Short-range weather forecasts of AM2 for the TOGA-COARE period

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April 25, 2006

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Introduction

- We believe that diagnosis of drifts from and differences with observations in short (< 10 days) integrations of a climate model initialized with numerical weather prediction analyses can reveal a lot about the character of model errors and potentially be an insightful way to interpret the errors in a model's climate
- This is because the errors are so large that they can only be ascribed to errors in the climate model (and generally the parameterized physics) rather than to errors in the analyses we use or our omission of data assimilation techniques in the production of our initial conditions

Experiments

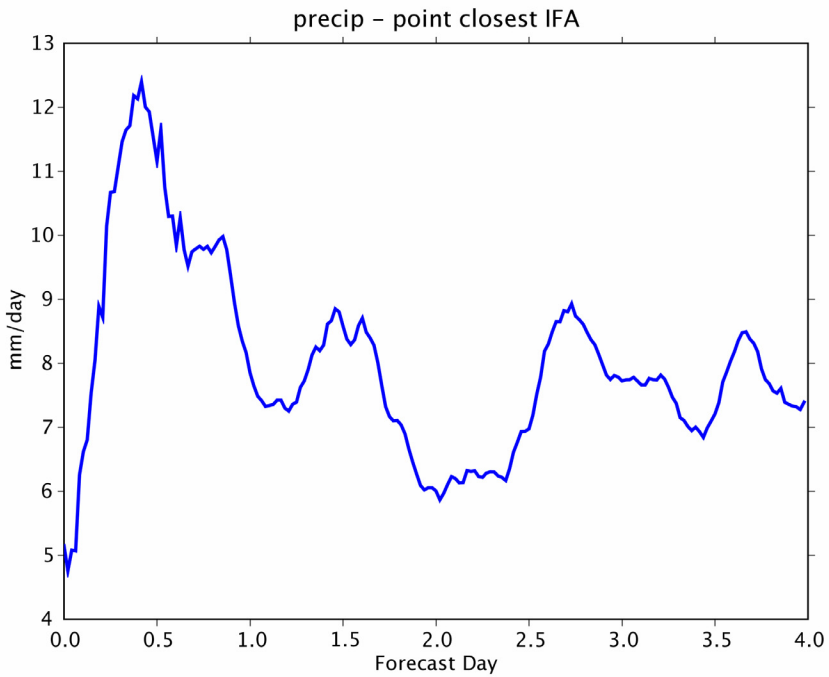
- A series of 10 day integrations of GFDL AM2 (am2p12c - n45) were performed starting once per day from the ECMWF ERA-40 re-analysis for the period of October 1992 through February 1993 (Xue Wei did the integrations at NOAA/ESRL)
- We focus on the simulation of tropical variability over the Tropical Western Pacific where the TOGA-COARE field experiment occurred (IFA = "Intensive Flux Array")
- Jim Boyle has also done the same integrations with the NCAR CAM3 and the NCAR CAM3 with the modifications to deep convection closure of Guang Zhang (these are used in Donner convection)

Convection Closure/Triggers

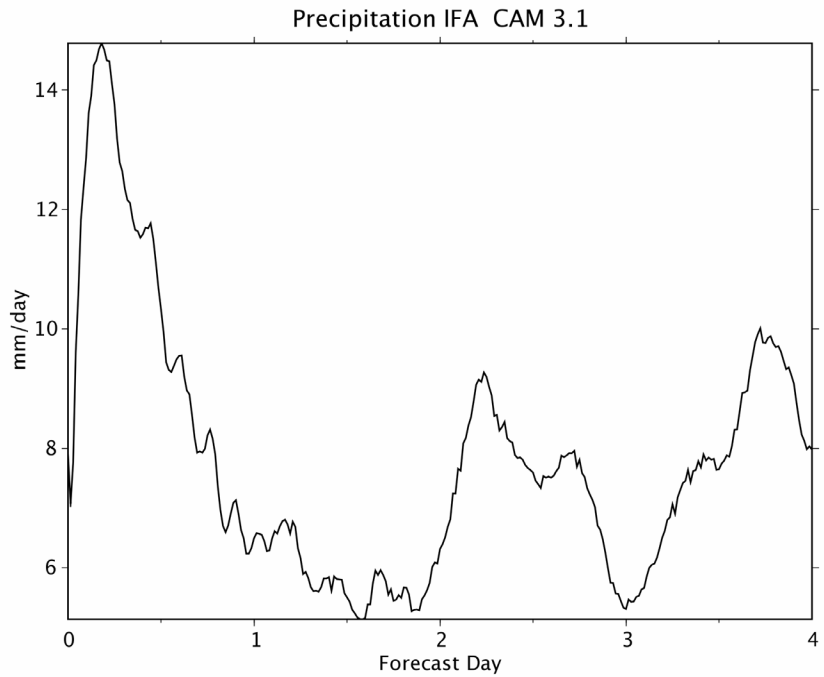
- AM2 (RAS) – “CAPE relaxation” + lateral entrainment rate minimum threshold (tokioka)
- CAM3 (Zhang-McFarlane) – “CAPE relaxation”
- CAM3 (Zhang modifications) – convective heating proportional to destabilization of the free troposphere by the large-scale circulation

Precipitation adjustment issues

GFDL AM2



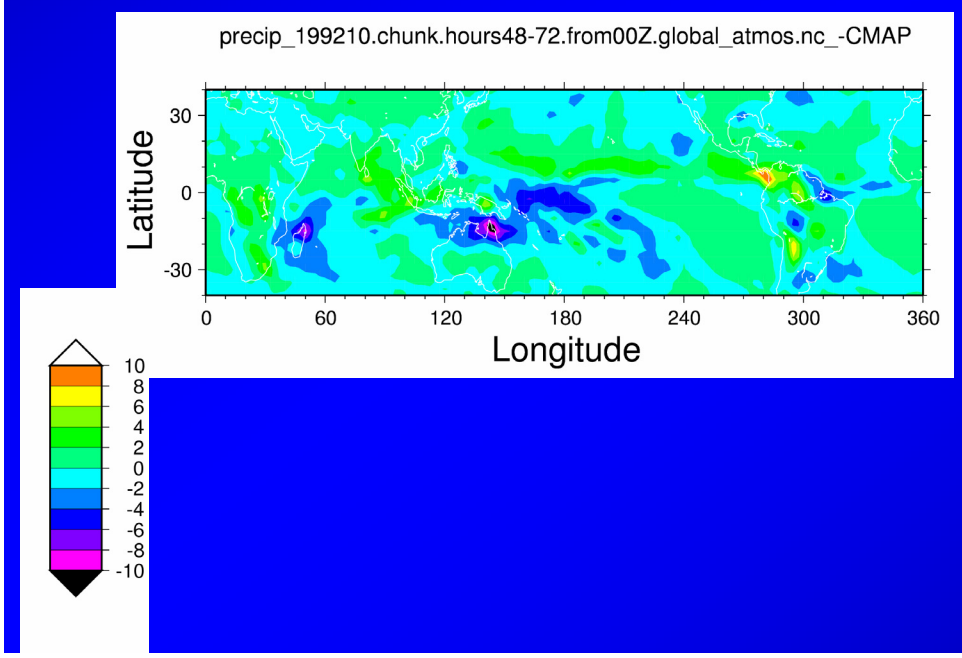
NCAR CAM3.1



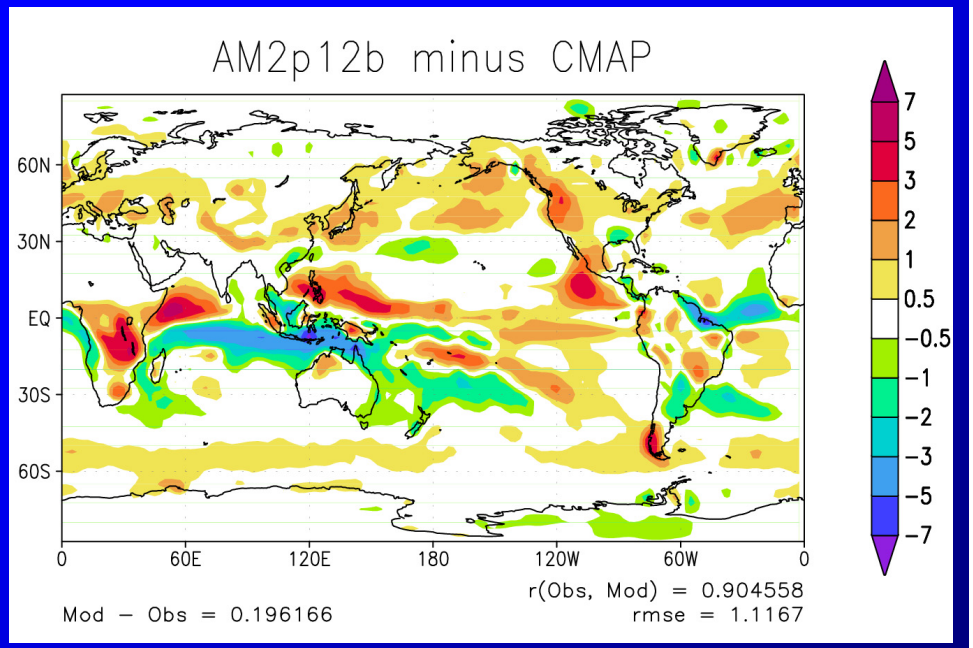
In the tropics, we typically examine model results in the range of 3-6 days

Are weather forecasts relevant for climate?

Day 3 Precipitation Error for DJF 1992-93



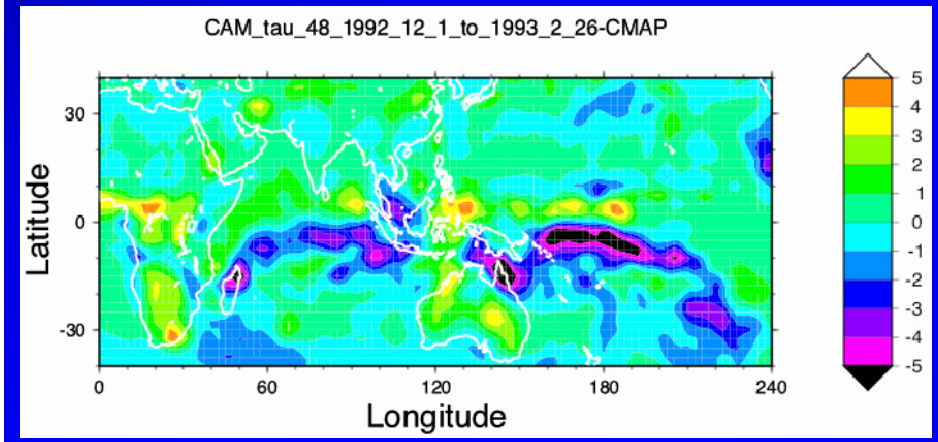
DJF Climatological Error



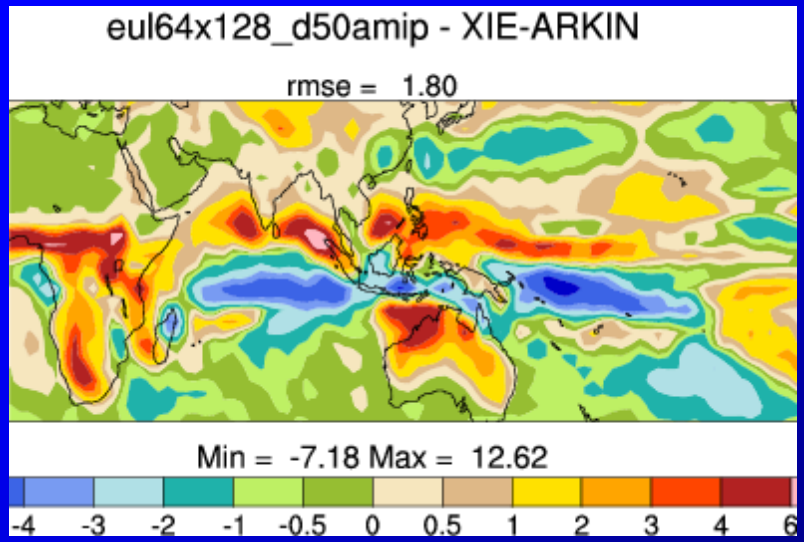
Are weather forecasts relevant for climate?

NCAR CAM3

Day 3 Precipitation Error for DJF 1992-93



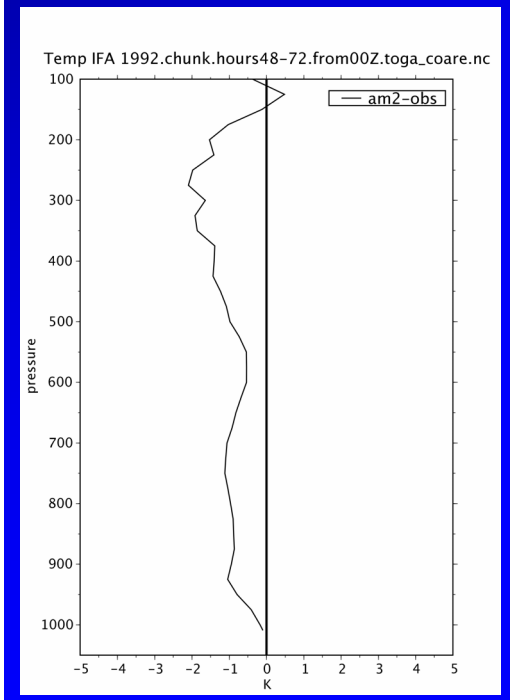
DJF Climatological Error



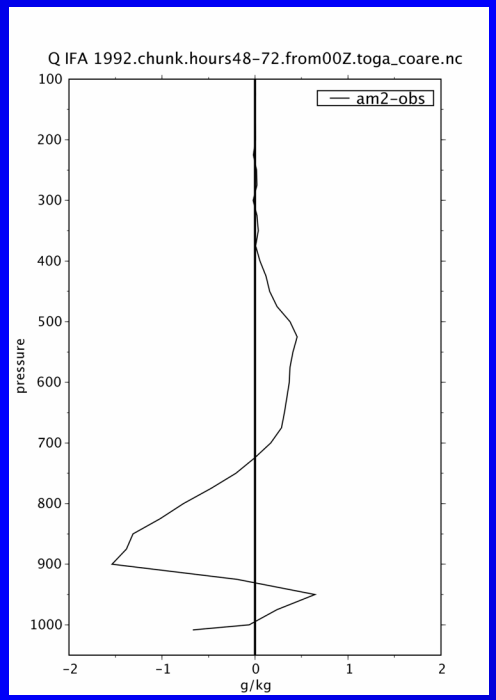
Temperature/Moisture Drifts

Day 3 Forecast Error at IFA

Temperature (K)

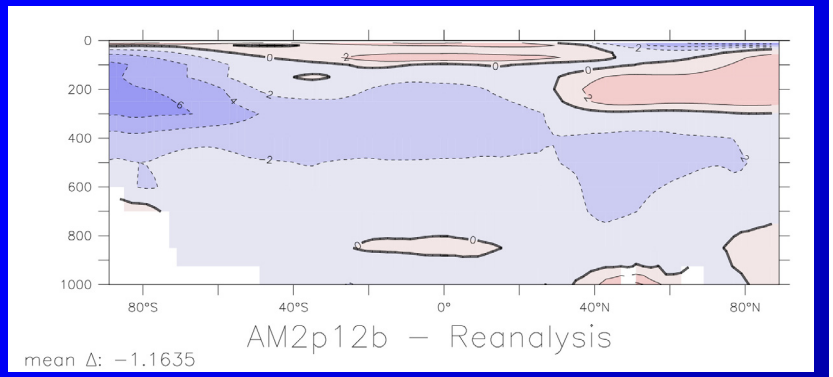


Specific Humidity (g/kg)

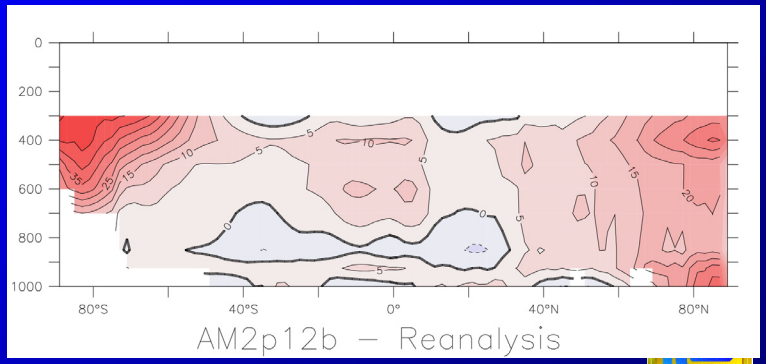


DJF Climate Error

Temperature (K)

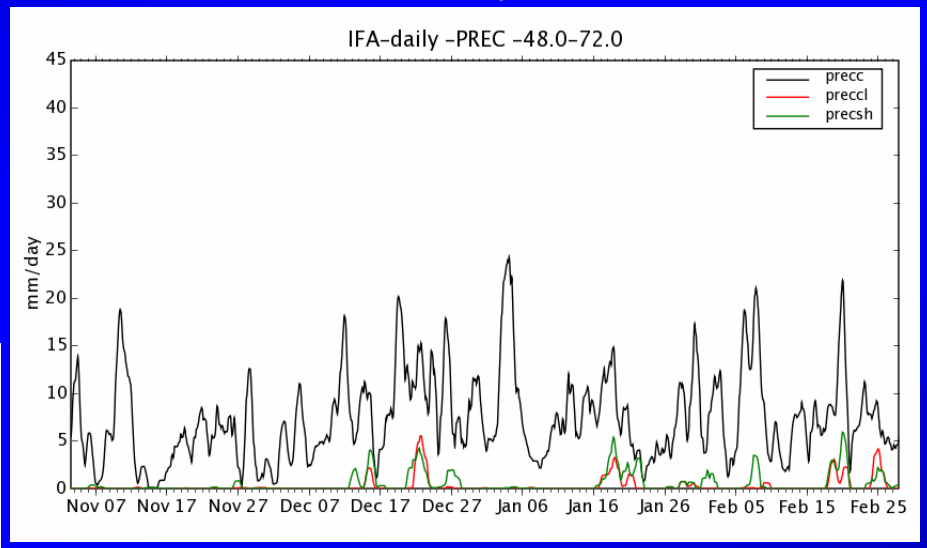


Relative Humidity (%)

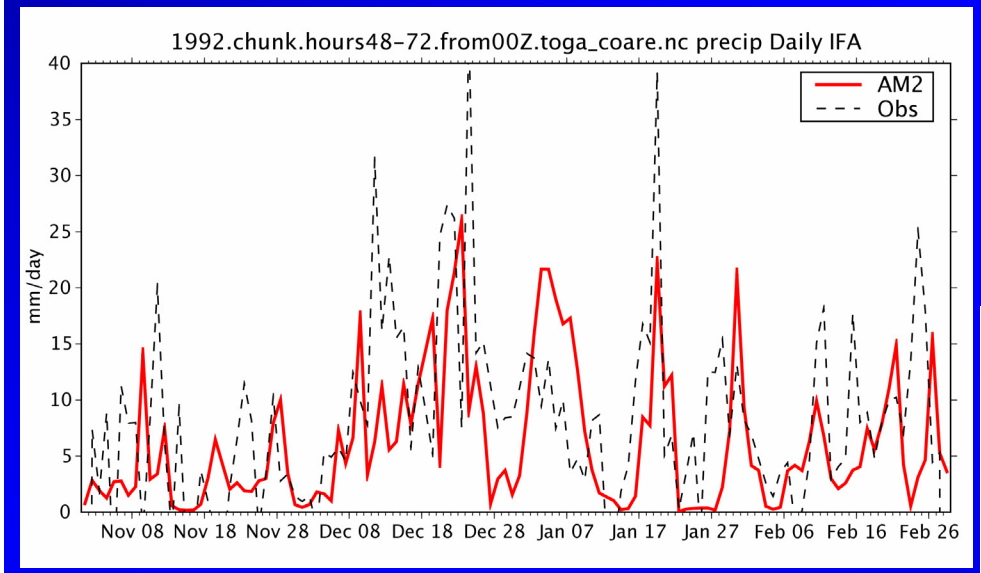


Precipitation at the IFA

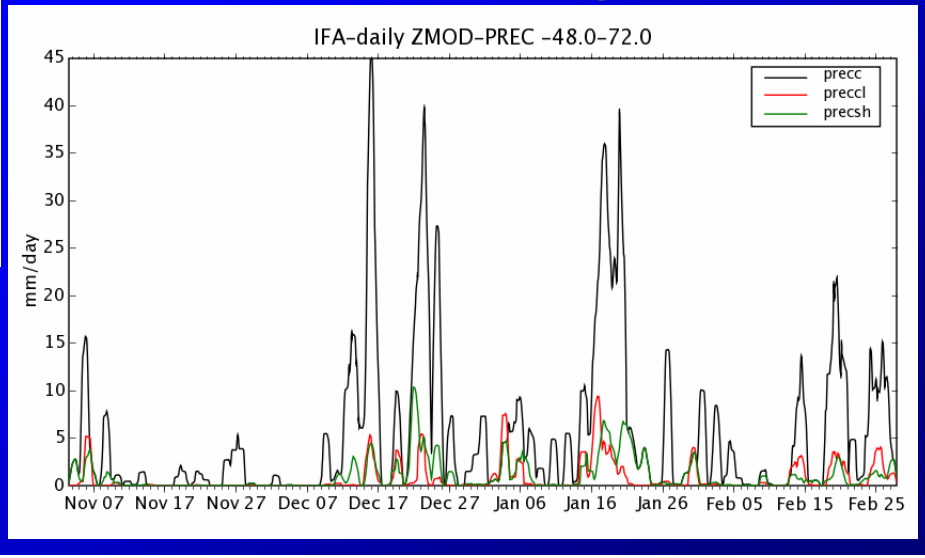
NCAR CAM3 (Day 3 of Forecasts)



IFA observations and AM2



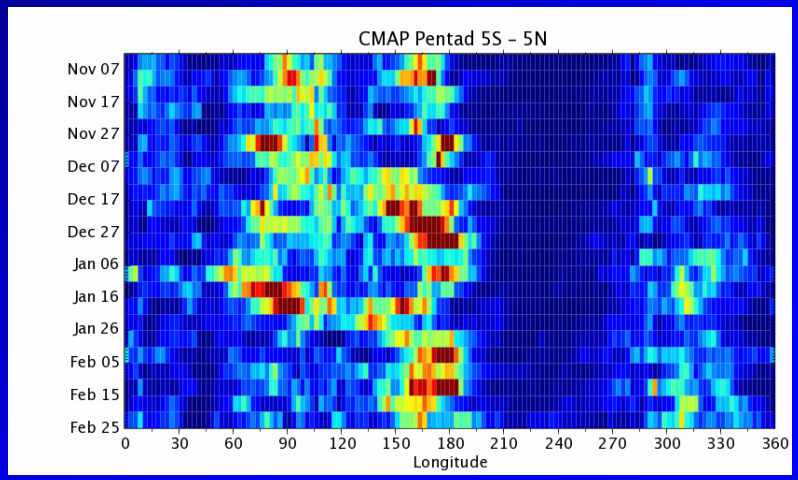
NCAR CAM3 with Zhang Modifications



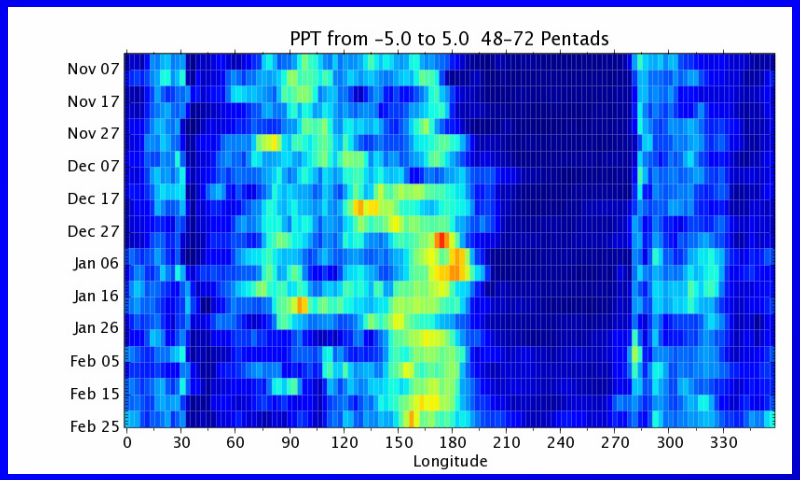
Tropical Precipitation Variability

Precipitation averaged over 5-day intervals and averaged from 5N to 5S between November 1992 and February 1993

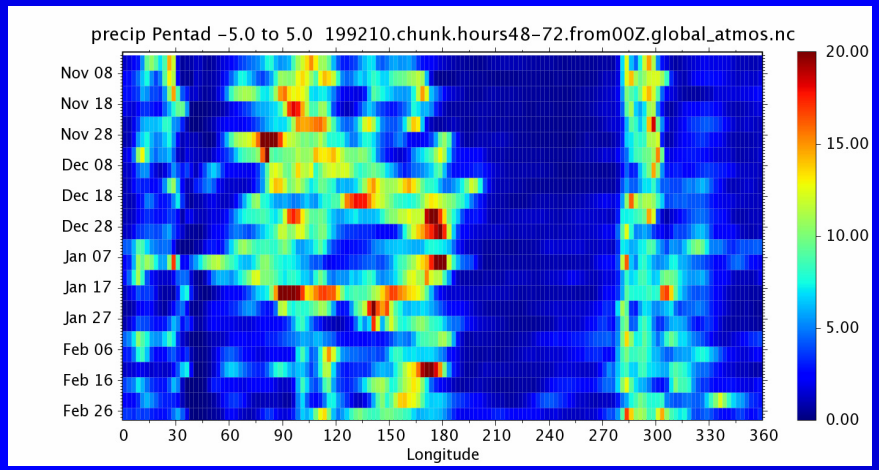
Satellite observations



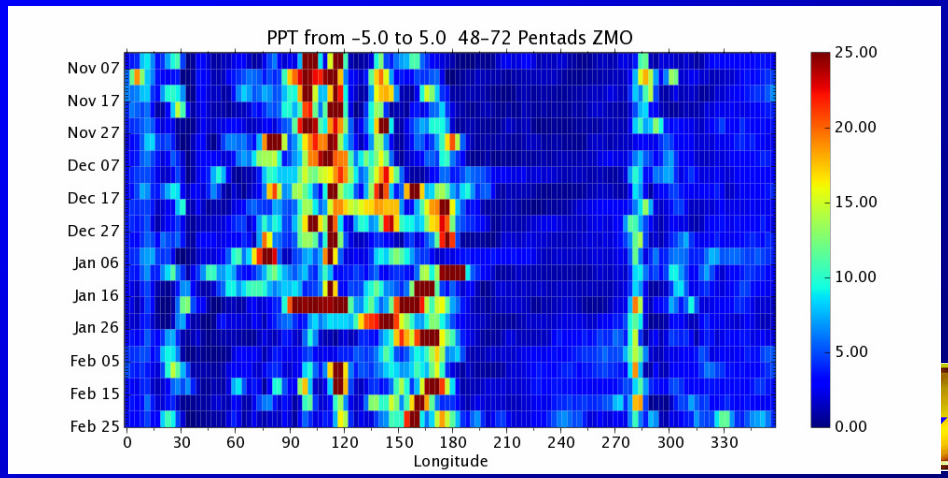
CAM3 (Day 3)



AM2 (Day 3)

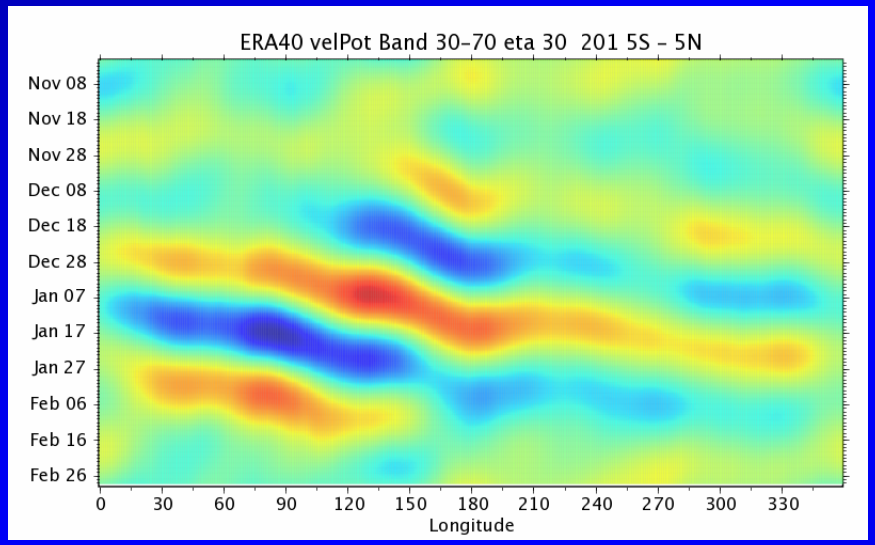


CAM3 with Zhang Modifications (Day 3)

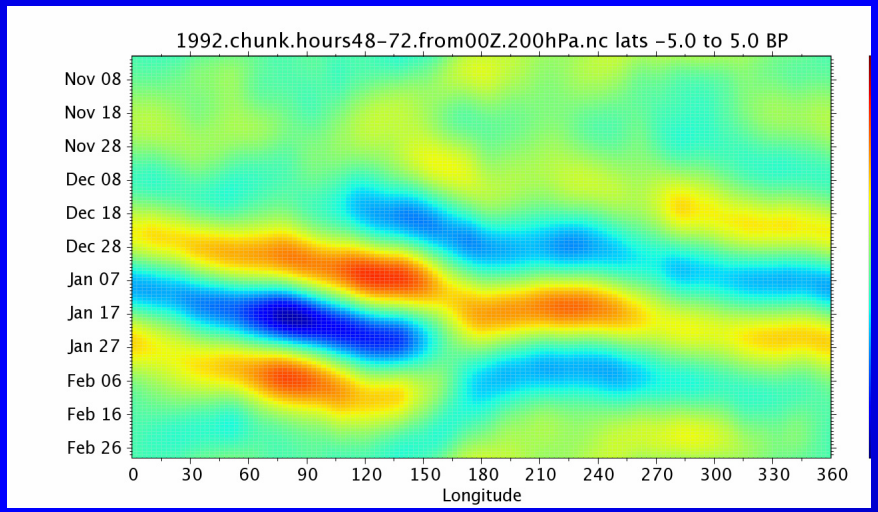


Intraseasonal Variability in 200 hPa Velocity Potential

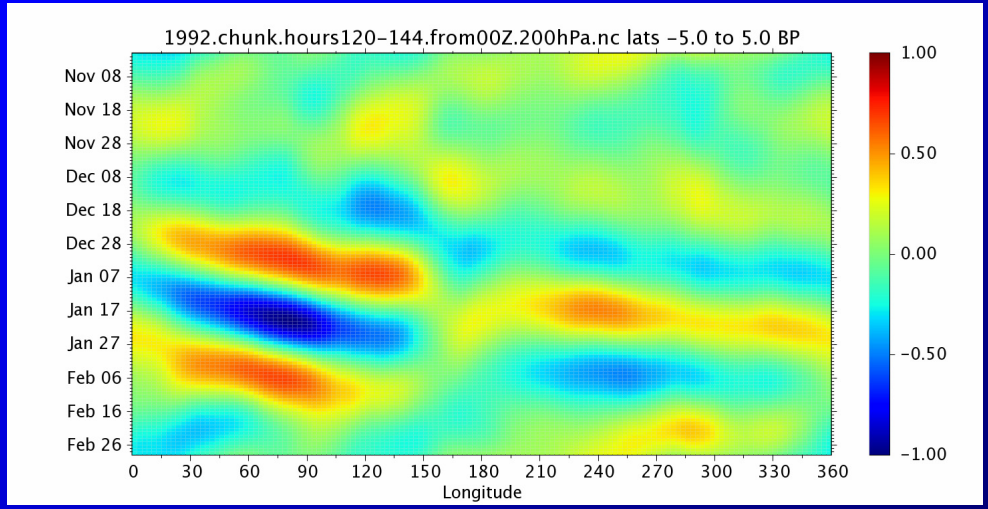
ERA 40



Day 3 – AM2



Day 6 – AM2



Intraseasonal Variability in 200 hPa Velocity Potential

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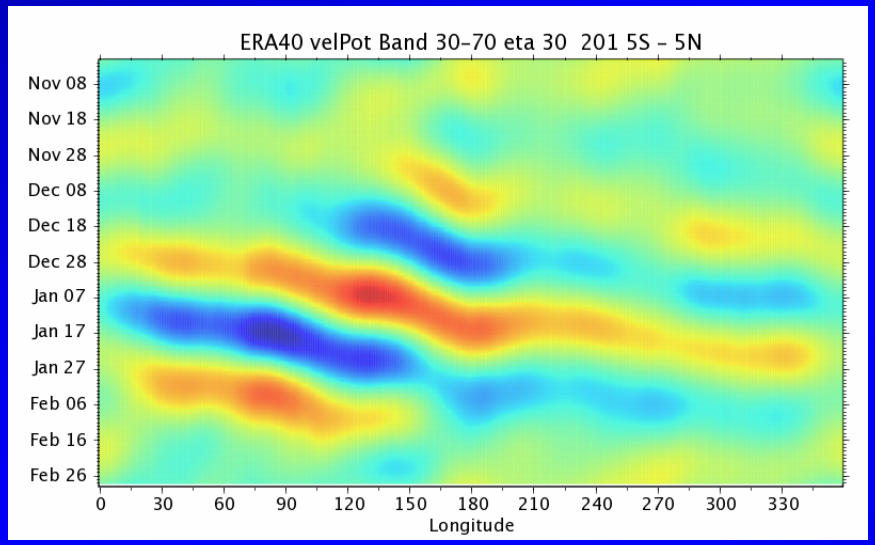
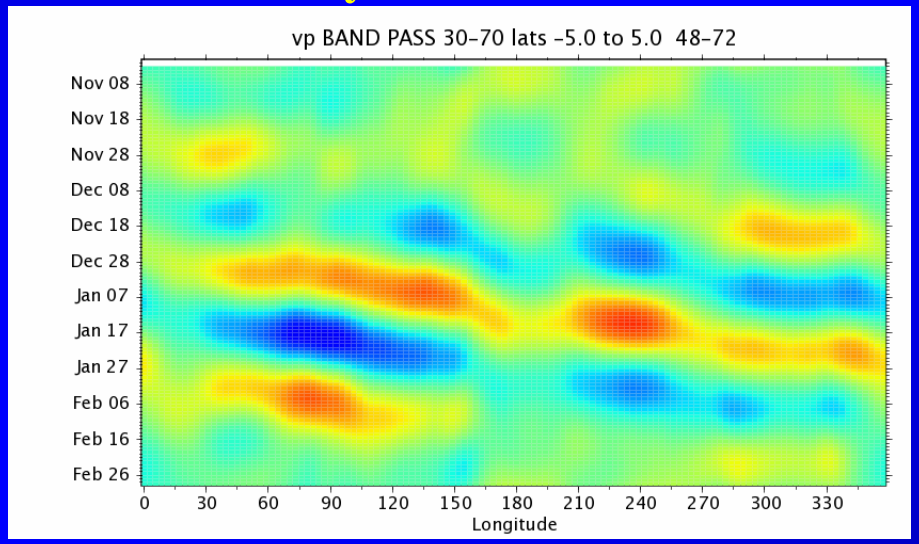
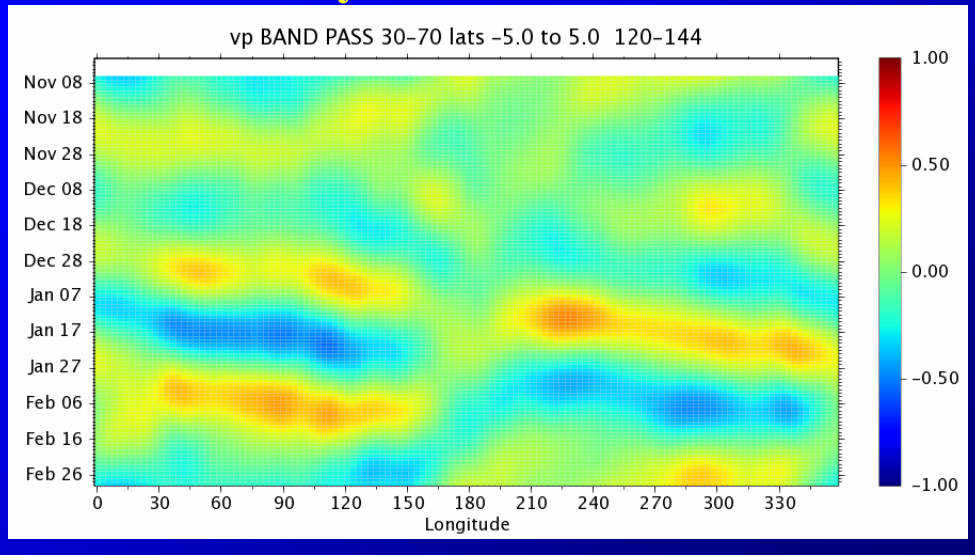


Day 3 – CAM 3

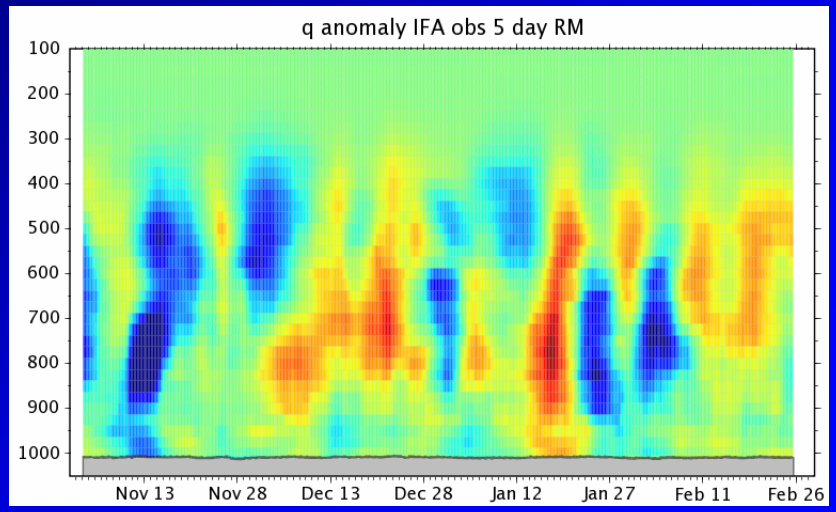


Day 6 – CAM 3

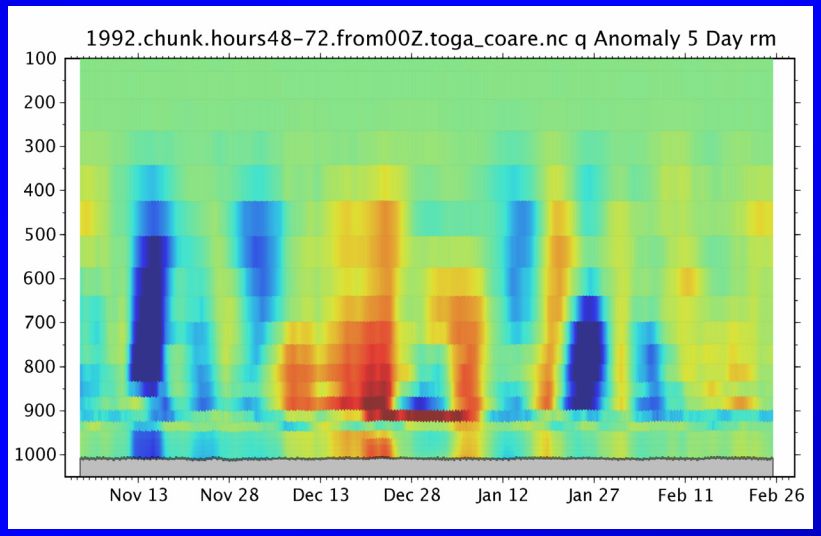


Moisture Variability at the IFA

IFA Obs

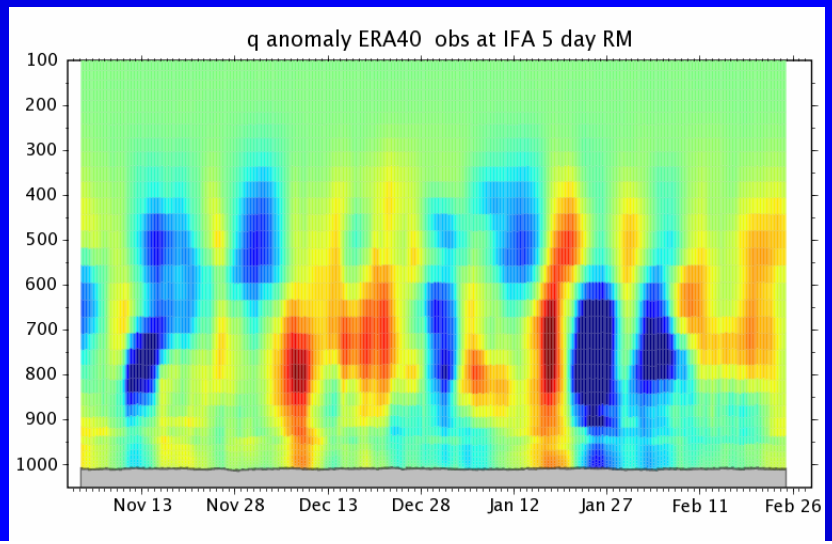


Day 3 – AM2

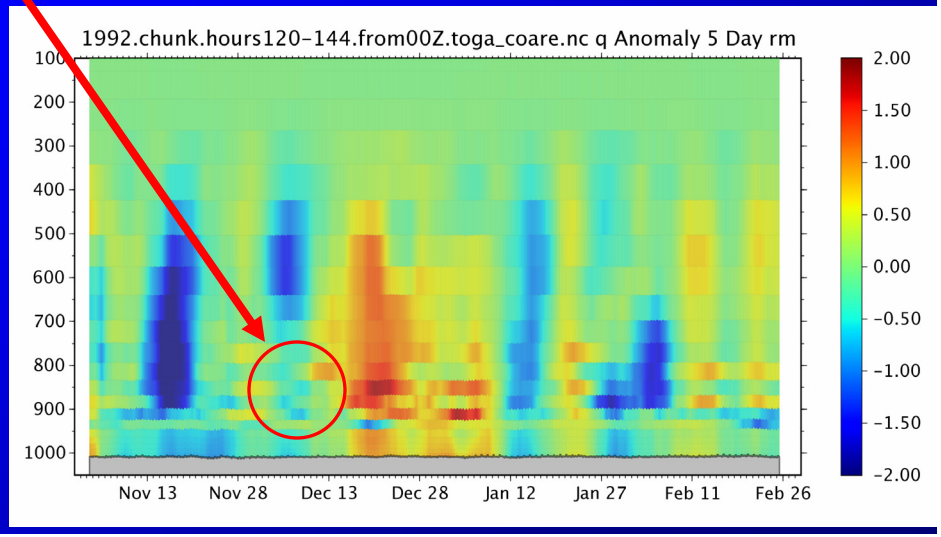


Unrealistic drying

ERA 40

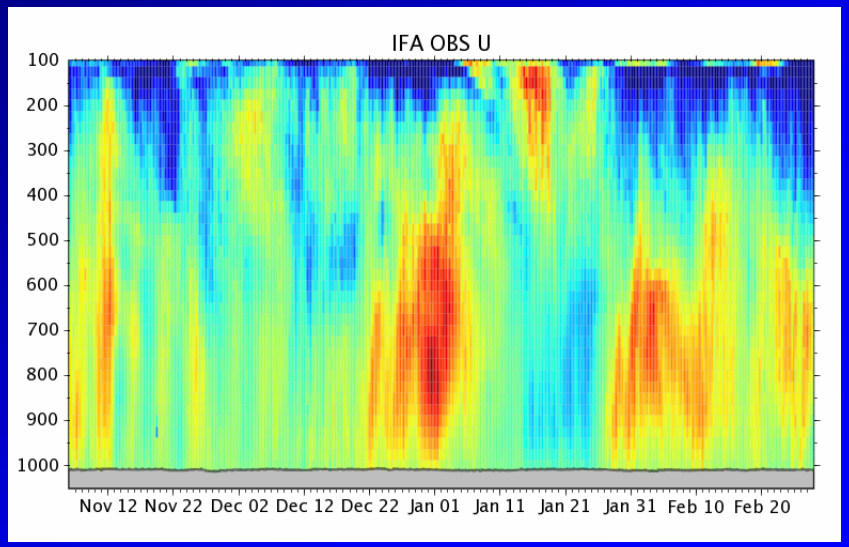


Day 6 – AM2

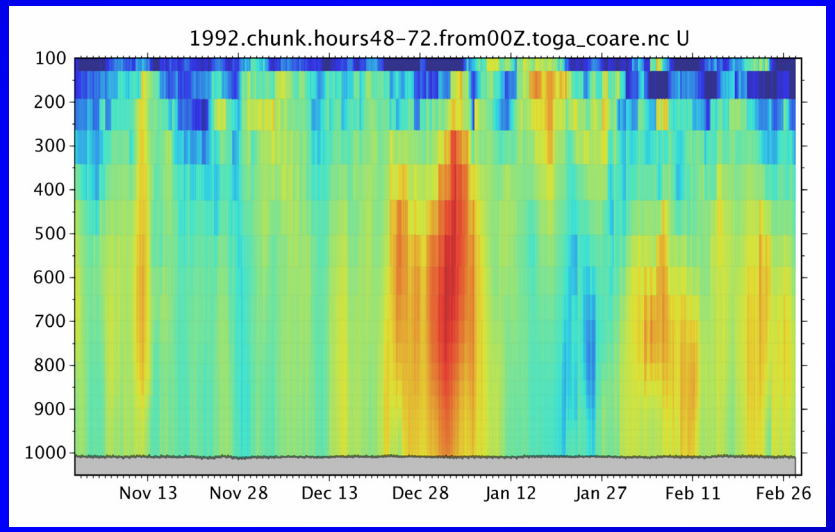


Zonal Wind Variability at the IFA

IFA Obs



Day 3 – AM2



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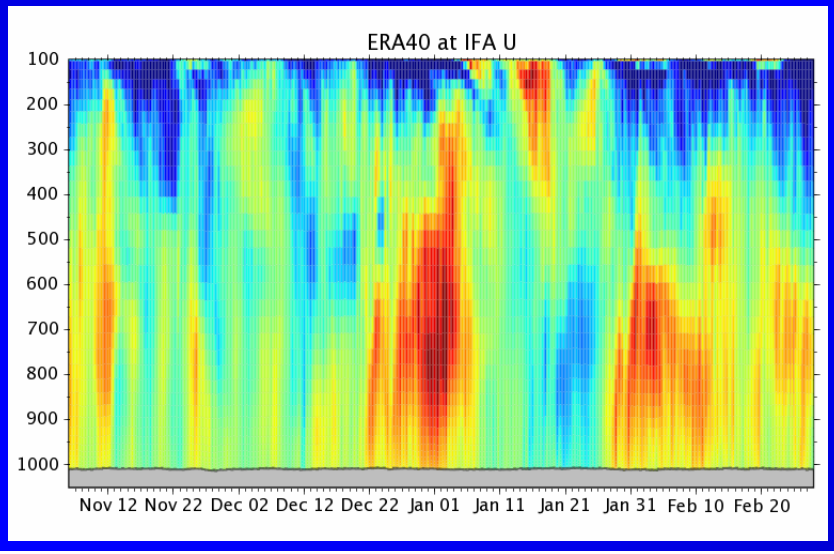
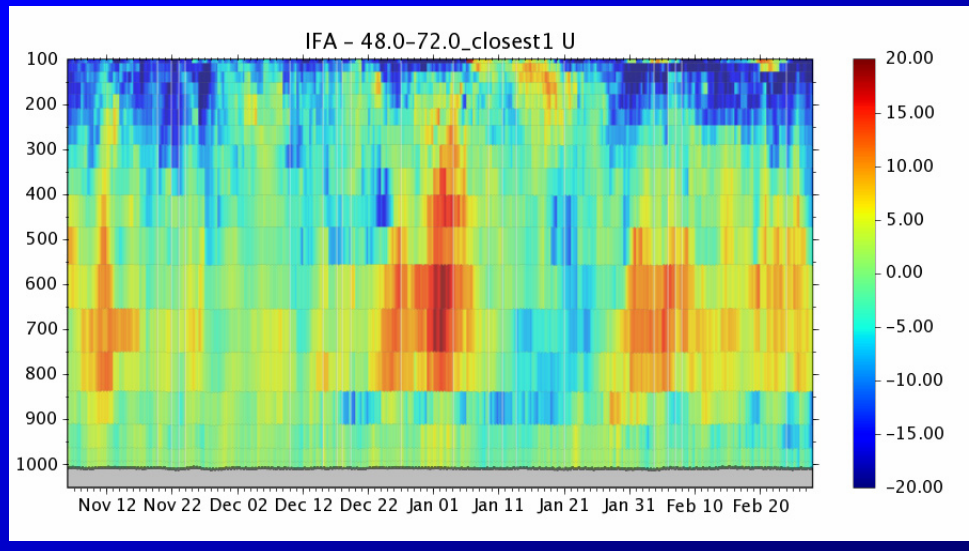


Day 3 – CAM 3

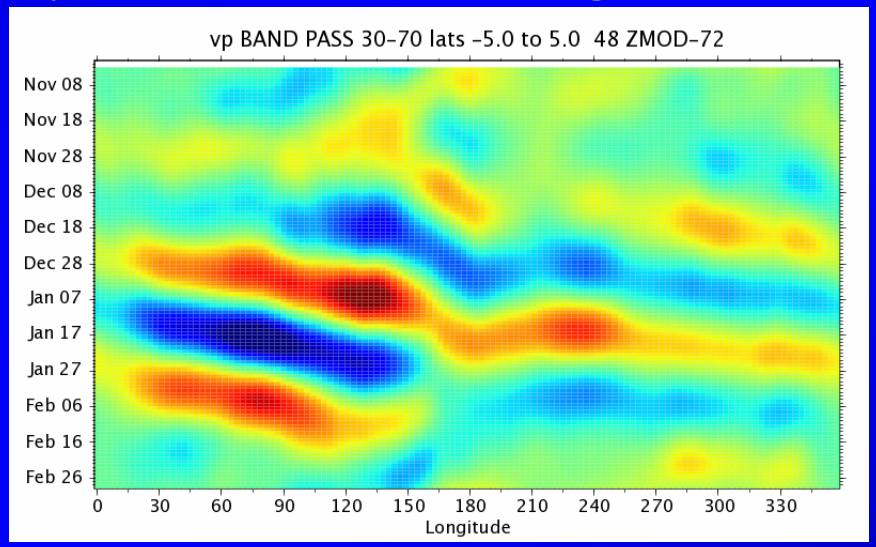


Tentative results

- AM2 short-range drifts from ERA-40 have some correspondence to the climate drifts of the model: vertical errors in T & q – precipitation less so
- AM2 does sustain intraseasonal variability present in ERA-40 – but significant errors are present: lack of moisture build-up prior to deep convection *(RAS dries too much as a shallow convection scheme?)*
- Comparison of AM2/CAM3 shows impact of deep convection closure
- AM2 surface wind anomalies are acceptable in comparison to CAM3

200 hPa Velocity Potential With Zhang Modifications

Day 3 – CAM 3 with Zhang Modifications



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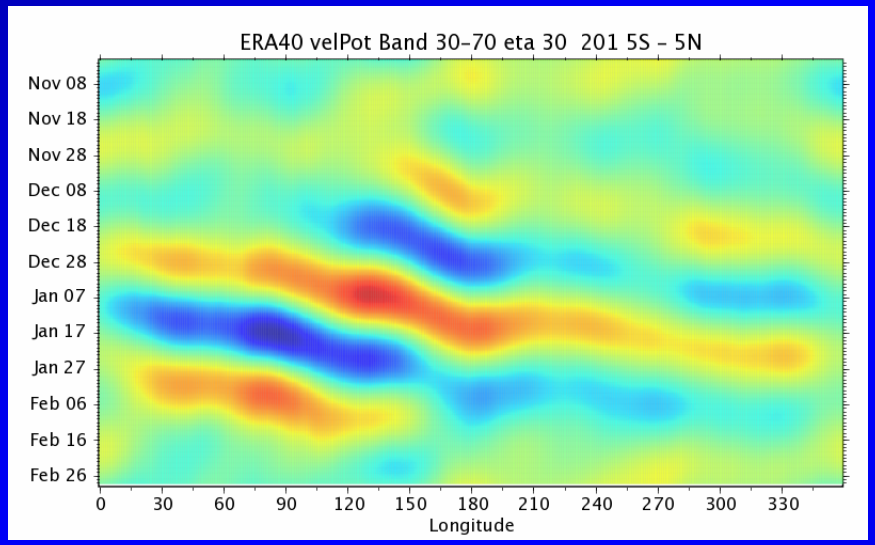
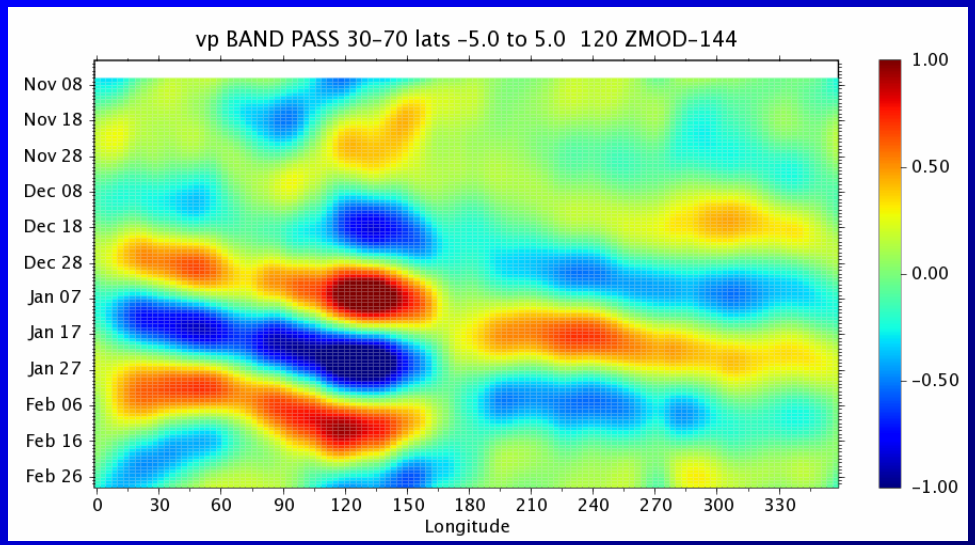


Day 6 – CAM 3 with Zhang Modifications



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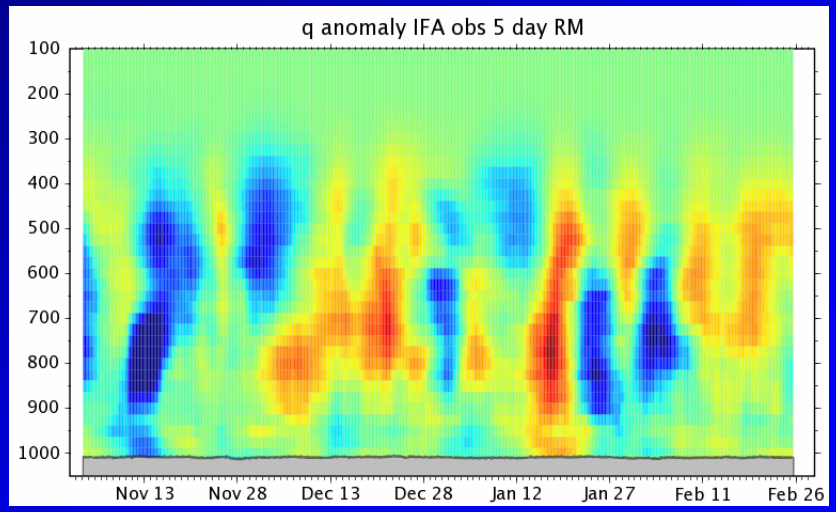
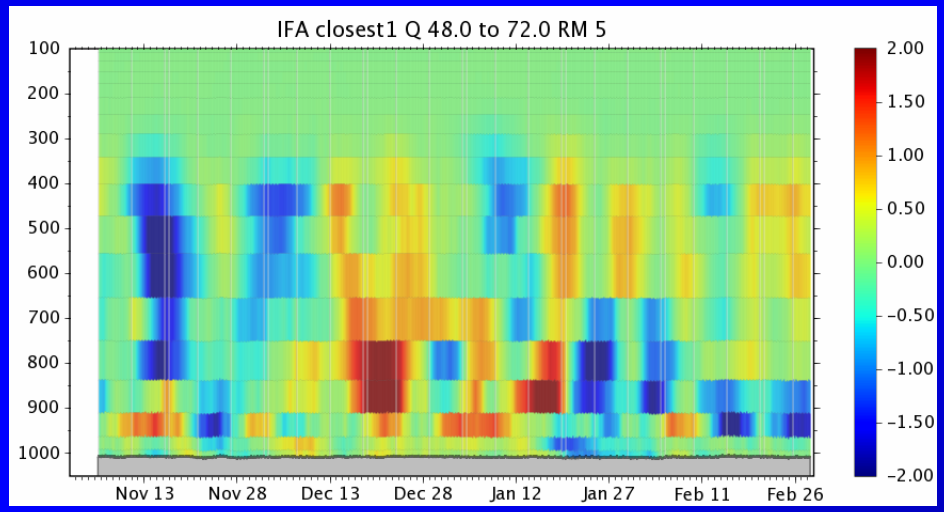
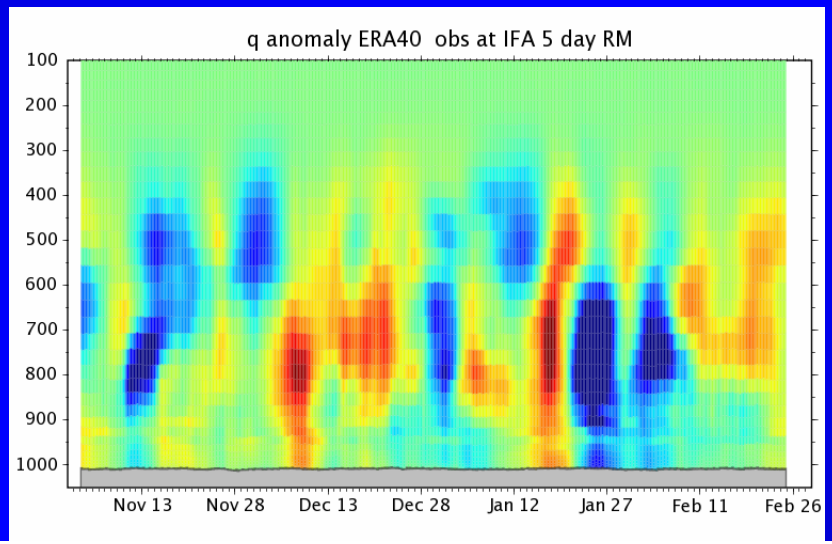
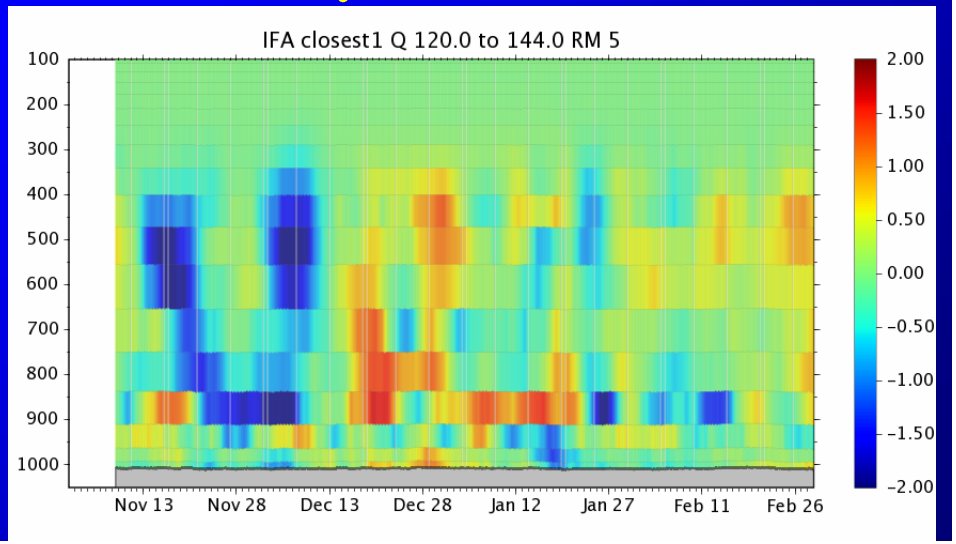


Day 3 – CAM3



ERA 40



Day 6 – CAM 3