

# ALADIN in climate research (project ENSEMBLES)

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## Introduction

LAM model ALADIN has been already utilized for climate research purposes at more European meteorological services. CNRM/MF and CHMI participate in EC FP6 project ENSEMBLES focusing on climate change projections using state-of-art global and regional climate models. Ensemble approach adopted in the project allows for inter-comparison of model performance and better understanding of uncertainty in model behavior.

CHMI adopted its regional climate model (ALADIN-CLIMATE/CZ) based on development of ALADIN NWP version CY28 T3. CNRM developed its model (ALADIN-CLIMATE V4.5) from ALADIN CY15 and prepared ARPEGE-CLIMATE physics for the use in the regional model.

Here we present first comparison of past-climate (forced by ECMWF ERA-40 lateral boundary conditions) in the frame of ENSEMBLES RT3 (dealing with regional models, past climate). We are focusing on two aspects: the ability of models to reproduce annual course of temperature and precipitation and investigation of model ability to capture weather regimes as represented in ERA-40 reanalysis. Both methods are then supposed to be a part of methodology to weight models reliability for future climate change scenario integrations.

## Experiment parameters:

Spatial resolution: 25 km  
 Common Integration area : ~5000 x 5500 km  
 Common Integration period: 1.1 1960 – 31.12 2000

## Input data:

ECMWF ERA-40 reanalysis

## Participating ENSEMBLES RT3 Institutes/Models:

- 1) Danish Meteorological Institute (DMI)
- 2) The Royal Netherlands Meteorological Institute (KNMI)
- 3) Swedish Meteorological and Hydrological Institute (SMHI)
- 4) UK Met Office, Hadley Centre for Climate Prediction and Research (HC)
- 5) Météo-France, CNRM
- 6) Max-Planck-Institute for Meteorology (MPI)
- 7) Czech Hydrometeorological Institute (CHMI)
- 8) Charles University (CUNI)
- 9) Swiss Institute of Technology (ETHZ)
- 10) GKSS Forschungszentrum Geesthacht GmbH (GKSS)
- 11) The Abdus Salam Intl. Centre for Theoretical Physics (ICTP)
- 12) Instituto Nacional de Meteorologia (INM)
- 13) The Norwegian Meteorological Institute (met.no)
- 14) Universidad de Castilla La Mancha (UCLM)
- 15) Community Climate Change Consortium for Ireland (C4I)
- 16) Ouranos Consortium (OURANOS)

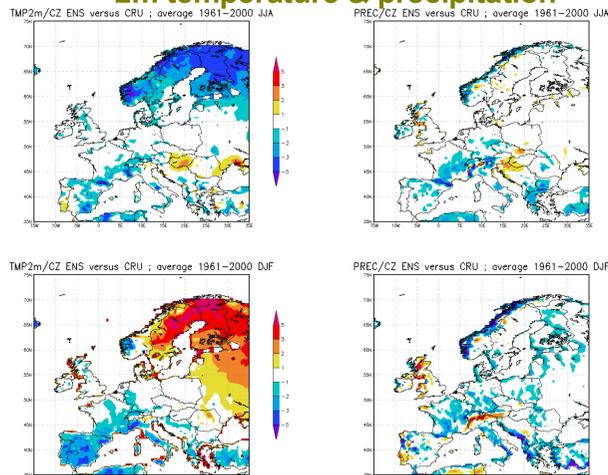
## References:

Sanchez E., (2008): Ability of an ensemble of regional climate models to reproduce the weather regimes during the period 1961-2000. *Climate Dynamics*, submitted.  
 Taylor, K.E.: Summarizing multiple aspects of model performance in a single diagram. *J. Geophys. Res.*, 106, 7183-7192, 2001

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## Overall performance of ALADIN-CLIMATE/CZ: 2m temperature & precipitation



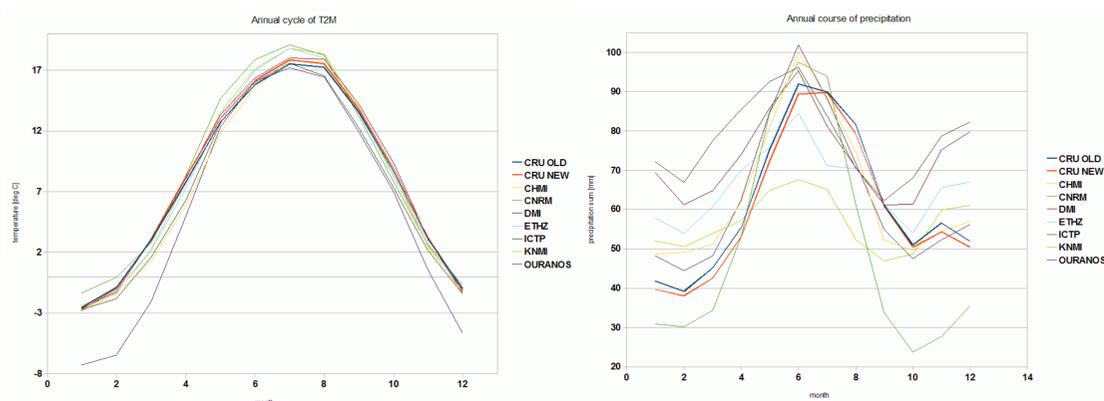
Left: average ALADIN 2m temperature for the years 1961 – 2000 [K]; Right: 40 year average ALADIN precipitation [mm/day]. Top: JJA season; Bottom DJF season. Model data are compared to Climate Research Unit (CRU) University of Eastern Anglia dataset.

## Model performance:

ALADIN model slightly underestimates temperature over Central and Eastern Europe, this is given mainly because of cold temperature bias during late winter and early spring. Bias in northern Scandinavia and Russia (both cold in summer and warm in winter) is rather systematic error given by CRU database.

Precipitation field shows strong variability both spatially and temporarily. Characteristically summer and fall are dryer whilst winter and spring are excessively wet. Geographically, precipitation overestimation occurs in Western and Northern Europe whilst Central and Eastern Europe remains closer to CRU data, with some particular areas having tendency to significantly underestimate precipitations

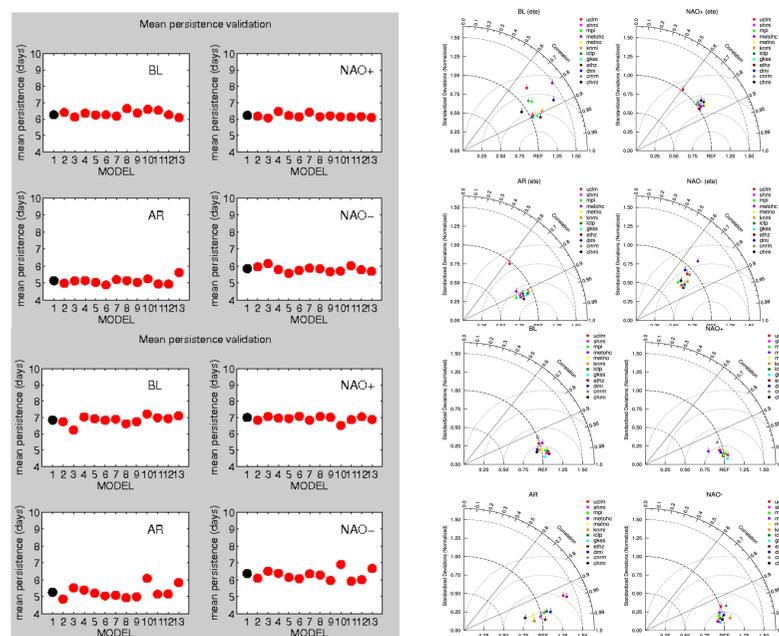
## Annual course of temperature and precipitation



Left: annual course of temperature field for a group of selected models. Right: annual course of precipitation field. Compared to high-res. and low-res. Version of CRU datasets for the time period: 1961 - 2000

Majority of models reproduces the annual course of temperature well in the Central Europe (with exception of Canadian OURANOS). However, annual courses of precipitation poses a problem for some of them. Typical is significant overestimation particularly during colder half of the year. Model ALADIN-CLIMATE/CZ performs well with tendency to slight overestimations whilst ALADIN-CLIMAT is dryer during SON/DJF season.

## Weather regimes as simulated by models



Mean persistence of basic weather regimes – comparison between ERA-40 and models. Upper kvartet JJAS, bottom kvartet DJFM.

- 1) ERA-40, 2) CHMI, 3) CNRM, 4) DMI, 5) ETHZ, 6) GKSS, 7) ICTP, 8) KNMI, 9) met.no, 10) METO-HC, 11) MPI, 12) SHMI, 13) UCLM

Taylor Diagrams WR residence frequency time series for basic weather regimes. Upper kvartet JJAS, bottom kvartet DJFM.

## Weather regimes:

Four basic weather regimes over Northern Atlantic/Europe are taken into account when classifying large scale features of circulation in climate models: Zonal (NAO+), Greenland Anticyclone (NAO-), Blocking (BL) and Atlantic Ridge situation (AR).

As a part of ongoing effort to investigate models performance in simulation of large-scale circulation features we present some of them computed for all available models in frame of RT3. On the picture to the far left a persistence of single regimes is shown compared to the one computed from ERA-40 data. Results are illustrating good accordance between models and reanalysis data albeit in winter some specific behaviour is visible for single models.

To the left a residence frequency time series is shown and their properties in form of Taylor diagram (Taylor, 2001) showing the scale of accordance between measured data in form of correlation, ratio of variances and centred MSE.

Generally and with only few exceptions of out-laying models weather regimes are reproduced in accordance with forcing data. Similar conclusion could be drawn even in case of model based frequency time series properties.

Complete results are to be found in Sanchez (2008).

**Conclusions:** Investigated models including both versions of ALADIN behaves generally well particularly when assessing basic aspect of simulation. However, investigation of particular aspects of model performance such as annual courses of simulated fields and character of large scale circulation could reveal problems and peculiarities of single models. Ensemble of multi-model runs then yields better confidence to the results of future climate scenario integrations and model ALADIN is capable of necessary performance to be a part of such effort.