First step of an extreme climate adaptation in Hungary based on regional climate models

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Outline

- Modelling basis, uncertainty
- Modelling at the Hungarian Meteorological Service
- Application of model results for impacts (ORIENTGATE)
- Climate Extremes Index
- Summary

Global and regional models

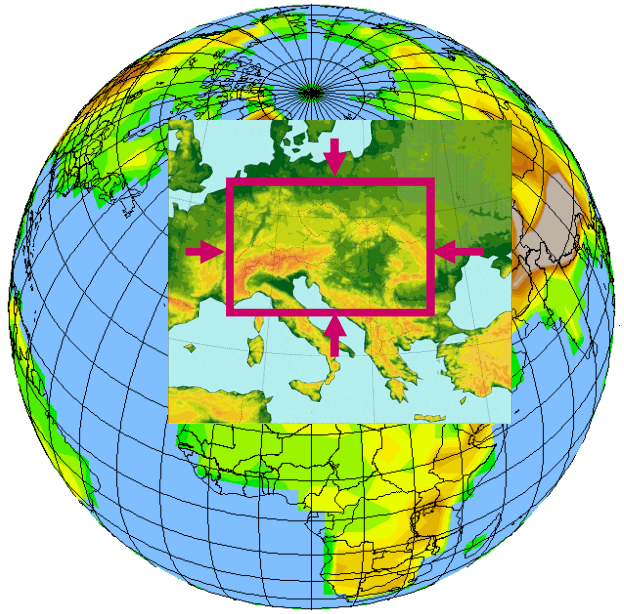
Global climate models (GCMs): able to describe the whole climate system; covering the whole Earth on a 3D grid (100-200 km)

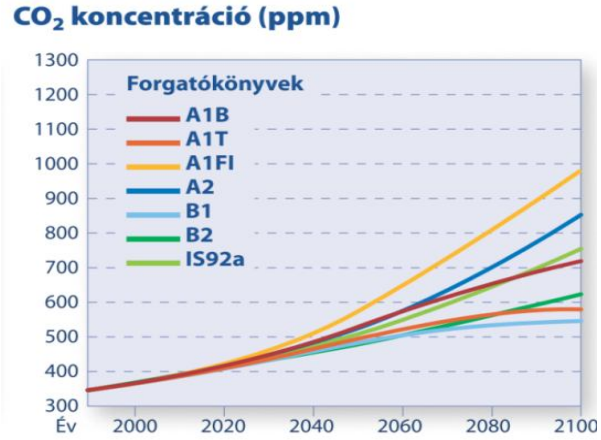
Regional climate models (RCMs): smaller area, better capture of processes, better resolution (10-50 km)

RCM <-> GCM (added value)

1.validation for the past (against observations)

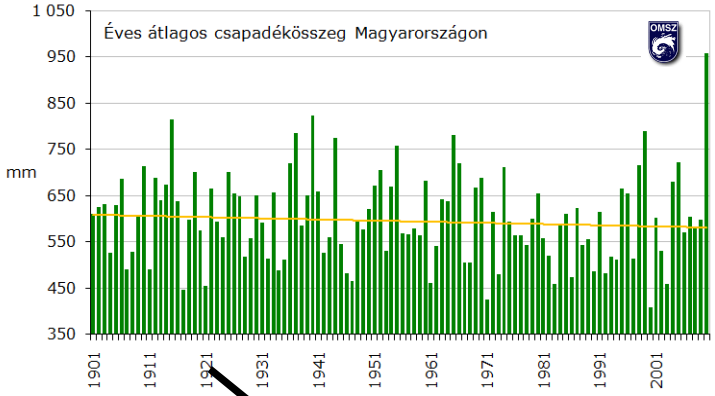
2. future projections:
hypothetical scenarios taking into account
all anthropogenic forcings
delta method = future results – MODEL reference



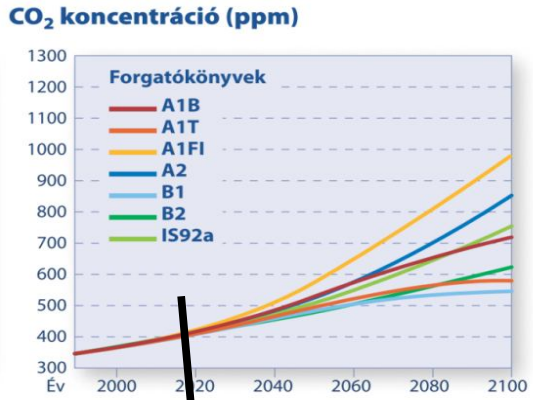


Modelling uncertainties

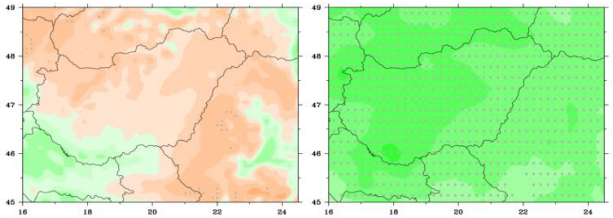
Internal variability:
nonlinear feedbacks,
occurs without external forcing

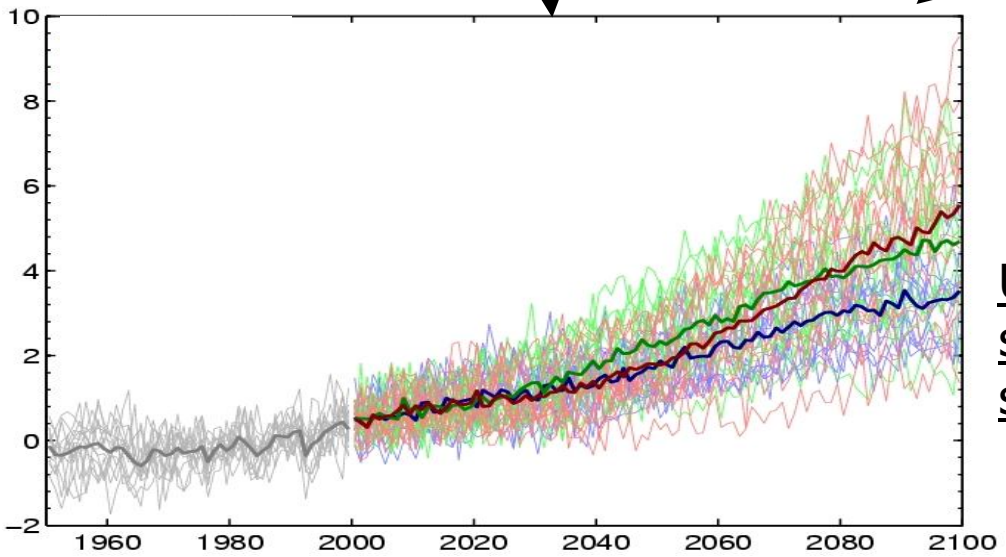


Scenario uncertainty:
hypothetical,
models simulate how
climate reacts to it



Model uncertainty:
different models have
different results





<u>Uncertainties:
several models and
scenarios are needed</u>

Climate projections for the Carpathian Basin

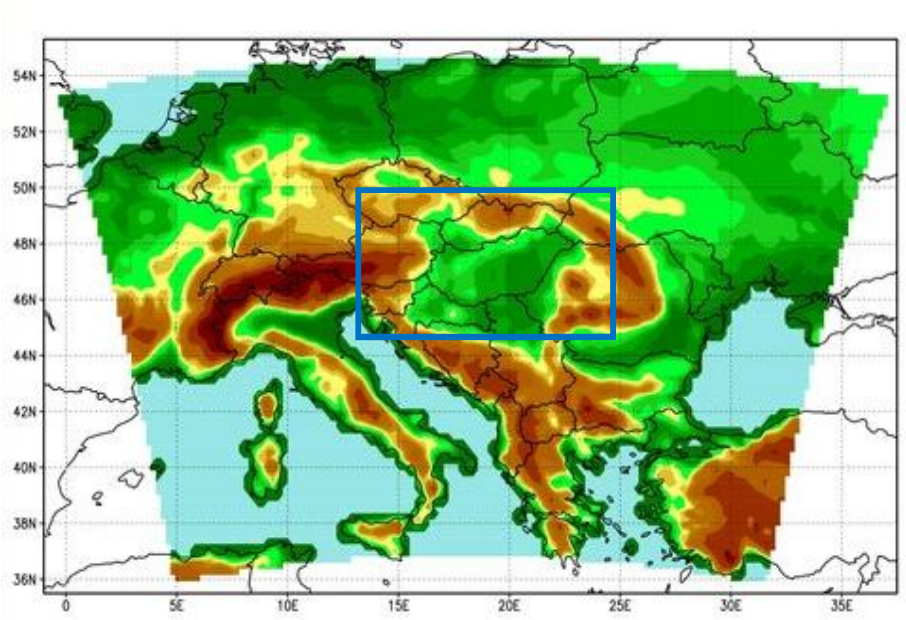
models	used boundary conditions	horizontal resolution	scenario	levels	integration period
ALADIN–Climate (from: Météo France)	ARPEGE	10 km	A1B (medium)	31	1961–2100
REMO (from: MPI-M)	ECHAM5/ MPI-OM	25 km	A1B (medium)	20	1951–2100

+ ENSEMBLES:

25 km

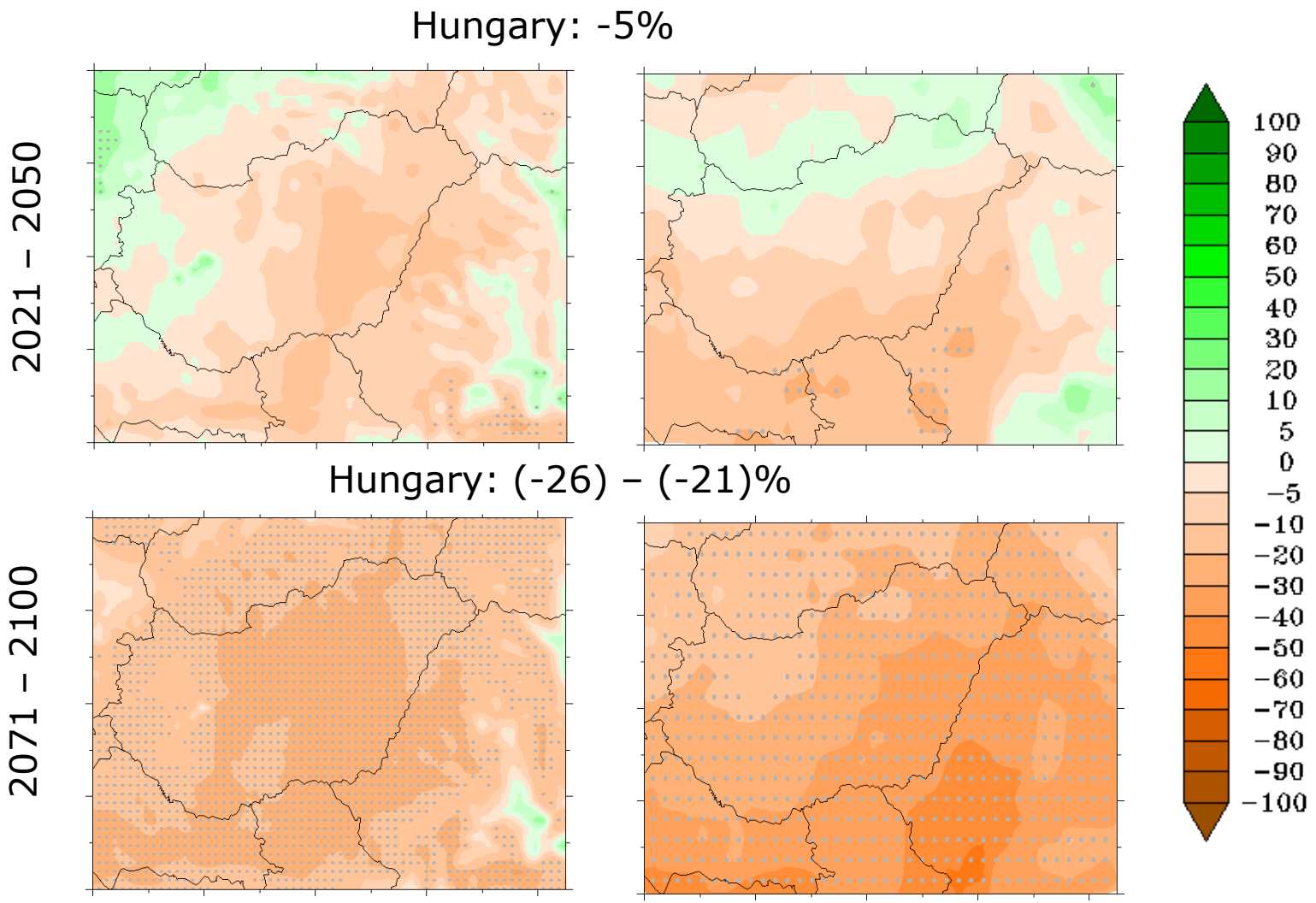
probabilistic projections

A1B scenario

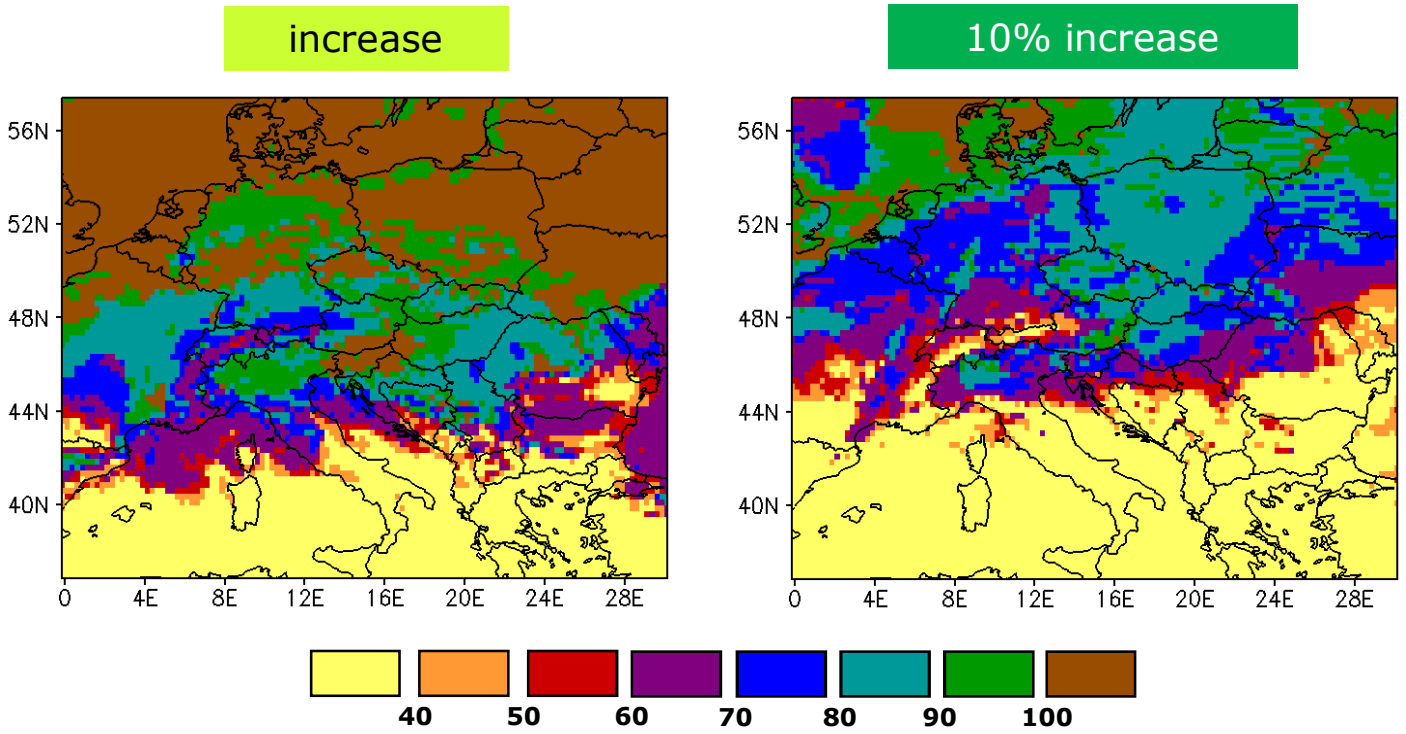


Summer precipitation change (%) Ref: 1961 – 1990

Obvious summer shortage, autumn precipitation increase



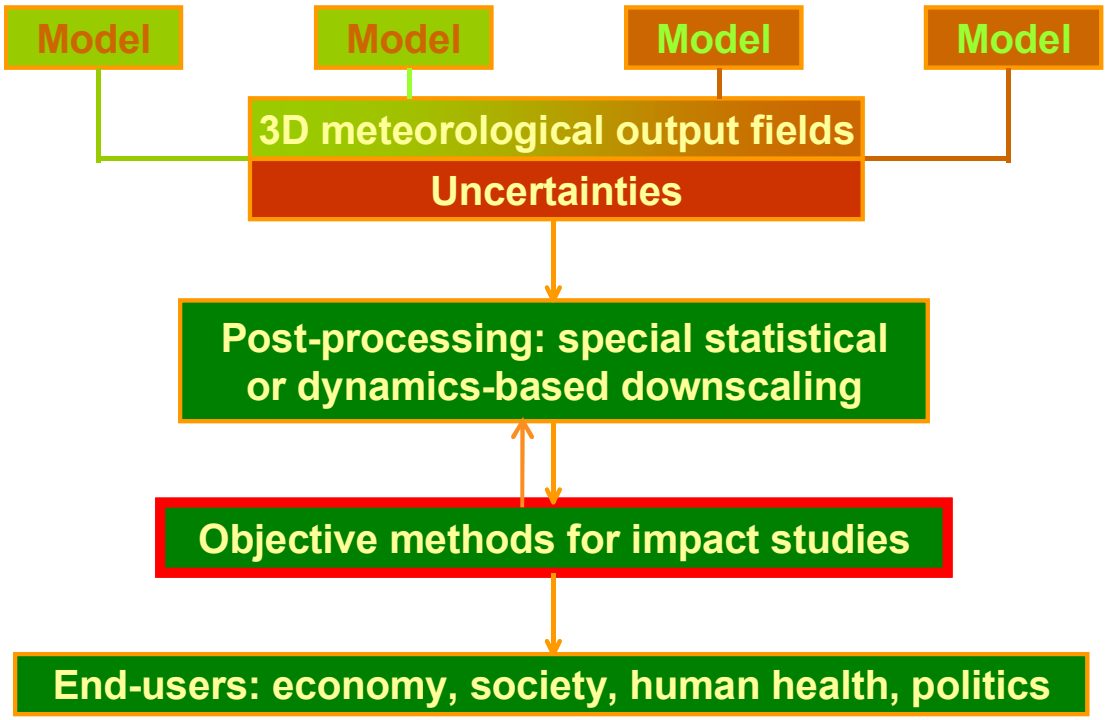
When two models are not sufficient: Winter precipitation change (%) 2071-2100, ref: 1961-1990



ENSEMBLES models: two thirds of the models agree on 10% increase

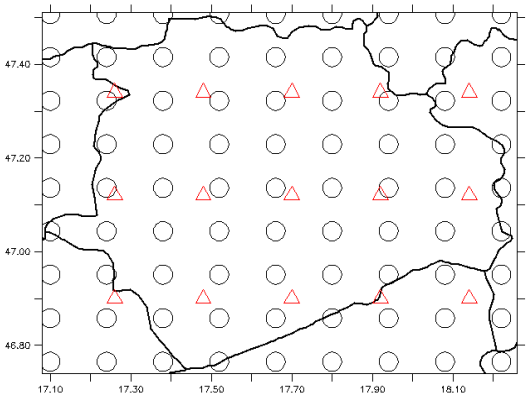
How can we use the RCM results?

- two locally run RCMs: finer resolution, additional variables
- several models provide extra information
- interaction between meteorologists and impact researchers: needs and limitations



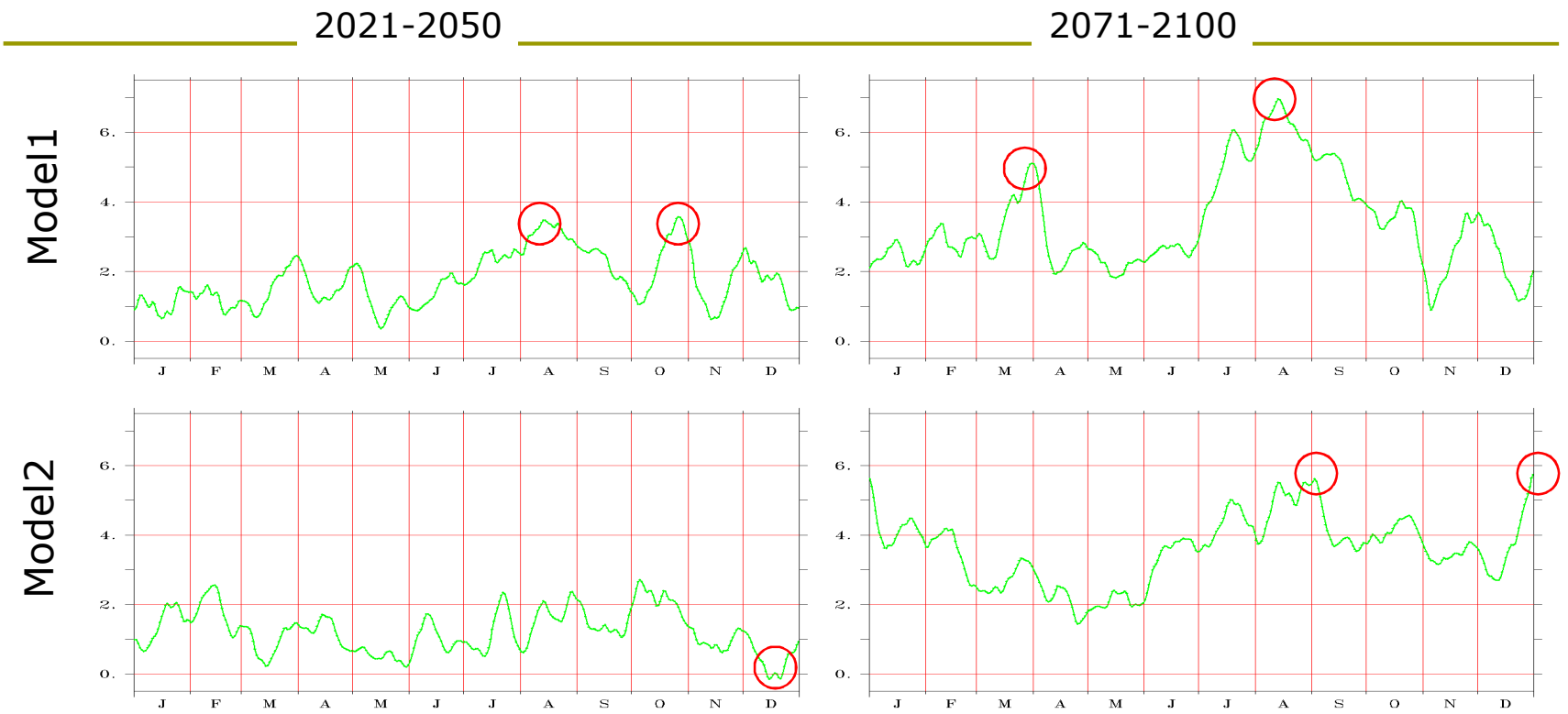
Application of RCM results for impacts: Vulnerability assessment for Veszprém county

- coordinated climate adaptation actions across South Eastern Europe
- communicate up-to-date climate knowledge for policy makers (urban planners, nature protection, development agencies, public works authorities)
- climate models, obervations, quantitative impact studies
- 3-year project, until 2015



- pilot area: Veszprém
- goal: how big will be the heat stress?
- input: two RCMs; 2021-2050 & 2071-2100; 1961-1990 as reference period
- climatological anomalies from the past (daily T and P)
- linear trend coefficients (monthly T and P) within future

Climatological anomalies (°C) averaged over Veszprém; reference: 1961-1990

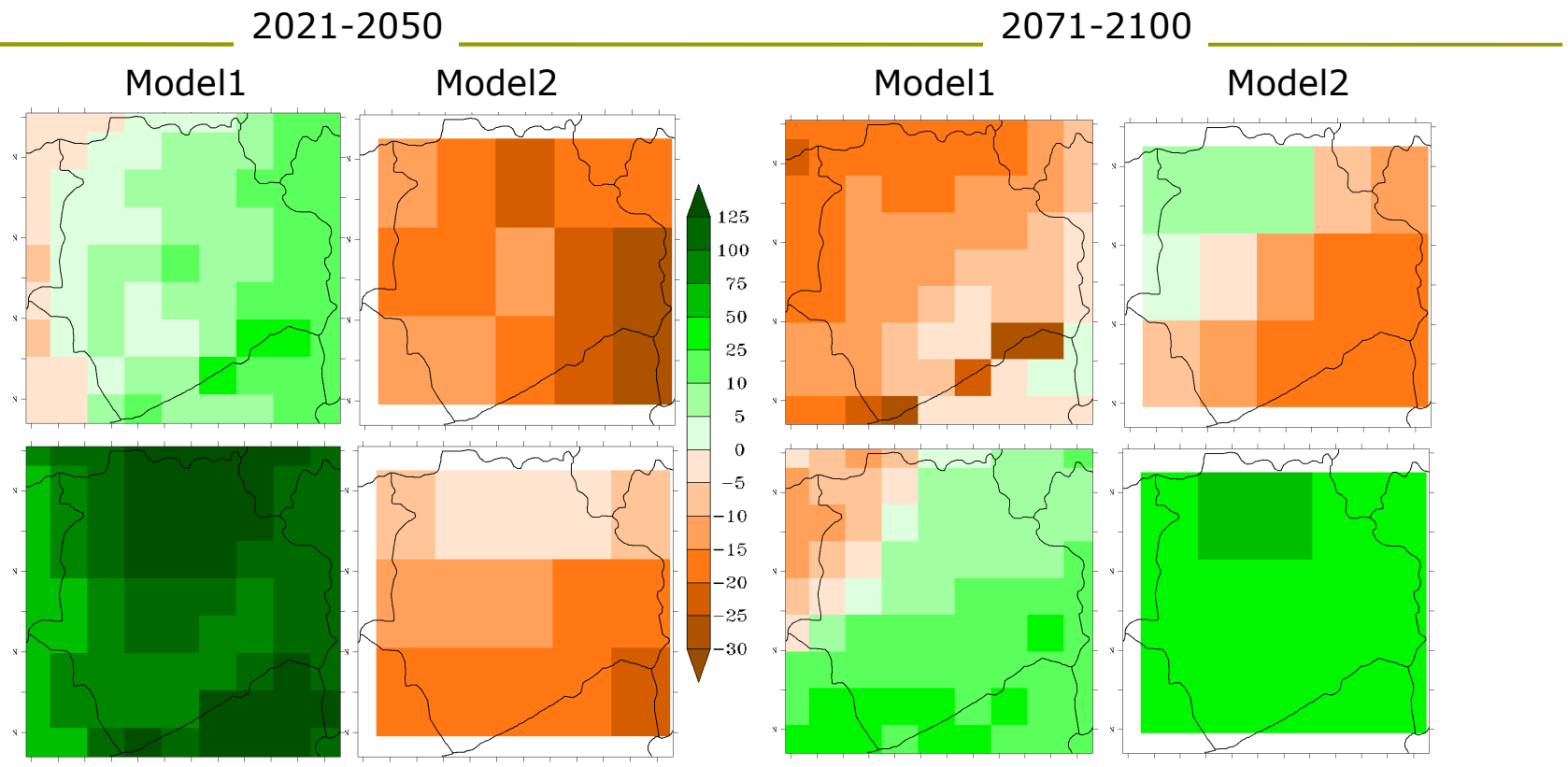


warming peaks: 2021-2050: mid-August and mid-October; 2071-2100: August and end-December & end-March

even decrease is possible for 2021-2050

Model1 gives higher change in near future, later they are equally high (precipitation change is less clear)

Spatial distribution of linear precipitation trend coefficients (%/30ys)



Summer: disagreement, then certainty in negative trend

Autumn: big uncertainty, then agreement on positive trend

Spatial distribution is important

Climate Extremes Index: CEI

- measures how an area is effected by extremes
- to have a complete view on extreme characteristics (a number)
- could be a simple basis for decision making

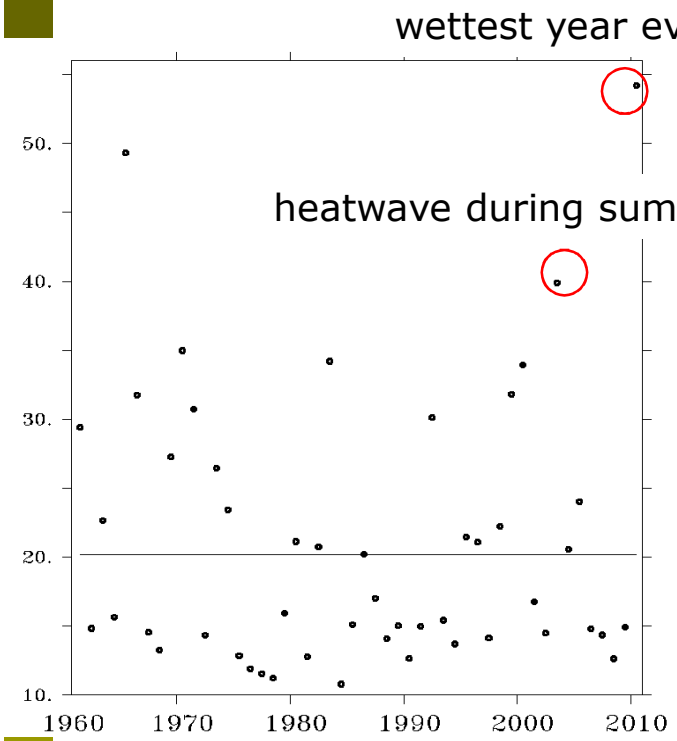
Modified version:

1. daily maximum temperature: 90th and 10th percentile
2. daily minimum temperature: 90th and 10th percentile
3. daily precipitation (when >1 mm): 90th percentile
4. standardized precipitation index (SPI) >1.5 or <(-1.5)
5. severe droughts, moisture surplus in a year: >90th percentile or <10th percentile

Observations for 1961-2010
2 RCMs for 1961-1990, 2021-2050, 2071-2100

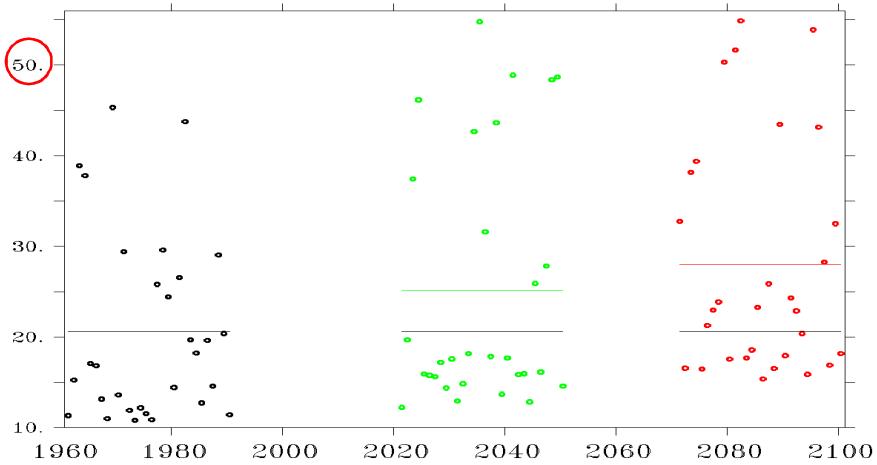
CEI results

area of Hungary (%) effected by the average extent of the 5 extremes

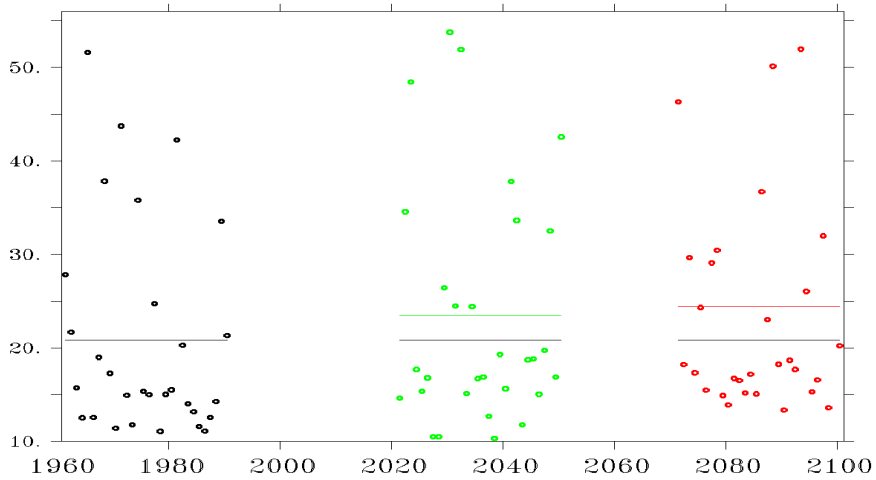


Observations

Model1



Model2



- in models: years are not actual years (30-year average is important)
- model1 gives more intensification of extremes effected area: higher values and bigger shift in mean (5-8%)
- model2 shifts the mean only (3-4%)
- question: which type of extremes grow? -> further study is needed

Summary

• regional climate models of 10-25 kms are capable to describe local climate& climate change -> they are good basis for impact studies

• more models and their uncertainty should be taken into account

• Hungary: clear summer shortage of precipitation; winter is uncertain -> using more models (ENSEMBLES) increase is expected;

• CEI: a complex index to describe spatial coverage of extremes
• intensification of the effected area by extremes is expected, but further study is needed to decide which counts more

Thank you for your attention!

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www.met.hu/en/RCM