C2SM-NEWSLETTER

Center for Climate Systems Modeling
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Make climate services happen – The CH2011 initiative

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"Climate is what you expect, weather is what you get". With ongoing climate change, this famous quote is given a new meaning. Traditionally climatologists use historical data to quantify the "expected climate". But the past is no longer the best predictor. A hierarchy of complex models is now needed to accurately describe future climate. As a consequence, climate related decisions become more complex and new challenges arise for climate services. Among the most difficult issues is the need to understand, quantify and communicate uncertainties associated with the climate projections. The CH2011 initiative, that recently released the new Swiss Climate Change Scenarios CH2011, provides an excellent example of the inherent complexity.

Taking the right decisions in climate- and weather-related risk management is not an easy task. Traditionally, national Meteorological Services provided climate information based upon historical data. For instance, the widely used temperature or precipitation "normals" are based on the 30-year period 1961-1990 as defined by the World Meteorological Organization (WMO). Another example for the use of historical climate data is the estimate of return periods of heavy precipitation for designing infrastructures such as dams and bridges. All these concepts are based on the assumption that the best predictor for future climate is the past behavior or, in other words, that climate is considered to be in a quasi-stationary state. This specific assumption is most likely not true in the future, if the climate continues to change into a stage that we have not yet experienced.

>> page 2

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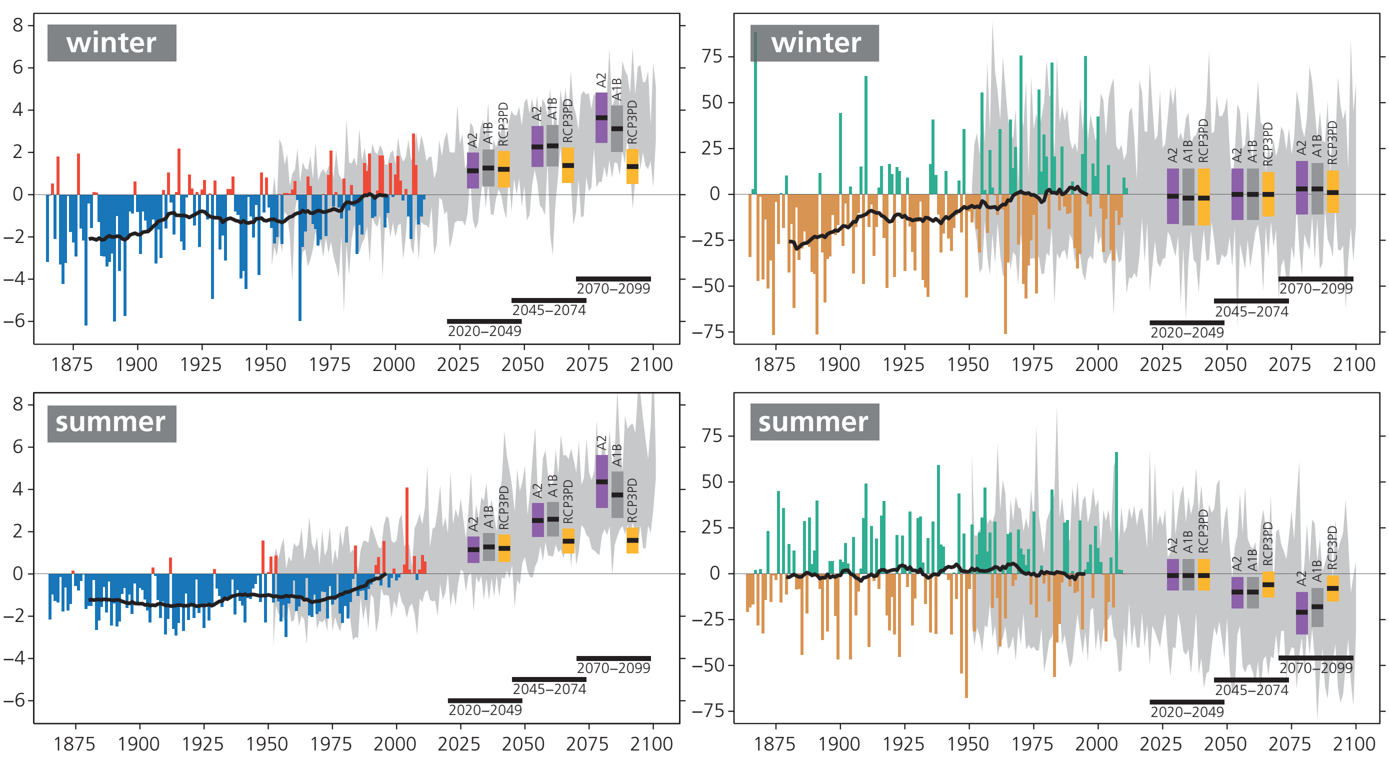
As a result, accurate estimates of future climate need to be based on a hierarchy of complex model projections including socio-economic developments together with sound historical data; and there is a need to adapt the methods used for constructing climate information.

One of the key challenges of climate service in the past was to improve the data quality and homogeneity of the climate observations. In the context of climate projections, many new challenges arise. Among the most relevant issue for end-users is the need to understand and quantify uncertainties associated with the models and methods. Realizing that this challenging mission needs a wide range of expertise from research and operational institutions, the WMO has initiated a Global Framework for Climate Services (GFCS) in 2009. The primary goal of this framework is to achieve greater availability and access to climate information in an operational sense, enabling governments and decision makers to reduce the potential negative consequences of climate variability and climate change. The services to be provided through the GFCS should complement the assignments of the Intergovernmental Panel on Climate Change (IPCC) that focuses on assessing climate change from a scientific perspective, but without conducting research or monitoring of climate-related data. The implementation of the GFCS services is planned for three different geographical domains – global, regional and national.

At the Swiss level, the CH2011 initiative is an excellent example of such a climate service. The aim of the CH2011 initiative was to conduct an assessment of how the Swiss climate may change over the next decades and to provide a set of national climate projections that can be used as input for a wide range of impact and adaptation studies. The initiative started as a small project within the National Centre of Competence in Research Climate (NCCR Climate) and aimed to update existing scenarios. However, it became quickly evident that the new model data and methods require much more than a simple update. Under the umbrella of C2SM, the initially small project progressively grew into a larger initiative and received substantial scientific, technical, and financial support from C2SM and its partners ETH Zurich, MeteoSwiss, ART, and OcCC. More than two dozens climate scientists were involved in the project and the hottest debates in the meetings were about understanding and quantifying the scenario uncertainties. After about 20 meetings of the Coordination Group and numerous technical meetings the new Swiss climate change scenarios, together with the associated report, were released to the public on September 28th, 2011. The new scenarios data can now be used as a common base for a variety of climate change related studies and decisions. One of the key figures of the CH2011 report that combines past observations and future climate projections is shown below.

>> page 3



Past and future changes in seasonal temperature (°C) and precipitation (%) over northeastern Switzerland for three greenhouse gas emission scenarios including estimates of the year-to-year variability and projection uncertainty ranges. Compared to the past 30 years, all three emission scenarios project an increase in seasonal mean temperature in the course of the 21st century, whereas mean precipitation is projected to decrease in summer, but not in winter.

In the near future, climate research will continue, climate models will further develop, and new observations will become available. Hence the climate scenarios provided by the CH2011 initiative will have to be updated and extended on a regular basis, so that decision national makers and end-users can rely on the best possible projections. Planning the development of the next generation of Swiss climate scenarios (say, the CH2016 scenarios) should start soon and account for the outcomes of the next IPCC assessment report (scheduled for 2013-2014). In several European countries, such a regular update of climate scenarios is already well established and an inherent part on the scientific and political agenda. This requires close collaborations among climate research communities located in both academia and government, strong links to international projects and institutions such as the EU Framework Programmes and IPCC, and long-term funding. Going back to the call of the WMO for implementing a Global Framework for climate services, the CH2011 initiative serves as an excellent example of how such a national climate service could be established in Switzerland.

» www.ch2011.ch

CHIRP-2 and SNF Sinergia projects funded

In the process of preparing the Center's second phase, the C2SM community was successful in obtaining funding for two large collaborative projects.

The first project is a Collaborative, Highly Interdisciplinary Research Project (CHIRP)-stage2 project lead by Prof. Niki Gruber (ETH) and funded by ETH Zurich with CHF 1.5 Mio. The project entitled "Modeling the water cycle in a changing climate – a multiscale interaction challenge" involves a total of 18 co-applicants from ETH Zurich, MeteoSwiss, and ART. The main goal is to make fundamental 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 second project is a Sinergia project lead by Dr. Dominik Brunner (Empa) funded with CHF 1.4 Mio. The project entitled "CarboCount-CH" involves 8 co-applicants from ETH Zurich, University of Bern, and Empa. It will center around the development of a prototype modeling and observing system for CO_2 and CH_4 at the regional scale with the objective to quantify and understand their fluxes and their sensitivity to recent and current climate variability.

Both projects will strongly rely upon the modeling systems maintained by C2SM, that is, the regional climate model COSMO and the global climate model ECHAM. **(ib)**

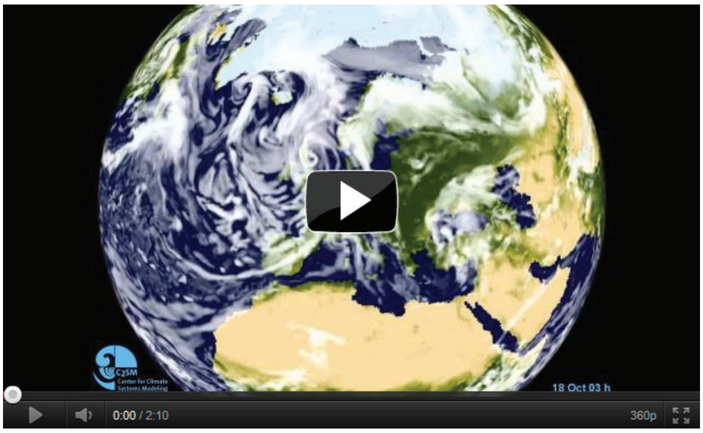
» www.c2sm.ethz.ch/research/

Animated high-resolution climate simulations

Watch our first climate animations online or download them for lectures and public presentations.

A tropical cyclone in the Pacific, the occasional cirrus cloud in Central Africa, orographic precipitation over the Alps - today's climate models are capable of simulating climate and weather phenomena in great detail. In the development of climate models, we usually focus on their deficiencies. We look for biases in mean values and variability, unresolved phenomena and missing processes. How would we otherwise advance? However, we thus risk not appreciating the overall performances and capabilities of the models, especially in comparison to the early generations.

C2SM would like to uncover some of the capabilities of models used in the community. In cooperation with the Institute for Atmospheric and Climate Science (IACETH), we have visualized results from the Community Earth System Model (CESM). This global climate model was therefore run at a high resolution of 25 km, a resolution usually reserved for regional climate models.



Screenshot of our animated visualization mimicking NASA's Blue Marble images based on simulated cloud, sea ice, snow and soil moisture information..

You can watch the movies on youtube, or download them from our website for offline presentation. We certainly plan to add further animations and look forward to your suggestions and comments. **(tc)**

» www.c2sm.ethz.ch/services/data_visualization/

PhD project "Impact of Aerosol-cloud-interaction on regional climate"

The interaction between aerosol particles and clouds represents one of the main uncertainties of anthropogenic climate forcing. In current climate models, aerosols and their interactions, if considered at all, are only described in a very simplified way. Needless to say, an adequate representation of aerosol particles is needed to better estimate their overall impact on climate, since aerosols can affect cloud formation, properties and lifetime as well as precipitation formation.

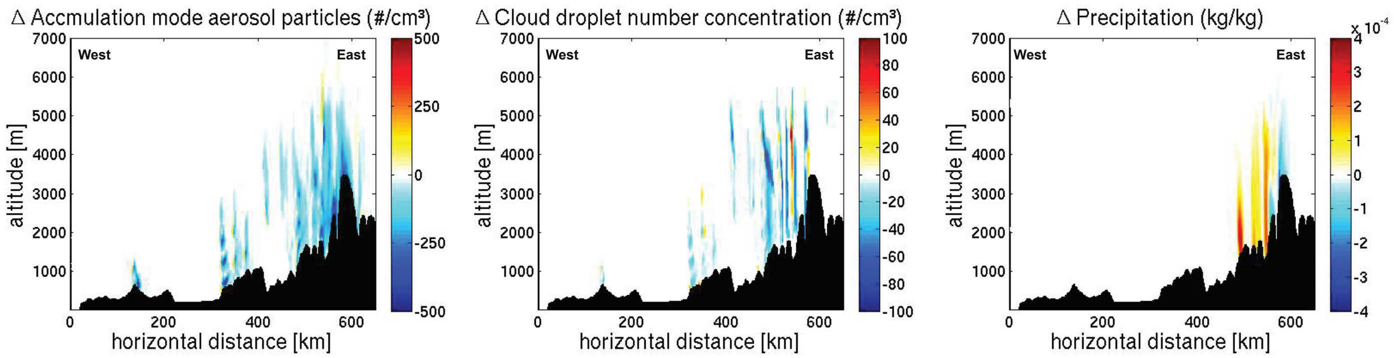
Many climate models still do not consider aerosol-cloud interactions due to the high demand of computational time for a detailed aerosol description. More sophisticated models include the effect of aerosol particles on liquid clouds. They allow the aerosol population to influence the number of cloud droplets, as some aerosols can act as condensation nuclei for cloud droplet formation. More advanced models consider the ice nucleating abilities of certain aerosols, including the impact of aerosol particles on mixed-phase and ice clouds.

Only the most advanced models also account for the feedback of clouds on aerosol particles and more precisely, for the changes in the aerosol size distribution and mixing state due to processing within the cloud hydrometeors. In fact, only by including all three steps the complete cycle of aerosol-cloud-interactions including feedbacks can be simulated.

The purpose of the PhD project of Sara Pousse-Nottelmann (group of Prof. Lohmann) is to extend the COSMO-CLM model by a detailed treatment of cloud cycling of aerosol particles. For this, an enlarged model version of the COSMO-CLM model is used including a bulk microphysical scheme which is coupled to an aerosol module. As a first part of the project, a detailed parametrization of aerosol processing in clouds is implemented in the model. The performance of the new model system is compared to observational data from the high Alpine station Jungfraujoch. In a second step, long term simulation will be conducted to evaluate the impact on regional climate projections.

The new model version enables the simulation of cloud cycling of aerosol particles by keeping track of the particles even when scavenged into clouds. This allows not only to better the representation of the aerosol size distribution and properties, but also to investigate questions regarding the repartition of aerosol particles to cloud condensation nuclei and ice nuclei, their evolution and impact on cloud formation. Questions regarding the dominant freezing mode in mixed-phase clouds, the predominance of certain aerosol effects as well as the influence on precipitation formation are investigated. The figure below shows results of a simulation case study. Further simulations will also be used to study the impact of aerosols on radiation and climate. **(sp)**

» www.c2sm.ethz.ch/research/phd/chemistry-aerosol-cloud



Study of the impact of aerosol processing on cloud formation over a West-East cross section of the Alps at 2.2km resolution. The plots, resulting from a case study on 20 March 2004 with westerly wind conditions, show the differences between a simulation including aerosol processing and the reference simulation after 1 hour. Changes in the aerosol properties (e.g., left panel: difference in accumulation mode aerosols) have an impact on cloud properties (e.g., middle panel: difference in cloud droplet number concentration) and precipitation formation (e.g., right panel: difference in precipitation).

Agenda

Events in Switzerland

Monday Seminars – Climate & Environmental Physics
until December 2011 (Mondays, 16:15)
University Bern, Sidlerstrasse 5, Bern

» www.climate.unibe.ch/?L1=courses&L2=seminar

Kolloquium – IAC ETH Zurich
October - December 2011 (Mondays, 16:15)
ETH Zentrum, Univerisätstrasse 6, Zürich

» www.iac.ethz.ch/events/?type=a

AGU Chapman Conference on Advances in Lagrangian Modeling of the Atmosphere
Monday-Friday, 10-14 October 2011
Grindelwald

» www.agu.org/lagrangian

9th Swiss Gesocience Meeting 2011
Friday-Sunday, 11-13 November 2011
ETH Zurich

» www.geoscience-meeting.scnatweb.ch/sgm2011/

3. Symposium Anpassung an den Klimawandel
Friday, 18 November 2011
Uni S Bern

» www.proclim.ch/4dcgi/occc/de/event?2019

How much high performance computing does meteorology need?
Tuesday, 29 November 2011
MeteoSwiss, Zurich

» meteoswiss.ch/web/de/forschung/veranstaltungen/aktuell.html

Updates & Further events

» www.c2sm.ethz.ch/news

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Credits
Cover: Nasa/courtesy of nasaimages.org
Page 2: CH2011
Page 3: Youtube / Thierry Corti
Page 4: Sara Pousse-Nottelmann

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