Using the DART-CAM Ensemble Data Assimilation System for Climate Model Development

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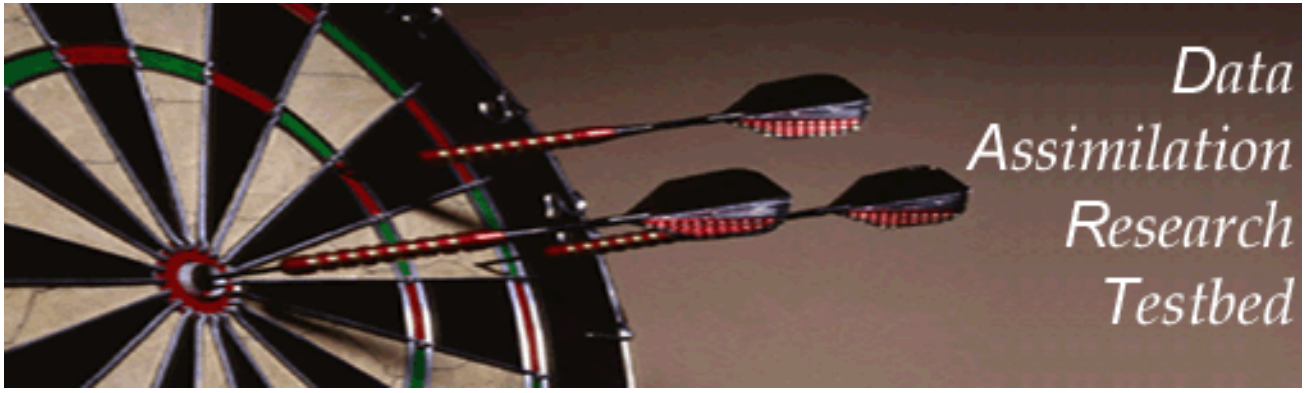


DART/CAM

A mature ensemble data assimilation facility for CAM.

Easy to use with CAM3.x spectral and FV.

Works with variety of physics options.

Competitive with operational NWP assimilation capabilities.

Converges within a few days in N.H. and tropics, a week in S.H.

Runs on variety of parallel architectures and compilers.

Run your own reanalyses and forecasts with CAM.

What we have available now...

Many 1-month assimilations with reanalysis obs.

1. T85 3.1 or 3.5 physics, Jan. and July
2. FV 3.5 physics Jan. and July

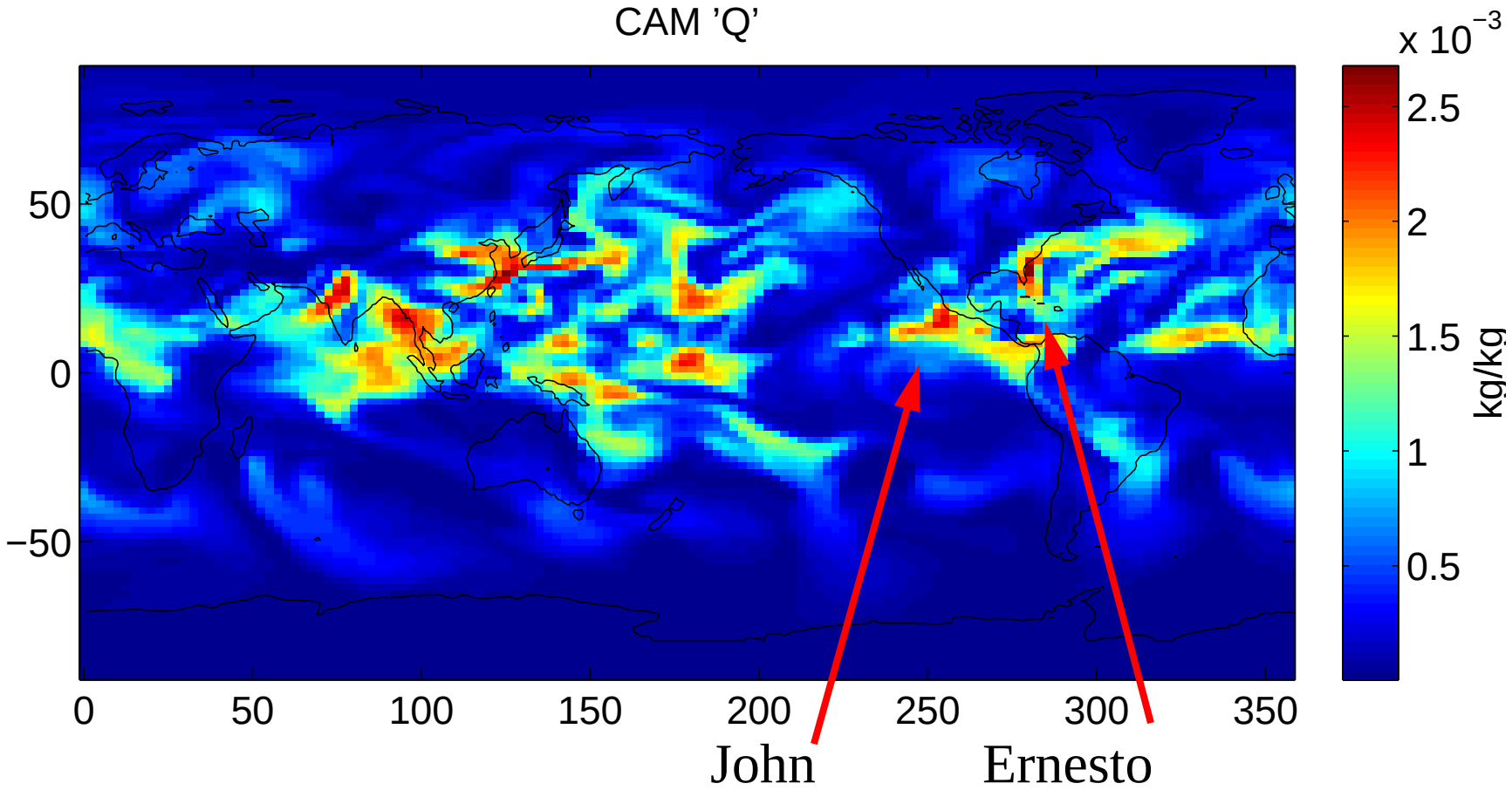
Year-long assimilations

1. FV 3.5 physics

What you can look at...

1. CAM analyses and forecasts (ensemble mean or ensembles).

31 August, 2007 6-hour forecast ensemble mean valid at 06 GMT
CAM FV 3.5 1.9x2.5 Q at 368 hPa



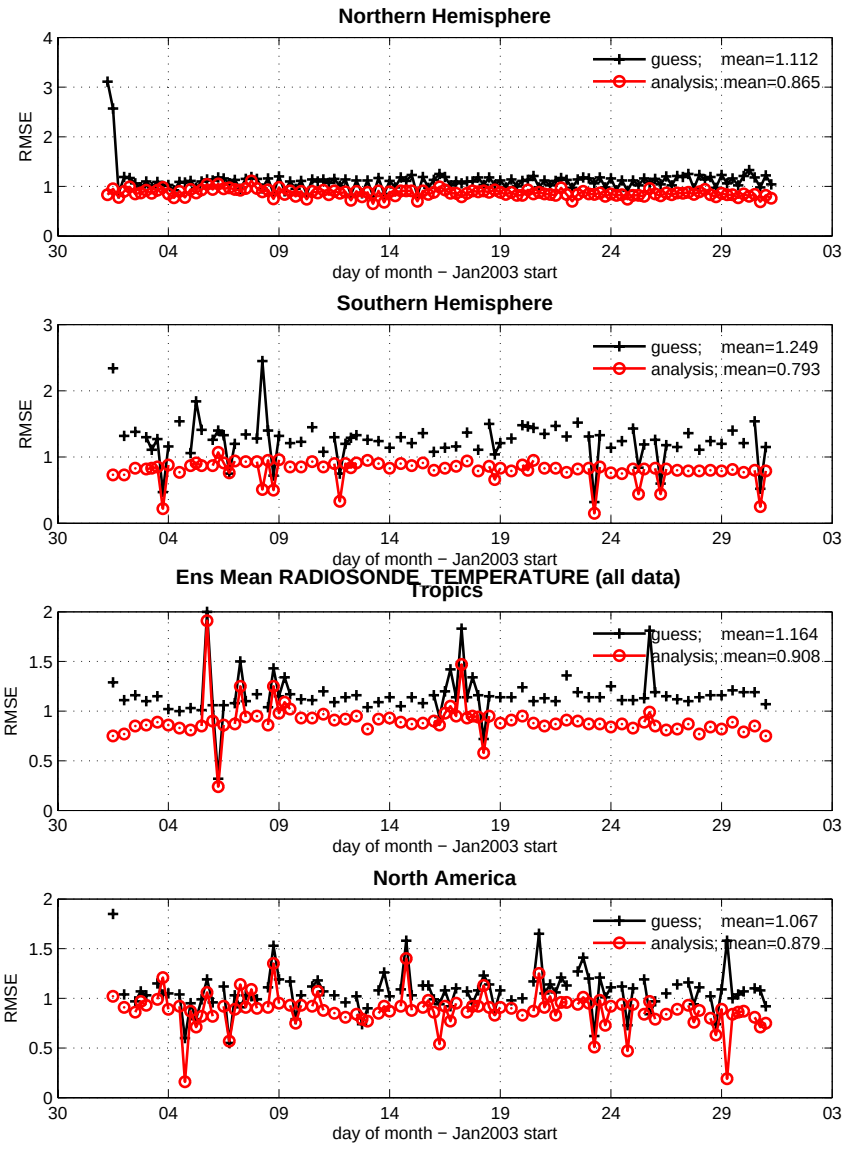
What you can look at...

1. CAM analyses and forecasts (ensemble mean or ensembles).

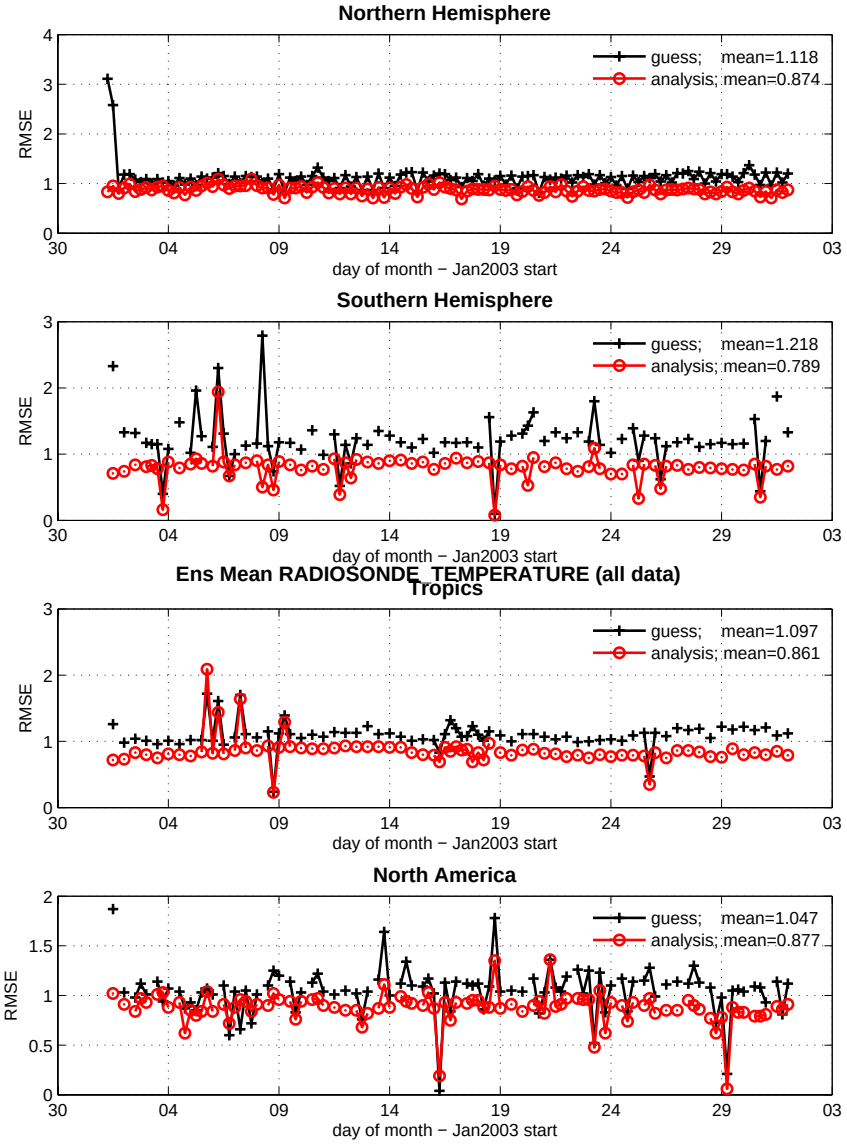
2. Comparisons to observations.
    a. By region,
    b. By level,
    c. RMS error,

January 2003 RMS Error for 500 hPa T versus Radiosondes

T85 3.1



T85 3.5



January 2003 RMS Error for 500 hPa T versus Radiosondes

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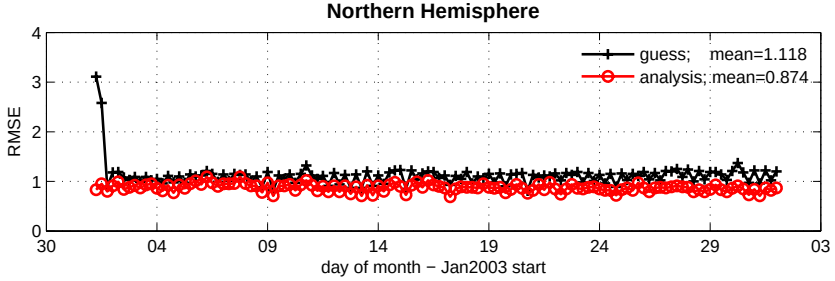

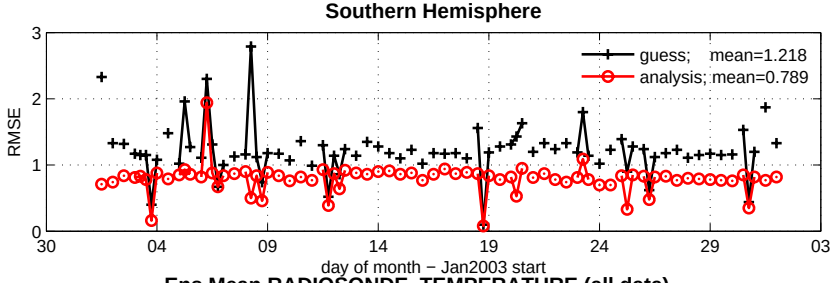

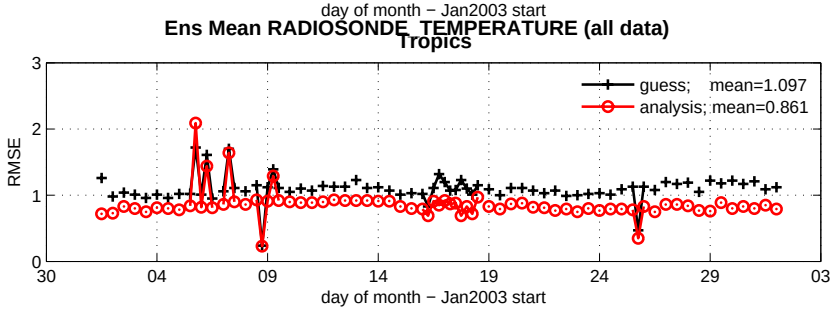

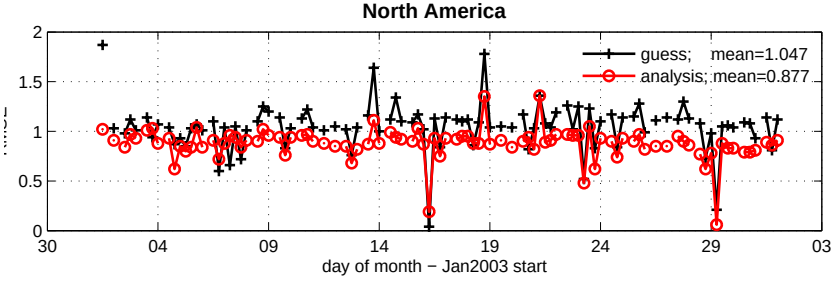

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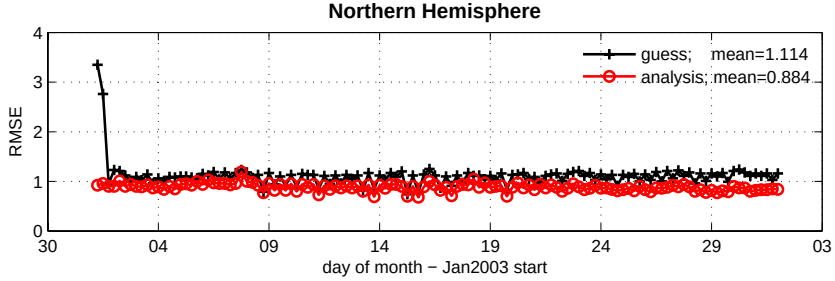
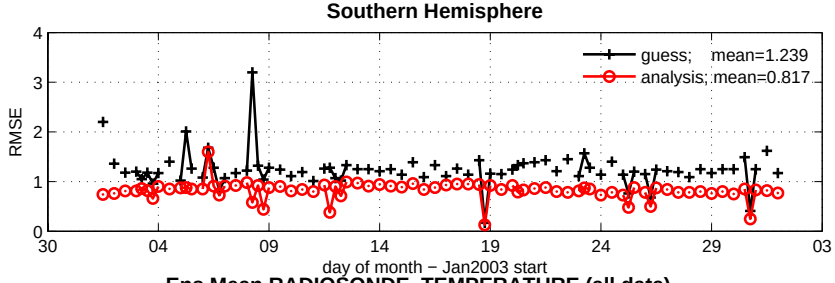
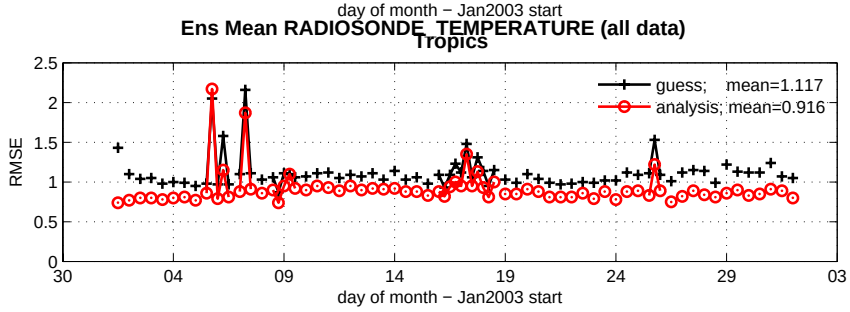
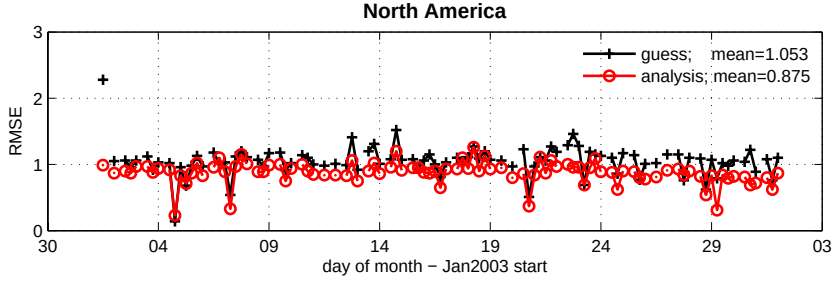
FV 3.5









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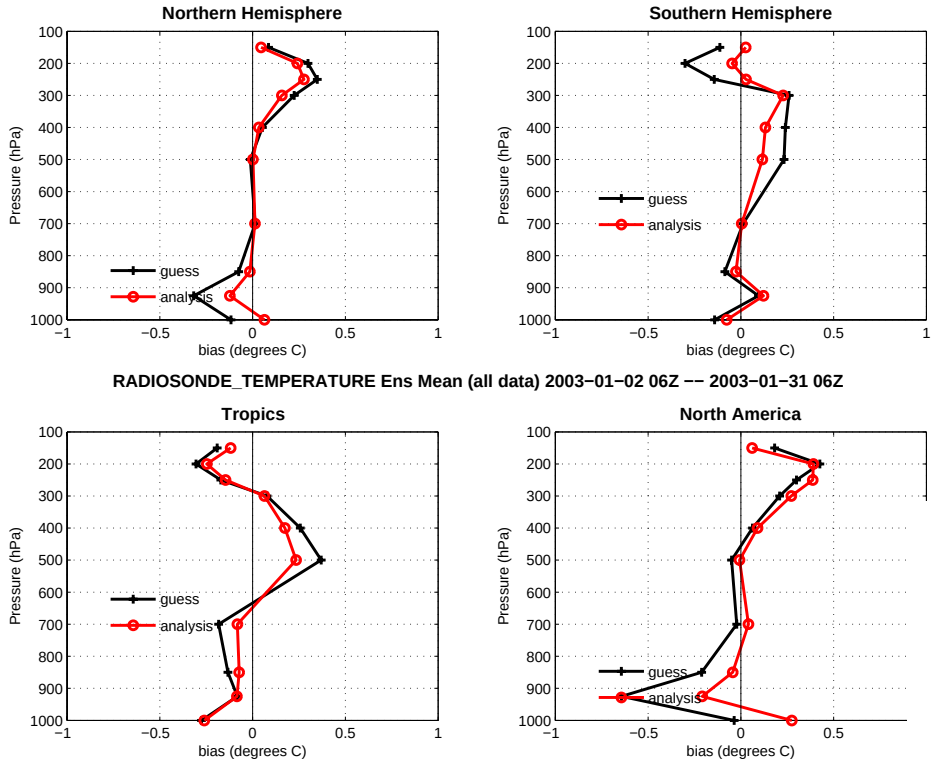
1. CAM analyses and forecasts (ensemble mean or ensembles).

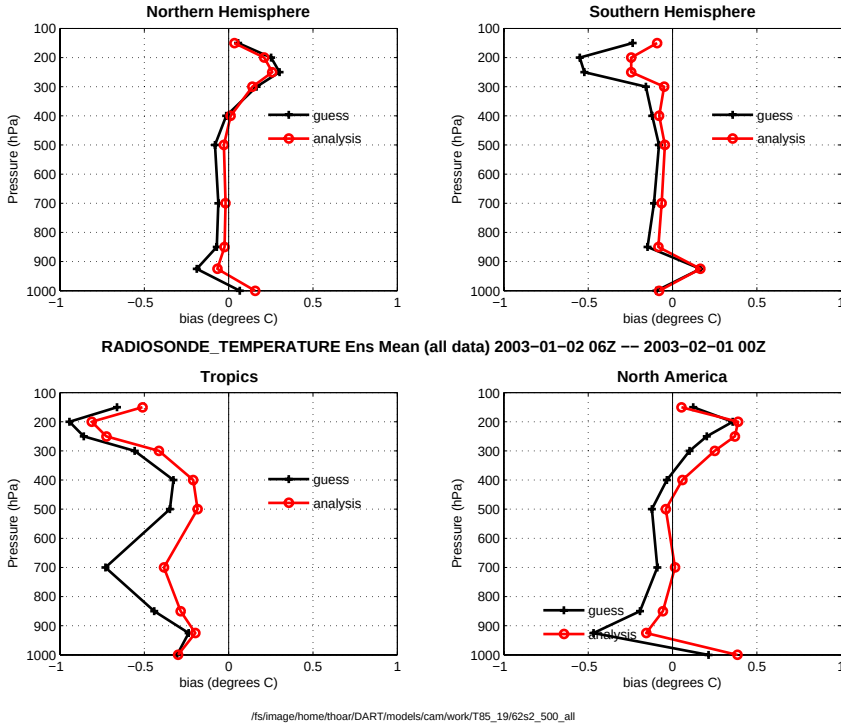
2. Comparisons to observations.
    a. By region,
    b. By level,
    c. RMS error,
    d. Systematic error (bias).

January 2003 Bias for T versus Radiosondes (Forecast - Observ.)



T85 3.1

T85 3.5



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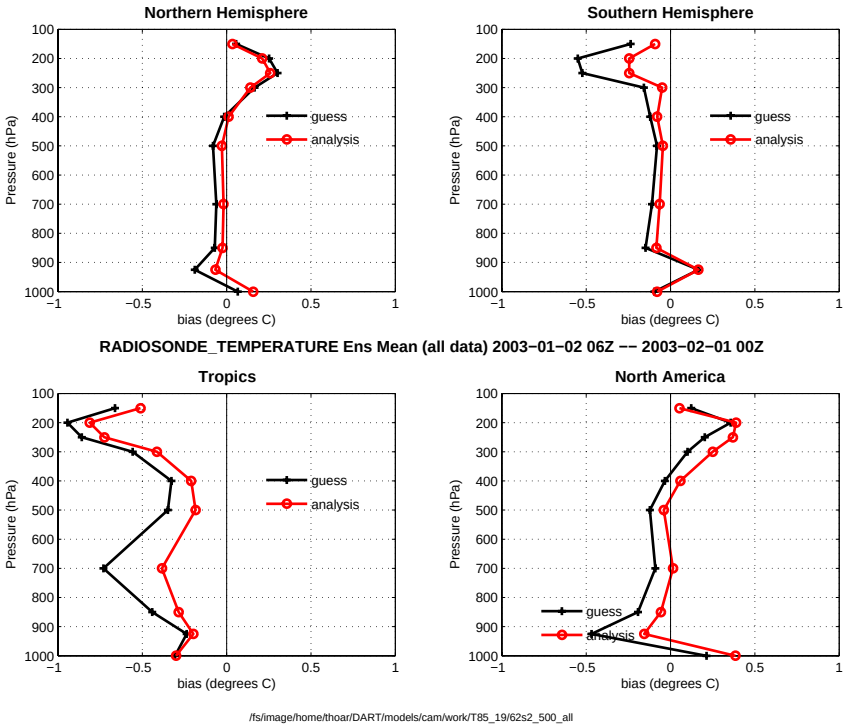
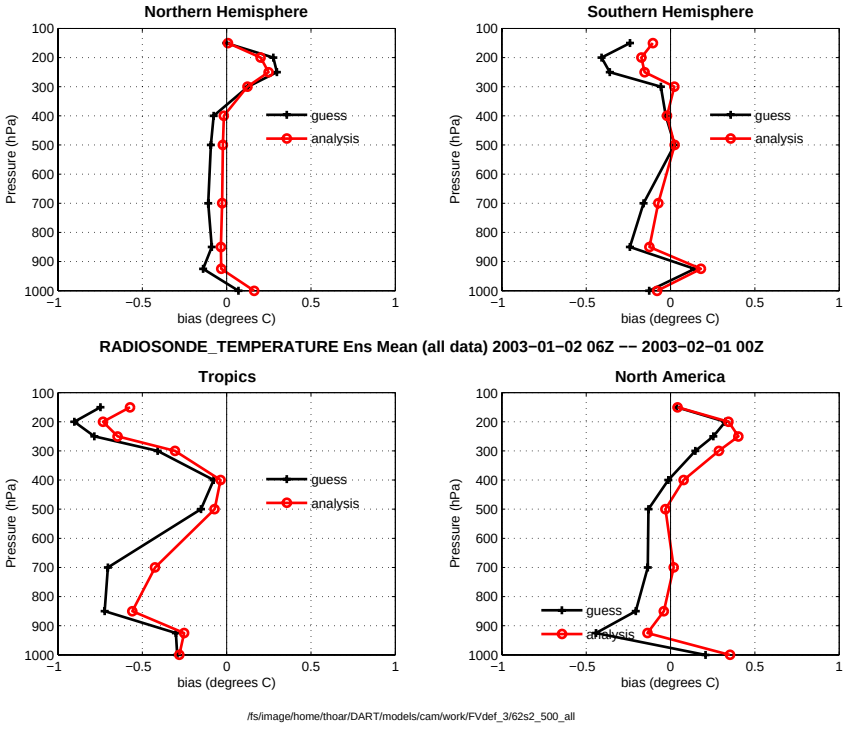


T85 3.5

FV 3.5



What you can look at...

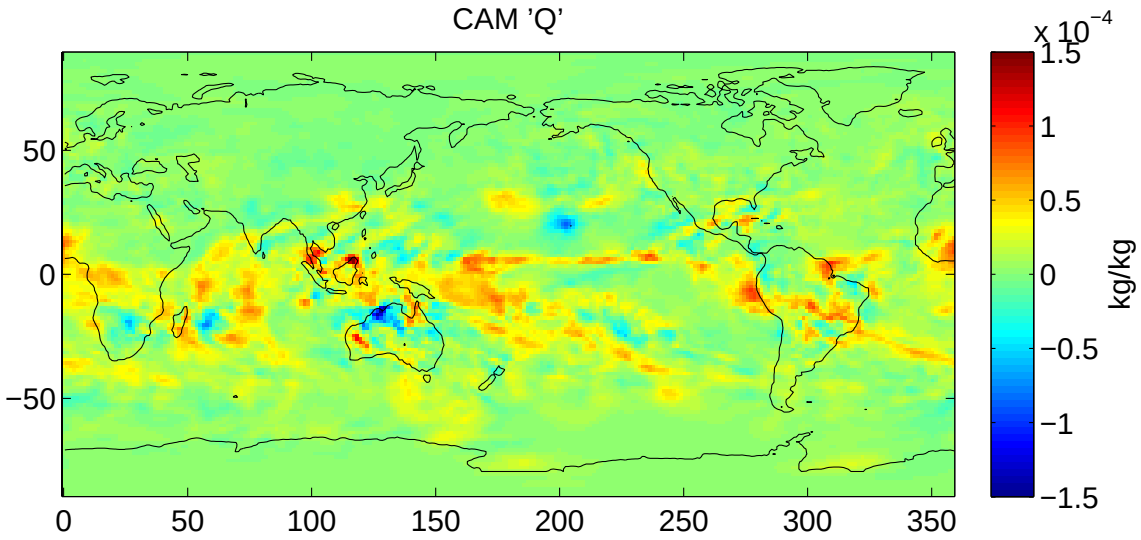
1. CAM analyses and forecasts (ensemble mean or ensembles).

2. Comparisons to observations.
    a. By region,
    b. By level,
    c. RMS error,
    d. Systematic error (bias).

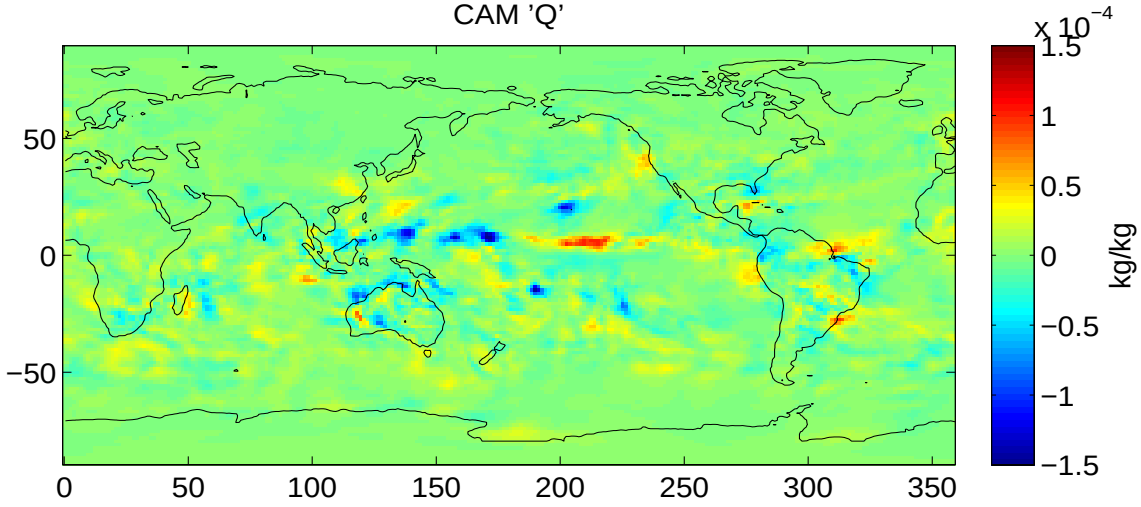
3. Time-mean innovations.
    a. Diagnostic of short-term forecast error.
    b. Can slice and dice in space and time.
    c. Conditional (season, ENSO, MJO, ...).

January 2003 433hPa Q mean Forecast - Analysis (Model bias)

T85
3.1 Physics



T85
3.5 Physics



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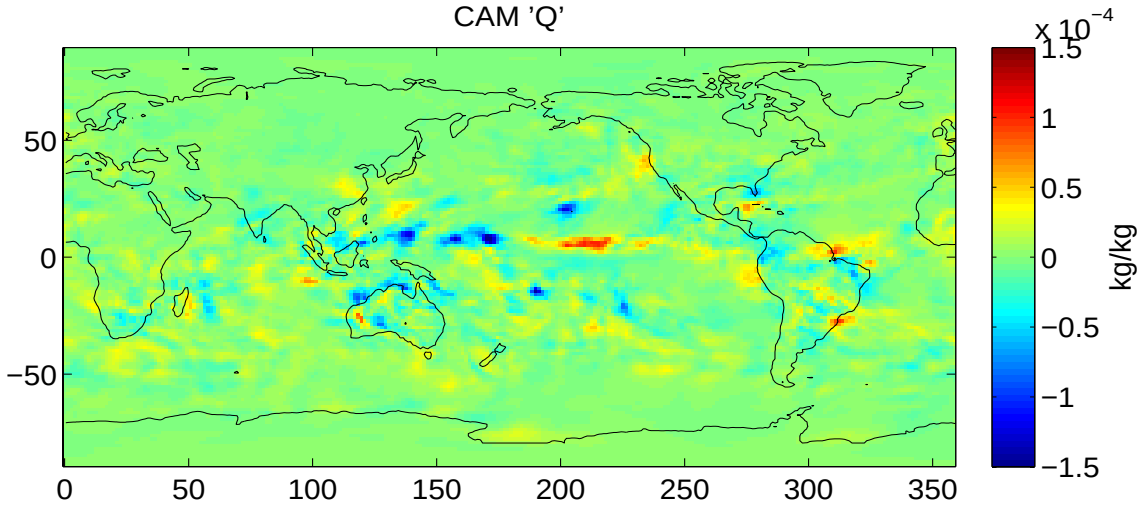
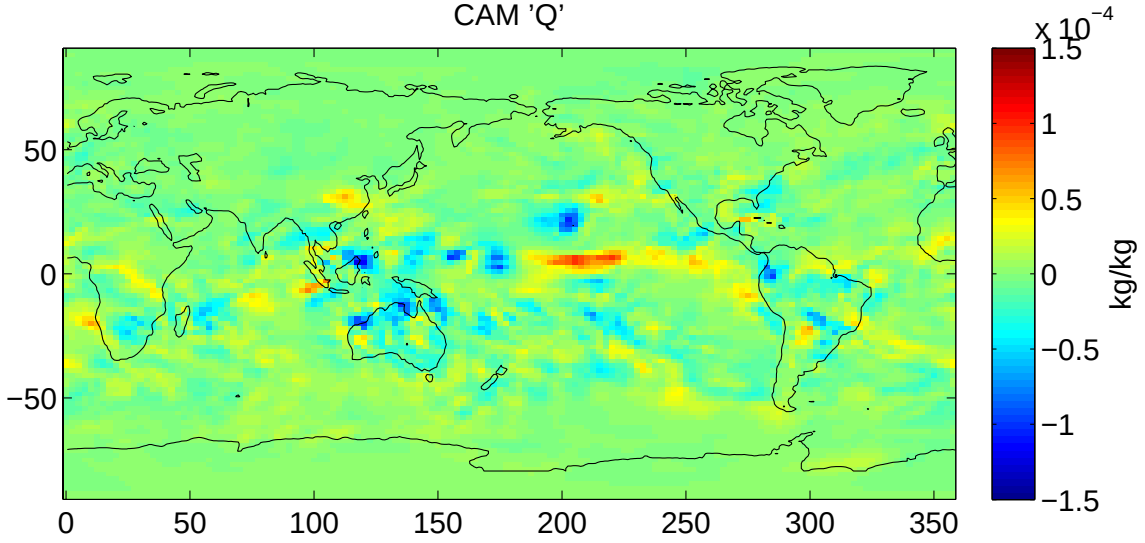


FV 1.9x2.5
3.5 Physics



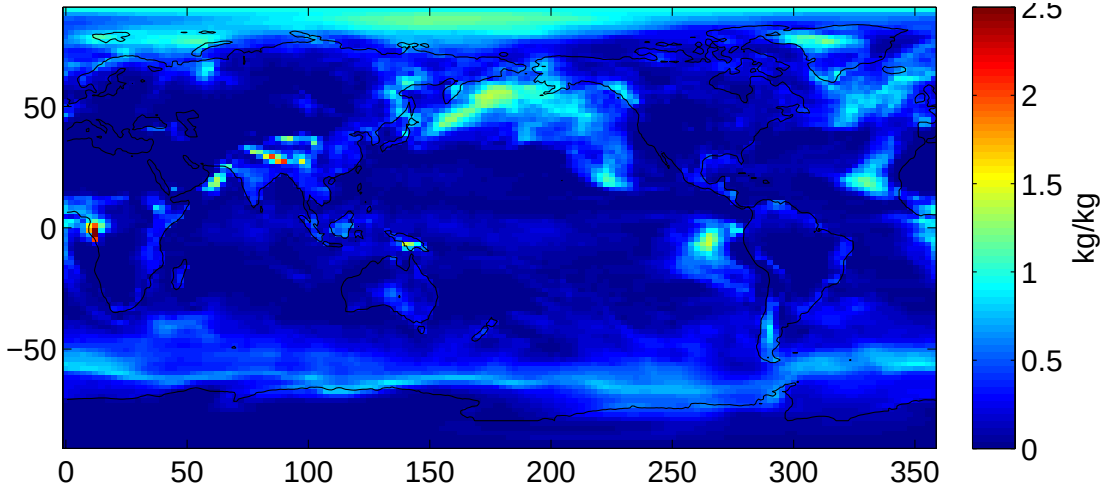
How does CAM work when it is ‘close’ to real atmosphere?

Let assimilation constrain CAM.

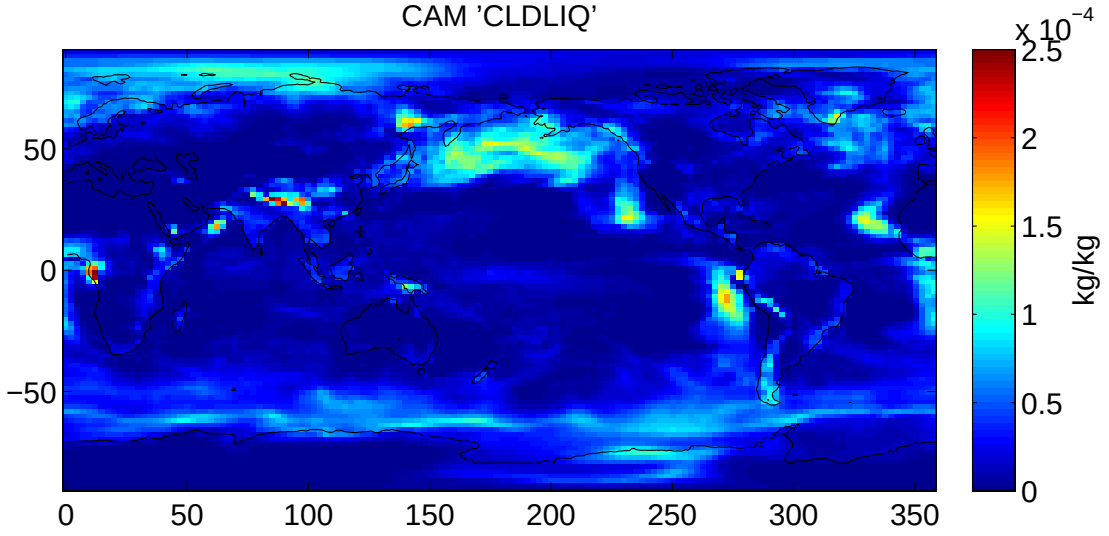
How do CAM parameterizations act with a realistic...

- ENSO,
- MJO,
- Arctic Circulation,
- Your favorite phenomenon?

CAM FV 3.5 July Monthly Mean 6-hour Forecasts
Cloud Liquid Water at 929 hPa



2006



2007

What we can do now...

1. Run for ANY time since 1947 to (present - 1 month).
2. Provide GAUs/diagnosis/expertise for runs of interest.
3. Assimilate GPS soundings for more info on moisture/temps.
4. Run with many existing parameterization options.
5. Add arbitrary tracers to state.

What we could do soon...

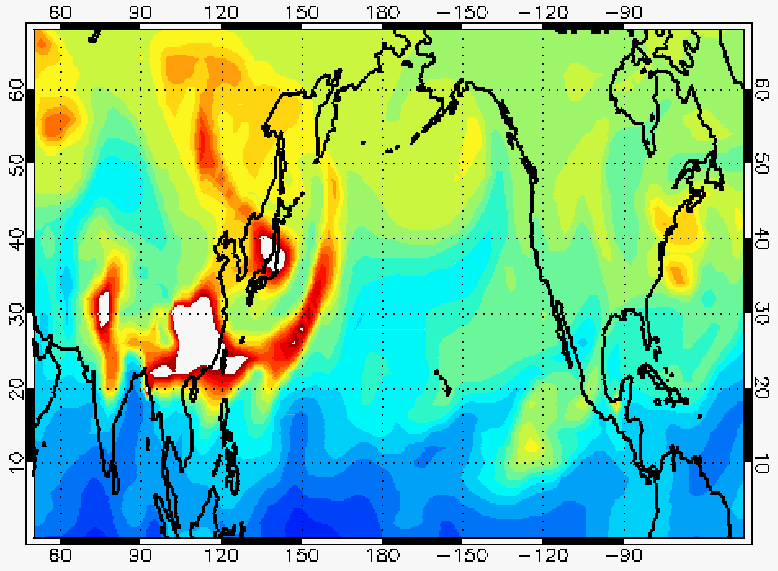
1. Assimilate additional observations provided by you.
2. Run with new parameterization options.
3. Directly assimilate values for parameters.
4. Run with sample of parameter values to view sensitivity.
5. Generate additional diagnostic capability.
6. Add chemistry/aerosol modeling options.
7. Other?

<u>Plus: Ensembles for everything</u>

Compute significance,
Evaluate sensitivity, etc.

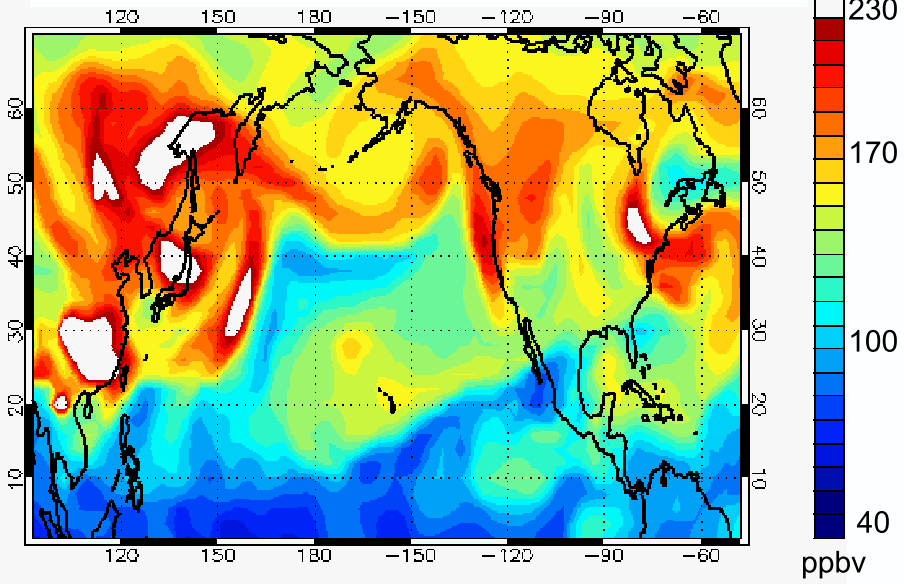
Impact of Assimilation in Modeled CO

No Assimilation @700 hPa 041706 18Z



Assimilating MOPITT CO provides important constraints to regional CO distribution in the troposphere.

Assimilation @700 hPa 041706 18Z



Suggests the utility of assimilation in providing better initial/boundary conditions to regional CO forecasts.