GEWEX Global Atmospheric System Studies (GASS)

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

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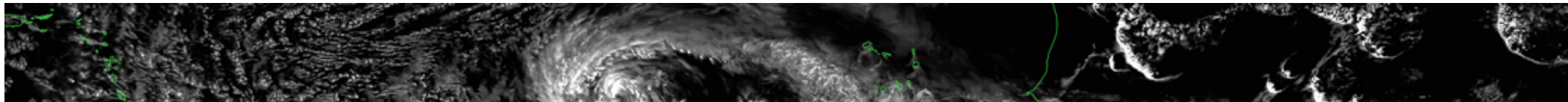

Science Objectives and Activities

Scientific Objectives of GASS:

to improve the understanding of physical processes in the atmosphere and their coupling to atmospheric dynamics.

Activities of GASS:

To facilitate and support international projects that use observations, process studies, and numerical model experiments to develop and improve the representation of the atmosphere in weather and climate models.

At present, GASS has four active projects with two more in the pipeline.

Two more projects (UTCC PROES and GABLS-4) are affiliated with GASS.

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Key Results: GASS

- Four projects are entering the productive phase. Experiments are submitted and first analysis are being performed. They are highly related to the top three errors from WGNE Systematic Error Survey Results Summary

  --- Precipitation diurnal cycle, intensity and frequency

  --- Surface fluxes and temperature diurnal cycle

  --- Cloud microphysics

- Two Affiliated projects (UTCC PROES and GABLS-4) are making progress.

- Two new panel members recruited, representing WCRP Grand Challenge (Sandrine Bony) and early-career scientist (Martin Singh).

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Key Results: GASS

- 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.

- Close collaboration with the DOE ARM:
  --- ARM observations will be used in GASS projects;
  --- ARM is willing to provide small support for GASS-related meetings;
  --- ARM is willing to host GASS data and currently this is tested with data from the Demistify project

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Key Results: Surface drag and momentum transport project

COnstraining ORographic Drag Effects (COORDE):

Goal: Understanding the effects of resolved and parametrized orographic drag through the COORDE-nation of different modeling groups.

Results were submitted by 8 modelling centres
-> impact of resolved orographic drag is similar across models. This gives faith in using the high resolution simulations to constrain parameterizations.

-> The parameterized orographic drag impact is diverse across models in terms of magnitude and position.

-> robust signal of insufficient/misplaced gravity wave drag in lower stratosphere in most models.

Protocol: https://osf.io/37bsy/
An article was published in GEWEX News in February 2019 issue

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Key Results: LES and NWP fog modelling intercomparison project

Demistify: LES and NWP fog modelling intercomparison:

Motivation: Most operational NWP centres will list errors in fog forecasting amongst their top model problems, with the requirement for improvement considered high-priority. Aviation is the key customer driving this. Good case for studying micro-physics, radiation and turbulence interactions.

Results were submitted from 10 modelling centres
-> significant variations between models.

-> Not more consistency for LES than SCMs, suggesting microphysics & radiation as key causes (and not turbulence).

-> representation of cloud droplet sedimentation important. Aerosols not so important.

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Key Results: LS4P project (impact of init. land temperature and snowpack on S2S)

Goal: This project intends to address two questions:

(1) What is the impact of the initialization of large scale LST/SUBT and snow pack, including the aerosol in snow, in climate models on the S2S prediction over different regions?

(2) What is the relative role and uncertainties in these land processes versus in SST in S2S prediction? How do they synergistically enhance the S2S predictability?

This project focuses more on the process understanding and predictability rather than the operational S2S prediction.

Results were submitted by 20 modelling centres

-> High elevation land surface and subsurface temperatures in the Third Pole region have substantial predictive capability for precipitation on S2S time-scales.

-> Impact on precipitation anomalies is global.

Two articles were published in GEWEX News (1st and 4th quarters, 2019).

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Key Results: diurnal and sub-diurnal precipitation project

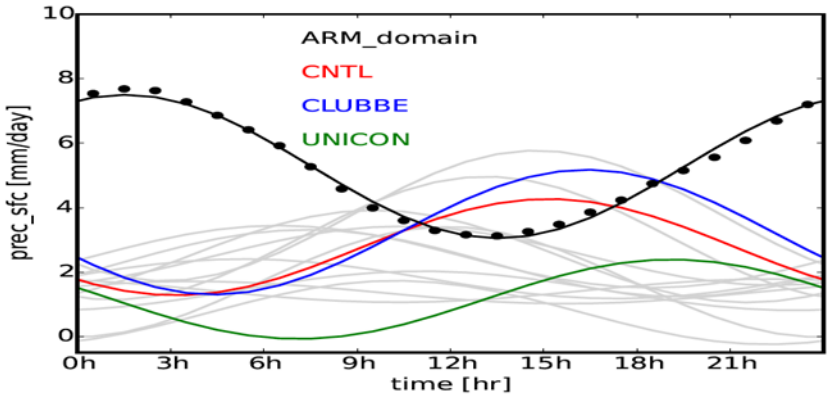
Improving the simulation of the diurnal and sub-diurnal precipitation over different climate regimes:

Goal: to understand what processes control the diurnal and sub-diurnal variation of precipitation over different climate regimes in observations and in models and to identify the deficiencies and missing physics in current GCMs to gain insights for further improving the parameterization of convection in GCMs.

Multiple phases: Interaction between convection and water vapor; Nocturnal convection over land; Diurnal cycle of convection over ocean; Convection transition

Results are being submitted
-> early phase of project. Simulations are ambitious, but results are being submitted

Missing summertime nocturnal precipitation at SGP



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Key Results: UTCC PROES

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

Goal: advance our knowledge of climate feedbacks of UT clouds; therefore gain a better understanding of the interconnection between the convection and the properties of the outflowing anvils. The focus may be widened to the role of cirrus originating from in situ freezing driven by large-scale forcing, via a link to the Stratosphere-troposphere Processes And their Role in Climate (SPARC) Project

Key results:

- 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

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Key Results: GABLS-4

GEWEX Atmospheric Boundary Layer Study (GABLS-4):

Goal: study of the interaction between the boundary layer and the surface in strong stability and during the diurnal transition focussing on the decrease of the turbulence

Key results:

- 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.

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Key Results: Partnership

GASS contributed to the development of a position paper of the WCRP modeling groups to the WCRP chairs as well as to a position paper led by WGNE concerning the reorganisation of WCRP modeling activities.

Setting up a survey in collaboration with WGNE to inquire modelling centers about deficiencies in process representations in climate and NWP models.

Reporting to WWRP and linking GEWEX and WWRP activities.

Interacting with the CLIVAR/GEWEX Monsoon Panel on potential collaborations.

Interacting with SPARC on both UTCC PROES and COORDE activities

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Contributions to GEWEX Science Questions

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 gray zone project and the physics-dynamics coupling project.

Global Water Resource Systems

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

Changes in Extremes

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

Water and Energy Cycles

- All GASS projects aim to improve weather and climate models, including their capability in studying the water and energy cycles.

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