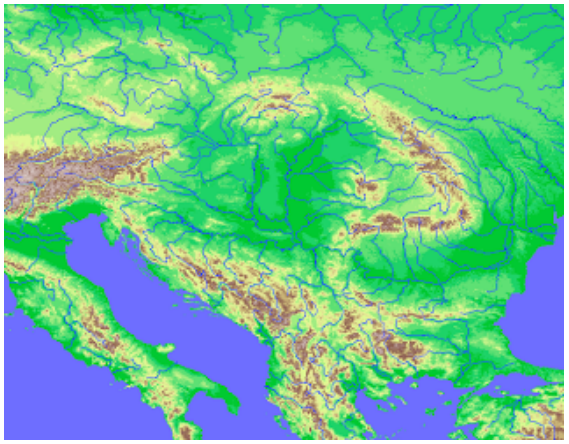
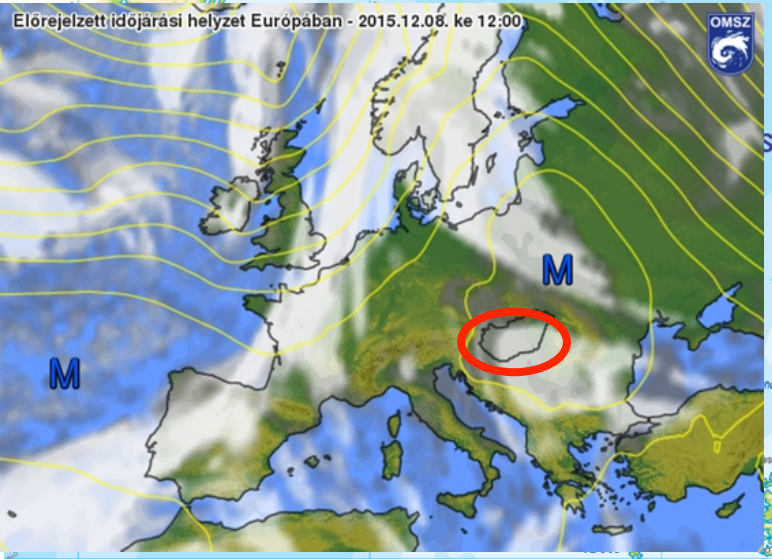


PannEx: Towards a Regional Hydroclimate Project in the Pannonian Basin

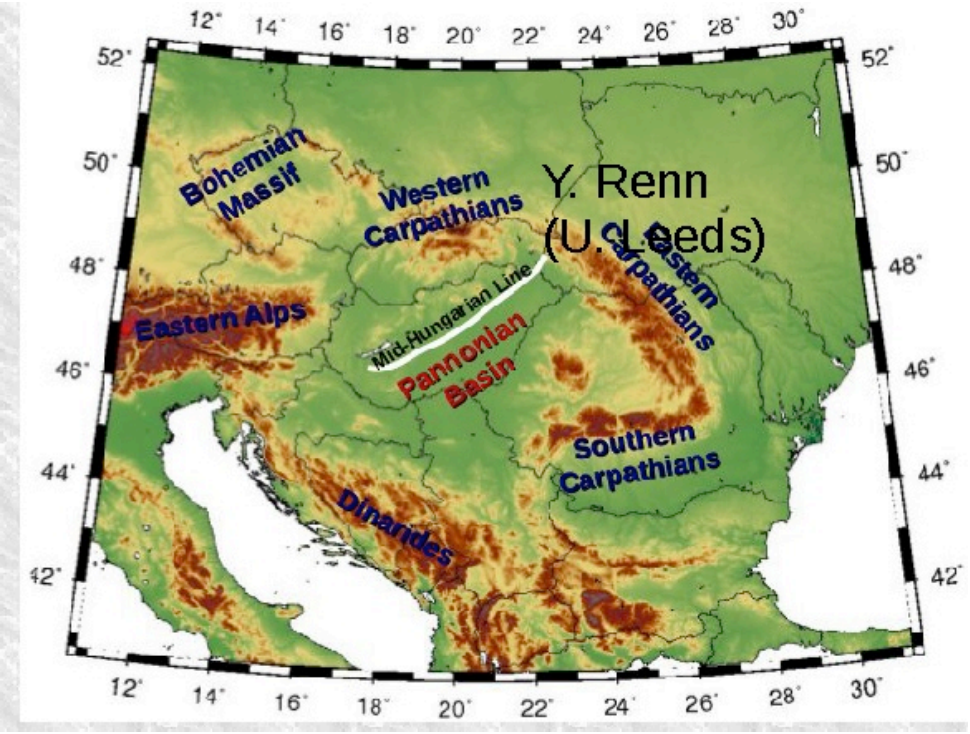
Monika Lakatos, Ivan Guettler, Danijel Jug, Tamás Weidinger, Vladimir Djurdjevic, Adina Croitoru, Branka Ivancan Picek, Joan Cuxart Rodamilans

GEWEX GHP Meeting, Gif-sur-Yvette, France, 3-5 October 2016



08. December 2015

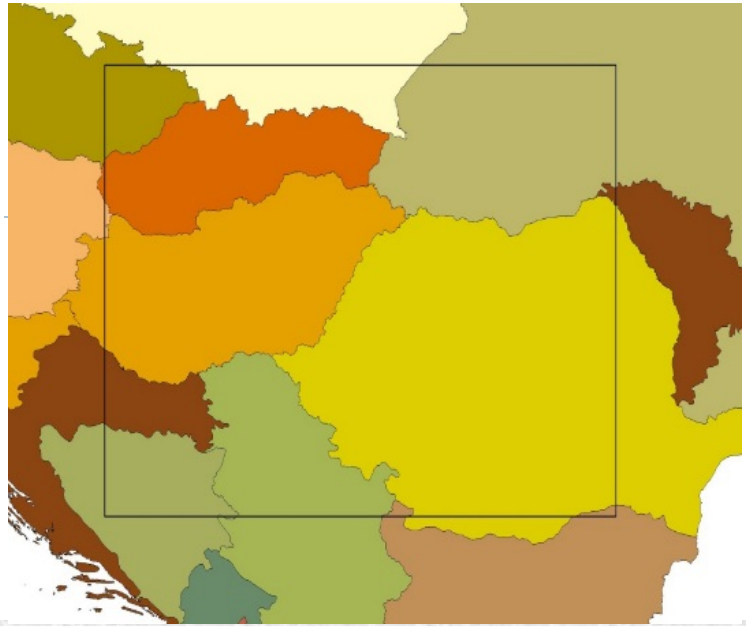
Physical motivation

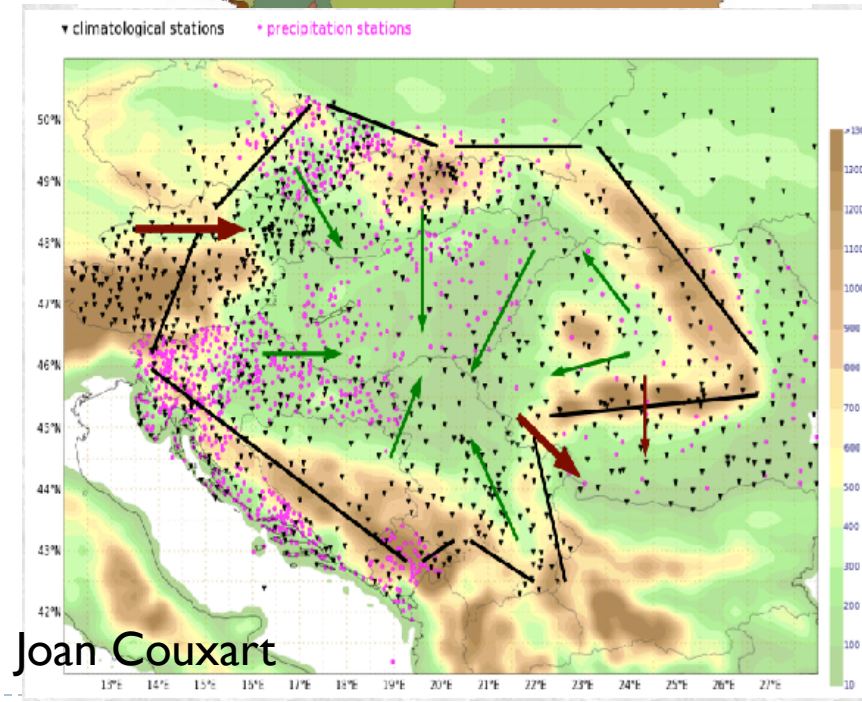


- A closed basin with only one outflow, the wind gates
- large low central plain (100 m asl) surrounded by mountains with elevations nearing 2000 m asl
- being a very good test area for many processes (natural or human-induced)
- The Pannonian basin is a transition area between mediterranean, atlantic and continental climates

Opportunity

- The area is fragmented in many different countries, sometimes with difficult communication amongst them
- Several research institutions and universities are well recognized, some recent activities of networking are established, but the recognition of them is not widespread
- Countries are in good position to apply EU research funding.
- Pannonian Basin lies in between the HyMeX and Baltic Earth areas with opportunity for future collaboration





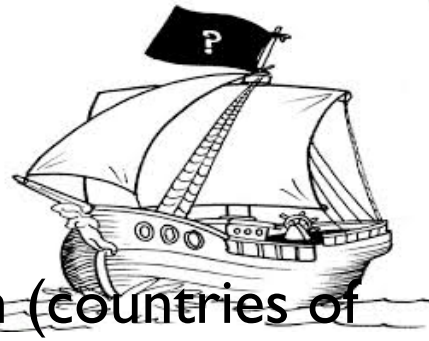
Joan Couxart

Initiation of PannEx as an RHP

- The GEWEX-promoted workshop on the „Climate System of the Pannonian Basin" took place at the Faculty of Agriculture of the University of Osijek, **9 - 11 November 2015**
- Organized by the Hydrometeorological Service of Croatia, the University of Osijek, the University of Zagreb and the GEWEX Hydrological Panel

1st PannEx WS Osijek → ~Half year → 2nd PannEx WS Budapest, 1-3 June

Results of the 1st Workshop



- 50 attendees from institutions of the Pannonian Basin (countries of Croatia, Hungary, Serbia, Slovakia, Romania, Czech Republic and Austria) were present
- state of the art of research of meteorology, climatology, hydrology, agronomy and other environmental issues in the region
- explore the status of the networks and the different recent transnational initiatives related to the regional Climate System
- discussion flagship science questions and cross cut subjects
- a Core Group formed
- a preliminary agreement was reached on that the first draft of a white book will be discussed in Budapest in June 2016

International Planning Committee

- Branka Ivancan-Picek (DHMZ, Croatia) *member of the GEWEX SSG from 2017 January*
- Monika Lakatos (OMSZ, Hungary) *PannEx chair*
- Adina Croitoru (University of Cluj-Napoca, Romania)
- Danijel Jug (University of Osijek, Croatia)
- Vladimir Djurdjevic (University of Belgrade, Serbia)
- Tamás Weidinger (Eötvös Loránd University at Budapest, Hungary)
- Ivan Guettler (DHMZ, Croatia) *PannEx secretary*
- *Joan Couxart UIB and Jan Polcher GHP co-chair Laboratoire de Meteorologie Dynamique, Paris – members of PannEx Scientific Committee*

The PannEx Flagship science Questions and Cross Cut subjects

FQ1: Adaptation of agronomic activities to weather and climate extremes

FQ2: Understanding of air quality under different weather and climate conditions

FQ3: toward a sustainable development

FQ4: water management, droughts and floods

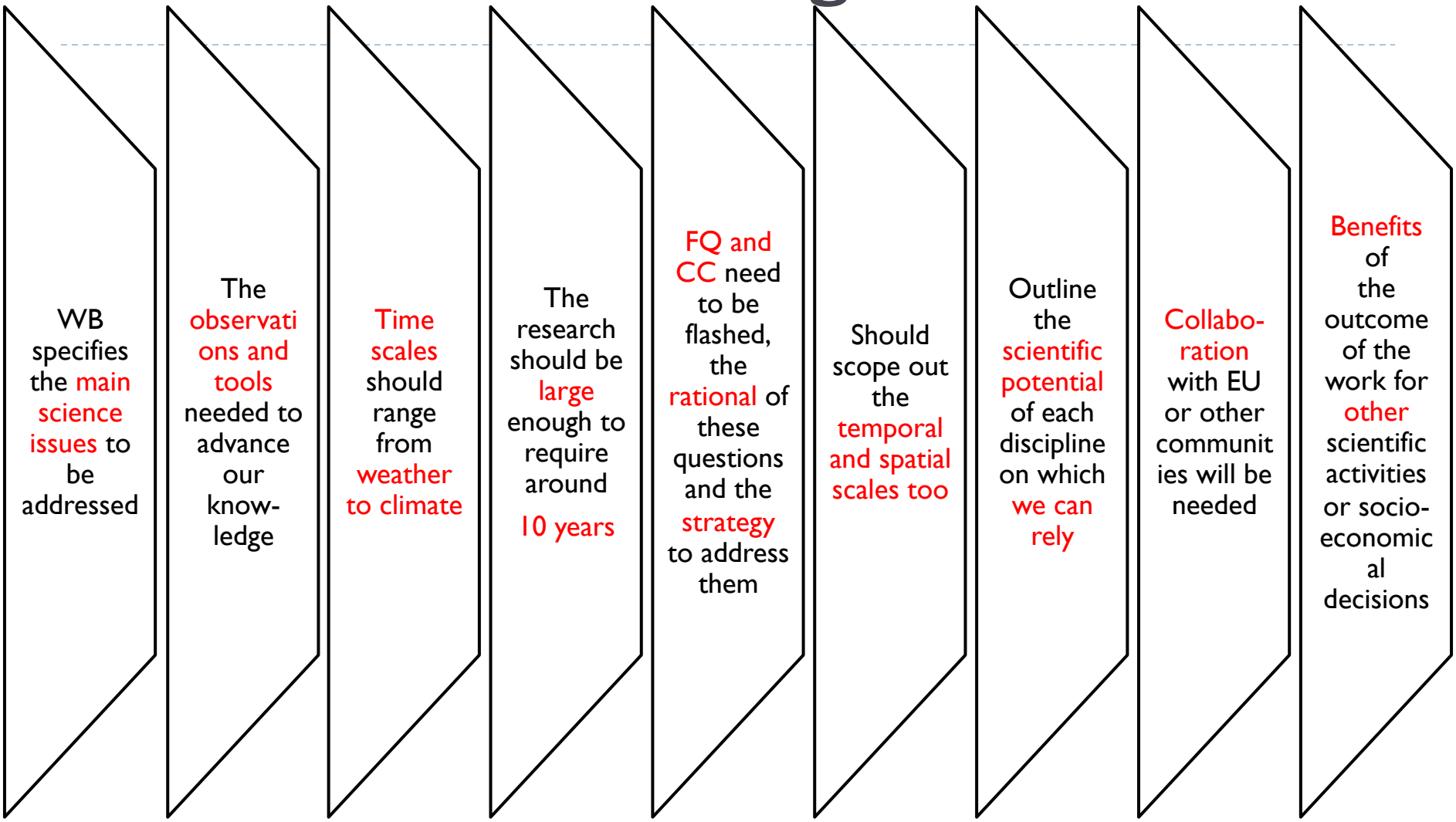
FQ5: Education, knowledge transfer and outreach

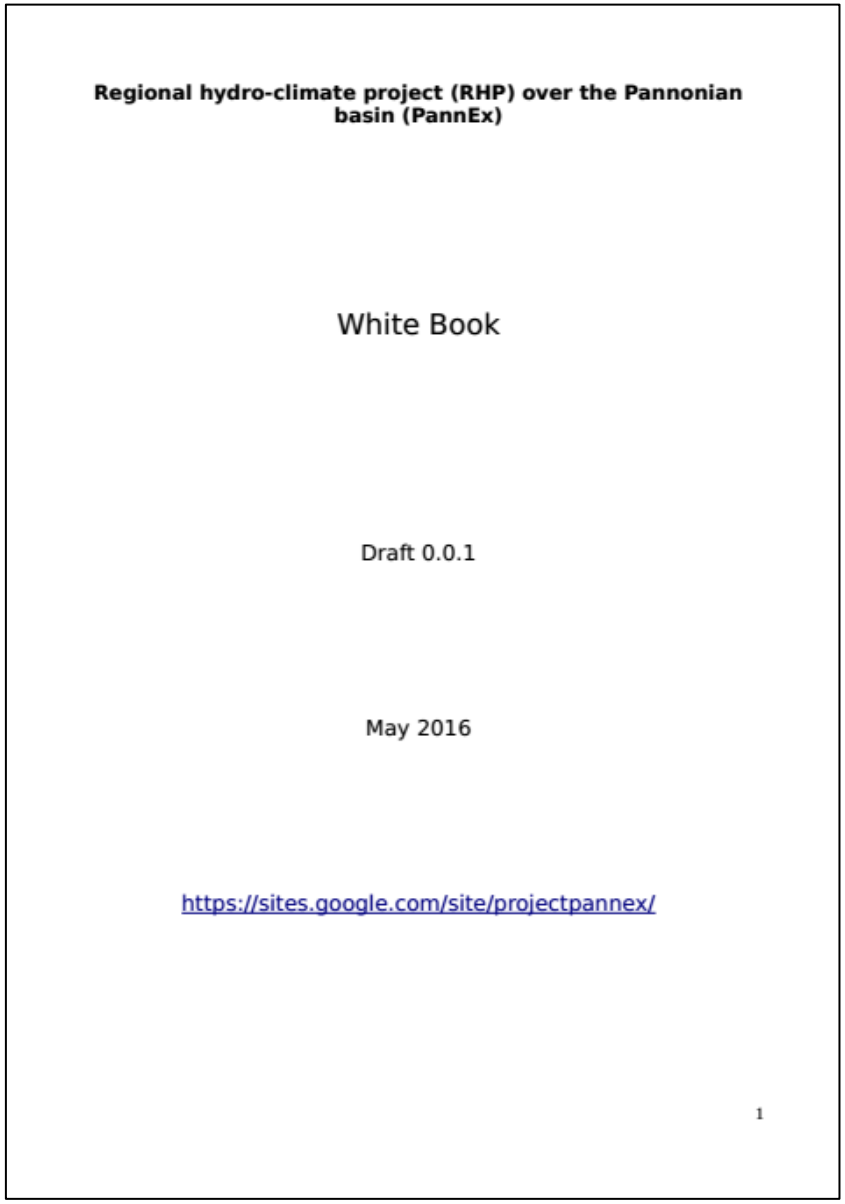
CC1: Data/ knowledge rescue and consolidation

CC2: Process modelling

CC3: Development and validation of modelling tools

Guidelines for drafting the PannEx WB





Regional hydro-climate project (RHP) over the Pannonian basin (PannEx)

White Book

Draft 0.0.1

May 2016

https://sites.google.com/site/projectpannex/

1

The suggested structure for each FQ and CC

- Background
- Knowledge gaps and relevance
- Potential activities
- Expected outcomes

Ver.0.0.1.

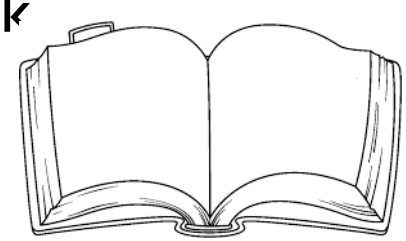
99 pages

was ready for the Budapest WS

Results of the 2nd Workshop

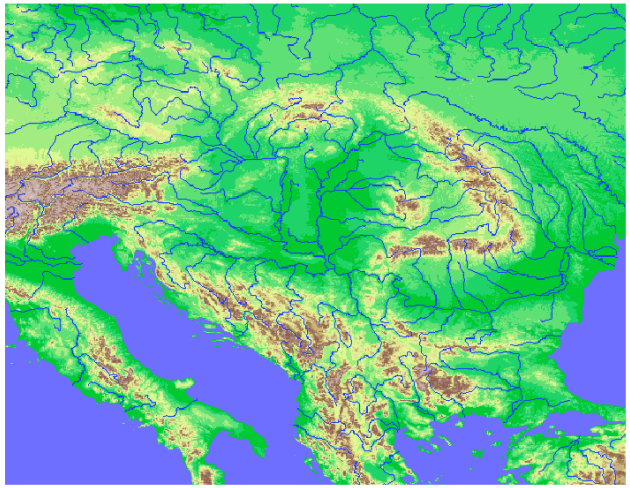
- Host: Hungarian Meteorological Service (OMSZ), ELU poster boards
- 70 attendees from institutions of the Pannonian Basin (countries of Hungary, Croatia, Romania, Serbia, Slovenia, Ukraine, Slovakia, Bosnia-Hercegovina and representatives of WCRP and AgMP)
- GEWEX support

- **The main objectives of the workshop were**:
- i) to consolidate and enlarge the PannEx community
- ii) to review and revise the draft of the White Book
- iii) to define further steps



Regional hydro-climate project (RHP) over the Pannonian basin (PannEx)

White Book



version: 0.0.7

September 2016

https://sites.google.com/site/projectpannex/

WB ver0.0.1 were opened for suggestions and comments

Ver0.0.7

76 pages,

~60 contributors

Open for discussion at GHP

FQ1: Adaptation of agronomic activities to weather and climate extremes

- Weather scale predictions of yields and plant phenology
- Response to climate change (farming practices, crop types, pests and diseases)
- Water management and irrigation
- Land and soil use changes
- Perception of agricultural stakeholders and evolution of European policies
- Preserving ecological services

FQ1: Adaptation of agronomic activities to weather and climate extremes

FQ1 chapter – group of writers - Coordinator: Danijel Jug (*status 2016-05-31*)			
Contributors	Field of expertise	Country	Contact
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Background

- Climate change strongly impacts the Pannonian Basin and it is one of the main factors affecting the entire agroecosystem, recognized also as an element which will have a significant weight on the form, scale and spatial and temporal impact on agricultural productivity

- Agricultural production is the sector most vulnerable to climate change and biodiversity due to direct dependence of the weather conditions

- Climate change affects agriculture:

directly – plant level: effects of increasing CO_2 at crop productivity and resource use efficiencies, effects of temperature, precipitation, radiation and humidity at crop development and growth and damages caused by extreme events like heat waves, floods and hail

indirectly – system level: changing suitability of different crops such as northward expansion of warm-season crops, changes in crop nutrition and occurrencies of weeds, pests and diseases and environmental pollution or degradation of the main resources

- Recent climate changes are showing raise of the temperature and more inconsistency in precipitation patterns in Pannonian basin region

Knowledge, gaps and relevance

- With regional differences agriculture is affected by ongoing climate change in the Pannonian region increasingly, for example:

- extreme weather events such as drought, dry winds, wet spells, intensive precipitation, frosts, heat and cold waves,
- soil salinization,
- decline of SOM (soil organic matter),
- better weeds response in growth and reproduction (compare to crops),
- decrease of crop growth and development because of higher air temperatures,
- increasing spatial and interannual yield variability due to extreme weather,
- annual rainfed summer crops with high water demand (e.g. sugar beet) are already disappearing in some regions by climatic reasons (where irrigation systems or water is not available or economic),
- potential increasing of soil erosion,
- change of pest and disease occurrence; pests are generally considered by farmers as the second important danger beside of drought,
- shortening of the cropping cycle, effecting field work timing.

Potential activities

- Define and implement adequate and effective measures to face climatic changes
- Precisely predict the time and place of a negative or positive impact of climate change on agriculture, as well as consequences for the crop and soil management
- Conduct certain activities to develop adaptable agricultural production which will affect other key elements of crop production:
  - plant nutrition,
  - soil quality,
  - irrigation,
  - plant breeding,
  - crop protection,
  - environmental considerations,
  - etc.
- Continuous implementation of field testing (of the most important agronomic traits of crops, such as yield and quality, in a series of comparative experiments on a number of locations along with the continuous monitoring of climatic conditions is an essential activity of future programs

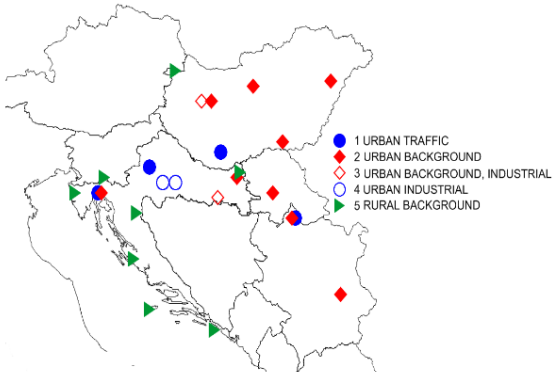
Expected outcomes

Some-of-many of positive effect and outcomes which derived from successful implemented know-how technics and technology:

- Creating starting point for further decision making strategies,
- Upgraded and improved understanding of the plant-soil-environment relation processes in light of adaptation and mitigation of climate changes,
- Improved or "updated" or new rules in crop/plant production which taking into account *specificum* of each agroecological region/conditions,
- Collecting and monitoring relevant data with the methods agreed among the countries of the Pannonian region, as a base for open-approach of collected data sets,
- Stronger interconnections of different science and research institutions/centers at national and especially at international levels, as a base for further actions,
- Stronger connections and bonding of science/scientists (knowledge, relevance, achievement) and farmers (implementation of…),
- Defined some stable networks and infrastructures for education processes according to relevance and specific problems/issues at national and international levels

FQ2: Understanding air quality under different weather and climate conditions

3.1 How does a warmer climate affect air quality and human health?
3.2 What kind of interactions do the soil, water and air have with agricultural practices?
3.3 Physics and chemistry of the surface and of the PBL; improving forecasts.
3.4 Refinement of emission inventories.
3.5 Perception of populations, urbanization



Stations for gridded PM_{10} emissions dataset (EMEP4HR)

FQ2: Understanding air quality under different weather and climate conditions

Stearing Group:

Tamás Weidinger	– Eötvös Loránd University, Budapest,
Györgyi Baranka	– Hungarian Meteorological Service, Hungary
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Inna Semenova	– Odessa State Environmental University, Ukraine
Sonja Vidic	– Meteorological and Hydrological Service, Croatia

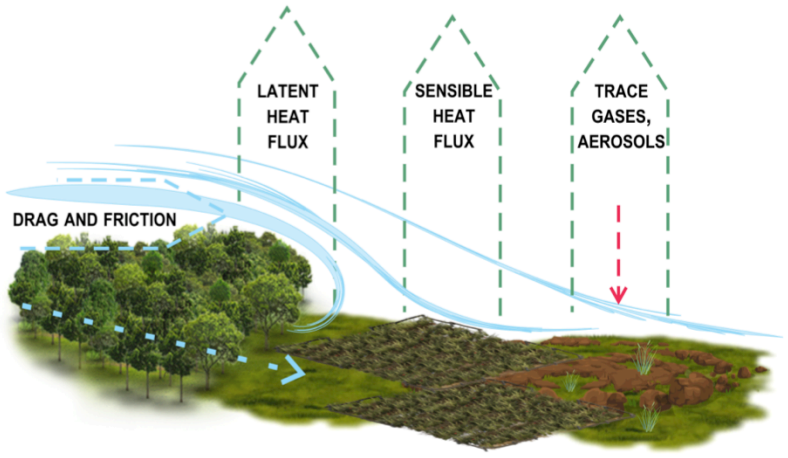
Hungarian Co-authors: Zita Ferenczi, Judit Kerényi, Krisztina Labancz, Dóra Lázár, Attila Machon, Balázs Szintai

1. Introduction and motivation

- Air quality is highly dependent on weather and therefore is sensitive to climate change.
- Globally the future climate is expected to be more stagnant, due to a weaker global circulation and a decreasing frequency of mid-latitude cyclones
- In order to understand and predict the variety of scale dependent atmospheric processes
- and climate system appropriate cooperation in
  - measurements,
  - developments of regional datasets and
  - Modelling (SVAT, weather, air pollution and RegC

2. Theoretical background

- Dynamical aspects
  - Circulation types, influences, weather situation
- Atmospheric chemistry and physics aspects
  - boundary layer, turbulence, parameterizations)
- Human effects, urbanisation, etc.



3.1 How does a warmer climate affect air quality and human health?

- Air pollutant and pollens transported over country borders – common activity to mitigate their harmful health effects.
- Spatial representativeness of monitoring sites, intercomparison of atmospheric chemistry measurements.
- Satellite imagery produced by EUMETSAT for Pannonian Basin.
- Monitoring the general condition of the land surface, soil and vegetation.
- Mapping of air pollutant concentrations and depositions over country borders is also essential.

3.2 What kind of interactions do the soil, water and air have with agricultural practices?

- exchange and interaction between the atmosphere, biosphere, hydrosphere and soil system.
- Ecosystem modelling of eutrophication and long-lived toxic elements (Pb, Cd etc.)
- Agronomical and hydrological aspects.

3.3 Physics and chemistry of the surface and of the PBL; improving forecasts.

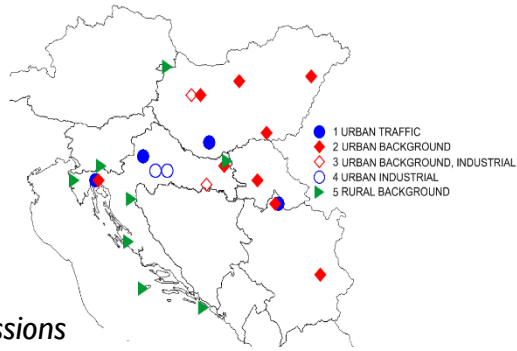
- Parametrization of physical processes and budget calculations.
- Improved measurement and modelling techniques.
- Scale dependent coupled meteorological/air pollution models, ensemble forecast

3.4 Refinement of emission inventories.

- Updated emission databases calculated by harmonized methods considering uncertainties of different emissions projections

3.5 Perception of populations, urbanization.

- Sharing best practice how to mitigate harmful effect of climate change in urban environment.



Stations for gridded PM_{10} emissions dataset (EMEP4HR)

PannEx – FQ3 Toward a sustainable development

Current drafting team: Vladimir Djurdjevic, Imelda Somodi, Ákos Bede-Fazekas, Wantuchné Dobi Ildikó, Birone Kircsi Andrea, Maja Telišman Prtenjak, Andreina Belušić, Alica Bajić, Kristian Horvath, Maja Božićević Vrhovčak, Tijana Nikolic, Sonja Trifunov

Subtopics:

1. Preserving ecological services
2. Hydropower potential evolution
3. Wind and solar energy potential
4. Biomass production and conflict with agronomic needs
5. Building the infrastructure for forecasting and coordination of the energy production
6. Evolution of the energy needs (cooling and heating) in a warmer climate

1. Preserving ecological services

Outcomes/Proposed activities:

- Provide essential information on weather and climate, air quality, hydrological and soil conditions that are needed relevant to ecological services and biodiversity in the region.
- Develop a common set of indicators that can be relevant for ecological services and biodiversity monitoring.
- Comprehensive analysis of potential impact of climate change on natural habitats in the Pannonian region.
- Explore possibilities for development of different nature-based mitigation strategies, which can help to improve eco-services but also to reduce future risks related to climate change
- Identification of areas vulnerable and identifying restoration priorities
- Understand the impact of past climate change and agriculture practices on hydrological cycle

2. Hydropower potential evolution

Outcomes/Proposed activities:

- Develop comprehensive and detail analysis of changes in different elements within hydrological cycle in region relevant to hydropower production
- Assess future changes in hydropower potential
- Estimate negative impacts on the riverine ecology and general impact on environment
- Assessment of impact from water temperatures increase on power plant cooling process

3. Wind and solar energy potential

Outcomes/Proposed activities:

- Develop comprehensive and detail analysis of wind and solar potential for power production in the region, based on wide spectrum of information from observed conditions in the past (*in situ observations*, gridded climatology, reanalysis, RCM hindcast) to the possible future changes using climate change scenarios.
- Estimate possible future risks related to the extreme weather and climate events (super-cell storms, hail, strong winter winds, floods, icing, heat waves and high temperatures etc.).
-Estimate potential negative impacts on the environment, especially in the case of not well-planed development (to avoid negative outcomes).
-Estimate of air-pollution reduction after closing fossil thermal power plants (PM, SOx, etc.,). Reduced emissions of pollutants, beside positive impact on human health, also have impact on radiation budget
-- Harmonization of high-resolution wind atlases in region

4. Biomass production and conflict with agronomic needs

Outcomes/Proposed activities:

- Understand extent and complexity of bio-energy's environmental overall impact in Pannonian region in the context of current production capacities and impacts of potential future climate change.

-Understand impact on water resources, since agriculture is the major source of nitrogen pollution of European water bodies, including lakes, rivers, ground water and the European seas.

- Understand impact on soil, since farming exposes soils to water and wind erosion, and can lead to soil compaction and salinisation if inappropriate farming practices are used.

5. Building the infrastructure for forecasting and coordination of the energy production

Outcomes/Proposed activities:

- Proposal for observational network upgrade and optimization, especially because of possible improvements in assimilation cycles for short range forecast for wind and solar.

-Development of inter-institutional multi-model ensemble prediction products specially developed for renewable power sectors needs.

-Experiments with super hi-resolution (~1 km) non-hydrostatic models over areas with dense wind farms facilities.

-Development of seamless prediction forecast products from days to seasons relevant for hydro power production and agricultural activities related to the biomass production.

- Specially designed experiments/case studies related to the improvement of different physical parameterization (e.g. surface turbulence for wind, radiation for solar, surface hydrology for hydro) relevant for solar/wind/ hydro power production.

6. Evolution of the energy needs (cooling and heating) in a warmer climate

Outcomes/Proposed activities:

- Assessment of current trends in heating/cooling demands, and their relation to observed trends in temperature and other relevant parameters.

-Assessment of cooling demands during extremely high temperatures and prolonged heat waves in the past (e.g. heat wave during July 2007), in residential and service sectors, with estimate of possible excessive pressure on energy production system.

-Assessment on changes in heating/cooling demand in the future following different climate change scenarios, together with demand on energy production, or redistribution of energy production during the year.

- Proposal to upgrade relevant metrics to monitor cooling and heating needs (currently Heating and Cooling degree days common in use)

FQ4: water management droughts and floods

- Evolution of precipitation and temperature (weather) extremes and risk assessment
- Understanding the water cycle of the Pannonian basin (hydrological perspective)
- Hydrometeorological forecasting and early warning systems
- Anthropogenic influence (dams, reservoirs...) on the hydrological cycle
- Regulation of Danube and tributaries: management of floodplains

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Evolution of precipitation and temperature (weather) extremes and risk assessment

Potential activities:

Sub-daily scale examinations for understanding the regional precipitation extremes and changes on different time scales which are relevant for the societies.

Survey and developments of definitions and methodologies for calculating extreme weather and climate events, such as heat waves and cold waves have to reflect on the final application (such as agricultural, hydrological, or risk management; or for weather and climate monitoring purposes and early warning systems and climate watches).

Identification of more complex extreme indices considering duration, intensity and persistence of the extreme events is needed.

The identification of regional extremes that influence wider region, even the whole territory of the Danube catchment could support the risk assessments.

Understanding the water cycle of the Pannonian basin (hydrological perspective)

Potential activities:

The review of water balance modeling made in past, namely the presentation, comparison and evaluation of method used in water balance modeling. To choose a uniform method is proposed for the calculation of catchments scale evaporation

Drought

Knowledge gaps and relevance: Drought monitoring and forecasting remains on the agenda – if not purely due to academic challenge, also due to constant requirements from the users. For this reason, despite doubts on practical and even theoretical possibilities, **long term drought forecasting** remains as one of important tasks and challenges. On the other hand – following requirement that **drought monitoring systems should be more connected to drought impacts – more emphasis should be put to remote sensing**.

Drought/potential activities

Questions to be addressed: how well have the current weather forecast systems done in predicting recent droughts over various timescale?

are there any postprocessing/downscaling/other methods and techniques for forecasting droughts?

Is there potential (in our region) for remote sensing data to improve drought forecasting? Or measurements and modeling of soil moisture that has potential to improve drought forecasts?

To do:

The identification of measures used for management of water shortage and floods problems in the past differently for regions and watersheds

The evaluation of effectiveness and cost-benefit analysis of the used measures in the flood and water shortage management

The evaluation of new aspects and conditions in the development of future strategy of water management

Anthropogenic influence (dams, reservoirs…) on the hydrological cycle

Potential activities:

Developing method to separate the antropogenic and non-antropogenic effects, including the climatic effects in the changing hydrological regime

– Assessing the possibilities of the use of hydrological system-wide modelling for detection of change in hydrological regime

– The extension of study results to non studied catchments and rivers inside of Pannonian Basin

– The evaluation of the effects of change in hydrological cycle and hydrological regime, particularly on the existing ecosystems.

FQ5. Education, knowledge transfer and outreach

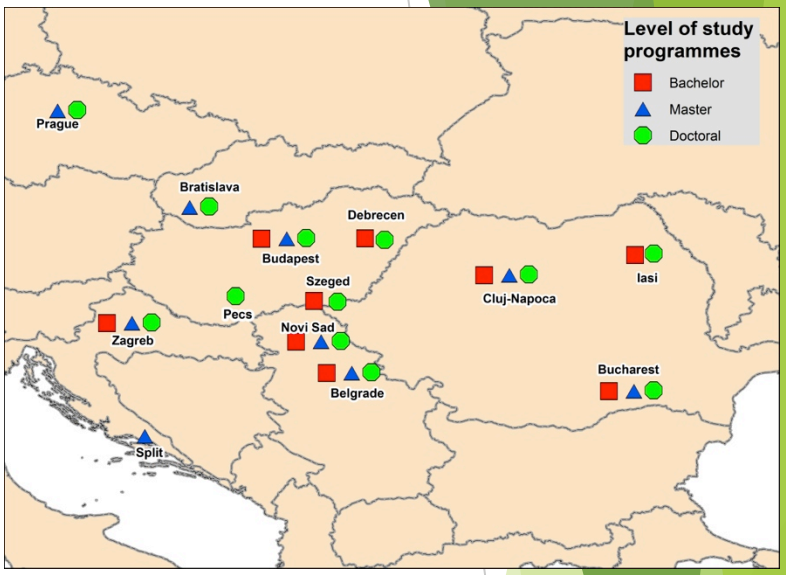
- 5.1.1. Status of Higher education in Meteorology and Hydrology in PannEx countries
- 5.1.2. Development of higher education in Meteorology and Hydrology under the framework of PANNEX project
- 5.2. Knowledge transfer
- 5.3. Outreach

Coordinator: Adina-Eliza Croitoru
Contributions: Adina-Eliza Croitoru, Ivan Guttler, Vladimir Djurdjevic, Rita Pongracz, Martina Zelenakova, Livia Labudova, Jeffrey Wilson, Janos Unger, Valeriya Ovcharuk

3. Higher education in meteorology and climatology in PannEx region: present status

- A quick overview has been done until now for six countries in the region:
  - Croatia*
  - Czech Republic
  - Hungary
  - Romania
  - Serbia
  - Slovakia

  * Countries are listed in alphabetical order.



- Twelve universities provide higher education in Meteorology, at different levels (Bachelor, Master, and Doctoral study programs) in the PannEx area:
  - two in Croatia: University of Zagreb and University of Split;
  - one in Czech Republic: Charles University in Prague;
  - three in Hungary: Eötvös Loránd University, University of Debrecen, and University of Szeged;
  - three in Romania: University of Bucharest, Babes-Bolyai University of Cluj-Napoca, and Al. I. Cuza University of Iasi;
  - two in Serbia: University of Belgrade and University of Novi Sad;
  - one in Slovakia: Comenius University in Bratislava.

Domain where higher education in Meteorology is affiliated

5. Development of higher education in meteorology under the framework of PannEx project

Cooperation between universities in order to harmonize the study programs at different levels can be developed under the framework of PannEx program.

Actions to be done:

- Harmonization of the study programs at all levels (Bachelor, Master and PhD.) in participating countries according to the WMO - No. 1083 (*Manual on the Implementation of Education and Training Standards in Meteorology and Hydrology. Volume I - Meteorology*) and national regulations ;
- Establishing protocols for organizing exchanges of professors among the universities in PannEx area;
- Establishing protocols for organizing exchanges of MSc. and PhD. students among the universities in PannEx area.

2. Development of higher education in meteorology under the framework of PannEx project

Actions to be done:

- Organizing two PhD. "schools" per year: e.g. one virtual, on modelling and theoretical topics, and one by personal presence, on observational techniques organized as a "summer school" by one of the universities of countries participating in the project;
- Encouraging students to choose PhD. and MSc. dissertations on topics similar to those of PannEx project and/or
- Involving students in research activities;
- Organizing one training school per year for employees in Meteorology and Hydrology services by universities in cooperation with NMHSs in the PannEx countries;
- Due to low number of students for each study program in meteorology, in some cases, we need lobby to maintain them, as usually the universities and Ministries of Education considers them as financially unsustainable.
- Developing protocols for hiring procedures in Met Services at national level, by considering WMO recommendations.

Knowledge transfer

Knowledge transfer will be focused in few directions:

- From professor to young generations of students (BSc, MSc. and PhD students);
- From researchers in other regions of Europe or of the world (where similar projects were or are under development) to PannEx countries researchers;
- From PannEx researchers to stakeholders in the PannEx region
- From stakeholders to researchers in PannEx in order to identify new directions to be studied so can improve the community needs for scientific based information (e.g. in workshops we can organize a session for stakeholders) ;
- Defining early on protocols on how to share data and algorithms related to PannEx activities (we should stress open-data and open-code approach)
- Defining metadata for our modeling and observational products
- Developing a platform for data upload-download

Outreach

to scientific community

- Organizing special issues in national and international journals once per year on various topics and subtopics: Quatenary International, Idojaras, Geographia Technica, Riscuri si catastrofe, Geofizika, Hrvatski meteorološki časopis etc.
- Organizing PannEx sessions in high visibility international conferences (e.g. EGU and EMS);
- Organizing PannEx sessions in regional conferences (e.g. Air and Water – Components of the Environment);
- Contributing in various ways to GEWEX and WCRP visibility in all our activities.

Outreach to public authorities and decision makers

- Delivering *Special Reports* to the public authorities at local/regional/national level focusing the main results of the research activities in the project in the field of agriculture, health, atmosphere protection etc

Outreach to large community

- Organizing active project webpage on social media (e.g. Facebook, Twitter, Google+ profiles): new content added periodically
- Preparing and releasing *Newsletters* to community (to be delivered 2 or 3 three times per year in the media)
- Inviting media to PannEx workshops
- Organizing press conference during PannEx meeting events

The 3 cross cut subjects reflect to the GEWEX science questions:

- 1. Observations and Predictions of Precipitation
- 2. Global Water Resource Systems
- 3. Changes in Extremes
- 4. Water and Energy Cycles and Processes

CC1: Data/knowledge rescue and consolidation

Meteorological, hydrological, agronomical, economical etc. data

Meteorological observations: The operational observational network is working well at basin scale. The **strict national data policy** often blocks international data exchange.

- **CarpatClim** leader: Hungarian Met. Service
- Homogenized, harmonized, gridded
- unified methods: MASH-MISH
- 1961–2010, daily, ~10 km res
- 13 ECVs, 37 drought indices and climate indicators
- **DanubeClim**

Regional climate model projections

Lots of regional climate model projections are conducted and still ongoing in the EURO-CORDEX and MED-CORDEX initiative.

CC1 knowledge gaps and potential activities

- Get more precise info on the national networks and each country's singular structures, weaknesses and strengths of the networks
- Build a metadata catalog for observations
- Assessing data availability (meteorological, hydrological, satellite, etc.)
- Internal agreement on data usage in the PannEx community
- Selecting areas with good data series for pilot studies
- Collecting publications of recent projects and existing methods related to water cycle in the region

CC2: Process modelling (I): Definition

Purpose: An adequate treatment of the basic mechanisms intervening transversally in all Flagship Questions.

Methodology: Challenge the present schemes in models using observational data obtained in the region and try to improve them if possible.

Actors: Combined efforts of Meteorological and Hydrological Services, Universities and Research Centers.

Data: Use available data bases and generate new specific data sets for well identified key questions.

CC2: Process modelling : Processes

i) Quantifying surface energy and water budgets: needs good data/representation of radiation, precipitation, atmospheric-boundary layer turbulent fluxes and soil measurements.

ii) Atmospheric chemistry: identify anthropic and natural sources of compounds and understand their chemical and physical evolution in air and precipitation.

iii) land-surface interactions: measure with detail the upper layers of the soil and its interactions with the atmospheric surface layer, including biological and agronomic processes.

iv) precipitating systems: characterize precipitation events due to frontal passages or to convective systems, and inspect the evolution of the regimes at several time scales.

v) crop modelling; evaluate crop reaction to changing climate conditions and inspect alternatives.

vi) hydrological modelling: measure and model river flow, basin-scale ET, surface and underground runoff and assess on the impact of new dams or irrigation channels.

CC3: Development and validation of modelling tools

Potential activities

4-a) convective-permitting (~1-3km) RCM simulations over Pannonian Basin.

4-b) evaluation of NWP and RCM models using specific observations produced by PannEx.

4-c) development of the seamless prediction system over the PB.

4-e) development and evaluation of RCM (and NWP) models with online and offline coupling with crop, hydrological, air chemistry and dynamic vegetation models.

4-f) the use (and contribution to development) of OpenIFS and its evaluation over PB

4-g) all modeling activities may be jointly organized as a special ECMWF research projects where specific disk and CPU time quota can be acquired.

4-e) climateprediction.net-type of experiments over the PB

CC3: Development and validation of modelling tools

Expected outcomes

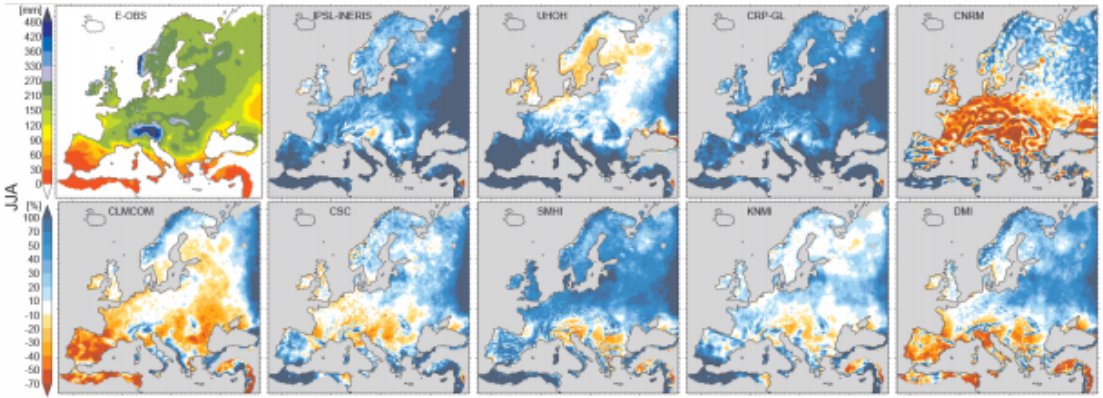
5-a) Reduction of model systematic errors (from weather to climate models) over the PB.For example, most RCMs still have dry bias during summer over PB.

5-b) Description of the uncertainties of weather to climate prediction systems on all time-scales over the PB

5-c) Active contribution of PannEx-CC3 researchers to WCRP/ CORDEX

5-d) Active contribution of PannEx-CC3 researchers to WCRP/ GEWEX

5-e) Active contribution of PannEx-CC3 researchers to other PannEx-CCs and PannEx-FQs



From Fig. 3 in Kotlarski et al. (2014)

Next WS in Romania, Cluj-Napoca, 20-22 March, 2017

Science Plan – main aim of the next WS

- Science Plan will be developed based on the White Book afterwards
- PannEx community needs to work on defining the objectives and the methodologies which could be used to reach the goals
- and what type of observation (geophysical, ecological, economical, social, ...) and modelling efforts need to be undertaken

Potential funding in the region

- *Horizon2020*
- Interreg, **Danube Transnational Programme 2014-2020**
- **Balkan-Mediterranean Transnational Programme** (2014-2020)
- ***COST* (cost.eu)**
- *The International Visegrad Fund* (visegradfund.org/home/)
- *The NATO Science for Peace and Security Programme* (nato.int/cps/en/natolive/78209.htm)
- CEEPUS (Central European Exchange Program for University Studies, ceepus.info/default.aspx#nbb)
- Bilateral calls

Recent bilateral calls responded by the PannEx community

- **Hungarian-Croatian** and **Hungarian-Serbian** cooperation were launched
- **Two submissions** from the PannEx community (with ELU, Budapest, Hungary)
- to **strengthen the cooperation** in PannEx (travel expenses and the daily allowance for the visits)

National PannEx Seminars in Hungary

- 25 October 2016: Land Degradation Neutrality (talk from UNCCD: The LDN Programme) – FQ1, FQ3 and CC2
- 17 November 2016: Adaptation of agronomic activities to weather and climate extremes (José Camacho, AgMP, WMO) – FQ1

Thank you for your kind attention!