

Operational Use of the ATOVS radiances in global data assimilation at the JMA

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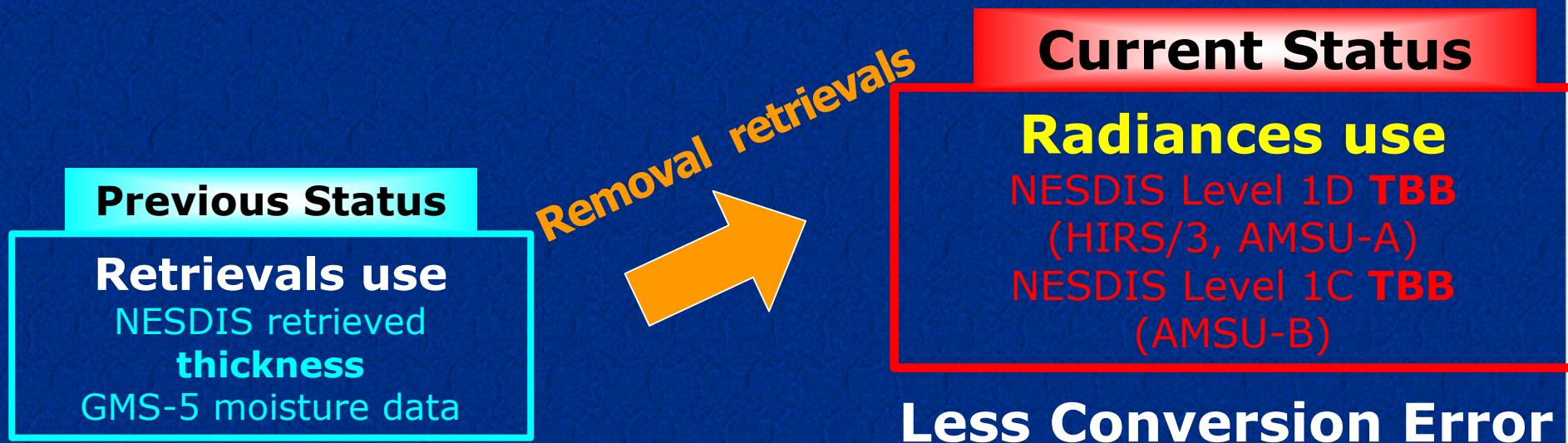
Japan Meteorological Agency(JMA)

Recent Progress of Satellite Data

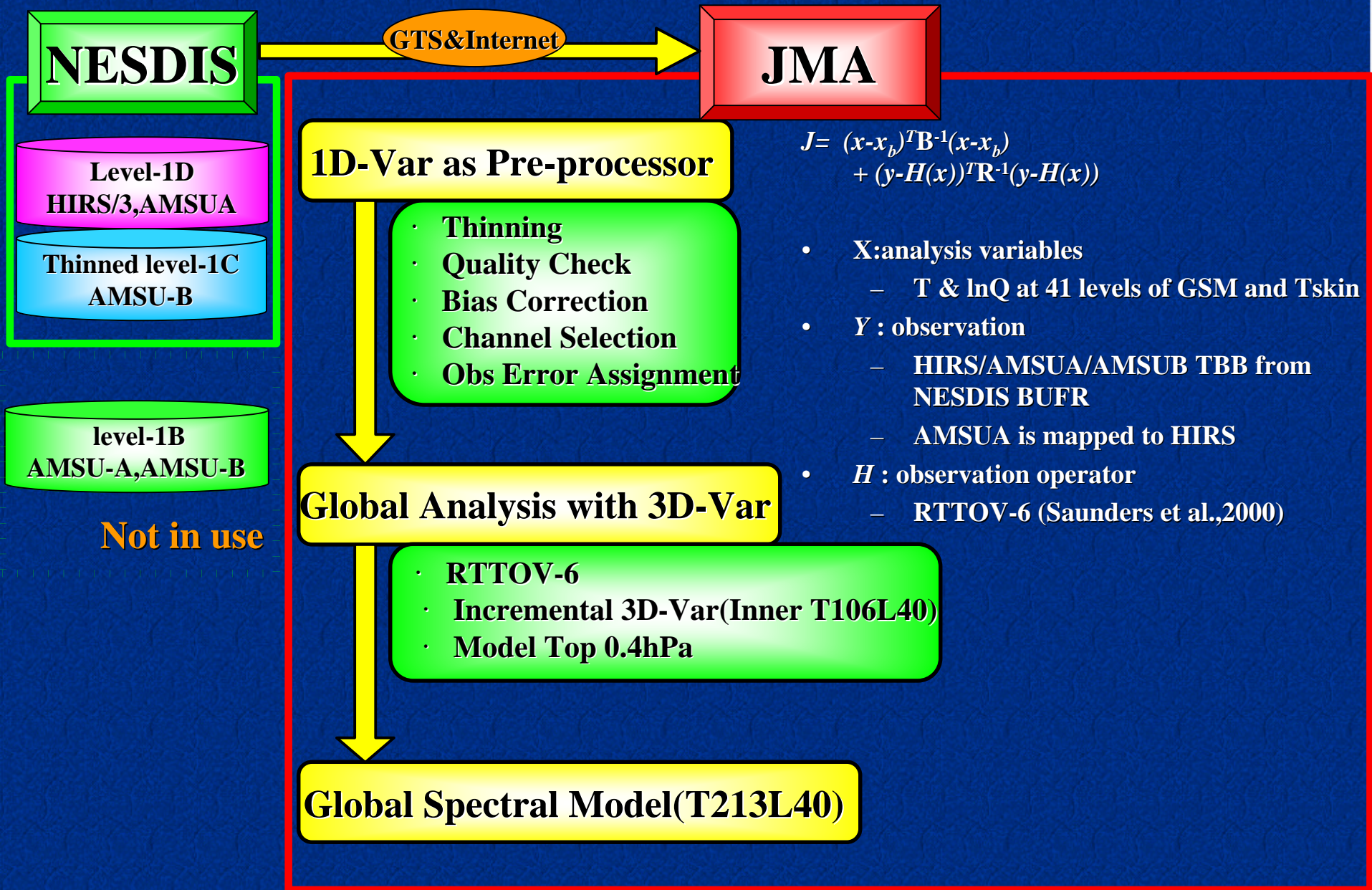
Assimilation in JMA

Global data assimilation

- **Sep 25 2001** implementation of **3D-Var** global data assimilation
- **May 6 2003** use of **QuikScat** sea surface wind data
- **May 6 2003** use of **Meteosat** high-density atmospheric motion
Wind data
- **May 28 2003** start of operational direct assimilation of NOAA15&16
ATOVS radiance + new cumulus parameterization scheme



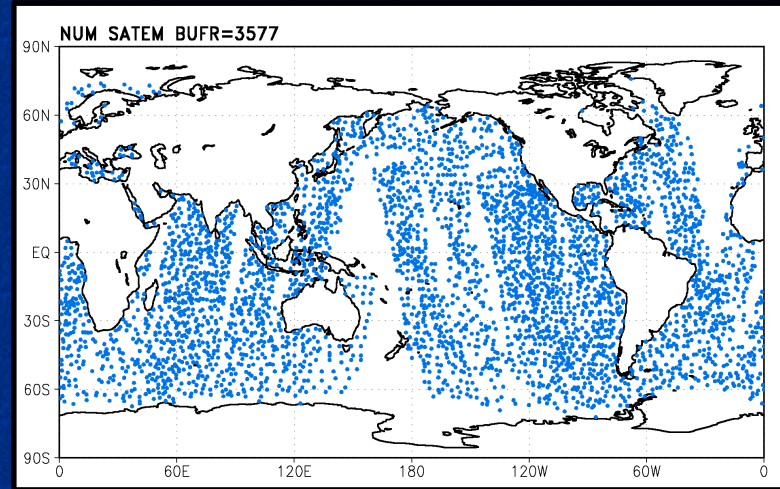
Processing of ATOVS radiances



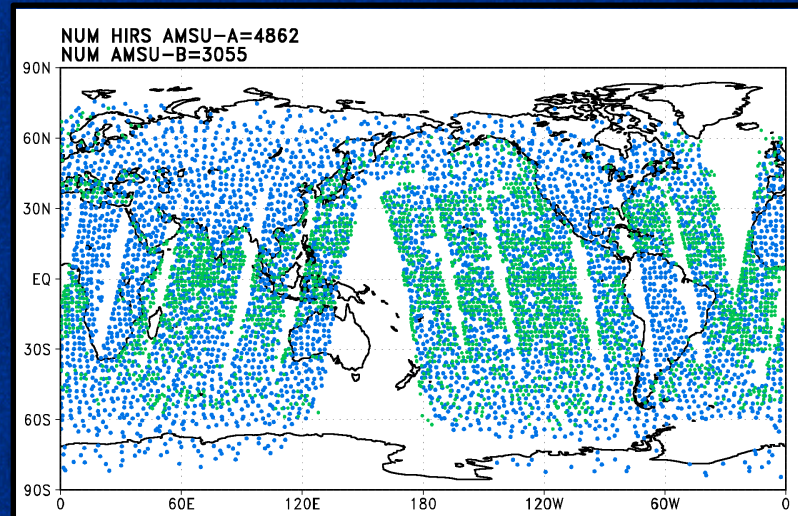
Change of distribution of available data

Thinning

- Constant distance
 - 250km(HIRS/AMSA)
 - 180km(AMSUB)
- Priority is given to
 - clear radiances
 - satellite closer to analysis time



Temperature(thickness) retrieved by NESDIS



Use of data on Land in the upper air.

JMA TBB Bias Correction scheme

$$\text{BIAS}_j(n) = a_{j0} + \sum_{i=1}^5 a_{ji}(n) X_{ji}(n)$$

BIAS=<TBobs- TBcal> global mean and 1-Year averaged dataset

TBobs: Observed TBB(Collocated with RAOB within 2degree & 90min)

TBcal: Calculated from profiles of **RAOB**

RAOB are used due to the presence of a model bias

Guess is used to complement the lack of the upper stratosphere temp. & moist.

Predictors X

AMSU-A Ch5 Calculated TBB

AMSU-A Ch7 Calculated TBB

AMSU-A Ch10 Calculated TBB

TPW(Total Precipitable Water from first guess)

Surface Temperature(JMA SST Analysis)

The coefficients was defined every scan position.

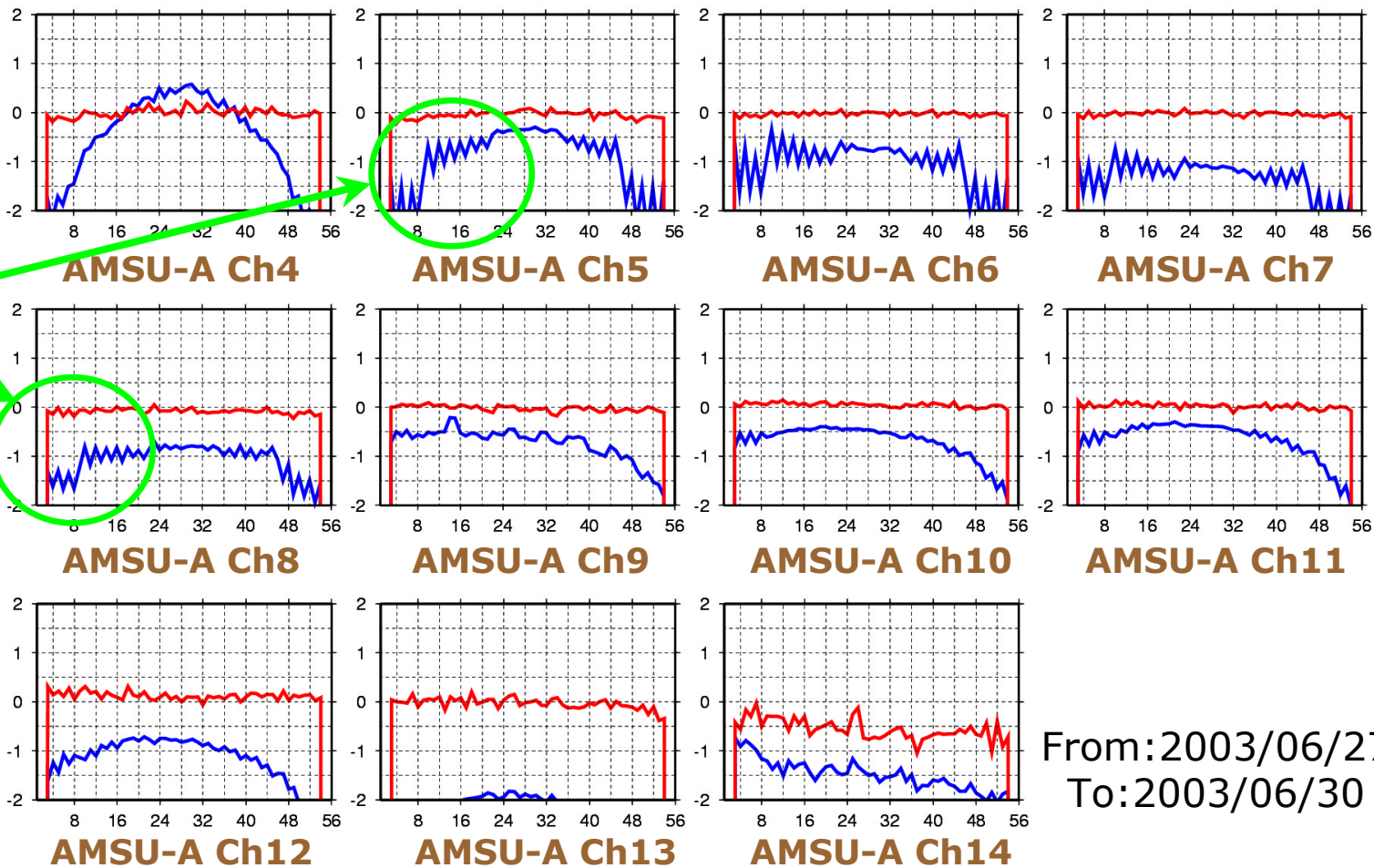
(There are 56scan position due to level 1D data mapped to HIRS Spot)

Not bias-correct AMSU-A12-14, AMSU-B, HIRS11-12 due to large model bias

Complicated Scan Bias of Level 1D data

— With BIAS Correction
— W/O BIAS Correction

Effect of Mapping to HIRS Spot



From:2003/06/27
To:2003/06/30

Cycle Experiments

Period

2001 December

2002 July

Model

JMA Global Spectrum Model : T213L40

Assimilation system : 3D-Var with RTTOV-6

Setting

CNTL ATOVS Retrievals assimilation

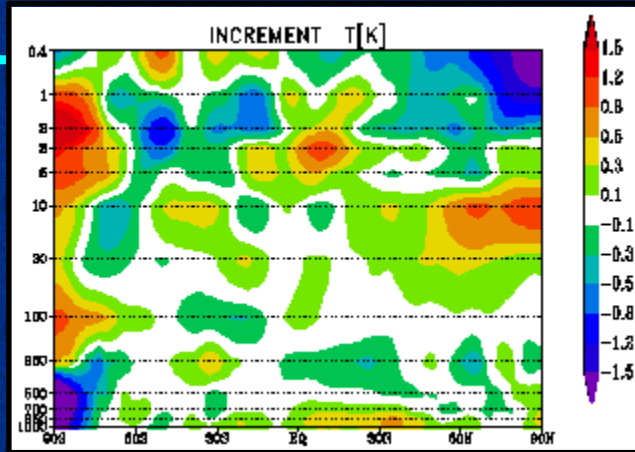
TEST ATOVS radiance assimilation
NOAA15,NOAA16, HIRS/3,AMSU-A,AMSU-B

Change of Analysis Increment

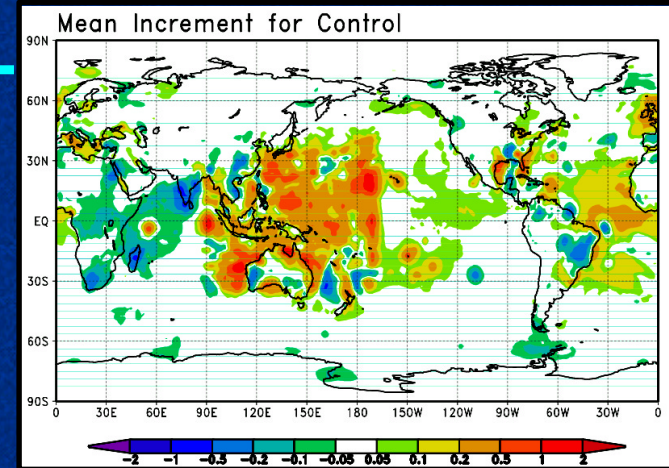
Temperature (Zonal mean)

Moisture 850hPa (Specific Humidity)

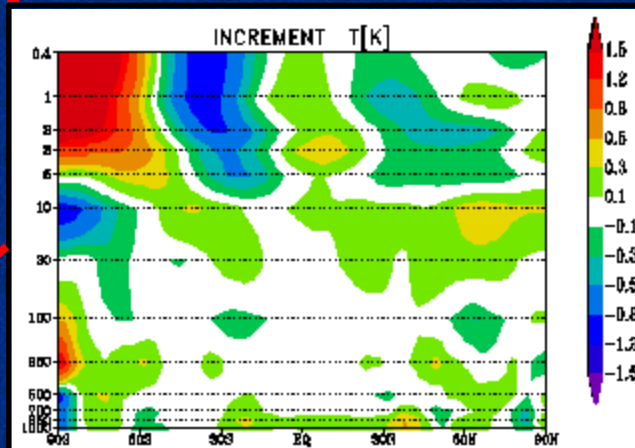
CNTL



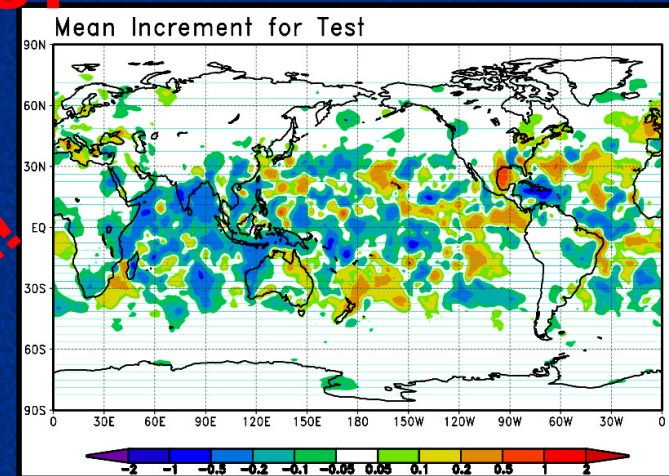
CNTL



TEST



TEST

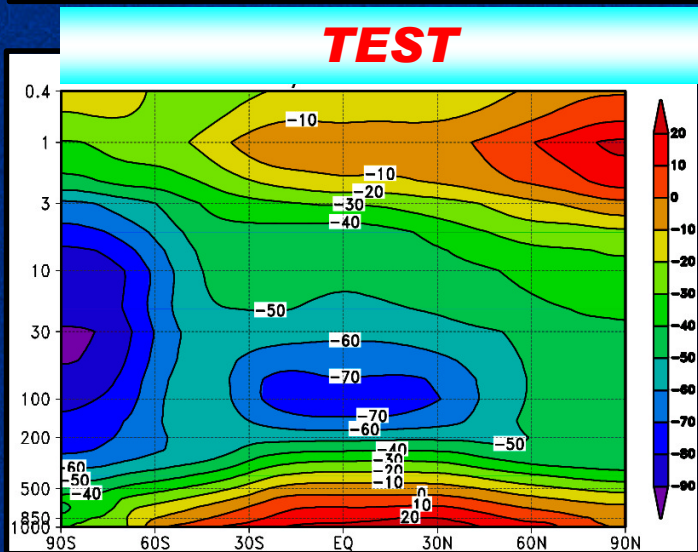
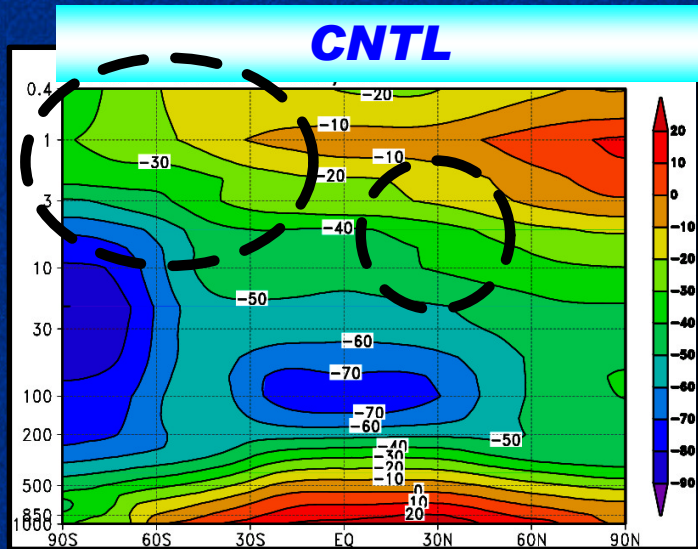


Spread
vertically!!

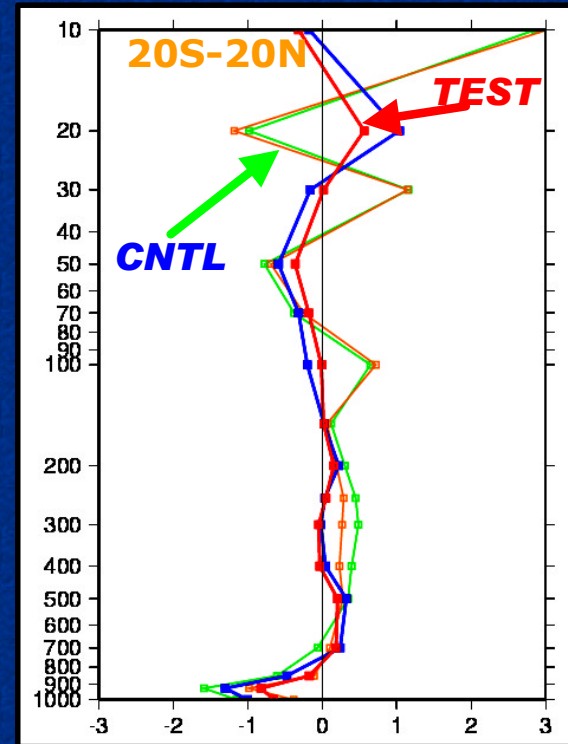
Globally!!

Analysis Impact for Temperature

Zonal Averaged Monthly Mean July 2002



Verification against RAOB
Temperature BIAS Error



Smooth!!

Decrease of Bias!!

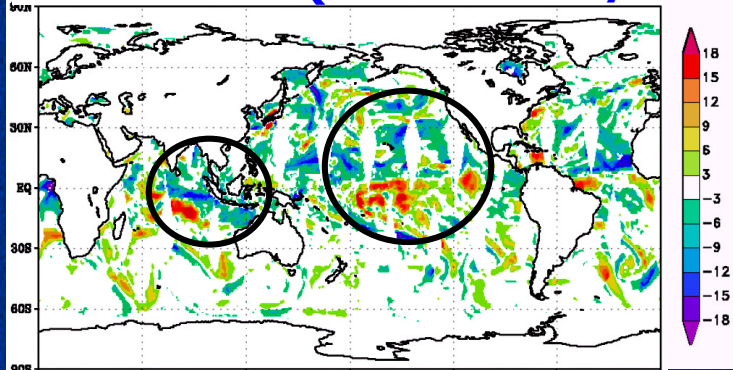
Analysis Impact for Humidity

Effect of ATOVS moisture channels

(HIRS/3:ch10,ch11,ch12 & AMSU-B:ch3,ch4,ch5)

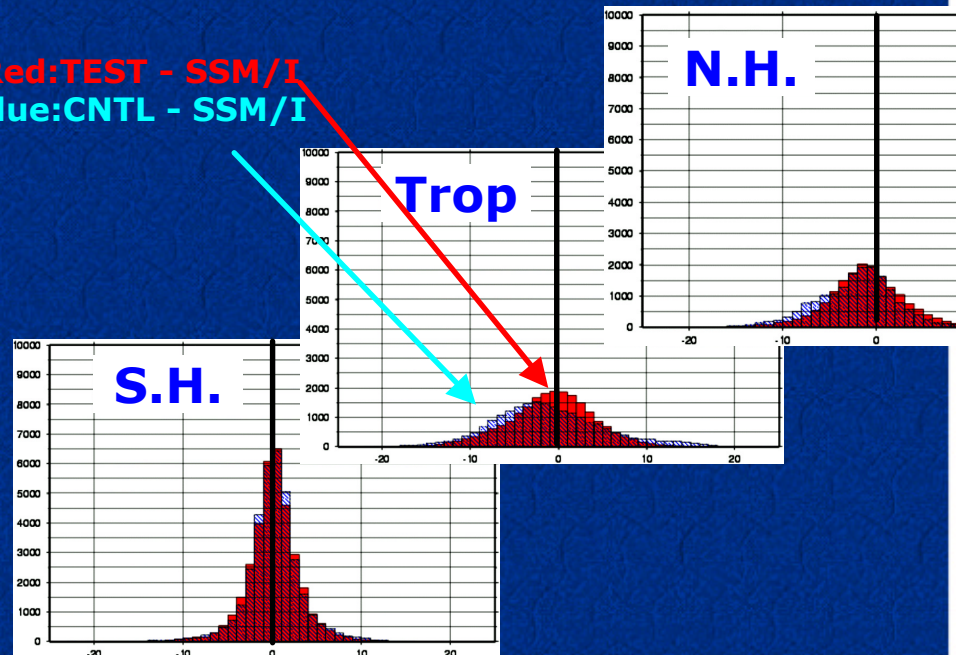
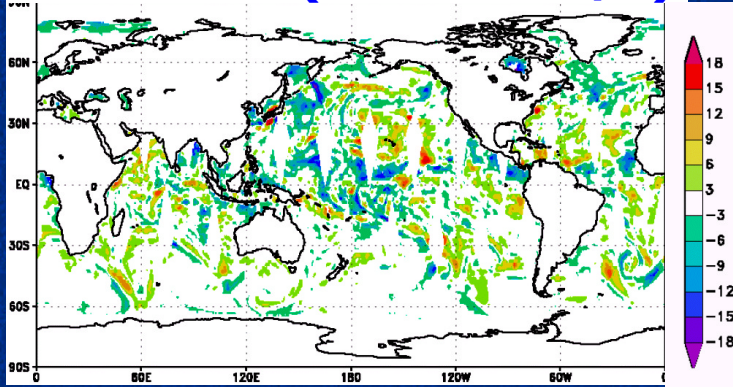
Validation against SSM/I TPW **Large impact on Total precipitable water in tropics was found.**

Difference(CNTL-SSM/I)



Red: TEST - SSM/I
Blue: CNTL - SSM/I

Difference(TEST-SSM/I)



Humidity field is close to SSM/I observation and became realistic!

(2002/07/15 12UTC)

Forecast Impact

500hPa Geopotential Height

Verification against RAOB

CNTL

TEST

Jul2002

RMSE

BIAS

Dec2001

RMSE

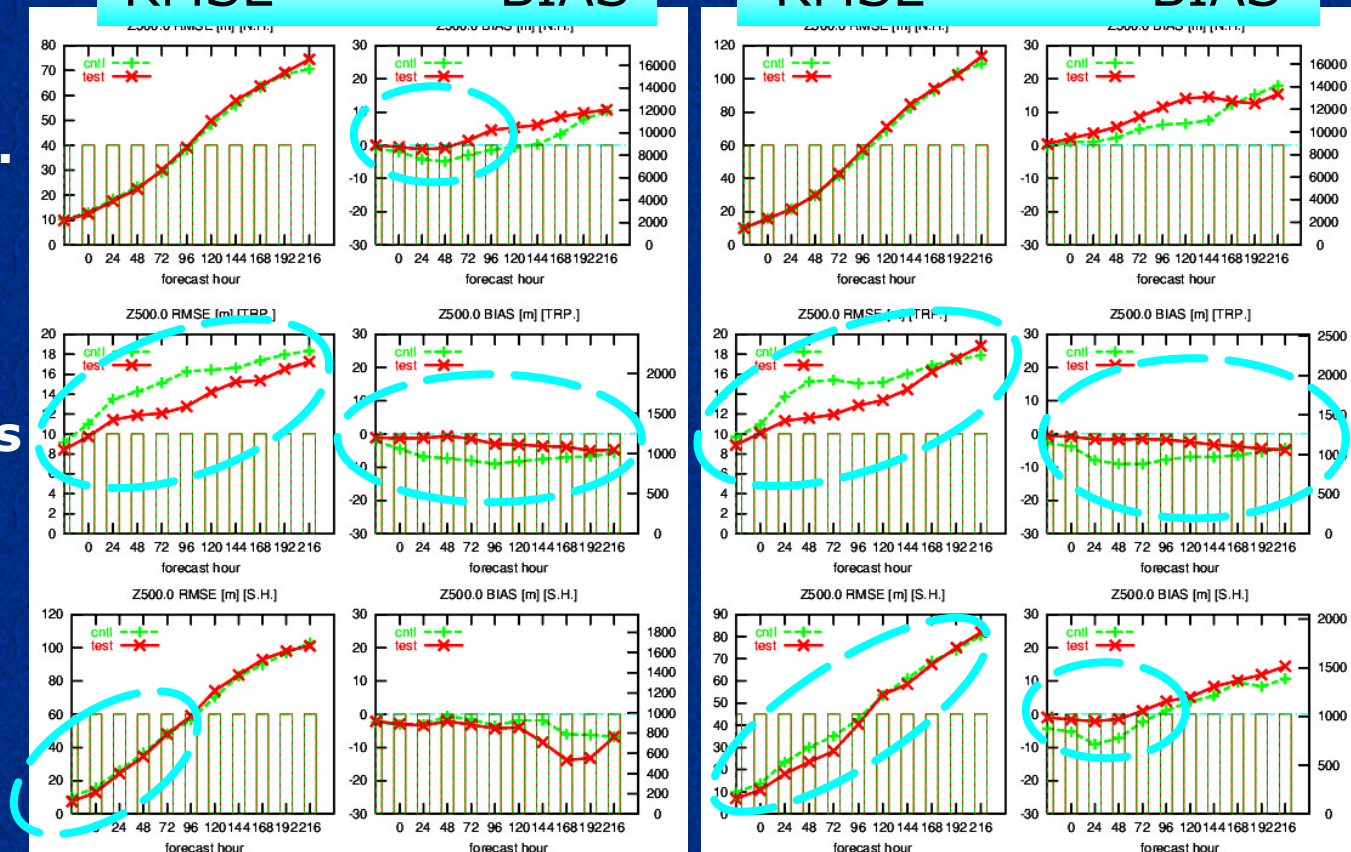
BIAS

N.H.

Tropics

S.H.

**Positive
Impact!!**



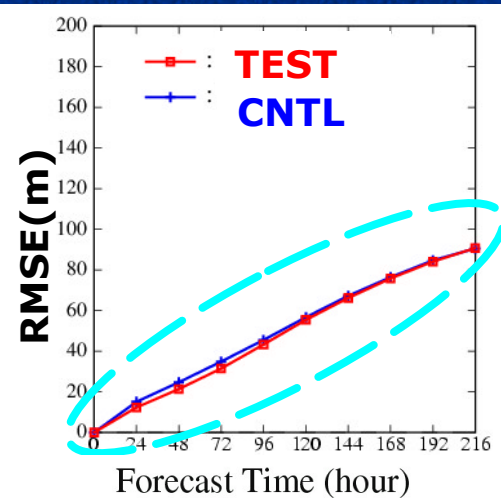
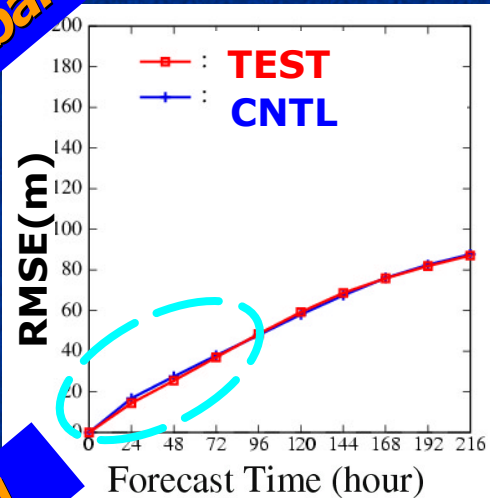
Forecast Score Z500 (against Initial)

Jul2002

Dec2001

Global

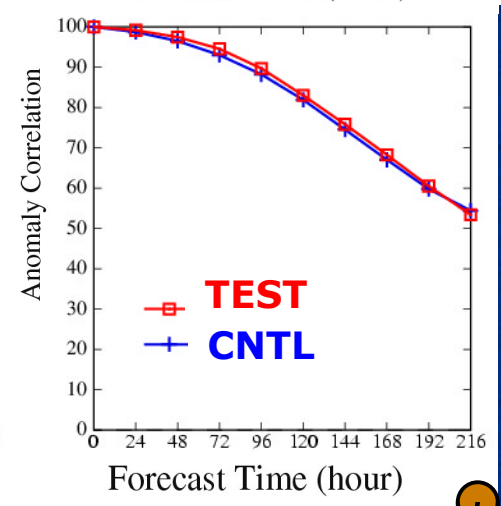
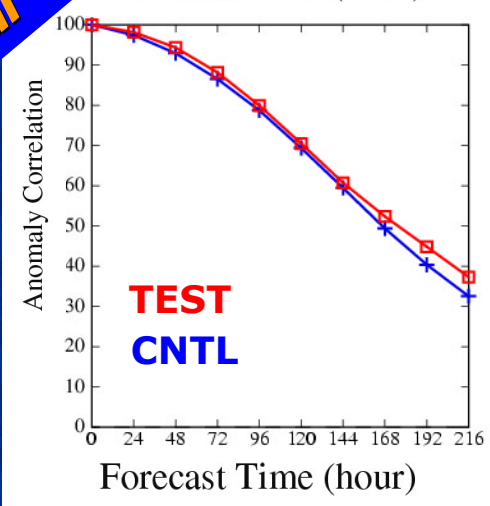
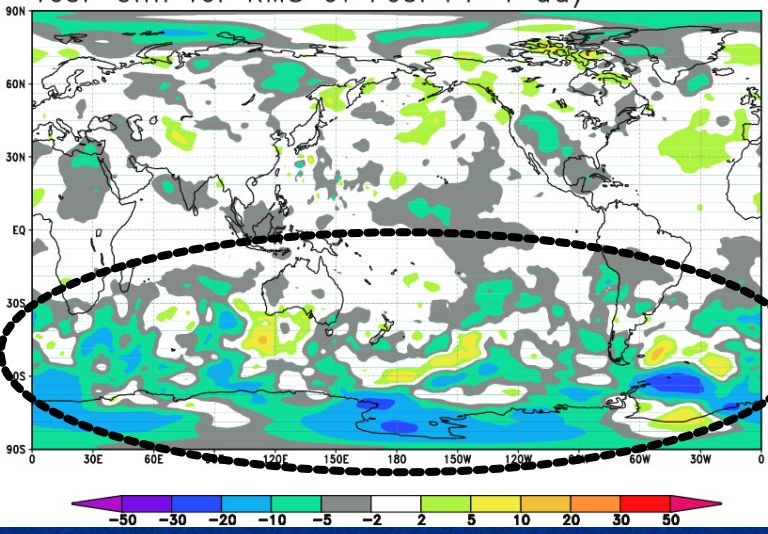
RMSE of 500hPa geopotential height improved especially in former part of Forecast time.



Global

RMSE Difference (TEST-CNTL) 24hour Forecast (30days ave.)

Test-Cntl for RMS of Fcst FT=1 day

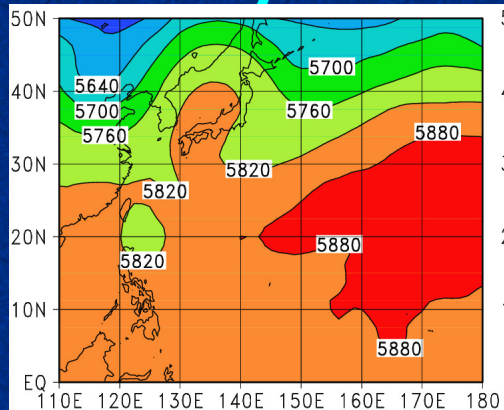


Impact is remarkable on Southern Hemisphere in 24hour forecast!!

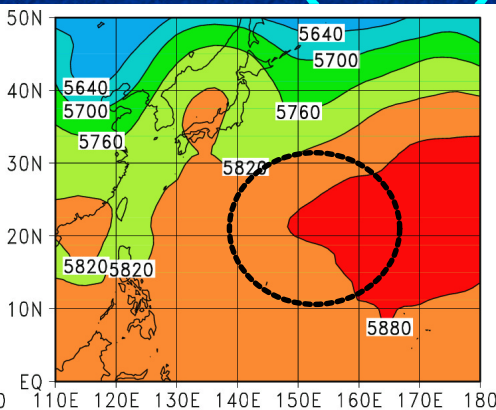
Case Study: Typhoon Track Prediction

500hPa geopotential height

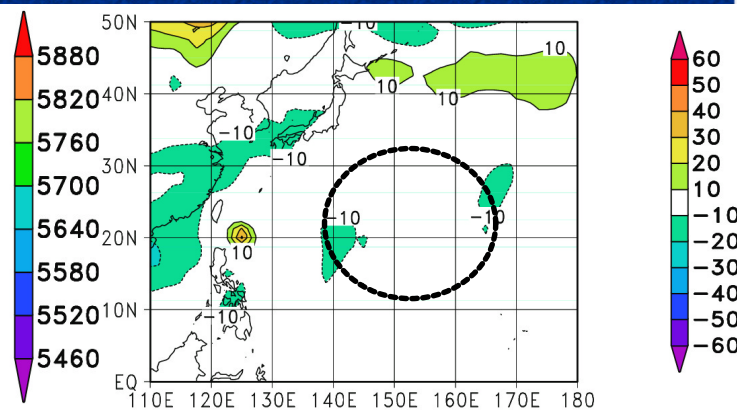
Analysis



Forecast(TEST)

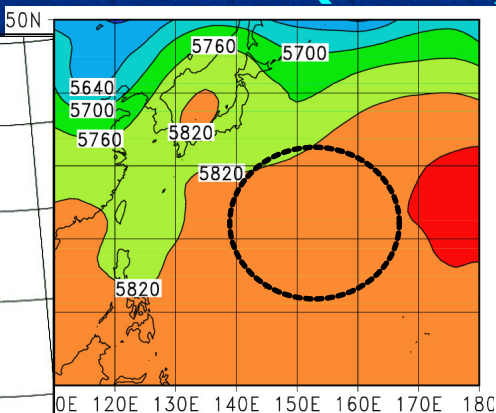


Difference

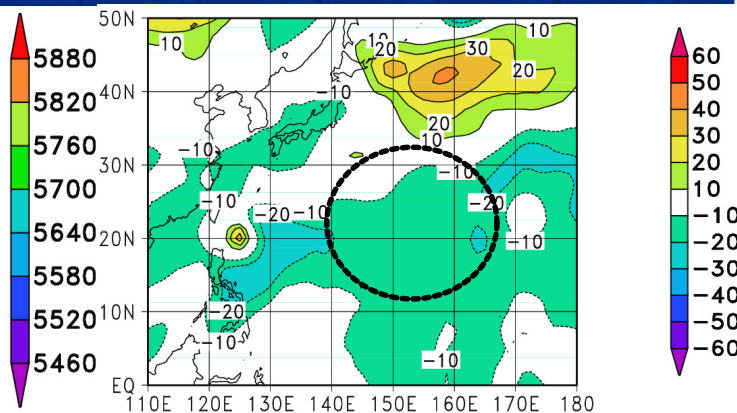


27 May 2003 12UTC INIT

Forecast(CNTL)



Difference



Analysis

TEST

CNTL

Tip of arrow means
36hour forecast

Forecast of strength of subtropical high pressure affects forecast of typhoon track prediction.

Comparison with Other NWP Center

JMA: Direct assimilation ATOVS radiances

JMA: Retrievals assimilation

ECMWF

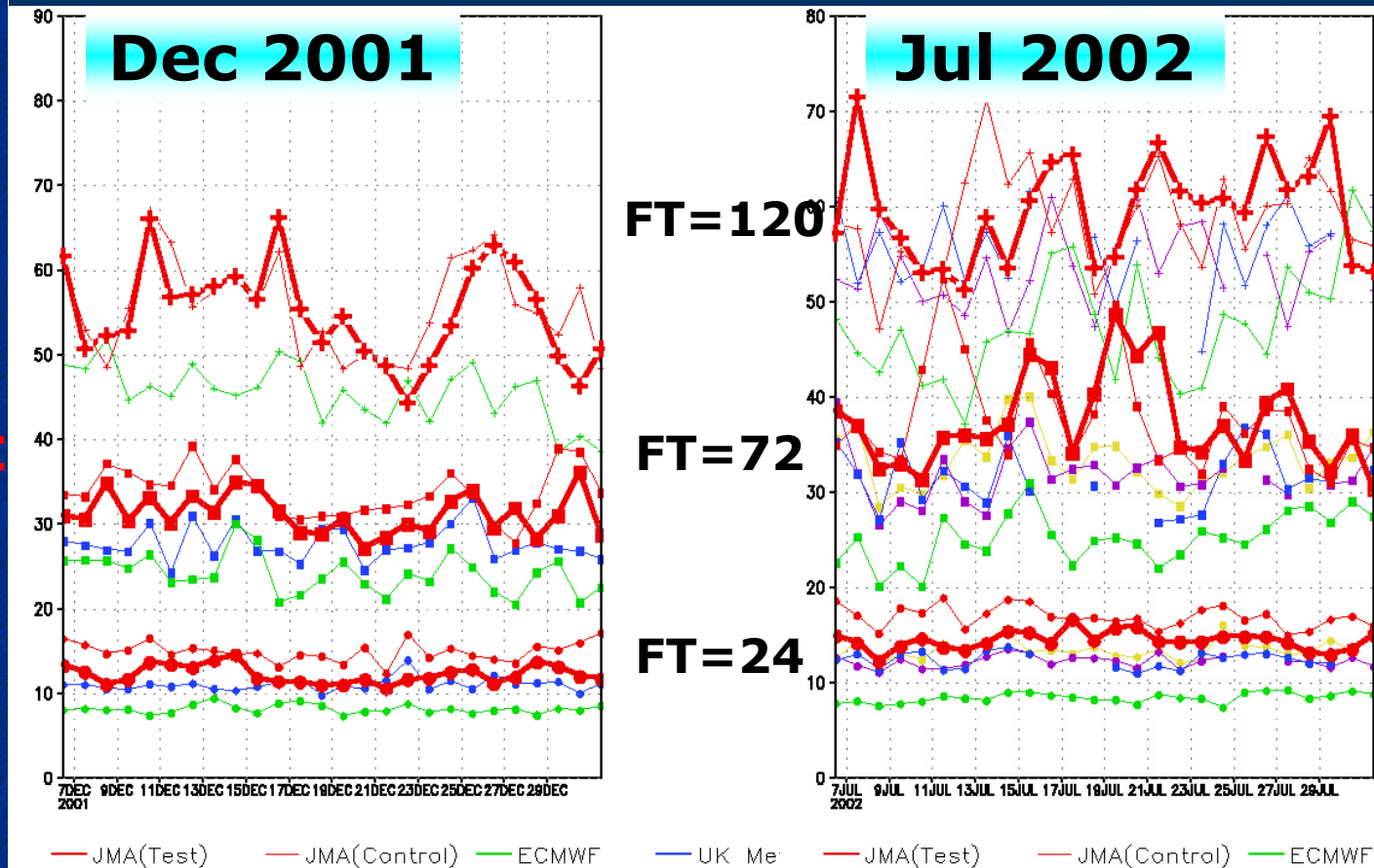
UKMO

NCEP

CANADA

**Improvement
of 24hour
forecast is
remarkable!!**

RMSE of Global 500hPa Height



Summary and Ongoing Work

- Since 28 May 2003, JMA has started direct assimilation of ATOVS radiances in global 3d-Var operationally.
- In the experiments, analyzed temperature and humidity field were verified and became realistic.
- For forecast skills, very positive impact was found, especially, in tropics and southern hemisphere at short term forecast.
But, the improvement in northern hemisphere was not large.

Moreover, to improve forecast skills,

- we have some plans and are going to.
 - Use level 1B data,
 - Revise TBB bias correction scheme,
 - Use NOAA 17 (HIRS,AMSU-A,AMSU-B)
 - Upgrade radiative transfer model (RTTOV-6 ---> RTTOV-7)
 - Use other new satellite data SSM/I,TRMM,AMSE,AIRS etc.