Assessing the Climate Change Fitness of Spatial Planning

A Guidance for Planners

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clisp
Climate Change Adaptation by Spatial Planning in the Alpine Space

Alpine SPACE
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Impressum

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www.clisp.eu

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This document is open to future improvements through continuous peer review, field-testing and piloting. It is published in electronic format to facilitate its widespread application and to solicit comments from practitioners.
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Content

Background

Climate change adaptation and spatial planning in the Alpine Space

The EU White Paper on Adaptation recognizes the Alps among the most vulnerable areas to climate change in Europe (EC 2009). Within the last 150 years yearly mean temperature in the Alpine Space has already increased significantly by + 2° C. This is more than twice the rate of average warming of the Northern hemisphere. The observed warming trend has caused changes in seasonal mean temperatures, shifts in precipitation patterns and river runoff regimes, a decline in snow cover, and widespread retreat of glaciers. Climate change scenarios project continuously rising temperatures for the Alps up to +4 °C until the end of the 21st century even for rather moderate emission scenarios (A1B), with an accelerated increase in the second half of the century. As in the past, the Alps will be exposed to a stronger warming than in the European average. Temperature will rise strongest in higher elevations (> 1500 m a.s.l.), where an increase of +4.2°C is expected. Changes in precipitation amounts are projected to be rather moderate in terms of the yearly total, with decreases being likely south of the Alpine main ridge. However, significant changes are expected in seasonal distribution of precipitation amounts: summers are projected to become considerably drier in all regions, and in particular in the South, whereas in winter and spring precipitation will increase in the North and North-West and decrease in the South and South-East of the Alps (EEA 2009). Winter precipitation is expected to increasingly fall as rain rather than snow, leading to a rise of the snow line and fewer days with snow cover. As a consequence, winter run-off will increase in most regions, and summer run-off will generally decrease. Future climate change, especially an increase in temperature, a higher variability in precipitation between years, further retreat of glaciers and thawing of permafrost zones, more frequent water scarcity in summer, reduced snow reliability in winter, and an increase in occurrence and magnitude of extreme weather events are expected to have strong effects on natural and socio-economic systems and territorial development. This threatens to modify today's living and working conditions, to negatively affect regional development and growth potentials, to deepen interregional disparities, and to jeopardize territorial cohesion in the Alpine Space (Beniston 2005, ClimChAlp 2008, EEA 2009, EEA 2010).

Climate change and its impacts strongly affect land use and land use development. In its Green Paper "Adaptation to climate change in Europe – options for EU action" the European Commission points out the potential of spatial planning to define cost-effective adaptation measures to adapt to the impacts of climate change and emphasizes its "key role for awareness-raising among the public, decision makers and professionals as well as for triggering a more proactive approach at all levels".

The ETC Alpine Space project CLISP - “Climate Change Adaptation by Spatial Planning in the Alpine Space” is the first transnational project in the Alpine Space Programme area to focus on climate change and spatial planning. CLISP aims at preventing increases in climate change-induced spatial conflicts and at reducing vulnerabilities, damages and costs by providing ‘climate proof’ spatial planning solutions for future sustainable territorial development in the Alps. A main objective of the project is to tackle the question whether spatial planning in the Alpine countries is fit for the challenges posed by climate change, and how spatial planning and spatial development in the Alpine countries can be made climate-proof.

The guidance document at hand helps planners to address these issues and to assess the climate change fitness of their spatial planning policies and instruments. The following sections introduce the guidance document and explain how it should be used and what this guidance can help you to do. The guidance offers a practical step-by-step assessment of the climate change fitness of spatial planning. It recommends useful tools and resources to implement the assessment and refers to findings and experiences from the CLISP project. Core elements of the guidance have been successfully field-tested and applied in the CLISP model regions during the project.

About the Guidance

Aim, Focus and Scope

- The guidance is designed for application by planners on national, regional and local levels who must evaluate whether or not their spatial planning policies and instruments are fit for climate change adaptation..

- The guidance provides a framework for a climate change fitness assessment of spatial planning in a transnational context that shall be generally applicable to different territorial levels within the different spatial planning systems in the Alpine countries. Further specification to the respective requirements of spatial planning systems at national and lower-ranking levels is thus encouraged.

- The guidance offers a step-by-step approach and helps spatial planning authorities and policy makers to assess the degree of the climate change fitness of their spatial planning policies and instruments and to identify enhancement options for climate proofing spatial planning.

- The guidance focuses on the regional context of climate change adaptation and on the responses of spatial planning to climate change.

- The guidance offers a user-friendly self-assessment and aims at supporting and facilitating cross-cutting climate change adaptation processes as well as the identification of adaptation strategies and specific measures with regard to spatial planning policies and instruments (see fig. 1).

- The guidance is available as a 15 page PDF file in English, German, Italian and Slovenian languages plus 25 pages of useful tools and resources.

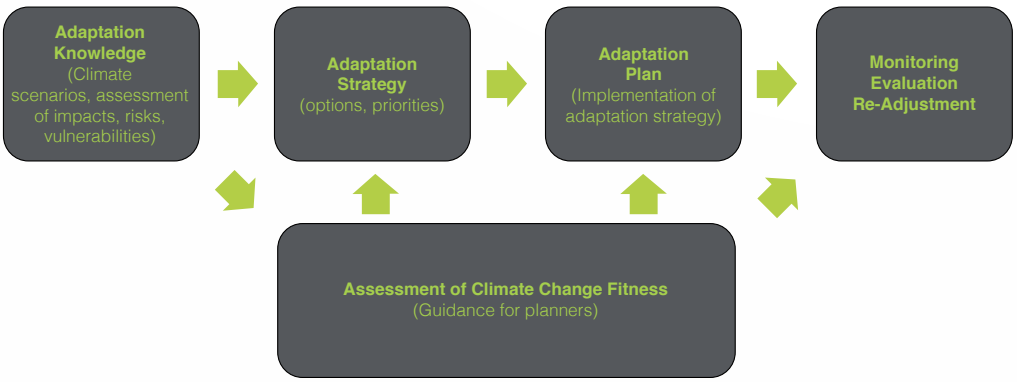


Figure 1: The guidance's position in comprehensive climate adaptation processes

The concept of the guidance references to the UKCIP Adaptation Wizard. It transforms the principles and contents of the Wizard to the Alpine Space and narrows it down to spatial planning's response to climate change.

THIS IS A GUIDANCE, IT WON'T DO THE WORK FOR YOU!

Using the Guidance

Why should I use the guidance?

It helps you to...

...review whether your spatial planning policies and instruments are able to cope with climate change.
...identify strengths and weaknesses in the adaptation performance of spatial planning.
...consider the specific context of climate change adaptation in your region.
...analyse the needs for further action on climate adaptation.
...elaborate a spatial planning climate adaptation strategy.
...raise your own climate adaptation awareness and those of other policy makers and stakeholders.
...climate-proof your spatial planning policies and instruments.

What can the guidance be used for?

It allows for a user-friendly, appealing and easily understandable self-assessment of spatial planning policies and instruments targeted at professionals.
It supports policy making and decision making processes related to climate change adaptation. Ideally, it is directly linked to and supports the elaboration of a comprehensive (regional) climate change adaptation strategy.

What can the guidance not be used for?

It does not offer an assessment of climate change impacts, risks or vulnerabilities.
It is not a database.
It is not designed as an interactive web or software tool.
It won't do the work for you.

How long does it take to complete the assessment?

To complete the assessment will take about 10 to 15 work days.
Depending on your decisions concerning methodology and involvement of stakeholders as well as depending on the availability of climate change impact studies or other input information for the assessment, the actual working days of carrying out the assessment could be spread across several months.

What will be the outcome of the assessment?

You will know whether your spatial planning policies and instruments are fit for climate change. You will have elaborated a climate change fitness assessment report, including strengths and weaknesses of spatial planning as well as enhancement options for climate proof planning.

The results of the assessment and the experience of having gone through the procedure will provide a valuable basis for developing climate adaptation strategies and measures. You will have established a team of experts for climate adaptation issues. You will have engaged with stakeholders and built commitment and motivation among them for delivering climate adaptation in your region. You will have increased awareness for climate adaptation among spatial planning policy and decision makers.

Climate Change Fitness Assessment: A 4-Step Guideline

Overview

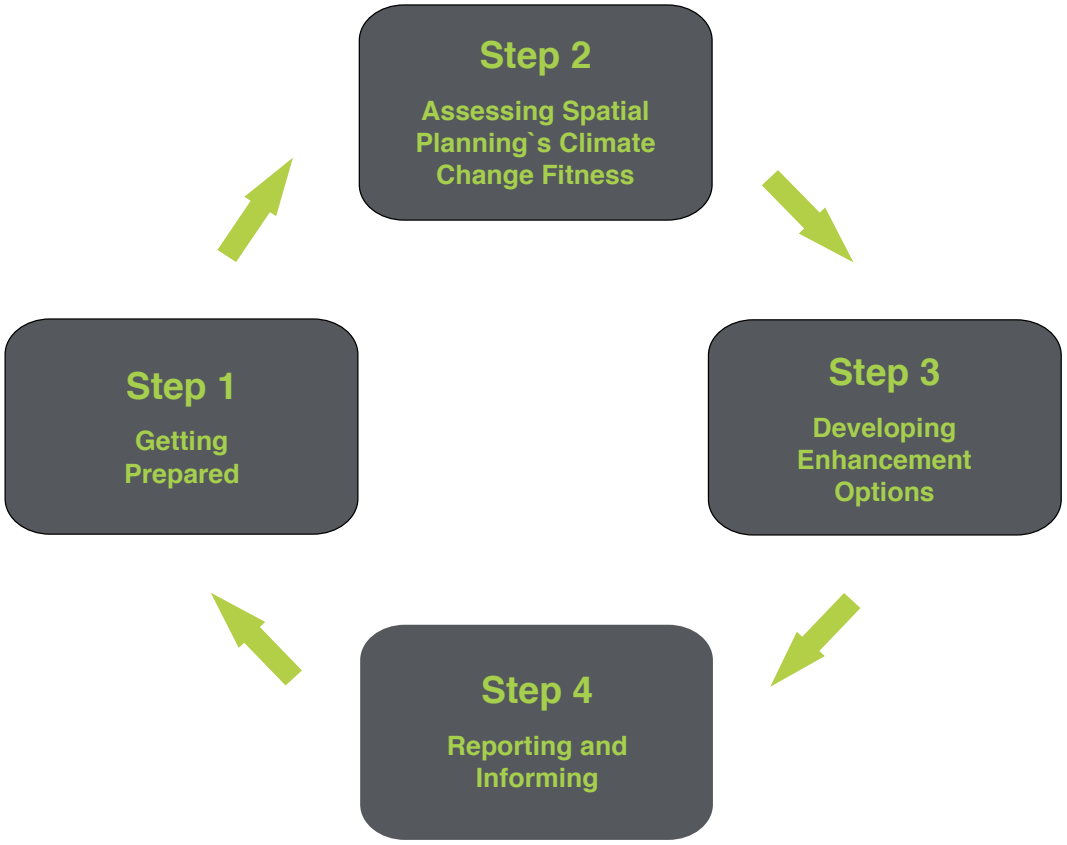


Figure 2: Workflow of the guideline

The next section presents a step-by-step guidance including tasks, checklists, tools and resources.

Step 1 Getting Prepared

The first step in the climate change fitness assessment helps you to focus the assessment, to decide upon the required methods, to assemble your team, and to arrange all of the procedures you need to successfully complete the assessment. Setting the focus is very important to establish a common understanding of the assessment, and to meet the expectations of the participants.

Tasks

1.1 Define the focus, the objectives and the process owner of the assessment

- Specify the instrumental, thematic and spatial focus of the assessment:
  a) Instrumental focus: choose the spatial planning instrument or policy you would like to assess. If appropriate, relevant sectoral planning instruments could also be included in the assessment.
  b) Thematic focus: concentrate on issues of concern that have priority for climate change adaptation in your region. The thematic focus should correspond to the results of climate change impact assessments or vulnerability assessments for your region. The CLISP Climate Impact Chains may help you to select your thematic focus.
  c) Spatial focus: select the planning level and territory (region, sub-region and/or municipalities) to which the assessment is to be applied.
- Depending on the points of focus, specify the objectives of your assessment
- Define the process owner of the assessment, i.e. the key stakeholder responsible for preparing and conducting the assessment, as well as for communicating and implementing its results.

1.2 Assemble the assessment team

Involve your colleagues and assemble a small team of people you can work with throughout the assessment. These people could come from spatial planning authorities, sectoral planning authorities, the scientific community, private enterprises or non-governmental organisations. It is helpful to appoint stakeholders with different perspectives and expertise to the assessment team in order to permit for a broadly supported assessment of the climate change fitness of the chosen planning instruments or procedures.

1.3 Identify and allocate resources

Make sure that you have sufficient personnel and time available to complete the assessment. You might also need funds for workshops and for contracting additional reports or studies.

1.4 Establish the process design for the assessment

Establish the process design for the assessment including all necessary agreements between the process owner, team and further stakeholders.

Useful Tools and Resources

- Existing climate change knowledge and studies for your region, your country or the Alpine space in general (e.g. climate scenarios, risk assessments, impact assessments, vulnerability assessments)
- CLISP Climate Change Impact Chains
- Expert networks and databases, e.g. the Intergovernmental Panel on Climate Change IPCC, ProClim, AustroClim, KomPass, Climate Service Center Germany
- Stakeholder analysis

Outcome

- Focus, objectives and ownership of the assessment are defined.
- Assessment team is assembled and stakeholders identified and committed.
- Resources and roles are allocated.
- Process design for the assessment is established and agreed.

Don't Forget

- Have you set the instrumental, thematic and spatial focus for your assessment?
- Have you set the objectives for your assessment?
- Have you defined process ownership for your assessment?
- Have you involved your colleagues and assembled an assessment team?
- Have you identified and engaged relevant stakeholders?
- Do you have resources available to complete the assessment?

Step 2 Assessing the Climate Change Fitness of Spatial Planning

The second step will help you to assess the climate change fitness of spatial planning policies and instruments in your region. This will make it easier for you to identify the necessary responses to climate change by spatial planning and to develop enhancement options to improve the adaptation performance of spatial planning and of climate adaptation policy in general. Please note that this step represents the core and the most time consuming part of the assessment.

Tasks

2.1 Define criteria for the assessment of the climate adaptation fitness of spatial planning.

To start with the assessment, determine the main criteria for the assessment of spatial planning's climate change fitness. You might select criteria from the list of the CLISP Climate Change Fitness Assessment Criteria list or set your own criteria. These assessment criteria include judgment standards in order to make an evaluative statement about how ready spatial planning in your region is to cope with climate change.

2.2 Define assessment methods.

Define how to conduct the assessment. Identify the methods you want to use throughout the assessment. Methods used in different stages of the assessment may include workshops, interviews, SWOT analysis, etc. We recommend making use of the CLISP Climate Change Impact Chains to analyse what potentials an instrument might have to respond to different types of climate change impacts impacts in areas of concern. The assessment team assembled in Step 1 must agree upon assessment criteria and assessment methods.

2.3 Collect climate change information, data and knowledge.

Take stock, gather and analyse relevant information, data and knowledge about climate change scenarios, impacts, risks, vulnerabilities, and adaptation capacities in your region. Identify and prioritise the key impacts, risks and vulnerabilities in your region that your chosen planning policies and instruments are to be evaluated against. You will need specific information about your region if you are to assess climate change fitness, identify gaps in your policies and instruments, and develop the enhancement options

2.4 Conduct the actual assessment.

Apply the defined assessment criteria and methods to the planning policy or instrument you have selected for the assessment. We recommend conducting stakeholder workshops and expert interviews. The CLISP Climate Change Fitness Checklist may be a helpful tool that can assist you in reviewing the adaptation performance of your spatial plan.

2.5 Identify strengths and weakness of spatial planning policies and instruments.

Use a SWOT analysis to identify the strengths, weaknesses, opportunities and threats of the spatial planning policy or instrument you have selected for the assessment.

Useful Tools and Resources

- CLISP Climate Change Fitness Assessment Criteria
- CLISP Climate Change Fitness Checklist
- Stakeholder workshop
- SWOT analysis

Outcome

- Assessment criteria and methods are defined.
- Regionally specific climate information, data and knowledge are compiled; key impacts, risks and vulnerabilities are identified; knowledge gaps are identified.
- Assessment completed, including judgment of the climate change fitness of the selected planning policy or instrument.
- Strengths and weaknesses, potentials and constraints of your policies and instruments are identified.

Don't Forget

- Have you decided on assessment criteria?
- Have you decided on assessment methods?
- Have you collected relevant information and knowledge about climate impacts, risks and vulnerabilities in your region? Have you identified and prioritised the key impacts, risks and vulnerabilities in your region? Have you identified knowledge gaps? What information is missing?
- Have you identified specific strengths and weaknesses in the adaptation performance of your planning policies and instruments?

Step 3 Developing Enhancement Options for Climate-Proof Planning

The third step will help you to enhance the capacity of your spatial planning policies and instruments to support and deliver adaptation. By compiling and appraising the lessons learned from the assessment, by identifying enhancement options for climate-proof planning, and by defining their priorities and tradeoffs, you will be able to make progress with climate adaptation in your region.

Tasks

3.1 Compile the lessons you have learned from the assessment.

Compiling and analysing the lessons learned from the assessment will help you to reflect on the appropriateness and effectiveness of the assessment.

3.2 Identify enhancement options for climate proof planning.

Enhancement options must be identified to draw up strategies, actions and measures for climate adaptation within and by spatial planning. The enhancement options should improve the capacity of your policies and instruments to respond adequately to the key impacts, vulnerabilities and risks in your region. They should focus on the strengths and weaknesses you have identified in Step 2 of the assessment.

3.3 Define the priorities and tradeoffs of the identified enhancement options.

Defining priorities and tradeoffs for the enhancement options you have identified will help you systematically to select the most important and most effective options (e.g. using cost/benefit analysis or multiple-criteria analysis). When setting your priorities and tradeoffs you select the enhancement options, you should consider general principles of good adaptation decision-making, such as prioritising no/low regret options, multiple-benefit options, robust solutions that will work under the entire range of plausible future climate conditions, and options that foster adaptive management and planning approaches (ETC/ACC 2010). Any adaptation options should be checked for their sustainability, including potentially negative effects on the environment, social groups, or other sectors, as well as their own ability to adapt.

Useful Tools and Resources

- CLISP Transnational Strategy for Climate Proof Spatial Planning
- CLISP good practice examples of climate-proof planning activities
- Stakeholder workshop
- Cost/benefit analysis
- Multiple-criteria analysis
- Guiding Principles for Adaptation to Climate Change in Europe (ETC/ACC 2010)

Outcome

- Lessons have been learned from the assessment exercise.
- Enhancement options are identified.
- Priorities and tradeoffs are defined.
- Enhancement options are prioritised, in line with general principles for coping with uncertainties, and checked for sustainability and possible negative side effects.

Don't Forget

- Have you reflected upon and identified the lessons learned from the assessment?
- Have you determined enhancement options for the selected policies, instruments or procedures and for their implementation?
- Have you applied the general principles of coping with uncertainty in adaptation decision-making? Have you evaluated your possible enhancement options for their sustainability and possible negative external effects?
- Have you prioritised and agreed which are the most important enhancement options?

Step 4 Reporting and Informing

The final step will help you to report the findings of the assessment and to inform the stakeholders. This will help you to disseminate information about how to increase the climate change fitness of spatial planning in your region, how to enhance climate adaptation and how to improve the effectiveness of spatial planning in response to climate change.

Tasks

4.1 Report assessment results.

Report the assessment results in a transparent and comprehensible way. Consider the table of contents proposed for the CLISP Climate Change Fitness Report . Provide an executive summary. Make the results available to the public...

4.2 Inform stakeholders about the assessment results and enhancement options.

Proactively disseminate the assessment results and enhancement options to stakeholders. This will also help you to build support for their implementation from policy-makers. Ensure effective information by means of suitable target group-oriented formats, such as brochures, workshops or events. .

Useful Tools and Resources

- CLISP Climate Change Fitness Report table of contents
- Stakeholder workshop

Outcome

- Climate fitness assessment report is available.
- Public and stakeholders are informed.

Don't Forget

- Does your report cover all the assessment results?
- Have you disseminated the assessment results and enhancement options to the public and stakeholders?

Next Steps

Implementation, Monitoring and Evaluation

Implementation

This guidance provides planners with a generally applicable framework, tools and resources to complete a climate change fitness assessment of spatial planning policies and instruments. As part of the process of mainstreaming adaptation to climate change, the guidance, or parts thereof (such as the CLISP Climate Change Fitness Checklist), can be incorporated into regular spatial planning processes and administrative routines (codes of conduct). It can be used by planning authorities as part of the approval procedure for plans or projects. It can also be integrated into sustainability appraisals, strategic environmental assessments or environmental impact assessments. Alternatively, the guidance can be incorporated into policy-making on climate change adaptation, e.g. by conducting assessments as part of the drafting of national or regional adaptation strategies. The assessment results in the evaluation, identification and prioritisation of adaptation options for spatial planning. These priority adaptation options must be implemented, however. As spatial planning is a cross-cutting theme that affects many different policy fields, implementing adaptation options will, in many cases, require coordination with other fields of activity. Moreover, the assessment of spatial planning's climate change fitness is expected to provide substantial hints for the enhancement of climate adaptation strategies in other policy fields.

A climate change fitness assessment needs resources. Personnel, time, available information and knowledge are the critical factors for its successful completion and effective implementation.

Monitoring and Evaluation

Climate change adaptation is not accomplished when the climate change fitness assessment is finished, or when the climate adaptation action plan is implemented. Climate adaptation is an iterative process that should be embedded in an adaptive management approach. This calls for ongoing monitoring of the implementation process and of changes in climatic stimuli, impacts and available knowledge. Monitoring ensures that your organisation is fit for climate adaptation not only today but also in the future. You need continually to assess the climate change fitness of spatial planning policies and instruments in your region against new information about climate-related and other relevant trends, and check whether or not adjustments to your planning policies and instruments are needed. You should therefore establish a system for monitoring spatial development, climatic trends, the effectiveness of adaptation, and the climate change fitness of spatial planning in your region. This will enable you to assess whether or not observed changes in climate, trends in spatial development or any new knowledge require the reassessment of spatial planning's climate change fitness in your region. As part of an adaptive planning approach, monitoring results should be linked to the revision of your spatial plans in regular planning cycles. Monitoring thus also encourages a learning process surrounding adaptation.

Useful Tools and Resources

This section compiles tools and other resources useful for assessing the climate change fitness of spatial planning policies and instruments.

CLISP tools supporting the assessment of climate change fitness

- CLISP Climate Change Impact Chains
- CLISP Climate Change Fitness Assessment Criteria
- CLISP Climate Change Fitness Checklist
- CLISP Climate Change Fitness Report

Other helpful CLISP products

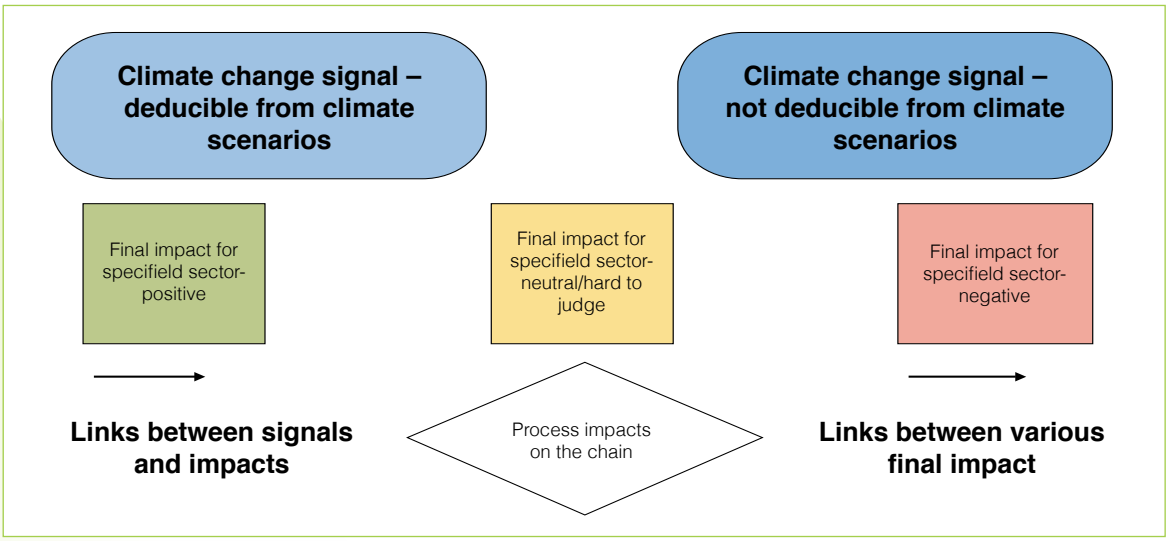
- CLISP Climate Change Scenarios for the Alps
- CLISP Toolbox for Vulnerability Assessments
- CLISP WP5 Synthesis Report
- CLISP WP5 model region evaluation results
- CLISP Lessons learnt from stakeholder dialogue in model regions
- CLISP Good Practice Examples of Climate Proof Planning Instruments
- CLISP Risk Governance Manual
- CLISP Transnational Strategy for Climate Proof Planning

More information on the CLISP Website www.clisp.eu

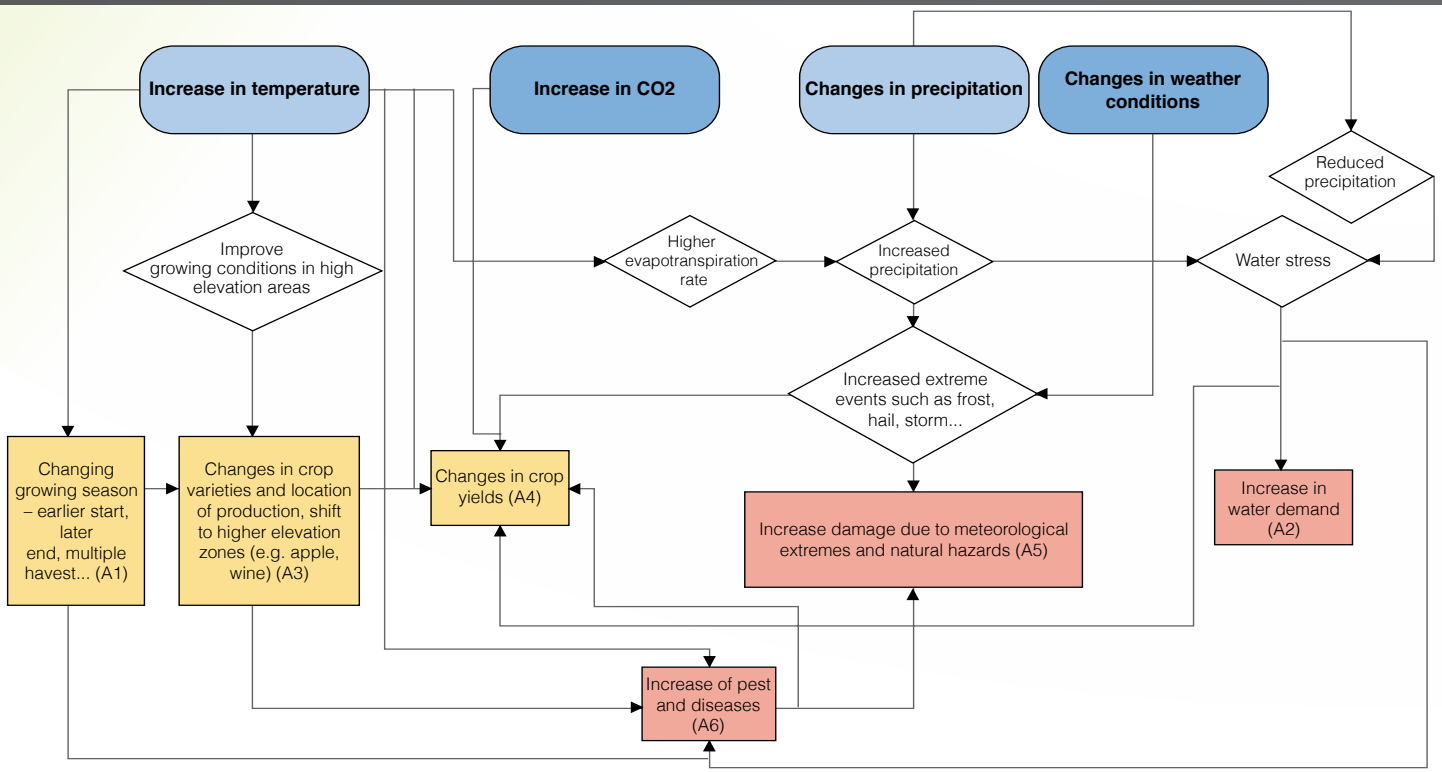
CLISP Climate Impact Chains

Climate impact chains are general cause-effect relations that describe how, in principle, climatic changes are expected to cause impacts on the sectors of concern. Impact chains name the most important chains of cause and effect leading to the potential impacts. The CLISP Climate Impact Chains may help you to select your thematic focus.

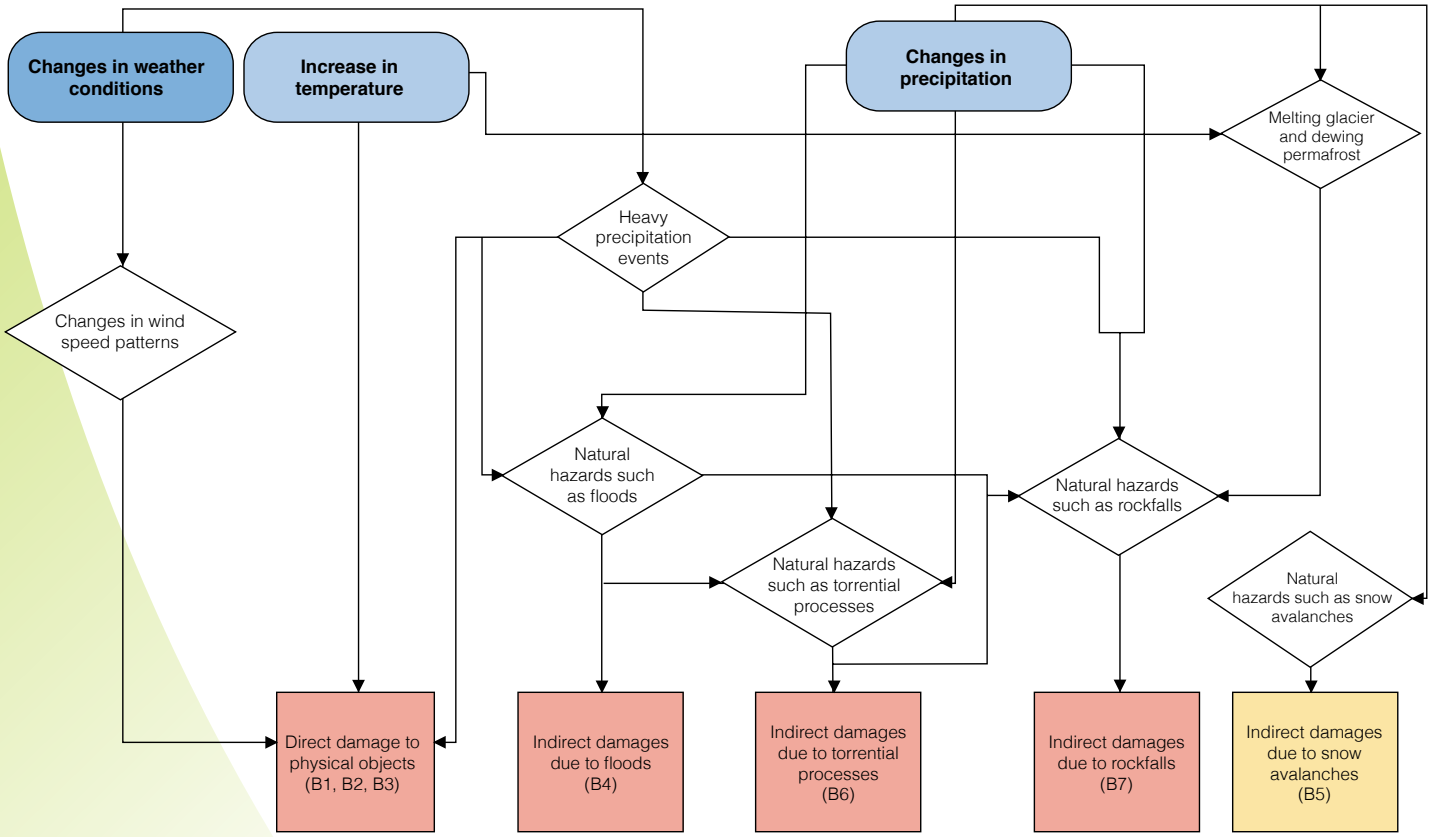
Legend



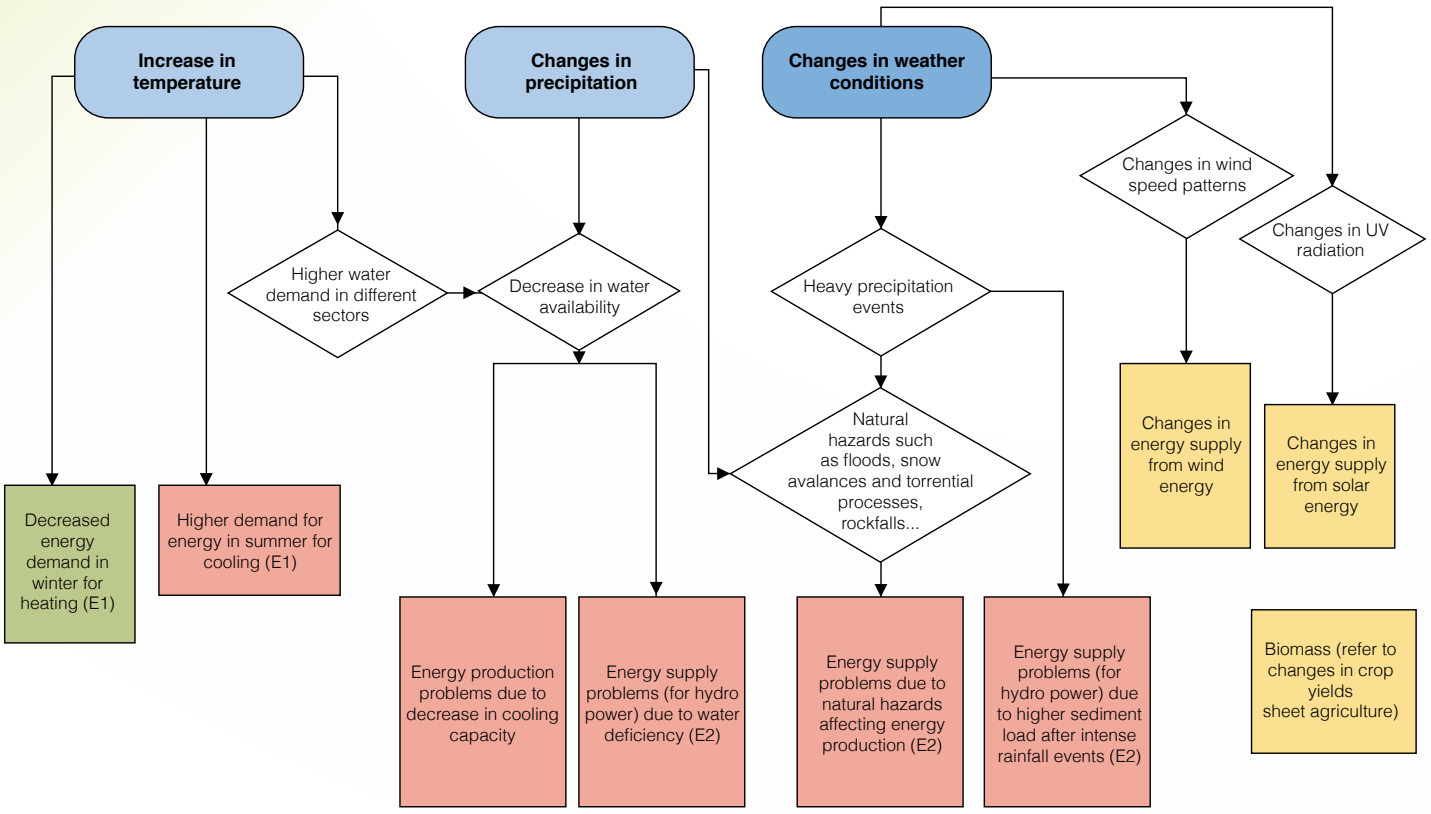
Climate change impact chains – Agriculture



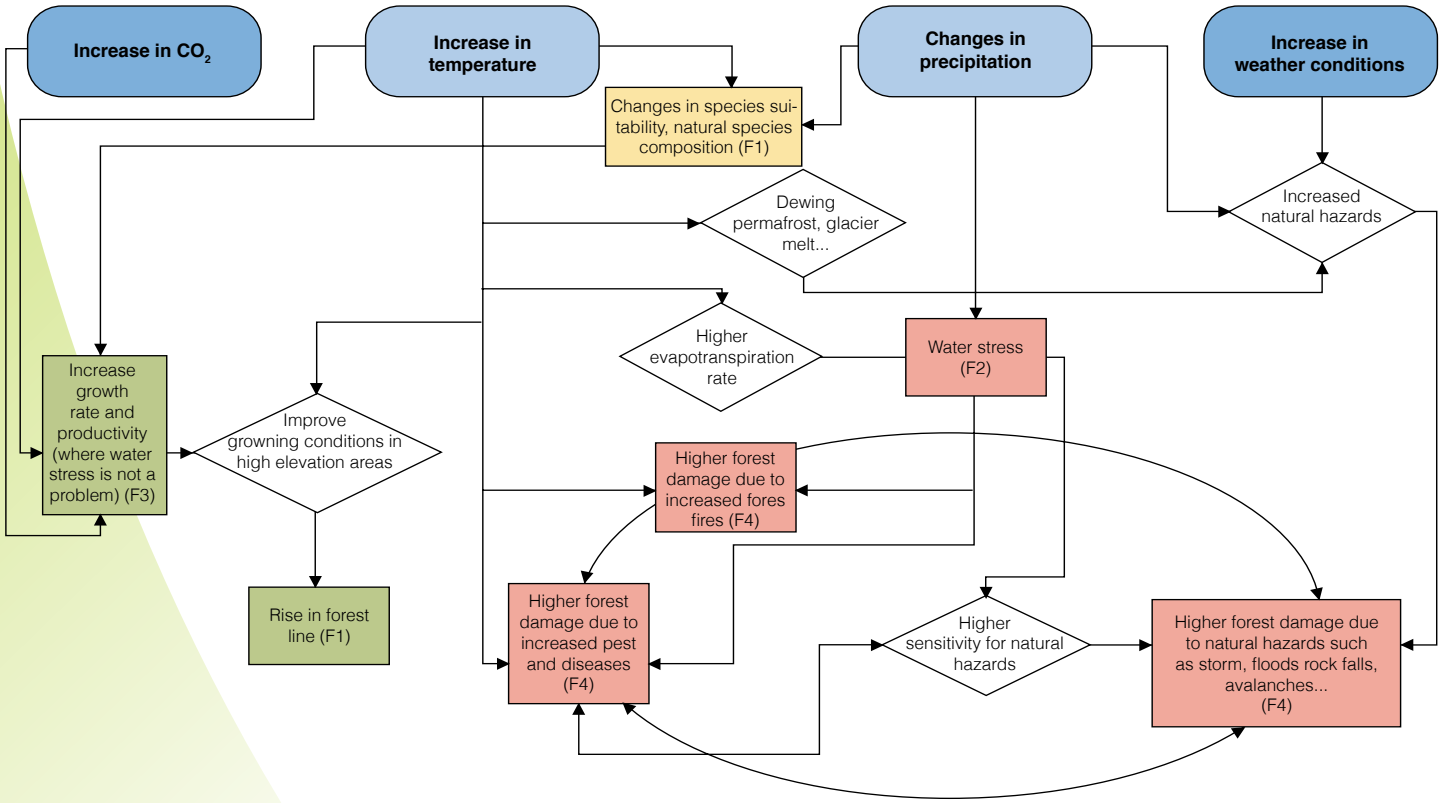
Climate change impact chains – Built-up areas / land development



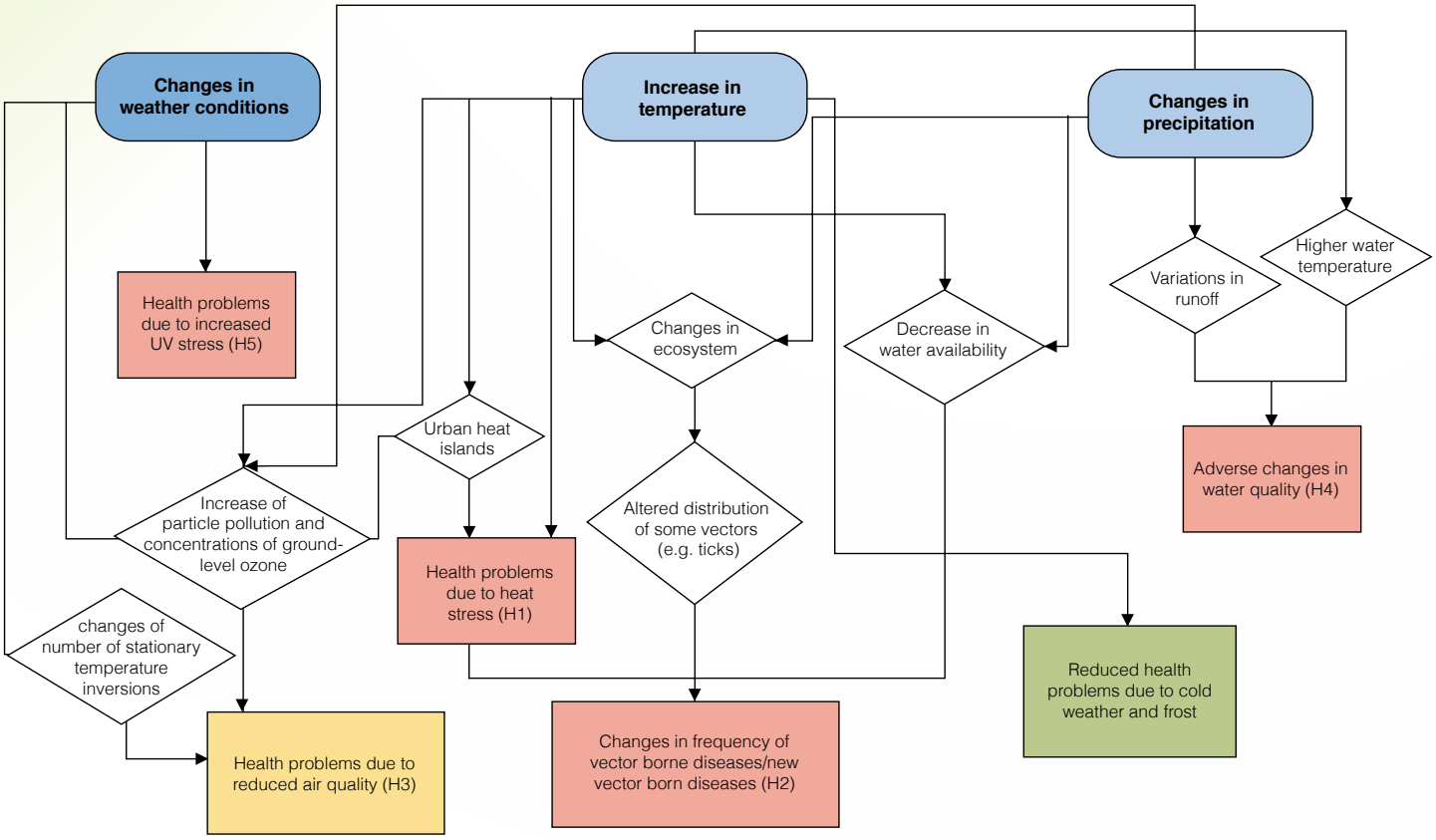
Climate change impact chains – Energy



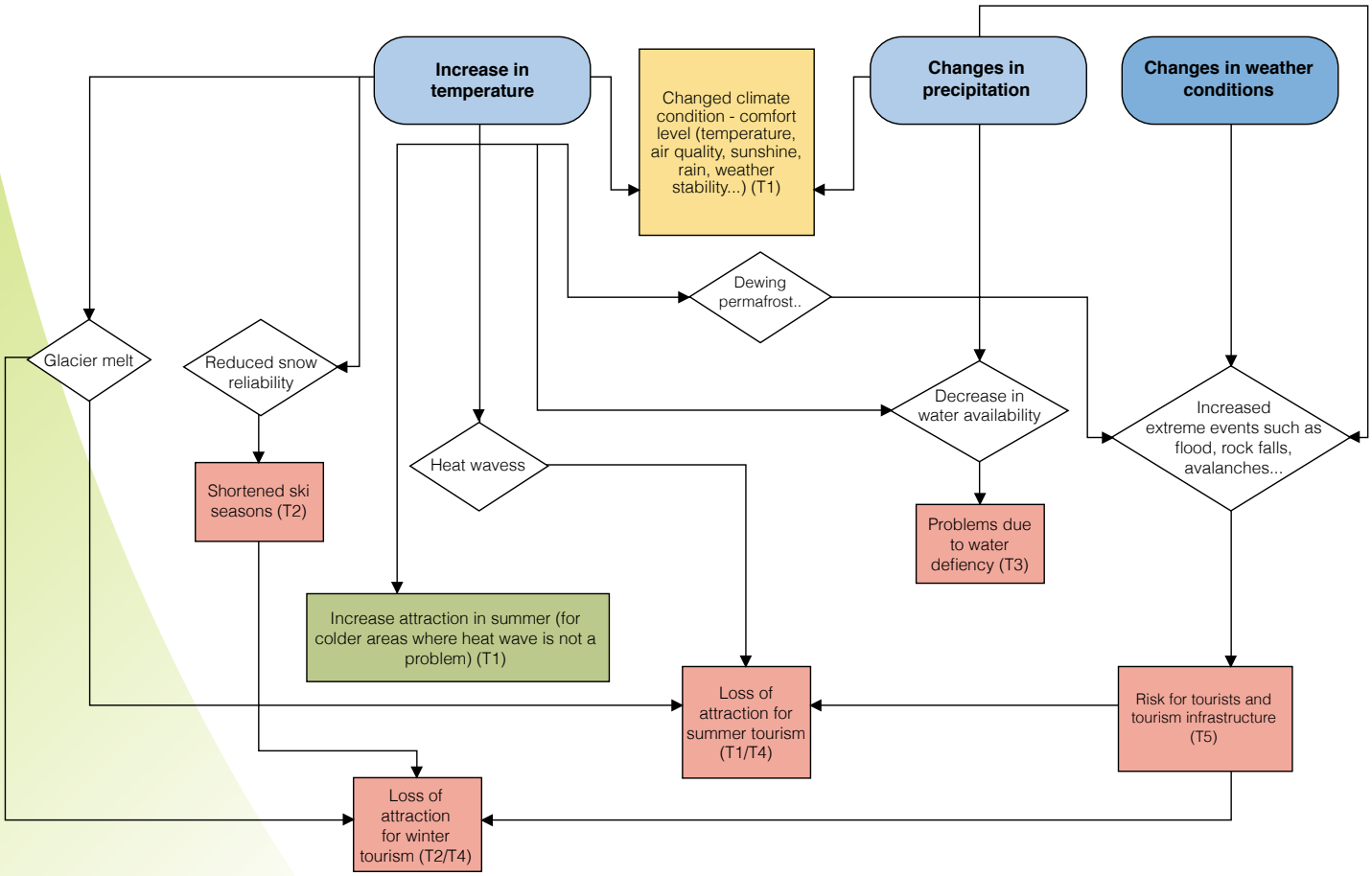
Climate change impact chains – Forestry



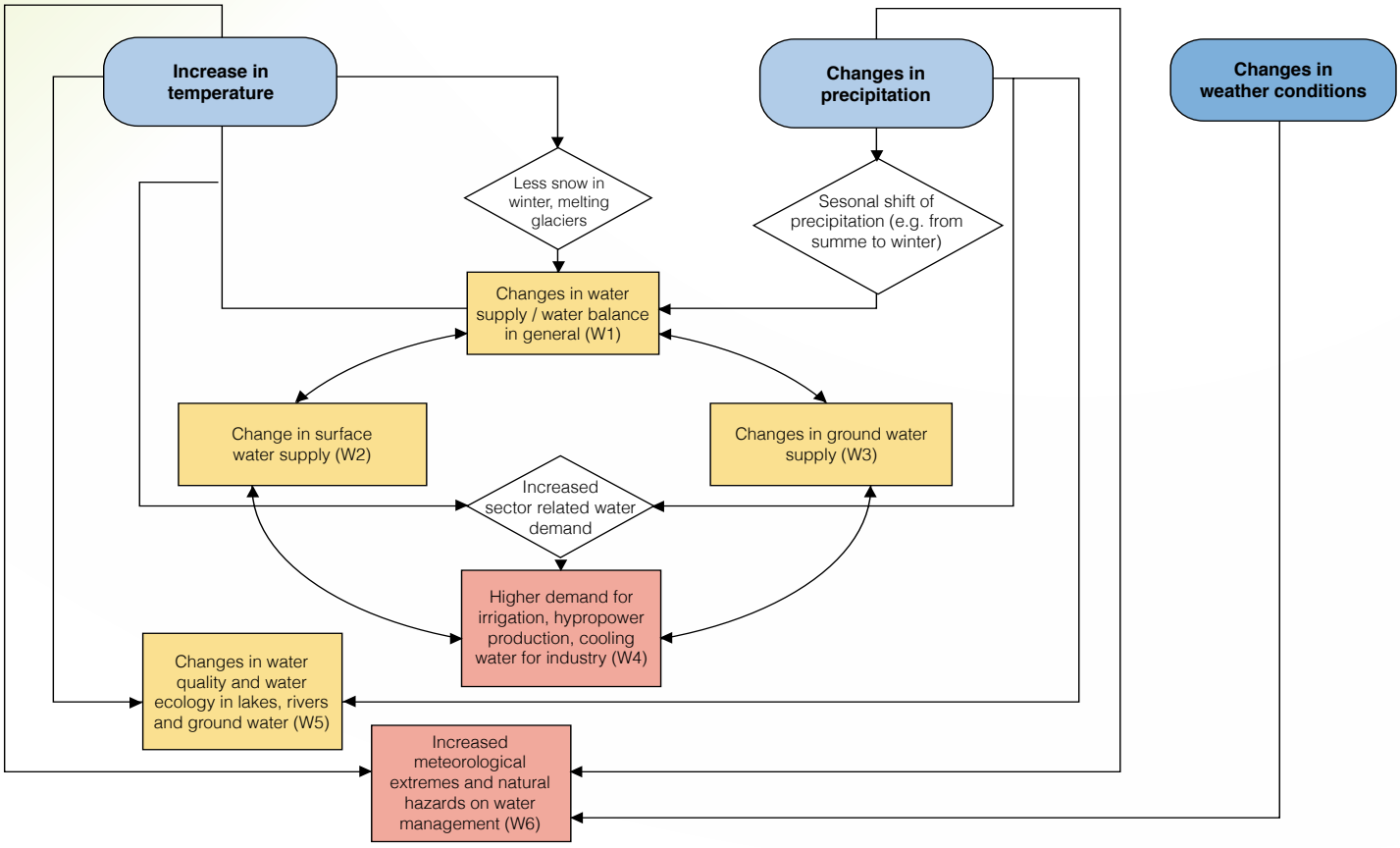
Climate change impact chains – Health



Climate change impact chains – Tourism



Climate change impact chains – Water management



Back to Step 1 or Back to Step 2

CLISP Climate Change Fitness Assessment Criteria

To monitor action point 5.2 and action point 5.3 (cf. chapters 2 and 3) in detail, common evaluation criteria and evaluation standards were developed together with the planning authorities. These then carried out the evaluation in the form of a self-assessment with the support of scientific partners. The overall criteria and evaluation standards are the following:

	Overall Criteria	Example for CLISP Model Region/Case Study-Specific		
		Targets	**Indicators**	**Evaluation Standard**
A Concerning the CLISP Model Region context and the spatial and thematic focus	**1. Priorities for Climate Change adaptation:** Which are the priority sectors for climate adaptation in the CLISP Model Region? What are the main adaptation requirements for the CLISP Model Region from the perspective of spatial planning?	1. Priorities for climate adaptation are set. 2. Available information is identified. 3. Knowledge gaps are identified. 4. The main adaptation requirements are identified.	1. Guiding principles, e.g. in the regional climate change strategy. 2. Expert knowledge, e.g. in a consultant report. 3. Alternative scenario, e.g. for water availability	For example: 1. Available/not available. 2. Quality /sufficiency of knowledge on a scale of 1 (none) to 7 (high).
	2. Problem awareness & political will to take action on climate adaptation action: What is the status of problem awareness and political will to implement activities fostering climate adaptation?	1. Problem awareness exists among the actors involved. 2. Political will for climate adaptation exists. 3. Barriers and reasons for a lack of problem awareness and political will are identified.	1. Public debate, media. 2. Current projects and publications; political and expert commissions; government decisions on climate. adaptation; budget decisions; adaptation strategy.	For example: Intensity of public debate on a scale of 1 (no debate) to 7 (very intense). Projects and publications available/not available. Description of barriers.
B Concerning the instrumental focus	**3. Relevance of adaptation priorities:** How relevant is the selected instrument to climate adaptation in the CLISP Model Region?	1. The selected planning instrument/procedure is relevant to climate adaptation in general. 2. The selected planning instrument/procedure is relevant to the priority sector of interest. .	Qualitative description of the relevance of the selected instrument based on your own expert judgement, on interviews with planning experts and practitioners, stake-holders, and a monitoring or evaluation report.	For example: 1. Relevance on a scale of 1 (none) to 7 (very high).
	4. Flexibility/stability[1] : How flexible/stable are decision-making processes and amendments to existing instruments? How flexible/ stable is the interpretation of planning instruments in the implementation process? How relevant is the flexibility or stability of the chosen instrument to climate adaptation?	1. Decision process is flexible. 2. Amendment process is flexible. 3. Interpretation of the instrument is flexible.	1. Decision-making process. 2. Planning horizon, planning cycles (revisions, amendments) in the last 30 years. 3. Extent of scope for interpretation.	For example: 1. Decision-making process a) within planning authority; b) by government; c) by regular individuals. 2. Amendment every 3/5/7/10 years.

[1] Flexibility and stability are two states of the same continuum. Spatial planning has to deal with the dilemma that on the one hand adaptation to climate change requires planning instruments that are flexible to adjust rather quickly to changes in order to prevent damages; on the other hand societal and economic development depends on a stable and reliable planning system.

	5. Binding nature: How binding is the instrument or procedure, and how relevant is the binding nature of the chosen instrument or procedure to climate adaptation?	1. Content of the instrument is binding upon planning authorities. 2. Content of the instrument is binding upon landowners.	1. Binding upon authorities. 2. Binding upon landowners.	For example: Binding nature: high/low; relevance of binding force to climate adaptation on a scale of 1 (not relevant) to 7 (very relevant).
	6. Coherence, synergies and conflicts: Are the instrument, its adaptation-related contents, and the planning procedure coherent within the vertical system of spatial planning? Is there coherence with sectoral planning? Are there synergies or conflicts with sectoral planning?	1. The instrument and its adaptation activities are coherent with sectoral planning. 2. Conflicts and synergies with other instruments have been identified. 3. Conflicts and synergies have been resolved/ coordinated with sectoral planning and other objectives.	Qualitative description of the relationship with other plans/ objectives, and of conflicts and synergies.	For example: 1. Coherence with other objectives on a scale of 1 (low) to 7 (high). 2. Conflicting potential on a scale of 1 (low) to 7 (high).
C Concerning the implementation	**7. Effectiveness, efficiency and feasibility:** How effective, efficient and feasible is the implementation of adaptation activities within the instrument/procedure?	1. Implementation of adaptation activities is a) effective. b) politically feasible. c) financially feasible. d) efficient in terms of costs and benefits. e) possible within a reasonable time frame. 2. Implementation of adaptation activities according to sustainable spatial development	1. Examples and experience of successful implementation with political support. 2. Examples of projects realised on a balanced budget. 3. Impact assessment; cost/ benefit analysis; consecutive costs have been reduced. 4. Time management, monitoring. 5. Sustainable impact assessments.	For example: Financial feasibility on a scale of 1 (low) to 7 (high) Description of the effects of adaptation activities.
	8. Collaboration with sectoral planning; participation and stakeholder consultation: How do you assess collaboration with sectoral planning? Do participation and stakeholder consultation foster or hinder adaptation activities?	1. Spatial planning and sectoral planning collaborate sufficiently in the implementation of Climate Change activities. 2. Stakeholder participation strengthens the implementation process.	1. Number and quality of conflicts, number and quality of synergies, unexpected side effects 2. Key actors	For example: Participation on a scale of 1 (none) to 7 (very intensive).
	9. Enhancement options: Where do you see the main enhancement options to foster climate adaptation as part of the instrument's implementation? Which factors enable or hinder the realisation of the enhancement options?	1. Enhancement options to foster Climate Change adaptation exist and are identified. 2. Factors that enable or hinder Climate Change adaptation are identified	1. Amendments 2. Evaluation reports. 3. Qualitative description of the internal assessment of enhancement options.	For example: Implementation of enhancement options on a scale of 1 (not implemented) to 7 (high implementation rate).

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CLISP Climate Change Fitness Checklist

The CLISP Climate Change Fitness Checklist will help you with your actual climate change fitness assessment. The checklist is especially helpful when reviewing the adaptation performance of your spatial plan. It also helps you to identify the strengths and weakness of spatial planning policies and instruments.

1 My spatial planning policy or instrument is fit for climate adaptation, if regional adaptation challenges are addressed.

Rationale:
Climate adaptation must to be informed and evidence-based.
Climate adaptation must to respond to current climate sensitivities and future climatic changes, climate change impacts, and vulnerabilities.
Climate adaptation action needs to consider the regional context and to be regionally specific.

Regional adaptation challenges are addressed by providing …:

Open, green and blue spaces: My spatial planning policy or instrument provides regulations, designations or content for:

- The conservation of open space ✔
- Ecological landscape connectivity (e.g. networking of protected areas, wildlife corridors, migration axes) ✔
- Corridors for runoff water ✔
- Networks of green and blue spaces in urban areas and agglomerations („green infrastructure“) ✔
- Brownfield site recycling ✔
- Preservation of natural carbon sinks (e.g. wetlands, peat bogs) ✔

Heat in urban areas: My spatial planning policy or instrument provides regulations, designations or content for:

- Fresh air corridors for urban areas and agglomerations ✔
- Greening of inner courtyards, rooftops, facades and roadside areas; ensurin green and blue areas of sufficient size and functional structure ✔
- Cooling of rooftops ✔
- Urban gardening ✔
- Bioclimatically favourable orientation of buildings, windows and facades ✔
- Ensuring sufficient shade ✔

Water resources: My spatial planning policy or instrument provides regulations, designations or content for:

- Priority areas for securing ground and drinking water resources (ground water bodies, ground water renewal areas, drinking water extraction areas) ✔
- Support for integrated watershed and river basin management ✔
- Support for inter-municipal water transfer (regional water supply networks) ✔
- Cross-sector coordination with water management policies and concepts ✔
- Strict assessment of water-intensive land uses and projects in areas prone to water scarcity ✔
- Compact settlement structures that allow households to be connected cost-effectively to the public water supply network ✔

Tourism: My spatial planning policy or instrument provides regulations, designations or content for:

- Hazard maps, hazard zones, hazard indices and other hazard-related information ✔
- Support for alternatives to snow-dependent winter tourism ✔
- Stricter assessment of new winter tourism infrastructures before approval ✔

Natural hazards: My spatial planning policy or instrument provides regulations, designations or content for:

- Hazard zones, hazard maps, hazard indices and other hazard-related information ✔
- Preventing the zoning of building land in hazard zones ✔
- Re-zoning of existing building land in hazard zones ✔
- Securing and restoring flood runoff and retention areas (priority areas for passive flood prevention) ✔
- Display of areas exposed to residual risk ✔
- Active risk management (areas earmarked for structural protection measures) ✔
- Maintenance and improvement of the protective functions of protective forests ✔
- Prescription of individual risk precautions for buildings and real estate potentially exposed to natural hazards (e.g. in structural building plan) ✔
- Compact, appropriately dense, inward-oriented settlement development ✔
- Support for inter-municipal and inter-regional cooperation and cost-benefit sharing models in flood risk management ✔

Energy: My spatial planning policy or instrument provides regulations, designations or content for:

- Compact, low-carbon and energy-efficient settlement structures and transport infrastructures ✔
- The optimised exploitation of solar energy generation potential in urban areas (e.g. favourable orientation of rooftops and building facades) ✔
- Compact and dense settlement structures suitable for centralised long-distance heating and cooling ✔
- Identifying and securing areas suitable for renewable energy generation (e.g. biomass, solar energy, wind farms) ✔

Transport and other technical infrastructure: My spatial planning policy or instrument provides regulations, designations or content for:

- Hazard zones, hazard maps, hazard indices and other hazard-related information ✔
- Active risk management and protection measures for critical infrastructures ✔
- Support for the disturbance-tolerant and resilient design of infrastructure net works (e.g. redundancies in critical supply infrastructures, avoiding the bundling of strategic transport and supply infrastructures within the same corridor) ✔

2 My spatial planning policy or instrument is fit for climate adaptation if decision making processes are well connected and coordinated across different levels and policy fields or sectors.

Rationale:

Climate adaptation is a cross-cutting task that needs the involvement of stakeholders and planning domains from all sectors to be effective.

Characteristics of well-connected decision-making processes:

- Strong expert network is set up across all relevant sectors and institutions ✔
- Climate change adaptation is accepted by every stakeholder as an everyday planning issue ✔
- Risk communication concept is in place ✔
- Risk governance process is in place ✔

3 My spatial planning policy or instrument is fit for climate adaptation if the shared benefits of linking adaptation to mitigation and regional development are achieved.

Rationale:
Climate adaptation needs to be strategically aligned with other strategies to be effective.

Characteristics of the shared benefits of linking adaptation to mitigation and development:

- Coordination and cooperation mechanisms with other strategies are in place ✔
- Synergies and potential conflicts are identified and addressed ✔
- Adaptation options have been audited for possible negative effects on sustainability, the environment, social groups, and other sectors ✔
- Adaptation options have been checked for maladaptation risks ✔
- Priorities for climate adaptation are set and coordinated with other relevant strategies ✔

4 My spatial planning policy or instrument is fit for climate adaptation, if adaptive capacity is high and/or increasing.

Rationale:
Climate adaptation is an ongoing and iterative process and needs to bring about transformation.

Characteristics of high/increasing adaptive capacity:

- Political will for adaptation exists and is strong ✔
- Policy makers and stakeholders are aware of the need for action ✔
- Sufficient resources are available ✔
- Implementation is ongoing ✔
- Incentives and national/regional climate change adaptation programmes are in place ✔
- Uncertainties are dealt with in a pro-active and precautionary approach ✔
- No/low-regret measures have been identified and are being implemented ✔
- Planning instruments and procedures are flexible enough to cope with climatic changes and to respond to the availability of enhanced and new knowledge ✔
- Short-term action considers long-term climatic processes ✔
- Adaptive planning and management procedures, including monitoring and evaluation, are being applied and linked with regular revision cycles for spatial plans ✔

5 My spatial planning policy or instrument is fit for climate adaptation if a sound system of monitoring regional climate change impacts or risks is in place (with particular reference to spatial planning).

Rationale:
Climate adaptation needs to understand the regional adaptation challenge better.

Characteristics of sound monitoring:

- A monitoring system for spatially relevant climate change impacts has been established. ✔
- Examples of indicators for monitoring regional climate change impacts include the size of heat islands, and damage potential per zoning area. ✔

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CLISP Climate Change Fitness Report

The report consists of two parts: an executive summary and a detailed main part. The executive summary should focus on the main results and not exceed approx. 10 pages. Please follow the general table of content and the guiding questions as a common structure. The questions under each heading illustrate what sort of content is recommended for the synthesis. In the main part of the report the results may be elaborated in length and the structure adjusted in a way that fits best the specific evaluation design in your region.

A Executive Summary

1 Introduction

1.1 Description of the region

- Which are the characteristics of your region (incl. sub-region(s) or muni cipalities)? In which way are they representative or relevant for the region? In which way are they exposed to expected regional climate change (priority sectors of concern)? Which are the expected climate change impacts on the sectors relevant to spatial development?
- Which are the main adaptation requirements and impact chains concerning your region out of the perspective of spatial planning?
- Which are the spatial planning instruments or procedures which potentially could meet those requirements?

1.2 Methods and evaluation criteria

- Which evaluation criteria, targets, indicators and evaluation standards have been chosen to evaluate the climate change fitness of the selected instrument/procedure? Which are most important?
- Which methods have been used during the evaluation process?

2 Evaluation of selected instruments or procedures

2.1 Description of evaluated instruments or procedures

- What is the objective of the instrument? Special characteristics?
- In which way is it potentially relevant for climate change adaptation? In which way can it reduce the vulnerability of the chosen area?
- How is the instrument implemented?

2.2 Assessment of evaluated instruments or procedures

- Which are the current approaches/solutions to meet the challenges of climate change?
- In which way does it foster the climate change fitness of spatial planning? Please consider your list of criteria and targets.
- In which way has the instrument or procedure been able to reduce vulnerability in the chosen sub-region or municipality? Give examples.
- Which are the main strengths and potentials of the instrument/procedure and of its implementation concerning climate change fitness? Please consider your list of criteria and targets.

- Which are the main weaknesses and constraints of the instrument/ procedure and of its implementation concerning climate change fitness? Please consider your list of criteria and targets.
- Which are the main enhancement options for the chosen instrument/ procedure and for its implementation in order to improve the climate change fitness? Please consider your list of criteria and targets.

3 Conclusion and Summary

3.1 Climate change fitness

- How „fit“ are the spatial planning instrument(s) or procedure(s) considering their potential impact as well as their current implementation?

3.2 Enhancement Options

- What are the main enhancement options for fostering the climate change fitness within the region?
- What priority adaptation options have been identified as the result of analyzing priorities and trade-offs as well as of evaluating the sustainability and robustness of the enhancement options?

3.3 Lessons learned

- What are the lessons learned from the in-depth evaluation of the selected planning instrument(s) or procedure(s)?

B Report

Following the same structure at length, adjustment of the structure is possible. The assessment and its results should be comprehensible to any reader.

C References and Annex

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Decision Tools Supporting Climate Change Adaptation

UKCIP Adaptation Wizard

The UKCIP Adaptation Wizard is a tool to help your organisation adapt to climate change. It will take you through a 5-step process that will help you to assess your organisation's vulnerability to current climate and future climate change, identify options to address your organisation's key climate risks, and help you develop and implement a climate change adaptation strategy. The Wizard is also a guide to the information, tools and resources available from UKCIP to help organisations plan how to adapt.

Reference: UKCIP 2010 www

UKCIP LCLIP – Local Climate Impact Profiles

The phenomenon of climate change continues to move up the local government agenda. As it does, councils and other organisations are becoming increasingly aware of the potential impacts of a changing climate and the need to develop adaptation responses. But, is it changing weather events or a changing climate to which local councils must adapt? These pages describe Local Climate Impacts Profile (LCLIP): a simple tool designed to help organisations to assess their exposure to weather and climate. The LCLIP process highlights a locality's vulnerability to severe weather events and how these events affect local communities as well as local authority assets, infrastructure and capacity to deliver services. An LCLIP is a pragmatic, and effective, starting point for a better understanding of the future.

Reference: UKCIP 2009 www

Climate Adaptation Atlas: strategic tool for decision making on climate change

The Climate Adaptation Atlas (CAA) discloses spatial information on climate change impacts to a wider audience. The Atlas is a discussion/decision support tool. The easily accessible database - or geoportal – with an emphasis of visualizing information by means of G.I.S. makes the information comprehensible for a wider public and allows local governments to work towards a climate-proof future. The CAA has been developed for the Netherlands. It's methodology has proven to be successful in supporting governments to develop adaptation strategies. This methodology can be applied internationally. Countries working on climate adaptation face the same problems: What is the impact? How can we adapt? How can I make information accessible for stakeholders and policy makers? Therefore, as a discussion/decision support tool the Climate Adaptation Atlas can be very attractive globally. The atlas is being developed by a consortium consisting of knowledge institutes (Alterra-Wageningen UR, Deltares, KNMI) and consultants (DHV Group, Geodan Next) in close collaboration with regional stakeholders and governments. The CAA contains information about projected impacts of regionalized climate change scenarios, including flooding, ecosystem shifts, urban heat island effect and agricultural production. The Atlas is successfully being applied in numerous workshops and design sessions with different groups of stakeholders.

Reference: Goosen et al. 2009 www

ESPACE Climate Change Impacts and Spatial Planning Decision Support Guidance

The ESPACE (European Spatial Planning: Adapting to Climate Events) project was funded by the European Commission's North West Europe INTERREG IIIB Programme, the ESPACE Partnership and the Department for Communities and Local Government. ESPACE recommends how adaptation to climate change can be incorporated into spatial planning policies, processes and practices. Concentrating on water management issues, it was one of the first projects of its kind to focus on increasing awareness of the need for spatial planning systems to adapt to the impacts of climate change and to begin to provide some of the necessary policy guidance, tools and mechanisms to incorporate adaptation into planning systems and processes.
Reference: ESPACE 2008 PDF

EEA/ETC's 10 Guiding Principles for Good Adaptation

1. Initiate adaptation, ensure commitment and management
2. Build knowledge and awareness
3. Identify and cooperate with relevant stakeholders
4. Work with uncertainties
5. Explore potential climate change impacts and vulnerabilities and identify priority concerns
6. Explore a wide spectrum of adaptation options
7. Prioritise adaptation options
8. Modify existing policies, structures and processes
9. Avoid maladaptation
10. Monitor and evaluate systematically

Reference: ETC/ACC 2010 PDF

OECD Policy Guidance on Integrating Climate Change Adaptation into Development Co-Operation

The OECD has recently developed a Policy Guidance with information and advice on how to facilitate the integration of adaptation within development processes. While efforts to integrate climate change adaptation will be led by developing country partners, international donors have a critical role to play in supporting such efforts as well as in integrating consideration of adaptation within their own plans and activities. To this end, partners and donors alike need operational guidance. The objectives of the OECD Policy Guidance are to: i) promote understanding of the implications of climate change on development practice and the associated need to mainstream climate adaptation in development co-operation agencies and partners countries; ii) identify appropriate approaches for integrating climate adaptation into development policies at national, sectoral and project levels and in urban and rural contexts; and iii) identify practical ways for donors to support developing country partners in their efforts to reduce their vulnerability to climate variability and climate change.

Reference: OECD 2009 www

Future Cities Adaptation Compass

The Future Cities Adaptation Compass is a guidance tool for developing climate-proof city regions. It interlinks the different stakes of adaptation needs within a city. The computer-aided guide is being developed by the Future Cities project partners based on their practical experiences and will be available in 2012.

Reference: Future Cities Project Partnership 2010 PDF www

UBA KomPass Klimalotse – Leitfaden zur Anpassung an den Klimawandel [Guideline for Adaptation to Climate Change]

The „Klimalotse“ supports organisations to deal actively and systematically with climate impacts and adaptation: from sensitization to the development of adaptation measure and strategies to implementation and evaluation. The “Klimalotse” offers structures, guiding questions, methods and examples supporting decision making. It is not producing a climate adaptation strategy but rather starts the discussion about adaptation in organisations and inspires the development of adaptation measures and strategies. The guideline is built up of five components sketching a general adaptation process. There is three version available from 30 minutes to one or more days depending on your time budget. Also, there is an offline version available. The “Klimalotse” is only available in German.

Reference: Kind/Mohns 2010 PDF www

BBSR KlimaExWost Stadtklimalotse

Climate change confronts cities with new challenges. They have to face the causes and consequences of climate change with new urban concepts. Climate friendly urban development demands for integration of social, ecological and economical aspects. Additionally, complexity and uncertainty confront decision makers with particular difficulties. Until today only few and mostly large cities developed concepts to face climate change. Particularly medium and small sized municipalities lack (human) resources and capacities restraining them in developing appropriate adaptation strategies. This is the point of departure of KlimaExWoSt: Current problems and constraints are analysed and approaches for a climate friendly urban development are tested within this project. The following topics are focused: Principles of climate friendly urban development, decision support for urban development, international examples for climate-friendly urban development, adaptation strategies on different regional levels. Based on scientific evidence a decision support system (DSS) was developed focusing on German municipalities as central actors. This DSS called "Stadtklimalotse" (city climate guide) supports the identification and implementation of appropriate measures for mitigation and adaptation in urban development. The "Stadtklimalotse" is only available in German.
References: BMVBS/BBSR 2009a, BMVBS/BBSR 2009b www

OECD Climate Lens

A climate lens is an analytical tool to examine a strategy, policy, plan, programme or regulation. The application of such a climate lens at the national or sectoral level involves examining: (i) the extent to which a measure – be it a strategy, policy, plan or programme – under consideration could be vulnerable to risks arising from climate variability and change; (ii) the extent to which climate change risks have been taken into consideration in the course of the formulation of this measure; (iii) the extent to which it could increase vulnerability, leading to maladaptation or, conversely, miss important opportunities arising from climate change; and (iv) for pre-existing strategies, policies, plans and programmes which are being revised, what amendments might be warranted in order to address climate risks and opportunities. For example, planned development of certain geographical zones (e.g. coastal areas vulnerable to sea-level rise and storm surges) or sectors (such as hydropower in the energy sector) may be viewed in a different light when the medium- to long-term risks posed by climate change are taken into consideration. The application of a climate lens to a policy, strategy, regulation, plan or programme can help improve its general directions and priorities.
Reference: OECD 2009 www

BBSR Regionaler Handlungs- und Aktionsrahmen Klimaanpassung („Blaupause“): Schritt für Schritt zur regionalen Klimaanpassung (Regional action framework for climate adaptation („blueprint“): step by step towards regional climate adaptation)

The regional action framework for climate adaptation („blueprint“) developed by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development is addressing municipal stakeholders. The “blueprint” offers decision support for urban and regional climate adaptation strategies and action plans. 12 steps for climate adaptation are proposed:

1. Why should preventative mitigation activities be complemented by adaptation measures?
2. Which spatially relevant climate change impacts do affect my region?
3. What are the vulnerable features of my region, and where are they located?
4. What are the climate change risks in my region? What are the opportunities of climate change in my region?
5. What is the value of climate adaptation in the weighting to other issues?
6. Who should be responsible for the process of awareness raising and taking action on climate adaptation in my region?
7. What are the climate adaptation actions ?
8. How are these actions going to be implemented? Which instruments are appropriate?
9. Who should be involved in the awareness raising and action process on climate adaptation?
10. How should the awareness raising and action process on climate adaptation be institutionalised?
11. What are the goals of awareness raising and climate adaptation action in my region?
12. How could the climate adaptation strategy be promoted towards citizens and decision makers?

Reference: BMVBS/BBSR 2009c PDF

Transnational European Projects

- ADAGIO Adaptation of Agriculture in European Regions at Environmental Risk under Climate Change www
- ADAM Adaptation and Mitigation Strategies – Supporting European Climate Policy www
- AdaptAlp Adaptation to Climate Change in the Alpine Space www
- ALP-FFIRS Alpine Forest Fire Warning System www
- AlpWaterScarce Water Management Strategies against Water Scarcity in the Alps www
- AMICA Adaptation and Mitigation – an Integrated Climate Policy Approach www
- ASCCUE Adaptation Strategies for Climate Change in the Urban Environment www
- ASTRA Developing Policies & Adaptation Strategies to Climate Change in the Baltic Sea Region www
- BaltCICA Climate Change: Impacts, Costs and Adaptation in the Baltic Sea Region www
- BalticClimate Baltic Challenges and Chances for local and regional development generated by Climate Change www
- BRANCH Biodiversity Requires Adaption in Northwest Europe under a Changing climate www
- CapHaz-Net Social capacity building for natural hazards: Toward more resilient societies www
- CCTAME Climate Change — Terrestrial Adaption and Mitigation in Europe www
- CIRCLE 2 Climate Impact Research for a Larger Europe www
- ClimAlpTour Effects of climate change on Alpine tourism www
- ClimChAlp Climate Change, Impacts and Adaptation Strategies in the Alpine Space www
- CLIMSAVE Climate change integrated assessment methodology for cross-sec toral adaptation and vulnerability in Europe www
- ESPACE European Spatial Planning — Adapting to Climate Events www
- ESPON CLIMATE Climate change and territorial effects on regions and local economies www
- GRaBS Green and Blue Space Adaptation for Urban Areas and Eco Towns www
- MANFRED Management strategies to adapt Alpine Space forests to climate change risk www

- MEDIATION Methodology for Effective Decision Making on Impacts and Adaptation www
- mountain.TRIP Mountain Sustainability: Transforming Research Into Practice www
- PARAmount Improved accessibility: reliability and security of Alpine transport infrastructure related to mountainous hazards in a changing climate www
- PermaNet Permafrost Long-Term Monitoring Network www
- PESETA Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis www
- RESPONSES European responses to climate change: deep emissions reductions and mainstreaming of mitigation and adaptation www
- SILMAS Sustainable Instruments for Lakes Management in the Alpine Space www

Websites

- Alpine Convention, Climate Portal www
- European Environment Agency, Climate Change www
- DG CLIMA – Directorate-General for Climate Action www
- KlimaPortal (ProClim-) www
- Klimawandel-Anpassung in Österreich www
- KomPass – Kompetenzzentrum Klimafolgen und Anpassung www
- Climate Service Center (CSC) Germany www
- Plattform Klimawandel und Raumentwicklung www
- CIPRA cc.alps – Klimawandel: Einen Schritt weiter denken! www

Glossary

Adaptation

Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones, etc. (IPCC 2007).

Adaptive capacity

The whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures (IPCC 2007).

Climate Change Impacts

The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts: (a) Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation; (b) Residual impacts: the impacts of climate change that would occur after adaptation (IPCC 2007).

Climate Change Fitness

Climate change fitness refers to the capacity of spatial planning systems to adapt spatial development and existing spatial structures to climate change impacts, i.e. to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. Spatial planning instruments and processes are “fit” for climate change when they support and deliver adaptation, including by raising problem awareness and willingness to adapt, strengthening preparedness and the ability to react to climate change impacts, increasing the resilience of societies, raising flexibility of spatial planning systems to respond to climatic changes and connected uncertainties, and integrating short term planning horizons with long-term climate change (CLISP Working Definition).

Climate Proofing

Climate proofing comprises methods, instruments and procedures that guarantee that plans, programmes and strategies and related investments are made resilient and adaptable to the present and future impacts of climate change and that moreover contribute to the objectives of climate change mitigation (Birkmann/ Fleischhauer2009).

Resilience

The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change (IPCC 2007).

Spatial Planning

Spatial planning [Raumordnung, Raumplanung] refers to the various actions taken within a particular territory at various scales with the purpose of affecting or influencing the spatial development of the community, of industry and commerce, and of the natural, built and social environment. Spatial planning activities are carried out at different administrative or governmental levels. Spatial planning is the cover term which embraces different tiers of supra-sectoral planning, e.g. federal spatial planning; state spatial planning, which includes regional planning; and local/urban land-use planning. Taken together, these different planning tiers constitute a coherent spatial planning system. The supra-sectoral and co-ordinating remit which is a central aspect of the planning system means that spatial planning has to be seen as legally, organisationally and materially distinct from spatially relevant sectoral planning (cf. CEMAT 2007, COMMIN 2007).

Stakeholder

A person or an organisation that has a legitimate interest in a project or entity, or would be affected by a particular action or policy (IPCC 2007).

Uncertainty

An expression of the degree to which a value (e.g., the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures, for example, a range of values calculated by various models, or by qualitative statements, for example, reflecting the judgement of a team of experts (see Moss and Schneider, 2000; Manning et al., 2004) .

Vulnerability

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC 2007).

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