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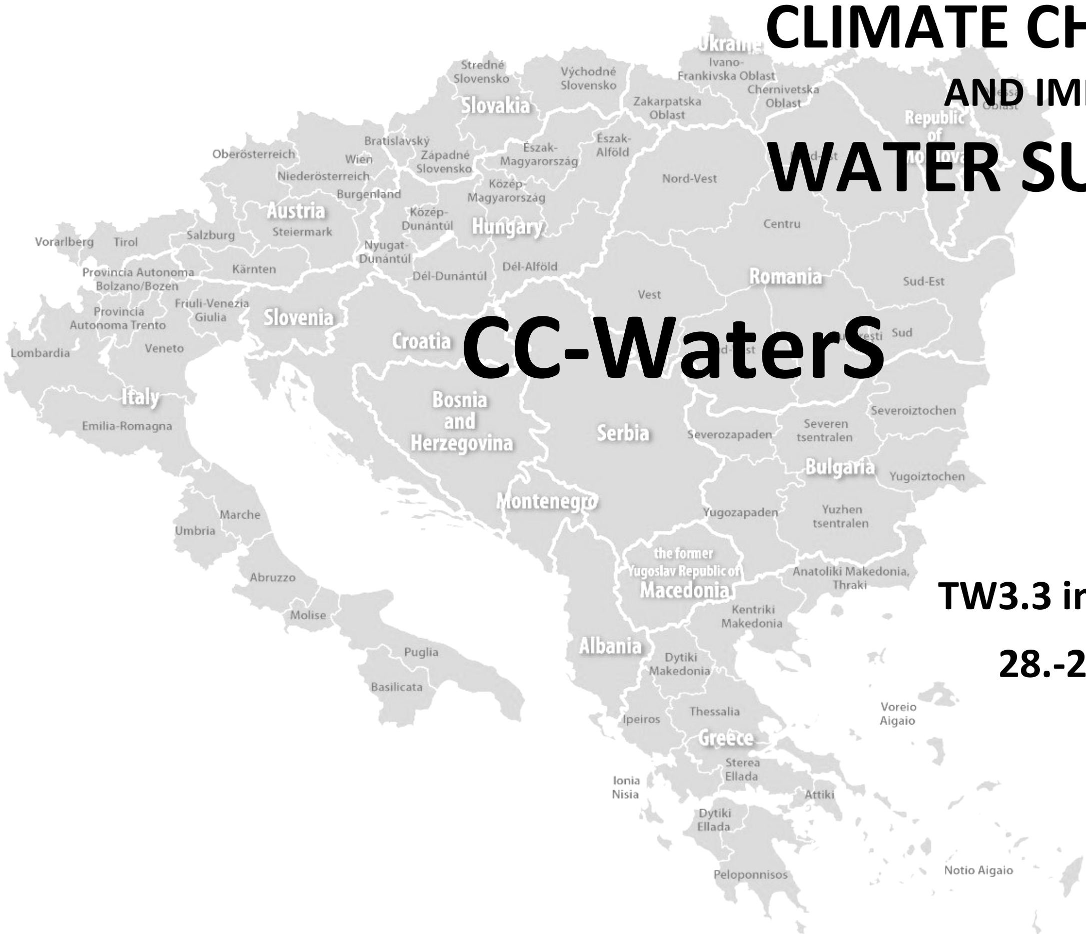
# CLIMATE CHANGE
## AND IMPACTS ON
# WATER SUPPLY




# CC-WaterS

**TW3.3 in Belgrade**

**28.-29.06.2010**
**MINUTES**

# Table of contents

# 1 Introduction

Zoran Stevanovic opens the workshop and introduces the Dean of the University who welcomes all CCWaters partners.

## 1.1 Goran Pejanovic RHMSS, Belgrade

SEEVCCC – Enhancing sub-regional SEE cooperation in climate related issues.

**Goals**

- Establishing atmospheric model: NCEP NMM B on a global, regional and local level
- Climate Monitoring
- Seasonal forecast is not a weather forecast, but of duration of about half a year (RCM-SEEVCCC vs. ECMWF / climatology vs. Observation)
    - this model can be also used as model for volcanic forecasts
    - temperature changes over time

**Models**

- Atmosphere: NMM E non hydrostatic model
- Land: land surface model
- Hydrology: HYPROM 21 – surface runoff
- HYPROM 1D – river routing

Morava river discharge and Savinja river (Slovenia) – flash flood forecasts

# 2 Lead Partner Presentation

## 2.1 LP

Cornelia Stehlik outlines the importance of raising questions in order to be clear of all outputs and to decide on how to transfer the outputs to the partners.

Prof. Nachtnebel presents the WP3 summary.

**Goals**

- Transnational database: server available, hydro-meteorological data collected
- Selection of appropriate climate changes scenarios: agreement on Scenarios (A1B), Models (Aladin, PROMES; RegCM), Methods, test beds with more detailed analysis
- Scenario data base: Obtaining Regional Circulation Model (RCM) data, Bias correction of RCM data, Downscaling of RCM data for selected test areas
- Developing a downscaling method: the technique will be tested and compared with RCMs, finally downscaling techniques will be available for different climate regions
- Estimation of uncertainties: uncertainties due to different sources are assessed

**Data available**

- Gridded observation data available

- ALADIN/ARPEGE, PROMES and RegCM3 are corrected, tested and available at a 25km grid
- A download web tool is available to download data at http://climdat.boku.ac.at/opendap/

**Methodology**

- RCM data exhibit in the control run large differences to observations, therefore an Adjustment (Bias correction) is needed
- Transnational data base (FTP server): download should be started with monthly means
- Observations versus raw RCM results (up ALADIN, down RegCM3): Winter and summer precipitation
- EOBS data vs. Local Observations: Problems:
    - EOBS observations don´t consider all local observations
    - EOBS observations show considerable discrepancies with local observations
        - Solutions: recalibrating the model according to the bias corrected existing data
        - Modifying the bias corrected data set according to the difference found between local data and bias corrected data
        - Determining the impact of CC by using the simulations with bias corrected control run data and CC scenario data – absolute change: existing resources + impact of CC.
    - Partners should compare EOBS observations and local observations and report differences (in means, seasonality and variance)

<u>Remarks</u>

Formayer mentions to be careful with small-scale scenarios (climate change signal).

**Downscaling approaches**

- Dynamic downscaling: already done
- Statistical downscaling: already done
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**To do´s**

Recommendations for use of downscaling methods in SEE catchments: there is a need to compare the techniques and the outcomes and outline advantages and disadvantages of different techniques

<u>Uncertainty assessment</u>

- Quite different RCMs have been compared
- Control runs have been compared with EOBS data base
- Bias correction describes the regional uncertainty in the past
- The range of the corrected model outputs describe the regional uncertainty in the future
- Comparison between local observations and EOBS provide some info about local variability
- Comparison with downscaling gives some info about uncertainty of the modeling approach

<u>In Progress</u>

- statistical downscaling

Remarks

Mihailo Andjelic asks if there is also a quantification of an uncertainty.

Gerhard Kuschnig replies that if you have a quantification of the uncertainties is fine, but it is important to know who receives the message. For the water management it is important to know that there are uncertainties and that they have a strategy. It is more important to know what uncertainty means, rather than the quantification.

Mihailo Andjelic answers that, however, for decision makers the quantity of uncertainty is very important.

Herbert Formayer states that it emission uncertainty is not reflected, as only scenario A1B is used. Until the middle of the 21$^{st}$ centurythis uncertainty is small, as there are no big differences in emissions in the different scenariosNachtnebel: Ranges in difference from scenarios are similar to those from different models

Report of WP3

- A wiki type homepage will be opened where all partners can upload their text. The wiki or shared document will be opened by mid July.
- A tentative table of content will be provided by the WP leader (structure) Structure will closely follow the project proposal and the defined outputs. All partners should revise this structure until end of July.
- Full access by all partners to text editing
- All partners should include their contributions until mid September. After completion of the report with all partners' contributions a short executive summary will be edited by the LP.

Proposal report for improved monitoring stations

This is a deliverable that should have been ready in February. Therefor it needs to be compiled as quickly as possible. Each partner should contribute 1-2 pages until the end of July.

Example: would be good for the future to have more stations in alpine areas for Austria (location, parameters)

Remarks

Mihailo Andjelic: I have difficulties with it. The inputs of the WPs are over. I see a need for feedback. Partners will take the data and might face difficulties. There is a need that partners can seek advices.

Gerhard Kuschnig: If there are just questions regarding understanding can be done by e-mail and telephone. If there are major problems, partners should state it in the second Scientific Advisory Board that a solution can be found.

Prof. Nachtnebel: The data is available since 2 month. So there was already plenty of time to test it.

Mihailo Andjelic: I understand the project structure, but it would be important to establish a feedback cycle in order to maintain an information cycle.

General remark: All partners, even the partners which are not participating at TW3.3. in Belgrade, have to deliver all outputs described in the AF.

Herbert Formayer presents:

**Content of web interface**

The use of the database is explained.

Already available:

- E-OBS temperature and precipitation observation (daily and monthly data) for common domain and the period 1951-2009
- ALADIN, REGCM3 andPROMES raw and bias corrected temperature and precipitation data
- Same for the Alpine region with ETHZ precipitation correction
- Documentation including all cited publications

# 3 Partner Presentations

## 3.1 PP14 Aristotle University of Thessaloniki: Statical downscaling for Greek test areas

Marios Vafeiadis presents the future precipitation scenarios for the Aravissos and Patra test sites. Seasonal data was used.

**Statistical downscaling model**

Artifical Neural Network approach

- Predictor determination: 500hPa
- Predictants: seasonal precipitation heights
- Validation period: 15 years (1979-1993)

**Dynamical downscaling model (RCM)**

KNMI-RACMO2 – Royal Netherlands Meteorological Institute (KNMI)

Time period: 1950s 1979-1993

Physical parameterization of ECMWF

Spatial Resolutions 25x25km

114 grid points in longitudinal direction and 100 in latitudinal direction – 40 vertical level

Location: Aravissos and Patra

**Results of the validation period**

RCM: spring, summer and autumn – underestimations (winter overestimation)

Statistical downscaling: gave better results: summer and autumn (ok); winter – underestimation; spring – overestimation

PP14, however, does not know if they can use the results as trend lines, because they don´t know if they have better results with statistical downscaling also in the future.

<u>Remarks</u>

Prof. Nachtnebel asks why PP14 did not use the data the LP provided. Will they use data of the models applied in CCWaters in a later stage ?

Prof. Vafeiadis answers that at the time of calculation, there was not the data ready to download. They will use CCWaters models.

Herbert Formayer: There is no temporal correlation between  cimate model simulation  and observation.

Vafeiadis: Temperature can be provided also for WP4 and 5, but for WP3 there was not sufficient data of temperature.

## 3.2 LP, BOKUMET: Statistical Downscaling for the Austrian test area

Boku: Herbert FormayerHerbert Formayer presents:

**Downscaling:**

- Use of additional local information to refine daily climate change scenarios on 1km resolution
- Local info is the high resolution Analyses (INCA) of the Austrian weather service (ZAMG)
- Scenario input is biass corrected daily fields of precipitation and temperature on 25km scale.

**Downscaling approach Temperature**

- Derive locally and time dependant (monthly) vertical lapse rates of temperature from 5year INCA climatology.
- Apply the monthly correction value on the daily field of EOBS and bias corrected scenarios.

**Downscaling approach Precipitation**

- INCA datasets used
- Algorithm to automatically classify relevant flow classes from RCM fields
- Redistribute daily bias corrected RCM precipitation depending on season and flow class on 1km grid.

<u>Remarks</u>

Prof Nachtnebel: Extreme rainfall events as well as drought periods are very important.

Herbert Formayer: Bias corrected RCM data is realistic until 99% quantiles. Extreme periods beyond the 99% quantiles as predicted by RCM data cannot be used .

Philipp Stanzel presents:

## 3.3 LP IWHW: Statistical Downscaling for the Austrian test area

Precipitation

- Calibration period: 1961-1980
- Model test period 1981-2000
- Predictions

Tables are shown which compare Original RCM data with Statistical Downscaling in the above mentioned periods. Moreover, yearly precipitation is presented.

<u>Remarks</u>

Prof. Nachtnebel: This model describes perfectly the past, but it is hard to describe the future.

Judit Bartholy: Analysis on precipitation. Summer precipitation is the largest and winter is the smaller. However, summer precipitation will increase around 1—20%.

## 3.4 PP6 Dynamical downscaling to 10km resolution for the Bükk and Nyirség area

Rita Pongracz

Validation results: Validation: annual cycle of temperature and precipitation for both target regions.

- 1961-1990 using E-OBS dataset
- Climate change analysis: 2021-2050, 2071-2100

Outcomes of the Validation of the test areas are shown with the following models:

- ALADIN
- UCLM (PROMES/HadCM3)
- ICTP (RegCM/ECHAM5): 25km and 10km resolution model
- Note:
  - Reg CM 10km does not show a summer warming at all in contrast to the rest of the models
  - Precipitation increase for winter and precipitation decrease for summer in Hungary is very likely

**Trend analysis - Conclusions**

- Validation results for the target regions:
- ALADIN,PROMES are warmer in summer, colder in other seasons
- RegCM is warmer in winter, colder in other seasons
- RegCM using 10km resulted in smaller bias values
- Seasonal climate change for the target regions located in Hungary:
- Significant temperature increase by 2021-2050:0.5-2.8 C by 2071-2100: 2.4-5.0C
- Significant annual mean temperature trend 0.27-0,35degree/decade

<u>Remarks</u>

RegCM gave very bad results: 300% precipitation wrong; in 5 points the parameters have been changed – RegCM β version

Philipp Stanzel asks whether EOBS observations are similar to the local observations.

Rita Pongracz answers that it was not done yet.

Prof. Nachtnebel wants to know more regarding extremes.

Rita Pongracz : A 10km resolution run has been completed, but it has not been analysed yet.

Herbert Formayer: Bias correction should not alter the climate change signal.

Prof. Nachtnebel: Temperature increases in summer and precipitation decreases, which looks rather critical.

## 3.5 PP 09 – Statistical downscaling-preliminary results

Aristita Busuioc, National Meteorological Administration, Romania

Uncertainty: Comparison between statistical downscaling results and more RCMs (10RCMs), including the 3 RCMs used in CCWaters**Results**

- T850 is the best predictor for temperature alone for summer
- Combination between temperature and precipitation as predictand gives more skilful statistical downscaling models for temperature in winter with T850 as predictor
- SLP is the best predictor for precipitation alone as predictand in winter, but the skill is also significant for combination between temperature and precipitation
- Comparison between statistical downscaling and RCM bias corrected: example one station (Craiova) and one RCM (ALADIN-ARPEGE).

The SDMs are calibrated over the period 1961-1990 and validated over the period 1991-2007.

Tables of the comparison of different models for temperature and precipitation in summer and winter months are shown (periods: 2021-2050; 2070-2100)

Changes in the mean temperature over Romania derived from the 9 ensembles RCMs:

- 2021-2050: 1,2-1,9
- 2070-2100: 2,6-3,2

<u>Remarks</u>

Prof. Nachtnebel asks about the differences between the RCM outputs and the statistical downscaling method.

Artista Busuioc answers that in the statistical downscaling are larger climate signals than in the RCM outputs.

## 3.6 Serbia IPA1 and IPA2

The two test areas are shown: Beljanica catchment test area and stara planinia catchment area

- Beljanica catchment test area: Aladin scenario and Echam scenario: is very similar, which means that the Echam scenario is really useful.
- Stara planania: Echam and Aladin scenario have the same results from 1961-2008, however the observed precipitation is much higher.
- Trend line: precipitation decrease

<u>Remarks</u>

Herbert Formayer: Correction of temperature with elevation is fine.For precipitation it is more complicated, a monthly corrections would be good.

Prof. Nachtnebel: Observations don´t show a trend while the RCM control runs show a trend.

Prof. Nachtnebel gives a closing speech.

**29.06.2010**

## 3.7 PP_04 - Slovenia, University of Nova Gorica: EOBS dataset verified by local observations

Presented by Bostjan Muri

- EOBS data set compared with measurements from three stations (Kredarica, Lubljana, Murska Sobota)
- Comparison of RCMs predictions from all stations
- RCM verification (EOBS; ALADIN; PROMES, RegCM3)

**Approach**

- Daily data
- Correction of yearly averages
- Calculate residuals
- Correcting the distribution of residuals by quantile mapping

Remarks

Herbert Formayer: It would be better to first calculate on monthly base and then on yearly base. For precipitation take dataset bias corrected with the alpine ETHZ observations (which also cover Slovenia) and not the EOBS data set. Both data sets are available online on the database.

Prof. Nachtnebel: Will you use daily data?

Bostjan Muri: Aim is to have daily data.

## 3.8 Bulgaria

Wp3 V. Vesselin Alexandrov – Bulgaria Water Service

- NIMH weather stations are shown. 25 weather stations have been provided in the area of the Struma river basin.
- Objectives: Data homogenization included:
  - Control of monthly data of average, max & min air temperature
  - Detection of breaks and outliers within the collected and controlled time series
  - Correction of the climate long-term series according to the defined breaks and outliers – homogenized series
  - To validate the located breaks
- Methods: the currently used in Météo-France homogenization procedure, which does not require computation of regional reference series, was applied
- Quality control is an important topic in Bulgaria.
- Climate Change Scenarios for Bulgaria: GCM simulated change of air temperature and precipitation for winter and summer in Bulgaria from1961-2100 are shown.
- The use of ALADIN was started for the downscaling 50km and 10km 1961-2100 (calculations regarding maximum and minimum temperature in different seasons and historical time periods)

Remarks

Prof. Nachtnebel: The CCWaters RCM data was not used. If this data will not be used by the Bulgarian partner , it should at least be compared with the data used by the Bulgarian partnerThe comparison of the ALADIN data with the RCM data should be still done.

Vesselin Alexandrov: Yes we will compare the data.

# 4 Conclusions of WP3

## 4.1 Experiences

Presented by Prof. Nachtnebel:

- RCMcorr(t) fit well for whole SEE (EOBS(t))
- RCMcorr(t) show deviations from local observations xlocal(t)
- Local observations xlocal (t) may have a trend
- Which input data will be used for impact models ?

## 4.2 LP recommendation for a correction procedure

- Seasonal pattern of observations xlocal(ti), i from 1 to 12 of from 1 to 365.
- deltaX(ti)=RCMcorr(ti) - xlocal (ti)
- RCMcorr_adj(t)=RCMcorr(t)-deltaX(ti)
- Works for T
- For P with n number of rainy days in month ti

## 4.3 Conclusions

- The long term pattern of RCMcorr(t) will be maintained
- The monthly (daily) means of Xlocal will be preserved in the past
- All local observations within a grid element will be corrected in the same way (independently from altitude)
- Models could be calibrated by observations and could be driven by RCMcorr_adj(t)

Remarks

Herbert Formayer: If you are focusing more at extreme events (like Slovenian) your calculations will be more complex. If the differences in precipitation are not very large, also a multiplicative approach is possible.

Prof. Nachtnebel: It is mostly related to the RCM data and not to the adjustment data. There are differences between local observations and the RCM corrected data.

Mihailo Andjelic: You use number of rainy days in the RCM.

Barbara Cencur Curk: Should we focus on the extremes or on the average seasonal values. This topic should be discussed.

Prof. Nachtnebel: This will be different for each partner, depending on the impact study. In WP3 all partners should start with the RCM corrected data and compare it with local data.Means, seasonality, local extremes, long-term droughts should be calculated by all partners.

Janos A. Szabó: You cannot compare point values with spatial values.

Herbert Formayer: Point values are more comparable in mountainous regions. And some groups want to do a comparison with local station observations.

Prof. Nachtnebel: It is not possible to interpolate the RCM values (the terrain is not very well reproduced). People compare grid values with local observation. Local observations are always used by driving impact models. Now the difference of the RCM output and the local observation can be explained.

## 4.4 Final Report

**Introduction and tasks**

Tasks

Background info on GCMs and RCMs (state of the art)

**Methodology**

- Selection of GCMs (LP)
- Bias correction GCM (LP)
- Downscaling approaches (some partners)

**Application**

- Test beds (each PP)
- Correction and description of RCMcorr(t) (LP)

**Results**

- Analisis of climate changes in each test bed by using RCMcorr_adj(t) (each partner)
- Trends in the mean
- Seasonality and variance
- Extremes

**Uncertainties**

- Differences of RCMs in the control period and in the future (LP+PPs)
- Differences between EOBS(t) and RCM(t) (LP)
- Differences of EOBS(t) and local observations (each partner)
- Differences among RCMcorr(t) in the future (2020-2050) (each partner)
- Differences among RCMcorr(t) in the future (2021-2050, 2071-2100) (each partner)

**Reccomendations for improving the observation network (each partner)**

Existing quality data

How to improve

**Summary 10-15 pages for the final booklet)**

This report should document what was done and there are no limits of pages. The structure of the report can be edited in the wiki page. The wiki page/shared document will be ready by mid July

# 5 To do´s

## 5.1 Final report

A wiki type homepage will be opened where all partners can upload their text.

The wiki page/shared document will be ready by mid July.

Comments on the structure of the report should be stated until 2 weeks after the publication of the wiki/shared document.

All partners' contributions should be added until**mid September.**

**End of July chapter 6 must be completed.** Chapter 6 is the first which need to be done in order to be able to show it to the programme. Every partner should submit around one page

Remarks

Mihailo Andjelic: It is a well structured content table.

Gerhard Kuschnig: The contribution of each single partner should be marked.

Marios Vafeiadis: is there a need of some additional templates from the programme? Answer: no

## 5.2 Reporting period

**End of November** is the end of the next reporting period.

Gerhard gives a closing speech and draws conclusions on the results of the WP3.