# GASS
# Global Atmospheric System Studies

**Daniel Klocke & Xubin Zeng**

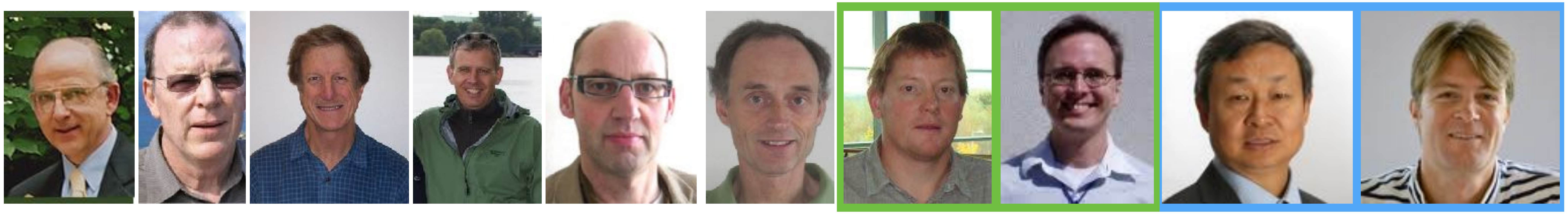
Goal of GASS: to understand the physical processes and the coupling of those processes to atmospheric dynamics, particularly those that define the atmospheric branch of the **hydrological cycle**.

Mission of GASS:

- to facilitate and support the international community that carries out and uses observations, process studies, and numerical model experiments with the goal of developing and improving the representation of the atmosphere in **weather** and **climate** models.

- to coordinates scientific projects that bring together experts to contribute to the development of **atmospheric models**.

1993 2011 2017



GCSS → GASS

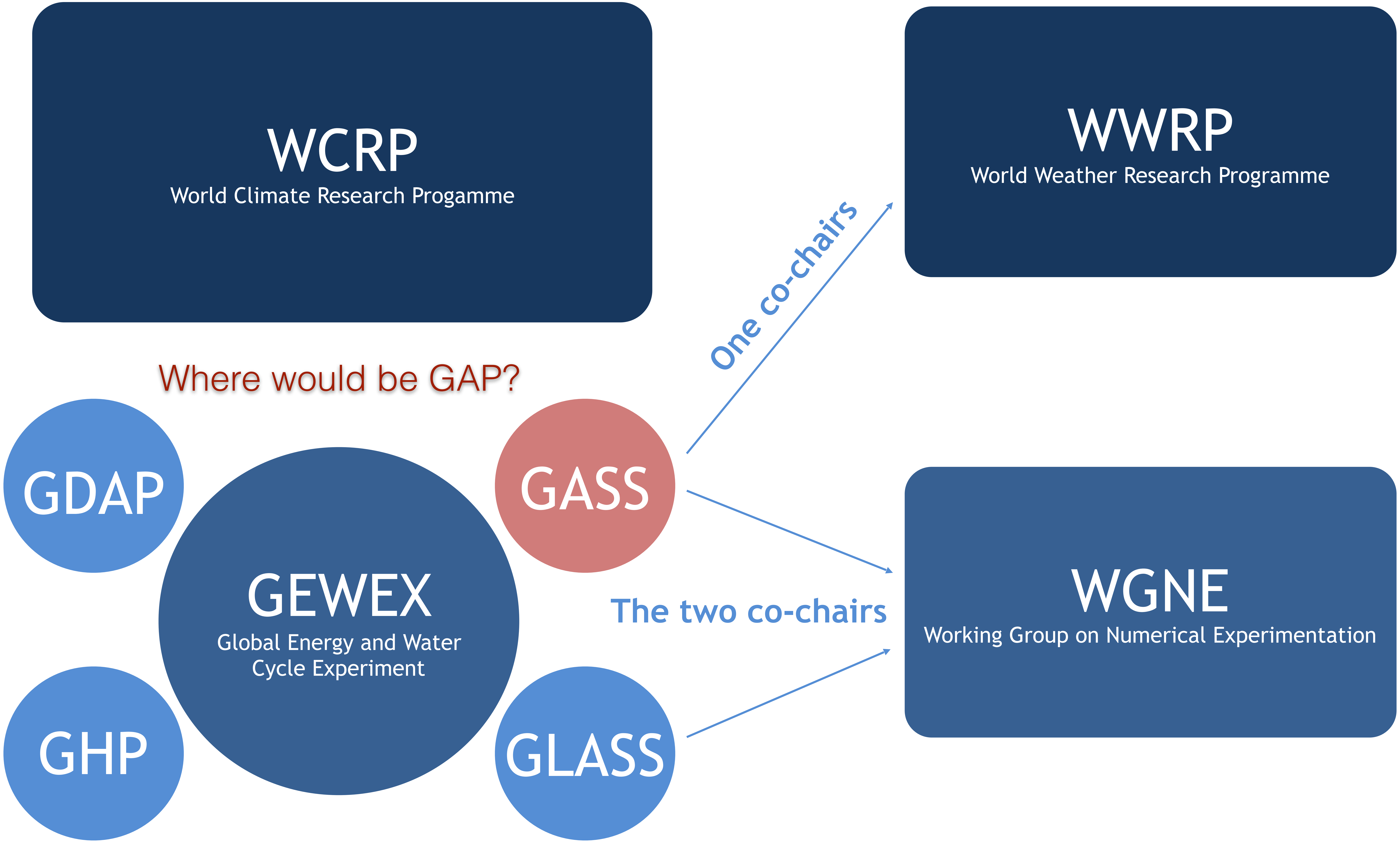
GABLS → CIRC

ICRCCM → CIRC

CIRC → GASS

GASS →

Radiation
Micro-physics
Clouds
Boundary layer
Convection




GASS: Global Atmospheric System Studies GLASS: Global Land/Atmospheric System Studies
GHP: GEWEX Hydroclimatology Panel GDAP: GEWEX Data and Assessments Panel

# Connection to WWRP:

- We will also report to WWRP (through Daniel)
- WWRP organises its work in ‚Action Areas‘
- GASS will contribute to some Action Areas

## Contributions to AA1: Address limitations

- Shallow and deep convection: stochasticity, scale-awareness, organisation, grey-zone
- Boundary-layer mixing, drag, convective momentum transport
- Clouds and their interaction with circulation and radiation (grand challenge)
- Microphysics and aerosol-cloud interactions
- Coupling of atmosphere-land, atmosphere ocean (CLIVAR)
- Physics-dynamics coupling, methods, thermodynamic consistency
- Role of convective scale models for extreme weather

## Contributions to AA2: Uncertainty

Address uncertainties in atmospheric models :
- physically based stochastic parmaeterizations
- tuning and parameter estimation using eg. data assimilation methods (DAOS?), AI

## Contributions to AA9: Precipitation Processes

- Follow-up of the grey-zone project with focus on deep convection
- Micro-physics and cloud-aerosol coupling
- Momentum transport, through drag and physics (convection)
- Physics-dynamics coupling (becomes very important with higher resolution)

**Potentially relevant Action Areas:**

AA3: Fully coupled (precipitation, wind are essential for coupling)
AA5: Verification (process based)
AA7: Integrated water cycle (the atmospheric part)
AA10: Hydrological Uncertainty (input to hydrological models)
AA12: Observations & Processes (new observations for processes)
AA13: Urban Predictions (include processes relevant for urban predictions)
AA14: Advanced Methods (high-resolution, observations, tools)

# Modelling connections: WGNE

- WGNE and GLASS are other groups concerned with model development
- Boundaries are fluid between the aspects worked on, but we see potential in working and interacting with those two groups.
- WGNE drag project -> momentum transport GASS project

# Modelling connections: GLASS

- GLASS is the other group concerned with model development within GEWEX
- momentum tranport and drag
- S2S: snow and soil temperature impact on atmospheric predictions
- Boundary layer and GABLS

# GASS Highlights

- Two new co-chairs were appointed in July 2017
- GASS is organizing the Pan-GASS Conference from 26 Feb - 2 Mar 2018 in Lorne, Australia (sponsored by ARC).
- We are proactively seeking leaders to help organize GASS projects on a variety of issues, such as:
  - dynamics-physics coupling,
  - precipitation diurnal cycle over different regimes,
  - impact of snowpack and soil temperature on subseasonal to seasonal (S2S) prediction
  - Joint Modelling Activity over the Caribbean,
  - Gray-zone follow up (deep convection)
  - Momentum transport and drag
  - RCE and CFMIP
- We are seeking partnerships with WWRP, WGNE, ACPC, GLASS, CFMIP, CLIVAR, SPARC and other programs for joint projects

World Climate Research Programme

WORLD WEATHER RESEARCH PROGRAMME

# Preliminary!

**Improving the simulation of the diurnal cycle of precipitation climate regimes**

**(A white paper for future GASS activities)**

**Shaocheng Xie**
**Lawrence Livermore National Laboratory**
*(with input from Wuyin Lin of BNL and Yunyan Zhang of LLNL*

**1. Motivation**

General Circulation Models (GCMs) for weather forecasts and climate simulatio difficulties in modeling the diurnal cycle of precipitation particularly over lands. Th inappropriate representation of the processes that control convection initiatic propagation, as well as the interaction between convection and its large-scale atmos and the underlying land surface.

Over mid-latitude lands, such as warm seasons at the Southern Great Plains (SGP), tl peaks of precipitation from observations: 1) a predominant nocturnal peak of precipita eastward propagating mesoscale convective systems which usually originate over th and are often elevated and decoupled from the local surface and 2) a secondary associated with the transition from shallow to deep convection which is strongly cou surface forcing. Most GCMs often fail to capture the observed nocturnal peak and instead tend to simulate a diurnal peak of precipitation around noon, much earlier than the observed late-afternoon peak.

Over tropical lands, such as over the Amazon and Darwin regions, the diurnal variability of precipitation are strongly influenced by different large-scale environments (e.g., dry versus wet seasons over the Amazon, or active versus break periods of monsoon), adding difficulty for GCMs to capture the distinguishable behavior. Moreover, difficulties facing the modeling of diurnal convection are also some of the key issues related to the skill of modeling convectively coupled process at longer time scales. Understanding and improving the modeling of diurnal precipitation processes can therefore have broader impact on the fidelity of climate simulations.

Given that diurnal precipitation can be controlled or influenced by vastly different factors, to

**Constraining drag processes**

Main session: Surface drag and momentum feedbacks:

- Tue 27/02 9:00-10:30, Wed 28/02 9:00-10:30

Breakout sessions: Presentations & discussion - Wednesday:10:30-12:00

Discussion - Tue Evening

Despite playing a key role in the atmospheric circulation, momentum transport has been largely overlooked by the model development community over the past ten years or so, compared with diabatic and radiative processes. There are a multitude of processes exerting drag and contributing to momentum transport in the atmosphere that affect the atmospheric circulation on a wide range of spatial and temporal scales. It is widely acknowledged that the accuracy of both numerical weather predictions (NWP) and climate projections crucially depends on an accurate representation of unresolved components of the momentum budget, such as turbulent drag due to surface roughness, orographic drag (including turbulent form drag, low-level blocking, gravity-wave drag, etc), convective momentum transport, turbulent momentum transport in the boundary layer or non-orographic gravity-wave drag.

As all of these drag processes are not fully resolved in global, or even regional models, their representation relies on parametrized approximations based on theoretical understanding, observations and empirical relationships derived from idealised experiments. The absence of direct observations of momentum fluxes at global or even regional scales, leads to large uncertainties in these parametrizations and leaves the representation of drag processes exposed to tuning. Parameter choices made in drag parametrizations are often the result of tuning exercises aimed at improving NWP skill or model climatology. The consequences of uncertainties associated with the representation of drag processes, and of repeated tuning exercises, are evidenced by the recent WGNE Drag inter-comparison project, which found a large inter-model spread in the magnitude of the parametrized surface drag and in its partitioning between the various processes.

Several studies, both old and new, have demonstrated the importance of drag processes for the fidelity of models and the sensitivity of the large scale circulation to the

**Proposal: Joint Modeling Activity over the Caribbean**

December 2017

(Jan/Feb) a large field experiment (EUREC⁴A, see link below) East of Barbados is planned ective to elucidate the couplings between (low) clouds, convection and circulation. EUREC⁴A o simultaneously measure the large scale forcing as well as the cloud macrophysical proper- ide wind cumuli that are subjected to these forcings. In that respect EUREC⁴A, along with the ud Observatory (BCO), will provide a unique opportunity to spin up a joint modeling activity e optimal use of this campaign.

ing activity could help answering many of the open questions we have concerning the role of imulus in weather and climate such as: *what controls the convective mass flux, convective depth and cloud fraction of shallow cumulus clouds? What is the role of the wind and verti- n transport? What is the role of meso-scale organisation? What is the impact on the radiati- important is the atmosphere and ocean surface interaction at the meso-scale?* This will di- ipon the question how well we are able to parameterize these processes in current models iny scales of interest and what is needed to improve the representation of these processes in

these questions that will require a more process-oriented modelling approach, we can also ng up a more extended period in which we can evaluate those models (both global and limi- els) that run operationally over the Caribean for longer periods. It will allow us to assess ng capability over the maritime sub-tropics, not only for shallow clouds that are predominant season, but also extending the scope to deeper convection and associated high impact wea- recipitation, tropical cyclones and flooding).

modelling activity that will include a hierarchy of models ranging from global weather and ls to high resolution mesoscale models, but also more process oriented Large Eddy Simulati- on (LES) models and Single Column Models (SCM).

We are planning a breakout session during the upcoming Pan-GASS meeting in February to further shape these ideas. If you are interested to get involved please let us know by email and we will put you on the email list. In addition, we would like to ask all of you to prepare your ideas and present them during the

World Climate Research Programme

WORLD WEATHER RESEARCH PROGRAMME

- 200+ abstracts
- 168 accepted
- 160+ registrations
- 10 sessions
- breakout groups
- planery discussions

with the goal to initiate projects

# Understanding and Modelling Atmospheric Processes

The 2nd Pan-GASS meeting sponsored by the ARC Centre of Excellence for Climate System Science

26TH FEBRUARY 2018 – 2ND MARCH 2018, LORNE, VICTORIA, AUSTRALIA

HOME

VENUE & LOCAL INFORMATION

CONFERENCE BUS

ABSTRACT SUBMISSION

REGISTRATION

SCIENTIFIC COMMITTEE

SPONSORS

## NEWS

The 2nd Pan-GASS meeting: 'Understanding and Modelling Atmospheric Processes' (UMAP) will take place between the **26 Feb-2 Mar 2018** in Lorne, near Melbourne, Victoria, Australia.

To keep up to date with UMAP 2018 announcements, sign up to our mailing list.

## ABOUT

The UMAP 2018 meeting aims to bring together NWP and climate scientists, observationalists, and modellers to discuss the key issues of atmospheric science. The program will include all aspects and methods of model development from deterministic numerics to stochastic forcing; process modelling to parametrization; observational constraints to diagnostic techniques; and idealized modelling to operational forecasting and climate predictions.

In addition to plenary and poster sessions, the meeting will also include breakout sessions to discuss new ideas and projects related to modelling the atmosphere. This will provide the opportunity for members of the community to propose common activities (e.g., intercomparisons,

## CONTACT

For all enquiries about the UMAP 2018 meeting please email umap2018@monash.edu

## MAILING LIST

To keep up to date with UMAP 2018 announcements, sign up to our mailing list.

## VENUE

The UMAP 2018 meeting will take place at the Cumberland Lorne Resort,

| | | | | | |
|---|---|---|---|---|---|
| 09:00 | Session I<br>Setting the scene | Session V<br>Surface Drag and Momentum Feedbacks I | Session IX<br>Surface Drag and Momentum Feedbacks II | Session XI<br>Microphysics and aerosol interactions | Session XV<br>Land-atmosphere interactions |
| 09:30 | | | | | |
| 10:00 | | | | | |
| 10:30 | Coffee Break | Coffee Break | Coffee Break | Coffee Break | Coffee Break |
| 11:00 | Session II<br>Shallow and Deep convection I | Session VI<br>Next generation modelling | Session X<br>Parallel discussion sessions | Session XII<br>Shallow and Deep convection II | Future GASS Projects |
| 11:30 | | | | | |
| 12:00 | | | | | |
| 12:30 | Lunch/Posters | Lunch/Posters | Lunch/Posters | Lunch/Posters | Meeting Close |
| 13:00 | | | | | |
| 13:30 | Session III<br>Clouds, radiation and circulation feedback I | Session VII<br>Physics-dynamics coupling | Plenary discussion | Session XIII<br>Clouds, radiation and circulation feedback | |
| 14:00 | | | | | |
| 14:30 | | | Activity? | | |
| 15:00 | Coffee Break | Coffee Break | | Coffee Break | |
| 15:30 | Session IV<br>New observational efforts | Session VIII:<br>Polar prediction/GABLS4 | | Session XIV<br>Methods for gaining model insight | |
| 16:00 | | UM Partners meeting | | | |
| 16:30 | | | | | |
| 17:00 | | | | | |
| 17:30 | | | | | |

# Potential GASS Project areas

- Surface drag and momentum transport: orographic drag, convective momentum transport, drag coefficients, boundary-layer mixing
- Processes relevant for polar prediction: stable boundary layers, mixed-phase clouds, coupling to the surface
- Shallow and deep convection: stochasticity, scale-awareness, organization, grey zone issues
- Clouds and circulation feedbacks: boundary-layer clouds, CFMIP, cirrus
- Microphysics and aerosol-cloud interactions: microphysical observations, parameterization, process studies on aerosol-cloud interactions
- Radiation: circulation coupling; interaction between radiation and clouds
- Land-atmosphere interactions: Role of snow, soil moisture, soil temperature, and vegetation in sub-seasonal to seasonal (S2S) prediction
- Physics-dynamics coupling: numerical methods, scale-separation and grey-zone, thermodynamic consistency
- Next generation model development: challenge of exascale, dynamical core developments, regional refinement, super-parameterization
- High Impact and Extreme Weather: role of convective scale models; ensembles; relevant challenges for model development
- Precipitation diurnal cycle over different climate regimes

## Legacy projects: what will continue, or have follow ups?

- GEWEX Atmospheric Boundary Layer Study 3 (GABLS-3)
- GEWEX Atmospheric Boundary Layer Study 4 (GABLS-4)
- Vertical Structure and Diabatic Processes of the Madden-Julian Oscillation: A joint project with the MJO Task Force using YOTC data
- Clouds Above the United States and Errors at the Surface (CAUSES)
- Microphysics Project
- Boundary Layer Cloud Projects
- CFMIP-GASS Intercomparison of LES and SCMs (CGILS)
- Polar Cloud Project
- Cirrus Model Intercomparison Project
- Grey Zone Project: Cold Air Outbreak Intercomparison Case
- Continuous Intercomparison of Radiation Codes

# Looking ahead: short term action items

- Have a successful pan-GASS conference (end of February)
- Set up projects, project leads (beginning of March)
- Have a panel (April)
- Communicate our activities through a paper (end of year)
- Meet with the GASS panel and review projects (Winter)?