Convection-resolving climate simulation of the tropical-to-subtropical Atlantic

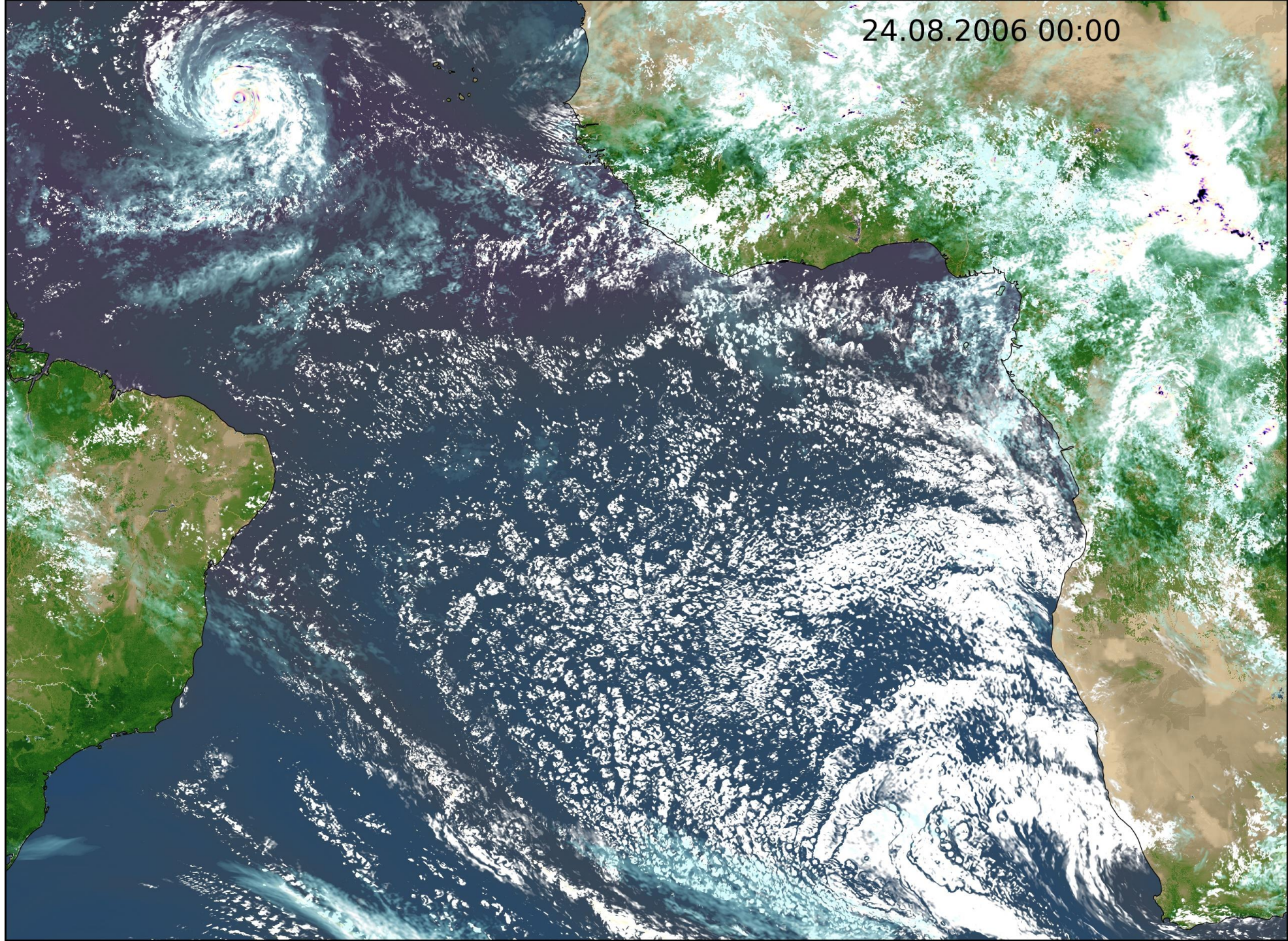
Christoph Heim [1]
Christoph Schär [1]

1. ETH Zürich, Institute for Atmospheric and Climate Science

EGU General Assembly 2022
AS2.4 – Advancing understanding of the coupling between clouds, convection and circulation

25.05.2022

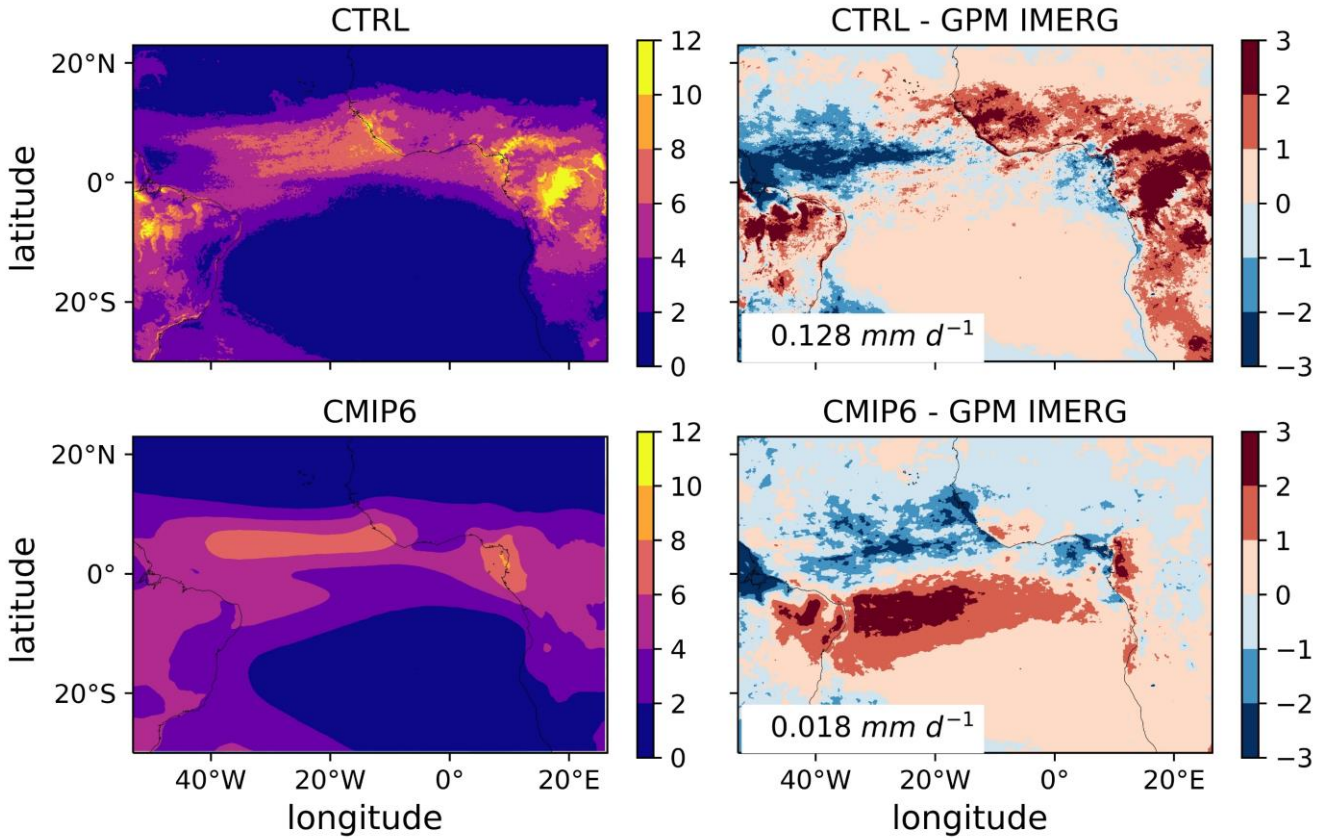
- COSMO model simulation:
  - 3.3 km Δx
  - 2750 x 2065 x 60 grid points
- Domain:
  - 54.54° W – 27.93° E
  - 37.45° S – 24.77° N
- Time period:
  - 3 years (2007-2009)
  - 5 months of spin up in 2006
- Experiments:
  - CTRL (ERA5)
  - PGW (ERA5 + Δ climate)
  - Δ climate = MPI-ESM1-2-HR: SSP5-8.5 (2070-2099) – historical (1985-2014)

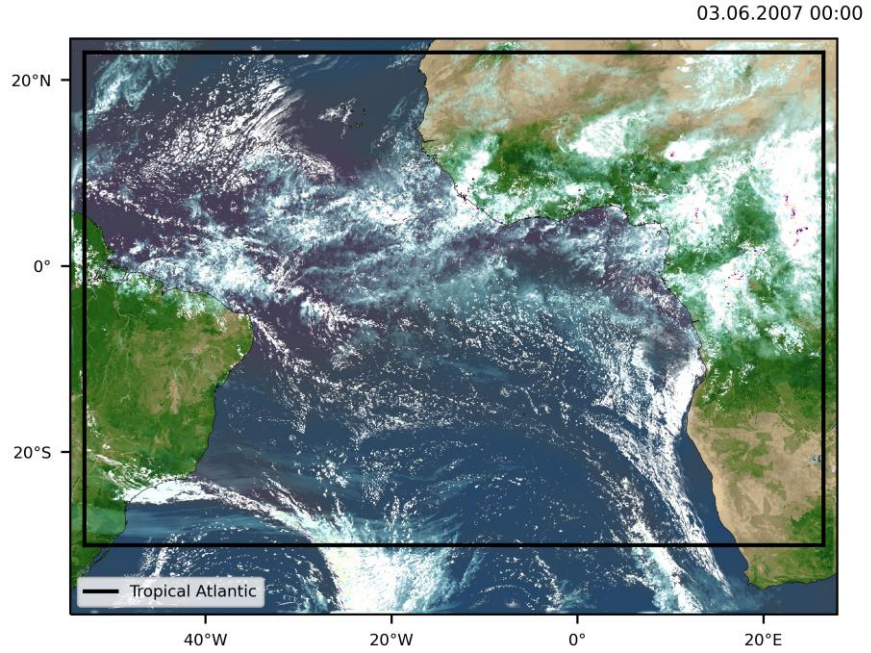


Heim et al. 2022a in preparation

Precipitation in CTRL

[mm d^{-1}]

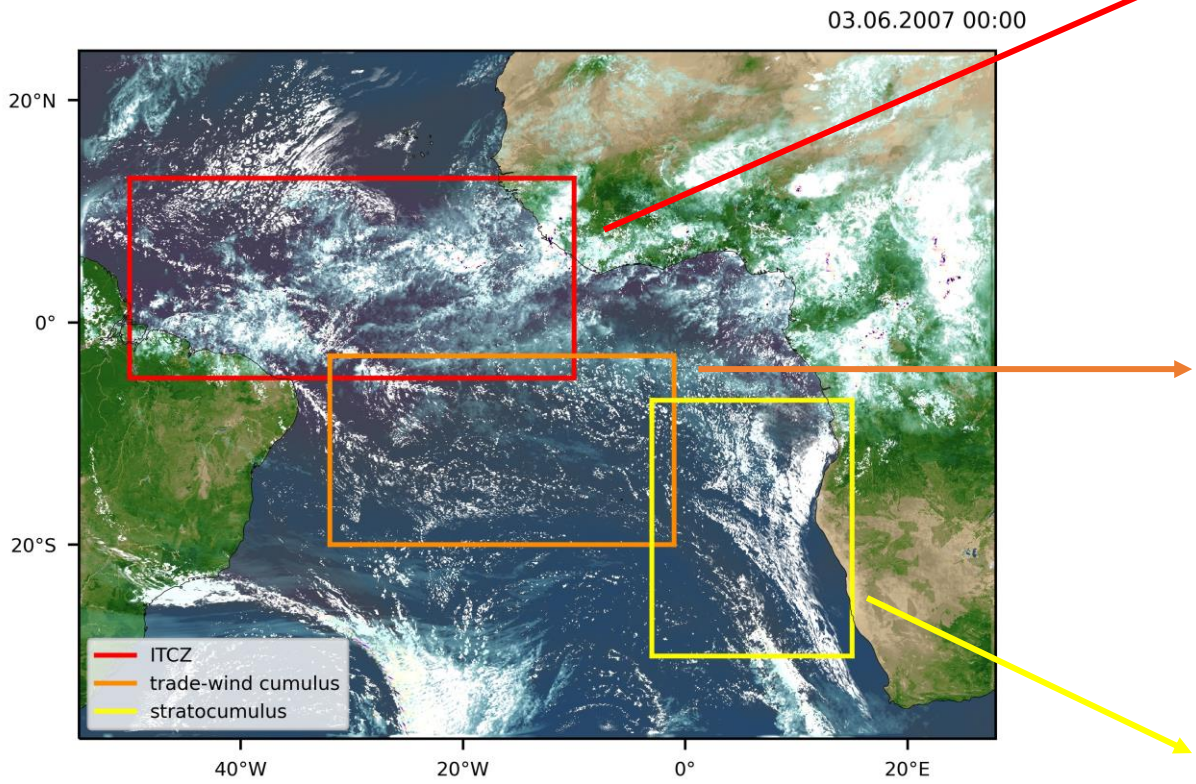


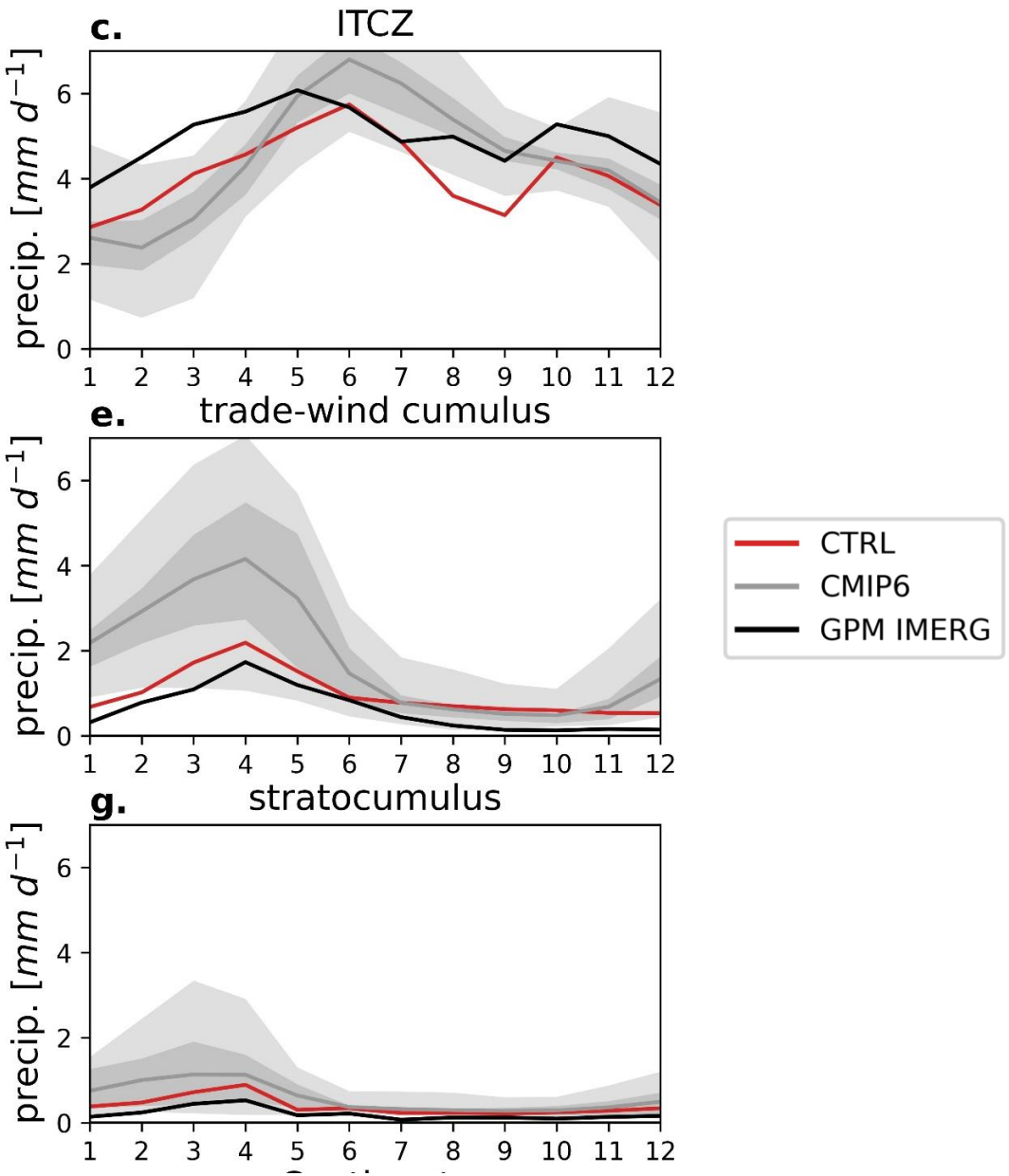


COSMO, GPM IMERG: 2007-2009
CMIP6 climatology: 1985-2014

Precipitation in CTRL

[mm d^{-1}]



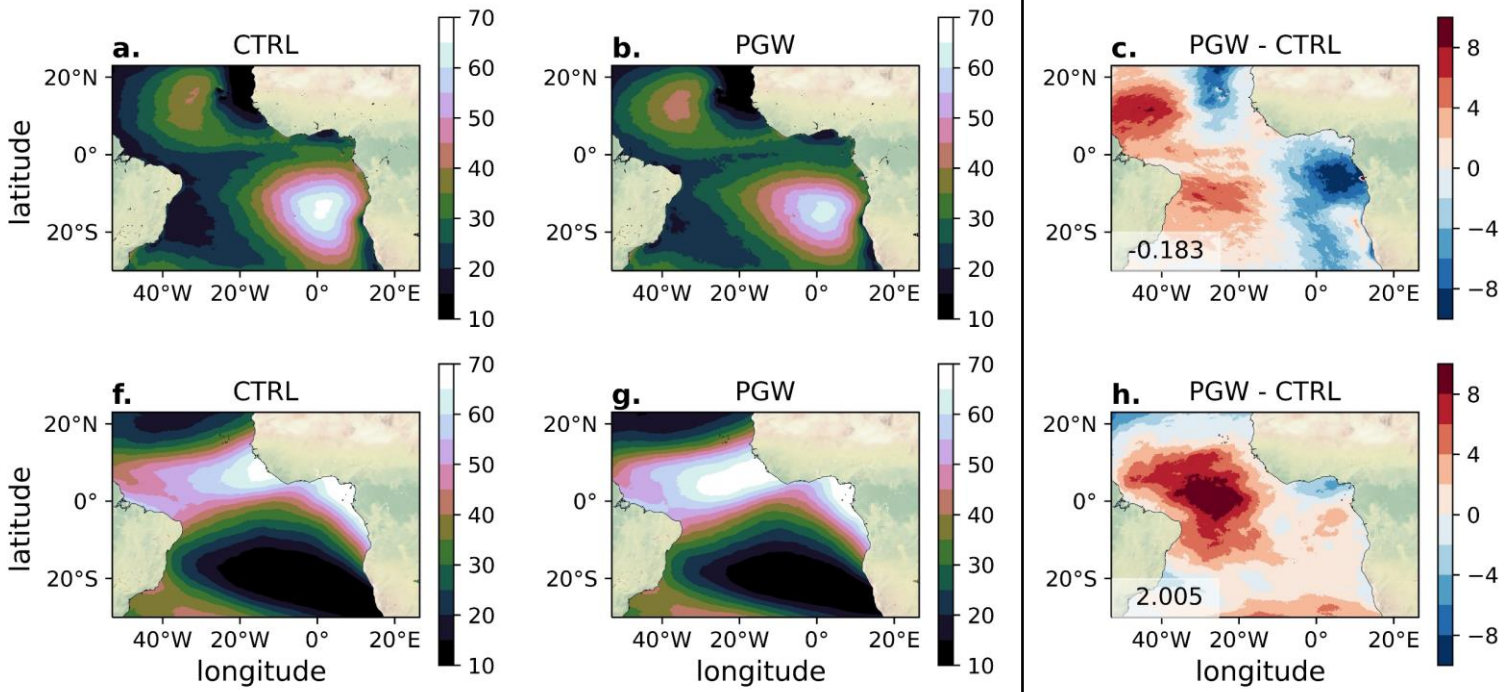


COSMO, GPM IMERG: 2007-2009
CMIP6 climatology: 1985-2014

Cloud cover change (PGW – CTRL)

low cloud cover
[%]

Δ low cloud cover
[%]



high cloud cover
[%]

Δ high cloud cover
[%]

COSMO
2007-2009

Summary

- 3-year-long COSMO simulation at Δx=3km on tropical-to-subtropical domain to study marine cloud-radiative feedback

- Evaluation under current climate conditions (CTRL):
  - Good representation of different cloud regimes and their annual evolution

- Climate change response from Pseudo-global Warming simulation (PGW):
  - reduction in stratocumulus cloud cover
  - increase in trade-wind cumulus cloud cover in the eastern basin
  - increase in high clouds at the ITCZ

- Publications in preparation:
  - *Heim, C., Leutwyler, D., & Schär, C. (2022). Application of the Pseudo-Global Warming Approach in the Tropics in a Kilometer-scale Climate Simulation. In Preparation.*
  - *Heim, C., Leutwyler, D., & Schär, C. (2022). Tropical Marine Cloud-Radiative Feedback in a Convection-Resolving Climate Simulation. In Preparation.*

Backup Slides

Heim et al. 2022a in preparation

Vertical Wind

[m s^{-1}]

ERA5
2007-2009

COSMO
2007-2009

MPI-ESM1-2-HR:
SSP5-8.5: 2070-2099
historical: 1985-2014