

## GASS Panel Reports for the 32nd GEWEX SSG Meeting 2020

**Full Panel Name (Acronym)** : Global Atmospheric System Studies Panel (GASS)  
**Reporting Period** : 01 January - 31 December 2019  
**Starting Date** : 2018  
**End Date (where appropriate)** : NA  
**URL** : [www.gewex.org/panels/global-atmospheric-system-studies-panel](http://www.gewex.org/panels/global-atmospheric-system-studies-panel)

### Membership

**Chair(s) and Term Dates** : Xubin Zeng, 2017 - Present  
Daniel Klocke, 2017 - Present

**Members and Term Dates** : Sandrine Bony, 2019 - Present  
Ian Boutle, 2018 - Present  
Irina Sandu, 2018 - Present  
Martin S. Singh, 2019 - Present  
Shaocheng Xie, 2018 - Present  
Yongkang Xue, 2018 - Present

Claudia Stubenrauch (leading UTCC PROES)  
Eric Bazile (leading GABLS-4)

### Panel Objectives, Goals and Accomplishments during Reporting Period

#### Overall Panel Objective(s)

- The Global Atmospheric System Studies (GASS) Panel facilitates and supports 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. Primarily, GASS coordinates scientific projects that bring together experts to contribute to the development of atmospheric models.

#### List of Panel Goals

##### *Adjust yearly*

- Work with existing project leaders to reach their yearly goals
- Launch the grey-zone II project and Dynamics-Physics Coupling project
- Develop panel by adding one YESS member and one other member
- Plan pan-GASS conference for 2021
- Develop the questionnaire to survey climate and NWP modelling centres about their priorities in addressing deficiencies in represented process.

#### List of Key Results

##### *Adjust yearly with respect to goals*

- Four projects are entering the productive phase. Experiments are submitted and first analysis are being performed.
- Two Affiliated projects (UTCC PROES and GABLS-4) are making progress
- Two new panel members recruited (see above).
- Intensive communication with WGNE and WWRP and input to implementing WCRP reforms in terms of organising modelling activities across WCRP and coordinate with WWRP and WGNE.

## **Other Science Highlights**

*Not part of the 2-3 major accomplishments*

### **COORDE (drag)**

- At resolutions of 80-100km, most of the models exhibit insufficient or misplaced orographic gravity wave drag in the lower stratosphere with respect to the resolved drag obtained from the km-scale simulations.
- There is a large spread in magnitude and spatial distribution of the parametrized orographic drag across models.
- Some of the models exhibit surprising resolution sensitivities in their orographic drag parametrizations

### **Demistify (fog)**

- Representation of cloud droplet sedimentation is essential for NWP fog simulation
- Small changes in fundamental parametrizations are more important to fog development than aerosol

### **DCP (diurnal cycle of precipitation)**

- Developed experiment plan and procedure for both SCM/CRM/LES modelling and GCM/ESM modelling.
- Created necessary case library that contains both forcing and evaluation datasets for process studies using process models.
- Performed SCM runs with the US DOE E3SM for all the selected cases to test forcing strategies for further refinement and generate initial diagnostics for group to discuss.
- Start to receive SCM/CRM/LES results from participating modelling groups.

### **LS4P (surface and sub-surface temperature)**

- Based on multi-model ensemble mean, the significant impact of Tibet Plateau spring land surface and sub-surface temperature on global summer precipitation is confirmed.
- Two workshops were held to discuss the LS4P Progress and report major results.
- Two articles were published in the GEWEX NEWS to report LS4P activities.

### **UTCC PROES (Upper Tropospheric Clouds and Convection Process Evaluation Study)**

- Cloud System Analysis allows process studies by relating anvil properties to convection & provides new observational metrics to further constrain model parameterizations.
- The emissivity structure of mature convective systems changes with convective depth, with more surrounding thin cirrus

### **GABLS-4 (GEWEX Atmospheric Boundary Layer Study)**

- better simulation of the Low-Level Jet in many models (compared to the previous GABLS experiment) thanks to a TKE scheme and a height of the first level about 3m.
- For the LES, to reduce the differences or the uncertainties in the LES results it is necessary to use a resolution about 1meter for the horizontal and the vertical directions.

## Panel Activities during Reporting Period

### List of Panel Activities and Main Result

#### COORDE (drag)

- All high-resolution experiments have been performed, data has been submitted and analysed
- All experiments with and without parametrized drag at resolutions of 80-100km have been performed, data has been submitted and analysed
- The results have been communicated to contributors via email exchanges
- The second phase, which involves looking at parametrized drag at intermediate resolutions (~40km) has been initiated and most of the model data has been submitted

#### Demistify (fog)

- 12 participating models submitted results for stage 1.
- Analysis of submitted results undertaken by PI and circulated around project members for discussion and next steps planning.

#### DCP (diurnal cycle of precipitation)

- The GCM/ESM part of the project is in preparation.

#### LS4P (surface and sub-surface temperature)

- Conducted Task1, Task 2, and Task3 experiments and analysed preliminary results.
- Most modelling groups have submitted their results, which confirm the land surface and sub-surface temperature effect on S2S precipitation prediction.

#### UTCC PROES (Upper Tropospheric Clouds and Convection Process Evaluation Study)

- Bulk microphysical properties of ice clouds, such as fall speed and ice crystal size distribution, strongly impact the lifetime and the radiative effects of these clouds. More realistic bulk ice schemes, when integrated into the LMDZ GCM, seem to lead to more realistic anvil size growth with convective depth.
- The working group brings together scientists from several communities: satellite observations, radiative transfer and transport modelling, as well as small-scale process and climate modelling.

#### GABLS-4 (GEWEX Atmospheric Boundary Layer Study)

- To draw conclusion for the interaction with surface, requires more experiment with a better control of the surface characteristics for all the models.
- The LES manuscript on GABLS4 was submitted in December 2019, and another general paper on GABLS-4 is under preparation.

### List of New Projects and Activities in Place and Main Objective(s)

- No new projects launched.
- In close interaction with the Grey Zone 2 project and Dynamics-Physics coupling project lead scientists to move these projects forward.

### List of New Projects and Activities Being Planned, including Main Objective(s) and Timeline, Lead(s)

- Second Phase of the "Grey Zone" Project Based on the EUREC4A and Phase III of the GATE Field Campaigns WGNE/GASS White Paper on Scale-Awareness, Stochasticity, and Convective Organization, Objective: It is designed to have two parts: 1) focusing on shallow convection, and 2) exploring deep convection, Leads: Lorenzo Tomassin, Rachel Honnert, George Efstathiouk, Adrian Lock, Pier Siebesma. This project represents another excellent partnership between WGNE and GASS: The first phase was already a joint WGNE/GASS activity, while we take the

next step as a GASS/WGNE joint project. This is also related to the WCRP CFMIP project. This project has gone through iterations with international programs (WGNE, WWRP) and the GASS community, and it will be launched after the EUREC4a campaign in mid 2020.

- Physics-dynamics coupling; Objective: to improve the understanding and numerical treatment of physics-dynamics coupling in atmospheric models; Leads: Hui Wan and Ben Shipway. White paper has been prepared; we plan to launch it in 2020.
- There are early discussions about a follow up on the GABLS projects. Potentially in collaboration with GLASS around the MOSAIC campaign.
- After the EUREC4A campaign, a project on convective momentum transport is being envisaged following COORDE.
- An analysis of diurnal cycle of precipitation simulated by CMIP6 models is being planned as part of DCP. This work will be done by collaborating with scientists in PCMDI. The goal is to provide an assessment of current climate model capability to capture the diurnal cycle of precipitation over different climate regimes, which can be used as a benchmark for the current GASS diurnal cycle of precipitation project. The analysis is expected to be completed by May 2020.

## Science Issues and Collaboration during Reporting Period

### Contributions to Developing GEWEX Science and the GEWEX Imperatives.

#### a. Data Sets

- all data relevant to GASS projects (forcing data, model output, and validation data) will be available to the community; DOE ARM is willing to host GASS data. Currently this is tested with data from the Demistify project.
- The LS4P data bank has also been established in the TPE Big Data Center

#### b. Analysis

- GASS projects are expected to develop new analysis tools and software that will be available to the community

#### c. Processes

- GASS projects are about process understanding and model treatment (e.g., precipitation, clouds, surface fluxes, coupling surface to atmosphere, aerosols, dynamics-physics coupling)

#### d. Modeling

- GASS projects aim to improve different aspects of atmospheric models and related processes

#### e. Application

- GASS projects intend to improve both weather and climate models

#### f. Technology Transfer

- GASS projects intend to transfer improved model treatments to weather and climate centres

#### g. Capacity Building

- GASS email list includes 500+ people (from graduate students to senior scientists in developed and developing countries); all GASS project white papers are circulated on this email list; junior scientists and scientists with limited resources are also encouraged to participate in GASS projects.

### List contributions to the GEWEX Science Questions and plans to include these.

#### a. Observations and Predictions of Precipitation

- Three existing GASS projects directly address precipitation: the precipitation diurnal cycle, LS4P, and GAP
- Two projects to be launched in 2020 will also address precipitation: the grey zone project and the physics-dynamics coupling project.

## b. Global Water Resource Systems

- One GASS project (LS4P) is directly related to the global water resources systems.

## c. Changes in Extremes

- All GASS projects aim to improve weather and climate models, including their capability in studying weather and climate extremes

## d. Water and Energy Cycles

- All GASS projects aim to improve weather and climate models, including their capability in studying the water and energy cycles. For instance, in the UTCC PROES, upper tropospheric clouds play a crucial role in the climate system by modulating the Earth's energy budget and heat transport. These clouds are most abundant in the tropics, where they often form as cirrus anvils from convective outflow, building mesoscale systems. The radiative heating of the thinner cirrus within the anvils may be critical to cloud climate feedback.

### **Other Key Science Questions**

*List 1 – 3 suggestion that you anticipate your community would want to tackle in the next 5-10 years within the context of a land-atmosphere project*

- GASS does not have overarching “key science questions” for the next 5-10 years. Three projects list such questions and they are provided below.
- How realistic are the high-resolution simulations of orographic processes using observations? How can we develop the seamless orographic drag parametrization formulation?
- How does LST/SUBT over global high mountain regions (Including Tibetan Plateau, Rocky Mountains, and other high mountains) affect the global precipitation at S2S scales?
- The strong stable boundary layer is still a challenge for LES (to reduce the uncertainties) and for the flux measurement.

### **Contributions to WCRP including Current Grand Challenges**

*Briefly list any specific areas of your panel's activities in particular to the grand challenges “Extremes” and “Water for the Food Baskets” which is not covered under 2.*

- GASS LS4P and precipitation diurnal cycle projects address precipitation that is directly related to “Water for the Food Baskets”
- All GASS projects aim to improve weather and climate models, enabling the modeling study of weather and climate “extremes”
- UTCC PROES contributes to the WCRP Grand Challenge: Clouds, circulation and climate sensitivity.

### **Cooperation with other WCRP Projects, Outside Bodies and links to applications**

*e.g. CLIVAR, CliC, SPARC, Future Earth, etc.*

- WGNE, SPARC, S2S Prediction Project, CFMIP, and Monsoon panel
- Develop a survey in collaboration with WGNE, GLASS to gather information from NWP and climate modelling centres about deficiencies in process representations to prioritize future projects.

## **Workshops and Meetings**

### **List of Workshops and Meetings Held in 2019**

*Meeting title, dates and location*

- Four highly efficient videoconferences attended by GASS Panel members (on 30 April, 17 June, 16 September, and 12 November 2019). For one videoconference, we invited the GLASS Co-Chair Mike Ek to join us. We also invited the GDAP Co-Chairs to join us for other videoconferences, but their schedule didn't work out. Each meeting agenda is similar, and the agenda on 12 November 2019 included: updates on the WGNE (including the WCRP modelling white paper) and WWRP meetings, CORDEX, each GASS project, the dynamics-physics coupling white paper, and the grey-zone project; discussions on Annual Reporting Templates, Pan-GASS meeting in 2021 and other GASS meetings in 2020, and Next video-conference; and open discussions.

- UCP, Berlin, Germany, in February 2019. Including in a preparatory meeting for the grey-zone II project.
- LS4P Workshop during AGU December 2019 Fall meeting, San Francisco, USA.
- LS4P Workshop, July 2019, in Nanjing, China.
- COORDE results have been presented at Innsbruck University seminar in November 2019, Reading University seminar 2019, WCRP 40 years symposium at AGU 2019, opening talk of the International Conference on Mountain Meteorology September 2019.
- UTCC PROES results were presented at IUGG, July 2019, Montreal, Canada

### **List of Workshops and Meetings Planned in 2020 and 2021**

*Meeting title, dates and location and anticipated travel support needs*

- Continue to have regular videoconferences of panel members
- Improvement and calibration of clouds in models, Toulouse, France, in June 2020. Including a grey-zone II workshop.
- September 2020, Fourth International GEWEX/GASS/LS4P and TPEMIP Workshop in USA or China
- A session on "Diurnal Cycle of Precipitation in Observations and Weather and Climate Models" will be organized at the Asia Oceania Geosciences Society (AOGS) 2020 annual meeting, 28 Jun - 4 Jul 2020, Hongcheon Korea.
- COORDE result will be presented at Reading University seminar in January 2020, at University of East Anglia seminar in January 2020, and at EGU in May 2020.
- 4th UTCC PROES workshop, 9-11 Sep 2020, New York, USA
- Pan-GASS meeting in 2021 (exact time, location, and local hosts TBD)

### **Other Meetings Attended On Behalf of GEWEX or Panel in 2019**

- WWRP, Geneva, Switzerland, in October 2019, D. Klocke gave a GASS update.
- WGNE, Offenbach, Germany, in September 2019, D. Klocke gave a GASS update and discussed collaborations.
- GEWEX Water Vapor Assessment workshop, Jun 2019, Madrid, Spain; representing UTCC PROES
- ISCCP-NG workshop, Oct 2019, Darmstadt, Germany; representing UTCC PROES

## **Publications during Reporting Period**

### **List of Key Publications**

- Ek, M. And X. Zeng, 2019: What is the Role of GEWEX in R2O and O2R? p. 3-4, GEWEX News, Vol. 29, Quarter 1, 2019.
- Xue, Y., A. Boone, and T. Yao, 2019: Remote Effects of High Elevation Land Surface Temperature on S2S Precipitation Prediction: First Workshop on LS4P and TPEMIP. p. 14-16, GEWEX News, Vol. 29, Quarter 1, 2019.
- Stubenrauch, C., and the GEWEX UTCC PROES Working Group: Process Evaluation Study on Upper Tropospheric Clouds and Convection: 2018 Highlights. P. 16-17, GEWEX News, Vol. 29, Quarter 1, 2019.
- Klocke D., W. Schubotz, A. Wing, B. Stevens, U. Lohert, and A. Macke, 2019: UCP2019: Understanding Clouds and Precipitation. p. 8-9, GEWEX News, Vol. 29, Quarter 2, 2019.
- Xue, Y., W. K.-M. Lau, T. Yao, and A. Boone, 2019: Remote Effects of Tibetan Plateau Spring Land Surface Temperature on Global Summer Precipitation and its S2S Prediction: Second Workshop on LS4P and TPEMIP. p. 8-10, GEWEX News, Vol. 29, Quarter 4, 2019.
- Couvreur, F. and co-authors (2020) on GABLS-4 LES intercomparison, under review.