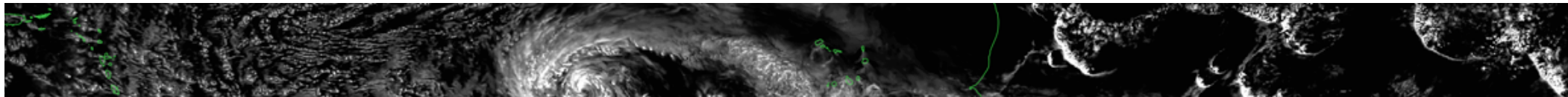
GEWEX Global Atmospheric System Studies (GASS)

Daniel Klocke (Co-Chair, Germany), Sandrine Bony (Co-Chair, France)
Irina Sandu (ECMWF), Shaocheng Xie (USA),
Ian Boutle (UK), Yongkang Xue (USA), Martin Singh (Australia),
Carla Gulizia (Argentina), Ann Fridlind (USA)

Claudia Stubenrauch (France; leading UTCC PROES),
Eric Bazile (France; leading GABLS-4)
Philip Stier and Susan van den Heever (UK, USA, leading GAP)

Nov 2021, WGNE, Internet

GASS Global Atmospheric System Studies



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:
GASS Panel activities facilitate and support the international community that carries out and uses observations, process studies, and numerical model experiments with the goal of advancing the understanding and prediction of weather and climate. Primarily, GASS coordinates scientific projects that bring together experts to contribute to the physical understanding of atmospheric processes and their representation in weather and climate models.

GASS
Global Atmospheric System Studies

GASS: overview

- Tow projects are entering the final phase and we are thinking about a second phase, or closing the project. Two projects are entering the productive phase. All are related to the top three errors from WGNE Systematic Error Survey Results Summary
  --- Convective precipitation, its diurnal cycle, intensity and frequency
  --- Surface fluxes and temperature diurnal cycle
  --- Cloud microphysics

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

- New initiatives under discussion

- PanGASS conference coming up in July 2022

GASS
Global Atmospheric System Studies

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: Phase II of the project is completed and the paper is published
-> impact of resolved orographic drag is robust across models. This gives faith in using the high resolution simulations to constrain parameterizations.

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

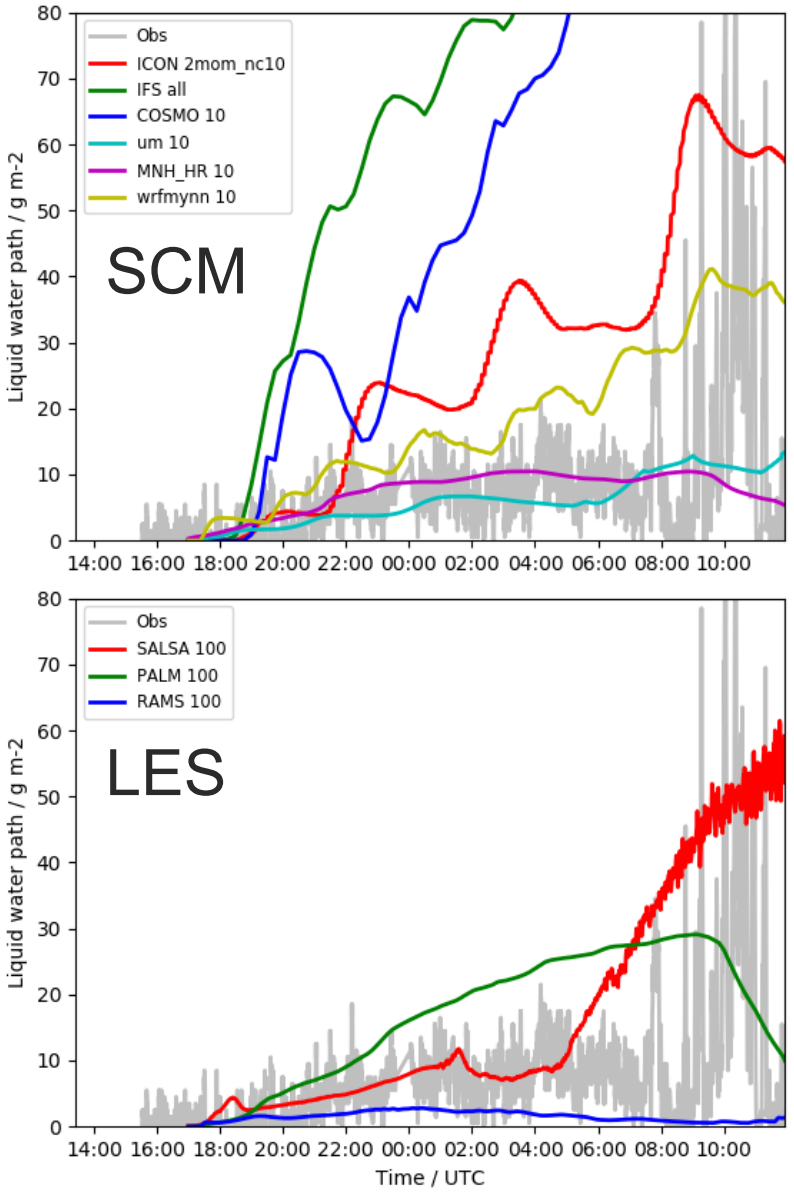
-> robust signal of insufficient/misplaced gravity wave drag in lower stratosphere in most models.

Next steps: interest in continuing the collaboration in this group, particularly from Eric Bazil who has a student looking at COORDE-like experiments over the Rocky mountains
For the moment, information about current and future model development on orographic drag from different collaborators is gathered.

GASS
Global Atmospheric System Studies

LES and NWP fog modelling inter-comparison project

- Paper submitted
  - Significant variation between models
  - No more consistency for LES than SCMs, suggesting microphysics & radiation as key causes (not turbulence)
- Follow-up study is discussed among participants (searching a new lead)



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

Goal: This project addresses 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

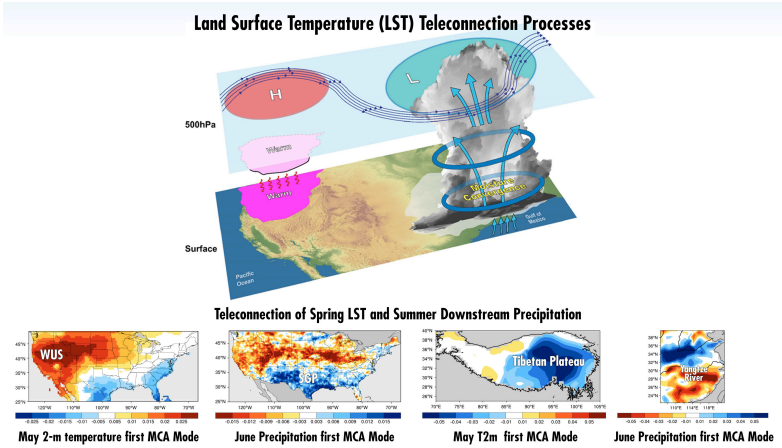
-> High elevation land surface and subsurface temperatures in the Third Pole region have substantial predictive capability for precipitation on S2S time-scales.

-> Impact on precipitation anomalies is global.

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

Status: Phase I paper is submitted and there is a special issue in Climate Dynamics for LS4P

Next steps: Phase II experiment with Rocky Mountains LST effect as the main focus



Impact of Initialized Land Surface Temperature and Snowpack on Subseasonal to Seasonal Prediction Project, Phase I (LS4P-I): Organization and Experimental design

Yongkang Xue[1], Tandong Yao[2], Aaron A. Boone[3], Ismaila Diallo[1], Ye Liu[1], Xubin Zeng[4], William K.-M. Lau[5], Shiori Sugimoto[6], Qi Tang[7], Xiaoduo Pan[2], Peter J. van Oevelen[8], Daniel Klocke[9], Myung-Seo Koo[10], Zhaohui Lin[11], Yuhei Takaya[12], Tomonori Sato[13], Constantin Ardilouze[3], Subodh K. Saha[14], Mei Zhao[15], Xin-Zhong Liang[5], Frederic Vitart[16], Xin Li[2], Ping Zhao[17], David Neelin[1], Weidong Guo[18], Miao Yu[19], Yun Qian[20], Samuel S. P. Shen[21], Yang Zhang[18], Kun Yang[22], Ruby Leung[20], Jing Yang[23], Yuan Qiu[11], Michael A. Brunke[4], Sin Chan Chou[24], Michael Ek[25], Tianyi Fan[23], Hong Guan[26], Hai Lin[27], Shunlin Liang[28], Stefano Materia[29], Tetsu Nakamura[13], Xin Qi[23], Retish Senan[16], Chunxiang Shi[30], Hailan Wang[26], Helin Wei[26], Shaocheng Xie[7], Haoran Xu[5], Hongliang Zhang[31], Yanling Zhan[11], Weiping Li[32], Xueli Shi[32], Paulo Nobre[24], Yi Qin[22], Jeff Dozier[33], Craig R. Ferguson[34], Gianpaolo Balsamo[16], Qing Bao[35], Jinming Feng[11], Jinkyu Hong[36], Songyou Hong[10], Huilin Huang[1], Duoying Ji[23], Zhenming Ji[37], Shichang Kang[38], Yanluan Lin[22], Weiguang Liu[39,19], Ryan Muncaster[27], Yan Pan[18], Daniele Peano[29], Patricia de Rosnay[16], Hiroshi G. Takahashi[40], Jianping Tang[18], Guiling Wang[39], Shuyu Wang[18], Weicai Wang[2], Xu Zhou[2], Yuejian Zhu[26]

GASS Global Atmospheric System Studies

Diurnal and sub-diurnal precipitation project

Improving the simulation of the diurnal and sub-diurnal precipitation over different climate regimes (US great plains and Amazonas):

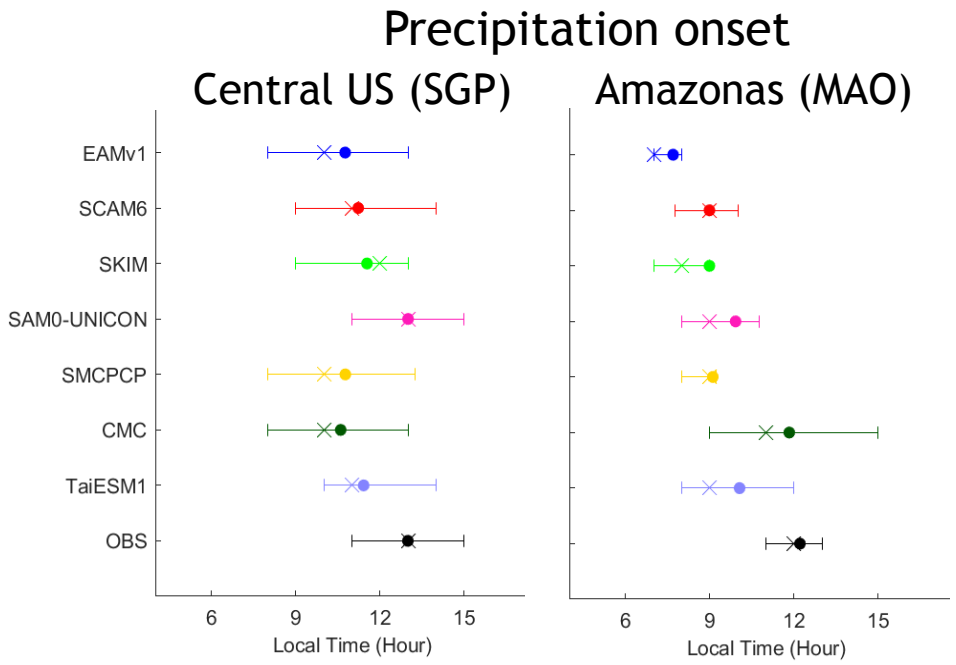
Goal: to understand what processes control the diurnal and sub-diurnal variation of precipitation over different climate regimes in observations and in models and to identify the deficiencies and missing physics in current GCMs to gain insights for further improving the parameterization of convection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

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

Result: First paper will be submitted this week with results from multi-year SCM runs over two climate regimes. GCM, CRM and LES studies are following.

GASS
Global Atmospheric System Studies

Key Results: diurnal and sub-diurnal precipitation project



- Long-term statistics over different climate regimes (12 summer for SGP and 2 continues years for MAO) with SCM
- Model better at SGP than MAO and not always the same discrepancies (-> not universal parameterisation?)
- Too early onset more severe in MAO, due to lack of shallow-to-deep (better in unified schemes)
- A follow up intercomparison with full models will reveal the contributions and interactions of large-scale versus physics

Long-Term Single-Column Model Intercomparison on Diurnal Cycle of Precipitation Over Midlatitude and Tropical Land

Shuaiqi Tang[1], Shaocheng Xie*[2], Zhun Guo[3], Song-You Hong[4], Boualem Khouider[5], Myung-Seo Koo[4], Phani Murali Krishna[6], Vince E. Larson[7,1], Sungsu Park[8], Jihoon Shin[8], Paul Vaillancourt[9], Yi-Chi Wang[10], Jing Yang[9], Chimene Laure Daleu[11], Cameron R. Homeyer[12], Todd Jones[11], Daniel Klocke[13], Martin Kohler[14], Neelam Malap[15], Roel Neggers[16], Thara Prabhakaran[15], Enver Ramirez[17], Courtney Schumacher[18], Cheng Tao[2], Peter Bechtold[19], Hsi-Yen Ma[2], David Neelin[20], and Xubin Zeng[21]

Global Atmospheric System Studies

Direction of future GASS projects

Planning:

- **Mesoscale organization of shallow convection and tradewind cloud feedback processes:** analysis of EUREC4A observations, evaluation of a hierarchy of models, implications for modeling and cloud feedbacks. This work will be done in collaboration with CFMIP (which is part of WGCM) and WGNE.
- **Organization of deep convection:** understanding the underlying mechanisms and assessing the impact of convective organization in the models behaviour and performance. Work to be done in collaboration with WGNE and CFMIP, and with the Digital Twins LHA. Potential link to extrems and WWRP.
- **Air-sea coupling:** Role of the air-sea coupling on the local scale for shallow clouds and their organisation and the effect of the local scale coupling on the large-scale circulation (ie ITCZ) (this also goes the other way of course). Exploiting the atmospheric and oceanic parts of EUREC4A, coupled storm- and eddy-resolving models.

GASS
Global Atmospheric System Studies

Direction of future GASS projects

Under consideration:

- Mixed-phase clouds
- Stable boundary layer (follow-up on GABLS3/4); e.g. around the MOSAiC campaign over the Arctic– under discussion
- 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 collaborated with scientists in PCMDI.

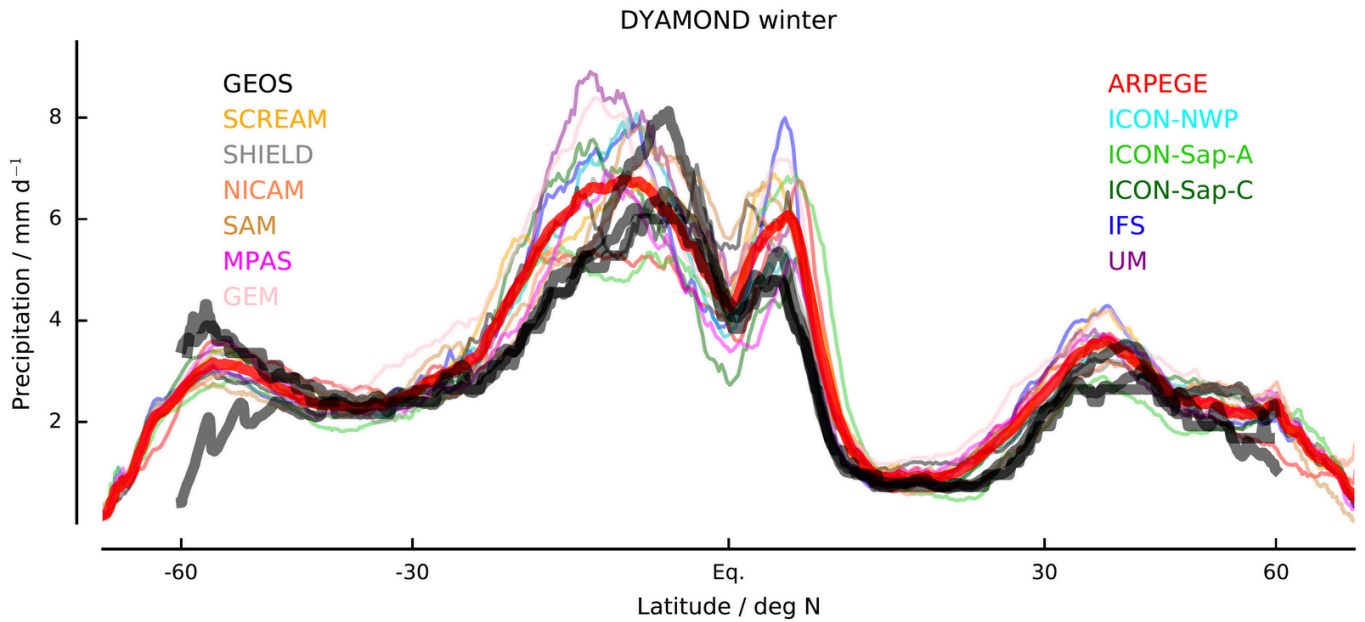
GASS
Global Atmospheric System Studies

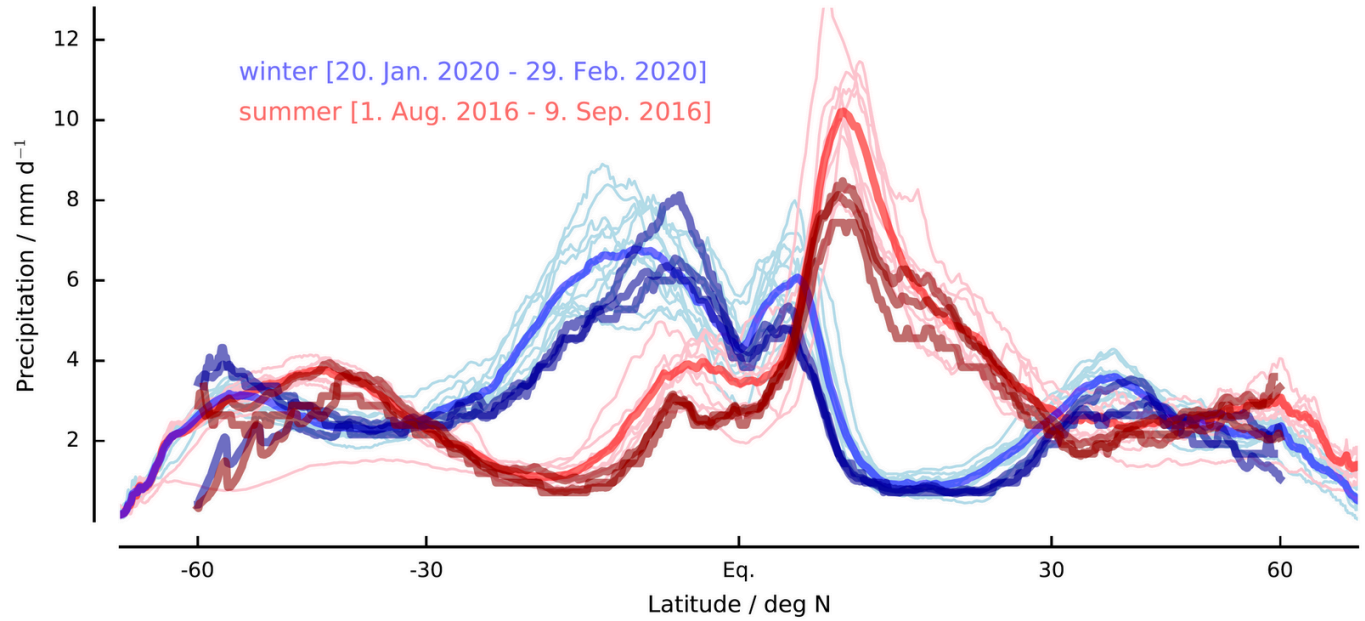
WCRP Light house activity 'Digital Earths'

Role of GASS/GEWEX

- GASS/GEWEX sees itself as the home of high-resolution (atmospheric) modelling.
- Process models (CRM and LES) were developed and used in GCSS, later GASS, to study key cloud systems on Earth.
- It became clear, that these models can realistically simulate cloud systems.
- On larger simulation domains, also the organisation into meso-scale convective systems.
- Now, global simulations with storm-resolving resolutions are emerging.

GASS
Global Atmospheric System Studies





GASS
Global Atmospheric System Studies

3RD PAN-GASS MEETING
UNDERSTANDING AND MODELING ATMOSPHERIC PROCESSES

JUL 25 - 29, 2022 | MONTEREY, CA, USA

Registration opening soon!

https://www.gewexevents.org/events/3rd-pan-gass-meetingunderstanding-and-modeling-atmospheric-processes/

ECR Competitions

UMAP 2022 has organized three competitions for Early Career Researchers (ECRs). You are deemed an ECR if you are an undergraduate or postgraduate (Masters/PhD) student or a scientist who has received his or her highest degree (BSc, MSc, or PhD) within the past six years. If parental leave fell in this period, up to one year of parental leave time may be added per child, up to a maximum of four years.

DYAMOND Competition

In collaboration with the center of Excellence in Simulation of Weather and Climate in Europe (ESiWACE), the GEWEX GASS panel has organized a data analysis competition to encourage the use of the data set of the DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains (DYAMOND). The winner will receive travel support.

DOE-ARM Competition

In collaboration with the Atmospheric Radiation Measurement (ARM) program of the U.S. Department of Energy (DOE), the GEWEX GASS panel has organized a competition for ECRs whose studies have used or will use ARM data. The winners will receive travel support.

GEWEX/WCRP Presentation Competition

In collaboration with the World Climate Research Programme (WCRP), the GEWEX GASS panel has organized a competition where competitors will be judged on technical content, technical knowledge of the topic, as well as the oral or poster presentation delivery during the conference.

More information on the different competitions and the awards can be found here.

Thank you

Global Atmospheric System Studies