CARPIVIA

CARPATHIAN INTEGRATED ASSESSMENT OF VULNERABILITY TO
CLIMATE CHANGE AND ECOSYSTEM-BASED ADAPTATION MEASURES

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CARPIVIA + CarpathCC

+ CARPATCLIM colleagues

CarpathCC CLIMATE CHANGE FRAMEWORK PROJECT

CARPATCLIM Climate of the Carpathian Region

WAGENINGEN UR For quality of life

ECORYS

ECNC european centre for nature conservation

Grontmij

WWF

Three linked projects

Funded by European Commission

Contributes to preparatory action **"Climate of the Carpathian Basin"** approved by the European Parliament:

- ***Vulnerability of water, ecosystems & ecosystem based production systems to climate change and other man-made pressures***
- ***Adaptation measures, particularly adaptive water management & ecosystem-based approaches***

Focus selected to:

- ***Benefit national and regional authorities of Carpathian Region***
- ***Support policy proposals*** *in line with Commission White Paper on Adapting to Climate Change, National or Regional adaptation strategies, or a Danube Climate Adaptation Strategy*
- ***Contribute to EU Information System on Climate Change Vulnerability and Adaptation (EU Clearinghouse)***

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CARPATCLIM — Climate of the Carpathian Region

Three linked projects

Today's presentation:

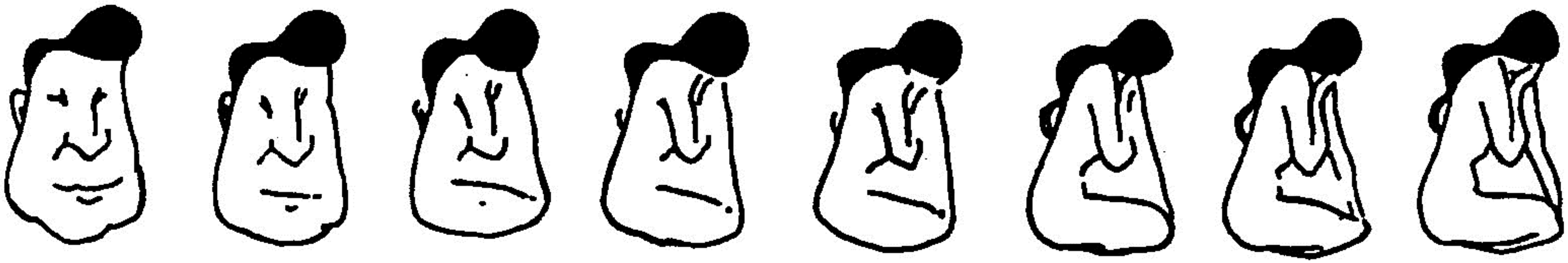
CARPATCLIM: harmonised gridded climate data in the Carpathian Region (historic data 1961-2010) **Historic trends**

CARPIVIA: service contract for an integrated assessment of vulnerability of environmental resources and ecosystem-based adaptation measures (ENV.D.1/SER/2010/0048) **Vulnerabilities and adaptation measures**

CARPATH-CC: a framework contract for in-depth assessments of knowledge gaps identified during first year of CARPIVIA (ENV.D.1/FRA/2011/0006) **Climate trends** **& case studies**

Experiment

Experiment



Ecosystem and ecosystem-based production systems

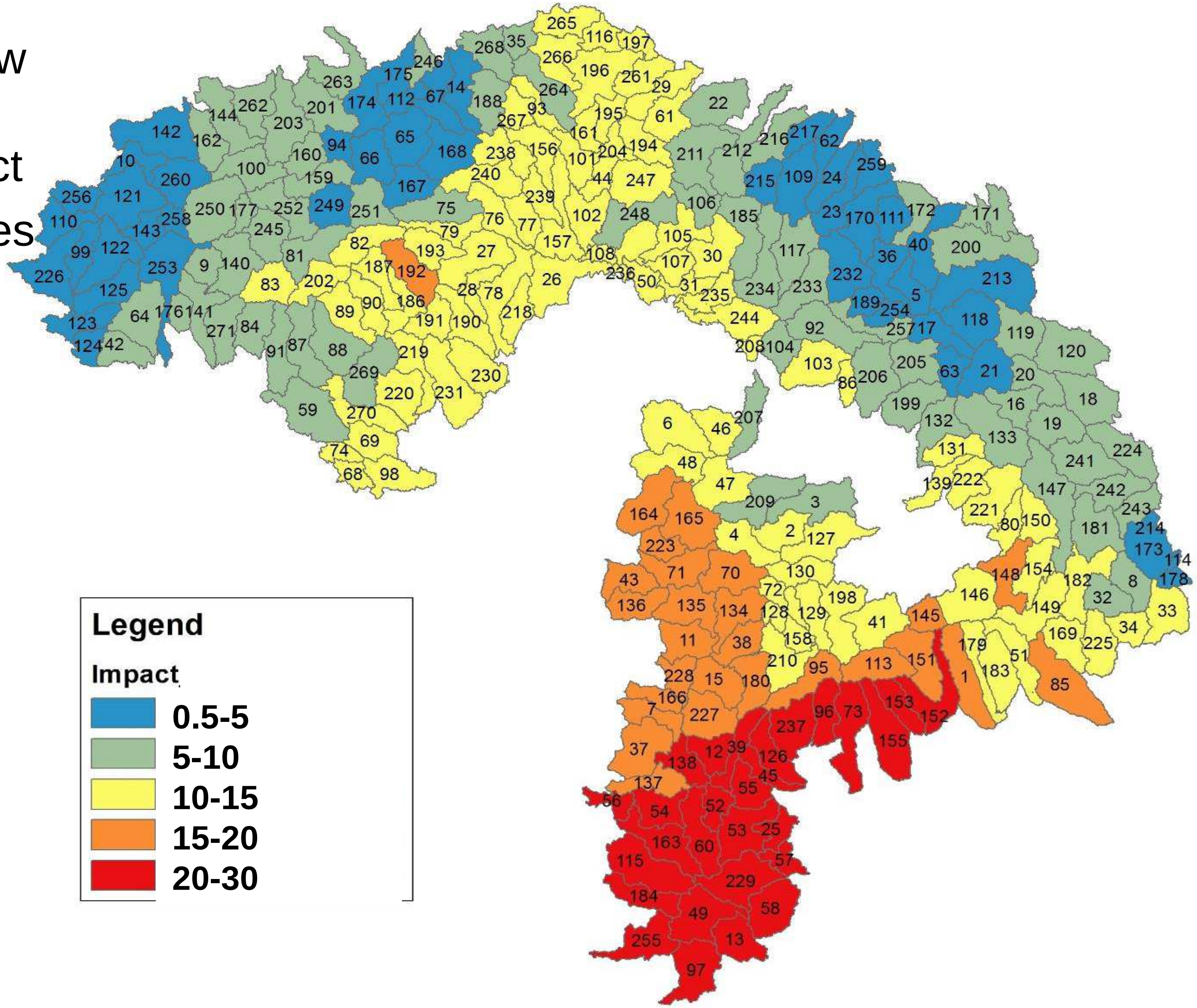
- Forests / forestry
- Wetlands
- Grasslands (natural and semi-natural)
- Agriculture
- Tourism

- (water resources)

Water resources - vulnerability

Considering: low flow conditions and temperature impact

>Indicative for succes water framework directive



Water – recommended adaptation

- New reference sites (for monitoring and implementation WfD) should be established in locations with high ecological status/ reference conditions in the southern part of the Carpathian region, where greater changes in thermal and flow conditions are expected
- Most affected river basins should be the focus for development and application of adaptation measures in the framework of river basin management plans in order to achieve and sustain good ecological status. Such adaptation measures could include the adjustment of permits for water abstraction/water use/pollution discharge; the introduction of smart irrigation systems; the afforestation of catchment areas; the management of catchment land use to reduce diffuse nutrient loading and soil erosion; and the restoration of riparian floodplains to buffer extreme runoff and reduce flows of nutrients.

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Forests / Forestry – key impacts

- Impact depends on diverse factors, such as tree species, forest structure, elevation
- Lower elevation forests, mainly in south SVK, HUN, ROM, SRB are especially prone to drought and temperature rise
- Treeline moving upward, changes in composition
- Intensifying droughts and windstorms followed by outbreaks of bark beetles and defoliating insect are the main risks; +potential influx of new pest species (e.g. Northern spruce bark beetle throughout ROM)
- Increase in extreme rainfall events & deforestation may increase risk of landslides

Bükk

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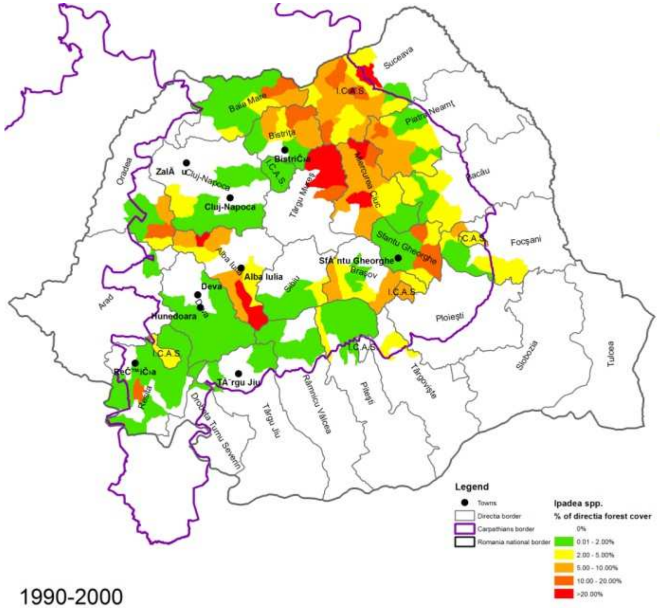
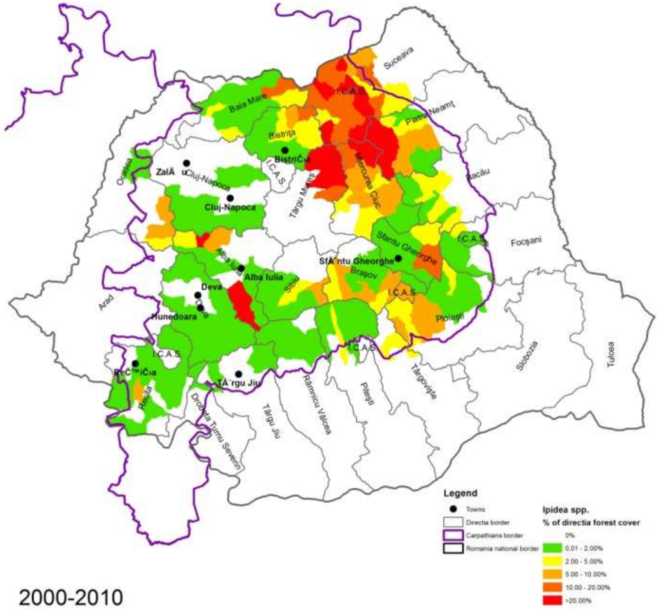
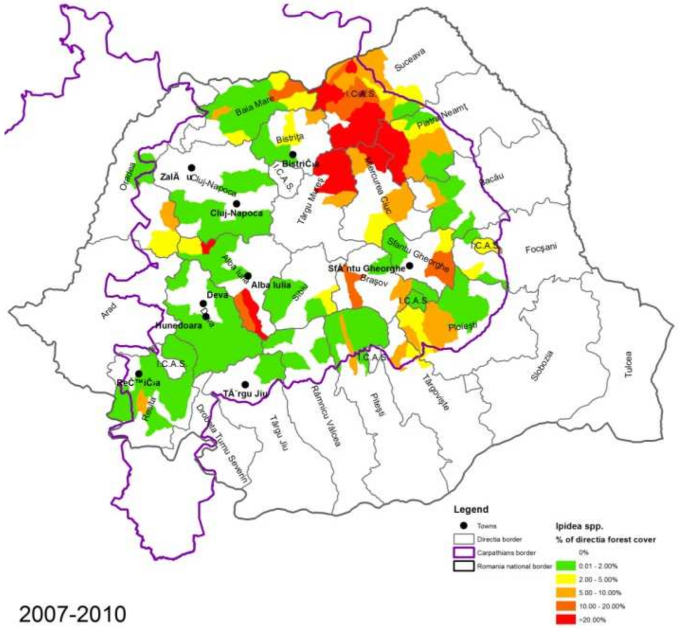
Example: Recent distribution of spruce bark beetle – the most damaging insect pest – in the Romanian Carpathians



1990-2000

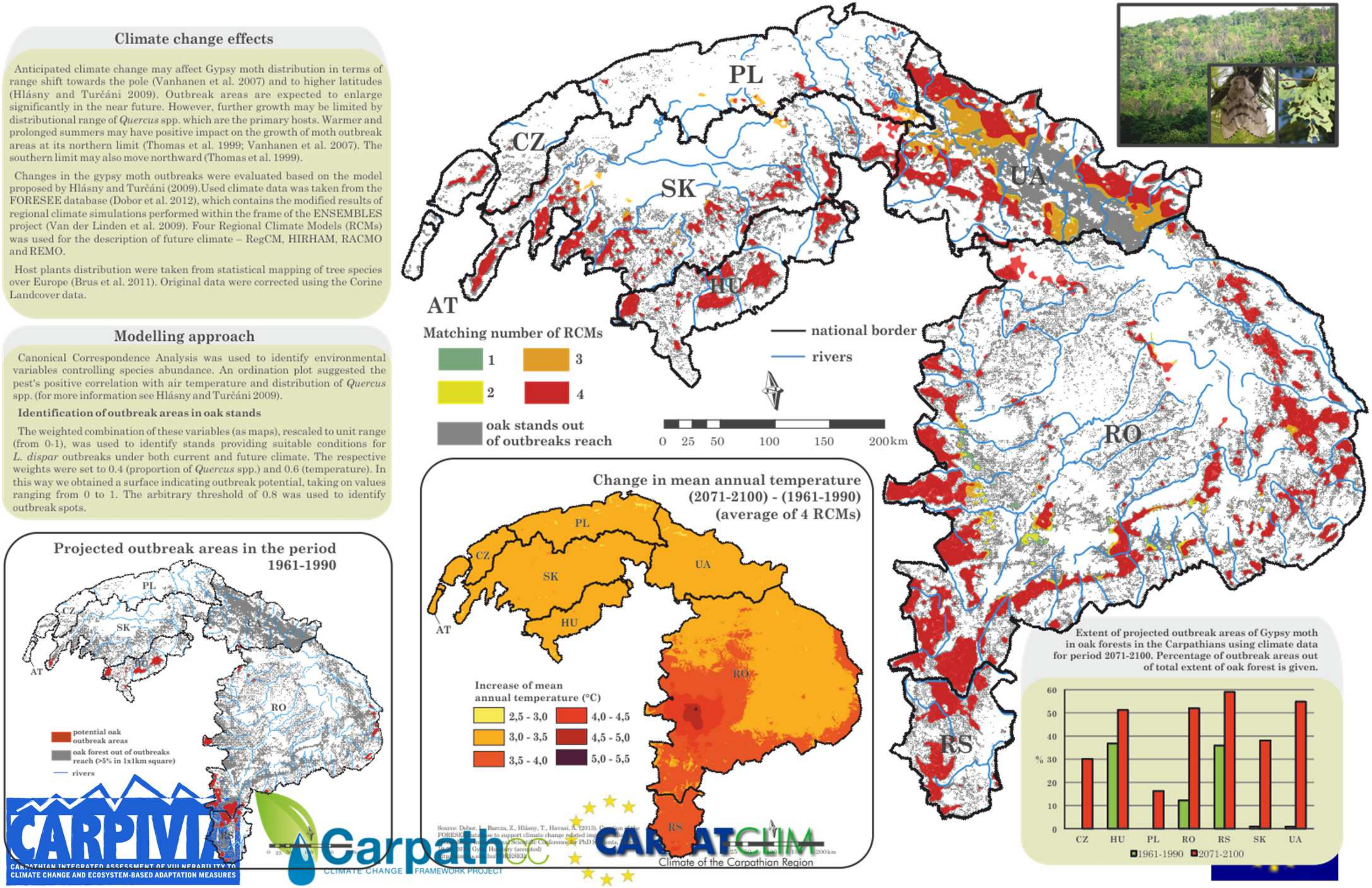


2000-2010

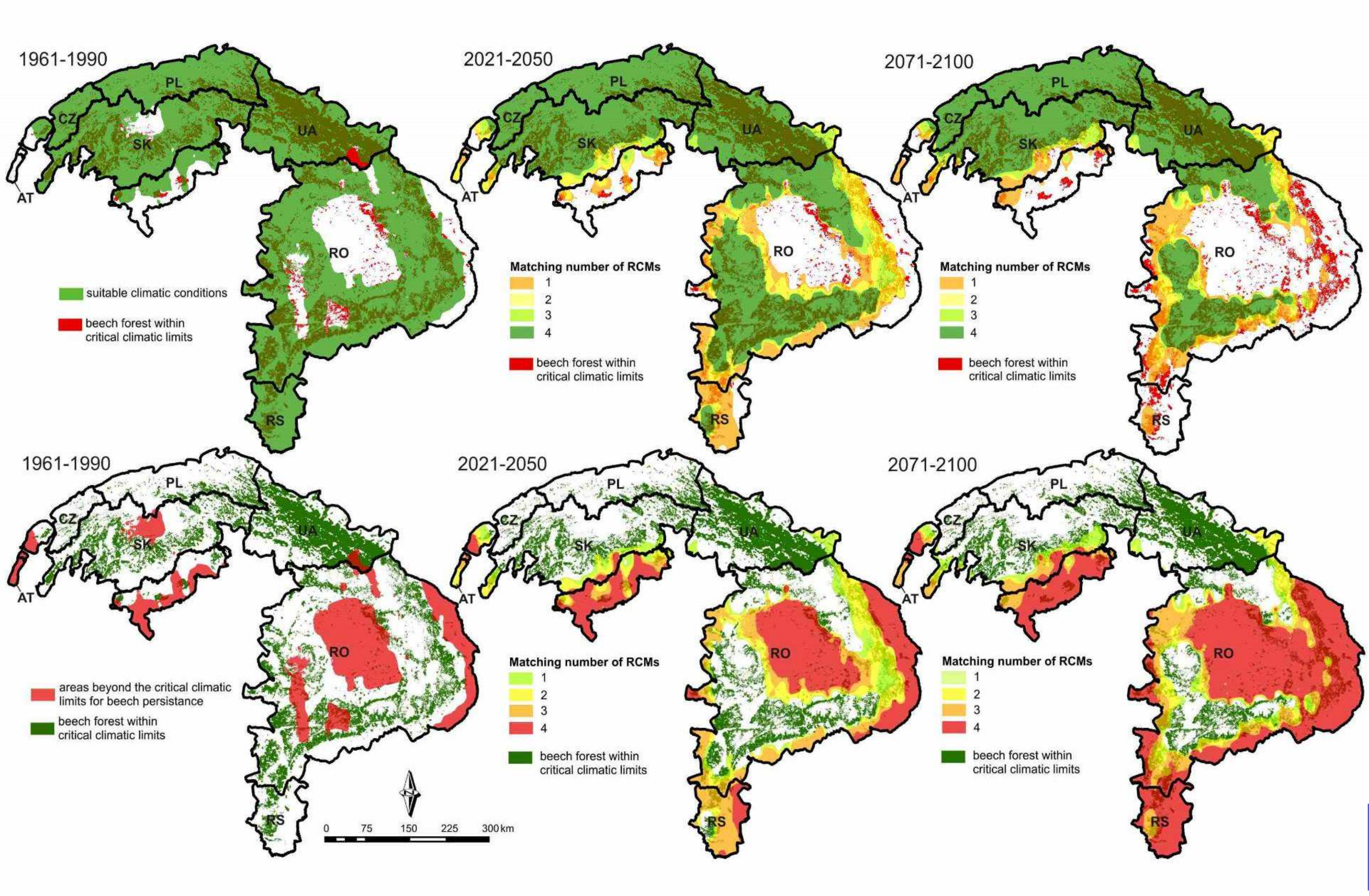


2007-2010

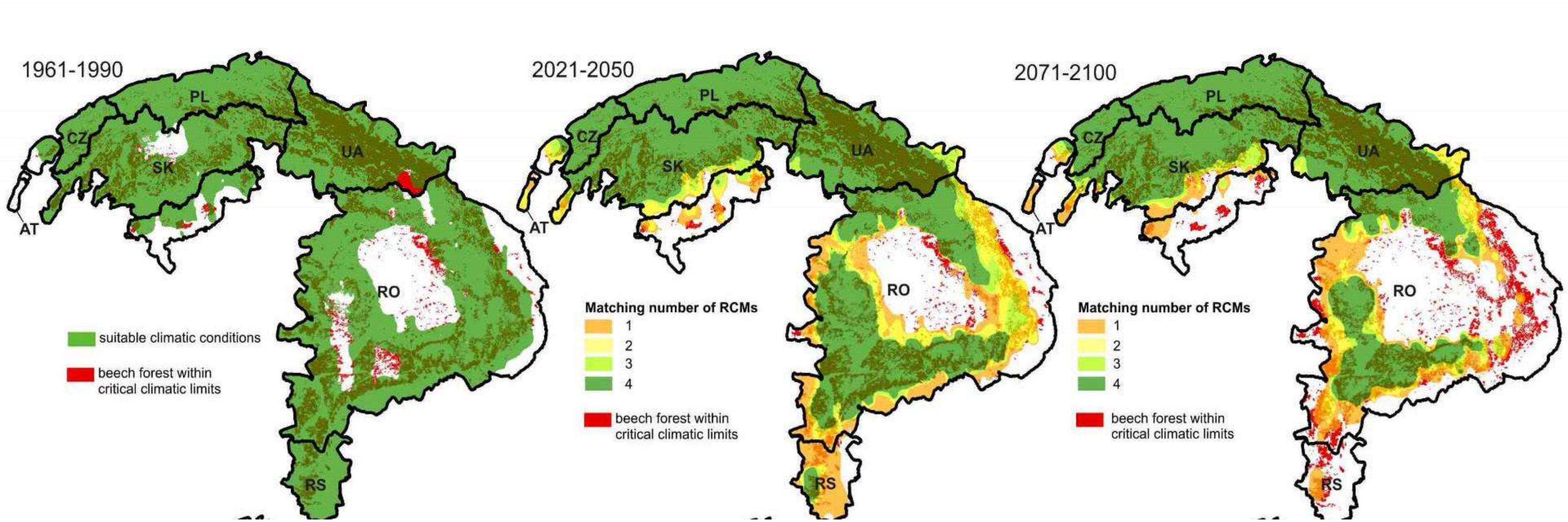
Example 2: Projected outbreak areas of Gypsy moth in oak forests in the Carpathians



Example 3: Projected reduction on climates suitable for beech



Example: Projected reduction area suitable for beech



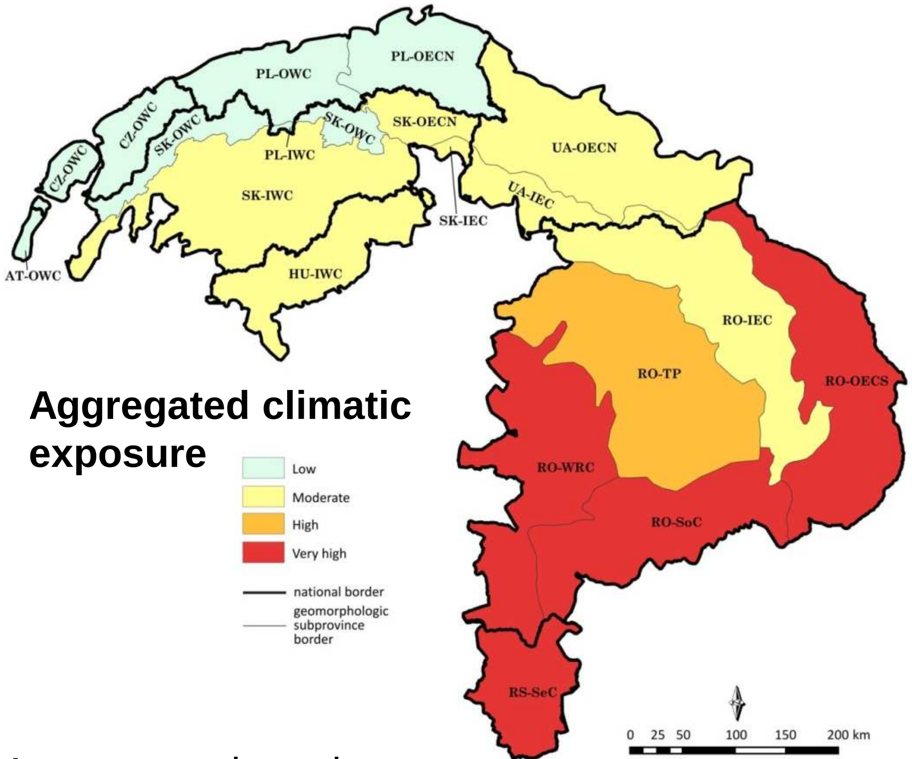
Factors included in analysis:

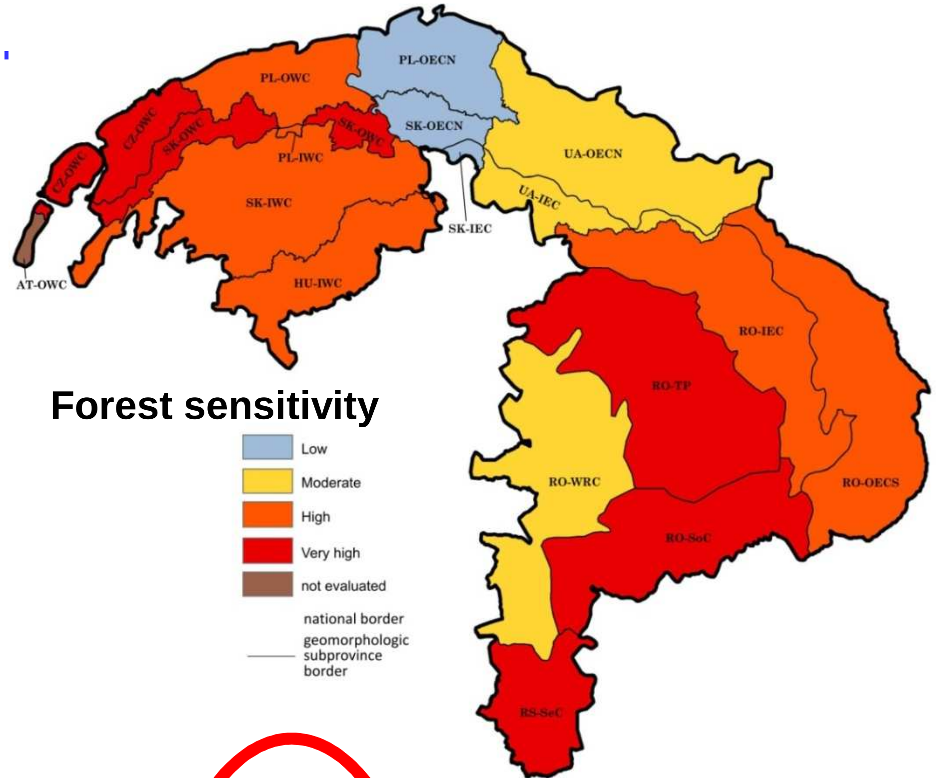
- Climate exposure of Carpathians, 2021-2050 and 2071-2100
- Adaptive capacity of forest management, differences among countries
- Current distribution of main forest pests in the Carpathians
- Projection ranges of key pests, identification of threatened areas
- Review of recent evidences on tree species shift + projections

Key evaluations used for forest vulnerability assessment

- Climatic exposure of the Carpathians, 2021-2050 and 2071-2100
- Adaptive capacity of forest management, differences among countries
- Current distribution of main forest pests in the Carpathians
- Projection of distributional ranges of key pests, identification of threatened areas
- Review of recent evidences on tree species shift
- Projections of species shift
- Integrated vulnerability assessment

Integrated vulnerability assessment of the Carpathian forests





Assessment based on gmf units intersected with country boundaries

Country	Code	Exposure	Sensitivity	Adaptive capacity	Vulnerability
AT	AT-OWC	Low	not evaluated	not evaluated	not evaluated
CZ	CZ-OWC	Low	Very high	Moderate	Very high
SK	SK-IEC	Moderate	Low	Moderate	Moderate
SK	SK-IWC	Moderate	High	Moderate	High
SK	SK-OECN	Moderate	Low	Moderate	Moderate
SK	SK-OWC	Low	Very high	Moderate	Very high
PL	PL-IWC	Low	High	Moderate	High
PL	PL-OECN	Low	Low	Moderate	Low
PL	PL-OWC	Low	High	Moderate	High

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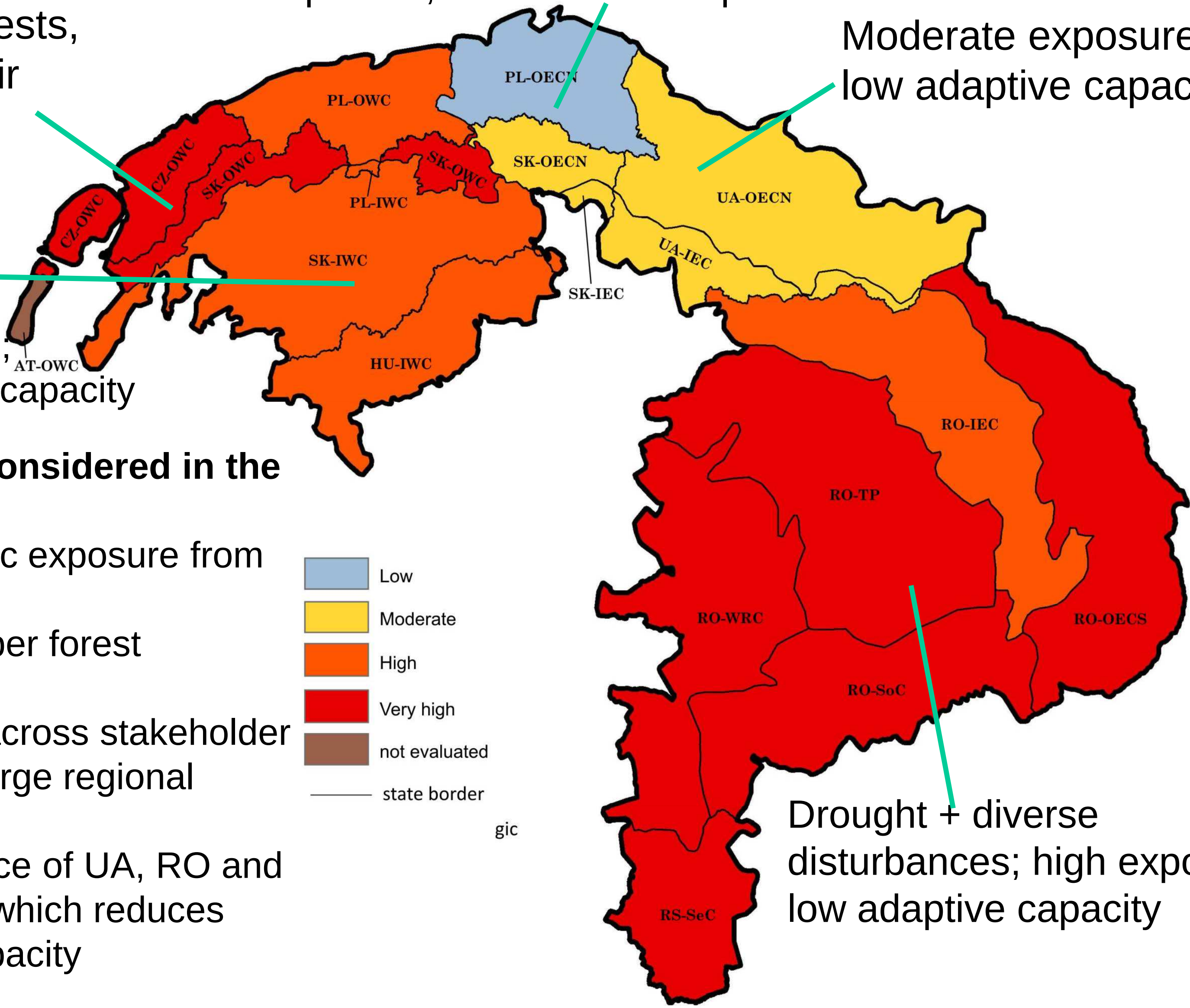
Forests – vulnerability

Secondary spruce forest, pests, former air pollution

Good forest structure, lower exposure, moderate AdCap

Moderate exposure; low adaptive capacity

Drought; diverse disturbances; moderate exposure; moderate adaptive capacity



Drought + diverse disturbances; high exposure; low adaptive capacity

Important factors considered in the assessment

- Increasing climatic exposure from N-W towards S-E
- Long-term improper forest management
- Low awareness across stakeholder groups, though large regional differences
- Lower performance of UA, RO and SRB economies which reduces their adaptive capacity

Forests – recommended adaptation

- Promote (transnational) *sustainable forest management* enabling natural processes (concepts like close-to-nature-forestry, reduced clear-cutting, natural regeneration). Progressive implementaiton forestry plans, e.g. after extreme event
- Erosion control measures (close to villages) in relation to logging & rains
- *Monitoring*: Supporting and harmonizing regional and European forest monitoring schemes, including newly emerging pests and pathogens, changes in species distribution
- Preservation of large-scale, not fragmented green areas, incl corridors and network of areas with non-intervention management
- *Financial support programme* to promote and encourage the introduction of locally adapted tree species in the lowlands (mainly oak)
- Increase awareness on the importance of integrated watershed management and effects of forests on water retention and drinking water

- **€xample**: Maintenance alluvial forests: 1,018 EUR/ha for 2 year period in Divici Pojejena (ROM)

Wetlands – key impacts

- Wetlands are crucial for both flood management (acting as sponges and thus levelling off flood peaks in winter and low flows in summer) and for biodiversity.
- Increased temperatures & drought will lead to drying out of wetlands
- Habitat fragmentation could threaten migratory birds and amphibians at a regional scale

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Wetlands – vulnerability

- Regionally differentiated
- Most vulnerable: peat lands (limited resilience to climate variability, and their sensitivity to human activities)
- Less vulnerable: halophytic habitats and some types of water and river banks habitats. Habitats can adapt to climate fluctuations, yet are highly sensitive to human activities and changes in land use
- Lowest vulnerability: habitats subjected to regular flooding, for example river banks. However, human intervention important impact

Wetlands – recommended adaptation

- Develop and support ecosystem monitoring systems, network to monitor the state of waters and aquatic ecosystems in the region
- Integration of wetland protection with flood control practices: Support programmes aiming for wetland and peatland restoration, floodplain rehabilitation and creation of new wetland and lakes to enhance local water retention capacity and support biodiversity
- River and floodplain restoration
- Small scale water retention in lowland forests

Grasslands – key impacts

- Grasslands are of high biodiversity value, often direct result of hundreds of years of traditional management and animal husbandry
- General deterioration of grasslands due to other threats (abandonment) making grasslands more susceptible to climate change
- Habitat loss and fragmentation due to species migration and upward shifting treeline

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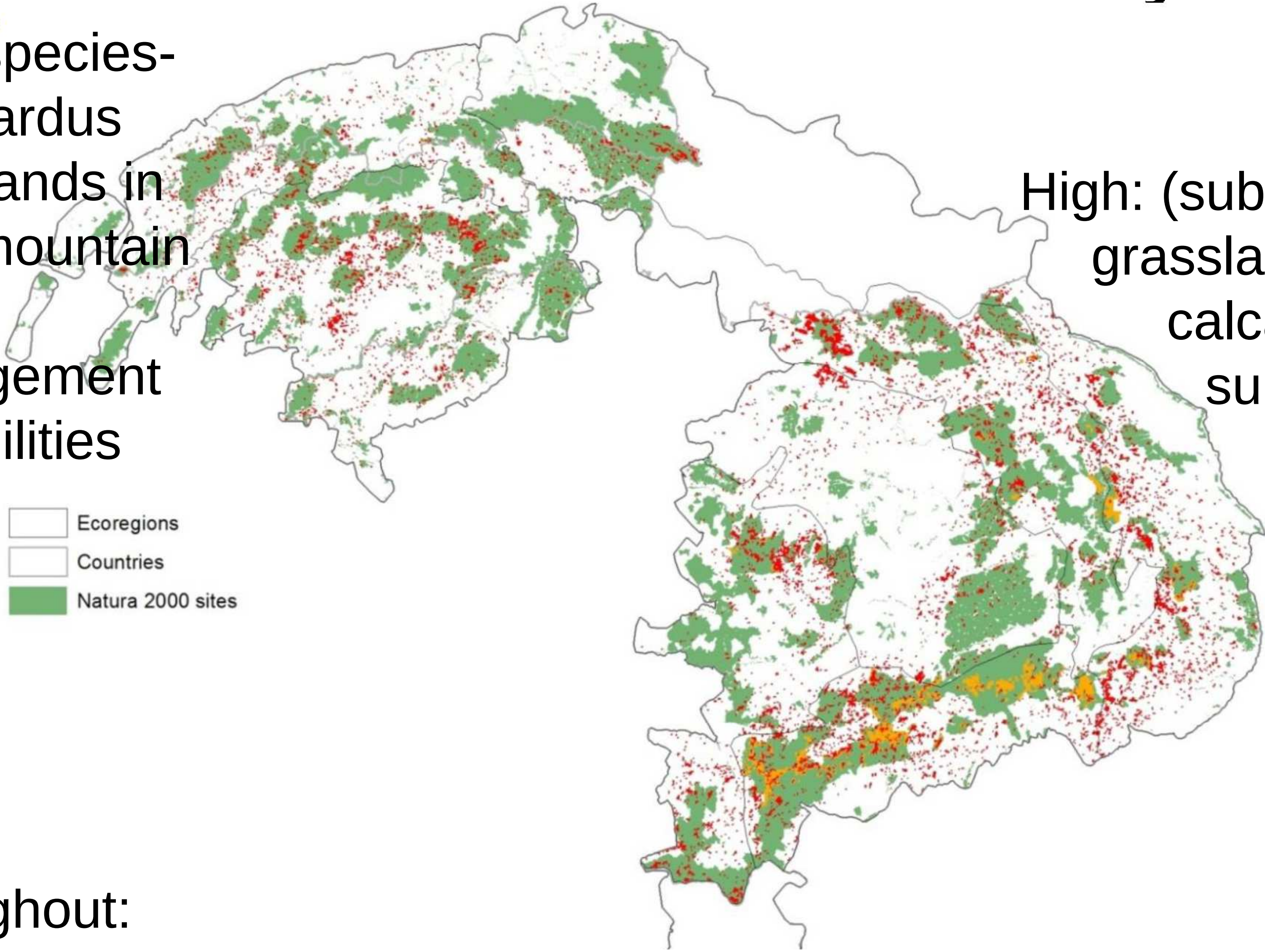
Grasslands - vulnerability

Low: species-rich Nardus grasslands in (sub)mountain areas, management possibilities exist



High: (sub)alpine grasslands on calcareous substrate

Throughout:

- depends on altitude and geologic substrate (grassland type)
- land use change/abandonment (red), natural grassland (yellow)

Grasslands–recommended adaptation

Implement agri-environment measures&Natura2000 management plans

Diversify species and breeds of crops and animals

Manage through grazing, mowing, not abandonment, mulching, fertilization

Adaptation measures can only be successful when also striving for an economically viable country side.

€xample: Restoration of degraded grasslands with high biodiversity value and preserving existing small grasslands and pastures (Bükk, Hungary. Natura 2000, Habitat Directive Site)

- Removing invasive trees (acacia): 1,702 EUR/ha
- Manual clearance of bushes and scrubs: 1,361 EUR/ha
- Crashing of stalk in the soil: 340 EUR/ha
- Mechanical mowing: 477 EUR/ha (to be maintained by users)
- Costs of planting fruit trees: 4.29 EUR/tree
- Purchasing area: 1,702 EUR/ha

Benefits: Fruits, grasslands, water regulation.

Agriculture – key impacts

- Feasible at higher altitudes
- In parts of the Carpathians maize and wheat yields projected to decline, whilst sunflower and soya yields might increase due to higher temperatures and migration of these crops' northern limit
- Shift spring planting towards winter crops possible (winter wheat)
- Pest incidence expected to to rise
- Productivity losses due to drought, groundwater depletion, and extreme weather events

Tarnava Mare

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Agriculture – Vulnerability

- Vulnerability strongly interlinked with socio-economic trends; traditional mixed agro-ecosystems may disappear through combination of land abandonment, land use change and increased advancement of forest area, encouraged by climate change

Agriculture - adaptation

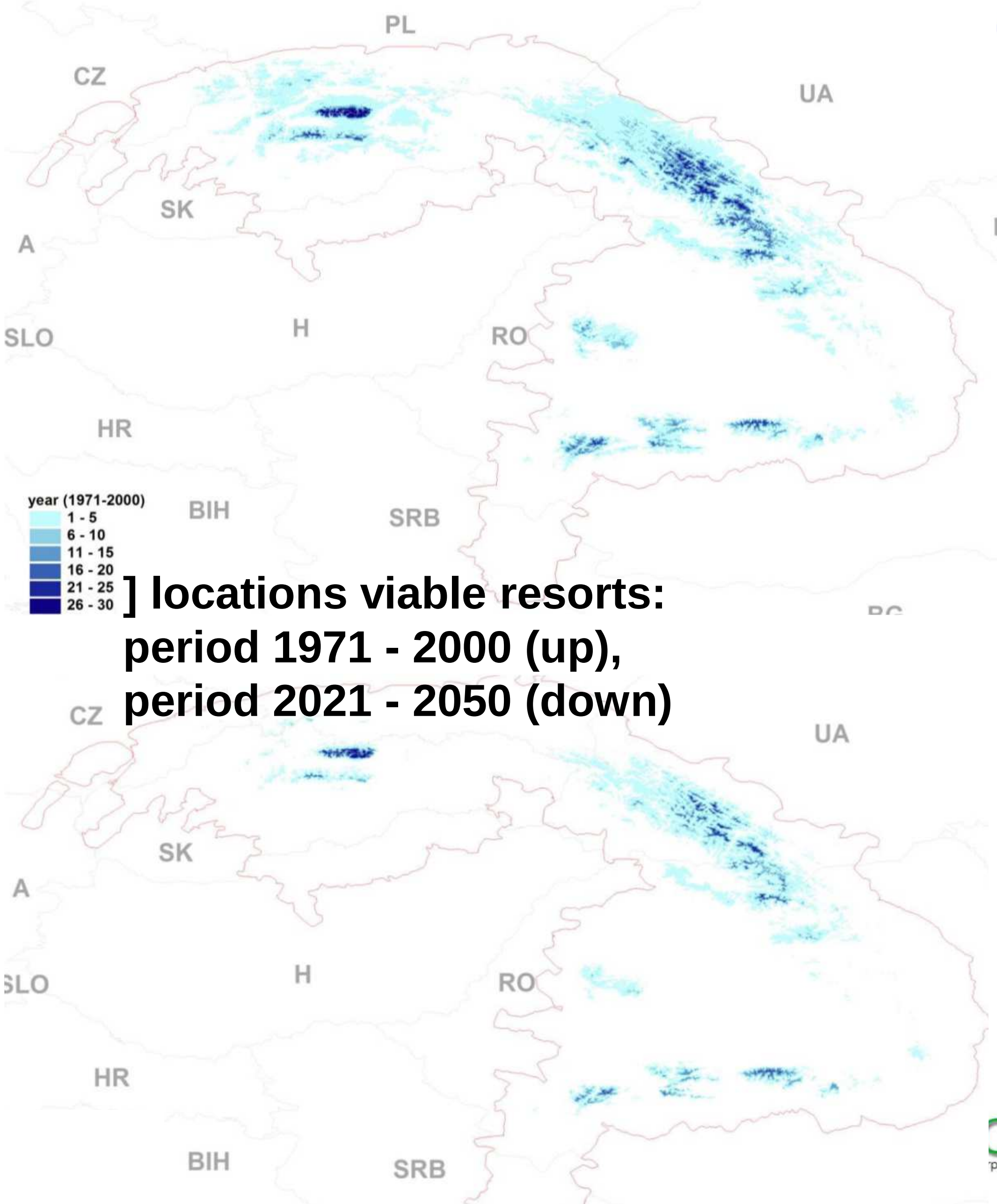
- Small-scale traditional farms, which are an important economic activity in the Carpathian region, deliver multiple ecosystem services and should be supported.
- Agro-environment programmes are critical to maintain and enhance biodiversity and viability of semi-natural grasslands and mixed agro-ecosystems.
- **€xample**: Stimulation of high nature farming in Romania. Farmers can voluntarily enter into a five year agreement and receive payments set at 124 EUR/ha in return for adhering to a specified set of management requirements. At present this measure cannot be implemented at case location as property rights are unresolved, especially for grasslands used for common grazing.

Tourism – key impacts

- Positive and negative impacts from climate change. Ecotourism, summer tourism, health tourism and vocational tourism can be positively influenced by climate change. Rising temperatures can bring more tourists to the mountains. On the other hand, the possibilities of winter sport will become more limited.

- Climate change can bring 60-75.000 additional tourists per year with 9,6-12 million EUR additional revenue for the region (only c.a. 1% of the total revenue from tourism)

Tourism - vulnerability winter

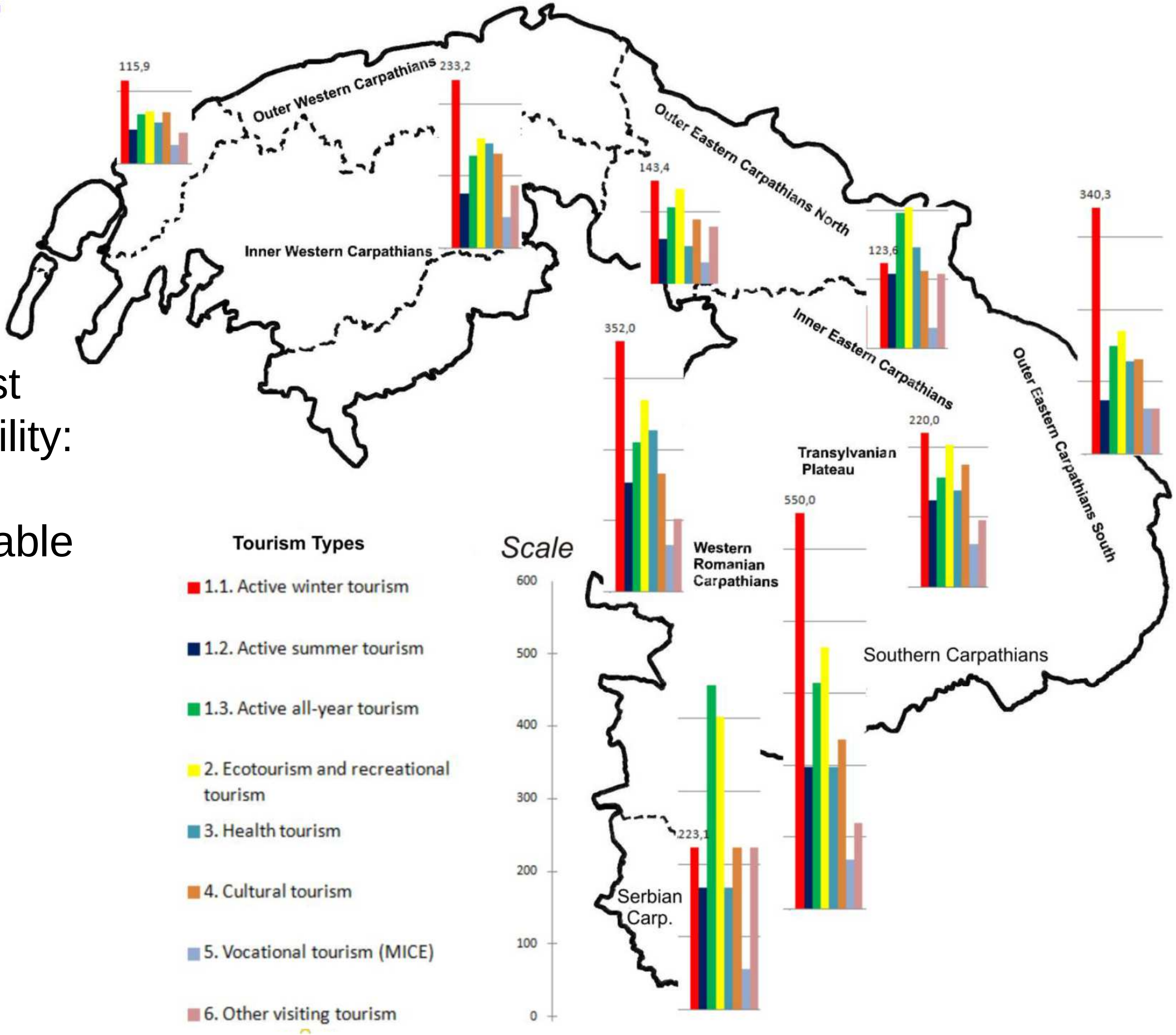


] locations viable resorts: period 1971 - 2000 (up), period 2021 - 2050 (down)

- Resort economically viable: 7 out of 10 winters snow cover at least 30 cm on at least 100 days between 1 Dec-15 April
- as tourism is diversified, only part of visitors depends on snow availability. Thus snow cover and snow depth change less impact on entire tourism turnover as was supposed
- Profile of old, winter sport-based resorts is changing and majority of tourists visit hotels and pensions in summer periods nowadays

Tourism - vulnerability

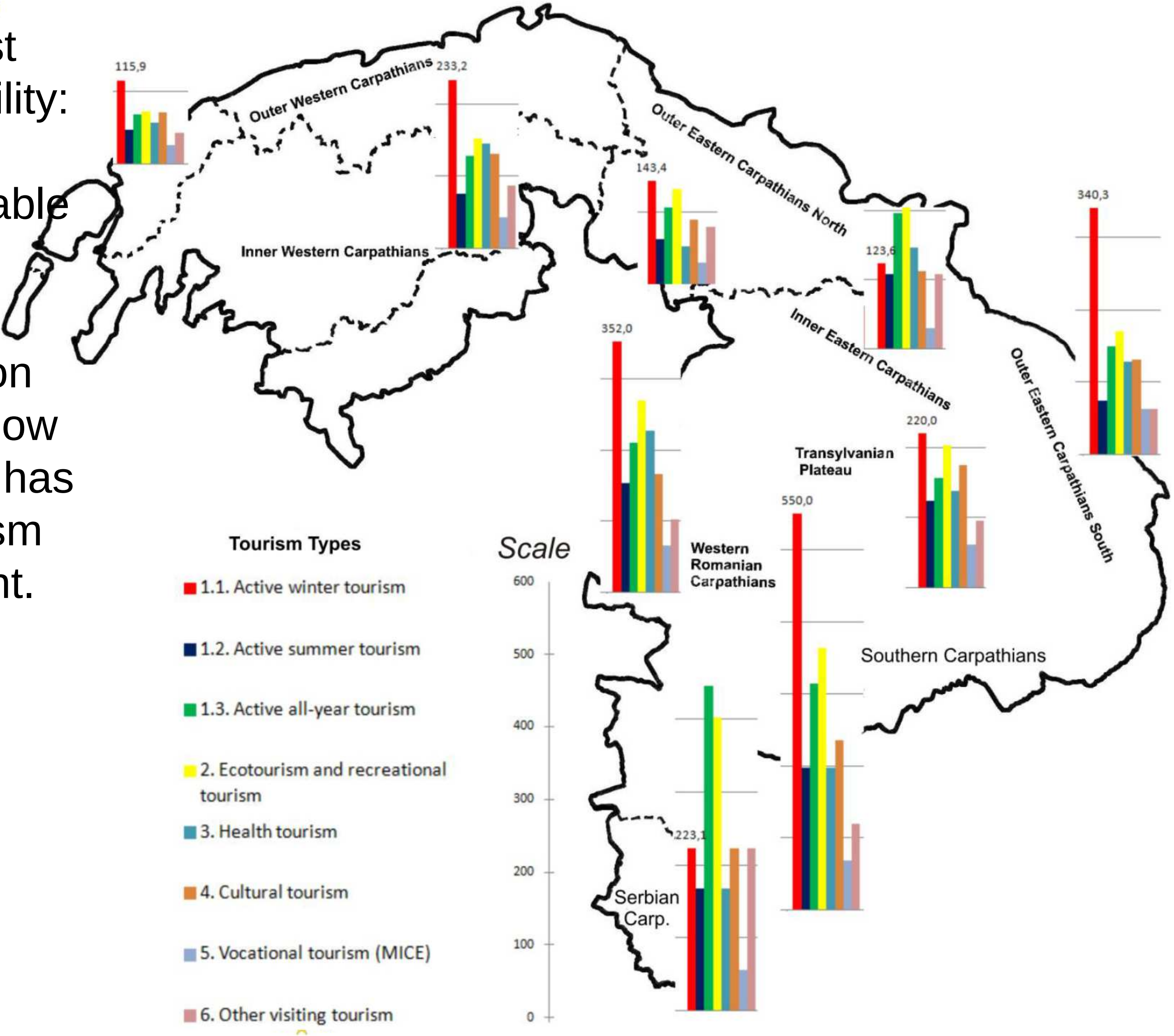
Southeast-Northwest gradient of vulnerability: South-Carpathians' tourism most vulnerable



Tourism - vulnerability

Southeast-Northwest gradient of vulnerability: South-Carpathians' tourism most vulnerable

As tourism is diversified, only part of visitors depends on snow availability. Snow cover/depth change has less impact on tourism turnover than thought.



Tourism – recommended adaptation

- Continue diversification resorts
- Market diversity
- As for tourism activities, ecotourism, health tourism active tourism with cycling would be more preferred.
- Broadening tourism service structure connecting existing accommodations
- Supporting tourism information networks in region among accommodations, suppliers and tourism organizations; up to date information about current touristic situations (snow depth, hazards, traffic jams, etc.)
- Protecting the environment and its natural character / landscape

Further information

www.carpatclim-eu.org

www.carpivia.eu

www.carpathcc.eu

The draft final report of the CARPIVIA Project and other meeting documents can be downloaded for your review from:

www.carpivia.eu/events/workinggroup

The CARPIVIA explorer can be accessed through CARPIVIA website:

www.carpivia.eu/vulnerability-explorer *or* **http://137.224.11.82/**