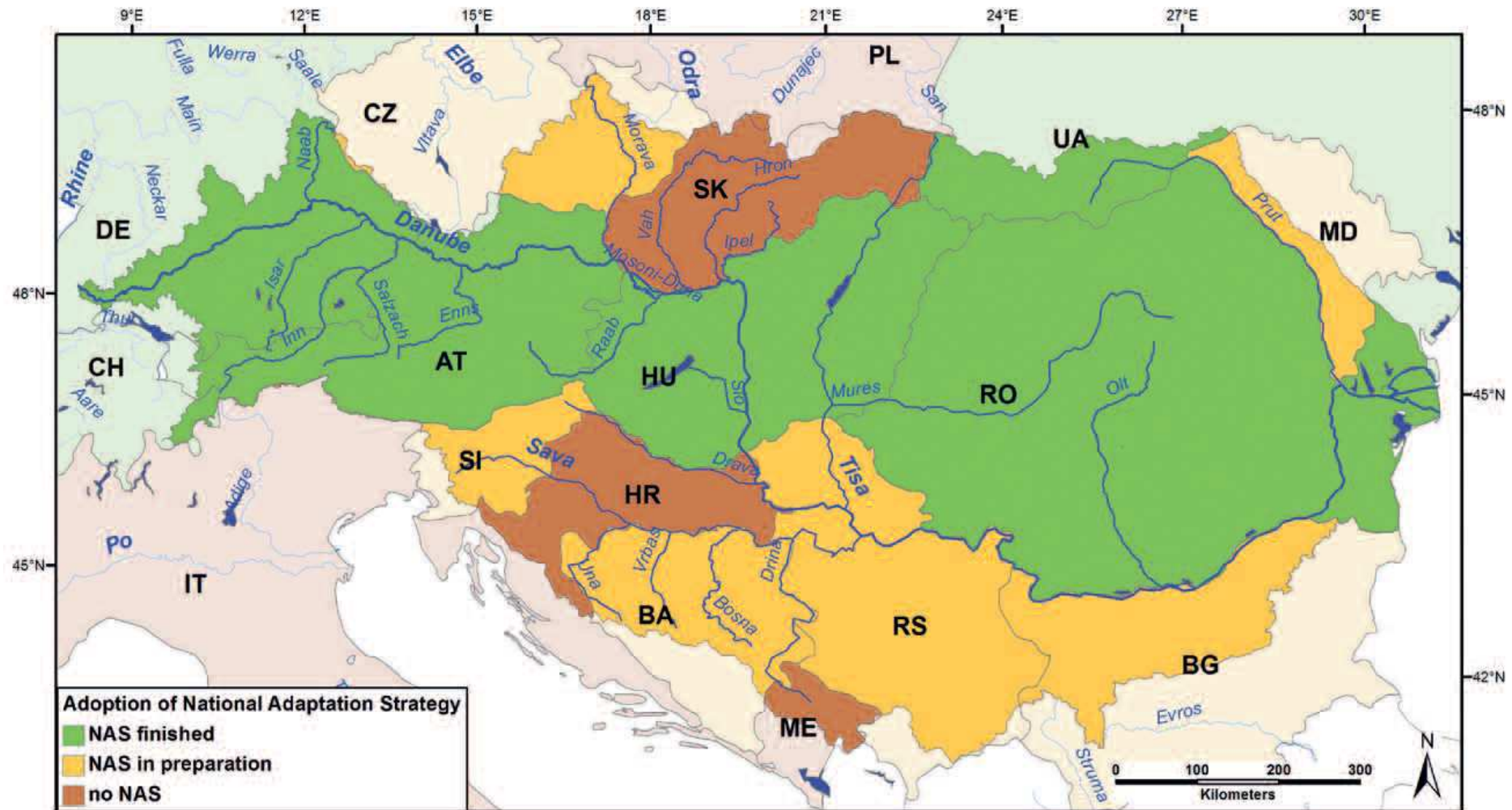


Cooperations on climate change in the Carpathian region

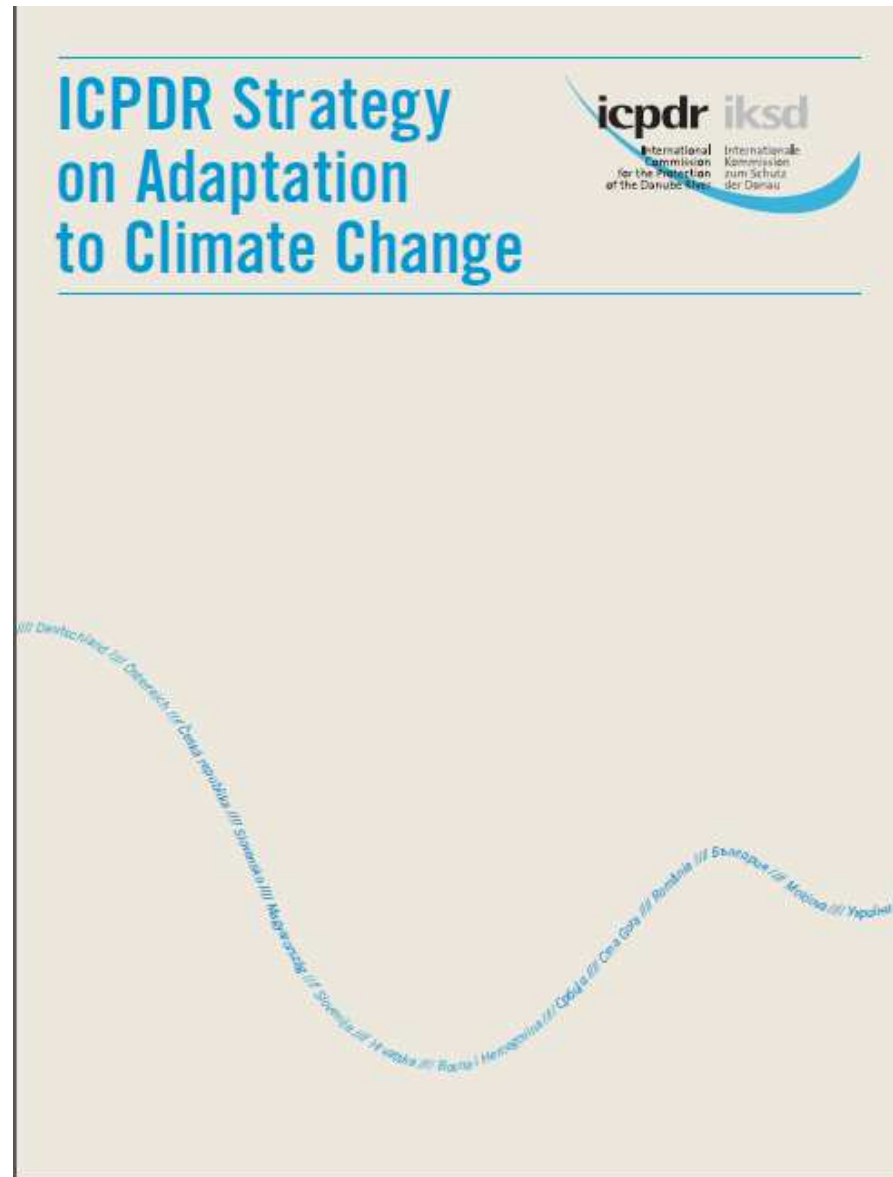
Sandor Szalai

szalai.sandor@mkk.szie.hu

National adaptation strategies in the region (DAS, 2012)

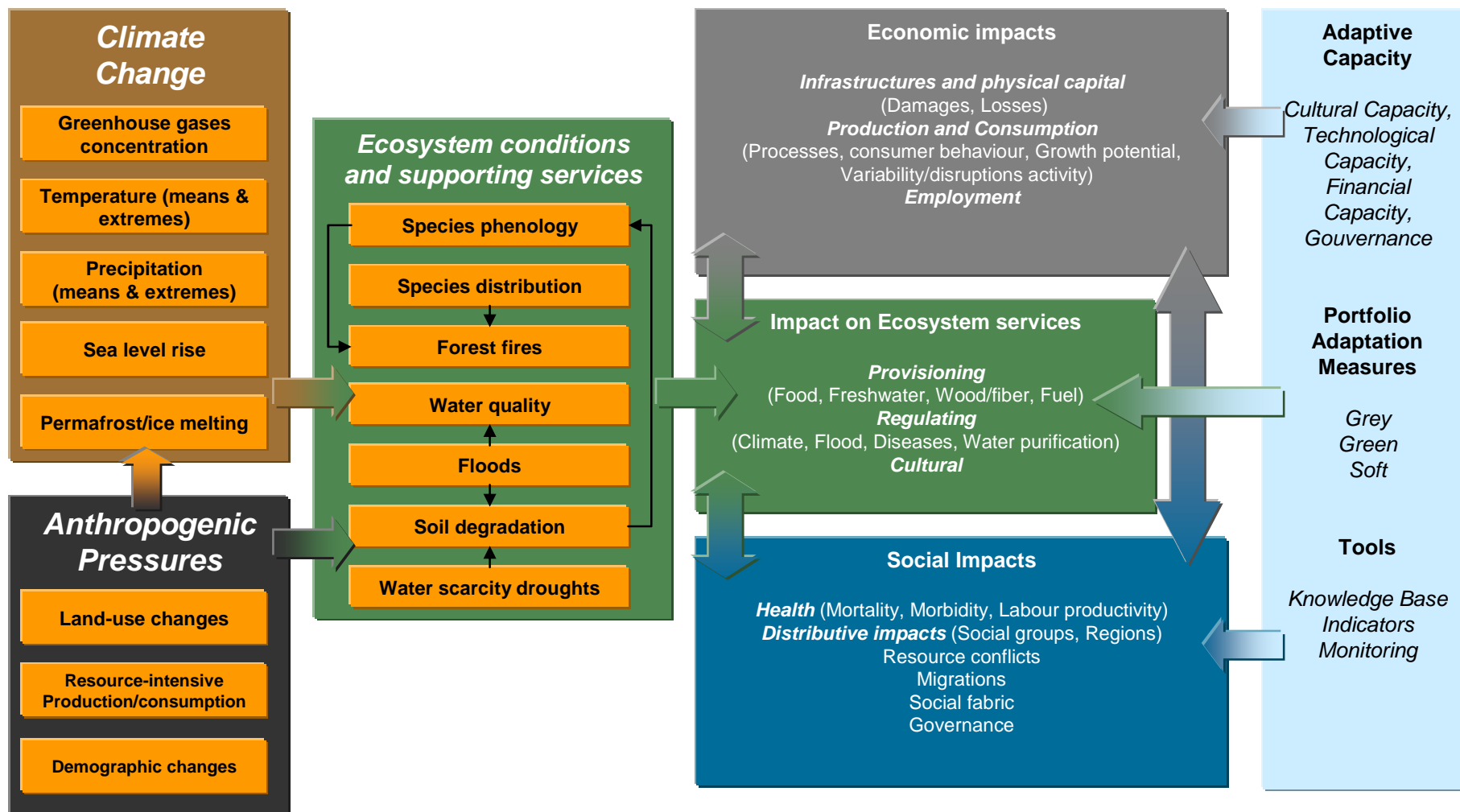


Danube Adaptation Strategy (ICPDR, 2012)



Environmental pathway of vulnerability and adaptation

Jacques Delsalle, Evdokia Achilleos, DG Environment, Unit D1 – Protection of Water Resources



Preparatory actions

- Three projects:
 - Climate of the Carpathian region
 - Integrated assessment of vulnerability of environmental resources and ecosystem-based adaptation measures (Service contract CARPIVIA)
 - In-depth assessment of vulnerability of environmental resources and ecosystem-based adaptation measures (Framework contract CarpathCC)

CARPATCLIM results

- High-resolution (10 km*10 km) freely available databases
- Data availability on monthly and daily level
- Time frame: 1961-2010
- www.carpatclim-eu.org

Territory of the project

- For the production of the digital climate atlas, the resulting climatological grids should cover the area between latitudes 50°N and 44°N , and longitudes 17°E and 27°E , approximately.

Countries of the Carpathian Region

Country	Area in sq. km
Croatia	14 662,66
Czech Rep.	17 570,58
Hungary	86 996,47
Poland	19 794,32
Serbia	45 015,09
Slovakia	48 520,49
Bulgaria	1 208,63
Moldova	437,90
Romania	184 434,63
Ukraine	71 530,71

Philosophy of CARPATCLIM

- No common database of raw data
- Each country provide the same work (hope for the availability of most possible data)
- Common softwares
- National and international consistency
- Near border data exchange (minimum number of data exchanged on equal basis)

Participants

- Leading organisation: Hungarian Meteorological Service

- Participants:

(Hydro)meteorological institutes and services of Austria, Croatia, Czech Republic, Poland, Serbia, Slovakia, Ukraine

National Research and Development Institute of Environmental Protection of Romania

Szent Istvan University from Hungary

Structure

- Module 1: Data rescue, quality control, and data homogenisation by the use of MASH. (Leader: SHMU)
- Module 2: Data harmonisation and gridded datasets by the use of MISH. (Leader: OMSZ)
- Module 3: Climate Atlas, publicly accessible dedicated web site, gridded climatological datasets and searchable metadata catalogue (Leader: RHMSS)

Data rescue

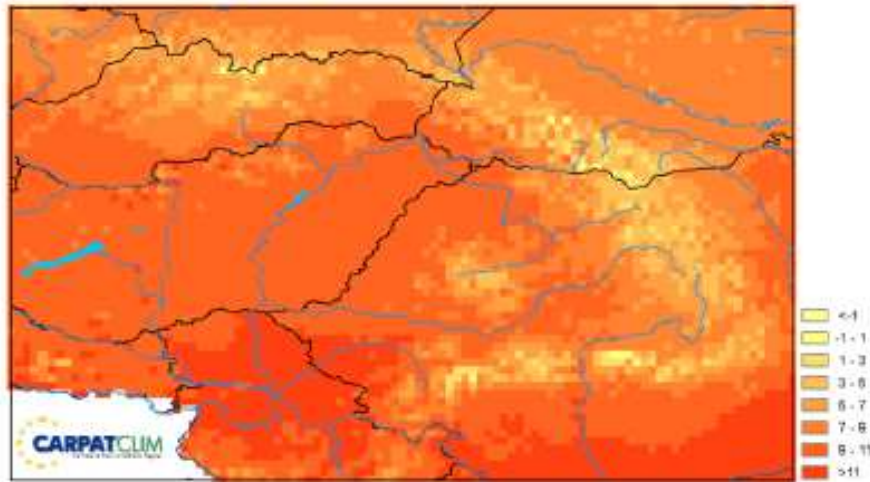
Country	Nb. of digitalized dat
Croatia	0
Czech Republic	0
Hungary	1 303050
Poland	389455
Romania	1525700
Serbia	107100
Slovakia	394200
Ukraine	9 964 500

Set of meteorological variables in daily temporal resolution to be provided

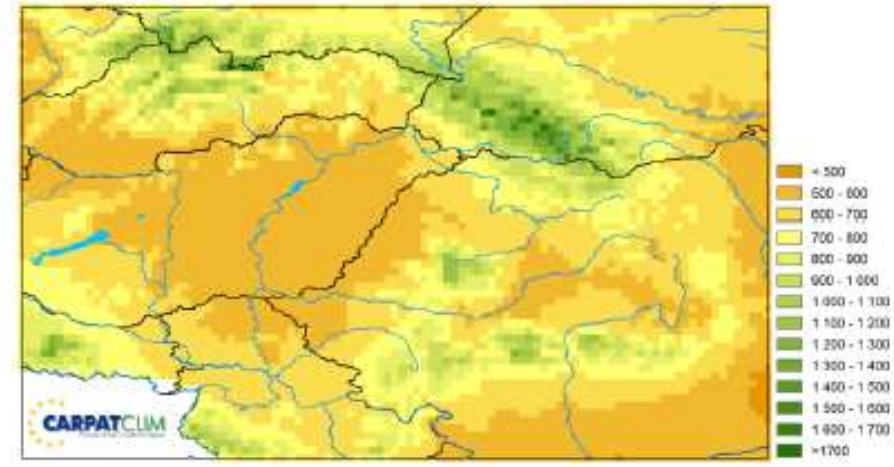
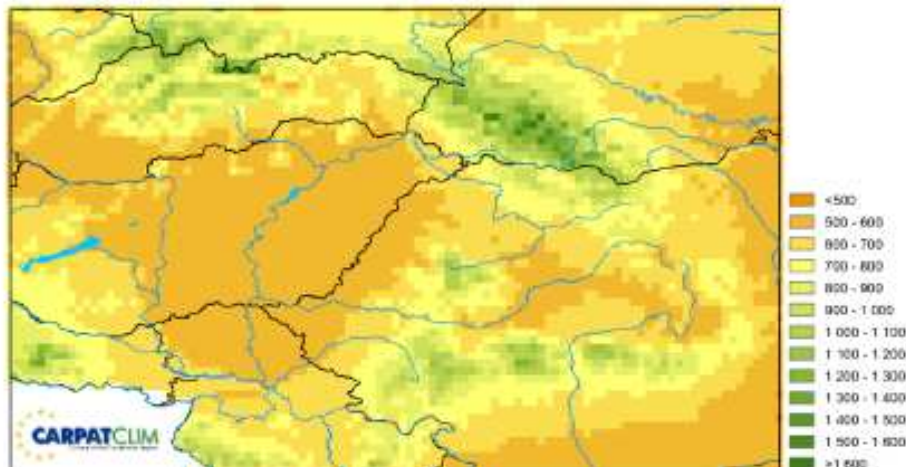
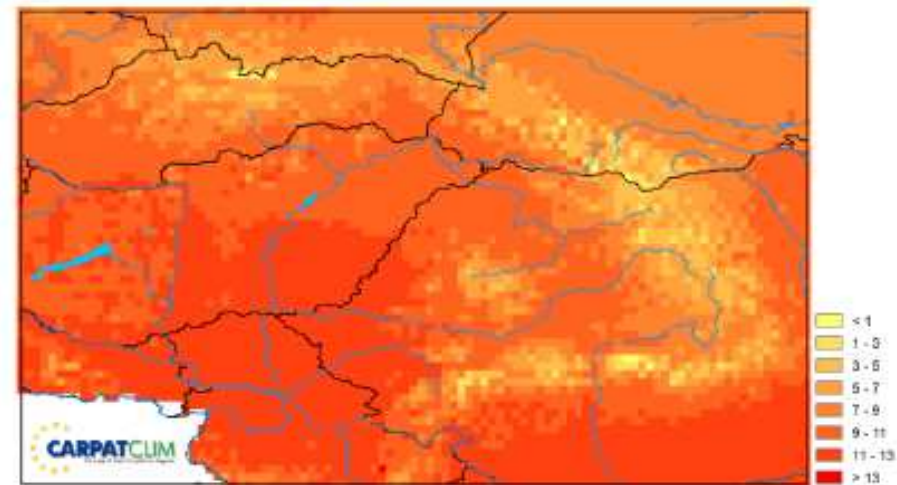
Acronym	Variable	Unit	Measured	Homogenized	From	Analyzed
CC	Cloud Cover	<i>tenths</i>	x	x		x
PA	Surface Air Pressure	<i>mbar</i>	x	x		x
RH	Relative Humidity	%	x	x		x
VP	Surface Vapour Pressure	<i>hPa</i>		x	TN, TX, RH	
RR	Precipitation	<i>mm</i>	x	x		x
SS	Sunshine Duration	<i>hrs</i>	x	x		
RS	Relative Sunshine Duration	-			SS	x
GR	Global Radiation	<i>MJ/m²</i>		x	SS	
TN	Minimum Temperature	°C	x	x		x
TM	Mean Temperature	°C			TN, TX	x
TX	Maximum Temperature	°C	x	x		x
DTR	Temperature Range	°C			TN, TX	x
WS10m	Wind Speed at 10 m	<i>m/s</i>	x	x		
WS2m	Wind Speed at 2 m	<i>m/s</i>			WS10m	x
WDu,v	Wind Direction(s)	<i>deg</i>	x	x		
WG	Wind Gust	<i>m/s</i>	x	x		
SD	Snow Depth	<i>cm</i>	(x)		model	
SW	Snow Water Equivalent	<i>cm</i>	(x)		model	

Temperature and precipitation averages

1961-90



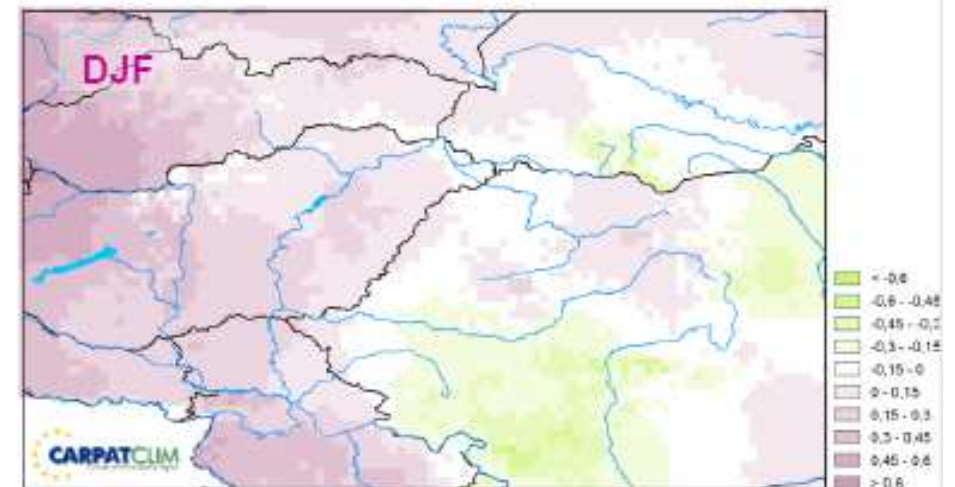
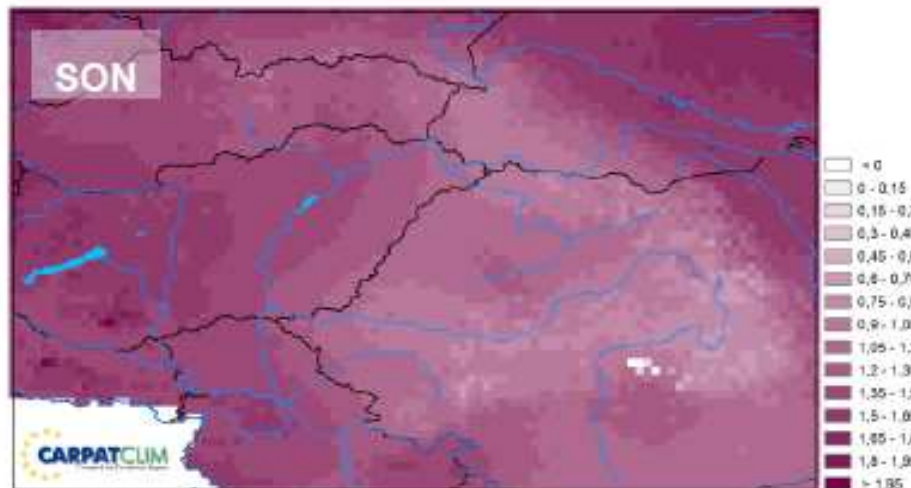
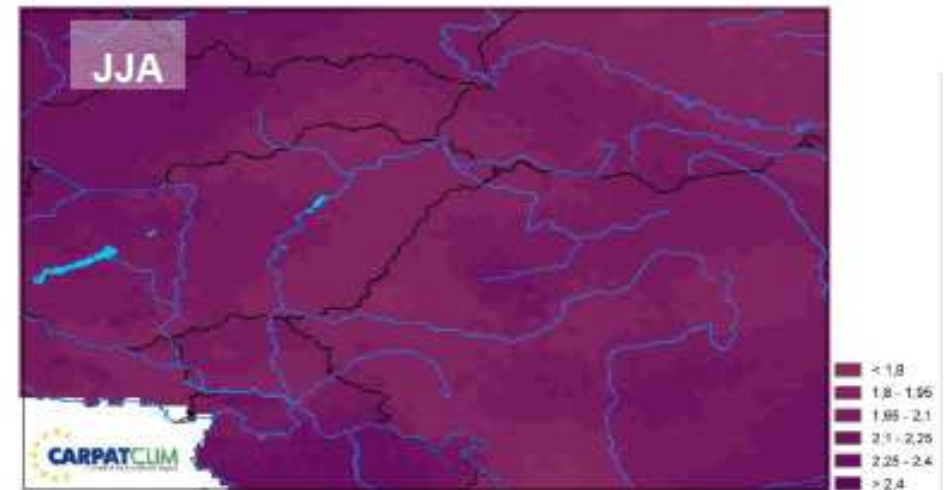
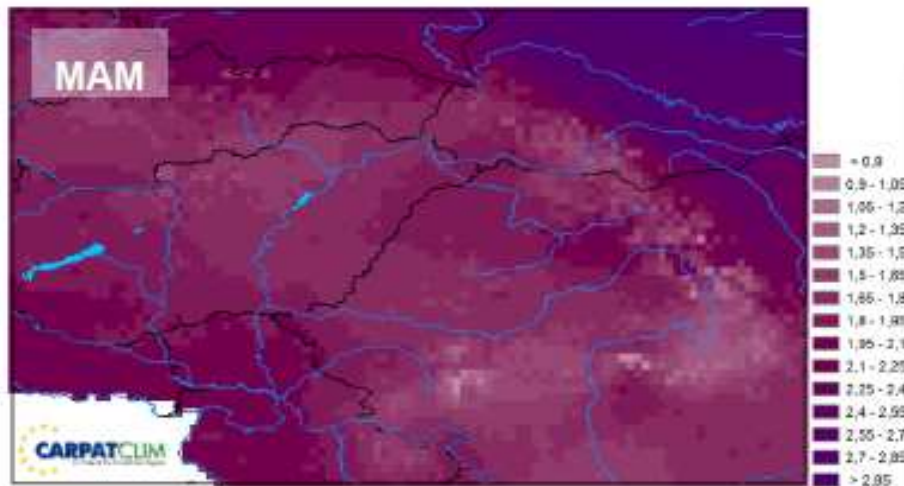
1981-2010



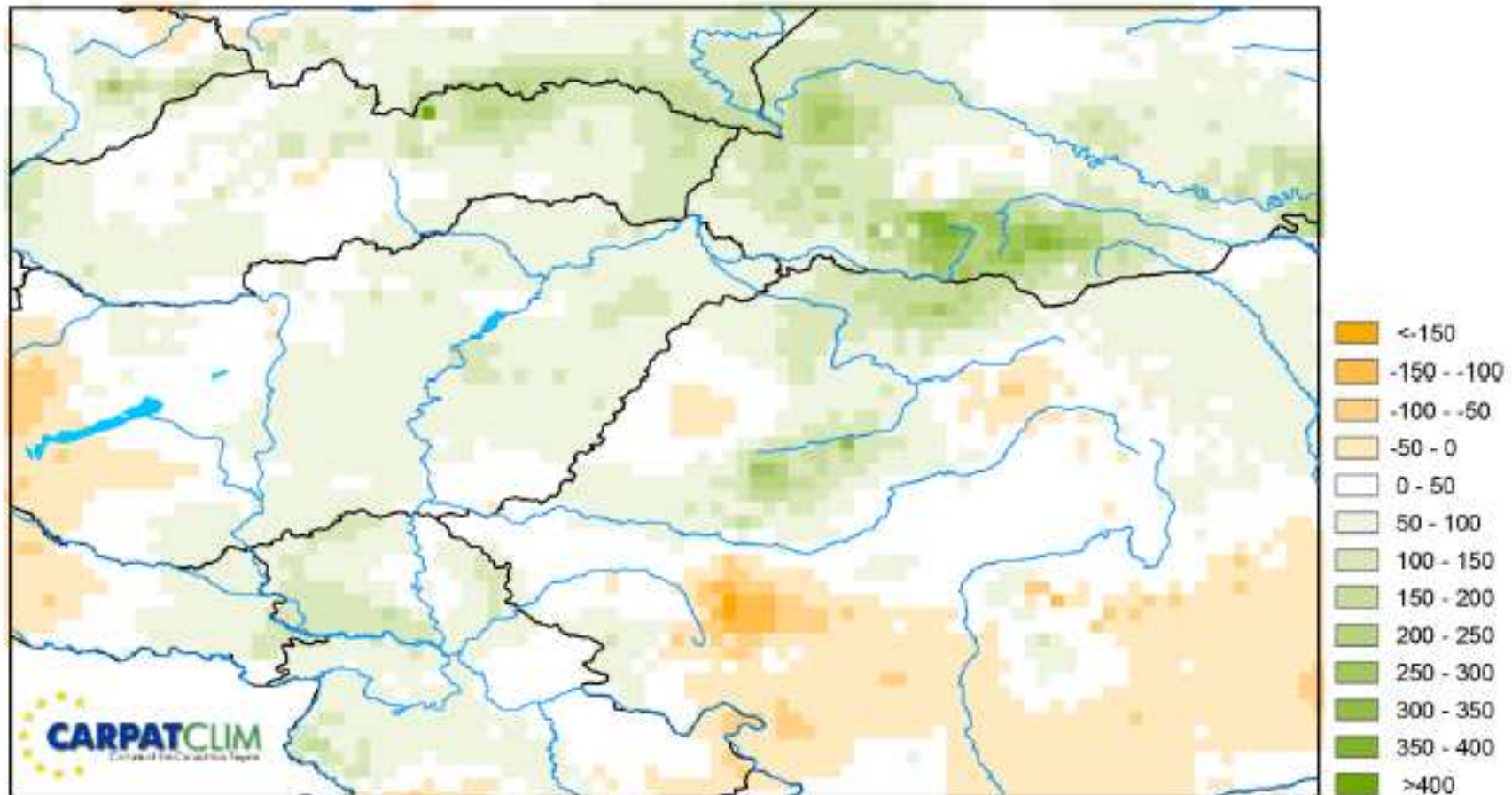
(Lakatos et al., 2013)

Seasonal temperature changes, 1961-20

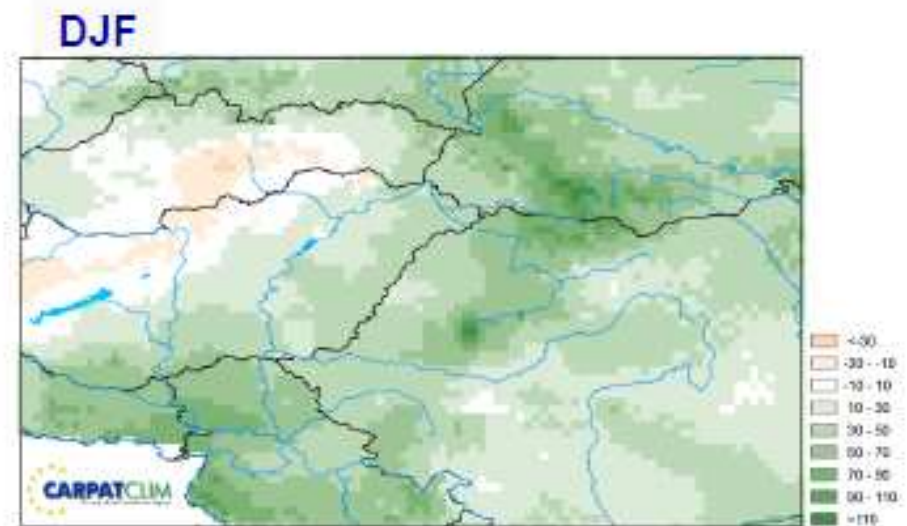
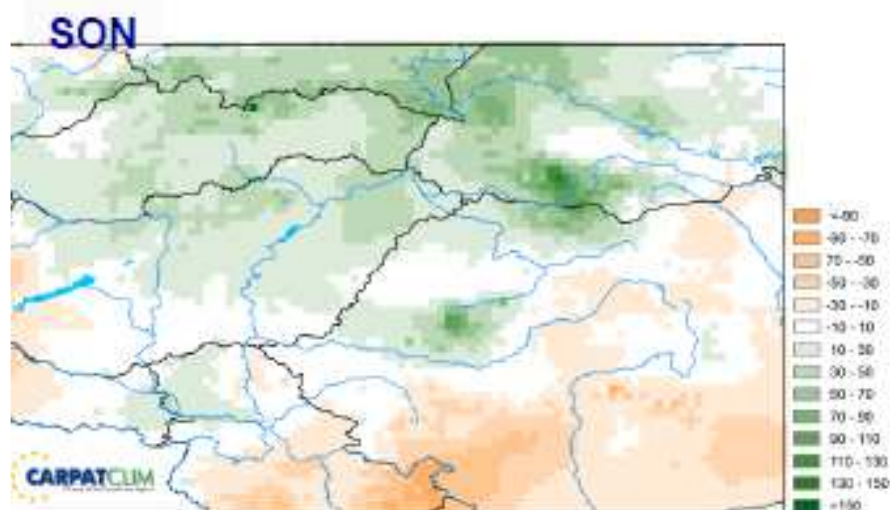
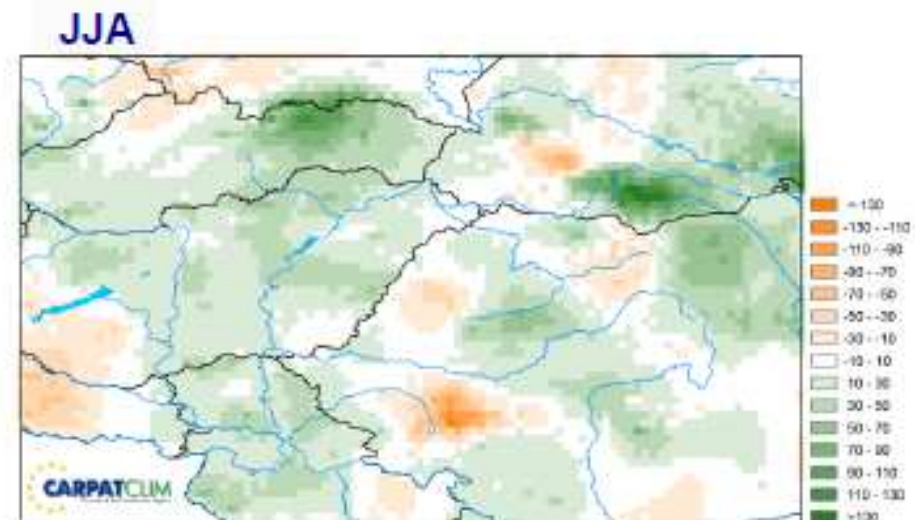
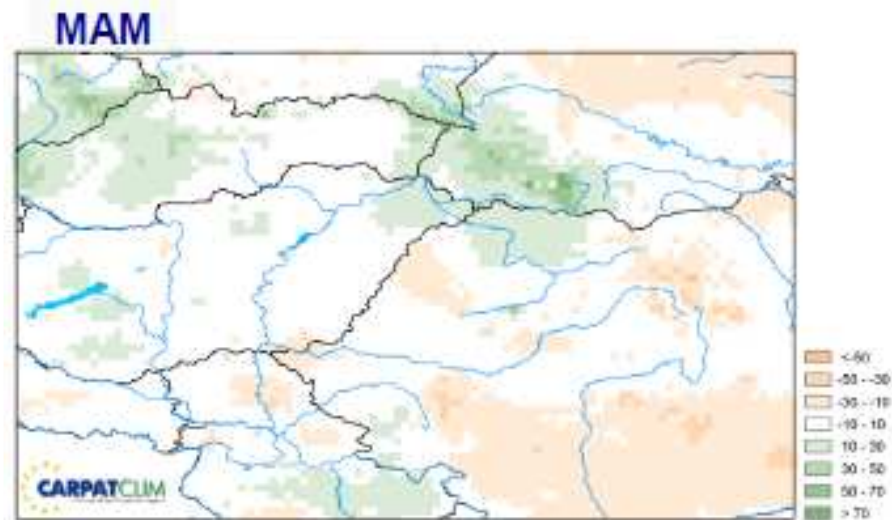
(Lakatos et al., 2013)



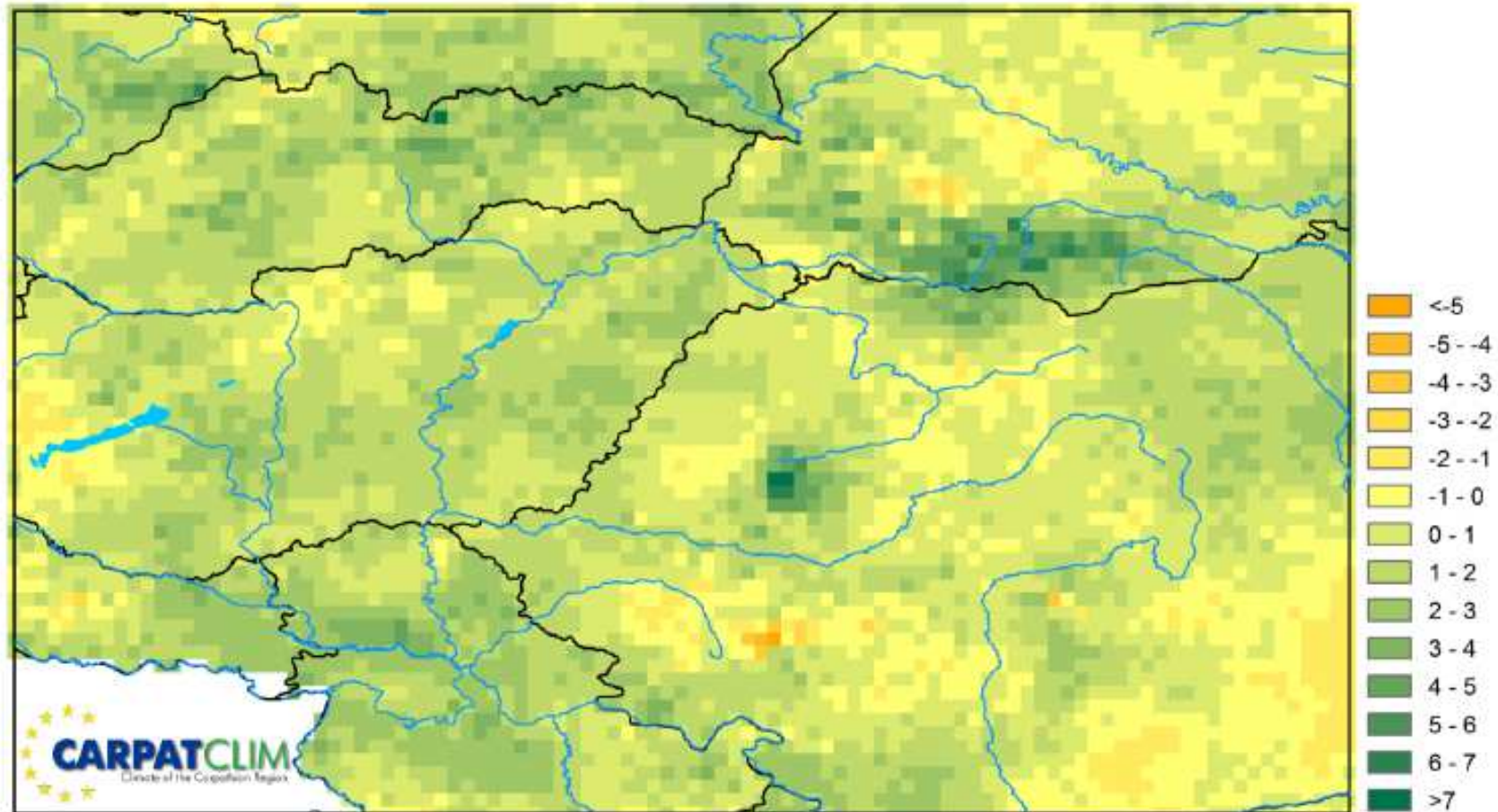
Change of the annual precipitation sum 1961-2010



Change of the seasonal precipitation sums 1961-2010



Change in the number of days with precipitation above 20 mm, 1961-2010



CARPIVIA project

Werner, 2012

CARPIVIA Tasks and Outcomes:

- Integrated assessment & discussion of key of vulnerabilities & adaptation measures, including cost-benefit analysis and policy recommendations
- Data inventory & knowledge gap analysis (->framework proj)
- Web-supported information system
- Stakeholder consultation and cooperation with Carpathian Convention

CARPIVIA runs until 2013. Partners: Alterra Wageningen UR with ECNC, ECORYS, Grontmij and WWF-DCP

CarpathCC framework project

(SR4: ARCADIS, Arany, Kopataki, Mogyorosy et al. Aquaprofit,
CEEWEB)

The Carpathian Region



In-depth study on the key climate change threats and impacts on water resources

- Produce maps for projected floods, droughts and changes snow cover
- Assess projected seasonal shift in water balance and impacts on soils
- Assess the potential impacts of climate change on the implementation of the water framework directive and flood directive
- Assess the risk of landslides in relation to changing precipitation patterns and flash floods
- Impact of changes in ecosystems and adaptation measures on water resources

In-depth study on the impacts of climate change threats on ecosystems

- Assessing the effect of pests and pathogens on the Carpathian forests; climate change-induced increase in virulence; change in distributional and outbreak ranges, and change in populations dynamics of both resident and newly-emerging forest pests and pathogens will be addressed;
- Assessing the effect of climate change on protective function of montane and subalpine forests in the Carpathians;
- Evaluating the effect of management practices on forest vulnerability to climate change, including expected adaptation potential of forest management;
- Evaluating the anticipated changes in species composition of forests, wetlands and grasslands, including climate change effect on grasslands productivity

In-depth study on the impact of climate change on ecosystem based production systems

- Positive and negative climate impacts on ecosystem services with specific reference to multifunctional landscapes and grasslands
- Assessment of the vulnerability of the tourism sector

In-depth study on adaptation measures

- Ex post evaluation of adaptation measures
- Supporting costs and benefits studies
- Ecological networks and ecosystem fragmentation
- Assessing and tailoring adaptation measures for the Carpathian region
- Agri-environmental schemes and other farmer support

Table 1 Main CC threats and adaptation requirements for Carpathian region presented at the CarpathCC Workshop in Eger (January 2013)

	Water Resources	Forest	Non-agricultural grasslands	Agricultural grasslands	Wetlands
Main CC threats	<ul style="list-style-type: none"> Floods Water availability 	<ul style="list-style-type: none"> Decreased water availability together with rising T Susceptible to storms Erosion of top soil Pests Loss of forest ecosystem services (erosion control) 	<ul style="list-style-type: none"> General deterioration of grasslands due to other threats making grasslands more susceptible/sensitive to climate change Habitat loss and fragmentation due to changes in T and water surplus or decrease in some areas at certain locations, localized flooding + erosion remove top soil 	<ul style="list-style-type: none"> Water deficits will limit rain-fed agriculture Widening of pests 	<ul style="list-style-type: none"> in some areas lower precipitation will have negative effects in other areas increased precipitation will improve wetland habitats quality (positive effect) peat bogs are under threat lack of function for water retention due to climate change
Adaptation requirement	<ul style="list-style-type: none"> Integrated water resources management including flood control, water retention, drainage control nutrient control, Ensuring water availability eq for households Protection of vulnerable habitats such as karstic springs 	<ul style="list-style-type: none"> support sustainable forest management enabling natural processes and strengthening the forests' natural resilience and adaptation capacity reforestation measures erosion control measures integrated water resources management 	<ul style="list-style-type: none"> need to maintain/enhance natural grassland areas to ensure resilient grassland habitats responding better to CC effects (T increase, and increased or decreased precipitation) - (by applying traditional grassland management and reduce land use change and land abandonment integrated water resources management 	<ul style="list-style-type: none"> improve drought tolerance water resources management 	<ul style="list-style-type: none"> wetland restoration management integrated water resources management including drainage control peat bog management/protection wetland restoration and creation to fulfill retention function

Table 2 Regional impact Carpathian region based on results on changes in exposure (seasonal precipitation changes and seasonal temperature changes projections for 2021-2050 as compared to the reference period 1971 versus 2000).

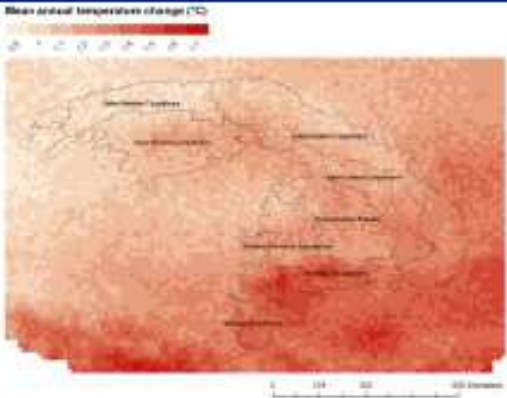
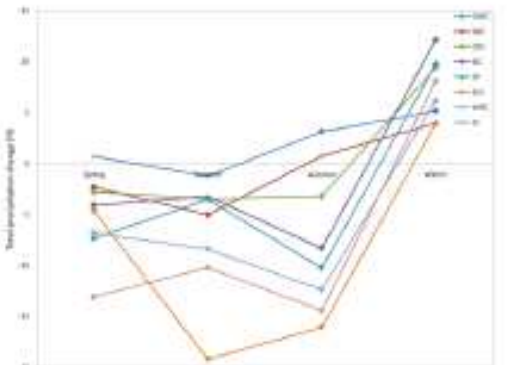
	Lowered precipitation and temperature rise in spring, summer, autumn	Increased precipitation in winter	Adaptation measures needed focussing on the following CC impact	Carpathian regions (with CORINE land use cover as background)
Outer Western	0	++	Reducing vulnerability to high precipitation events	 
Inner Western	+	+	Reducing vulnerability to high precipitation events in winter and droughts in spring, summer and autumn	
Outer Eastern	+	++++	Reducing vulnerability to high precipitation events during winter	
Inner Eastern	++	+++++	Reducing vulnerability to high precipitation events during winter and attention to droughts in spring, summer, autumn	
Transylvanian	++	++++	Reducing vulnerability to high precipitation events during winter and attention to droughts in spring, summer, autumn	
Western Romanian	+++	++	Reducing vulnerability to droughts in spring, summer and autumn and attention to high precipitation events in winter	
Southern	++++	+++	Reducing vulnerability to droughts and increased precipitation events in winter	
Serbian	+++++	+	Reducing vulnerability to droughts in spring, summer and autumn) and attention to increased precipitation in winter	

Table 3 Adaptation requirements defined per parameter determining the vulnerability analysis

 <p>CORINE Land cover</p>	<p>Sensitivity towards impact</p> <p>-: high sensitivity</p> <p>+: low sensitivity</p>	<p>Adaptive capacity (current and potential)</p> <p>+: high adaptive cap.</p> <p> -: low adaptive cap.</p>	<p>Vulnerability (depending on exposure, impact and adaptive capacity)</p> <p>0: low vulnerability</p> <p> -: high vulnerability</p> <p> +: low vulnerability</p>	<p>Adaptation requirement (on top of current compliance Natura2000, WFD, Ramsar)</p> <p>0: no high requirement</p> <p> +: high adaptation requirement</p>		
<i>Ecosystem</i>	<i>Current</i>	<i>current</i>	<i>Adaptation potential</i>	<i>Projected 2050</i>	<i>2021-2050</i>	<i>Projected 2021-2050</i>
<i>Water resources</i>	-	+	+	0		0
<i>Forest (protected)</i>	-	-	+	-		+
<i>Forest (managed)</i>	-	-	++	-		+
<i>natural grasslands (protected areas)</i>	--	+	++	-		+
<i>Semi-natural (agricultural area) grasslands</i>	--	-	+	--		++
<i>Wetlands</i>	-	+	+	0		+

Table 4 Summary of the criteria for scoring the suitability of adaptation measures to be applied in the Carpathian region

<i>Effectiveness</i>	<i>Side effects</i>		<i>Efficiency</i>	<i>Feasibility</i>
<i>Does the measure address the foremost CC threat identified for the ecosystem at hand?</i>	Win-win: <i>Does the measure entail positive side-benefits for other social, environmental or economic objectives and/or sectors?</i>	No regrets: <i>Is the measure is be beneficial even if there is no need for adaptation, because it alleviates an existing problem?</i>	Negative side effects: <i>Does the measure negatively affect other agents (for example the structural changes to river course may have as an unintended consequence a higher water stages during the flood event and thus higher probability of floods)?</i>	Applicability: <i>That the measure can be applied, and is relevant and/or appropriate. This relates to technical capacity, economic strength, legal settings, etc.</i>
			The measure's effect (impact) in relation to its cost.	Acceptance: <i>Approval by stakeholders (e.g. socio-cultural acceptance, economic acceptance).</i>

Long list of adaptation measures - LIFE +
- Interreg projects 300 adaptation measures
- FP7 projects
- UNEP –GEF projects



structuring



Ecosystem:
o Forests
o Agricultural (semi-natural) grasslands
o Natural grasslands
o Wetlands
o Water resources
- Adaptation option About 200 adaptation measures
o Monitoring and research
o Awareness and capacity building
o Adapted species composition
o Expansion and preservation
o Hazard management
o Drought & Water conservation
o Integrated land use & water management
o
Duplicated information or irrelevant information

About 150 am)

Review 90 experts



1. Measures that were missing and identified as very relevant to the Carpathian region were added
2. Measures were recommended in order to be very relevant for CC adaptation to Carpathian region
3. Extra info on attributes was added, in order to make the database more complete
4. Ecosystem-based measures were selected (hard technical measures were excluded from the database)
5. Measures applicable in mountainous areas were retained (lowland measures were deleted in case no relevance to the applicability in the Carpathian region)

Scoring by the suitability criteria

1. Information collected from the attributes of each of the measures during the inventory
2. expertise, both internal and external (own team, as well as local experts and scientists).
3. local stakeholder knowledge (solicited via workshops).

70 measures, of which 33 measures are recommended by experts

Example: forests

Table 6 Shortlisted measures for forests, non-agricultural (natural) grasslands, agricultural (semi-natural) grasslands presented at the CarpathCC workshop (Eger, Hungary, January 2013)

Forests: From total of 86 there are 25 (20 recommended) in final shortlist proposed for consultation at the CarpathCC workshop

Forests	Measures	Recommended by expert	CC threat
Monitoring and research	<ul style="list-style-type: none"> • Forest tree species atlas • Defining adaptation strategies for the forests 	<ul style="list-style-type: none"> • Yes • yes 	<ul style="list-style-type: none"> • Indirect • indirect
Ecological Forest Management	<ul style="list-style-type: none"> • Extraction of timber: conserving stocks and soils • Stabilising and improving the protection function of forests • Securing and strengthening important forest functions • Forest rehabilitation • Forest management within the water protection and sanctuary zone for the purpose of drinking water protection. • Maintenance and management of coppice forests • non-intervention management ; network of areas with non-intervention management • Preparation of Natura 2000 management plans • Controlling invasive species 	<ul style="list-style-type: none"> • Yes • Yes • Yes • Yes • Yes • no • yes • Yes • yes 	<ul style="list-style-type: none"> • Direct • Direct • Direct • Direct • Direct • Direct • Indirect • Indirect • Direct
Awareness and capacity building	<ul style="list-style-type: none"> • Forestry: Policy level measures to adapt to climate change: Education • informing tourists • PAN Parks • FUTUREforest • Biodiversity Conservation Management Project • exchanging of experiences and good practices for improving regional policies so as to cope with fires right after their outbreak in sensitive forest areas. 	<ul style="list-style-type: none"> • Yes • Yes • No • No • No • Yes 	<ul style="list-style-type: none"> • Direct • Direct • Direct • Direct • Direct • Indirect

Table 7 Shortlisted CC adaptation measures

Measure	Option	Forests managed	Forest strict protected	Grasslands	Wetlands	Water resources
1. Develop and support ecosystem monitoring systems						
Measure 1.1: Supporting and harmonizing institutional, natural and European forest scheme (SR2)	Monitoring and research	X				
Measure 1.2: National and European monitoring of newly emerging pests and pathogens and for monitoring of changes in distribution, population dynamics and virulence of present pest and pathogen species	Monitoring and research	X				
Measure 1.3: Awareness and capacity building: Improving the use of forest monitoring data for the assessment of forest vulnerability to climate change; Based on forest monitoring data, assessment of forest vulnerability to climate change and dissemination of this information to all stakeholders	Monitoring and research	X	(X)			
Measure 1.4: Improving the systems of forest monitoring in forests under high conservation regime, mainly with focus on the adverse effects of climate, with special emphasize on monitoring of pests and pathogens	Monitoring and research	(X)	X			
Measure 1.5: Hazard mapping	Hazard management (and risk reduction)	X	X	X	X	X
Measure 1.6: Preparing a network to monitor the state of waters and aquatic ecosystems in the region	Monitoring and research				X	X
2. Implementing adaptation measures at landscape scale						
Measure 2.1: Preservation of large-scale, not fragmented green areas	Expansion and preservation:	X	(X)	X		
Measure 2.2: Preserving and restoring large-scale corridors	Expansion and preservation:	X	(X)	X	X	
Measure 2.3: Support cross-sectoral cooperation to allow for the development of landscapes adapted to climate change	Expansion and preservation:	X	(X)	(X)	(X)	(X)
3. Enable natural adaptation in forests under high						

Measures to be tailored

- Measure 1: Maintenance of alluvial forests (Wetland Ecosystems)
- Measure 2: Supporting and implementing high nature value farming (HNV) (Grassland Ecosystems)
- Measure 3: Compensation schemes for forest protection (such as Payments for ecosystem services/PES) (Forest Ecosystems)

Factsheets (example Carpathian-wide questionnaires)

- General information regarding the implementation of the measure in your country
- Administrative and regulatory framework in your country
- Costs and additional income (for your country; when answering these questions, please keep your answer to question 1 regarding the possible scale of the measure in mind)
- Barriers and supporting factors in your country

Supporting stakeholder interaction

- series of stakeholder workshops will be organised and managed using knowledge-based facilitation techniques in order to generate: a) a number of action scenarios in relation to the impacts of climate change, based on key impacts and assessments of vulnerability; b) generate a number of adaptation options in relation to these scenarios; c) evaluate the costs and benefits of the options along with their feasibility; and d) identify preferred options and adaptation pathways

Integral vulnerability assessments in focal areas

- Tatra mountain, including Zakopane
- Rodnei and Maramures
- Tarnava Mare area
- Irongate national park and foothills
- Bükk mountains

Thank you for your attention!