Evaluation of the IPSL climate model in a weather-forecast mode

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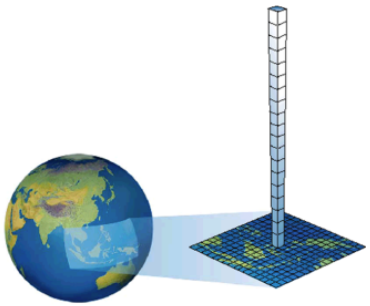
Solange Fermepin, Sandrine Bony and Laurent Fairhead

LMD/IPSL

Institut Pierre Simon Laplace

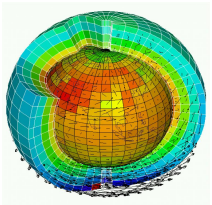
- We need to identify systematic biases in the physics of General Circulation Models (GCMs) to guide model development.
- We need to evaluate climate models in configurations where the dynamics is well constrained.

- A classical approach → **Single Column Model (SCM) simulations**:



  - One column integration of model physics forced by observed large scale dynamical forcings.
  - Limited number of locations.

- Another approach → **Transpose AMIP simulations**:



  - Global short term integrations.
  - GCM initialized from a very well defined state (reanalysis).

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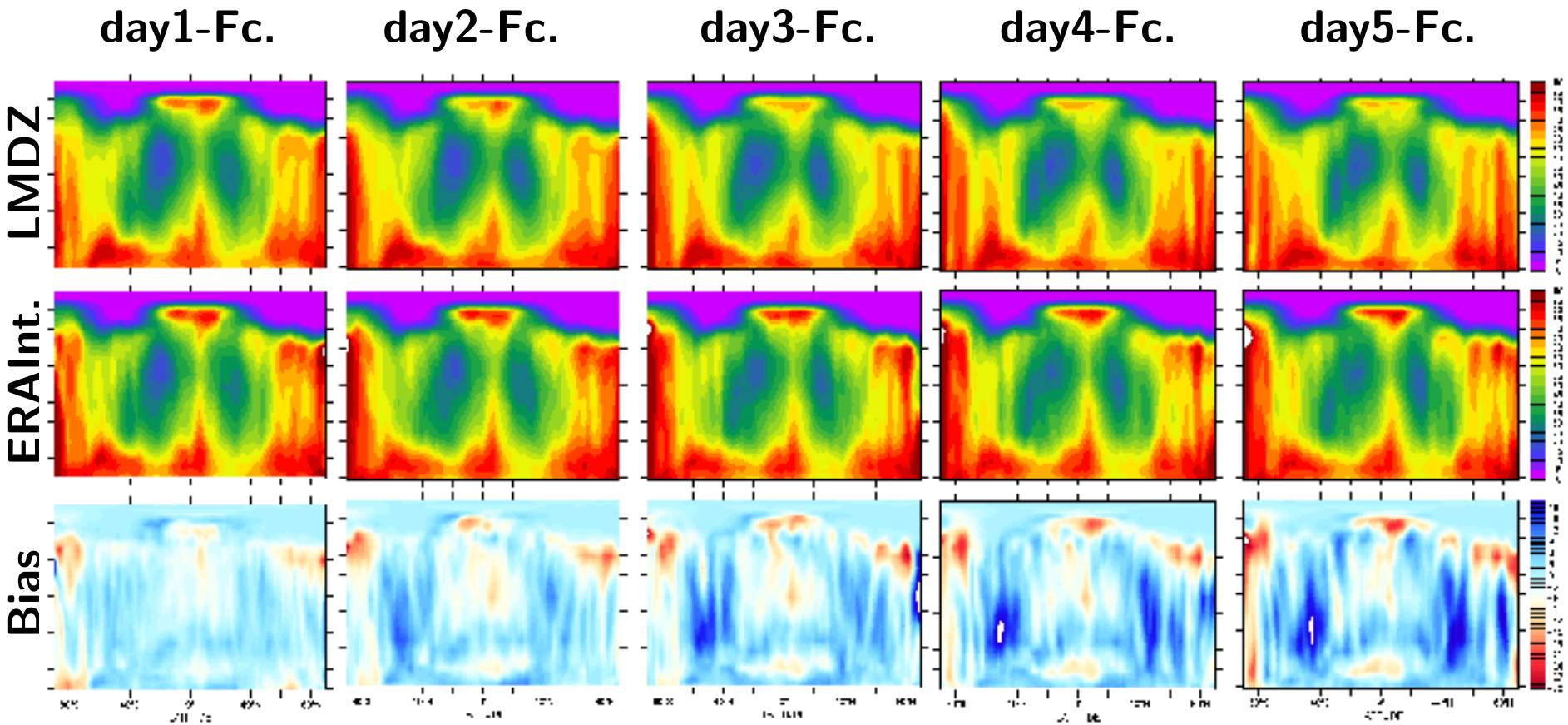
Motivation: to identify errors in the model physics and their influence on the model dynamics.

An example: RELATIVE HUMIDITY errors in LMDZ, 15-Oct-2008



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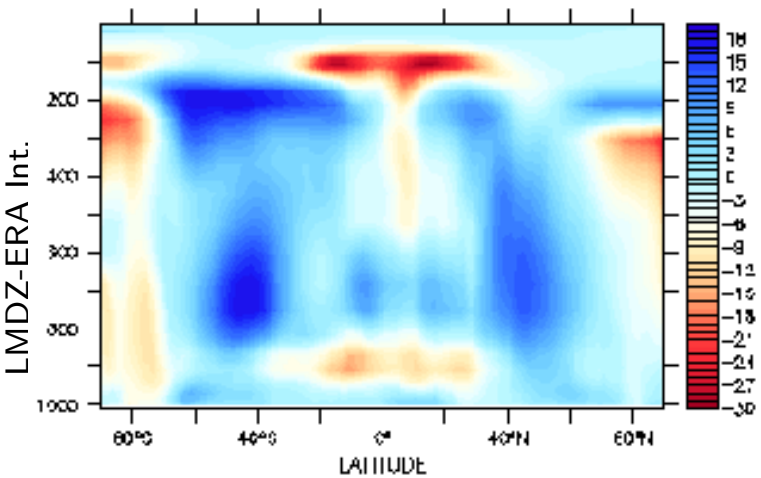
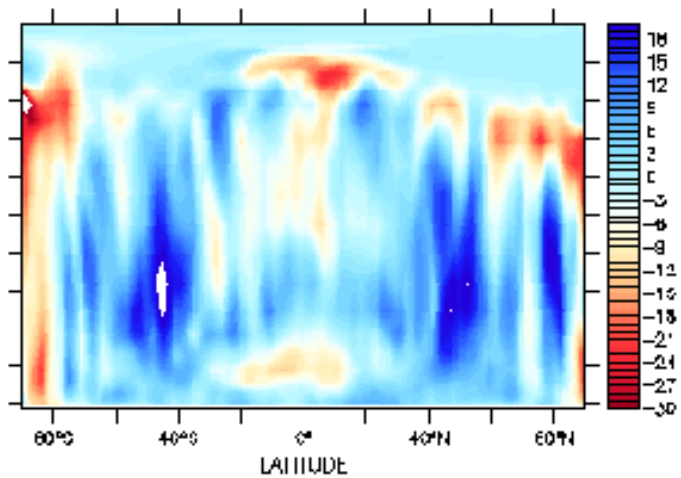
10-yr. October Climatology errors



day5-Forecast errors



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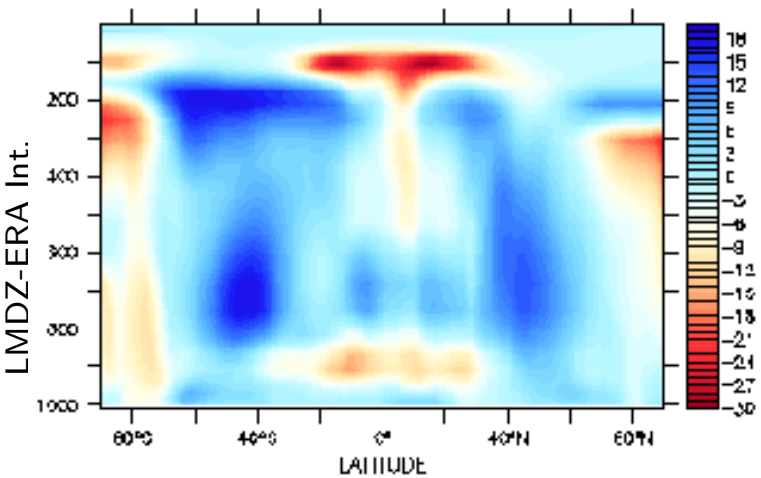

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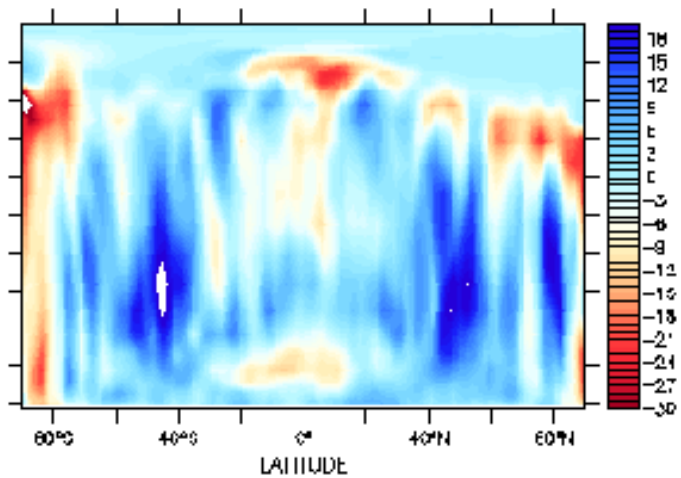

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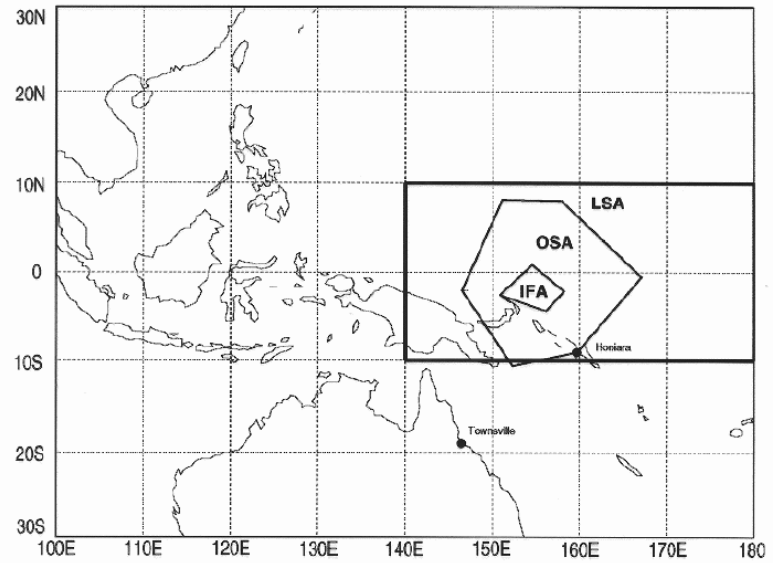
Which approach better points out the reasons for the climatological biases of LMDZ?

Case of study: TOGA-COARE

Tropical Ocean Global Atmosphere Coupled Ocean Atmosphere Response Experiment

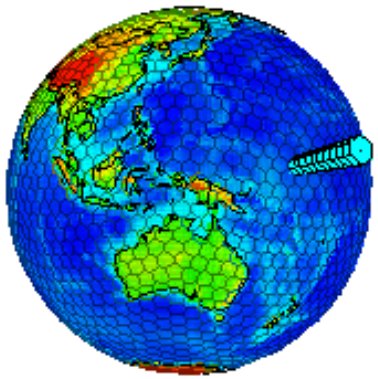
- From 1992-Nov-01 to 1993-Feb-28
- [a] Comprehensive observational Dataset
- Wester Pacific Warm pool
- Intensive Flux Array (IFA) (155E, 2S)



[a] Ciesielski, et al. (2003)

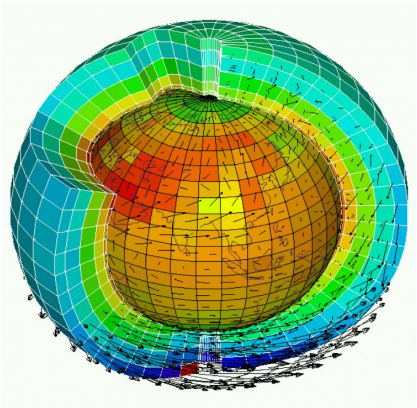
SCM

- Single column version of LMDZ
- Location: 155E, 2S
- 39 vertical levels
- SSTs observed
- TOGA-COARE forcings



LMDZ

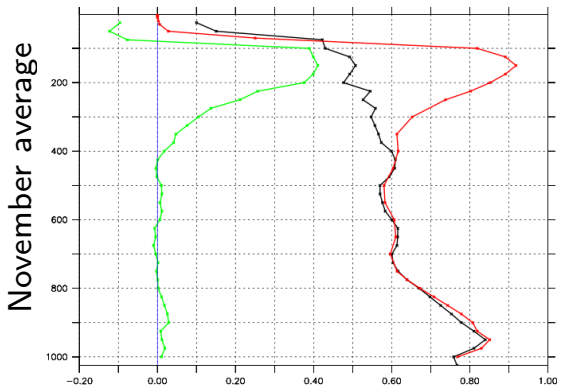
- Atmospheric component of IPSL climate model
- 3.75 x 1.87 resolution
- 39 vertical levels
- SSTs prescribed
- ERA Interim for initialization (u,v,r,T,sp) with TOGA obs. assimilated



Relative Humidity: Observations, Reanalyses and models

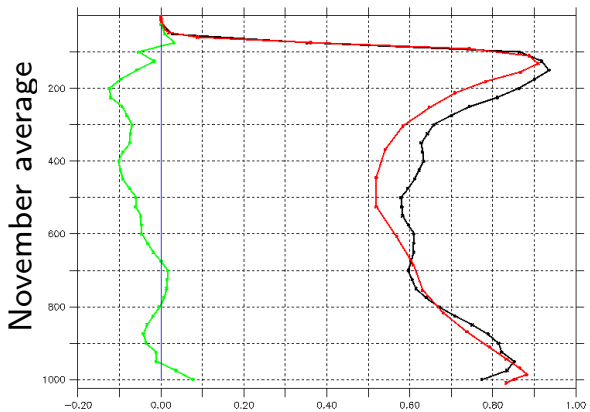
ERA Int. vs IFA Obs.

IFA Obs.→
ERA Int.→
ERA - Obs.→

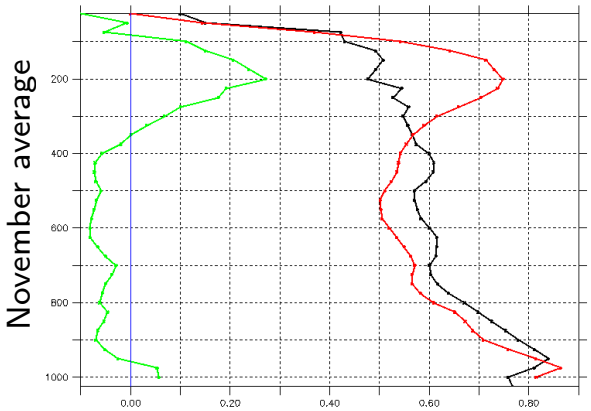


day1-FC vs ERA

ERA Int.→
day1-fc.→
Fc. - ERA→



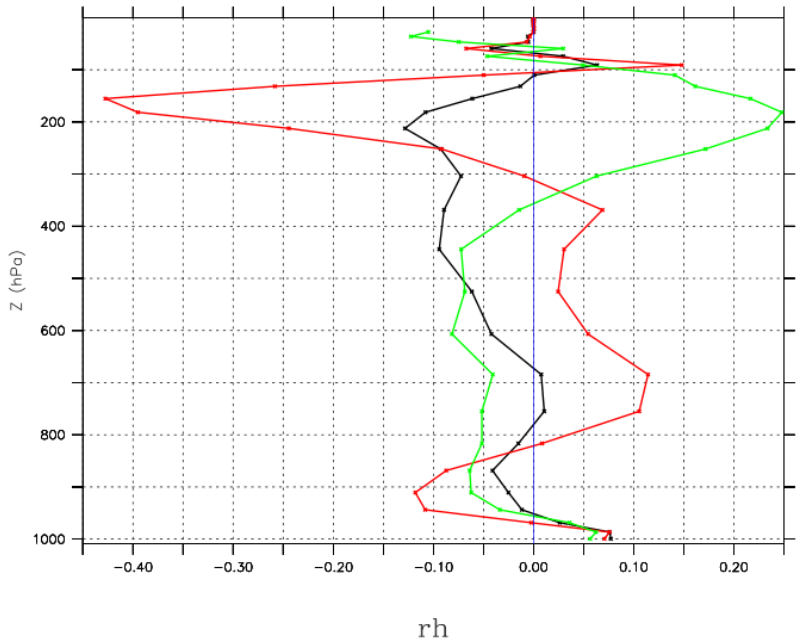
SCM vs IFA Obs.



← IFA Obs.
← SCM
← SCM - IFA Obs.

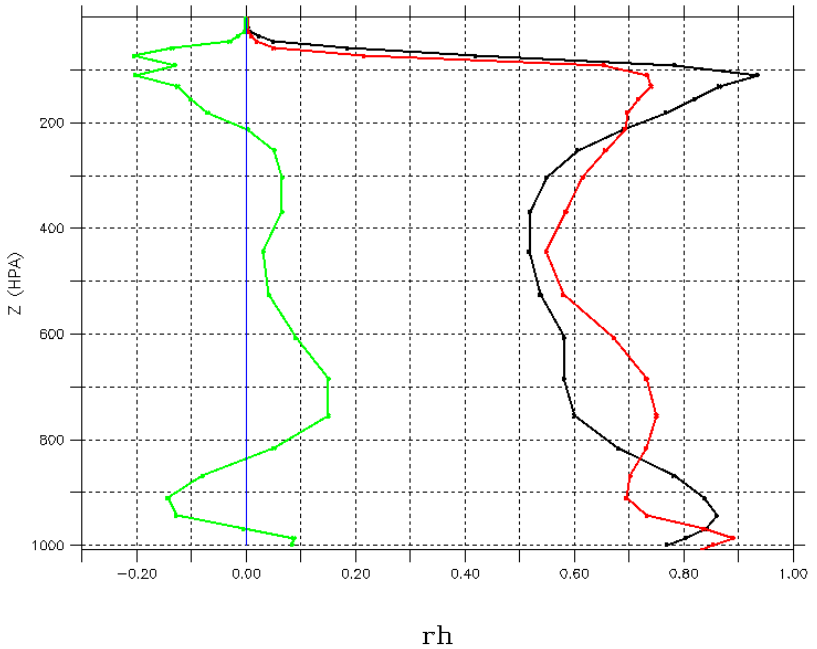
Relative Humidity at the IFA: November Bias

November 1992



→ day1-Fc. - ERAInt
→ day5-Fc. - ERAInt
→ SCM - IFA Obs.

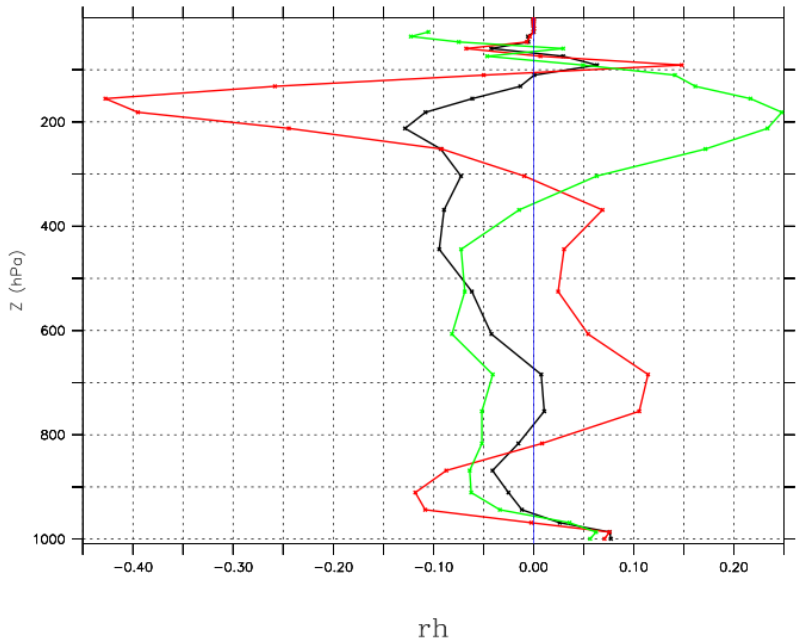
10-yr. November Climatology



→ 10-yr ERA Int. Clim.
→ 10-yr. LMDZ Clim.
→ Bias = LMDZ - ERA Int.

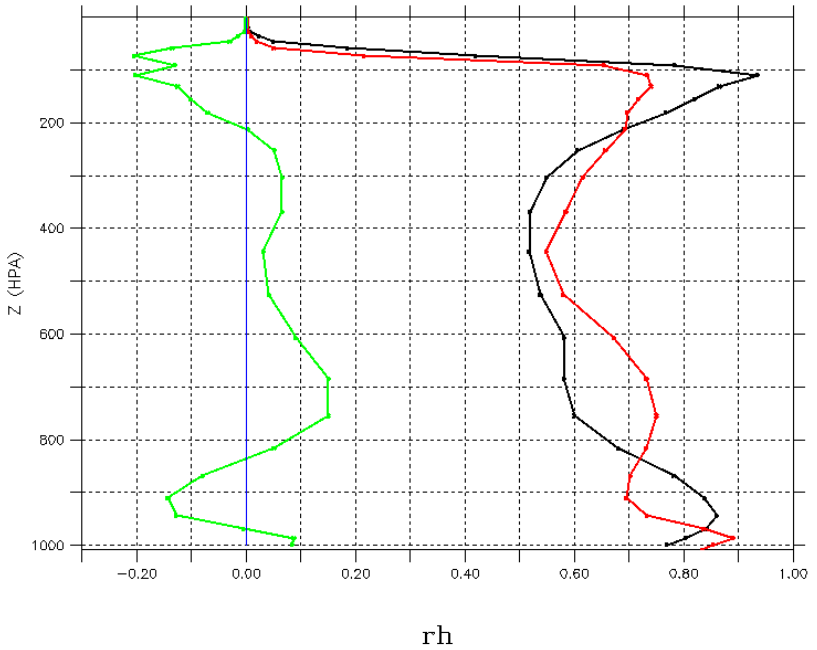
Relative Humidity at the IFA: November Bias

November 1992



→ day1-Fc. - ERAInt
→ day5-Fc. - ERAInt
→ SCM - IFA Obs.

10-yr. November Climatology



→ 10-yr ERA Int. Clim.
→ 10-yr. LMDZ Clim.
→ Bias = LMDZ - ERA Int.

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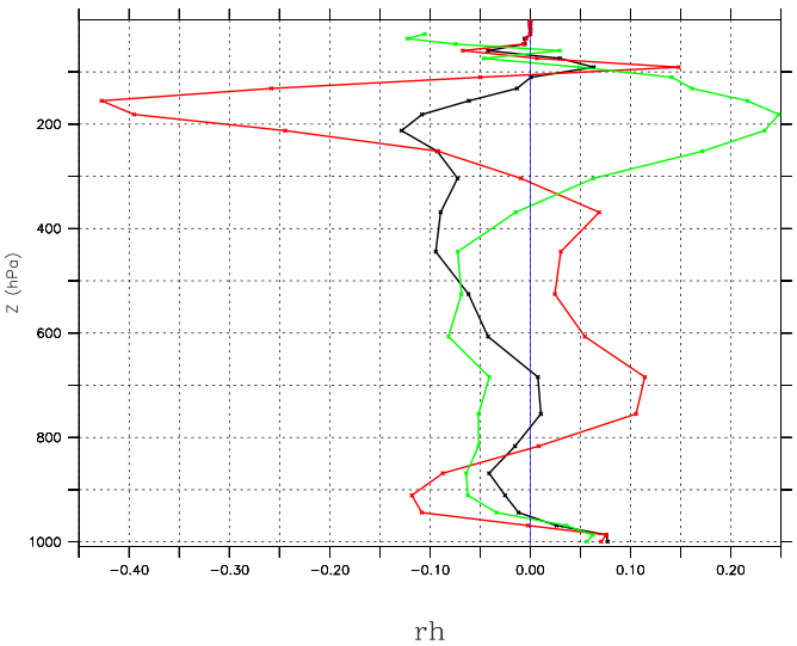
Influenced by dynamics?

Relative Humidity and Vertical Velocity at the IFA

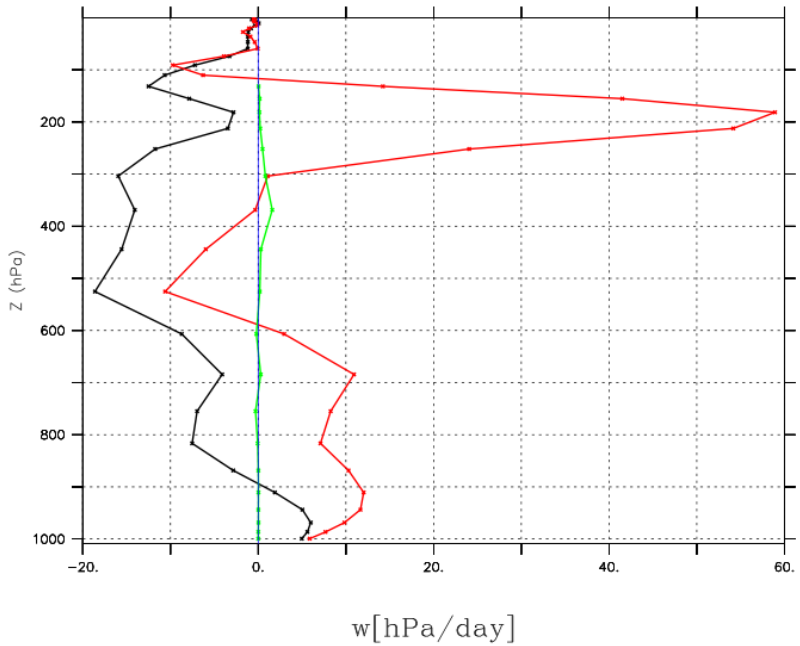
November 1992

Relative Humidity



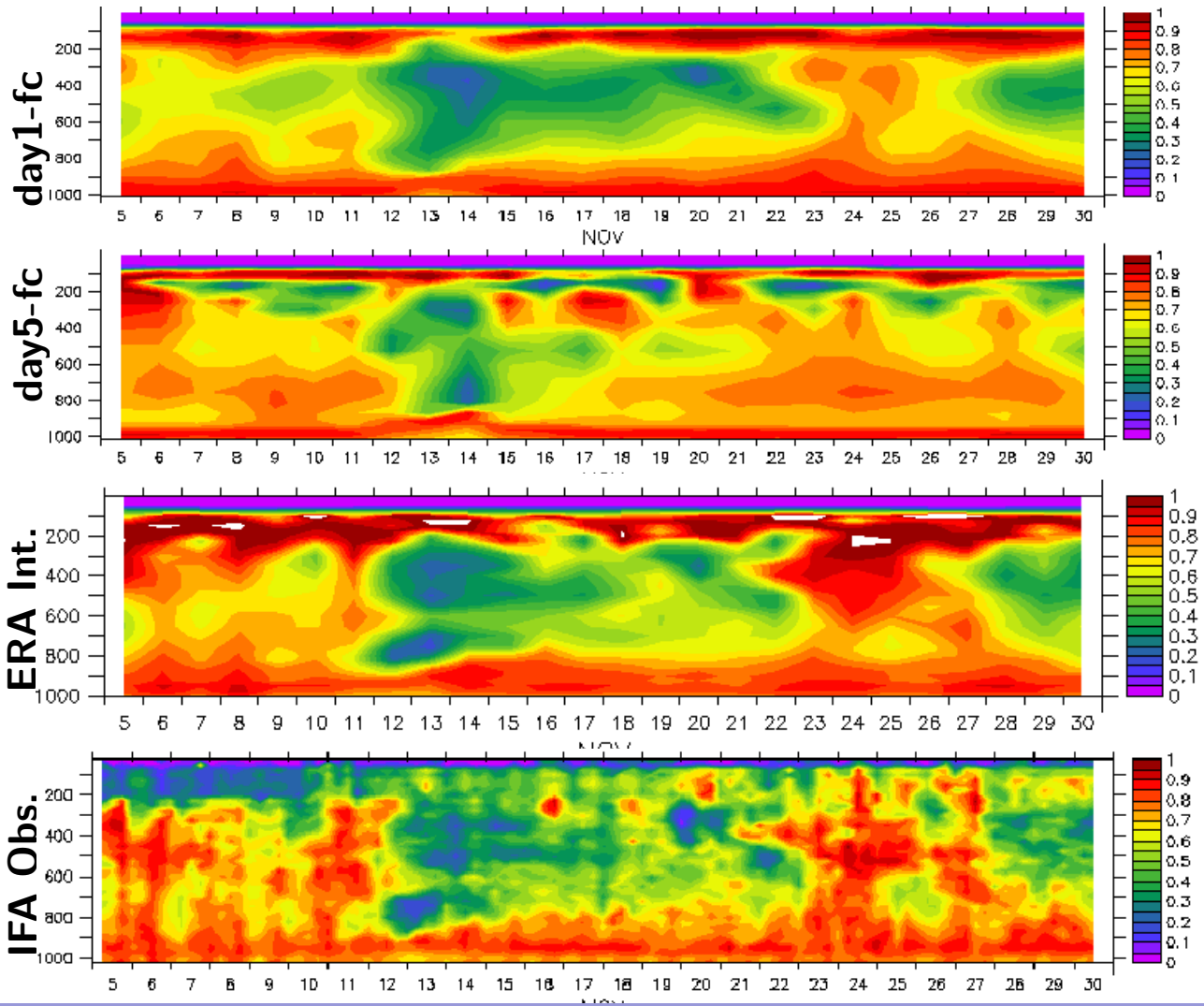
→ day1-Fc. - ERAInt
→ day5-Fc. - ERAInt
→ SCM - IFA Obs.

Vertical Velocity

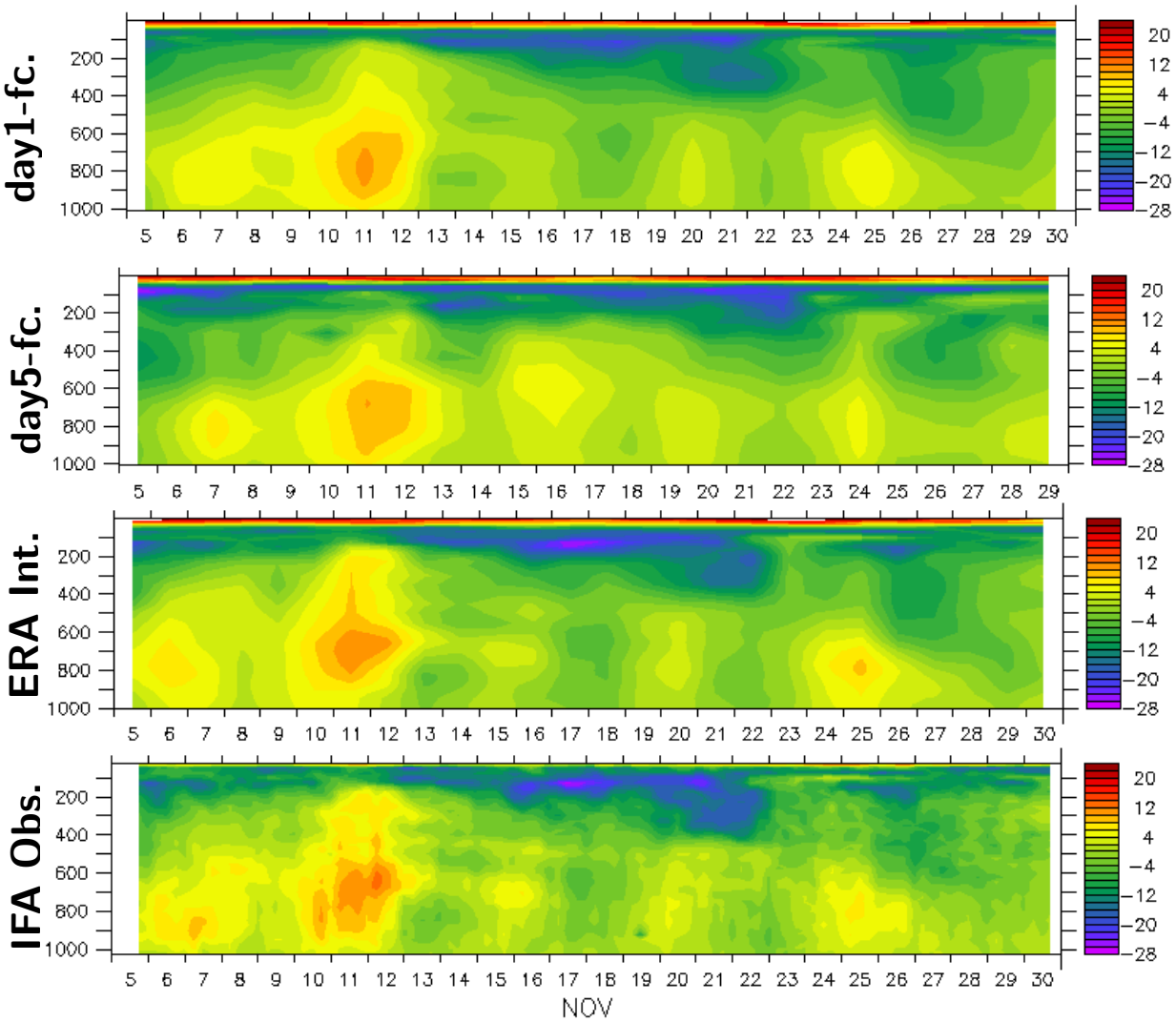


→ day1-Fc. - ERAInt
→day5-Fc. - ERAInt
→ SCM - IFA Obs.

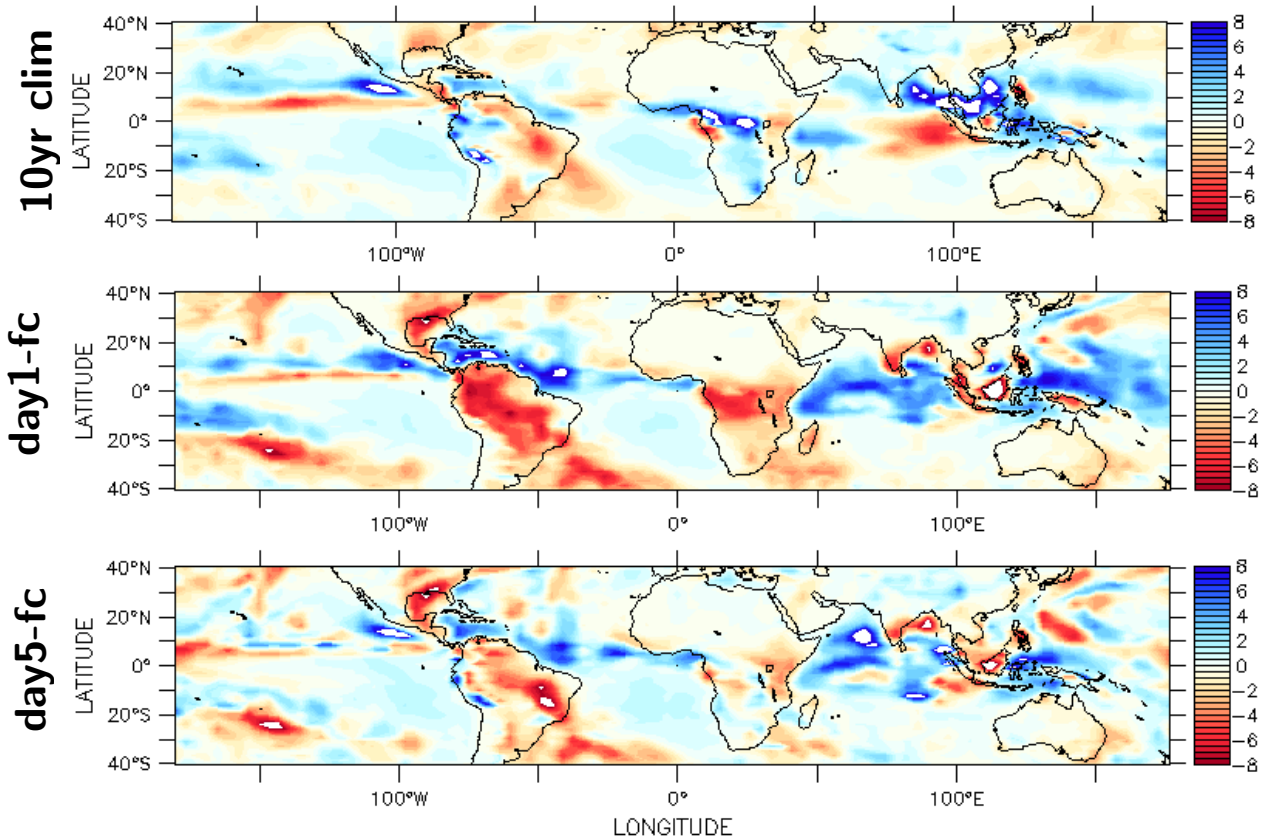
Relative Humidity time series at the IFA



Zonal Wind at the IFA



Precipitation: November average errors (mm/day)



So far...

- Some model biases appear early in the Transpose-AMIP simulations and amplify very quickly over the first few days of integration.
- First day Transpose AMIP forecasts show good agreement with Single Column Model simulations as expected, since in both cases the dynamics is well constrained.
- By the fifth day of integration, the errors in Transpose AMIP simulations resemble the climatological errors in the model, showing that Transpose AMIP approach allows us to study the influence of dynamics errors on the physics of the model.

...for the future

- Transpose AMIP will be used to study the influence of the representation of clouds on the large scale dynamical biases.
- It will also be used to study the resolution sensitivity of the parametrization of convection in the LMDZ model.

Thank you!