USE OF REANALYSES TO EXAMINE CLIMATE MODEL ERRORS IN SHORT FORECASTS

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Forecasts with climate models

- **from operational analyses and reanalyses**
- **at climate model production resolution**

Gain insight into parameterization errors

- **by comparing parameterized variables to estimates**
  - **from field campaigns (e.g. ARM)**
- **when states fed to parameterizations are still**
  - **close to atmospheric analyses**

Also useful just to examine model state errors

- **compared to reanalyses**
- **sensitivity studies to address hypotheses**

Benefit of using multiple reanalyses:

- **Establish sensitivity to different analyses parameterizations and dynamics behaviors**
- **Native analysis can bias the results**

SPIN-UP DURING FORECAST

NWP goal – make best possible forecast of evolving weather

- **Spin-up of precipitation is common problem**
  - **occurs because model is inconsistent with analyses**
- **Precipitation ignored for first few hours of forecast**

Our goal – gain insight into model errors

- **Spin-up is primary signal**

Problem – analysis errors might contribute to spin-up

Precipitation Errors in Eastern Tropical Pacific

Standard CAM 5.1

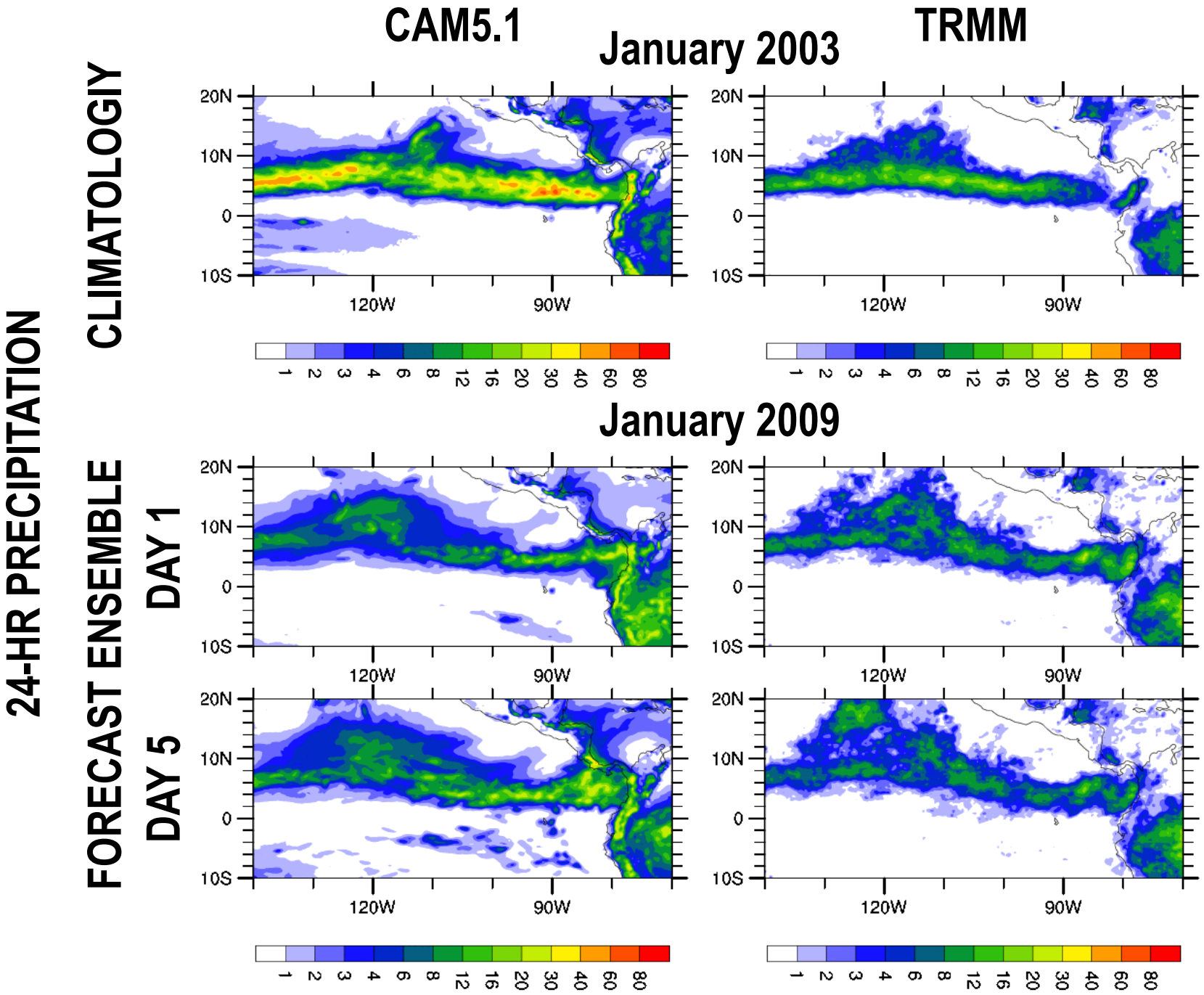
- 0.25 degree Finite Volume Dynamical Core
  - 1 degree physics tuning parameters
  - 15 minute physics time step

5-day forecasts initialized from

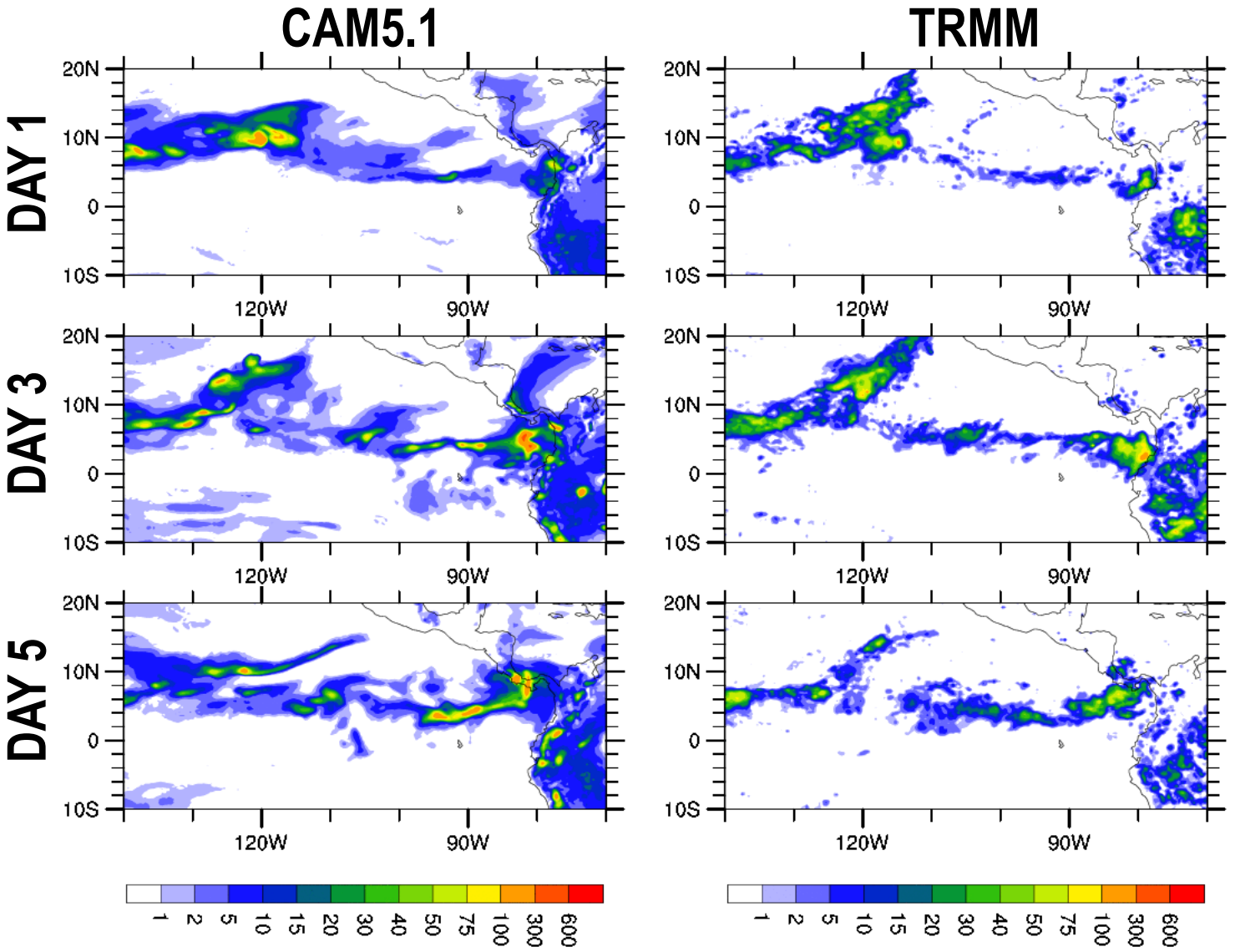
- ECMWF YOTC analyses
- MERRA YOTC analyses
  - 00Z January 3 to January 24, 2009

Compare to

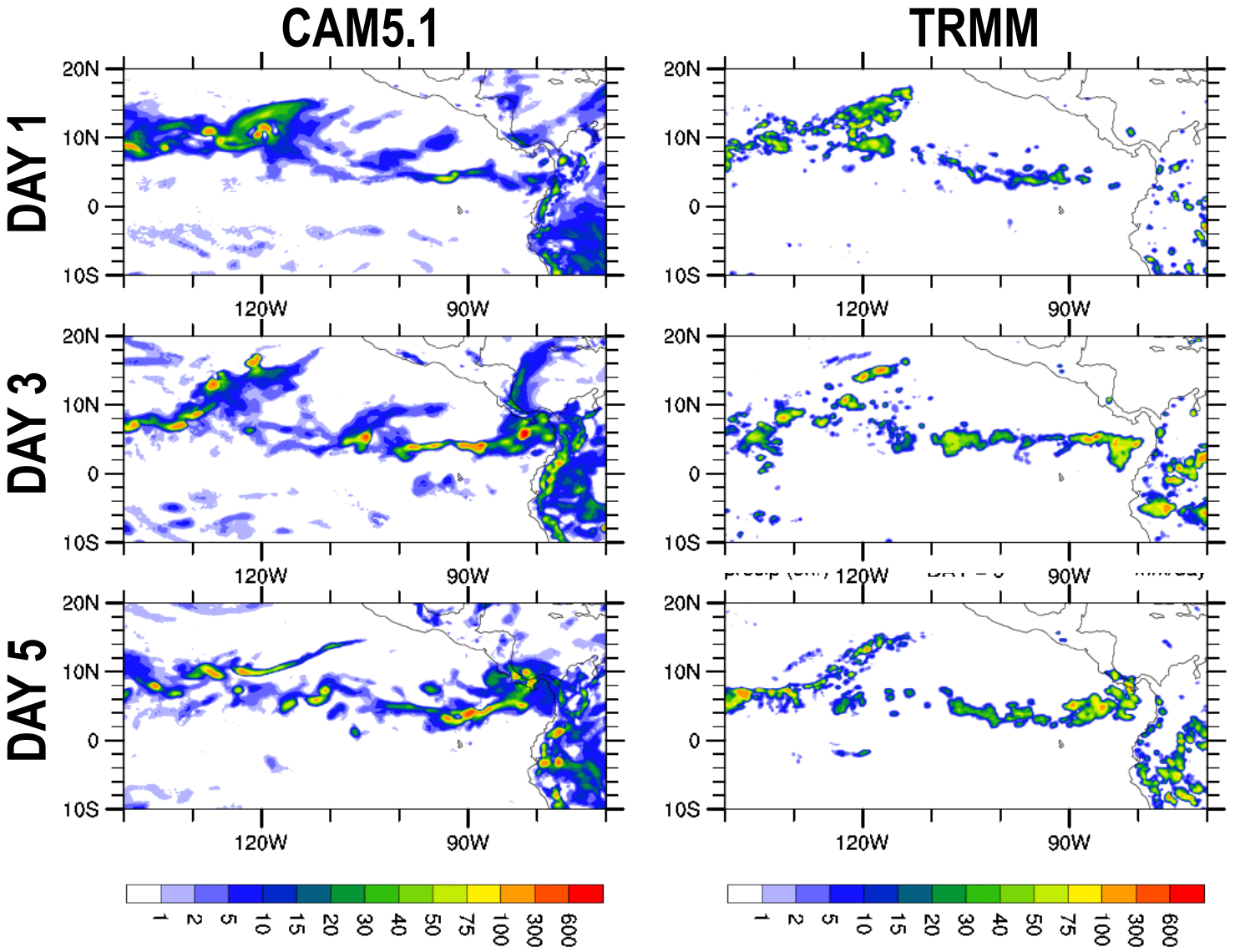
- Precipitation from 3-hourly 0.25 degree TRMM (3B42)
- State from reanalyses


24-HR PRECIPITATION
CLIMATOLOGIY
FORECAST ENSEMBLE
DAY 1
DAY 5
CAM5.1
TRMM
January 2003
January 2009
20N
10N
0
10S
120W
90W
1
2
3
4
6
8
12
16
20
30
40
60
80

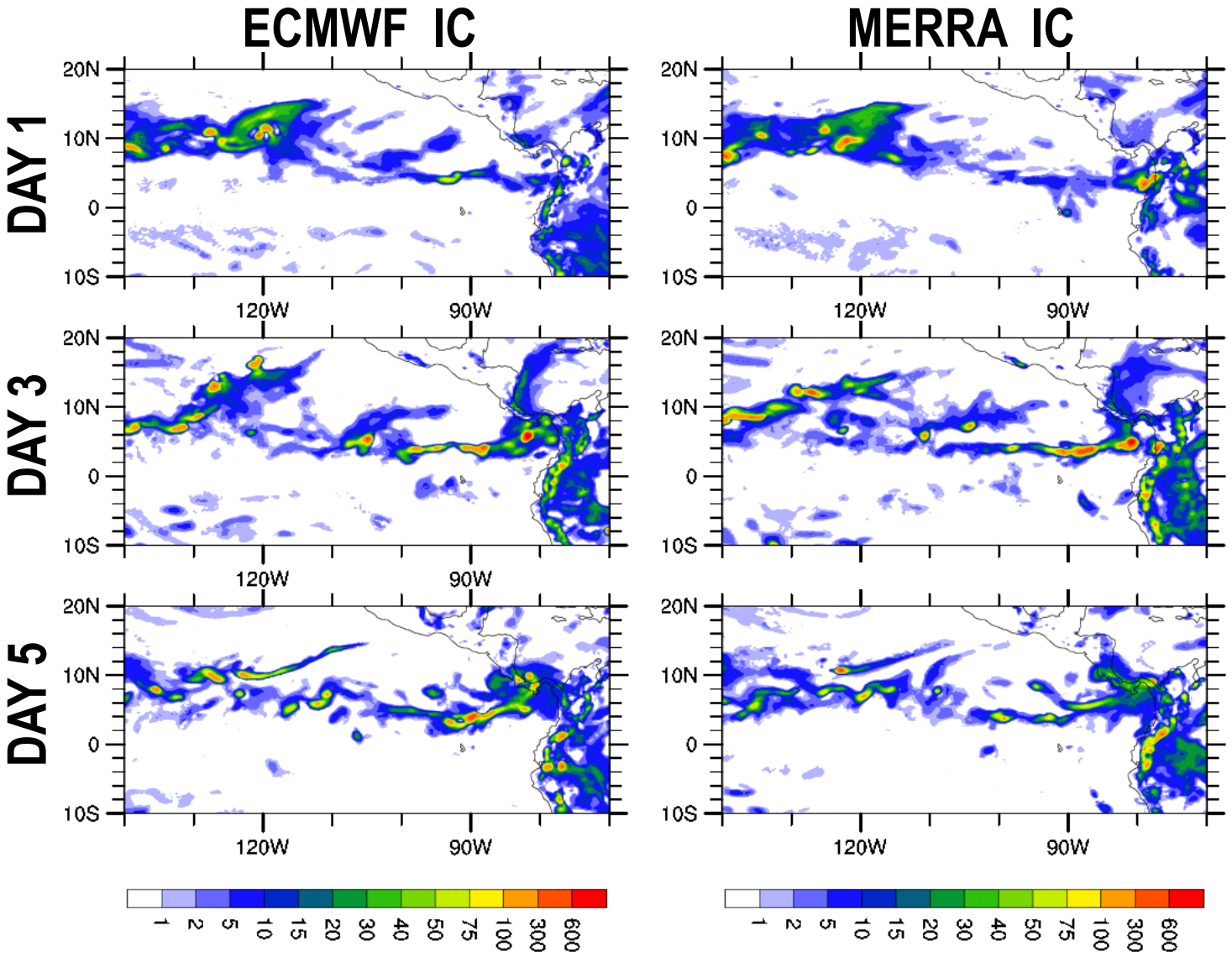
24-HR PRECIPITATION, IC = ECMWF 03 January



3-HR PRECIPITATION, IC = ECMWF 03 January

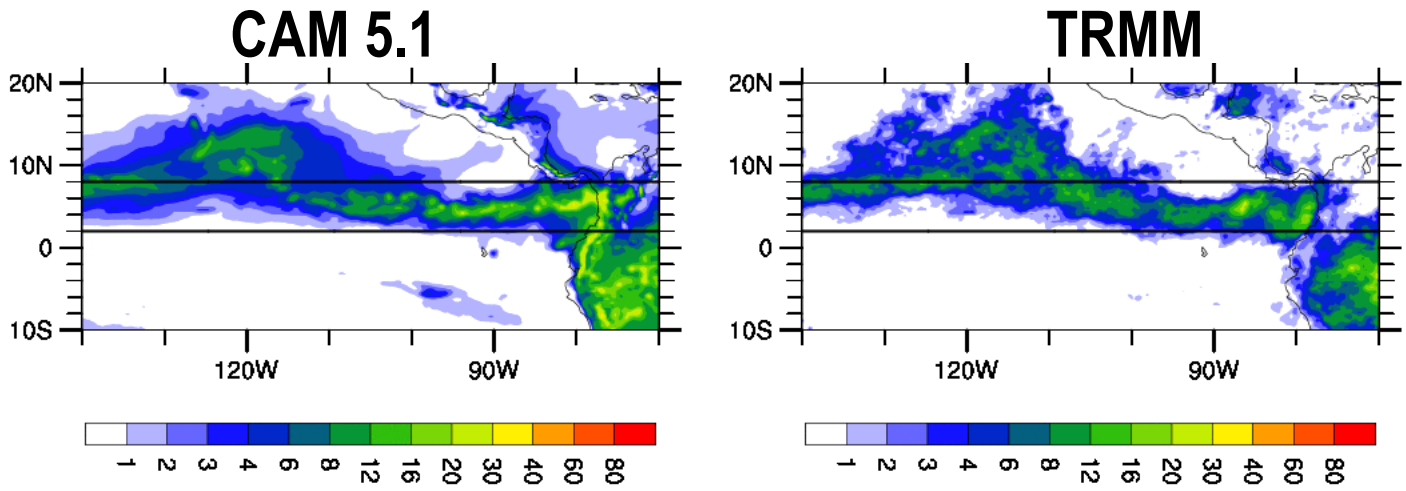


CAM5.1 3-HR PRECIPITATION, IC = 03 January



FORECAST ENSEMBLE 24-HR PRECPITATION

DAY 1



INDIVIDUAL FORECASTS
2 to 8 DEGREES

IC = 6 JAN

IC = 15 JAN

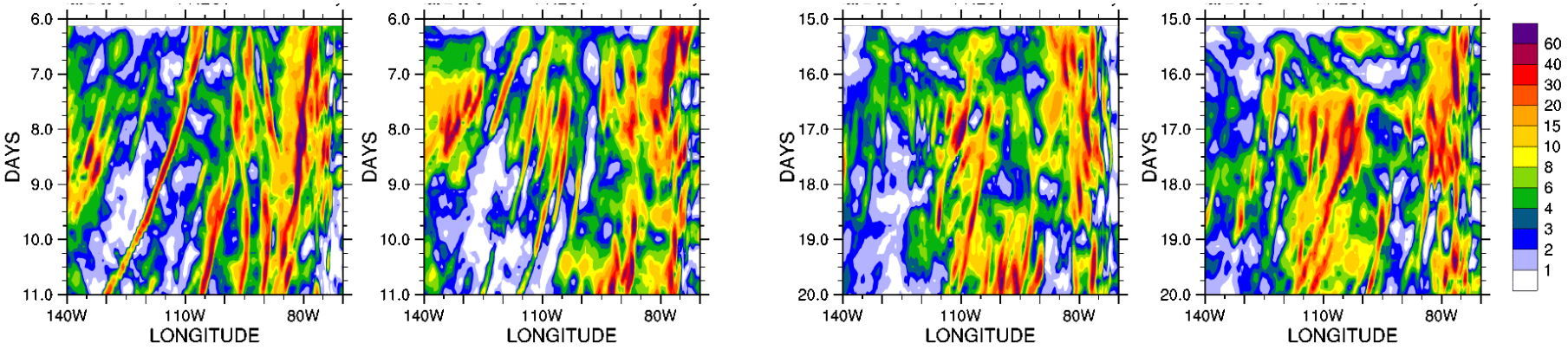
ECMWF

MERRA

ECMWF

MERRA

CAM5.1

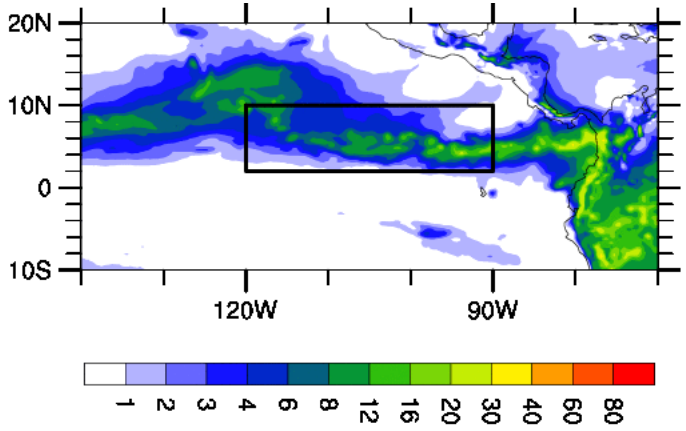


TRMM

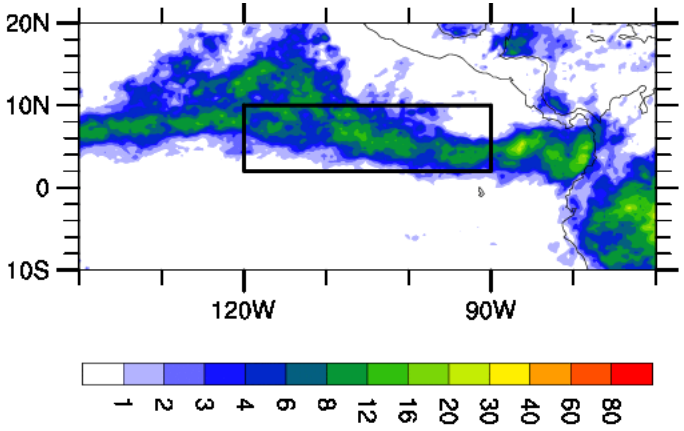
FORECAST ENSEMBLE 24-HR PRECPITATION

DAY 1

CAM 5.1



TRMM



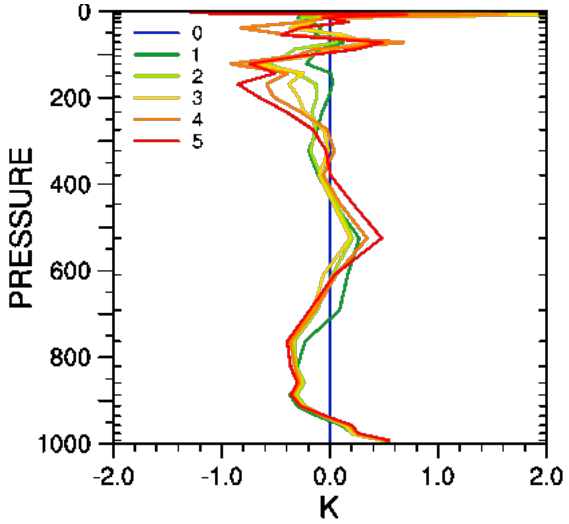
FORECAST ENSEMBLE TEMPERATURE ERROR

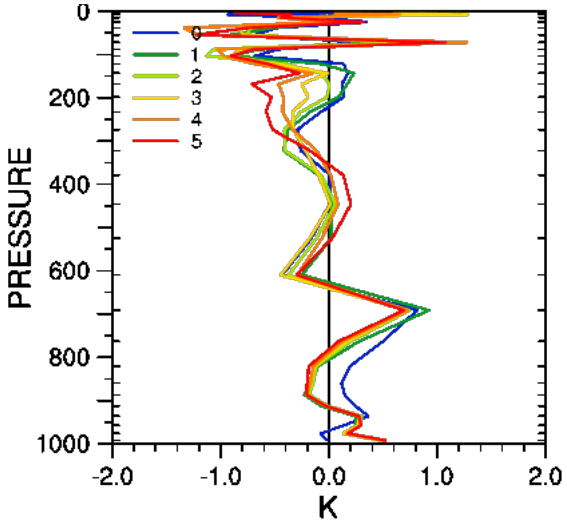
versus ECMWF

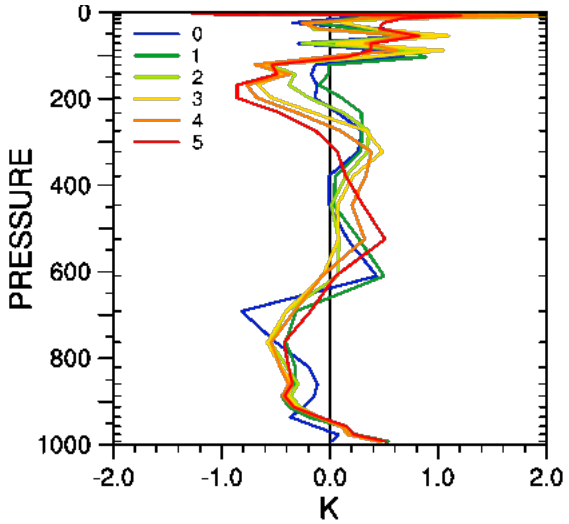
versus MERRA

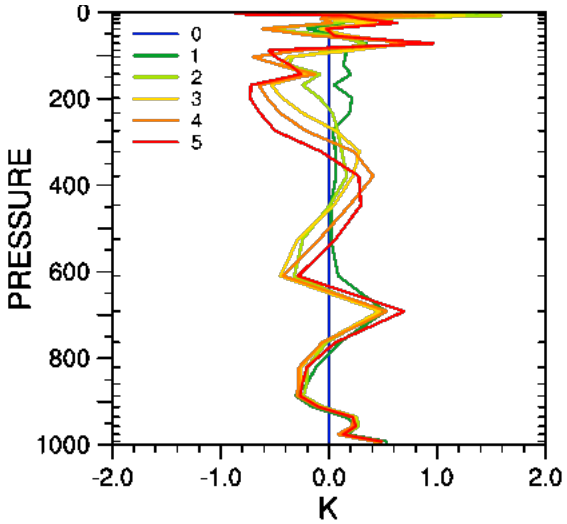
ECMWF IC

MERRA IC









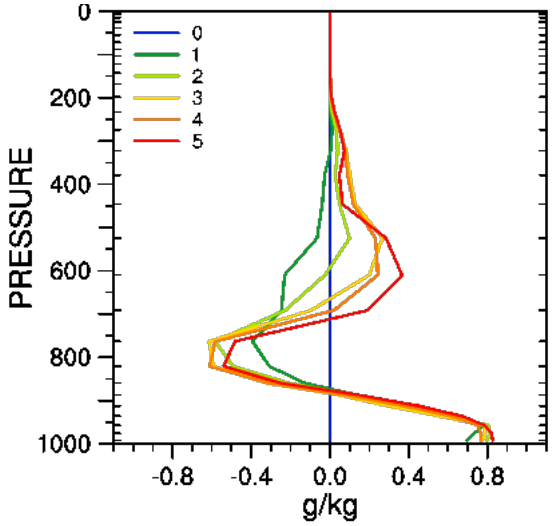
FORECAST ENSEMBLE SPECIFIC HUMIDITY ERROR

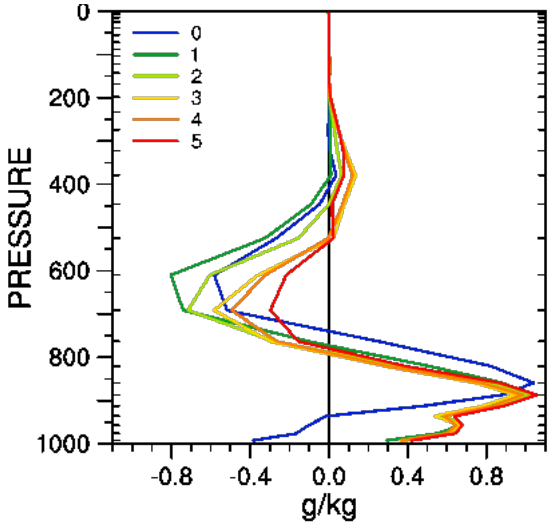
versus ECMWF

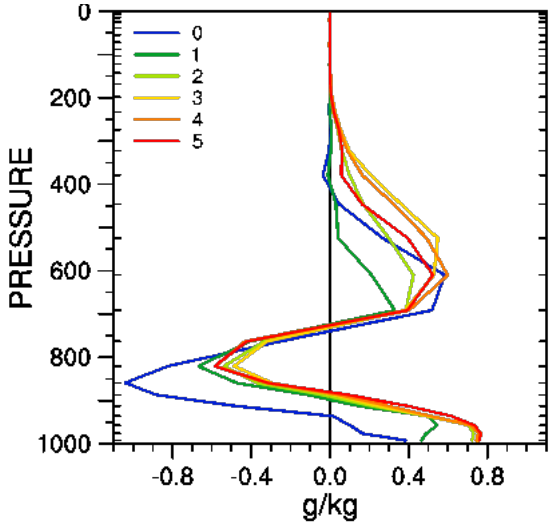
versus MERRA

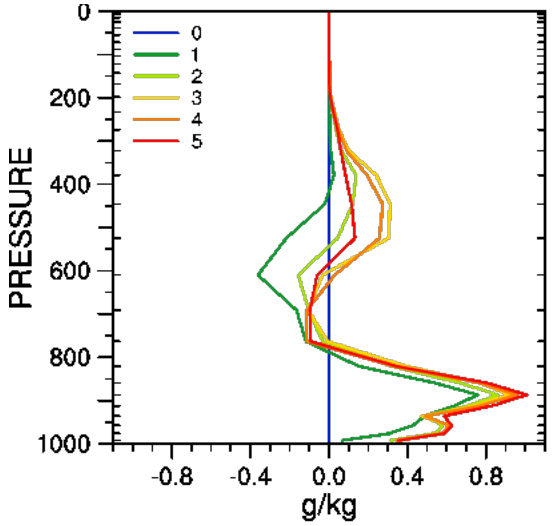
ECMWF IC

MERRA IC









Relatively inexpensive approach to examine primary errors before climate balancing occurs

Should have reanalysis on native grid

Allows experiments that might not survive long climate runs

Useful for sensitivity studies against reanalyses alone

Forecasts exposed a flaw in the model
    strong precipitation cells

Analysis of the model processes during the forecast
    reveals the source of that problem

Can eliminate that problem

Others remain with less obvious causes

Examine state errors based on reanalyses

- **How can we tell which are reliable and which to use?**

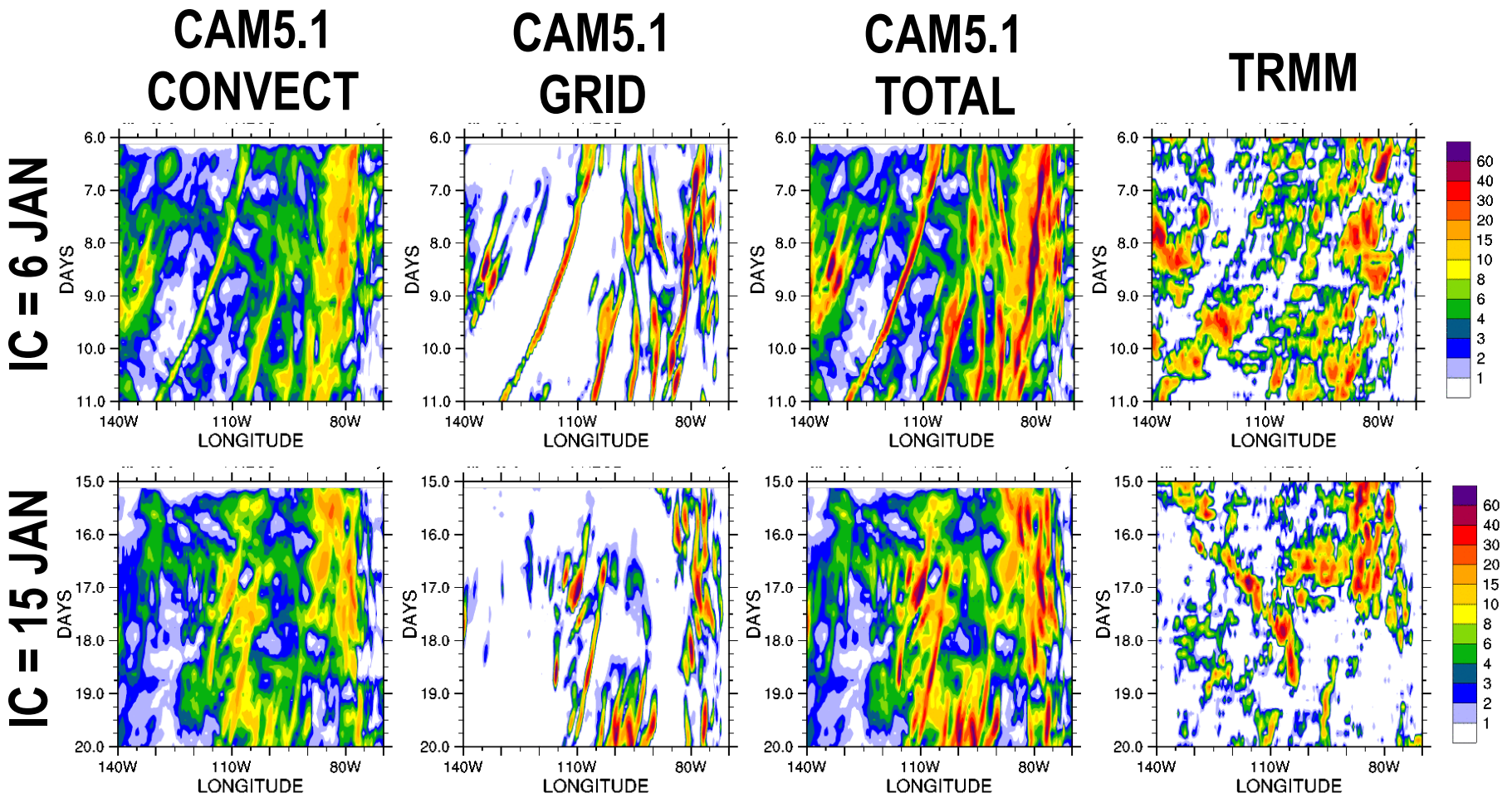
Simple first order statements like

- **Observations did affect the analysis in this area**
- **Analysis is very close to model first guess**

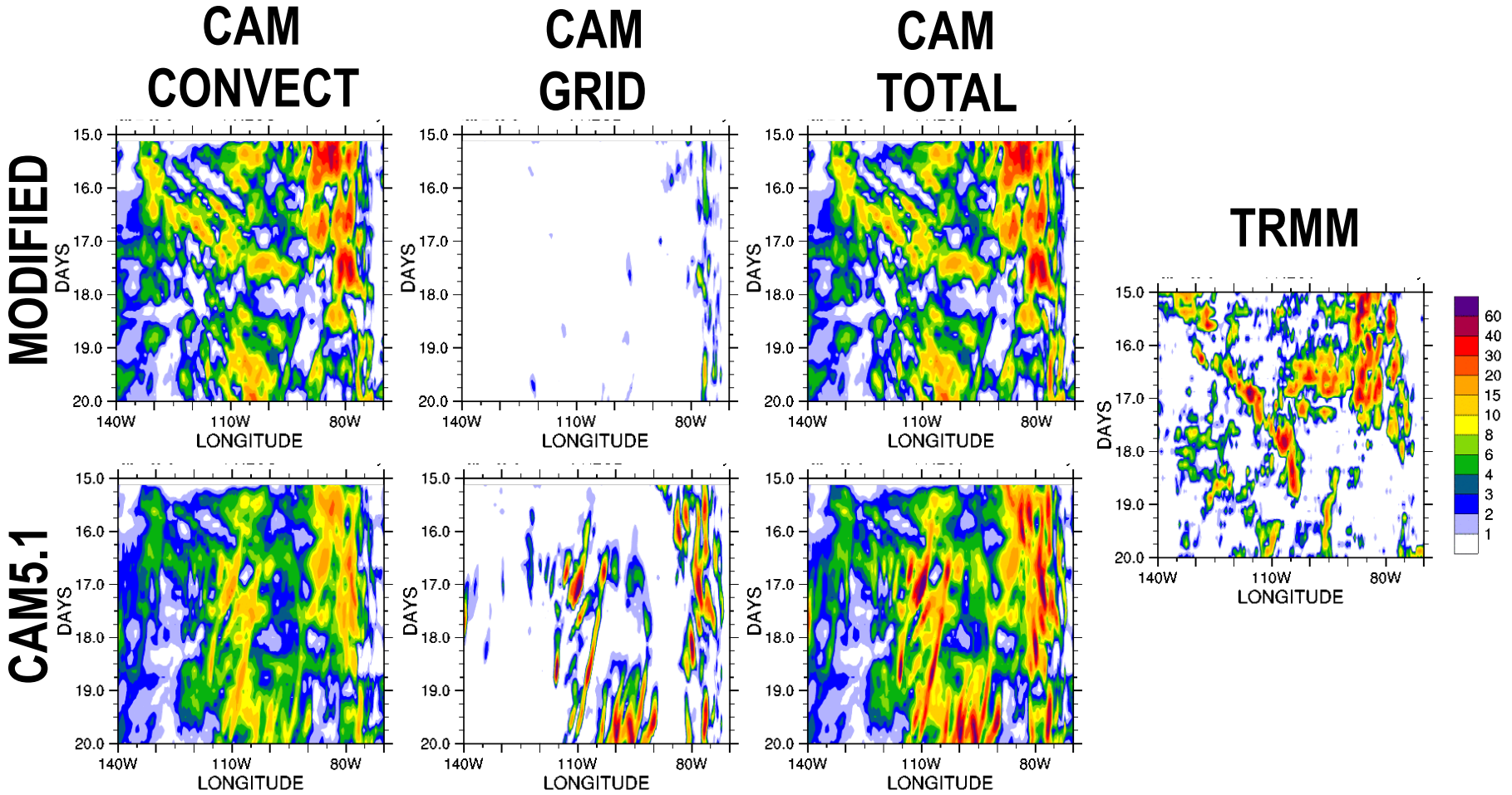
Community should make quality comparisons

- **and advise potential users on what the analyses**
  - **should and should not be used for**

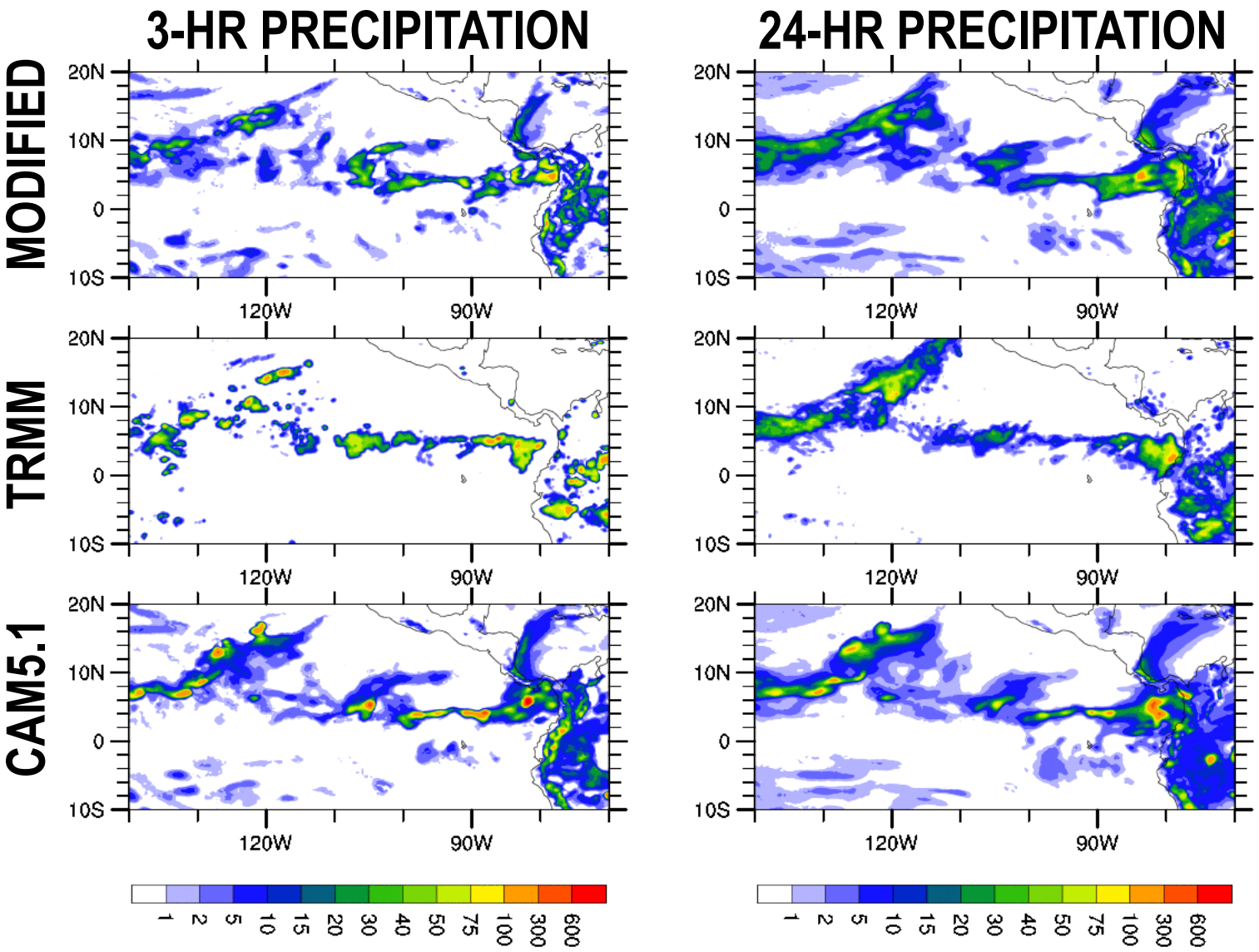
INDIVIDUAL FORECASTS FROM ECMWF
2 to 8 DEGREES



INDIVIDUAL FORECASTS, IC = 15 JAN
2 to 8 DEGREES



IC = ECMWF Jan 3, DAY 3 FORECAST



FORECAST ENSEMBLE TEMPERATURE ERROR

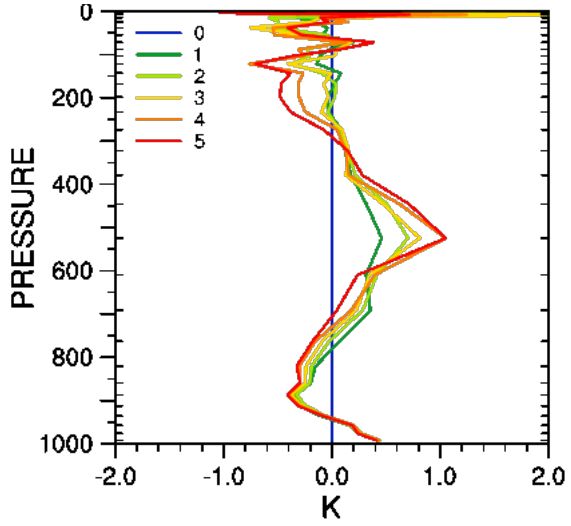
ECMWF IC

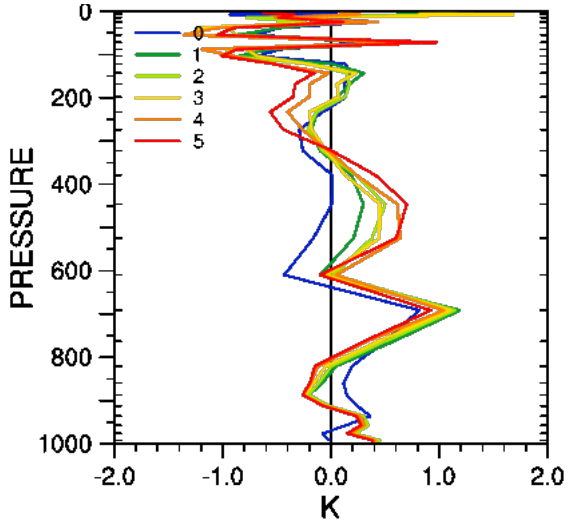
MODIFIED

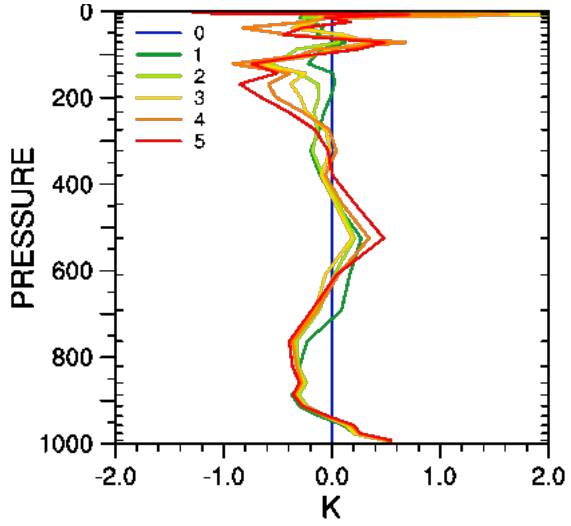
CAM5.1

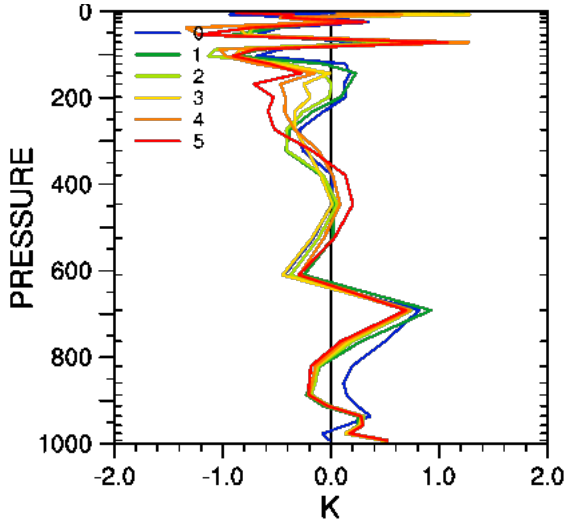
versus ECMWF

versus MERRA









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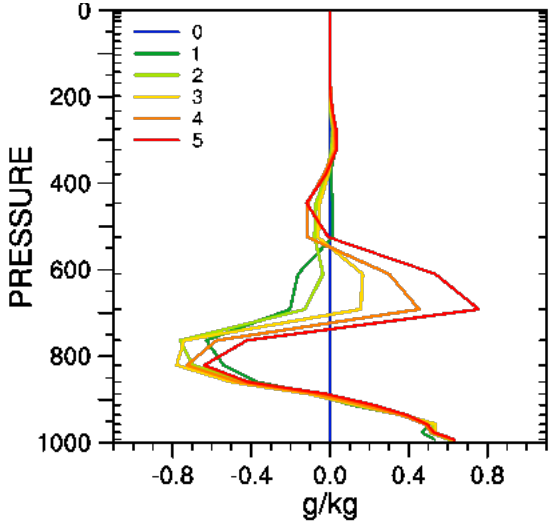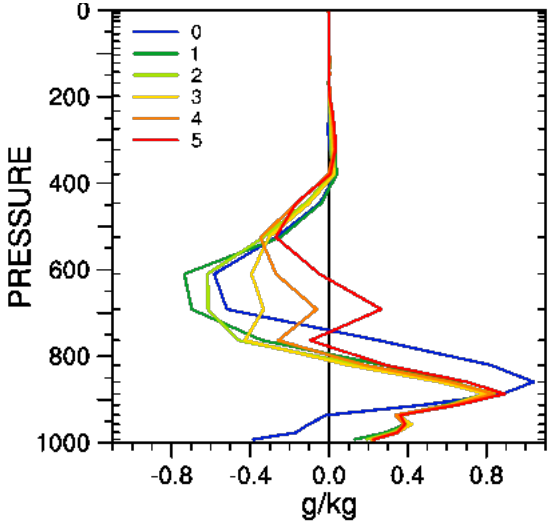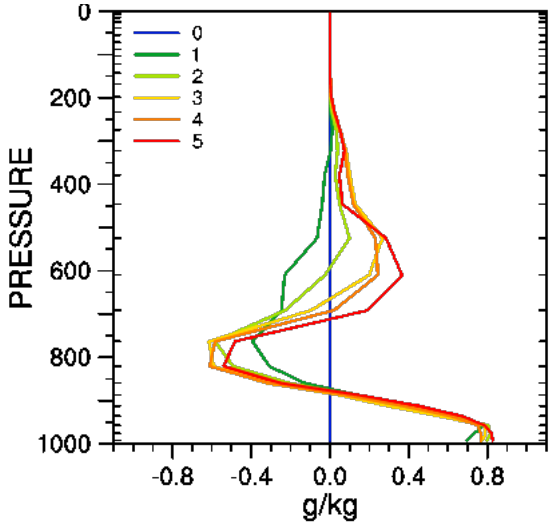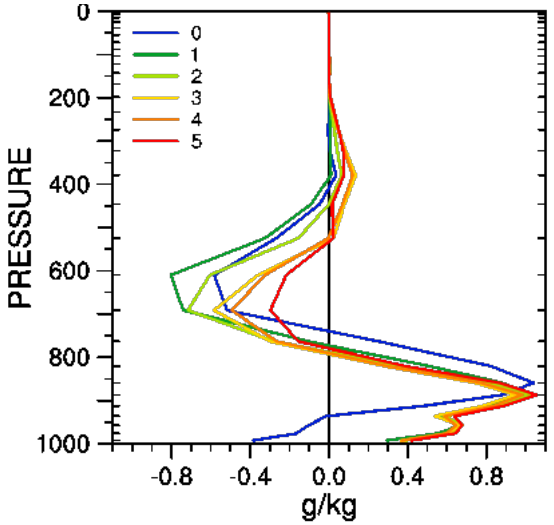
versus MERRA