

# RCMTÉR: Új éghajlati scenáriókkal a klímaváltozáshoz való alkalmazkodásért

## RCM GiS: New climate scenarios for the adaptation to climate change

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# OUTLINE



**1. Introduction**

**2. RCMGiS project**

**3. Outlook**

# Motivation

- Climate dynamics research in Hungary since 2004
- Adaptation of regional climate models, test simulations, projections, establishment of international cooperations, involvement in *international* projects on impact assessments
- 2009: final meeting + stakeholder event of CLAVIER project in Budapest



# Motivation

- Climate dynamics research in Europe since 2004
- Adaptation of regional climate simulations, projections, establishment of international cooperations, in particular *international projects on impact assessments*
- 2009: final meeting + stakeholder meeting CLAVIER project in Budapest



# Motivation

- Adaptation in Hungary: based either on the principle for preparing for *any* possibility or on the scenario kept *intuitively* the most likely
- Not sustainable (expensive, wrong ways)
- For targeted and sustainable adaptation *credible* information is needed
- High-quality meteorological information, objective, quantitative and comparable impact assessments, considering uncertainties



# Present

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- National Climate Change Strategy, National Adaptation Strategy
- Adaptation information system, scientifically sound input data for the climate impact assessments



VS



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- Adaptation information system, scientifically sound input data for the climate impact assessments
- Programme for *Adaptation to Climate Change in Hungary*
- 3 important topics:
  1. Development of NAGiS
  2. Extension of NAGiS to further sectors (critical infrastructure, tourism, agriculture, forecasts)
  3. **Improvement of climate scenarios**



VS





# Present

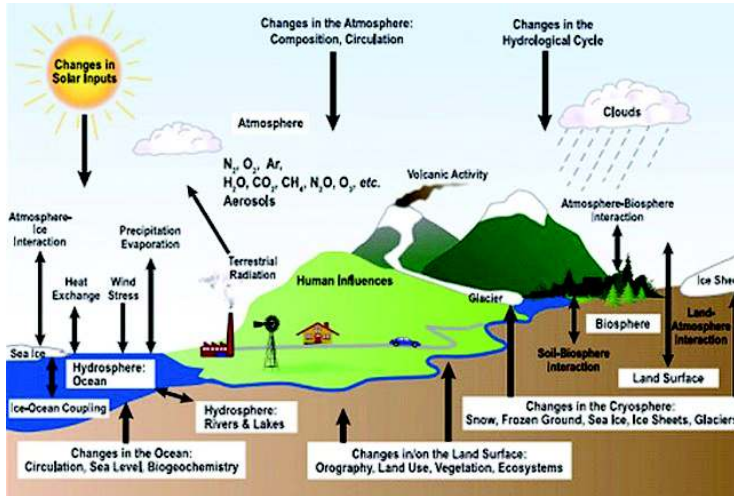
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  - 3. Improvement of climate scenarios**



VS



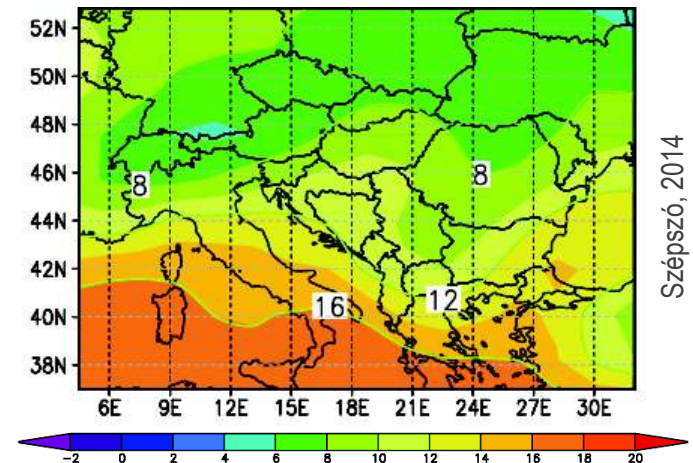
# Scientific background



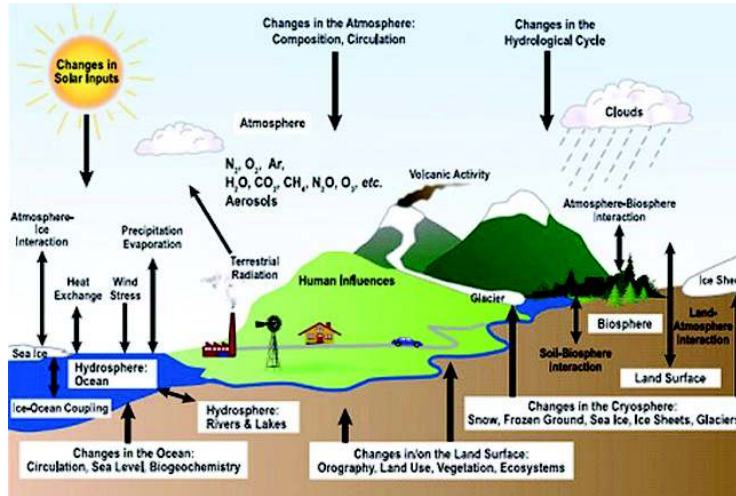
- Description of processes and interactions in climate system with modelling tools
- Physical laws – set of partial differential equations → numerical models

- Representation of anthropogenic activity
- Global climate models for simulation of Earth system
- Regional climate models for investigation of local changes

Mean temperature [°C]; 1961–1990  
Global model, 200 km



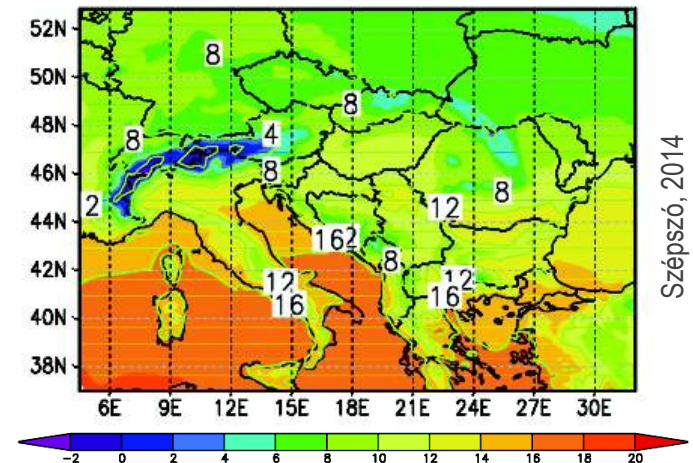
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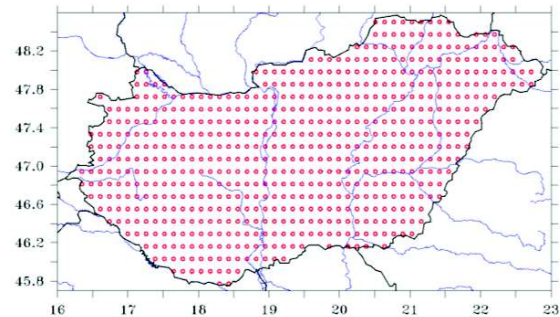
Mean temperature [ $^{\circ}C$ ]; 1961–1990  
Regional model, 25 km



# NAGiS prototype

- Climate projections for 2 targets:
  1. 2021–2050: „short-term” planning
  2. 2071–2100: long-term strategy, robustness & significance
- Impact studies based on meteorological data (for Hungary):
  - Hydrology: ground water, drinking water
  - Natural ecosystems
  - Agriculture, forestry

<b>Model</b>	<b>ALADIN</b>	<b>RegCM</b>
<b>LBC</b>	ARPEGE	ECHAM
<b>Resolution</b>	10 km	
<b>Scenario</b>	SRES A1B	



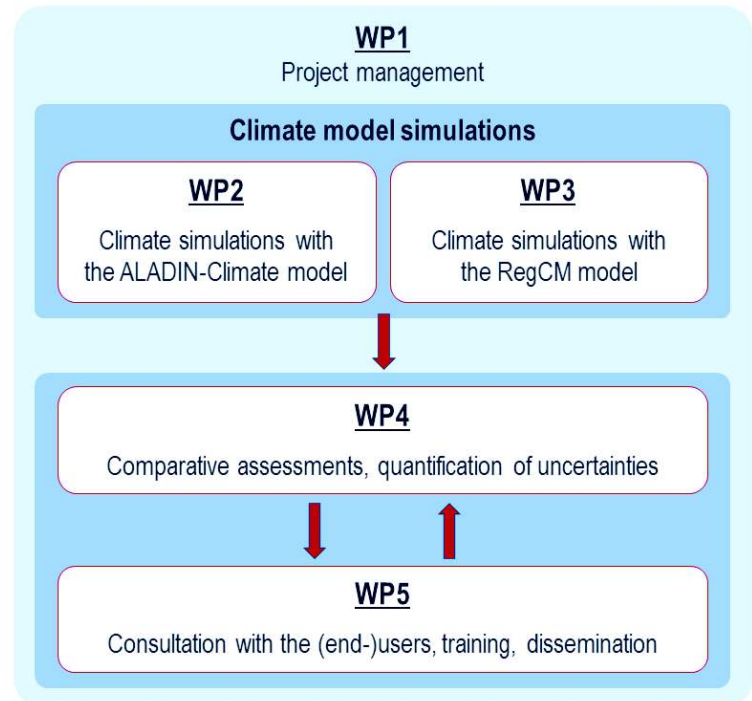
# Improvement of climate scenarios

- Title: New climate scenarios based on radiative forcing change over the Carpathian Basin
- Consortium:
  - Hungarian Meteorological Service (coordinator)
  - ELTE Department of Meteorology (partner)
- Duration: 15 December 2014 – 29 February 2016
- Financial background: EEA Grants
- Web page: [rcmter.met.hu](http://rcmter.met.hu)



# Main objectives

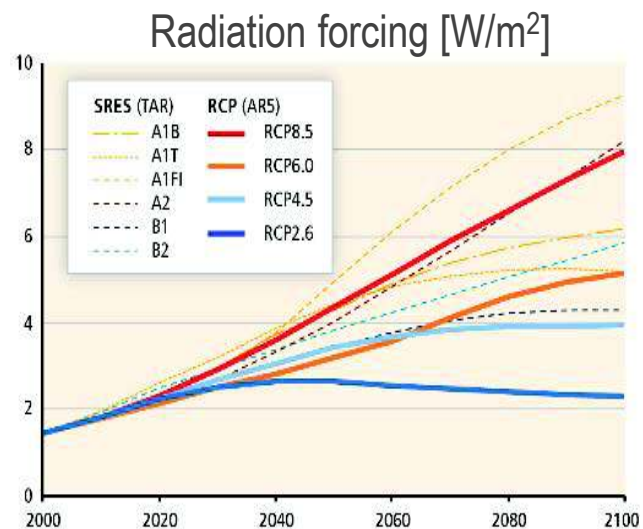
1. Development of climate model data providing future climate information for NAGiS
2. Quantification of climate projection uncertainties
3. Provision of climate model data for impact assessments
4. Training and support of the users to apply projection results and uncertainty information



# Model simulations

- 2 regional climate models
- Core simulations:
  1. Sensitivity studies  
(domain size, parameterization)
  2. Re-analysis and GCM-driven validation runs  
(homogenized and gridded reference data)
  3. Climate change projections
- New model versions, forcing fields, emission scenarios, domains
- Uncertainties:  
scenario (temperature) and  
model uncertainties (precipitation)

RCM	ALADIN	RegCM
LBC	ARPEGE → ALADIN	HadGEM → RegCM
Resolution	10 km	
Scenario	RCP8.5	RCP4.5

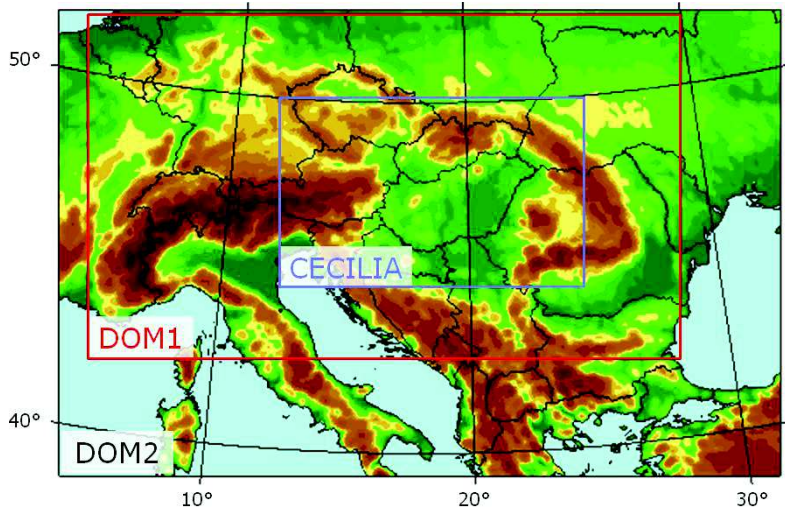
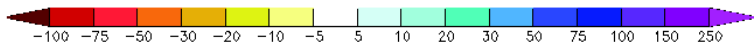
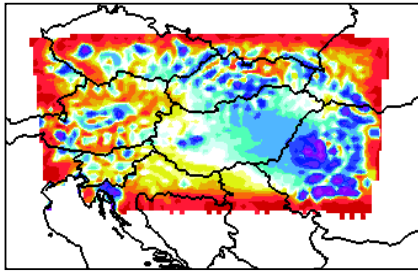


# Sensitivity studies

## ALADIN: test of integration domain

ALADIN – EOBS; 1971–1980

Boros-Török et al., 2015



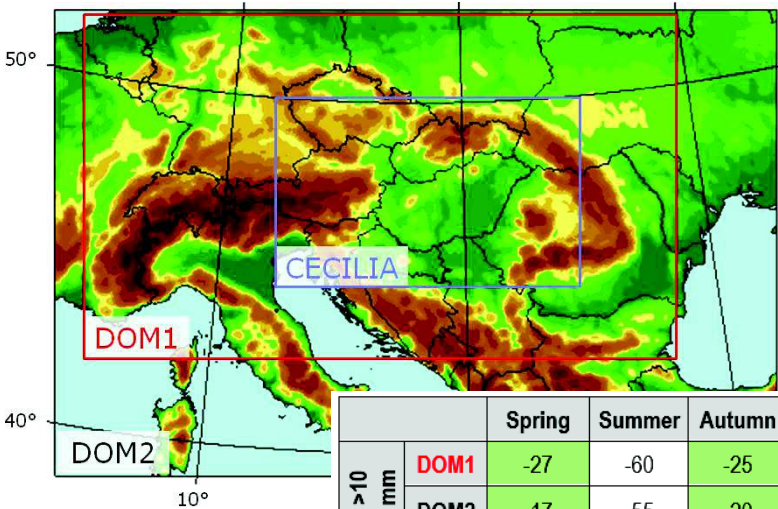
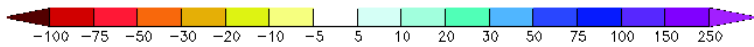
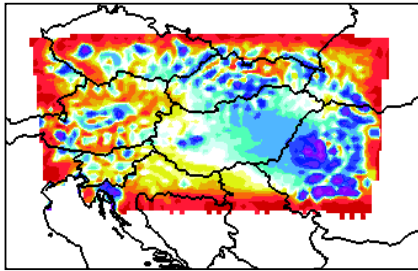


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		Spring	Summer	Autumn	Winter
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	DOM2	-17	-55	-20	-27
10-20 mm	DOM1	-21	-54	-29	-22
	DOM2	-9	-47	-21	-20

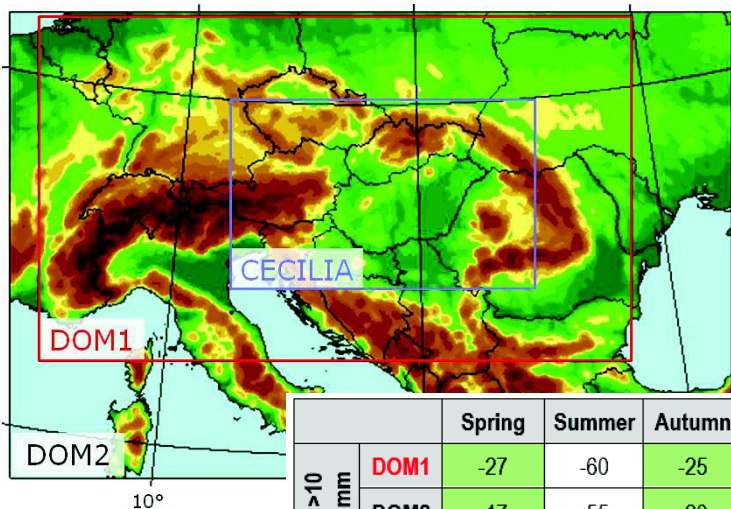
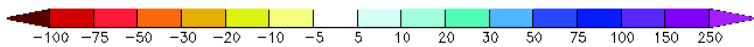
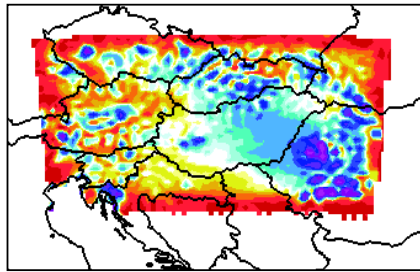
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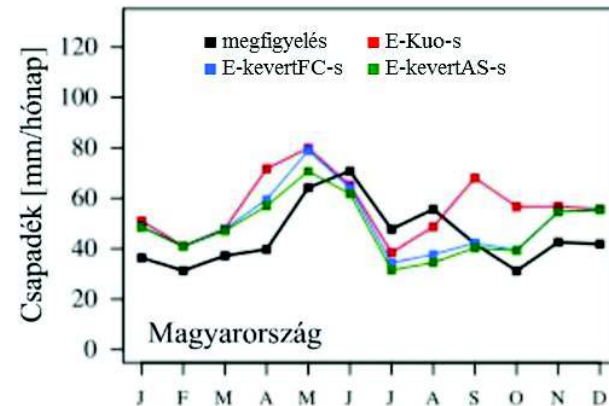


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## RegCM: test of parametrization

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E-kevertAS-s	RegCM_50		AS		-
E-Kuo-s		Kuo	-		1990



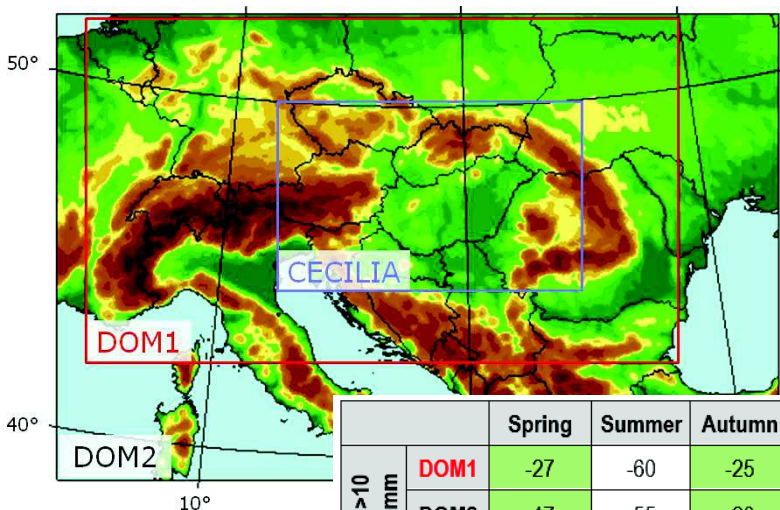
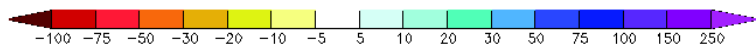
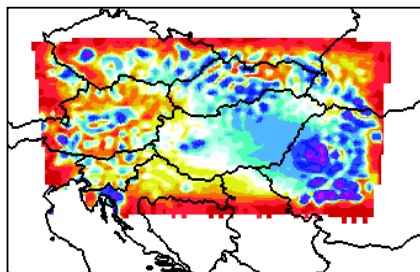
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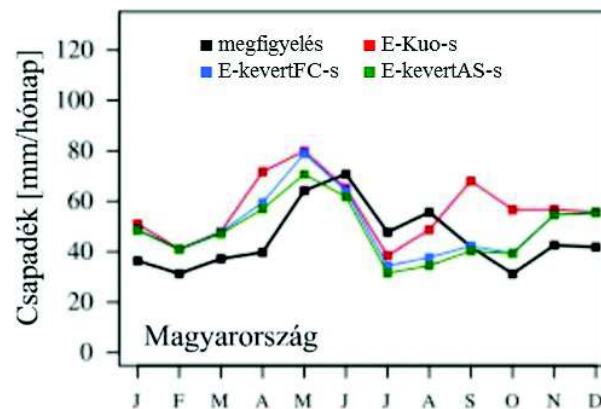


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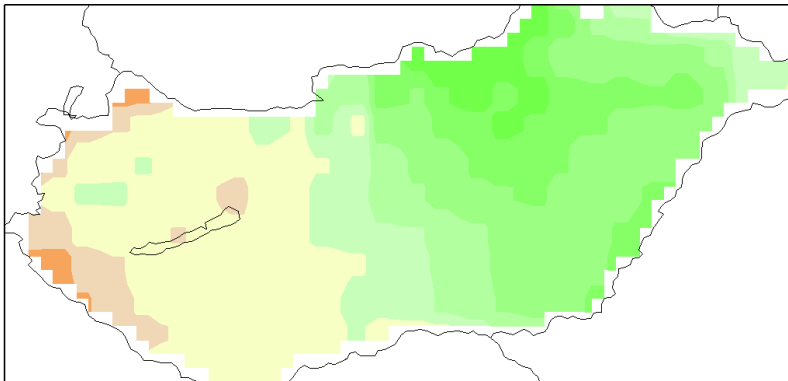


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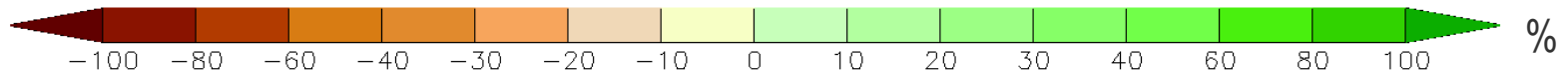
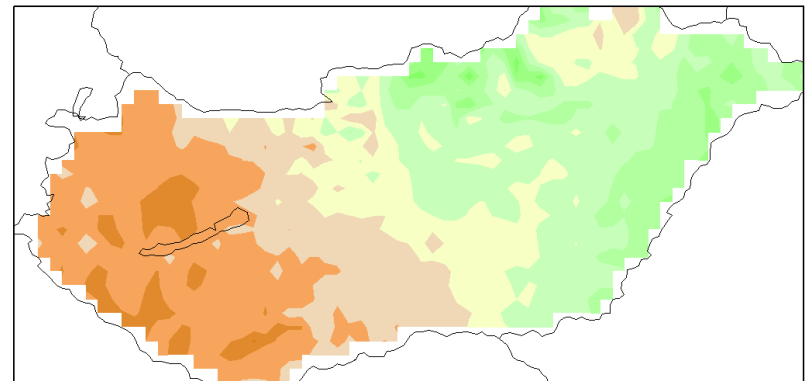
# Validation results

## Winter precipitation validation for 1981–2000

ALADIN – EOBS; HU: **9** %

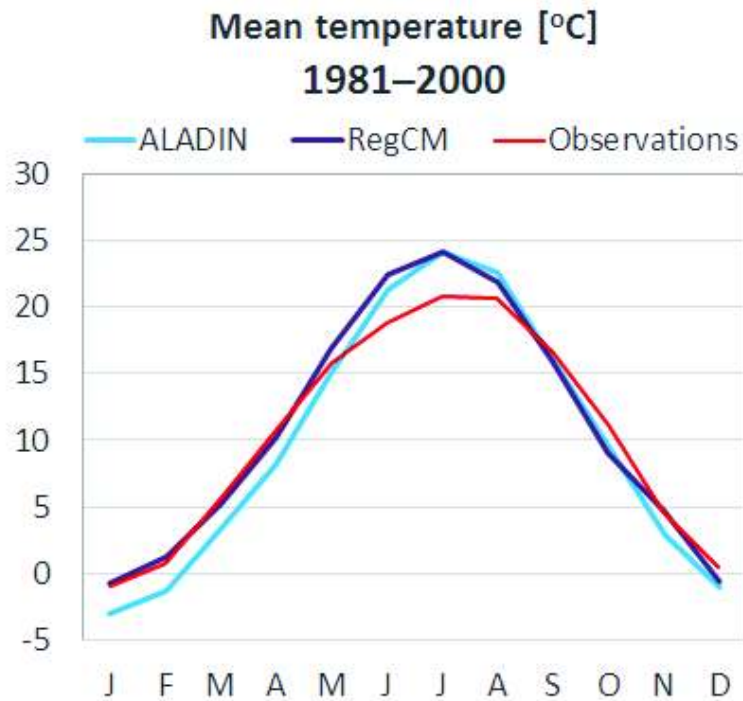


ALADIN – CARPATCLIM; HU: **-9** %



# Validation results

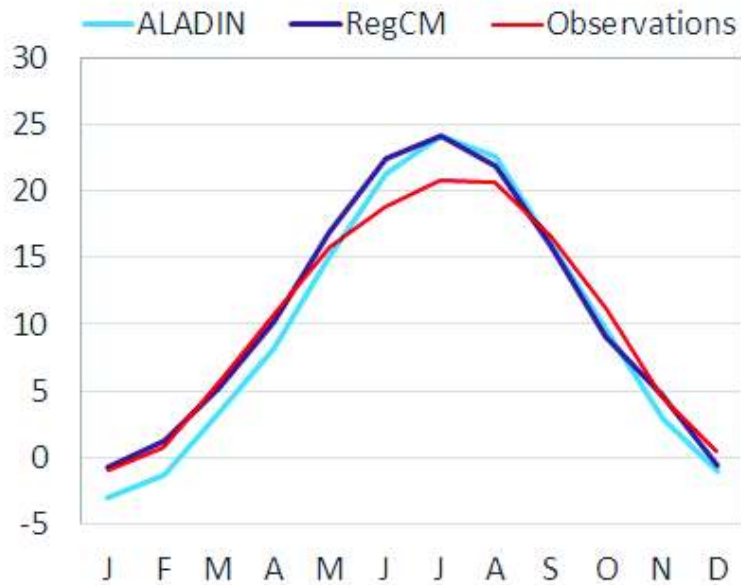
## New and earlier simulation results



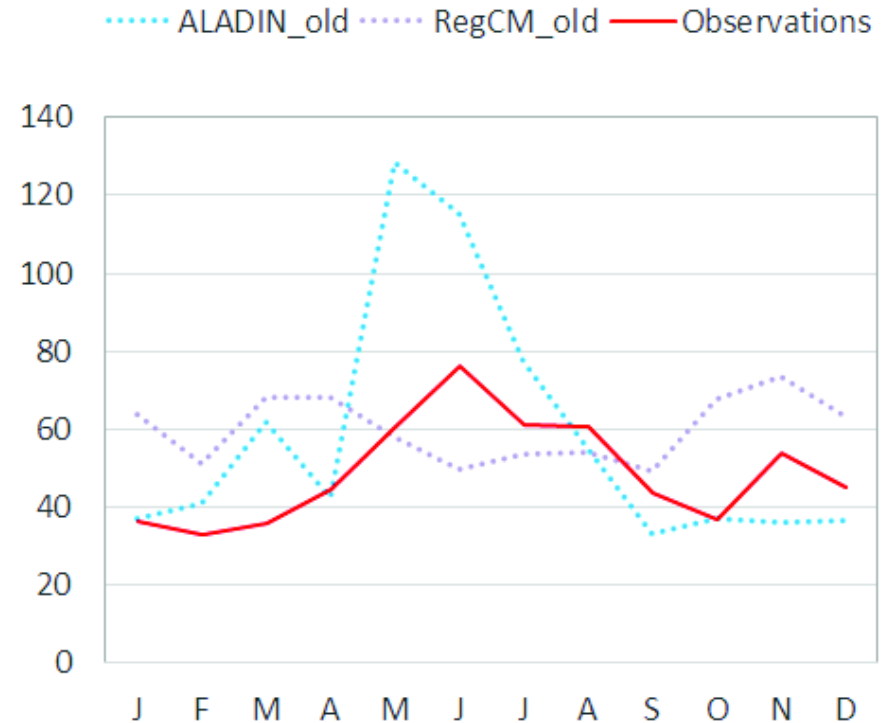
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## New and earlier simulation results

Mean temperature [°C]  
1981–2000



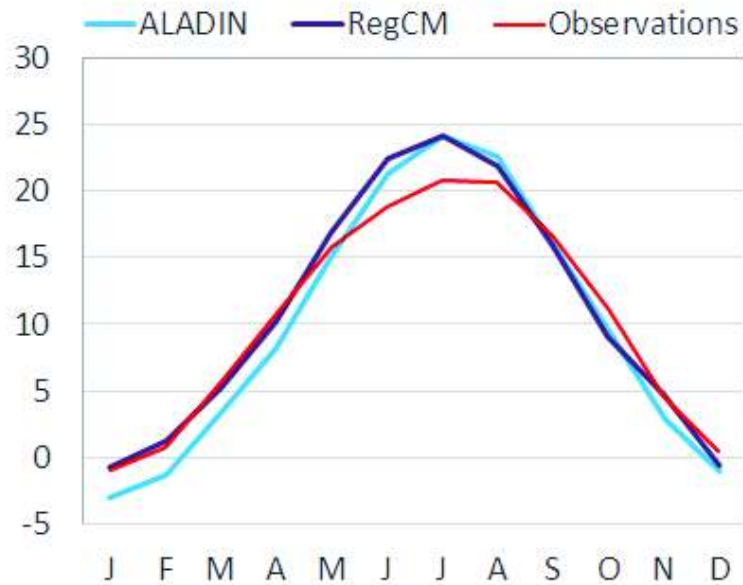
Precipitation [mm/month]  
1961–1990



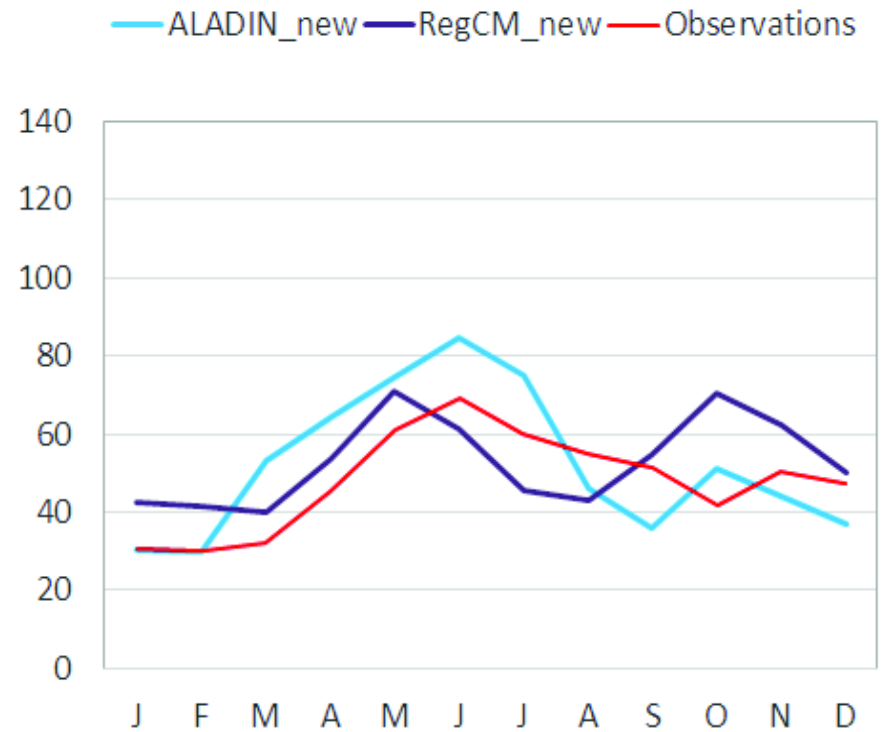
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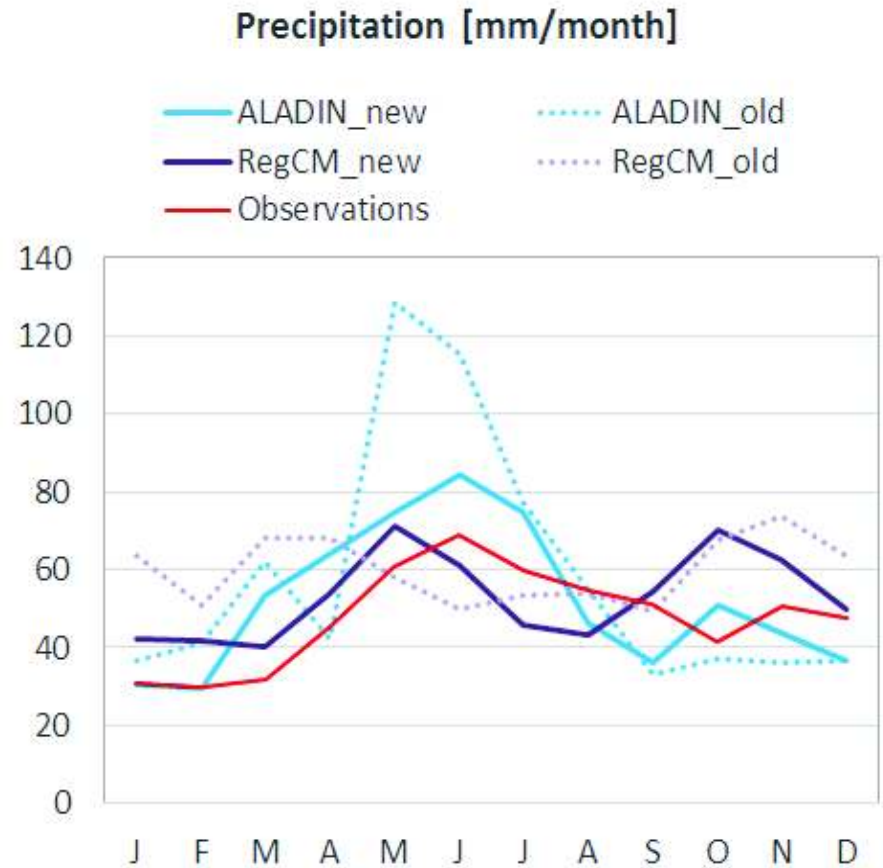
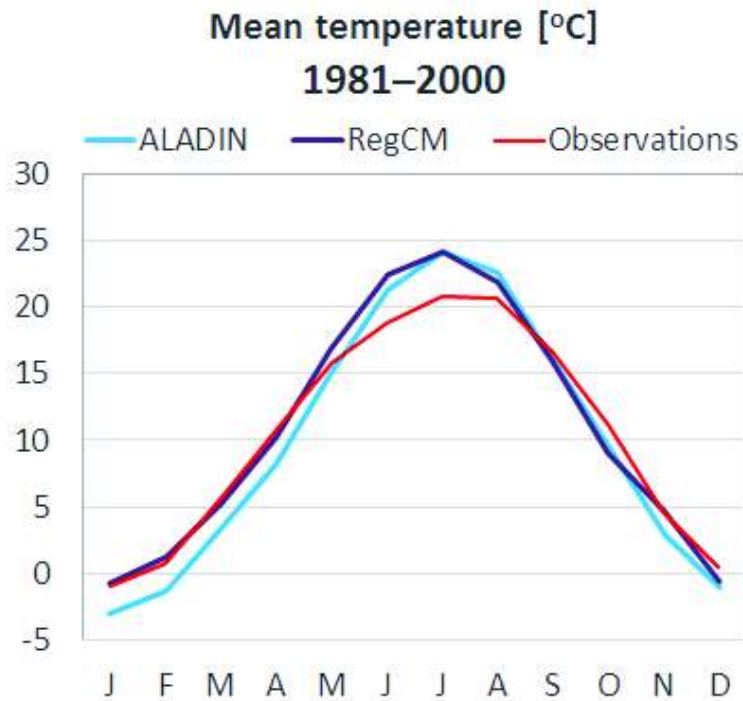


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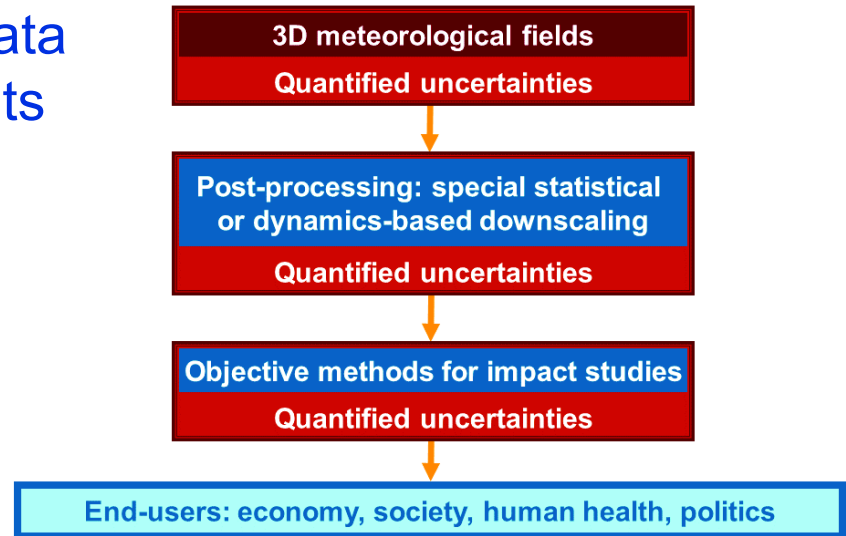


More details in presentation of I. Pieczka and J. Sábitz



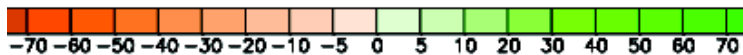
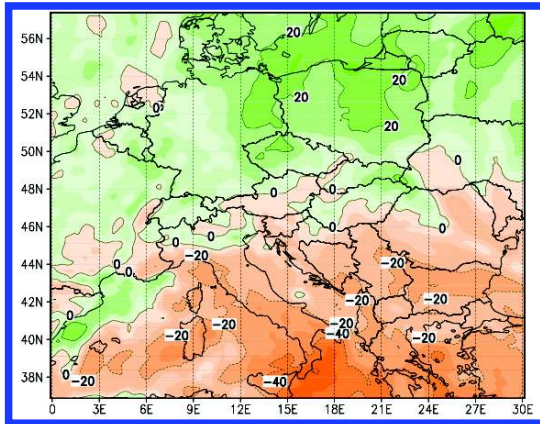
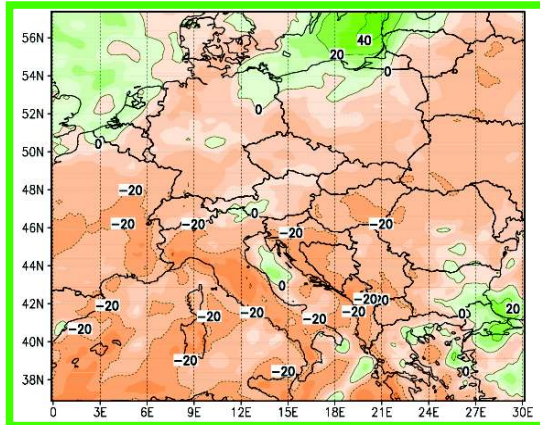
# Application of model information

- Climate models provide input data for objective impact assessments
- Quantitative information + uncertainties
- Support of users: consultation workshops (later)
- Extension of NAGiS to further sectors: tourism and critical infrastructure in Hungary
- Most impact studies are still based on results of a single RCM



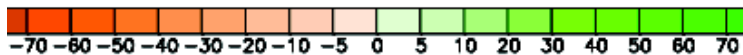
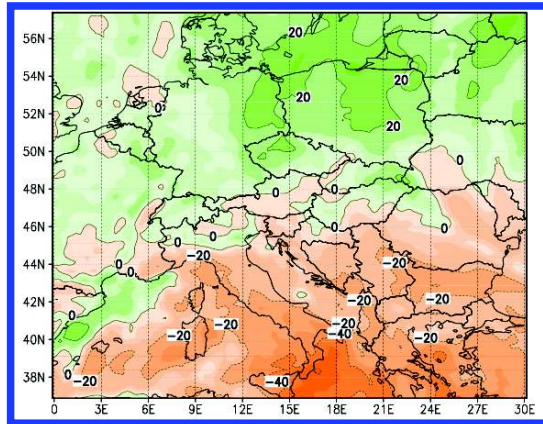
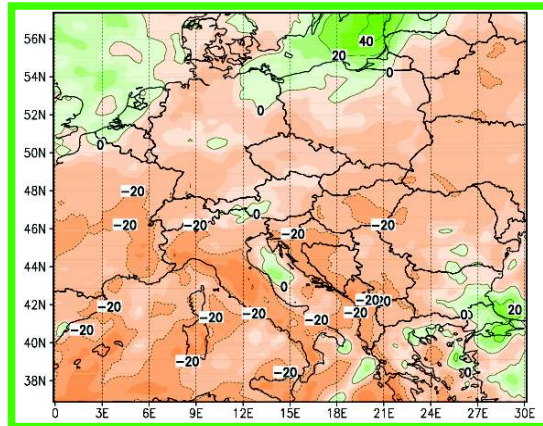
# Example of good impact study

Representative projections for  
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from 1961–1990 to 2021–2050

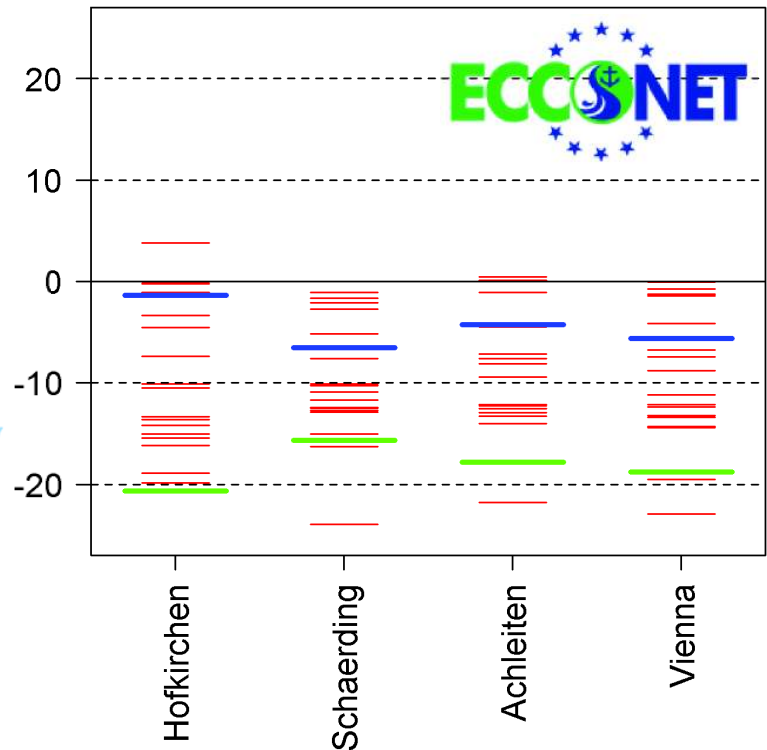


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Representative projections for summer precipitation change [%] from 1961–1990 to 2021–2050



Summer runoff change [%] from 1961–1990 to 2021–2050



# Trainings for users

- Two workshops
- Aim: consultation between meteorologists providing climate information and users applying meteorological information
- After some key presentations participants discuss pre-defined questions in parallel sessions → summary in plenary
- Number of participants: around 40 persons

# 1st consultation workshop

- Held on 22 June 2015
- Aim: consultation about user needs, possibilities and limitations of model data
- Presentations:
  - Using climate model data in impact studies
  - Cooperation experience at ELTE
  - Hydrological investigations based on climate model results



# 1st consultation workshop

- Main conclusions of discussions:
  - Points of data use: **public accessibility**, availability, spatial and temporal resolution (quality?)
  - Current resolution is not sufficient for every study (interpolation of model data instead of modifying the impact model?)
  - **Uncertainty** information: some good examples, but users need help to avoid ad hoc model data selection



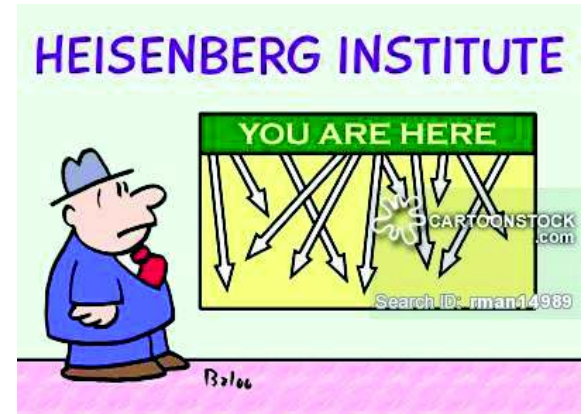
# 2nd consultation workshop

- Held on 19 February 2016
- Aim: consultation about challenges of using climate model data in impact studies
- Presentations:
  - Post-processing methods to use climate model information in impact studies
  - Investigation of future hydrological conditions of Balaton (delta method)
  - Using climate model data in plant production models (statistical correction)



# 2nd consultation workshop

- Main conclusions of discussions:
  - User needs on quantified uncertainties – already based on a single scenario
  - For decision makers it is important to be aware also of the unavoidable scenario
  - **Forever dilemma**: decision method of decision makers and probabilistic information of researchers





# Dissemination

- Web page: [rcmter.met.hu](http://rcmter.met.hu) (Hungarian and English versions)
- Leaflet
- Newsletters
- Participation in international workshops and conferences
- Representation of project in national events (opening, final events, workshops of co-projects)
- Project booklets (Hungarian and English versions)



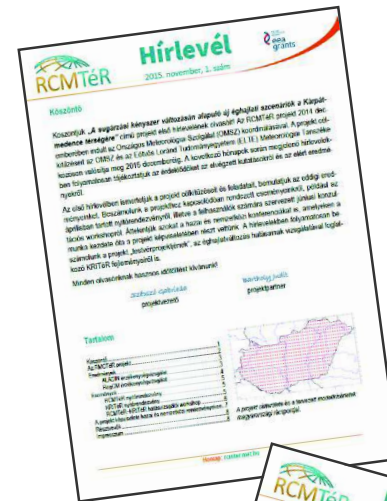
A sugárzási kényszer  
változásán alapuló új  
éghajlati scenáriók  
a Kárpát-medence  
társégére

New climate  
scenarios based  
on radiative forcing  
change over the  
Carpathian Basin



# Newsletters

- Two issues in November & February
- Content:
  - Opening
  - Introduction/Progress of the project
  - Results
  - Events
  - Presentation of the project results and goals in national and international events



# International workshops & conferences

- General Assembly of EURO-CORDEX (2015, 2016), Germany – regional climate modelling cooperation
- Training of EUPORIAS (European Provision Of Regional Impacts Assessments on Seasonal and Decadal Timescales) project
- 3rd OpenIFS workshop & 10th Eumetcal training, UK – using probabilistic information in decision making
- 9th International Conference on Urban Climate, France – impact studies
- Our Common Future under Climate Change, France – climate change in general
- UERRA workshop, France – regional re-analyses

# Representation of the project in events

- General Assembly of European Geosciences Union, Vienna
- Annual Meeting of European Meteorological Society, Bulgaria
- International Union of Geodesy and Geophysics, Czech Republic
- 9th HyMeX conference, Greece
- 5th EUGEO Congress on the Geography of Europe, Hungary
- IPCC Workshop on Regional Climate Projections and their Use in Impacts and Risk Analysis Studies, Brazil

# Events of co-projects

- Workshop on the application possibilities and limitations of NAGiS, preliminary results of vulnerability assessments (3 November 2015)
- Final event of (EEA-C12-11) project entitled *Long-term socio-economic forecasting for Hungary* (7 December 2015)
- Final event of CRIGiS (EEA-C12-13) project (8 December 2015)
- Final Event of AGRAGiS (EEA-C12-12) project (21 December 2015)

# Bilateral cooperation

- Participation of the bilateral consultation organized by MFGI and REC on 19 October 2015 in Szentendre
- Visit of *Stefan Sobolowski* from the Bjerknes Centre & Uni Research Climate in Bergen at OMSZ →
- Consultation about the cooperation possibilities →
- International workshop on networking

# Workshop on networking



- Objective: building partnership on climate change adaptation
- Date: 6–8 June 2016
- Place: Budapest, OMSZ
- Participants: experts from Hungary and Norway, Copernicus, Central and Eastern European region

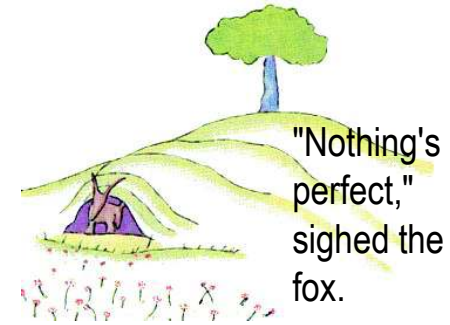
# Summary & outlook

- High-quality meteorological information
- Objective and quantitative impact assessments
- Ideal path of development: information not only about projection uncertainty, but uncertainties in every level
- Iterative consultation between meteorologists and users
- Importance of training, even decision makers (not fully hopeless)



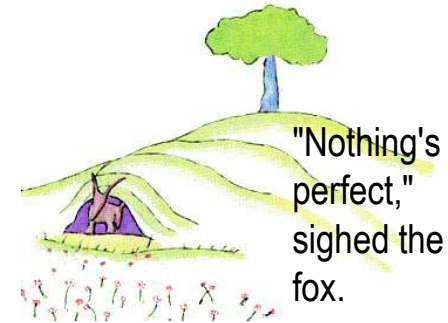
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## Thank you for your attention!

E-mail: [szepszo.g@met.hu](mailto:szepszo.g@met.hu)

Web: [rcmter.met.hu](http://rcmter.met.hu)