Validation of different regional climate models over the Carpathian Basin

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Motivation

A couple of years ago research activities had been started on regional climate modelling in Hungary in order to establish the modelling basis for climate dynamics analysis. Four regional climate models were adapted:

(i) the **ALADIN-Climate** model developed by Météo France on the basis of the internationally developed ALADIN modelling system (Spiridonov et al., 2005),

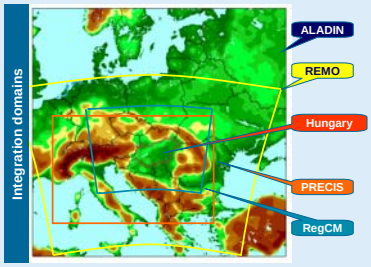
(ii) the **PRECIS** model developed by the Hadley Centre of the UK Met Office (Jones et al., 2004, Wilson et al., 2005),

(iii) the **RegCM** model originally developed at NCAR and available from the International Centre for Theoretical Physics in Trieste (Giorgi et al., 1993a, 1993b), and

(iv) the **REMO** model developed by the Max Planck Institute for Meteorology in Hamburg (Jacob and Podzun, 1997).

It is anticipated in Hungary that these models will be able to give realistic regional climate estimations for the next few decades particularly for the area of the Carpathian Basin (where one of the largest climate projection uncertainties can be found as it was already identified by several large international climate projects such as PRUDENCE for instance).

In order to test our regional climate models, simulations were accomplished covering the three decades of 1961–1990. The model domains include continental Europe with 25 km and 10 km horizontal resolution. The large-scale forcings for the regional model integrations were provided by the ERA40 re-analysis fields. The model results were evaluated with the CRU-dataset (Mitchell et al., 2004) over Europe and Hungary. The poster briefly summarises the first validation results of the four regional climate models.



Characteristics of the applied regional climate models

	Model	ALADIN-Climate V4.5	PRECIS	RegCM3.1	REMO5.0
DYNAMICS	Horizontal derivatives	Spectral	Gridpoint	Gridpoint	Gridpoint
	Plane geometry	Lambert-projection	Rotated spherical system	Lambert-projection	Rotated spherical system
	Horizontal grid	Arakawa A	Arakawa B	Arakawa B	Arakawa C
	Vertical coordinate system	Hybrid	Hybrid	Sigma	Hybrid
	Hydrostatic assumption	Hydrostatic	Hydrostatic	Hydrostatic	Hydrostatic
	Prognostic variables	u,v,T,q_{spec},p_s	u,v,Θ,c_v,p_s	u,v,T,p_s	u,v,T,q_{spec},c_w,p_s
	Temporal scheme	Semi-implicit + semi-Lagrangian	Explicit + Heun's scheme	Split-explicit scheme	Explicit leapfrog + semi-implicit
	Treatment of LBCs	Davies	Davies	Davies &Turner	Davies
PHYSICS	Radiation	Fouquart & Bonnel, Morcrette	Edwards & Slingo	Kiehl	Fouquart & Bonnel, Morcrette
	Soil model	ISBA	MOSES	BATS	Warrilow
	Number of soil layers	4 (T_s), 2 (q_s)	4	3	5
	Large scale precipitation and cloud	Smith, Ricard & Royer	Smith	Pal et al.	Sundquist, Roeckner
	Convection	Bougeault	Gregory & Rowntree	Grell	Tiedtke, Nordeng

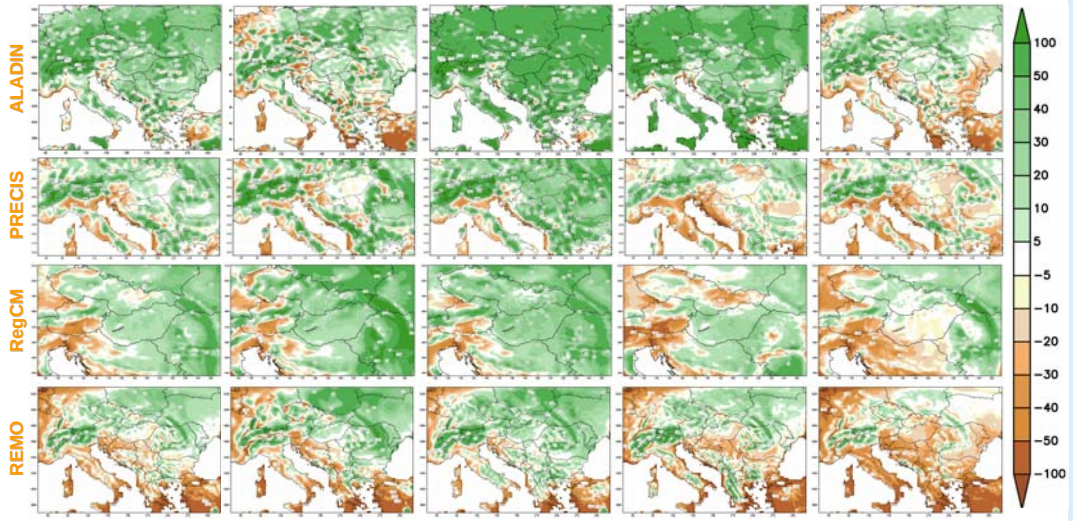
ERA-40 driven experiments

	ALADIN	PRECIS	RegCM	REMO
Integration period	1958–2000	1959–1990	1960–1990	1957–2000
Horizontal resolution	25 km	25 km	10 km	25 km
Coupling frequency	6h	6h	6h	6h
Number of vertical levels	31	19	18	20
Time step	15 min	5 min	1,5 min	2 min

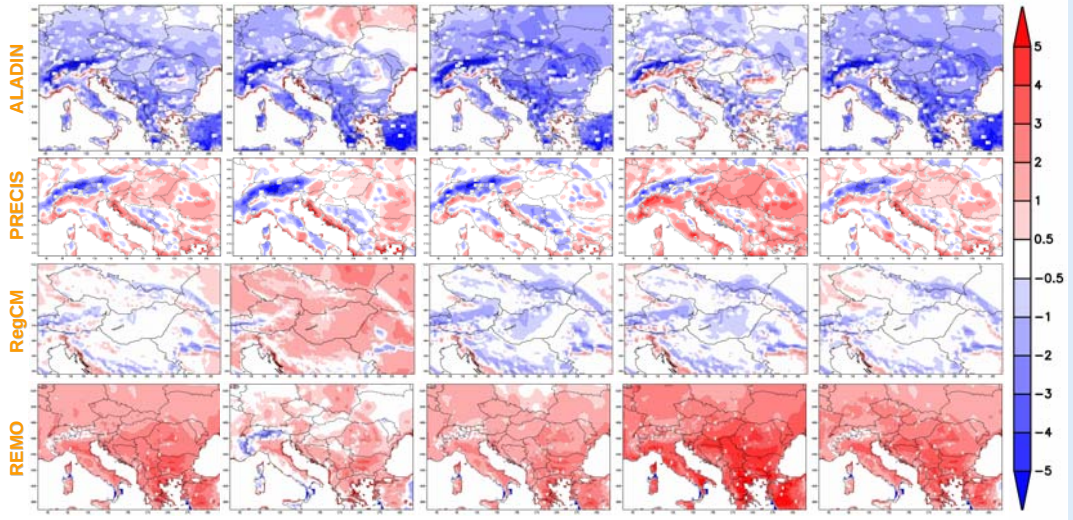
Mean differences with respect to the CRU1.2 dataset, period: 1961–1990

Annual | Winter (DJF) | Spring (MAM) | Summer (JJA) | Autumn (SON)

Precipitation [%]



Temperature [°C]



Mean differences: model–obs; reference: CRU1.2
Period: 1961–1990, area: Hungary

		ALADIN	PRECIS	RegCM	REMO
PRECIPITATION [%]	Annual	31	4	17	-2
	Winter (DJF)	12	0	30	9
	Spring (MAM)	68	33	29	13
	Summer (JJA)	33	-4	13	-8
	Autumn (SON)	8	-7	0	-18
TEMPERATURE [°C]	Annual	-1.1	0.9	0.1	2.0
	Winter (DJF)	-0.7	0.5	1.3	0.5
	Spring (MAM)	-2.0	0.1	-0.5	1.5
	Summer (JJA)	-0.3	2.2	-0.4	3.4
	Autumn (SON)	-1.6	0.9	-0.2	2.5

Conclusions

Precipitation:

- In general ALADIN and RegCM are too humid, while in fields of PRECIS and REMO a separation line can be noticed (isolating the too humid and too dry regions simulated by the models).
- Over Hungary REMO and PRECIS have the best annual performance (partly due to the compensation of positive errors in winter-spring and negative errors in summer-autumn), while ALADIN and RegCM are too humid in every season with the lowest relative differences in winter.

Temperature:

- In general ALADIN is too cold, while REMO is rather warm over the major part of the domain. RegCM as well as PRECIS underestimate the temperature over the highly elevated regions of Europe, however PRECIS is too warm over the Carpathian Basin.
- Over Hungary the temperature is most realistically simulated by RegCM with a slight positive bias (however its errors are mainly negative with the only exception of winter). ALADIN simulates too cold past climate with the largest differences in the transition seasons. Contrary to that PRECIS and REMO are too warm all over the year with highest errors in summer.

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Acknowledgements

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