IMPACT STUDIES OF AMVS AND SCATTEROMETER IN THE JMA GLOBAL OPERATIONAL NWP SYSTEM

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Outline

- Introduction
- AMV Satellite Status update for NWP use of JMA
- OSEs of AMVs and Scatterometer winds
  - Global Experiments Specification
  - Experimental design
  - Results of OSE
  - Adjoint sensitivity diagnostics in 2010
- Summary

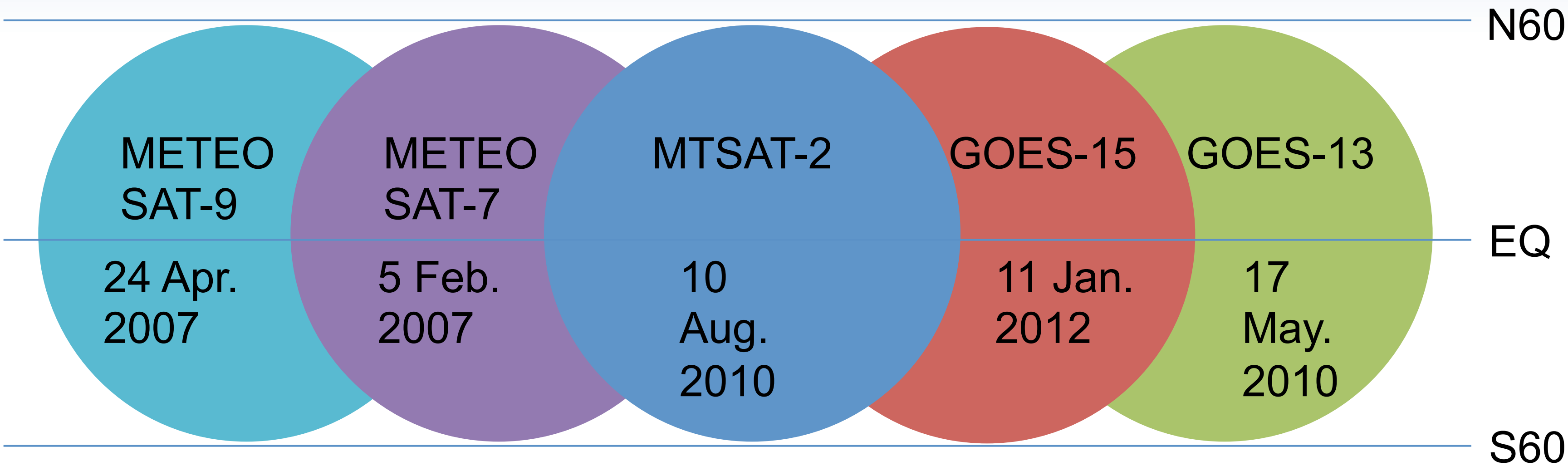
Introduction

- To learn more about the influence of AMVs and scatterometer winds on the different NWP assimilation systems recommended from IWW10
  - Make a presentation from J. Cotton and C. Payan as “Coordinated study of NWP winds impact : Common features and differences”

- To report about JMA’s independent impact studies of AMVs and scatterometer winds

AMV Satellite Status update for NWP use of JMA

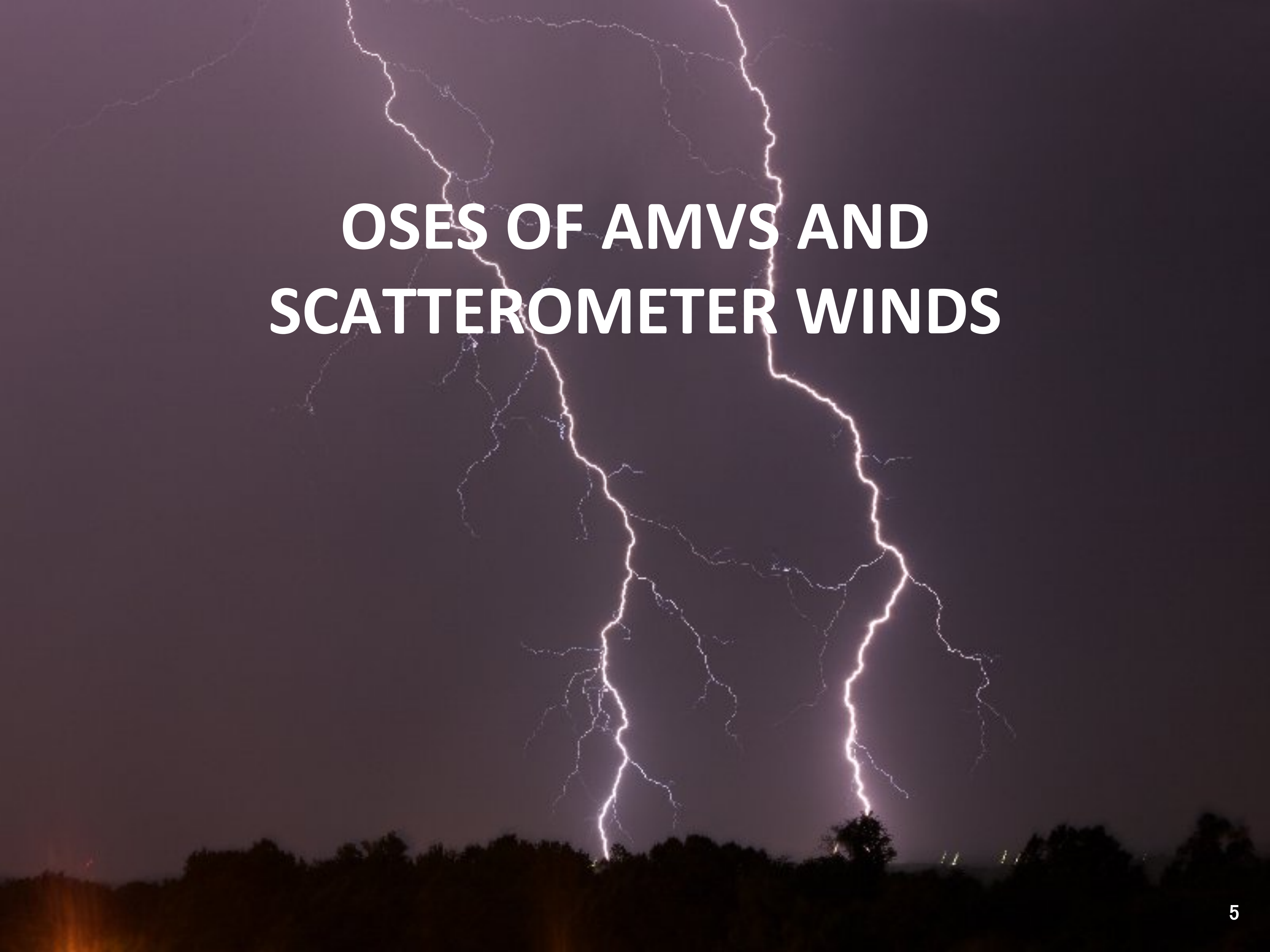
NESDIS and CIMSS MODIS polar winds (Terra and Aqua)
Direct broadcast MODIS polar winds (Terra and Aqua) from 11 Feb. 2011



NESDIS and CIMSS MODIS polar winds (Terra and Aqua)
Direct broadcast MODIS polar winds (Terra and Aqua) from 11 Feb. 2011

※ 28 JUL 2009 Assimilation of Metop-A/ASCAT data started.

- In near future plan
  - AVHRR polar winds from NOAA 15-19 and Metop
  - Leogeo winds



OSES OF AMVS AND SCATTEROMETER WINDS

Global Experiments Specification

GSM (Hydrostatic Global Spectral Model) Same as routine except horizontal rez. (CNTL)	
Horizontal rez./ Vertical rez.	60 km / 60 level
Top	0.1 hPa
Inner-loop model rez. for DA	120 km
Assimilation method	4D-Var
Time windows	6 hour
Forecasts	216 hours (only 12UTC)
Used AMVs	MTSAT-1R, GOES and Meteosat IR, VIS and WV (cloudy) AMVs; MODIS Terra and Aqua (IR and WV)
Other satellite data	Clear-sky radiance from MTSAT, Meteosat, GOES, 6 AMSU-As, 5 AMSU-B/MHSs, AMSR-E, TMI, SSMIS; scatterometer winds from ASCAT; Metop and COSMIC GPSRO

Experimental design

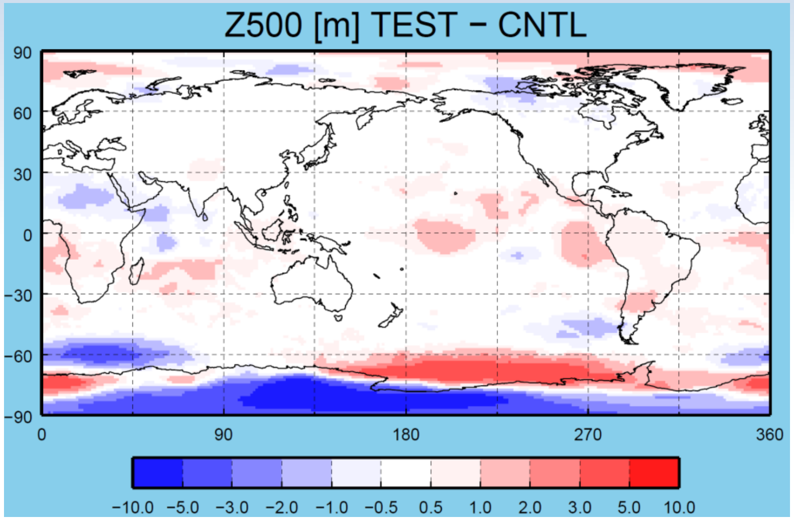
- Four experiments were performed in each of two seasons to assess the impact of AMVs.

NOAMV (SM), NOAMV(WN)	CNTL + No all AMVs
NOPLR (WN)	CNTL + No Polar AMVs
NOSCAT (SM)	CNTL + No Scatterometer winds

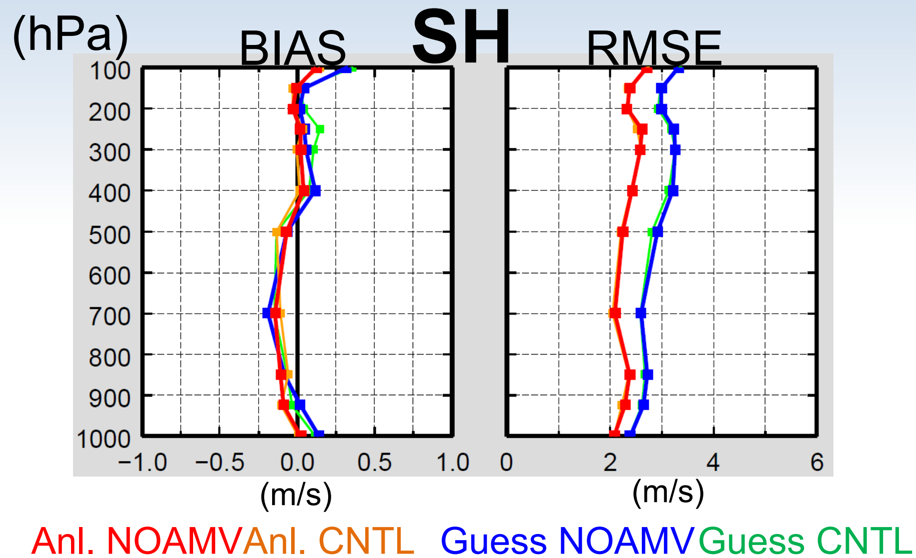
  - Period
    - Atlantic hurricane (northwest Pacific typhoon) season in 2010 from 15 August to 30 September
    - Northern Hemisphere (NH) Winter season in 2010/11 from 1 December to 15 January

- Adjoint sensitivity diagnostics (Langland and Baker 2004) in January (WN) and August (SM) 2010

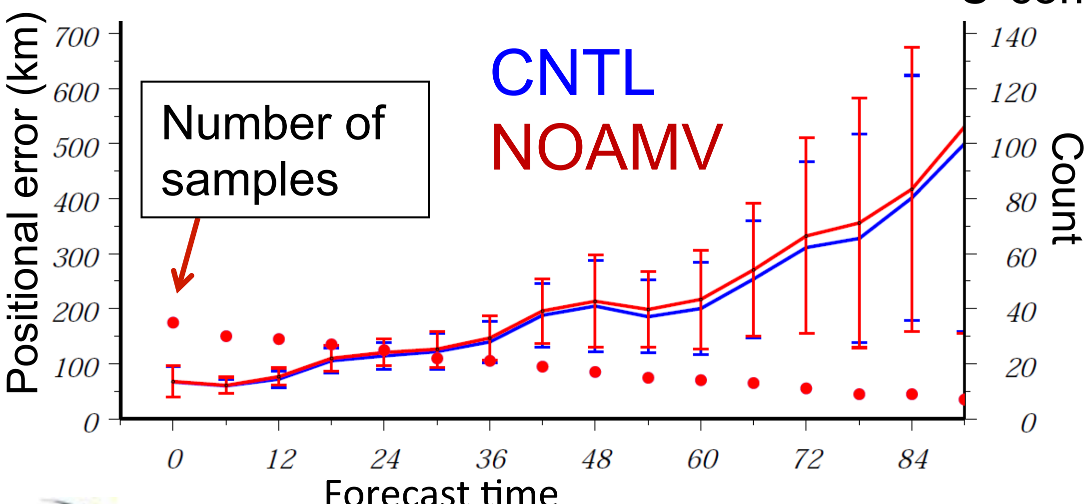
NW Pacific typhoon season in 2010 (NOAMV vs CNTL)



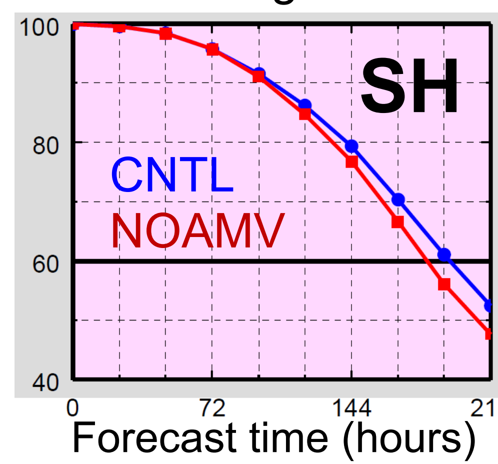
Mean Z500 analyzed fields (NOAMV-CNTL)



U-component winds against sonde



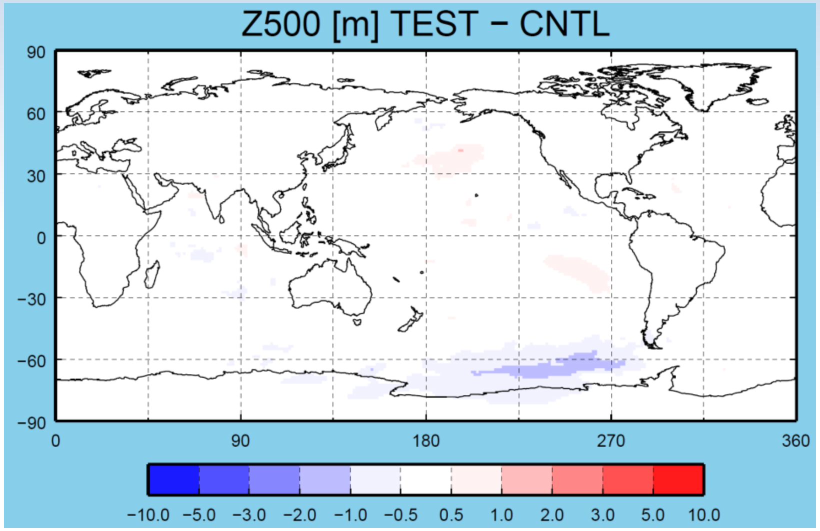
Mean 8 TCs Track Forecast Error



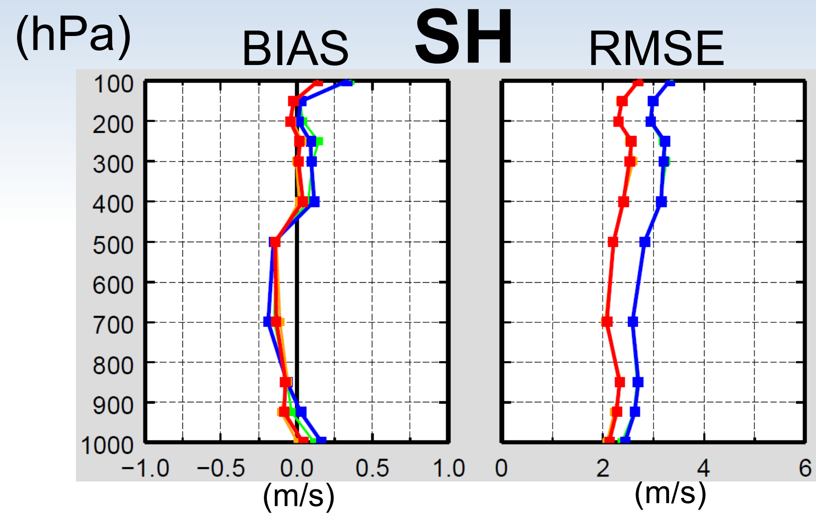
Anomaly correlation for Z500

Japan Meteorological Agency
JMA

NW Pacific typhoon season in 2010 (NOSCAT vs CNTL)

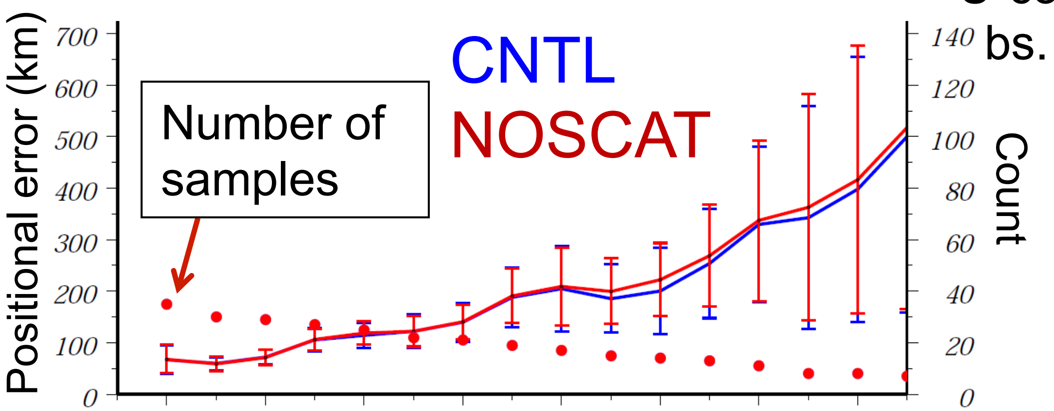


Mean Z500 analyzed fields (NOSCAT-CNTL)



Anl. NOSCAT Anl. CNTL Guess NOSCAT Guess CNTL

U-component winds against sonde

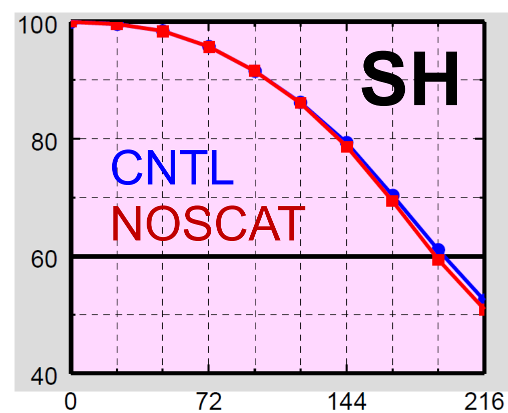


bs.

Forecast time

(hours)

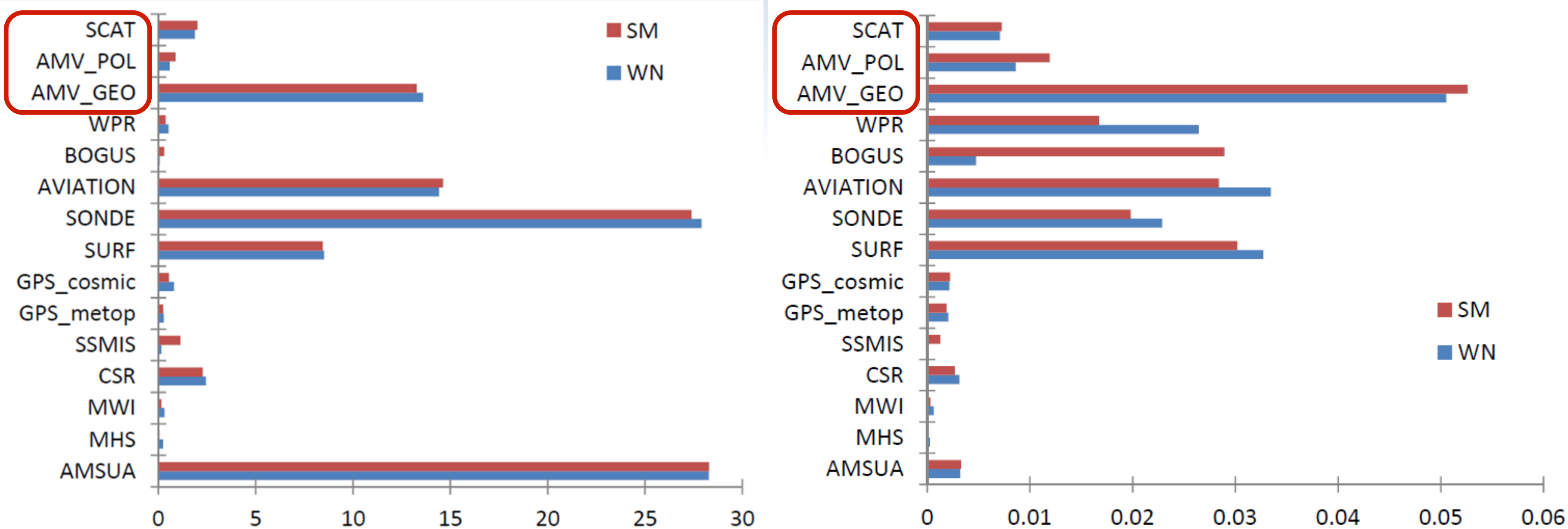
Mean 8 TCs Track Forecast Error



Forecast time (hours)

Anomaly correlation for Z500

Adjoint sensitivity diagnostics in 2010



Against each of all observations　　Against each of one observation

15-hour forecast error contribution ratio (%). Positive values correspond to a decrease in the dry energy norm of forecast error.
(Condition : dry total energy norm and global NWP system with wet process)

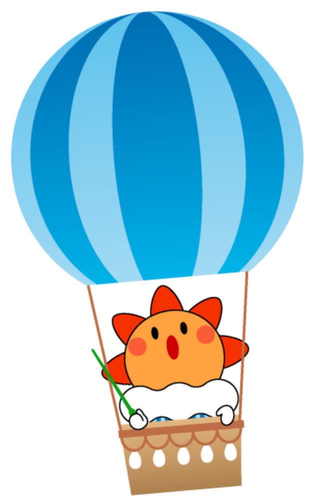
- Best reduction of forecast error is also observed from geostationary satellite AMVs (AMV_GEO) per one observation.

Summary

- Four experiments were performed in each of two seasons to assess the impact of AMVs.
- Assimilation
  - AMVs of geostationary satellites
    - Positive impacts mainly on the mean wind analysis at the range of 500-100 hPa (reduction of RMSE against sonde observations)
  - Polar AMVs (not shown figures)
    - Positive impacts on the mean wind analysis at the range of 500-100 hPa (reduction of BIAS against sonde observation)
  - Scatterometer winds
    - Slight positive impacts on the mean wind analysis below 850 hPa (improvement of BIAS against sonde observations), especially over the southern hemisphere

Summary

- Forecast
  - Significant positive impact on the forecast skills for AMVs in NW Pacific typhoon season
  - Slight positive impacts on the forecast skills mainly in the southern hemisphere for scatterometer winds
  - Slight improvement in mean TC track forecast errors for AMVs and scatterometer winds
- Adjoint sensitivity diagnostics
  - Best reduction of forecast error by AMVs against one observation in the JMA operational NWP system



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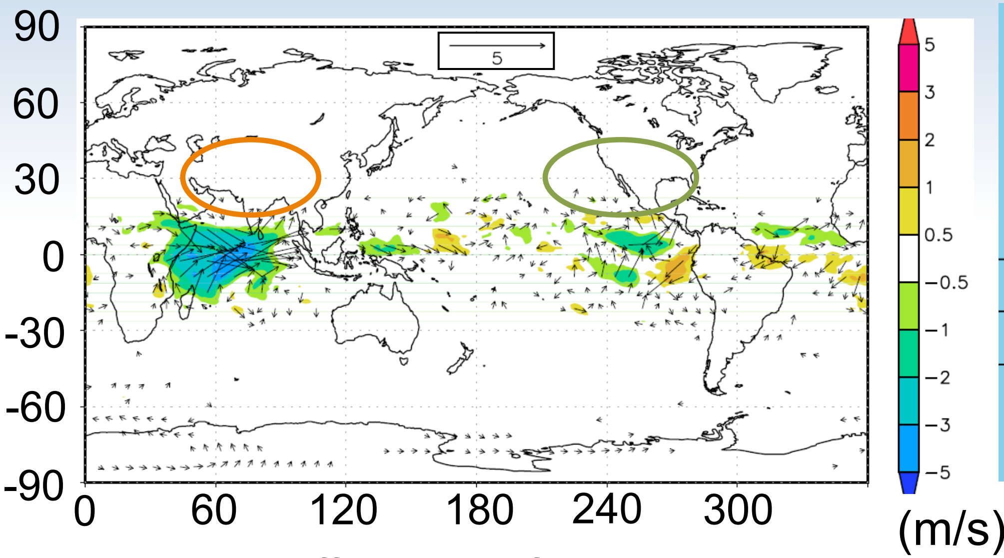
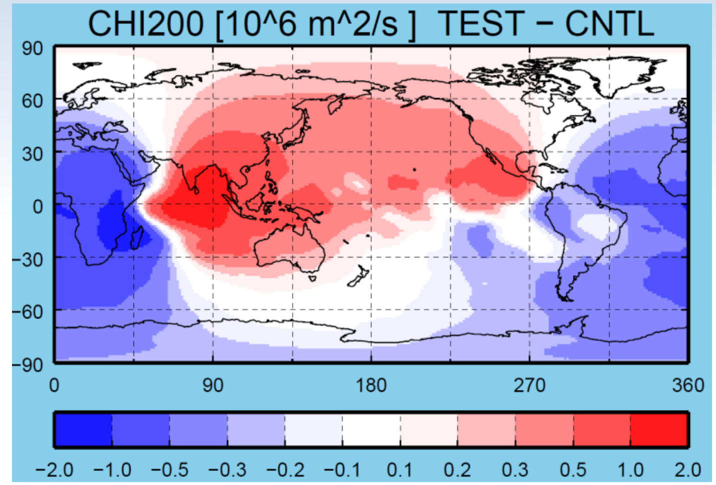
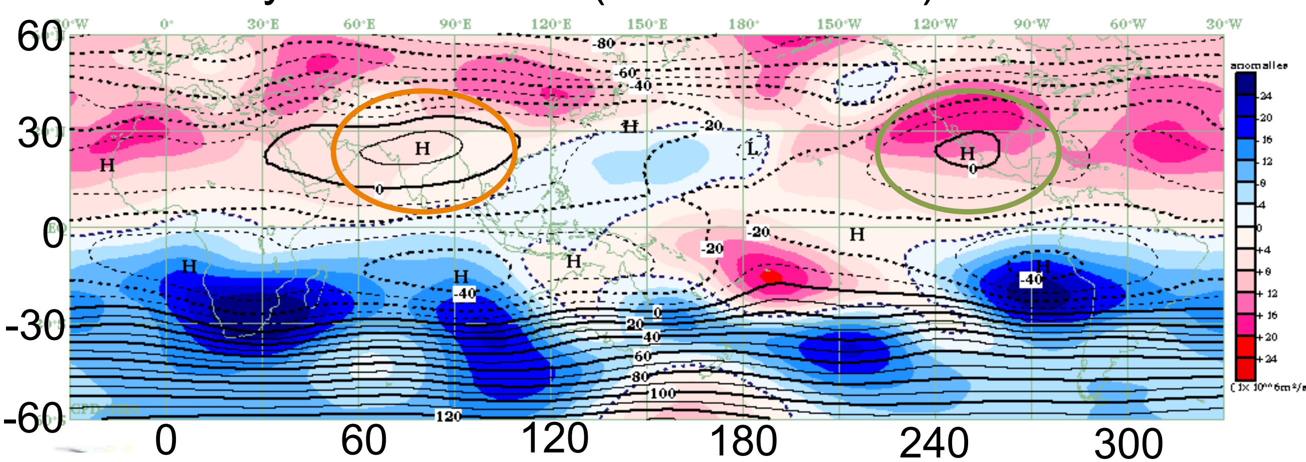
NW Pacific typhoon season in 2010 (NOAMV vs CNTL)



Vector difference of mean wind analysis at 200hPa (NOAMV-CNTL)



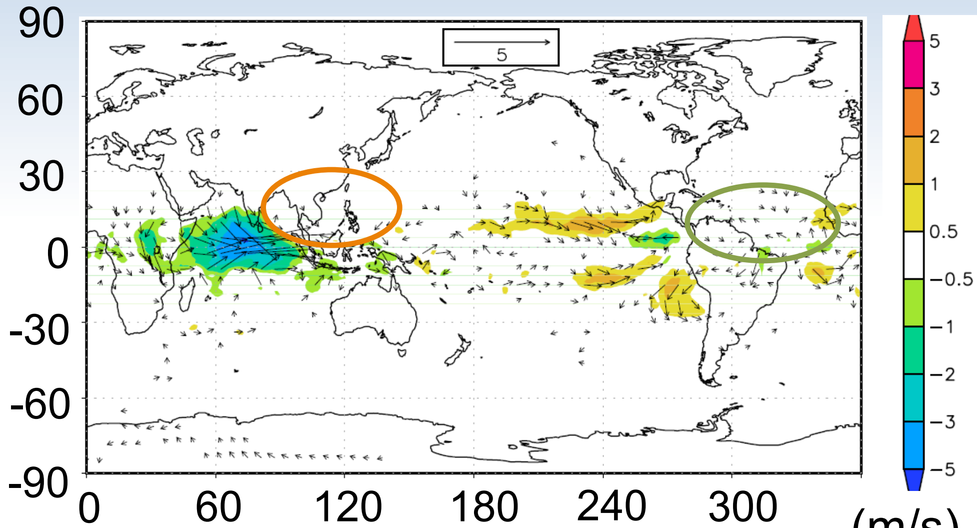
Mean 200 hPa velocity potential (NOAMV- CNTL)



Mean 200 hPa stream function and anomaly in September 2010

- Impacts in the south end of two anticyclones
- No AMVs bring weak anticyclones.

NH Winter season in 2010/11 (NOAMV vs CNTL)



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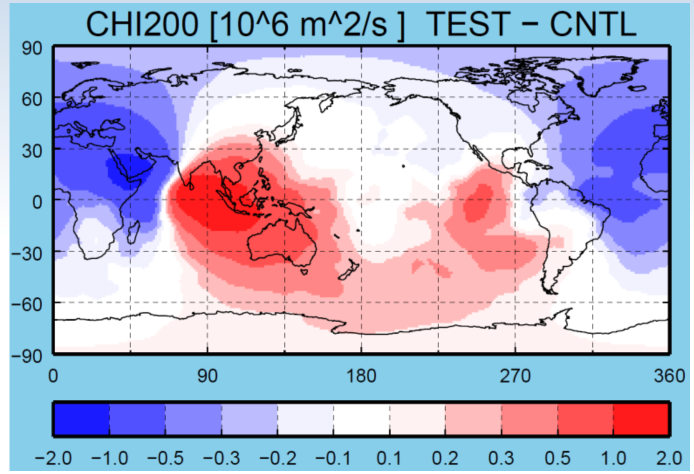

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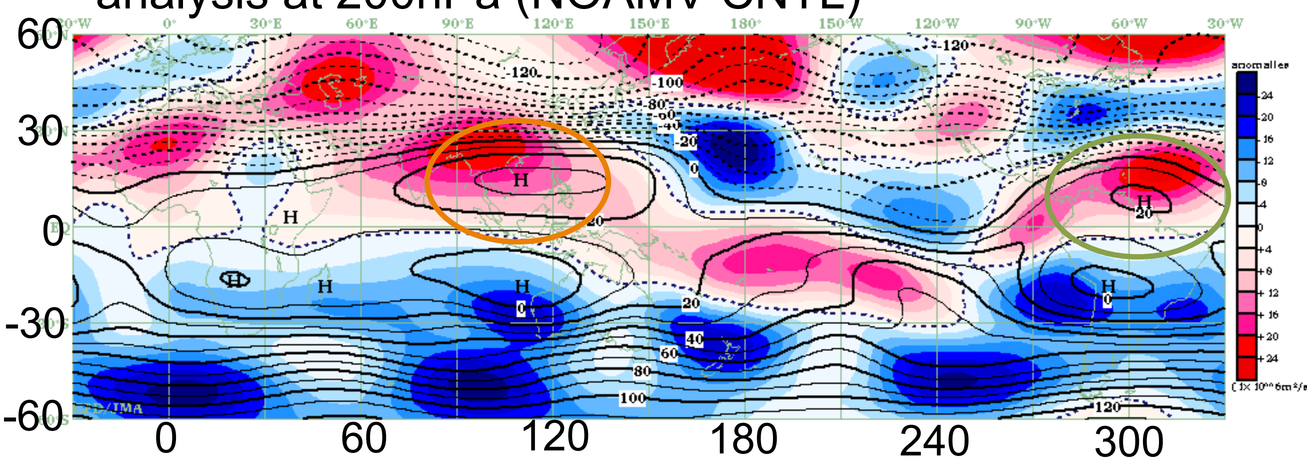
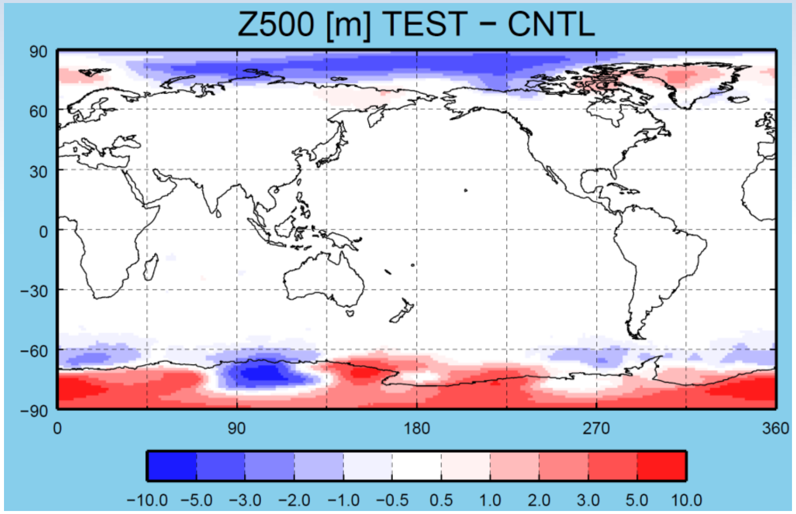


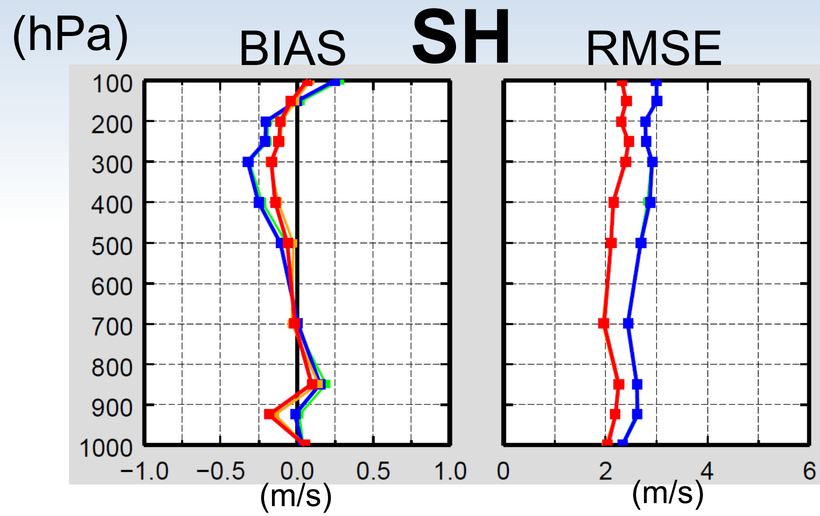
Mean 200 hPa stream function and anomaly in December 2010

- Impacts in the south-west end of two anticyclones
- No AMVs bring weak anticyclones.

NH Winter season in 2010/11 (NOPLR vs CNTL)

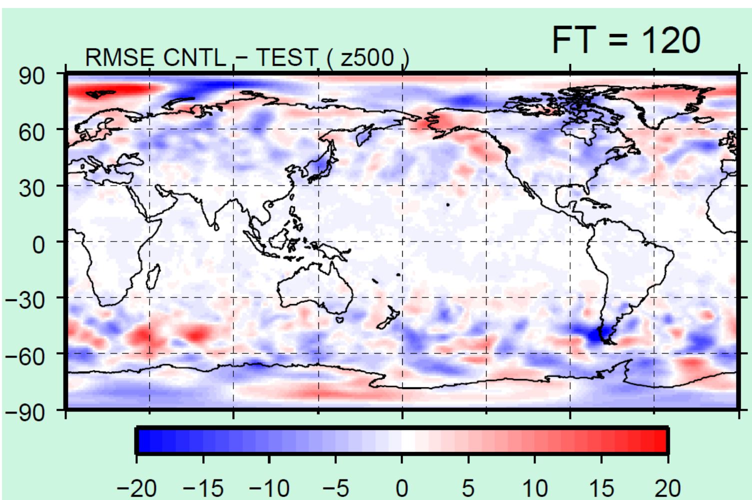


Mean Z500 analyzed fields (NOPLR-CNTL)

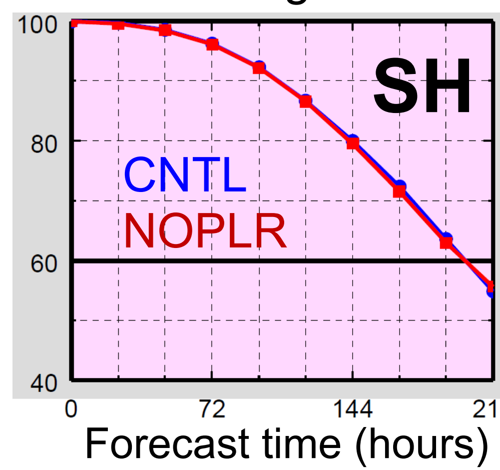


Anl. NOPLR Anl. CNTL Guess NOPLR Guess CNTL

U-component winds against sonde obs.

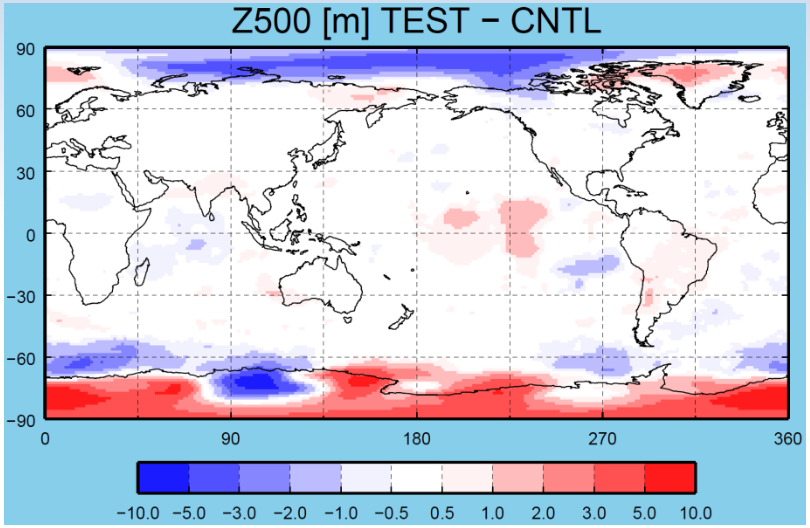


RMSE of forecast errors (CNTL-NOPLR)



Anomaly correlation for Z500

NH Winter season in 2010/11 (NOAMV vs CNTL)



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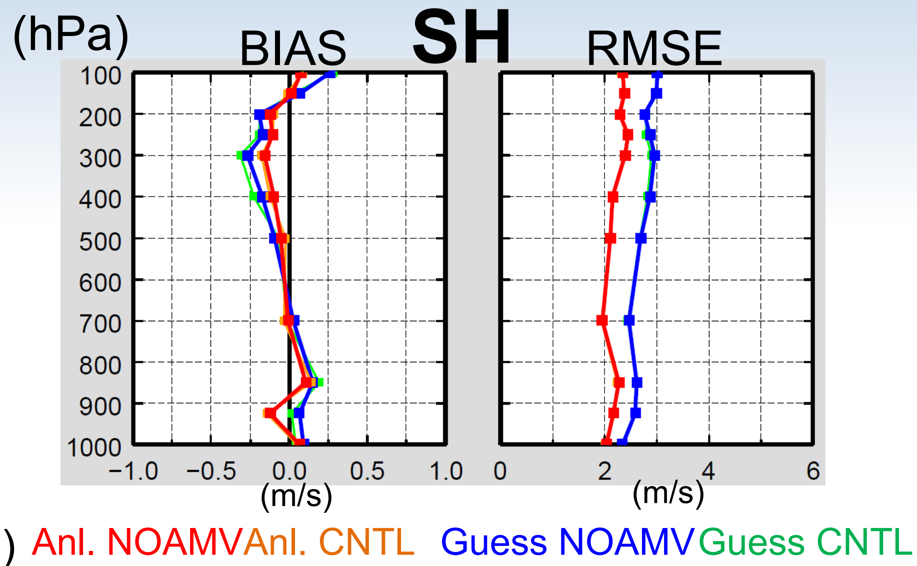

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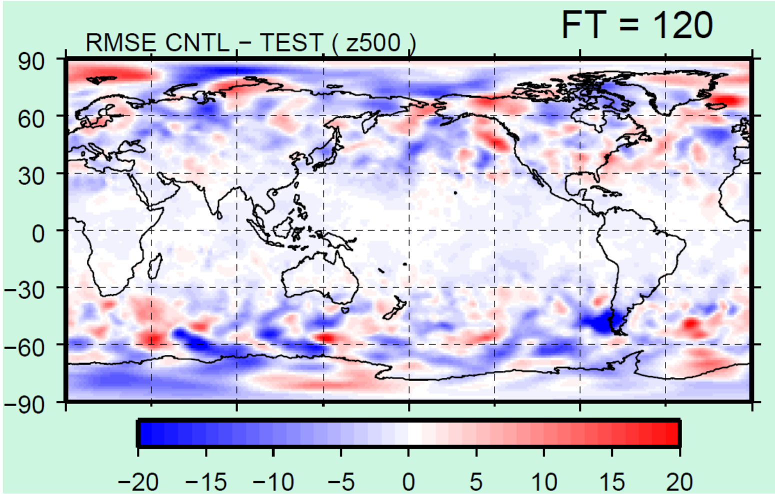
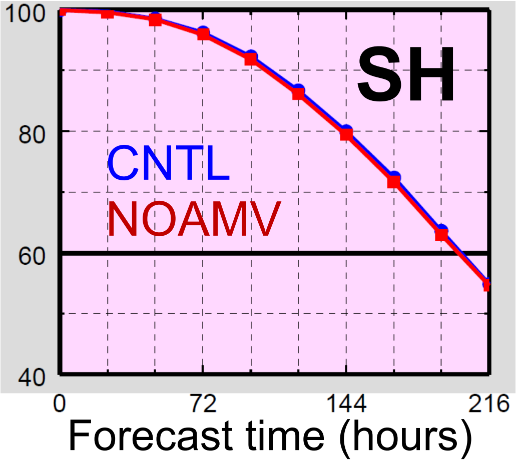


RMSE of forecast errors (CNTL-NOAMV)



Anomaly correlation for Z500

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