Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

GERICS
Climate Service Center Germany

Available climate simulations and GERICS products for adaptation

Claas Teichmann and María Máñez
and the GERICS team

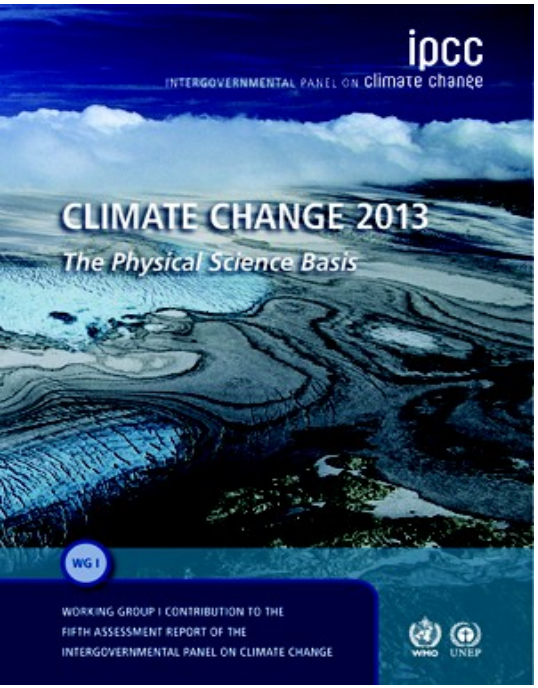
Expert meeting to assess progress made in the process to formulate and implement National Adaptation Plans (NAPs)

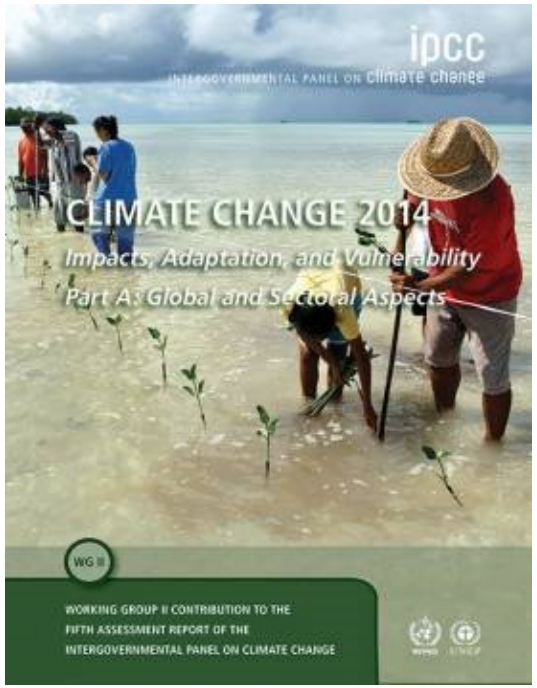
7–9 February 2018, Sao Tome, Sao Tome and Principe

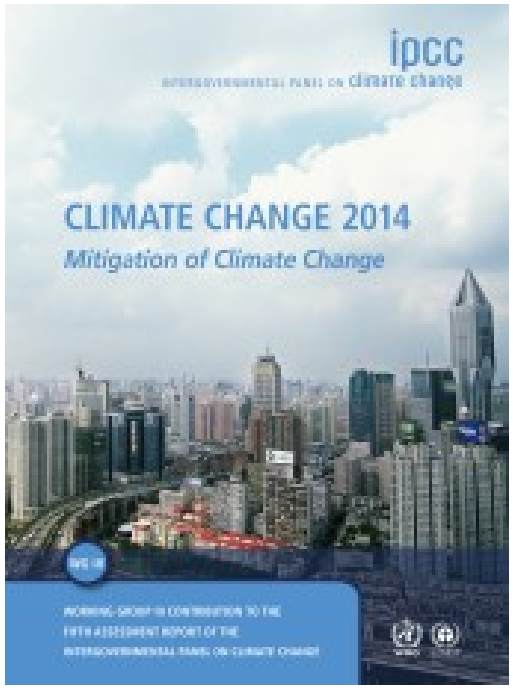
IPCC Assessment Report 5

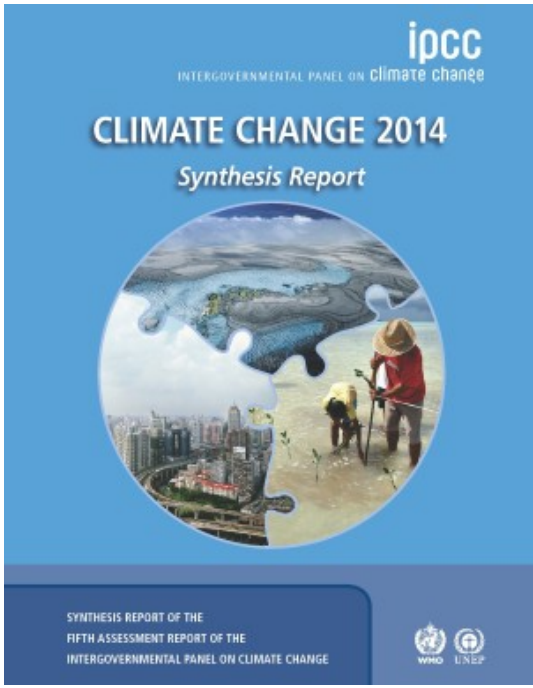
Current state of scientific knowledge relevant to climate change:

http://www.ipcc.ch/report/ar5/





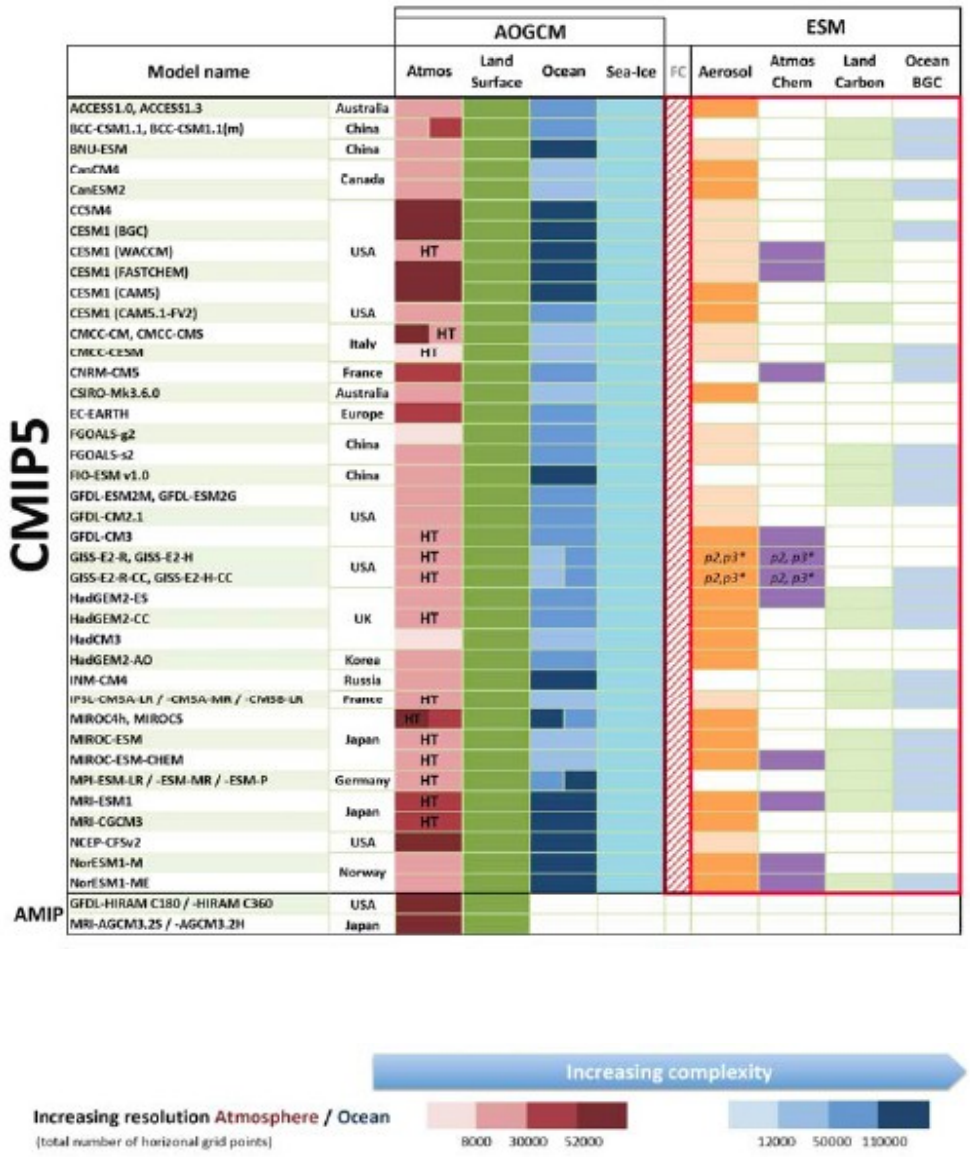


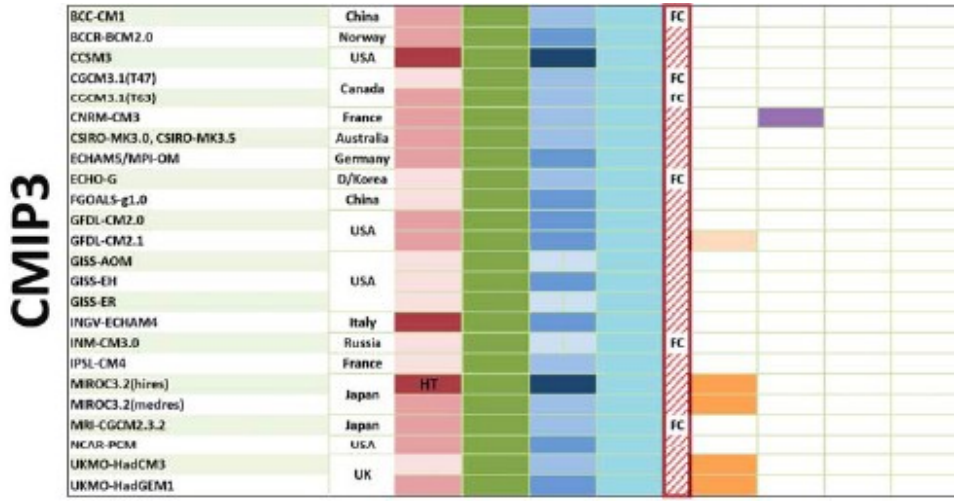


5th Assessment Report of the Intergovernmental Panel on Climate Change:

WGI 2013, WGII, WGIII,SYR 2014

Multi-model ensemble CMIP5 and CMIP3





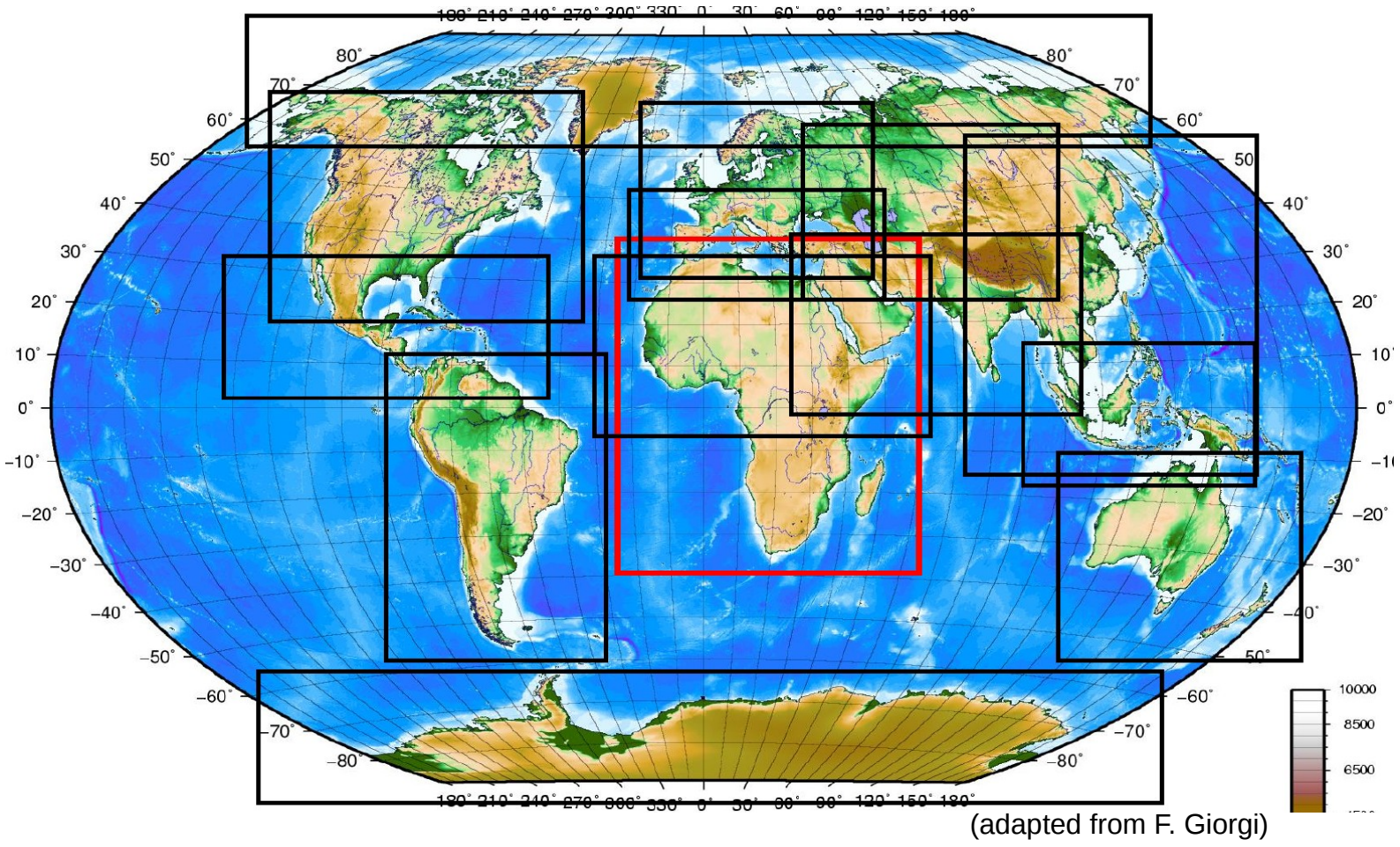
MIPs Model Intercompariso Projects (since 1990): standard experiment protocol and an world wide community-based infrastructure in support of model simulations, validation, intercomparison, documentation and data access.

CMIP3: coordinated climate projections, based on emission scenarios from SRES, global model basis for IPCC AR4

CMIP5: a new set of coordinated, based on the new RCPs, global model basis for IPCC AR5

Source: IPCC 2013 AR5 Chapter 9

Regional climate simulations: WCRP CORDEX



(adapted from F. Giorgi)

14 domains with a resolution of 0.44° x 0.44° (approx. 50 x 50km²)

High resolution simulations with 0.11° x 0.11° (approx. 12 x 12km²) for Europe

CORDEX data available via *Earth System Grid Federation*: https://esgf-data.dkrz.de/search/cordex-dkrz/

- CORDEX focus on Africa
- GERICS participates in many CORDEX-regions

CORDEX vision and goals

The CORDEX vision is to advance and coordinate the science and application of regional climate downscaling through global partnerships.

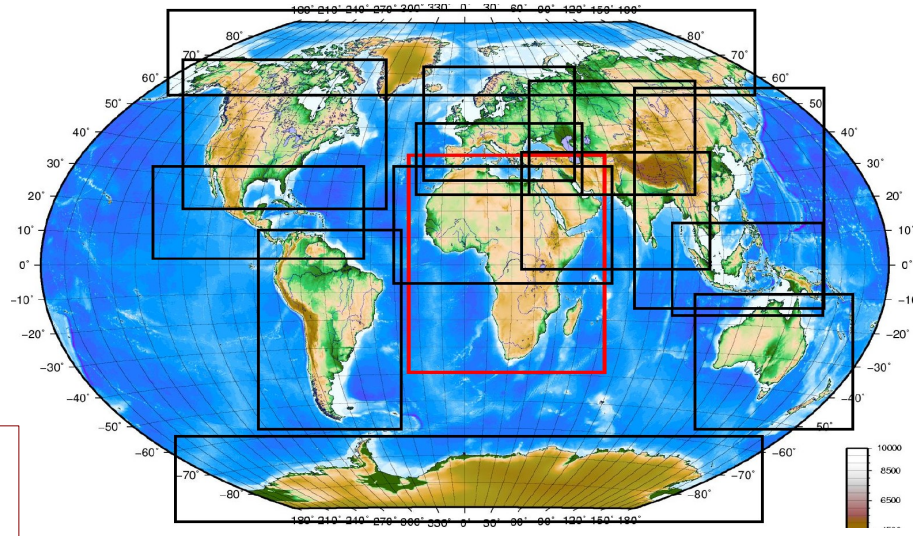
- To better understand relevant regional/local climate phenomena, their variability and changes, through downscaling.
- To evaluate and improve regional climate downscaling models and techniques
- To produce coordinated sets of regional downscaled projections worldwide
- To foster communication and knowledge exchange with users of regional climate information

Emerging scientific challenges

- Added value
- Human element
- Coordination of regional coupled modelling
- Precipitation
- Local wind systems

Great parts of the information of climate change is based on CORDEX activities

CORDEX domains

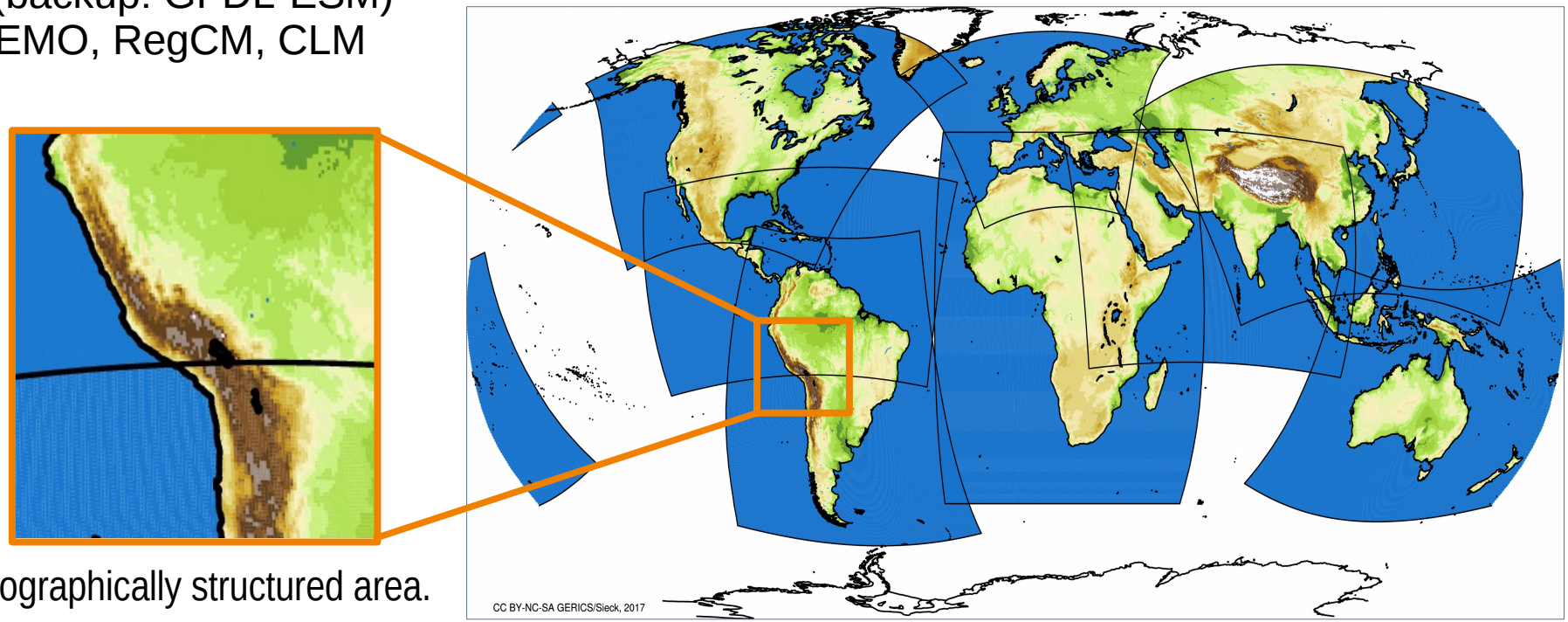


(adapted from F. Giorgi)

CORDEX-CORE

Towards a homogeneous high-resolution simulation dataset for the world

Horizontal resolution: 0.22° (~25km) resolution
Forcing: re-analysis (ERA-Interim), RPC2.6 and RCP8.5 driven global simulations
GCMs: HadGEM (backup: MIROC5), MPI-ESM (backup: EC-Earth), NorESM (backup: GFDL-ESM)
RCMs: REMO, RegCM, CLM



Orographically structured area.

CORDEX-CORE model domains as setup for simulations by the regional climate model REMO.
Domains from top-left to bottom right: North America, Central America, South America, EURO-CORDEX, Africa, South Asia, East Asia, Australasia.

CORDEX-CORE

Towards a homogeneous high-resolution simulation dataset for the world

Horizontal resolution: 0.22° (~25km) resolution
Forcing: re-analysis (ERA-Interim), RPC2.6 and RCP8.5 driven global sim
GC
No
RC

The main ideas of the CORDEX CORE framework are

- to use a core set of RCMs
- to downscale a core set of GCMs
- to cover the major inhabited areas of the world
- to use different representative concentration pathways (RCPs)
- to incrementally extend the CORDEX-CORE ensemble with further contributions by additional models/experiments

CORDEX-CORE model domains as setup for simulations by the regional climate model REMO.
Domains from top-left to bottom right: North America, Central America, South America, EURO-CORDEX, Africa, South Asia, East Asia, Australasia.

Further information

- Accessing observation data:
  - www.ncdc.noaa.gov
- Accessing simulation data:
  - https://esgf-data.dkrz.de/projects/esgf-dkrz/
- Quick visualization of simulation data
  - http://climexp.knmi.nl/plot_atlas_form.py

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

GERICS
Climate Service Center Germany

GERICS products for adaptation

Claas Teichmann and María Máñez

January 25, 2018

Interlinking Science and Society

We develop innovative, cutting-edge solutions

- regional climate modelling
- regional system modelling
- climate change impacts
- economics and politics
- transdisciplinary processes

- prototype product development
- inter- and transdisciplinary approaches
- application of climate service infrastructure
- evaluation of climate services

- climate-fact-sheets and focus papers
- maps and visualisations
- modular toolkits
- training concepts
- books, reports and studies

- strategic partnerships and associates
- creating and facilitating networks
- hosting secretariats
- operationalising climate services
- continuous user interaction

Products for adaptation

SOCIETAL NEEDS

Adaptation

Description of region under study or sector of interest

Climate change scenarios

Identification of climate change impacts

Identification of adaptation measures

Selection

- Toolkit for cities
- Toolkit for companies
- Regional modelling toolkit

Adaptation Toolkits

- Climate Fact Sheets
- Site-characteristic Climate-Fact-Sheets

Fact Sheets

- Climate signal maps
- Rain maps

Maps & visualizations

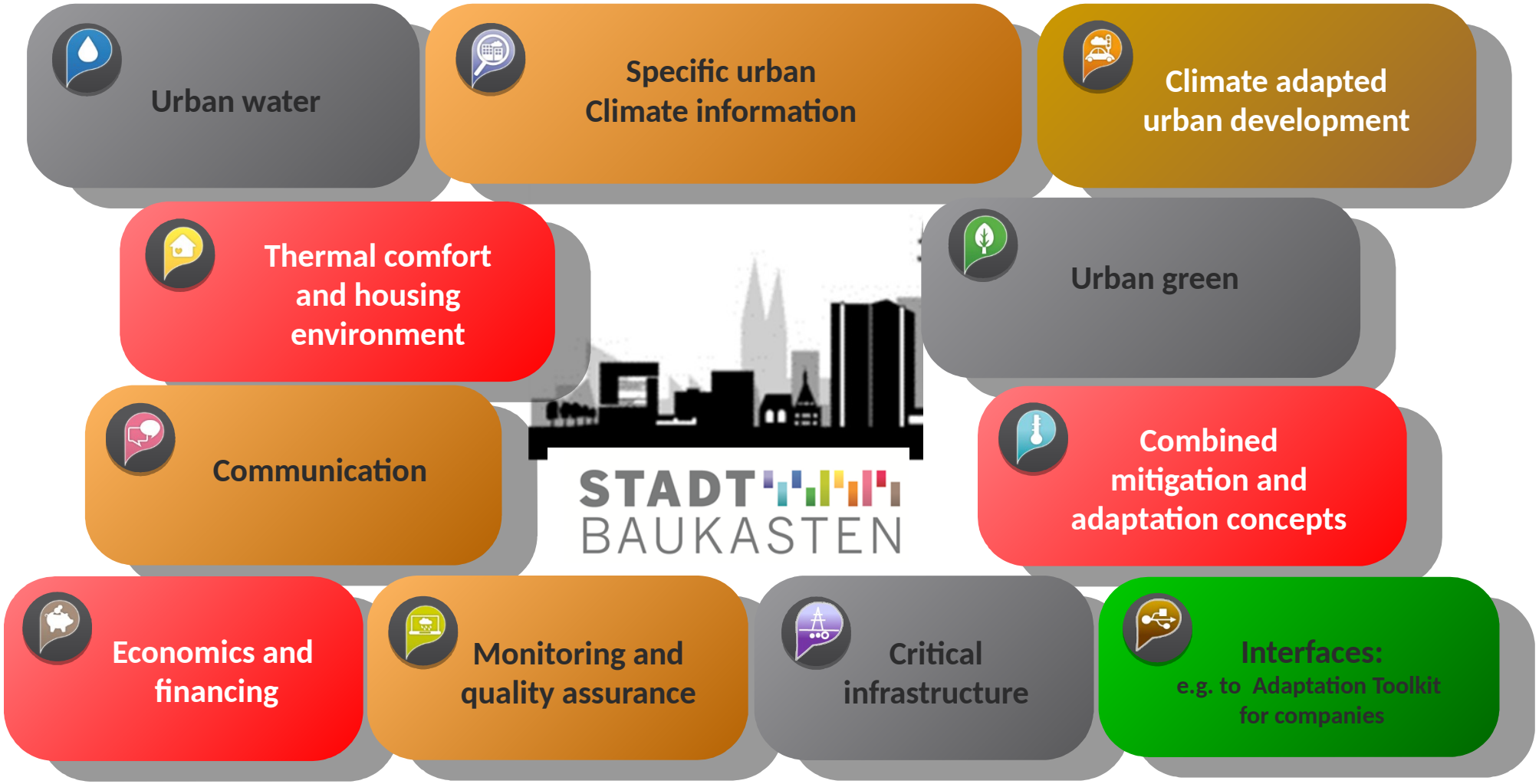
Lay the groundwork and address gaps

Preparatory elements

Implementation strategies

Reporting, monitoring and review

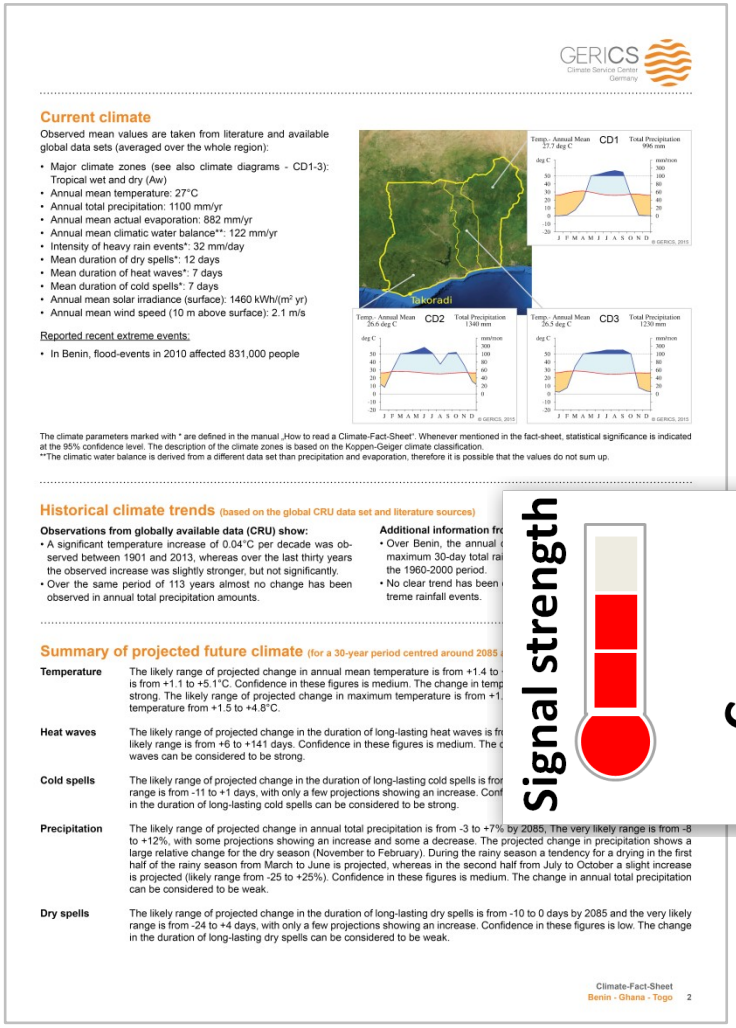
GERICS Adaptation Toolkit for Cities

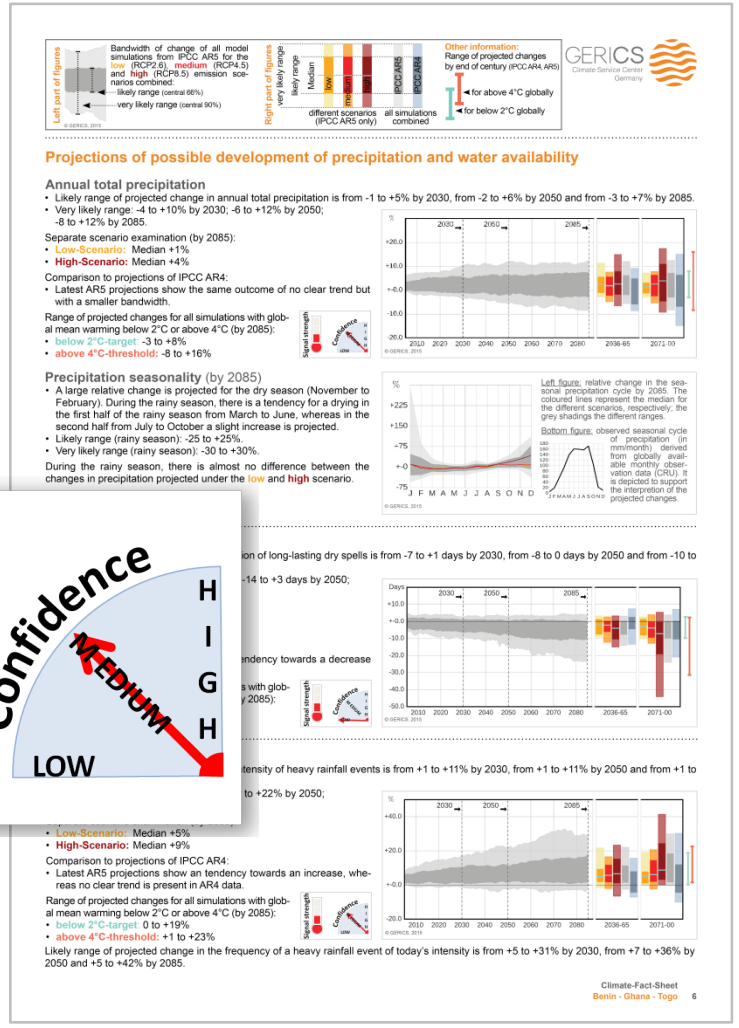


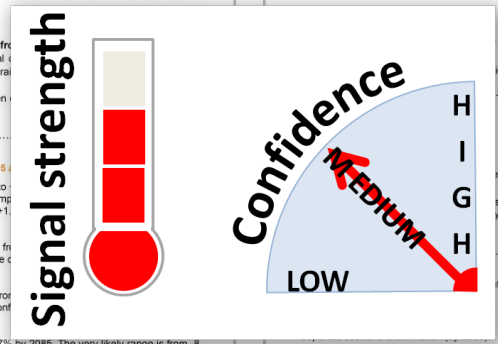
GERICS Climate-Fact-Sheets

Example-pages from CFS: Burkina Faso – Togo – Ghana

Concise climate characteristics of individual countries or regions







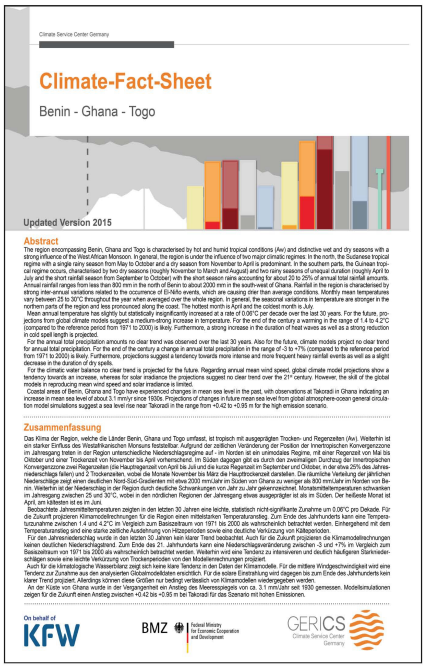
Available on request:
www.climate-service-center.de/climate-fact-sheets

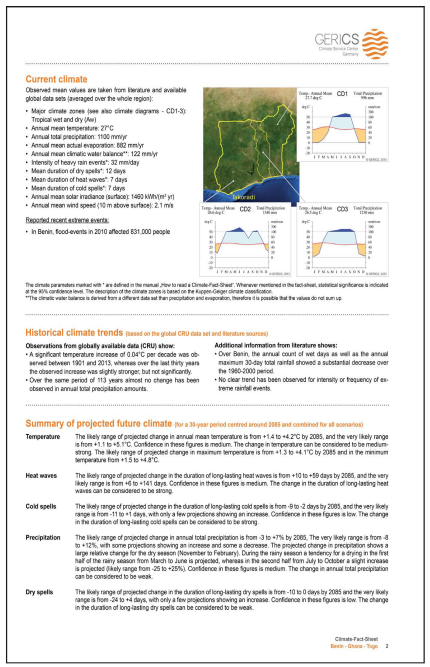
Jointly developed with KFW

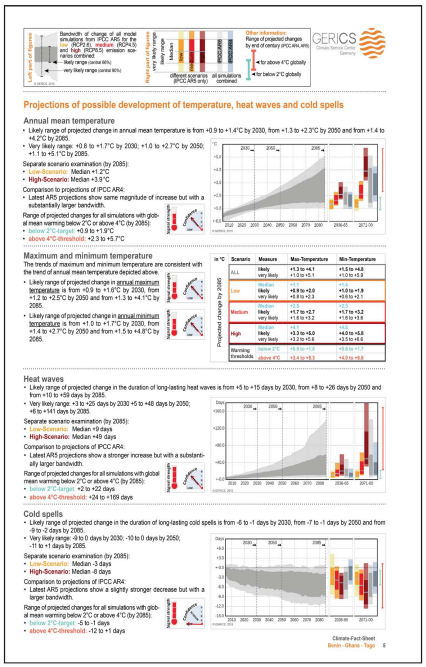
The Climate-Fact-Sheet – a successful prototype product

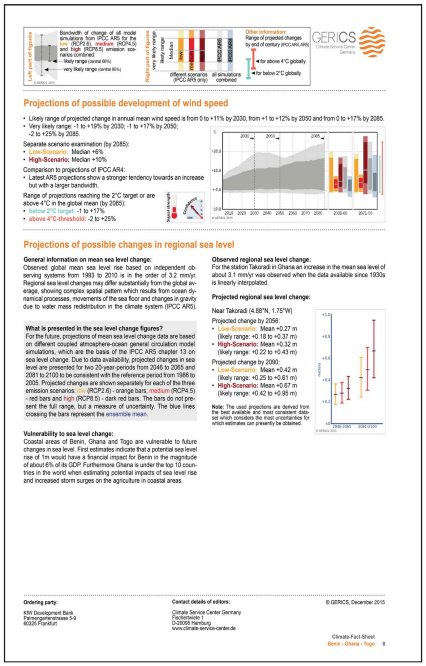
Key data of the Climate-Fact-Sheets

- 58 Climate-Fact-Sheets available as of December 2017
- ~ 300 different single customers
- 14 new Climate-Fact-Sheets will be produced for IFAD







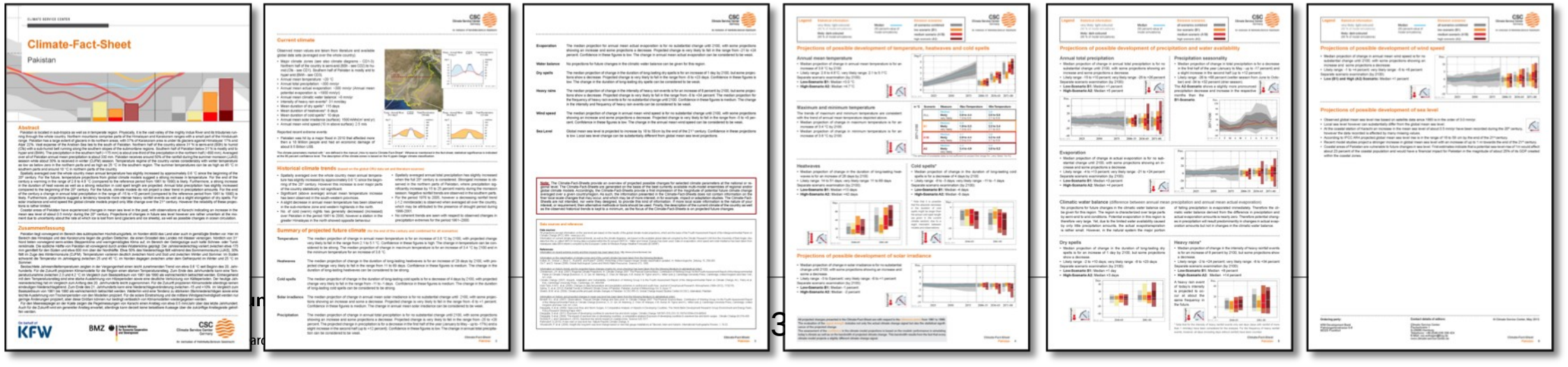


Climate-Fact-Sheets in a nutshell

- Climate-Fact-Sheets usually have some 4 to 6 pages with short text passages, tables and different diagrams
- Focus of the Climate-Fact-Sheets is on the projected future changes. Short information on current climate and past extremes is also included.
- Information is based on primary data (e.g. projections from global and regional climate models or continental wide observational datasets) and literature review

Climate parameters included in the Climate-Fact-Sheets

Temperature (Annual mean, min, max)
Heat waves and cold spells
Precipitation (Annual total, Seasonal cycle), Evaporation, climatological water balance
Dry spells and heavy rainfall events
solar Irradiance, Wind speed, Sea level rise



Main elements of a Climate-Fact-Sheets

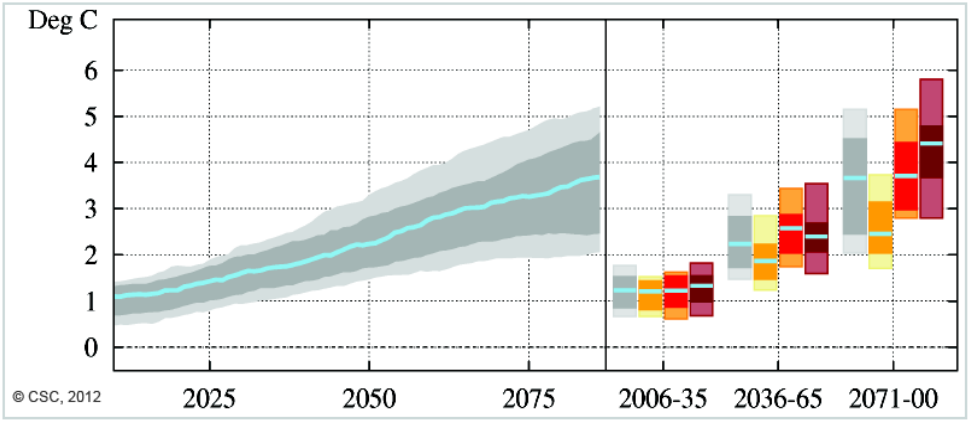
Detailed description of temporal development projected changes

Annual mean temperature

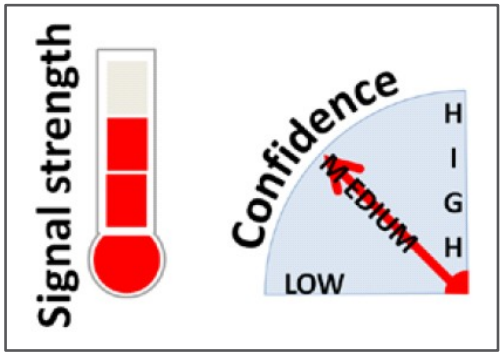
- Median projection of change in annual mean temperature is for an increase of 3.7 °C by 2100.
- Likely range: 2.5 to 4.5 °C; very likely range: 2.0 to 5.2°C

Separate scenario examination:

- **Low-Scenario B1:** Median +2.5 °C
- **High-Scenario A2:** Median +4.4 °C



Expert Judgement on signal strength and confidence



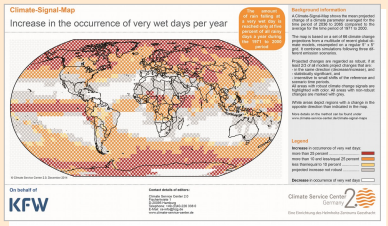
based on

- statistical significance & magnitude of absolute change
- quality of simulations in comparison to observations
- signal-to-noise ratio of projected changes
- agreement of model simulations

Fact-Sheet concept covers global scales and issues

Global

Global
Climate-Signal-Maps



Country

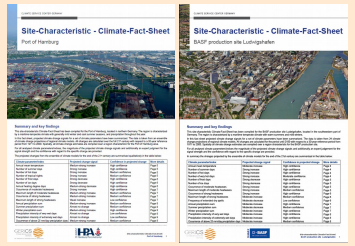
Climate-
Fact-Sheets

Federal

Bundesländer
Fact-Sheets

Local

Site-characteristic
Climate-Fact-Sheets



cross-sectoral

Climate-Focus Paper

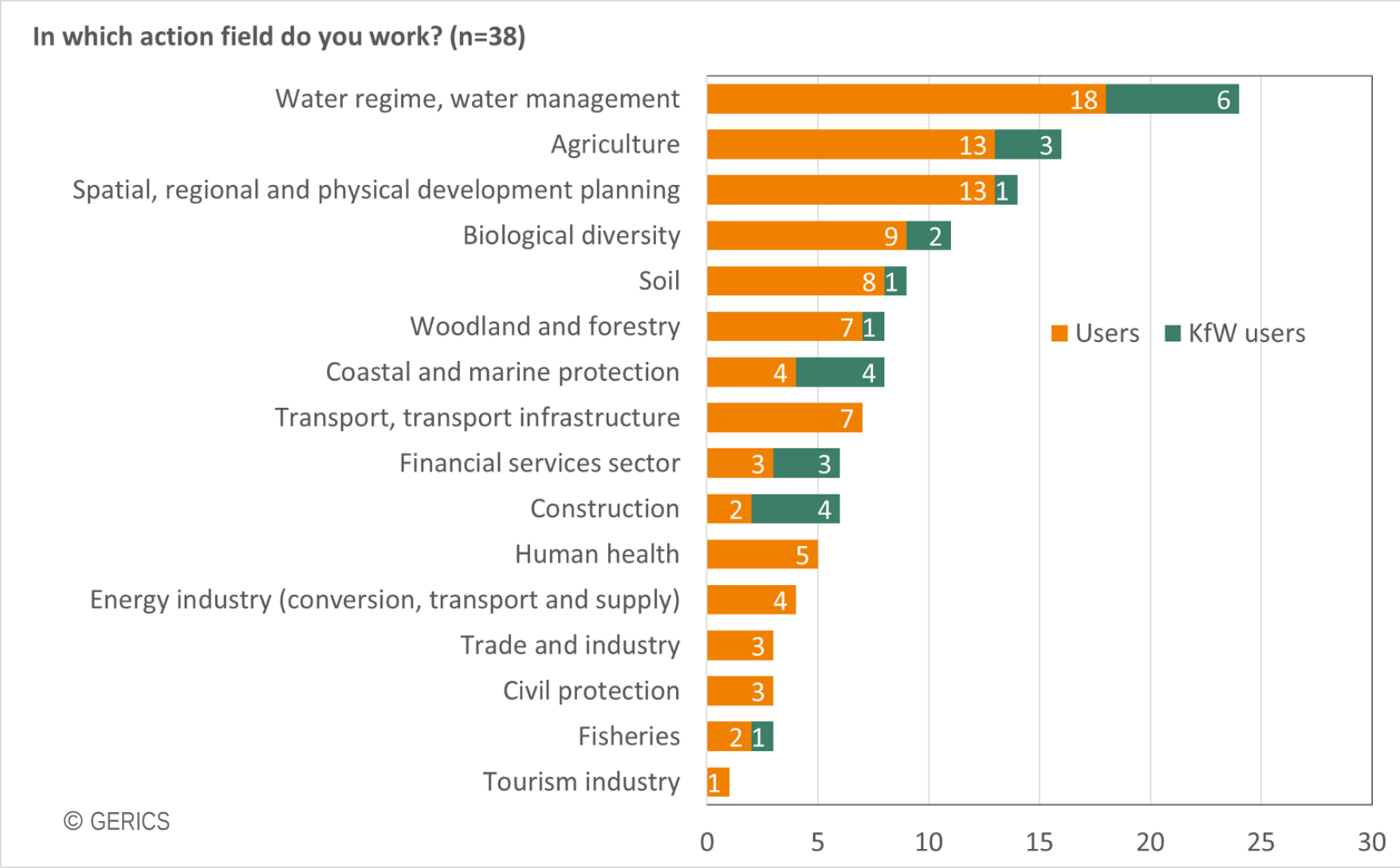
Sector-specific Climate Impact Fact-Sheets

Use of GERICS Climate-Fact-Sheets (CFS)

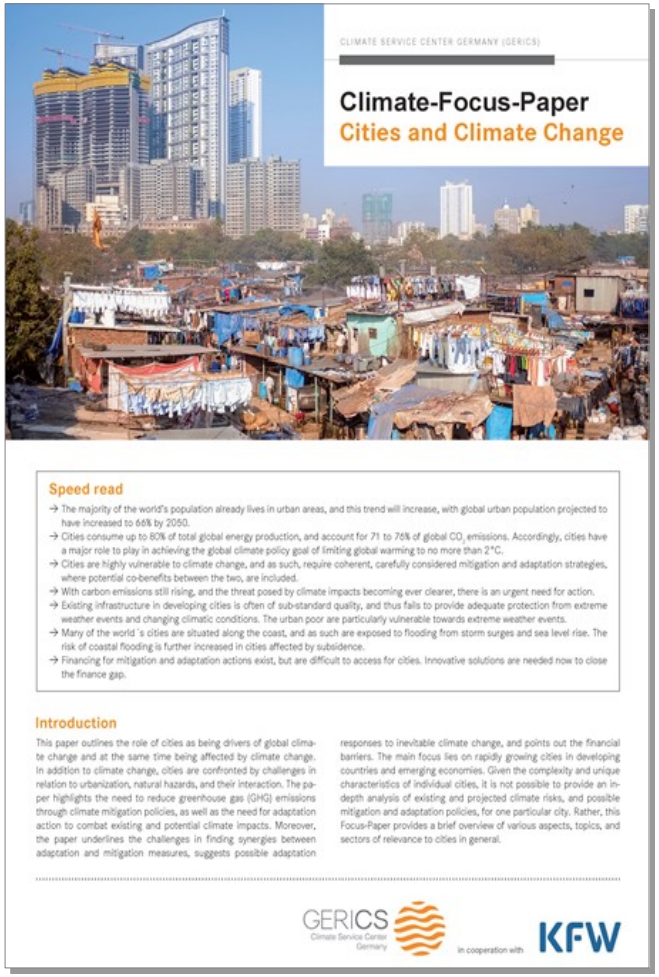
Criteria: use
Indicator: breadth of use
> 284 users worldwide
(except for KfW)

© GERICS

Use of GERICS Climate-Fact-Sheets (CFS)



GERICS Climate-Focus-Papers



CLIMATE SERVICE CENTER GERMANY (GERICS)

Climate-Focus-Paper
Cities and Climate Change

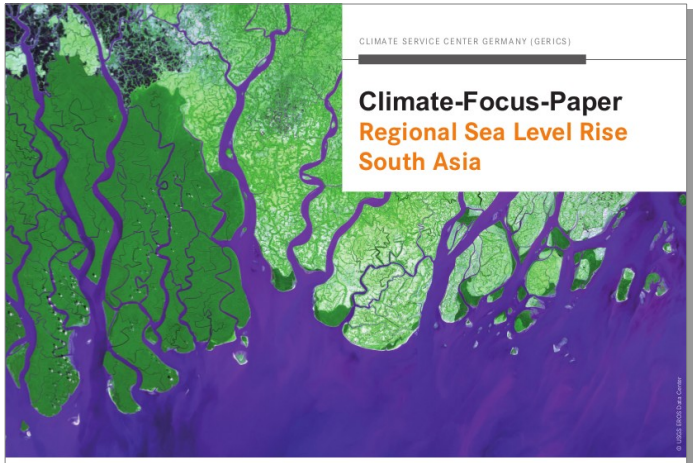
Speed read

- The majority of the world's population already lives in urban areas, and this trend will increase, with global urban population projected to have increased to 66% by 2050.
- Cities consume up to 80% of total global energy production, and account for 71 to 76% of global CO_2 emissions. Accordingly, cities have a major role to play in achieving the global climate policy goal of limiting global warming to no more than 2°C.
- Cities are highly vulnerable to climate change, and as such, require coherent, carefully considered mitigation and adaptation strategies, where potential co-benefits between the two, are included.
- With carbon emissions still rising, and the threat posed by climate impacts becoming ever clearer, there is an urgent need for action.
- Existing infrastructure in developing cities is often of sub-standard quality, and thus fails to provide adequate protection from extreme weather events and changing climatic conditions. The urban poor are particularly vulnerable towards extreme weather events.
- Many of the world´s cities are situated along the coast, and as such are exposed to flooding from storm surges and sea level rise. The risk of coastal flooding is further increased in cities affected by subsidence.
- Financing for mitigation and adaptation actions exist, but are difficult to access for cities. Innovative solutions are needed now to close the finance gap.

Introduction

This paper outlines the role of cities as being drivers of global climate change and at the same time being affected by climate change. In addition to climate change, cities are confronted by challenges in relation to urbanization, natural hazards, and their interaction. The paper highlights the need to reduce greenhouse gas (GHG) emissions through climate mitigation policies, as well as the need for adaptation action to combat existing and potential climate impacts. Moreover, the paper underlines the challenges in finding synergies between adaptation and mitigation measures, suggests possible adaptation responses to inevitable climate change, and points out the financial barriers. The main focus lies on rapidly growing cities in developing countries and emerging economies. Given the complexity and unique characteristics of individual cities, it is not possible to provide an in-depth analysis of existing and projected climate risks, and possible mitigation and adaptation policies, for one particular city. Rather, this Focus-Paper provides a brief overview of various aspects, topics, and sectors of relevance to cities in general.

GERICS Climate Service Center Germany — in cooperation with KFW



CLIMATE SERVICE CENTER GERMANY (GERICS)

Climate-Focus-Paper
Regional Sea Level Rise
South Asia

Speed read

- South Asian countries bordering the Bay of Bengal are subject to a number of climate related hazards, chief among which is rising sea levels. Rising sea levels lead to impacts in many different economic sectors, including agriculture, water resources, and human health. As such, many economic sectors will need to adapt to the threat posed by rising sea levels.
- Successful adaptation to rising sea levels requires an understanding of the relative importance of the various drivers of change, whether these be climatic, or non-climatic factors. Understanding changes in sea level in the highly populated and low-lying south Asian region is of major importance, but is challenging because of inadequate tide-gauge, and subsidence time-series, data.
- Tide gauge observations of changes in sea level in the region show a large range of variation in linear rates of relative sea level rise (RSLR), ranging from 0.7 mm yr-1 at Chennai, to 8.2 mm yr^{-1} at Charchanga, in the Ganges delta.
- Projections of future changes in RSLR across the region, in 2080-2099, are fairly similar, with mean increases in the range 0.32 m to 0.38 m under a stringent mitigation scenario (RCP2.6), and 0.53 m to 0.58 m under a business-as-usual scenario (RCP8.5). These projections do not take account of local subsidence, however, which in some areas is a more important driver of changes in RSLR than climatic factors.
- Coastal flooding is one of the most important impacts associated with rising sea levels, and a major study shows the avoided damage costs by investing in infrastructure adaptation, i.e. dikes and sea walls, to maintain present day standards, may be as high as 1800%.

Introduction

Changes in mean sea level are the result of the complex interplay of a number of climatic and non-climatic factors. Regional and local mean sea level may differ significantly from global mean sea level because of variation in the relative importance of the different factors across the world[1]. A Focus Paper on Global Sea Level Rise is also available which discusses these issues[2]. Particularly at the regional and local level, the importance of non-climatic factors, e.g. subsidence or uplift, may be more important drivers of sea level change, than climatic ones. As such, when developing projects and considering investment decisions that may be sensitive to changes in sea level, it is important that adequate consideration of all relevant factors has been taken, and the implications this may have for projects well understood. This Focus Paper highlights the challenge of understanding changes in sea level, and the associated impacts, for a region in south Asia, focused on the Bay of Bengal.

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CLIMATE SERVICE CENTER

Climate-Focus-Paper
Global Sea Level Rise

Speed read

- Global mean sea level (GMSL) rise is one of the main indicators of climate change, and is of major concern for policy and decision makers, as it can have wide ranging impacts including on freshwater resources, agriculture, the incidence of flooding events, and loss of land in coastal areas.
- Adapting to these impacts is essential but challenging, as there is large uncertainty around how high sea levels may rise, and how fast.
- GMSL has increased by 0.19 m over the period 1901-2010, and the rate of increase has accelerated during the 20th century, with current rates estimated at 3.2 mm yr^{-1}.
- GMSL is projected to increase over the 21st century by between 0.28 m and 0.98 m by the year 2100 (IPCC AR5), and the future rate of increase is very likely to exceed the rate observed over the period 1971-2000.
- Using the IPCC AR5 estimates, it is possible to suggest an upper limit for GMSL of between 1.4 m and 1.6 m by the year 2100.
- This Climate-Focus-Paper is intended to provide information on various issues associated with GMSL rise, in order to support investment decisions in coastal and low-lying areas.

Background

When planning projects and investments in coastal and low-lying areas the potential impact of sea level rise (SLR) is highly relevant, particularly in the context of feasibility studies. Planners and decision makers may wish to know what a plausible upper limit for sea level rise may be. Establishing an upper limit for sea level rise is extremely challenging, as changes in sea level are the result of a range of different physical processes. At the global scale the chief processes are through thermal expansion as the oceans warm, and through the addition of water from land ice i.e. from melting glaciers and ice sheets. It is estimated that since the early 1970s these two processes account for around 75% of the observed global mean sea level rise[1]. Adapting to the impacts of SLR however, will take place at the local to regional scale, where additional processes related to vertical land movement e.g. subsidence or uplift, sedimentation rates, ocean currents, gravity, and regional variation in temperature and salinity, will also need to be considered in deriving local estimates of sea level change[2]. These factors will be discussed in more detail in a supplementary regional sea level focus paper. Here, the focus is on understanding past and future changes in global mean sea level, and the impacts that SLR has in a range of different economic sectors, illustrated with a detailed analysis of the impacts associated with flooding events. The work presented in this paper draws heavily on the results reported in the recent IPCC Fifth Assessment Report (AR5).

Climate Service Center Germany 2.0 — Eine Einrichtung des Helmholtz-Zentrums Geesthacht — In cooperation with KFW

Climate-Focus-Paper

Value

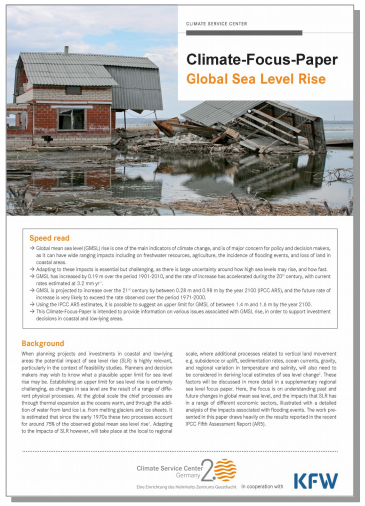
Climate-Focus-Paper provide an **accessible but wide-ranging introduction** to a topic of major relevance to the work of development cooperation. The paper helps project managers and technical experts **to better incorporate and consider** the importance of the specific topic, when carrying out climate feasibility studies

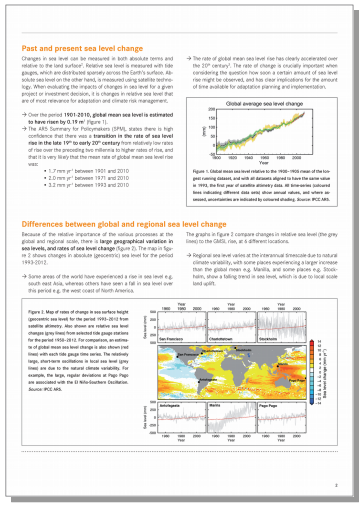
Topics included in the Climate-Focus-Paper on Global Sea Level Rise

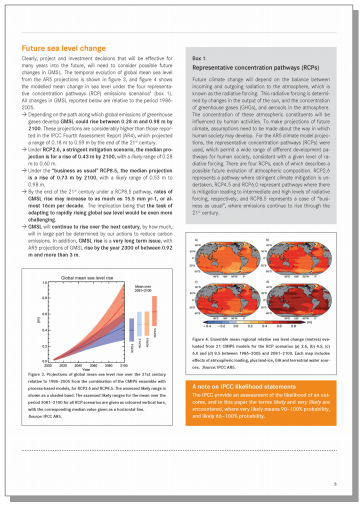
- "Speed Read" und Background
- Past and present sea level rise
- Differences between global and regional sea level change
- Future sea level change; potential limits of global mean sea level rise
- Impacts and Costing global mean sea level rise
- References and Weblinks

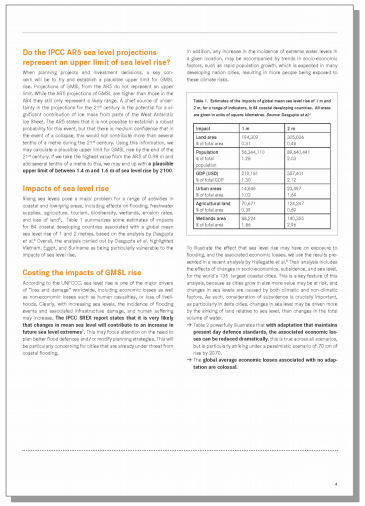
Concept of a Climate-Focus-Paper

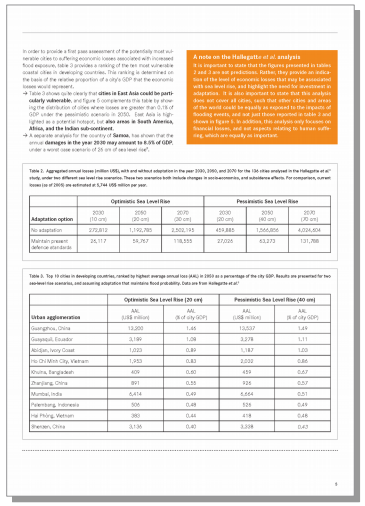
- Information provided in the Climate-Focus paper is based on a wide range of different but consistent sources (IPCC AR5, SREX, research paper)
- Climate-Focus-Paper are written in a condensed but easy understandable way (consisting of speed read; information boxes), tailored towards the practical use.
- The major issues tackled within a Climate-Focus-Paper are selected according to the needs of the main target group

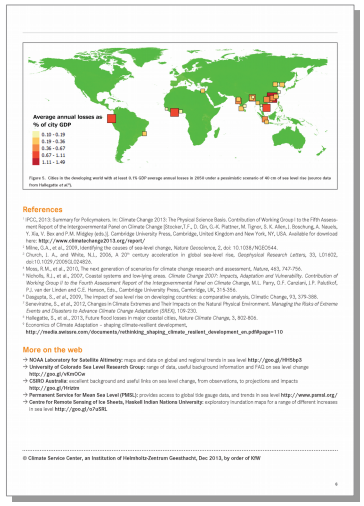








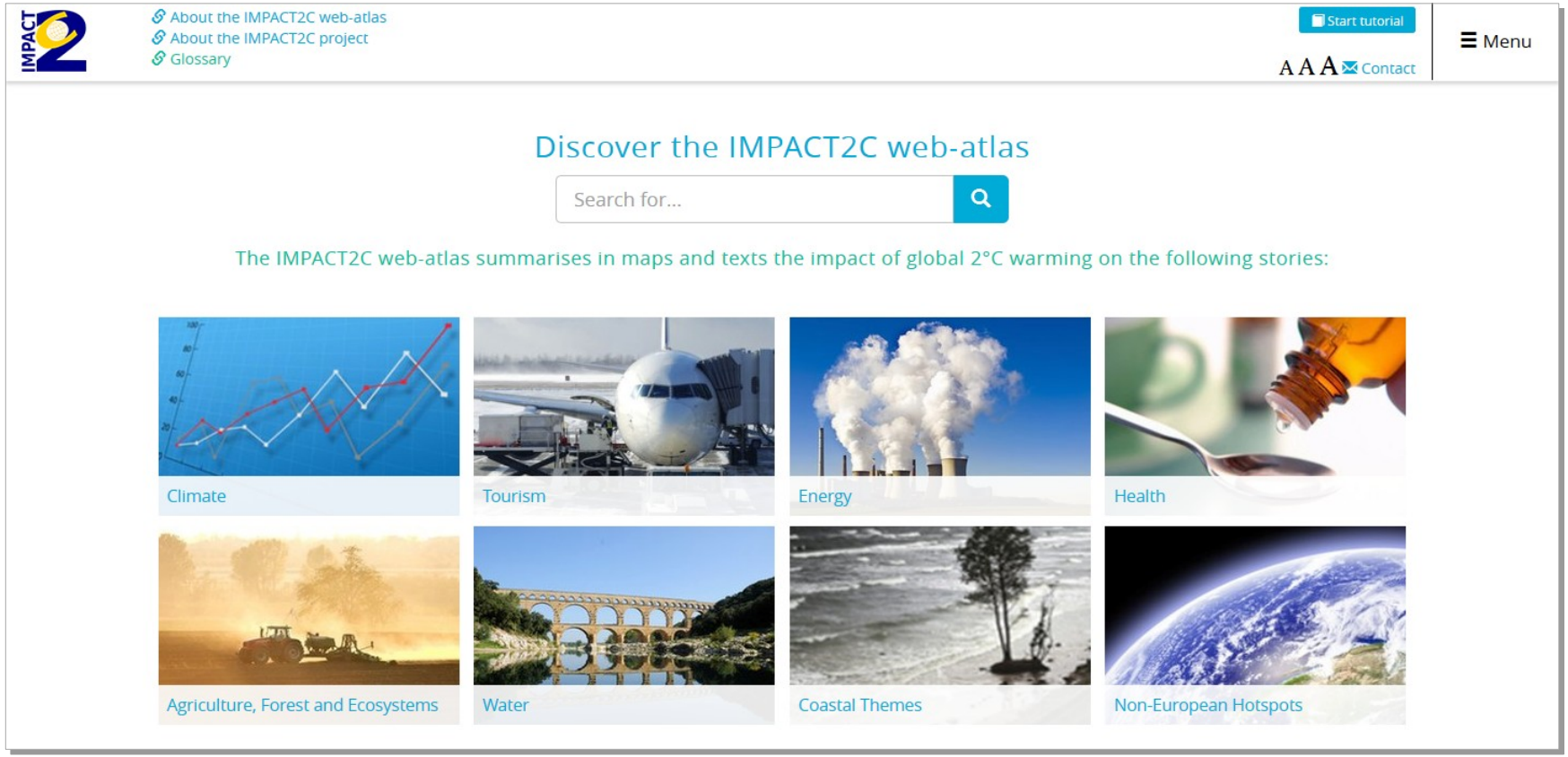




IMPACT2C web-atlas

GERICS coordinated the EU Project IMPACT2C: Estimating the key impacts of a +2°C climate change signal for different regions and sectors of the world. The IMPACT2C web-atlas provides climate change information for the development of possible adaptation strategies.

www.atlas.impact2c.eu

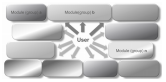


GERICS products in a nutshell

Fact Sheets

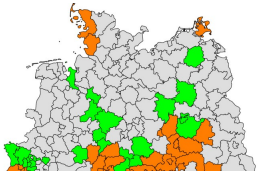
- Climate Fact Sheets
- Site-characteristic Climate-Fact-Sheets
- GERICS Climate-Focus-Paper

Toolkits



- Adaptation toolkit for Cities (*Stadtbaukasten*)
- Adaptation toolkit for Companies (*Unternehmensbaukasten*)
- Regional modeling toolkit (*Regionaler Modellierbaukasten*)

Maps and Visualizations



- GERICS Climate Signal Maps
- GERICS Climate Signal Maps (global)
- GERICS Rain Map

Trainings

- Customer specific training
- Sector specific training
- Capacity building programmes for countries in Africa, Asia and Latin-America
- Publications and tools supporting our capacity building measures

Publications

- National Assessment on Climate Change
- GERICS Reports
- Studies, Brochures and Documentations
- Klima konkret
- Newsletter
- Books
- GERICS articles at Earth System Knowledge Platform (ESKP) of Helmholtz-Association
- Publications in scientific journals

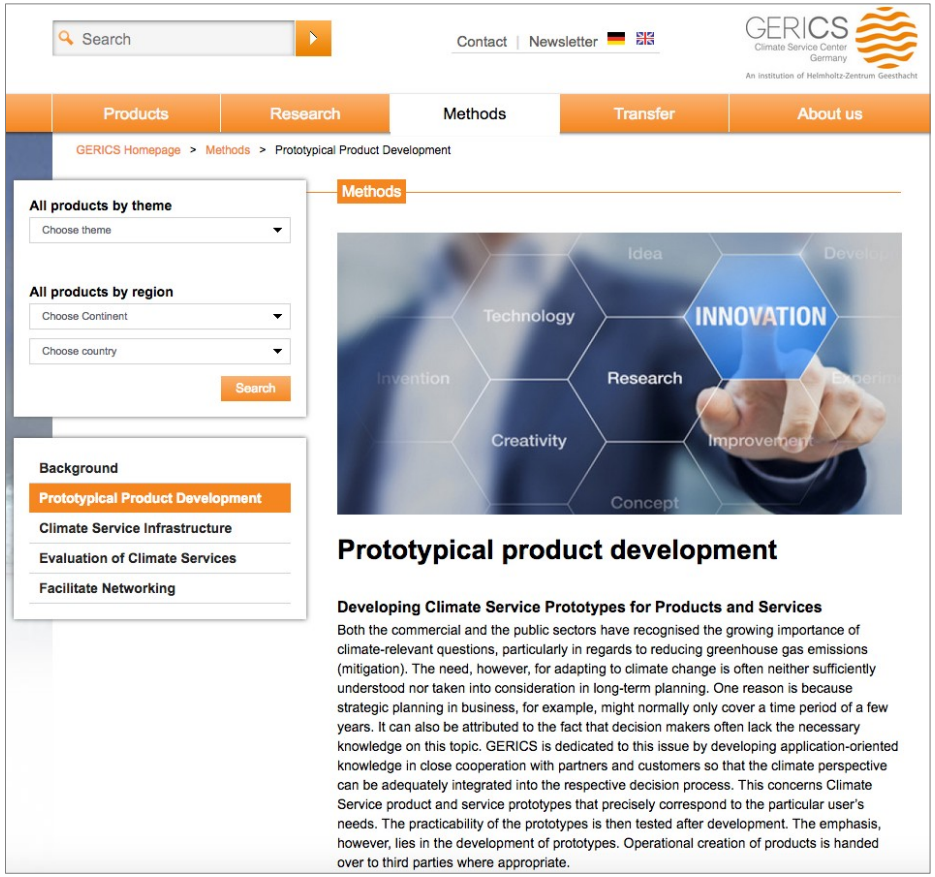
Webportals

- IMPACT2C Web-Atlas
- Klimanavigator
- Document Server Climate Change (Dokumentenserver Klimawandel)

For further information: Visit GERICS online

www.gerics.de

Key interfaces to users and practitioners are the GERICS web-services. The main gateway is the homepage, which is available in German, English, and in Arabic (only main pages).



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