Process Evaluation Study on Upper Tropospheric Clouds & Convection

UTCC PROES

to advance understanding of UT cloud feedback

Bridge between

GEWEX Data & Analysis Panel **GDAP & GASS** Global Atmospheric System Studies

Claudia Stubenrauch

Laboratoire de Météorologie Dynamique IPSL, Paris, France

GEWEX UTCC PROES workshop, Paris, France, 19-21 Mai 2025

MODIS AQUA
2 Dec 2013

UTCC PROES links communities from observations, radiative transfer and transport modelling, as well as small scale process and climate modelling.

- 3 workshops since *Nov 2015*: talks & GEWEX news articles at *https://gewex-utcc-proes.aeris-data.fr/*

- 2 breakout meetings (during Pan-GASS *Jul 2022* & CFMIP-GASS *Jul 2023*):

first inventory of MCS datasets **together with WG on convective organization**

AOS-INCUS-GEWEX Convection tracking algorithm & science workshop (*Apr 2024*):

many algorithms & datasets available

https://sites.google.com/view/convection-tracking-workshop/home

International Discussion Activities related to UTCC PROES

- PIRE International Partnership for Cirrus Studies (NSF-supported) Virtual Cirrus Journal Club
  organized by *Peter Blossey* (2020 - 2023)

- IPCC (International Commission on Clouds and Precipitation) Virtual Journal Club
  organized by *Martina Krämer, Greg McFarquhar, Odran Sourdeval* (monthly since 2023)

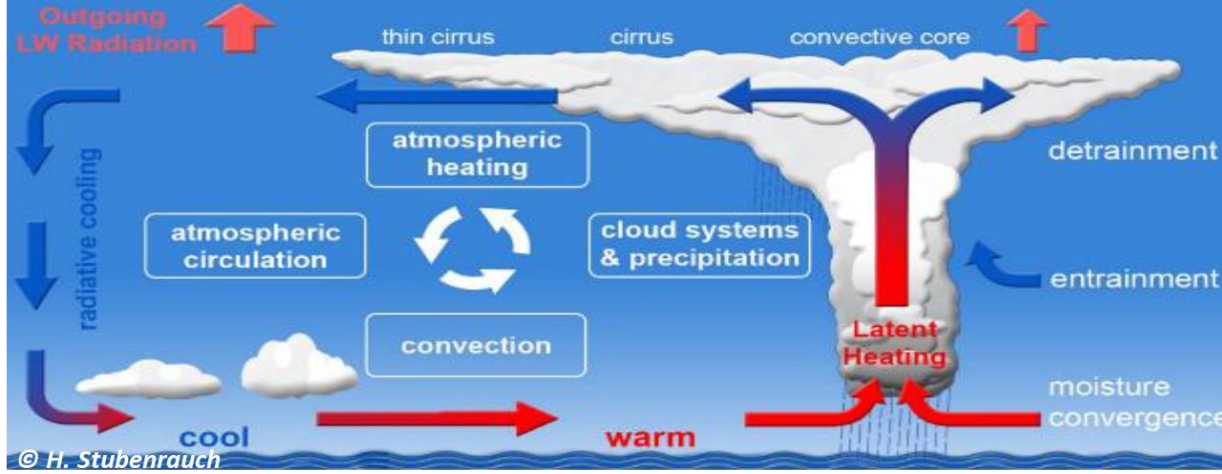
- ECS & Cloud Feedback Virtual Symposium
  organized by *Andrew Dessler, Christi Proistosescu* (monthly since 2020)
  Nick Lutsko, Scripps, Xia Li, Jonah Bloch-Johnson, Andrew Williams, Matthew Luongo

- Cloud Tracking Workshop (Apr 2023) organized by *Philip Stier*

- Ice Cloud Workshop (pre-EGU since 2024) organized by *Blaz Gasparini, Aiko Voigt, Martina Krämer, Odran Sourdeval, Peter Spichtinger*

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

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. ACP 2025 in press)*
- **Lagrangian Convection Tracking** based on cold T_B^{IR} *(Fiolleau et al. 2020)* & precipitation *(Takahashi et al. 2021)*

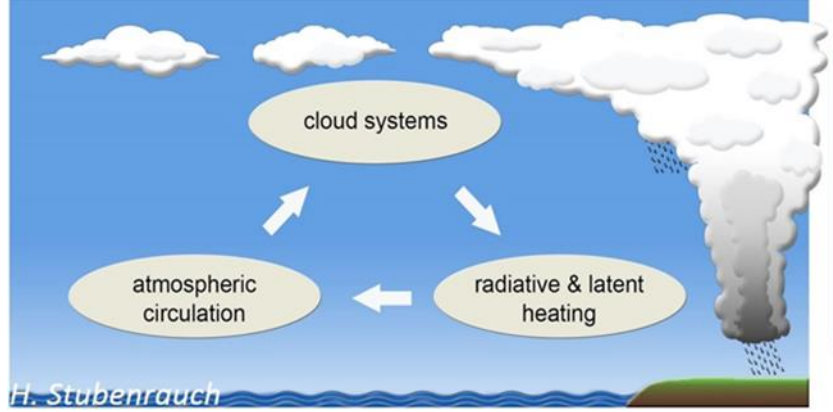
- **assess** convection-cloud-precipitation-diabatic heating datasets
  characterize convection & deep convective organization

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*

Science Questions

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



How much are anvil properties influenced
by convective strength & organisation?

Which cirrus types are most responsible for atmospheric heating
and thus influential to climate sensitivity?

- How much of the heating can be traced to convectively generated cirrus ?
- How much of the variability of UT heating is governed by variability in areal coverage, emissivity and microphysics ?

How does the heating affect the large-scale atm. circulation?

How does convective organization affect the precipitation & the heating?

Do we see any robust changes in Cirrus with current climate warming ?

How can we better constrain the climate model simulations

Topics for this UTCC PROES meeting

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

UTCC PROES has helped to set up datasets for process studies *https://gewex-utcc-proes.aeris-data.fr*
& new assessments

Discussion points

- **Do we have all the data needed : synergetic data – analysis methods ?**
- **Some analysis methods are complicated** (cloud system analysis, composites, tracking) **to install for GCM model evaluation, may be easier with global CRM model simulations**
- **Data / analyses for process studies & model evaluation: uncertainties in heating rates**
- **How to measure deep convective organization ?**

Tropical thunderstorms over Brazil
Source: NASA Space shuttle, STS41B-41-2347