# *Short Range Systematic Errors i*
# *the NCEP GFS*


**by**

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***I'm responsible for this presentation;***
***The others are responsible for the GFS***

# GFS Global Forecast System

*64 sigma layers*

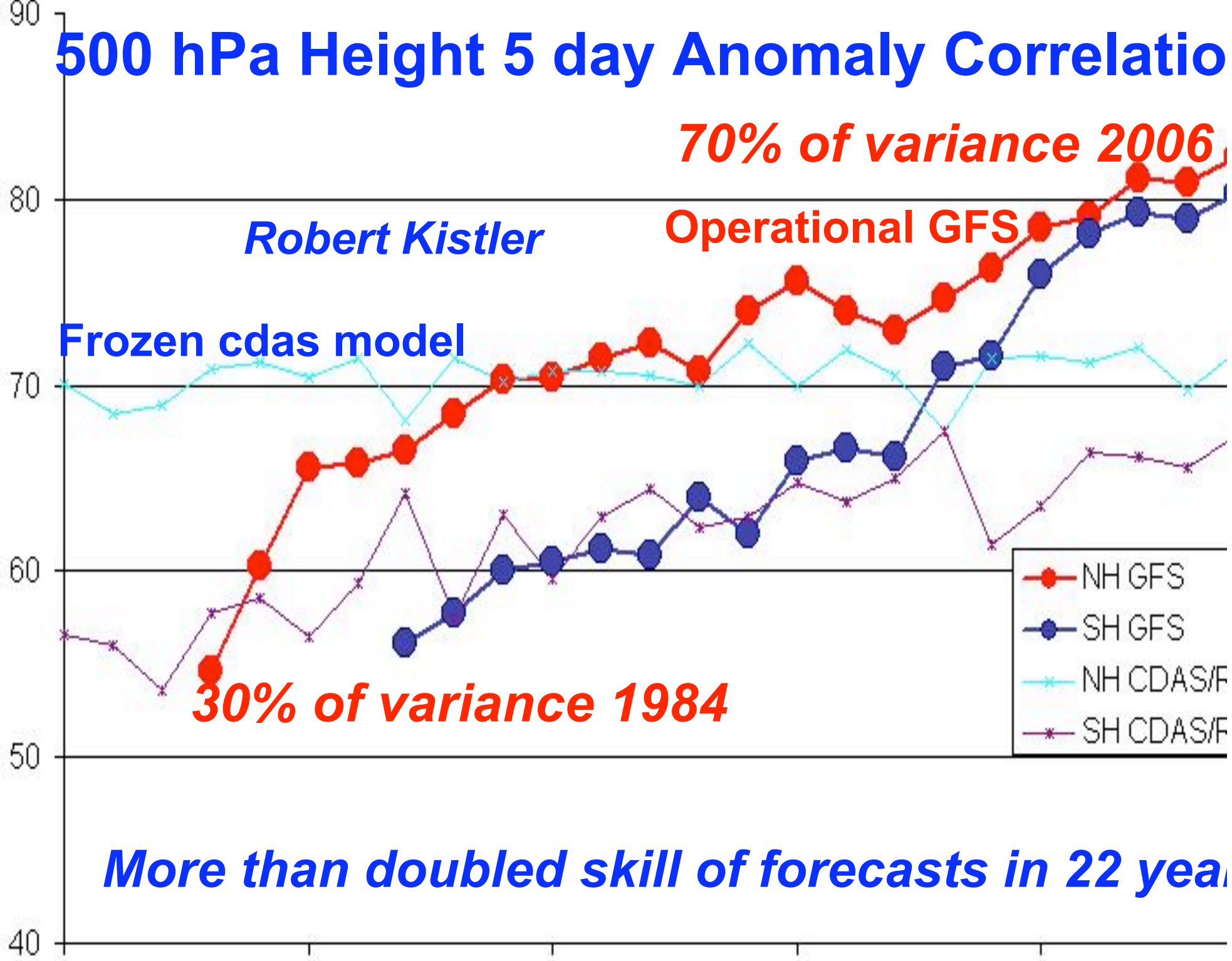
*T382 to 180 hours, T190 to 384 hours 4 times a d*

*Guidance for NWS aviation, hurricane, medium a*
*extended range forecasts (12 hours-9 months)*

*Atmospheric model used in NWS Climate Foreca*
*System for monthly, seasonal forecasts*

# GDAS Global Data Assimilation System

*SSI Spectral Statistical Interpolation 3DVAR—us*
*as initial and boundary conditions for other syste*


500 hPa Height 5 day Anomaly Correlatio
70% of variance 2006
Robert Kistler
Operational GFS
Frozen cdas model
30% of variance 1984
More than doubled skill of forecasts in 22 yea
NH GFS
SH GFS
NH CDAS/F
SH CDAS/F
90
80
70
60
50
40

**My web page:**
**http://wwwt.emc.ncep.noaa.gov/gmb/noor/oct98op/text.h**
**--monthly, seasonal systematic errors in GFS 9/1998 on**
**--monthly comparison of GFS and other NWP centers 9/2003 on**

**Today will discuss using short-range errors (day or less) to diagnose GFS**
**--comparison to other centers**
**--"transplant" experiments—running GFS model from ECMWF Analyses and ECMWF model from GFS analyses**

**Poster Thursday on long range errors using multi decadal ocean-atmosphere coupled integrations t diagnose GFS**

# Major implementation May 31, 2005

--higher resolution 50 km to 35 km

--improved analysis

--new sea-ice, land-surface models

***--enhanced orographic height by 10% of mountai***

***variance in calculation of mountain blocking***

***dissipative forces***

***--reducing both background diffusion in free***

***atmosphere and turbulent diffusion length from 1***

***to 30 m in stable cases***

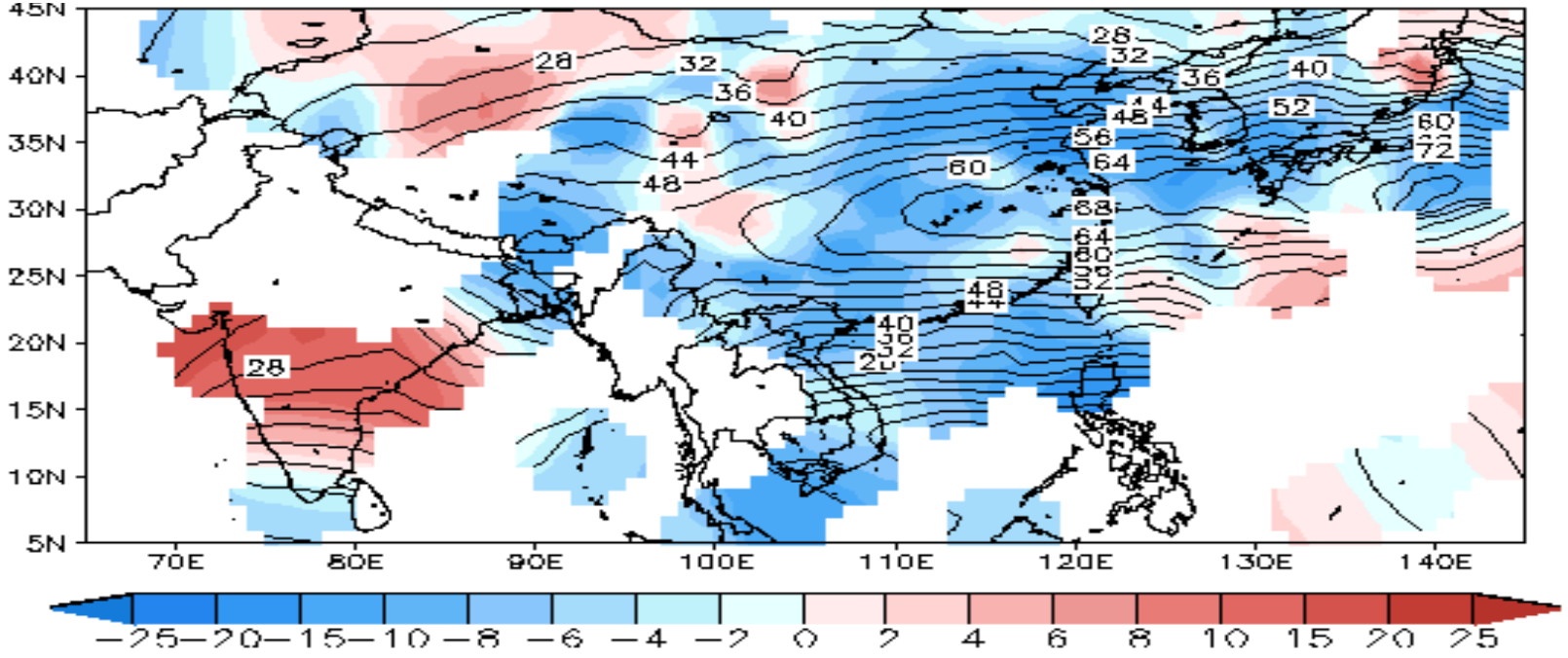
***Last two tested (and tuned) in 1-day experiments***

***winter cases 2004-2005 (emphasized period in Fe***

***2005 where our skill dropped off relative to ECMW***

***and found to work together to improve forecasts***

# Bias in 200 hPa Wind speed 24 hr forecasts Jan 2005




SURANJANA BAHA, GMB/EMC/NCEP/NWS/NOAA

Black Isolines are from actual observa

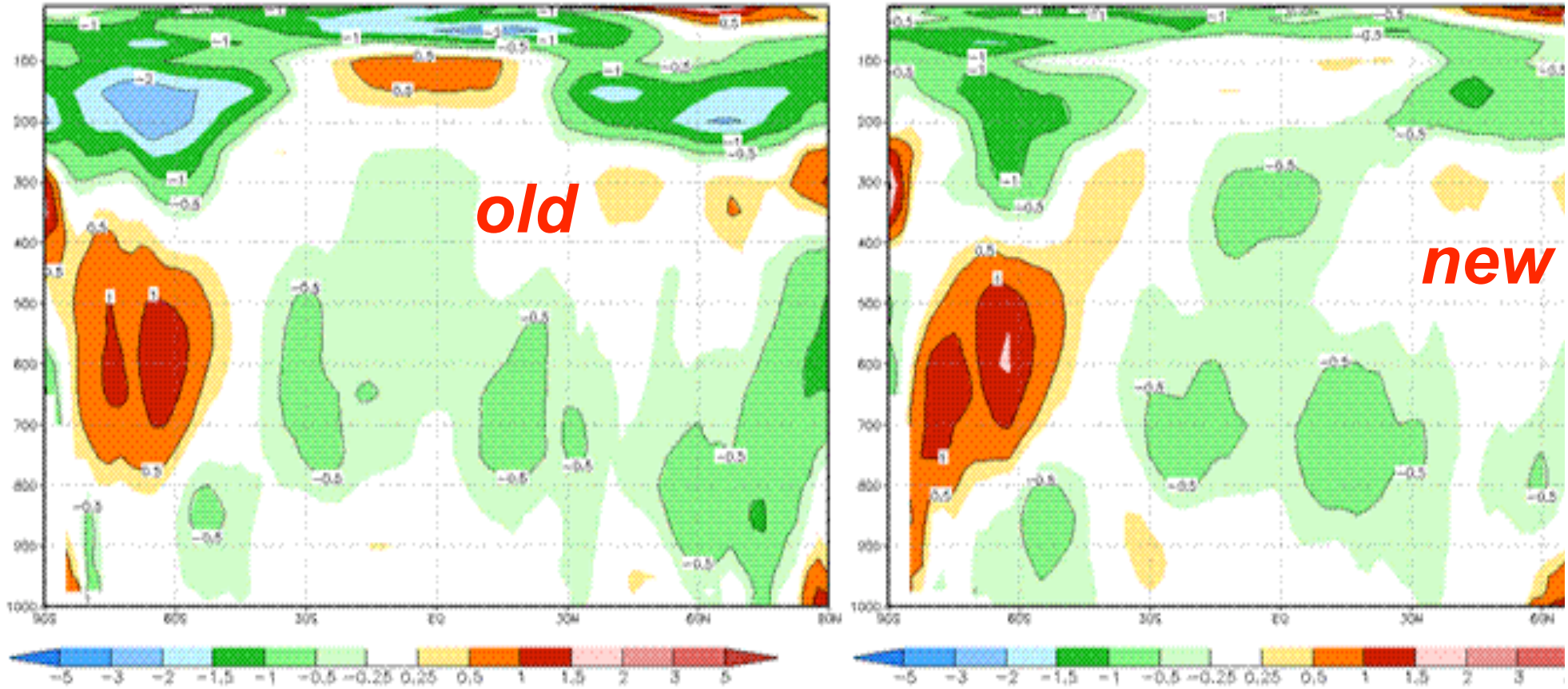
***Negative bias in GFS Asian jet compared observations***

***This suggested too much diffusion***

***Reducing diffusion did not eliminate bias***

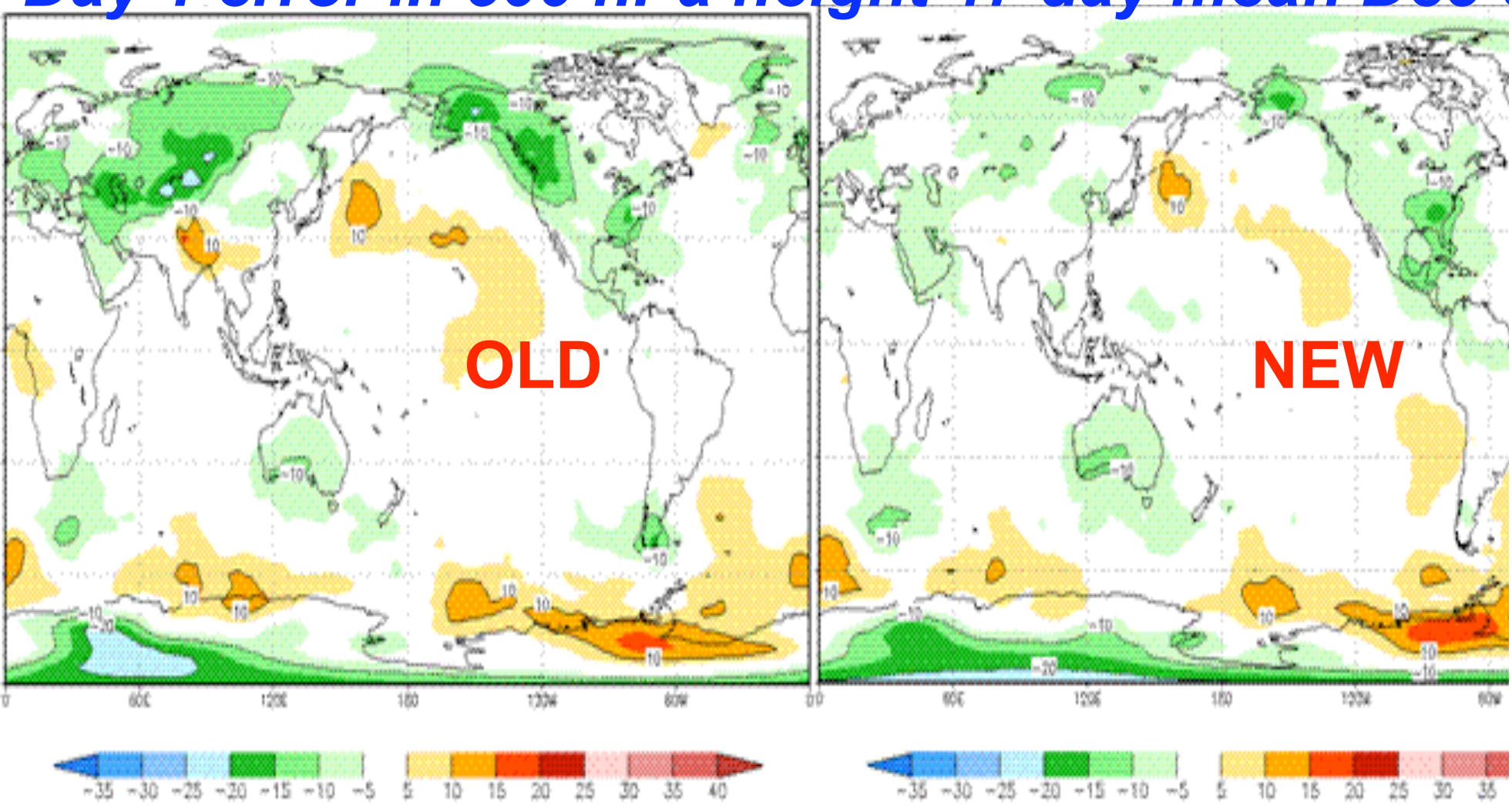
# Zonal mean 5day error in temperature

## 47 day means Dec.-Jan




**Reducing diffusion produces drier, warmer stratosphe**

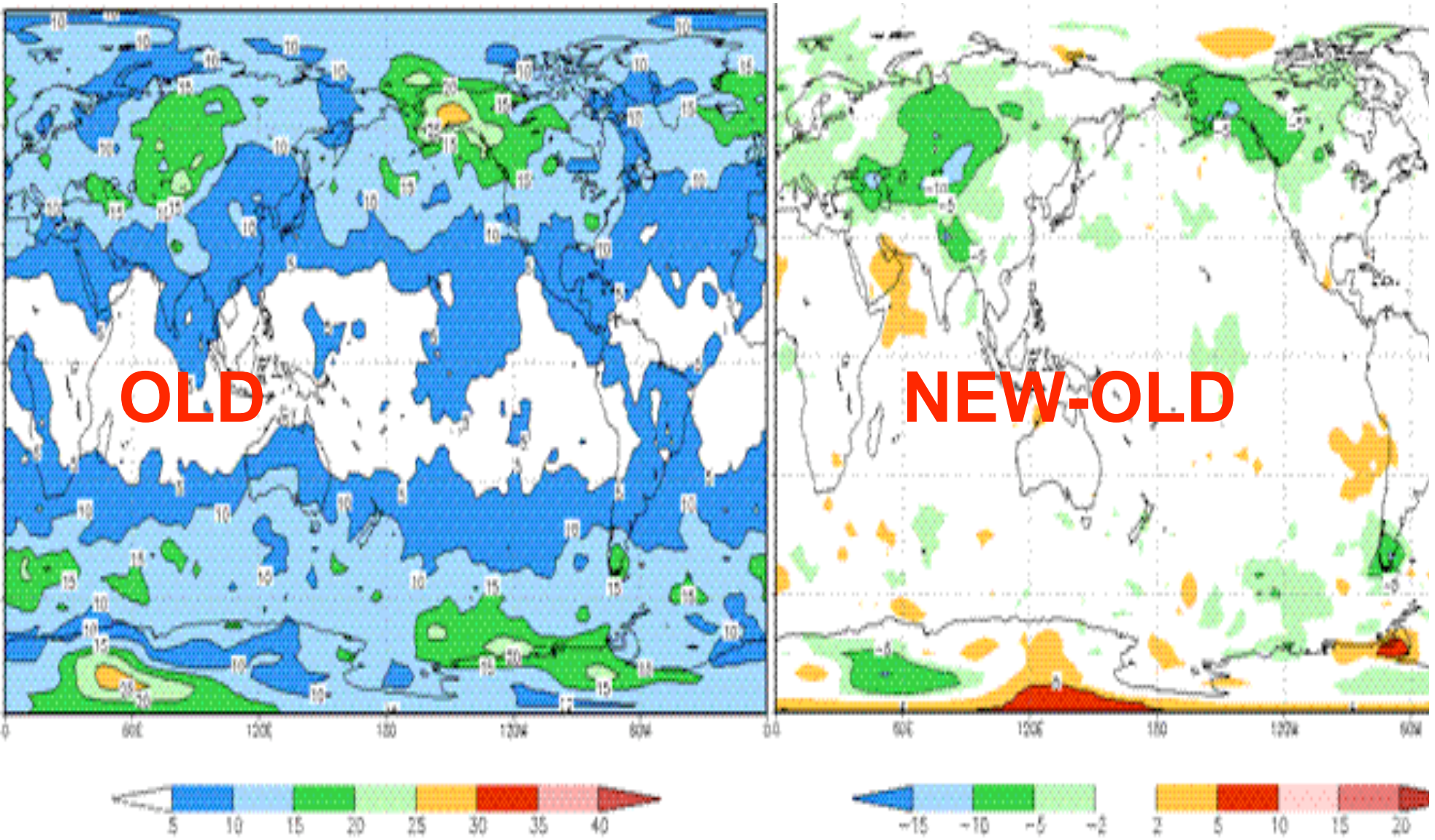
# Day 1 error in 500 hPa height 47 day mean Dec-




**Day 1 error (left) implies problem with orograph**

**Enhanced mountain blocking reduced error ove**
**Himalayas. Rockies**

# RMSE 1 day error 500 hPs height 47 days Dec.-Jan.




# Day 1 rms height error reduced over mountai

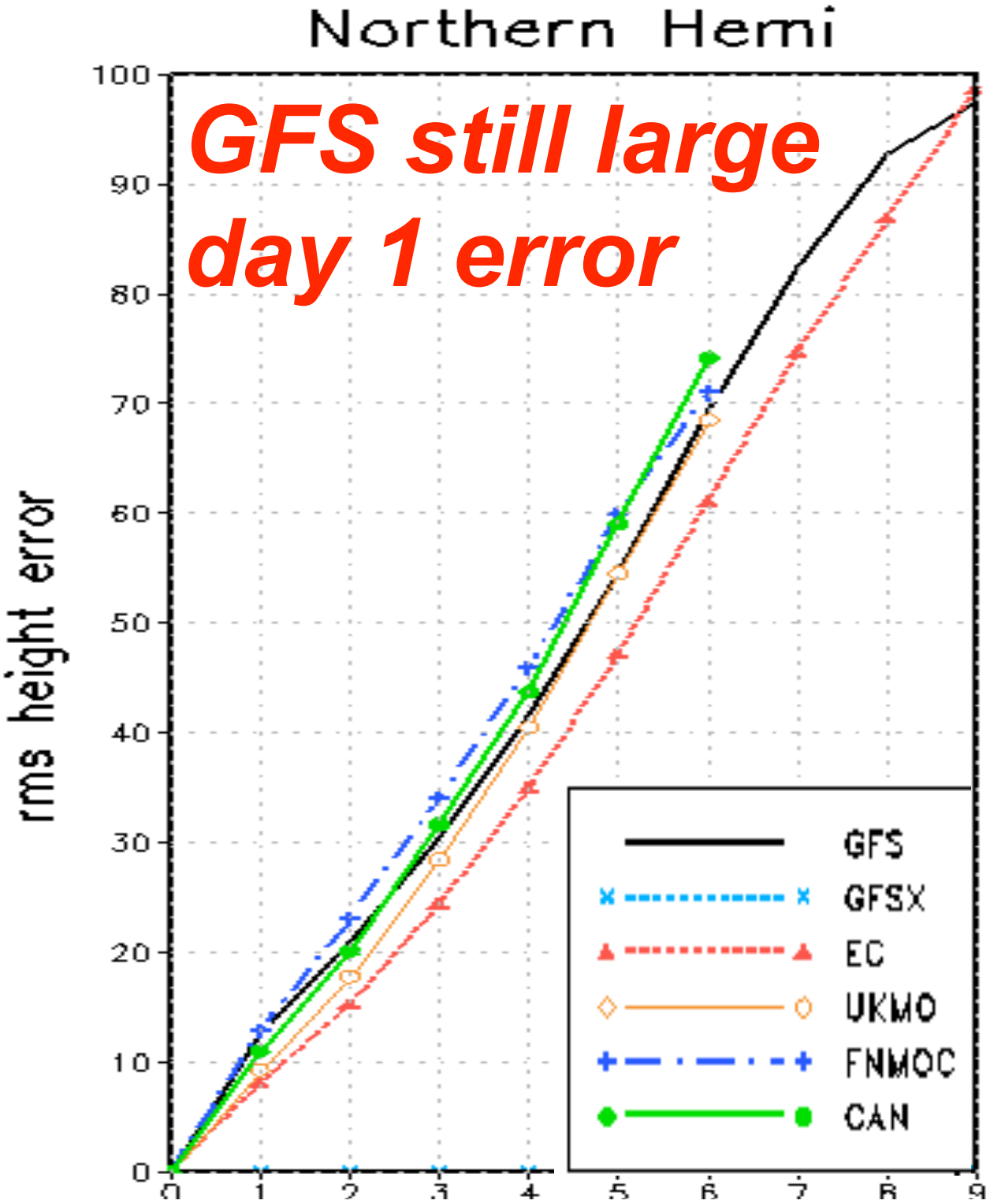
# *April 21-June 4, 2005*
# *20-80N 500 hPa height*
# *Anomaly correlation*

| | Day 3 | Day 5 | Day 7 |
|---|---|---|---|
| Old GFS | .950 | .815 | .587 |
| New GFS | .958 | .844 | .635 |
| ECMWF | .967 | .868 | .693 |

*Examining day 1 errors indicate areas of concern in gfs.*

*Reducing day 1 errors improved medium-range forecasts.*

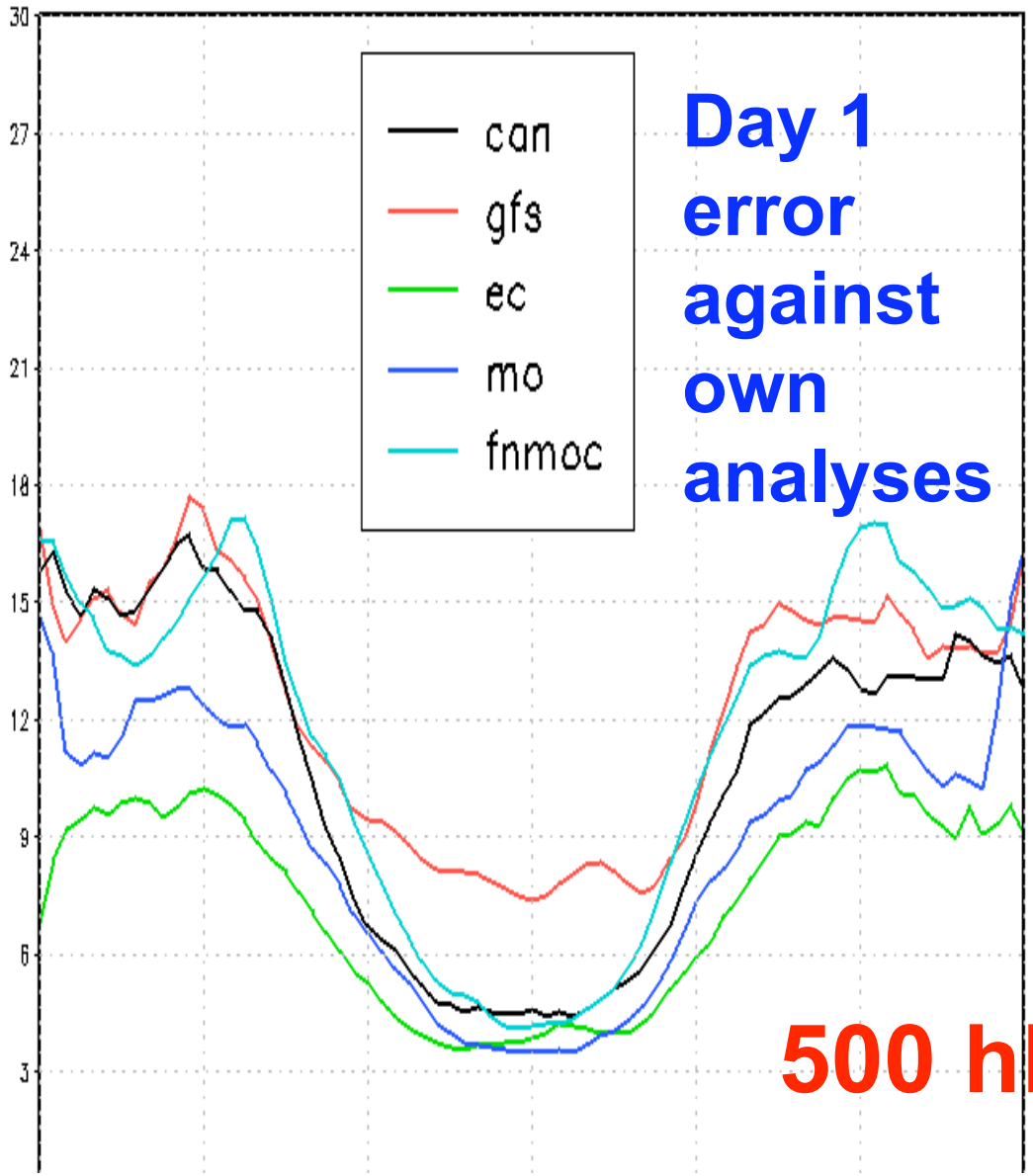
*Non-linear processes less time t act in shorter-range forecasts; source of error may be clearer.*

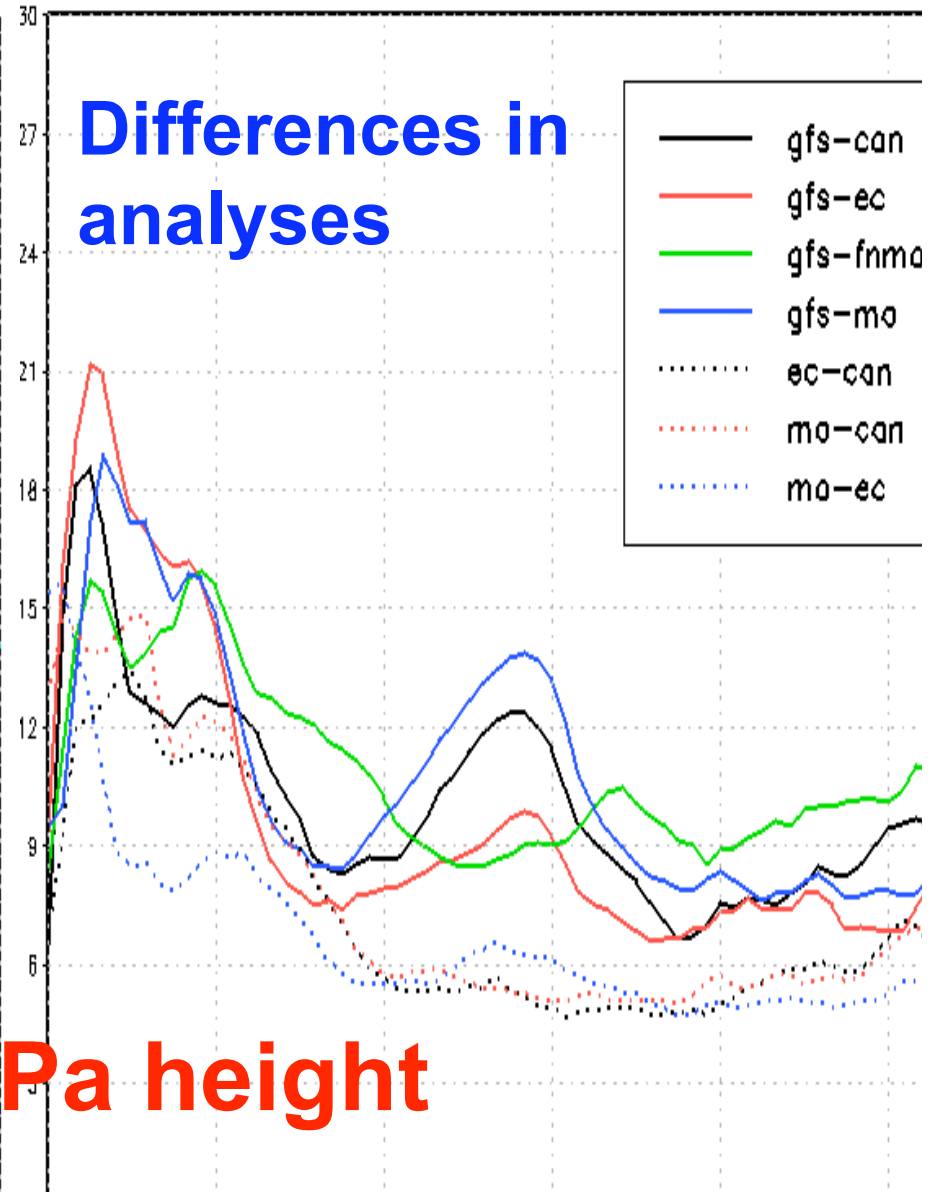



**RMS Error vs forecast time Z 500 hPa Dec. 2006**

***GFS error against own analysis grow rapidly first 2 hours; More slowly***

# *Day 1 "errors" against own analyses comparable to analysis differences betwe different nwp centers* December 2006



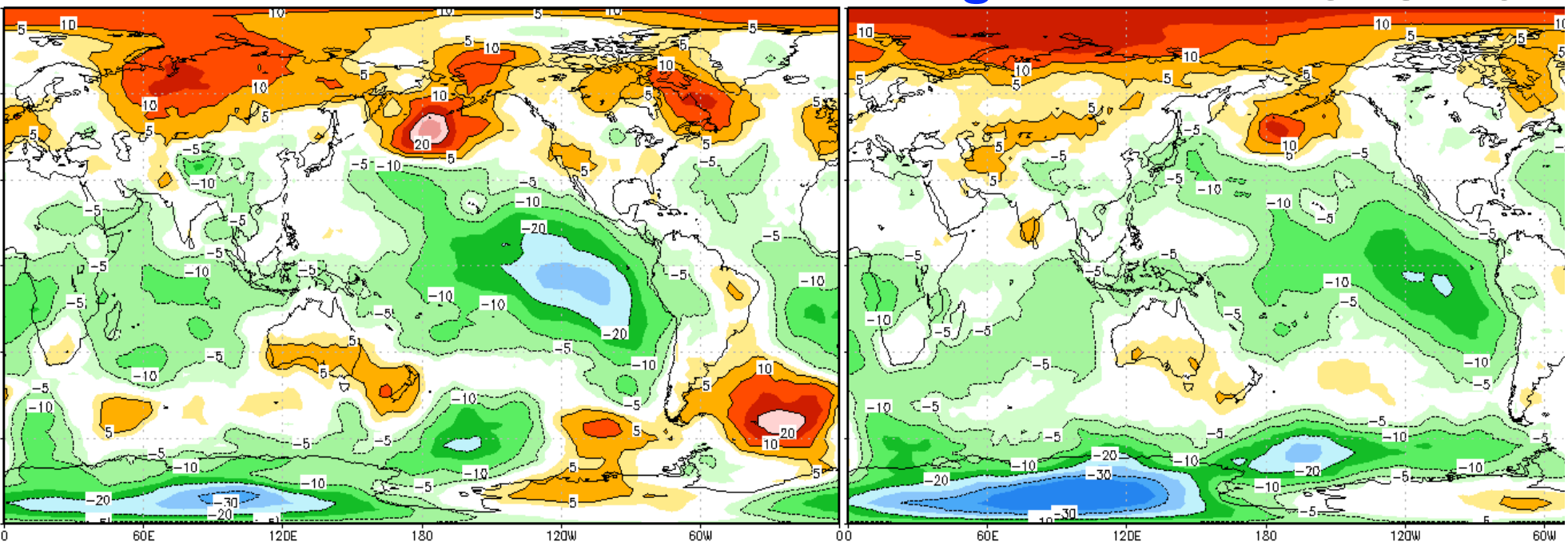




**500 hPa height**

GFS-Canada

# 500 hPa height

GFS-ECM



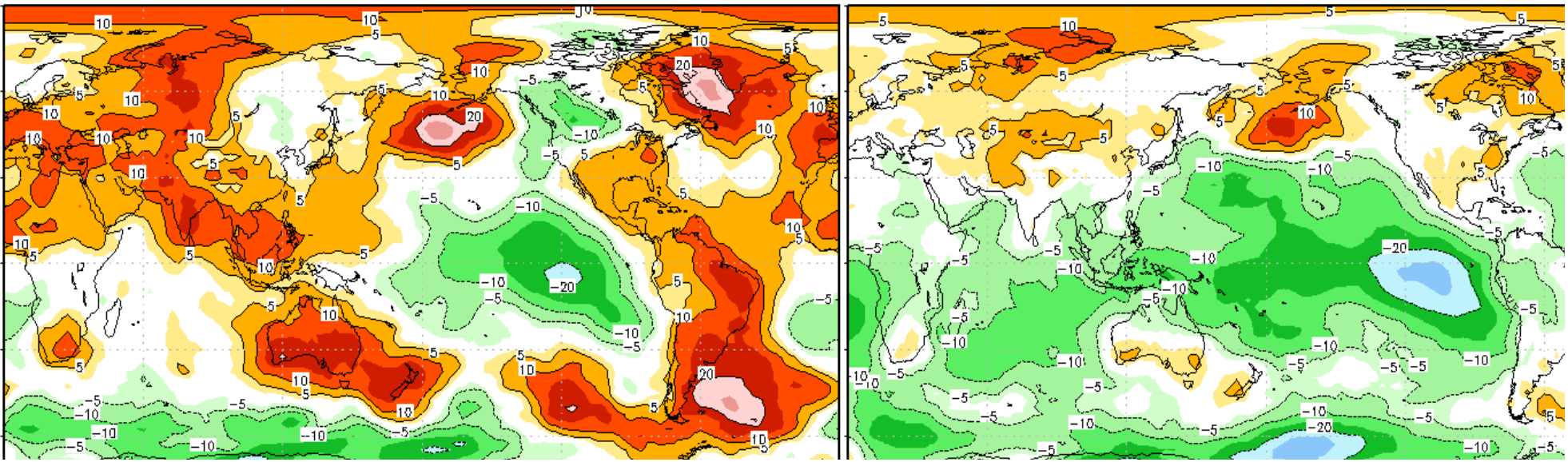


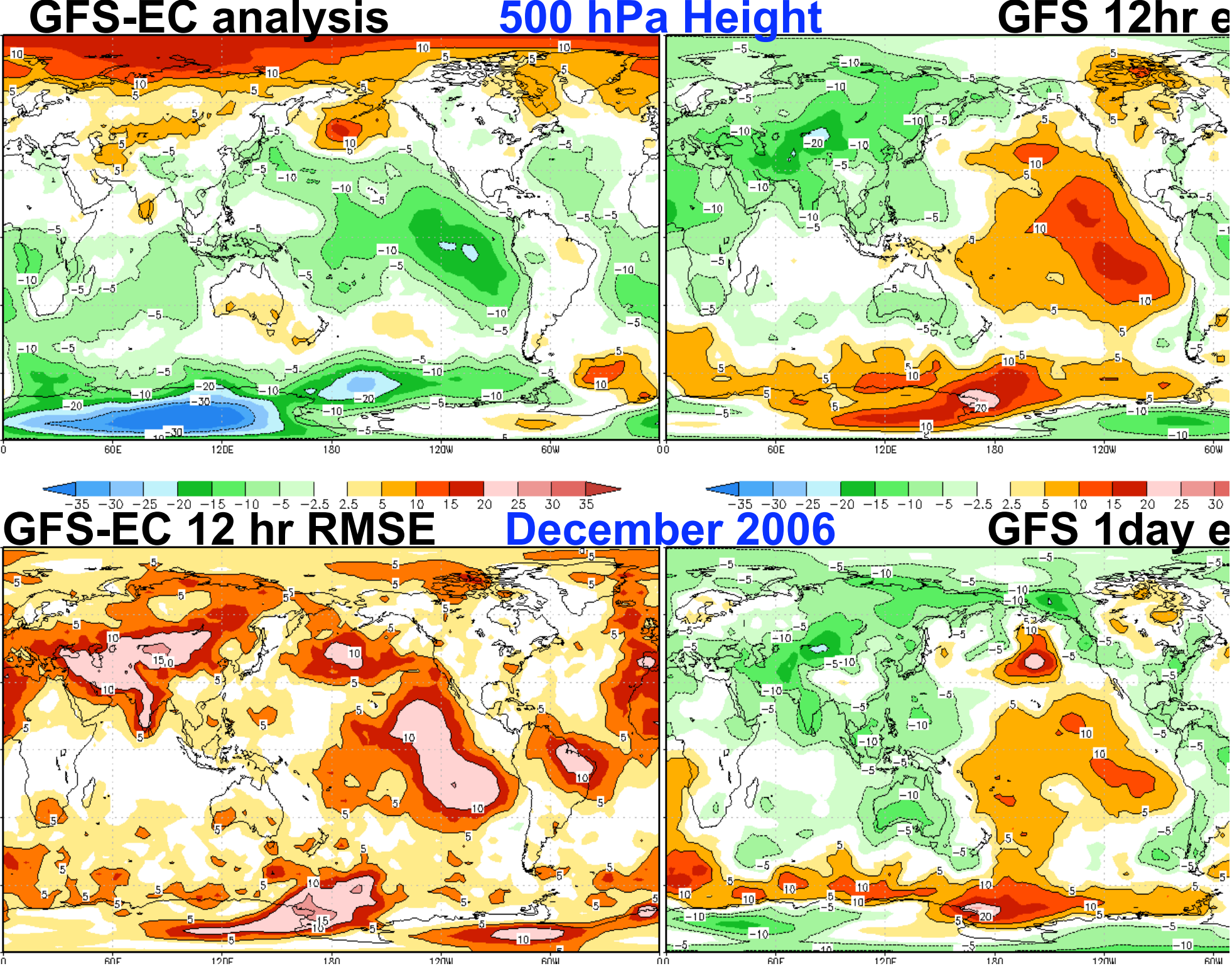
## Monthly mean GFS analysis difference from other center

GFS-FNMOC

## December 2006

GFS-Met Of




GFS-EC analysis
500 hPa Height
GFS 12hr e
GFS-EC 12 hr RMSE
December 2006
GFS 1day e

***GFS analysis doesn't agree with other centers' analyses***

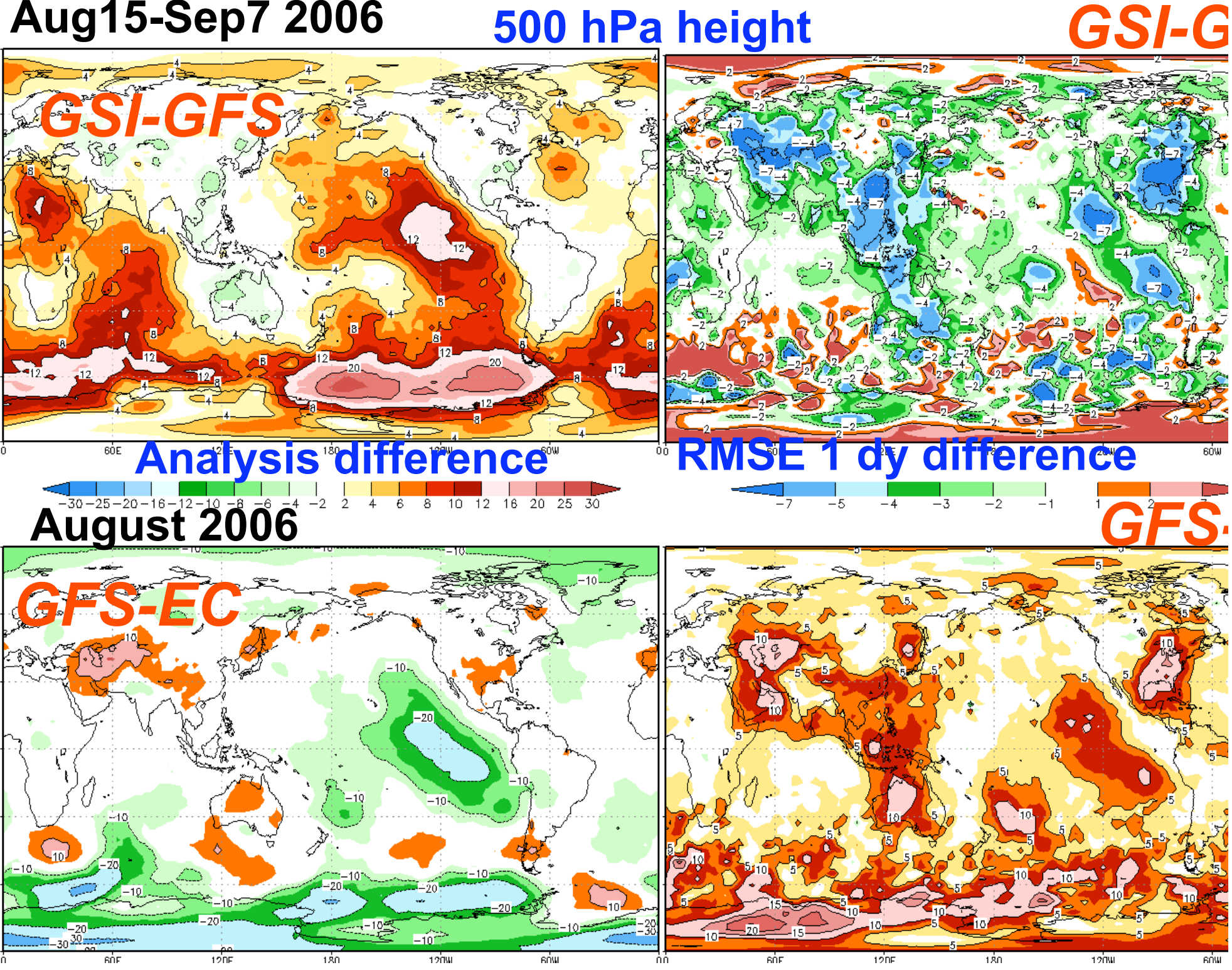
***GFS forecast model doesn't agre with GFS analysis***

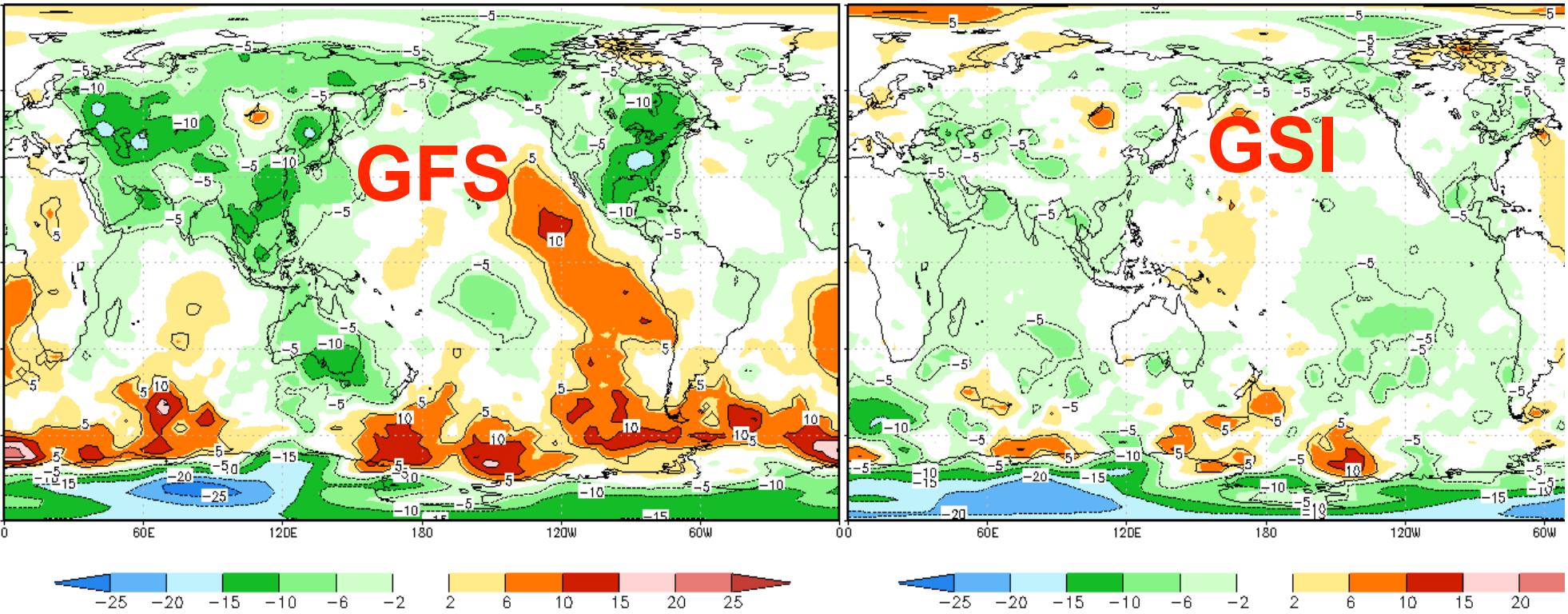
***GFS 1 day forecasts try to remov analysis differences from other centers***

***New GSI analysis appears to agre more with other analyses***

# *GSI/Hybrid*

***Hope to implement this spring***
***gridpoint statistical interpolation and***
***hybrid sigma pressure vertical***
***coordinate***
***Grid space definition of background***
***error***
***Improved balanced equations***
***Beats operational GFS at day 1;***
***day 5 ?***


Aug15-Sep7 2006
500 hPa height
GSI-G
GSI-GFS
Analysis difference
RMSE 1 dy difference
August 2006
GFS-
GFS-EC




# 1 day error 500 hPa hgt 500 Aug 15-Sep 7 20(

***New analysis has much less day one err(***

***Transplant experiments***

***--EC analyses and forecasts from 000 UT***

***--GFS analyses and forecasts from 000 UT***

***--ECGFS: EC analyses to GFS model from 000 UT (Treat EC analyses as observations***

***--EC analyses and forecasts from 1200 UT***

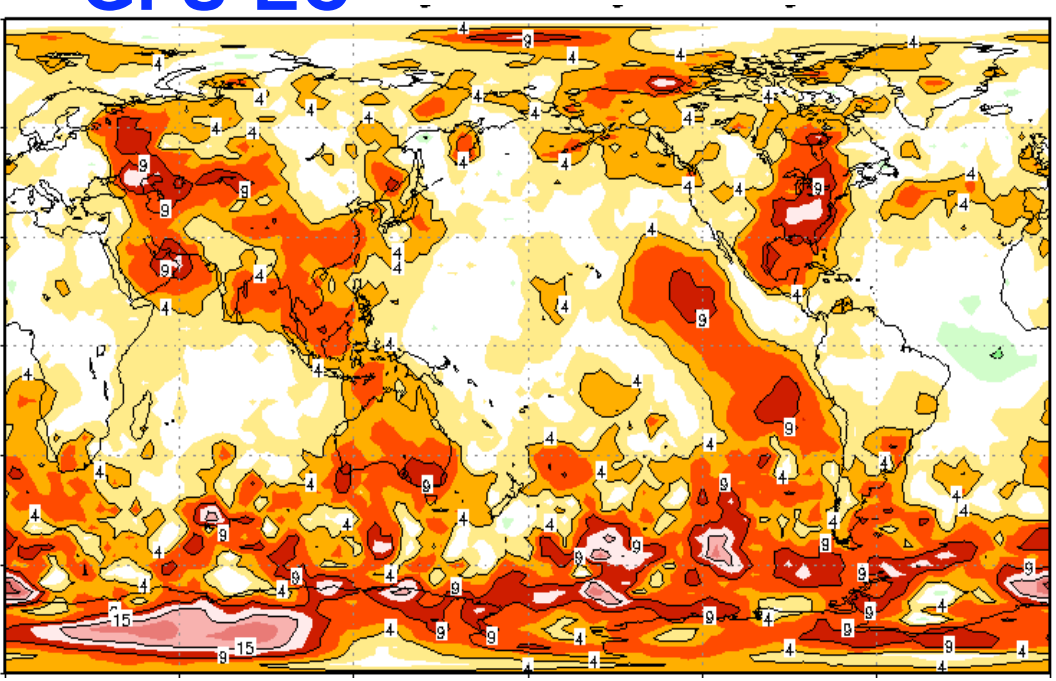
***--GFS analyses and forecasts from 1200 U***

***--GFSEC: GFS analyses to EC model from 1200 UT***

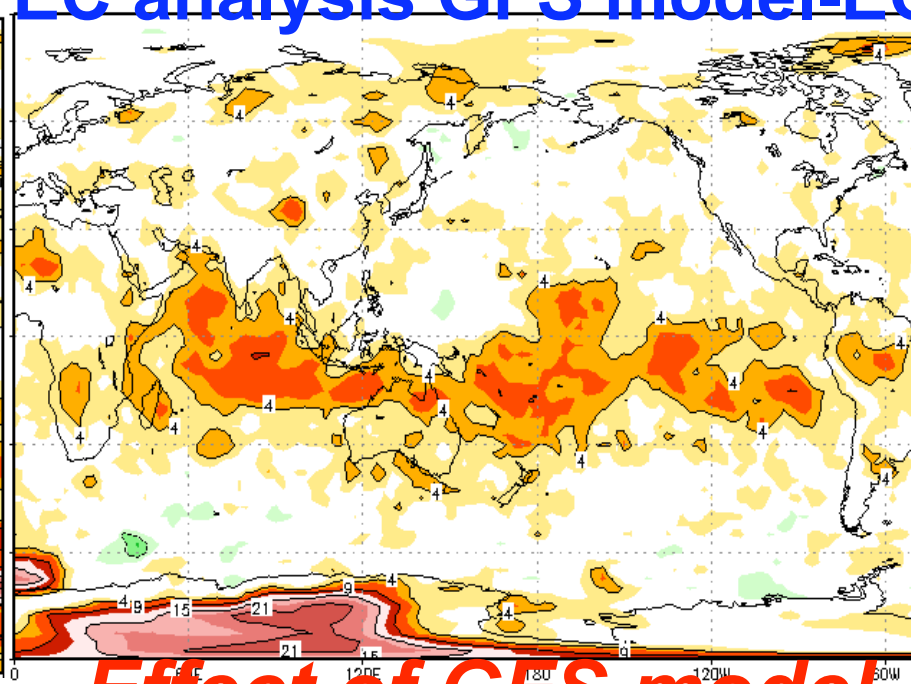
***--Are differences due to analysis or model?***

***GFS minus ECGFS effect of GFS assimilation***

GFS-EC

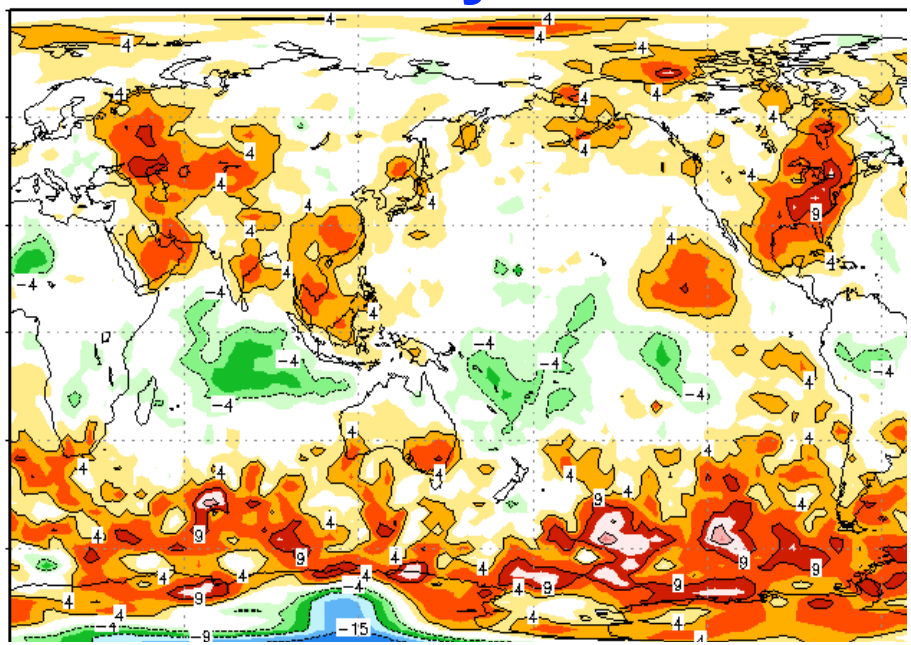


EC analysis GFS model-EC



*Effect of GFS model*


GFS-EC analysis GFS mo

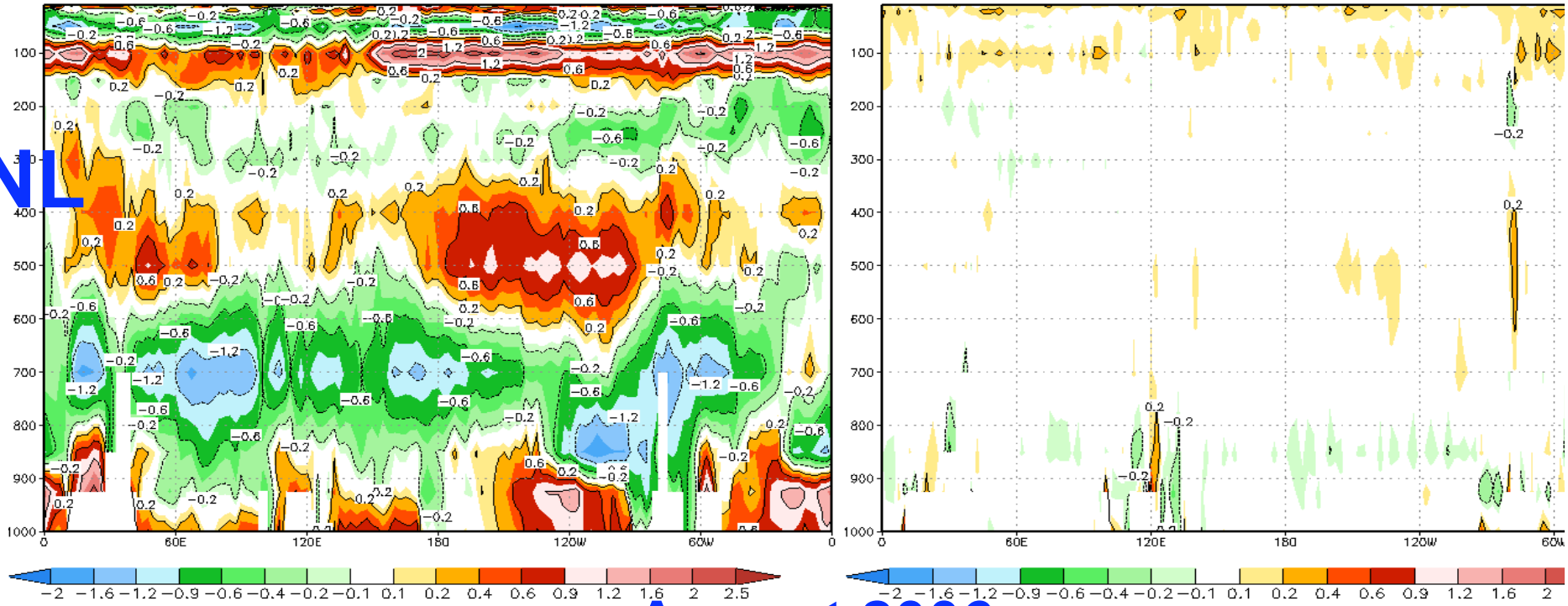


# RMSE 1 dy 500 height Aug 2006

***Much of day 1 error in 500 hPa height in GFS appears to come from GFS assimilation, not from GFS model***

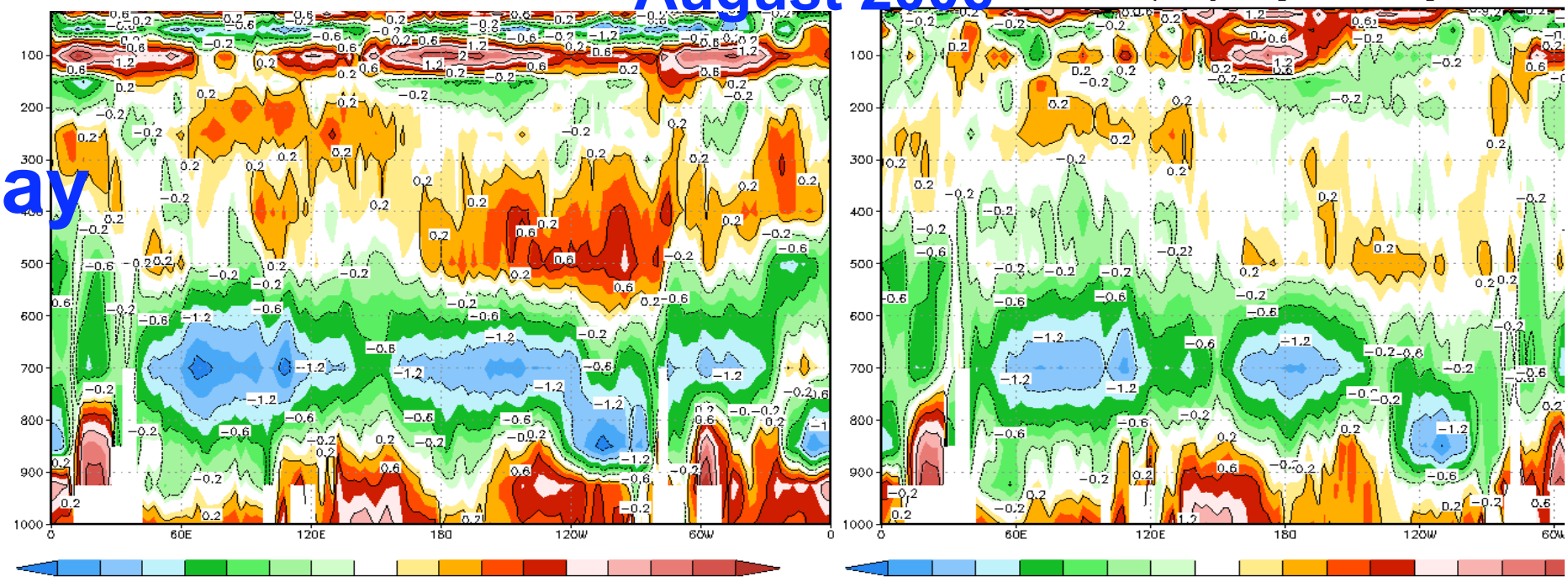
GFS-EC T equator EC analysis GFS model

ANL



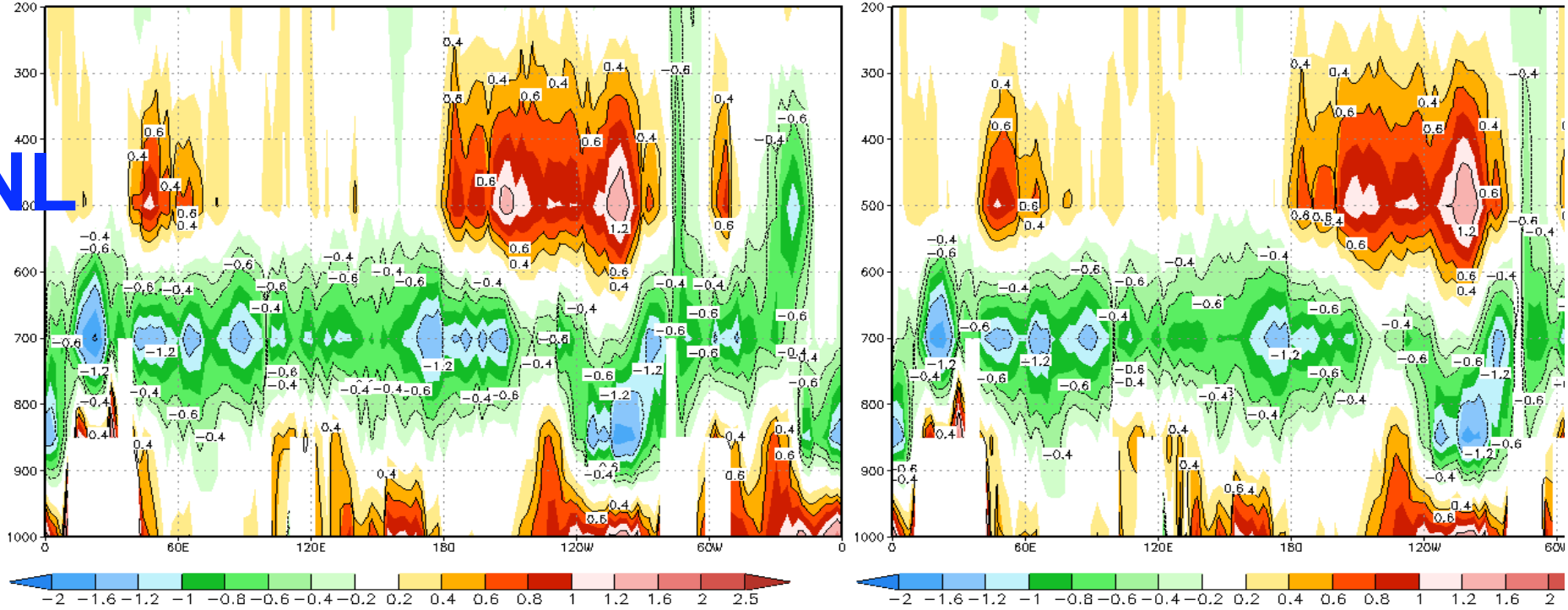

August 2006

1day



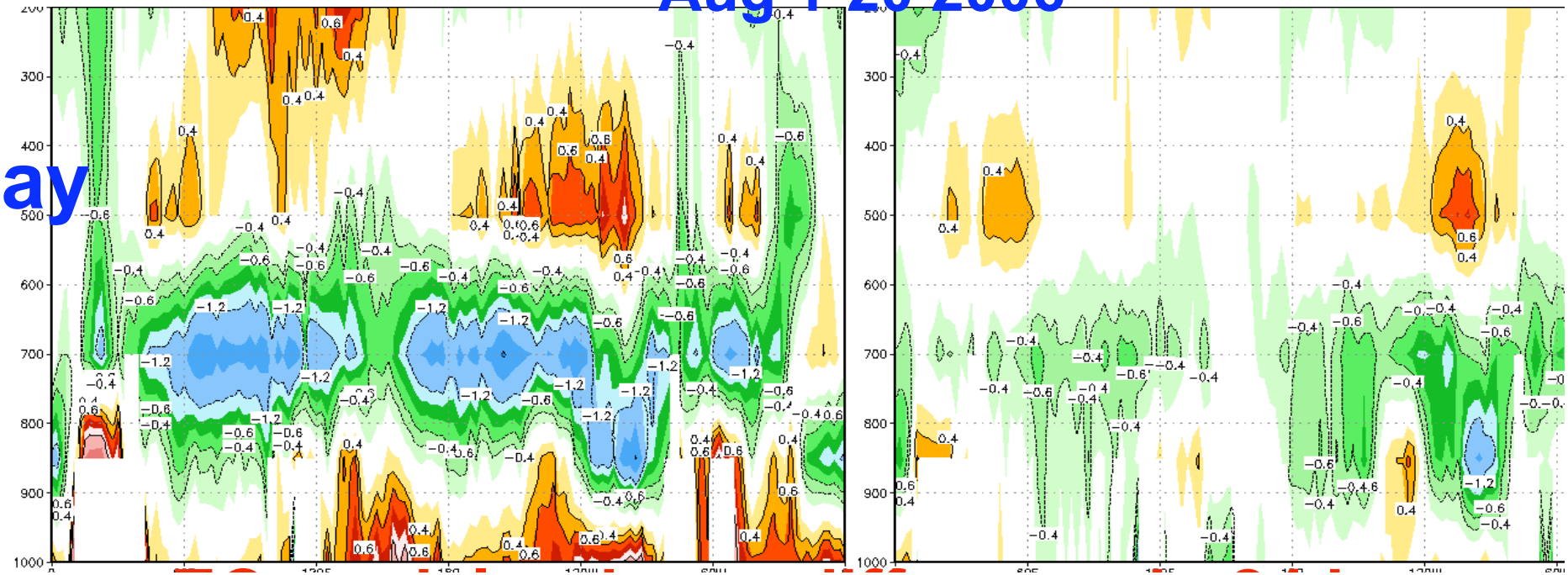
GFS-EC T equator GFS analysis EC model

ANL




Aug 1-20 2006

1day



--Differences in height appear largely due
assimilation

--Differences in equatorial temperature structure reflect model differences

--Examination of short-range errors can he identify specific problems; need to determine whether assimilation or model t blame

--Reducing day 1 errors *MAY* reduce medium range errors