Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

POSTERS

On-site visit RU 4

25.01.2018

Scientific Evaluation
Coastal Research and Climate Services

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Content

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

19. Lennart Marien — Towwards Improved Accuracy in Complex Terrain

20. Thomas Remke — Assessing climate change impacts on wind energy sector

21. Marius Stankoweit — Climate Change Impacts on Electricity grid Infrastructure

22. David Williams — Decision-making and policy-planning amidst uncertainty

23. Shoupeng Zhu — East Asian Summer Monsoon Modeling

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

IMPACT2C
Quantifying projected impacts under 2°C global warming

Daniela Jacob, Lola Kotova, Andreas Hänsler, Claas Teichmann, Swantje Preuschmann, Paul Bowyer
and IMPACT2C team

IMPACT2C examined the impacts of a +2°C global warming on Europe and key vulnerable regions in Africa (the Nile and Niger river basins), Bangladesh and the Maldives.

This four-year multi-disciplinary research project (from 2011 to 2015) was funded by the European Commission's Seventh Framework Program under the grant agreement No. 282746. The project was coordinated by Climate Service Center Germany (GERICS).

Researchers from 29 different institutions and 17 countries joined their competence within this project. IMPACT2C represented a major advance in understanding the complex processes and interactions between environmental, economic and social systems.

Objectives

IMPACT2C identified and quantified the impacts and most appropriate response strategies of a +2°C global warming for a broad range of **European sectors**, namely **water, energy, coasts, tourism, forestry, agriculture, ecosystems services, health and air quality-climate** interactions and **three vulnerable regions of the world**.

A sampling method to provide information across the matrix of emission scenarios, climate and impact models, and socio-economic pathways were undertaken.

Innovations

IMPACT2C developed a methodological framework integrating the uncertainties within and across the different sectors in a consistent way.

Cross-sectoral relationships were included into the analysis for particularly vulnerable areas where cumulative effects may arise.

Harmonised socio-economic scenarios were used to ensure that both individual and cross-sector assessments are aligned to the 2°C (1.5°C) scenarios for both impacts and adaptation.



©i-stock

IMPACT2C partners

The +2°C* threshold

**global mean near surface temperature rise of +2°C compared to a pre-industrial period (1881-1910)*

Most global climate models (GCMs) don't exceed +2°C at all for the low emission RCP2.6. The central estimates for selected GCM simulations show that +2°C is likely to be crossed by around **2040 for RCP8.5** (only twenty three years away from now) and by **2049 for RCP4.5.**

The IMPACT2C results make clear that a +2°C global warming would substantially affect a wide range of sectors and regions in particular throughout Europe. Some regions or sectors will benefit from a future warming, but some will experience disadvantages

How might the climate change in a +2°C world?

- **In most regions of Europe, the projected regional warming is more pronounced than the global temperature increase. Projections for annual mean precipitation show wetter conditions in northern Europe and drier conditions in southern Europe.**
- **Under a +2°C global warming, a European-wide increase in the frequency of extreme events is expected. Heatwaves are projected to double and extreme precipitation events tend to become more intense.**
- **For West and East Africa, the warming is above the global temperature increase. West Africa could experience a modest increase in rainfall, whereas for East Africa no clear trend is projected.**

What are the associated impacts?

- **Up to 10 million overnight stays in winter are at risk (ca. +7.3 million nights); winter tourism in Austria and Italy are most affected;**
- **In a +2°C world the wind power potential in Europe will be altered only to a small extent;**
- **A limitation to +2°C global warming will not stop sea-level rise due to the delayed reaction of the oceans. Therefore costs due to coastal flooding will incur even with adaptation measures.**
- **Bangladesh and the low-lying islands like Maldives are expected to feel the consequences of climate change, due to the continuous rise of sea-levels enhancing the risk for storm surges and flooding.**

IMPACT2C highlighted its key messages in the **Policy Briefing Notes** which are suitable for awareness raising and attractive to a wide audience, including policymakers, the media and other interested parties.

www.impact2c.eu

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Lola Kotova • Email: lola.kotova@hzg.de • www.climate-service-center.de

GERICS´ capacity development activities

Training concepts for the integration of climate change information into practice

Diana Rechid, Andreas Hänsler, María Máñez Costa, Bettina Steuri
Climate Service Center Germany (GERICS)

CAPACITY BUILDING
GERICS shares its experiences with multipliers and decision makers from business, administration, science, academic education, from cities and municipalities and with organisations and institutions from nations worldwide in order to support their efforts to develop climate services and also national climate service centres.

TRAINING
GERICS develops prototype training programs for the integration of climate change information into practise. These are prototype training concepts for customer specific and sector specific training, and for countries worldwide, such as in Africa, Asia and Latin-America.

TOOLS
GERICS provides tools to support the implementation of climate service products into practice, ranging from generic guidance to user-specific tools.

CAPACITY BUILDING for climate service providers — selected examples

TRAINING specific for customers, sectors & regions — selected examples

TOOLS to support education and training — selected examples

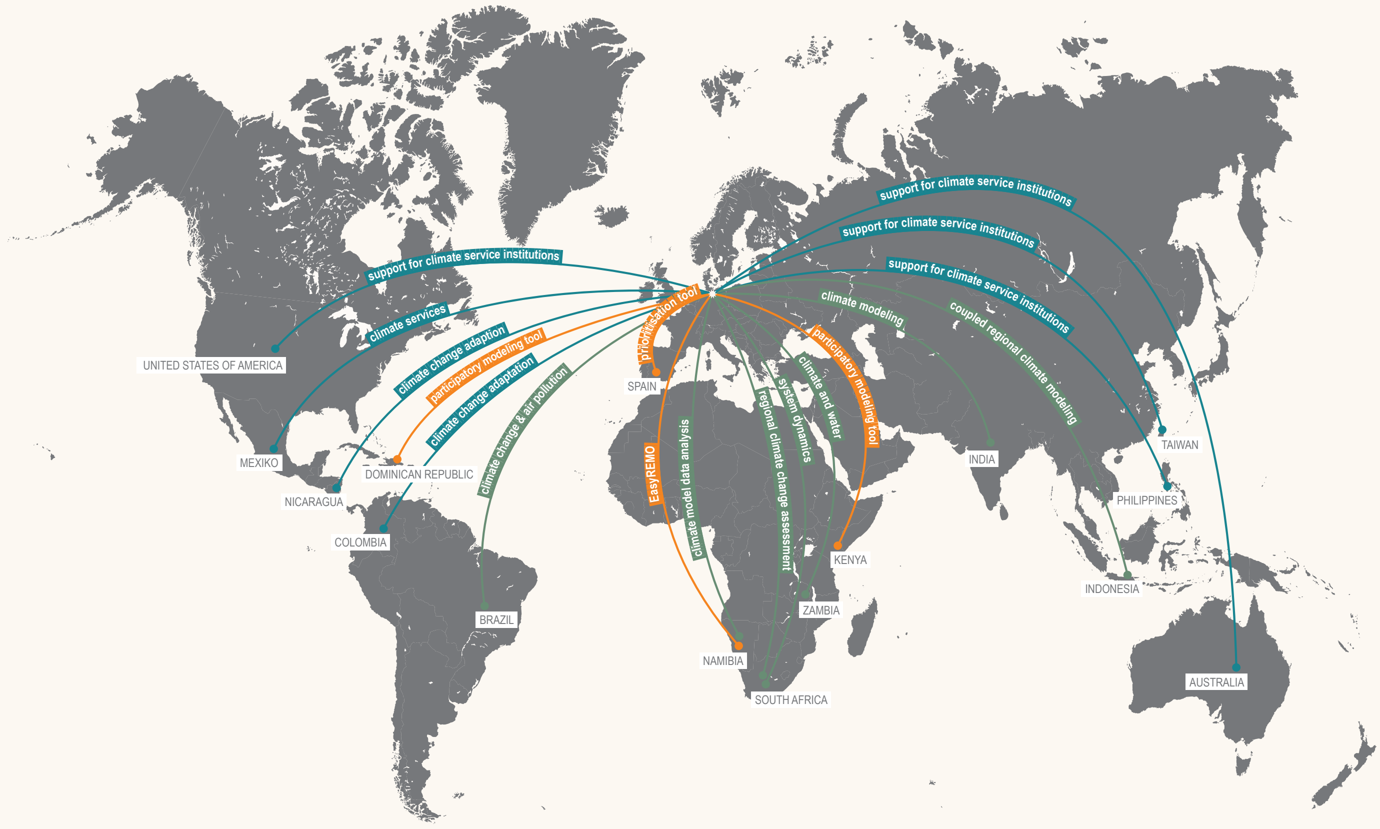


Figure 1: an extract of GERICS´worldwide capacity development activities (own graphic)

example

SUPPORTING THE DEVELOPMENT OF CLIMATE SERVICE INSTITUTIONS

Representatives of several international institutions visited GERICS through the years in order to exchange experiences in planning and developing climate service institutions, among them Australia, Austria, Belgium, Brazil, China, Dominican Republic, Mexico, Nicaragua, Norway, Philippines, Taiwan, the USA, and states belonging to the Alliance of Small Island States (AOSIS).

example

SASSCAL CLIMATE WORKSHOP

In the frame of the BMBF project "Southern African Science Service Centre for Climate Change and Adaptive Land Management" (SASSCAL), GERICS developed several trainings for scientists and students in Africa. For exampe, in April 2016 GERICS has held a four-day climate workshop in cooperation with The University of Zambia in Lusaka entitled "SASSCAL short course on regional climate change assessment and uncertainty analysis". The workshop was organized in close cooperation with the Friedrich Schiller University Jena. Thematic focus was the topic "climate and water". Two further workshops were held in 2017, namely in Stellenbosch (South Africa) and Windhoek (Namibia).

example

EasyREMO

GERICS has developed easyREMO, an easy-to-use version of the regional climate modelling REMO. EasyREMO runs on a common PC and is equipped with a graphical user interface. It is preconfigured for, but not restricted to the SASSCAL region. For the first time, producing regional climate projections is possible with minimum technical knowledge and hardware requirements. Scientists and students in the SASSCAL region will be enabled to do climate projections on their own, and to gather first experiences with climate data.

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Bettina Steuri • Email: bettina.steuri@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Building bridges between Modeling and Applications communities

The Vulnerability, Impacts, Adaptation and Climate Services Advisory Board for CMIP6

Claas Teichmann[1], Alex C. Ruane[2] (co-chairs of the VIACS Advisory Board)

[1]Climate Service Center Germany (GERICS), [2]NASA Goddard Institute for Space Studies

Motivation

Climate change adaptation relies on a foundation of science that extends from complex physical models of the climate system into sectoral impacts and climate services to support specific decisions. Communication has long been a challenge between the various communities involved. These include climate modelers, the array of researchers who utilize climate model outputs to study sectoral impacts, and the spectrum of climate service experts. This is not surprising given differences in disciplines, geography, scales of interest, community organization, and methods of evaluating success. Bridging the gap between these groups is vital to improving future plans related to adaptation, mitigation, and policy planning around the world. In particular, it is critical that output and analysis requests can work their way from the applications communities back to the modelers, and likewise that the modelers are able to communicate key assumptions and caveats to warn of applications that may be on shaky ground.

Methodology

In its latest iteration, the Coupled Model Intercomparison Project (CMIP6) has endorsed a new effort to facilitate two-way interactions between climate modelers and climate model applications experts. The Vulnerability, Impacts, Adaptation, and Climate Services Advisory Board (VIACS AB) was formed to enable more fruitful dialogue between leading climate modeling centers participating in CMIP and major sectoral leaders (including water resources, agriculture, health, urban, ecosystems, forestry, fisheries, transportation), climate service agencies, international projects and programs (e.g., ISI-MIP, AgMIP, TGICA, CORDEX, WGRC), and regional experts applying climate model output around the world. The VIACS Advisory Board is tasked with meeting with CMIP leadership on a regular basis in order to field questions and requests from the climate modeling community, survey their respective communities, and then return composite answers and questions of their own for the CMIP climate modelers. In September, 2015, the Programme of Research on Vulnerability, Impacts, and Adaptation (PROVIA) Scientific Steering Committee agreed to anchor the VIACS AB, establishing coherence and a strong partnership in the applied climate communities. Together with the CMIP6 endorsement, the VIACS AB now is firmly established as a bridge between the modeling and societal applications communities.

Findings

As its first activity, the VIACS Advisory Board solicited feedback from more than a dozen groups across a number of projects, regions, and sectors in order to identify priority variables and MIP experiments for CMIP6. As different VIACS groups have different needs concerning CMIP6 variables, it was not reasonable to create a single priority list that represents the demand of the entire community. Nevertheless, some variables and MIP experiments are clearly relevant across various groups, e.g.:

Frequent variables:

- Temperature
- Precipitation
- Solar radiation

Frequent MIP experiments:

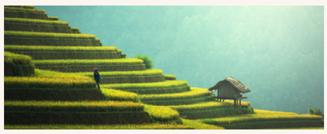
- DECK Historical simulations
- ScenarioMIP RCP simulations

Additional requests are a mixture of priorities depending on the sector.

Sectors

Board members interact with each other and with CMIP6 on behalf of their broader impact sector communities, including:

- Agriculture and Food Security
- Water Resources and Hydrology
- Infrastructure/Transportation
- Health
- Biomes/Ecology
- Oceans/Fisheries
- Coastal
- Forestry
- Energy
- Urban

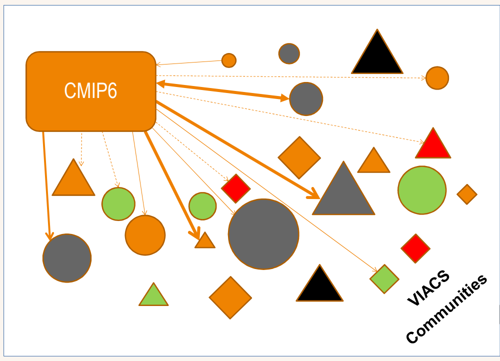


Pictures: CC0 Creative Commons

Partners

Built around participation of leaders of major societal sector research and established international programs and projects, e.g.:

- **PROVIA** (The Program for Research on Climate Change Vulnerability, Impacts, and Adaptation)
- **Climate Services**
- **TGICA** (IPCC Task Group on Data and Scenario Support for Impact and Climate Analysis)
- **WGRC** (The World Climate Research Programme (WCRP) Working Group on Regional Climate)
- **ICONICS** (International Committee On New Integrated Climate change assessment Scenarios)
- **ISI-MIP** (The Inter-Sectoral Impacts Model Intercomparison Project)
- **AgMIP** (The Agricultural Model Intercomparison and Improvement Project)

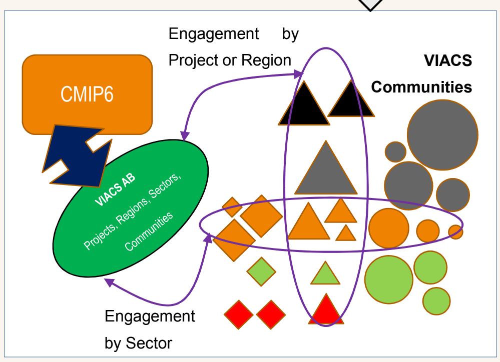


Different regions, projects, sectors, scales, organization levels

Interactions with CMIP6 too diverse, difficult and inefficient

Mutual Benefit to Coordinated Interactions

VIACS Advisory Board – Allows for coordinated interaction between CMIP6 and VIACS Communities



Facilitation of two-way communication around science and application goals:

- construction of model scenarios and simulations
- informed use of model outputs
- design of online diagnostics, metrics, and visualizations of relevance to society.
- Identify best practices and priority areas of research and application

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Claas Teichmann • Email: Claas.Teichmann@hzg.de • www.climate-service-center.de

The CORDEX-CORE initiative

High resolution regional climate information for the world

Claas Teichmann, Kevin Sieck, Lars Buntemeyer, Daniela Jacob
Climate Service Center Germany (GERICS)

Background

The CORDEX-COmmon Regional Experiment (CORE) Framework aims at providing high-resolution regional climate information for all major inhabited areas of the world. It is the answer of the WCRP CORDEX project to the growing demand for information about regional climate change and its impact all over the world. It aims at contributing to the next IPCC report with a homogeneous dataset of high-resolution regional climate information.

In order to assess climate change impacts, high-resolution climate change information is needed. This need can only partly be covered by Global Climate Models. This led to the proposal of CORDEX-CORE at the International Conference on Regional Climate 2016 in Stockholm, where it was discussed with and approved by the regional climate modelling community.

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

Setup

At GERICS we are using the following setup (in **bold**, common setup to CORDEX-CORE participants)

- Horizontal resolution: **0.22° (~25km)** resolution.
- 27 vertical layers
- REMO2015
- **CORDEX-CORE domains** depicted in Fig.1

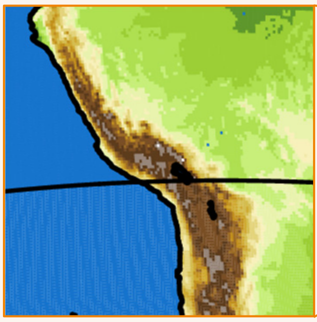


Figure 1b: Orographically structured area at CORDEX-CORE resolution of 0.22°.

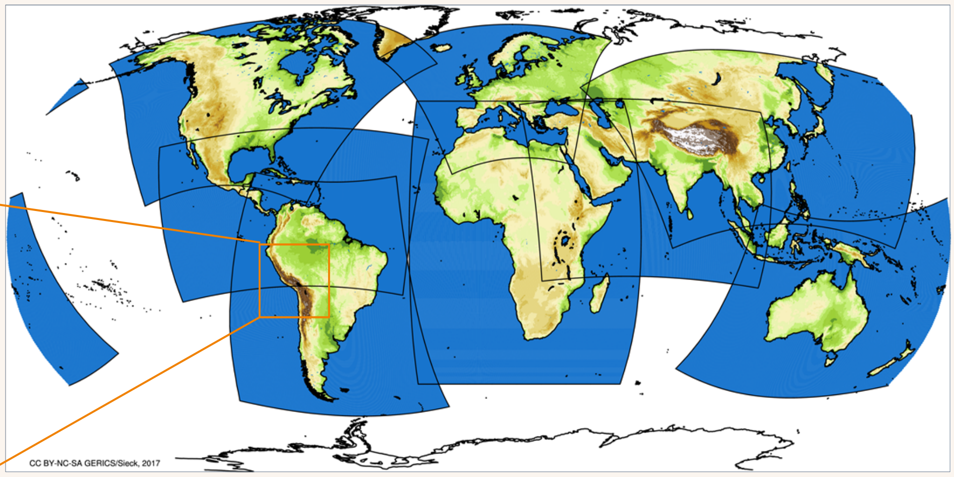


Figure 1a: CORDEX-CORE model domains as setup for simulations by the regional climate model REMO. Domains from top-left to bottom right: North America, Central America, South America, EURO-CORDEX, Africa, South Asia, East Asia, Australasia.

Planned simulations

Three models are contributing to the CORDEX CORE framework: the REMO model (contribution by GERICS), the RegCM model (coordinated by ICTP, Italy) and the CLM model (coordinated by the CLM community).

- Forcing: re-analysis, RPC2.6 and RCP8.5 driven global simulations

As boundary forcing, ERA-Interim is used for the evaluation simulations. For climate change simulations, three GCMs are envisaged to be used for boundary forcing reflecting high, medium and low climate sensitivity. In case of an insufficient model performance in a region, the "backup" GCMs are used:

- HadGEM (backup: MIROC5)
- MPI-ESM (backup: EC-Earth)
- NorESM (backup: GFDL-ESM)

Outlook

- Foster interaction with global modelling groups in the frame of CMIP6 to scientifically assess high-resolution global model and CORDEX-CORE simulations (e.g., via the CMIP6 High-Res MIP)
- Foster interaction with the Vulnerability Impact Adaptation and Climate Services (VIACS) communities to enable a broad application of the CORDEX-CORE simulations (e.g., via the CMIP6-endorsed VIACS Advisory Board)
- Refinement of common output and analysis strategies

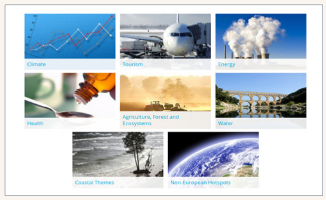


Figure 2: Example of possible regional impact assessments (screenshot taken from the IMPACT2C project homepage (www.impact2c.eu)).

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany • Phone +49 (0) 40 226 338 441 • Fax +49 (0) 40 226 338 163
Contact: Claas Teichmann • Email: claas.teichmann@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

How GERICS shapes the Copernicus Climate Change Service

GERICS-Team
Climate Service Center Germany (GERICS)

GLORIOUS
GLObal useRs In the cOpernicUs climate change Service (C3S422 Lot 1)
Sep 2017 – Oct 2019

- About: Demonstration of the users' uptake of relevant and high-impact climate information from the Climate Data Store world-wide

- Quality assurance of Climate Impact Indicators, user involvement and guidance

PRINCIPLES
Producing RegIoNal ClImate Projections Leading to European Services (C3S34bLot 2)
May 2017 – April 2020

- About: Providing an optimal matrix of RCP/GCM/RCM-combinations on available and forthcoming projection runs, that characterizes the source of spread invariability in climate projections over the European region.

- new EURO-CORDEX Simulations and assessment of the RCP/GCM/RCM modelling set up

Climate Change Service
climate.copernicus.eu

- Climate Data Store
- Quality and Evaluation
- Outreach and Dissemination
- Sectorial Information System

DECM
Data Evaluation for Climate Models (C3S51 Lot 4)
Aug 2016 – Oct 2018

- Assessment of user requirements regarding the quality of climate model data and products

- About: Evaluation of the development of climate services by assessing the technical and scientific quality of the service including the value to users. Quality assurance for multi-model climate projections

SECTEUR
Sector Engagement for C3S: Translating European User Requirements (C3S52 Lot 2)
May 2016 – Jul 2017

- Inventory of available climate impact indicators being applied for six sectors: agriculture and forestry, coasts, infrastructure, insurance, health, and tourism

- About: Analysis of available climate change impact indicators and identification of gaps and missing indicators in cooperation with the users.

CLIM4ENERGY
Providing climate products tailored for the energy sector (C3S 441 Lot 2)
Jan 2016 – Mar 2018

- Climate Impact Fact Sheets and Focus paper for the energy sector

- About: Provision of essential climate variables specific for the energy sector and demonstration of the value chain from climate data to actionable information in the energy sector based on case studies.

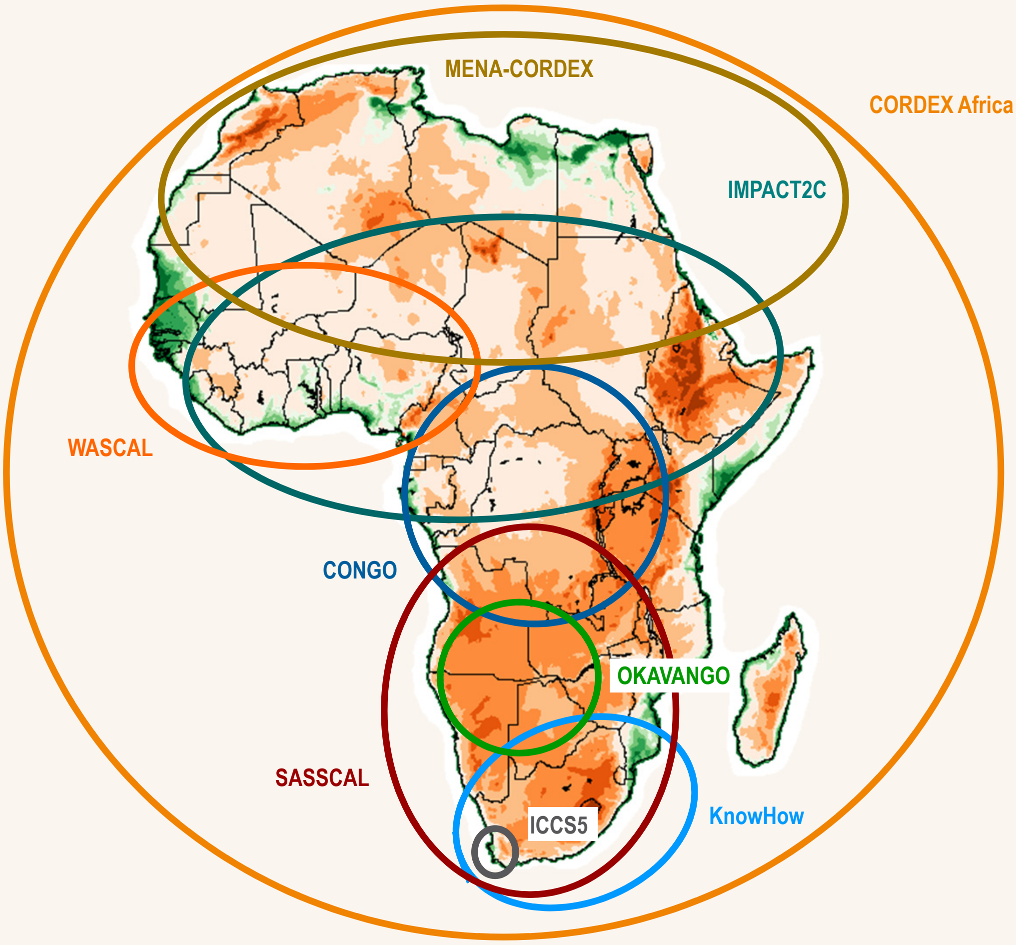
Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Juliane Otto• Email: juliane.otto@hzg.de • www.climate-service-center.de

Activities of GERICS in Africa

Climate Service in, with and for Africa

Andreas Haensler, Torsten Weber, Maria Máñez, David Williams, Arne Kriegsmann, Tanja Blome, and Daniela Jacob
Climate Service Center Germany (GERICS)

- Africa has a large demand for climate change information, knowledge building and technology transfer for local climate adaptation activities.
- Local decision-makers, scientists and stakeholders need tailored regional climate change information for their subject area.
- GERICS is working in Africa in various activities and regions, and provides regional climate change information, capacity building and knowledge transfer.



- **CORDEX-Africa** & **MENA-CORDEX:** Non-funded initiative; Contribution of regional climate change projections and analysis; Since 2009
- **IMPACT2C:** EU-FP7 project; Coordination of project, analyzing impacts under 2°C global warming & establishing IMPACT2C Web-Atlas; 2011-2015
- **WASCAL**: BMBF project; Scientific advisory board and supervision of PhDs; 2016-2018
- **CONGO:** BMZ via GIZ; Regional climate change assessment & capacity building; 2010-2013
- **SASSCAL:** BMBF project; Regional climate change projections and analysis, capacity building & technology transfer; 2013-2017
- **Okavango:** BMBF project; Regional climate change assessment; 2010-2015
- **ICCS5:** Global climate service conference with focus on Africa; Organizer; Held in February 2017
- **KnowHow:** EU-Project; Stakeholder interaction, knowledge transfer & capacity building; 2014-2016

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Andreas Haensler • Email: andreas.haensler@hzg.de • www.climate-service-center.de

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

GERICS Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Towards a framework for the evaluation of climate service and knowledge transfer products within climate and coastal research

Susanne Schuck-Zöller[1], **Elke Keup-Thiel**[1], Holger Brix[2], Christian Buschbaum[3], Jörg Cortekar[1], Christiane Eschenbach[2], Irene Fischer-Bruns[1], Stephan Frickenhaus[3], Klaus Grosfeld[3], Lars Gutow[3], Wolfgang Hiller[3], Daniela Jacob[1], Gesche Krause[3], Elke Meyer[2], Insa Meinke[2], Lars Nerger[3], Diana Rechid[1], Corinna Schrum[2], Johannes Schulz-Stellenfleth[2], Emil Stanev[2], Renate Treffeisen[3]

Definition

In 2016 the German "Wissenschaftsrat" (Council of Science and Humanities) broadened the meaning of the term **"knowledge transfer"** by including processes of trans-disciplinary research and thus overarching **unidirectional as well as bidirectional transfer activities.**

Working group within Helmholtz Association (Earth and Environment, PACES II)

To develop criteria for evaluation and respective indicators, appropriate to evaluate knowledge transfer and dialogue processes with stakeholders as well as climate and coastal service activities, scientists of various disciplines within Research topic 4 (Bridging Research and Society) worked together. They came from the Institute for Coastal Research and the Climate Service Center Germany (both Helmholtz-Zentrum Geesthacht) and the Alfred Wegener Institute Bremerhaven.

Unique activity within Helmholtz Association

Objects of evaluation

Every phase of project management can be an object of evaluation.

Input | Process | Output | Outcome | Impact

Criteria and indicators for output (preliminary version)

Criterion	Indicator
Availability	• Accessibility • Media responsivity • Easy-entry • Support for downloads
Visibility, dissemination in target groups	• Publications • Events and presentations • Information (material) on product • Public relations material and activities
Scientific quality, methodological quality	• Quality of data • Graphic design • Level of language • Up-to-date • Completeness • Extent • Transparency • Reflexivity • Reliability • Quality assurance (internal/external)
Degree of innovation	• Originality
Scaling	• Breadth and depth of product
Practical relevance	• Coverage of target group • Achievement of purpose • Usefulness • Lucidity • Navigation • Usability • Permanent improvement • Rights of use
Strategic potential	• Potential for transfer • Potential for societal transformation • Strategy for further development

Criteria and indicators for outcome (preliminary version)

Criterion	Indicator
Use	• Breadth of use • Depth of use • Frequency and duration of use • Suitability for target group • Relevance • Applicability for education
Satisfaction	• Comprehensibility • Target achievement • Users' appreciation • Perception of being up-to-date • Estimation of trustability • Identification with product
Dissemination, attention	• Quotations/references • Degree of recognition • Intensity of perception • Multiplier effects • Awards • Indirect effects
Users' learning effects	• Degree of innovation • Improvement of expertise • Scientific connectivity • Societal transformation capability
Valorisation	• Licensing • Operationalisation • Transferability

Outlook

- Enhance networking on this issue within whole Helmholtz Association
- Promote definition of clear project objectives and respective evaluation criteria already with application for funding
- Develop criteria to evaluate the process of the product/project development and care for continuous monitoring

Summary of the working group discussions

- A first preliminary framework for evaluation could be designed
- It is possible to standardize the criteria for evaluation across different research fields
- Evaluating impact is difficult and needs accompanying research
- It should be possible to evaluate results qualitatively and quantitatively
- Describing results by narratives („story-telling") might give an overall impression and a better interpretation
- Every evaluation is led by the objectives of the product or project. They might have changed during the process of development.
- For every product or project the weight of the criteria has to be adapted and an individual set of indicators is to be chosen.

References

- OECD (2002): Glossary of key terms in evaluation and results based management, http://www.oecd.org/development/peer-reviews/ 2754804.pdf, last access 14 July 2016
- Wissenschaftsrat (2016): Wissens- und Technologietransfer als Gegenstand institutioneller Strategien

- Design of the poster: Hanna Dunke -

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

[1]Climate Service Center Germany (GERICS), Helmholtz-Zentrum Geesthacht, Germany - [2]Institute for Coastal Research, Helmholtz-Zentrum Geesthacht, Germany - [3]Alfred Wegener Institute Helmholtz Center for Polar and Marine Research (AWI), Bremerhaven, Germany

Contact: Susanne Schuck-Zöller/Elke Keup-Thiel • Email: susanne.schuck,@hzg.de, elke.keup-thiel@hzg.de • www.climate-service-center.de

Evaluation of climate service and co-development products (1)

Proof of framework developed in PACES WG by application on Climate-Fact-Sheets

Susanne Schuck-Zöller / Elke Keup-Thiel
Climate Service Center Germany (GERICS)

Objectives

- Test of preliminary criteria and indicators from evaluation framework developed in the PACES working group (Poster 1)
- Ex-post Evaluation of "Climate-Fact-Sheets" by using criteria and indicators developed in PACES WG to assess the product quality (Poster 2)

Product development of Climate-Fact-Sheets

1) Prototype development together with KfW (for 3 countries)
2) Prototypes applied for 58 countries or regions
3) All Climate-Fact-Sheets can be ordered by the general public via homepage

Making criteria and indicators assessible

How can quality criteria be assessed in evaluation processes? A system, similar to a cascade, helps to categorize different steps.

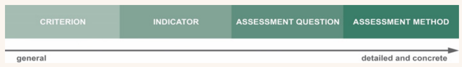


Figure 1: The evaluation cascade scales down from quite general evaluation dimensions (cut off in this figure) to criteria and indicators. Assessment questions and respective methods (qualitative or quantitative) allow for tangible assessment results (Schuck-Zöller et al., 2017)

Framework of criteria and indicators adopted

Output

Criterion	Indicator
Availability	Accessibility Media responsivity Easy-entry Support for downloads
Visibility, dissemination in target groups	Publications Events and presentations Information (material) on product Public relations material and activities
Scientific quality, methodological quality	Quality of data Graphic design Level of language Up-to-date Completeness Extent Transparency Reflexivity Reliability Quality assurance (internal/external)
Degree of innovation	Originality
Scaling	Breadth and depth of product
Practical relevance	Coverage of target group Achievement of purpose Usefulness Lucidity Navigation Usability Permanent improvement Rights of use
Strategic potential	Potential for transfer Potential for societal transformation Strategy for further development

Outcome

Criterion	Indicator
Use	Breadth of use Depth of use Frequency of use Duration of use Suitability for target group Relevance Applicability for education
Satisfaction	Comprehensibility Target achievement Users' appreciation Perception of being up-to-date Estimation of trustability Identification with product
Dissemination, attention	Quotations/references Degree of recognition Intensity of perception Multiplier effects Awards Indirect effects
Users' learning effects	Degree of innovation Improvement of expertise Scientific connectivity Societal transformation capability
Valorisation	Licensing Operationalisation Transferability

Figure 2: All criteria for output and outcome were used and appropriate indicators were chosen (green: criteria and indicators used in survey, red: indicators not assessed in survey, blue: indicators assessed in combination with indicators linked

Methodological Approach

To make as many users as possible participate the range of questions had to be limited:

- Some criteria and indicators were combined
- Output indicators referring to the potential of the product (i.e. "usability" or "potential for transfer") would have needed a neutral reviewer. To minimize the effort they were assessed by questions to evaluate the related outcome indicators ("usability" by "relevance" and "users' appreciation", "potential for transfer" by "transferability")
- Some indicators were overlapping and therefore combined to avoid repetitions (i.e. "achievement of purpose" and "target achievement")

As the objectives of the project lead the choice of evaluation criteria and indicators, a few indicators had to be left out, as they did not correspond to the objective of the co-creation process (i.e. "media responsivity" and "public relations material and activities")

To gain an organic flow of the questions and to hide the indicators in the back a bit the sequence of the questions was changed

General remarks on concept

- As many users as possible were to be motivated to participate in the survey
- The indicator to be assessed by the single questions should not be too obvious to the survey participants

Conceptual overview of workflows

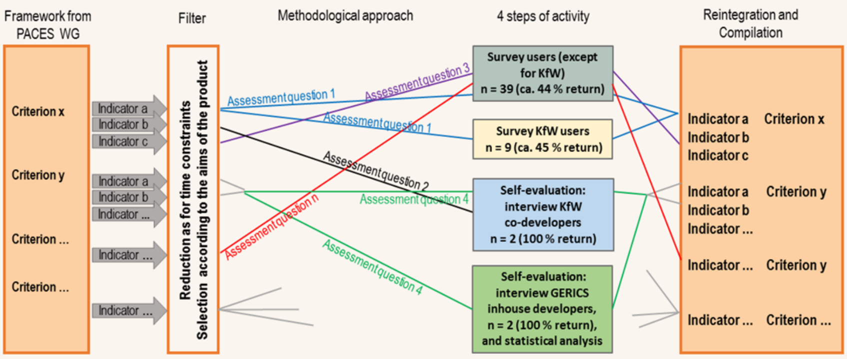


Figure 3: The criteria from the PACES framework had to be filtered and the respective assessment questions were selected for one or more survey target groups. The results of surveys and interviews were reintegrated again afterwards .

Summary & conclusions

- Different questionnaires are necessary for the evaluation of all criteria, having been developed in the PACES WG (user survey versus developer survey). In the case of a co-created product, there are even at least three target groups to be surveyed (developers and co-developers, users). If the product is - after the co-creation process - delivered to the general public, there are even four target groups to be questioned (the user group has to be spread up into users affiliated with the co-creating institution and users from beyond).
- As the documentation of the co-creation process was not quite systematic the surveys of the co-developers (self-evaluation with GERICS and KfW) delivered the information to be assessed in terms of criteria like "scientific quality" or "degree of innovation"
- Some criteria (i.e. "availability" or "breath of use") could partly be assessed by testing and statistical analysis

Outlook and open questions

- In favour of a systematic documentation of co-creation processes special workflows have to be established in the future, thus the self-evaluation should be unnecessary
- Is it desirable to derive a final overall grade from the different results of every single indicator or should rather every product be assessed individually?
- Does it make sense to compare different products by a final overall grade?
- A final overall grade would only be possible, if all results were quantitative
- To gain a final overall grade the different criteria and indicators would have to be weighted

References

Schuck-Zöller S, Cortekar J, Jacob D (2017): Evaluating co-creation of knowledge: from quality criteria and indicators to methods, in: Advances in Science and Research 14, 305-312

Design of the poster: Joana Cortes Kollert, Julia Cramer, Hanna Dunke

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Susanne Schuck-Zöller • Email: susanne.schuck@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Evaluation of climate service and co-development products (2)

Climate-Fact-Sheets: selected results of evaluation

Elke Keup-Thiel / Susanne Schuck-Zöller
Climate Service Center Germany (GERICS)

Objectives

- Test of preliminary criteria and indicators from evaluation framework developed in the PACES working group (Poster 1)
- Ex-post Evaluation of "Climate-Fact-Sheets" by using criteria and indicators developed in PACES WG to assess the product quality (Poster 2)

Product development of Climate-Fact-Sheets

1) Prototype development together with KfW (for 3 countries)
2) Prototypes applied for 58 countries or regions
3) All Climate-Fact-Sheets can be ordered by the general public via homepage

Key data of the evaluation survey

- Period of the evaluation: October – December 2017
- 108 users contacted (88 users + 20 KfW users) = good number of potential interviewees, although statistical not representative
- 48 users participated (39 users beyond KfW + 9 KfW users)
- Except for the users, questionnaires were prepared for the product developers (4 different questionnaires altogether)
- Assessment of 12 criteria and 34 indicators

Results of self-evaluation by developer institutions

Output Product is **up-to-date** and **complete:** In 2016 an update has been made according to the global climate simulations of IPCC/AR5. In addition a search on observational climate data has been made and all available data have been used. New methods of visualisation and tailored explanation formats show the **originality** of the product.

Outcome **Target achievement** fulfilled: the co-developers of KfW, as well as the GERICS developers confirm that their targets were achieved. The **transferability** of method was proofed as further products like the Site-characteristic Climate-Fact-Sheets could be derived

Results of evaluation: output

Availability: easy-entry

Figure 4: The website of the Climate-Fact-Sheets is offered to searchers on 1st position in all common search engines (test on 01.12.17, items: Climate-Fact-Sheets, Climate Fact Sheets and Climate-Fact Sheets).

Results of evaluation: outcome

Use: breadth of use

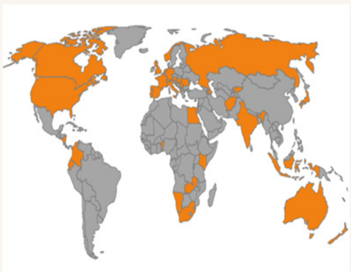


Figure 5: Users origin from 37 different countries worldwide (n=284; 26.10.2017)

Use: breadth of use

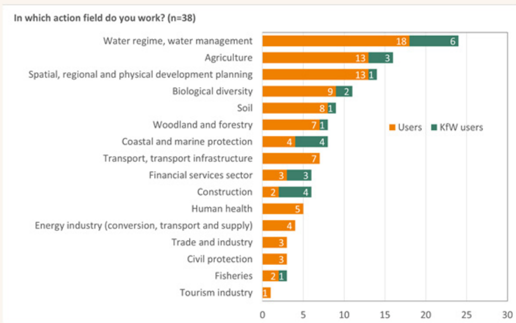


Figure 6: The Climate-Fact-Sheets are being used across all different action fields. The main action field for both user groups are water regime and water management followed by agriculture as well as spatial, regional and physical planning.

Satisfaction: estimation of trustability

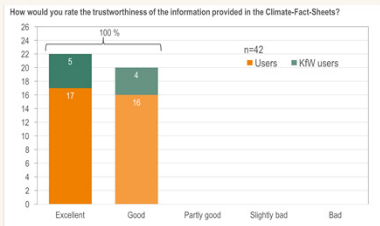


Figure 7: All users (100 %) estimated the trustability as excellent or good

Satisfaction: users' appreciation

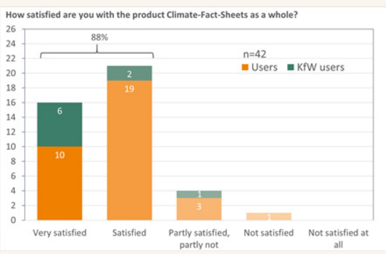


Figure 8: The main part (about 88 %) of both user groups are satisfied or even very satisfied with the product. As expected more KfW users are 'very satisfied" since the CFS have been developed for them

Satisfaction: identification with the product

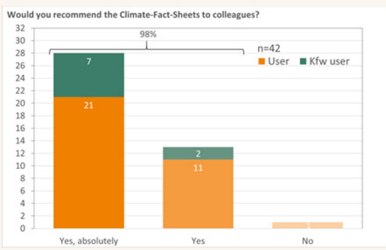


Figure 9: Nearly all users identify with the product and would recommend it to colleagues

Valorisation: transferability

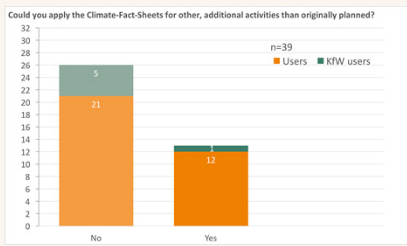


Figure 10: 13 out of 39 users (about 33 %) could apply the product for other, additional activities than originally intended

Summary & conclusion

- Though the statistical analysis is not representative as for too small numbers of participants, the number of respondents of the survey is satisfying (more than 44 % return)
- The real effort of this detailed evaluation lead to meaningful results.
- The combination of quantitative and qualitative assessment methods worked well.
- Open questions delivered interesting aspects towards user needs and further product development
- The Climate-Fact-Sheets turned out to be a successful, usable and very efficient product
- All criteria and indicators from the PACES working group can after minor adoptions be transformed in assessable methods and will allow for significant results.
- The concept of spreading up the criteria and indicators in four different surveys and recollect the results afterwards was successfully approved
- As shown for the Climate-Fact-Sheets enough criteria and indicators are available to evaluate newly developed products

Outlook

- A detailed product evaluation following the example of the Climate-Fact-Sheets should be a regular element of product development and operationalization.
- The proof of the evaluation framework developed in the PACES working group will be refed into the scientific community again to share the experiences
- More experience needed to judge the results (How many percentage in users' appreciation is normal/good/excellent?)

Design and figures of the poster: Julia Cramer und Hanna Dunke

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Elke Keup-Thiel • Email: elke.keup-thiel@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

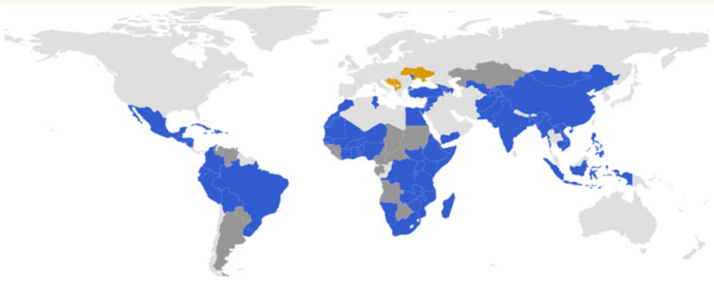
Providing facts to support action

The example of GERICS Fact-Sheet products

Andreas Hänsler, Diana Rechid, Susanne Pfeifer, Elisabeth Viktor
Climate Service Center Germany (GERICS)

About

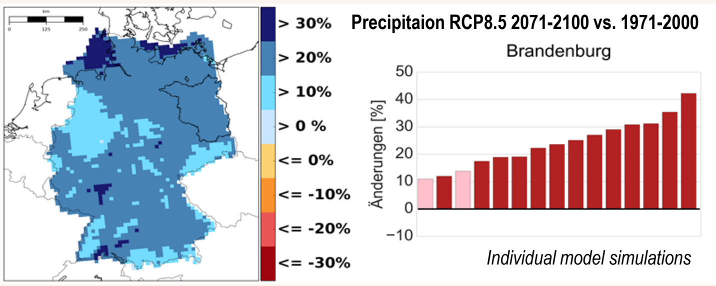
- GERICS offers **different Fact-Sheet formats** with information on different spatial scales and with sectoral focus.
- All Fact-Sheets provide non-climate experts with **facts and expert judgement** on the magnitude and robustness of projected climate change to support the implementation of climate data into planning processes of the **public and private sector**.
- All sets of Fact-Sheets have been developed for specific user groups in a **joint effort**.
- All Fact-Sheets are based on **multiple sources** of recent research data and findings and use **state-of-the-art methods** to **condense** the large data volumes and informational basis into concise facts.



blue – global CFS; orange – regional CFS; grey – planned CFS

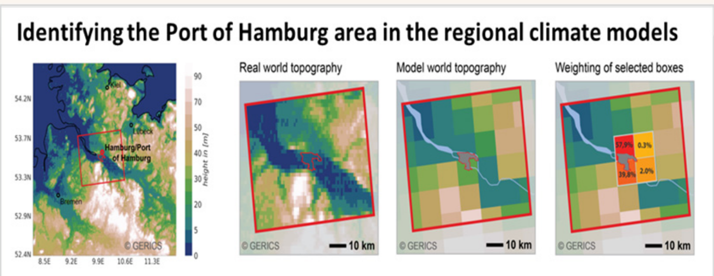
Climate-Fact-Sheets (CFS)

- Harmonized and easily accessible climate change information on a **national scale** as basic information for an **initial climate screening** of development projects
- Originally developed to serve the purpose of **KfW Development Bank**, meanwhile widely used
- Combination of the findings from **IPCC AR4 & AR5**
- Currently available for **65** countries/regions
- **Future Potential:** Increase in flexibility of use by implementation of a publicly available dynamic Climate-Fact-Sheet generator



„Klimaausblick"

- Individual compilation of **region-specific (sub-national scale)** relevant climate parameters and thresholds
- Visualize projected climate changes under the **RCP8.5, RCP4.5 and RCP2.6** scenario conditions based on EURO-CORDEX ensemble
- **Prototype** developed for the German federal state of Brandenburg
- **Future Potential:** Increase of the variety of climate indices presented to enhance the relevance for different regional to local actors



Site-characteristic Climate-Fact-Sheets

- Robust climate change information on a **local scale** for the development and maintenance of production sites or port infrastructure
- Concept developed with **BASF-SE** and transferred to the Port of Hamburg for **HPA**
- Based on the state-of-the-art high-resolution **EURO-CORDEX ensemble**
- **Future Potential:** Expansion of concept to cities and operationalisation

Climate Change Service

- Wind Power Generation
- Bioenergy production conditions (timber)
- Hydropower
- Electricity Demand – Generation Balance
- Oil and Gas (offshore)
- Influence of freezing rain on the energy infrastructure

Copernicus
Europe's eyes on Earth

Sector-specific Climate Impact Fact-Sheets

- Climate change impact on **sector-specific** conditions and processes using essential climate variables and derived indicators
- Based on the state-of-the-art high-resolution **EURO-CORDEX ensemble**
- **Case studies** to illustrate the benefit of integrating the indicators into decision-making processes
- First Fact-Sheet set is being developed for the **energy sector** in the context of the Copernicus Climate Change Service project Clim4Energy
- **Future Potential:** Expansion to other sectors

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Andreas Hänsler • Email: andreas.haensler@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center
Germany
An institution of Helmholtz-Zentrum Geesthacht

Innovation in Climate Service Provision

INNOVA – An ERA4CS Project 2017-2020

María Máñez Costa, Louis Celliers, David Williams
Climate Service Center Germany (GERICS)

Transform climate-related data into customized products such as projections, forecasts, information, trends, economic analysis, assessments (including technology assessment), counselling on best practices, development and evaluation of solutions and any other climate services that are useful to society at large.

1 INNOVA will undertake cutting edge research through:

- A combination of social and economic innovation, both technological and non-technological elements that can lead to employment and sustainable growth.
- The development of technological and performance assessment for risk management and extreme risk response options, fostering adaptive innovation.
- Monitoring the performance, effectiveness and scalability of approaches, including post-implementation requirements, and operational, organizational and governance needs.

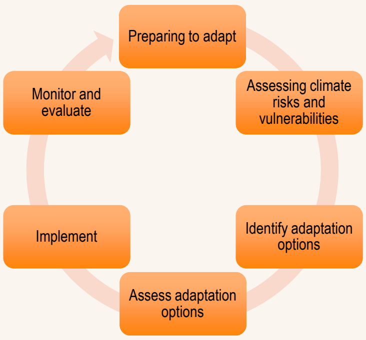


Figure 1: Adaptation cycle - the theoretical backbone of the innovation process of INNOVA

2 The INNOVA approach is adaptive and co-management focused including:

- Co-produced identification of risks and vulnerabilities.
- Adaptive climate services innovations to adapt to the risk, including the identification of suitable business models shifting from risks to opportunities.
- Monitoring, evaluation and learning for enhancing and up-scaling innovation in climate services development for adaptation.

3 INNOVA will learn and innovate by way of exploring four geographically and developmentally distinct case studies (hubs):

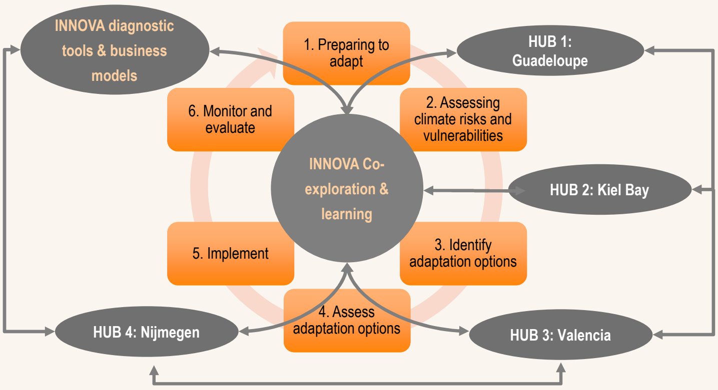


Figure 2: Hubs development status

- Hubs are generally representative of other areas in Europe (Mediterranean, North European; and islands urban and peri-urban areas.
- The development of adaptation options for hubs are different along the adaptation policy.

Table 1: Description of INNOVA hubs or case study areas

Bio-geographical unit	Risk description	Climate Services Development
A. Guadeloupe archipelago and Martinique, French West Indies islands: Small island states	Increasing magnitude and frequency of flash floods and droughts create worsening conditions for agriculture.	Incipient
B. Kiel Bay, Germany: coastal communities in low-lying areas at the Baltic coast of Schleswig-Holstein	Climate change stimulates an increase in extreme weather events such as: excess surface runoff during heavy rainfalls and an increasing erosion trend at the coast with increasing usage of the coast.	Emergent
C. Valencia, Spain: Mediterranean coastal urban area	Protracted droughts and flash floods; reduction of available resources with climate change; water quality reduction.	Emergent
D. Nijmegen on the river Waal, The Netherlands: upper part of the Rhine, Maas, Schelde delta	New urban developments are being realised along the river. During this development process climate services showed that the Waal river near Nijmegen should be broadened to lessen the risk of flooding.	Maturing

4 INNOVA is implement thought six work packages:

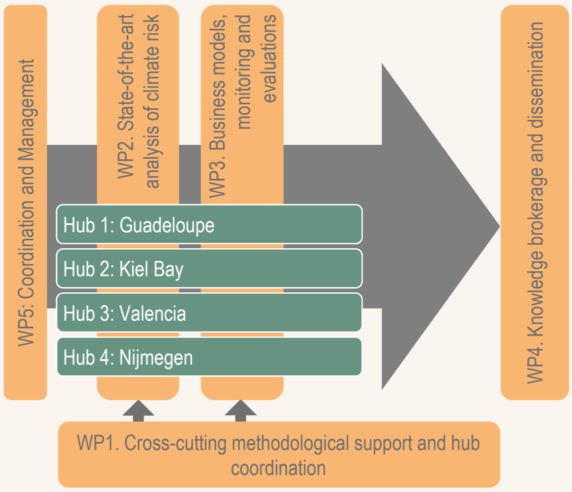


Figure 3: INNOVA work package flow

5 INNOVA offers novel planning processes for climate service:

- Core to INNOVA is real-world examples (hubs) of the potential of scientific data to be negotiated with stakeholders and converted to climate services in order that society can derive benefit.
- Three groups of people work together on innovative solutions to real problems related to climate change and extreme weather events: societal actors, the public sector and knowledge or knowledge brokerage institutions.
- Develop innovative tools for the evaluation, planning, development and implementation of climate services for local adaptation.

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Louis Celliers • Email: louis.celliers@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center
Germany
An institution of Helmholtz-Zentrum Geesthacht

Scientific secretariats at GERICS

Supporting scientific networks

Tanja Blome, Ragnhild Eisengarten, María Máñez Costa, Daniela Jacob
Climate Service Center Germany (GERICS)

Motivation

Networks help to connect people, institutions and schools of thought. The initiate new and strengthen existing collaborations, facilitate the exchange of ideas, findings and methods, as well as enable meetings and joint projects.

Scientific secretariats at GERICS

GERICS hosts the secretariats of three scientific networks:

- The **Climate Services Partnership (CSP)**
- The **Helmholtz-Institut Climate Service Science (HICSS)**
- The **Earth League (EL)**

The specific focuses of the CSP, HICSS and EL networks are explained below. Figure 1 shows partners' locations.

Tasks

The tasks of the secretariats comprise:

- research coordination,
- networking,
- support of outreach activities,
- scientific support.

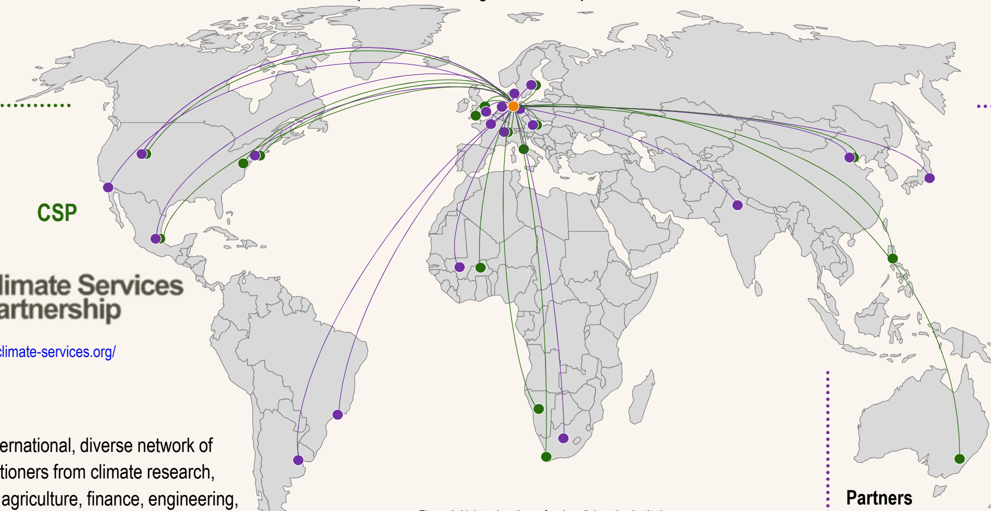


Figure 1: Links to locations of main collaborating institutions, for CSP (●), HICSS (●) and EL (●).

CSP

Climate Services Partnership

http://www.climate-services.org/

Partners

The CSP is an international, diverse network of scientists & practitioners from climate research, development aid, agriculture, finance, engineering, politics & community management.
HZG/GERICS is founding partner & member of the steering group.

Aim

The CSP develops, implements & operationalises climate services: It informs decision making regarding climate & climate change, on scales from the regional & national down to the micro scale.

Activities

The CSP facilitates the exchange of methods, knowledge & experience among the larger CSP group (> 2000 contacts), through:

- permanently available information on the web,
- large, bi-annual conferences.

Outcomes

- Comprehensive newsletters, guidelines, webinars & other material on the web page (Fig. 2, left)
- The International Conferences on Climate Services (ICCS), most recent: ICCS5 (Fig. 2, right)

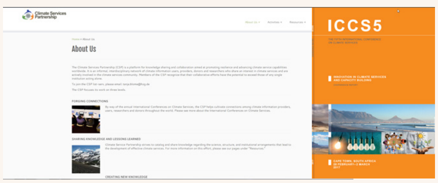


Figure 2: Screenshot of CSP home page (left), Cover of ICCS5 report (right), available at http://www.climate-services.org/wp-content/uploads/2017/09/ICCS5_Report.pdf

HICSS

Partners

Helmholtz-Zentrum Geesthacht (HZG) & Universität Hamburg cooperate in the frame of the HICSS.

Aim

To pool common competencies of GERICS, a scientific organizational entity of HZG, and Universität Hamburg in natural, social and economic sciences for the research area „Climate Service Science".

Activities

Joint research, promotion of young researchers, and knowledge transfer in the focus areas

- From knowledge to action
- Modeling of complex systems
- Evaluation of knowledge gained from climate and Earth system research

The executive board is supported by the HICSS administrative office, operated by GERICS.

EL

http://www.the-earth-league.org/

Partners

The EL is a global network of leading scientists from internationally outstanding institutions & diverse disciplines: Earth system & climate science, economics, biodiversity, & resilience research.

Aim

The EL fosters & synthesises cutting edge science on urging problems related to global environmental change to inform decision making at the national & international level.

Activities

- Scientific research & publications
- Major outreach activities
- General EL meetings every one to two years, with adjoint, public symposia

Outcomes

- Earth Doc programme
- High-level, synthesising scientific papers
- Science based cutting edge statements on, e.g., UN climate conferences COP21, COP23 (Fig. 3)

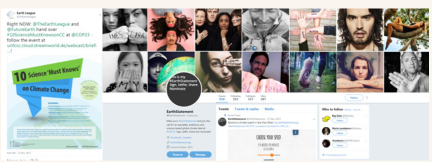


Figure 3: EL activities at COP23 in Bonn in November 2017 („10 Science Must-Knows ...", left); at COP21 in Paris in November 2015 („Earth Statement", screenshot of Twitter activity, right).

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Tanja Blome • Email: tanja.blome@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

UseUClim - Urban Climate under Change

Review of an urban climate model´s practicability and user-friendliness

Bettina Steuri, Jörg Cortekar, Steffen Bender

Climate Service Center Germany (GERICS)

PROJECT DETAILS & AIM

SPONSORED BY THE Federal Ministry of Education and Research

Cities and metropolitan areas are sensitive to climate change and, thus, they have to be prepared for its consequences. High-performance urban climate models are the basis for prospective planning decisions, however, as of today no practice-oriented model exists. Therefore, the funding programme Urban Climate Under Change [UC]² aims to develop an innovative and user-friendly urban climate model that allows simulating present and future climate as well as air pollution problems in urban areas.

The programme is structured into three collaborating modules: module A develops the urban climate model, module B collects observational data and module C reviews its user-friendliness (see fig. 1). The programme started on 1st June 2016 with a duration of three years. The Federal Ministry of Education and Research (BMBF) funds the programme as "Research for Sustainable Development" (FONA). The German Aerospace Center (DLR) Project Management Agency is providing the programme, the funding code is 01LP1604A.

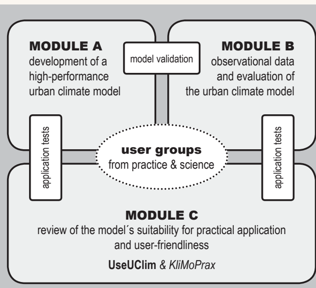


Figure 1: project structure (adapted from www.uc2-program.org/, 2016)

1 // STAKEHOLDER-ANALYSIS

At first, the potential user groups, which inlcude more than municipalities, were identified by a detailed stakeholder-analysis (see fig. 2). Since not all stakeholders can be identified at the beginning of the project, this analysis will be a continuous process throughout the project. This task was led by Fraunhofer Institute for Building Physics, our project partner.

MUNICIPAL PLANNING AUTHORITIES | URBAN PLANNERS

REAL ESTATE DEVELOPERS | ACADEMIC INSTITUTIONS | INSURANCE & REINSURANCE COMPANIES

ENVIRONMENTAL ASSOCIATIONS | TRAFFIC PLANNERS

Figure 2: potential user groups (own graphic)

2 // LITERATURE RESEARCH

In a next step, the respective requirements of the different stakeholders have to be analysed in order to develop a model that supports them in their daily work. Thus, a literature and project review has been carried out. It served as a basis for the online-survey and provided a scientific perspective to the requirements elicitation. Various sources have been consulted to obtain an overview on relevant topics (see fig. 3).

BOOKS // for example:

- National Academy of Sciences - Board on Atmospheric Sciences and Climate (2012). *Urban Meteorology: Forecasting, Monitoring, and Meeting Users' Needs.* Washington, D.C.: The National Academic Press.
- Ng, E. & Ren, C. (2015). *The Urban Climatic Map: A Methodology for Sustainable Urban Planning*. New York, NY: Routledge.

RESEARCH PAPERS // for example:

- Mills, G. (2014, December). *Urban climatology: History, status and prospects*. Urban Climate, 10 (3), 479-489.
- Briley, L., Brown, D. & Kalafatis, S. E. (2015). *Overcoming barriers during the co-production of climate information for decision-making.* Climate Risk Management, 9, 41-49.

WORKSHOPS | URBAN CLIMATE ANALYSES | RESEARCH PROJECTS | REQUIREMENT CATALOGUES | URBAN CLIMATE MODELS | GUIDELINES & POLICIES

Figure 3: document types for the desk research (own graphic)

3 // ONLINE-SURVEY

On the basis of the stakeholder-analysis and the literature research, an online-questionnaire has been developed. It consisted of 44 questions, divided into 7 thematic parts. The questionnaire has been sent to a widespread range of stakeholders (see fig. 2).

This approach ensured that the results represent the requirements of a broad basis and, thus, are transferable to other users and cities. The survey has been online from mid February to the end of April 2017. 104 potential users have participated and provided valuable information for the development of a user-friendly urban climate model (see fig. 4).

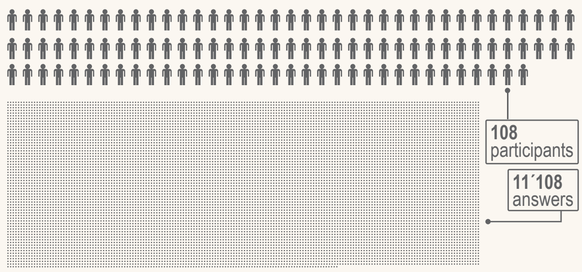


Figure 4: participants and answers (own graphic)

4 // REQUIREMENTS CATALOGUE

The results of the previous steps - stakeholder-analysis, literature and project research as well as the online-survey - were collected and discussed in close cooperation with the project partners. For this purpose, UseUClim organised a workshop, to which cities and other stakeholders as well as the model developers (module A) and model evaluators (module B) were invited. The aim of this workshop was to refine and specify some of the collected requirements as well as to bring together the experts with the potential user groups. The conclusively defined requirements are currently collected in a requirements catalogue and will be delivered to the model developers and model evaluators.

UPCOMING STEPS

EXPERIMENTATION: UseUClim will conduct two test phases with partners from practice to evaluate the correctness and satisfaction of user demands as well as to identify potentials for future development.

EVALUATION: UseUClim will evaluate, whether or not the model fits in urban planning processes. Thus, we will evaluate the user´s feedback from the test phases and report it to the model developers.

Furthermore, UseUClim will identify interfaces of the urban climate model to other software and a dissemination strategy will be elaborated to share the obtained knowledge and achievements.

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany

Bettina Steuri • Email: bettina.steuri@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center
Germany
An institution of Helmholtz-Zentrum Geesthacht

Climate Services for Urban Sustainability in Drought-prone Areas

Water-Energy-Land Nexus: from Resource Security to Synergies in Practice

Roger Cremades
Climate Service Center Germany (GERICS)

Enhancing Climate Services with the Water-Energy-Land Nexus:

- **Why is the Water-Energy-Land Nexus relevant for Climate Services?** Earlier research has shown that measures taken to adapt the agricultural sector to climate change produce, in numerous cases, trade-offs implying an increase on Greenhouse Gas emissions. These trade-offs might be expected in other sectors, for example in cities, particularly in their water supply. Hence, the nexus provides a conceptual framework to analyze which options could create co-benefits and avoid trade-offs between a diversity of societal goals.

Climate Services for the Water-Energy-Land Nexus (CLISWELN) is a JPI Climate ERA4CS project:

- **Aim**: to connect climate services with local sustainability in drought-prone urban areas & agriculture, using the water-energy-land nexus to explore the cross-sectorial links of drought-risk management and provide policy advice on the opportunities to create synergies with locally relevant sustainability narratives and the targets of the Sustainable Development Goals (SDGs).

- **Exploring the opportunities for co-beneficial outcomes**: feasible space for creating co-benefits between water security and reduced CO_2 emissions is constrained, on one hand, by the management of agricultural and urban land use, and on the other hand, by the technological options employed to provide water security during drought episodes.

The SDGs at municipal scale?

- The nexus approach allows climate services information and tools that support decision makers to consider cross-sectorial feedbacks and synergies, thus allowing to explore the links between climate services and sustainability.
- In the urban case studies of the CLISWELN project, these links are considered for the SDGs Sustainable Cities and Communities (SDG 11) and Climate Action (SDG 13). E.g., SDG 11 is analyzed with the indicator "11.A.1. Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs".

Figure 1: The CLISWELN project contributes to the Sustainable Development Goals 11 and 13 at the municipal and county scales, by exploring cost-effective means of planning water security without increasing linked Greenhouse Gas emissions under sustainable land use scenarios (Source: UN).

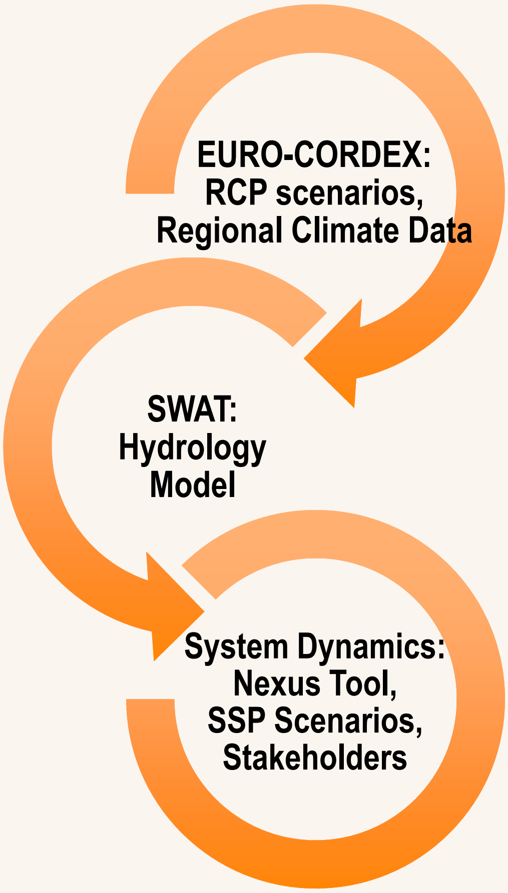


Figure 2: Integrated chain of data and models used to capture the influence of climate change and of diverse socio-economic and technological scenarios on the WELFN of urban water supply processes in the drought-prone touristic hotspot of Marina-Baixa county (Spain).

Analyzing vulnerable sectors in drought-prone regions:

CLISWELN covers urban and agricultural case studies in drought-prone areas where considering the nexus adds value to climate services. The following project partners focus on climate impact and nexus modeling in the following sectors (and case studies). Universität für Bodenkultur Wien (BOKU): agriculture (Seewinkel, Burgenland, Austria). Institutul Național de Cercetare-Dezvoltare în Silvicultura (INCDS): forest and cities (Tărlung river and city of Braşov, Romania). Centro de Investigación Ecológica y Aplicaciones Forestales (CREAF): water (Marina Baixa County, Spain). Climate Service Center Germany (GERICS): water and cities (Marina Baixa County, Spain).

- **SUMMARY:**
  Climate services are crucial to provide information about the security of urban water supply in the future, and using an integrated nexus approach (e.g. as shown in Figure 2) climate services can inform stakeholders about the opportunities to provide synergies between adaptation to climate change, mitigation of climate change, and other locally relevant sustainability narratives.

References
Cremades, R., Rothausen, S., Conway, D., Zou, X., Wang, J. and Li., Y. (2016). Co-Benefits and Trade-Offs in the Water-Energy Nexus of Irrigation in China. *Environmental Research Letters* 11, 054007. DOI:10.1088/1748-9326/11/5/054007

CLISWELN JPI Climate
Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Roger Cremades • Email: roger.cremades@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Training program for consultants and financing institutions

Integrating climate information into development projects and climate risk analyses

Diana Rechid, Andreas Hänsler, Paul Bowyer, Peer Seipold, Daniela Jacob
Climate Service Center Germany (GERICS)

Two-stage training program for "both sides"

(I) Consultancy service providers

to strengthen their capabilities to integrate state-of-the-art climate information into climate risk analyses

Training session regarding adaptation to climate change in cooperation with "European Financing Institutions Working Group on Climate Change Adaptation" (EUFIWACC)

(II) Project manager of financing institutions

to strengthen their capabilities to judge on the quality of climate information and to develop more specific terms of references for climate risk analyses.

In-house training for German Development Bank KfW „Evaluation of climate change information in climate risk analyses and project design"

Keys for a successful training

Key 1 Co-Development

Development of training program with partners representing the target group

- Co-design of training contents, formats and tools
- Understand demand and offer on both sides
- Facilitator of the process who is familiar with climate services ***and*** the business world
- Training contributions and presentations by all partners

Key 2 Tailored formats and learning tools

Example: Checklist for assessing the quality of climate information

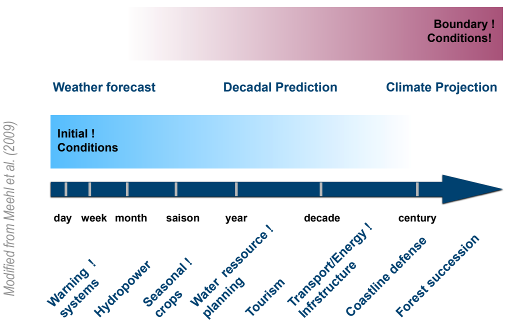
CLIMATE RISK ANALYSIS
FEASIBILITY
Terms of Reference

CLIMATE INFORMATION

☑ TRANSPARENCY	☑ RELEVANCE
☑ STATE-OF-THE-ART	☑ SPATIAL SCALES
☑ SCIENTIFIC QUALITY	☑ TEMPORAL SCALES
☑ COMPLETENESS	☑ ROBUSTNESS

Key 3 Put science into practical context

Example: Time scales of climate information and temporal context of the project



Modified from Meehl et al. (2009)

Key 4 Reduce complexity – increase utility

Example: Explain scientific backround of climate projections and provide tools for interpretation

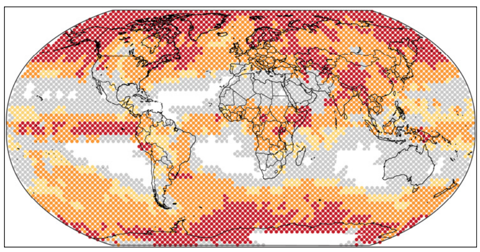


Figure: *Robustness map for increase in extremely wet days based on CMIP5 multi-model simulations*

Training workshops were very successful and highly appreciated, one major challenge now:
How can we support a sustained use of provided knowledge and tools in every day working life?

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Diana Rechid • Email: diana.rechid@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

MiKlip II: Decadal climate predictions

Challenges of bringing development stage climate predictions into practical usefulness

Bente Tiedje, Claas Teichmann, Peer Seipold, Andreas Hänsler
Climate Service Center Germany (GERICS)

1 MiKlip II in a nutshell

- Decadal climate predictions cover a time period of 1 to 10 years. They close the gap between short term weather or seasonal forecasts and long term climate projections.
- The aim is to predict climatic trends over longer time periods (e.g. several years) and larger regions (e.g. 100km x 100km), in the form of deviations from a normal state.
- MiKlip II involves 16 national partners that work together on the improvement and operationalisation of the decadal prediction system developed in MiKlip's first phase.
- One crucial part of this development is to analyse how scientific results and interests of potential users of the decadal prediction system fit together.
- In the framework of MiKlip II the analysis of the applicability in the private sector is taken over by GERICS.

2 Summary of known user needs

From scanning recent user projects (e.g. CLIPC, EUPORIAS, DECM, SECTEUR) and GERICS's private sector experience we know:

- Top 3 climate variable groups: temperature, precipitation, and wind
- Extreme events and climate indices are often requested
- Temporal and spatial resolution: the more detailed, the better

3 How to specify user needs concerning decadal predictions?

Building on these general user needs, we aim to develop prototype products, that actually create a benefit for companies, and seek to establish close co-developments:

- Selected business sectors: renewable energies, agriculture, insurance, and tourism
- Development of a user contact approach structuring time line, interactions, and internal processes for evaluation of information
- Composition of a user interview to get specific answers we need to know for user-oriented evaluation of decadal predictions (user-topic-region-key)

Effort to establish user contacts in numbers

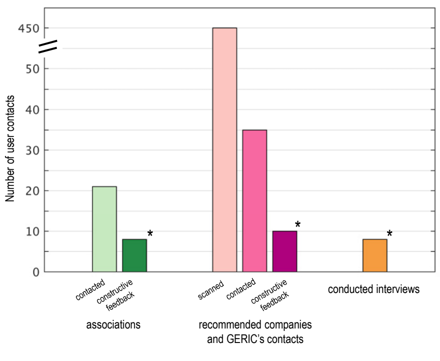


Figure 1: Numbers of scanned and contacted associations and companies. Only a fraction of the contacts lead to a constructive feedback or, ultimately, to user interviews. *Note that the contacting process is still ongoing and the numbers are still varying. (Last updated: December 2017)

4 Do MiKlip's research publications contain user-relevant information?

Only 45 of more than 150 peer-reviewed papers deal with the quantification of predictability in a broader sense (last updated: February 2017):

- Predictability varies between the most recent and earlier generations of the decadal prediction system
- Most publications analyse the predictability on a global scale/resolution
- Top 3 climate variable groups: temperature, precipitation, and wind → no general analysis on extreme events or climate indices

Findings from MiKlip's literature research

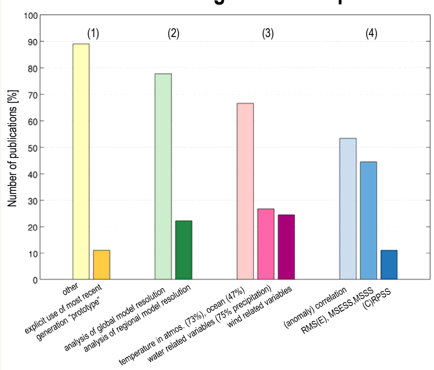


Figure 2: The number of publications that (1) explicitly use the most recent generation "prototype", (2) use global and reginal model resolution, (3) analyse the 2 mostly used climate variables, and (4) use correlation, MSESS or RPSS as quantification metrics. Note that only publications were considered that quantify predictability in a broader sense (n=45). (Last updated: February 2017)

5 How to find answers to specific user needs?

Since MiKlip's publications and the established evaluation methods do not provide sufficient user-relevant information, a new evaluation tool is currently developed that:

- brings together what is scientifically reasonable and what is user-relevant
- enables to select preferred climate indices or climate variables
- permits to change the reference and lead year time periods
- offers to choose a specific region and gives an overview of the model domain
- provides hindcast and forecast information comprehensibly (figure 3)

Towards an user-oriented evaluation tool

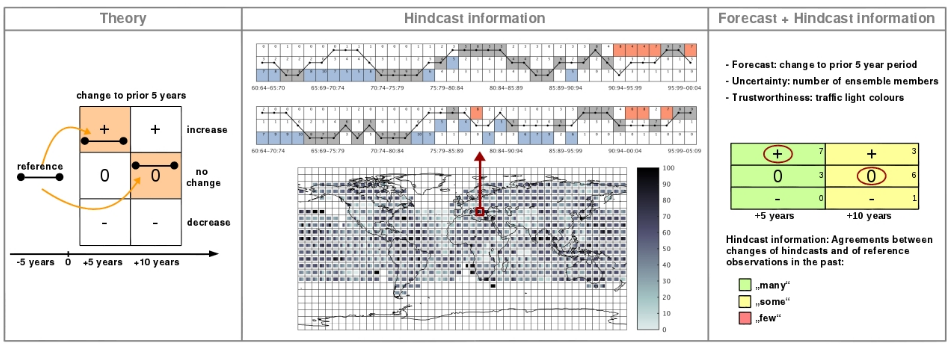


Figure 3: Schematic figure of the evaluation tool which is currently developed. It illustrates the basic idea to consider the changes (increase, no change, decrease) to a prior reference period (Theory) and how well the changes of the hindcasts (different lead years) reproduce the changes of a reference observation in the past (Hindcast information: time-dependent for a specific region (upper two plots) and summed up agreements between changes of the hindcasts and of a reference observation as a spatial overview (lower plot)). Note that this example is for a reference and lead year time period of 5 years. The actual forecast for a specific region is given in a table together with details on the uncertainty and trustworthiness derived from the hindcast informations (Forecast + Hindcast information).

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung
FONA Mittelfristige Klimaprognosen BMBF
MiKlip

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Bente Tiedje • Email: bente.tiedje@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

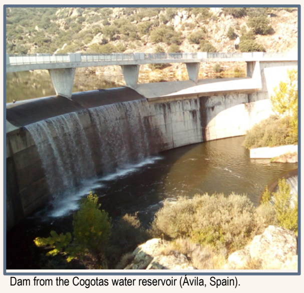
Assessing the viability of Nature Based Solutions (NBS)

Reducing the economic and human costs of water-related hazards

Eulalia Gómez Martín
Climate Service Center Germany (GERICS)

1. Introduction

Climate change is highly likely to increase the frequency and intensity of water-related hazards such as floods and droughts, leading to an even higher number of human and economic losses.



Dam from the Cogotas water reservoir (Ávila, Spain).
© Eulalia Gómez Martín, GERICS.

Nature Base Solution example: Riparian buffer
© European Commission

GREY APPROACHES
- Designed to combat one specific risk.
- High amount of economic investment.

NBS APPROACHES
- Working with nature.
- Sustainable and cost-effective
- Multi-purpose

Conceptual framework on NBS as an umbrella term for ecosystem-related approaches © IUCN

This project is focused on the assessment of **NBS to reduce the negative effects of water-related hazards.**

A multidisciplinary and trandiscipllinary approach will be used to find the **balance between economic, social and ecological targets**

This PhD will contribute to **NAIAD project (Horizon 2020)** by working in three of its DEMOS.

Research questions

- Are NBS a cost/effective approach for climate change adaptation compared with grey infrastructures?
- Which are the most efficient NBS to reduce the negative effects of droughts and floods?
- How can we assess the effectiveness of these measures?
- Can NBS help to find a sustainable balance between social, economic and environmental targets?

2. Methodology

Three quantitative System Dynamic (SD) models are being built to study the effectiveness of different adaptation measures to reduce the risk of water-related hazards. The SD model will act as a metamodel integrating a physical, social, economic and climatic model. This approach will be applied in three case studies:

Medina Del Campo (Spain)

Medina del Campo river basin, Spain. © NAIAD

Case Study for Rural (8000 km²)

Aquifer overexploitation has lead to the deterioration of provisioning ecosystem services in the basin**. Diffuse agricultural pollution** and elevated levels of **Arsenic** (As) threat its quality status.

Copenhagen (Denmark)

In the left, map showing areas affected by flooding from extreme precipitation. In the right, map showing areas affected by flooding caused by sea level raise. © NAIAD

Case Study for Urban (88 km²)

Focused on the urban part of the Østerbro subcatchment and a larger area that surrounds the subcatchment.
Climate change and the ongoing sea level rise are increasing **urban-surface and groundwater** induced **flooding**.

Lez (France)

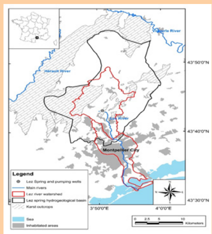


Figure 3 Location of Lez case study in Southern France. ©NAIAD

Case Study for peri-urban (1160 km²)

Uncontrolled use of water by farming and geochemical plants is increasing **droughts events. Floods** can occur due to sea level raise and due to lack of drainage of urban runoff.

3. Expected results

- NBS framework for decision making
- Three integrative models that will act as decision support tools
- Identification of barriers and challenges for NBS implementation
- NBS resilience compared with other adaptation measures.
- Integration of temporal and spatial models framework

4. Conclusion and outlook

- The **inclusion of local climate information** in an integrative dynamic model is an innovative way of assessing the long-term impact of NBS
- There is **little evidence** on how to implement NBS **in rural areas**. This project will throw some light on the matter.

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Eulalia Gómez Martín • Email: eulalia.gomez@hzg.de • www.climate-service-center.de

CORDEX data assessment for urban applications

C40 cities as case studies

Gaby Langendijk
Climate Service Center Germany (GERICS)

CORDEX & C40

WCRP Coordinated Regional Climate Downscaling Experiment (CORDEX) has the potential to play a crucial role in providing regional climate data and information for urban applications, through their framework for evaluating and comparing various regional climate downscaling techniques leading to improved regional climate projections.

C40, a leading global network of 92 cities committed to addressing climate change, forms a suitable outset to connect climate information and services with city needs, as well as urban policy and planning.

Data assessment

1. Based on available literature and physical calculations of climate impacts a set of potentially relevant urban variables has been identified (Table 1)
2. Exploration of CORDEX available output variables in the DKRZ data node of ESGF
3. Model output details: Regional Climate Models (RCMs), spatial scale of 12km (0.11°), temporal scale of 2006-2100, RCP2.6; RCP4.5; and RCP8.5. European domain (EUR-11)
4. Summary of the assessment for a few variables and the respective numbers of available RCMs for each variable (Table 2)

Table 1. Brief summary of variables relevant to urban applications per climate change impact and potentially affected sectors.

CORDEX available output variables	Climate change impact	Affected sectors
(Near surface) Temperature, Max (near surface) temperature per day, Surface (skin) temperature, Humidity	Heat-cold wave, UHI, UTCI	Health, Planning, Industry
Precipitation, Max precipitation, Convective precipitation, Wind speed, Total and surface runoff, Evapotranspiration, Potential evapotranspiration	Floods, Storms, Extreme events	Policy, Transport, Tourism
Sea level pressure, Wind speed	Sea level rise, Inundation	Economy

Table 2. CORDEX output variable and respective RCM data availability. ´X´ is amount of RCMs that provide data for each variable.

Variable long name	Unit	Time frequency	RCM (X)
Near surface air temperature	K	3hr, day, mon, sem	9
Near surface max temperature	K	day	9
Precipitation	kg m-2 s-1	3hr, day, mon, sem	9
Max precipitation	kg m-2 s-1	day	4
Convective precipitation	kg m-2 s-1	day	6
Total runoff	kg m-2 s-1	day, mon, sem	7
Surface runoff	kg m-2 s-1	day, mon, sem	5
Evaporation	kg m-2 s-1	day, mon, sem	7
Potential evapotranspiration	kg m-2 s-1	day	1
Surface wind speed	m s-1	3hr, day, mon, sem	7
Surface wind speed max	m s-1	day, mon, sem	6

Conclusion & scientific challenges

- CORDEX data has the potential to guide decision making on a city scale through the development of regional to local climate information
- Need for higher spatial and temporal resolution, possibly reaching to 100m-1km and 1-3 hourly data sets
- CORDEX model runs required on 12km spatial scale (0.11°) in other domains than Europe
- Multi-model approach for all high-resolution RCMs and variables to ensure robustness
- A more systematic approach is needed incorporating urban structures, as well as studying a more diverse set of climate impacts in urban areas

C40 cities case studies: Milan & Berlin

Exploration of CORDEX data via the indicator toolbox of the project ´Constructing Europe's Climate Information Portal´ (CLIPC) (Figure 1)

Recent study by CORDEX-Belgium for Urban Heat Island (UHI) effect and Urban Thermal Comfort Index (UTCI) through a local climate model
UrbClim: urban boundary layer climate model containing land surface scheme with simple urban physics
The main input variables: wind speed, temperature, precipitation and specific humidity close to the surface
Models: UrbClim coupled to Limited Area Models (LAMs) and forced by 11 CMIP5 Global Circulation Models
Berlin simulation: UHI effect and UTCI calculated on 250m spatial resolution for RCP8.5 for period 2081-2100 in summer months (June - Aug)
Result: Although there is a large overall temperature increase in Berlin, the UHI does not change significantly with climate change

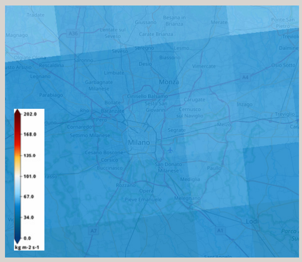


Figure 1. Example of CLIPC visualization for Milan. Heavy precipitation (r10mm) prediction for July 2099 with RCP8.5. Based on model output for GERICS multi-model ensemble, EUR-11.

Outlook for PhD project

High-resolution regional to local climate modeling for urban applications to identify co-existing climate change impacts/risks in a case-study city

→ Model development of REMO, possible approaches:
1. Urban surface parameterization of REMO, or
2. Coupling REMO with existing urban model, or
3. Integrate existing urban model in REMO

→ System dynamics approach to identify co-existence of climate change impacts/risks in a case-study city connected to regional climate model simulations

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Gaby Langendijk • Email: gaby.langendijk@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Towards Improved Accuracy in Complex Terrain

On Reducing the Pressure Gradient Error in REMO

Lennart Marien
Climate Service Center Germany (GERICS)

1. Introduction

- Users of climate services increasingly request local climate information, for example high-resolution precipitation data
- Such information is important for a variety of applications, including but not limited to tourism, disaster prevention and hydropower
- As resolution increases steep orographic slopes become more pronounced with strong effects on local flow patterns
- One of the resulting challenges is the accurate representation of the Pressure Gradient Force (PGF)
- Since the PGF is a main driver of atmospheric motion, this work aims at improving its approximation in the climate model REMO

2. The REMO Model

- Hydrostatic regional climate model developed by Jacob (2001)
- Spherical rotated longitude-latitude grid
- Terrain-following hybrid pressure coordinate
- Physical parameterizations based on ECHAM-4

3. Methodological Approach

- In terrain-following models such as REMO the horizontal PGF is given by the sum of a gravity and a buoyancy term, about equal in magnitude but opposite in sign (see Fig. 1)

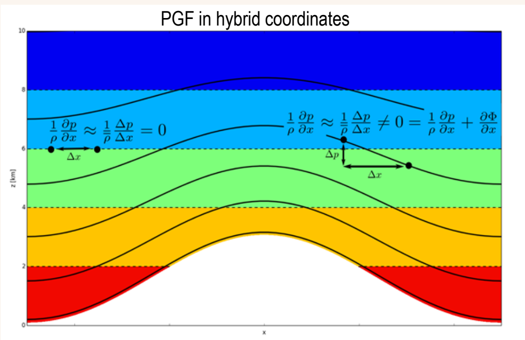


Figure 1: Schematic of Pressure Gradient Force in hybrid coordinates

- Unbalanced truncation errors in these terms can result in the generation of spurious acceleration, see Sundqvist (1975) and Steppeler (2002)
- To reduce such errors an approach by Botta et al. (2004) has been adapted to pressure based hybrid coordinates for the first time
- The approximation for the PGF is computed by solving appropriate initial-value problems for the hydrostatic equation in every grid-cell and time step

- **Main new result:**

$$-RT\frac{\partial \ln p}{\partial \lambda} - \frac{\partial \Phi}{\partial \lambda} \approx -\frac{R(T_{i+1}-T_i)}{2}\left(\frac{p_{i+1}-p_i+\tilde{p}_{i+1}-\tilde{p}_i}{\Delta\lambda}\right)$$

4. Test Case

- Isothermal atmosphere-at-rest
- A circular tracer bubble is initialized over a steep hill, this could for example be a pollutant or water vapour
- Horizontal resolution of ca. 1km with 27 vertical levels
- Bubble deformation and u-velocity after 48 hours are used as measure of improvement

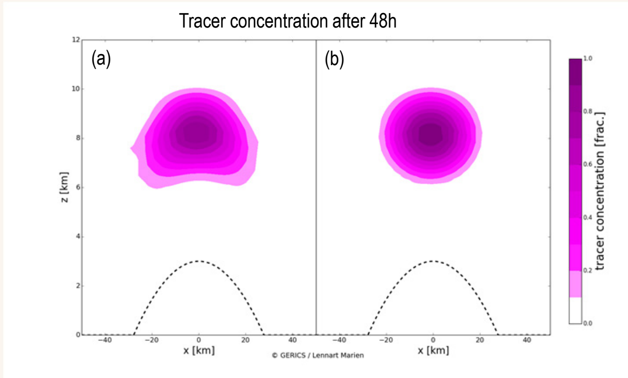


Figure 2: Tracer concentration after 48 h with the standard (a) and the new method (b)

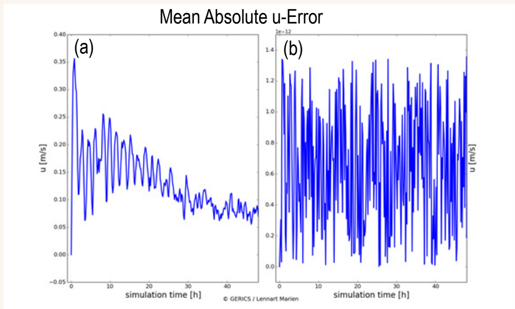


Figure 3: Mean absolute u-error over time for standard (a) and new method (b)

- Standard method shows strongly deformed tracer (Fig. 2a) and spurious u-velocity (Fig. 3a)
- New method shows no deformations (Fig. 2b) and the u-velocity is zero roughly to machine precision (Fig. 3b), i.e. cannot be improved any further

5. Conclusions and Outlook

- The new method produces optimal results for the tracer test case
- More complex cases, such as advection over a hill and mountain induced gravity waves have to be analyzed
- An extension to the non-hydrostatic regional climate model REMO-nh is planned

Sundqvist H., On truncation errors in sigma.-system models. (1975) Atmosphere, Vol. 13, Issue 3, 81-95
Steppeler J., Prediction of clouds and rain using a z-coordinate nonhydrostatic model (2006) Monthly Weather Review, Vol. 134, Issue 1998, 3625-3643
Jacob D., A note to the simulation of the annual and inter-annual variability of the water budget over the Baltic Sea drainage basin. (2001) Meteorology and Atmospheric Physics, Vol. 77, Issue 1-4, 19-43
Botta et al., Well balanced finite volume methods for nearly hydrostatic flows. (2004) Journal of Computational Physics, Vol. 196, Issue 2, 539-565

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Lennart Marien • Email: lennart.marien@hzg.de • www.climate-service-center.de

Assessing climate change impacts on wind energy financing

Towards a methodological framework for critical energy infrastructure

Thomas Remke[1,2]

[1]Climate Service Center Germany (GERICS) & [2]Leuphana University of Lüneburg

1. Introduction & climate service perspective

- Climate information of interest for planning and operational horizons
- Most large-scale wind power plant projects realized through financing requiring up to 80% of total project cost upfront project realization [1]
- Project financing based on yield assumptions derived from retrospective data [2]
- Climate change potentially affects wind resource and could foster outages (e.g. [3])

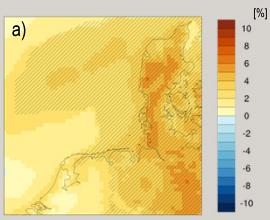
Should climate change impacts be considered specifically as an additional influencing factor on project financing for wind energy?

2. Conceptual approach & methodological requirements

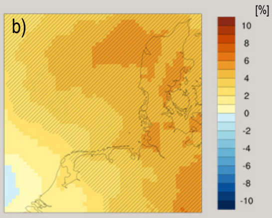
I. Identification of most significant physical quantities within project financing chain
   - Design standards [3] not likely to be exceeded by extreme and fatigue loads [4]
   - Operation and maintenance strongly linked to conservative design standards or adjustable on shorter manageable time scales
   - Yield through wind climate is essential component within project financing

II. Requirements for sector-specific climate information
   - Atmospheric boundary layer (ABL) characteristics of higher importance with increasing turbine hub heights and rotor diameters [5]
   - Widely applied extrapolation of near surface wind parameters to turbine heights physically limited and not accounting for non-linearity (e.g. [6])
   - State-of-the-art regional climate model projections indicate changes in turbulent energy transport potentially affecting ABL stability and causing differently pronounced climate change signals of wind characteristics with height (Figure 1)

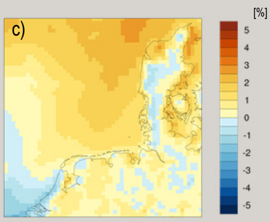
Wind speed autumn climate change signal



- Near surface wind speed (10m)
- REMO EURO-CORDEX RCP8.5
- End of 21st century
- Hatching indicates statistical significance



- Upper air wind speed (~200-400m)
- REMO EURO-CORDEX RCP8.5
- End of 21st century
- Hatching indicates statistical significance



- Difference upper air vs. near surface wind speed changes (a-b)
- Differently pronounced climate change signals with height in ABL

Figure 1. Autumn (SON) mean relative climate change signal of 10m (a) and upper air (b) wind speed and the difference of those vertical levels (c).

3. Novel high-resolution experimental framework

Framework for novel high-resolution climate simulations addressing wind conditions in the ABL using the non-hydrostatic regional climate model REMO-NH:

- Vertical resolution addressing wind conditions across blade swept area
- Spatial resolution better resolving topography and roughness
- Variables introduced for characterizing turbulence and stability specifically

I. Hydrostatic REMO
- EURO-CORDEX domain and setup
- 0.11° (~12 km) horizontal resolution
- Simulations on 27 and 49 vertical levels
- ERA-Interim forcing

II. Non-hydrostatic REMO-NH
- German Bight domain
- 0.022° (~2.5 km) horizontal resolution
- REMO forcing (49 vertical levels)
- 10-min velocity variables every 20 m

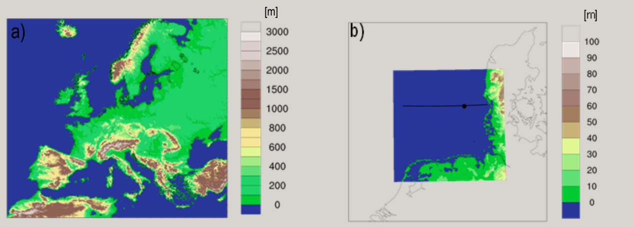


Figure 2. Domain and orographic resolution as represented by the hydrostatic REMO simulation (a) and the non-hydrostatic REMO-NH simulation (b).

4. Results

- REMO-NH sensitivity tests reveal enhanced spatial variability and finer resolved structures within ABL compared to state-of-the-art REMO standard setup (Figure 3)
- Prognostic computation of sector-specific variables unveil ABL characteristics
- Explicit analysis of climate change impacts across heights of wind turbine swept areas

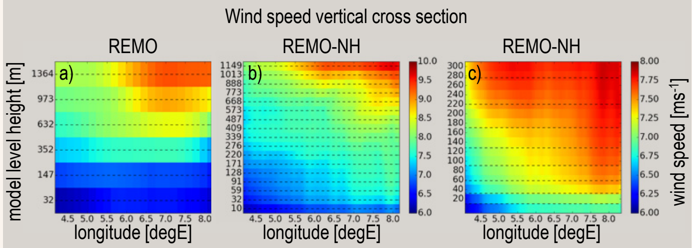


Figure 3. Longitudinal transect through the German Bight (at 55.195° N). Shown are 10min wind speed values averaged over five day unstable ABL conditions during October 2010 for simulations of REMO on 27 vertical levels (a) and for REMO-NH (b) up to about 1000 m height. In addition, the wind speed values at 20 m output intervals up to 300 m from REMO-NH (c) are shown. Dashed lines indicate the average height of the σ-model levels.

5. Conclusion & outlook

- Yield through wind climate is essential component within project financing
- Climate change signals of wind characteristics pronounced differently with height
- Experimental simulations under surrogate climate conditions to estimate bandwidth of climate change impact on wind energy yield
- Conclusion whether to consider climate change impacts on expected yield as additional influencing factor on project financing for wind energy

References

[1] Blanco, M.I. (2009): The economics of wind energy. *Renewable and Sustainable Energy Reviews*, Vol. 13, No. 6-7, pp. 1372-1382. doi:10.1016/j.rser.2008.09.004

[2] IEC 61400 (2015): International standard "Wind turbines". *International Electronical Commission.*

[3] Pryor, S.C. and R.J. Barthelmie (2010): Climate change impacts on wind energy: A review. *Renewable and Sustainable Energy Reviews*, Vol. 14, No. 1, pp. 430-437. doi:10.1016/j.rser.2009.07.028

[4] Pryor, S.C. and R.J. Barthelmie (2013): Assessing the vulnerability of wind energy to climate change and extreme events. *Climate Change*, Vol. 121, No. 1, pp. 79-91. doi:10.1007/s10584-013-0889-y

[5] Emeis, S. (2014): Current issues in wind energy meteorology. *Royal Meteorological Society Meteorological Application*, Vol. 21, No. 1, pp. 803-819. doi:10.1002/met.1472

[6] Stull, R.B. (1988): An Introduction to Boundary Layer Meteorology. *Springer*, 670p. ISBN:978-90-277-2769-5

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany

Thomas Remke • Email: thomas.remke@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

Climate Change Impacts on Electricity Grid Infrastructure

On the interregional heterogeneity of risks

Marius Stankoweit
Climate Service Center Germany (GERICS), Leuphana University Lüneburg

Motivation

- Atmospheric events are a major source for customer disconnections from the electricity grid
- Locally, the risks related to climate change impacts on grid infrastructure depend on:
  - Vulnerability of the grid
  - Economic impact of an interruption
  - Climate change induced alterations in the probability of potentially hazardous events

Regionality of vulnerability of the grid

- Wind contributes 60% to atmospherically induced customer disconnections [1]
- Commonly wind does not damages the grid, but causes trees to fall on the grid infrastructure [2]
- Consequently, the grid's overhead lines are the part of the system most vulnerable to atmospheric events

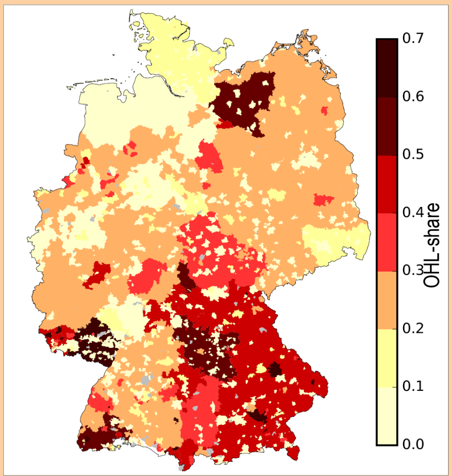


Fig. 1: *Share of overhead lines (OHL) in the medium voltage grid of the distribution grid operators (grey-colored domains indicate lacking data); Based on reporting of distribution grid operators.*

Box: Formulas

$$VoLG(o) = \frac{EP(o) \cdot EC(o)}{L(o)}$$

$$VaR(o) = VoLG(o) \cdot OHL(o)$$

o	distribution grid operator
EP	electricity productivity [€/kWh]
EC	electricity consumption [kWh]
L	grid length [km]
OHL	share of overhead lines [%]

Regionality of impact of interruption

- **Data:** Based on macroeconomic data and structural grid information [2]
- **Method (see also Formula-Box):**
  - Value of Lost Grid (VoLG): New concept to estimate the economic value of an uninterrupted distribution grid
  - Value of Lost Grid at risk (VaR): Provides information on where atmospheric events could lead to comparably large economic damages (Results: Fig. 2)

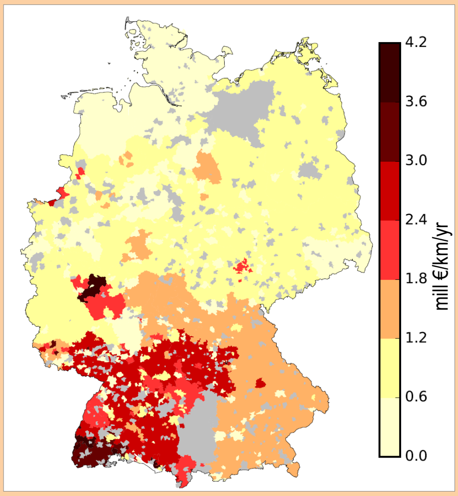


Fig 2: *Value of Lost Grid at risk (VaR); grey-colored domains indicate lacking data.*

Regionality of climate change

- **Data:** Ensemble of 17 regional climate models (EURO-CORDEX); Resolution: 0.11°x 0.11°; Scenario: RCP8.5; Periods: 2031-2060 & 1971-2000
- **Method:**
  - Maximum Likelihood Fit to extreme value probability distribution
  - Determine differences of the occurrence of extreme wind speeds (with 5-year return period)
  - Robustness criterion: 66% of models agree in direction with at least 85% significance

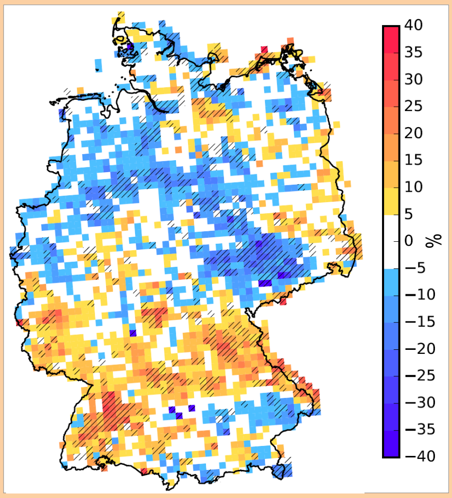


Fig. 3: *Changes in occurrence of extreme wind speeds; hatching indicates robust changes.*

Summary & Outlook

- **Finding I:** weather-related outages may lead to high economic losses in certain southern domains of Germany
- **Finding II:** the occurrence of extreme wind speeds is projected to robustly increase under climate change by 10-40% under climate change in certain southern parts of Germany
- **Finding III:** in the South/South-West of Germany, domains of high economic value at risk overlap with domains of robust increases in the occurrence of extreme wind speeds
- **Potential Application**: e.g. regulators that want to incentivize in a way that reduces economic/societal implications from grid interruptions
- **Outlook:** Since wind-throw is determined by interplay of different variables (see Fig. 4), consider changes of wind maxima, soil moisture & frozen soil under climate change

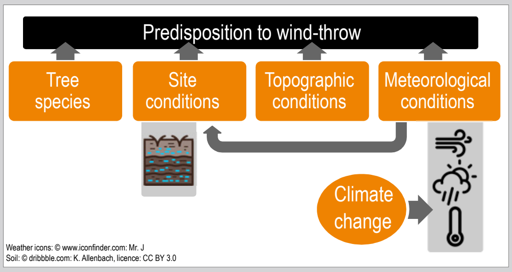


Fig. 4: Variables guiding a tree's predisposition to wind-throw

Literature

[1] Based on analysis of FNN Database, 2004-2015.
[2] Ward, D.: The effect of weather on grid systems and the reliability of electricity supply, Climatic Change, 2013.
[3] Stankoweit et al.: On the interregional heterogeneity of the economic value of electricity distribution networks: an application to Germany, Leuphana Working Paper Series, 2017.

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
Marius Stankoweit • Email: marius.stankoweit@hzg.de • www.climate-service-center.de

Decision-making and policy-planning amidst uncertainty

Climate knowledge integration for achieving SDG 13 (Climate action)

David Williams

Climate Service Center Germany (GERICS), University of Hamburg

Introduction and background:

- Decision-makers and policy-planners are faced with the task of balancing today's pressing needs with long term uncertainties and risks
- Uptake of climate knowledge vital not only for climate change adaptation, but also for sustainable development, meaning two fields cannot be treated separately
- SDG 13 designed to build resilience and decrease the risk from climate-related hazards
- Implementing climate change adaptation for risk reduction and achieving SDG 13 will depend on the ability of local governance to integrate climate knowledge
- Saliency, credibility, and legitimacy of climate knowledge needs to be evaluated for successful integration
- Barriers of implementation for integration of climate knowledge can consist of factors such as:

- **Functional**
  - **Divergent objectives and needs**
  - **Scope**
  - **Priorities**
- **Structural**
  - **Institutional setting and standards**
  - **Timelines**
  - **Agendas**
- **Social**
  - **Cultural values**
  - **Communication**
  - **Understanding**
  - **Mistrust**
  - **Beliefs**

- This work is part of the EU-funded project IMPREX (IMproving the PRediction and management of hydrological EXtremes)
- The project, consisting of 23 partners from 9 countries, aims to support the reduction of vulnerability to hydrological extremes through enhanced understanding of the impacts of hydrologic extremes
- In achieving this, the project aims to make a significant contribution in how to respond and act in the face of changing climatic conditions

imprex

Learn from today to anticipate tomorrow

Aims and objectives:

The aim of this thesis is to further understanding in how society engages with science by assessing functional, structural, and societal preconditions for climate knowledge integration in three diverging settings with the following objectives:

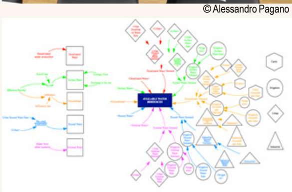
- To assess how climate knowledge needs to be presented for efficient integration into decision-making and policy-planning systems to best support risk reduction from hydrological extremes and to achieve the targets of SDG 13
- To examine the influence of varying functional, structural, and social preconditions on successful integration of climate knowledge at the local level for decision-making and policy-planning to reduce risk from extreme hydrological events and to achieve the targets of SDG 13

Methods:

- Group Model Building (GMB), a form of System Dynamics Modelling, has commonly been applied in climate change and sustainable development fields
- Key variables and their causal relationships can be identified and grouped, enabling exploration of structural causes for observed trends, analysis of unintended consequences and bottlenecks, and identification of potential leverage points in the context of climate knowledge integration
- The method will be applied in three case studies with strongly diverging functional, structural and social contexts to examine their varying effects on the integration of climate knowledge

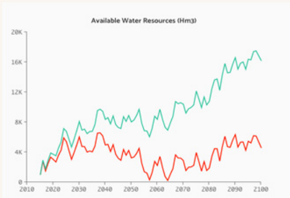
© Alessandro Pagano

- First step is to build an individual group model together with stakeholders
- Joint knowledge production through collaboration with scientists and non-scientists can help integrate knowledge from society into science



© Vensim

- Group models can then be combined to produce a collective group model
- The narratives from the group model building sessions can be used to quantify the causal relationships between the variables



© Forio

- By running simulations of "what if" scenarios, the impact of specific decisions and policies can then be tested on variables of interest
- Modelling climate knowledge integration can thus help examine the impact of functional, structural, and social barriers

Expected outcomes:

- Through furthering understanding in the requirements of local governance for climate knowledge integration, a significant contribution to achieving adaptation to hydrological extremes and SDG 13 will be made
- This work will therefore also make an important contribution to climate services by facilitating the production, translation, transfer and use of climate knowledge for decision-making and policy-planning
- The findings may be used for advising and negotiating with decision-makers and policy-planners from climate change adaptation and sustainable development

References:

- IMPREX (2014). Learn from today to anticipate tomorrow. http://www.imprex.eu
- Pennington, D. (2016). A conceptual model for knowledge integration in interdisciplinary teams: orchestrating individual learning and group processes. *Journal of Environmental Studies and Sciences*, *6*(2), 300-312.
- Weichselgartner, J., & Kasperson, R. (2010). Barriers in the science-policy-practice interface: Toward a knowledge-action-system in global environmental change research. *Global Environmental Change*, *20*(2), 266-277.

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany
David Williams• Email: david.williams@hzg.de • www.climate-service-center.de

GERICS
Climate Service Center Germany
An institution of Helmholtz-Zentrum Geesthacht

East Asian Summer Monsoon Modeling

Based on a regional atmosphere – global ocean coupled model ROM

Shoupeng Zhu

Nanjing University of Information Science & Technology (NUIST); Climate Service Center Germany (GERICS)

Introduction

The socio-economic dynamics in the whole East Asia are severely influenced by the East Asian monsoon, especially during summer. Climate disasters over East Asia, such as droughts, floods, and cold surges, could be attributed to the East Asian summer monsoon (EASM, Fig. 1) evolution and variability. Besides the land use and land cover change (LUCC), including deforestation, desertification, urbanization and etc., can also produce significant impacts on the regional climate. In order to provide reasonable climate change information at the regions strongly influenced by the EASM under the LUCC, the objectives of the thesis are as follows:

- To assess and validate the regional model simulations in the EASM region;
- To study the influence of LUCC on the EASM and find out the possible mechanisms, based on the model control experiments and sensitivity runs;
- To assess the future EASM variability under fairly realistic forcing conditions with high regional details.

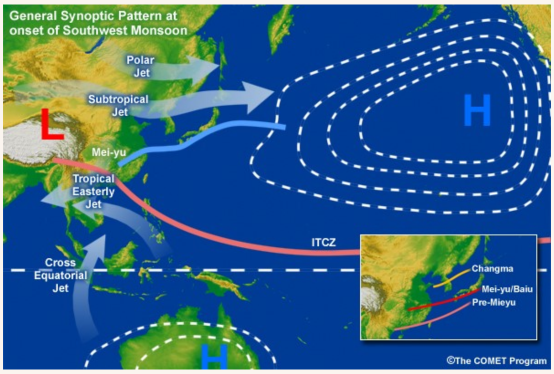


Fig. 1. General synoptic patterns of the EASM. The ITCZ represents the Intertropical Convergence Zone. The upper right H refers to the Subtropical high.

Data and Methods

The global ocean coupled with a regional atmosphere model (ROM)[1] is driven by the ERA-Interim reanalysis here. OASIS[2] is employed to couple the ocean-atmosphere fluxes every 3 hours. For the standalone REMO, the ocean component is switched off. The period of the study is 1980-2012. Detailed model descriptions are given in Fig. 2 and Sein et al.(2015).

- Regional climate model REMO[3]: Most part of China and the western Pacific, 50 km resolution.
- Ocean model MPIOM[4]: Global, regionally high horizontal resolution in Southeast Asia.

The following observational datasets are used:

- GPCC: The global precipitation analysis products V7 of the Global Precipitation Climatology Centre.
- ERA Interim: The European Centre for Medium-Range Weather Forecasts interim reanalysis.
- NCEP II: The National Centers for Environmental Prediction - Department of Energy Reanalysis II.

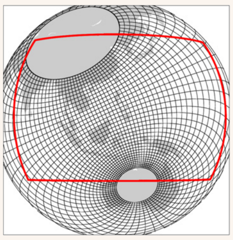


Fig. 2. Grid configuration. The red rectangle denotes the coupled domain. The black lines are the ocean model grid (only every 15th grid line is shown). [5]

Preliminary Results

For the first objective, the global ocean – regional atmosphere coupled model ROM and its atmospheric component REMO in standalone configuration are carried out over the EASM area to identify the added value of the coupled system in terms of the moisture transport and an index for the EASM.

The tropospheric vertically integrated moisture flux (TVIMF) is defined as:

$$\boldsymbol{Q} = \frac{1}{g}\int_{p_b}^{p_t} q\boldsymbol{V}dp$$

g: gravitational acceleration;
q: specific humidity;
$\boldsymbol{V}$: horizontal wind velocity;
p: pressure;
p_t: tropopause pressure;
p_b: surface pressure.

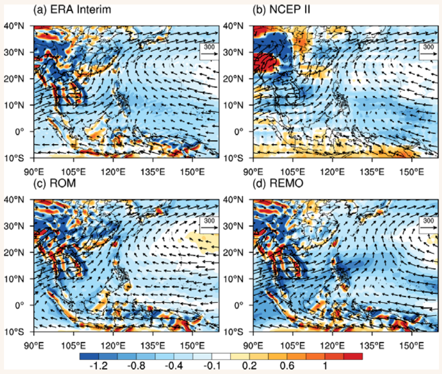


Fig. 3. Distributions of summer mean TVIMFs (arrows, unit: kg·m-1·s-1) and the corresponding divergences (shading, units:10-4 kg·m-2·s-1) averaged over 1980-2012 derived from (a) ERA Interim, (b) NCEP II, (c) ROM and (d) REMO. [5]

REMO (Standalone atmospheric model):

- Stronger and too far eastward westerly, the convergence shifting east toward the western North Pacific (WNP).
- Misrepresent the observed rainfall distributions which may be due to the warm and wet biases.

ROM (Coupled model):

- Resemble the water vapor pathways and convergences, as well as the western Pacific subtropical high (WPSH).
- Improve rainfall simulations in the East China, produce wet biases in the South China, well reproduce the distributions, especially alongside the Yangtze River Valley.

Atmosphere-ocean coupling → colder SSTs in WNP→ a reasonable WNP anticyclone → well reproduce the WPSH → improve the moisture circulation simulations

EASM index is calculated to indicate the strength of EASM. The EASM index[6] uses the shear vorticity of zonal winds over specific regions:

$$I = U_{850\ \text{hPa}}(10° - 20°\text{N}, 100° - 150°\text{E})$$
$$-U_{850\ \text{hPa}}(25° - 35°\text{N}, 100° - 150°\text{E})$$

$U_{850\ hPa}$: u-component of horizontal wind velocity at 850 hPa level.

ROM resembles the observed EASM indices due to its reasonable simulation of the moisture transport, whereas REMO tends to produce a stronger EASM circulation.

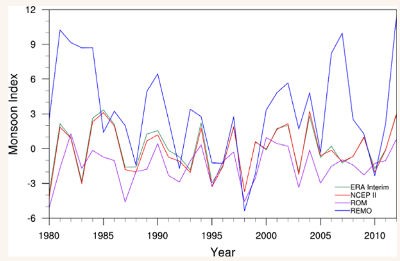


Fig. 4. Time series of the summer mean EASM indices for 1980-2012 derived from ERA Interim, NCEP II, ROM and REMO, which are marked by the green, red, purple and blue solid lines respectively. [5]

Conclusion & Outlook

- The coupling enhances the air –sea consistency and well reproduces the large scale atmospheric circulation for the EASM region.
- The coupled model should be preferred to study the EASM and the LUCC, which could provide valuable historical and future climate information for reasonable climate services.

References

[1] Sein D V, Mikolajewicz U, Gröger M, et al. Regionally coupled atmosphere-ocean-sea ice-marine biogeochemistry model ROM: 1. Description and validation[J]. Journal of Advances in Modeling Earth Systems, 2015, 7(1): 268-304.

[2] Valcke S, Caubel A, Declat D, et al. Oasis3 ocean atmosphere sea ice soil user's guide[R]. Prism Project Report, 2003, TR/CMGC/03-69, CERFACS, Toulouse, France.

[3] Jacob D. A note to the simulation of the annual and inter-annual variability of the water budget over the Baltic Sea drainage basin[J]. Meteorology and Atmospheric Physics, 2001, 77(1): 61-73.

[4] Marsland S J, Haak H, Jungclaus J H, et al. The Max-Planck-Institute global ocean/sea ice model with orthogonal curvilinear coordinates[J]. Ocean Modelling, 2003, 5(2): 91-127.

[5] Zhu S, Remedio A R C, Sein D V, et al. Climate modeling over East Asian summer monsoon area based on a regionally coupled model ROM[J]. In preparation.

[6] Zhang Q, Tao S, Chen L. The interannual variability of East Asian summer monsoon indices and its association with the pattern of general circulation over East Asia[J]. Journal of Meteorological Research, 2003, 61(4): 559-568.

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Geesthacht • Fischertwiete 1 • 20095 Hamburg • Germany

Shoupeng Zhu • Email: shoupeng.zhu@hzg.de • www.climate-service-center.de