The Sixth Asia/Oceania Meteorological Satellite Users' Conference
Session 2: Himawari-8, related status and application (S02-3: 10th November 2015)

Status of development for assimilation of Himawari-8 Atmospheric Motion Vectors into the Numerical Weather Prediction Systems of Japan Meteorological Agency

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Outline

- Background
- Purpose
- Verification of Himawari-8 Atmospheric Motion Vectors (AMVs)
- Revised pre-processing system for assimilation of Himawari-8 AMVs into Numerical Weather Prediction (NWP) Systems
- Test of observing system experiment (OSE) for Himawari-8 AMVs
- Summary

Background

- The Meteorological Satellite Center of JMA started production of Himawari-8 AMVs on July 7th, 2015.
  - The AMVs are being produced using three sequential Himawari-8 images with 10 minutes interval.
- It is reported that the quality of the Himawari-8 AMVs has been improved by employing new tracking and new height assignment algorithms.

  (Presented by Kazuki Shimoji in poster presentations tomorrow)
- It is expected that the typhoon track forecasts will be improved by assimilating such a higher-quality AMV data, consequently.

Purpose

- To start assimilating Himawari-8 AMVs in JMA NWP Systems with maximizing its impact
- For this purpose,
  - It needs to review the quality of Himawari-8 AMVs comparing with MTSAT-2 AMVs in detail.
  - And it needs to revise the quality control (QC) suitable for the Himawari-8 AMVs.

Verification of Himawari-8 AMVs (Configuration)

- Aim
  - To validate by comparison between Himawari-8 AMVs and MTSAT-2 AMVs
- Investigation items
  - Frequency histograms, Mean error (ME) and standard deviation (STD) of O-B (Forecast guess departure)
- Utilization data
  - Obs.: Himawari-8 and MTSAT-2 AMVs with QI* exceeding 60%

    * QI: quality indicator (Holmlund 1998)
  - The first guess: Six hours forecast of JMA's operational global model (GSM)
    - The horizontal resolution of the GSM is 20km, approximately
- Period : From 15 February 2015 to 20 March 2015

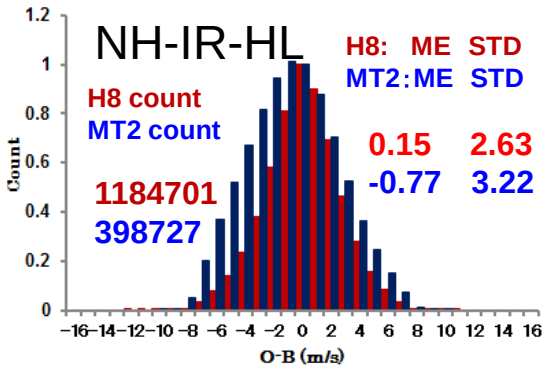
O-B wind speeds histograms at 90N-20N

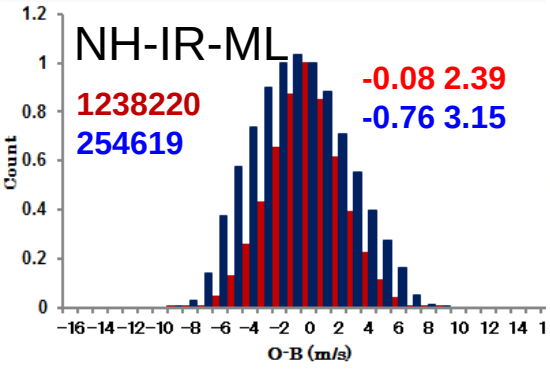
HL: ≦ 400hPa

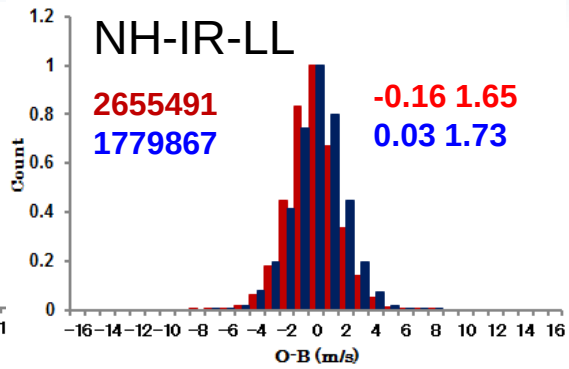
ML : 400-700hPa

LL : ≧700hPa

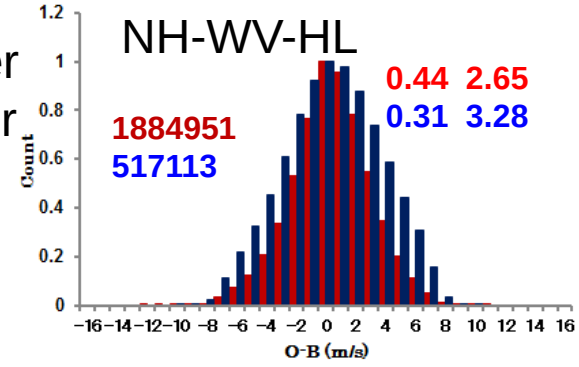
Infra red (IR)



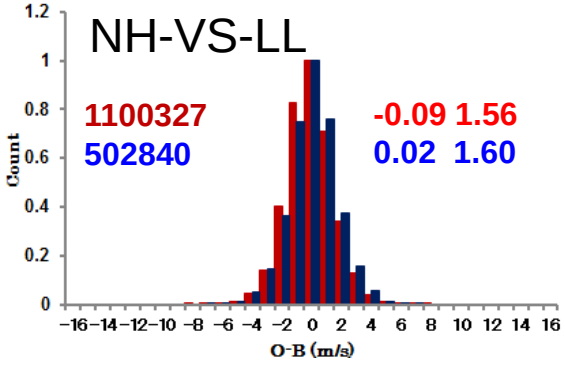




Water Vapor (WV)



Visible (VIS)



NH: 90N-20N

Himawari-8

MTSAT-2

ME: Mean Error (unit: m/s)
STD: Standard Deviation
(unit: m/s)

Revised pre-processing system for Himawari-8 AMVs

- Revised QI thresholds for rejecting AMVs with the low QI
- Introduction of a super-observation procedure (SPOB) which average AMVs in time, level, space, wind directions and speeds over Japan
  (20N to 45N and 120E to 150E)
- Revised climatological check
  - Rejecting of IR and VIS AMVs below 700 hPa over land

QI thresholds as of Nov.2015

		HL	ML	LL
NH	IR	85	94	88
	VIS	88	95	85
	WV	85	85	—
EQ	IR	85	85	88
	VIS	95	90	85
	WV	85	85	—
SH	IR	92	91	93
	VIS	96	96	85
	WV	95	85	—

Operational global NWP system (Routine)

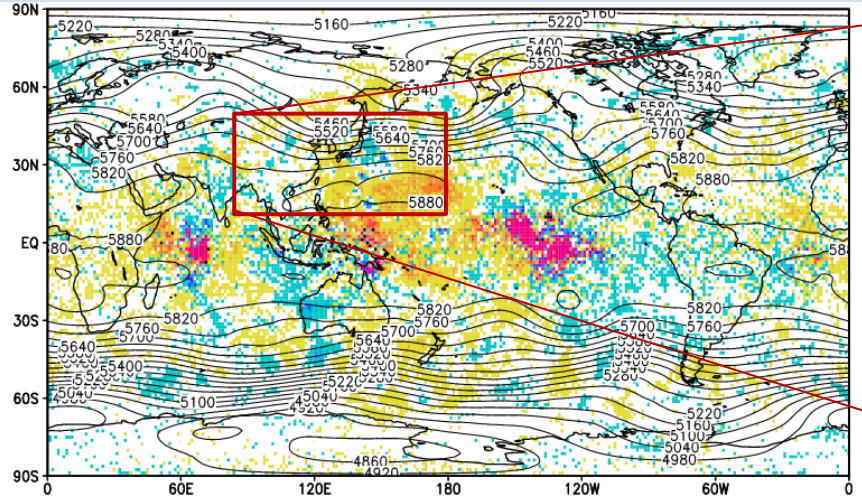
GSM (Global Spectral Model)	
Horizontal rez./ Vertical rez.	20 km / 100 level
Top	0.01 hPa
Inner-loop model rez. for DA	55 km
Assimilation method	4D-Var
Time windows	6 hour
Forecasts	84 hours / 264 hours (only 12UTC)
Used AMVs	MTSAT-2, GOES and Meteosat IR, VIS and WV (cloudy) AMVs; MODIS Terra and Aqua (IR and WV); NOAA and Metop AVHRR AMVs; LEOGEO AMVs
Other satellite data	Clear-sky radiance from MTSAT, Meteosat, GOES, 6 AMSU-As, 5 AMSU-B/MHSs, AMSR-E, SSMIS; scatterometer winds from ASCAT; Metop and COSMIC GPSRO

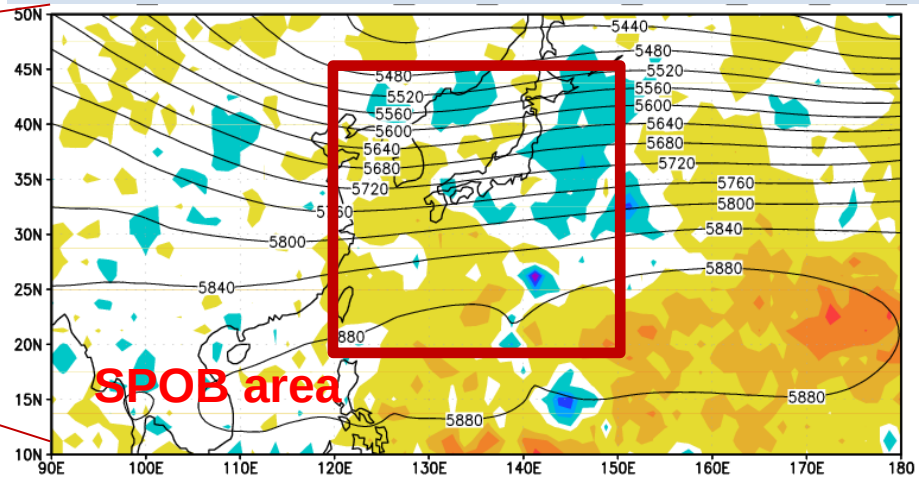
Experimental Design

Name	Specification
Routine (CNTL)	Same as Routine (Previous slide)
TEST	CNTL + Himawari-8 AMVs with revised pre-processing system + NO MTSAT-2 AMVs

- Target: two typhoon cases (NOUL (T1506) and DOLPHIN (T1507))
- Period:
  - Assimilation : From 1 to 24 May 2015
  - Forecast : From 1 to 20 May 2015

Normalized RMSE difference between TEST and CNTL on 500 hPa geopotential height against analyzed fields



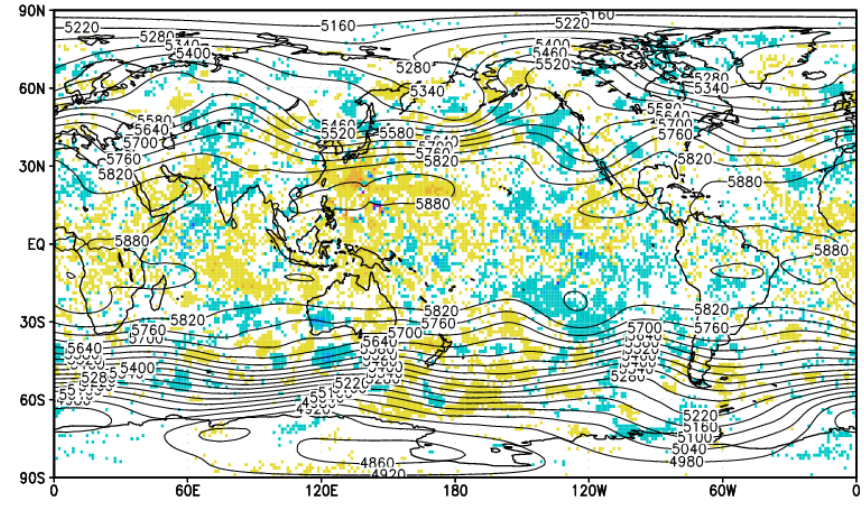


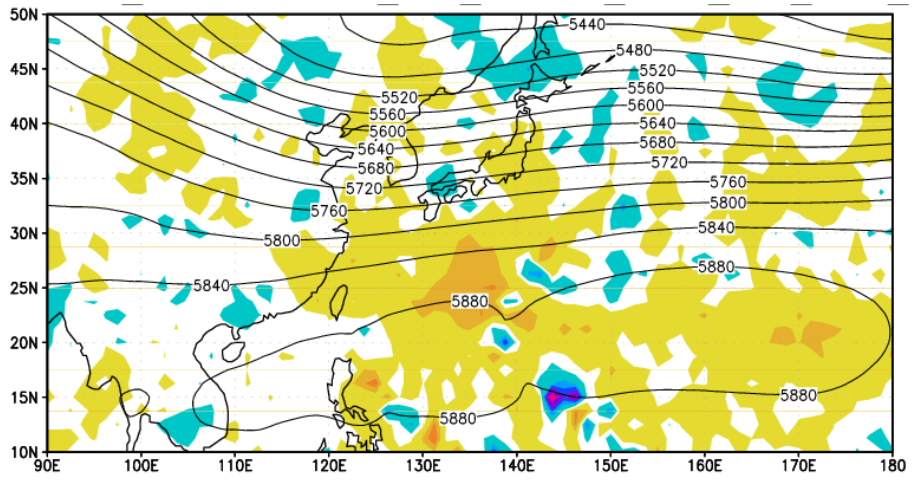
Forecast lead time 6-hour (FT6)

Better

Worse

−7 −5 −4 −3 −2 −0.5 0.5 2 3 4 5 7

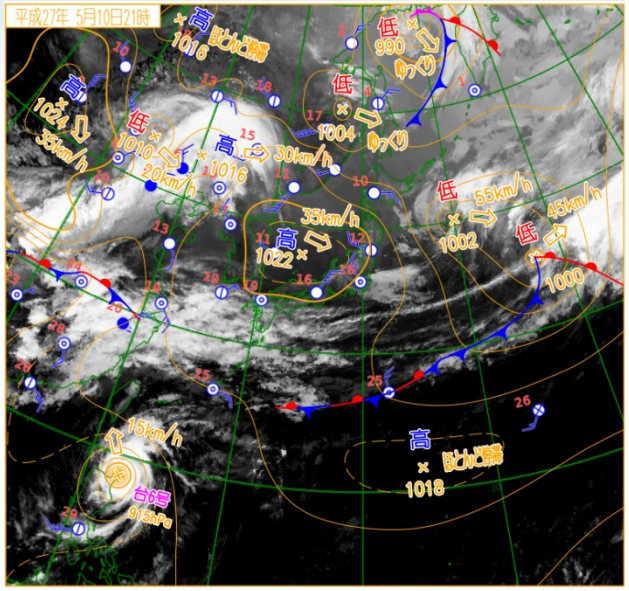




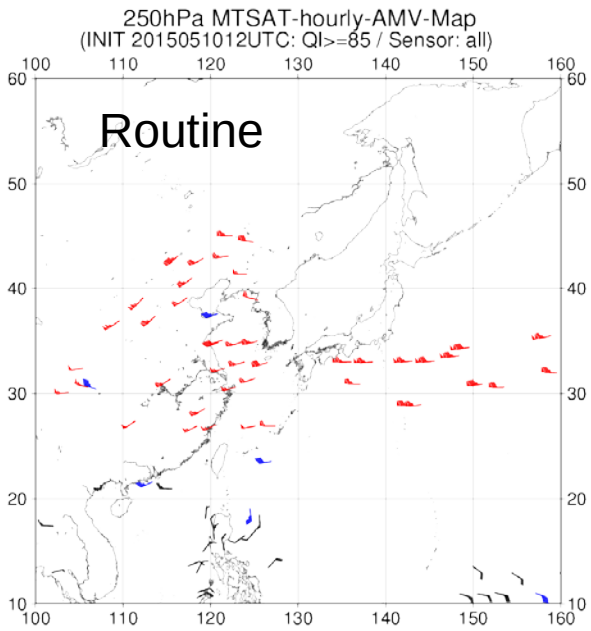
FT12

Case Study on Impact of Himawari-8 AMVs using JMA's global NWP system

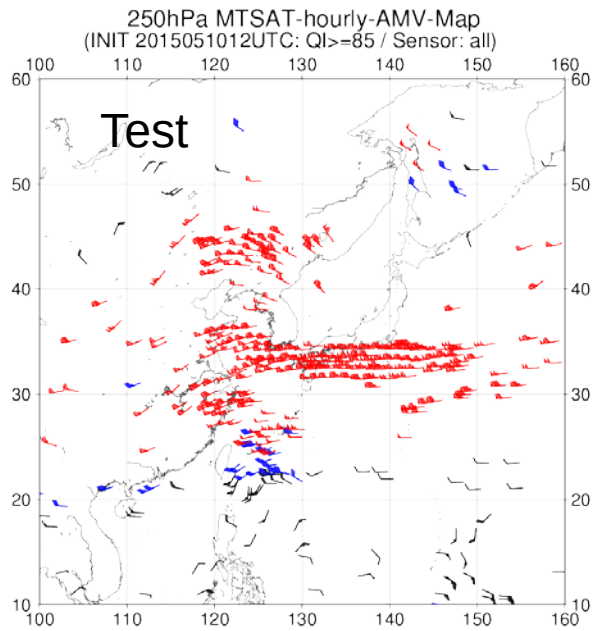
A sample of the assimilated data distribution (12 UTC, 10 May 2015)



Weather chart with MTSAT-2 infrared satellite image



MTSAT-2 AMVs on 250 hPa in vicinity of Japan, which were assimilated into the routine system



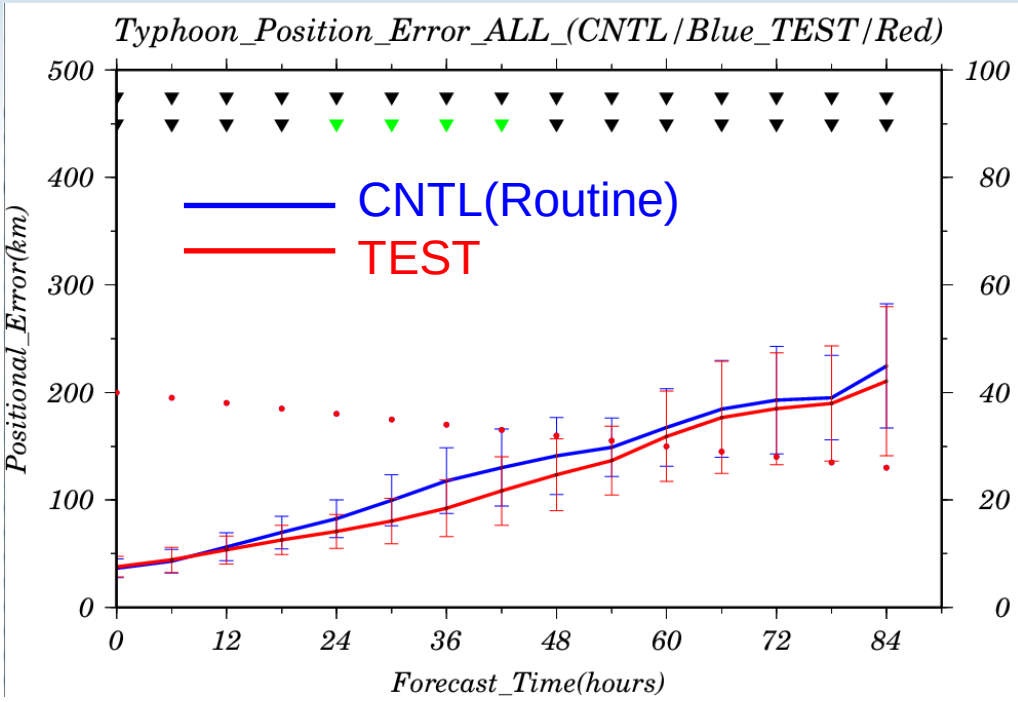
Himawari-8 AMVs on 250 hPa in vicinity of Japan, which were assimilated into the test system

Red:	≧ 50kt
Blue:	≧ 30kt
Black:	< 30kt

Himawari-8 AMVs were derived from three sequential satellite images with 10-minute time interval by a new retrieval method based on maximum likelihood estimation.
MTSAT-2 AMVs were derived from three sequential satellite images with 15- or 30-minute time interval.
（Himawari-8 and MTSAT-2 AMVs used for this study were produced by Meteorological Satellite Center of JMA.）

Typhoon track forecasts using Himawari-8 AMVs

- Impact of Himawari-8 AMVs compared to routine -



Typhoon track forecast errors averaged for NOUL (T1506)

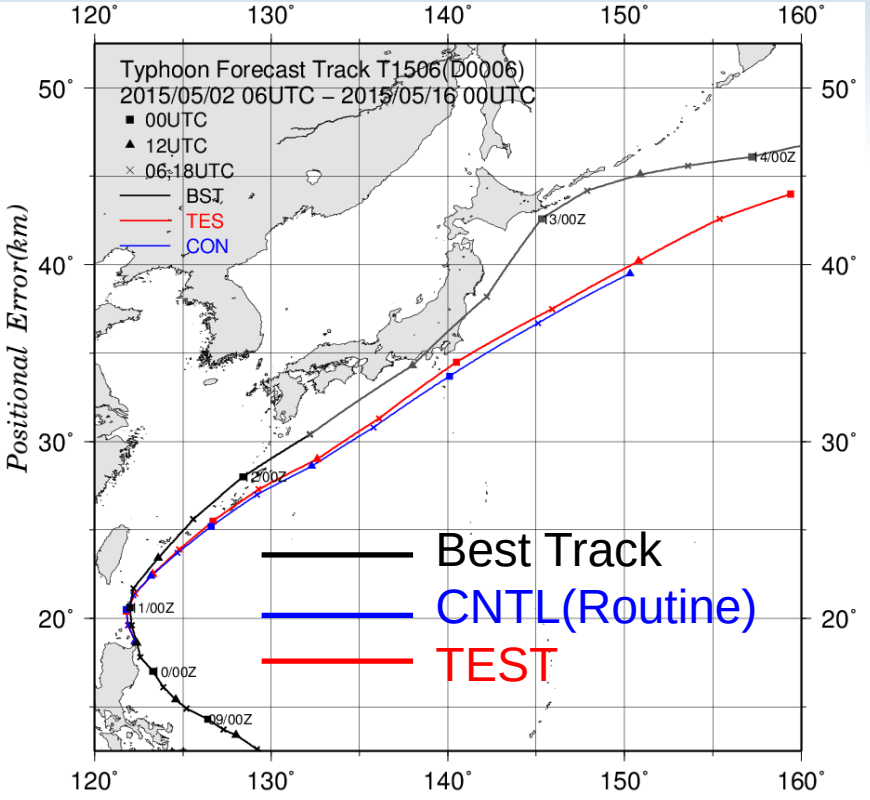
CNTL(Routine): Result by assimilating MTSAT-2 AMVs

TEST: Result by assimilating Himawari-8 AMVs

Period:

Assimilation : From 1 to 24 May 2015

Forecast : From 2 to 12 May 2015



Typhoon track forecast of NOUL (T1506) initialized at 12 UTC on 10 May 2015.

Black is the best track.

CNTL(Routine) and TEST are same to the left panel.

Summary

- Verification of Himawari-8 AMVs
  - Proper Gauss distributions in data assimilation
  - Better accuracy Himawari-8 AMVs comparing to MTSAT-2 AMVs
- Revised pre-processing system for assimilation of Himawari-8 AMVs
  - Revised QC and introduction of SPOB over Japan
- Test of OSE for Himawari-8 AMVs
  - Reduced forecast errors on 500 hPa geopotential height over the Himawari-8 observation area, especially around Japan
  - Reduced mean positional error for typhoon NOUL (T1506) after 18-hour forecast lead time
  - No impact on tract forecast of typhoon DOLPHIN (T1507)

THANK YOU FOR YOUR ATTENTION