# Conclusion Inconsistencies When Testing Physics Settings in Multiple Model Configurations


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**Thanks**: Cecile Hannay, Mat Rothstein, Brian Medeiros and Jerry Olson

# Hierarchy Definition

*"a system or organization in which people or groups are ranked one above the other according to status or authority."*

***Model class system (very British)***

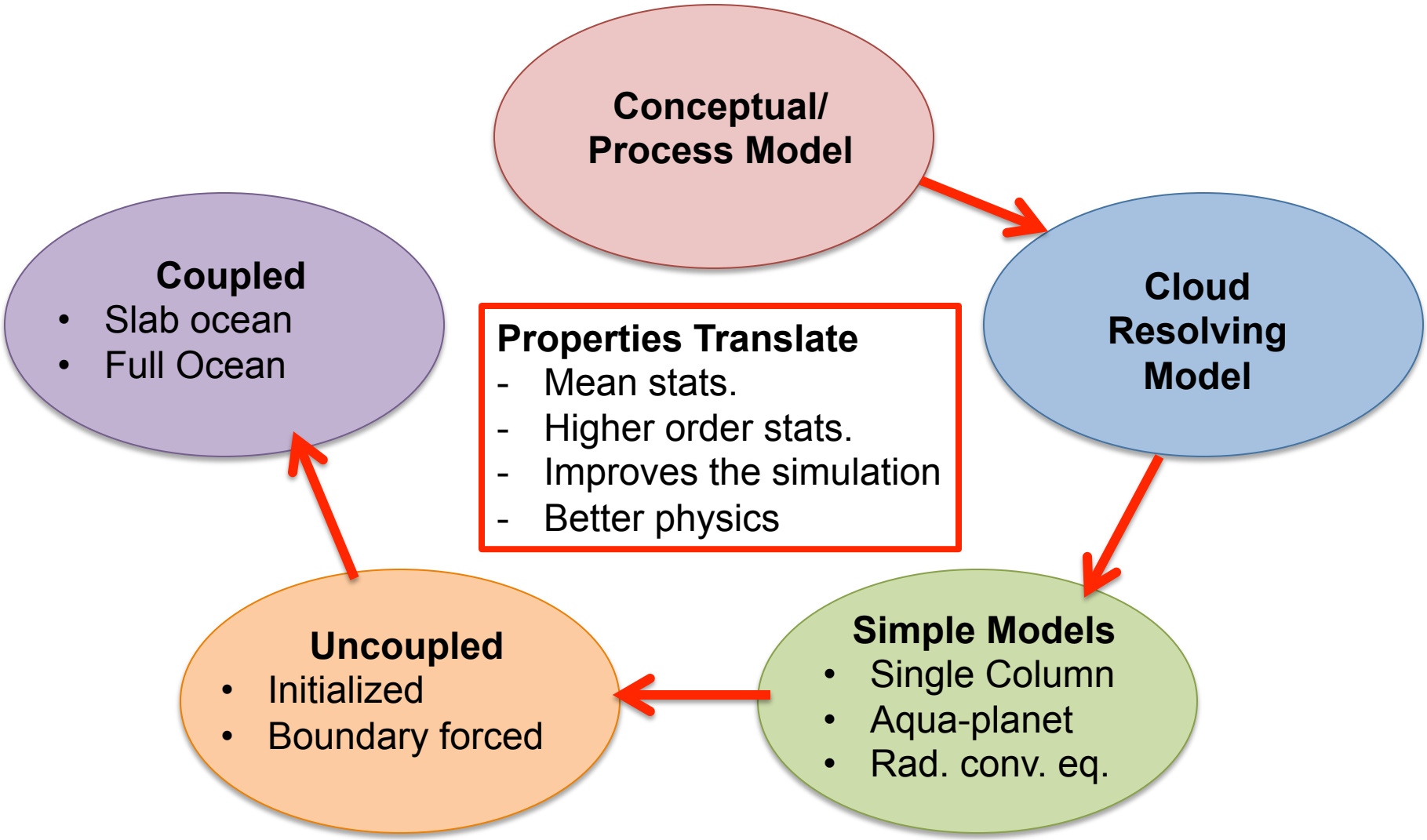
*"the upper echelons of a hierarchical system; those in authority."*

***GCMs rule!***

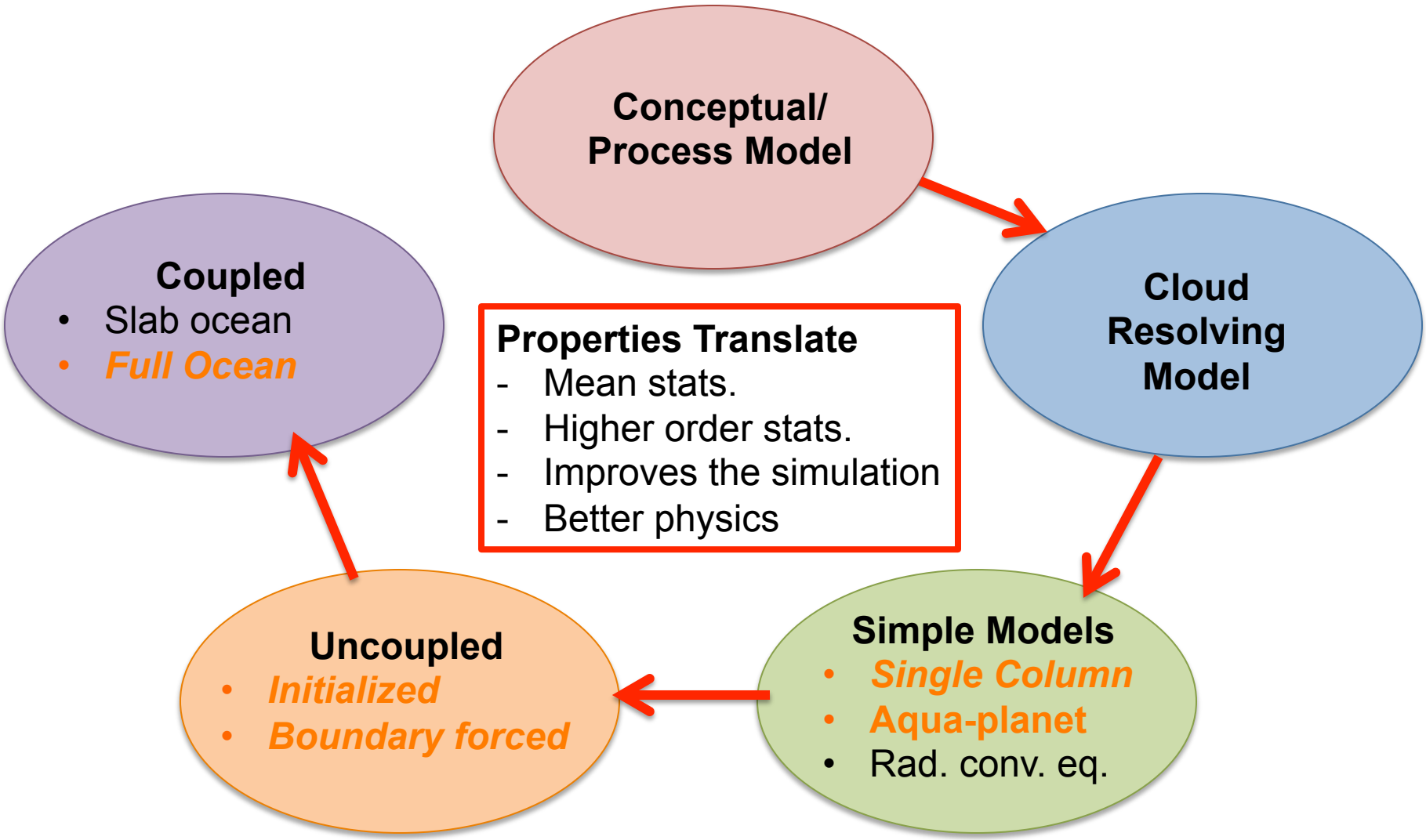
*"an arrangement or classification of things according to relative importance or inclusiveness."*

***'You say tomato…' + communism***

# **Model Hierarchy:** Atmosphere GCM Development



# **Model Hierarchy:** Atmosphere GCM Development

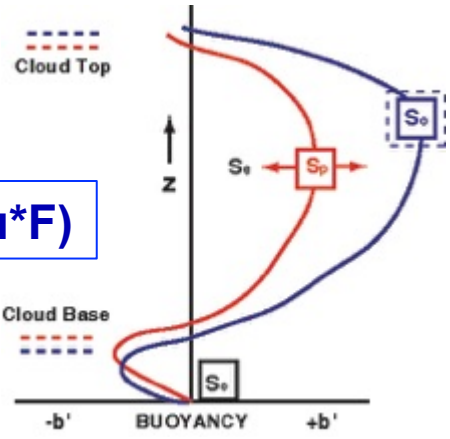


# Overview

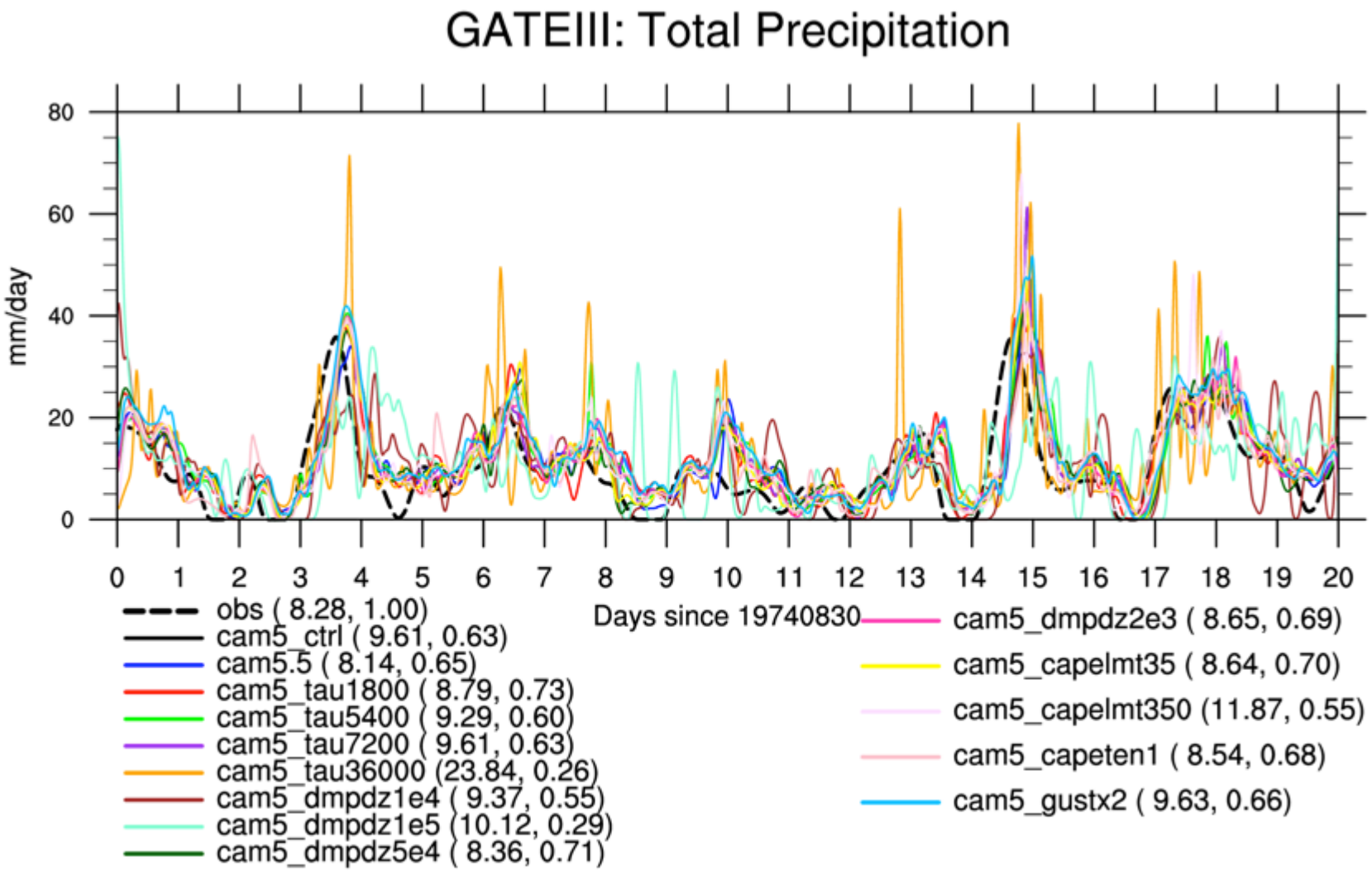
- How do we determine the success/impact of introducing a change into a comprehensive climate model?
  - We tune in AMIP and increasingly coupled configurations
  - CAPT (hindcast) and single-column model for developing not tuning (mostly)
  - Add potential tuning parameters at single column level
  - Move forward through CAPT/AMIP/coupled to assess performance
  - Variability not consistently assessed as a performance metric

- Community atmosphere model (CAM, version 5)
  - Perturbing deep convection timescale (TAU, tau) and entrainment (ENT, dmpdz)
  - Default values of tau=3600, dmpdz=1e-3

$M_{cb}$=CAPE/(tau*F)



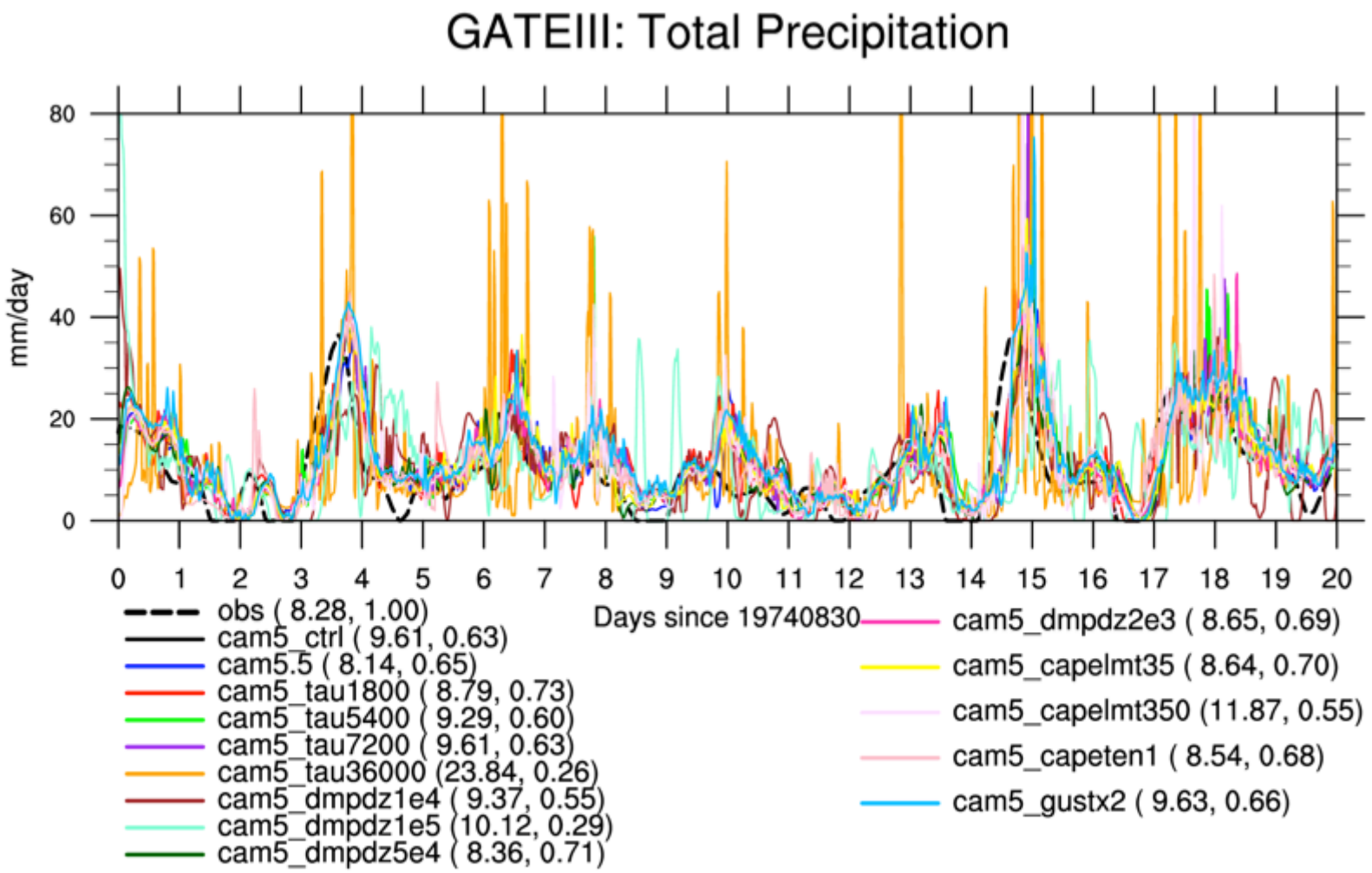
# Single Column Model (SCAM) - Sensitivities




(std. dev./correlation)

dmpdz = 1e-5,1e-4,5e-4, **1e-3,** 2e-3

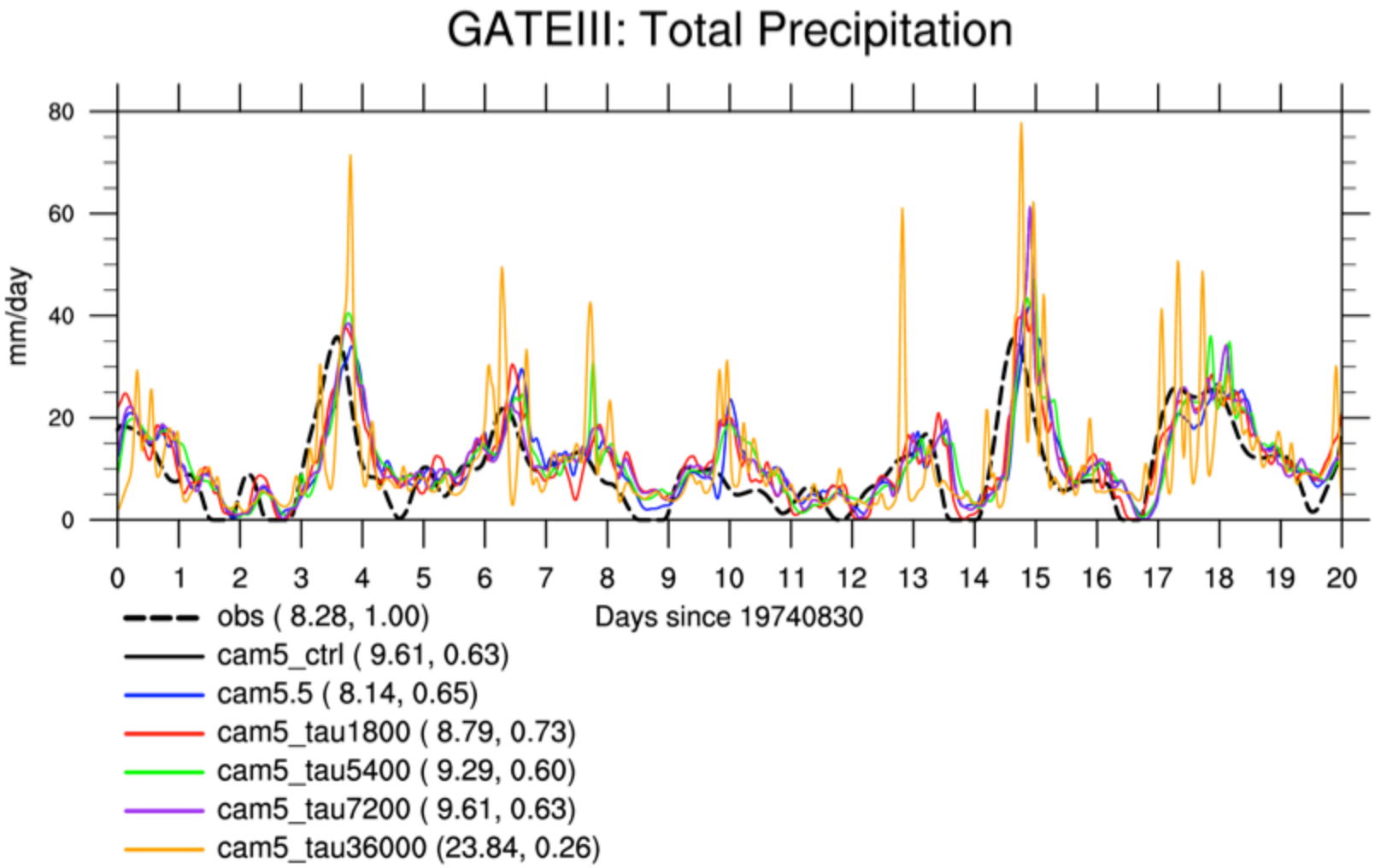
# Single Column Model (SCAM) – Noisy?




(std. dev./correlation)

dmpdz = 1e-5,1e-4,5e-4, **1e-3,** 2e-3

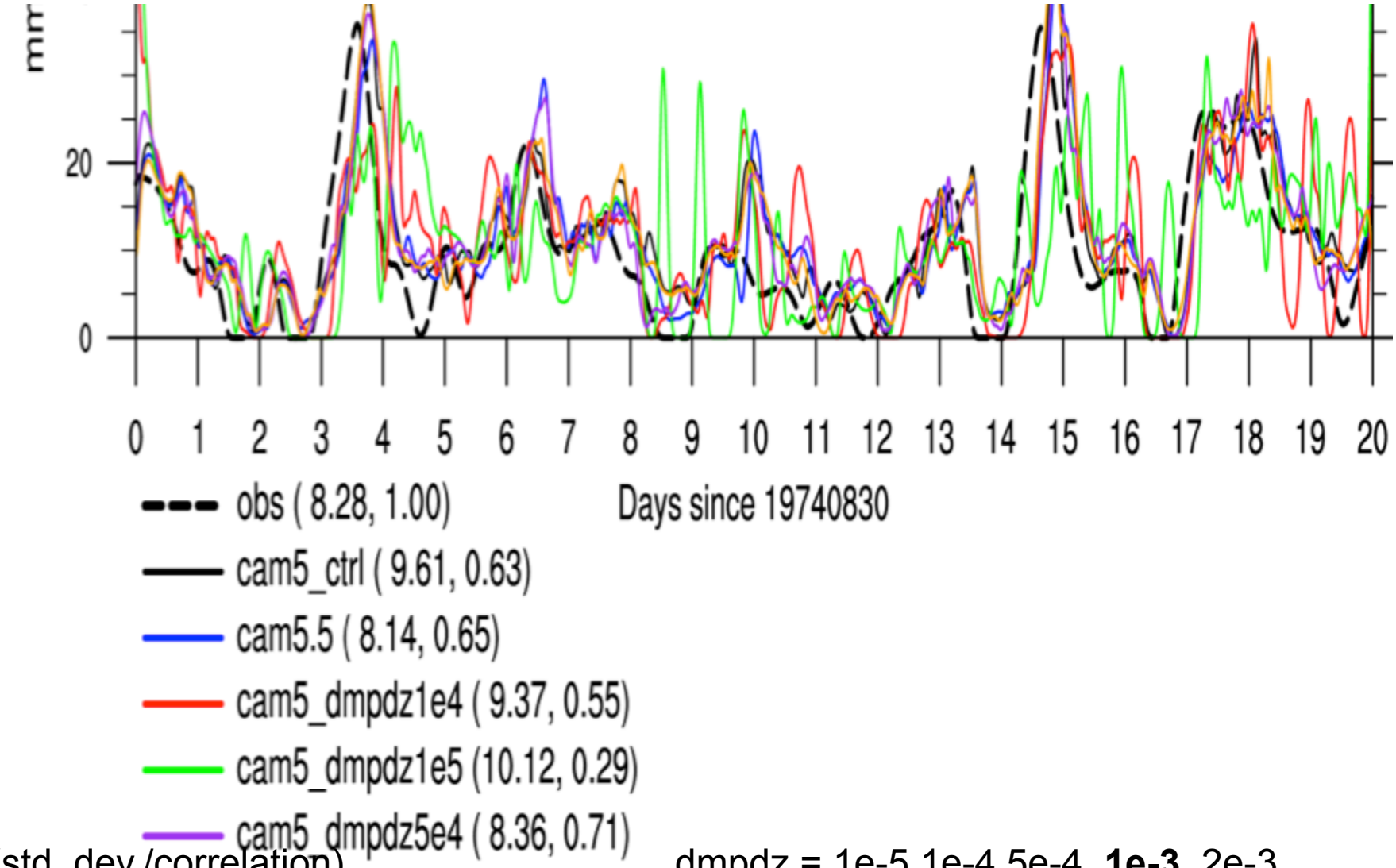
# Single Column Model (SCAM) – Timescale




(std. dev./correlation)

tau = 1800, **3600s**, 5400s, 7200s, 36000s

# Single Column Model (SCAM) – Entrainment




(std. dev./correlation)

dmpdz = 1e-5,1e-4,5e-4, **1e-3**, 2e-3

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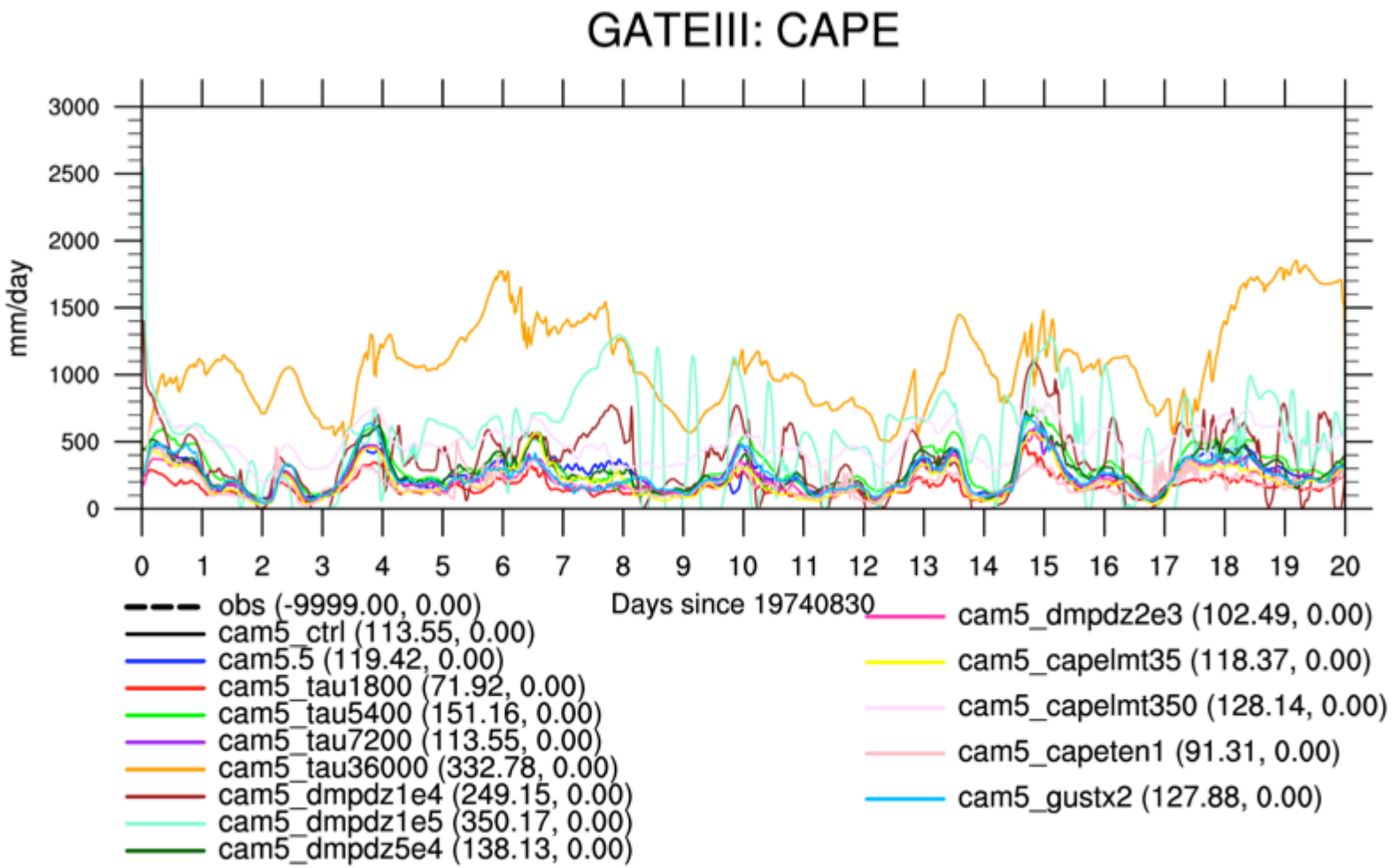


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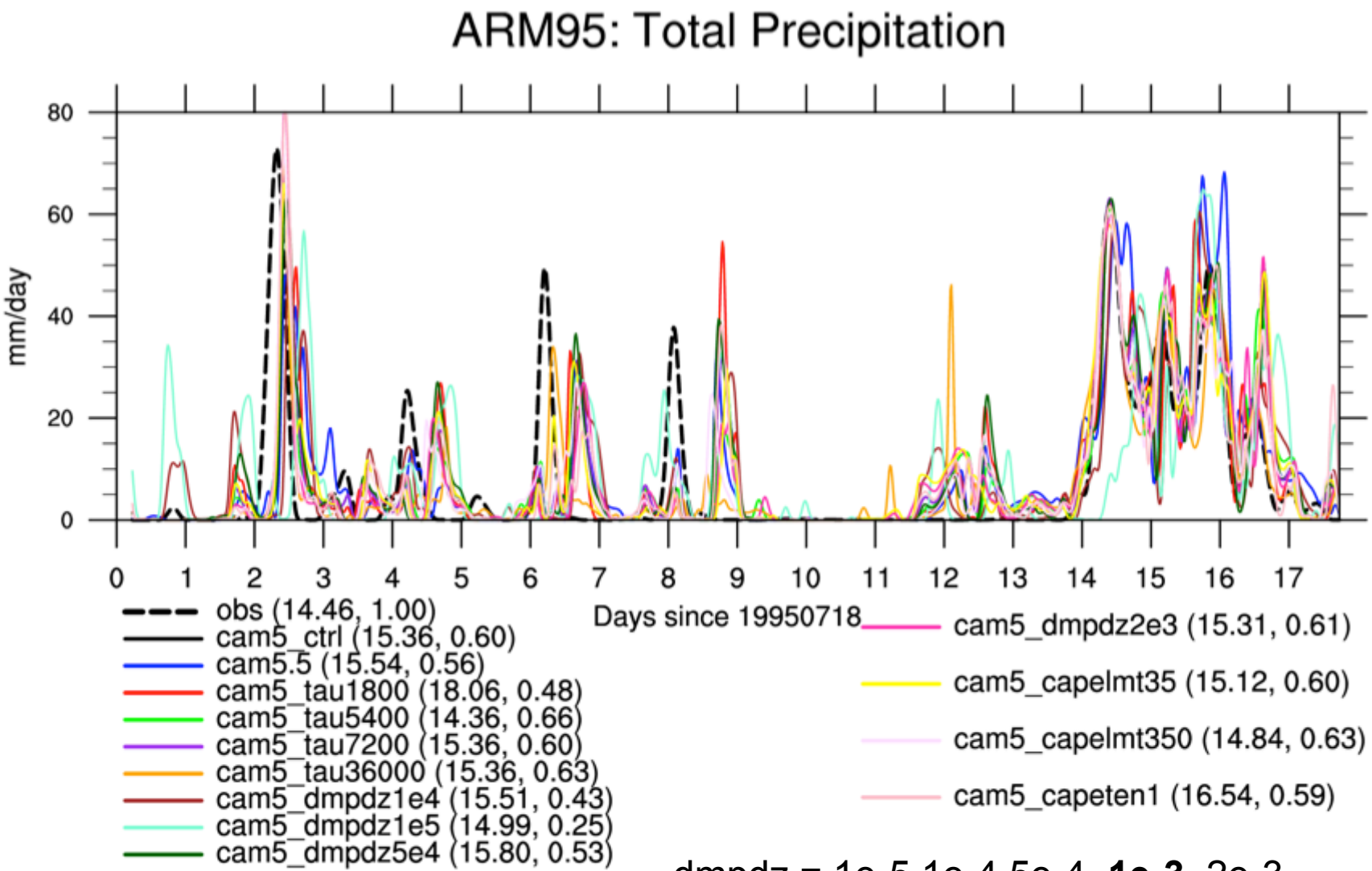
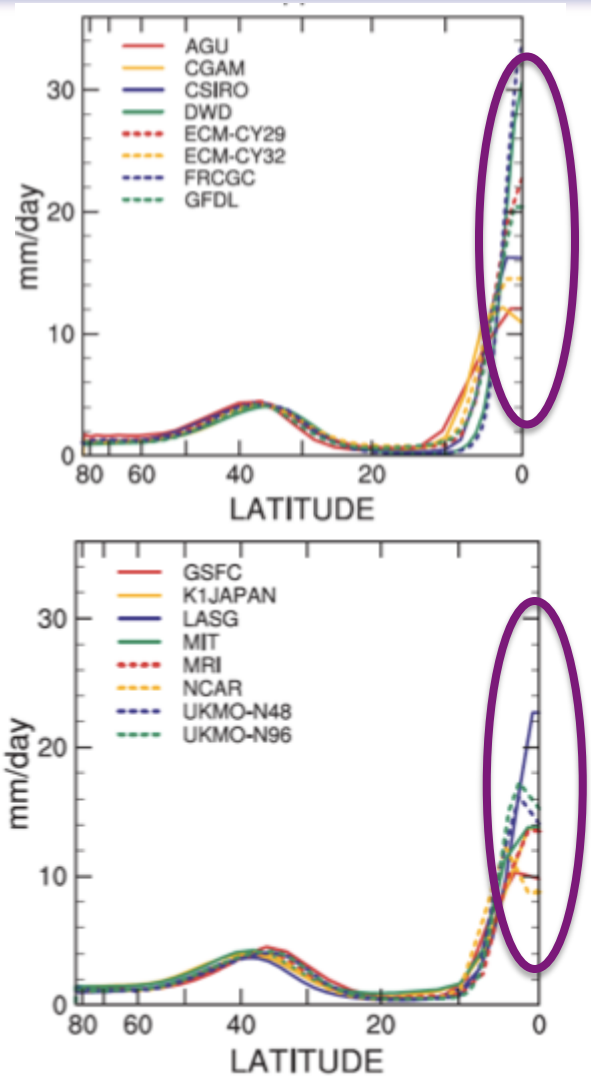


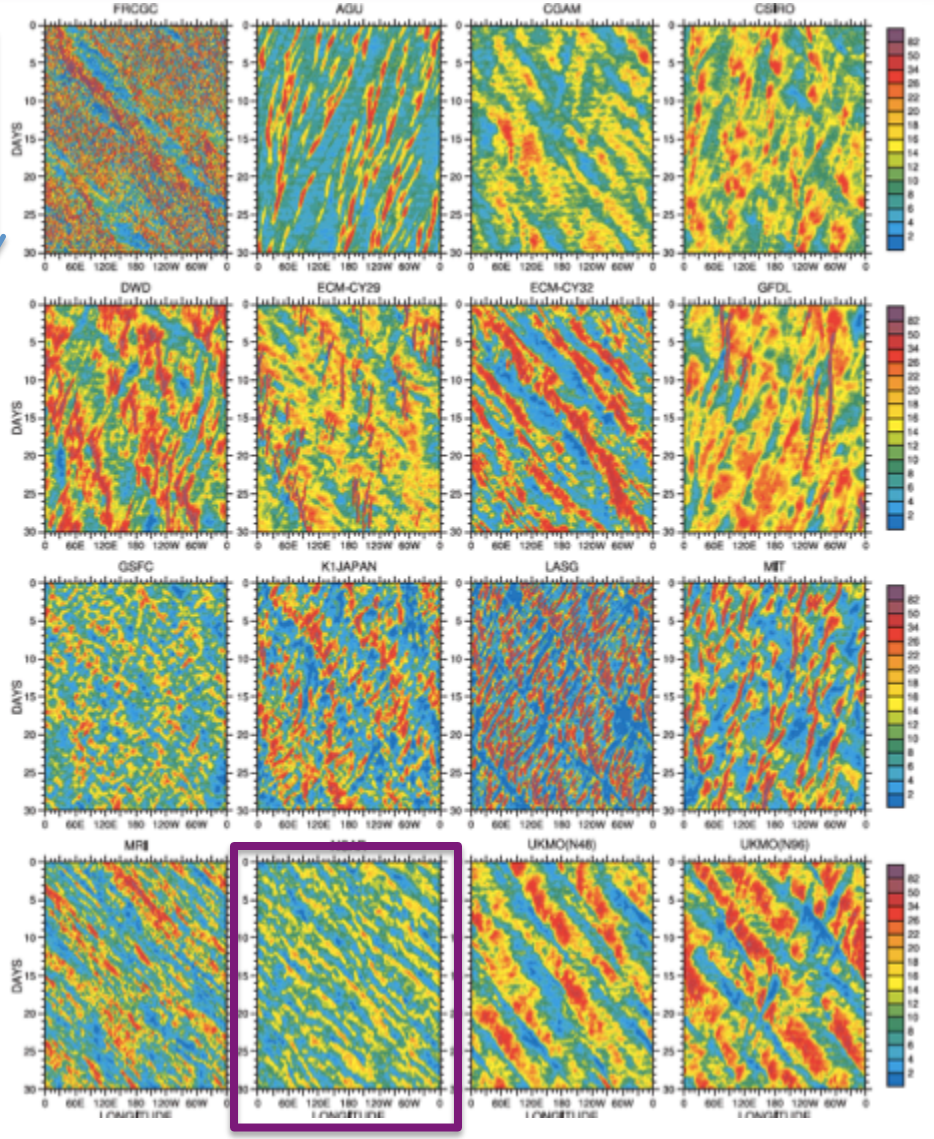

(std. dev./correlation)

dmpdz = 1e-5,1e-4,5e-4, **1e-3,** 2e-3

# Tropical variability across GCMs: Aqua-planet



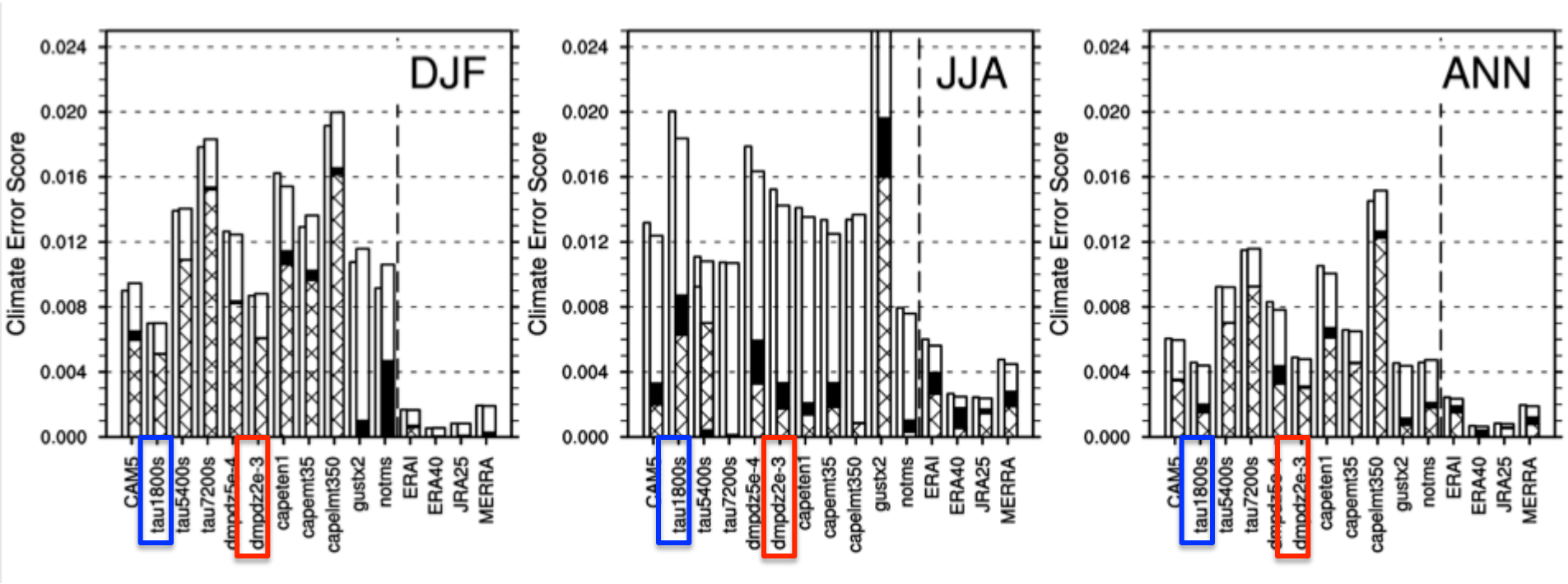

30 days




Blackburn et al. (2014) – APE catalogue

# AMIP simulations: Metrics of success

## Climate Skill Score (NHem 500-mb geo. height)




Phase errors (a)

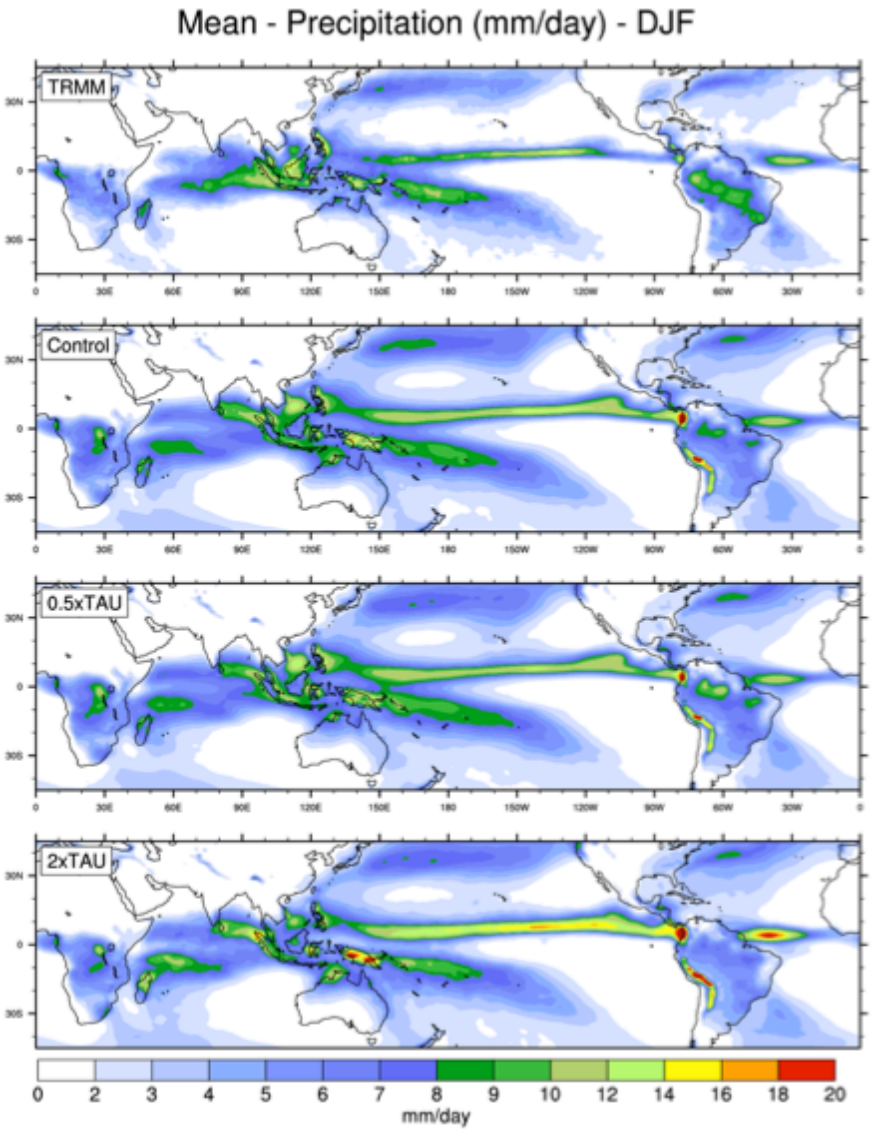
Conditional bias (b)

Unconditional bias (c)

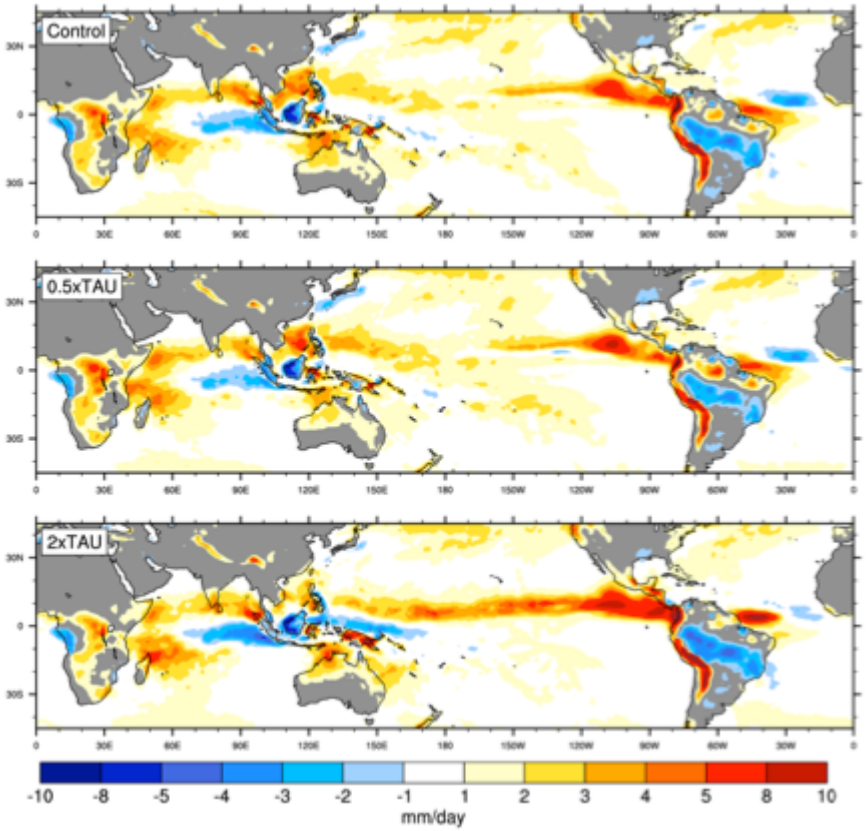
Scaled variance ratio

**NMSE** = (a)+(b)+(c)

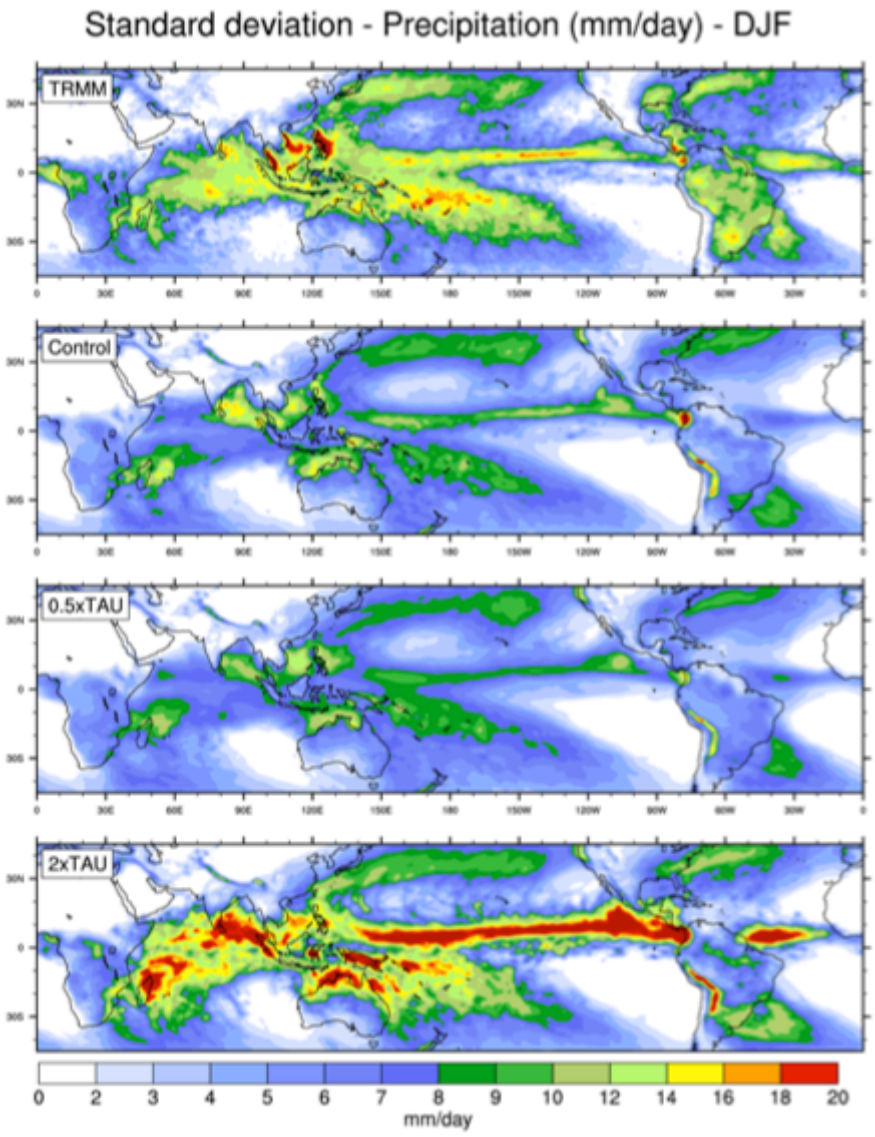
# Mean AMIP simulations: Time-scale (TAU)



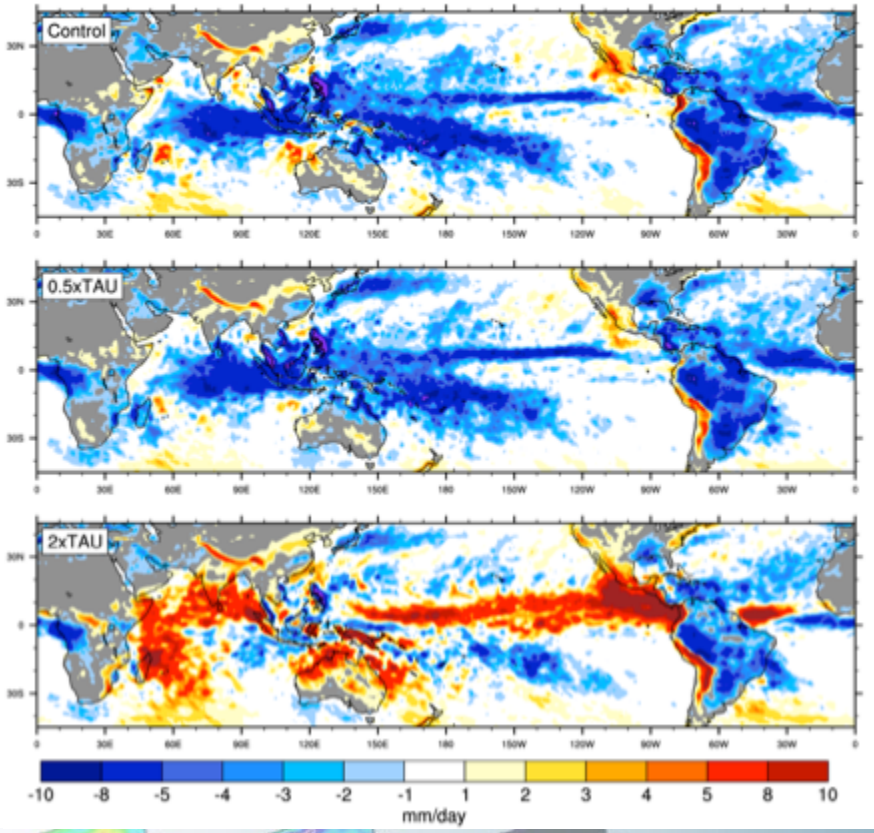

Model minus Observed



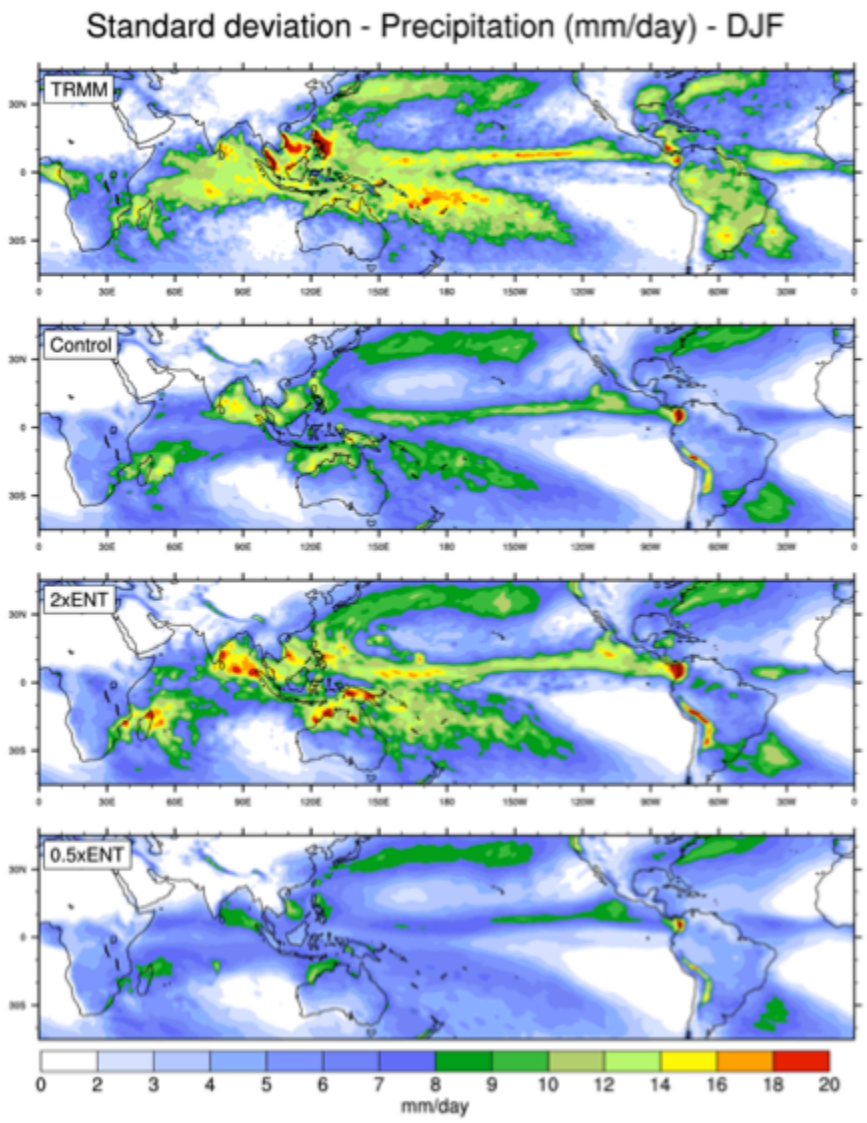
# Variability (daily data) AMIP simulations: Time-scale (TAU)




Model minus Observed



# Variability (daily data) AMIP simulations: Entrainment (ENT)

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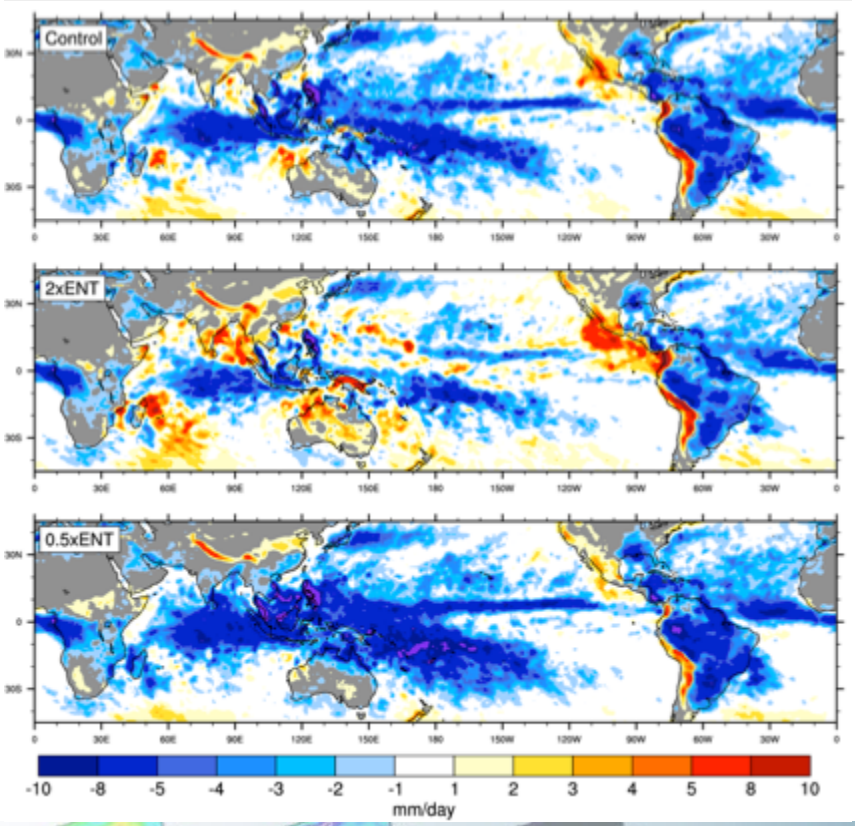

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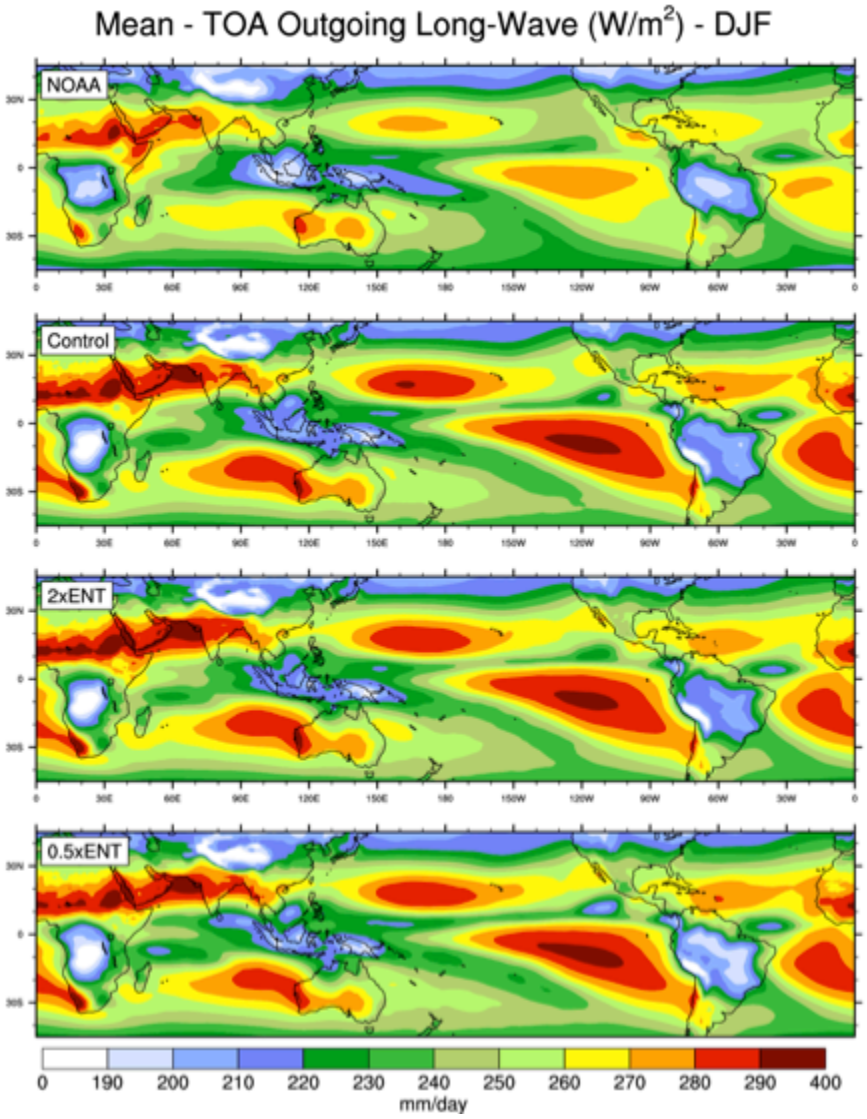


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