COMBINE **Quarterly Newsletter 2 – October 2010**

Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection

Autumn 2010 is reporting time: The writing of the first periodic report is currently the main collaborative activity for the COMBINE project partners. This report covers the period 1 May 2009 – 31 October 2010; and will consolidate the results of the first 18 months of the project.

This Newsletter reports on:

1. The WGOMD-GSOP Workshop on Decadal Variability, Predictability and Prediction, by M. A. Balmaseda. M. A. Balmaseda is co-leader of COMBINE WP5 Initialization, and member of the Organizing Committee of the WGOMD-GSOP Workshop.
2. Recent results from WP2 on shallow convection, provided by U Lohmann, co-leader of COMBINE WP2 Aerosols, Clouds, and Chemistry.

Announcements:

- The 2nd COMBINE General Assembly is scheduled for 24-27 May 2011, Exeter, UK, and is kindly hosted by the Met Office Hadley Center.
- COMBINE will hold its International Science Conference jointly with the 3rd International Conference on Earth System Modelling of the Max Planck Institute for Meteorology in Hamburg, Germany, 16-21 September 2012.

Project News:

- Dr Ir Paul Vossen is the new European Commission Project Officer for COMBINE. We welcome Dr Ir Vossen and look forward to collaborate with him.
- COMBINE, IS-ENES and METAFOR have been featured on International Innovation (Research Media), the leading global dissemination publication for the wider scientific, technology and research communities. The COMBINE article is available online (Project News page: http://www.combine-project.eu/?id=1627).

1. WGOMD-GSOP Workshop on Decadal Variability, Predictability, and Prediction: Understanding the Role of the Ocean. NCAR, Boulder, the 20-23 September 2010

M A Balmaseda (ECMWF, Reading, UK)

The workshop was jointly organized by the Working Group on Ocean Model Development (WGOMD) and the Global Synthesis and Observations Panel (GSOP) of Climate variability and Predictability (CLIVAR), a core project of the World Climate Research Programme (WCRP), and was motivated by the rapidly growing activities on decadal predictions. The workshop specifically focused on assessing the potential and limitations of the current capabilities (ocean observations, ocean models, forcing fields and data assimilation methods) for understanding, modeling and predicting the decadal variability.

A unique aspect of the decadal prediction problem is that it represents a joint initial and boundary value problem. This implies that best possible initial conditions of the climate system need to be provided. The global ocean is the primary source of the longer-term temporal 'memory' of the climate system. Therefore, robust decadal predictability and prediction assessment require that the ocean be initialized. A suite of coordinated decadal hindcast and prediction experiments for the period 1960-2035 are being carried out as part of the Coupled Model Intercomparison Project Phase 5 (CMIP5) to improve our understanding of decadal climate variability and predictability. Results from these experiments, which partly are also initialized using ocean data or ocean syntheses, will be evaluated for the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5).

Despite its prominent role in decadal variability and predictability, understanding of the underlying physical mechanisms of oceanic natural variability is still missing. So far many efforts have focused on the Atlantic Ocean, with the Atlantic Meridional Overturning Circulation (AMOC) as a key player, although the Pacific Ocean also contains intriguing variability on the decadal timescales. There are of course significant difficulties with the decadal variability and prediction problem associated with a paucity of observational data, the long time scales involved, and ocean (and climate) model limitations. The main goals of the workshop were:

- To assess how well the ocean models and ocean syntheses reproduce observed decadal variability,
- To understand and evaluate the robustness of simulated ocean internal variability,
- To identify the underlying physical mechanisms in the ocean in decadal climate variability,
- To evaluate the outcomes of the CMIP5 decadal prediction experiments.

The workshop consisted of invited plenary speakers and contributed talks and posters. The invited speakers were asked to review and encourage the discussion of the current state of research related to a particular topic with candid and critical comments. Session Chairs led end of session discussions assessing community consensus and future coordinated directions. The workshop culminated in a final summary discussion on what could be achieved by a joint effort, whether the community could develop a common framework in decadal variability, predictability and prediction research. The talks and posters are available from the meeting webpage (http://www.clivar.org/decadal.php).

An official summary report of the workshop will be available by the end of 2010. Below is a brief overview intending to guide the browsing of talks from the workshop website. A warning though: the separation into sessions was not so clearly cut, especially between sessions 3 an 4, where there were many overlapping topics (initialization, reanalysis, prediction and predictability)

The first session dealt with observational evidence for decadal variability, in which observational evidence for decadal variability in the Atlantic, Indo-Pacific and Southern oceans were discussed.

The second session dealt with the understanding and modelling of decadal variability, from both coupled models and ocean only simulations. Results showed that the robust simulation of the Atlantic MOC remains elusive.

The decadal predictability, predictions and the initialization problem was dealt with in session 3, where many new results were presented. Of special interest were the results on decadal predictability and prediction of the Atlantic tropical cyclones, which was evident with both the DePresys system and the statistical model developed by G. Vecchi. Even more interesting was the disagreement between these two systems on the attribution of the variability in the observed tropical cyclones. Also in this session, the work by G. Branstator and H. Tend showed a clear methodology to separate the initial condition predictability from the predicatability arising from the greenhouse forcing.

The potential and limitations of existing ocean re-analysis (or ocean synthesis products) were discussed in the last session, as well as results from decadal forecast when using different initialization approaches (both ocean and ice).

2. Shallow convection

U Lohmann (ETHZ, Zurich, Switzerland)

The representation of convection and its interaction with the rest of the model (such as large-scale clouds parameterization and radiation) in general circulation models (GCMs) is of crucial importance. Convection spanning over vast areas of the world, is a fundamental component of weather and climate, affecting the moisture and energy budgets and transports tracers. Despite the increasing complexity of parameterization, cloud effects and related feedbacks are the largest contribution to uncertainty in climate sensitivity (Randall et al. 2007).

Shallow cumuli are one of the most common cloud types in the troposphere and the most abundant of tropical clouds. The relevance of these clouds for large-scale atmospheric dynamics is evident in trade wind areas in the subtropical belts above the oceans. Shallow

cumuli transport humid air from the surface layer to the free atmosphere, influencing temperature, humidity, winds, cloud cover and depth of the planetary boundary layer. They contribute fundamentally to the moisture and energy balance in the lower troposphere.
Quantitative evidence for this on the global scale has been provided by von Salzen et al. (2005). In contrast to previous studies, the role of interactions with stratiform clouds was found to be of particular importance. Since deep convection is suppressed in the trade wind regions, the maximum evaporation rates from the ocean originate from fluxes of moisture associated with updrafts in shallow cumulus clouds. Part of the detrained moisture in the environment is transported to the inter-tropical convergence zone (ITCZ) by the trade winds at low altitudes and influences deep convection. Locally, shallower cumuli support the growth of the deep precipitating cumulus towers by their turbulent vertical transfer of water vapor and through mixing, which enhances surface fluxes.

Shallow cumuli have a short lifetime (from minutes to one hour) with active mixing with the environment both at the sides and the top of the cloud, leading to a strong dilution, as can be seen in observations and simulations. Although shallow cumuli are often defined as non-precipitating clouds, Short and Nakamura (2000) and others found evidence for light precipitation from shallow convection, which is dominated by warm rain processes.

A new shallow convection scheme has been implemented in ECHAM5 (Isotta et al., 2010) instead of the shallow convection scheme by Tiedtke (1989). Thie new shallow convection scheme is based on the scheme by von Salzen and McFarlane (2002) takes the life cycle of aerosols into account and with that calculates a time dependent cloud cover. In this scheme test parcels are lifted from the boundary layer up to the level of free convection (LFC) until the level of neutral buoyancy (LNB) is reached. The ascent takes entrainment and detrainment into account. These rates can vary depending on buoyancy. In order to obtain the cloud base mass flux, a simplified turbulent kinetic energy budget is solved.

Isotta et al. (2010) extended the shallow convection scheme to take the ice phase into account. In addition, a detailed double-moment microphysics approach has been added. In this approach, the freezing processes and precipitation formation are dependent on aerosols. Furthermore, in the scheme, tracers are transported and scavenged consistently as in the rest of the model. Results of a single column model simulation for the Barbados Oceanography and Meteorology Experiment (BOMEX) campaign are compared with large eddy simulation results.

Compared to the standard version, the global ECHAM5-HAM simulations with the newly implemented scheme show a decreased frequency of shallow convection in better agreement with observations (Figure 1). Convection in the Tiedtke (1989) shallow convection scheme was triggered far too often and also had too small entrainment and detrainment rates. Less shallow convection is compensated by more stratus and stratocumulus. Deep and especially mid-level convection are markedly affected by those changes, which in turn influence high level clouds. Generally, a better agreement with observations can be obtained when using the new shallow convection scheme.

References

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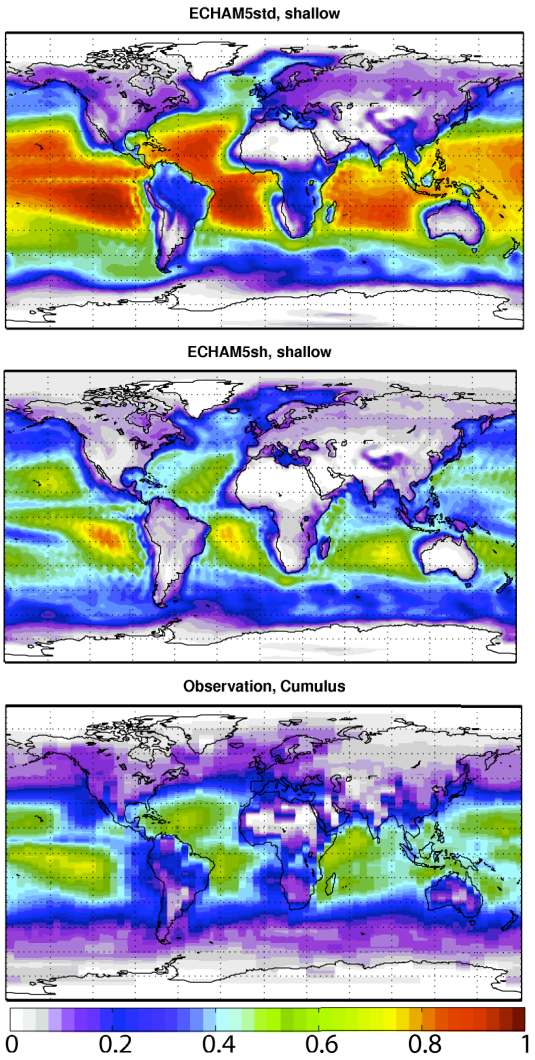

Figure 1: Frequency of appearance of shallow convection in ECHAM5std (top) and ECHAM5sh (middle). Bottom: The corresponding surface based cumulus cloud climatology from ships (1954-1997) and land (1971-1996) observational data from http://www.atmos.washington.edu/CloudMap and Warren and Hahn (2002). The data have been interpolated over the whole grid.

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EVENTS of interest:

3-5 November 2010 ***SPARC DynVar Workshop 2***, Boulder, CO, USA

6 - 8 December 2010 ***The Global Dimension of Change in River Basins – Threats, Linkages and Adaptation,*** Bonn, Germany

13–17 December 2010 ***AGU Fall Meeting***, San Francisco, CA, USA

28 February – 4 March 2011 ***AGU Chapman Conference on Atmospheric Gravity Waves and Their Effects on General Circulation and Climate***, Honolulu, Hawaii, USA

3–8 April 2011 ***EGU General Assembly***, Vienna, Austria

24-27 May 2011 ***2nd COMBINE General Assembly***, Exeter, UK

27 June – 8 July 2011 ***IUGG XXV General Assembly: Earth on the Edge: Science for a sustainable Planet***, Melbourne, Australia

12-15 July 2011 ***Past Present and Future Change in the Atlantic Meridional Overturning Circulation, International Science Meeting***, Bristol, UK

24-28 October 2011 ***WCRP OSC: Climate Research in Service to Society***, Denver CO, USA