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

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NAGiS bilateral event
7 November 2016
History

• Climate dynamics research in Hungary since 2004

• Adaptation of regional climate models, test simulations, projections, involvement in international projects on impact assessments

• 2009: final meeting + stakeholder event of CLAVIER project in Budapest

• 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)
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• For targeted and sustainable adaptation: high-quality meteorological information, quantitative and comparable impact assessments, considering uncertainties
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• Programme for *Adaptation to Climate Change in Hungary*

• Important development areas:
  
  – Development of an adaptation information system (NAGiS) providing scientifically sound input data for climate impact assessments
  
  – Extension of NAGiS to further sectors (critical infrastructure, tourism, agriculture, forecasts)

  – *Improvement of climate scenarios*
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For targeted and sustainable adaptation: high-quality meteorological information, quantitative and comparable impact assessments, considering uncertainties

Programme for *Adaptation to Climate Change in Hungary*

Important development areas:

- Development of an adaptation information system (NAGiS) providing scientifically sound input data for climate impact assessments
- Extension of NAGiS to further sectors (critical infrastructure, tourism, agriculture, forecasts)
- Improvement of climate scenarios
NAGiS prototype

• Climate projections for 2 target periods:
  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
  • …

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<th>Model</th>
<th>ALADIN</th>
<th>RegCM</th>
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<td>LBC</td>
<td>ARPEGE</td>
<td>ECHAM</td>
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<td>Resolution</td>
<td>10 km</td>
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<td>Scenario</td>
<td>SRES A1B</td>
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Improvement of climate scenarios

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

• Consortium:
  – Hungarian Meteorological Service (coordinator)
  – Eötvös Loránd University, Department of Meteorology (partner)

• Duration: 15 December 2014 – 29 February 2016

• Financial background: EEA Grants
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)

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<td>RCP8.5</td>
<td>RCP4.5</td>
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Radiation forcing [W/m²]
Validation results

Winter precipitation validation for 1981–2000

ALADIN – EOBS; HU: 9 %

ALADIN – CARPATCLIM/HU; HU: -9 %
Validation results

New and earlier simulation results
Validation results

New and earlier simulation results

Precipitation [mm/month]
1961–1990

ALADIN_old  RegCM_old  Observations

Courtesy: Bartholy J., Csorvási A., Pieczka I., Pongrácz R.
Validation results

New and earlier simulation results

Precipitation [mm/month]
1981–2000

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Validation results

New and earlier simulation results

Precipitation [mm/month]

ALADIN_new
ALADIN_old
RegCM_new
RegCM_old
Observations

Courtesy: Bartholy J., Csorvási A., Pieczka I., Pongrácz R.
Projection results

Mean changes over Hungary, reference: 1971–2000

Annual mean temperature [°C]

- Impact of scenario

Autumn precipitation [%]

- Non-linear changes

Mean change s over Hungary, reference: 1971–2000

RegCM RCP4.5  ALADIN-Climate RCP8.5

Courtesy: Bartholy J., Pieczka I., Pongrácz R., Zsebeházi G.
Application of model information

(Ideal case)

- Identification of sectors influenced by climate change
- Methodology for impact assessments
- Quantitative and detailed meteorological information for impact studies – iterative process
- Quantification of uncertainties →
- In the whole adaptation chain
- Sophisticated decision making

Diagram:

1. 3D meteorological fields
   - Quantified uncertainties

2. Post-processing: special statistical or dynamics-based downscaling
   - Quantified uncertainties

3. Objective methods for impact studies
   - Quantified uncertainties

End-users: economy, society, human health, politics
Trainings for users

• Two workshops (June 2015, February 2016)

• Aim: consultation between meteorologists providing climate information and users applying meteorological information

• After some key presentations participants discuss pre-defined questions in parallel sessions $\rightarrow$ summary in plenary

• Participants: researchers, decision makers

  agriculture, ecology, engineering, hydrology & hydrogeology, transport modelling, health care, tourism, wine production
Covered issues

• Main topics:
  – User needs, possibilities and limitations of model data
  – Challenges of using climate model data in impact studies

• Presentations:
  – Using climate model data in impact studies
  – Hydrological investigations based on climate model results
  – 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)
Main conclusions

• Points of data use: **public accessibility**, spatial and temporal resolution (quality?)

• Current resolution is not sufficient for every study (modifying the impact model?)

• User needs on quantified **uncertainties** – possibly based on a single scenario

• Important to be aware of the unavoidable scenario

• **Forever conflict**: decision method of decision makers and probabilistic information of researchers

• Adaptation: never-ending story
Dissemination

- Web page: rcmter.met.hu (Hungarian and English versions)
- Leaflet
- Newsletters (2 issues)
- Participation in international workshops and conferences
- Representation of project in national events (opening, final events, workshops of co-projects)
International Climate Change Workshop in Budapest

- Budapest (OMSZ), 6–8 June 2016
- Motivation: building partnership on climate change adaptation

- Sessions:
  - Climate change information: observations, re-analyses, seasonal predictions and climate projections
  - Climate change impact studies
  - Dissemination, education, communication

- Participants: experts from Hungary, Norway, Central & Eastern Europe, Copernicus C3S

- Web: ccworkshop.met.hu
Important conclusions

- Today no pure modelling (and scientific) projects → instead: (end-)users & interdisciplinarity & applications
- Everyone has his/her own user
- Development of the projection results is not „suspicious” in a „smart” adaptation system → continuous communication of limitations and uncertainties is needed
- Key to fruitful consultations with the users: users by users (instead of uniform treatment)
Summary & outlook

• Detailed climate projections → input to objective impact studies

• Iterative consultation between meteorologists and users → well-trained users who are open to use uncertainty information

• Ongoing: new simulations with ALADIN-Climate and REMO models with RCP4.5 and 8.5 scenarios (national programme)

• Ideal path of development: information not only about projection uncertainty, but uncertainties in every level
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Thank you for your attention!

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