ETH zürich

Center for Climate System Modeling

Annual Report 2012 - 2013 (Phase II)

C2SM Center for Climate Systems Modeling

EMPA Materials Science & Technology

WSL

The Center for Climate Systems Modeling (C2SM) is a competence center based at ETH Zurich and a joint initiative between ETH Zurich, MeteoSwiss, Empa, WSL, and Agroscope with the main objective to improve the understanding of the climate system and strengthen the predictive skill of climate models on time scales from months to millennia. The center was established in 2008 and is currently in its second phase (July 2012 – December 2016). This document highlights the main achievements over the period from July 2012 through December 2013.

The C2SM Steering Committee, October 2014.

The climate modeling challenge

Climate change is a challenging scientific issue that involves a multitude of complex, non-linear processes operating over a wide range of spatio-temporal scales in all sub-components of the Earth system. Over the last decades, numerical models have been used increasingly in research and service activities related to climate change. They are now forming the backbone for many applications including short-term weather forecast, climate data assimilation, climate predictions and projections (from seasonal to centurial time scales), process and attribution studies, and the testing of strategies to mitigate and adapt to climate change. Thus, numerical modeling has developed into the third pillar of science, without which much of the research in climate sciences would no longer be possible.

At the same time, the continuing development of the numerical codes and supporting infrastructure is becoming an insurmountable challenge for individual research groups, making it hugely beneficial for participating groups to share models and the tasks to maintain, upgrade, develop, optimize, and run them. The emergence of new supercomputing architectures also implies a rapidly growing new challenge for climate model development and maintenance. In addition, coordinated efforts are required to store and analyze the increasing amount of climate data currently generated, including observations and model outputs

Vision

A premier institution for climate modeling and data provision

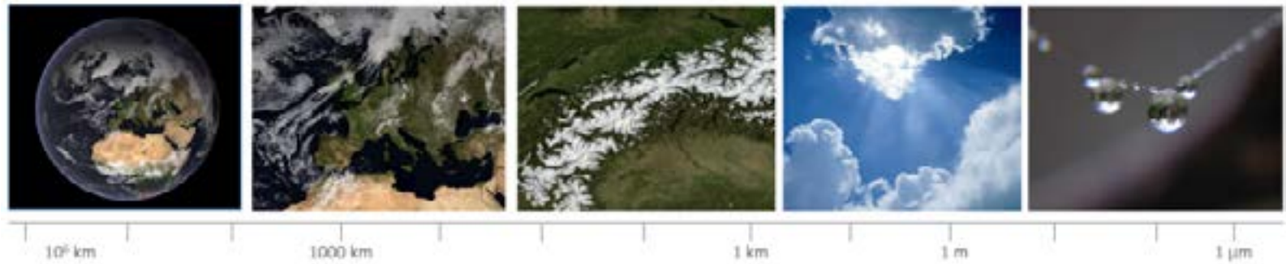
The center's vision is to become one of the premier institutions in these fields worldwide and to en-gage in assembling scientific and technical expertise from different partners into one single framework, thereby contributing towards improving the understanding of the climate and weather system and strengthening the predictive skill of climate models on a wide range of temporal and spatial scales.

Mission

The C2SM network

The center's mission is to provide a network for the partners institutions i) to enable and facilitate collaborations within C2SM's community and beyond, (ii) to exploit synergies among the partners in the areas of research, education, and outreach, (iii) to support the development and application of complex models of the Earth's climate system, and (iv) to support the analysis of climate related data. The C2SM also acts as the primary entry and interaction point for ETH, for national and international institutions, and for society at large on issues related to climate and climate change.

The C2SM network



C2SM aims to bridge across a range of scales within the climate system.

Research theme

Multi-scale, multi-component interactions within the climate system

The "Multi-scale, multi-component interactions within the climate system" form the C2SM's core research theme. This theme centers on one of the most challenging aspects associated with the modeling of the climate system. It is motivated by the fact that, while climate models have made rapid progress in the last decades, they still suffer from considerable limitations. This is partly because some of the underlying dynamical, physical, chemical, and biological processes remain uncertain, and partly because their numerical representations on current computing systems still mainly rely on coarse resolution and on parameterizations and approximations. The clear recognition that many processes relevant for climate change operate in, and at the interface of, several sub-components of the Earth system (including its atmospheric, oceanic, terrestrial, biospheric and cryospheric components) also results in a quest for increasingly complex models. In addition, many of these processes operate over a wide range of spatial and temporal scales and are interlinked by scale interactions, i.e. the processes operating at small scales strongly influence the phenomena at large scales and vice versa.

Activities

Coordination, Education, Outreach and Support

C2SM coordinates a world-leading network of research institutions and experts. C2SM strongly relies on its affiliated research groups to provide the respective disciplinary expertise and capabilities to advance the frontiers of knowledge in their research fields. C2SM sees its primary role in bringing together the climate research community and integrating this knowledge base.
A key set of activities aims to foster interdisciplinary research and interactions across disciplinary boundaries. A second set of activities centers around the establishment of a common and coherent modeling framework that allows the community i) to bridge the gap between different spatio-temporal scales and between the different (atmospheric, hydrological, oceanographic and terrestrial) components of the climate system and ii) to expand on new research themes. These activities enable the partner groups and institutions to undertake the challenging model development and applications studies that would otherwise not be possible.
More specifically, current activities include:

Research coordination

- To foster the collaboration between research groups by facilitating scientific discussions and exchanges
- To coordinate the development of large, collaborative research projects and to further manage them
- To develop a common modeling strategy that enables the development of new and original re-search avenues

Education and training

- To contribute towards an improved training of Ph.D. students through the establishment of projects across research groups, institutions, and disciplines.
- To train scientists (Ph.D. students, post-docs, etc.) in the areas of data visualization, data analyse, use and interpretation of climate data, and programming.

Outreach and events

- To inform the scientific community as well as broader audiences about climate and climate change
- To facilitate the dialog between the scientific community and the private and public sectors (including federal and cantonal agencies)

Support for research and education activities

- To maintain, improve, and provide to the center's community a hierarchy of state-of-the-art climate and climate-related models. In particular, the center is responsible for maintaining and re-fining both a global and a regional climate model as well as the associated modules e.g., for aerosols, atmospheric composition, (biogeo)chemistry, oceans, land surfaces, and clouds.
- To develop, exploit and disseminate key national and international data sets by providing a repository for them and by developing analysis and data management tools.
- To prepare for the exploitation of the next generation of high-performance computers.

Governance

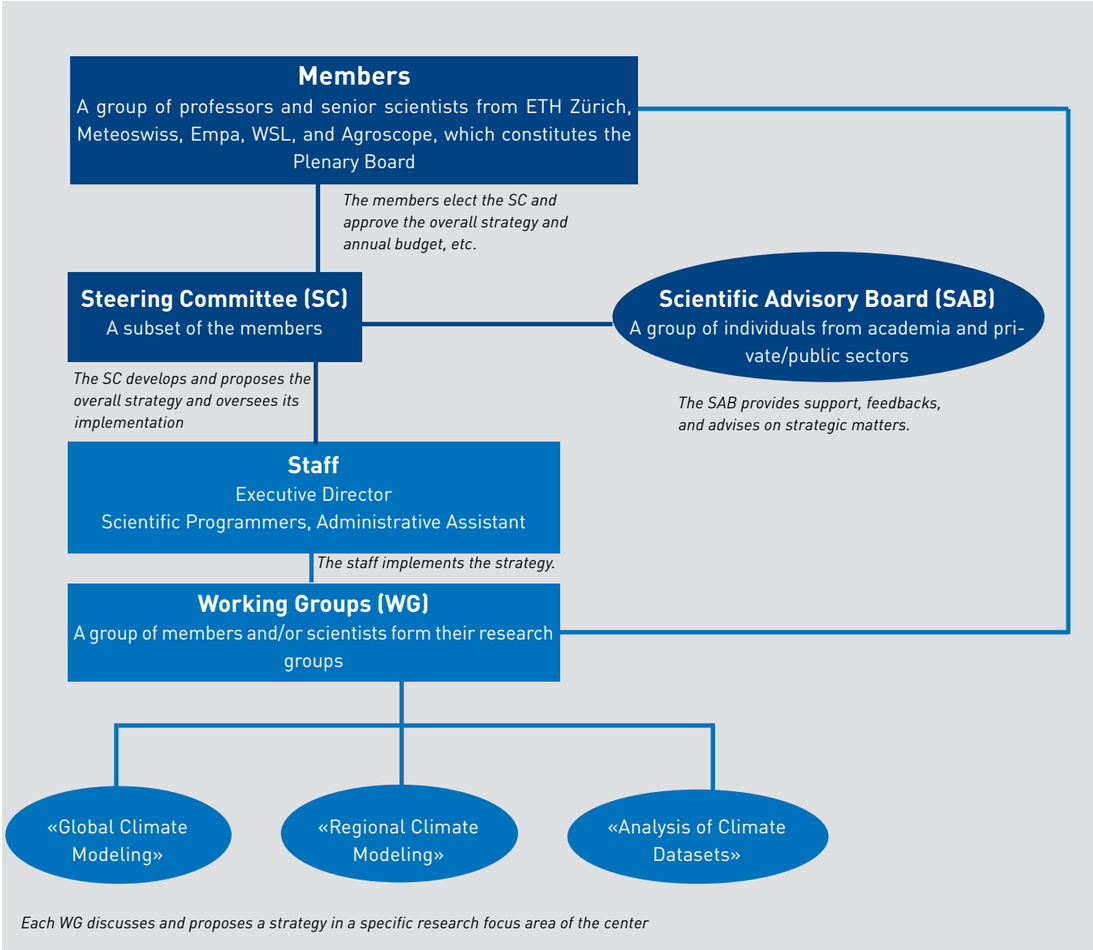
Structure, organization, and personnel

The center was established in 2008 by the funding partners ETH, MeteoSwiss, Empa, and Agroscope, and became operational in March 2009. WSL joined the center in 2013 to enhance the collaborations and respective expertise in the area of climate change and climate change impact.

As of 31.12.2013, the center includes 29 members, who are professors or senior scientists at the partner institutions ETH, MeteoSwiss, Empa, WSL, and Agroscope (see Annex for a detailed list) and form the center's Plenary. The C2SM community includes all students, post-doctoral fellows, and technical and scientific staff from the research group of each member and thus represents a group of over 250 people. Eight members out of 29 form the Steering Committee (SC), which defines the overall strategy and oversees its implementation. The SC elects a chair and co-chair from its members. The Scientific Advisory Board (SAB) consists of recognized individuals from different Swiss and European institutions and advises and supports the center in its strategic planning (see Annex for a detailed list).

Operationally, the center is run by an executive director, who oversees an administrative office composed of 4 core staff members (three scientists and a communication officer, total 4.1 FTE including director) supported by an administrative assistant. The scientists are active in three main focus areas: Global Climate Mode-ling (GCM), Regional Climate Modeling (RCM), and Analysis of Climate Datasets (ACD). Three working groups, composed of 7 to 10 C2SM members or researchers, meet on a regular basis to discuss and propose the strategy to be developed and the tasks to be performed in each of the three focus areas. The center also supports four post-doctoral fellows through specific research projects acquired by C2SM and its members (see Section 3.1 for more details on the current projects). The structure and organization of C2SM is described in greater detail in the Terms of Reference, which can be downloaded from the C2SM website.

http://www.c2sm.ethz.ch/the-center/documents.html →



Each WG discusses and proposes a strategy in a specific research focus area of the center

Core staff (as of 31.12.2013)

Role	Person
Executive Director	Isabelle Bey
Administrative assistant	Rahel Buri
Scientist "Global climate modeling"	Grazia Frontoso
Scientist "Regional climate modeling	Anne Roches
Scientist "Analysis of climate datasets	Harald von Waldow
Communication officer	This Rutishauser

*In addition to the core staff, four post-doctoral fellows are supported through project funding, including the HP2C-related projects (Xavier Lapillonne, Andrea Arteaga, Stefan Rüdisühli) and the "Turbisim" project (Steven Böing); See page 2 for more details on the current projects.

www.c2sm.ethz.ch/the-center/people.html →

Main Achievements

Research Coordination

C2SM and its community have contributed to the successful acquisition and subsequent implementation of several large collaborative projects addressing a range of topics that encompass, for example, the quantification of greenhouse gases fluxes, the water cycle, and high-performance computing.

CarboCount CH

Quantifying greenhouse gas fluxes

CarboCount CH is a collaborative project involving 8 partners from Empa, ETH, University of Bern, and C2SM and is funded by the Swiss National Science Foundation (Sinergia program). CarboCount CH investigates human-related emissions and natural exchange between atmosphere and biosphere of the two most important long-lived greenhouse gases carbon dioxide (CO2) and methane (CH4) in Europe and especially in Switzerland. The main outcomes of this project will be an improved understanding of the processes contributing to CO2 and CH4 sources and sinks. C2SM contributes to the maintenance and further development of the modeling tools used within the project and supports the project management.

www.c2sm.ethz.ch/research/ghg/CarboCountCH.html →

MAIOLICA-II

Global methane variability in a changing climate

MAIOLICA-II is a collaborative project involving 4 partners from ETH, WSL, Empa, and C2SM, and is funded within the ETH Competence Center Environment and Sustainability (CCES). The project aims at improving our understanding of the fundamental processes that contribute to the observed variability of atmospheric methane (CH4) concentrations in the recent past, focusing on natural CH4 emissions from wetlands and wildfires. Climate-related changes in atmospheric CH4 are also investigated including the feedbacks among terrestrial biosphere, atmospheric composition and climate.

www.c2sm.ethz.ch/research/ghg/maiolica-2.html →

CHIRP-2

Modeling the water cycle in a changing climate – a multi-scale interaction challenge

CHIRP2 involves a group of 18 co-applicants from ETH Zurich, MeteoSwiss, and Agroscope. The project aims to make essential advances in our understanding and our ability to quantitatively model a number of key processes and interactions within the Earth's water cycle, with a focus on those that involve strong scale interactions. The main tools are a set of models hosted by C2SM and its community: COSMO-CLM (atmosphere), CLandM (land surface), and ROMS (ocean) at the regional scale, and ECHAM (atmosphere and ocean) at the global scale. Observations from in-situ networks and remote sensing instruments will provide additional crucial sources of information and constraints for the models. The main outcomes of this project will be an improved understanding of the Earth's water cycle (including better constrained parameters and an improved numerical representations of critical processes in models), which will permit us to provide substantially improved projections of how the water cycle works in a changing climate.

www.c2sm.ethz.ch/research/CHIRP2.html →

HP2C

High Performance and High Productivity Computing

C2SM aims to prepare climate codes for the next generation of high-performance computers to exploit the emerging computing capabilities and thereby continue to contribute at the highest level to climate system science. C2SM has been involved in several consecutive projects of the Swiss initiative for High Performance and High Productivity Computing (HP2C), Those projects (untitled HP2C-COSMO, HP2C-OPCODE, and HP2C-COCoNet) all aim to develop a graphics processing unit (GPU)-enabled version of the limited-area climate and numerical weather prediction COSMO model. The development and dissemination of the GPU-enabled version of COSMO is further ensured by a project (so-called HP2C-Plus) currently supported by MeteoSwiss.
The follow-up initiative after HP2C is the Swiss Platform for Advanced Scientific Computing (PASC). The main goal of PASC is to promote collaborations between domain scientists, computational scientists and software and hardware vendors and providers. As a result of the key role played by C2SM in the HP2C initiative, climate was chosen as a relevant domain science for establishing one of the four PASC community networks in Switzerland. C2SM currently leads the *"Climate and Atmospheric Modelling"* network.

www.c2sm.ethz.ch/research/High_Performance_Computing.html →

www.pasc-ch.org/networks/climate →

Turbisim

Towards 1-kilometer resolution weather and climate simulations

The "Turbisim" project is part of the development of the 1-kilometer resolution numerical weather forecast model at MeteoSwiss (COSMO-1). At this resolution, thunderstorms are explicitly resolved, while shallow clouds and turbulence are not. Current kilometer-scale simulations show significant biases, typically with too late triggering of deep convection and too strong precipitation, especially in summertime.
ETH and MeteoSwiss are collaborating towards a unified representation of shallow clouds and turbulence and a better representation of deep convection, especially over complex topography as typically found in the Alps.

www.c2sm.ethz.ch/research/past-projects/chirp1/Towards_kilometer-scale.html →

Education and Training

C2SM contributes on a yearly basis to the organization of the Swiss Climate Summer Schools. In 2013, C2SM has also initiated the organization of a series of training workshops to provide specific skills related to climate data and modeling.

www.c2sm.ethz.ch/education.html →

Educational Development

Good practices in code development

This short technical training was organized for the C2SM Community to encourage the systematic usage of good practices in the development of code and scripts. The training provided an overview of some coding standards and presented basic principles of code versioning, debugging and performance analysis.

Regional climate model data for climate impact research

This technical training was co-organized by the Sinergia project "The Evolution of Mountain Permafrost in Switzerland" (TEMPS) and C2SM to train young scientists in the optimal use of regional climate model data for climate impact research.

Outreach and Events

C2SM fostered the science network with a redesigned newsletter and organised a number of events in 2012 and 2013 targeting lay audience, scientists, and various stakeholders.

Community building activities

A series of actions were taken in 2012 and 2013 to strengthen the links and exchange within the C2SM community. In particular, a community email list was created, the C2SM Newsletter was revived – to which the entire community is encourage to contribute – and a first C2SM Community Day was organized to foster scientific and informal exchange within the community.

www.c2sm.ethz.ch/events/past-events/c2sm-community-day-2013.html →
www.c2sm.ethz.ch/news/newsletter.html →

ETH Klimarunde 2013

Welche Schlüsse ziehen wir aus dem neusten UNO-Klimabericht 2013?

Klimarunde 2013 was organised soon after the release of the Working Group 1 report from IPCC Fifth Assessment Report (AR5), to which several C2SM members have contributed in leading roles. The event provided an overview of the new results from the AR5 and offered the opportunity for personal interactions between leading scientists and the general public at "Tischgespräche" discussions. Through a podium discussion with high level guests from science, industry and politics, the event also initiated a reflection on the role that universities and other organizations such as the IPCC should play in the climate debate. The event received high attention from the media and was ranked as one of the best outreach events at ETH.

www.c2sm.ethz.ch/events/past-events/eth_klimarunde_2013.html →

Scientific symposium

The water cycle in a changing climate

Climate change will fundamentally affect the Earth's water cycle. Yet, our understanding and our ability to predict changes in the water cycle are still limited. This scientific symposium was organized to review our current understanding of the processes governing the water cycle, and to explore new frontiers in using climate change information towards coping with emerging challenges. More than 200 scientists attended this two and a half day event at ETH main building.

www.c2sm.ethz.ch/events/past-events/symposium-water-cycle.html →

Scientifica: Risiko

C2SM organized a booth at Scientifica 2013, the main scientific outreach event in Zurich, which is cooperatively staged by University of Zurich and ETH Zurich. The topic of the 2013 edition was "Risks". To convey basic, yet counter-intuitive concepts related to climate risks, probability, and variability to a general public, C2SM organised a "Klimapoker" game using a set of electronic dices developed by the University Bern. By throwing the dices, visitors of all ages could modify climatic covariates such as solar irradiance and volcanic activity, and run a stochastic simulation of 100 years of summer temperatures for the Zurich area. The resulting heat wave occurrences, or lack thereof for individual runs, and the ensuing discussions very well served C2SM›s pedagogical aim, i.e., the fostering of a better conceptual grasp of the relationship between global warming and extreme weather events.

Support for research and education activities

Global climate modeling

Global climate modeling activities at C2SM are centered around the Max Planck Institute Earth System Model (MPI ESM). The MPI ESM is an Earth System Model originally developed and currently maintained and distributed by the Max Planck Institute for Meteorology (MPI-M) in Hamburg. The atmospheric component ECHAM is coupled to comprehensive aerosol (HAM) and trace gas chemistry (MOZ) modules, leading to the formation of the fully coupled aerosol-chemistry-climate model ECHAM-HAMMOZ. Since 2009, the HAMMOZ consortium is chaired by C2SM member Prof. Ulrike Lohmann and ETH/C2SM are responsible for the hosting of the ECHAM-HAMMOZ model for the growing international HAMMOZ consortium. In October 2012, a first version of the ECHAM6- HAMMOZ model, based on a completely new architecture and the latest version of the different components was released. An additional release took place in October 2013 to account for the implementation of new features in the aerosol scheme.)

https://redmine.hammoz.ethz.ch/projects/hammoz →

Regional climate modeling

The regional climate modeling activities at C2SM focus on the COSMO model, a limited-area atmospheric model developed by the Consortium for Small-Scale Modeling (COSMO), including MeteoSwiss and other European meteorological services. The model, which can be used in CLimate Mode (COSMO-CLM), is also further refined and applied in several groups at ETH, Empa and in the international "Climate Limited-area Modelling" Community. Over the years, the COSMO model has been coupled to different modules dedicated to tropospheric chemistry, aerosols, aerosol-cloud interactions, and land-atmosphere interactions, allowing for the investigation of additional processes relevant for the climate system. In particular, the COSMO-ART and COSMO-M7 versions, which include a detailed representation of atmospheric chemistry and aerosols and the COSMO-CLM2 version, which includes a more detailed representation of the land surface component (i.e., the Community Land Model (CLM)) are used within the C2SM community. C2SM provides extensive support for the COSMO model, e.g., by maintaining a code repository, providing local user support, and developing specific scientific and technical features that are needed by community-wide research projects. This greatly facilitates the joint use and sharing of COSMO and several of its extensions within the C2SM community and thus contributes to strengthen the collaboration between the partner institutions.

www.cosmo-model.org →
www.clm-community.eu →

Climate data analysis

The data related activities focused on data acquisition, management and dissemination. In particular, C2SM supported the acquisition, storage, and management of data from the Coupled Model Intercomparison Project Phase 5 (CMIP5) in support of IPCC's Fifth Assessment Report and data from the Coordinated Regional Climate Downscaling Experiment (CORDEX), in collaboration with the Institute for Atmospheric and Climate Science (IAC). In addition, C2SM contributed to the CH2014-Impacts initiative, which was initiated in 2012 by the Swiss research community to describe quantitatively the impacts of climate change in Switzerland on ecosystems, food, health, etc.. C2SM provided support regarding the utilization of the CH2011 scenarios and other climate data, and many members substantially contributed their expertise to several chapters of the CH2014-Impact report addressing climate 13 scenarios, climate indices, cryospheric aspects, biodiversity, forest properties and ecosystem services, and agricultural production. The release of 2014-Impact report is planned for the first quarter of 2014.

www.ch2014-impacts.ch →

Budget and Related Projects

Reporting period (01.07.2012 – 31.12.2013)

Budget

Saldo (CHF)# 1.06.2012	**239'236**
Income (CHF) 1.07.2012 – 31.12.2013	
ETH School Board	240'000
USYS Department	200'000
Members	23'000
MeteoSwiss	240'000
Empa	100'000
WSL	50'000
Agroscope	20'000
Funding through projects *	133'859
Total Income	**1'006'8569**
Expenses (CHF) 01.07.2012 – 31.12.2013	
Salaries core staff	688'473
Project support	25'095
Events	49'074
Running costs	20'181
Travels	20'181
Total Expenses	804'098
Saldo (CHF) 01.07.2012 – 31.12.2013	**441'897**

Transfer from Phase I
* The projects Carbocount-CH, MAIOLICA II, and HP2C-related have contributed to the core C2SM budget. See pages 6 and 7.

Within the C2SM community

Research projects related to C2SM

Project name *	Lead PI	Funding mechanism	Amount (kCHF)	Duration
Third-party projects initiated within the C2SM Community				
CarboCount CH	D. Brunner (Empa)	SNF Sinergia	1'400	01.01.2012 – 31.12.2014
CHIRP-2	N. Gruber (ETH)	ETH	1'500	01.01.2012 – 31.12.2014
HP2C-COSMO	I. Bey (C2SM)	HP2C	930	01.06.2010 – 31.05.201
HP2C-OPCODE	O. Fuhrer (MeteoSwiss)	HP2C	540	01.07.2011 – 31.06.2013
HP2C-COCoNet	I. Bey (C2SM)	HP2C	180	01.11.2012 – 31.06.2013
HP2C-Plus	P. Steiner (MeteoSwiss)	MeteoSwiss	340	01.10.2013 – 01.05.2015
Turbisims	P. Steiner (MeteoSwiss)	MeteoSwiss	250	01.04.2013 – 30.06.2015
MAIOLICA II	T. Peter (ETH)	CCES	925	01.08.2012 – 31.07.2016

* See pages 6 and 7 for more details on the current projects.

Scientific Highlights

Selected Scientific Highlights

Rapid acidification of the Eastern Pacific Ocean

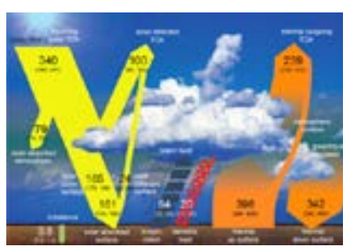
The increasing CO2 concentration in the atmosphere leads to the acidification of oceans. Nicolas Gruber and colleagues have investigated how the acidity along the west coast of the USA (an ecosystem particularly prone to ocean acidification) will evolve until the year 2050. They performed high-resolution simulations of the oceanic circulation and accounted for atmosphere-ocean exchange of CO2 by including models of the ecosystem and of the carbon cycle. They found that the water acidity will increase significantly by 2050, even under an optimistic CO2 emission scenario, likely impacting the ecosystem substantially (Gruber et al., 2012).

Prediction of extreme hot events

Climate change is likely to increase the frequency of hot extreme events in coming decades. Brigitte Mueller and Sonia Seneviratne have investigated the relationship between precipitation deficits – a proxy for surface moisture deficits – and hot extremes across the globe. They used observations and reanalysis data between 1979 and 2010 and found that surface moisture deficits in the three months leading up to the hottest month of the year were associated with an increased number of hot days during that month. Using such information may contribute to improve the skills of long-range forecasts and the prediction of extreme weather events (Mueller and Seneviratne, 2012).

Global energy balance revisited

New satellite missions have allowed a more accurate quantification of the energy exchange between Sun, Earth and space. Much less is known about the energy distribution within the climate system and at the Earth surface. Martin Wild and colleagues combined surface observations of radiative fluxes with model data from the Coupled Model Intercomparison Project (CMIP5) to infer best estimates of the global mean surface radiative components including uncertainties. The analysis revealed that CMIP5 models generally overestimate the downward solar and underestimate the downward thermal radiation fluxes, thereby nevertheless simulating an adequate global mean surface radiation by error compensation (Wild et al., 2013).



Global mean energy budget under present-day climate conditions. Numbers state magnitudes of the individual energy fluxes in W m–2. Numbers in parentheses attached to the energy fluxes cover the range of values in line with observational constraints. This figure, adapted from Wild et al. (2013), was used in the 5th IPCC assessment report..

Effects of stratospheric sulfate aerosol geo-engineering on cirrus clouds

Geo-engineering, as a way to prevent global warming, has increasingly become part of public and political discussions. One of the techniques suggested by several climate scientists is to cool the Earth through the injection of sulfate aerosols into the stratosphere. Miriam Kuebbeler and co-workers examined the potential impact of such approach on the hydrological cycle in their global aerosol-climate model. Their work revealed that indirect effects of stratospheric aerosols on cirrus clouds could be important and need to be considered in order to estimate the maximum cooling that would result from such an approach. Undoubtedly, the deployment of geo-engineering techniques still warrants more research (Kuebbeler et al., 2012).

Contrasting response of carbon and water fluxes to spring drought: grassland versus forest

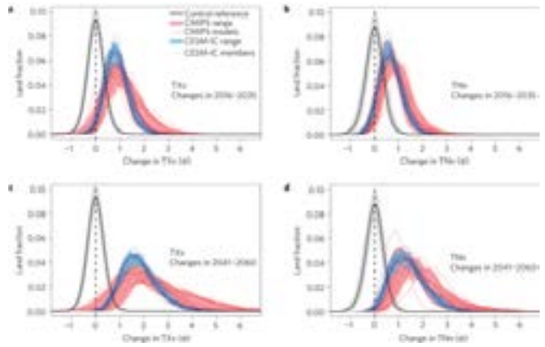
While the understanding of the effects of summer drought on ecosystem carbon and water vapour fluxes has recently advanced, the effects of spring drought remain unclear. Sebastian Wolf, Werner Eugster, Nina Buchmann and co-authors examined measurements from spring 2011 (March–May), which was the warmest and among the driest since the beginning of meteorological measurements in Switzerland. They found that spring phenological development was 11 days earlier in 2011 compared to the mean of 2000–2011 across all sites. Soil moisture related reductions of gross primary productivity (GPP) were found at the lowland grassland sites, where productivity did not recover following grass cuts. In contrast, spring GPP was enhanced at the montane grassland and both forests. Evapotranspiration (ET) was reduced in forests, which also substantially increased their water-use efficiency (WUE) during spring drought, but not in grasslands (Wolf et al., 2013)..

Ecosystem services in the European Alps in a 2°C warmer world

A 2°C increase in average global temperature is often presented as an «acceptable» amount of warming, and remains a stated target for reductions of greenhouse gas emissions. However, new research suggests that in the European Alps such a scenario would result in detrimental impacts on some essential ecosystem services. Ché Elkin, Harald Bugmann and colleagues used new regional climate projections of a 2°C warmer world from C2SM to examine the impacts on mountain forests and a range of ecosystem services that those forests provide. Forests projected to be most sensitive are those at low and intermediate elevations in regions that are currently warm-dry, e.g. in the Valais. In these areas small climatic shifts can induce drought-related negative impacts on ecosystem services such as rock fall protection. In contrast, ecosystem services at higher elevations, and in regions that are currently cool-wet, are projected to be comparatively resistant to a 2°C warmer world, with small but beneficial impacts on most ecosystem services, particularly carbon storage. Thus, even a mode-rate 2°C increase of global average temperature cannot be seen as a universally «safe» boundary for maintaining mountain forest ecosystem services (Elkin et al., 2013)

Projections of future climate extremes

Climate extremes leave strong impacts on ecosystems, infrastructure and society. The question of how extremes change in a future warmer climate is thus highly relevant. Erich Fischer, Urs Beyerle and Reto Knutti published new projections about the future distribution of heat and precipitation extremes. They found that climate variability is the dominant contribution to uncertainty in near-term projections of extremes at the local scale. As a consequence, this uncertainty cannot be reduced. How-ever, robust information about changes in climate extremes over the coming decades can be obtained by spatial aggregation (Fischer et al., 2013)



Probability Density Function (PDF) of the land fraction (66°S–66°N) experiencing a certain 20-year mean change in hot (a,c) and cold (b,d) extremes. 20-year mean changes are shown for the period 2016–2035 (a,b) and 2041–2060 (c,d) with respect to the 20-year mean in 1986–2005. Legend in (a) applies to all panels. The red lines mark individual models of CMIP5 and red shading the 5th to 95th percentile across the models for each bin marking a certain change. Likewise the blue lines show the individual CESM-IC members and the blue shading the respective range across different members. The changes expected owing to internal variability are shown as gray shading with the solid black line marking the mean. Twenty-year mean changes at each grid point are normalized by the inter-annual standard deviation of the respective annual extreme index values for 1986–2005. Adapted from Fischer et al. (2013).

Slected publications of members

Selected publications from the C2SM Community

Allen, R. J., J. R. Norris, and M. Wild, 2013: Evaluation of multidecadal variability in CMIP5 surface solar radiation and inferred underestimation of aerosol direct effects over Europe, China, Japan, and India. Journal of Geo-physical Research, 118, 6311-6336.

Anet, J. G., S. Muthers, E. Rozanov, C. C. Raible, T. Peter, A. Stenke, A. I. Shapiro, J. Beer, F. Steinhilber, S. Brönnimann, F. Arfeuille, Y. Brugnara, and W. Schmutz, 2013: Forcing of stratospheric chemistry and dynamics during the Dalton Minimum. Atmospheric Chemistry and Physics, 13, 10951-10967.

Anet, J. G., E. V. Rozanov, S. Muthers, T. Peter, S. Brönnimann, F. Arfeuille, J. Beer, A. I. Shapiro, C. C. Raible, F. Steinhilber, and W. K. Schmutz, 2013: Impact of a potential 21st century «grand solar minimum» on surface temperatures and stratospheric ozone. Geophysical Research Letters, 16, 4420-4425.

Bavay, M., T. Gruenewald, M. Lehning, 2013: Response of snow cover and runoff to climate change in high Al-pine catchments of Eastern Switzerland. Advances in Water Resources Research, 55, 4-16.

Bellprat O., S. Kotlarski, D. Lüthi, and C. Schär, 2012: Objective calibration of regional climate models. Journal of Geophysical Research, 117, D23115, doi: 10.1029/2012JD018262.

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 # New member of the Plenary elected in 2013

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The SAB has the mandate to advise the Centre on strategic matters and in particular to provide feedback regarding the achievements as well as the planned developments

Contact

ETH Zurich
Center for Climate Systems Modeling (C2SM)
Universitätstrasse 16
8092 Zurich

www.c2sm.ethz.ch

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