Evaluation of climate projections – preliminary results

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HUNGARIAN METEOROLOGICAL SERVICE
Regional Climate Modelling Group

RCMGiS final event –
Budapest, 29 February 2016

Outline

1.

- **Introduction**

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- **Simulations**
  - Previous - and
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4. **Results**
   - Temperature
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4. **Results**
   - Temperature
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5. **Summary**
   - Comparison to ENSEMBLES results
   - Use of results

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- No account to the **potential impacts of human activities** → development of climate data with new experiments (**RCP scenarios**)
    - Sensitivity studies to find the optimal settings of models
    - Validation to test the models
    - **Projections for the 21st century**

Simulations with RCMs

	Previous simulations		Present simulations	
	ALADIN-Climate	RegCM	ALADIN-Climate	RegCM
LBC GCM	ARPEGE	ECHAM	ARPEGE	HadGEM
Spatial resolution	10 km		10 km	
Time range	1961-2100	1961-1990 2021-2050 2071-2100	1961-2100	1961-2098
Reference period	1961-1990		1971-2000	
Scenario	SRES A1B		**RCP 8.5**	**RCP 4.5**

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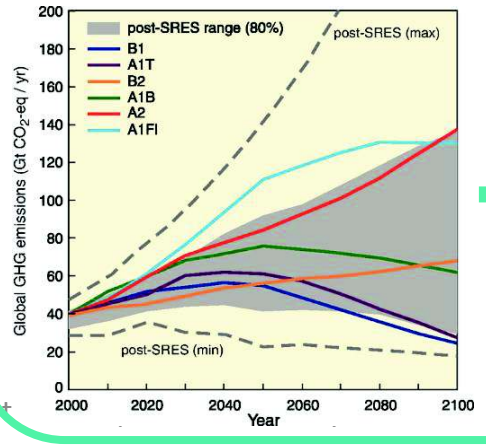
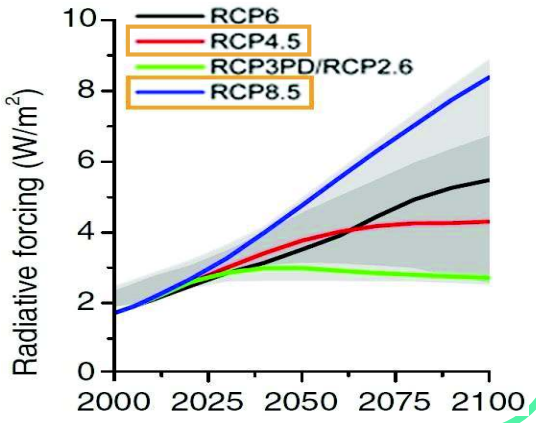
SRES



RCP



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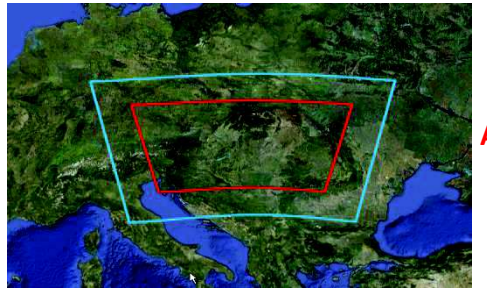
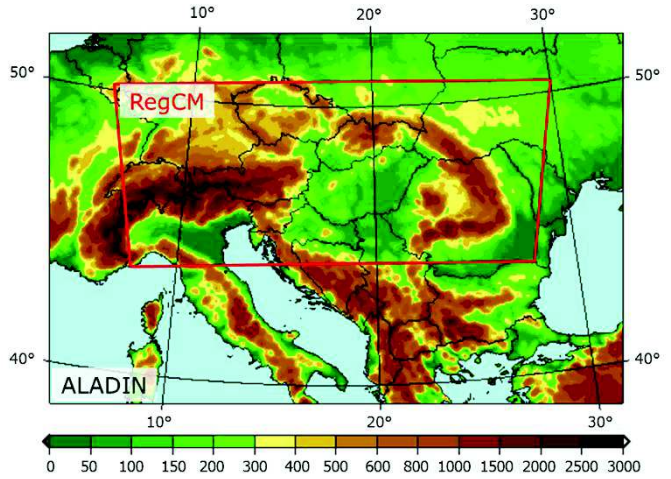
Integration domain of ALADIN and RegCM earlier and now





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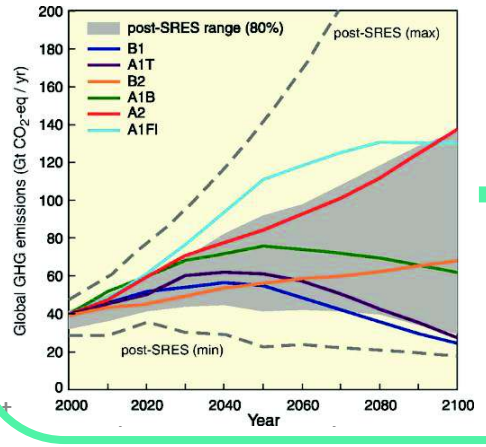

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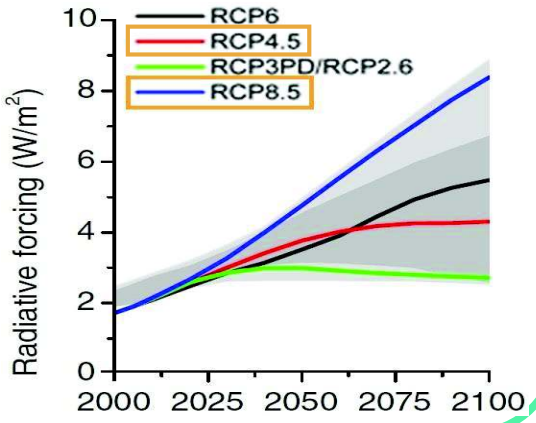
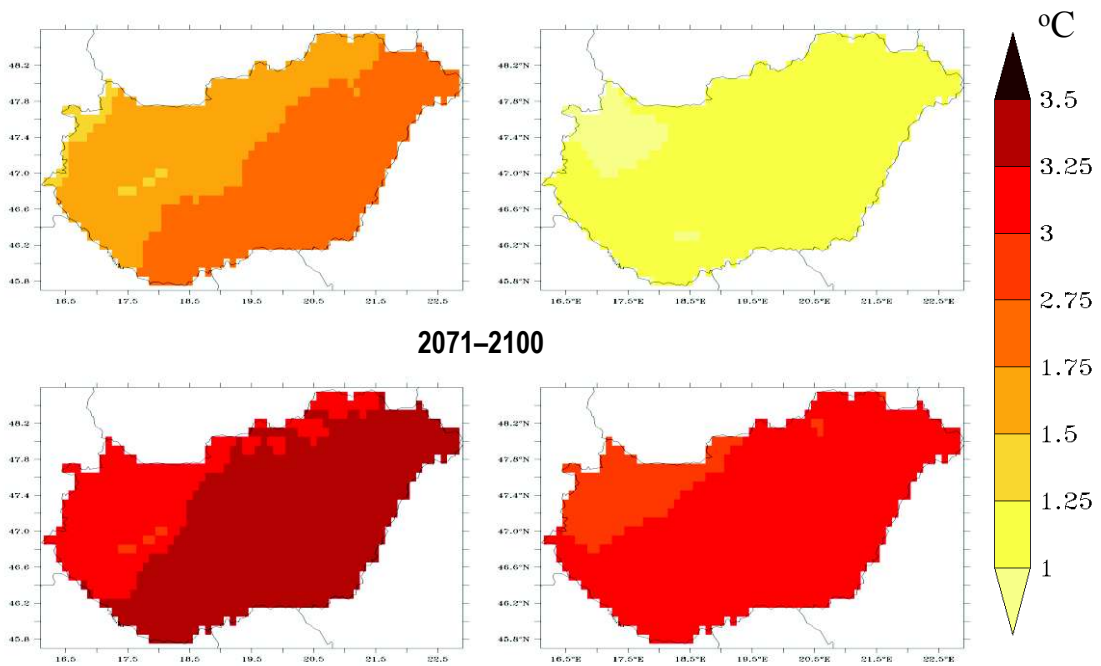


Previous results (A1B) – Temperature

Change of mean temperature (°C) over Hungary
for 2021–2050 and 2071–2100
Reference: 1961–1990



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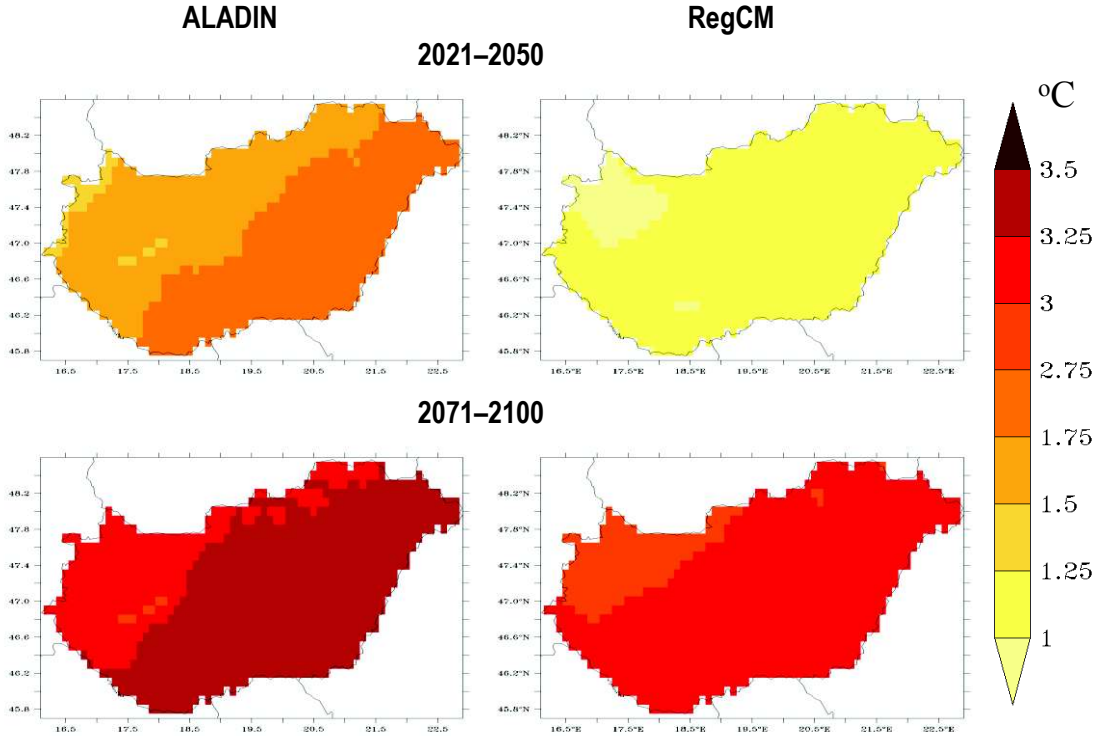

- Increasing annual and seasonal mean temperature
  - 2021-2050: **1-2°C**
  - 2071-2100: **3-4°C**
- Biggest warming in **summer: 3.5-4.5°C**
  - → more warm extremes
- Coldest month: January (T_{mean}> 0°C by the end of the century)
  - → less frost days
- Statistically significant changes - the rate of changes exceeds the natural variability

Previous results (A1B) – Precipitation

Change of precipitation (%) over Hungary
for 2071–2100
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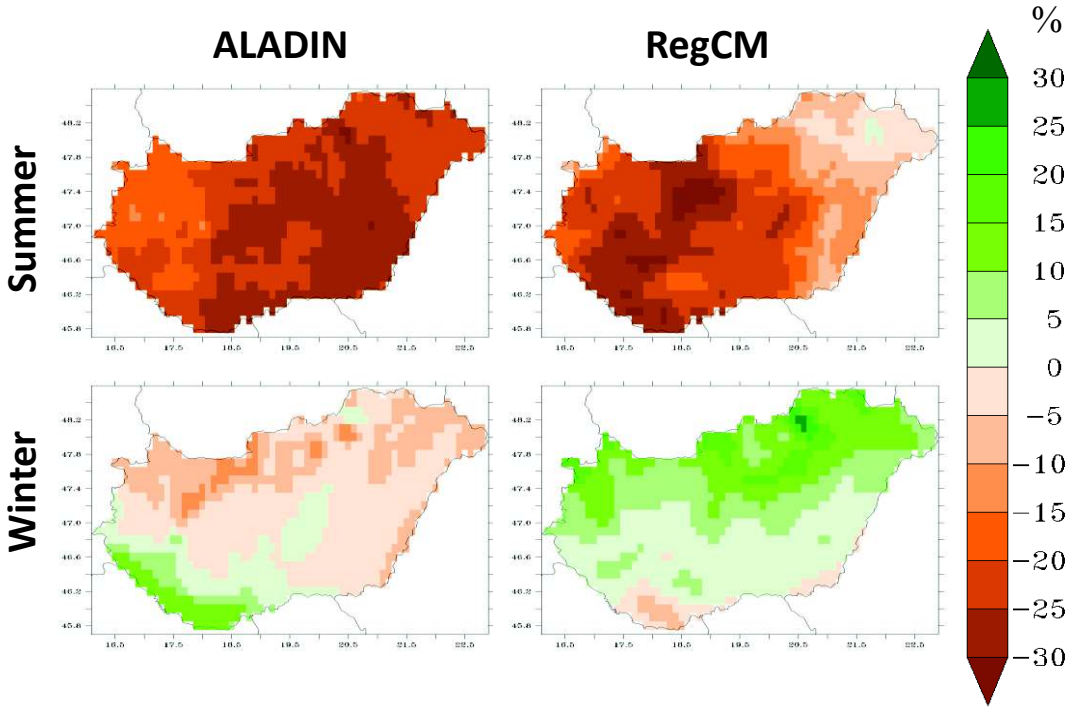

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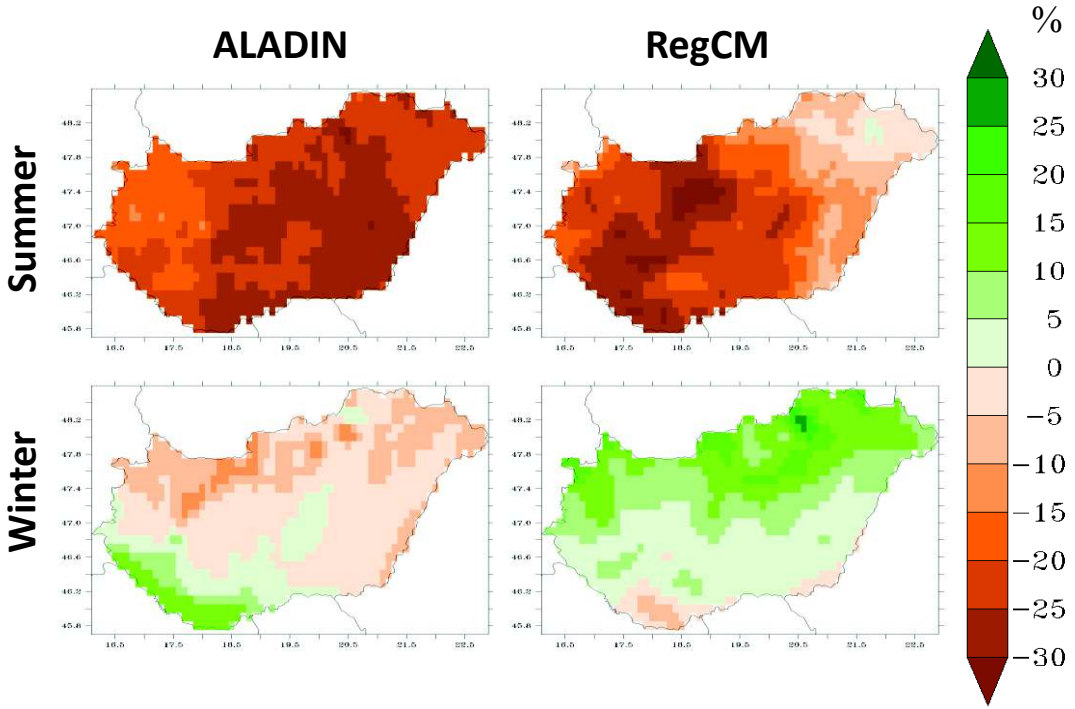


- Annual amount of precipitation over Hungary is expected to
  2021-2050: **decrease in east, equivocal change in west**
  2071-2100: mostly **decrease** by two models (≈ 10%)
- Near future: **summer and winter decrease (10-20%)** (spring and autumn increase by ALADIN, decrease in all seasons by RegCM)
- Far future: biggest **decrease in summer (20-30%; significant)**
- Biggest uncertainty between models: autumn (Δ ≈ 20 mm)

Present climate projections

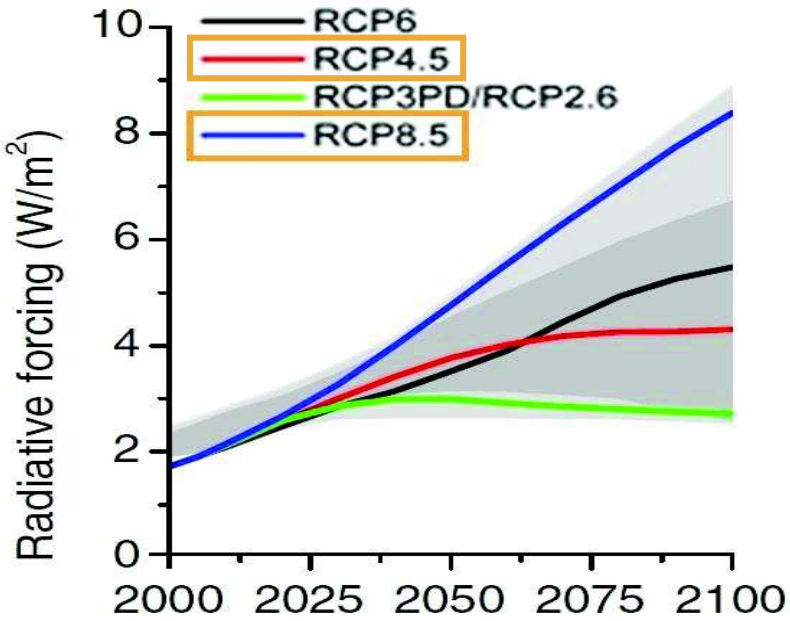
- Reference period: **1971-2000**
- Time ranges for

  near future: **2021-2050**

  - information about the uncertainty of models and of natural variability
  - useful for adaptation strategies and decision making

  end of the century: **2069-2098**

  - effect of the scenario (in case of temperature)
  - simulated changes exceed natural variability
- Monthly, seasonal, annual changes, extreme indices
  - mean temperature
  - precipitation



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Mean temperature changes (°C) over Hungary for 2069-2098
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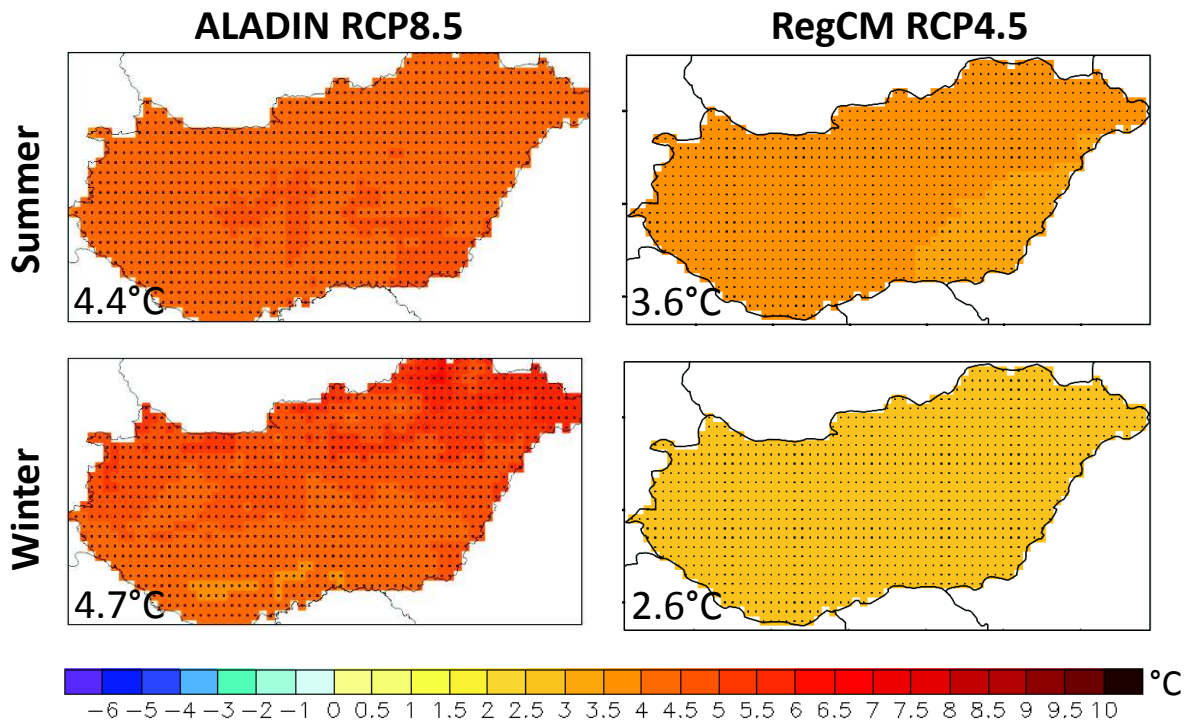

Results – Temperature

- Significant temperature increase for each period by the two models
- Annual mean temperature change over Hungary

  2021-2050: **≈ 2°C**

  2069-2098: **3-4°C**

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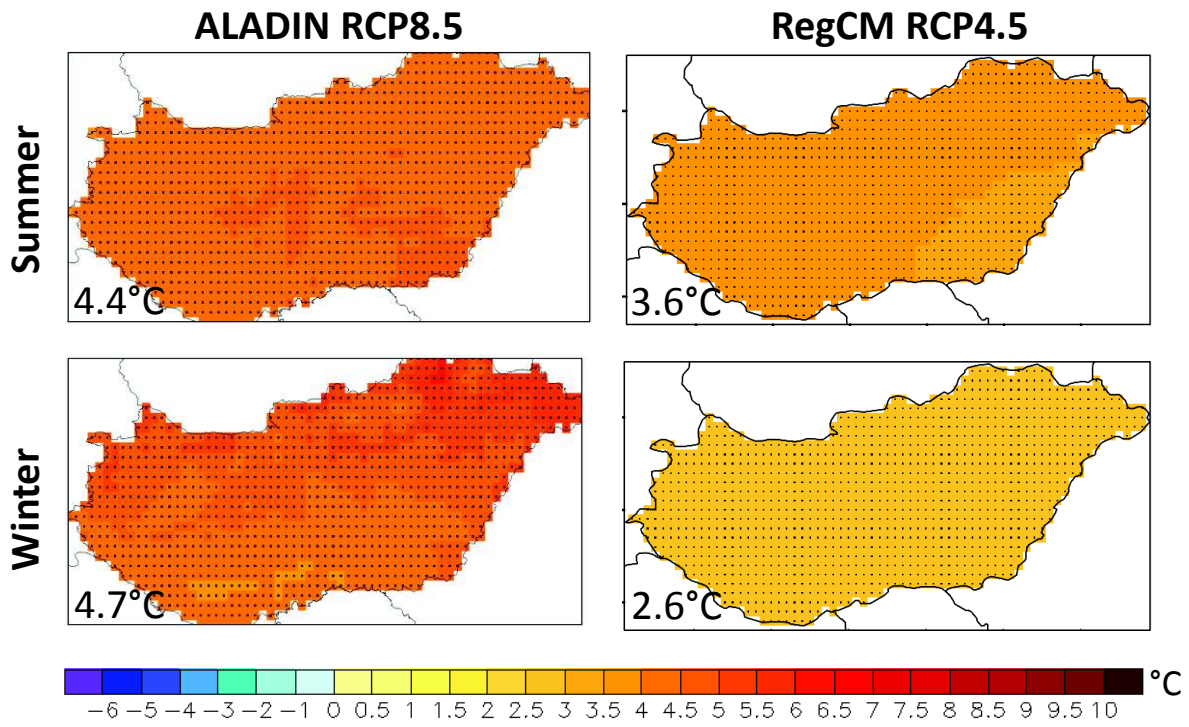

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- Biggest change by ALADIN (around 4°C)
- Difference between models in winter ≈ 2°C

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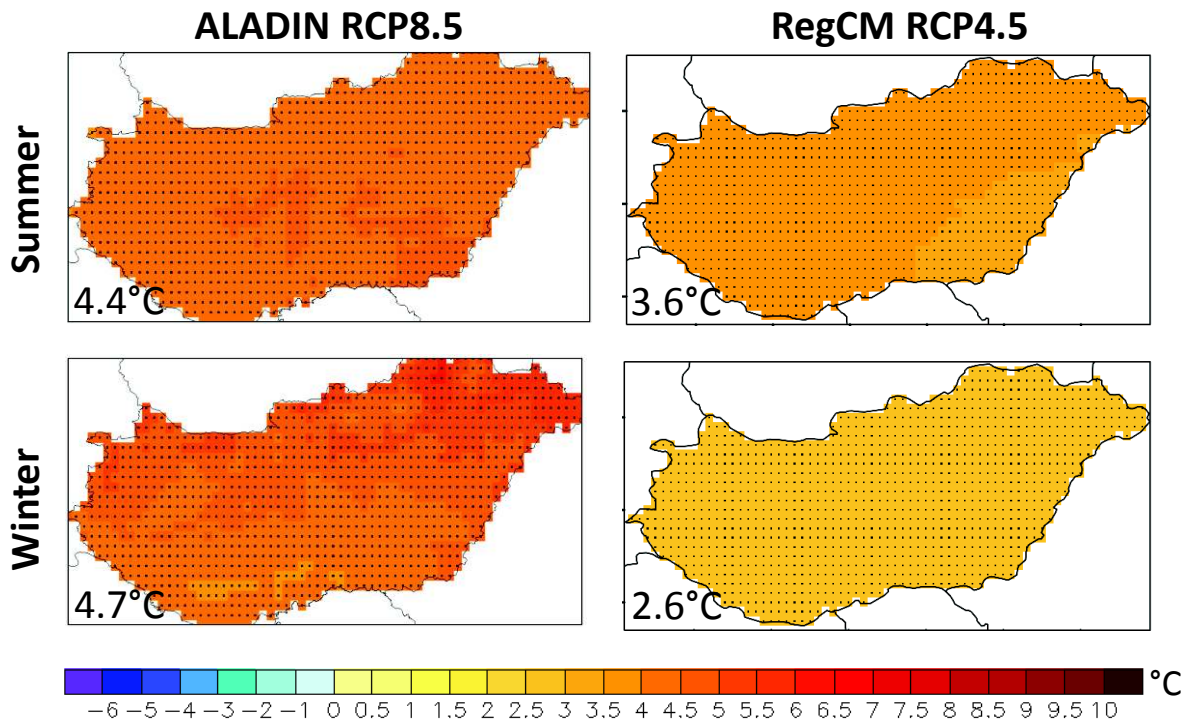

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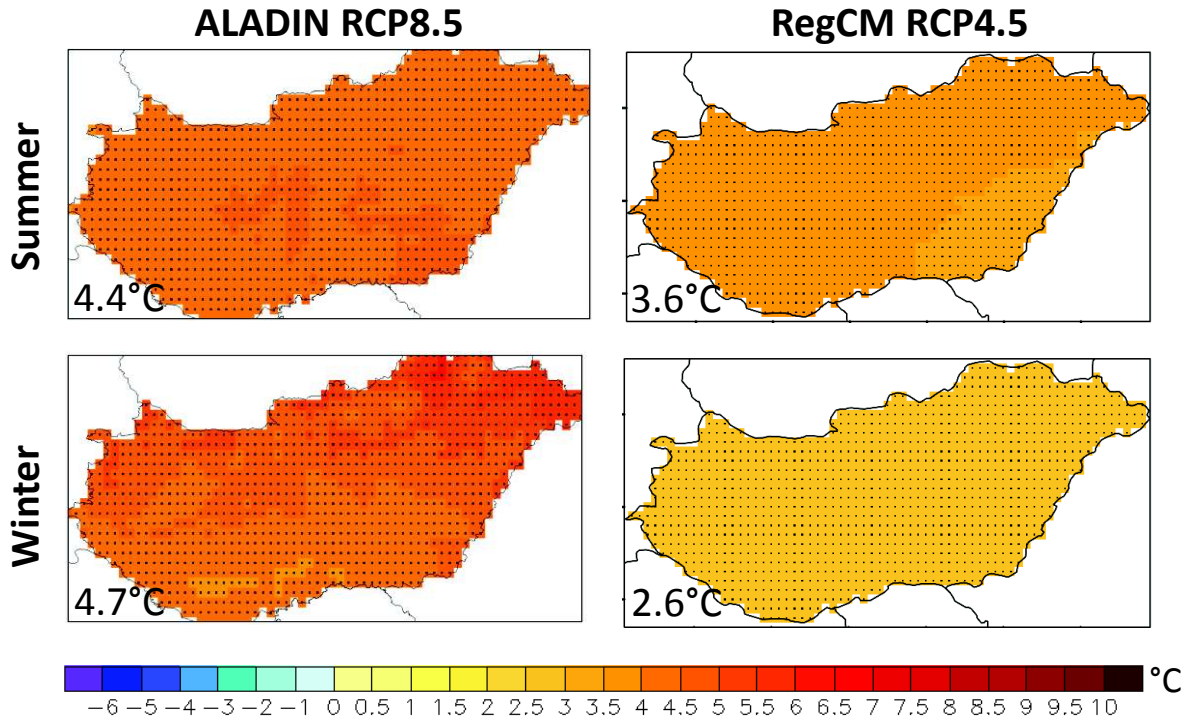

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	2069-2098	4,0	3,4	4,4	3,4	4,7
RegCM	2021-2050	1,9	1,8	2,5	1,6	1,8
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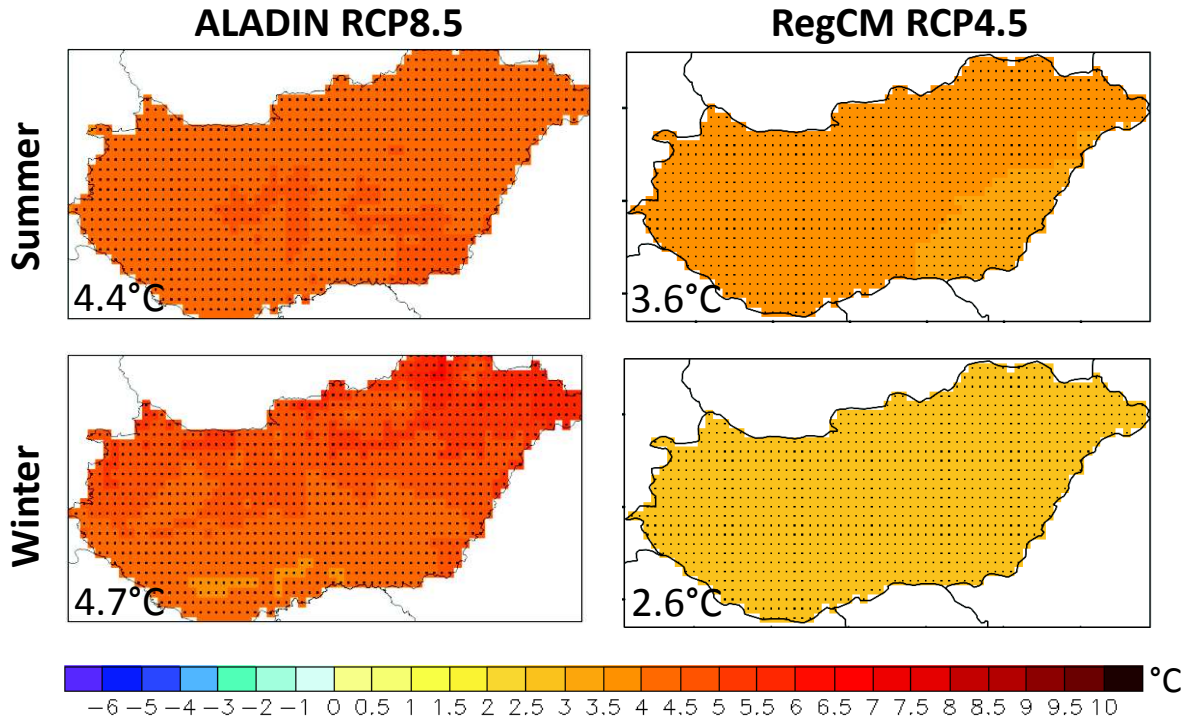

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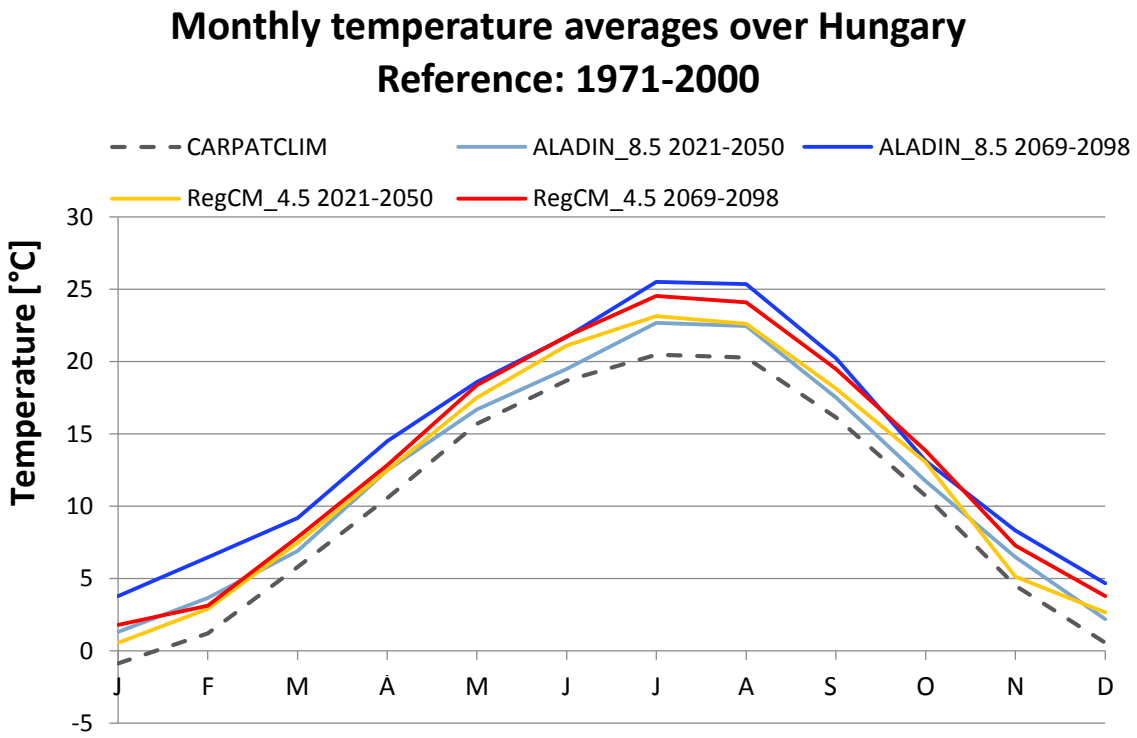

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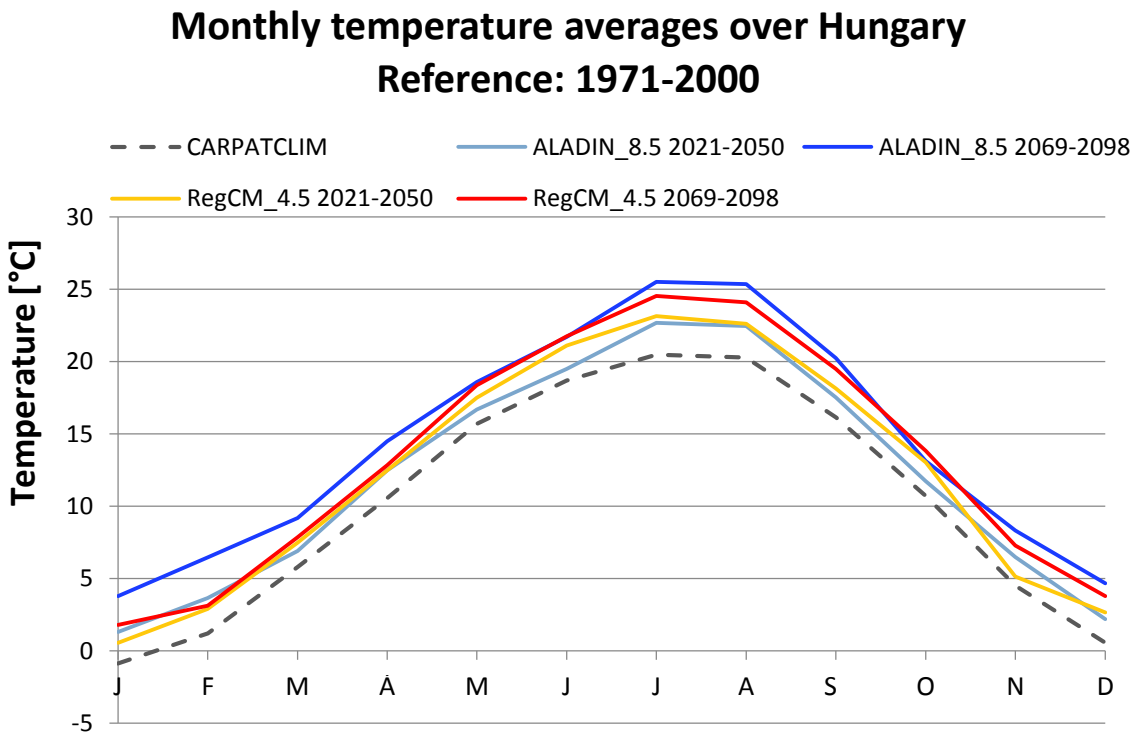

- Unchanged annual cycle: min in January, max in July
- ALADIN: biggest temperature rise in January

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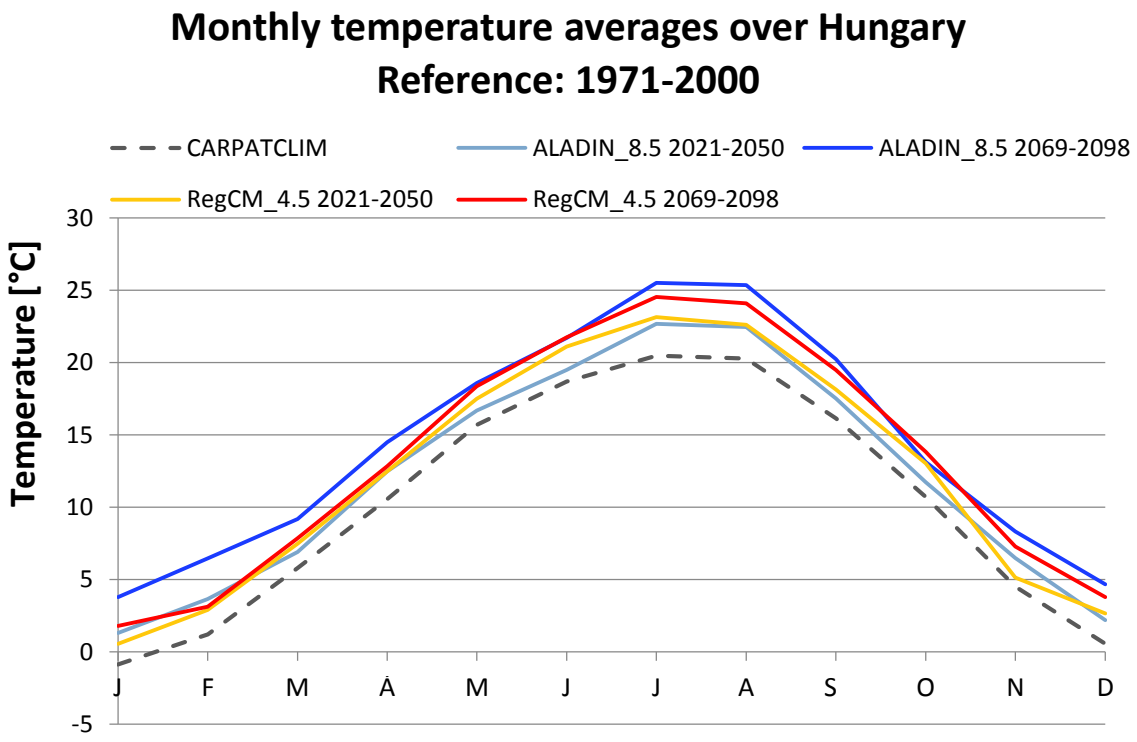

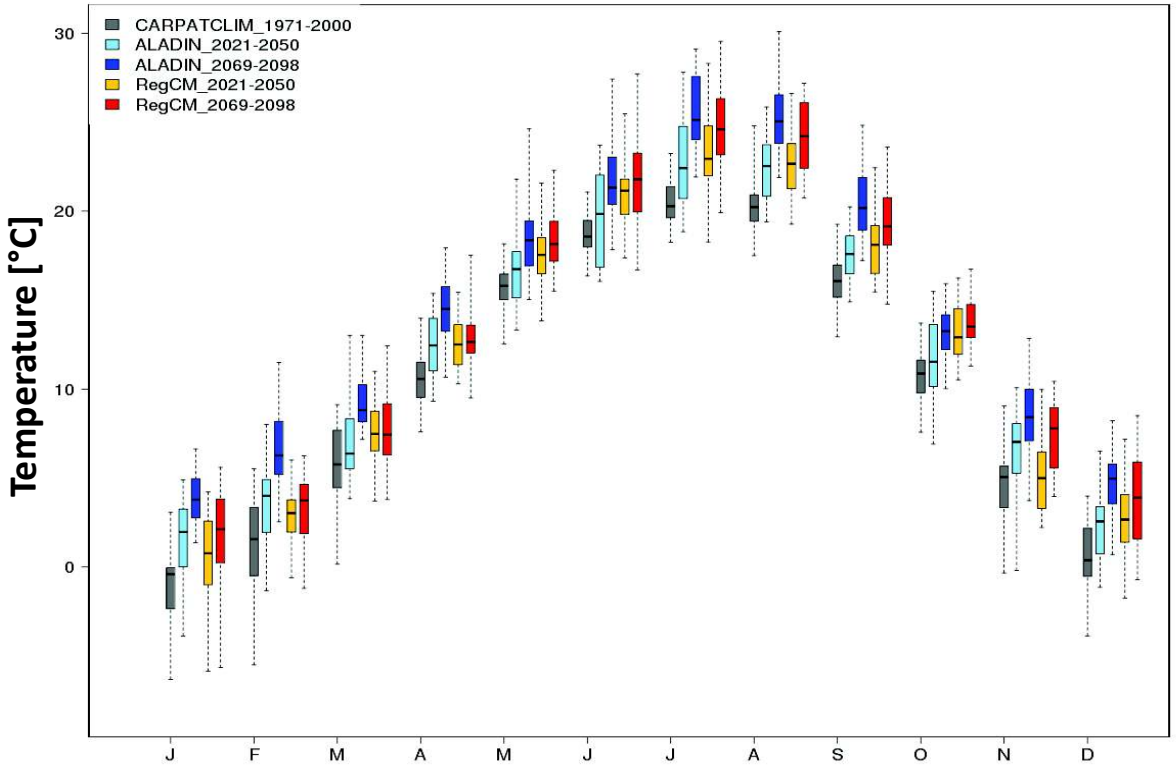

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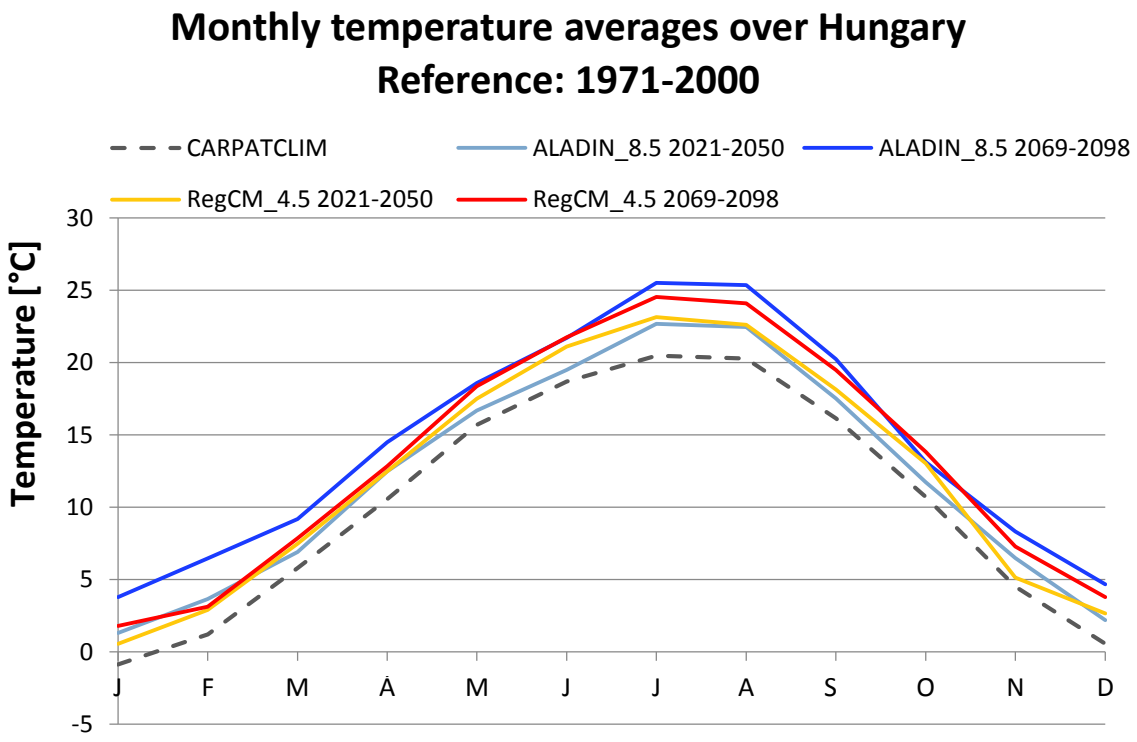

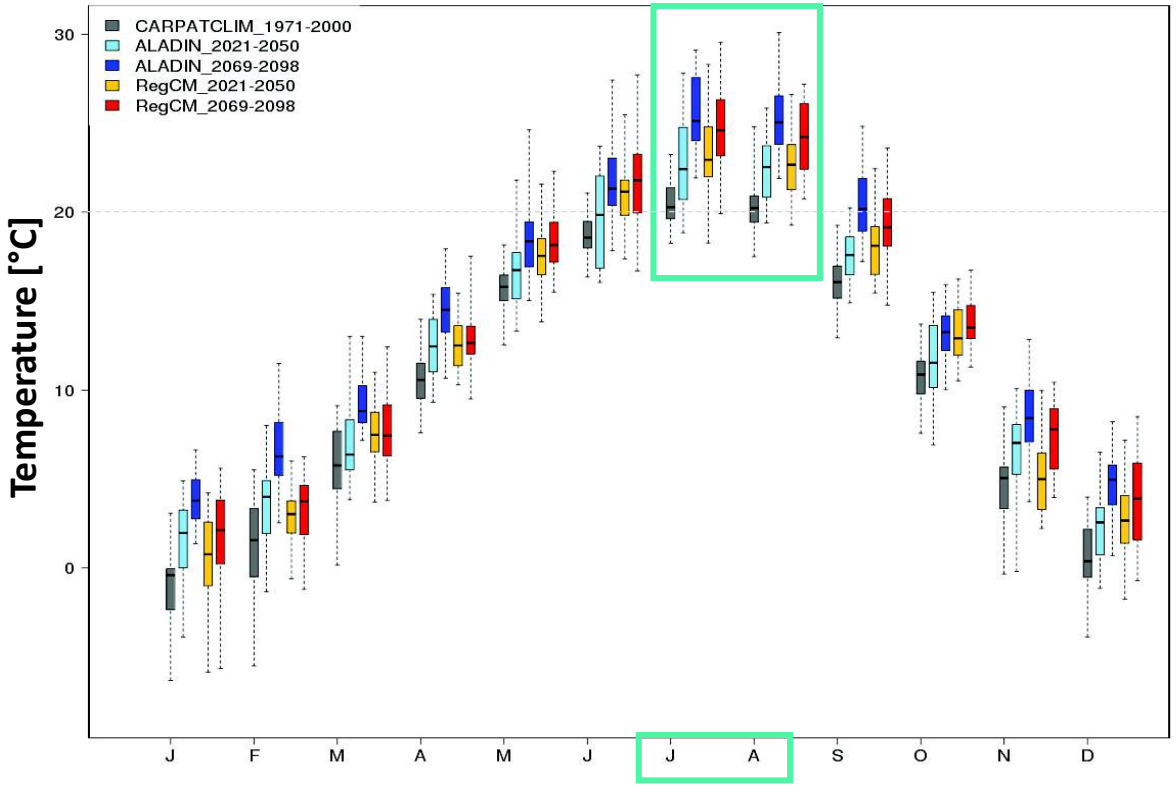

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- Mean temperature of July and August > 20°C

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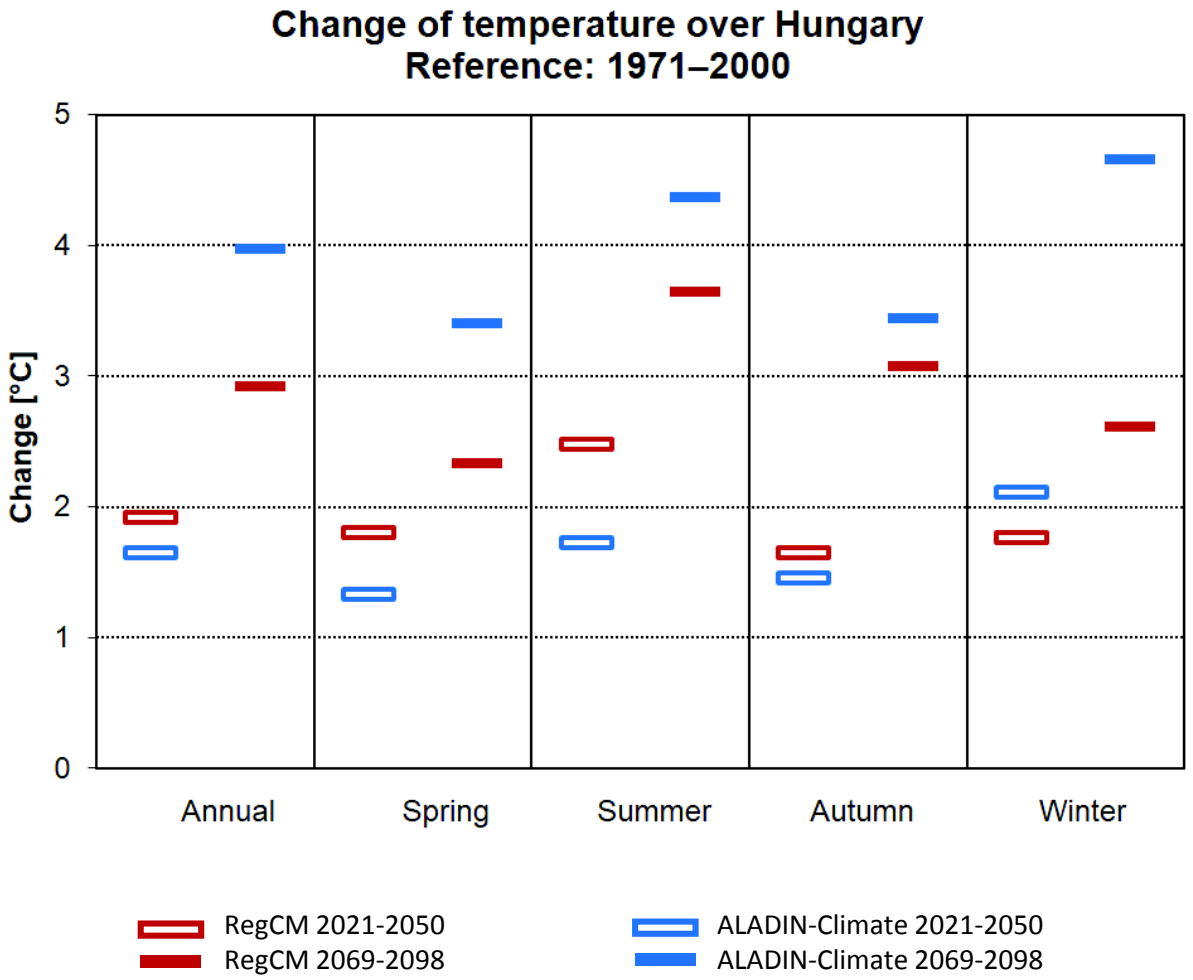

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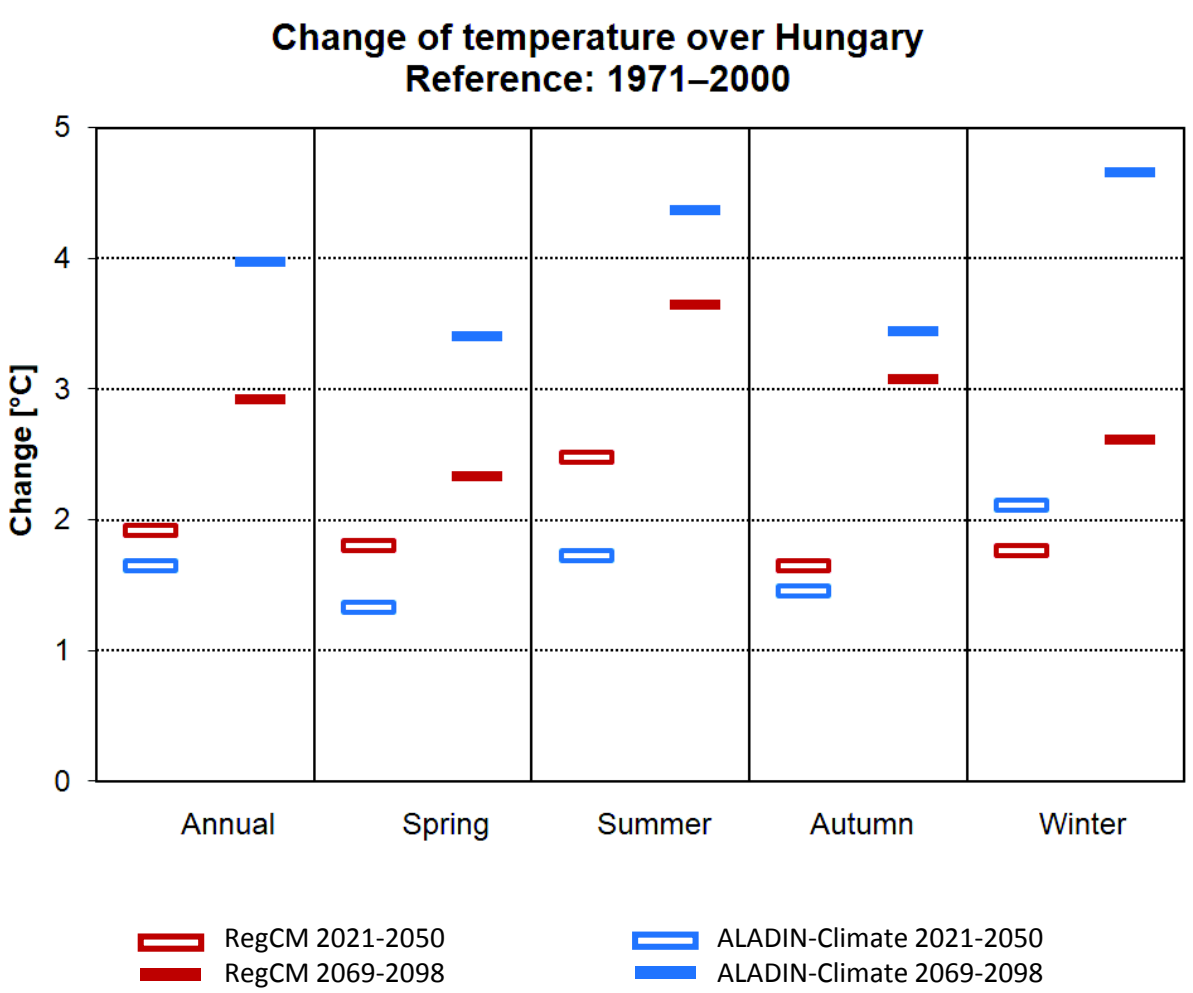

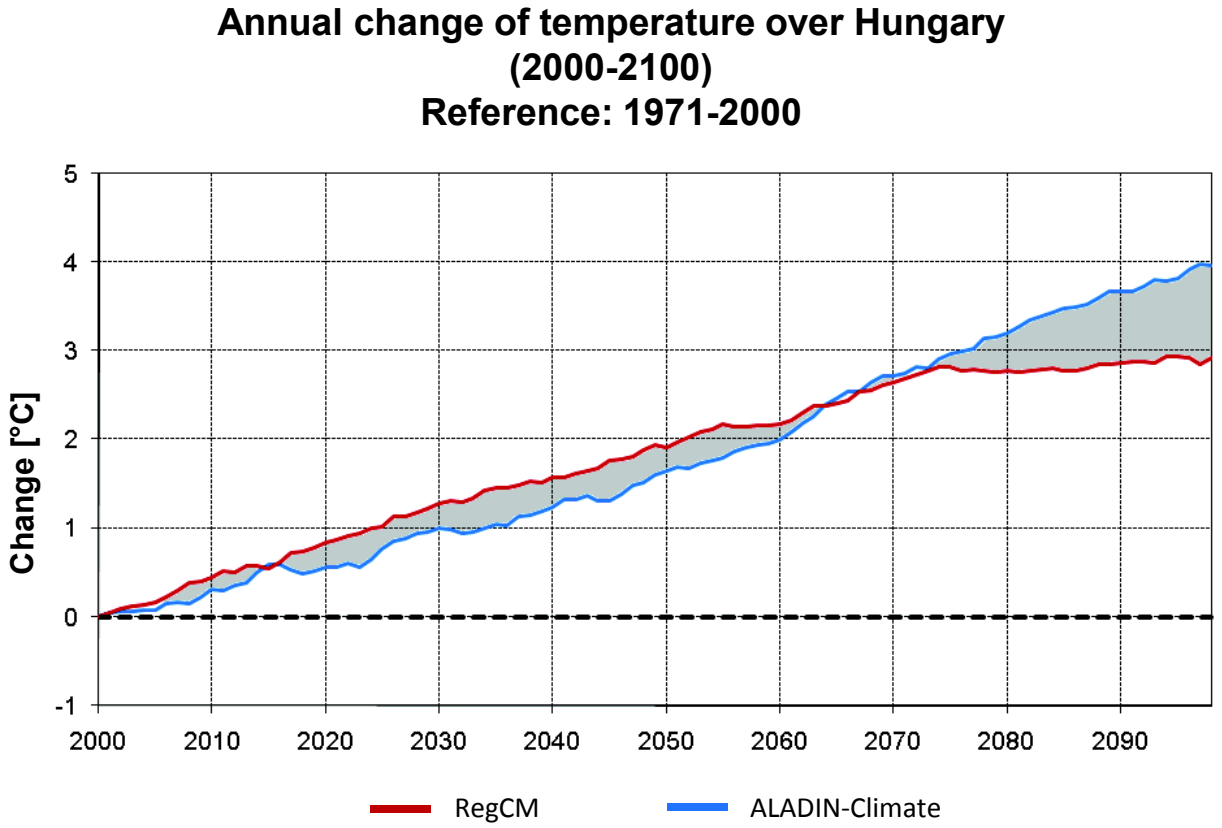

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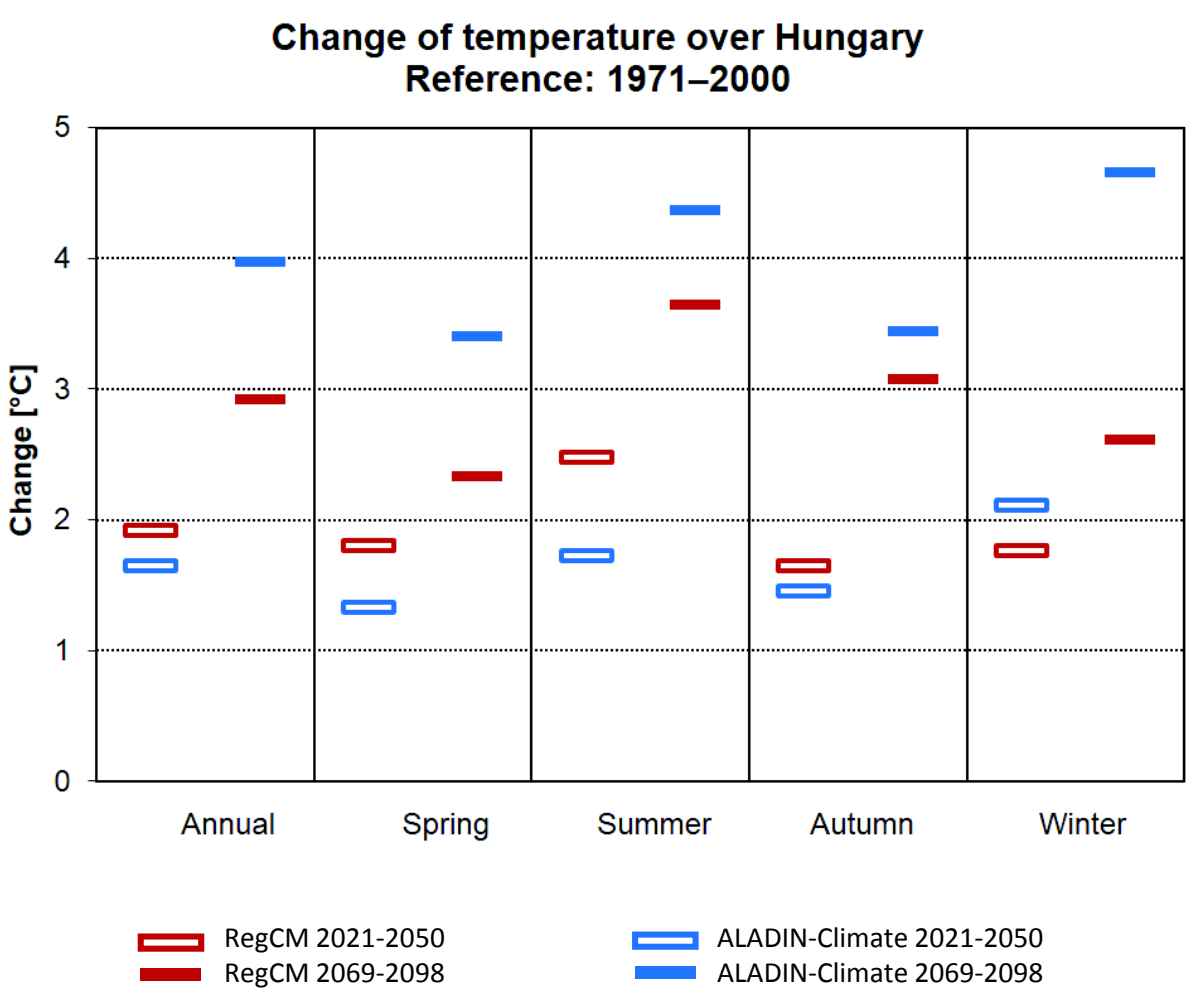
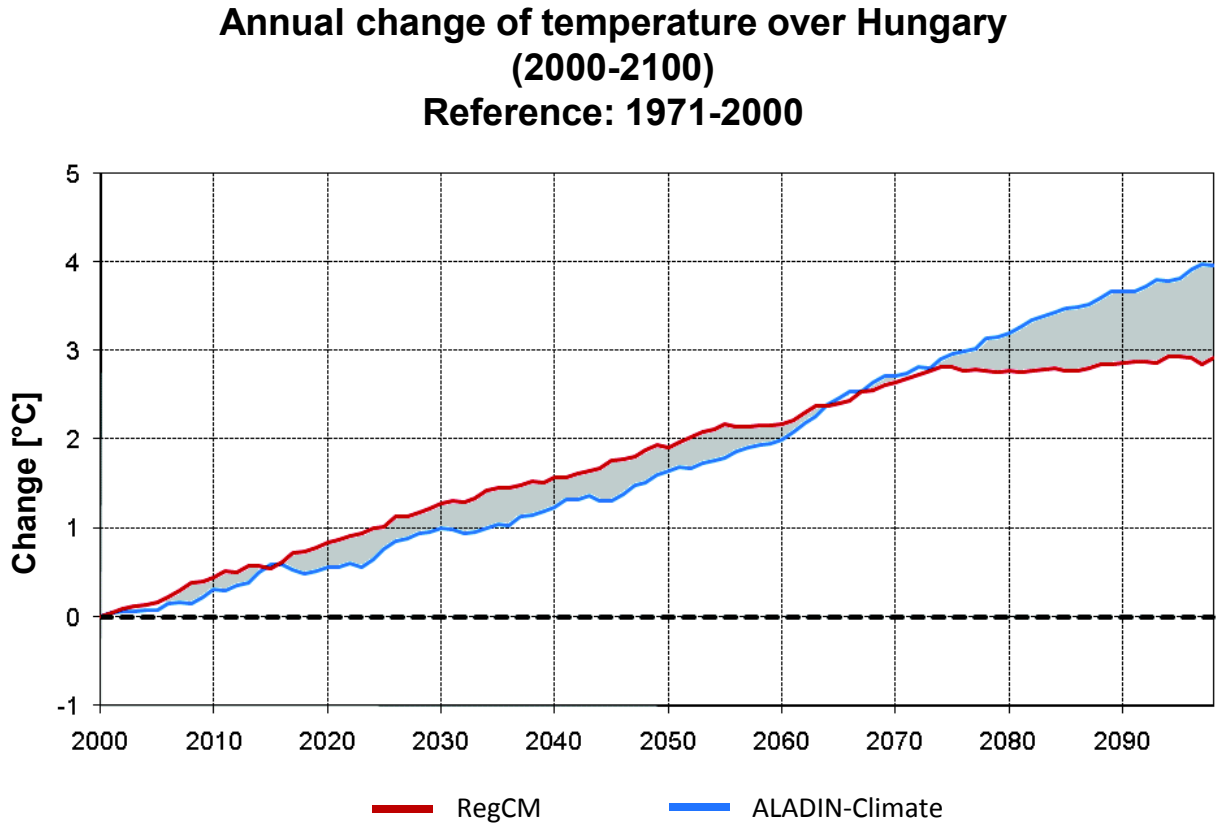


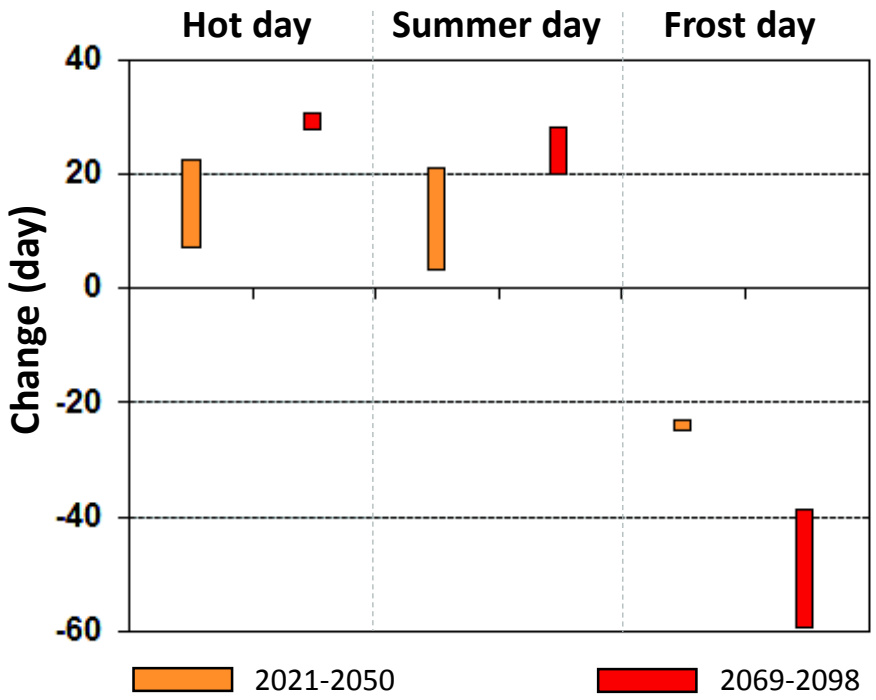


Effect of different RCP scenarios

- ALADIN RCP8.5 (pessimistic): higher change by 2100
- RegCM RCP4.5 (optimistic): lower rate of warming after 2070

Results – Temperature extremes

Change of the number of temperature extremes



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Summer day: daily Tmax > 25°C
Frost day: daily Tmin < 0°C

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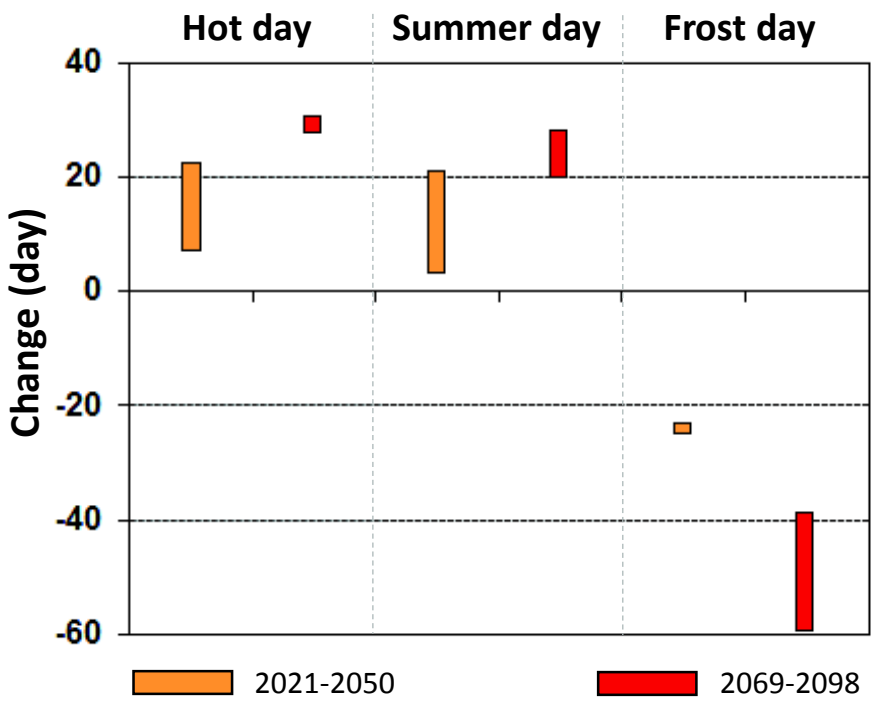

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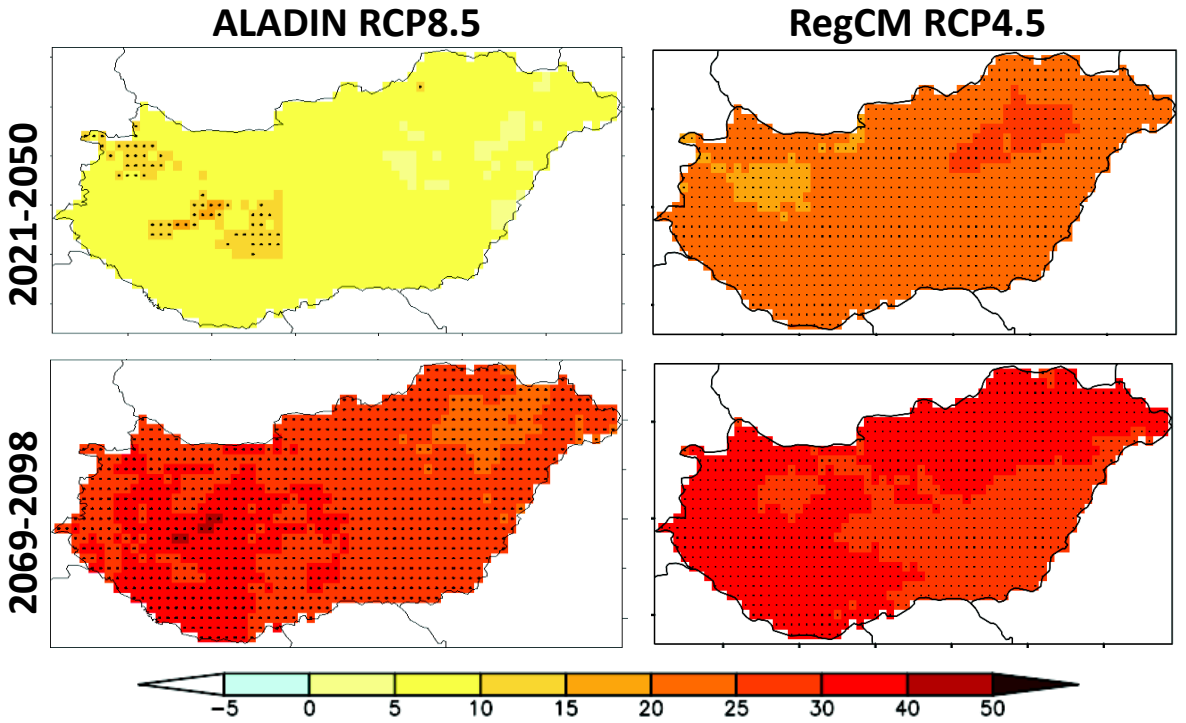

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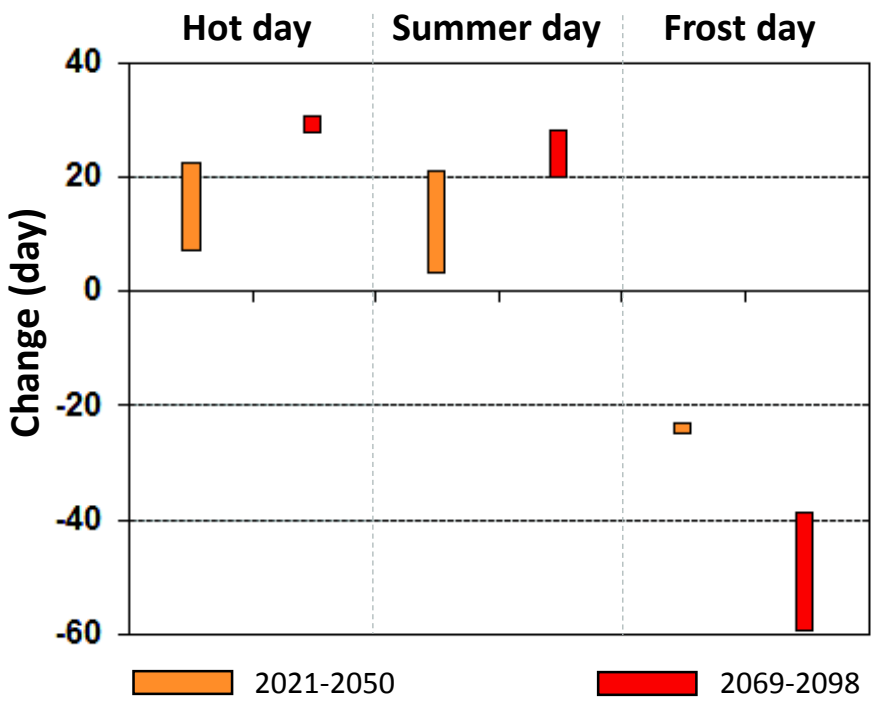

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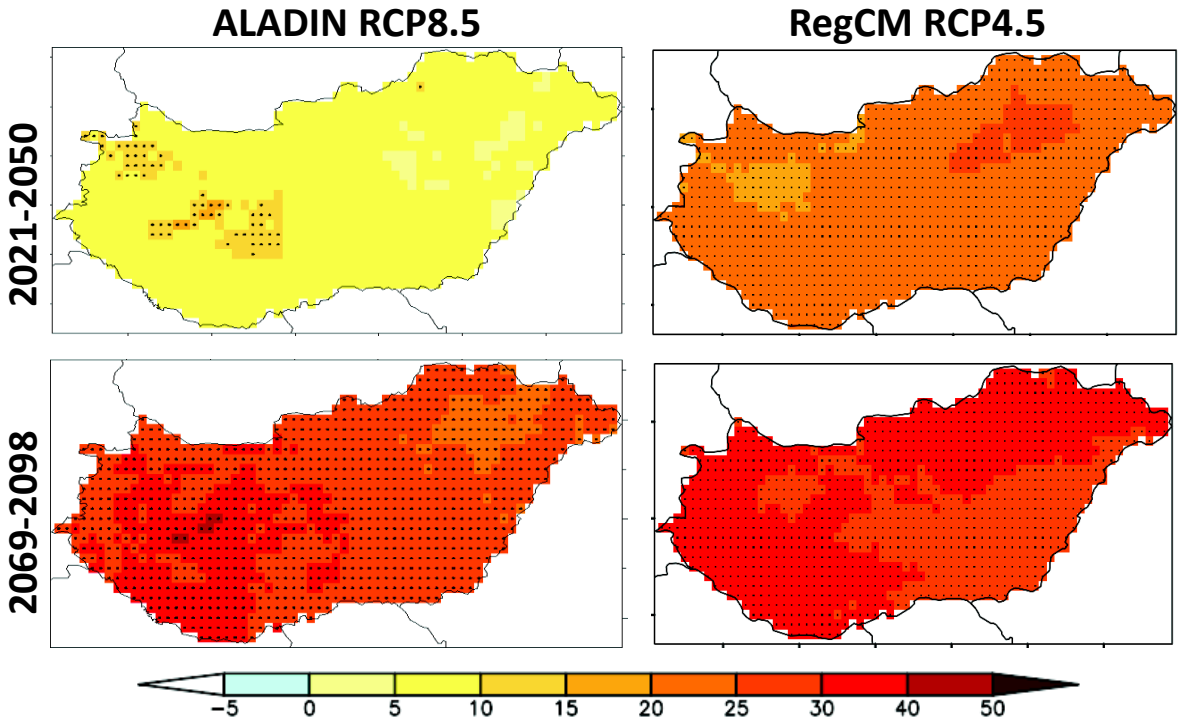
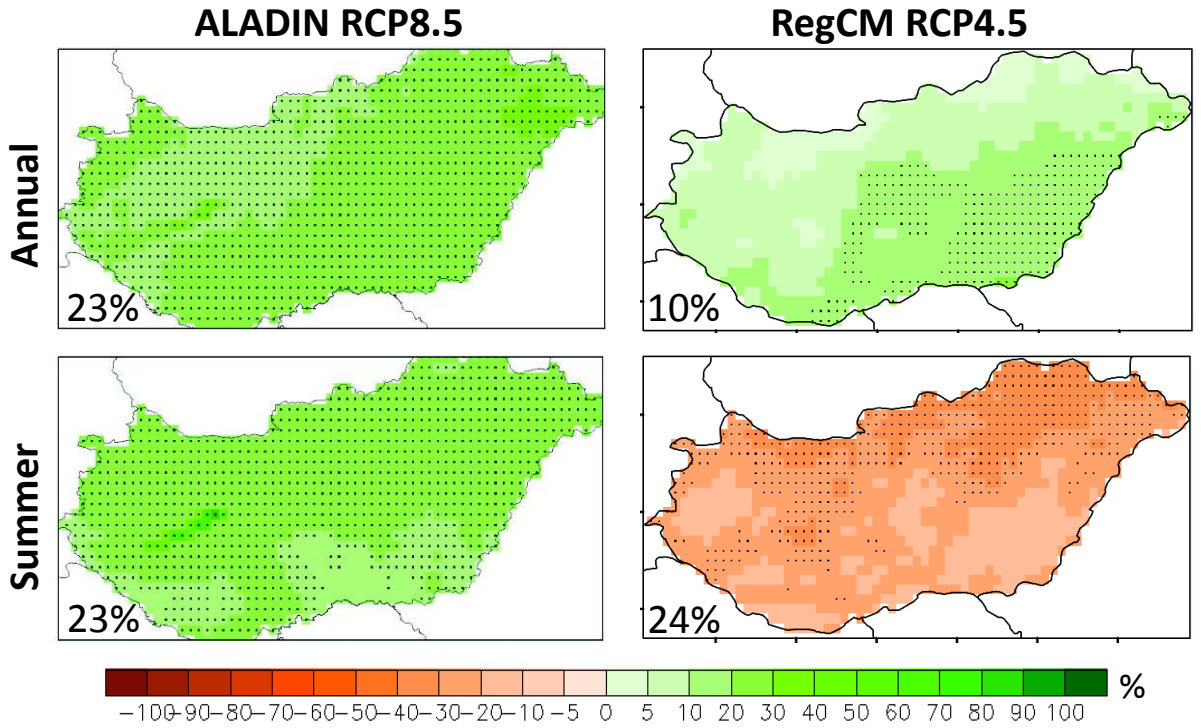


- Significant increase in number of warm extremes
- Frost days tend to become less frequent

Results – Precipitation

Precipitation changes (%) over Hungary for 2069-2098
Reference: 1971-2000



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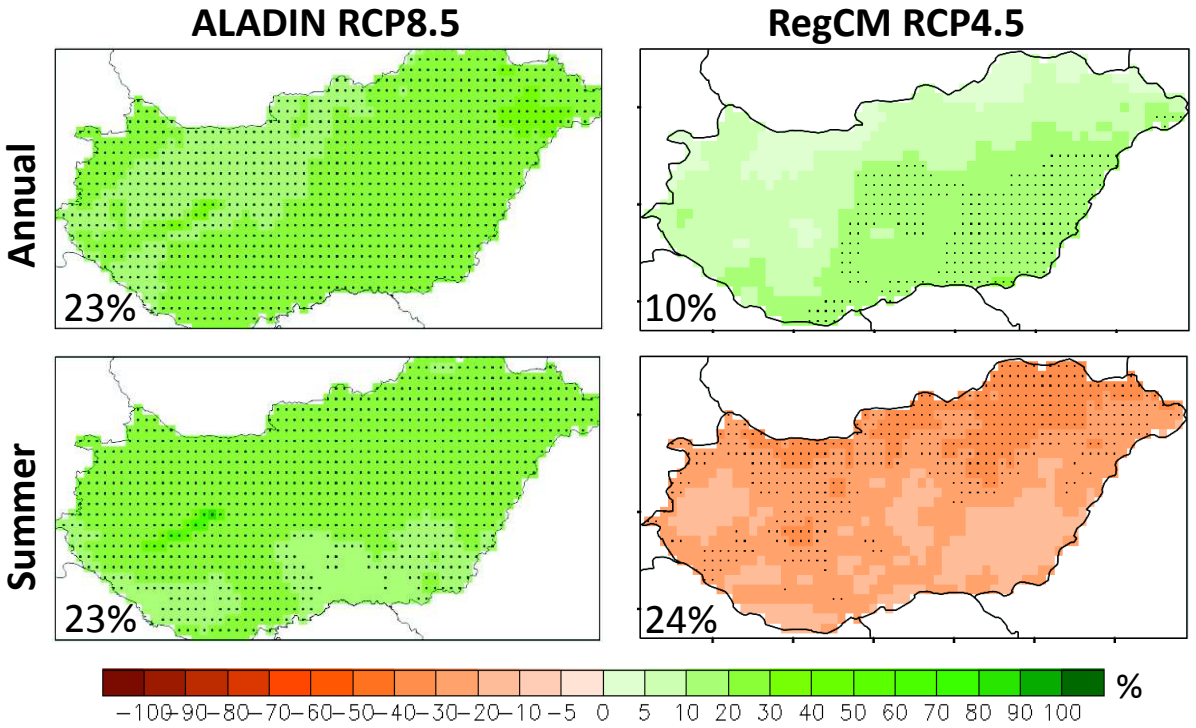

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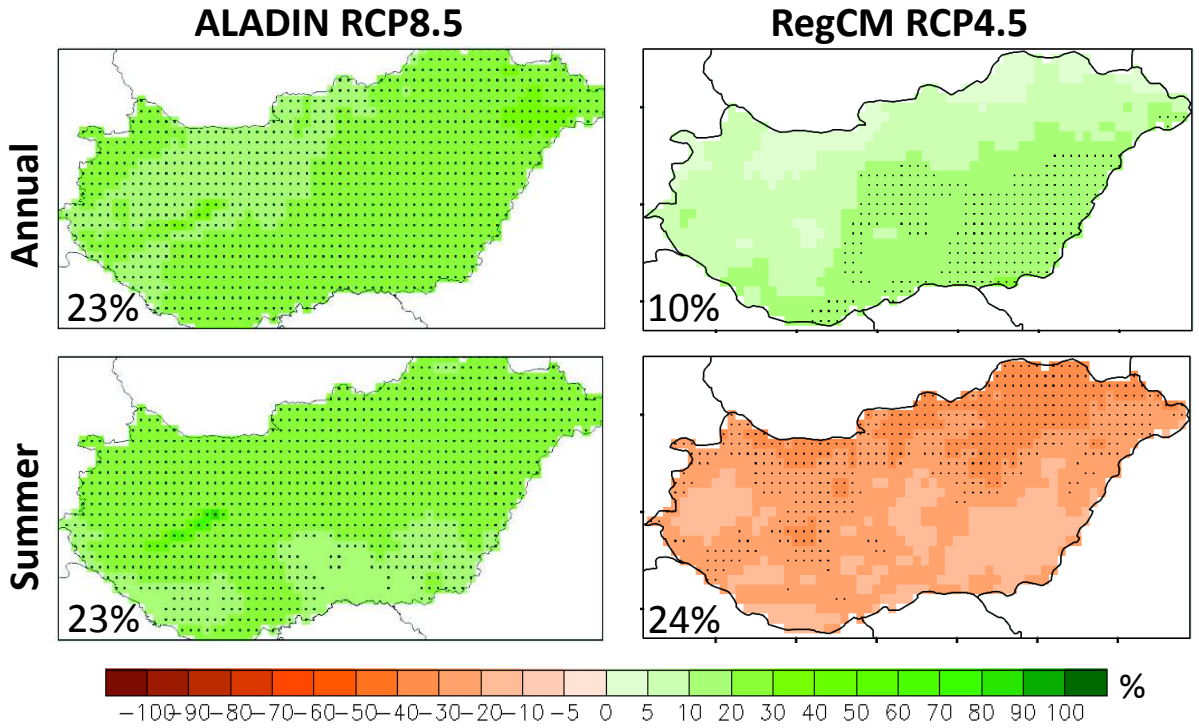

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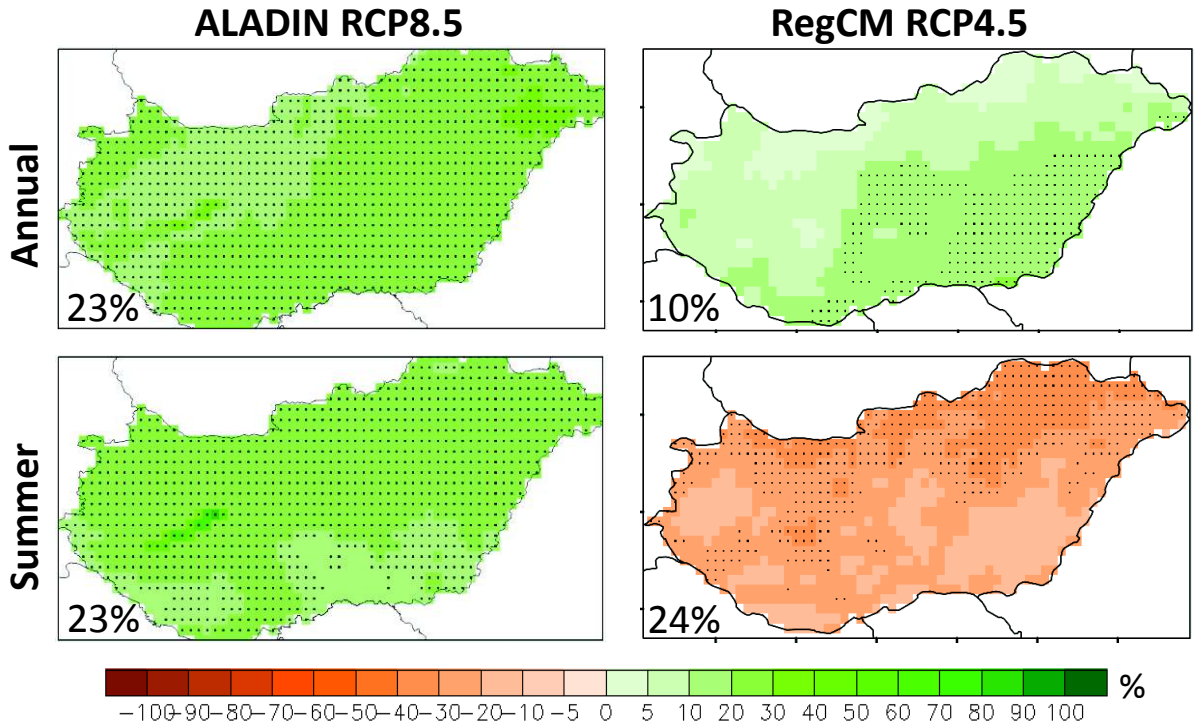

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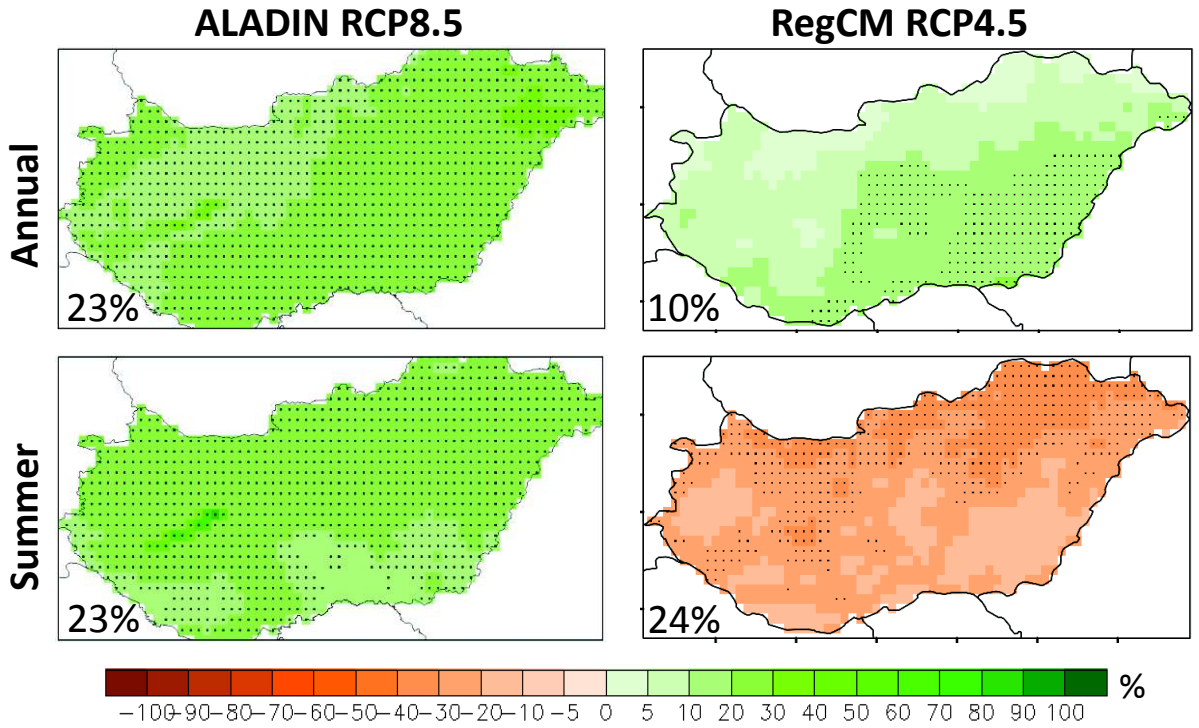
- Uncertain summer changes in far future

Precipitation changes (%) over Hungary for 2069-2098
Reference: 1971-2000



		Annual	Spring	Summer	Autumn	Winter
ALADIN	2021-2050	17	13	15	23	19
	2069-2098	23	16	23	33	24
RegCM	2021-2050	3	23	-16	-13	19
	2069-2098	10	24	-24	14	24

Results – Precipitation

- Annual precipitation amount will increase over Hungary
  2021-2050: 3-17%
  2069-2098: 10-23%

- Different sign of changes in autumn
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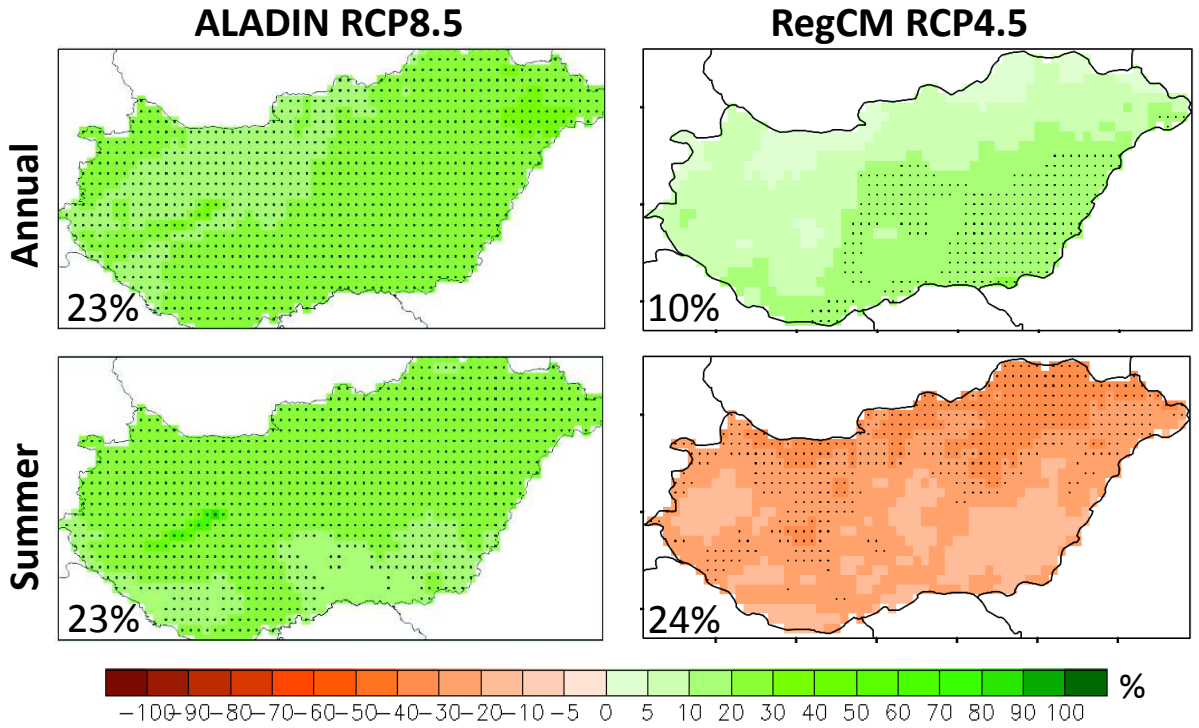

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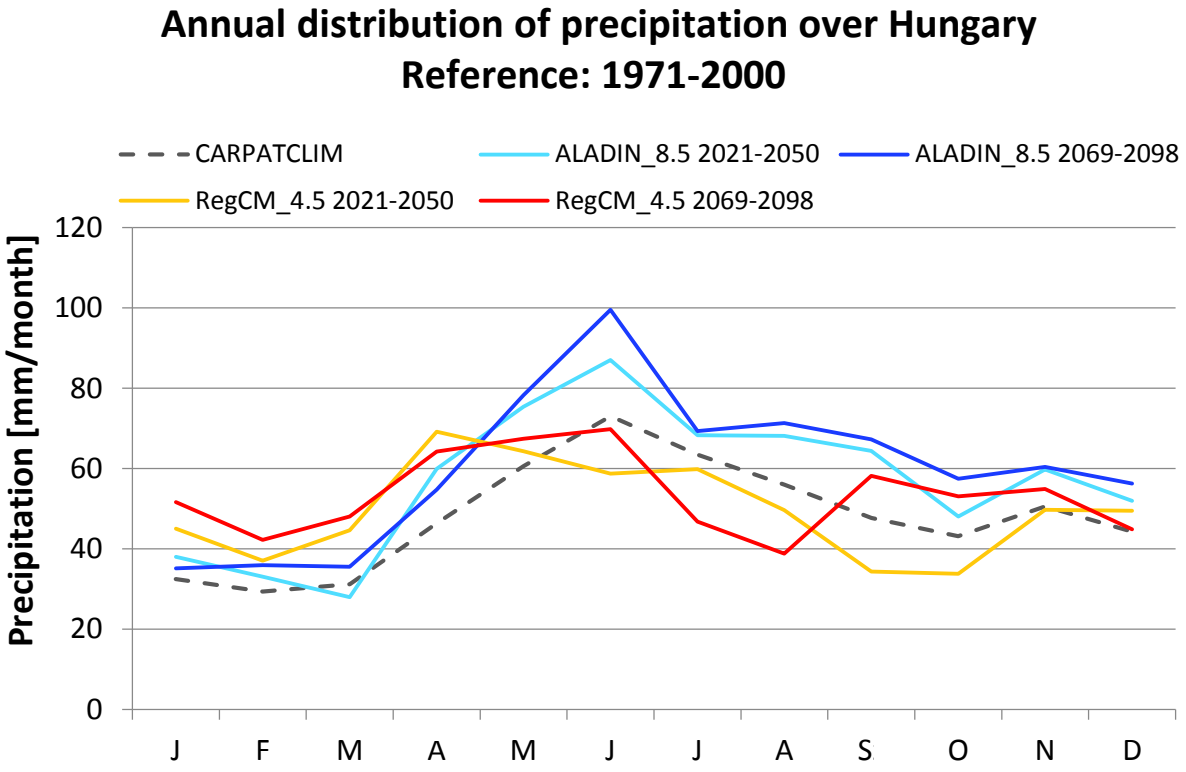

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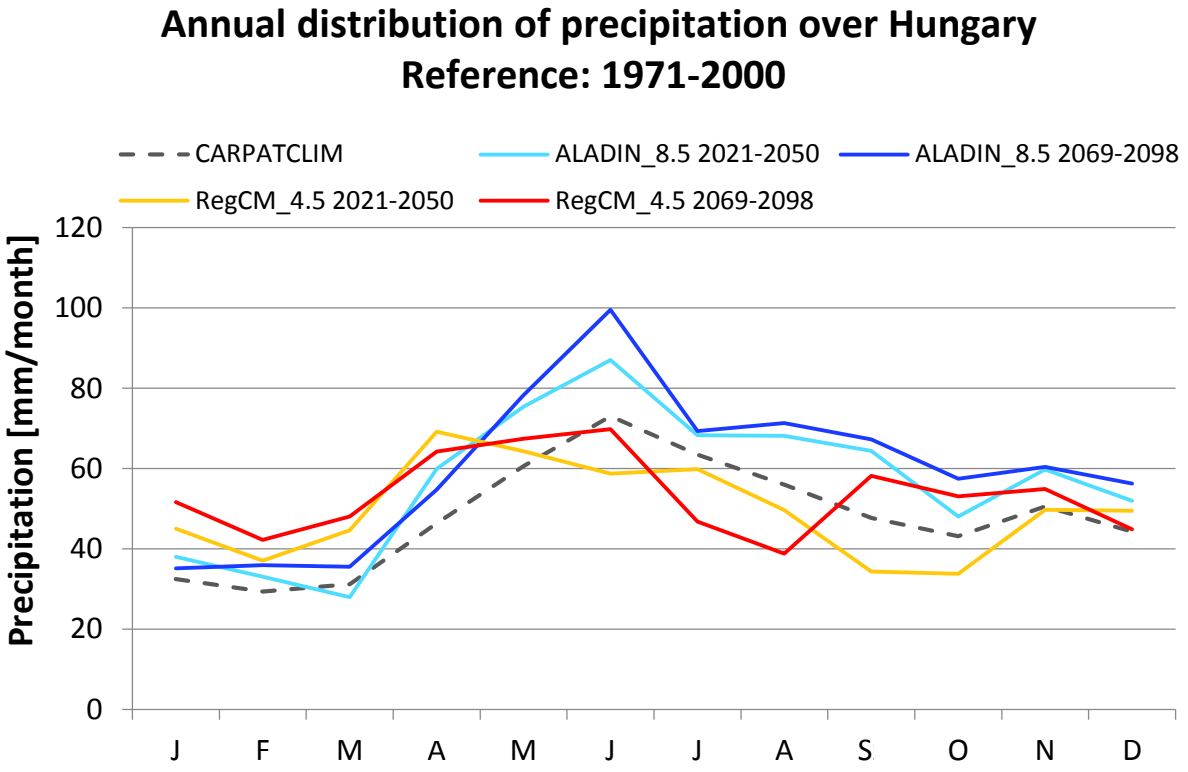


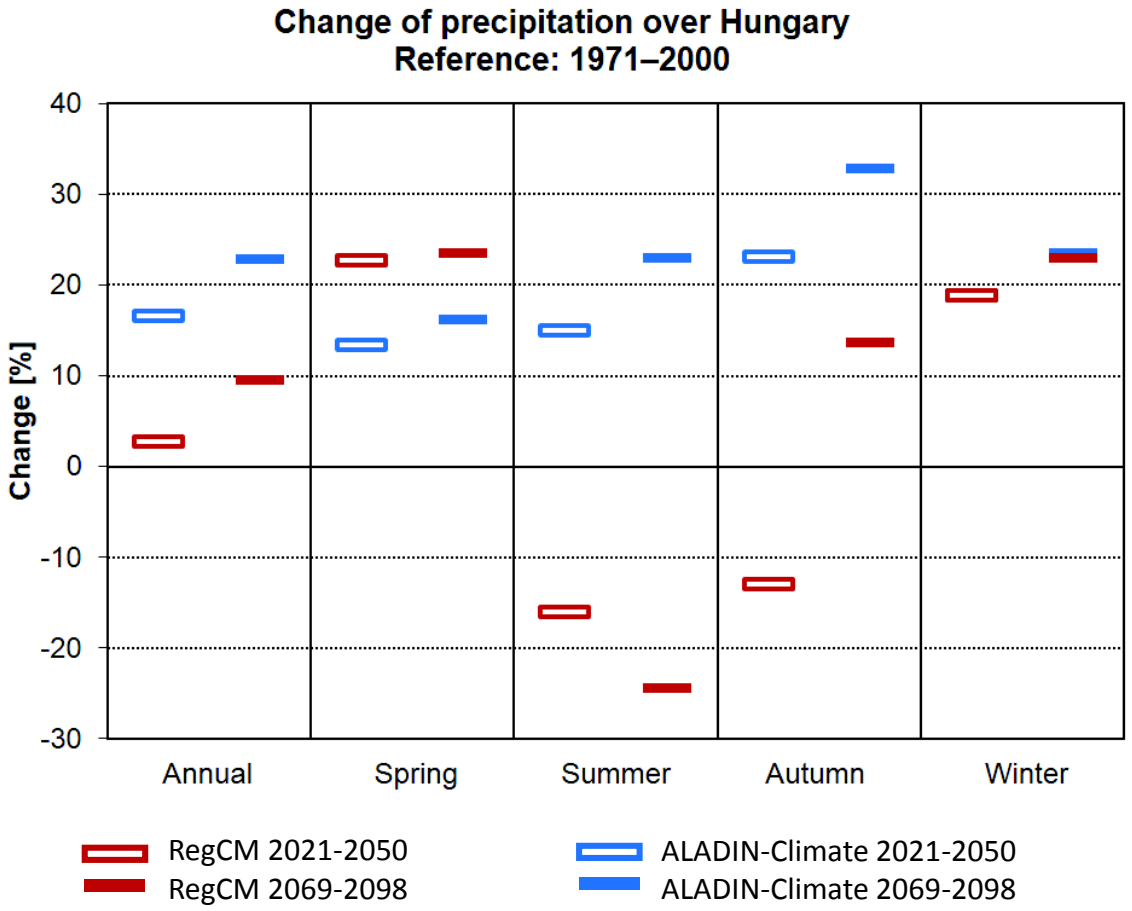
ALADIN

- Similar annual distribution (min in January, max in July, secondary max in November)
- Increasing precipitation amount (except March in near future)

RegCM

- Max is earlier in near future (April), secondary max in September in far future
- September is the most variable

Results – Precipitation



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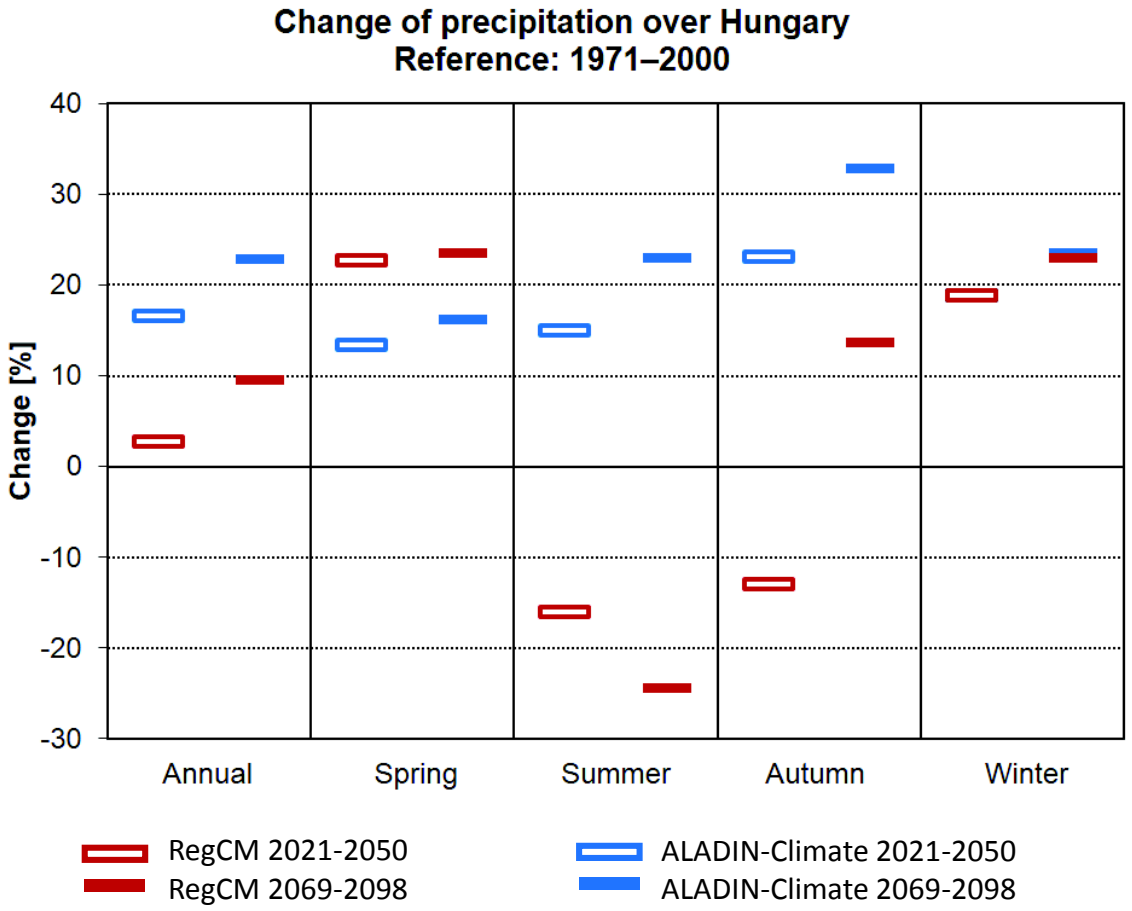

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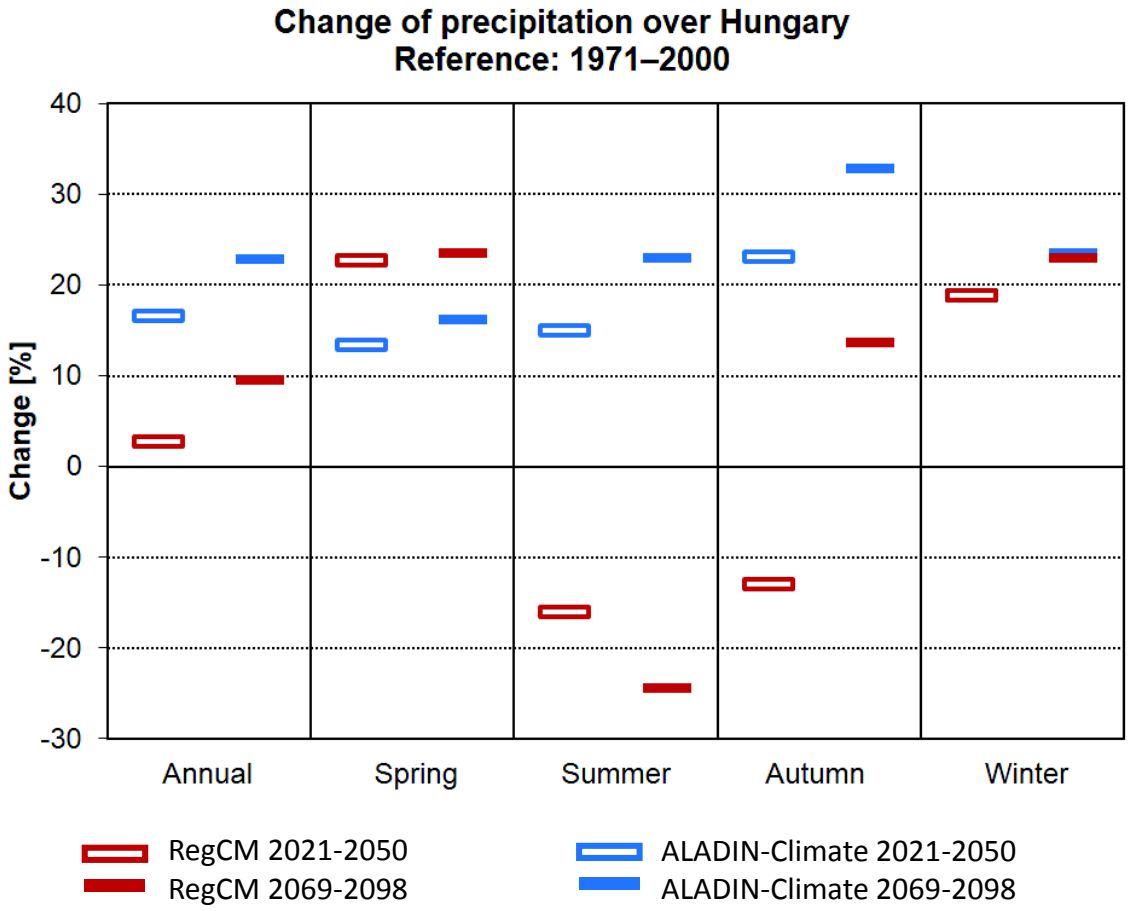

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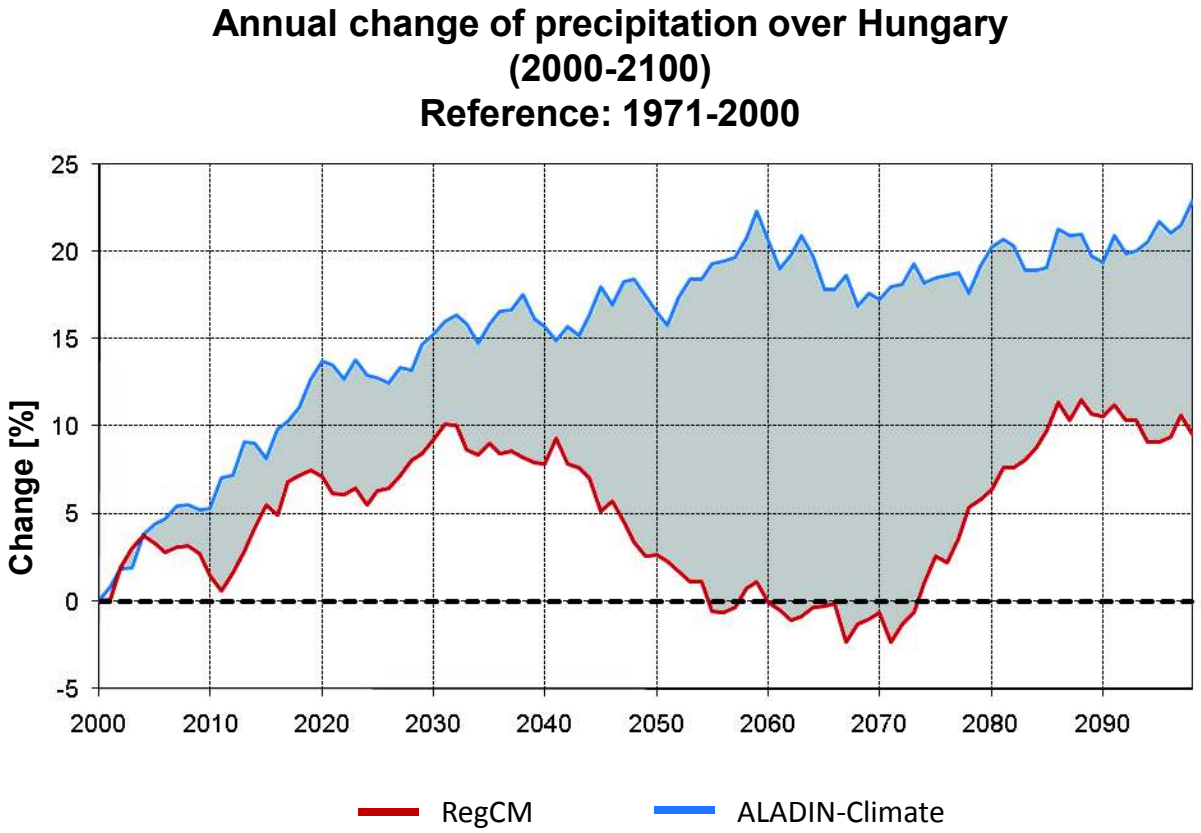

- Results of two RCMs already high uncertainties, but no probabilistic information → more model simulations needed

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Calculated indices:

RR1 - Precipitation day (P daily > 1 mm)
RR10 - Heavy precipitation day (P daily > 10 mm)
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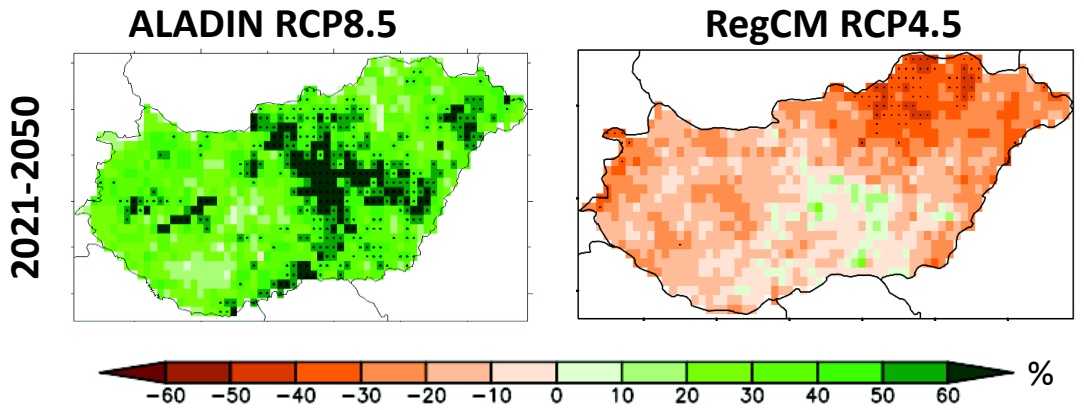

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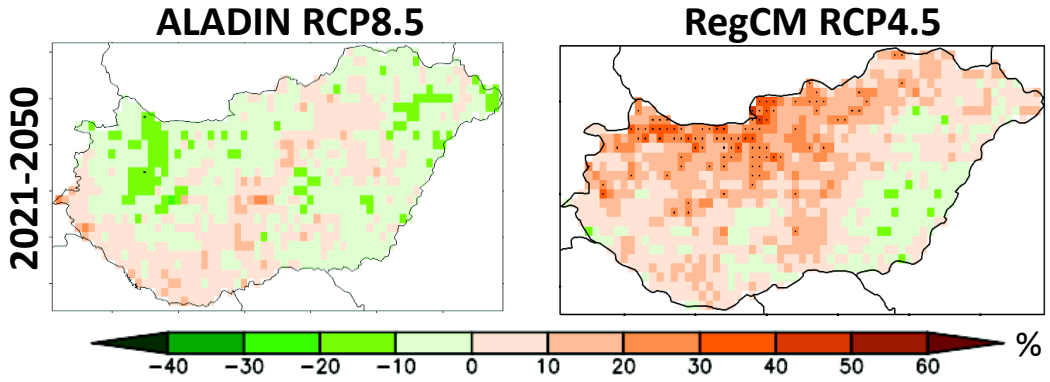

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- Uncertain change in space and time
- Indices mostly show more precipitation according to ALADIN
- Different models often different sign of changes
- Not consistent with previous results
- The largest precipitation intensity increase in autumn in 2069-2098

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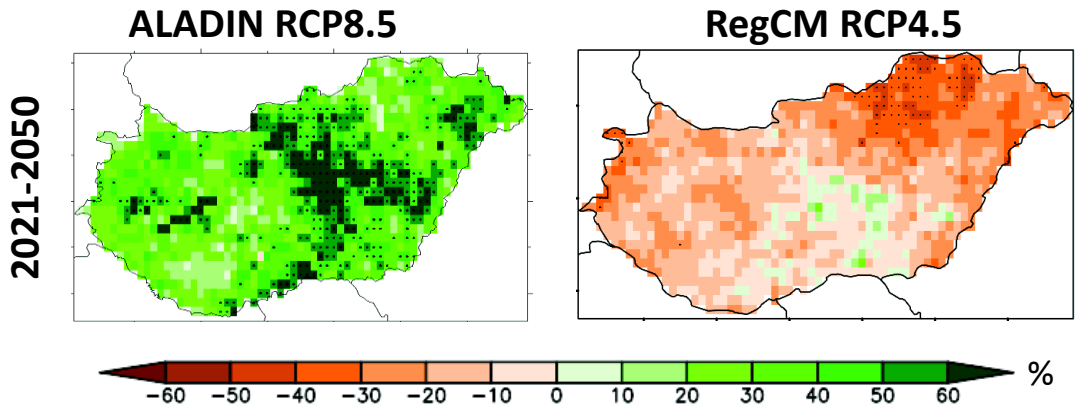

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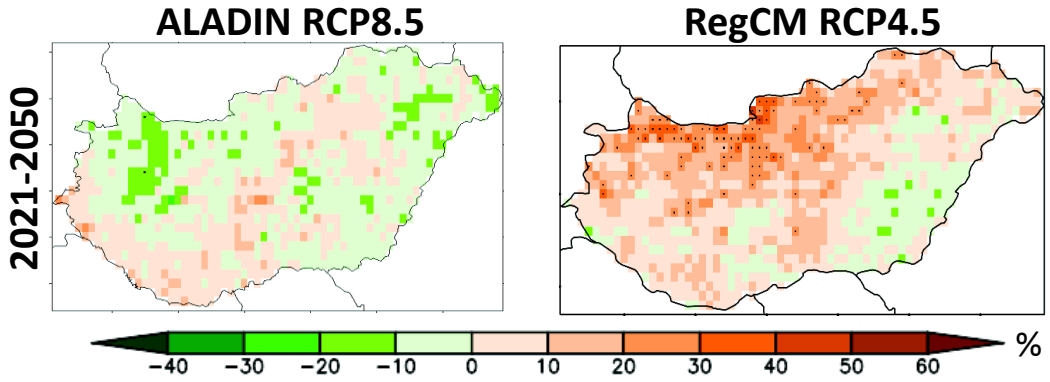

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- The results of two RCMs show two largely different future paths → to decide which one is more probable more simulations are needed

Comparison to ENSEMBLES results

- ENSEMBLES (A1B, 1961-1990 reference)
  - 17 models for 2021-2050
  - 13 models for 2071-2100

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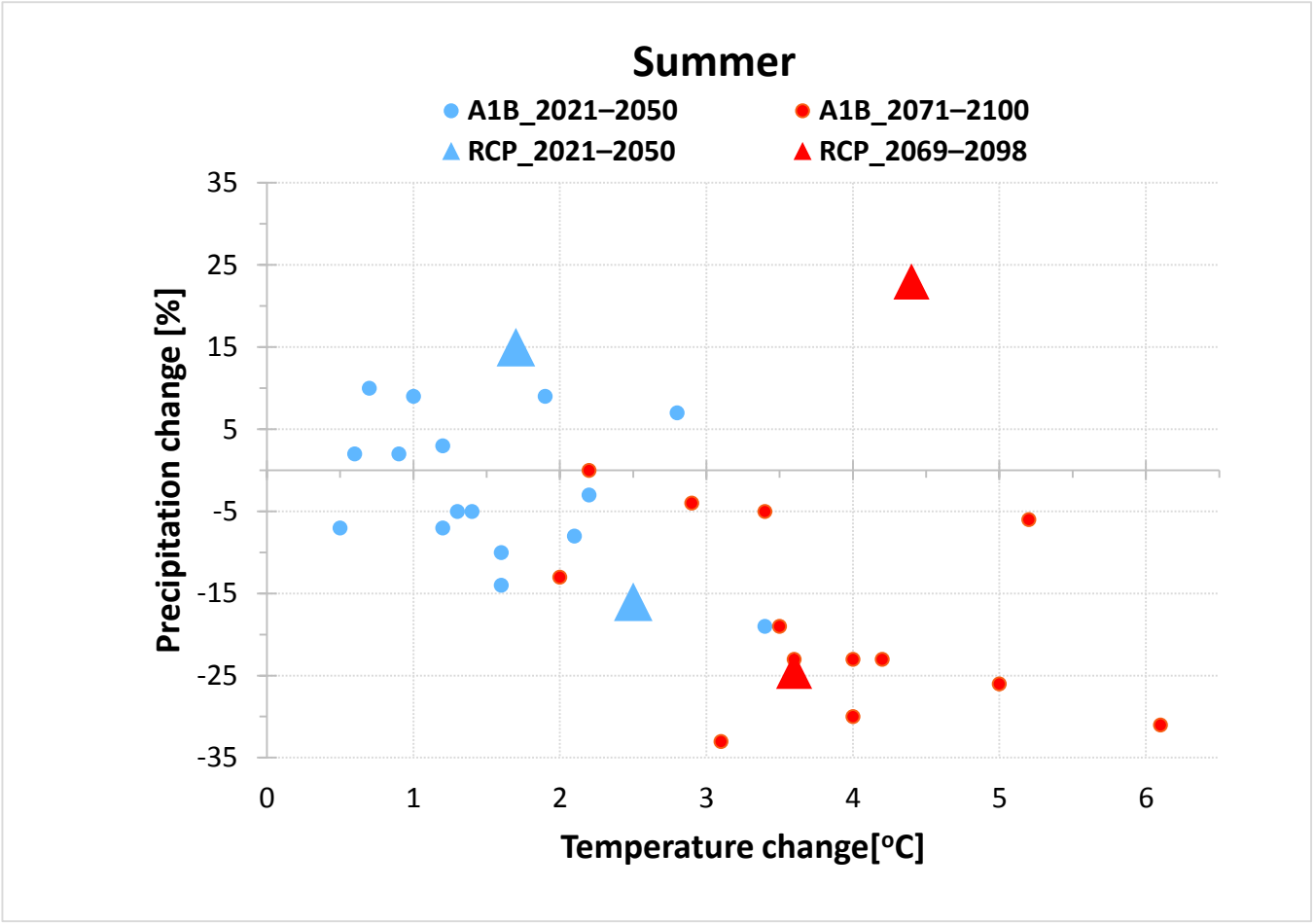

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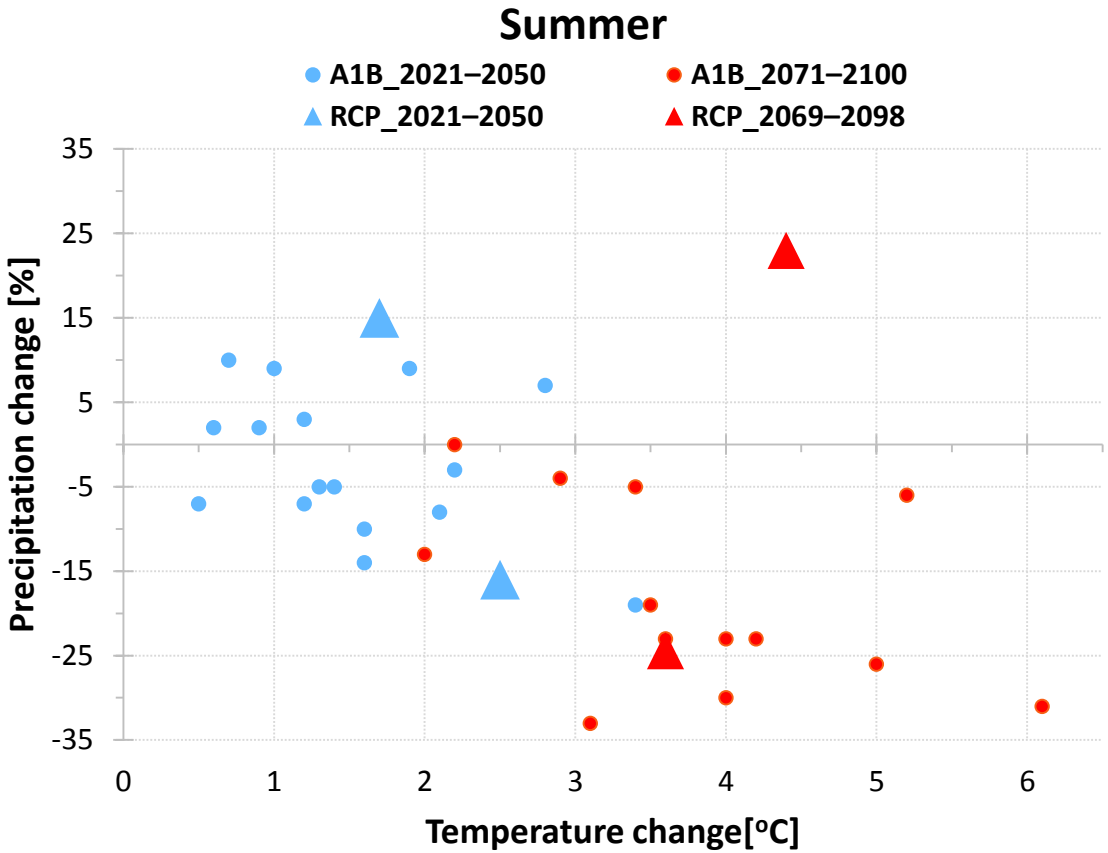
- RCP simulations with the same probability in near future, one is more probable in far future



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Thank you for your attention!

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