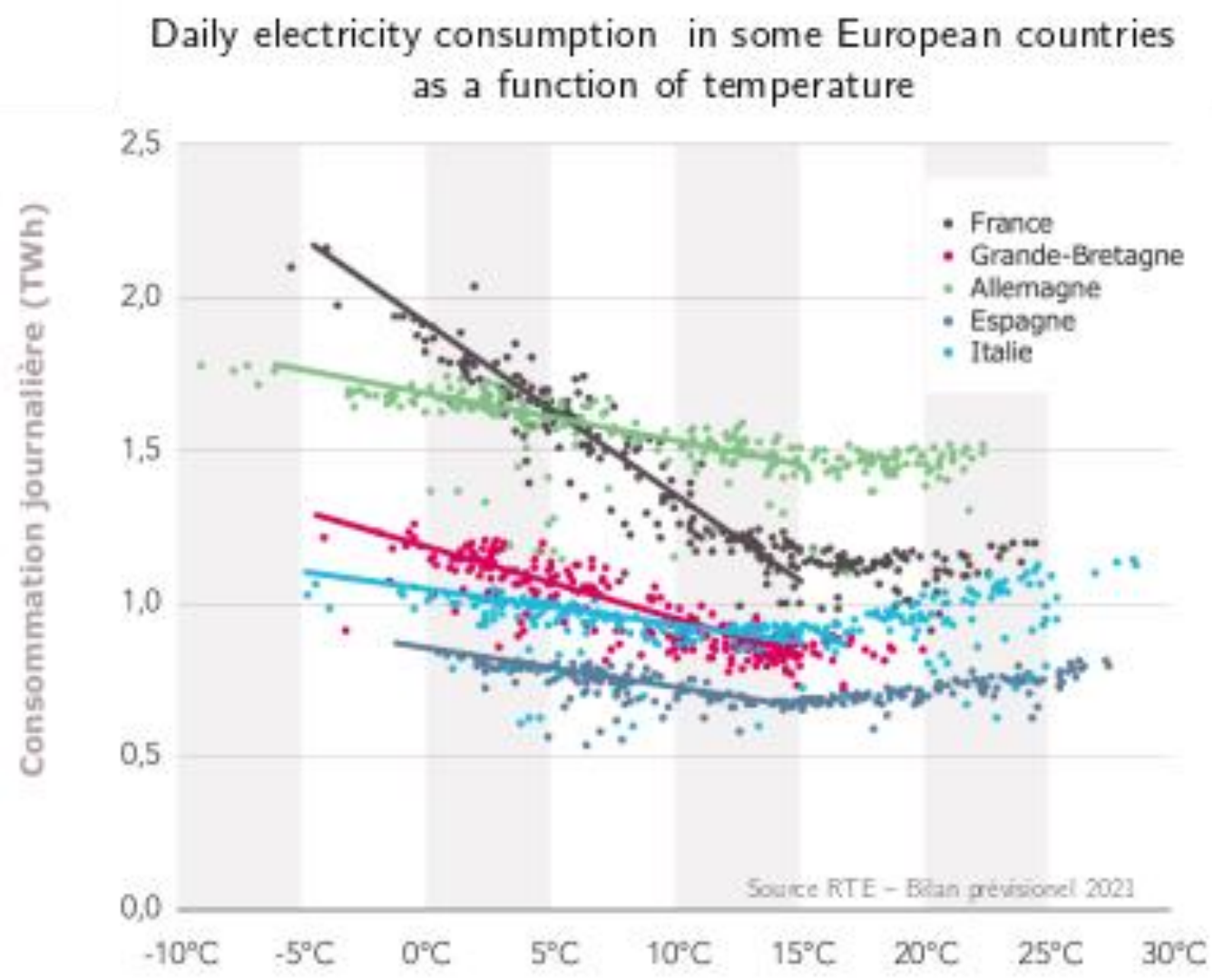


Impacts of climate change on the temporal fragmentation of electricity demand in Europe

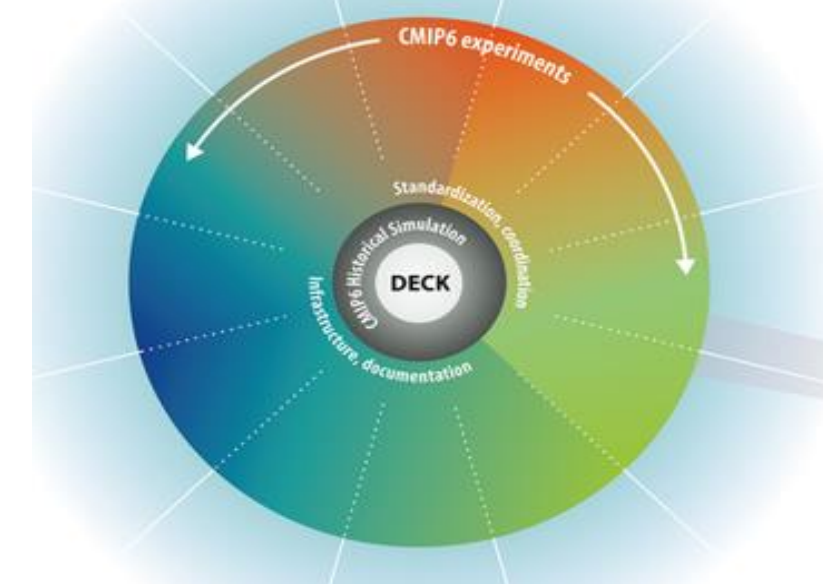
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1. CONTEXT



2. DATA

CMIP6 simulations



4 SSP scenarios
(SSP5-8.5, SSP3-7.0,
SSP2-4.5 et SSP1.26)

3 variables
(T° , T_{max}° , T_{min}°) 10 models
Selected

Downscaled and bias
corrected data using ERA5

3. METHODS

Winter (ONDJFM)

HDD

Indicators

CDD

$$T_{threshold,H} = 15.5^\circ\text{C}$$

$$T_{threshold,H} - Tas_{i,t}$$

$$(T_{threshold,H} - Tas_{min,i,t})/2 - (T_{asmax,i,t} - T_{threshold,H})/4$$

$$(T_{threshold,H} - Tas_{min,i,t})/4$$

$$0$$

$$T_{threshold,c} = 22^\circ\text{C}$$

$$Tas_{i,t} - T_{seuil,C}$$

$$(T_{threshold,C} - Tas_{min,i,t})/2 - (T_{asmax,i,t} - T_{threshold,C})/4$$

$$(T_{threshold,C} - Tas_{min,i,t})/4$$

$$0$$

$$T_{threshold,H} \geq Tas_{max,i,t}$$

$$Tas_{i,t} \leq T_{threshold,H} \leq Tas_{max,i,t}$$

$$Tas_{min,i,t} \leq T_{threshold,H} \leq Tas_{i,t}$$

$$T_{threshold,H} \leq Tas_{min,i,t}$$

$$T_{threshold,c} \leq Tas_{min,i,t}$$

$$Tas_{min,i,t} \leq T_{threshold,c} \leq Tas_{i,t}$$

$$Tas_{i,t} \leq T_{threshold,c} \leq Tas_{max,i,t}$$

$$Tas_{max,i,t} \leq T_{threshold,c}$$

Heating use

More than two days with
successive HDD > 1°

2 periods

Air conditioning use

More than two days with
successive CDD > 1°

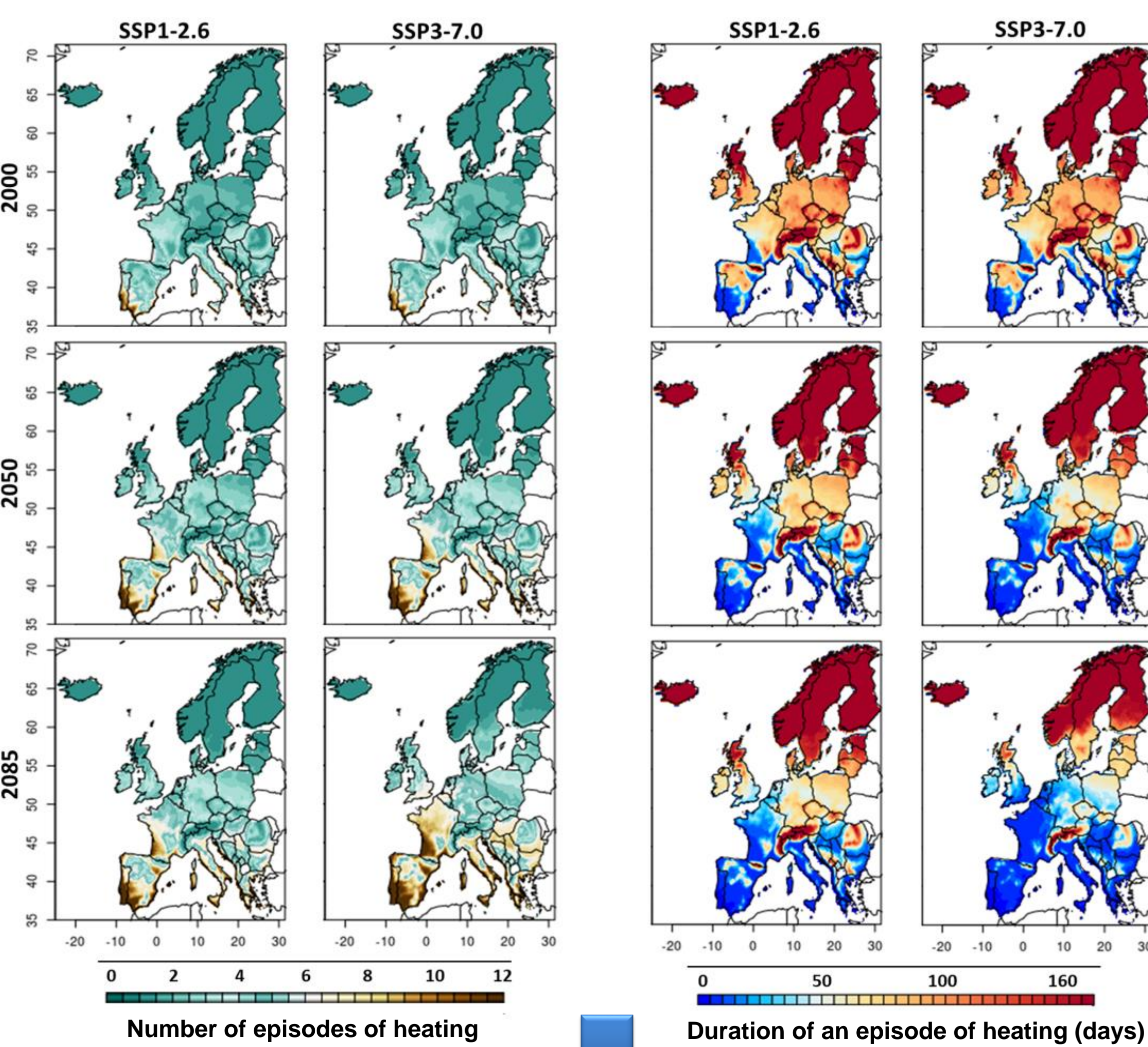
Summer (AMJJAS)

4. RESULTS

Heating use

A. The number of episodes

B. The average duration

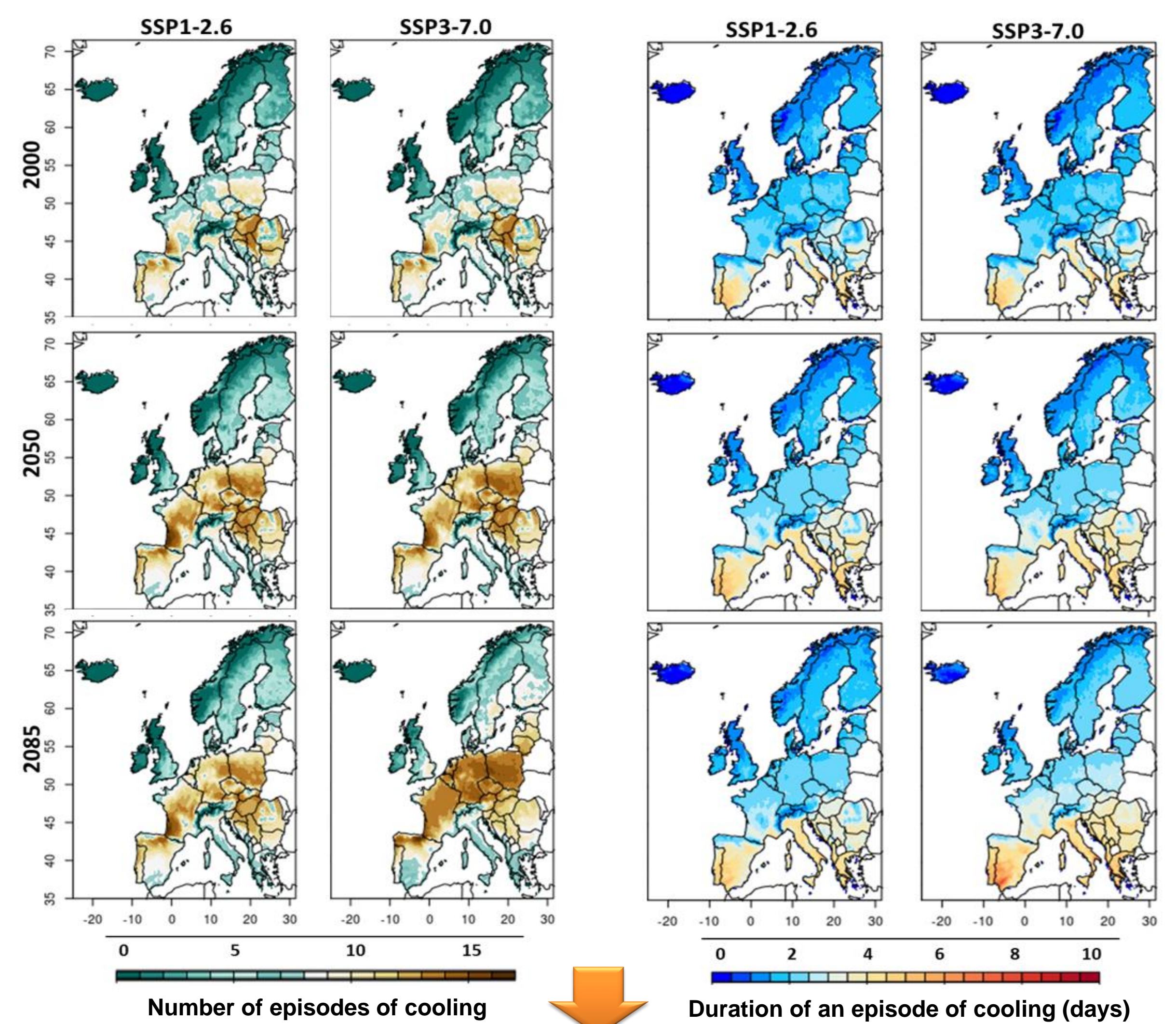


- In the future, the periods of heating use will become more fragmented in winter under the $T_{threshold,H}$ & $T_{asmax,i,t}$ scenarios.
- The periods of non use heating will become also longer in several regions of Europe.
- The periods of air conditioning use will become more frequent and longer in the future.

Air conditioning use

A. The number of episodes

B. The average duration



Energy system challenges

Electric system flexibility

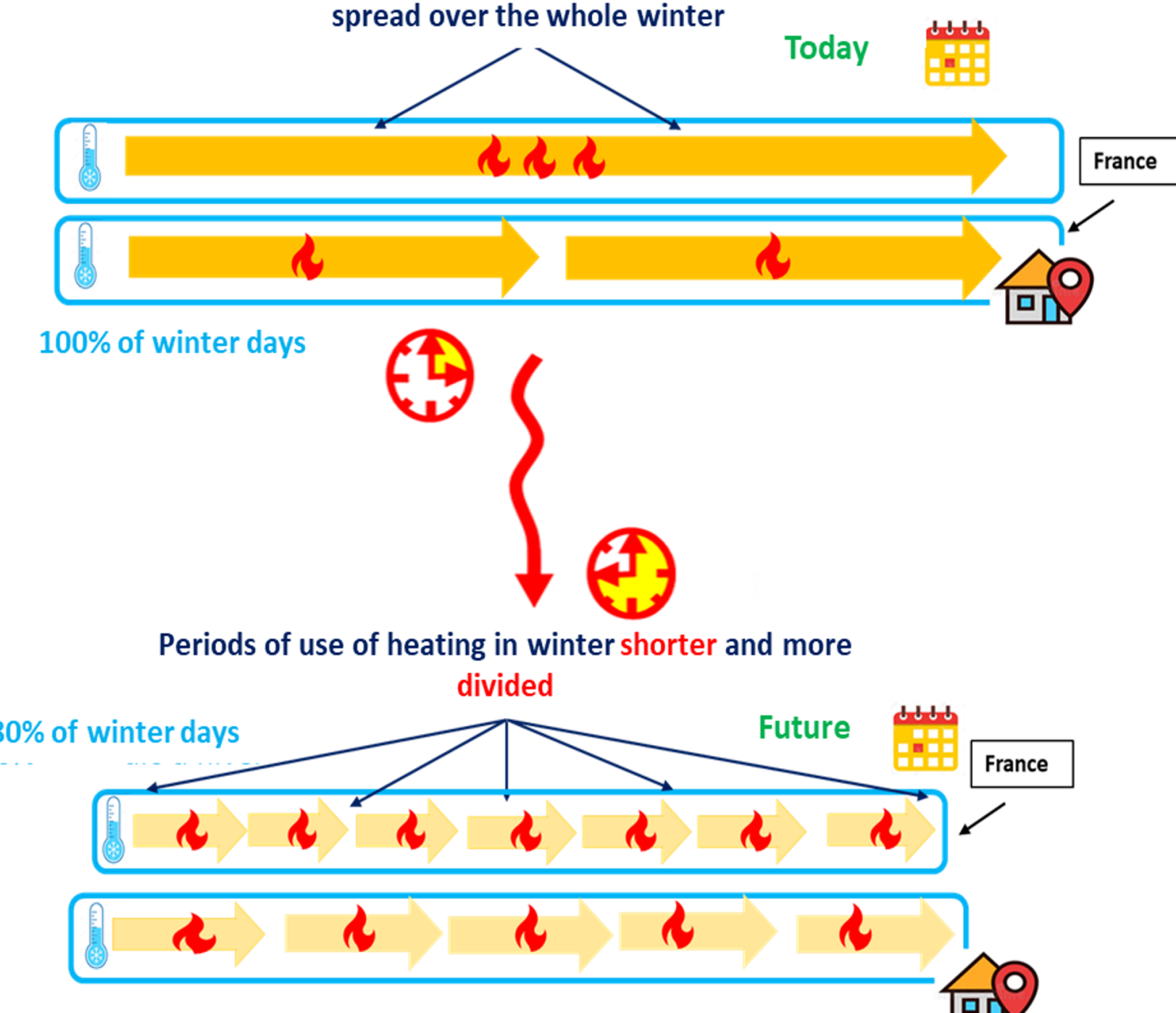
massive deployment of renewable energies + fragmented and variable demand --> A need for flexibility and manoeuvrability for the balance of the supply-demand

Economic cost of flexibility needs

A more fragmented and more variable demand could generate significant costs linked to the manoeuvrability of the power system.

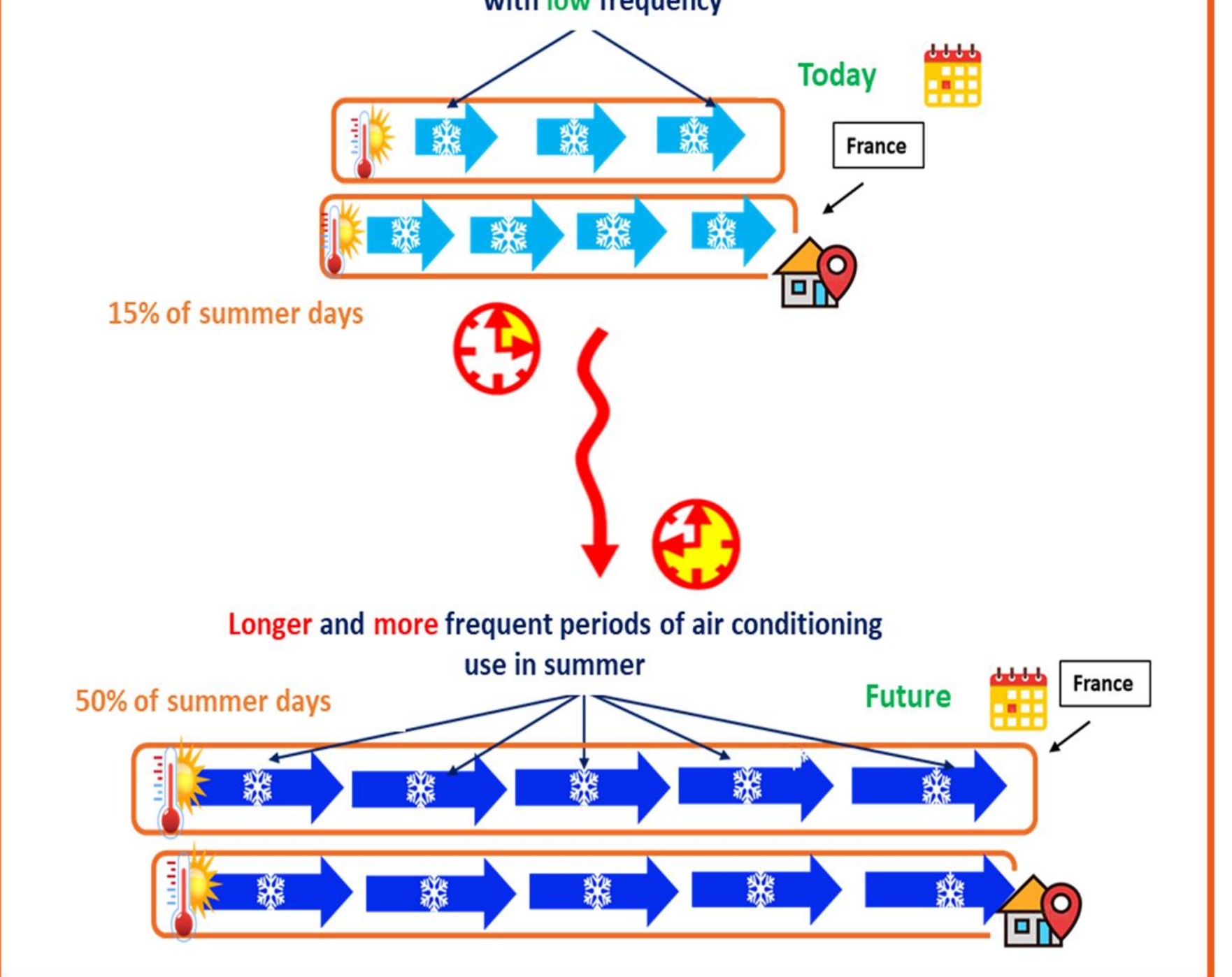
Winter (Oct, Nov, Dec, Jan, Feb, Mar)

Periods of use of the heating very long and which is spread over the whole winter



Summer (Apr, May, June, July, Aug, Sep)

Short periods of use of air conditioning in summer with low frequency



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