

# **Analysis of temperature-related climatic events in winter and spring - attribution to anthropogenic climate change**

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# Motivation

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- Global warming since 1900 can clearly be detected
- To distinguish the consequences of human-induced climate changes in climate indices from the effects of natural processes
- Fulfill research aims & increase public awareness
- Cooperation with journalists, media experts
- Using social media and a national platform with large media coverage (<https://masfelfok.hu>)

September 2021: Climate Attribution project launched in Hungary

# Data and methodology

- **Annual/seasonal indices are calculated from daily data**

- **Observations:**

HUCLIM – 0.1°, homogenized & gridded observations for Hungary, 1971-2020 (by HMS)

- **Climate simulations:**

CMIP6 GCMs – <2°, with both natural-only and historical forcings, 1900/1960-2014

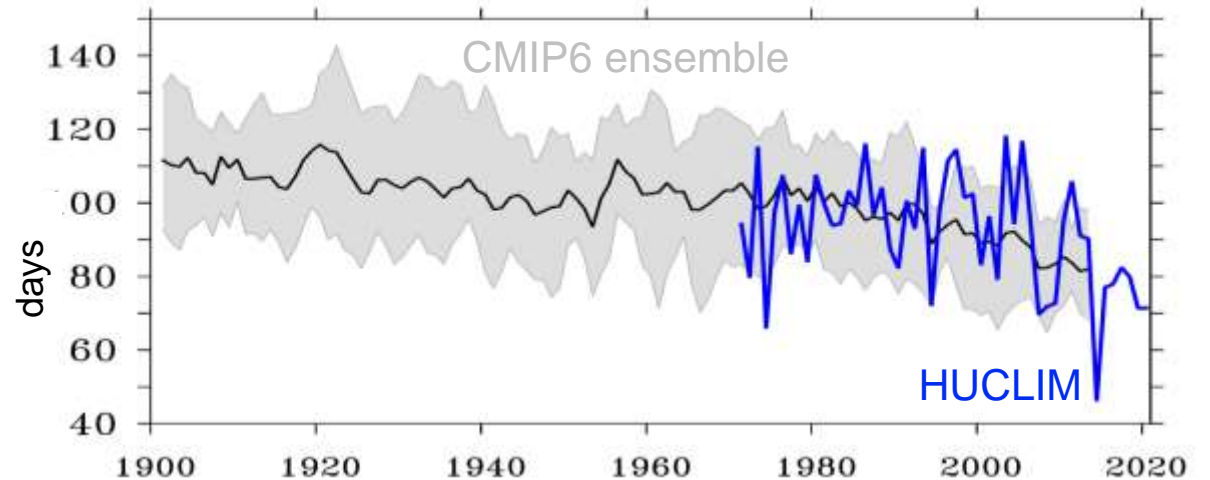
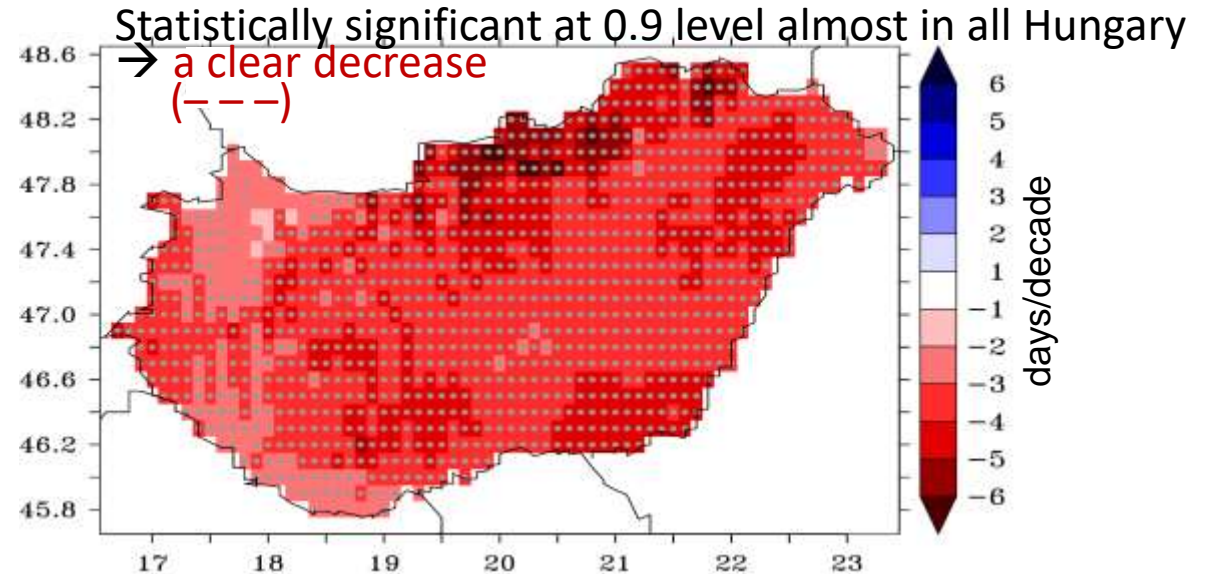
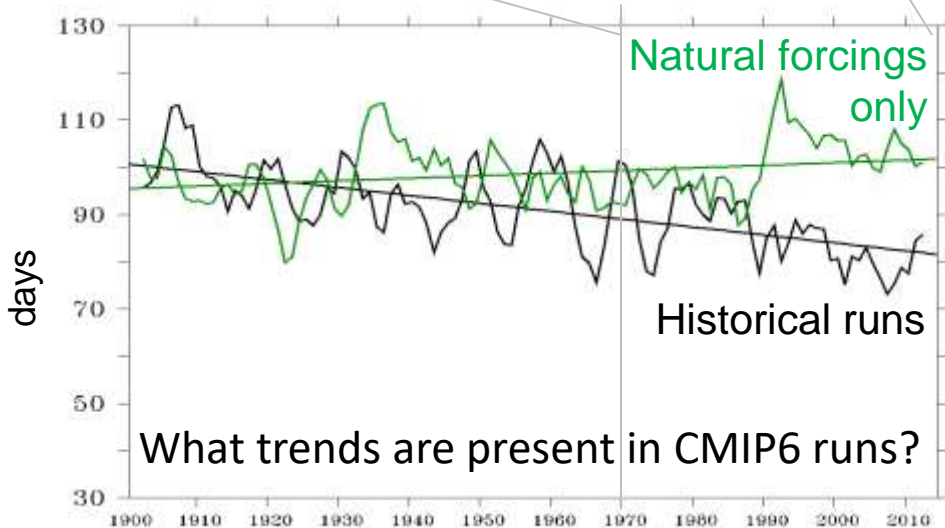
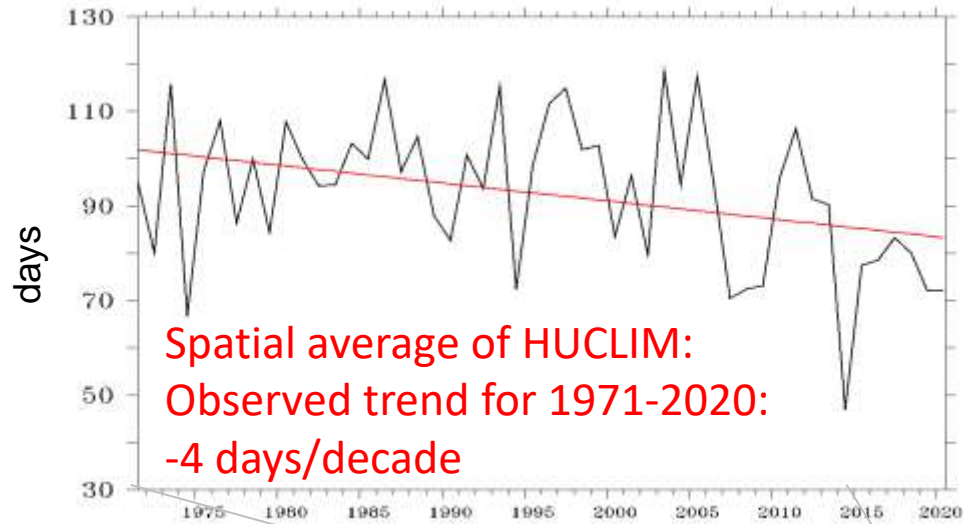
EURO-CORDEX RCMs – 0.11°, with historical & scenario runs (RCP4.5 and RCP8.5), 1971-2100



- **Seasonally-relevant climate indices using temperature (winter and spring):**

<b>Winter</b>	Frost days	$T_{\min} < 0 \text{ }^{\circ}\text{C}$
	Extreme cold	$\min(T_{\min})$
<b>Spring</b>	Start of vegetation period for cold-resistants	The first day when $T_{\text{mean}} > 5 \text{ }^{\circ}\text{C}$ for at least 5 days
	Start of vegetation period for warm-demandings	The first day when $T_{\text{mean}} > 10 \text{ }^{\circ}\text{C}$ for at least 5 days
	Late frost	The last day until June when $T_{\min} < 0 \text{ }^{\circ}\text{C}$
	Possible frost period	Difference between Late frost & Start of vegetation period for cold-resistants

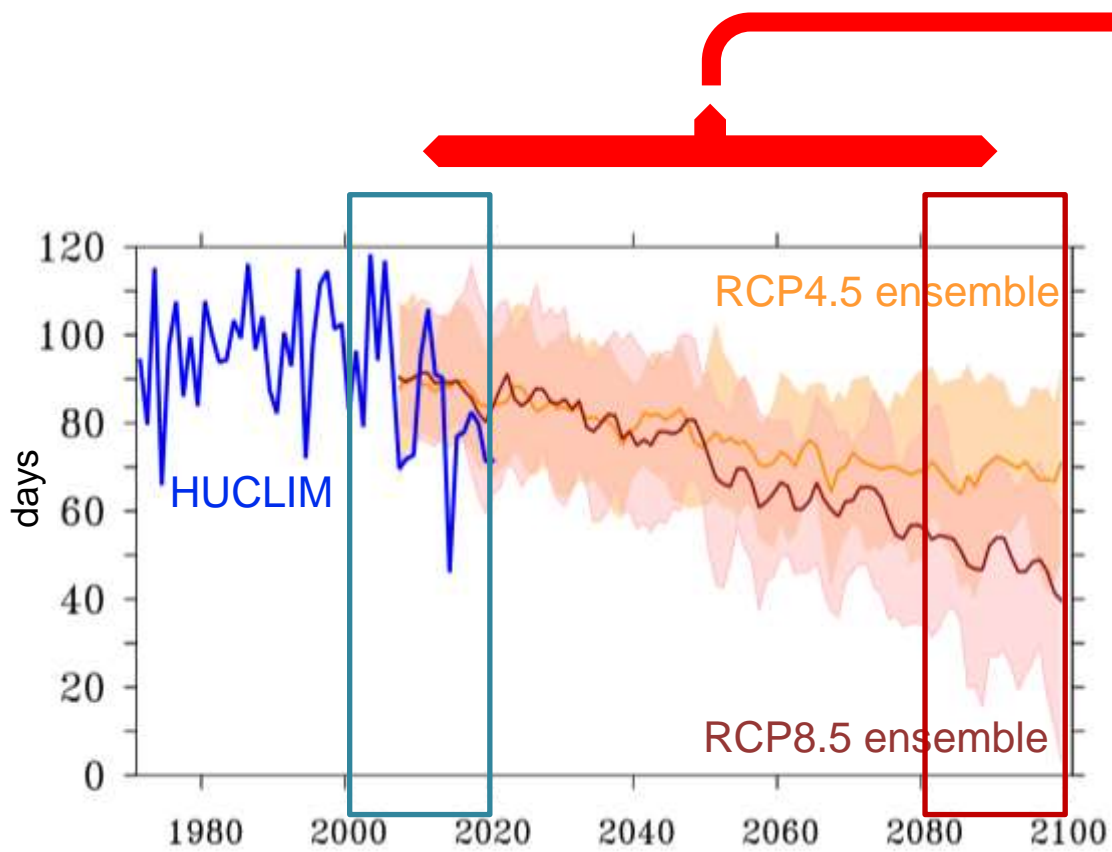
# Results: Frost days



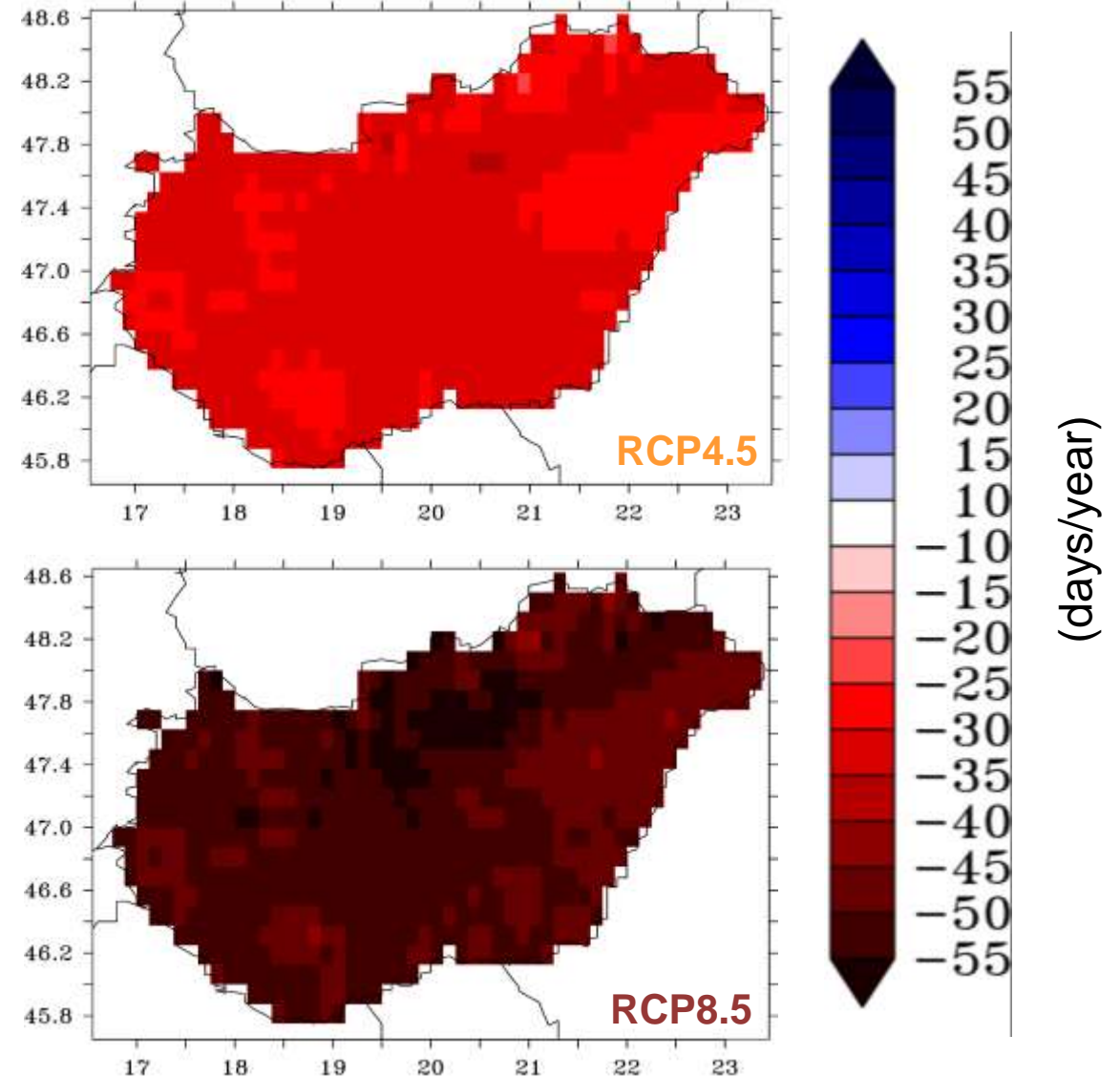
Bias-corrected CMIP6 simulations from 1900

→ decreasing trend due to human activity in 8/10 simulations

# Results: Frost days



Projected changes from 2001-2020 to 2081-2100



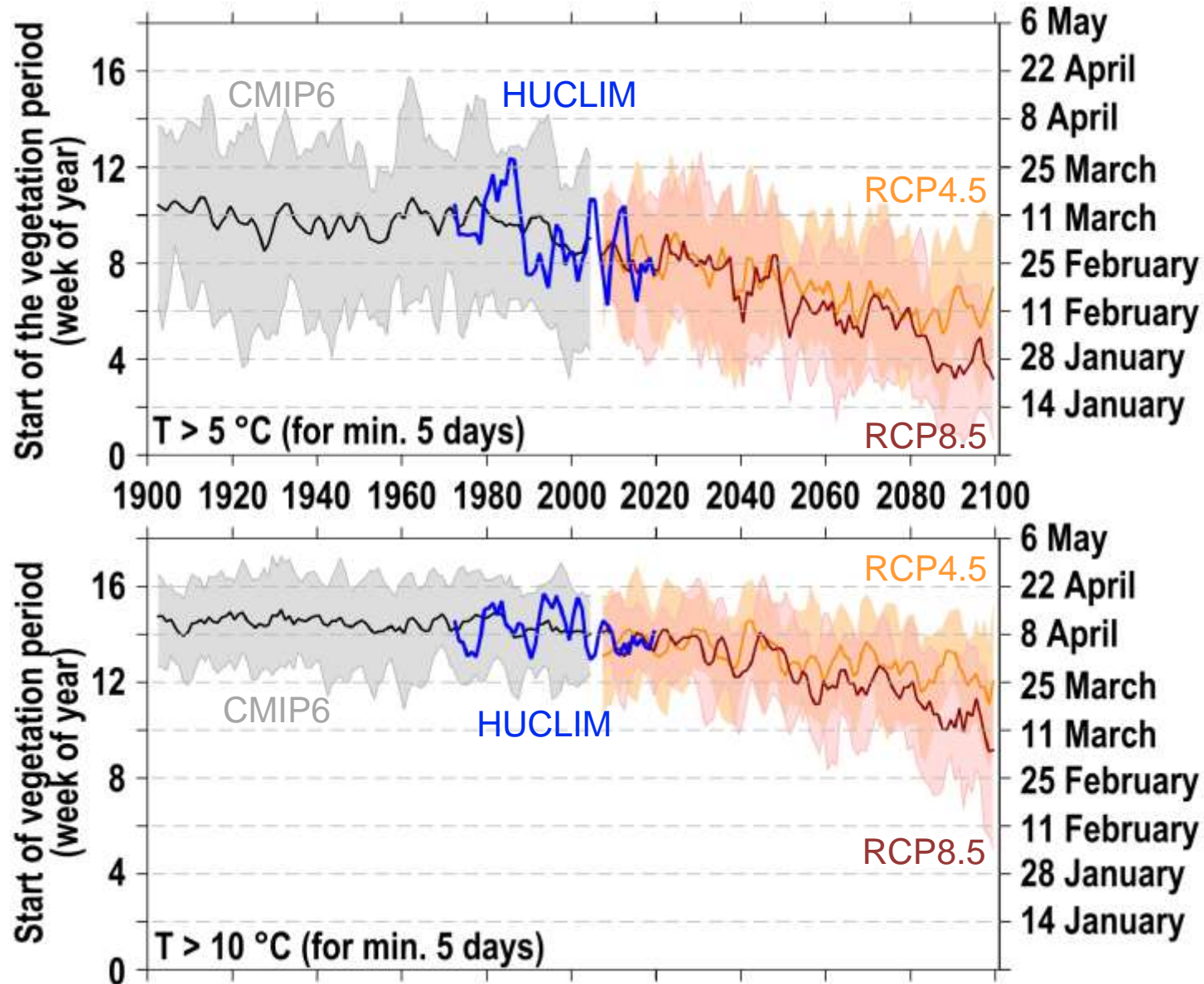
Future trends until 2100:

-3 days/decade for RCP4.5

-5 days/decade for RCP8.5

→ smaller decrease with RCP4.5 (---) than RCP8.5 (---)

# Results: Start of vegetation period



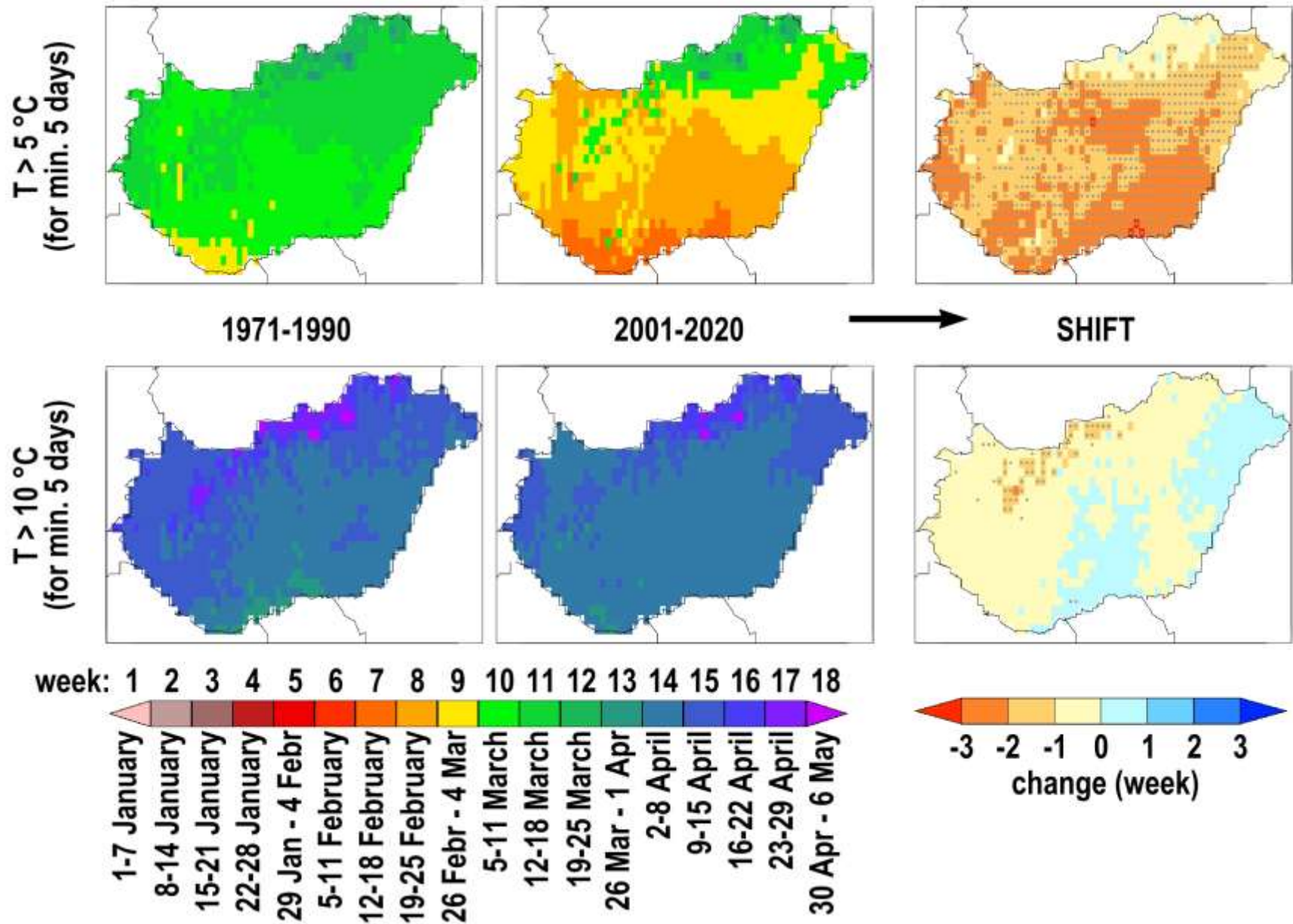
For cold-resistant plants

- Higher variability
- Clearer shift in the past

For warm-demanding plants

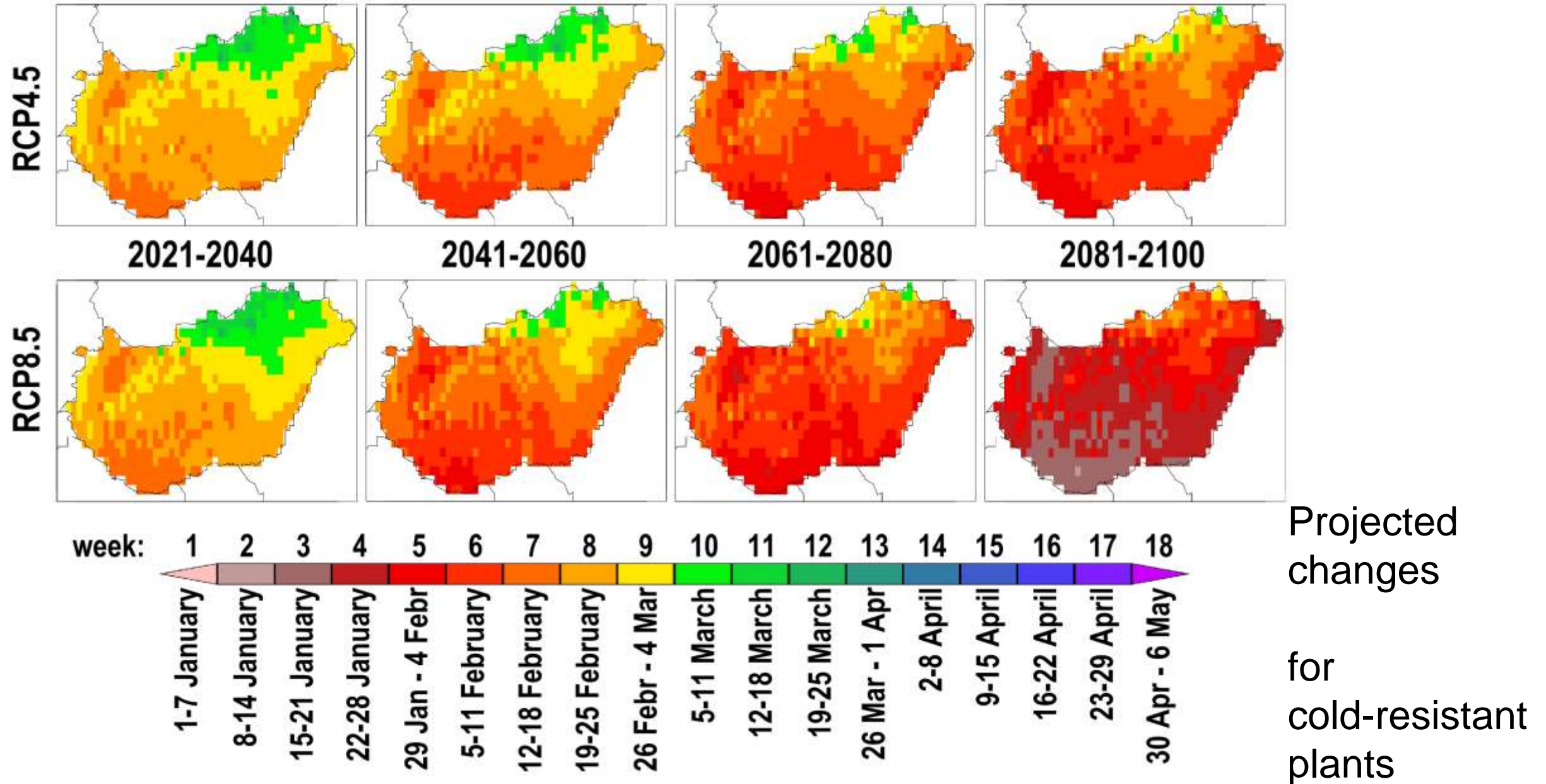
- Lower variability
- Less clear shift in the past

# Results: Start of vegetation period



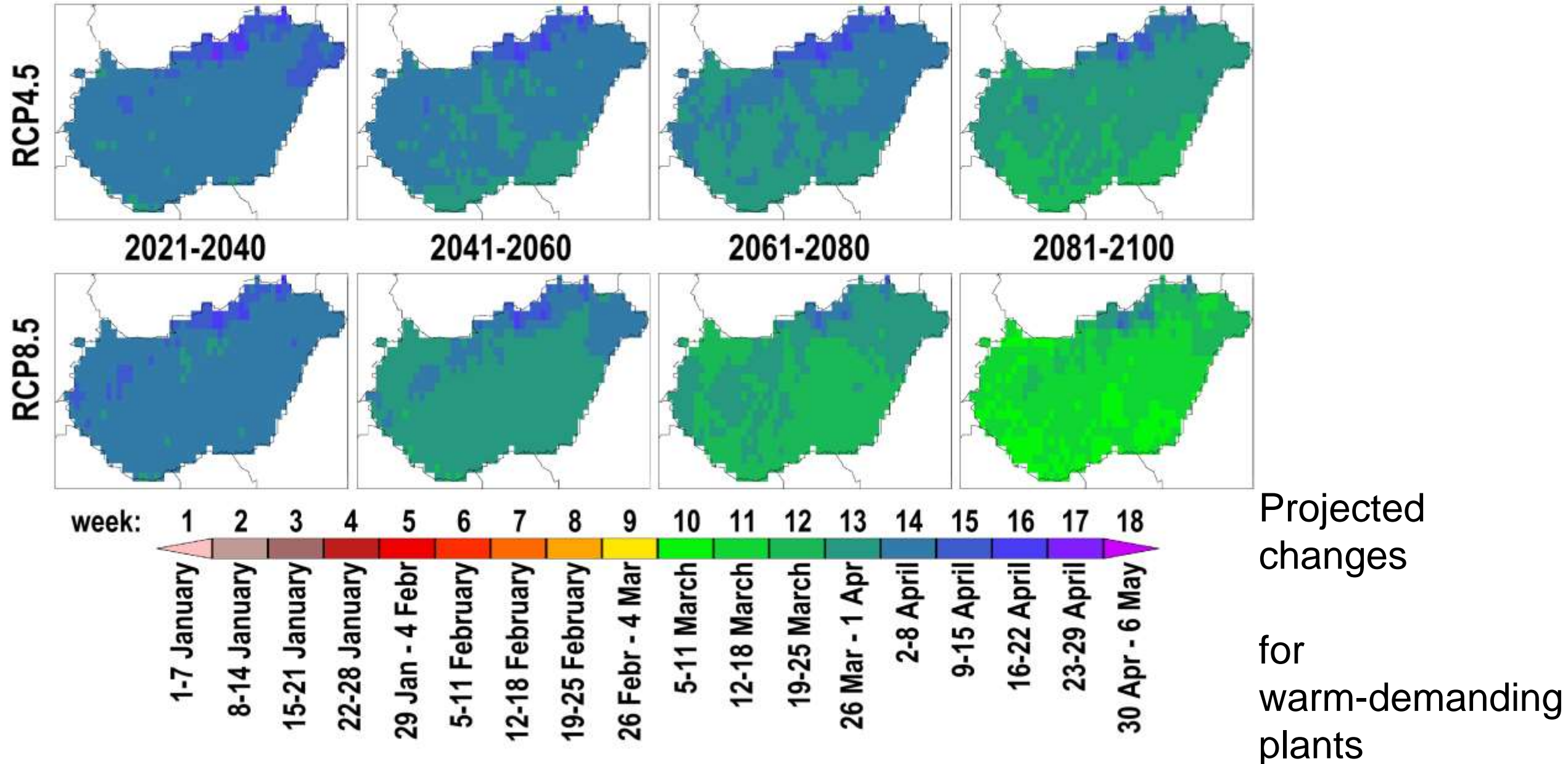
Detected changes

# Results: Start of vegetation period



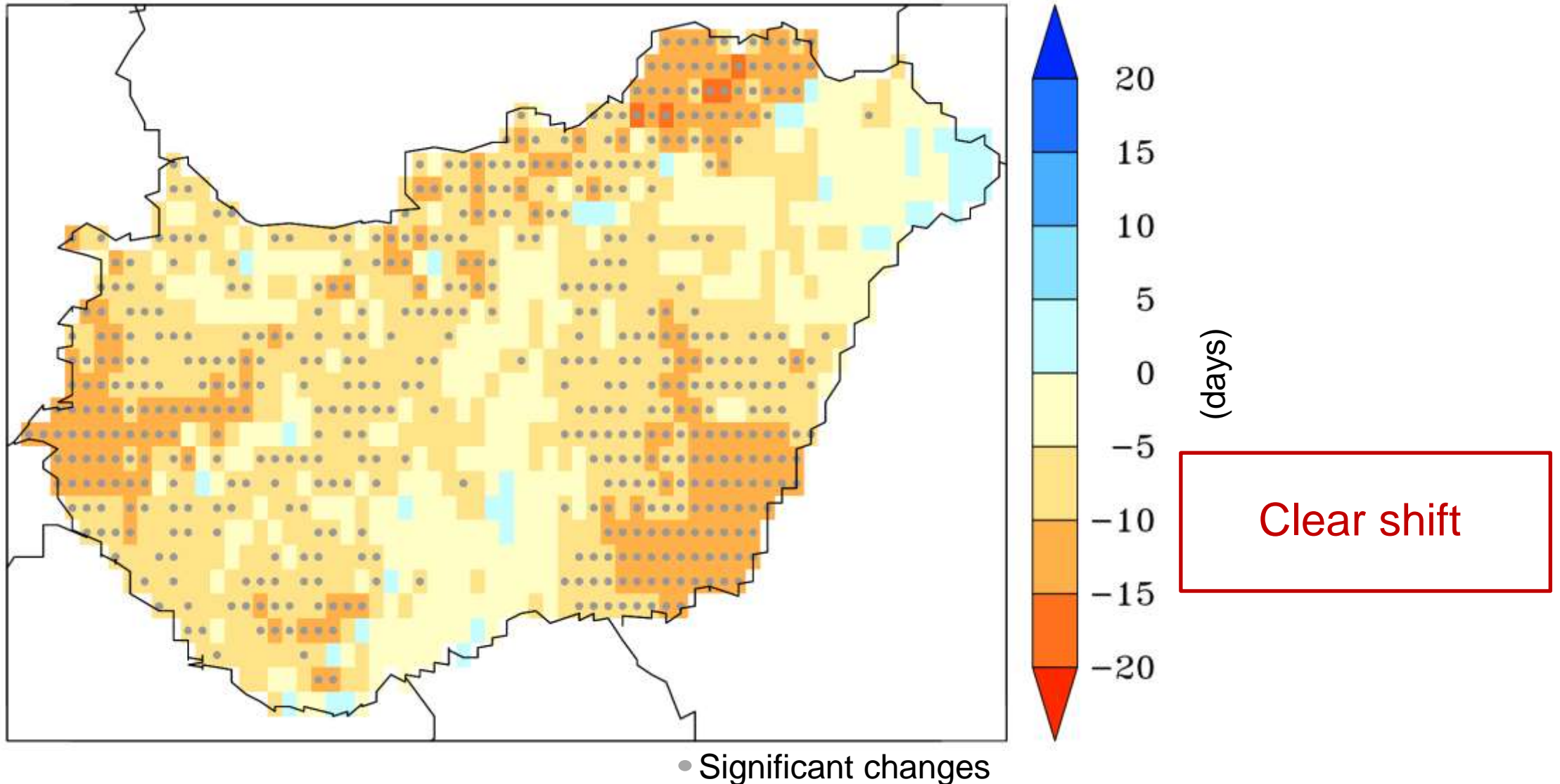


# Results: Start of vegetation period

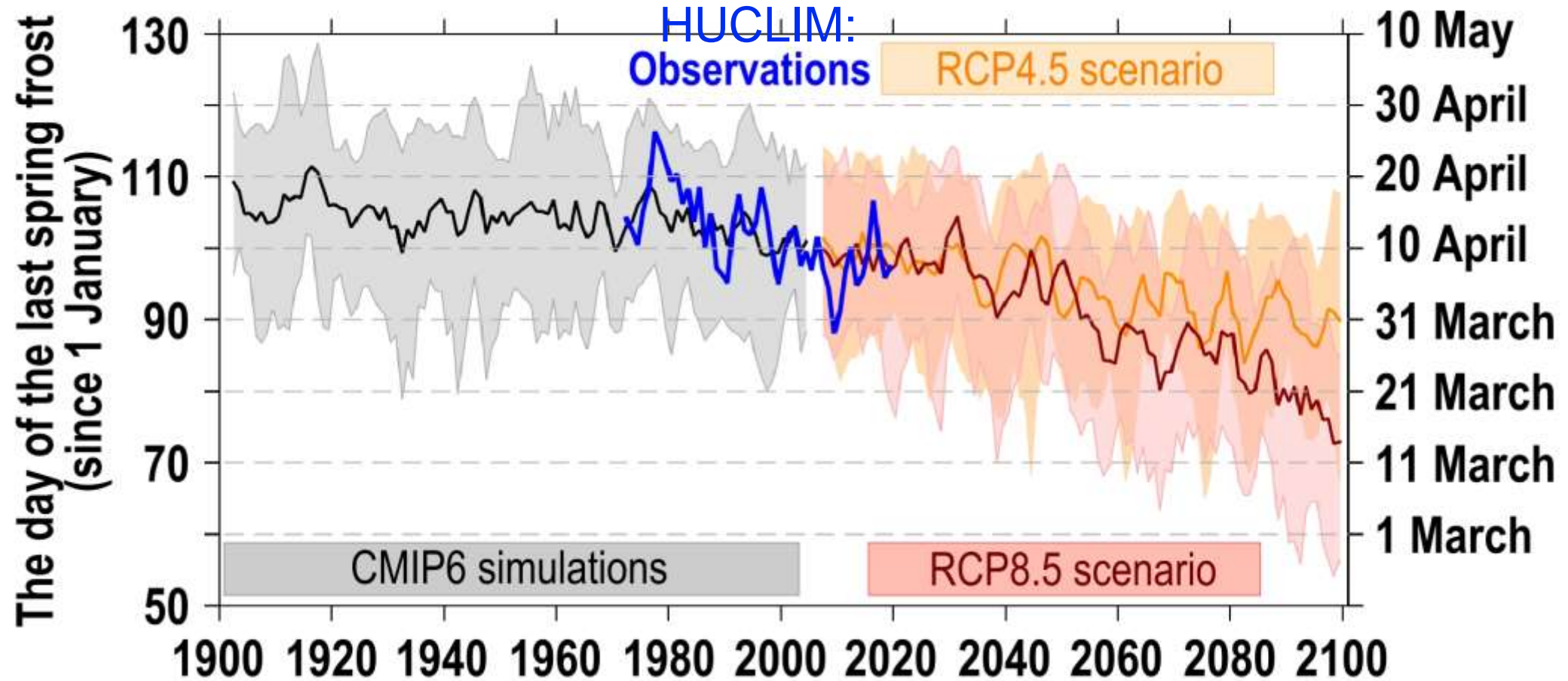


# Results: Late frost

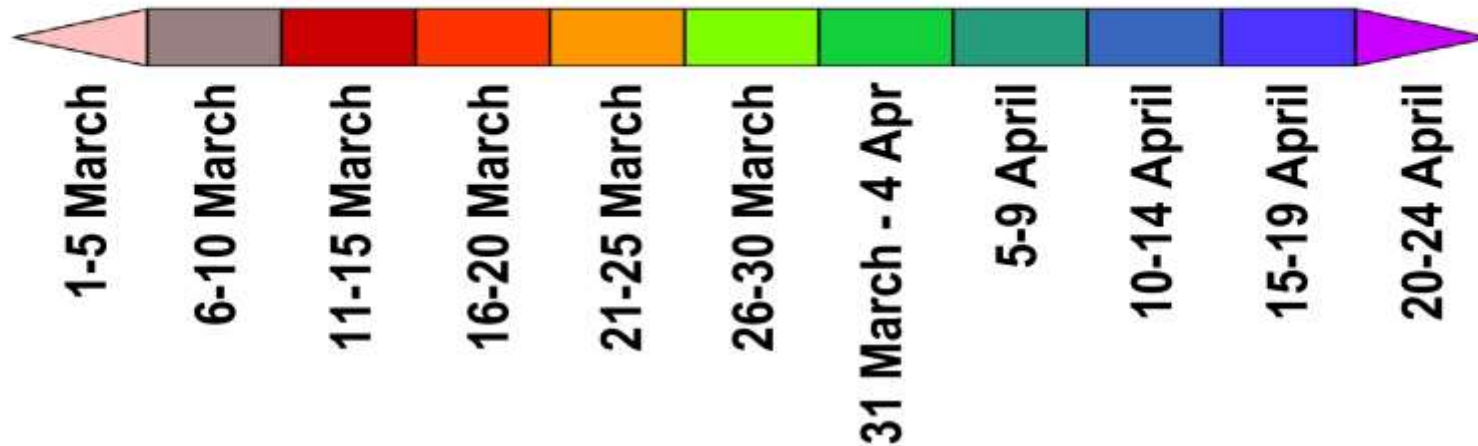
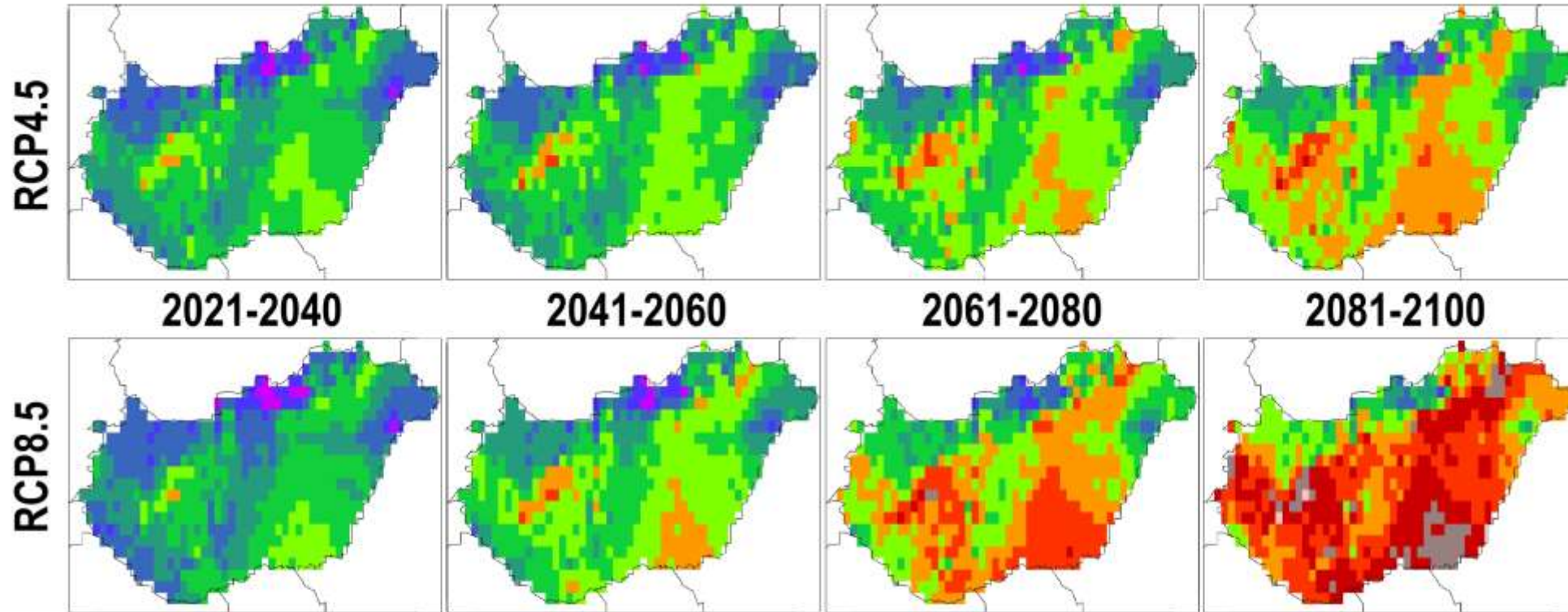
Detected changes from 1971-1990 to 2001-2020 on the basis of HUCCLIM



# Results: Late frost

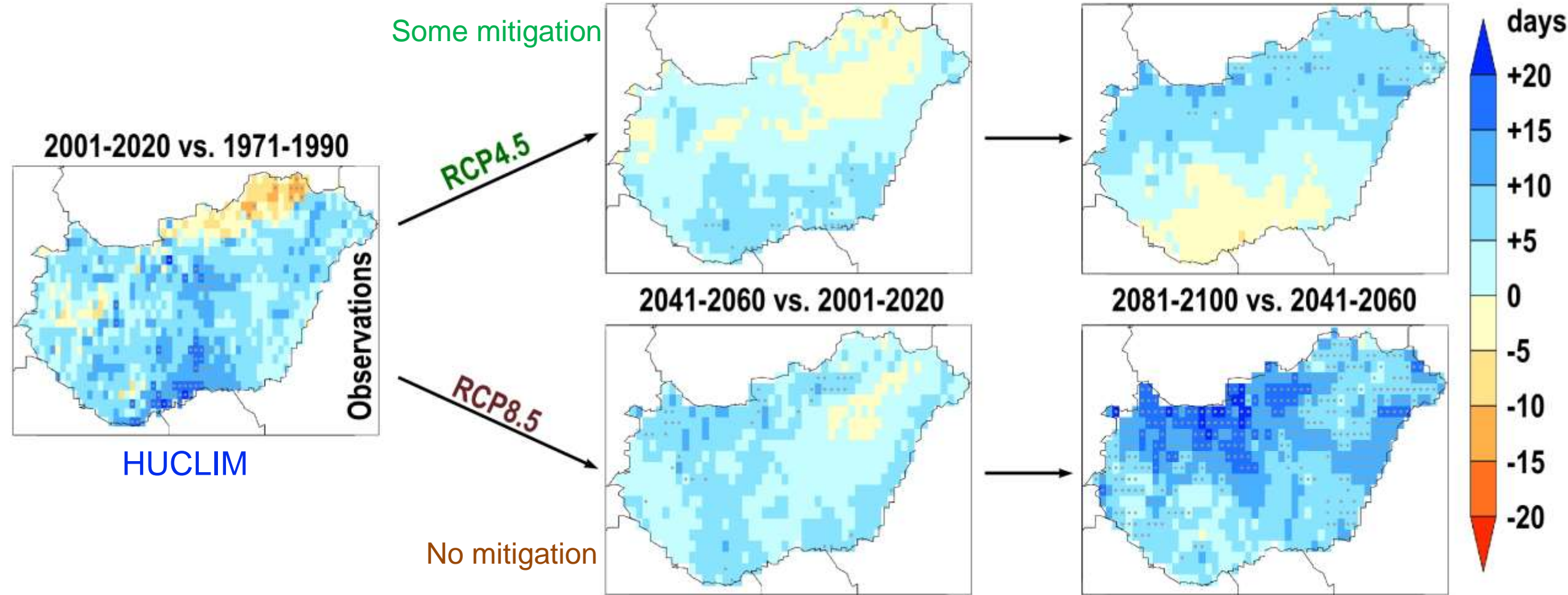


# Results: Late frost



Projected changes

# Results: Possible frost period



PROJECTED CHANGES ACCORDING TO DIFERENT SCENARIOS

# Summary

	Index	Observed trend: 1971-	Is it human-induced?	RCP4.5	RCP8.5
Winter	Frost days	---	Yes, 80%	---	---
	Extreme cold	0	No	-	--
Spring	Start of vegetation period for cold-resistant	--	Yes, 70%	-	--
	Start of vegetation period for warm-demanding	0	No	-	--
	Late frost	-	Yes, 70%	-	--
	Possible frost period	+0		+0	+