WCRP — World Climate Research Programme

GEWEX

Process Evaluation Study on Upper Tropospheric Clouds & Convection
UTCC PROES
to advance understanding of UT cloud feedback

Take Aways from this workshop

Claudia Stubenrauch & Meeting Participants

Joint UTCC PROES - GDAP Meeting, Paris, France, 21 May 2025

MODIS AQUA
2 Dec 2013

UTCC PROES links data analysis & assessment of **GDAP**
to process modelling activities of **GASS**

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Leading science question:
How does convection affect UT clouds &
how do the clouds feedback on the convection ?

Goals: - provide observational metrics to probe processes involving UT cloud systems
- understand relation betw. convection, cirrus anvils & radiative heating
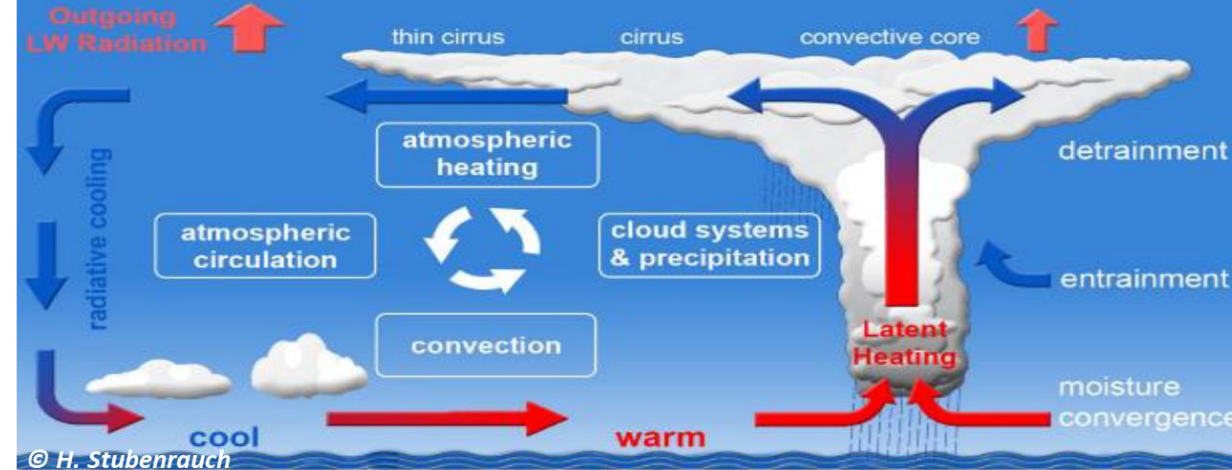
build synergistic datasets for process studies & model evaluation

- **3D description of UT cloud systems** via satellite data & ML *(Stubenrauch et al. ACP 2021, 2023; Chen et al. ACPD 2024)*

- **Lagrangian Convection Tracking** based on cold T_B^{IR} *(Fiolleau et al. 2020)* & precipitation *(Takahashi et al. 2021)*

- **assess** convection-cloud-precipitation-diabatic heating datasets
  characterize convection & deep convective organization

Synergy with GASS WGs
mesoscale organization of deep convection & DYAMOND

- **exploit** data & simulations at km-scale to improve CRM (& GCM) parameterizations:
  *ice microphysical processes, **convective organization**, convective transport, influence of aerosols*

*Much has been achieved since the first UTCC-PROES meeting in Nov 2015,
but **UT clouds are still the major uncertainty in climate projections***

This UTCC PROES meeting covered 5 topics:

- Feedbacks of UT clouds
- Microphysics – radiative heating – circulation
- Process-oriented studies
- Observational studies and datasets
- Deep convection and its organization

https://www.gewexevents.org/meetings/utcc2025/agenda/

with contributions from 30 participants in person & about 15 participants online
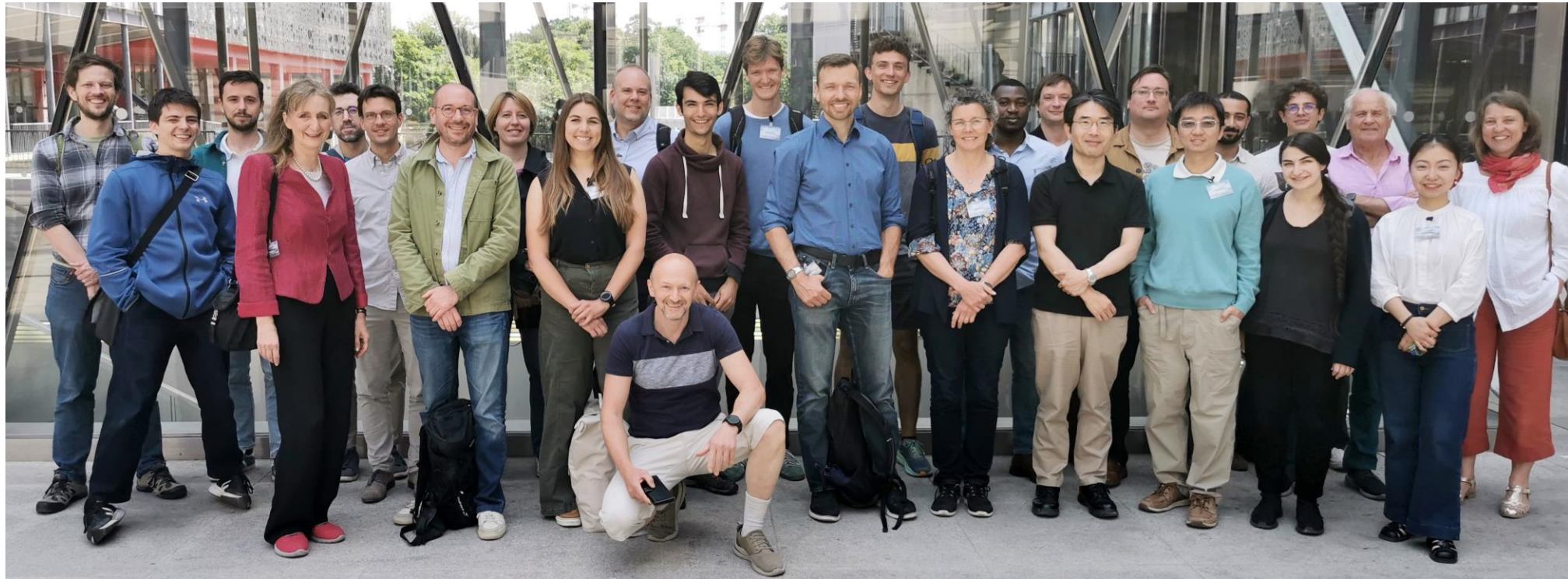
Feedback analyses based on theory, simulations, observations: try to understand mechanisms & to find multiple evidence, still open questions, in particular in dependence of IWP

Tracking methods are now also applied to GCRMs for evaluation

Complementary information is given by the CIRS-ML dataset, based on IR sounder measurements and providing snapshots of UT cloud systems which include the thinner part of the cirrus

Process studies lead to a better understanding

GCRMs are great new tools, as convection is resolved, microphysics plays a role -> MCSMIP
-> link to DYAMOND project of GASS

For GCM parameterizations, there are now ML methods used to simulate sub-grid variability
(microphysics, precipitation)

Convective systems much more complicated than convective core + anvil:
often layered cloud structure underneath the anvils, and thin cirrus on top of convective cores

Next step : connect with shallow convection studies ?

Deep convective organization: metrics & explanation -> link to Convective Organization project of GASS

Differential heating structure seems to be key to organization