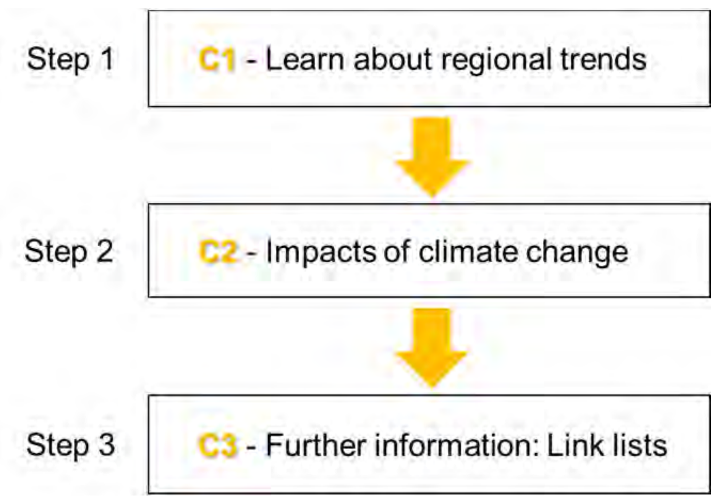
2 Understand Climate Change Impacts

Detailed research is being undertaken to determine the impacts of climate change. Nevertheless, climate models involve many assumptions about how the parameters will develop and interact. Almost every country is working on its own regional climate projection model derived from different global climate models. For some regions, various regional climate models are being used providing varying results. For a planner in the city the Adaptation Compass supplies practical information to guide you through questions such as:

- What do I need to know? What kind of information do I need?
- How can I handle uncertainties?
- Where can I get information?

2.1 Purpose of the module and proceeding

The module “Understand climate change impacts” consists of three sheets providing information:



Step 1: Learn about regional trends

For the regions of the FUTURE CITIES partners, trends for climate variables are provided, e.g. increase of temperature during summer. The trends are displayed with directions, not absolute values. A distinction between trends for summer and winter is necessary as some trends are directing in opposite ways.

The used parameters are **Air temperatures, Precipitation, Heavy precipitation, Storm** and **Sea level change.**

Key terms

Climate change

Any change in climate over time, whether induced by natural variability or as result of human activity (IPCC, 2007).

Climate model

A quantitative (mostly dynamic) model, which tries to simulate the global climate and related processes on earth.

Climate change impact

Impacts of climate change on natural or human systems (IPCC, 2007). In the Adaptation Compass these consequences are assessed for each receptor individually.

If you have more detailed information regarding your city and region, you can

- Alter the trend given, if this is incorrect for your situation: The altered trends will change the further results (see module "Assess Risks and Opportunities") or
- Add a new parameter to the list and select the trend suitable: The added parameters cannot be included in the appraisal of risks or the choice of adaptation measures, due to technical reasons.

C1 – Learn about regional trends

Country: Germany **Region:** North-Rhine Westphalia

Key parameters	**Climate change trend**		**Consequences for weather events - Summer**	**Consequences for weather events - Winter**
	Summer	**Winter**		
Air temperatures	increasing ↗	increasing ↗	**Heat waves - reinforcing in summer:** The average air temperatures in summer are increasing. Additionally, heat waves are expected to happen more often and last longer in future.	**Extreme cold - balancing in winter:** The average air temperatures in winter are increasing. Extreme cold are therefore expected to happen less frequently.
Precipitation	decreasing ↘	increasing ↗	**Drought - reinforcing in summer:** In summer not only less precipitation but also higher air temperatures and therefore higher evaporation rates will cause longer and more frequent droughts.	**Drought - balancing in winter:** Due to the increase in average rainfall in winter, the rising temperatures and therefore less buffering through snow, droughts are expected to happen less often in winter.

This sheet gives you information on the expected climate change trends for some key climate parameters. The trends are based on climate projections until 2050. The consequences for weather events explain the link between the climate change trends and the weather sensitivities identified in the module Check Vulnerability.

→ To **change the country and region**, click on the name and select other countries from the list. You can even change it to "Your country" – but then all parameters have to be filled by yourself.

→ You can **add more parameters** and **change the given trends** to adapt it to your local situation. But be aware, that the added parameters cannot be included in the following assessment steps.

Step 2: Impacts of climate change

Here you can see the impacts of the trend directions on the previously selected receptors (see module "Check vulnerability"). The impacts are the following:

- **Reinforcing**: The trends are intensifying the respective situation (e.g. it gets hotter in summer) and therefore the vulnerabilities identified in module "Check vulnerability" will increase in future.
- **Indifferent**: No changes in the trends are expected; therefore the vulnerabilities identified in module "Check vulnerability" will not increase in future.
- **Balancing**: The trends are balancing the respective situation (e.g. it gets warmer in winter) and therefore the vulnerabilities identified in module "Check vulnerability" will decrease in future.

Key terms

Climate change trends

A trend is defined as the direction of change of a variable for a specific time span. In the Adaptation Compass the term climate change trend refers to the direction of changes which are projected by regional climate models (see climate model) for the indicated time span. The trend gives no information about the amount and probability of change.

Climate parameter

Climate parameters are all parameters, which are essential to the climate system (e.g. humidity, temperature, radiation). In the Adaptation compass only a selection of climate parameters are used.

C2 – Impacts of climate change

Here you can see the impacts of the trend directions on your selected receptors and weather sensitivities (see module “Check Vulnerability”). The impacts are categorised as **Reinforcing** - **Indifferent** – **Balancing**
To change the selected country and region, you need to go back to C1- Learn about regional trends.

Country: Germany Region: North-Rhine Westphalia

	Receptors	Weather sensitivity	Climate change impact - Summer	Climate change impact - Winter
Population	Public health / vulnerable groups	Heat wave	reinforcing	n/a
		Extreme cold	n/a	balancing
		Drought	reinforcing	balancing
		Heavy precipitation / Floods	reinforcing	indifferent
		Storm	balancing	reinforcing

For the extreme weather events used in the module “Check Vulnerability” the following situation is apparent in North-West Europe:

	Climate change impact	
Extreme weather event	**Summer**	**Winter**
Heat wave	**Reinforcing**: The average air temperatures in summer are increasing. Additionally, heat waves are expected to happen more often and last longer in future.	n/a
Drought	**Reinforcing**: In summer not only less precipitation but also higher air temperatures and therefore higher evaporation rates will cause longer and more frequent droughts.	**Balancing**: Due to the increase in average rainfall in winter, the rising temperatures and therefore less buffering through snow, droughts are expected to happen less often in winter.
Extreme cold	n/a	**Balancing**: The average air temperatures in winter are increasing. Extreme cold are therefore expected to happen less frequently.
Heavy precipitation / Floods	**Reinforcing**: The average rainfall is expected to decrease in summer and increase in winter. As the climate in North-West Europe gets more extreme, also extreme and heavy precipitation events are expected to increase, especially in summer. This may lead to more flooding.	**Indifferent**: no changes expected

Key terms

Reinforcing effect

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

Balancing effect

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

Indifferent effect

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

	Climate change impact	
Extreme weather event	**Summer**	**Winter**
Storm	**Balancing**: To model the possible development of wind and storm for the future is very difficult and therefore uncertainties are high. Nevertheless, different models expect the average winds to decrease in summer and increase in winter. Future amount of storm days and intensities follow the same pattern.	**Reinforcing**: To model the possible development of wind and storm for the future is very difficult and therefore uncertainties are high. Nevertheless, different models expect the average winds. Future amount of storm days and intensities follow the same pattern.

Step 3: Further information: Link lists

For further information on climate projections and the important institutions on a national and regional basis, link lists are provided for all FUTURE CITIES regions.

The regions can be selected by clicking on the country field in Sheet C1.

C3 – Further information: Link lists

Here you can find links to important institutions that provide information on climate change in general, climate projections and climate impacts for the Future Cities countries and regions.

If you choose Your Region, feel free to add your own links. To change the selected country / region, go back to C1- Learn about regional trends.

Several institutions focus on the transfer of knowledge regarding climate change and adaptation; some major institutions are named here:

- KomPass - Kompetenzzentrum Klimafolgen und Anpassung in Umweltbundesamt
  http://www.anpassung.net/
- Regional climate information offices of the Helmholtz Gemeinschaft
  http://www.klimabuero.de/
  Süddeutsches Klimabüro: http://www.sueddeutsches-klimabuero.de/
  Mitteldeutsches Klimabüro: http://www.ufz.de/index.php?de=17016
  Norddeutsches Klimabüro: http://www.norddeutsches-klimabuero.de/
  and their key product "Regionaler Klimaatlas": http://www.regionaler-klimaatlas.de/
- Climate Service Center:
  http://www.gkss.de/science_and_industrie/klimaberatung/csc/index.html.de
- Websites of the Deutscher Wetterdienst (Germany's National Meteorological Service)

Countries and regions provided:

Climate trends and links are provided for the Countries and regions that participated in the project FUTURE CITIES:

→ Germany, North-Rhine Westphalia

→ Netherlands, Gelderland

→ United Kingdom, South East England

→ France, Haute-Normandie

→ Belgium, West - Flanders

If your city lies within the named regions, you can use the given information and eventually change it to your specific situation (climate change trends in C1).

If your city doesn't lie within the named regions, you can use "Your country / Your region" and fill the information yourself.

2.2 Climate change – practical information

The intention with the following sections is to give you a practical insight into the complexity of the data and figures on climate change to enable you to judge for your city:

- If you want to learn more about the regional and local climate changes to be expected or
- If – given the effort and uncertainties related with climate change data – the information provided here is enough.

The chapter is not meant to give you an overall explanation on what climate change is about.

2.2.1 Climate versus weather

The terms climate and weather describe two very separate circumstances. **Climate** is the **average** state of the atmosphere and the underlying land or water, whereas **weather** describes the **day-to-day changes** in atmospheric conditions.

Due to the chaotic nature of our earth's climate system**, weather** can only be predicted for a short time period. Little differences in the starting conditions of meteorological parameters, e.g. the humidity level, can lead to very large differences in the results, even over a short period of time.

Climate on the contrary is described by long-term statistic values, like means, variances, probabilities etc. of meteorological parameters. Long-term in the context of climate change typically means a time span of at least 30 years. The predictability of climate is further complicated by what is known as "climate change" and the unknown development of global greenhouse gas emissions in the next decades. Further internal influencing factors to global and regional climate are land use patterns, population, hydrological, glacial and geological activities – all of these are hard to predict for longer time ranges. And, what makes it even more complicated, these variables are interacting with our climate: They are influenced by changing climate conditions and their change, in turn, influences the climate changes. The information available on future climate is therefore no forecast but a pick from the various projections of a future climate situation.

No weather-like forecast of future climate for one specific year or month or day is thus possible, only ranges and changes of mean values can be provided.

2.2.2 Climate projections

Changes in mean values are valuable information if you know how to read it. Climate models calculate these mean values in order to deduce important trends in global climate:

Climate models that simulate the whole climate on earth are called **global climate models**. They can deliver data on a horizontal resolution of about 200 x 200 km. Since for many analyses this resolution is not detailed enough, **regional climate models** have been developed. These regional models use a

Key terms

Global Climate Model

A General Circulation Model (GCM), more commonly called a global climate model, is a mathematical model of the general circulation of the planet's atmosphere or oceans. GCMs are widely applied for weather forecasting, understanding the climate, and projecting climate change.

Regional Climate Model

A Regional Climate Model is a mathematical model of the general circulation of the atmosphere or oceans on a regional scale. These regional models use a statistical or dynamic downscaling of the global model data and reach horizontal resolutions of 10 x 10 km.

statistical or dynamic downscaling of the global climate model data and reach horizontal resolutions of 10 x10 km.

When considering a city with small scale features and lots of influencing factors to the micro-climate, even regional climate models are not detailed enough. But as uncertainties increase with time and resolution, a further downscaling makes little sense (see chapter “How to handle uncertainties”).

The bases for all climate models are assumptions on future development of emissions, demography, society, techniques, economy and ecology. These assumptions are described in scenarios. Most climate models use the SRES- (Special Report on Emission scenarios) **emission scenarios** defined by the Intergovernmental Panel on Climate Change (IPCC): The major four scenarios are describing the future worlds as follows (Nakicenovic et al., 2000):

- **Scenarios A1**: very rapid economic growth; rising global population until mid-century and thereafter declining; rapid introduction of new and more efficient technologies.
- **Scenarios A2**: a very heterogeneous world; increasing global population; regionally oriented economic growth that is more fragmented and slower than in other scenarios.
- **Scenarios B1**: same global population as in the A1 but with rapid changes in economic structures towards a service and information economy; reductions in material intensity; introduction of clean and resource-efficient technologies.
- **Scenarios B2**: emphasis on local solutions to economic, social, and environmental sustainability, continuously increasing population (lower than A2) and intermediate economic development.

The scenarios have “families” that involve further assumptions on future development, e.g. the commonly used scenario A1B, set together from A1 and B adding more environmental aspects (see side column).

2.2.3 How to handle uncertainties

Uncertainties in climate projections are manifold. They can be classified into four categories according to their origin:

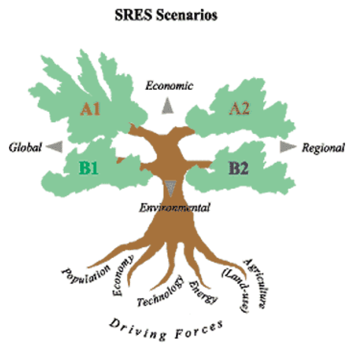
- Uncertainties from scenarios: Future emissions, land use and many other influencing factors on climate are projected under assumptions.
- Uncertainties from inaccuracies in global climate models are passed to regional climate models.
- Uncertainties from inaccuracies in regional climate models.
- The so called sampling uncertainties: The modelled climate always has to be estimated from a limited number of years. Statistically speaking it corresponds to the problem of population and random sample.

Moreover, there is the general problem, that climate is a chaotic system which cannot be forecasted (see chapter “Climate versus weather”). The amount or value of uncertainty is not sizable in general as it depends on the model input data, time frame, resolution and output parameters.

Key terms

Emission scenario

Assumptions on future development of emissions are the bases for all climate models. These assumptions are described in scenarios. The major scenarios A1, A2, B1, B2, A1B were defined by the IPCC Special Report on Emission Scenarios and are the so called SRES scenarios.



Uncertainty should not be used as an excuse for not taking appropriate action. Lots of decisions, in various fields like economy, politics, planning and water management, are taken in the face of uncertainty, e.g. most investment decisions. Decisions on adaptation should be approached similarly.

Therefore, the results of climate projections can be a valuable background information for regional and local adaptation decisions. The decisions though should always be taken on the basis of a variety of information, like vulnerability assessments or general spatial planning needs, development plans etc.

Most adaptation options are not only beneficial for climate change adaptation but also for other sectors, e.g. economic growth. Even if climate change impacts do not occur as expected the measures are though beneficial and cost-effective.

In the FUTURE CITIES Adaptation Compass several good-practice adaptation options are included and described. To explore them check the module “Explore Adaptation Options”.

2.3 Summary of projections for Regions of FUTURE CITIES

You can find a great number of very well designed online tools and information platforms to find out more about climate change. In the following chapters the climate change projections for the FUTURE CITIES regions are displayed in short. As the scientific basis, the models, emission scenarios and time scales used are different in the countries, the climate change projections cannot be compared without digging deep into the methodology. For the Adaptation Compass and the trends used in this module, it is sufficient to mention the most important regional climate models on national level, their time scales and scenarios used as well as the existing online tools or platforms to learn more.

2.3.1 Belgium, West-Flanders

In Belgium several studies have been conducted regarding climate change impact from the scientific point of view. The Belgian Federal Science Policy Office supports climate change research in Belgium through the “Science for a Sustainable Development” programme. A Climate Centre was created by the Belgian Federal Science Policy Office with the goal of interlinking climate research and services across the federal and private research institutes (Belgian national climate change adaptation strategy, 2010).

In Flanders, the climate projections are based on a number of foreign models. In general, the following scenarios are used:

- The wet climate scenario (a ‘high’ scenario)
- The dry climate scenario (a ‘low’ scenario)
- The moderate climate scenario (a ‘middle’ scenario).

The regional climate projections for Belgium are mostly modelled for the period 2071-2100 and compared to 1961-1990 like in Germany, France and the United Kingdom.

Key terms

No-regret measure

No-regret measures are measures that are not only beneficial for climate change adaptation but also for other sectors, e.g. economic growth. If the actual reason for implementing the measure - an expected climate change impact - doesn’t occur as expected, the measure is though beneficial.

FUTURE CITIES Partners & Regions

Lippeverband
→ Germany, North-Rhine Westphalia

City of Arnhem
→ Netherlands, Gelderland

Emschergenossenschaft
→ Germany, North-Rhine Westphalia

Hastings Borough Council
→ United Kingdom, South East England

City of Nijmegen
→ Netherlands, Gelderland

Rouen Seine Aménagement
→ France, Haute-Normandie

City of Tiel
→ Netherlands, Gelderland

West Vlaamse Intercommunale
→ Belgium, West - Flanders

Until now, no online tool or platform exists that provides easy accessible climate change information for the Belgian regions. The national climate change adaption strategy though gives a good overview on the expected changes and the impacts:

http://www.lne.be/themas/klimaatverandering/adaptatie/bestandenmap/nationale-adaptatiestrategie

2.3.2 France, Haute-Normandie

The national weather service *Météo France* provides information about the climate projections in France. There you can find an online tool, the *“simulateur climatique”,* which informs about the climate simulations between 2050 and 2100:

http://climat.meteofrance.com/jsp/site/Portal.jsp?&page_id=13609

The simulation refers to the regional climate model “*ARPEGE-Climat*”, developed by the *Centre de recherches de Météo-France*.

The projections are based upon two different future scenarios representing a rapid and less rapid increase of greenhouse gas emissions:

- A moderate scenario (B2 from IPCC): A less rapid increase of greenhouse gas emissions.
- An intensive scenario (A2 from IPCC): An increase of the greenhouse gas emission with today’s rate.

The simulation includes five parameters: maximum temperature, minimum temperature, precipitation, hours of sunshine and soil moisture. As in Germany and the United Kingdom the results of the projection are compared with the reference values of the 30-year period between 1960 and 1990.

On the web-platform you can find further information on climate change as well.

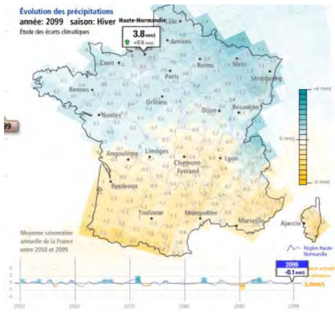
2.3.3 Germany, North-Rhine Westphalia

In Germany several regional climate models exist, which are developed and run by different scientific institutions. The four major models are (Walkenhorst & Stock 2009):

- The “Regional Model” REMO, a dynamic model, run by the Max-Planck-Institute for Meteorology: It calculates with the emission scenarios A1B, A2, B1.
- COSMO-CLM (CCLM), also a dynamic regional model developed by a community of around 25 institutions: The model is based on the emission scenarios A1B and B1.
- WETTREG, a statistical regional model dispersed by the company Climate & Environment Consulting Potsdam (CEC): Analogue to the model REMO it is based on the A1B, A2 and B1 emission scenarios.
- STAR, another statistical model, developed by the Potsdam Institute for Climate Impacts Research (PIK): The projections are based on the future scenario A1B.

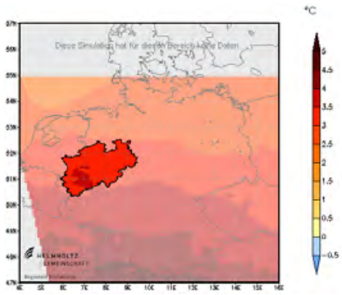
Examples of climate projection maps

Future precipitation in France/Rouen in winter 2099



© Météo-France, simulateur climatique

Future mean temperature in Germany/NRW in summer



© Regionaler Klimaatlas: model used: A1B REMO, time period: until 2100

The web-platform “Regionaler Klimaatlas” provides information about the climate projections of the regional climate models. The “Helmholtz-Gemeinschaft” with its regional climate offices operates the platform.

http://www.regionaler-klimaatlas.de/

The platform provides information on parameters such as maximum temperature, minimum temperature, precipitation, hours of sunshine and many more. The results can be compared with the reference values of the 30-year period between 1960 and 1990.

A further comprehensive climate atlas is provided and hosted by the German National Meteorological Service DWD. Several maps are available for download which compare today’s climate observations with the projections of the future.

http://www.dwd.de/

2.3.4 The Netherlands

In the Netherlands the Royal Netherlands Meteorological Institute (KNMI) developed and runs the Regional Climate Model RACMO which stands for Regional Atmospheric Climate MOdel. It played a crucial role in the formulation of the emission scenarios for the Netherlands, which are different to the emission scenarios used in France, Germany and the United Kingdom. Also, the reference period regarded is different than in the other FUTURE CITIES partner states: 1975 – 2005.

The four scenarios for 2050 are: W and W+ for “warm” as well as G and G+ for “moderate”.

The warm scenarios W/W+ are characterised by higher global mean temperatures compared to the moderate G/G+ scenarios. The scenarios with plus G+/W+ assume a change in the atmospheric circulation above the Atlantic Ocean and Western Europe which results in warm and wet winters, whereas the summers are extra hot and dry. In the G/W scenarios the air circulation pattern remains unchanged.

Further information on the climate model and the scenarios can be found here:

http://www.knmi.nl/research/regional_climate/models/index.html

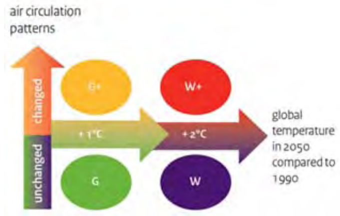
A practical tool that gives information on climate change projections and impacts in the regions of Netherlands is the *klimaateffect Atlas,* a geoportal that is supported by the *Royal Netherlands Meterological Institute, Alterra and DHV*.

http://klimaateffectatlas.wur.nl/bin/cmsclient.html

This platform shows you simulations of climate scenarios for a chosen province in the Netherlands. On the one hand you get information about temperature and precipitation; on the other hand maps on flooding, water surplus and water shortage and further detailed information are given.

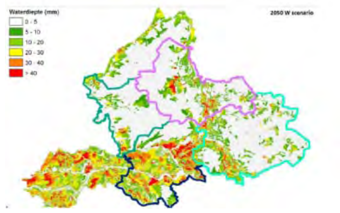
Examples of climate projection maps

The four scenarios for the Netherlands



© Climate change in the Netherlands; Supplements to the KNMI’06 scenarios, KNMI, De Bilt, The Netherlands.

Future water depth in the Netherlands/ Gelderland



© Klimaatatelier Gelderland 2010, model used: 2050 W

2.3.5 Great Britain, South-East England

In Great Britain climate projections are presented on the public information platform UK Climate Projections 2009 (UKCP09). The platform delivers detailed information about all results of the UK dynamic regional climate model HadRM3 up to the year 2100 including a user-interface for individualised maps. The results can be localised to the different regions in the UK.

The full set of results and prepared maps and graphs with key findings are available here:

http://ukclimateprojections.defra.gov.uk/

The Climate Projection Website gives you detailed information on the expected future climate conditions, similar as in the German *Regionaler Klimaatlas* or the French *Simulateur climatique*. The modelled scenarios are compared to the reference 30-year period 1961-1990.

The projections are based upon three different future scenarios representing High, Medium and Low greenhouse gas emission (corresponds to A2, A1B and B2 from the IPCC SRES). The data and science behind the projections are delivered by the Met Office Hadley Centre, which develops and runs both the Global Climate Model HadCM3 and the Regional Climate Model HadRM3.

2.4 Experiences from FUTURE CITIES

Experiences of the water boards Emschergenossenschaft and Lippeverband (DE)

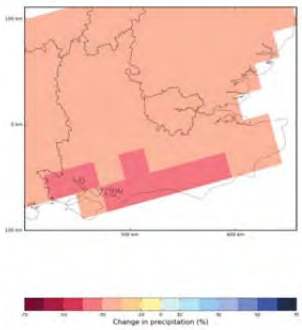
Which climate projections do we use?

To get an idea about possible impacts of changing climate conditions in the catchments of Emscher and Lippe, the water boards Emschergenossenschaft and Lippeverband use a broad pool of own water management data. These data are supplemented by data of the German Weather Service (DWD) as well as from the Federal state’s government North Rhine-Westphalia (NRW).

- For the observation of precipitation, Emschergenossenschaft and Lippeverband run 75 stations for terrestrial rainfall measurements, 16 of these stations since over 70 years.
- In addition, information from the radar measurements of the German Weather Service (DWD), climate data of the government NRW, the German Weather Service and the Ruhr-University Bochum is available regarding air temperature, relative air humidity, evaporation, wind speed and duration of sunshine.
- Further networks of the water boards, municipalities, industry, the state’s government and the mining industry provide more data for observing flood discharge and ground water levels – partly there is data available since the 1950’s.

Examples of climate projection maps

Future precipitation in South East England in summer



©UKCP09, used emission scenario: Medium, percentiles: 0.50, time period: 2070-2099

More examples from FUTURE CITIES:

Hastings, UK

When planning adaptation and assess risks, the UKCP09 key findings are regarded and used, but uncertainties are explained. It is still useful for the 'shock' factor to see how much hotter it could become, under three separate scenarios: low emissions, medium emissions and high emissions and the varying probabilities.

All these information give quite a good base for discussing possible impacts of climate change on the water cycle. But – concrete trends for the future climate development cannot be given, as no statistically relevant trend can be identified. Therefore, Emschergenossenschaft and Lippeverband work also with the SRES-scenarios of the IPCC. To break down these global scenarios to a regional relevance, existing regional climate models are used.

How to handle uncertainties?

Although these climate projections provide statements with a certain probability for large-scale trends, no secured conclusion can be made yet. It is not for sure how exactly the climate will change in the Emscher and Lippe catchments. We do not know how much rain exactly will fall in future.

Following the existing uncertainties, flexible strategies are needed with the possibility to adjust if necessary. Therefore, the water boards Emschergenossenschaft and Lippeverband follow a strategy based on no-regret measures, which is also supported by the German National Adaptation Strategy (DAS).

Within this strategy the water boards implement already today measures that will have a positive impact on a sustainable water management, independent from the dimension of climate change. These no-regret-measures serve also other objectives in the sense of sustainable development. They must be long-term effective, functional and reversible at reasonable costs if adaptation is needed. They shall create a robust and flexible system that serves multiple aims:

- strengthening the natural water cycle,
- increase the adaptive capacity of the water management,
- give time for more and better research,
- combine with attractive design of open space.

Combined with mitigation measures to reduce GHG, intense research work, close cooperation in projects such as FUTURE CITIES and active information and communication with stakeholders and citizens, the water boards Emschergenossenschaft and Lippeverband face the impacts of climate change despite existing uncertainties.

2.5 Get to know more

It is easy to get lost when searching for information about climate change on the internet. Searching for relevant information is very time consuming.

The Adaptation Compass gives you the basic links to start with. Mostly the links lead you to state institutions which provide good and easy to understand information. Often online maps are made available that show climate projections in a very clear way.

The link lists for the countries and regions of the FUTURE CITIES partners – Belgium, West- Flanders; France, Haute-Normandie; Germany, North-Rhine Westphalia; Netherlands; United Kingdom, South-East England - can be found in the Adaptation Compass.

More examples from FUTURE CITIES:

Ieper, BE

In the planning phase of the new sustainable city quarter “De Vloei” a water study was elaborated with the aim to have an integral vision on water within the quarter and in relation to the surrounding neighbourhoods. Climate change was an important element in the calculations (changed patterns and amounts in precipitation).