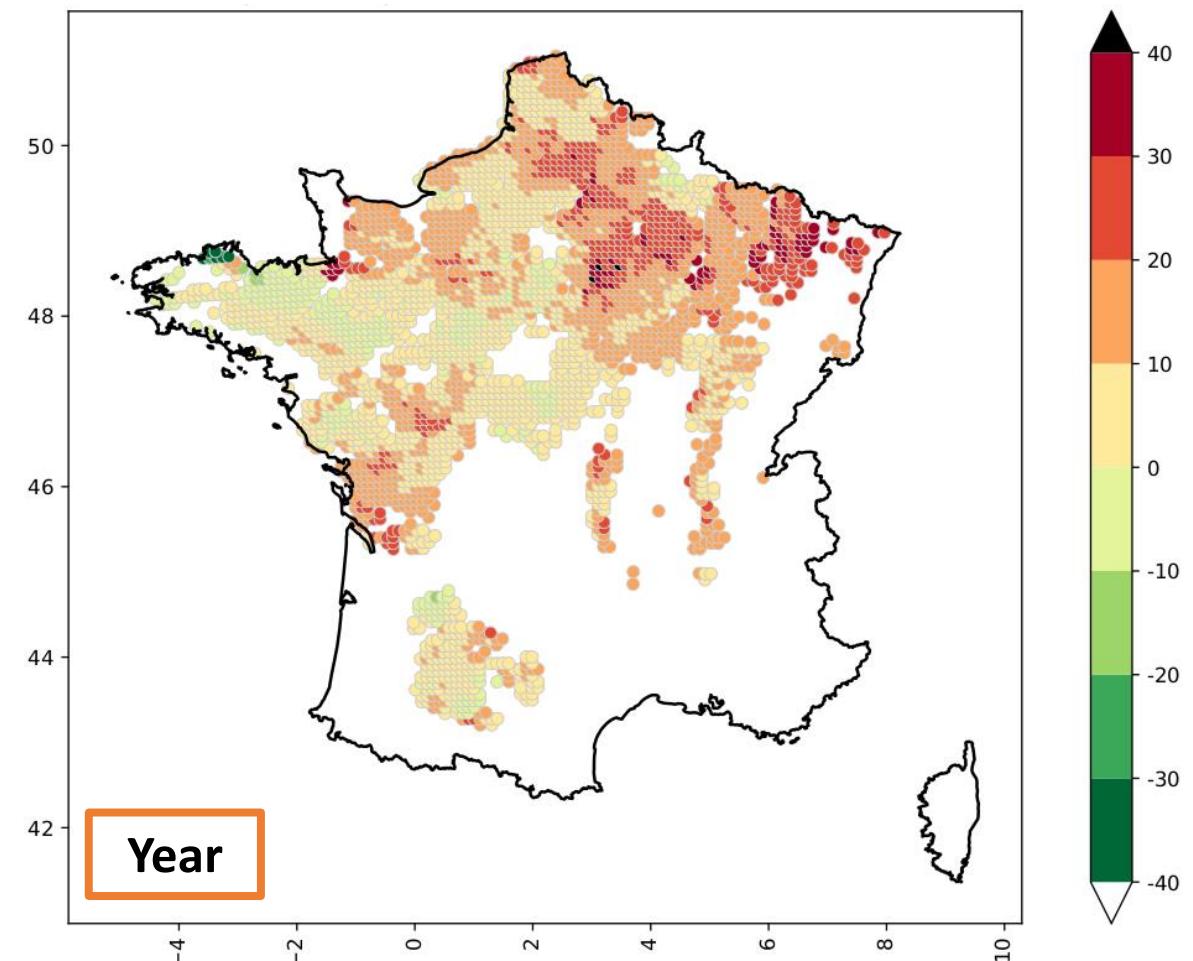


- **Offset in water balance daily mean cycle** regarding the 87/88 shift
- **Longer event of hydric stress**

Evolution of water balance of winter bread wheat

Spatial

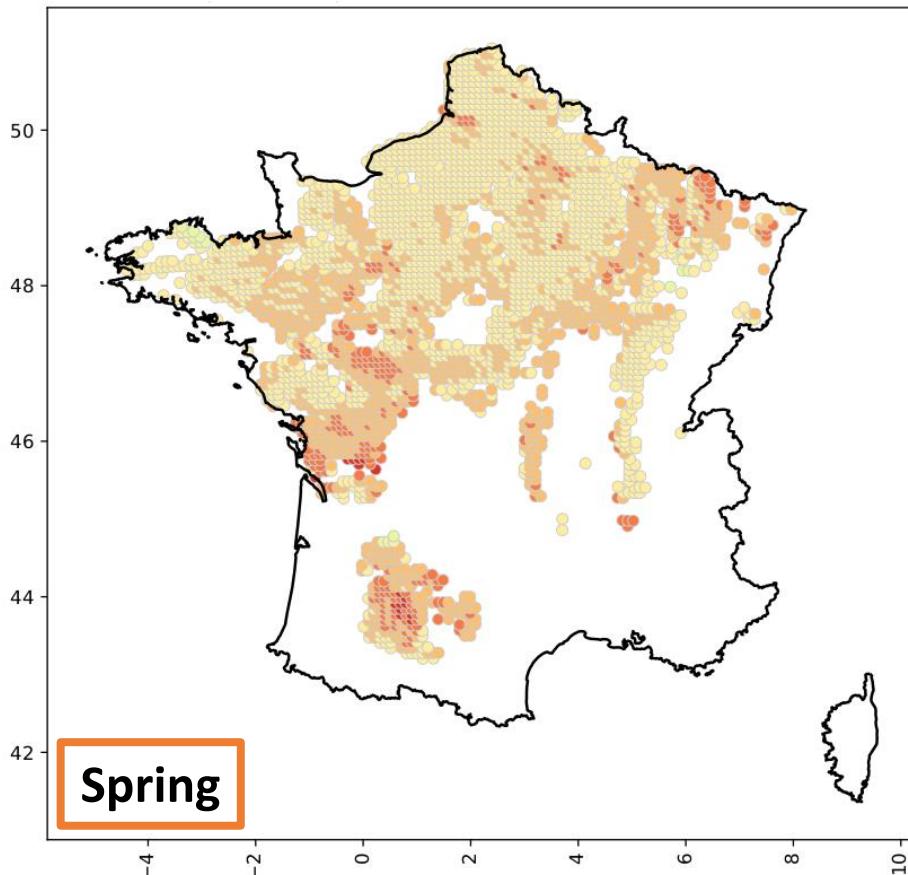
- Increase in number of days under hydric stress regarding the 87/88 shift over almost the entire territory at the annual scale
- North and Northeast of France particularly impacted: apparition of hydric stress after 87/88 shift



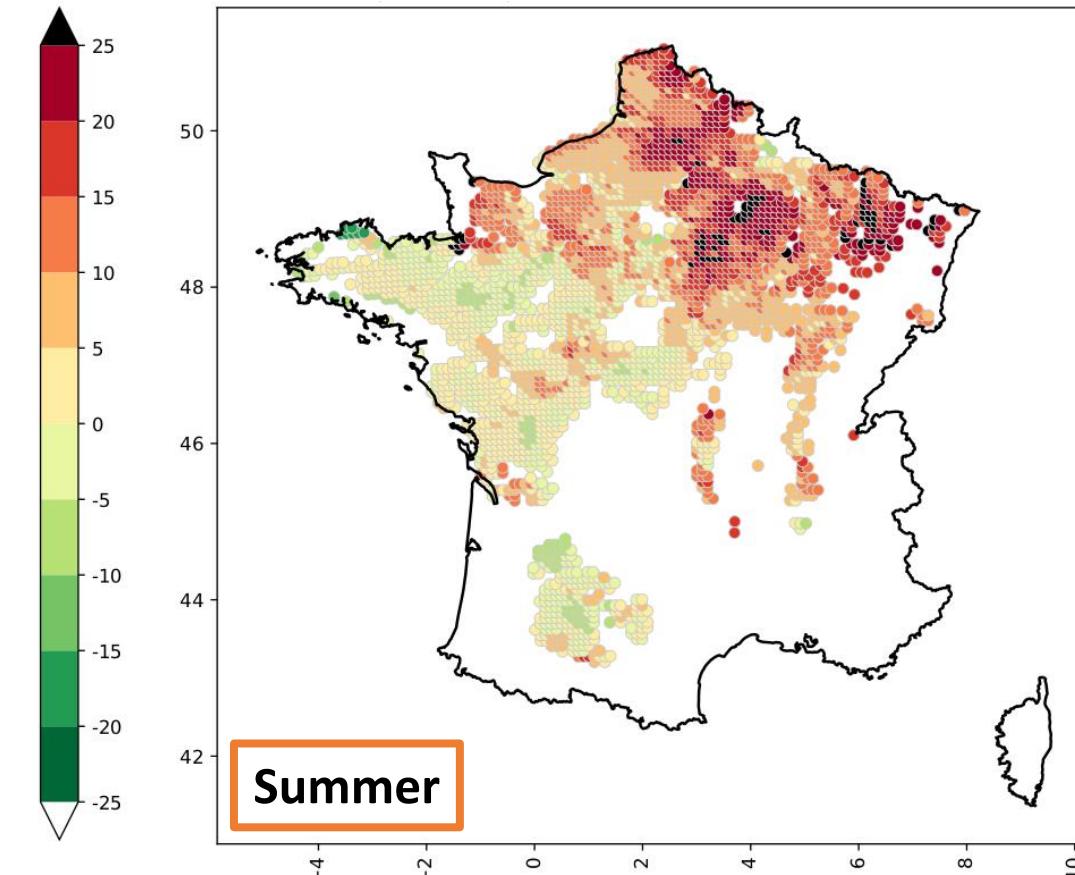
Yearly differences of number of days under hydric stress (post-shift - pre-shift) on winter bread wheat fields

Evolution of water balance of winter bread wheat

Spatial



Spring



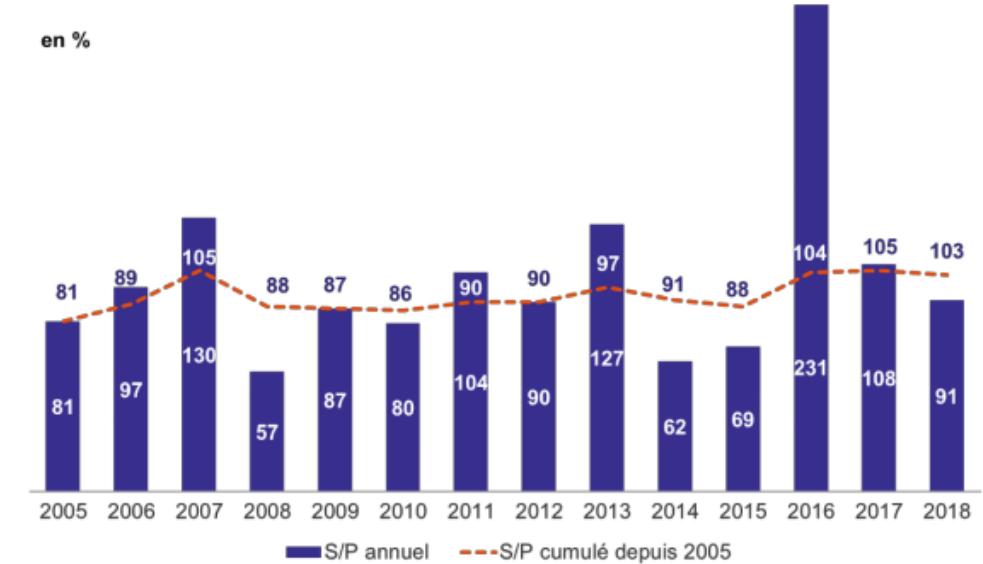
Summer

Seasonal differences of number of days under hydric stress (post-shift - pre-shift) on winter bread wheat fields

Conclusion

Modification of agro-climatic risk and impact on agricultural insurance performance

- **Impact of abrupt shift in air temperature on water stress and water balance**
- Modification of **length and intensity of hydric stress sequences** over main **winter bread wheat** production basin
- **Spatial disparities in modification of agro-climatic risk**
- Possible **impact on yields** and ultimately on **loss ratio** of MRC insurance



Results of MultiRisques Climatiques (MRC) insurance in France.
Létendart & Lelièvre, 2019.

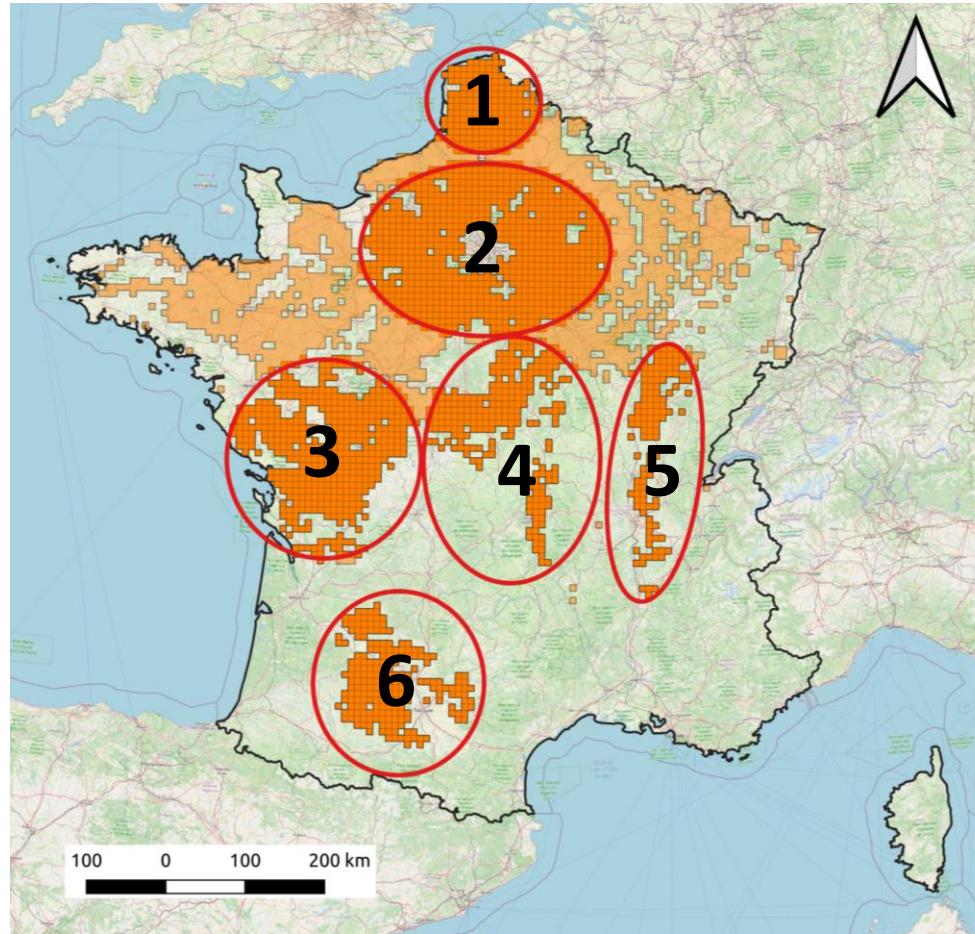
Bibliography

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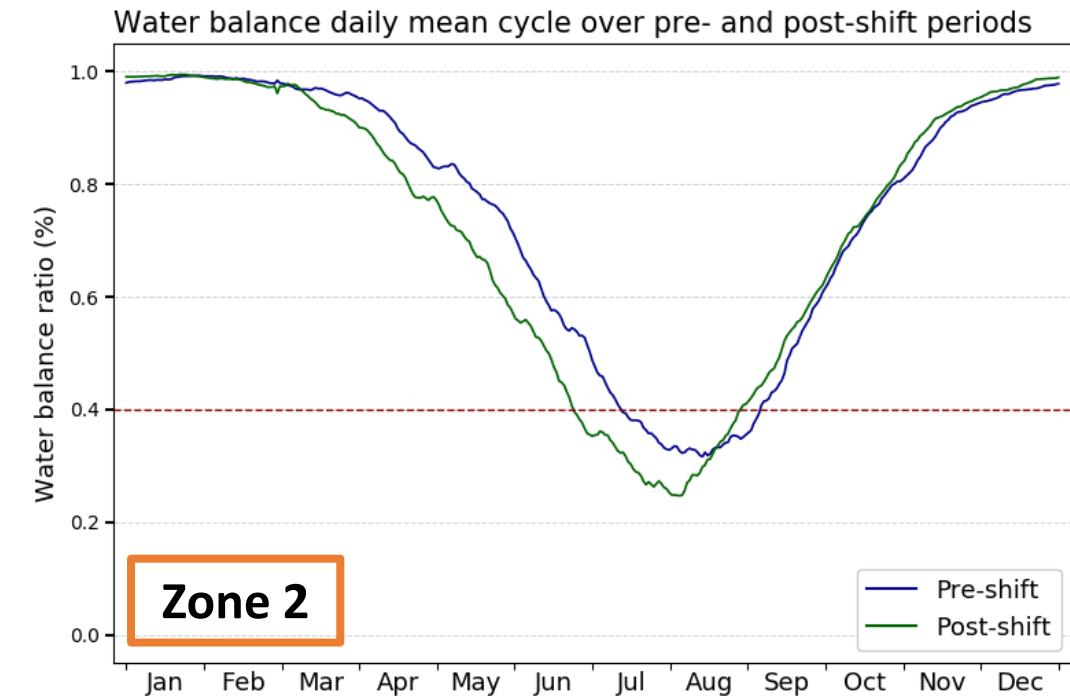
Annexes

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Temporal



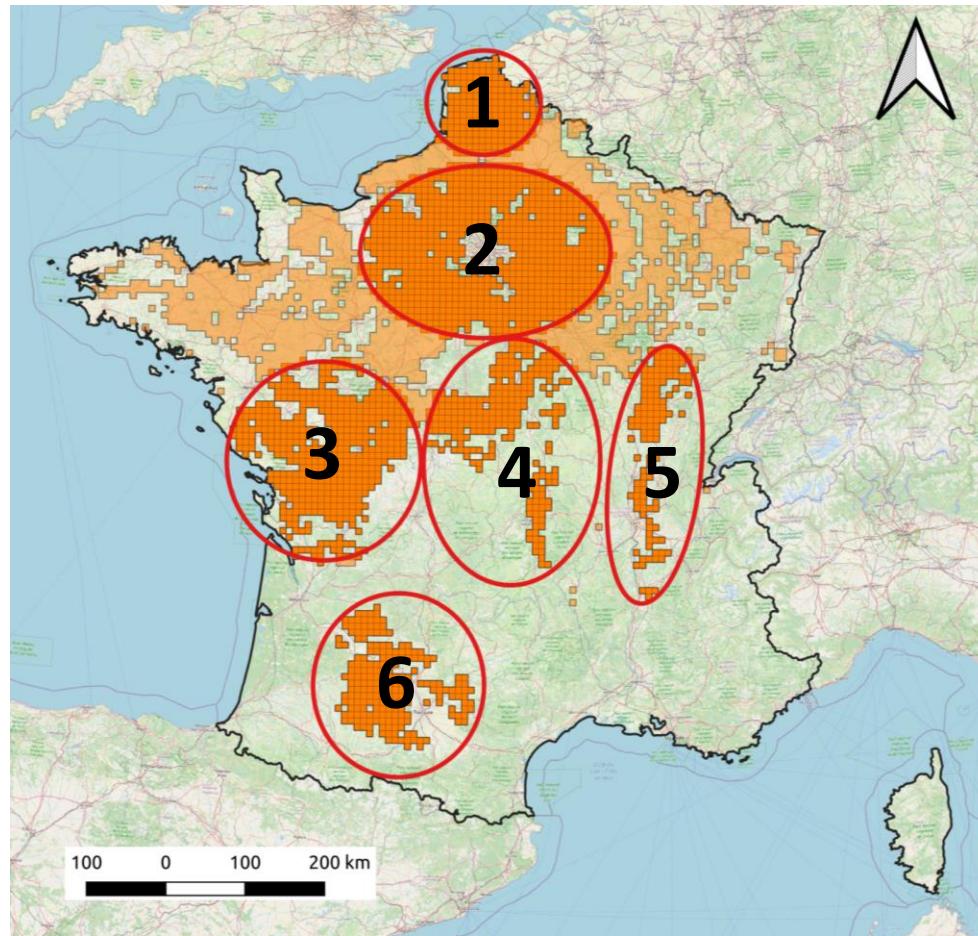
Main winter bread wheat production area



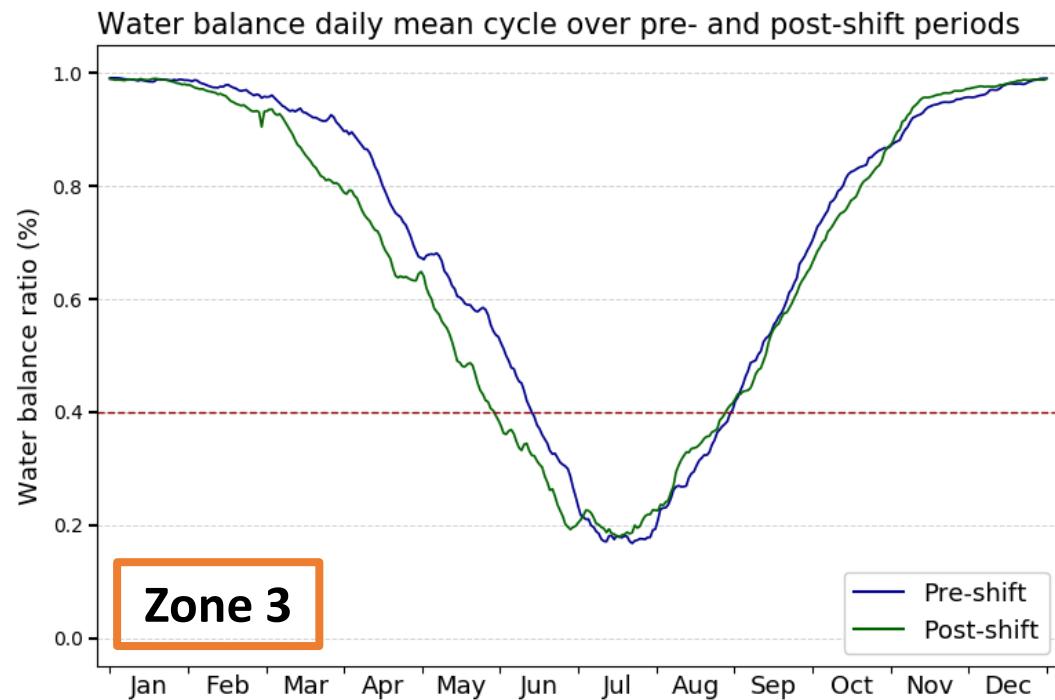
- notes

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Temporal



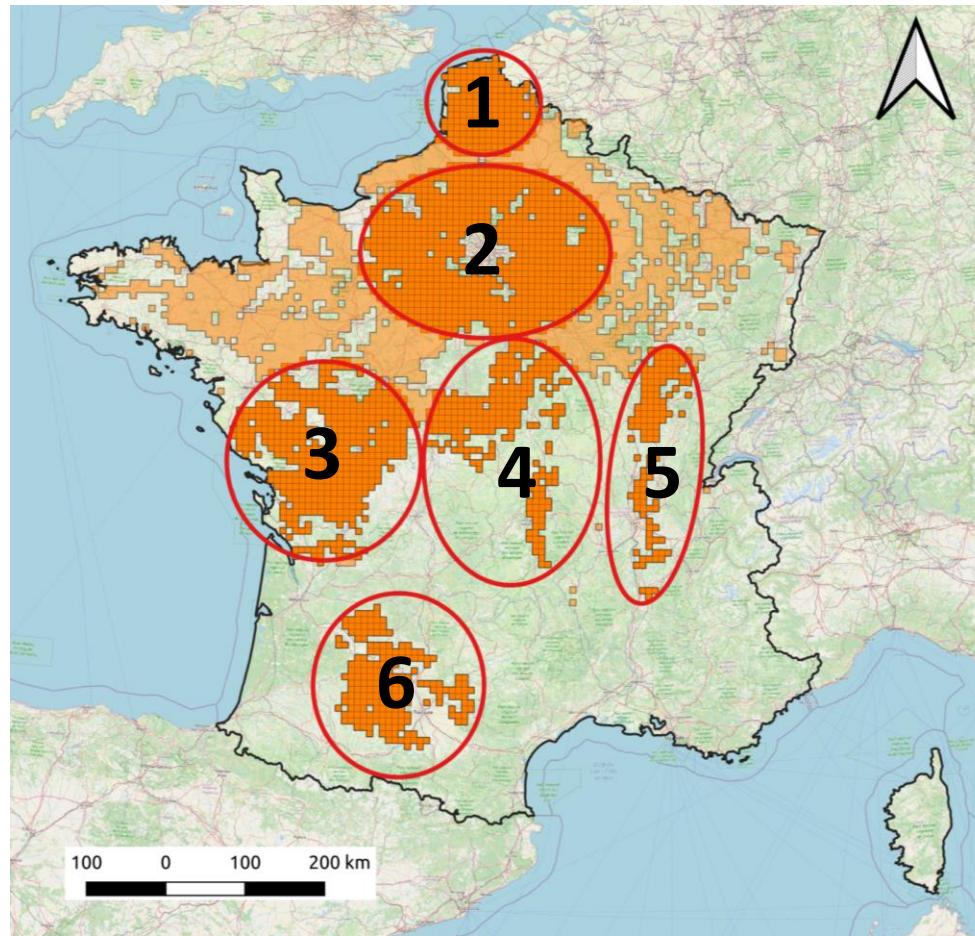
Main winter bread wheat production area



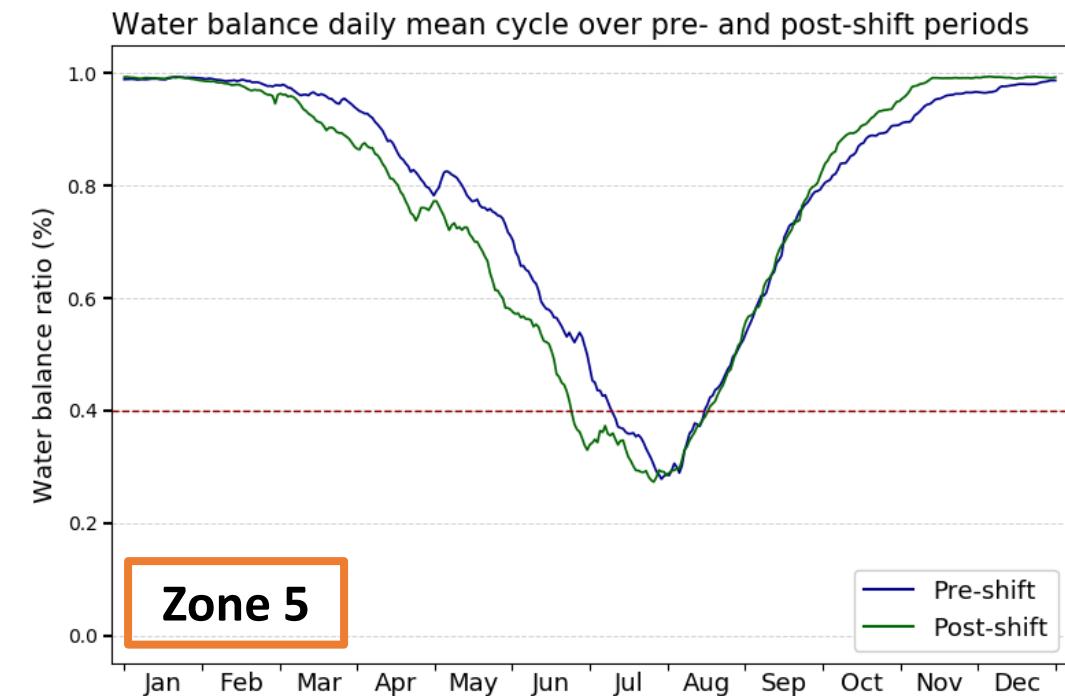
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Temporal



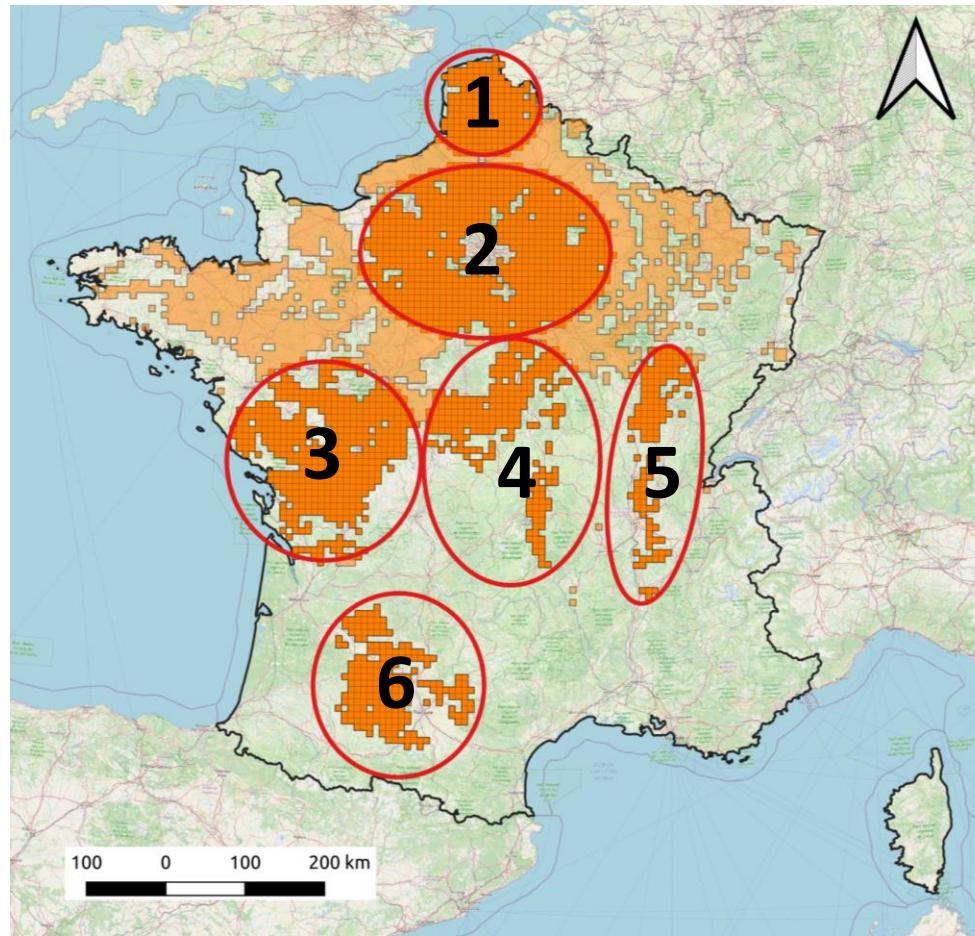
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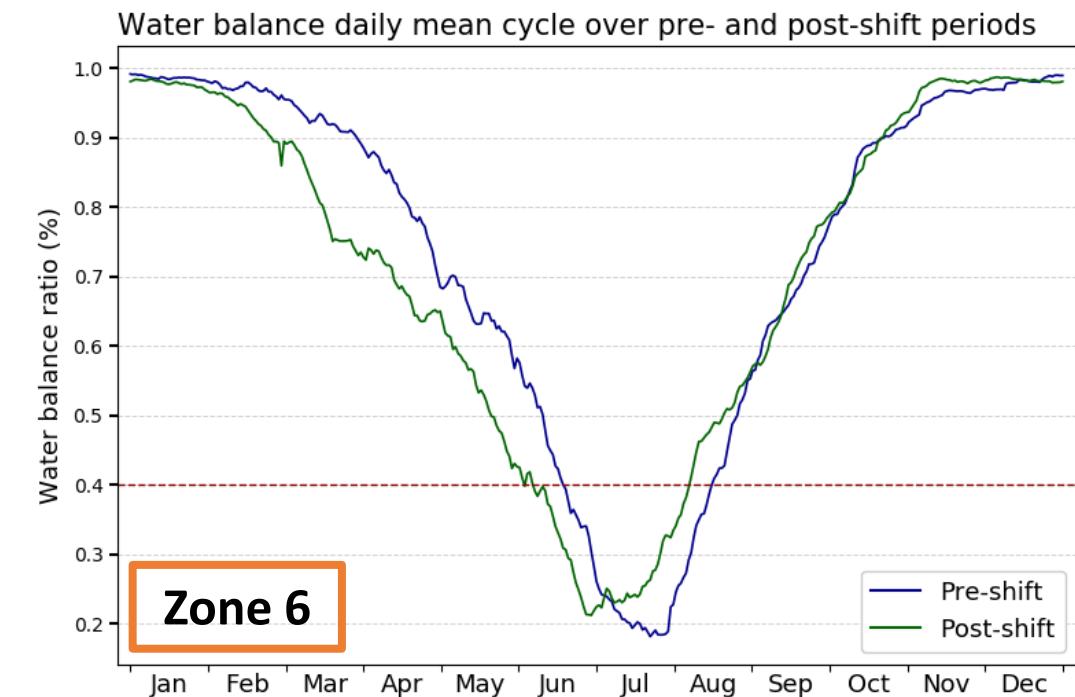
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Evolution of water balance of winter bread wheat

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Main winter bread wheat production area



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