

Climate Change Impact assessment in Central and Eastern Europe:

The CLAVIER project

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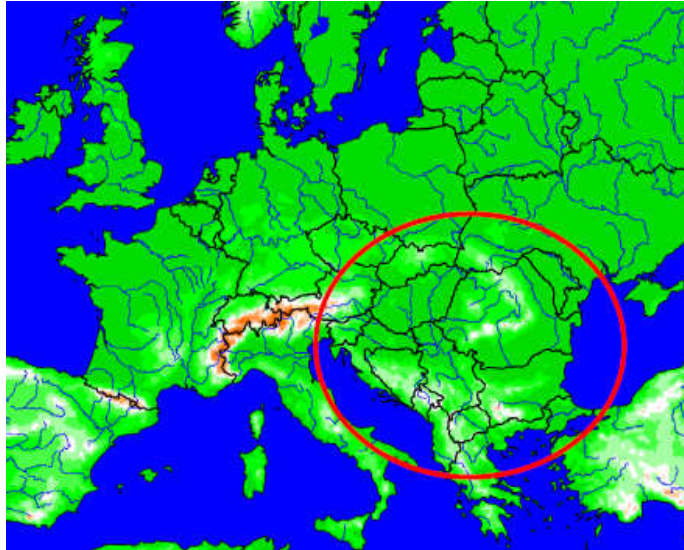
Coordination: Daniela Jacob, Max-Planck-Institute for Meteorology, Germany

financed under the 6th EU framework program (09/2006 - 08/2009)

13 partners from 6 European countries (Germany(1), Austria(2), France(1), Hungary(4), Romania(3), Bulgaria(2))

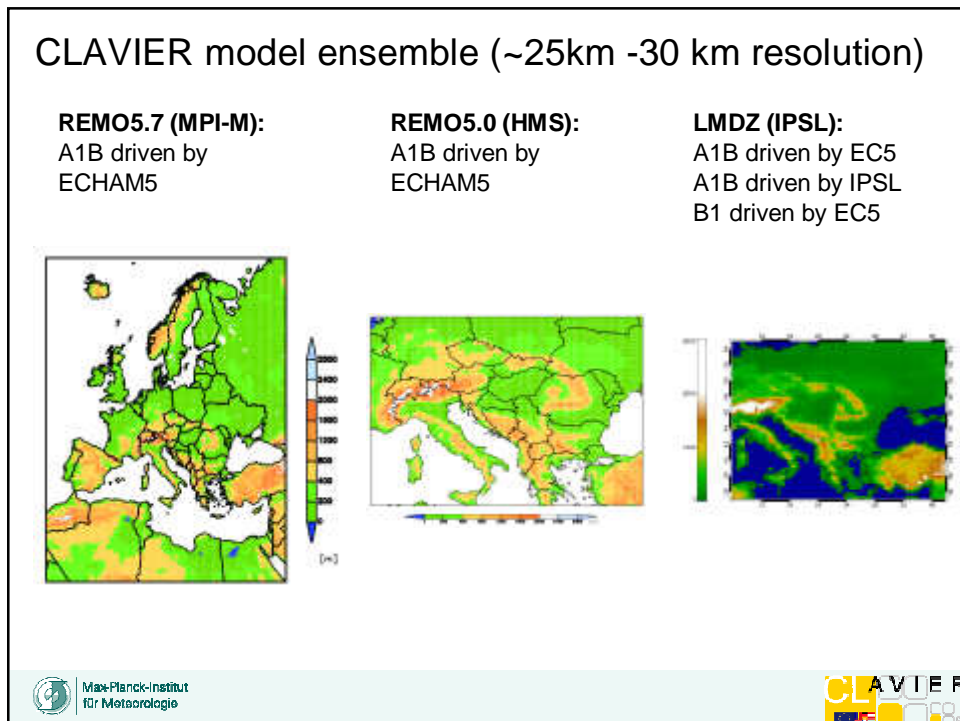
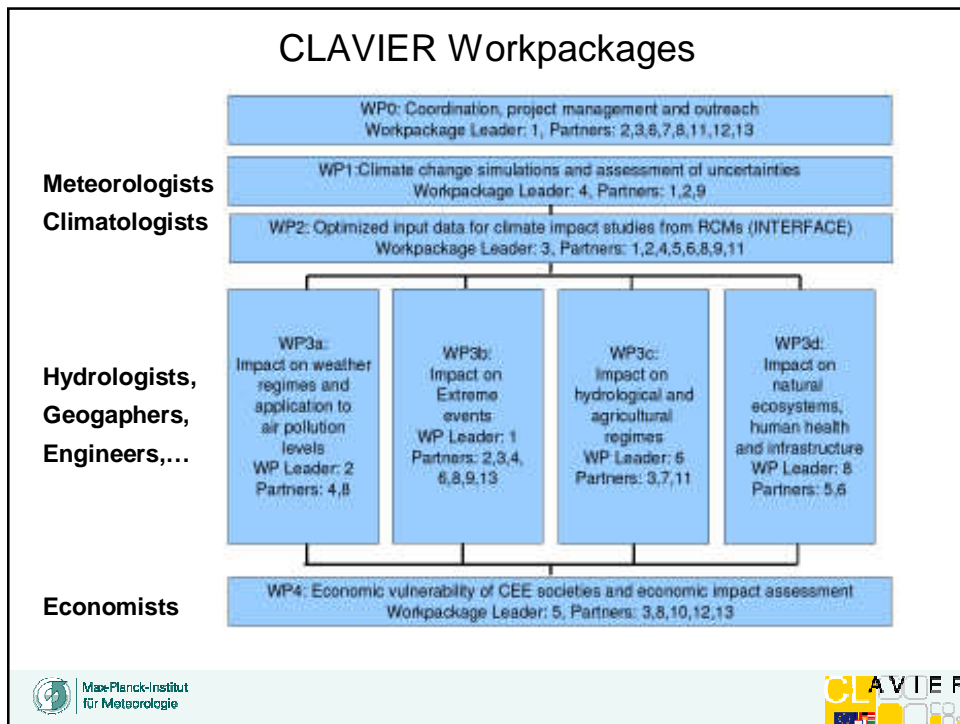


CLAVIER region of interest: Hungary, Romania, Bulgaria



CLAVIER goals

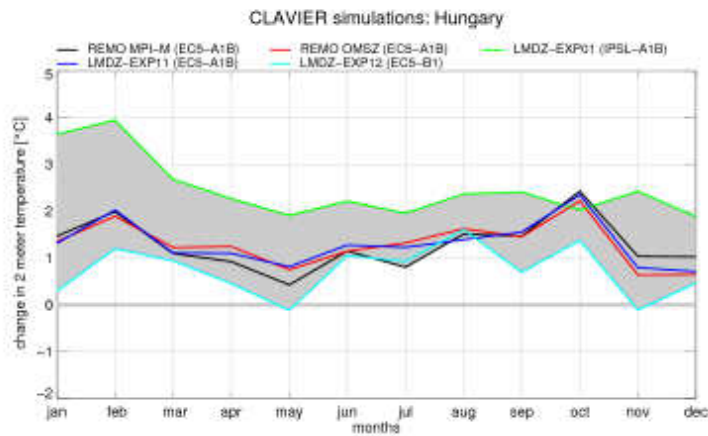
- Investigation of **ongoing and future climate changes** and their associated uncertainties in Central and Eastern European Countries (CEEC) until 2050
- Analyses of possible **impact of climate changes** in CEEC on **weather pattern** and **extremes**, **air pollution**, **human health**, **natural ecosystems**, **forestry**, **agriculture** and **infrastructure** as well as **water resources**
- Evaluation of the **economic impacts** of climate changes on CEEC economies, concentrating on four economic sectors, which are agriculture, tourism, energy supply and the public sector



	<i>Climate characteristics</i>			
	Temperature [°C]		Precipitation [mm/year]	
	Today	2021-2050* (9.96+1.72)	Today	2021-2050* (612-7)
Hungary	9.96	11.68 (9.96+1.72)	612	605 (-7)
Romania	9.6	11.27 (9.6+1.67)	620	613 (-7)
Bulgaria	10.56	12.34 (10.56+1.78)	565	533 (-32)

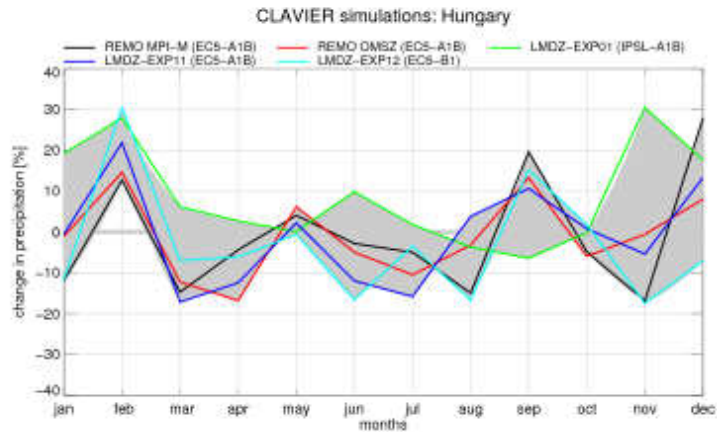
CLAVIER model ensemble

Analysis for Hungary: climate change signal in 2-meter temperature (2021-2050) - (1961-1990)



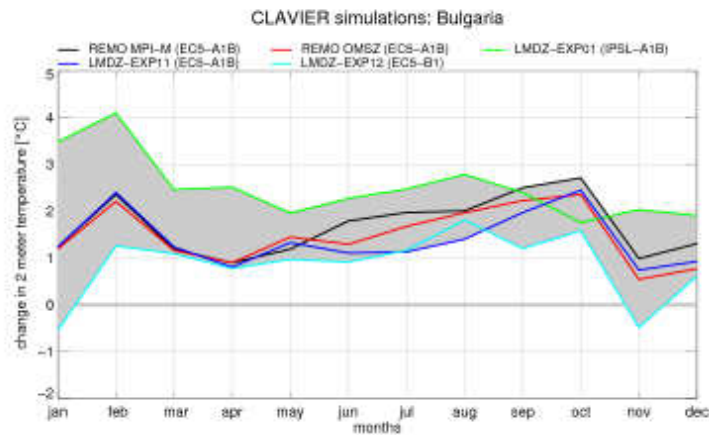
CLAVIER model ensemble

Analysis for Hungary: climate change signal in precipitation (2021-2050) - (1961-1990)



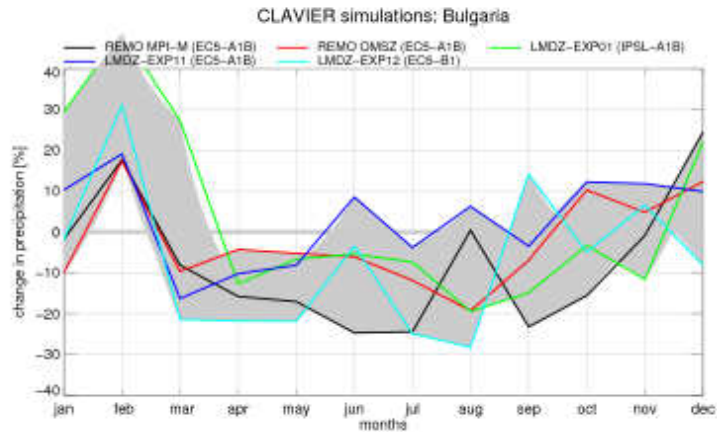
CLAVIER model ensemble

Analysis for Bulgaria: climate change signal in 2-meter temperature (2021-2050) - (1961-1990)



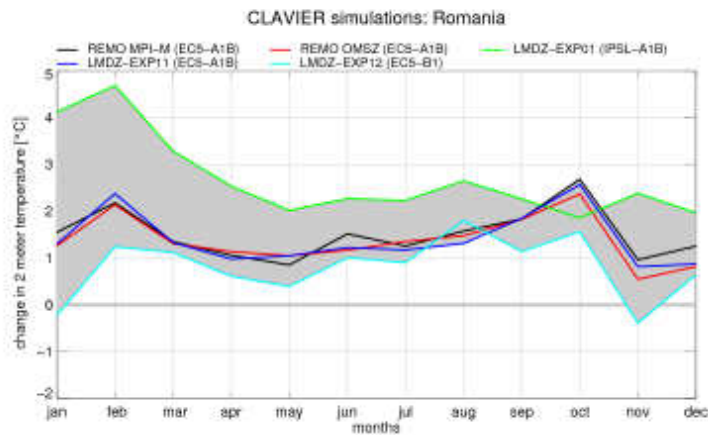
CLAVIER model ensemble

Analysis for Bulgaria: climate change signal in precipitation (2021-2050) - (1961-1990)



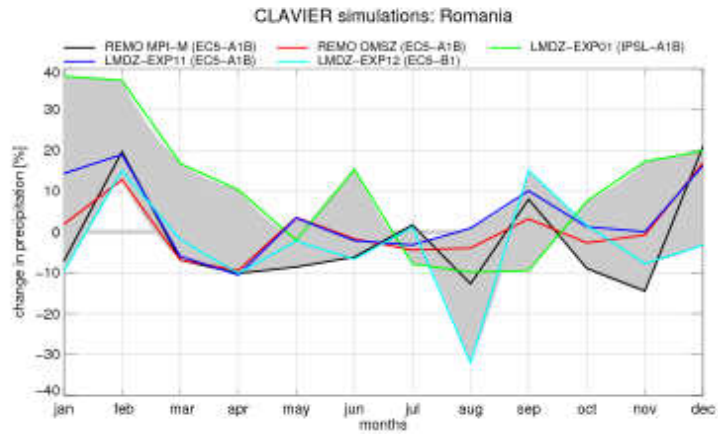
CLAVIER model ensemble

Analysis for Romania: climate change signal in 2-meter temperature (2021-2050) - (1961-1990)

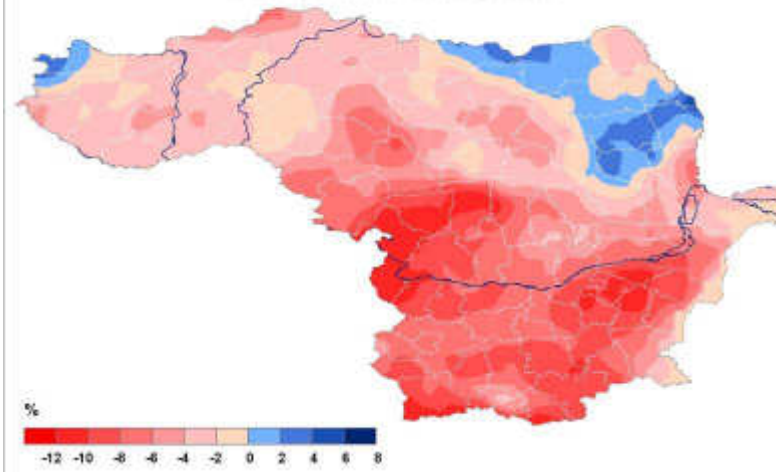


CLAVIER model ensemble

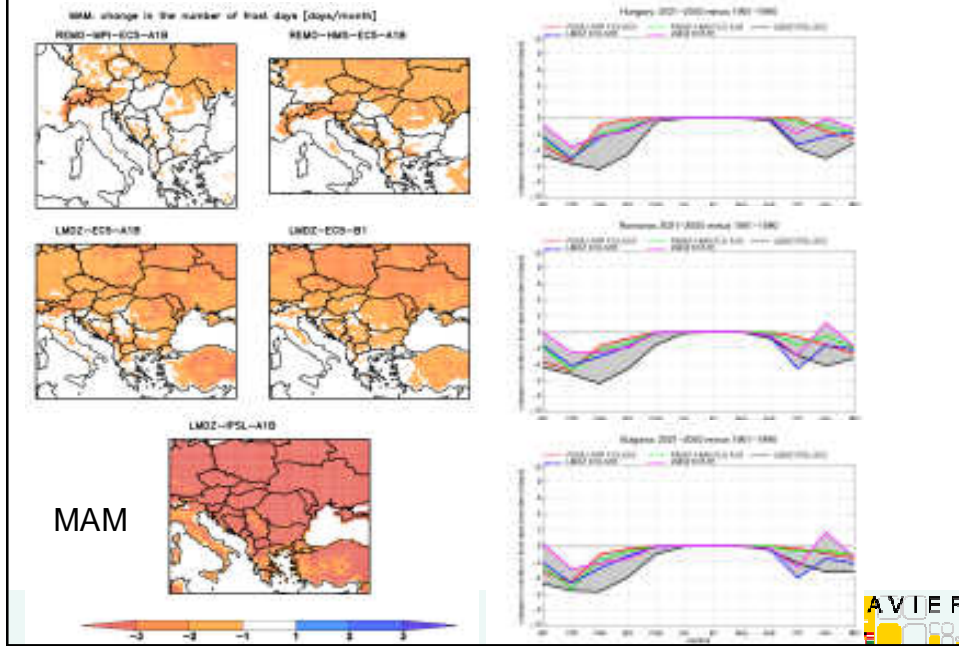
Analysis for Romania: climate change signal in precipitation (2021-2050) - (1961-1990)



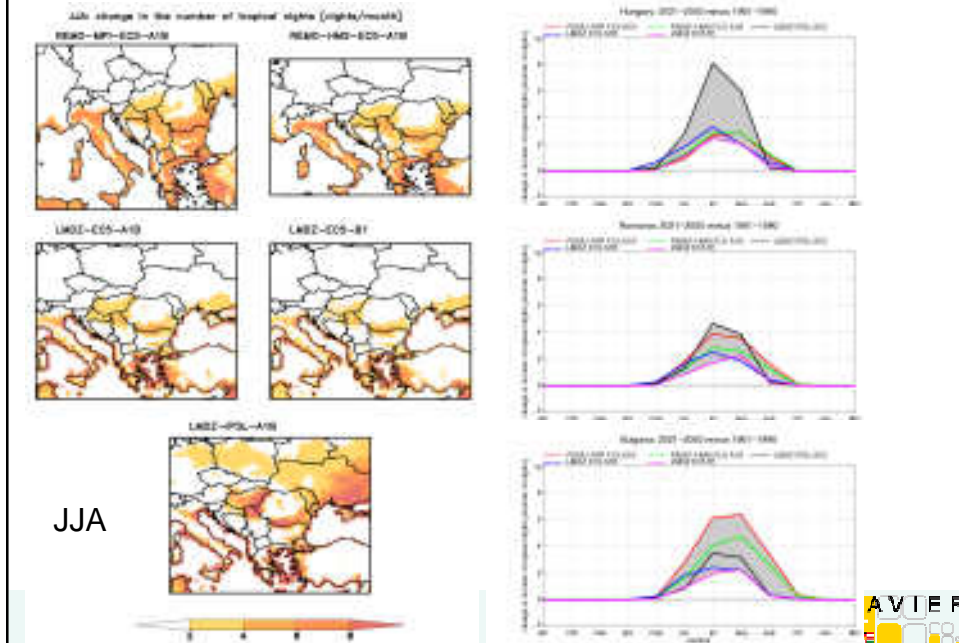
Annual mean precipitation change between 1961-1990 and 2021-2050 in percent
REMO5.7 error corrected A1B scenario



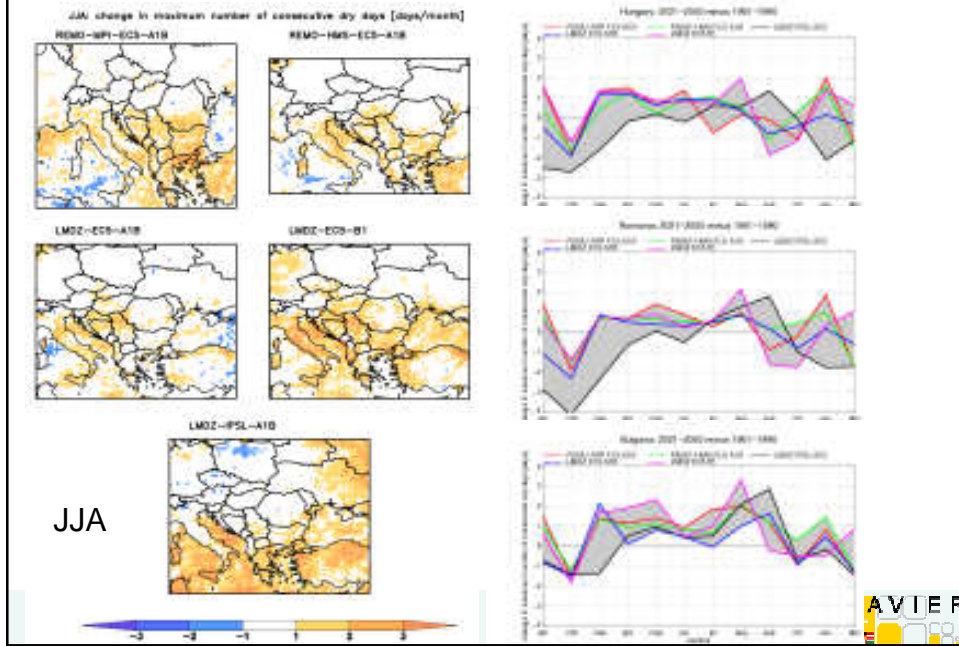
Number of frost days: projected changes



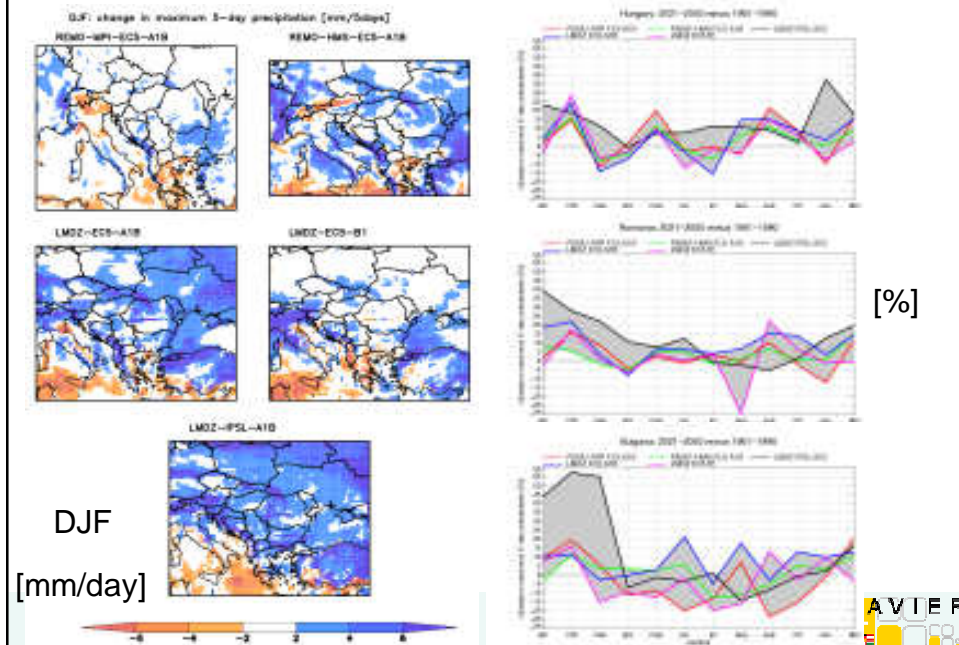
Number of tropical nights: projected changes



Number of consecutive dry days: projected changes



Maximum 5-day precipitation: projected changes



Interfacing Work package:

•Communication:

provides and moderates different communication channels

Information about the requirements of climate impact studies are collected and the potentials and restrictions of available climate scenario data are communicated

•Methodological interfaces:

Provides optimized input data for climate impact studies from regional climate models (dynamical and statistical techniques) -> e.g. palmer drought severity index , snow height (snow model), crop yield,...



A. Gobiet, Wegener Center, Graz



Palmer Drought Severity Index (PDSI):

- based on the calculation of a climatic soil water balance and requires as input long term temperature and precipitation data
- applied to output from the regional climate simulations and interpreted with regard to the impact of climate change on agricultural conditions

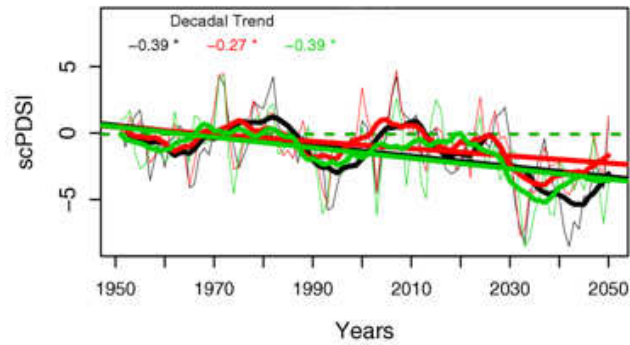
PDSI	Class
≥ 4	extremely wet
3.00 to 3.99	very wet
2.00 to 2.99	moderately wet
1.00 to 1.99	slightly wet
0.50 to 0.99	incipient wet spell
0.49 to -0.49	near normal
-0.50 to -0.99	incipient drought
-1.00 to -1.99	mild drought
-2.00 to -2.99	moderate drought
-3.00 to -3.99	severe drought
≤ -4	extreme drought



Flarek-Institut für Technologie
G. Heinrich, A. Gobiet, Wegener Center, Graz



Palmer Drought Severity Index (PDSI):



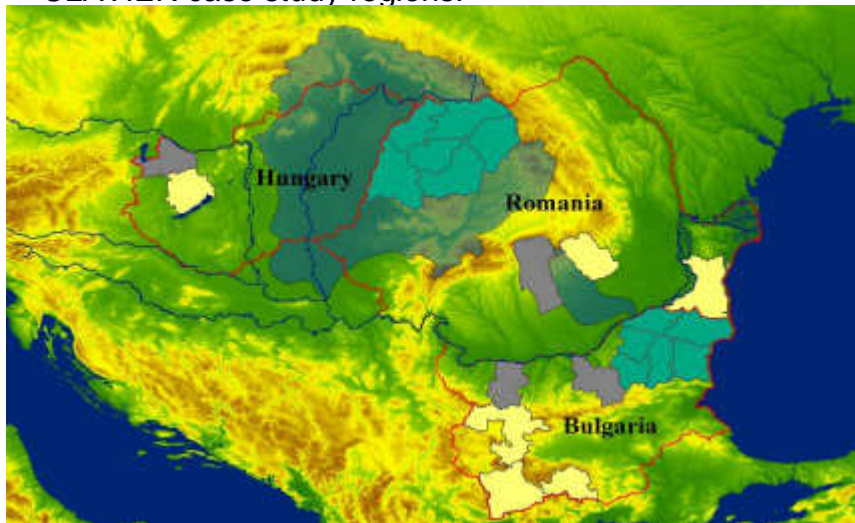
Annual values of PDSI and trends for Hungary (black), Romania (red) and Bulgaria (green) from 1950 to 2050. Bold lines: 10y running mean



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 G. Heinrich, A. Gobiet, Wegener Center, Graz



CLAVIER case study regions:



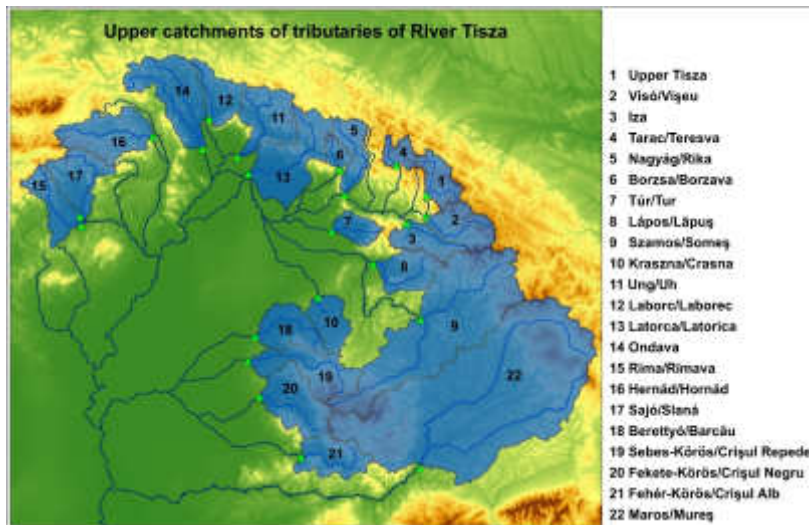
hydrological case study regions agricultural case study regions
 energy case study regions tourism case study regions



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Hydrological case study



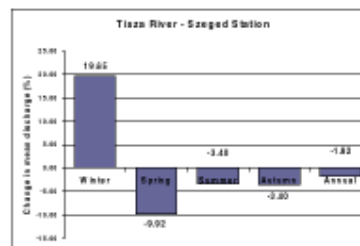
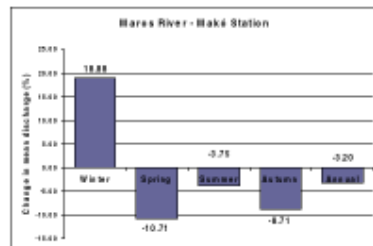
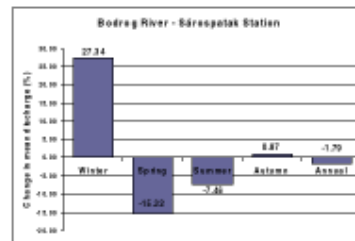
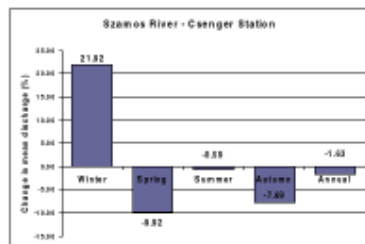
Investigated sub-basins within the Tisza catchment



G. Balint, VITUKI Hungary



Changes in seasonal flow, Tisza and tributaries 1961-1990 vs. 2021-2050



G. Balint, VITUKI Hungary



Mudflow / landslides case study

Assessment of landslides and mudflows in the Buzau Carpathians

D. Balteanu, IG Romania

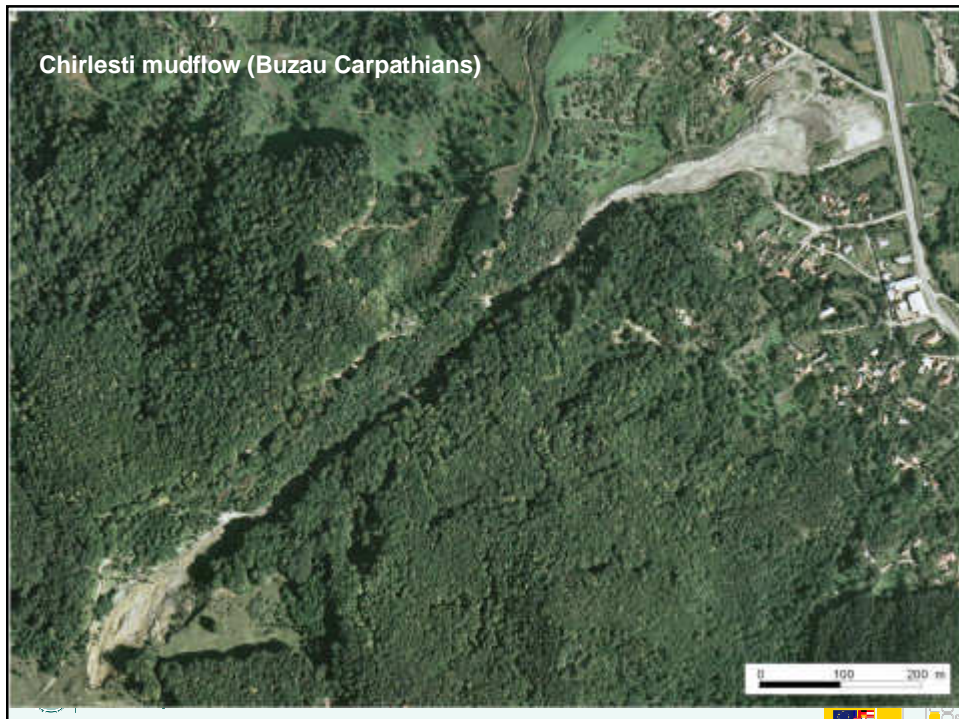


Muscel catchment (Buzau Subcarpathians)



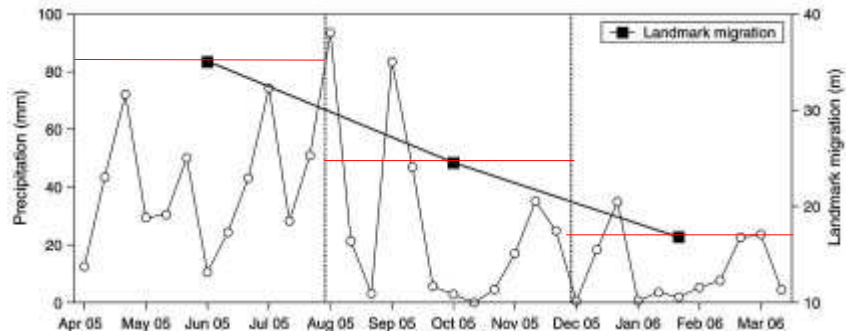


Nehoiu catchment (Buzau Carpathians)



Chirlesti mudflow (Buzau Carpathians)

Example for mudflow monitoring: Valea Viei Mudflow



The co-evolution of precipitation regime and mudflow dynamics. The landmark migration (black squares) was computed for each monitored interval (delimited by dot line) (Valea Viei mudflow)



D. Balteanu and colleagues, IG Romania



Mudflow / landslides case study

- Correlation landslide/mudflow dynamics and precipitation for today's climate (observed)
- Assessment of future changes based on the projected precipitation data



D. Balteanu and colleagues, IG Romania



Roads Impact Case Study

Adrienn Hunyady and Tamás Pálvölgyi
Env-in-Cent Consulting Ltd.



Selection of the most climate change sensitive road damages

WINTER DAMAGES



Pot-holes



Selection of the most climate change sensitive road damages - rutting

SUMMER DAMAGES



CLAVIER – economic impact assessment

CASE STUDIES
Agriculture (2), Tourism (4), Energy (3)



1st level:
physical impact assessment

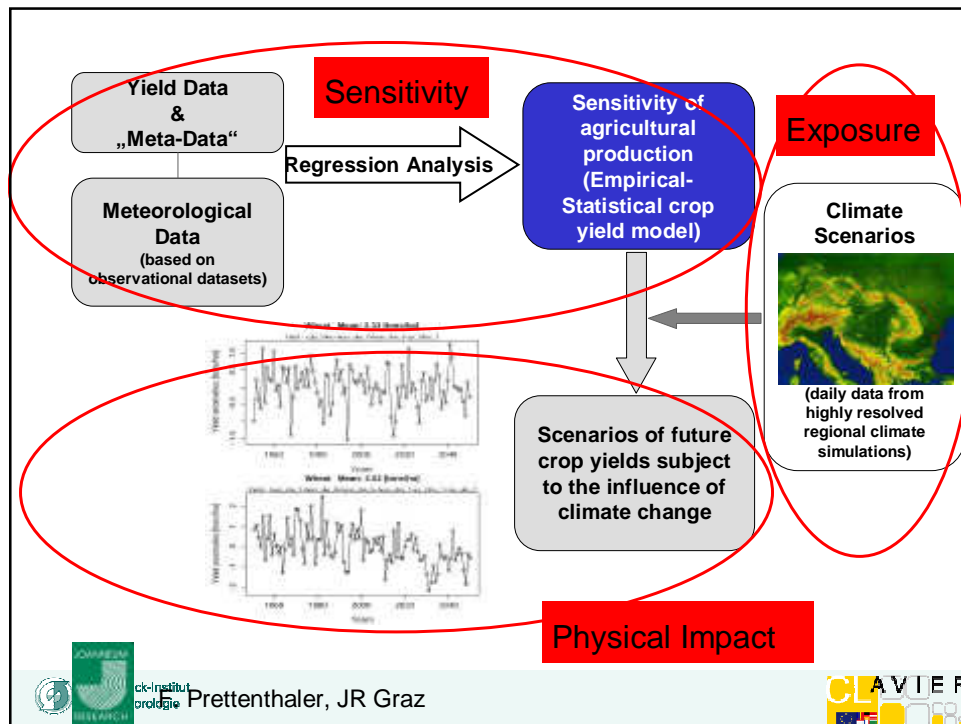


2nd level:
economic impact assessment



Prententhaler, JR Graz





Conclusions

- from Global climate change to regional economy (case study regions)
- sectoral approach is important
- temperature (+), precipitation (s-, w+)
- Quantification of climate change impact on sectors shows large diversity:
tourism (-), energy (-), agriculture (+)
(see fact sheets)

http://www.clavier-eu.org

CLAVIER
Climate Change and Variability:
Impact on Central and Eastern Europe

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Latest News

- 2015-06-07
The Year CLAVIER Newsletter is available!
- 2015-05-04
The associated climate scenarios to be used as input for the CLAVIER impact case studies are available online for project participants (INTACT-CLIMATE FOR-REMIT, internal link) on available online!
- 2015-05-28 to 2015-05-28
The Annual CLAVIER Meeting and the CLAVIER Stakeholders Meeting in Houston, Fort Worth. [More information \(external\)](#)

About CLAVIER

The nations in central and eastern Europe (CEE) face huge challenges of the ongoing economic and political transition, increasing vulnerability to environmental hazards, and long term impacts of global climate change. The overall aim of the EU FP6 project CLAVIER (Climate Change and Variability: Impact on Central and Eastern Europe) is to raise awareness of climate change with these challenges. Three representative CEE countries are studied in detail: Hungary, Romania, and Belgium.

In the framework of CLAVIER, ongoing and future climate changes are analysed based on long-term data and distributed projections with very high detail to fulfil the need of local and regional impact assessment. Researchers from five different disciplines investigate links between climate change and its impact on weather patterns, air pollution, extreme events, and water resources. Furthermore, an assessment of the economic impact on agriculture, tourism, energy supply and the public sector is conducted.

The CLAVIER project is supported by the European Commission's 6th Framework Programme (contract number 517013) as a 3-year Specific Targeted Research Project from 2005 to 2009 under the Thematic Sub-Priority "Global Change and Ecosystems".

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