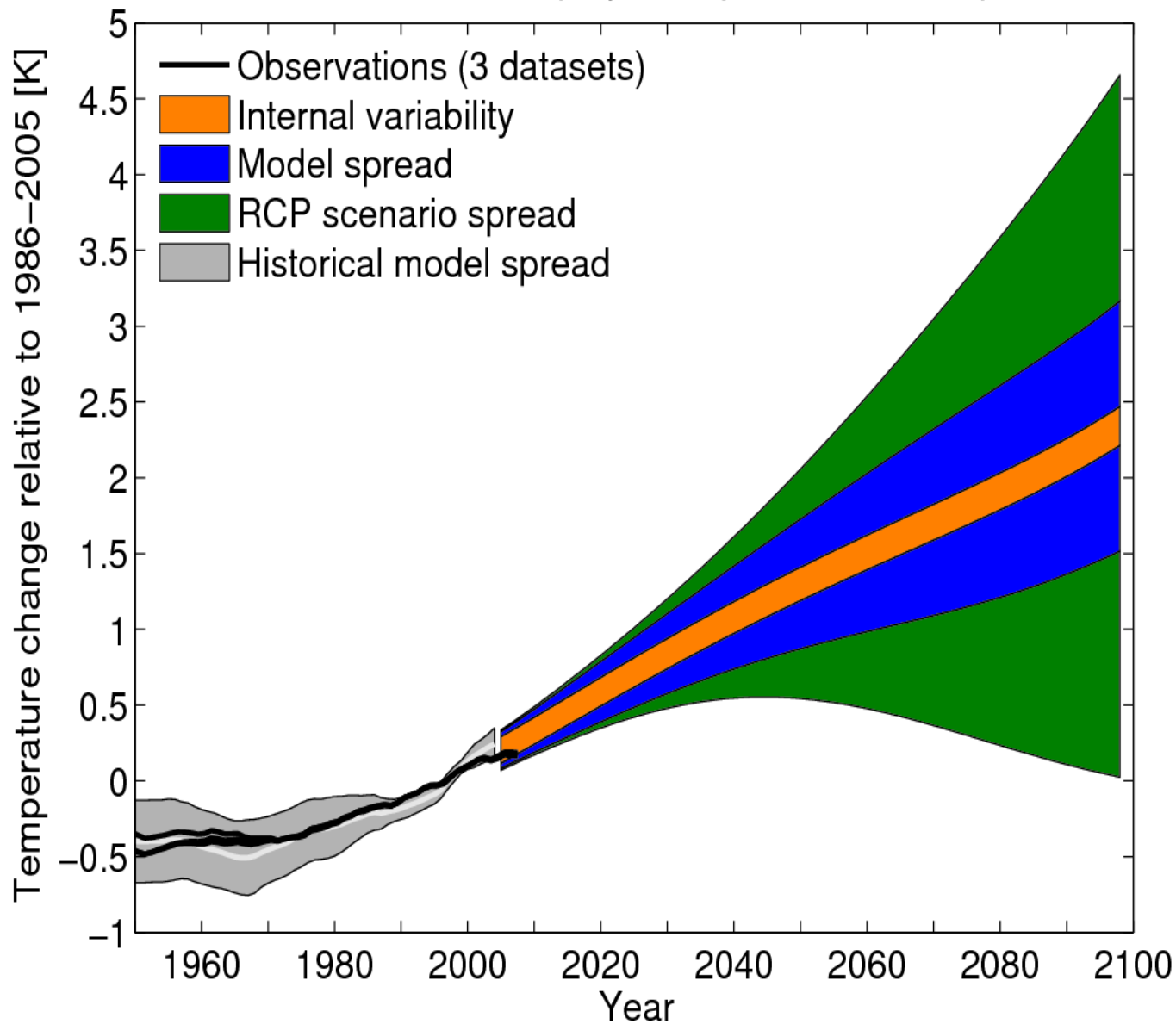


# Overview of the climate change issue in the Carpathian region

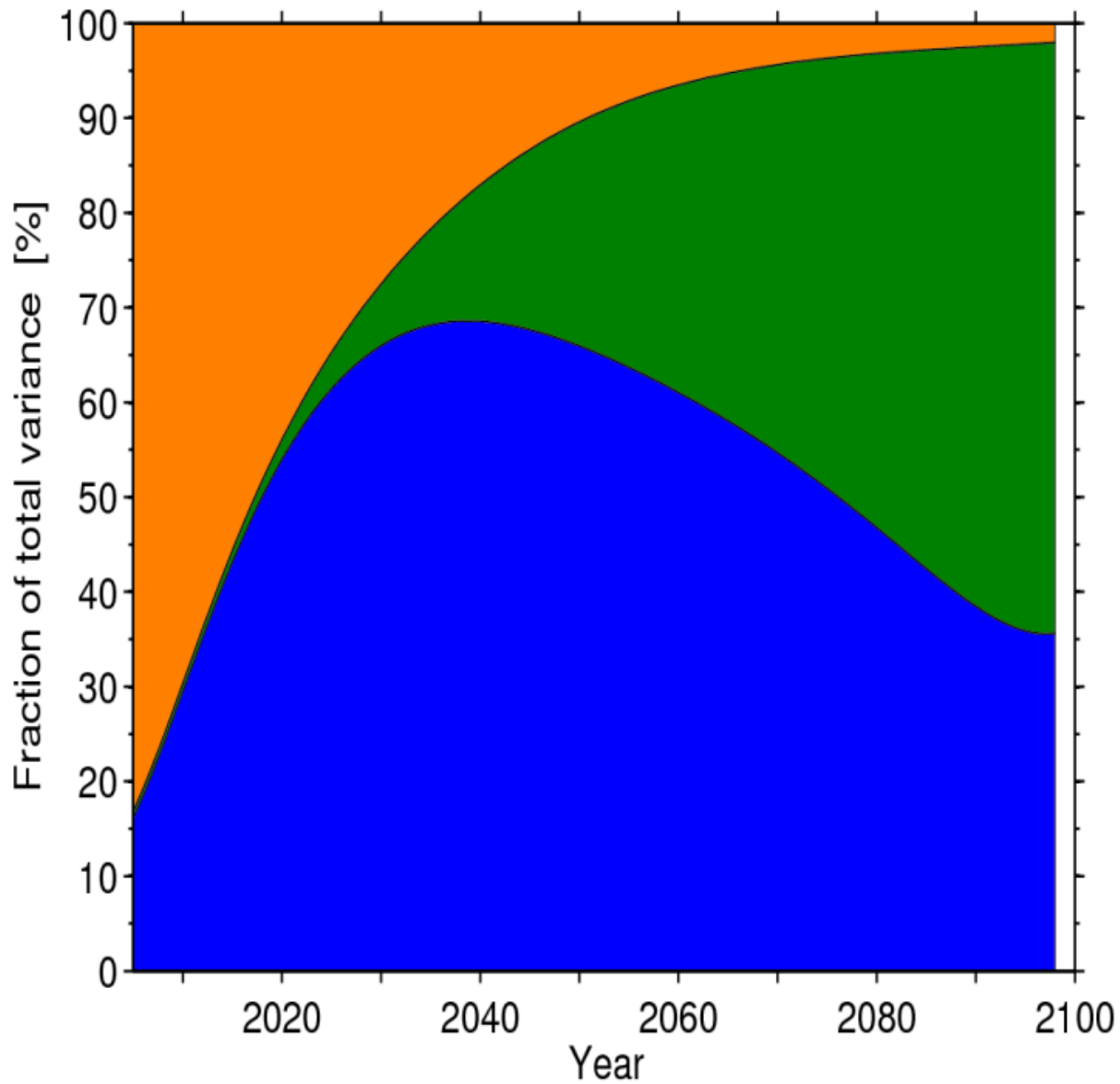
Sandor Szalai

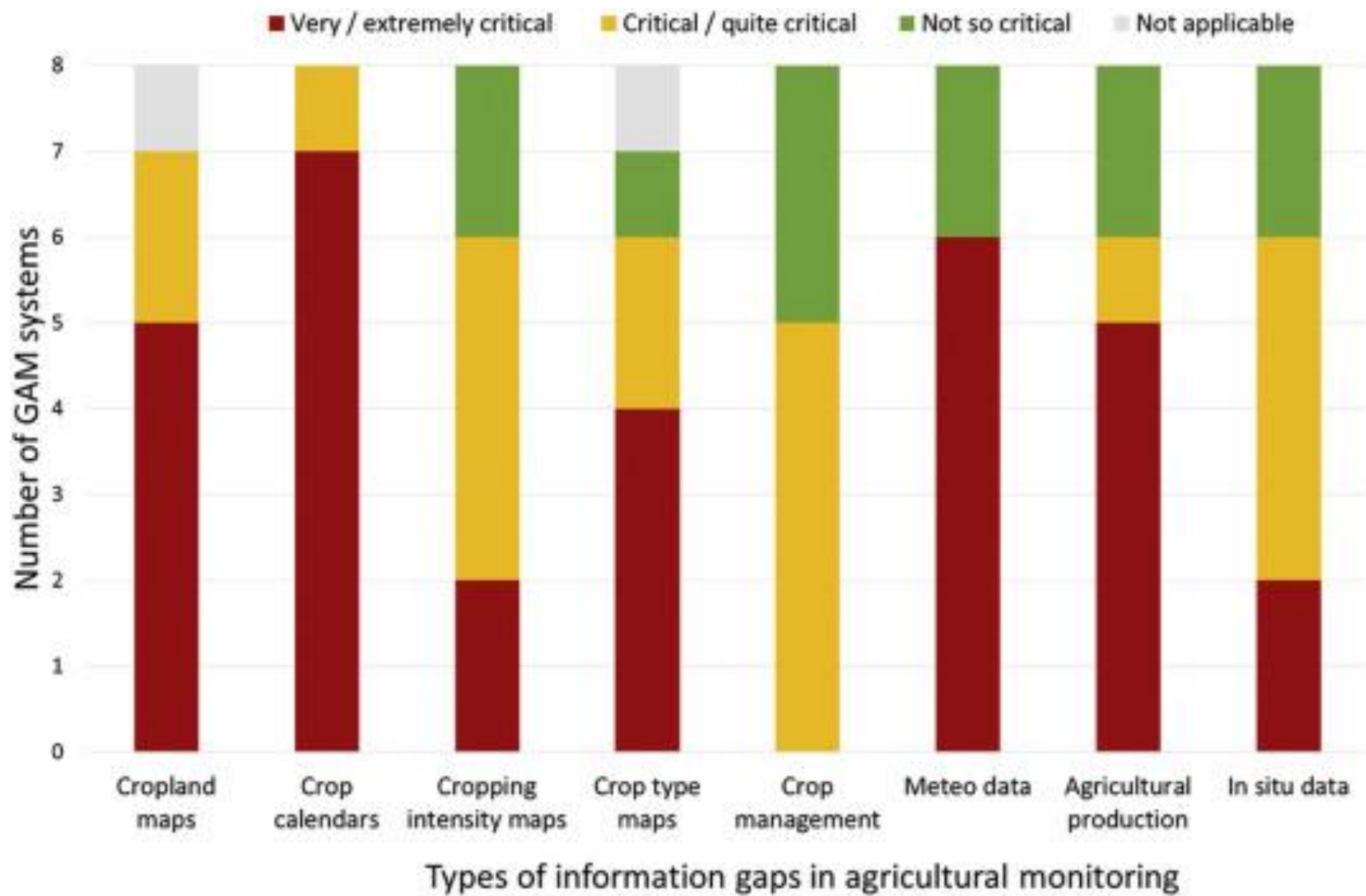
[Szalai.sandor@mkk.szie.hu](mailto:Szalai.sandor@mkk.szie.hu)

Sources of uncertainty in projected global mean temperature



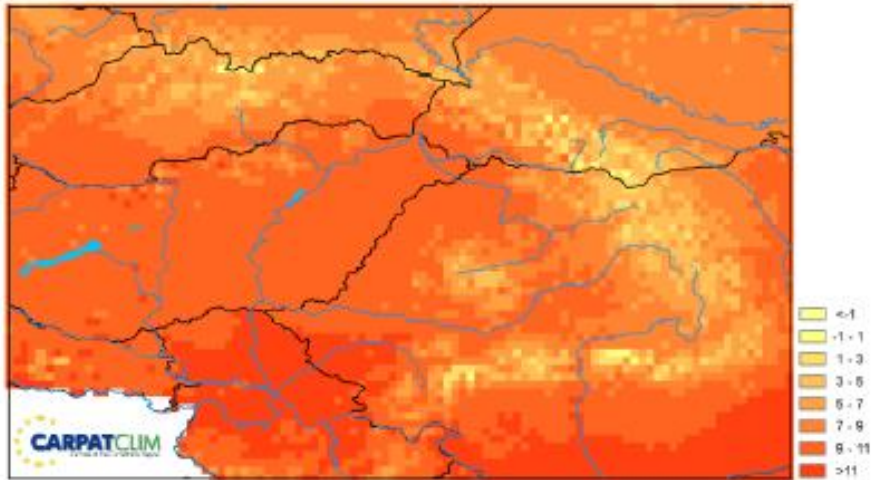
Uncertainty in Europe decadal mean DJF temperature



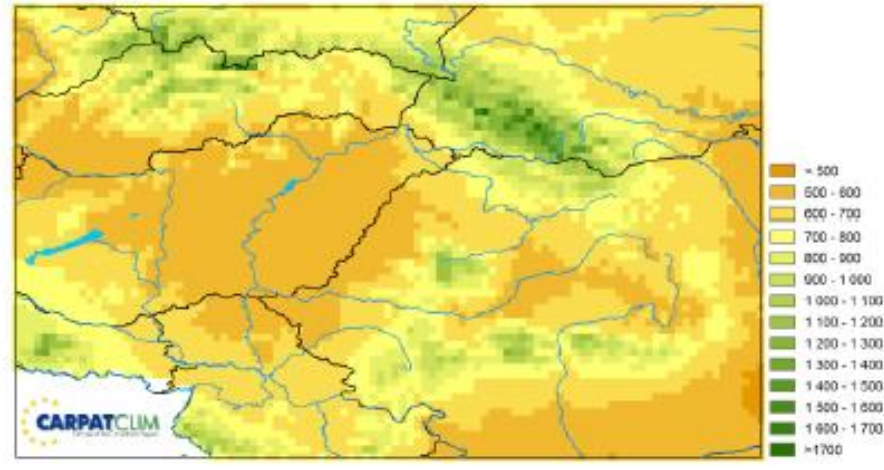
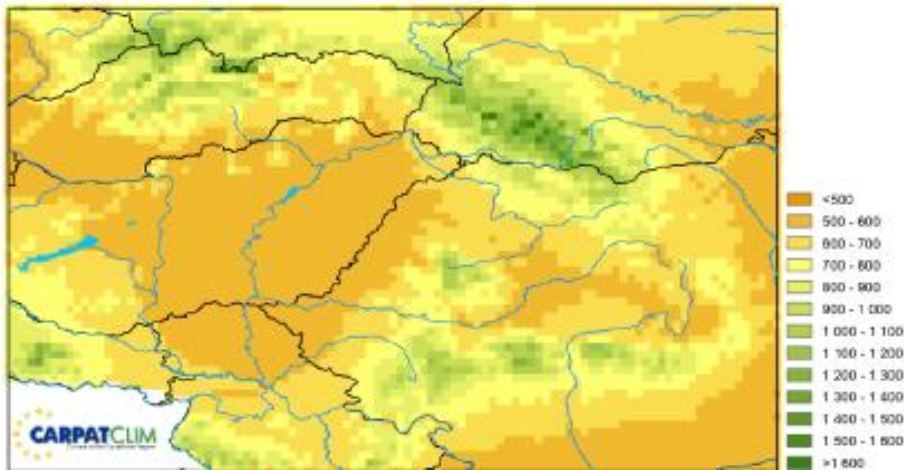
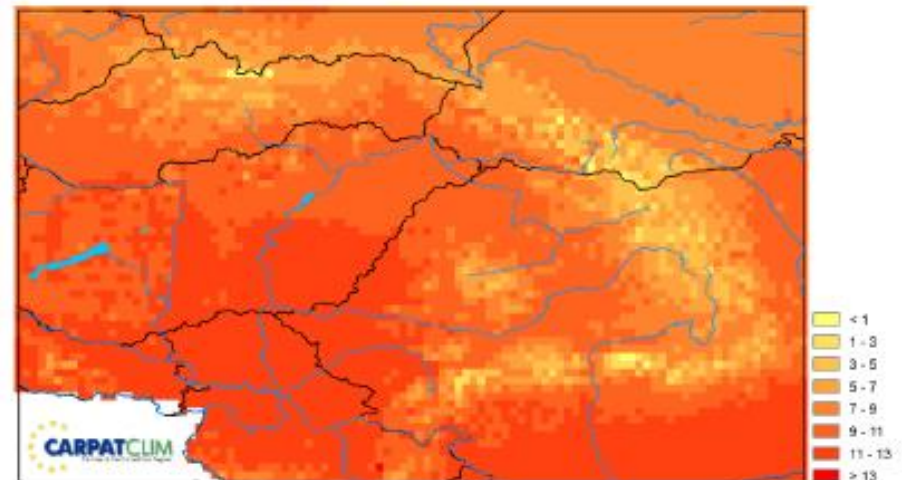


# Temperature and precipitation averages

**1961-90**



**1981-2010**

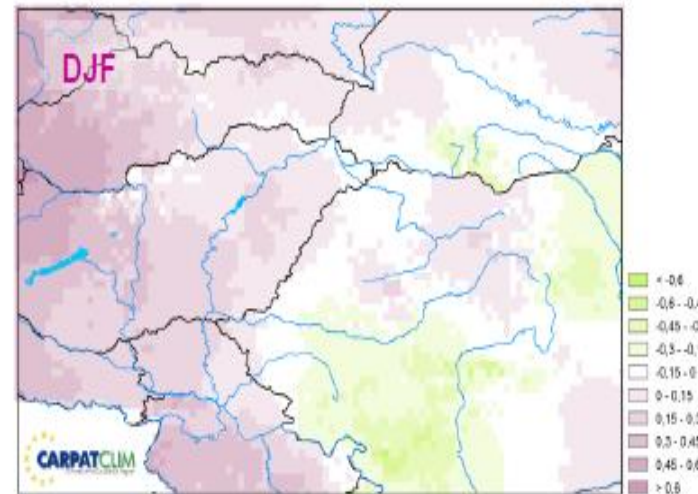
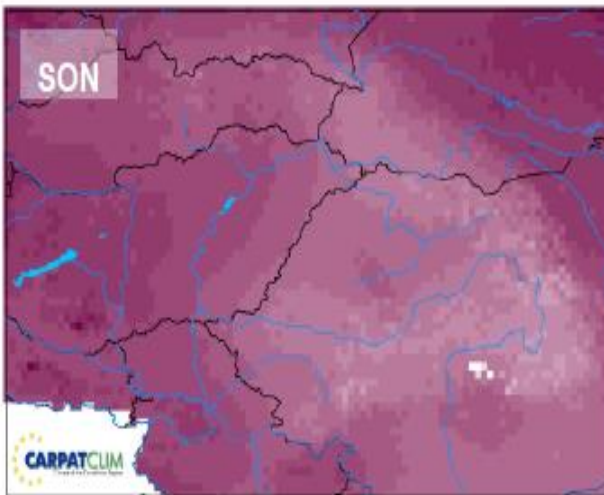
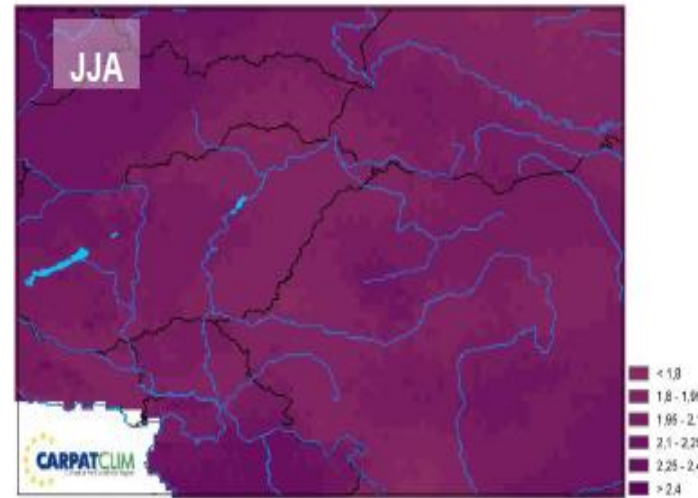
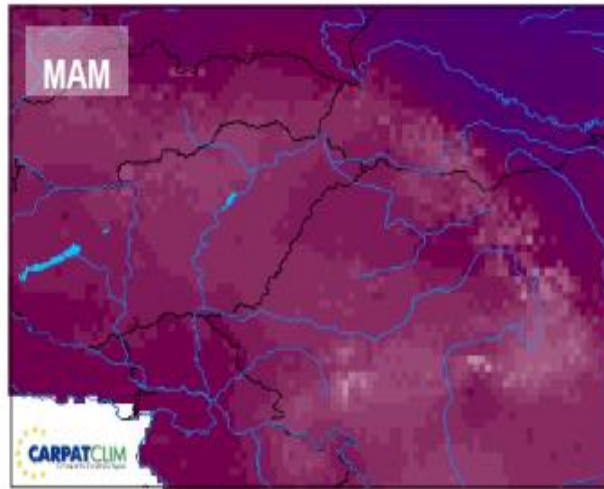


10/11/2019

DriDanube - Drought risk in the Danube Region

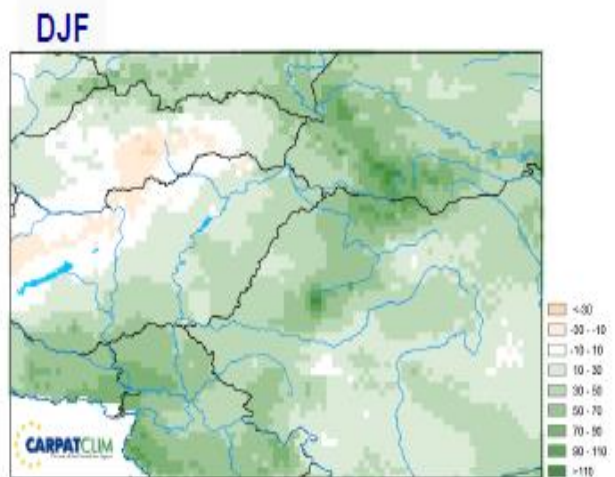
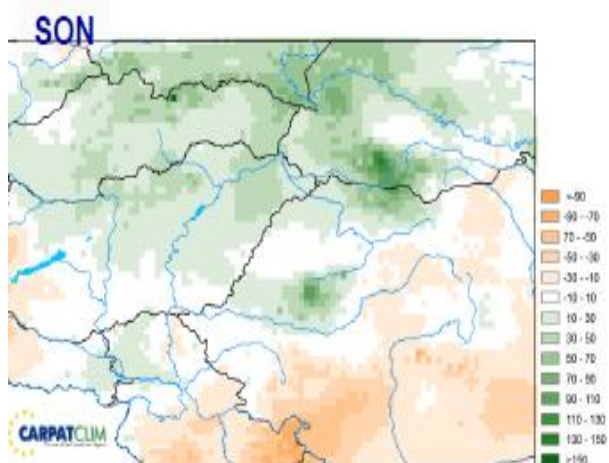
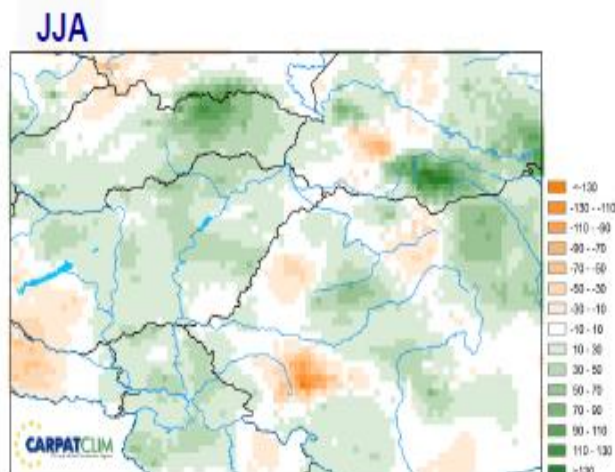
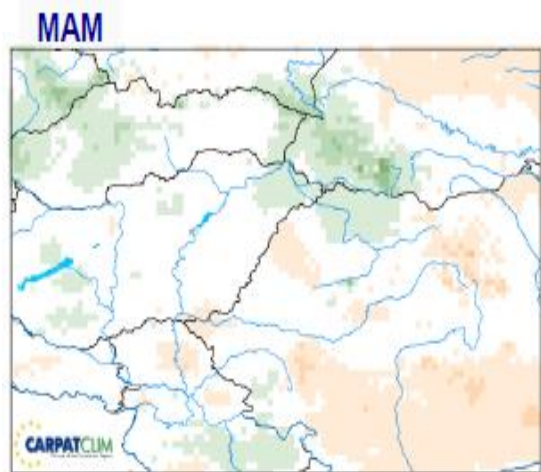


# Seasonal temperature changes, 1961-2010

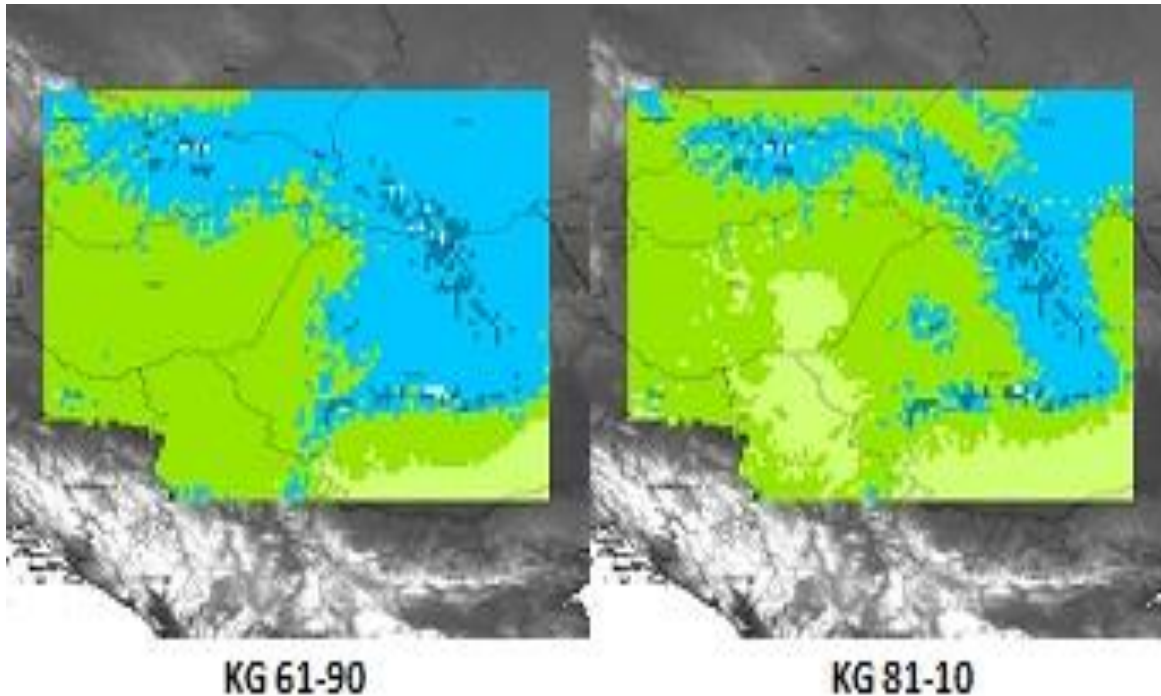


# Change of the seasonal precipitation sums

1961-2010



# 1961-90 versus 1981-2010 Köppen-Geiger's climate maps



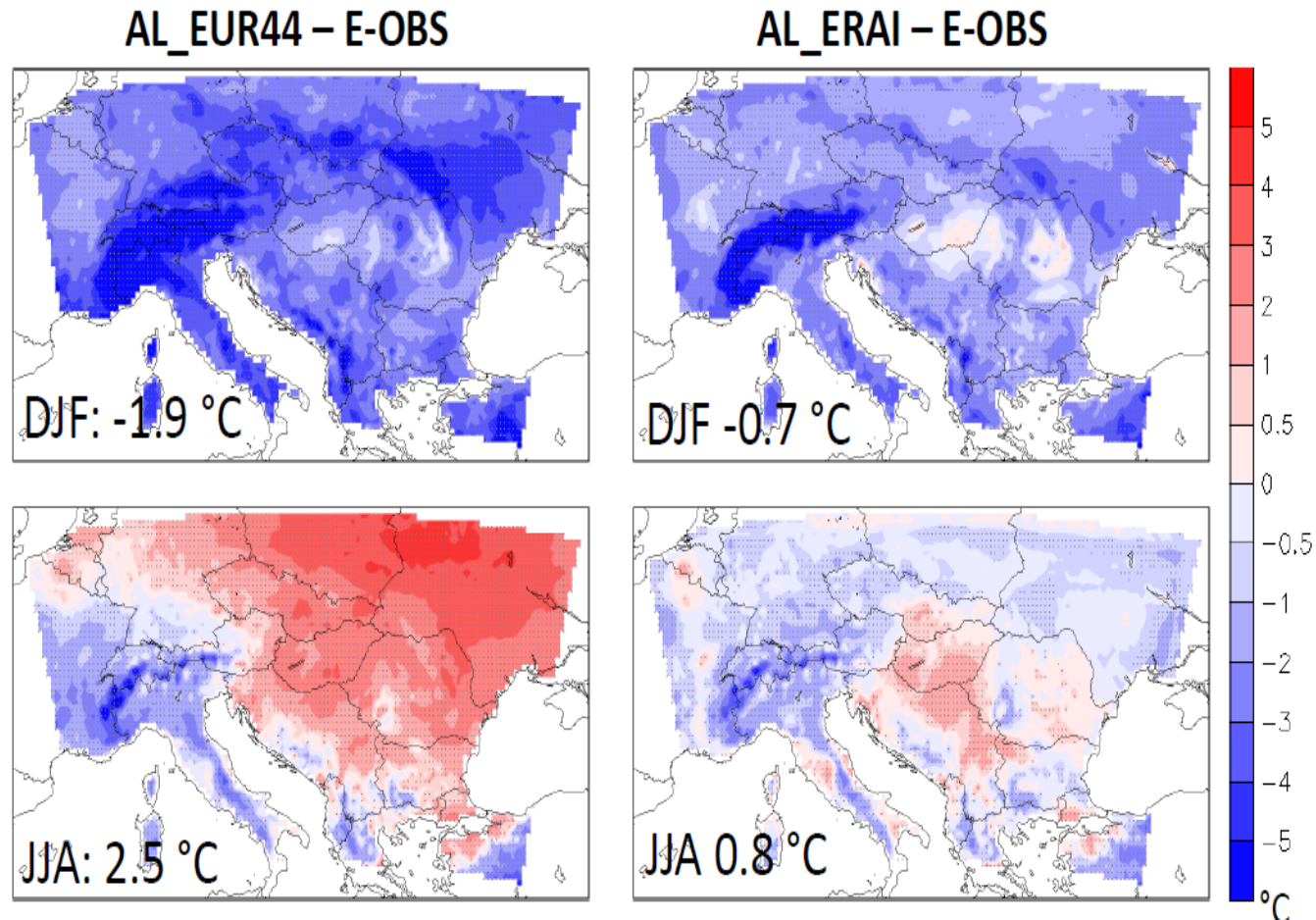


# Two main databases in the region

## E-obs

- European
- Daily
- 0,25° lanlong
- DQ is on basic level
- Carpatclim
- Regional
- Daily
- 0,1° lanlong
- Common DQ
- Harmonized

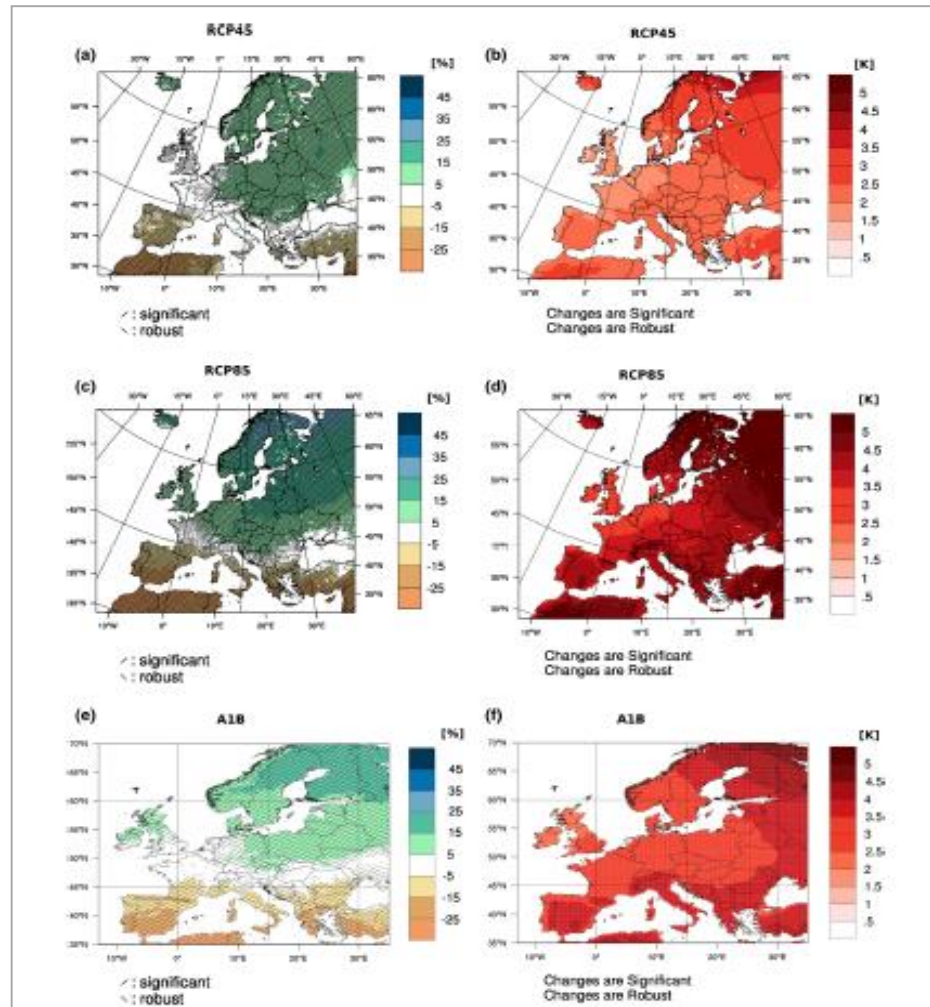
# Differences



<b>Spatial correlation of RCP8.5 and SRES A1B</b>	<b>Climate parameter</b>			
	<b>Mean annual temperature</b>		<b>Annual total precipitation</b>	
	<b>2021–2050</b>	<b>2071–2100</b>	<b>2021–2050</b>	<b>2071–2100</b>
Alpine	0.88	0.95	0.92	0.94
Atlantic	0.82	0.98	0.87	0.94
Continental	0.94	0.96	0.72	0.92
Northern	0.97	0.97	0.59	0.81
Southern	0.90	0.89	0.71	0.96

# Future temperature and precipitation changes based on old (SRES) and new (RCP) scenarios

(Jacob et. al, 2013)





# Models

## Results – Temperature

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

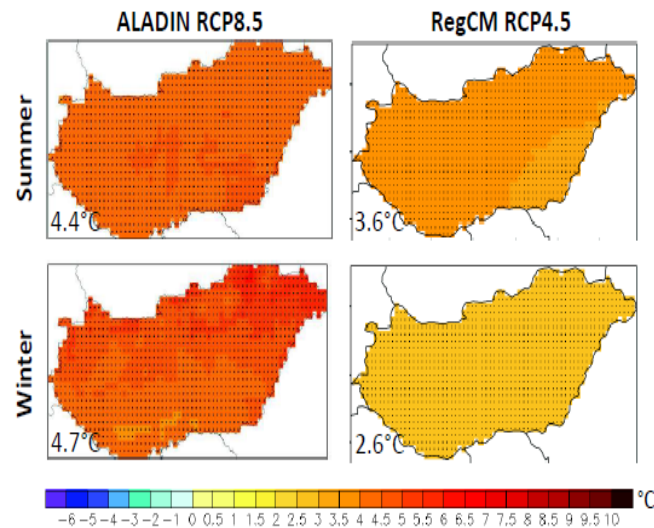
2021-2050:  $\approx 2^{\circ}\text{C}$

2069-2098:  $3-4^{\circ}\text{C}$



- Biggest warming during winter (ALADIN) and summer (RegCM)
- Biggest change by ALADIN (around  $4^{\circ}\text{C}$ )
- Difference between models in winter  $\approx 2^{\circ}\text{C}$

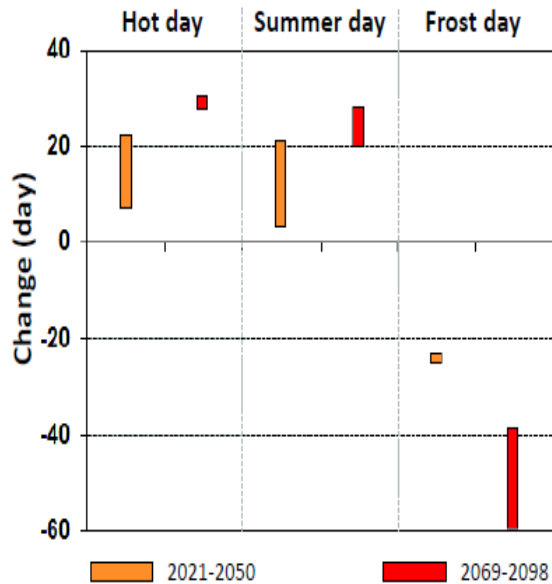
Mean temperature changes ( $^{\circ}\text{C}$ ) over Hungary for 2069-2098  
Reference: 1971-2000



		Annual	Spring	Summer	Autumn	Winter
ALADIN	2021-2050	1,7	1,3	1,7	1,5	2,1
	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
	2069-2098	2,9	2,3	3,6	3,1	2,6

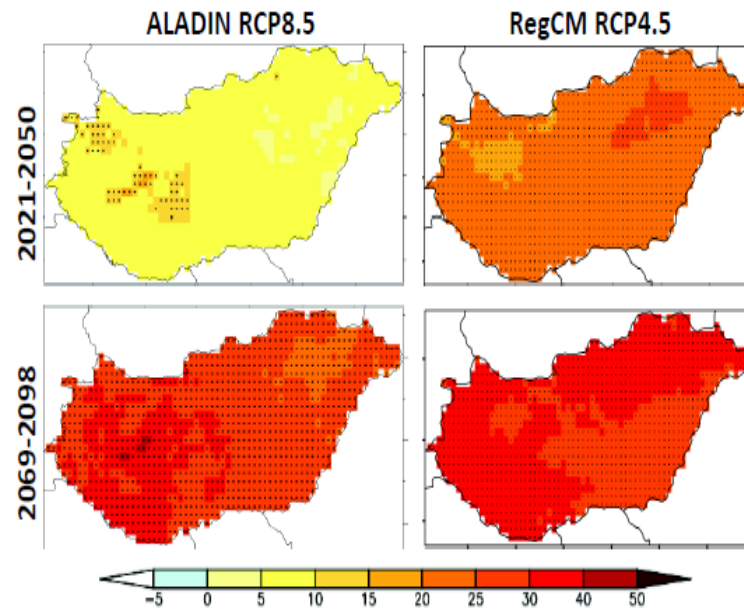
# Temperature extremes

Change of the number of temperature extremes



**Hot day:** daily  $T_{max} \geq 30^{\circ}C$   
**Summer day:** daily  $T_{max} > 25^{\circ}C$   
**Frost day:** daily  $T_{min} < 0^{\circ}C$

Change of the number of the hot days



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

# Precipitation

- Annual precipitation amount will increase over Hungary

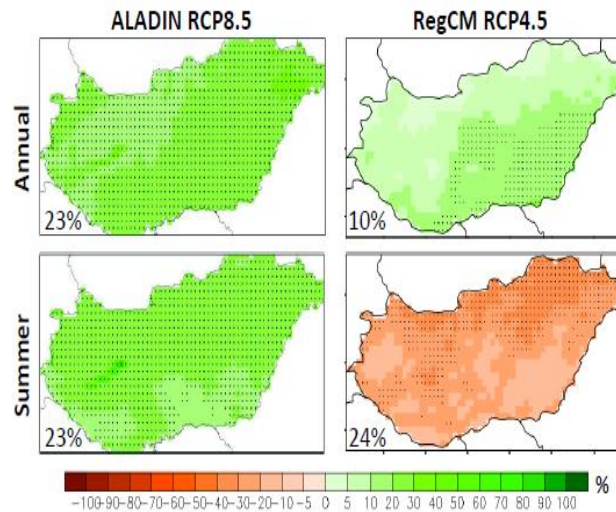
2021-2050: 3-17%

2069-2098: 10-23%



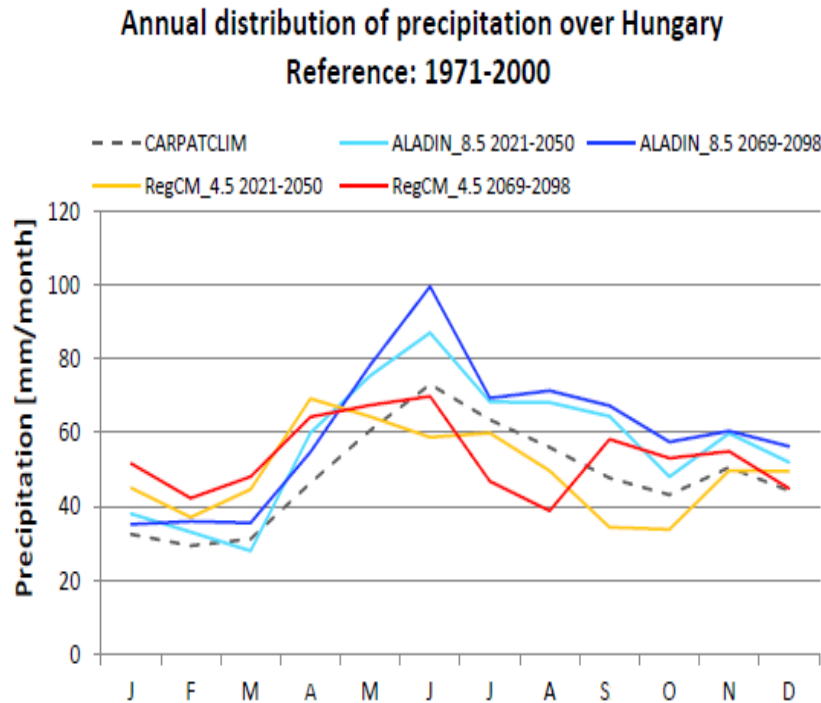
- Different sign of changes in autumn
  - ALADIN: indicates the biggest change
  - RegCM: decrease (13%) in 2021-2050 turns into increase (14%) in far future

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

# Precipitation - results



## ALADIN

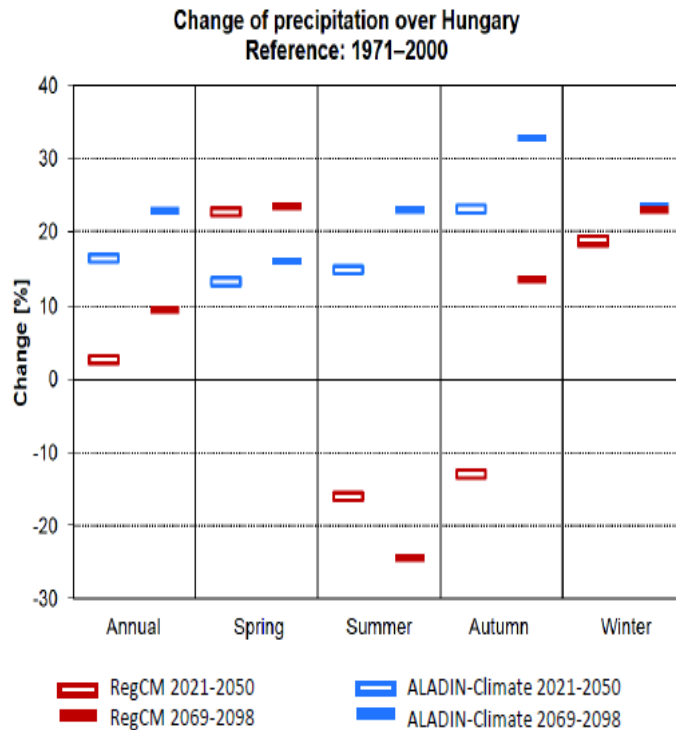
- Similar annual distribution (min in January, max in July, secondary max in November)
- Increasing precipitation amount (except March in near future)

## RegCM

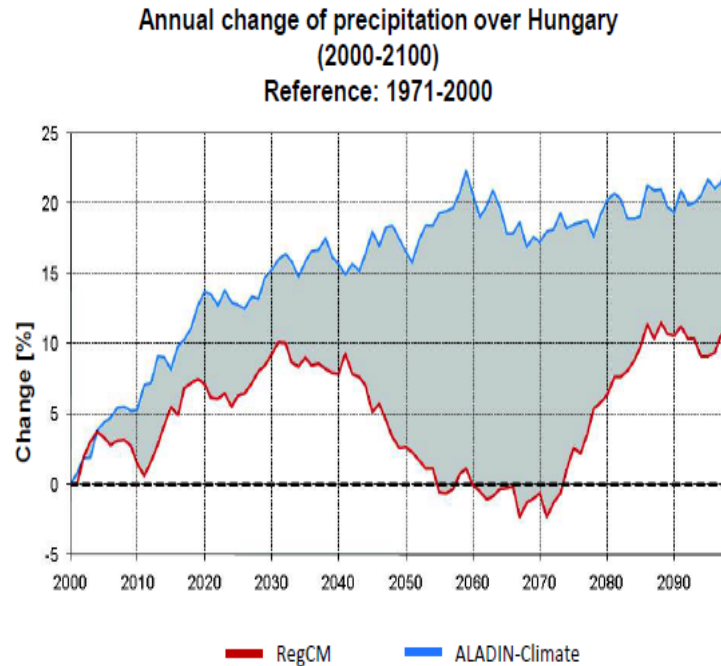
- Max is earlier in near future (April), secondary max in September in far future
- September is the most variable



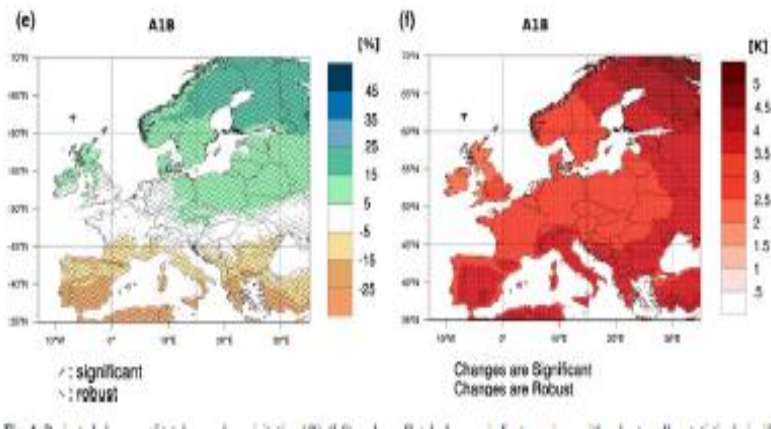
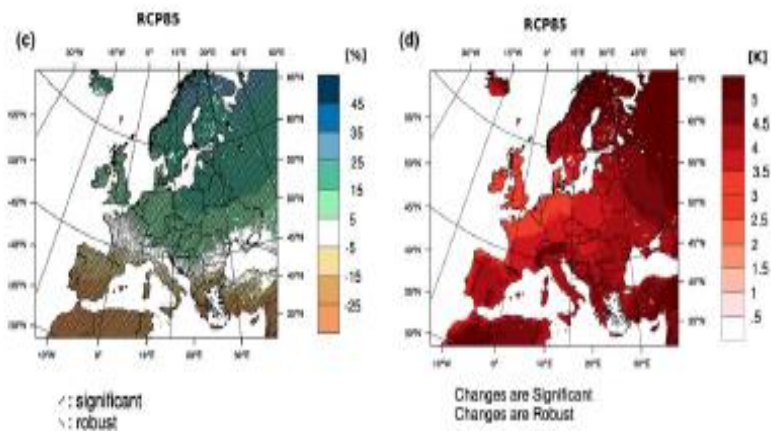
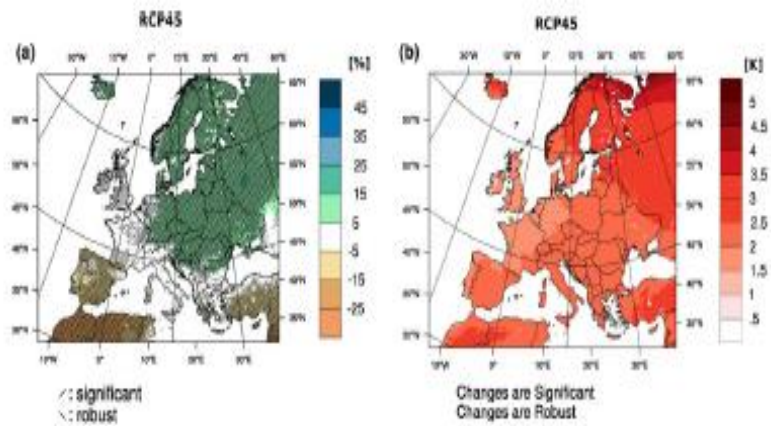
# Still differences ...



- Summer is the most uncertain
- Biggest change in autumn according to RegCM



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

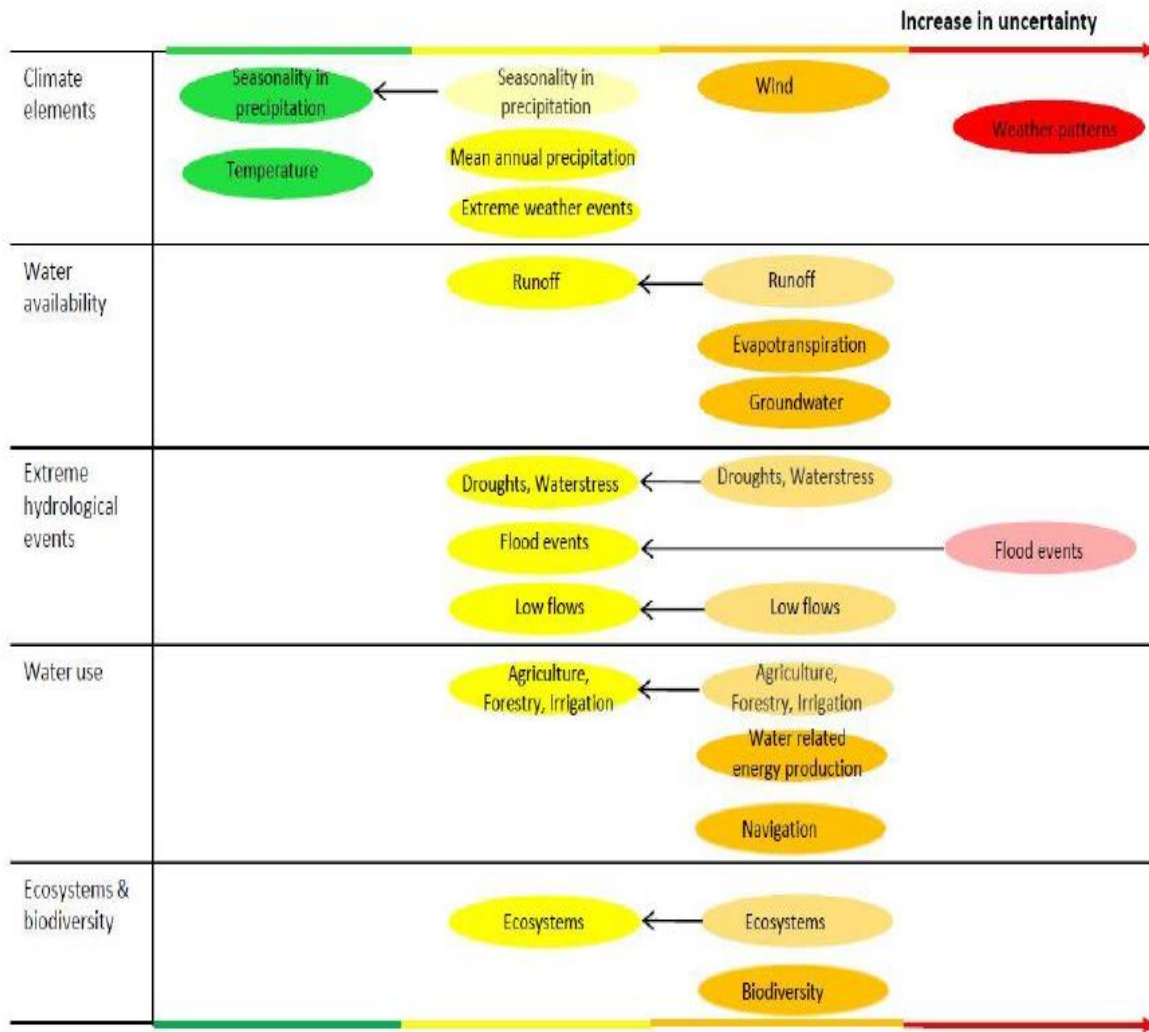


# Differences between past and future

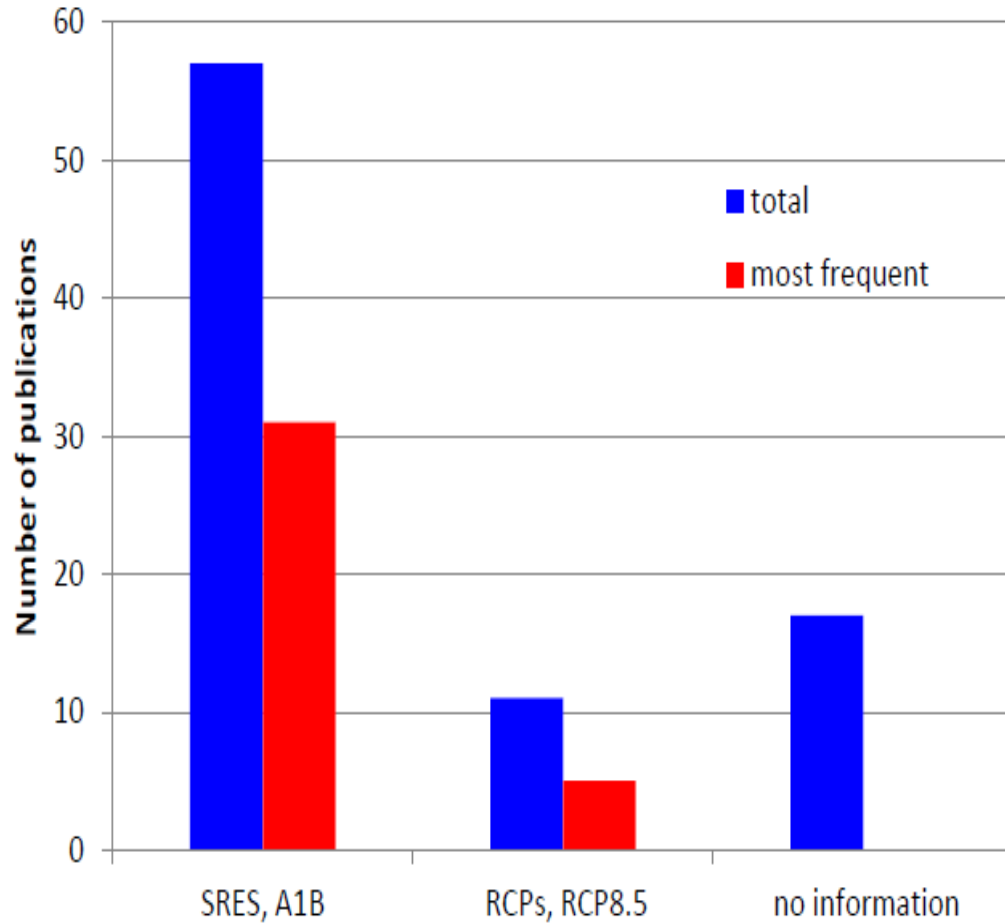
Jacob et al., 2013

-

# Uncertainties

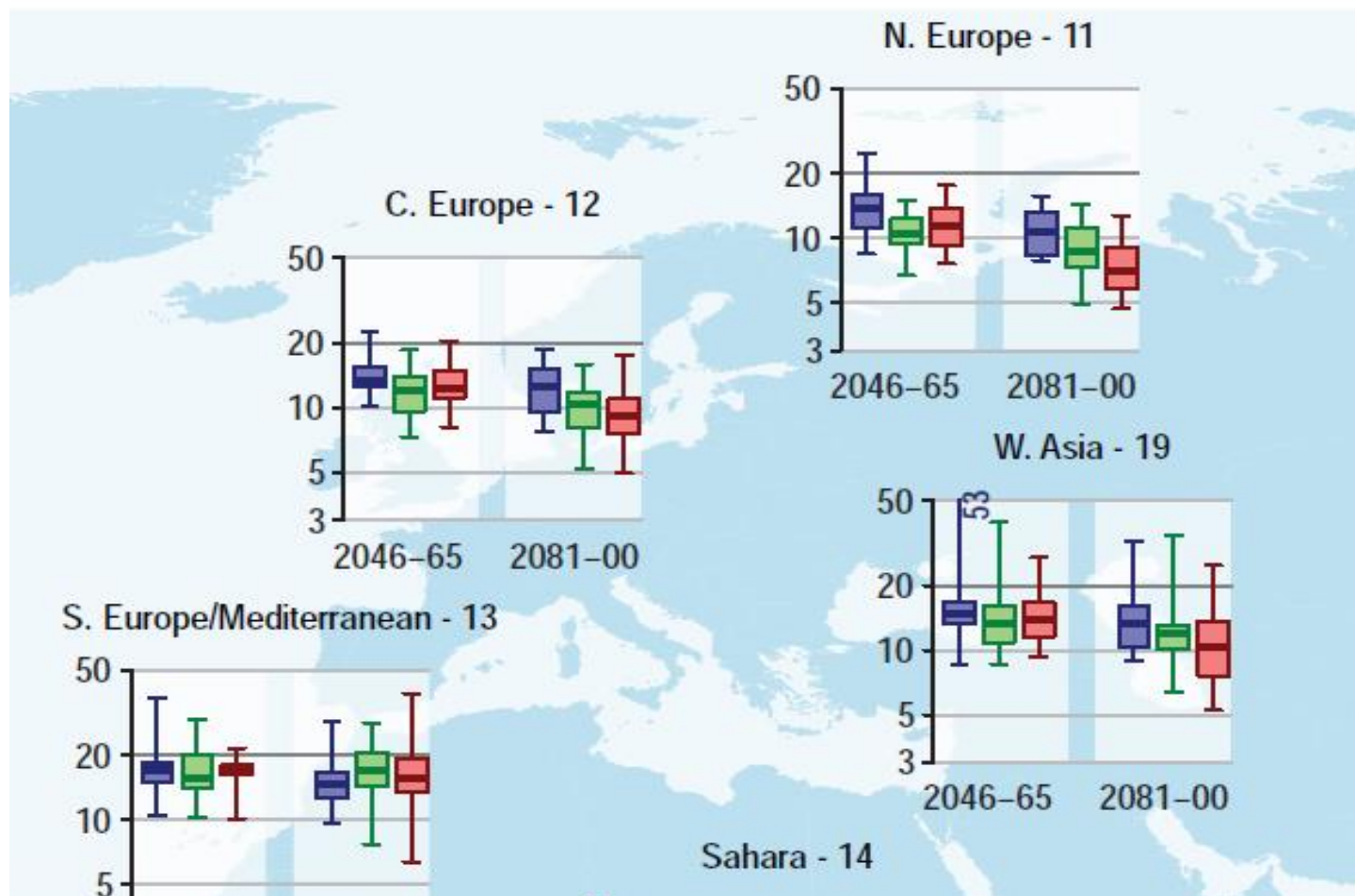


# ICPDR Study - Scenarios

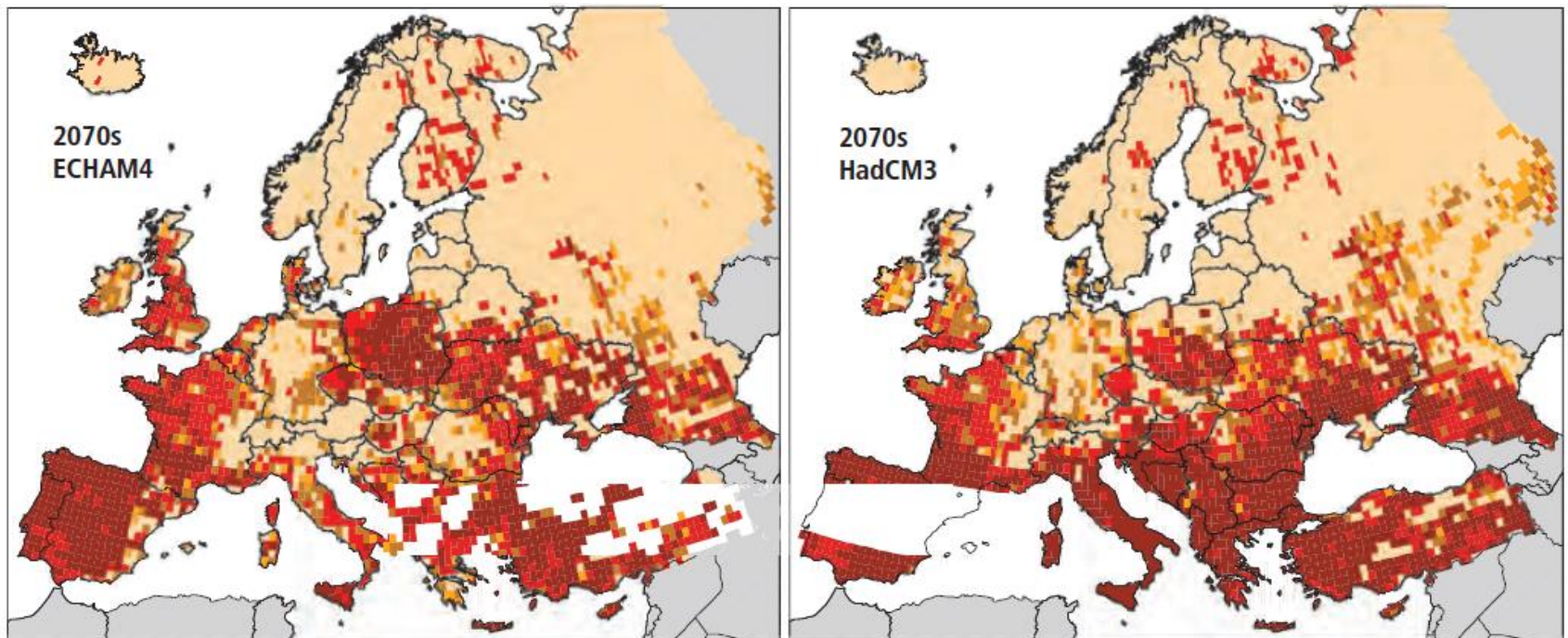




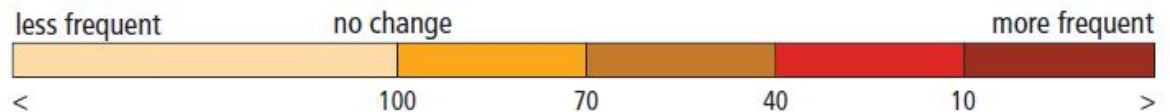
# Changes in the return period of 20-year daily precipitation, Europe



# Changes in the 100-year return period drought event



Future return period [years] of droughts with an intensity of today's 100-year events:



Thank you for your kind  
attention!