

# Global Atmospheric System Studies (GASS) Panel

**Reporting Period:** January 2010 – October 2011

**Starting date:** GCSS and GABLS combined at the end of 2010 to form GASS.

**URL:** [http://gewex.org/gass\\_panel.html](http://gewex.org/gass_panel.html)

**Chair(s) and term dates:** Jon Petch (ends March 2014) and Steve Klein (ends March 2015)

## Overview:

GEWEX GASS facilitates and supports the community that carries out and uses observations, process studies and numerical model experiments with a focused goal of developing and improving the representation of the atmosphere in weather and climate models. It aims to address this primarily through the coordination of scientific projects, which bring together experts from around the world to contribute to the development of atmospheric models.

GASS primarily oversees intercomparison projects based on observational field campaigns or more idealized studies which typically take from two to five years from initiation to completion with publication of the results. At any one time GASS may have around six or eight specific projects running.

GASS is managed by its Science Steering Committee (SSC). Each project will have a representative on the GASS SSC and typically at least one project lead who may not be a part of the SSC.

**Members of the SSC:** Chris Bretherton; Ann Fridlind; Christian Jakob; Adrian Lock; Hugh Morrison; Robert Pincus; Pier Siebesma; Bjorn Stephens; Gunilla Svensson; Steve Woolnough. All members serve a term of up to 4 years. The SSC held its first teleconference in June 2011 and these will continue every two months.

**Meetings:** GASS is planning a **Pan-GASS Science Conference on 10-14 September 2012 in Boulder, Colorado, USA**. The expected attendance is over 250 based on past conferences. All projects below will likely attend.

## Ongoing Project Reports

### ATMOSPHERIC BOUNDARY LAYER PROJECTS (previously under GABLS)

**SSC Sponsor:** Gunilla Svensson

**Project leads:** Gunilla Svensson and Bert Holtslag

### *Accomplishments*

During 2011, the two model intercomparison cases based on a carefully selected period from the observations made at Cabauw, The Netherlands, have entered their final stages and papers are being written. The first draft on the GABLS3 SCM intercomparison, lead by Fred Bosveld, KNMI, The Netherlands, was sent around early summer 2011 and the final paper is expected to be submitted by the end of this year. The case studies the model's performance for the low level jet (LLJ) development, morning and evening transitions and surface-atmosphere coupling.

The LES case is coordinated by Sukanta Basu at the North Carolina State University, USA, and is focusing on the morning transition and a shorter time period, nine hours of simulation time starting at midnight, from the SCM case selected. The project is coming along nicely, after some hiccups, and a new outline for the GABLS3-LES paper with a limited focus and updated figures has been formulated. The paper is expected to be submitted before the end of the year.

### *Activities for next 1-2 years*

The next activity is the workshop that GABLS is arranging together with ECMWF to be held at their premises in November 2011. The title of the workshop is "ECMWF/GABLS Workshop on Diurnal Cycles and the Stable Atmospheric Boundary Layer" and is organized by the GABLS co-chairs together with Anton Beljaars, ECMWF. The workshop has gathered substantial interest and we expect about 60 participants of which 25 are invited speakers. By the end of the workshop, we expect to have defined directions for GABLS activities for the next few years.

The co-chairs have submitted a proposal entitled “Diurnal cycles of temperature and wind - Still a challenge for weather and climate models?” to the *Bulletin of the American Meteorological Society*. The proposal has been accepted and the paper will be submitted early 2012.

### **List of Key Publications**

Svensson, G., A.A.M. Holtslag, V. Kumar, T. Mauritsen, G.J. Steeneveld, W. M. Angevine, E. Bazile, A. Beljaars, E.I.F. de Bruijn, A. Cheng, L. Conangla, J. Cuxart, M. Ek, M. J. Falk, F. Freedman, H. Kitagawa, V. E. Larson, A. Lock, J. Mailhot, V. Masson, S. Park, J. Pleim, S. Söderberg, M. Zampieri and W. Weng, 2011: Evaluation of the diurnal cycle in the atmospheric boundary layer over land as represented by a variety of single column models – the second GABLS experiment. *Boundary-Layer Meteorology*, **140**, 177-206.

Moene, A.F.; Baas, P.; Bosveld, F.C.; Basu, S., 2011: LES model intercomparisons for the stable atmospheric boundary layer. Quality and Reliability of Large-Eddy Simulations II. - *Ercofac Series 16* . - p. 141 - 148. Dordrecht : Springer, Second Workshop on Quality and Reliability of Large-Eddy Simulations II, 2009-11-09/ 2009-09-11

Baas, P.; Bosveld, F.C.; Lenderink, G.; Meijgaard, E. van; Holtslag, A.A.M., 2010: How to design single-column model experiments for comparison with observed nocturnal low-level jets. *Quarterly Journal of the Royal Meteorological Society* 136 (648). - p. 671 – 684

Kumar, V.; Svensson, G.; Holtslag, A.A.M.; Meneveau, C.; Parlange, M.B., 2010: Impact of Surface Flux Formulations and Geostrophic Forcing on Large-Eddy Simulations of Diurnal Atmospheric Boundary Layer Flow. *Journal of Applied Meteorology and Climatology* 49 (7). - p. 1496 - 1516.

### **Planned Meetings and Workshops**

7-10 November 2011: ECMWF/GABLS Workshop on Diurnal cycles and the Stable Atmospheric Boundary Layer.

## **POLAR CLOUD PROJECTS**

**SSC Sponsor:** Hugh Morrison

**Project Leads:** Mikhail Ovchinnikov and Hugh Morrison

### **Accomplishments**

Completion of SHEBA intercomparison project for Arctic mixed-phase boundary layer clouds:

- follow up to previous MPACE intercomparison, but under different conditions
- conducted jointly with the 2008 WMO Cloud Modeling Workshop
- relatively simple case allowed for detailed investigation of model differences
- focus on feedbacks between microphysics, radiation, and turbulence

### **Activities for next 1-2 years**

ISDAC intercomparison for Arctic boundary layer clouds (led by Mikhail Ovchinnikov):

- follow-up to SHEBA intercomparison, to be conducted jointly with the 2012 Cloud Modeling Workshop
- coordination with kinematic model tests using a fixed-flow field, which allows for isolation of differences in microphysics without complications due to feedbacks with dynamics

### **List of key publications**

Morrison, H., P. Zuidema, A. S. Ackerman, A. Avramov, G. de Boer, J. Fan, A. M. Fridlind, T. Hashino, J. Y. Harrington, Y. Luo, M. Ovchinnikov, and B. Shipway, 2011: Intercomparison of cloud model simulations of Arctic mixed-phase boundary layer clouds observed during SHEBA. *J. Adv. Mod. Earth Systems*, Vol. 3, M06003, 23 pp., doi:10.1029/2011MS000066.

### **Planned meetings and workshops**

- 2012 WMO Cloud Modeling Workshop will have a breakout session devoted to the ISDAC intercomparison case (July 2012 in Warsaw, Poland)

## MICROPHYSICS PROJECTS

**SSC Sponsor:** Hugh Morrison

**Project Leads:** Ben Shipway and Adrian Hill

### Accomplishments:

Release of 2D KiD model (<http://appconv.metoffice.com/microphysics>)

- provides 1D or 2D kinematic cases
- can be used in future stand alone intercomparison cases
- and used in conjunction with intercomparisons from other projects (e.g. Polar cloud projects)
- Submission of paper to Quarterly Journal of the Royal Meteorological Society:
- Shipway, B.J. and Hill, A.A, 'Diagnosis of systematic differences between multiple parametrizations of warm rain microphysics using a kinematic framework.'

### Activities for next 1-2 years

1) Warm rain microphysics kinematic intercomparison using the 2D-KiD:

- investigating the differences between models of differing complexity
- motivated in part by BL cloud RICO intercomparison

2) 2D kinematic tests in coordination with ISDAC comparison

- attempt to understand the sensitivities within microphysical parametrizations used in different models in a dynamically constrained framework

### List of key publications

Shipway, B.J. and Hill, A.A, 'Diagnosis of systematic differences between multiple parametrizations of warm rain microphysics using a kinematic framework.' (submitted to QJRMS)

Bretherton, C., A. Fridlind, H. Morrison, and B. Shipway, 2010: GCSS workshop on microphysics and polar/precipitating clouds. GEWEX News, 20, no. 4, 17-19.

Shipway, B.J. and Hill, A.A., 2011, The Kinematic Driver model (KiD), Met Office Technical Report No. 549

### Planned meetings and workshops

- Discussion of ISDAC component and other cases should take place at 2012 WMO Cloud Modeling Workshop

## CONVECTIVE SYSTEMS PROJECTS: TWP-ICE

**SSC sponsors:** Ann Fridlind and Jon Petch

**Project leads:** Ann Fridlind, Yanluan Lin, Ping Zhu and Laura Davies

### Accomplishments

- first model intercomparison project to involve four model types (CRM, LAM, SCM, GAM) with multiple international modelling groups participating
- first use of ensemble forcing data in the SCM component

### Activities for next 1-2 years

- guide remaining manuscripts through peer-review process
- complete final archiving of model results (CRM, LAM)
- Besides the 6 publications below, there are another 2 in preparation

### List of key publications

Bretherton, C., A. Fridlind, H. Morrison, and B. Shipway, 2010: GCSS workshop on microphysics and polar/precipitating clouds. *GEWEX News*, 20, no. 4, 17-19.

Fridlind, A., A. Ackerman, J. Petch, P. Field, A. Hill, G. McFarquhar, S. Xie, and M. Zhang, 2010: ARM/GCSS/SPARC TWP-ICE CRM Intercomparison Study. NASA-TM-2010-215858. National Aeronautics and Space Administration.

Varble, A., A. Fridlind, E. Zipser, A. Ackerman, J.-P. Chaboureau, J. Fan, A. Hill, S. McFarlane, J.-P. Pinty, and B. Shipway, 2011: Evaluation of cloud-resolving model intercomparison simulations using TWP-ICE observations. Precipitation and cloud structure. *J. Geophys. Res.*, 116, D12206, doi:10.1029/2010JD015180.

Fridlind, A.M., A.S. Ackerman, J.-P. Chaboureau, J. Fan, W.W. Grabowski, A. Hill, T.R. Jones, M.M. Khaiyer, G. Liu, P. Minnis, H. Morrison, L. Nguyen, S. Park, J.C. Petch, J.-P. Pinty, C. Schumacher, B. Shipway, A.C. Varble, X. Wu, S. Xie, and M. Zhang, 2011: A comparison of TWP-ICE observational data with cloud-resolving model results. *J. Geophys. Res.*, submitted.

Yanluan Lin, L. J. Donner, J. Petch, P. Bechtold, J. Boyle, S.A. Klein, T. Komori, K. Wapler, M. Willett, X. Xie, M. Zhao, S. Xie, S. A. McFarlane, C. Schumacher: TWP-ICE global atmospheric model intercomparison: convection responsiveness and resolution impact. *J. Geophys. Res.*, submitted.

Zhu, P., J. Dudhia, P. Field, K. Wapler, A. Fridlind, A. Varble, E. Zipser, J. Petch, M. Chen, and Z. Zhu, 2011: A limited area model (LAM) intercomparison study of a TWP-ICE active monsoon mesoscale convective event. *J. Geophys. Res.*, submitted.

#### **List of meetings, workshops held**

-- representatives of each intercomparison met for lunch at spring science team meeting of the US DOE ARM/ASR program (29 March 2011)

#### **Planned meetings, workshops**

-- planned plenary talk containing all results at next spring science team meeting of the US DOE ARM/ASR program (March 2012)

## **VERTICAL STRUCTURE AND DIABATIC PROCESSES OF THE MJO**

**SSC sponsors:** Jon Petch and Steve Woolnough

**Project leads:** Jon Petch, Duane Waliser, Prince Xavier, Nick Klingaman, Xianan Jiang & Steve Woolnough

#### **Accomplishments**

- early stages of a project bringing together GASS and the MJO-TF to study diabatic processes and physical tendency profiles
- making use of YOTC data
- Three components designed and project specification complete

#### **Activities for next 1-2 years**

- carry out comparisons of short (48 hour), medium (20 day) and climate (20 year) integrations of operational weather and climate models
- Expand comparison to include process models and make use of DYNAMO field campaign.

#### **List of key publications**

Petch, Jon, Duane Waliser, Xianan Jiang, Prince Xavier, and Steve Woolnough: A Global Model Intercomparison of the Physical Processes Associated with the Madden-Julian Oscillation, 2011, *GEWEX News* 21, 3-5.

#### **List of meetings, workshops held**

-- Informal break out at YOTC science meeting Beijing

#### **Planned meetings, workshops**

- Proposed session around the "workshop on the physics of climate models". 19<sup>th</sup> March 2012, Caltech, CA.

## LOW CLOUD FEEDBACKS UNDER CLIMATE CHANGE (CGILS)

**SSC sponsor:** Adrian Lock

**Project leads:** Minghua Zhang, Chris Bretherton and Peter Blossey

### ***Accomplishments***

CGILS is a collaborative project with CFMIP (Cloud Feedback Model Intercomparison Project) to investigate low cloud feedbacks under climate change, a major area of uncertainty in climate change modelling. The aims are to use LES both to improve understanding of the physical processes involved in cloud feedbacks under climate change, and as a benchmark for the credibility of SCMs to reproduce these. The challenge has been to keep the case sufficiently realistic that the SCMs exhibit similar behaviour to their parent GCM while making it tractable for LES. Excellent progress has been made, with a series of cases now completed and being written up for publication. The goal of the collaboration, of bringing together climate scientists and cloud modellers, has been very successful in spawning new insights and understanding.

### ***Activities for next 1-2 years***

Particularly through the collaboration with CFMIP and a European activity, EUCLIPSE, this initial study will be extended to include other climate change scenarios, sensitivity to the changes in the forcing in the perturbed climate and sensitivity to SCM

### ***List of key publications***

Lock, A.P. (2011) GCSS/CFMIP/EUCLIPSE Meeting on Cloud Processes and Climate Feedbacks. *GEWEX News*, August 2011

Zhang et al (2010) GCSS Teams with CFMIP to Understand the Physical Mechanisms of Low Cloud Feedbacks in Climate Models. *GEWEX News*, May 2010.

### ***List of meetings, workshops held***

- June 2011: at Met Office, Exeter UK, joint meeting with CFMIP and EUCLIPSE including further discussions on the Transition and CGILS cases
- Sept 2010: at KNMI, de Bilt, The Netherlands, joint workshop with EUCLIPSE on the Transition and CGILS cases
- March 2010: at Stony Brook University, NY, focused CGILS workshop
- June 2009: at UBC Vancouver, Canada, joint meeting with CFMIP: first results from CGILS cases

## STRATOCUMULUS TO CUMULUS TRANSITIONS

**SSC sponsor:** Adrian Lock

**Project leads:** Stephan de Roode, Irina Sandu, Roel Neggers

### ***Accomplishments***

This project studies the stratocumulus to trade cumulus transition, one that is of climatological importance for understanding low cloud cover variations in the marine subtropics. There are two parallel LES intercomparisons as well as SCM intercomparisons. These intercomparisons are being run in collaboration with EUCLIPSE, a European project. In combination these cases challenge models to produce both a realistic transition compared to detailed in situ data and also a realistic sensitivity of the speed of transition to changes in environmental forcing. Results so far suggest that the LES does a good job of capturing these details, although requiring very high (5m) vertical resolution. One of the motivations for this intercomparison was that these transitions would present a particular challenge for SCMs, many of which would need to make the transition between different parameterizations of vertical mixing. Although many SCMs do indeed struggle to generate realistic transitions, it is encouraging that those organizations that have worked hard to develop these aspects of physical parameterizations (invariably using previous GCSS intercomparison cases) can do a much better job. Papers are in preparation describing these studies in much more detail.

### ***List of key publications***

Lock, A.P. (2011) GCSS/CFMIP/EUCLIPSE Meeting on Cloud Processes and Climate Feedbacks. *GEWEX News*, August 2011

***List of meetings, workshops held***

- June 2011: at Met Office, Exeter UK, joint meeting with CFMIP and EUCLIPSE including further discussions on the Transition and CGILS cases
- Sept 2010: at KNMI, de Bilt, The Netherlands, joint workshop with EUCLIPSE on the Transition and CGILS cases

**GREY-ZONE PROJECT**

**SSC sponsor:** Pier Siebesma

***Accomplishments***

At the very early stages is work in collaboration with WGNE to evaluate convection permitting models (1-8km) at modelling moderate or even shallow convection. Currently project leads and appropriate case studies are being scoped.