

➤ French mountain pastoral regions facing climate change

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➤ Climate Change: Current Knowledge

Anticipating the consequences of climate change on water resources, plant resources, and livestock requires projections and indicators at a relevant spatial scale

**Climate
Change**



Update knowledge on climate change and its impact on hydrology, based on recent IPCC scenarios and scientific advances across the entire French territory throughout the 21st century

72 climate projections
9 surface hydrology models



VAACHERIN

Vulnerability, Adaptation and Mitigation to Climate Change in Ruminant and Pig Farming (*MP CLIMAE INRAE*)

4 contrasted climate projections from



RCP8.5, by 2050 (2041-2070)

70 agroclimatic indicators
On the scale of France's 714 small agricultural regions



INRAE

Mountain grassland & climate change

15 - 17 June 2026 / EAAP, Landquart (CH) / Veyssset et al.

➤ Main messages from



- As long as net greenhouse gas emissions continue, global warming will continue (with a sharper increase in the summer than in the winter, and a more pronounced increase in the southeast and in mountainous areas than in the northwest)

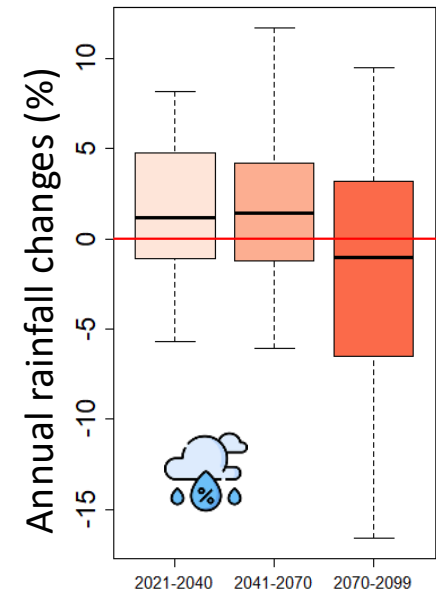
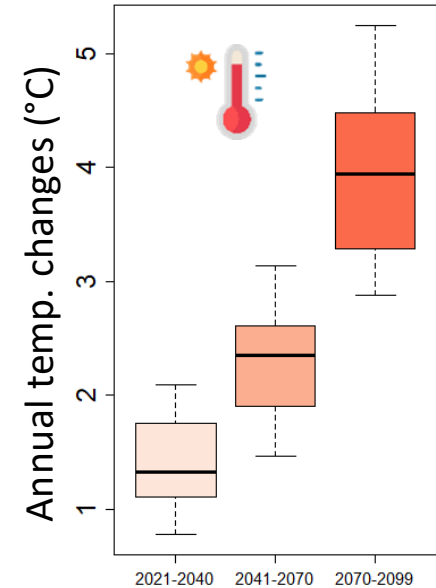
- Uncertainties regarding future precipitation trends across France due to its geographical location (transition zone)



- For moderate and high emission scenarios (RCP8.5), the majority of projections agree that by the end of the century
 - there will be an increase in winter precipitation
 - and a decrease in summer precipitation
 - A compensatory effect may occur with more contrasting seasons

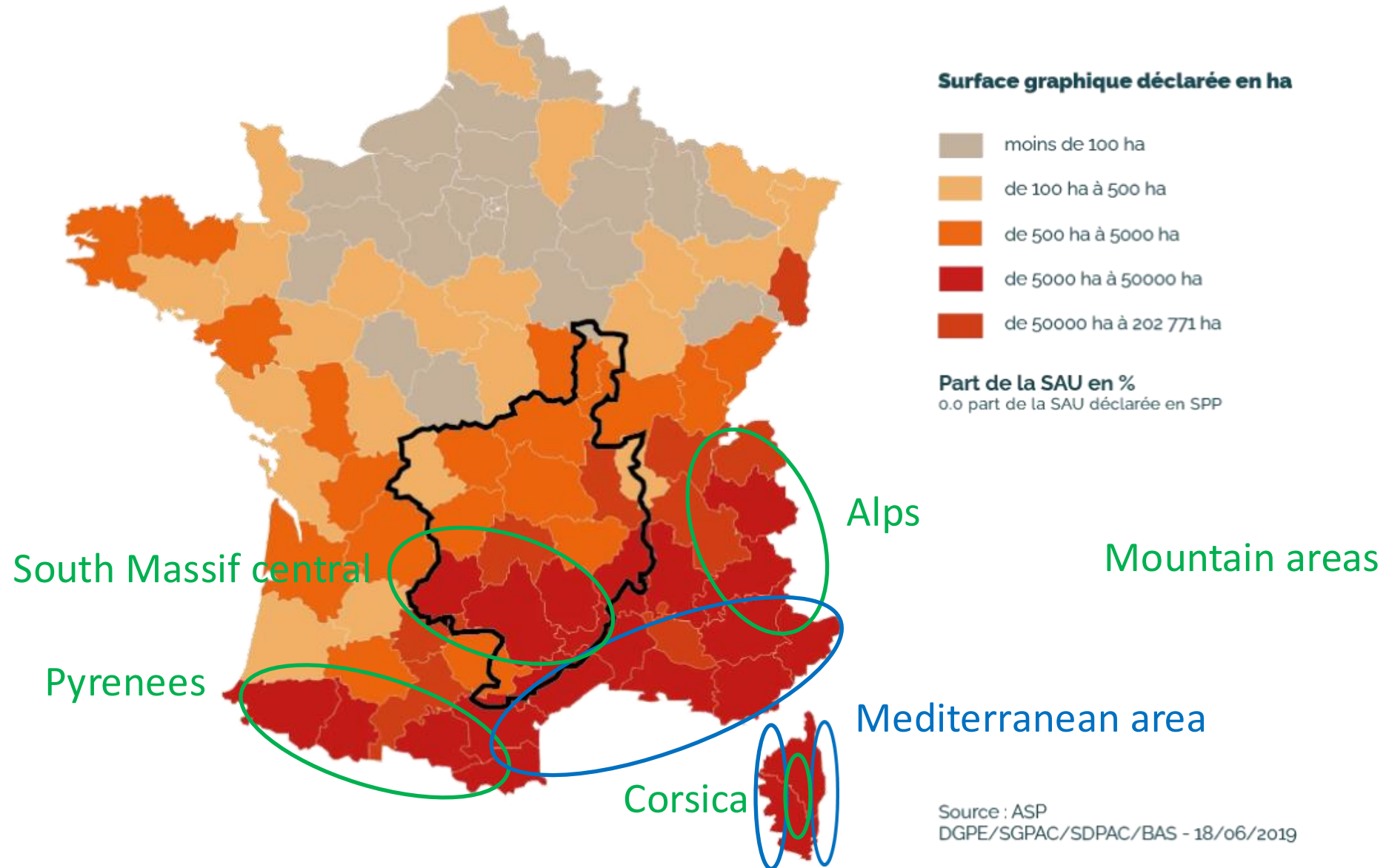


Year-to-year variability that will always exist and will affect hydrology and crops



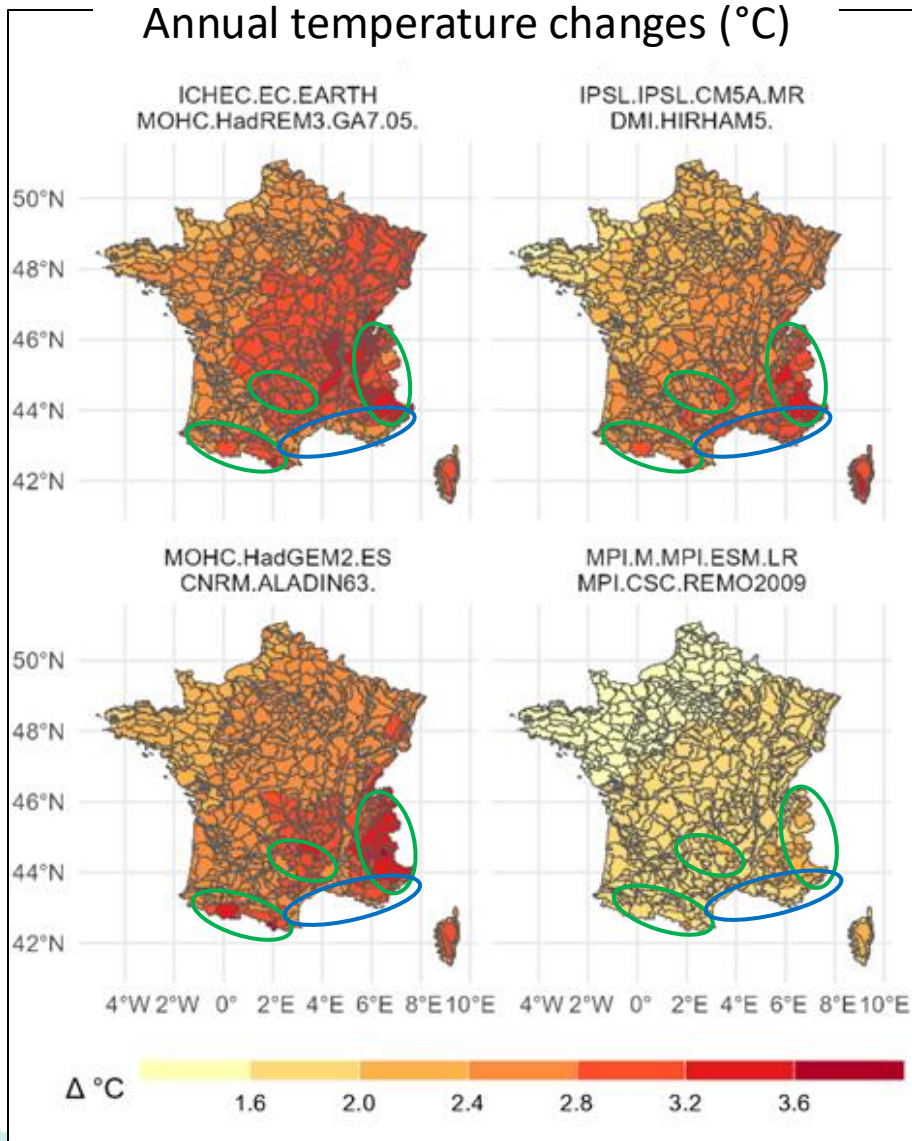
Mean
Mainland France
(base: 1976-2005)

➤ Pastoral areas in France (excluding permanent grasslands)



➤ Pastoral area in France

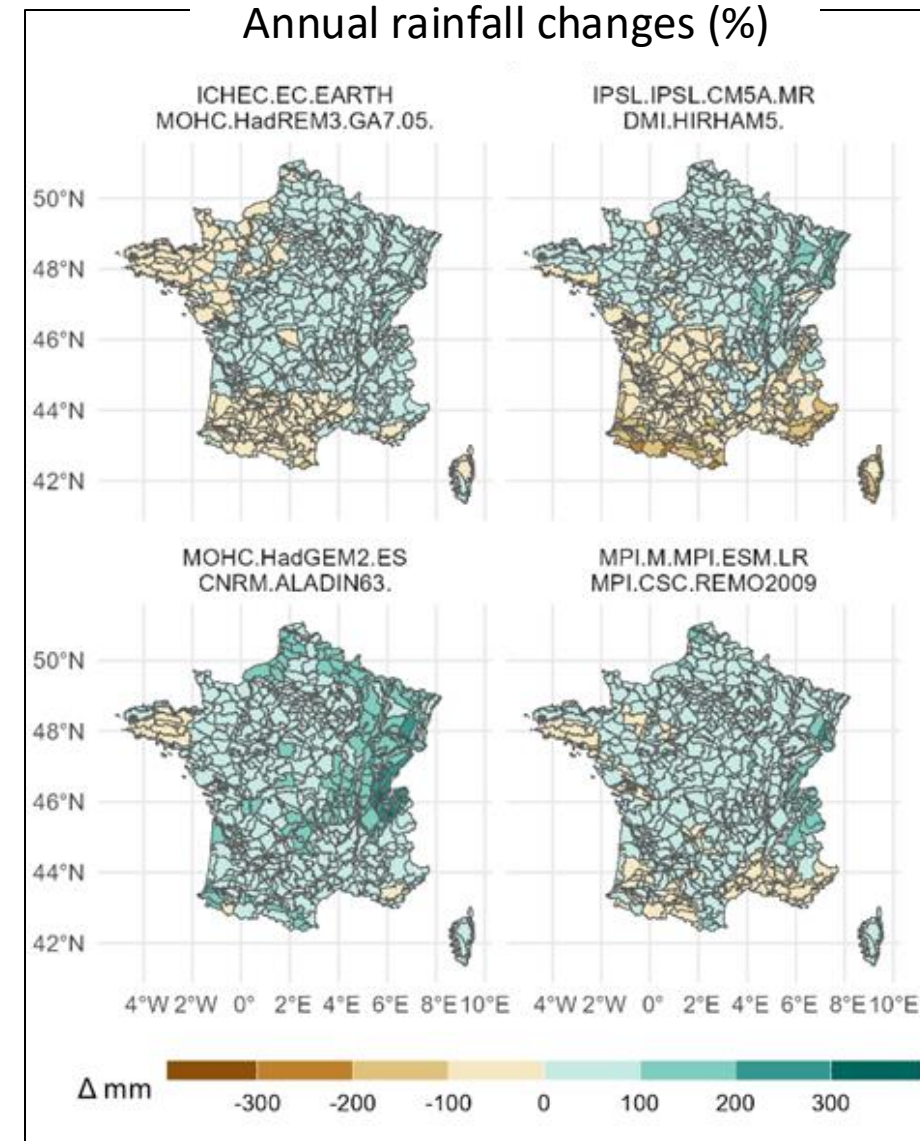
Climate trends by 2050 compared to the 1976–2005 reference period



Annual average warming is more pronounced (+2.0 to +3.5°C) than the national average (+1.5 to +3.0°C)

Little change in annual cumulative precipitation

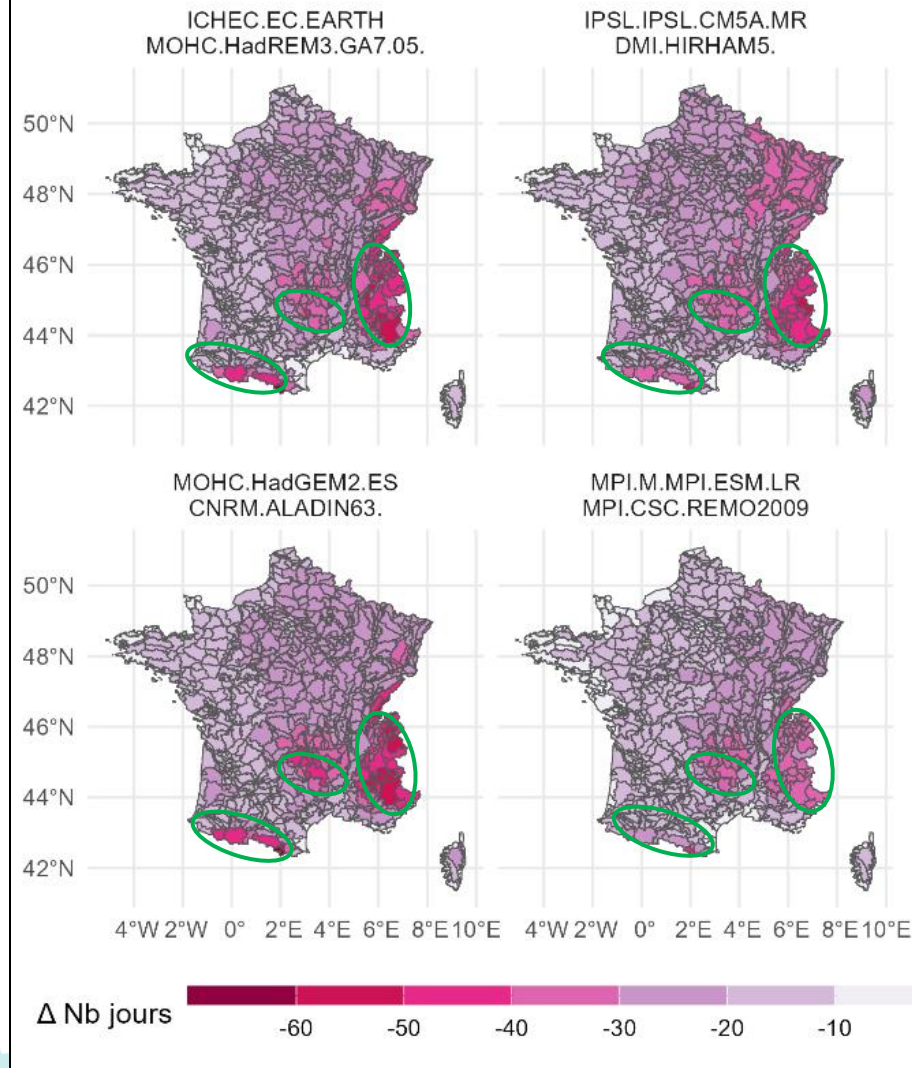
Increase in evapotranspiration
↓
less water potentially available in the soil and for rivers



➤ Pastoral area in France

Frost and heat by 2050 compared to the 1976–2005 reference period

Number of days with frost



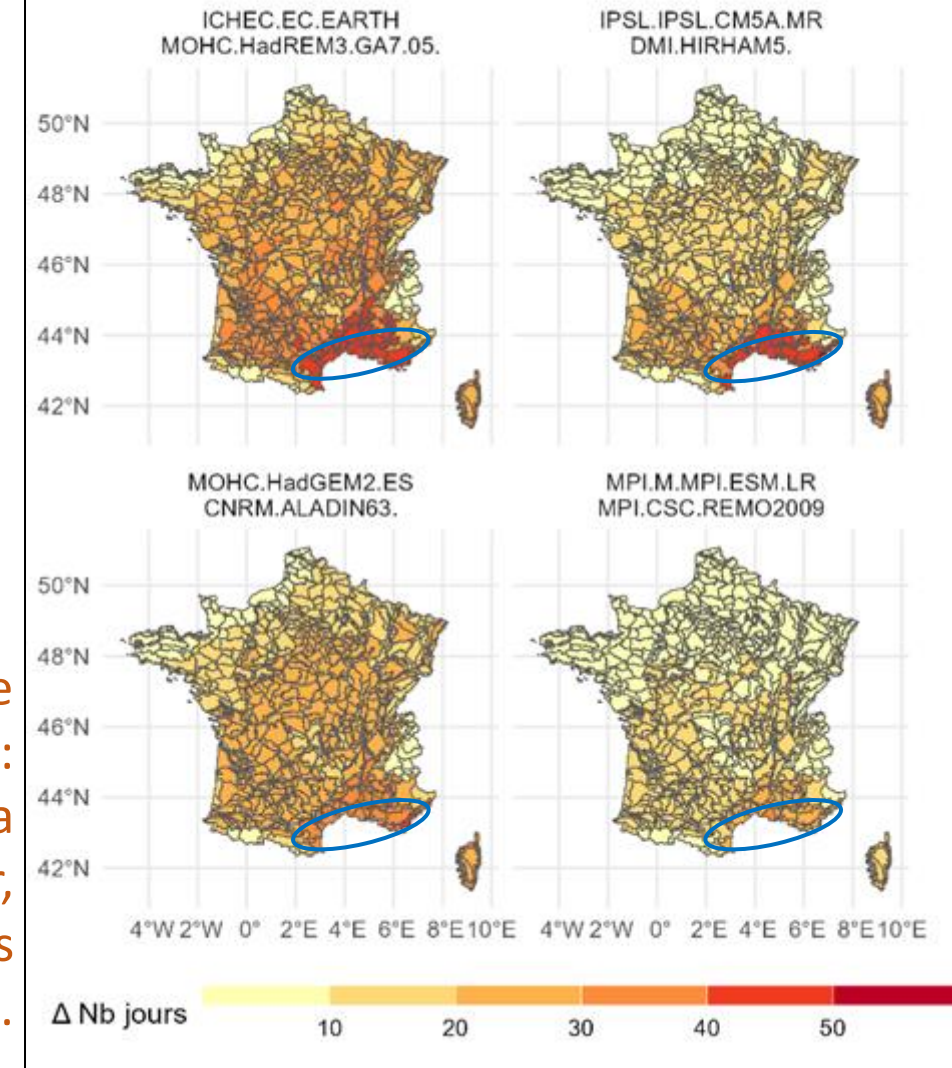
30 to 45 fewer days of frost per year in the mountains.

Average date of the first autumn frosts: 15 to 30 days later (first half of November)

Last spring frosts: 5 to 15 days earlier (mid-April on average)

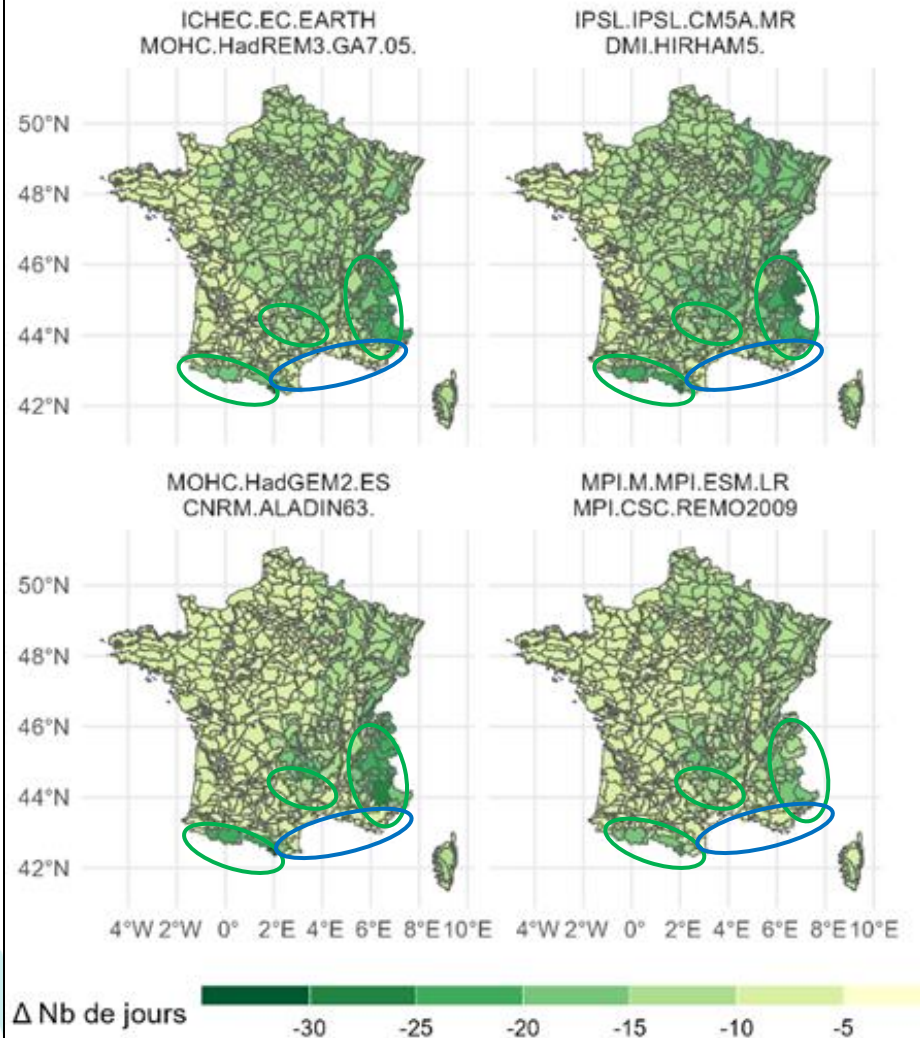
Very hot days in the “Mediterranean region”: +25 to +45 days/yr for a total of 45 to 70 days/yr, including 10 to 20 days with $T^{\circ}\text{max} > 35^{\circ}\text{C}$.

Number of very hot days ($T^{\circ}\text{max} > 30^{\circ}\text{C}$)



➤ Pastoral area in France and climate change Possible consequences for grass and grazing (2050 vs reference)

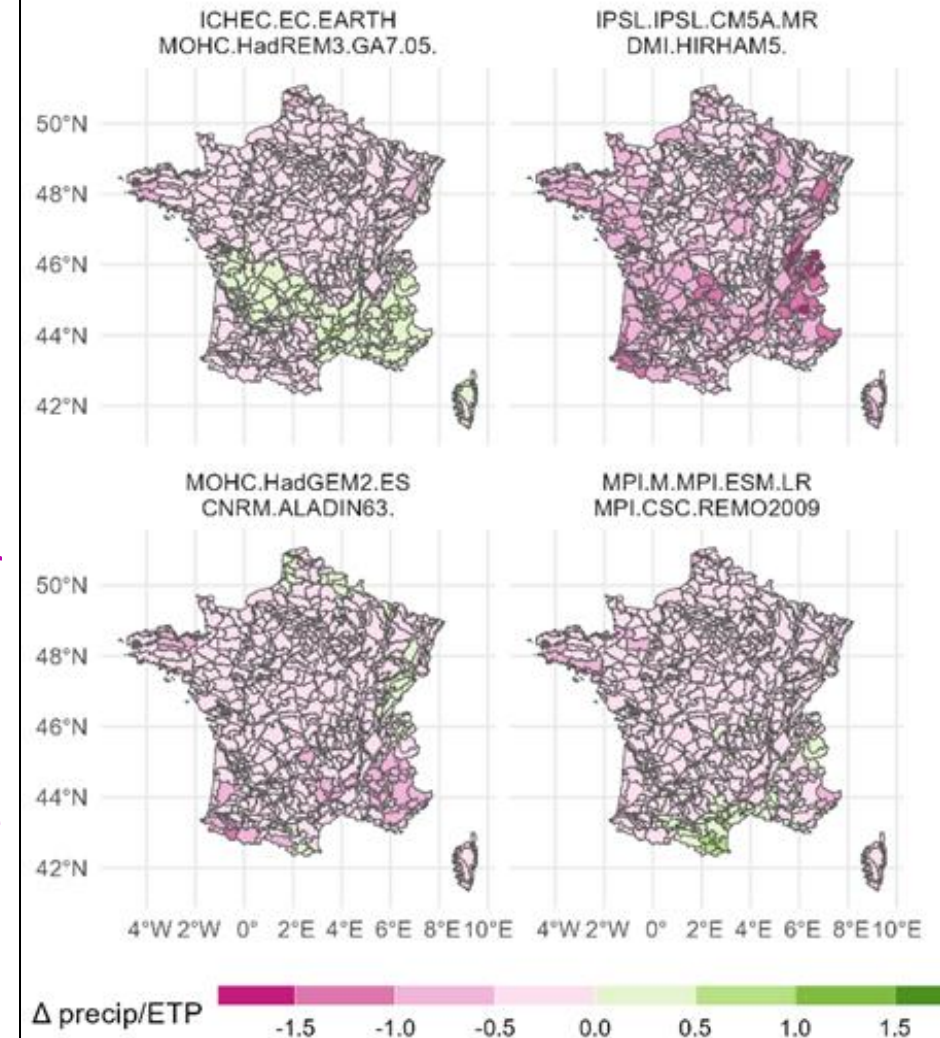
Date of turnout to grass



Rising temperatures →
earlier turnout to grass of
livestock (15 to 20 days
earlier in mountain areas)
Move up to the high
mountain pastures: late
May, or even earlier
depending on the reduction
in the snow cover period

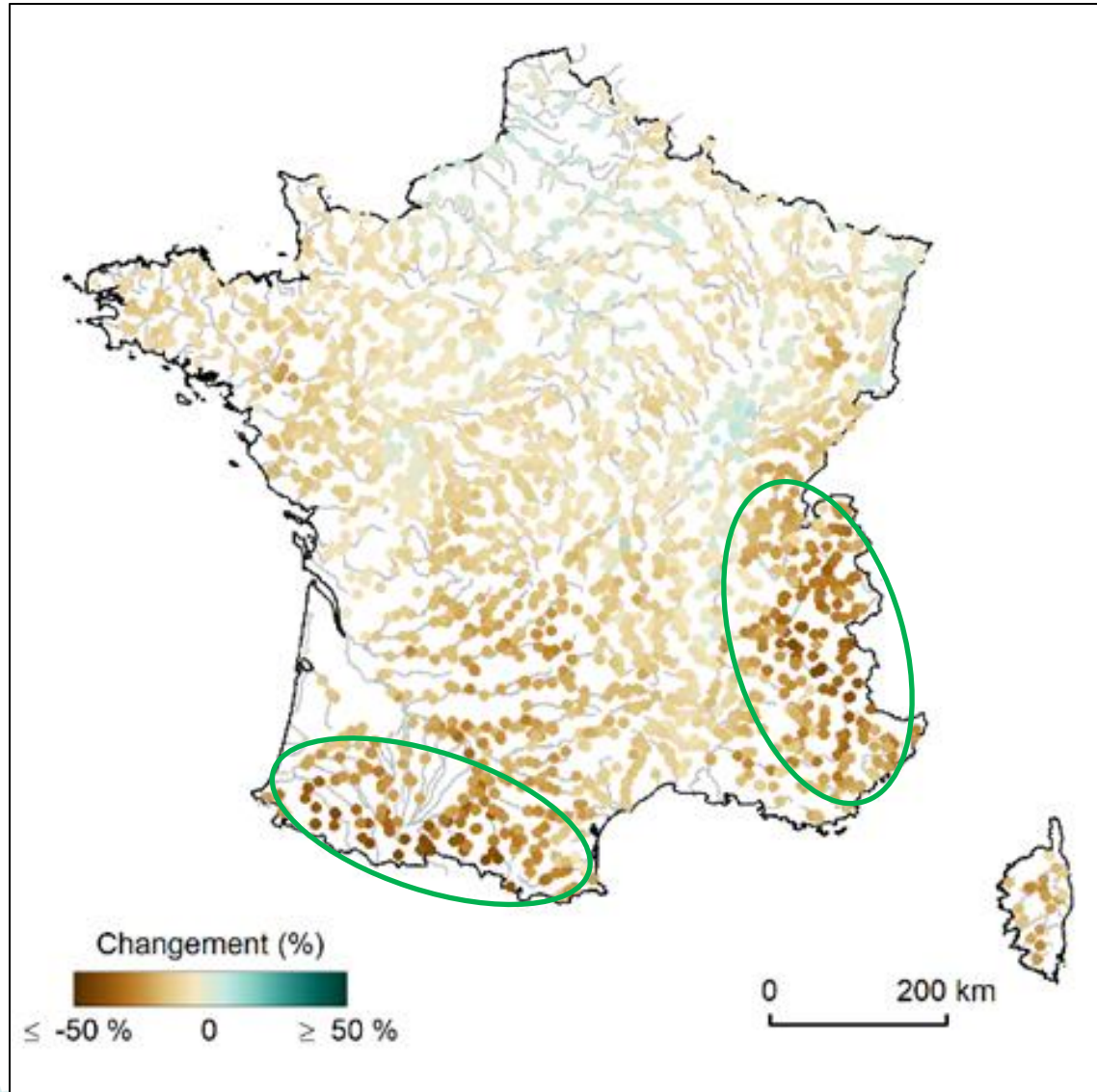
Water availability for
pastures: a key factor in
late summer for extending
the grazing season and take
advantage of the late
arrival of the first frosts.
This water availability will
be uncertain

Water availability for pastures in autumn



➤ Pastoral area in France and climate change

Water availability: Possible changes in summer river flows (2050 vs reference)



- ↗ evapotranspiration
 - ↘ summer precipitation
 - ↘ snow cover
- } hydrological droughts

Summer river flow (average flow over the months of June, July, and August) could decrease by up to 40% by 2050 compared to the 1976–2005 baseline in the Alps as well as in the Pyrenees → infrastructures to retain and store water?

On dairy mountain pastures, the summer decline in water flow could become a problem for cleaning milking and cheese-making facilities, as well as for the drinking water supply for shepherds

- ↗ mental strain and workloads for livestock farmers

➤ Pastoral area in France and climate change

Conclusion

- The more greenhouse gas emissions increase, the more severe the effects of climate change will be.
- Various projections for 2050 indicate, with a high degree of confidence, warming across mainland France, as well as an increase in soil and hydrological droughts due to a decline in summer rainfall and a rise in evapotranspiration.
- These changes in mainland France are particularly pronounced in mountainous areas.
- The later onset of the first frosts, and the earlier start of vegetation growth could allow for the use of grass over a longer period during the year and keep animals in summer pastures longer.
- If late-summer rains fail to materialize (uncertainty, temporal and regional variability), autumn regrowth will not be guaranteed.
- Water management for livestock watering can be a major challenge, even in mountain areas.
- Over the coming decades, the livestock sector will not have to contend with climate change alone. The socioeconomic environment of agriculture is constantly evolving, and all sectors will need to adapt to climate, economic, and demographic trends and uncertainties.

