ACCENT
ATMOSPHERIC COMPOSITION CHANGE
THE EUROPEAN NETWORK OF EXCELLENCE

ACCENT, the EU funded Network of Excellence on Atmospheric Composition Change, is now in his last year of operation. In these five years ACCENT has achieved a significant level of integration, involving a critical mass of scientists from the 43 European Partners Institutions and the 124 worldwide Associate Institutions, in close coordination with the main international activities and programs on atmospheric research.

During these exciting and productive years, ACCENT has reached a well established position, widely recognised also outside Europe: thanks to the several activities it has undertaken; the international connections that have set in place; and, the support that it has provided to the community, especially young scientists, to foster our science into the future.

ACCENT has made available several "tools" which are of paramount importance for the integration of the international atmospheric science community, facilitating the access to several databases, to research infrastructures and to a wide range of information functional for the atmospheric science community.

To conclude, ACCENT represents an excellent example of addressing the climate and environmental problems considering not only building the science consensus, but also serving the downstream needs of general public and, importantly, of policy makers.

www.accent-network.org

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Visit the SOLAS website at http://www.solas-int.org where you can keep an eye on your national pages, job listings, conference and meetings which are updated regularly.

If you would like to sign up to the monthly e-bulletin and the newsletter which you can receive by hardcopy or by e-mail visit http://www.uea.ac.uk/env/solas/news/newsletter/subscribe.html alternatively, you can contact us here at the IPO (solas@uea.ac.uk)

Additionally, if you have any vacancies, conferences or information for the e-bulletin that you would like to advertise please let us know. The SOLAS website and the newsletter are meant as a community resource so any contributions, comments and ideas are always welcomed.

Georgia Bayliss-Brown
SOLAS Project Officer

Marco Steinacher obtained a MSc. in Physics at the University of Bern, Switzerland, where he is currently doing his PhD. in the Division of Climate- and Environmental Physics of the Physics Institute. His research interests include carbon cycle and climate modeling, ocean acidification, and probabilistic projections of future climate change.

Imminent and Irreversible Ocean Acidification

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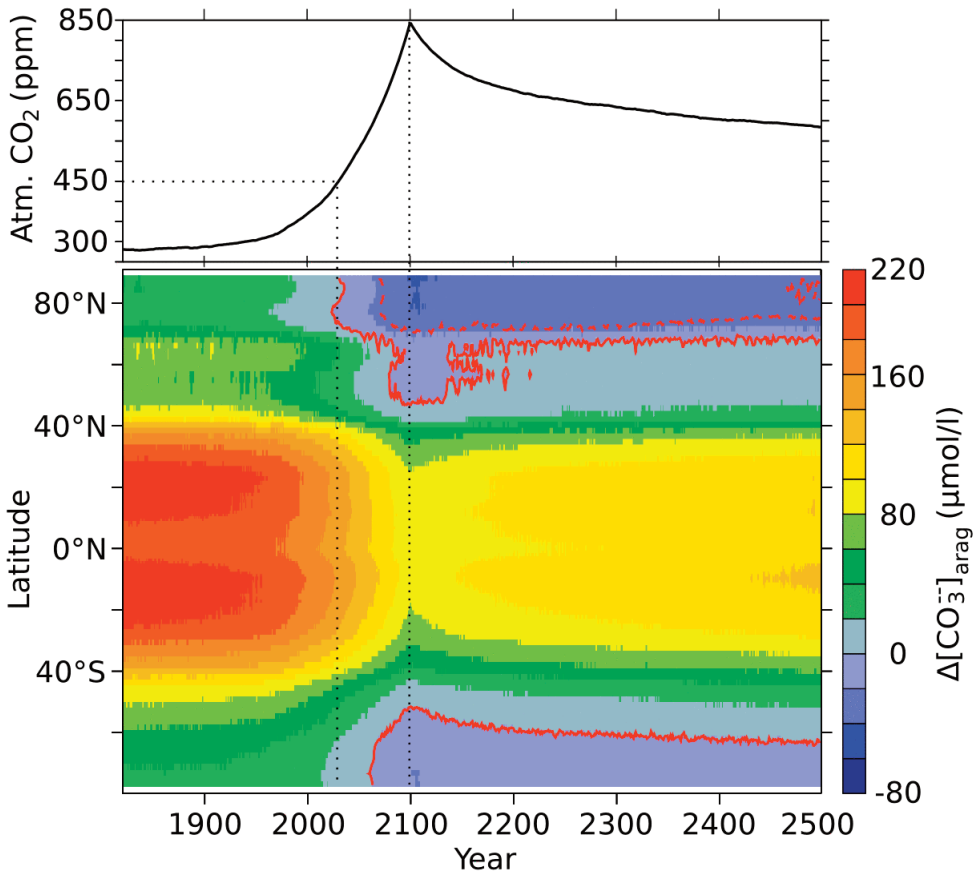
Anthropogenic carbon emissions force atmospheric CO_2 far above the natural range of the last million years and cause rapidly progressing global warming. Yet another issue linked to anthropogenic CO_2 has recently attracted wide attention. The uptake of anthropogenic CO_2 lowers ocean pH, the concentration of carbonate ions and the saturation state of seawater with respect to calcium carbonate (Orr et al., 2005). A particular concern of this "ocean acidification" is its impact on marine organisms and ecosystems (Doney et al., 2009).

We investigate ocean acidification with the comprehensive NCAR global coupled climate-carbon model forced with rising carbon emissions for the SRES A2 business-as-usual scenario until 2100 (Steinacher et al., 2009). Irreversible impacts of 21th century CO_2 emissions are quantified by extending the simulation (unrealistically) with zero emissions after 2100 (Frölicher and Joos, 2009). Here, the carbonate ion concentration [CO_3^{2-}] and the related saturation state with respect to aragonite are used as indicators. Aragonite is a mineral phase of calcium carbonate secreted by



Λ Figure 1: Simulated evolution of atmospheric CO_2 and of zonal, annual mean surface carbonate ion concentration, shown as deviation from the saturation concentration with respect to aragonite. Red lines indicate the transitions from over- to undersaturation with respect to aragonite (solid) and calcite (dashed).

many marine organisms to build their shells and other structures. Aragonite shells dissolve in undersaturated water in the absence of protective mechanisms.

Surface water saturation decreases rapidly in all regions until 2100 (Fig. 1) and remains reduced for centuries. Undersaturation in the Arctic is imminent and starts already within the next decade. By the time atmospheric CO_2 exceeds 490 ppm (2040 in A2), more than half of the Arctic is undersaturated (annual mean). Similarly, the Southern Ocean becomes undersaturated on average, when atmospheric CO_2 exceeds 580 ppm and saturation in the tropics drops below 300%, threatening the survival of coral reefs. By the end of the 21st century, undersaturation in the Arctic Ocean also occurs with respect to calcite and remains widespread for centuries after cutting emissions in 2100.

The main reasons for the vulnerability of the Arctic Ocean is its naturally low saturation state and that Arctic climate change amplifies acidification, in contrast to other regions like the Southern Ocean, where climate change has almost no effect in our simulations. Enhanced uptake of atmospheric CO_2 in response to sea-ice retreat, surface freshening and other effects lead to a decrease in Arctic surface [CO_3^{2-}] that is 34% higher than it would be without climate change.

Ocean acidification also affects the thermocline and the abyss as anthropogenic carbon continues to invade the ocean. Overall, the fraction of the ocean volume occupied by water oversaturated with respect to aragonite is projected to decrease from about 42% to 25% by 2100 and to 10% by 2300. The fact that the volume fraction continues to decrease significantly after 2100 demonstrates that some impacts of 21st fossil fuel carbon emissions are strongly delayed and aggravate even for the extreme case of an immediate emission stop.

Undersaturation of Arctic surface waters with respect to aragonite is likely to become reality in a few years only (Steinacher et al., 2009) and ocean acidification from business-as-usual carbon emissions is irreversible on human timescales (Frölicher and Joos, 2009). Experimental evidence is emerging (Doney et al., 2009) that ocean acidification has negative impacts on many organisms and may severely affect cold and warm water corals or high-latitude species such as aragonite producing pteropods. Considering the precautionary principle mentioned in the United Nations Framework Convention on Climate Change, our subjective assessment is that atmospheric CO_2 should not exceed 450 ppm in order to avoid the risk of large-scale disruptions in marine ecosystems.

References

Doney, S.C., Fabry, V.J., Feely, R.A., and Kleypas, J.A.: Ann. Rev. Mar. Sci., 1, 169–192, 2009.

Frölicher, T.L. and Joos, F.:, submitted to Clim. Dynam., 2009.

Orr, J.C. et al.: Nature, 437, 681–686, 2005.

Steinacher, M., Joos, F., Frölicher, T.L., Plattner, G.-K., and Doney, S.C.:, Biogeosciences, 6, 515-533, 2009.

Peter Liss awarded CBE

On March 27th of this year, Peter Liss, the first Chair of SOLAS, was appointed "Commander of the Order of the British Empire" by Prince Charles at a ceremony at Buckingham Palace. The award was in recognition of Peter's services to science. The "CBE" is one of the highest awards for citizens of the UK and the Commonwealth of Nations, and it is awarded to people from all walks of life. So Peter now joins the company of Robert Plant, Simon Rattle, Michael Caine, Ian MacEwan, David Attenborough, Stephen Hawking and Sting! All of us who have witnessed Peter's tireless energy and commitment to SOLAS and to other scientific activities and programmes over the years can agree that this is a very well-deserved award. Congratulations, Peter!

Doug Wallace, SOLAS Chair

GEWEX and its new Global Surface Flux Estimates

The Global Energy and Water Cycle Experiment (GEWEX), a project under the World Climate Research Programme (WCRP), explores ways to close the global energy and water budgets. Critical activities that support this goal include: producing consistent research quality data sets, quantifying the contributions of energy and water cycle processes to climate feedbacks; and improving the predictive capability for moist processes. The research is guided by the Scientific Steering Group (SSG) and three panels including the GEWEX Radiation Panel (GRP), which recently launched projects on surface fluxes over oceans (SeaFlux) and over land (LandFlux).

SeaFlux is developing estimates of latent and sensible heat fluxes over the global oceans at three hourly intervals and 25 km resolution. Fluxes are derived by blending winds with air temperature and heat content products while Sea Surface Temperatures are derived using a Seaflux technique. Comparisons between Seaflux products and in-situ data indicate that the products are very reliable, giving much smaller spreads than climate model simulations. SeaFlux products extend from 1999 to the present and Sea Surface Temperatures products extend from 1988 to the present. LandFLux is attempting to develop similar turbulent flux products over land. GRP also produces global cloud, radiation, precipitation, aerosol and water vapor products.

GEWEX supports land surface, cloud and boundary layer modeling through its Global Modeling and Prediction Panel (GMPP). The cloud process modeling relies on data from field campaigns which are available through the DIME (Data Integration for Model Evaluation) web site. GEWEX also oversees the Coordinated Energy and water cycle Observational Project (CEOP) which consists of a global network of regional studies supported by a distributed information system.

GEWEX is organizing an international science conference for August 24 to 28, 2009 in Melbourne Australia. Interested readers are encouraged to attend this conference and to learn more about GEWEX at www.gewex.org or by contacting Rick Lawford **(lawford@umbc.edu)** .

International GEWEX Project Office, Silver Spring, Maryland.

www.gewex.org