Use of satellite data in NWP and Reanalysis/Development of NWP

CGMS-40 Panel Discussion

7 November, 2012, Lugano, Switzerland

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former Director-General
of the Meteorological Research Institute, JMA

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- Scope of Satellite Data Utilization

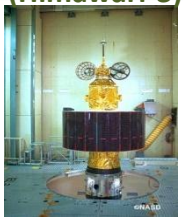
History of JMA's Geostationary Meteorological Satellites "Himawari"

GMS (Geostationary Meteorological Satellite)

GMS (Himawari) — Jul 1977

GMS-2 (Himawari-2) — Aug 1981

GMS-3 (Himawari-3) — Aug 1984



GMS-4 (Himawari-4) — Sep 1989

GMS-5 (Himawari-5) — Mar 1995

(GOES-9)
Back-up operation of GMS-5 with GOES-9 by NOAA/NESDIS

Launch failure Nov 1999

May 2003

MTSAT (Multi-functional Transport SATellite)

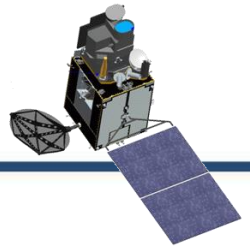
MTSAT-1R (Himawari-6) — Feb 2005

MTSAT-2 (Himawari-7) — Feb 2006

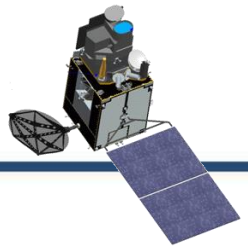
Nobuo Sato
Head of Satellite Program Office(1997-2000)

Himawari

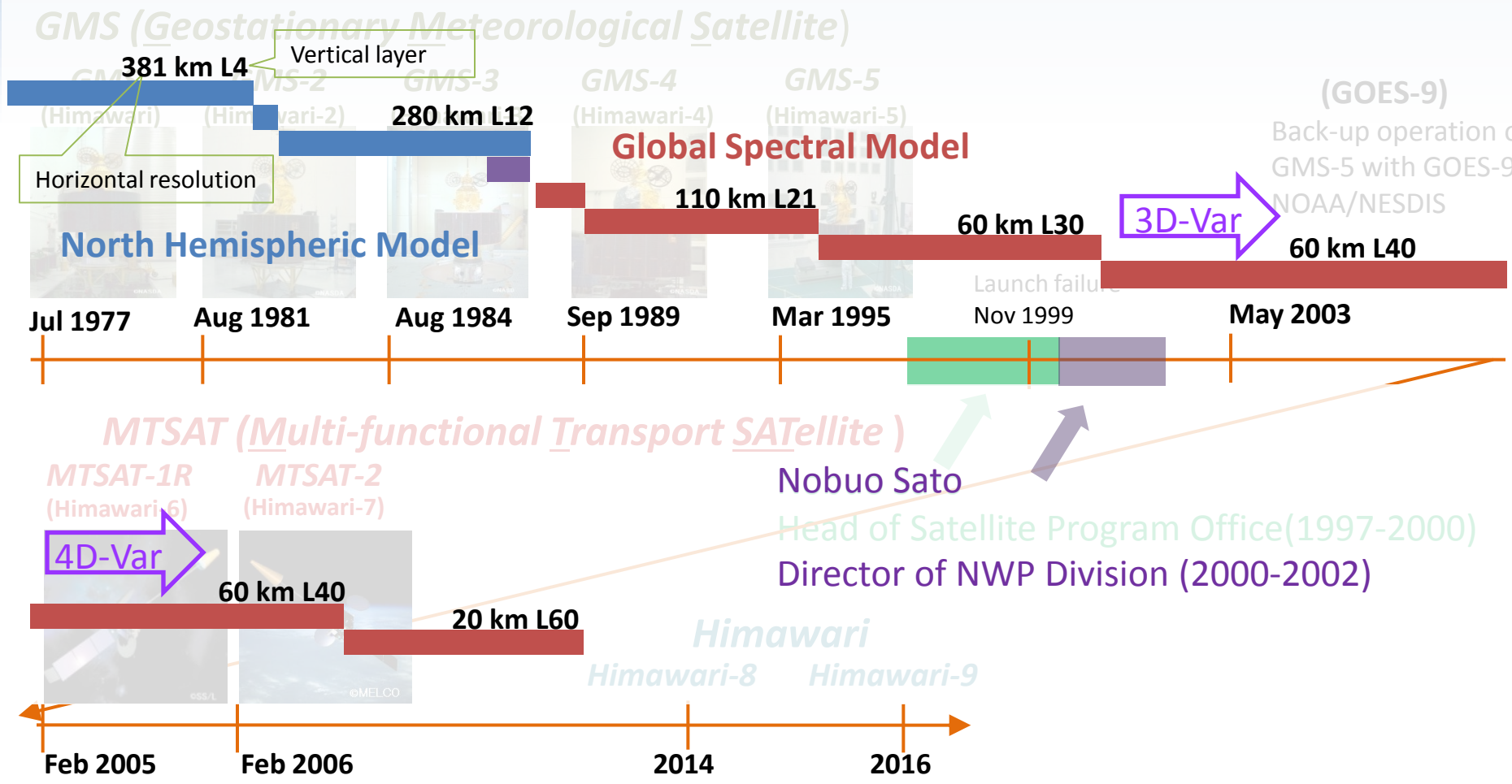
Himawari-8 — 2014



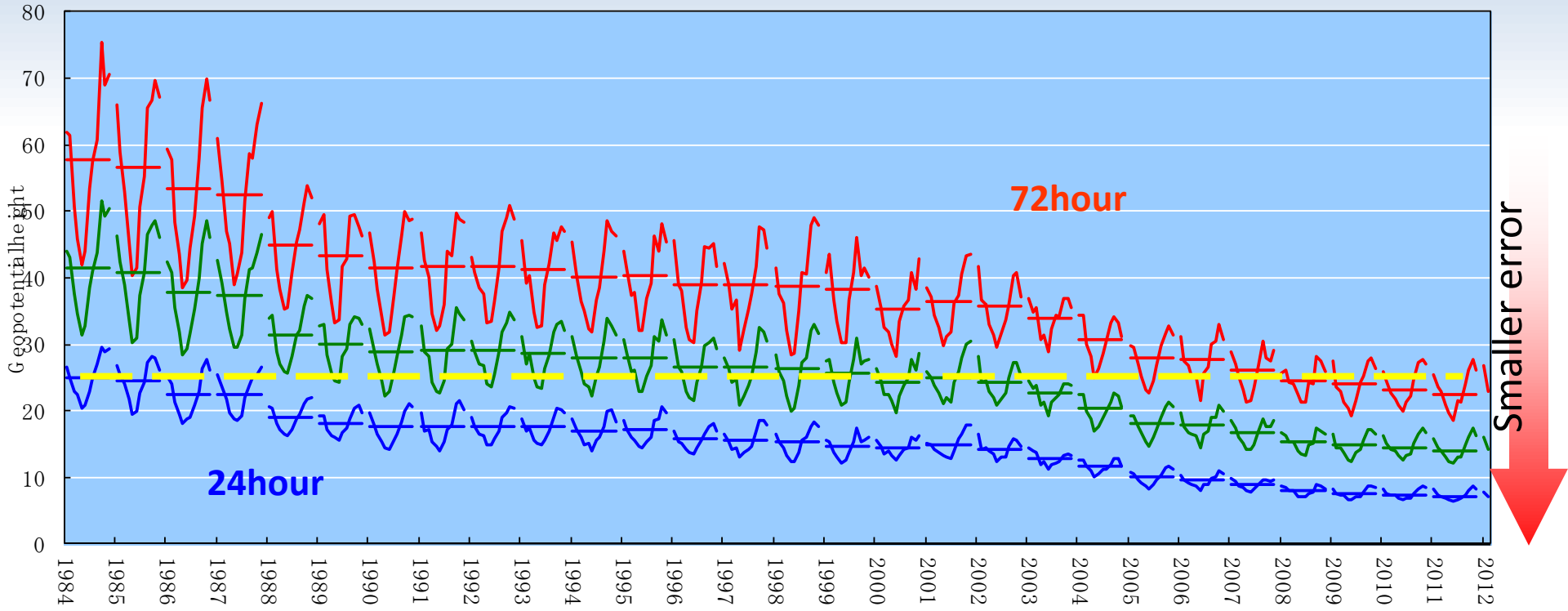
Himawari-9 — 2016



History of JMA's Geostationary Meteorological Satellites "Himawari" and Global Numerical Prediction Models



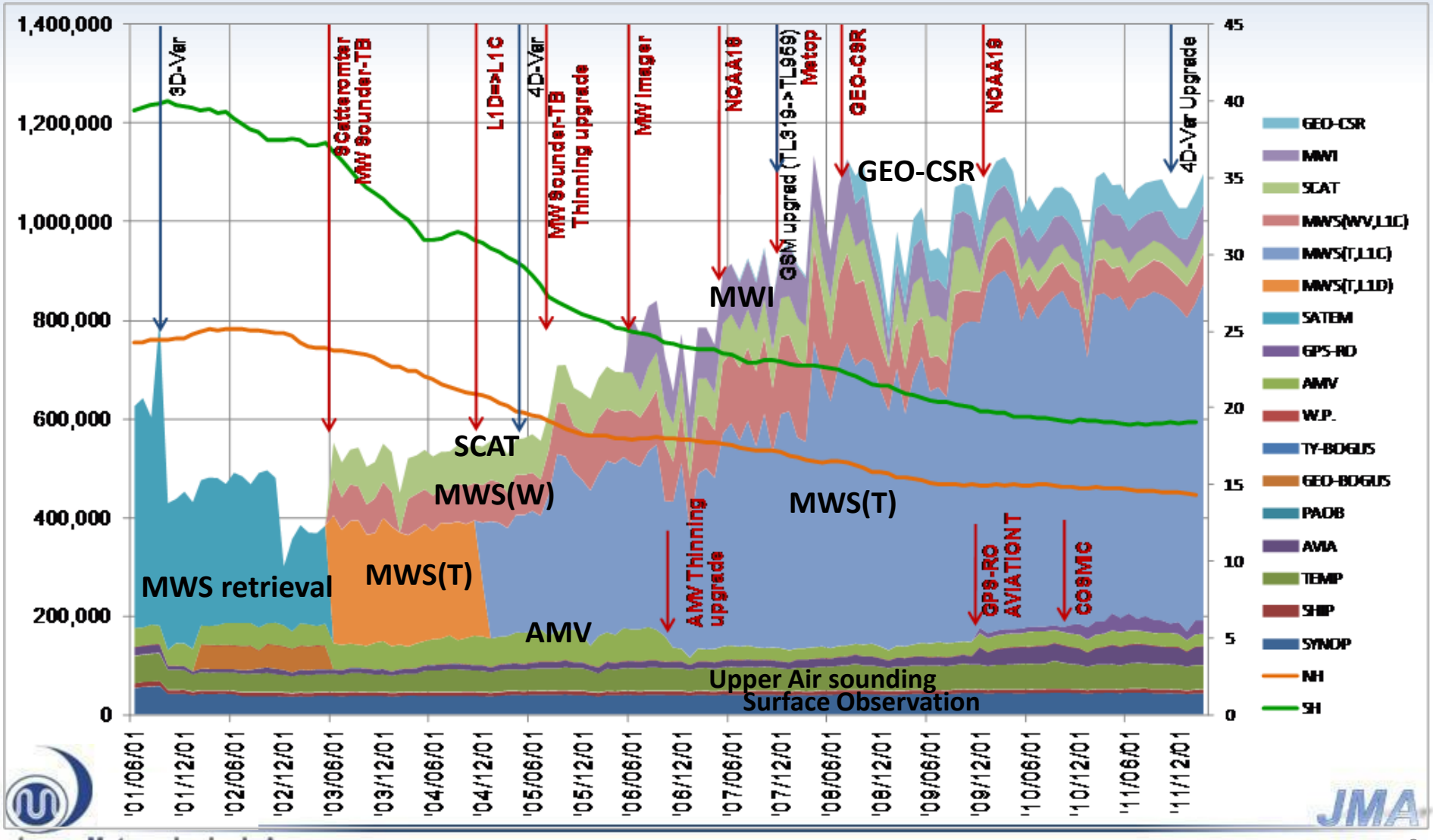
Improvement of Global NWP



RMSE of 500 hPa geopotential height in Northern Hemisphere (20-90N)
(JMA Global Model. Bar: annual mean)

The accuracy of 72hr forecast in 2010 exceeded that of 24hr forecast in 1980's.

History of Assimilated Data Amount and Forecast Error Trend



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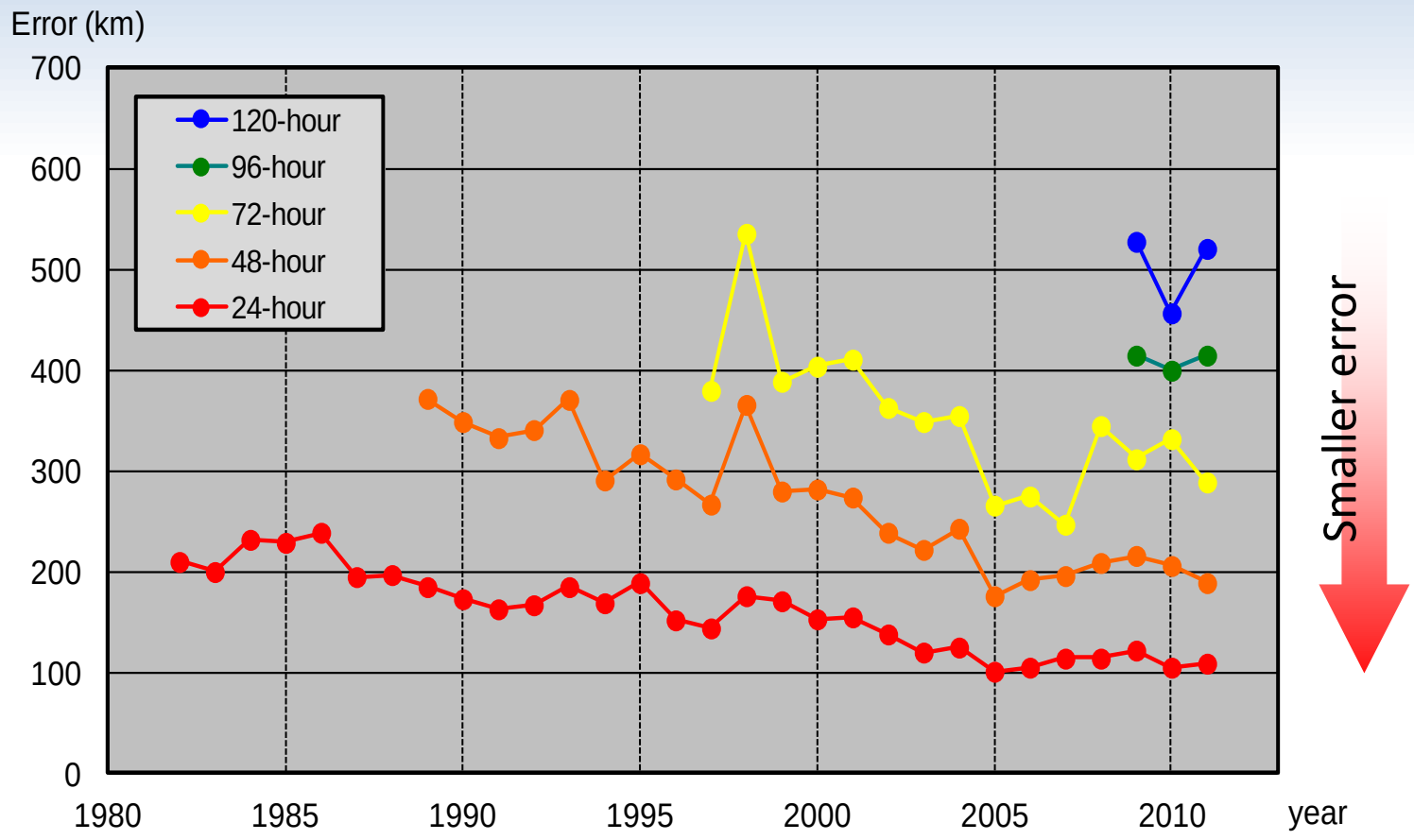
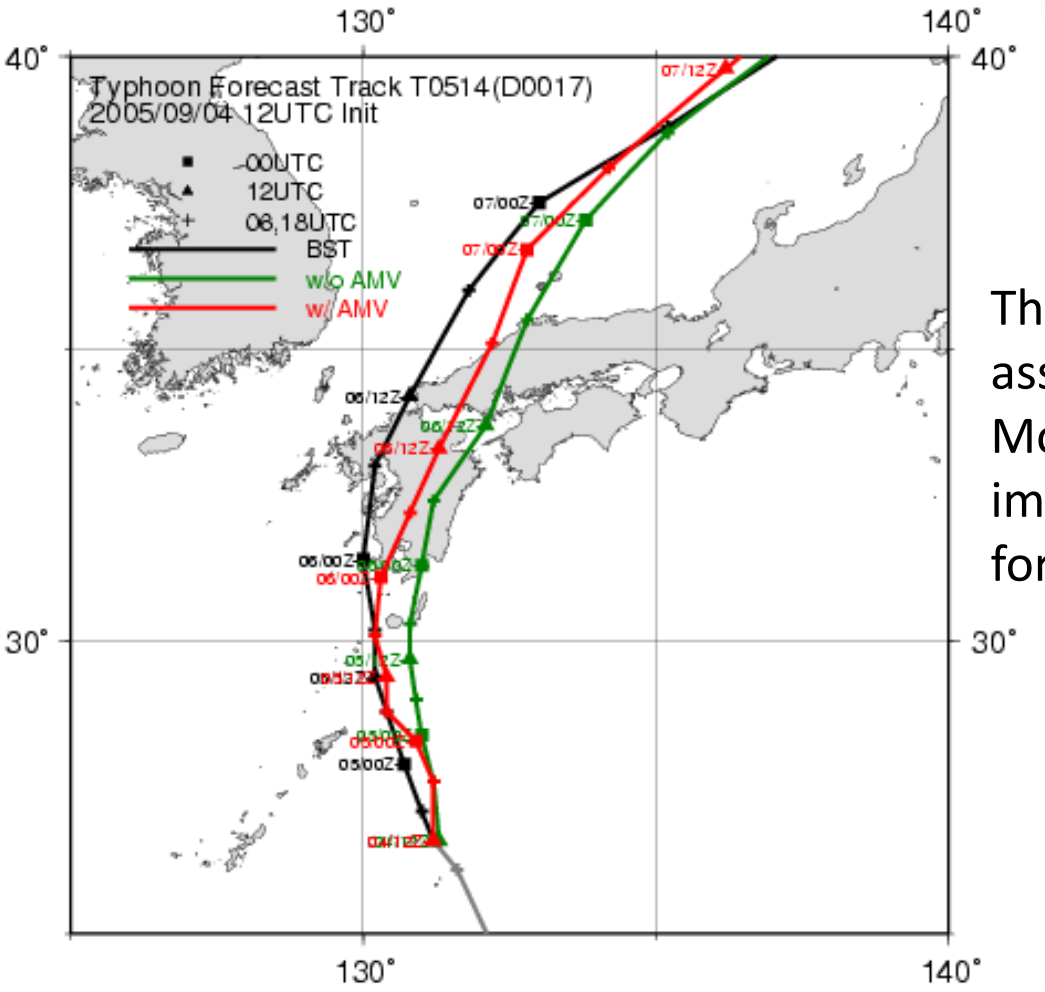
Improvement of Tropical Cyclone Forecast



Annual means of position errors
(Official Forecast of RSMC Tokyo – Typhoon Center)

Example of Tropical Cyclone Forecasts Improved by Satellite Data

Typhoon Track Forecast
12 UTC, Sep. 4, 2005

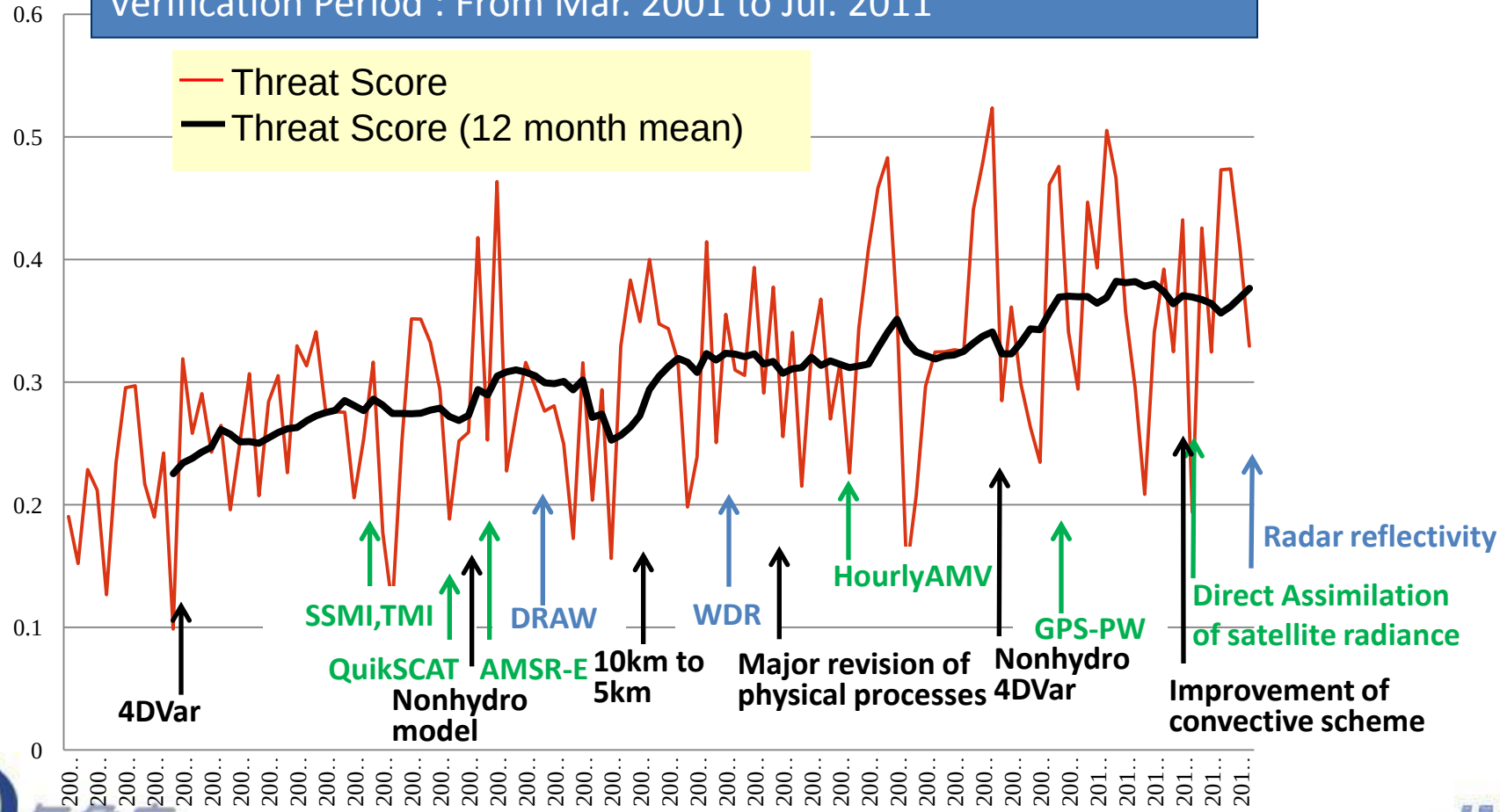


This example demonstrates assimilation of AMV(Atmospheric Motion Vectors) gives significant improvement on typhoon track forecast.

Improvement of Mesoscale NWP

Trend of JMA MSM Precipitation Forecast Accuracy

Verification Grid : 20km Square
Verified Element: 5mm/3hr , FT00-15 mean
Verification Period : From Mar. 2001 to Jul. 2011

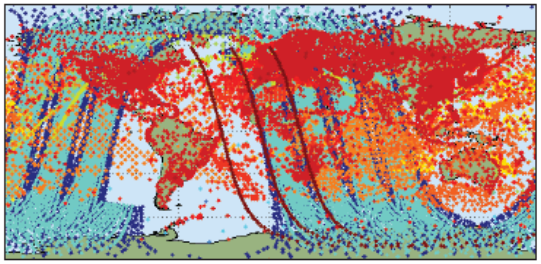


Contribution to Reanalysis Studies

Reanalyses have become an integral part of Earth system science research across many disciplines.

WCRP World Climate Research Programme

4th World Climate Research Programme International Conference on Reanalyses



Silver Spring, Maryland USA
7-11 May 2012

http://icr4.org

Proposed in 1988 by Bengtsson & Shukla and Trenberth & Olson

- for climate studies, following ECMWF and GFDL "FGGE" reanalyses for 1979

Three responses in the mid 1990s

- ERA-15 (1979 - 93), NASA/DAO (1980 - 93) and NCEP/NCAR (1948 - …)

Second round followed

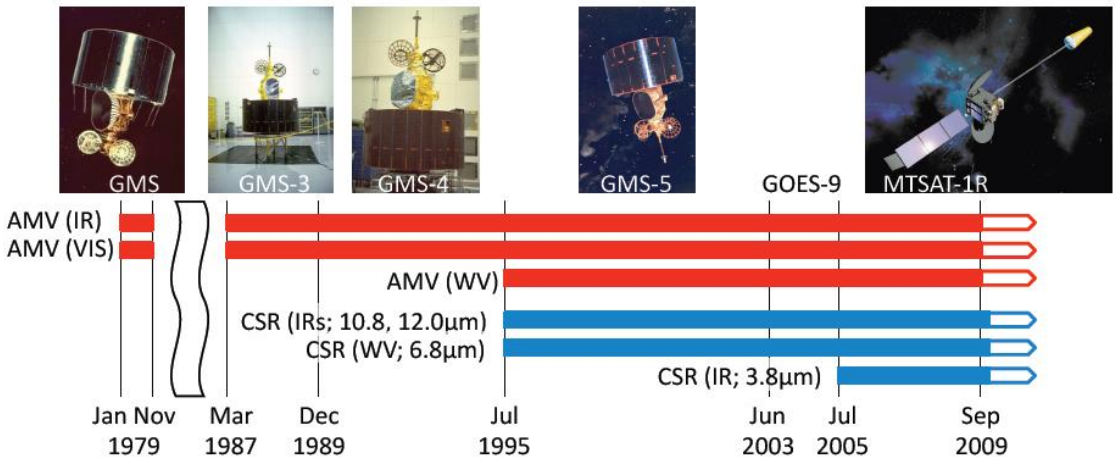
- ERA-40 (1958 - 2001), JRA-25/JCDAS (1979 - …) and NCEP/DOE (1979 - …)

Now towards end of third generation of comprehensive global reanalysis

- CFSR (1979 – 2010?), ERA-Interim (1979 - …), JRA-55 (1958 - 2012) and MERRA (1979 - …)

Presentation by Adrian Simmons, ECMWF,
at 4th WCRP International Conference on Reanalysis (2012)
http://icr4.org/ppts/Simmons_Keynote.pdf

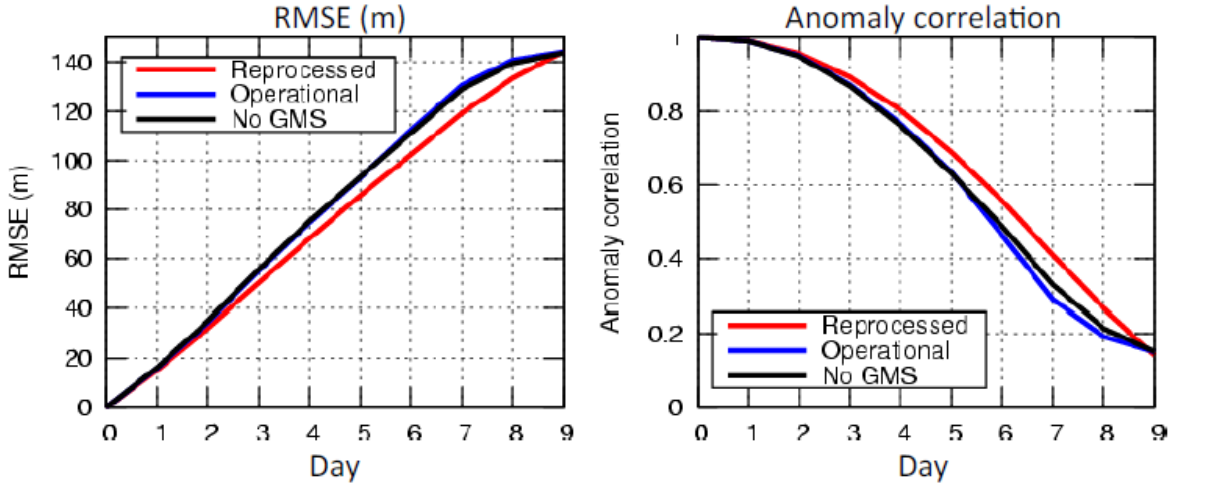
Impact of GMS Reprocessed AMVs to JRA-55



Reprocessed AMVs and CSRs are provided to the Japanese55-year Reanalysis (JRA-55)

Results of OSEs using the JRA-55 data assimilation system (TL319L60):

Reprocessed GMS AMVs significantly improve model forecasts.



Z500 forecast scores for the extra tropical southern hemisphere for Jun. 1990

Presentation by Shinya Kobayashi, JMA
at 4th WCRP International Conference on Reanalysis (2012)
http://icr4.org/ppts/Kobayashi.pdf

気象庁
Japan Meteorological Agency

JMA

Scope of Satellite Data Utilization

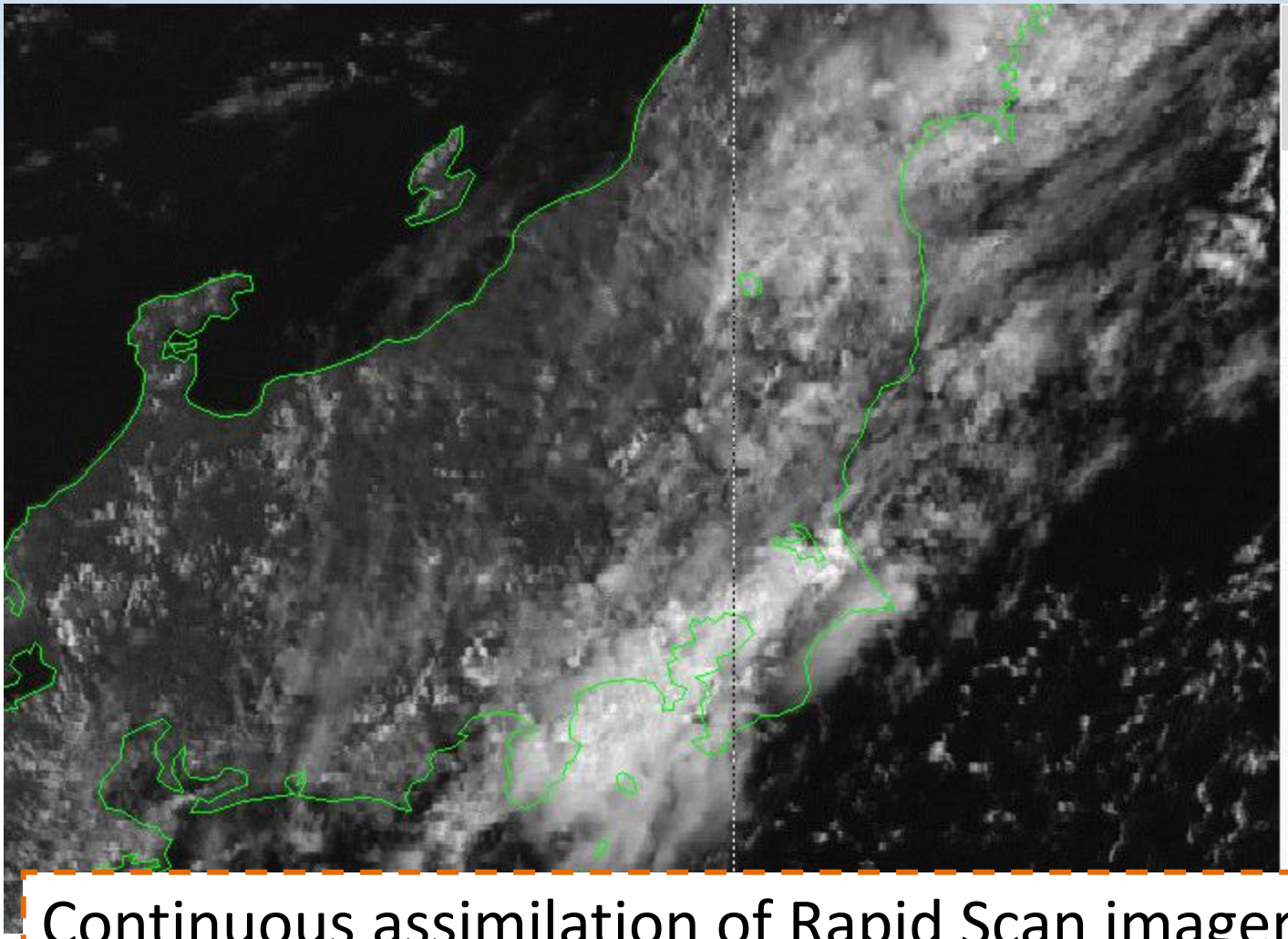
The Road So Far

- Over the last 40 years, the utilization of satellite data, together with development of data assimilation, brought tremendous improvement in numerical weather prediction.
- Reprocessing of the past satellite data contributes to improvement of reliability of Reanalysis products.

Expectations

- Frequent satellite data would improve nowcasting, and thus, disaster prevention
- Long-term satellite data would contribute to climate monitoring from space
- Possible satellite data users would be found in wider areas: ex. environment, natural energy, agriculture, …

I have a dream!



Continuous assimilation of Rapid Scan imagery
i.e. "Super Rapid Update Cycle"
would enable nowcasting of convective weather!