

MODIS polar winds assimilation at JMA

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Introduction

The geostationary satellites have provided wind data from the tropics to mid-latitudes for global numerical weather prediction (NWP), and their atmospheric motion vectors play a significant role to grasp the structure of wind field on global scale. While the polar regions have been remained as data poor regions for long time because the observations at high latitudes are difficult for the geostationary satellites. Furthermore, radiosonde and aircraft observations are sparse in the polar regions.

The MODIS is an instrument carried on the Terra and Aqua polar-orbiting satellites. Recently, the MODIS polar winds are derived at Cooperative Institute for Meteorological Satellite Studies (CIMSS) by tracking structures in successive swaths from the MODIS instruments (Key et al. 2003). Cloud patterns are tracked in the Infrared band and water vapour features are tracked in 6.7 μ m band.

Aiming to improve the forecast skill of NWP, JMA has started the acquisition of the MODIS polar winds from CIMSS since July 2003 and has investigated the quality of the MODIS polar winds.

Observation system experiments

The MODIS polar winds were acquired from a CIMSS FTP server via Internet. The earliest cut off time is 440 minutes for the cycle analyses, and 150 minutes for the early analyses at JMA. 80% of the produced data are available for the cycle analyses. The statistical investigation revealed that the MODIS polar winds in the Antarctic have larger BIAS against the first guess than those in the Arctic (Figure 1). And the lower level MODIS polar winds have poor quality. The quality of the MODIS polar winds in the Northern Hemisphere was acceptable for assimilation.

The MODIS polar winds assimilation experiments were performed for July 2003 and January 2004 with the JMA Global Spectral Model (GSM). In the experiments, the MODIS polar winds were used in the Arctic. The MODIS polar winds complement other observations and introduce analysis increment in data sparse regions. And by using the data from the couple of satellites, a better spatial coverage was acquired than single satellite case.

Analysis impacts of the MODIS polar winds were restricted in the Arctic. Increase in 500hPa geopotential height over ocean and decrease over land were found for both July 2003 and January 2004 (not shown).

As for forecast impacts, large improvements in forecast scores of geopotential height (Figure 2) and wind fields were found at 500hPa. The MODIS polar winds revealed that the analysis in the polar region is extremely important for the forecast of mid-latitudes because the improvements in the polar region at the initial state spread to mid-latitudes with the procession of forecasts.

Summary

The MODIS polar winds assimilation experiments were performed for July 2003 and January 2004 with the JMA GSM. Because the experiments showed the positive impacts on forecast scores, JMA started the operational assimilation of Terra and Aqua MODIS polar winds in the Arctic on 27 May 2004. And the quality of the MODIS polar winds in the Antarctic has been better since July 2004, the use of the MODIS polar winds in the Antarctic was started on 16 September 2004.

Wind Speed O-F From 27Dec2003 To 09Feb2004

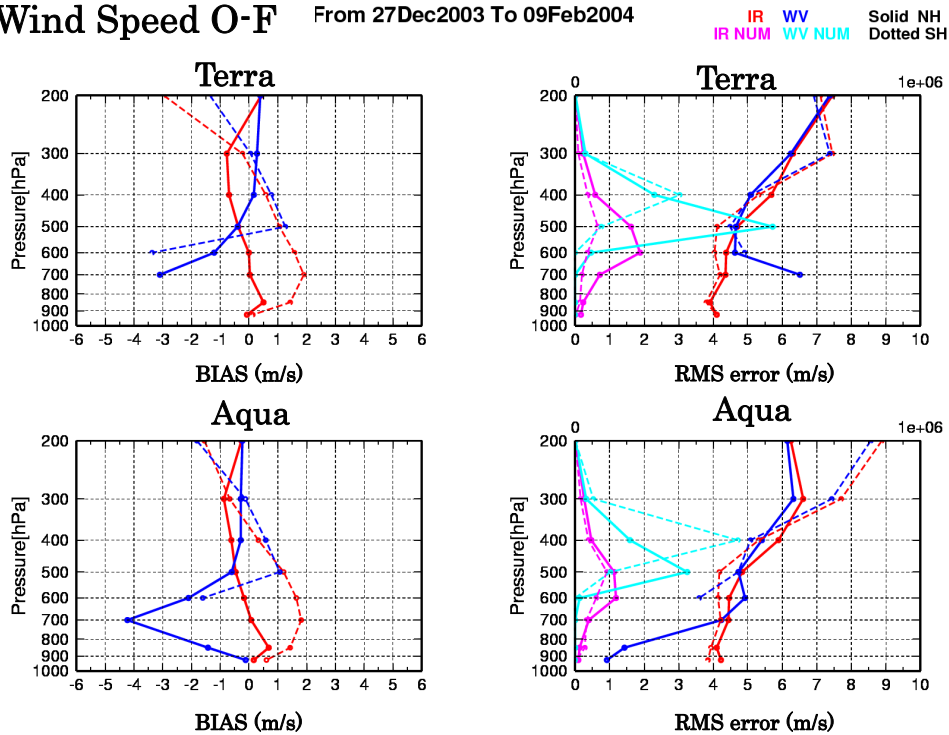


Figure 1. Statistics of wind speed against first guess for all MODIS polar winds from the CNTL. The upper panels are for Terra MODIS and lower ones for Aqua MODIS. Left panels show BIAS and right for the RMS error. Red line is for IR winds and blue line for WV winds. Solid lines are for the Arctic and dotted lines for the Antarctic. Light colour lines in the right panels show the numbers of data. The period is from 27 December 2003 to 9 February 2004.

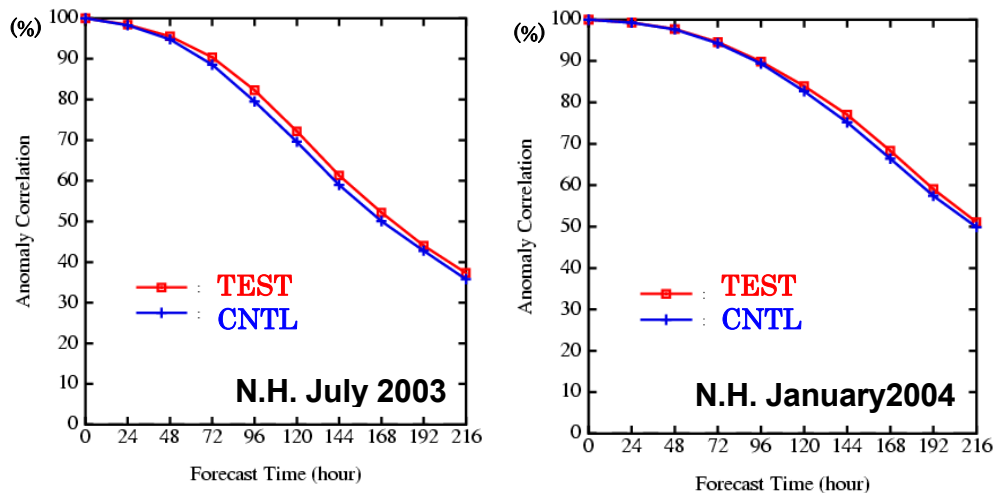


Figure 2. Anomaly correlation as a function of forecast time for the 500hPa geopotential height forecast in the Northern Hemisphere. Left panel shows that of July 2003 and right panel shows that of January 2004. The TEST (red) and the CNTL (blue) have been verified against their own analysis. The period is July 1-31, 2003 and January 1-31, 2004, respectively. The Northern Hemisphere is defined as the area north of 20 degrees.

Reference

Key, J. R., D. Santek, C.S. Velden, N. Bormann, J.-N. Thepaut, L.P. Riishojgaard, Y. Zhu, and W.P. Menzel, 2003: Cloud-drift and water vapor winds in the polar regions from MODIS. IEEE Transactions on Geoscience and Remote Sensing, 41(2), 482-492.