

Assimilation with CGD's Community Atmospheric Model (CAM)

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Funded by DAI, affiliated with CGD

1. Motivation
2. Description of CAM
3. Description of assimilation experiments
4. Results from a 1-month assimilation
5. Ongoing and future work with DART & CAM

Why do assimilation in a climate model?

Systematic error: Can one detect long-term biases quickly?

Model quality evaluation: Being a good forecast model increases climate model credibility.

Parameter estimation: Can model be 'tuned' with assimilation?

Observation system evaluation experiments: What is value of different observations? OSSEs.

The Community Atmosphere Model (CAM)

Atmospheric component of NCAR's Community Climate System Model

Designed for climate scenario integrations (IPCC) and research

Open source; estimate 1000+ users

This experiment uses spectral Eulerian, T42 resolution.

(Semi-lagrangian and finite-volume cores, T5 and T85 also available.)

Results from CAM Assimilation: January, 2003

Model:

CAM 2.0.1 T42L26

U, V, T, Q and PS state variables impacted by observations

Land model (CLM 2.0) not impacted by observations

Climatological SSTs

Assimilation / Prediction Experiments:

80 member ensemble divided into 4 equal groups

Initialized from a climatological distribution (huge spread)

Initial tests for January, 2003

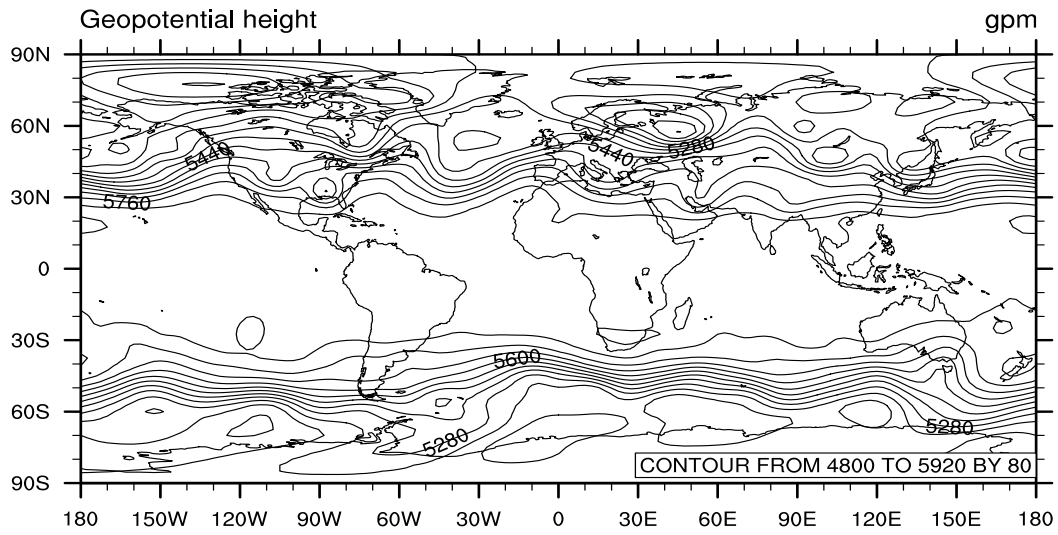
Uses most observations used in reanalysis

(Radiosondes, ACARS, Satellite Winds..., no surface obs.)

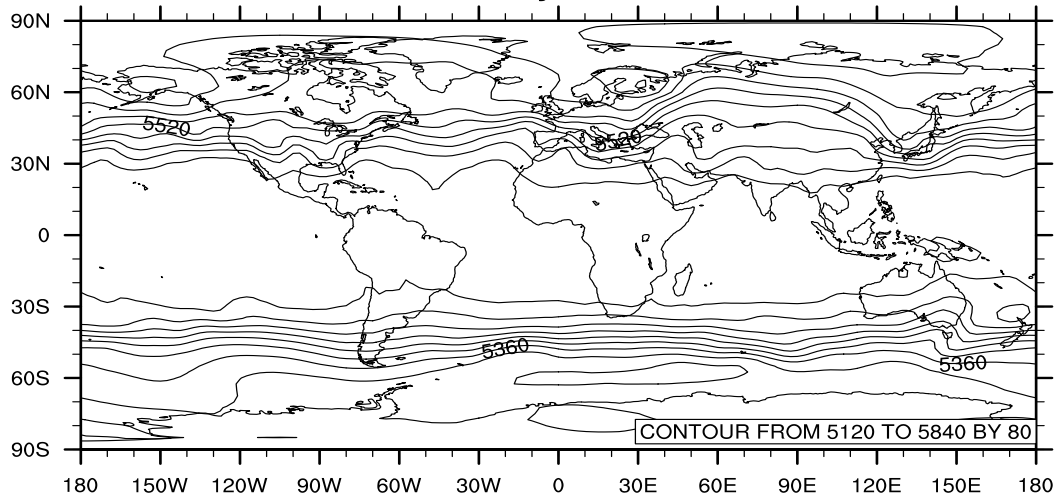
Assimilated every 6 hours; +/- 1.5 hour window for obs.

Run on CGD linux cluster Anchorage

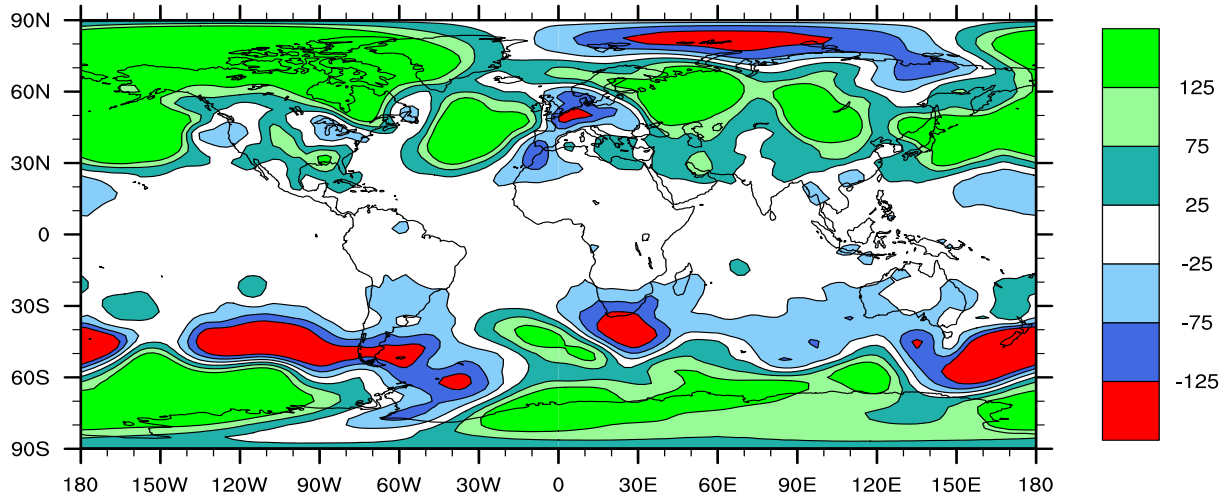
NCEP reanalyses, 500mb GPH, Jan 01 06Z



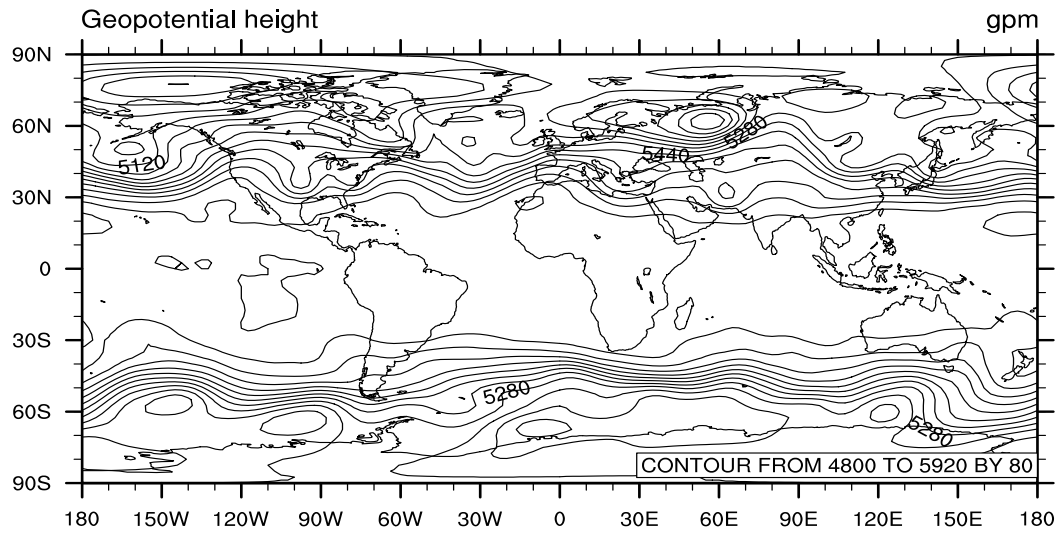
DART/CAM analyses, 500mb GPH



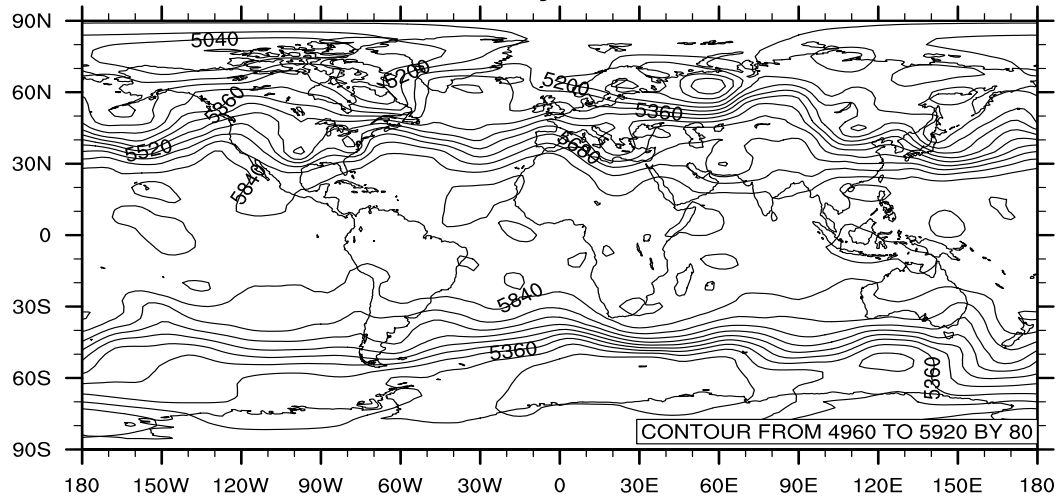
DART/CAM - NCEP



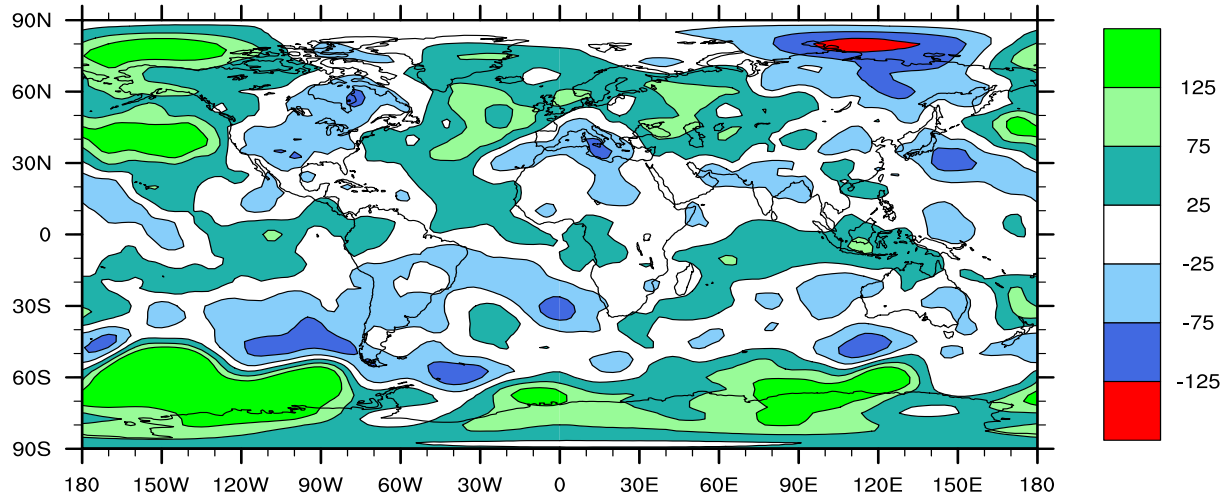
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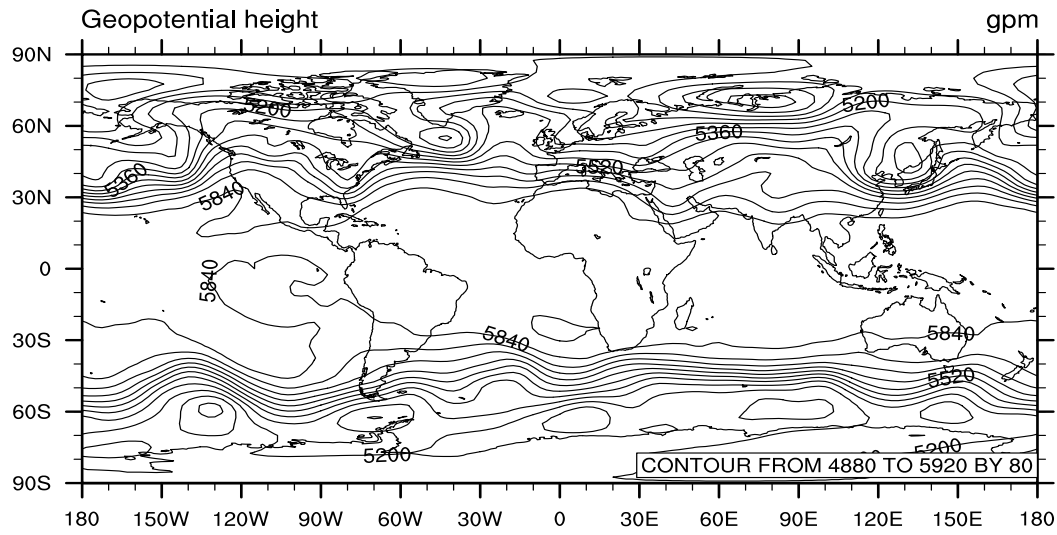
DART/CAM analyses, 500mb GPH



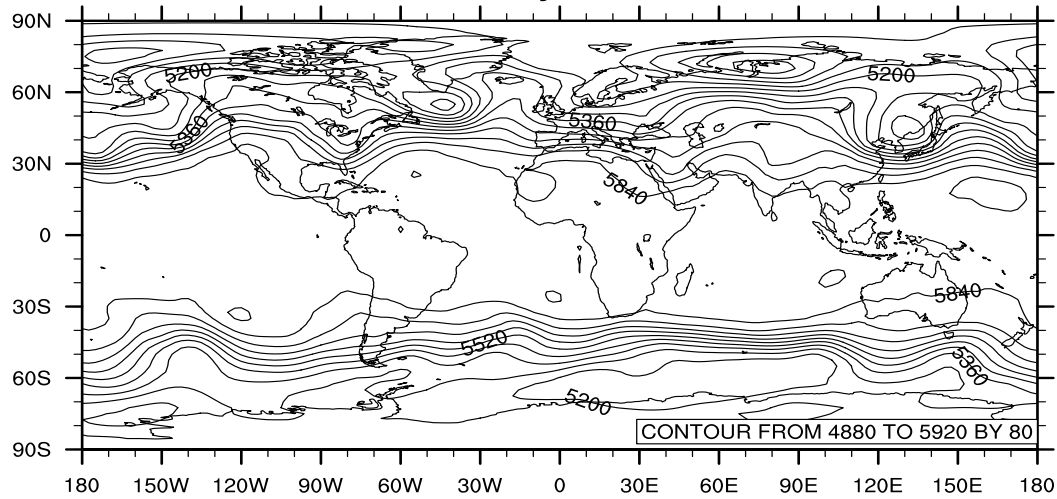
DART/CAM - NCEP



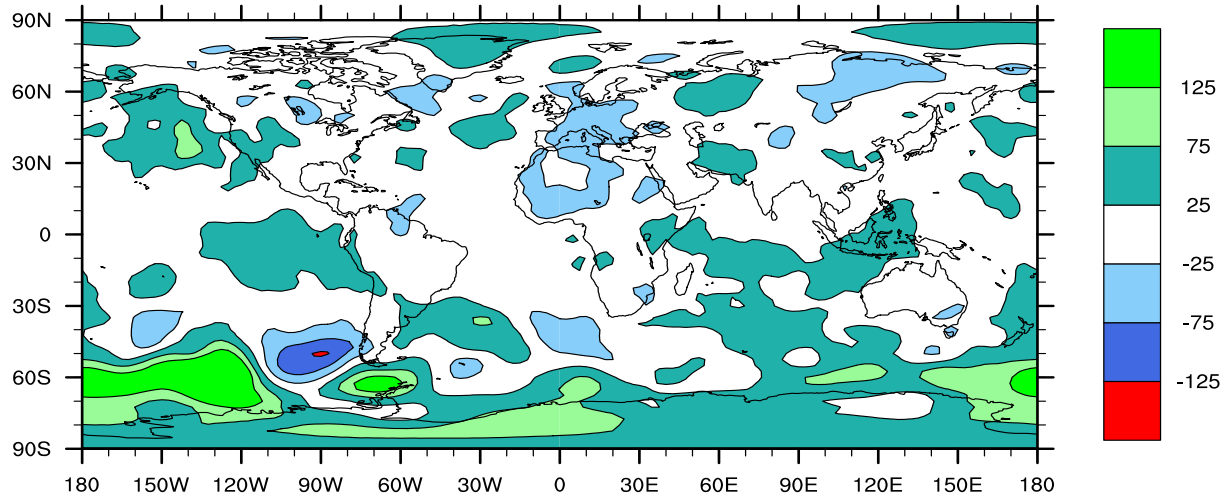
NCEP reanalyses, 500mb GPH, Jan 04 00Z



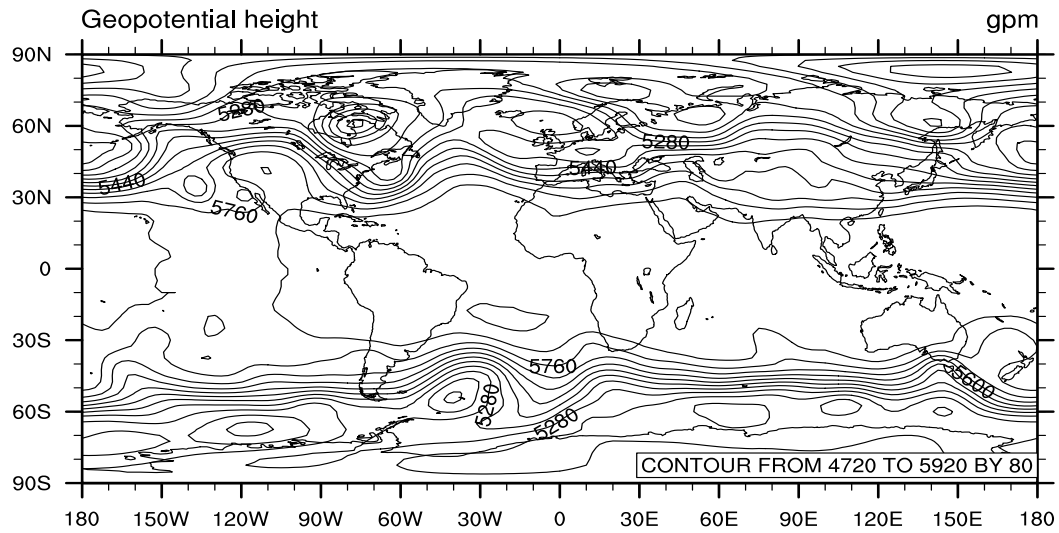
DART/CAM analyses, 500mb GPH



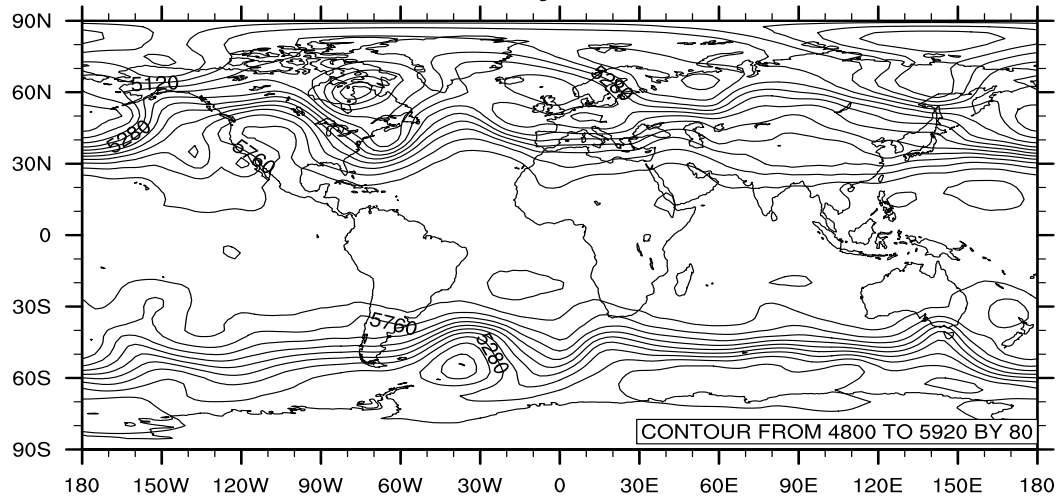
DART/CAM - NCEP



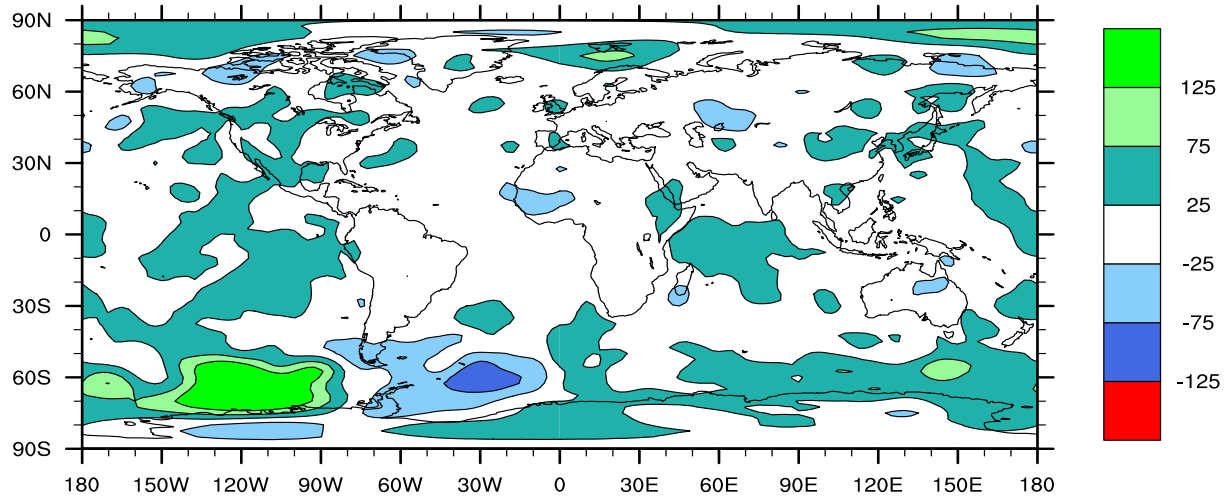
NCEP reanalyses, 500mb GPH, Jan 08 00Z



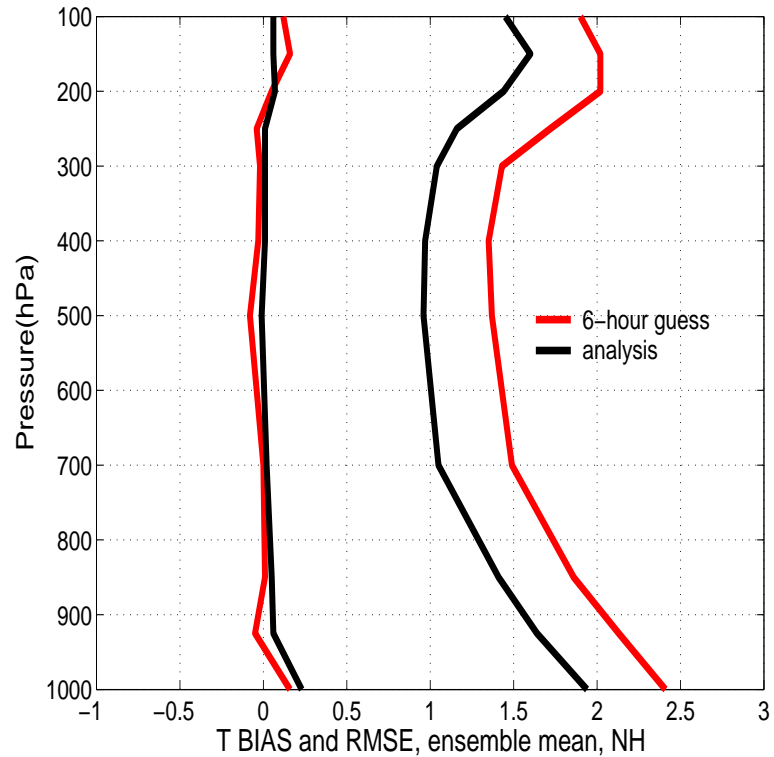
DART/CAM analyses, 500mb GPH



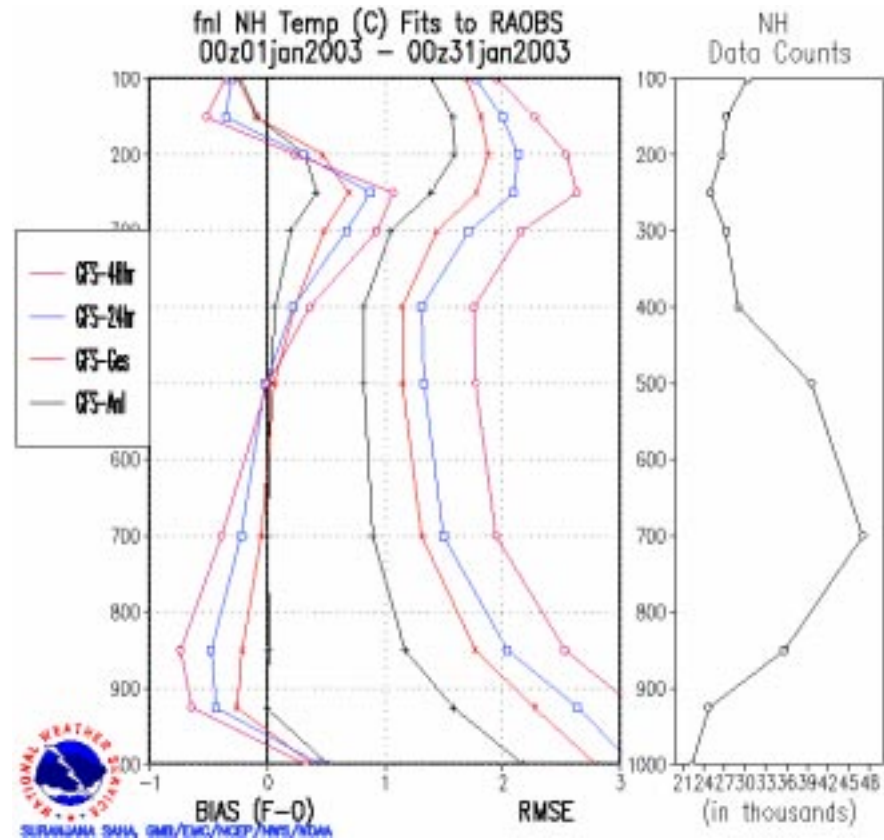
DART/CAM - NCEP



Northern Hemisphere Temperature: Bias and RMSE

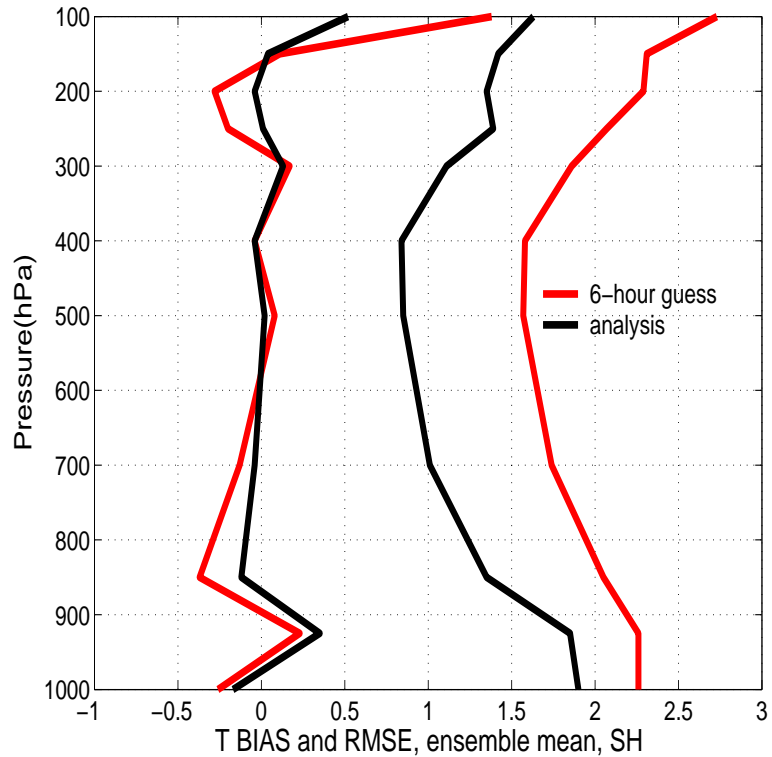


CAM

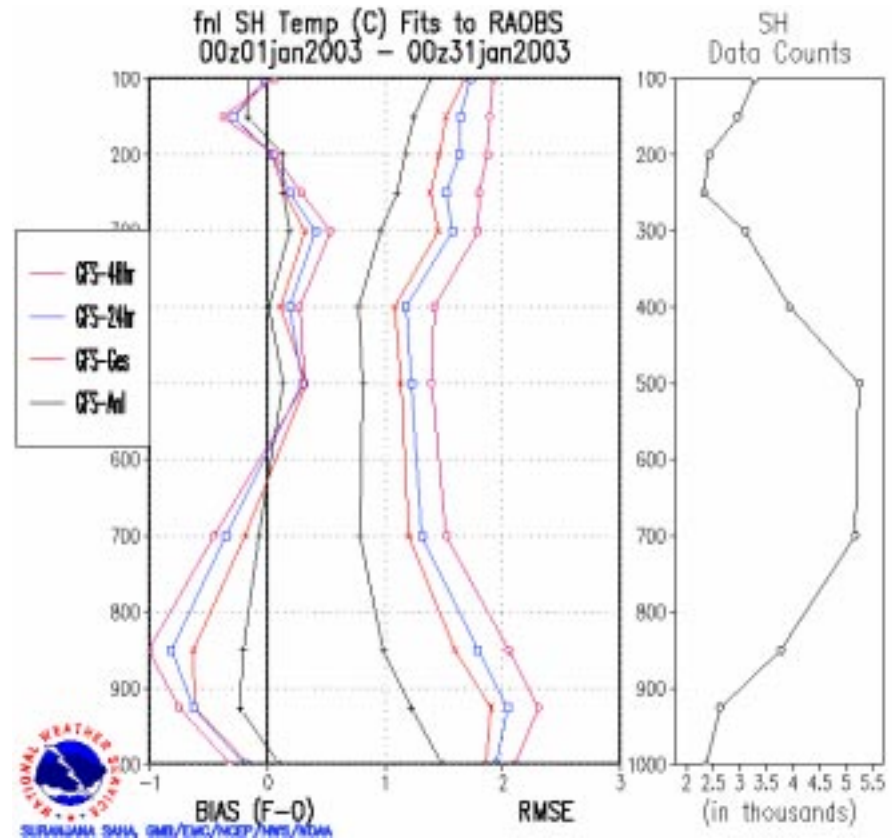


NCEP Reanalysis

Southern Hemisphere Temperature

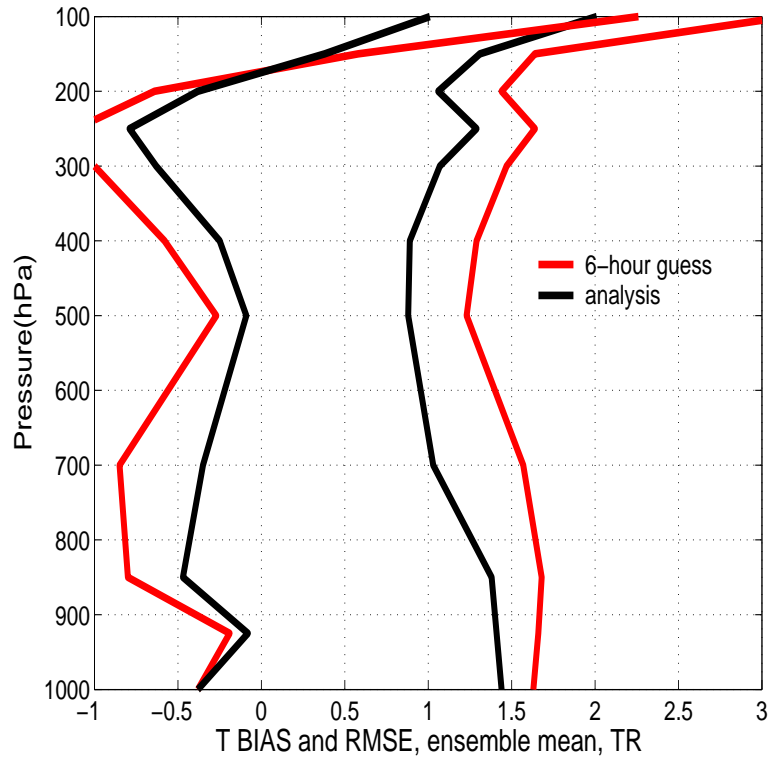


CAM

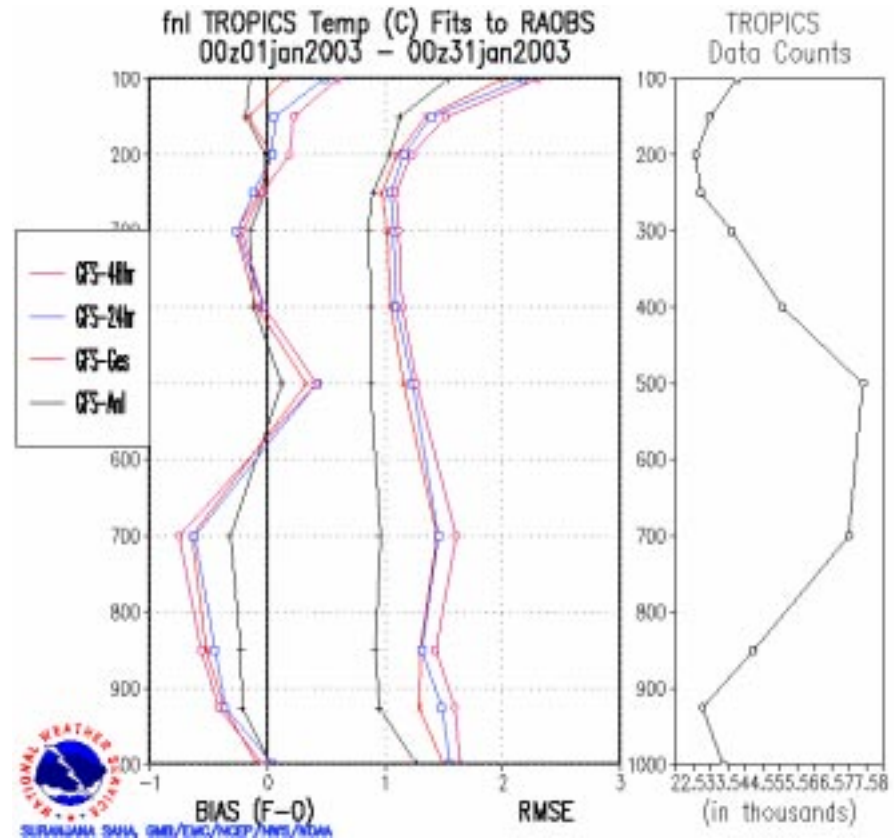


NCEP Reanalysis

Tropical Temperature

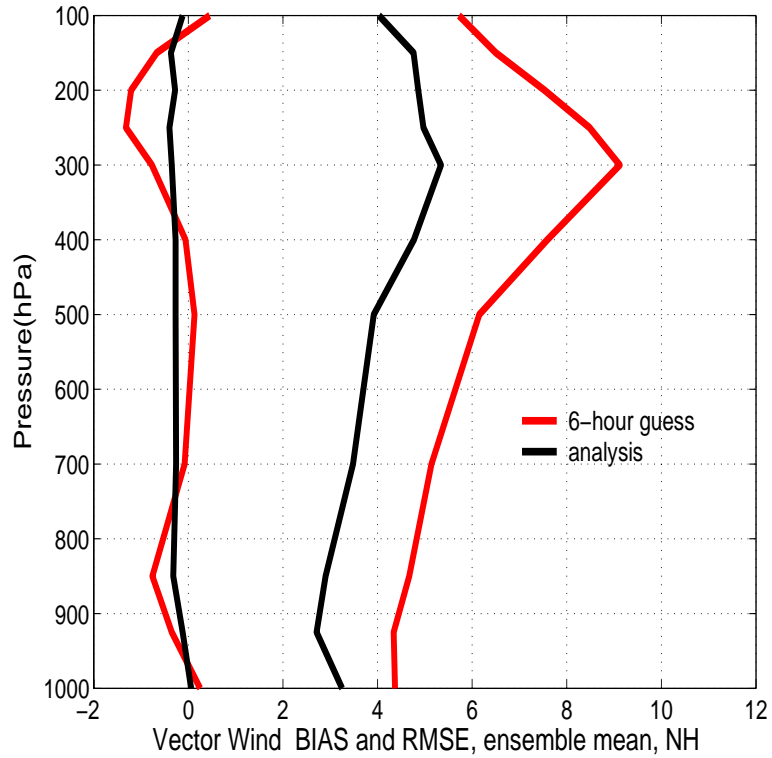


CAM

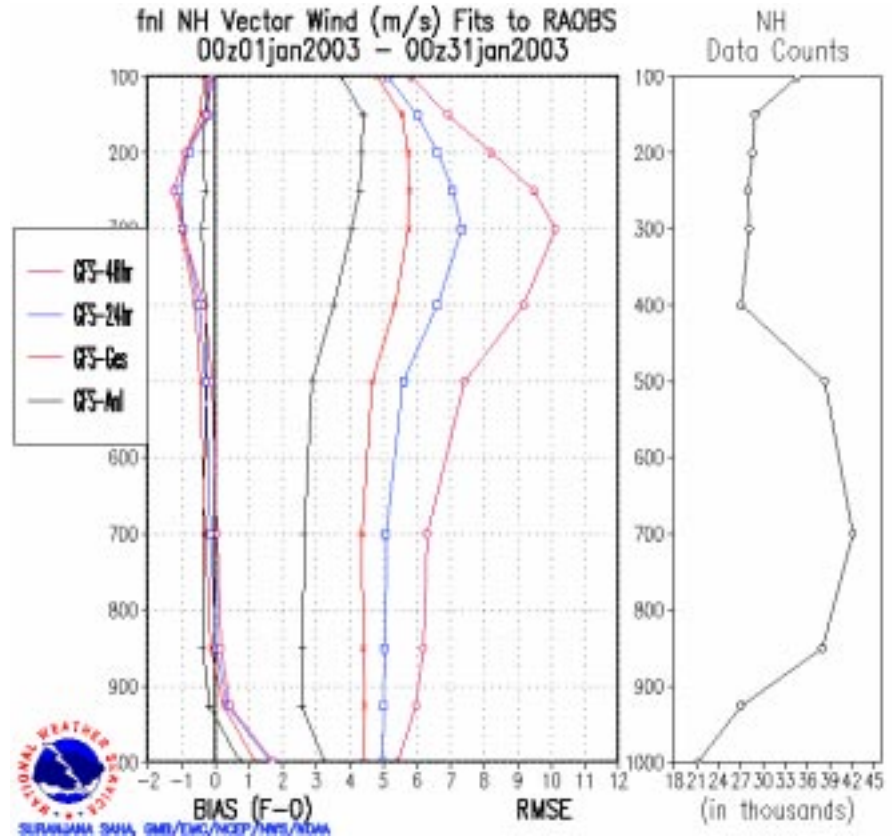


NCEP Reanalysis

Northern Hemisphere Winds

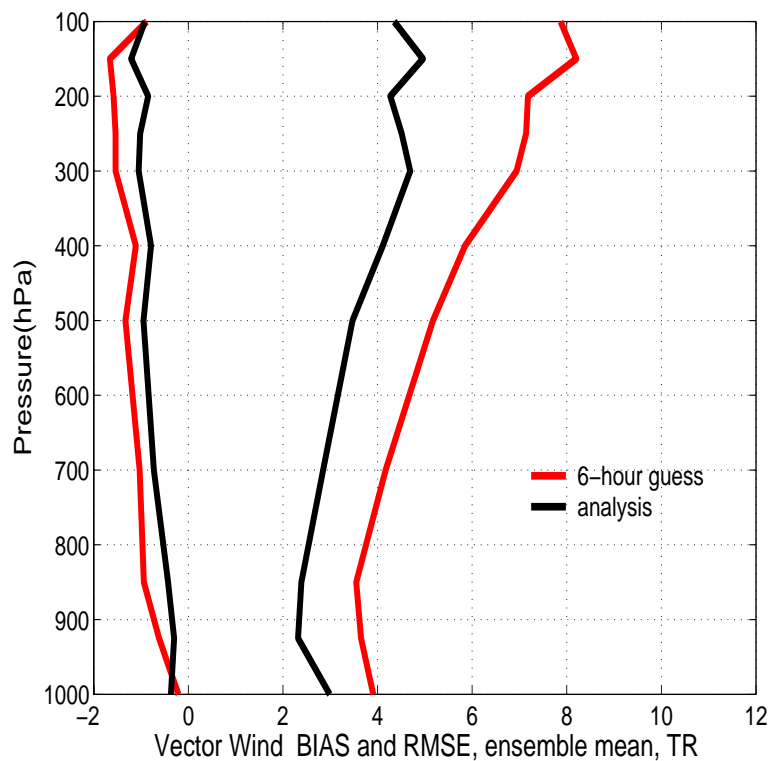


CAM

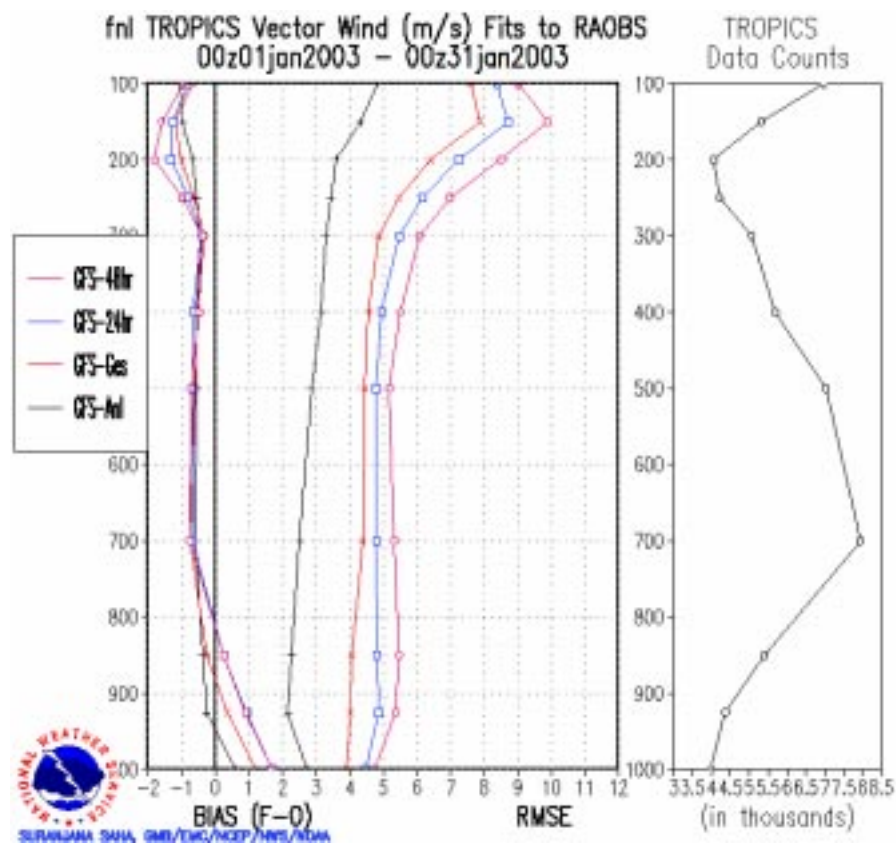


NCEP Reanalysis

Tropical Winds



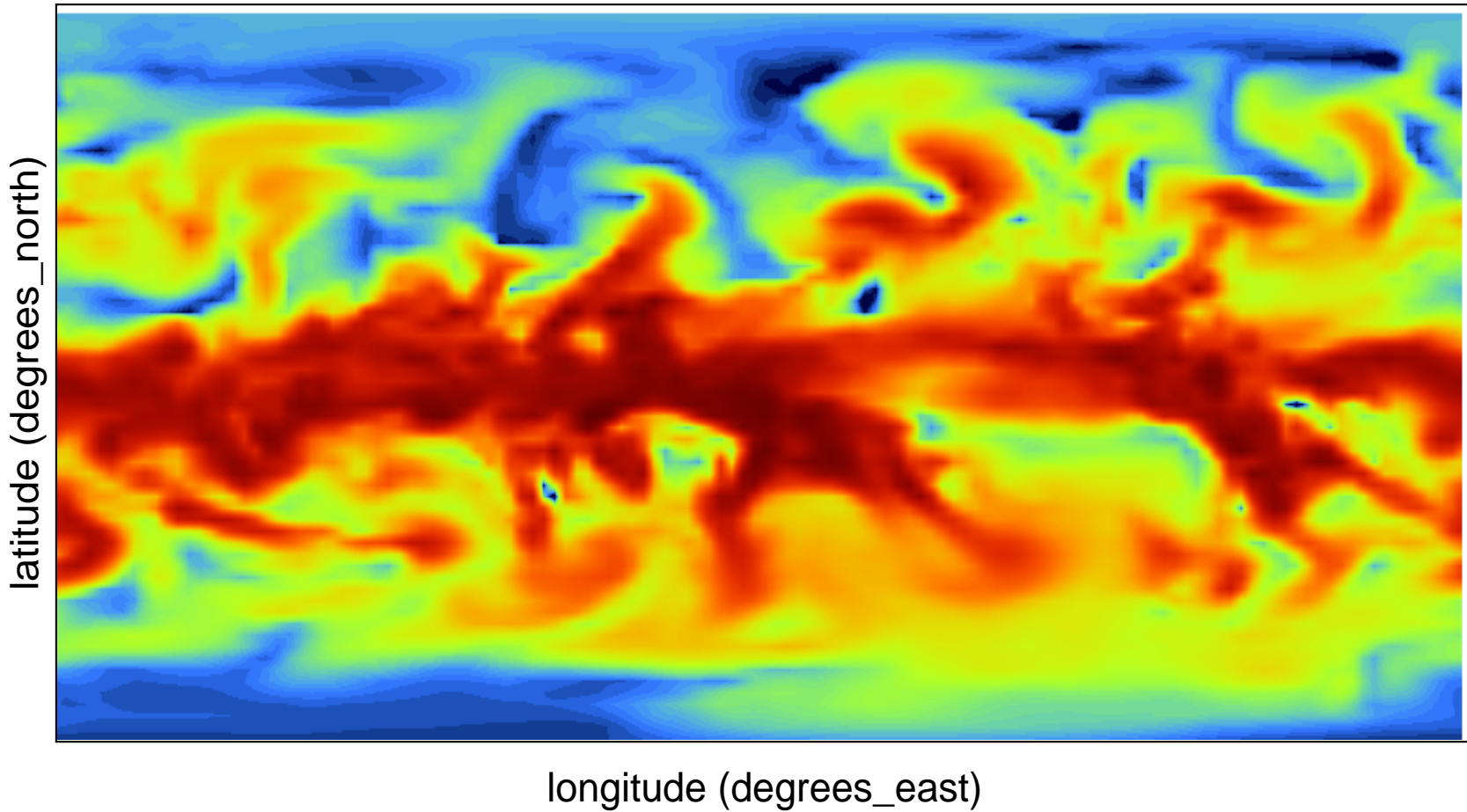
CAM



NCEP Reanalysis

12 GMT 4 January, 2004, CAM Analysis

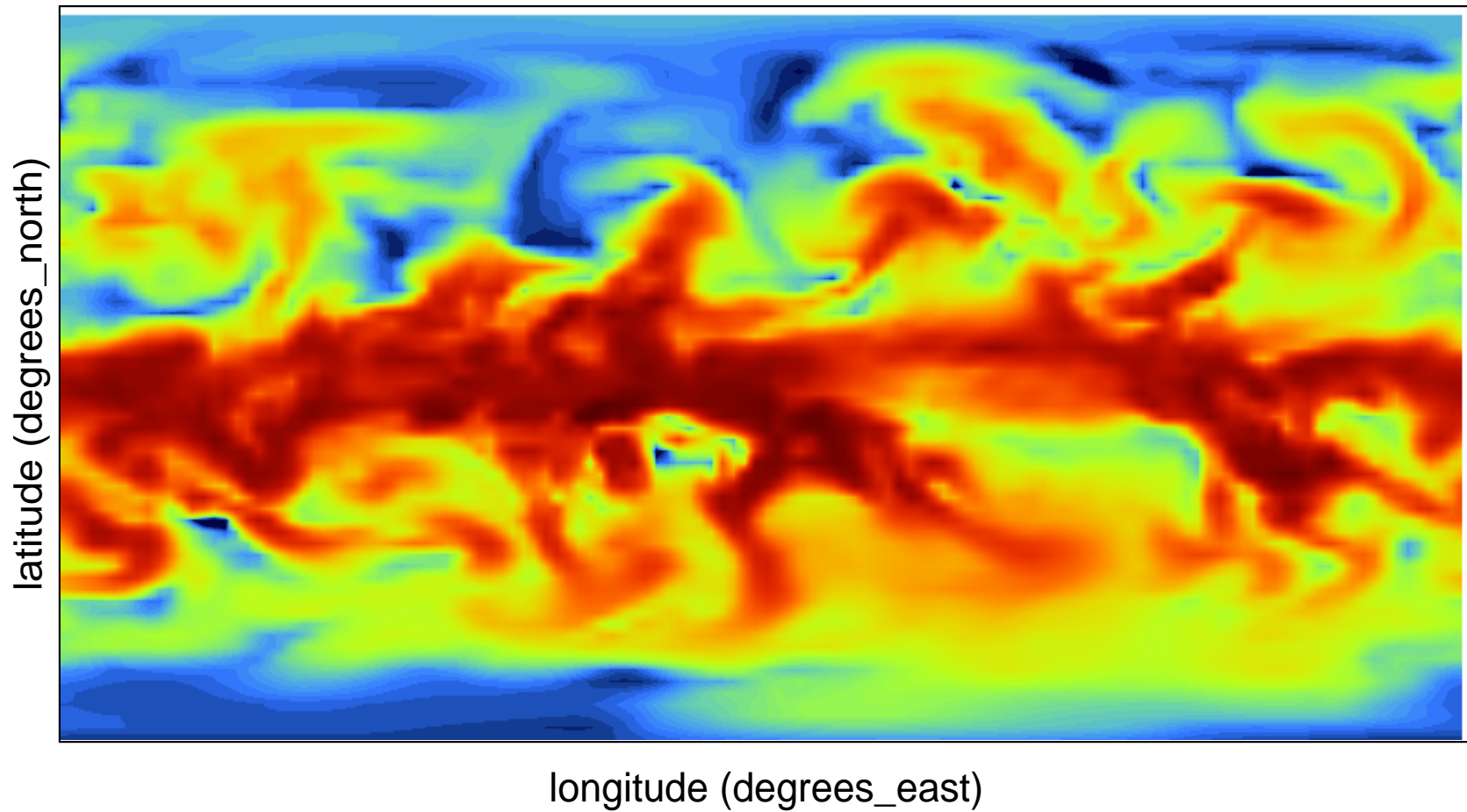
Specific Humidity (kg/kg)



ila Thu Jun 24 09:26:03 2004

00 GMT 5 January, 2003

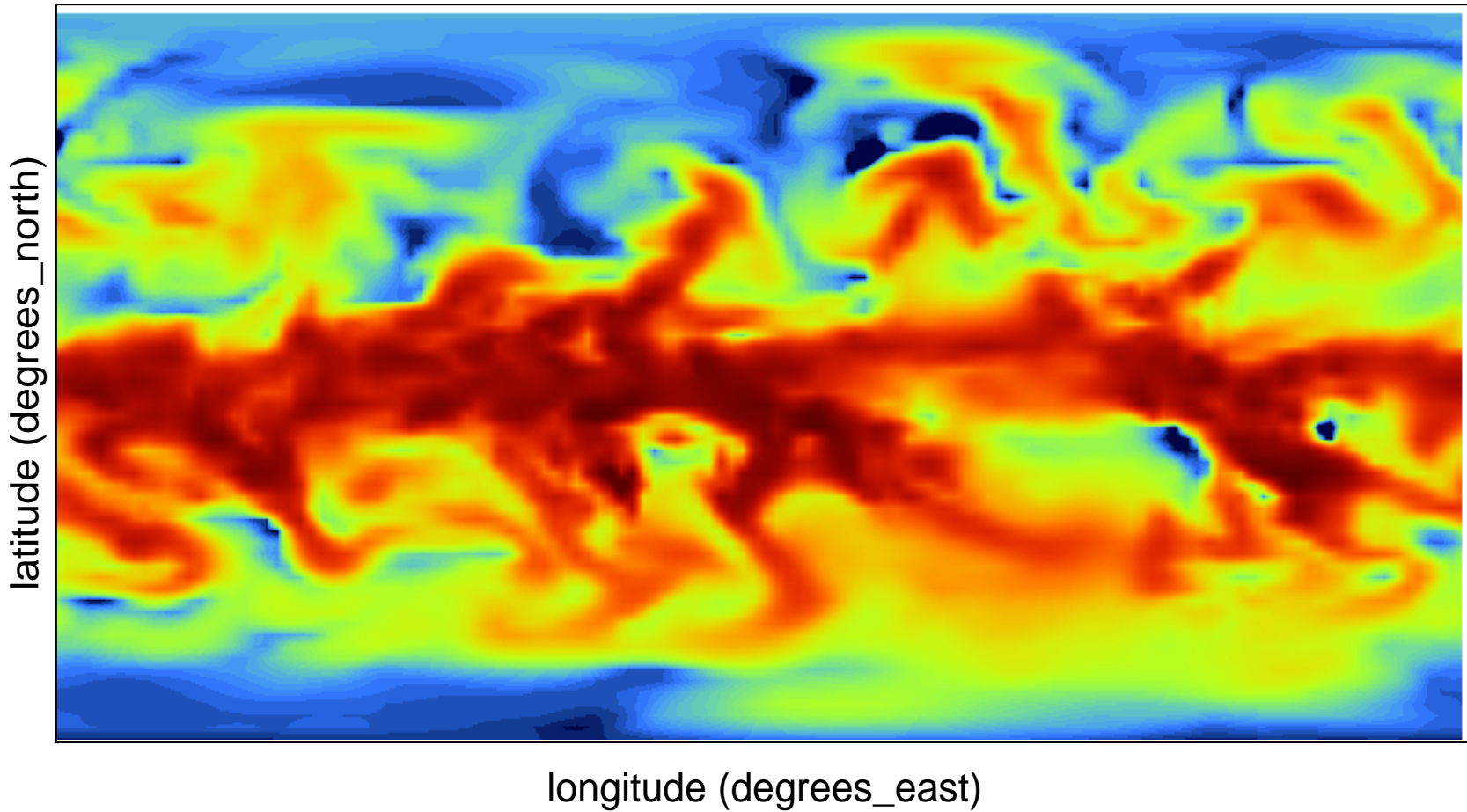
Specific Humidity (kg/kg)



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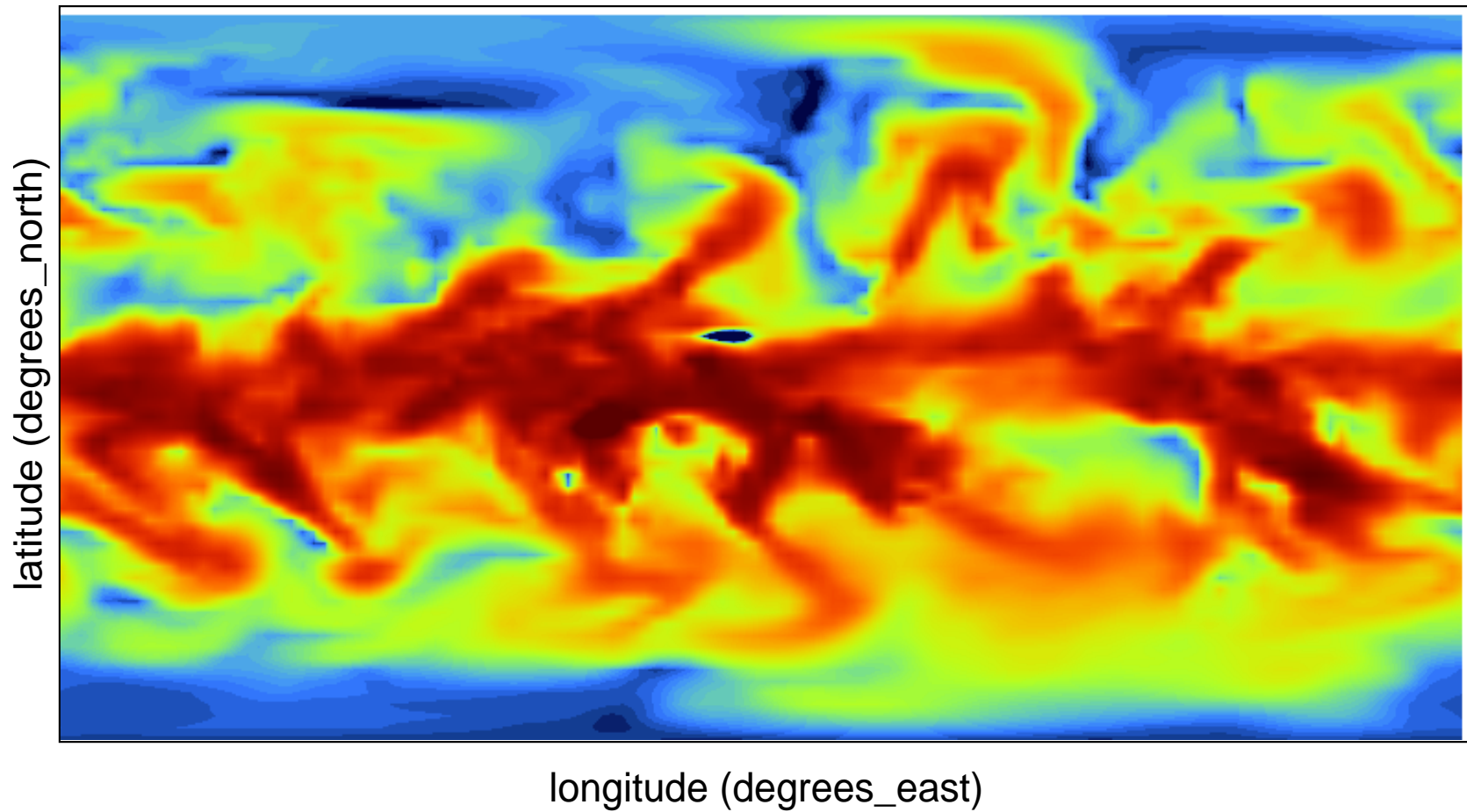
Specific Humidity (kg/kg)



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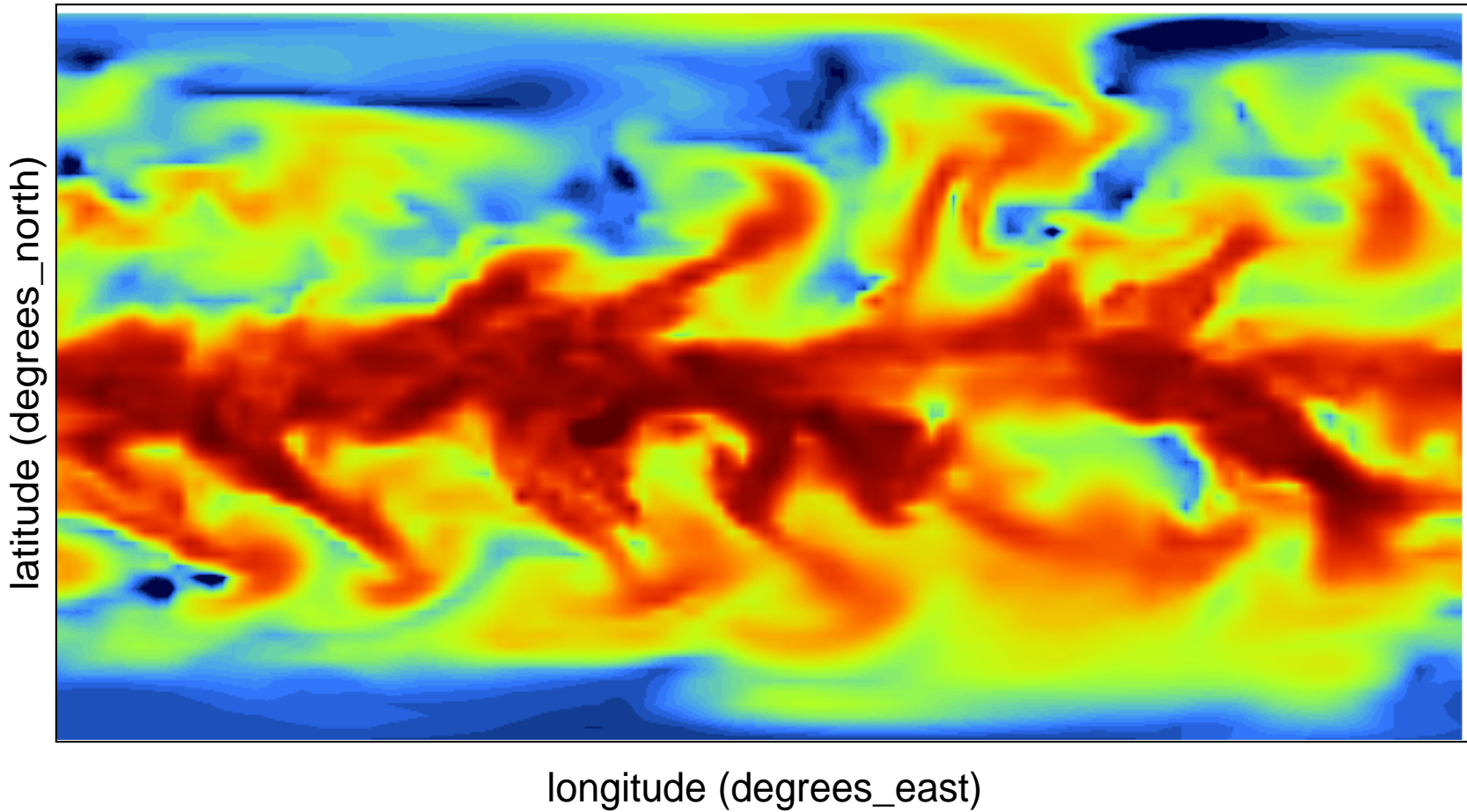
Specific Humidity (kg/kg)



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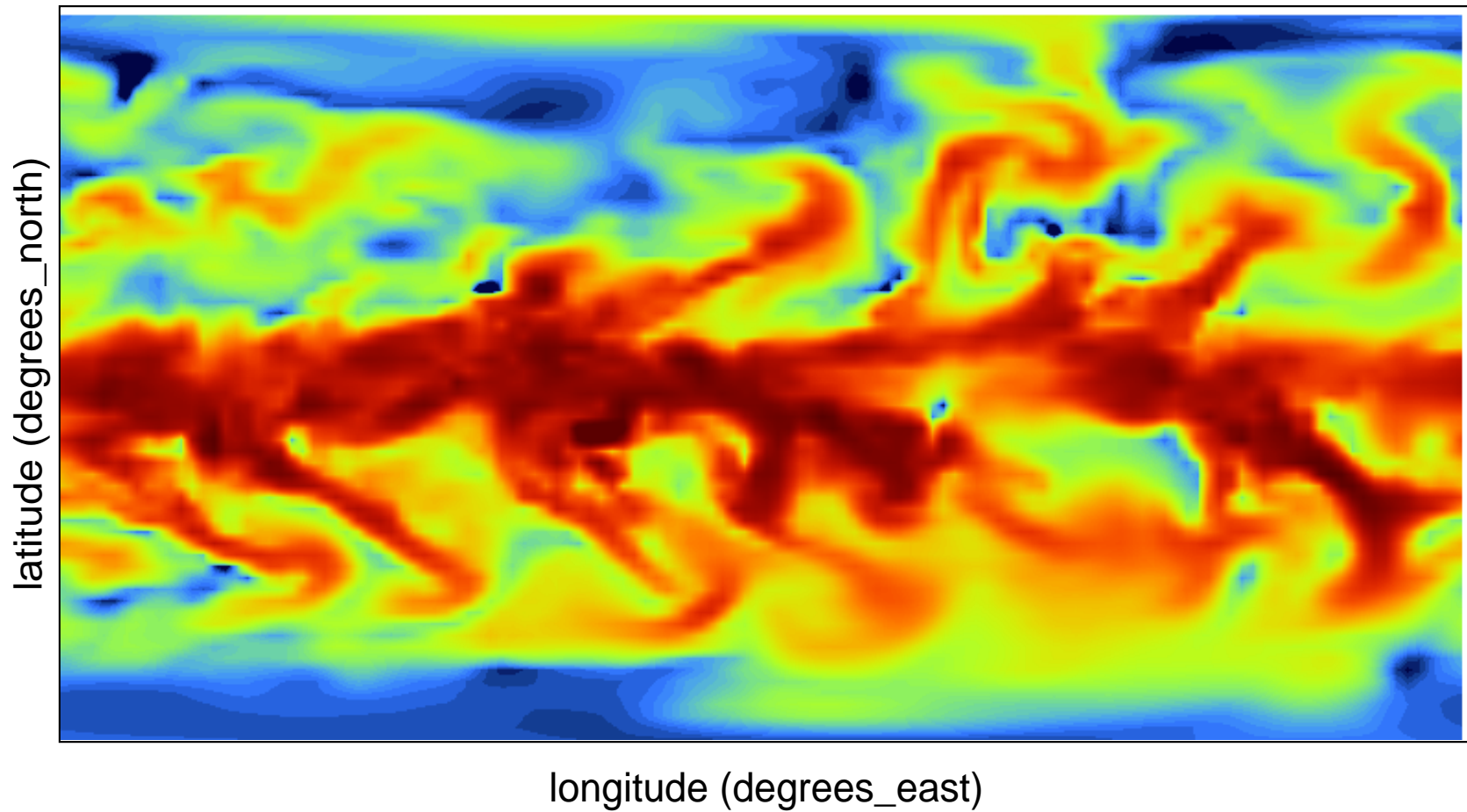
Specific Humidity (kg/kg)



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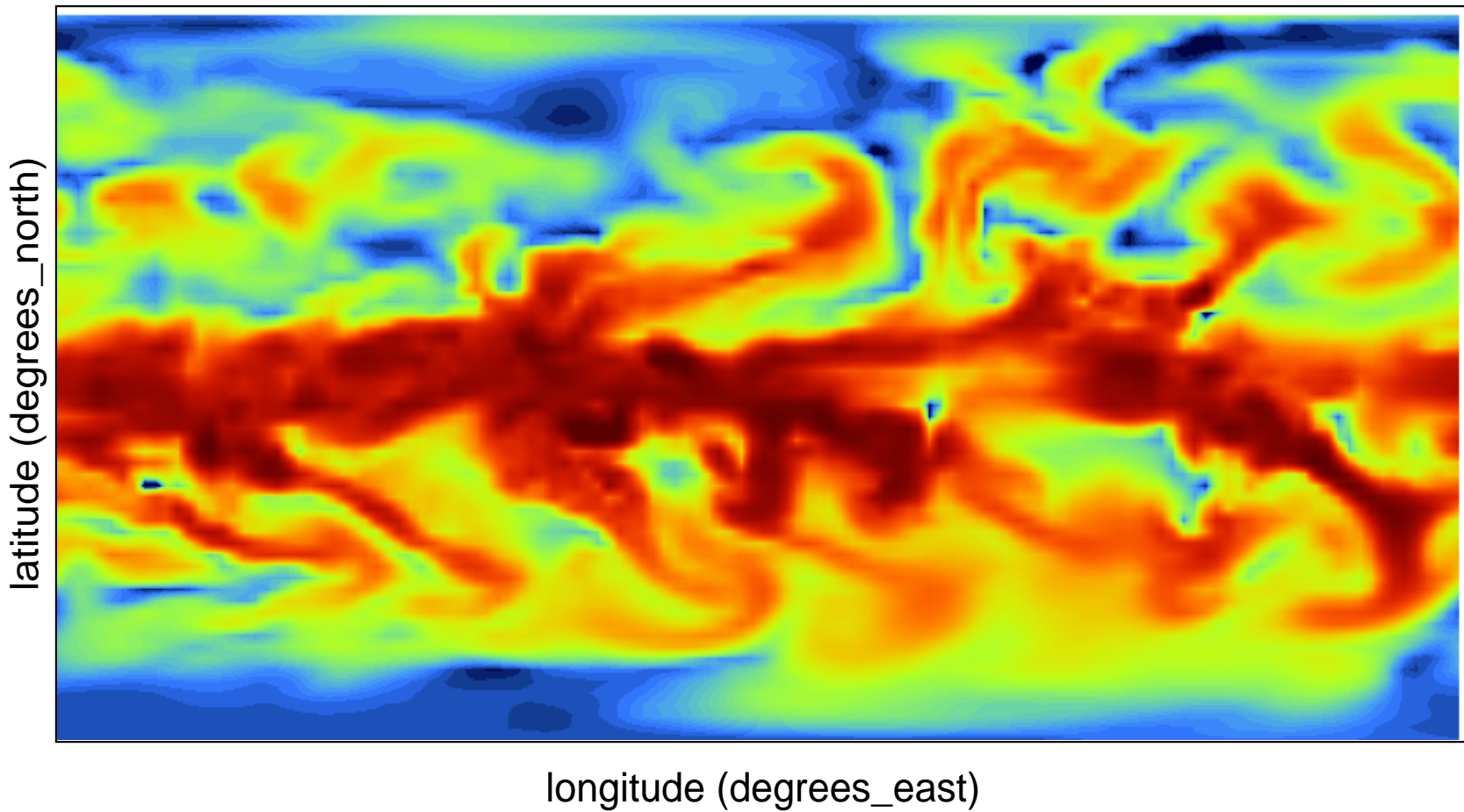
Specific Humidity (kg/kg)



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12 GMT 7 January, 2003

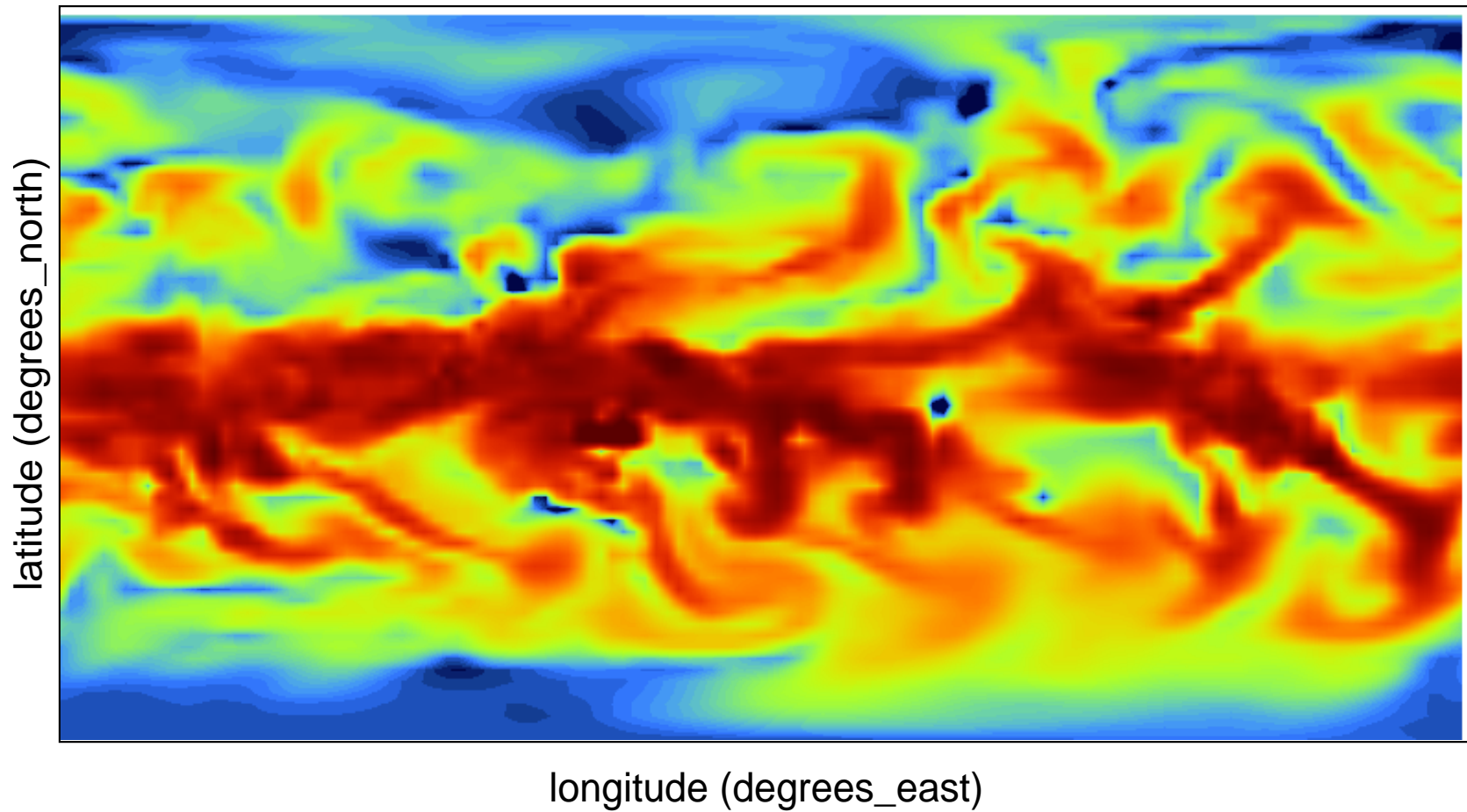
Specific Humidity (kg/kg)



ila Thu Jun 24 09:27:36 2004

00 GMT 8 January, 2003

Specific Humidity (kg/kg)



ila Thu Jun 24 09:27:47 2004

Future work with CAM / CCSM models

1. Model parameter estimation by assimilation in CAM 3.0
 - a. Gravity wave drag efficiency (Byron Boville)
 - b. Convective parameterization constants (Saravanan and Tribbia)

2. Observing system evaluation experiments
 - a. Evaluating value of GPS occultation observations (Liu)
 - b. Parameterization evaluation with ARM measurements (with PCMDI)

3. Towards an earth system assimilation capability
 - a. Adding land model (CLM) into state vector and assimilating
 - b. Long term: moving towards WACCM (whole atmosphere with chemistry)
 - c. Even longer term: going to fully coupled ocean-atmosphere-land CSM model

Summary

1. CAM assimilations working in DART
2. Have some initial guidance on model forecast quality
3. Provides some validation for DART filter algorithms
4. Significant interest in using assimilation with DART
(CGD, U. Arizona, U. Utah, PCMDI,...)