C2SM-NEWSLETTER

Center for Climate Systems Modeling
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Climate, weather and food – the need to integrate climate and agronomic information

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To reduce the risk of crop loss and food shortage, and to support adaptation to climatic change in the agricultural sector, climate information is needed that is tailored to the specific needs of models that are used to explore the sensitivity of crops and production systems, to evaluate the effectiveness of risk-reducing strategies, and to estimate implementation benefits and costs. This requires better integration of climatic and agronomic information in model chains through interdisciplinary collaboration.

There is considerable concern that global climate change may aggravate the provision of sufficient and safe food to a growing number of people in the world. Higher temperatures and altered precipitation may impair the productivity of crops and livestock, and more frequent heat waves, droughts or floods can have detrimental effects for local and regional agricultural production. In addition to direct damage from adverse weather, crop loss results from spreading pests, more virulent pathogens, loss of soil fertility due to erosion and soil organic matter decomposition, and last but not least, air pollution by ozone. On top of that, loss of production in major exporting countries can boost world market prices for important staple crops such as wheat, rice or maize because worldwide stocks are limited and the use of feedstock to produce biofuels is growing. Climate-related price spikes drive up costs of food and hit the poor and hungry people hardest, and there is a debatable risk that loss of livelihood, famine, social conflicts and migration may follow recurring periods of crop failure.

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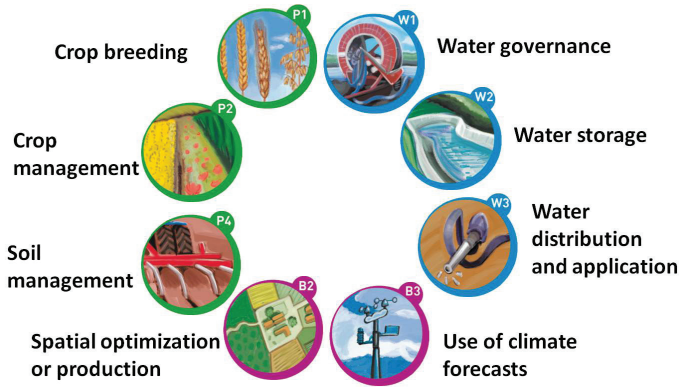
Coping with these threats will require both technical and institutional changes; as a transformative approach for developing countries, FAO (Food and Agriculture Organization of the United Nations) strongly promotes 'Climate-smart agriculture'.

There is another side to this story. In industrialized countries like Switzerland, the general public largely fails to notice any food shortage due to episodes of extreme weather because trade of agricultural goods buffers against local production shortage and secures full shelves for rich consumers. Possible loss of profit for local producers due to reduced yield, quality loss and higher production costs remain largely unnoticed, and the attention to headlines in the media is short-lived. Nevertheless, climate change has created the need to improve the resilience of farmer's livelihoods and ecosystems even in this country. At the core of the discussion are issues related to water, a public good that seems abundant, but is often not sufficiently available at the right time or at the right place. In response to the possibility that climate change could cause water conflicts, the Federal Office of Agriculture (FOAG) has released its 'Climate strategy' that includes – among others - targets for actions related to water shortage (see Figure). To foster such action, policy instruments are being put in place that provide incentives for individual farmers.

However, for adaptation to be effective, timely and tailored climate information is needed. Lacking such information may have contributed to some societal problems in the past. As an example, in their historical analysis of the coincidence of changes in society and climate in Europe, Büntgen et al. (Science 331 (6017), 678-582, 2011) hypothesized that after 250 AD the decline of the Roman Empire was related to the shift in climate towards more unfavorable conditions for the production of wheat as a key cereal at that time, and that shifting to crops that were better suitable for wetter conditions such as rye could have help to avoid food shortage. In future, this situation can be avoided, for instance, through targeted crop breeding for stress tolerance and by developing more 'climate-proof' production systems. However, given the lead time necessary for such developments, the research community needs information and data now that is consistent with the specific requirements of statistical or process-based models to explore the sensitivity of soil-crop-management systems, and of crop suitability. This information must not only address changes in means but needs to be resolved in time and space to account for the temporal dynamics of a crop's sensitivity to stress, possible combinations and sequences of stresses, and the spatial variability of soil properties. Shifts in the frequency, extent and timing of extremes behind the means are particularly important. This level of detail may never be fully achievable but progress could best be made through integration of climate, hydrological and agricultural information in ensembles of model chains. This requires close collaboration between disciplines in both national and international networks, and the C2SM with the Federal agricultural research institution 'Agroscope ART' as its member could be an ideal platform.

» www.c2sm.ethz.ch



Main target areas for adaptation to increased risks of water shortage in Swiss agriculture (according to the Climate strategy of the Federal Office of Agriculture, FOAG, www.blw.admin.ch)

CMIP5 data retrieval exceeds 100.000 files

In the effort to retrieve data from the Coupled Model Intercomparison Project Phase 5 (CMIP5), C2SM and IACETH have reached the symbolic mark of 100 thousand files.

The CMIP5 project provides a vast set of results from global climate simulations. The overall data volume of several thousands of terabytes poses a serious challenge in terms of data management. In collaboration with the Institute for Atmospheric and Climate Science (IACETH), C2SM obtains subsets of the data volume according to wish lists provided by researchers in the Center's community and authors of the upcoming IPCC Fifth Assessment Report.

Members of the Center's community are welcome to make use of this growing data set. Please contact us for local access to the archive. **(tc)**

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

PhD project "Stabilizing atmospheric CO2: On the role of oceanic eddies for carbon-climate feedbacks"

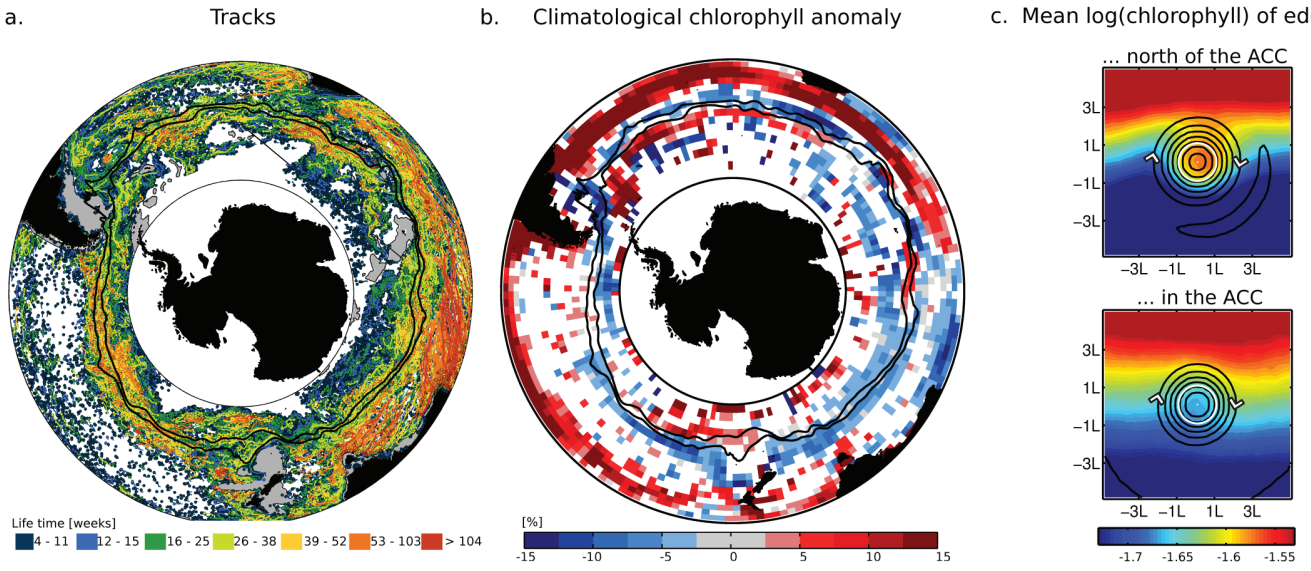
The Southern Ocean (SO) is a region of intense activity of mesoscale oceanic eddies which are typically not well resolved in coarse resolution climate models. The role of eddies for the uptake and transport of carbon in this globally crucial region is ill known. It is hypothesized that they might be important for controlling marine productivity.

The ocean is the largest carbon reservoir in the global carbon cycle and has taken up about a quarter of the anthropogenic CO2 emissions in the past two hundred years. To improve estimates of future atmospheric CO2 levels, it is essential to better quantify the carbon involving processes in the ocean and how they might respond to a changing climate. The SO is a key region in this context, as it connects the surface and the deep ocean, where the lion's share of the oceanic carbon is stored, and as it is hypothesized to be sensitive to climate change. One poorly understood aspect is the role of mesoscale eddies, which are frequent features in this area, as they develop from instabilities of the intense Antarctic circumpolar current (ACC). Eddies can impact the large-scale distributions of biogeochemical tracers, for instance by lateral stirring and the transport of water in their cores over vast distances. Additionally, they can have an effect on reactive biogeochemical tracers by locally establishing environmental conditions that favor, for example, phytoplankton growth by pumping up nutrient rich deeper waters.

The purpose of the PhD project of Ivy Frenger is to investigate the impact of SO eddies on marine productivity and carbon fluxes, with a focus on biophysical interactions. First, the properties of nearly 300'000 SO eddies were determined using satellite based observations from 1997 to 2010. For instance, we determined the temporal evolution of the diameter, the life time and the propagation velocity for each eddy. Then, using chlorophyll-a as a proxy, we investigated the impact of eddies on ocean productivity. Eddies have a significant imprint on chlorophyll-a, but in a spatially different manner. This imprint can be partially attributed to lateral stirring of the chlorophyll-a field due to the rotation of the eddy. Another fraction is due to the transport of chlorophyll-a trapped in the eddies' core, with the remaining fraction being the result of the local modification of vertical transport and mixing by eddies influencing phytoplankton growth.

A rough estimate of the carbon flux due to the chlorophyll-a transport by eddies across the ACC turns out to be small relative to the total carbon flux. In the near future, we aim to estimate all carbon fluxes associated with eddies, including those that are indirectly linked, such as an increase in productivity (and carbon export) due to eddies transporting nutrients laterally into nutrient depleted areas. These fluxes will be determined from a high-resolution regional ocean model coupled to a biogeochemcial-ecological model. An important guiding question for the future will be how climate change will be impacting these eddy-induced carbon fluxes. **(if)**

» www.c2sm.ethz.ch/research/phd/Southern-Ocean-CO2



Figures for cyclonic eddies only (clockwise rotation in the Southern Hemisphere): (a) Tracks of all 1997-2010 cyclones; black lines mark the mean positions of the major fronts of the ACC and gray shadings indicate areas shallower than 2000 m. (b) Significant related mean chlorophyll-a anomalies and (c) averaged log(chlorophyll-a) of cyclonic eddies north of (top) as well as in (bottom) the ACC (eddies indicated as black contours, the white circle denotes the eddy core; the eddies were rotated before averaging the chlorophyll-a, so that the large scale chlorophyll gradient points south-north).

Agenda

Events in Switzerland

PLANAT-Plattformtagung 2012
Dienstag-Mittwoch, 20-21 März 2012
Kultur- und Kongresshaus Aarau

» www.planat.ch/de/planat/plattformtagung-2012/

13th Swiss Global Change Day
Wednesday, 4 April 2012
Freies Gymnasium, Bern

» www.proclim.ch/4dcgi/proclim/all/event?1995

Abschlusstagung CCHydro
Freitag, 8. Juni 2012
Bern

» events.scnat.ch/proclim/index.php?id=16542

Updates & Further events

» www.c2sm.ethz.ch/news

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