5 Determine the Need for Action and Select Measures

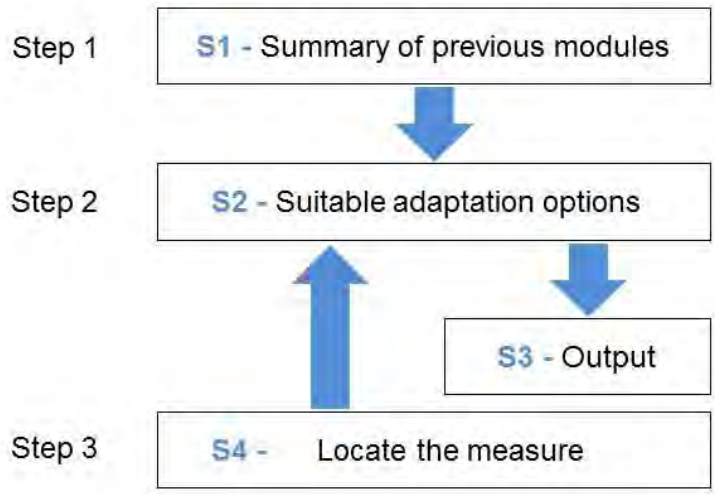
With this module the previously collected information and assessment steps are summarised and are matched with suitable types of adaptation measures. The result is a list of core problems which are to be addressed by measures, e.g. urban structures which are likely to heat up too much in an area where many older people live. In the list of adaptation measures, suitable actions and combinations of measures are given which will help mitigate the core problems. Additionally, guidance is provided on how locations for the implementation of the selected adaptation measures can be found.

5.1 Purpose of the module and proceeding

This module represents the conclusion from the previous modules and the previous work done. The purpose is to

- combine and consolidate work done in the previous modules
- select the types of adaptation measures suited best for the identified vulnerabilities and risks
- find the locations for implementing the selected adaptation options most effectively.

On the basis of these three goals three steps are provided:



Key terms

Vulnerability

The degree to which a system is susceptible to and unable to cope with adverse climate or weather induced impacts. Vulnerability is a function of sensitivity (assessed in “Select Receptors” and “Former Events”) and exposure (assessed in part “Spatial Relevance”) of a receptor to the weather impacts and the capacity to adapt towards those condition.s

Reinforcing

Climate change impacts the parameters in an intensifying way: extremes are amplified and therefore, identified problems will increase.

Indifferent

The climate change trends are not significantly changing the current situation; therefore, identified problems stay the same.

Balancing

Climate change impacts the parameters in a balancing way: weather extremes are moderated and therefore, identified problems will ease.

Adaptation options

= adaptation measures

Step 1: Summary of previous modules

First, when entering the module, you will see the results of the three modules:

- **Check vulnerability**: the identified class of vulnerability is given for each selected receptor and weather sensitivities.

  High – medium – low

- **Understand climate change impacts:** the impacts of climate changes on the receptors are repeated.

  Reinforcing – indifferent – balancing

- **Assess Risks and Opportunities:** based on the results of the modules on vulnerabilities and climate changes, the future risks have been determined in the module "Assess Risks and Opportunities". These are displayed again for each selected receptor and sensitivity.

  Very high – high – medium – low

If you realise that the outputs shown here are not correct for your situation or that important things are missing, please go back to the respective module to revise your input information.

S1 – Summary of previous modules

This table shows you the summarised results of your vulnerability check, the climate change trends and the concluded future risks.

Read through the results and check if the information is correct, according to your understanding of your city.

If yes, proceed to the next page. If not, please go back to the respective module and revised your input data.

Receptors and sensitivities	You have identified the following vulnerabilities:	Impact of climate changes regarding sensitivities:		Thereof arising risks identified:	
		Summer	Winter	Summer	Winter
ublic health / vulnerable groups - Heat wave	medium	reinforcing	n/a	**high**	**n/a**
ublic health / vulnerable groups - Extreme cold	medium	n/a	balancing	**n/a**	**low**
ublic health / vulnerable groups - Drought	medium	reinforcing	balancing	**high**	**low**
ublic health / vulnerable groups - Heavy precipitation / Floods	medium	reinforcing	indifferent	**high**	**medium**
ublic health / vulnerable groups - Storm	medium	balancing	reinforcing	**low**	**high**

After having read through the summarised results already collected in the previous modules and approving with them, the next page, S2, shows you a list of suitable adaptation options.

Step 2: Select suitable adaptation options

The suitable types of adaptation measures are already sorted according to your core problems determined in the previous modules. The list includes only structural measures, as raising awareness measures are tailored to a specific situation and are therefore not problem-specific.

The basis for the allocation of the adaptation options is the table of addressed problems, provided in the module "**Explore Adaptation Options**", A2.

Key terms

Risks

In the FUTURE CITIES Adaptation Compass risk is the combination of the current vulnerability (high, medium, low) and the climate change impact (balancing, indifferent, reinforcing) and is categorised in the classes very high, high, medium, low.

Reminder on the revision of input:

If some of the receptors are not relevant for your situation, you can de-select them in the module **"Check vulnerability"** on the table V3.

There you can also change the class of vulnerability, which might for your city differ from the pre-set answers.

The climate change trends given in the module **"Understand Climate Change Impacts"** can also be changed if the direction is not correct in your region.

But please only change the given values **on the basis of facts**! Especially regarding the climate changes, people tend to "believe" or have doubts.

Furthermore, information on spatial scale and time frame for implementation is given in short keywords.

The table on addressed problems (A2) is the basis for the ranking of the types of adaptation measures. The method is based on the multi-criteria analysis approach: The risks identified (very high, high, medium, low) and the effects on the addressed problems (++, +, o, n/a and –) are weighed with numbers, as shown in the table below. The values for the risk categories and the effect on the problems are then multiplied. The adaptation measure with the highest number has the highest effect on the identified problems.

	Category / Criteria	Value
Risk category	Very high	10
	High	5
	Medium	2
	Low	1
Effect on problem	++	5
	+	2
	o	0
	n/a	0
	-	-1

Though, please keep the following issues in mind:

- Be aware that the number of types of adaptation measures integrated into the Adaptation Compass is limited. Therefore, the selection of suitable measures is **not comprehensive**; it can though provide a first overview on adaptation options, which should be developed further for your city or your situation.
- Moreover, this also means that the types of measures included in the Adaptation Compass are **not addressing all the problems you have potentially identified** in the previous steps. For some risks, the suitable types of adaptation measures are not represented in the Compass, e.g. for risks connected with agriculture or forestry. But you have the possibility to add more measures to the Compass in the module “Explore Adaptation Options”, if it is necessary for your specific situation. Collections of measures can be found e.g. on several national and international adaptation platforms (compare chapter 2.3 and 2.5).
- The types of adaptation measures included in the Compass were derived from the FUTURE CITIES’ experiences and lessons-learned. The types are hence **mainly focused on cities**. They are representing what can be done in the water system and regarding green structures. If you are applying the Adaptation Compass on a different scale than for a city, the measures might need to be altered and/or new measures have to be added.

Use maps to locate your measures

Mapping is the best instrument to find a good location for the implementation of your adaptation measures. The described steps can also be applied for mapping:

1) Map your problem areas and the distribution of your affected receptors.
2) Combine them.
3) Integrate further aspects like, e.g. existing projects in your city.

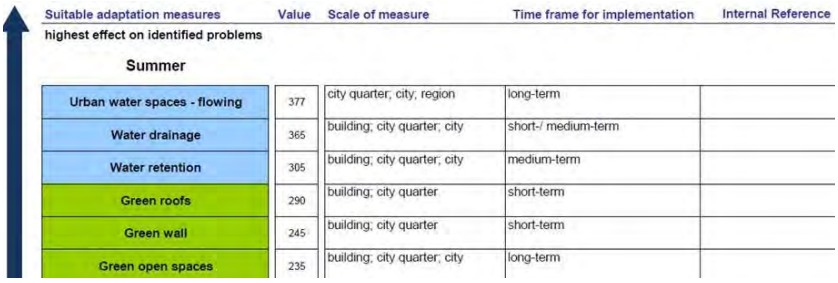
The order of appearance gives you a first impression on the possibilities you have and how these can be structured. To proceed in the selection of measures, you should gather more differentiated arguments concerning your specific situation.

S2 – Suitable adaptation options

The suitable adaptation options are sorted according to your core problems determined in the previous modules. The list includes only structural types of measures, as raising awareness measures are not problem-specific.

The basis for the allocation of the adaptation options is the table of addressed problems, provided in the module “Explore Adaptation Options”, A2.

By clicking on the Rank buttons below, you can see the suitable adaption measures for summer or winter.



Suitable adaptation measures highest effect on identified problems	Value	Scale of measure	Time frame for implementation	Internal Reference
Summer				
Urban water spaces - flowing	377	city quarter; city; region	long-term	
Water drainage	365	building; city quarter; city	short-/ medium-term	
Water retention	305	building; city quarter; city	medium-term	
Green roofs	290	building; city quarter	short-term	
Green wall	245	building; city quarter	short-term	
Green open spaces	235	building; city quarter; city	long-term	

If you want to change some input to see how it affects the selection of types of adaptation measures, please click through the sheets C2, R1 and A2 once more to make sure that the change is correctly taken into account.

The choice which of these listed measure types is implemented is of course up to you. Lots of different criteria other than adaptation may have to be considered, e.g. political and economic strategies/aims, local social aspects or demographic change. Please read chapter “Further aspects for selecting measures” to get some ideas. If you already have a preference for implementation, go further to learn how you could locate the measure.

Output

The output sheet gives an overview of the suitable adaptation options assessed for your city. There are text boxes where you can add comments about your work. You might also want to forward the results to colleagues, external experts and your superiors.

Evaluating the effects of adaptation measures on the addressed problems:

The table A2 in the module “Explore Adaptation Options” lists all types of adaptation measures and their addressed problems. The criteria for their evaluation are:

“++” Significant reduction of risks

“+” Reduction of risks

“o” If there is no impact to be expected

“–“ Increases risks or has a negative impact

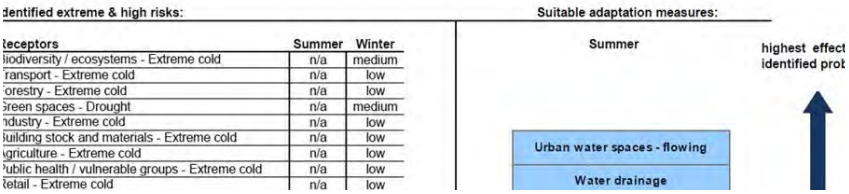
“n/a” No connection between the adaptation measure and the problem

S3 – Output / Summary

Comments: Please add comments. This might help others to understand the results of your selection.

Identified risks: The risks identified in module "Assess risks and opportunities" are listed here again, they are sorted according to the selection in S2 (summer or winter).

Suitable adaptation options: the types of measures are sorted according to your identified risks; Change the selection of summer or winter in S2.



dentified extreme & high risks:		
leceptors	Summer	Winter
iiodiversity / ecosystems - Extreme cold	n/a	medium
ransport - Extreme cold	n/a	low
orestry - Extreme cold	n/a	low
reen spaces - Drought	n/a	medium
ndustry - Extreme cold	n/a	low
uilding stock and materials - Extreme cold	n/a	low
griculture - Extreme cold	n/a	low
ublic health / vulnerable groups - Extreme cold	n/a	low
etail - Extreme cold	n/a	low

Step 3: Locate the measures

In the Compass you get advice on how to find a location where you can implement the chosen adaptation measure in your city. The Compass doesn't suggest one location where the measure should be implemented or build and no map tool is provided.

The searched location can be characterised as follows:

- **The potential for effective adaptation is high**,
  e.g. to set up a green space to create a climate oasis in the quarter is most effective if air exchange (wind channels) is guaranteed.
- **Further benefits are covered,**
  e.g. further urban development goals are reached.
- **A problem has already occurred there**,
  i.e. it is always easier to reach the people's and politician's acceptance if you solve an existing and possibly deteriorating problem.

To get a first idea about the location it is easiest to start with the question

(1) Where are my problems located?

In the Compass the addressed problems of your selected adaptation measure are displayed separately for the weather events and the receptors. Then, the locations are listed which were identified in the module "Check Vulnerability" in the descriptions of

- Former events for weather events and
- Spatial relevance for the selected receptors.

Probably, the same locations occur more than once on both sites. Therefore, as a second step, you need to

(2) Combine the information provided.

(3) Take into account further aspects

Use maps to locate your measures

Mapping is the best instrument to find a good location for the implementation of your adaptation measures. The described steps can also be applied for mapping:

1) Map your problem areas and the distribution of your affected receptors.
2) Combine them.
3) Integrate further aspects like, e.g. existing projects in your city.

Now, the impression you have about a potential location for implementing the adaptation measure is strongly dependant on the input information you filled in module “Check vulnerability”. Take into account further important aspects:

- **Always keep in mind the scale of the adaptation measure and your problem**, it is not the final solution to find one building where you could build a green façade, but your problem exists in the entire city quarter. Still, it could be the first step as part of a concept.
- **Climate change may also cause new problems in new locations** that are momentarily not known or expected.
- **Think cross-sectoral: Maybe other plans / projects or development goals can be combined with your measure**, e.g. the extension of a school building or the envisaged upgrade of a city quarter.
- **Use your existing resources:** Many cities have very good maps and geographical information systems. Maybe these could be developed further to facilitate future adaptation decisions? For an example on such a mapping project, see chapter 5.3.

S4 – Locate the measures

Here you get advice on how to find a location where it is suitable to implement the chosen adaptation measure in your city.

(1) Please choose the type of measure you want to locate from the drop-down list on top of the sheet.

(2) Previously collected data and information regarding the location of former extreme events and the spatial relevance should be checked again. You should go through the data and compare the locations given.

(3) Go through the further aspects that should be considered when searching for a good location to implement the adaptation options chosen.

(4) If you want to note your ideas for later use or colleagues, you can do so in the textbox given.

Key terms

Vulnerability

The degree to which a system is susceptible to and unable to cope with, adverse climate or weather induced impacts. Vulnerability is a function of sensitivity (assessed in “Select Receptors” and “Former Events”) and exposure (assessed in part “Spatial Relevance”) of a receptor to the weather impacts and the capacity to adapt towards those conditions (assessed in “Vulnerability Check”) (based on Smit & Wandel, 2006).

Risk

In the FUTURE CITIES Adaptation Compass risk is the combination of the current vulnerability (high, medium, low) and the climate change impact (balancing, indifferent, reinforcing) and is categorised in the classes very high, high, medium, low.

5.2 Further aspects for selecting measures

For choosing the adaptation measures you start to implement in your city, several criteria should be kept in mind:

→ Reduce your vulnerabilities and risks

The problems and risks identified in the modules “Check vulnerability” and “Assess risks and opportunities” should be approached. Especially the already existing problems, that will in future deteriorate are good starting points for adaptation. Furthermore, these problems will likely find political support.

→ Exploit opportunities

Climate change offers also opportunities, which can be exploited along the way, e.g. by building new green and water structures in a quarter, vulnerabilities are reduced and the quarter is upgraded.

→ Take into account regional and national legislation

There are two aspects to be considered:

- National / regional restrictions and regulations: There are of course different regulations in every country, which need to be checked before selecting an adaptation measure. Sometimes, your choice for a measure might be put into question, if e.g. the use of rain water is regulated restrictively.
- Political will and funding possibilities: Implementation of an adaptation process is also a political decision. Therefore, it is best to take into account the political will and funding options at an early stage of planning adaptation.

5.3 Experiences from FUTURE CITIES

Developing Urban Climate Recommendations in Arnhem

Mapping the city climate of Arnhem related to overheating is one step, determining the consequences of this diagnosis, is the second step needed. For this the city of Arnhem looked into the characteristics or land use of each ‘heated up’ area to determine whether it may lead only to uncomfortable situations or to serious health risks for certain social groups. The aim was to determine the urgency to act. This leads to a series of actions, such as highlighting areas that should be adapted to prevent serious health risks for its users and inhabitants, or building restrictions in areas to prevent building schemes that block cooling winds. Further actions comprise adaptive measures to improve the human comfort situation.

Key terms

Opportunities

In combination with climate change the term opportunities is used to describe the positive aspects of climatic changes for certain regions (see climate change impacts), e.g. hotter summer can influence the tourism sector positively