Assimilation of space based GPS occultation data for JMA GSM

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1 Introduction

Methods to assimilate GPS occultation data are being developed at JMA. The GPS occultation data have high potential to improve initial field of the Global Spectral Model (GSM). GPS radio occultation data have various merits. For example, the sensors for GPS radio occultation are calibration free, data are globally distributed with very high-density in the vertical direction. Assimilation experiments with space based GPS data have been conducted for GSM of JMA using 3D-Var and 4D-Var systems.

2 Methods

CHAMP (Satellite Mini-satellite Payload) data sets are provided through the Internet by GFZ (GeoForschungsZentrum Potsdam). There are various methods for GPS data assimilation, such as assimilating excess phase, bending angle, refractivity, temperature and specific humidity. Among them, refractivity and bending angle assimilation are examined to determine which method is more beneficial. We conducted three experiments of “Cntl”(without GPS), “TEST1”(with refractivity), “TEST2”(with bending angles), then we compared the forecast scores and computational costs of these experiments using JMA 3D-Var system. The experiments using 4D-Var system were also conducted based on results of the assessment.

3 Results

The period of the 3D-Var assimilation experiments is July 2002, and those of the 4D-Var assimilation experiments are August 2004 and January 2005. Figures 1 show difference of RMS error of geo-potential height between TEST1 and CNTL. Figures 2 are same as fugues 1 but compared with TEST2 and CNTL. These figures show little difference between TEST1 and TEST2, however bending angle assimilation has very high computational cost for our system. Taking into account this, the assimilation of refractivity is more effective for our system. As for refractivity assimilation using GSM 4D-Var system, forecast scorers of geo-potential height and temperature from 850hPa to 300hPa are improved in winter season. In summer season however, the forecast scores both in the Southern Hemisphere and in the Tropics become worse. These results may suggest a need for adjusting the observation errors properly in the Tropics and

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other areas.

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To develop bending angle assimilation codes, we referred the codes provided by Zou et al.(1998) and Matsumura et al. (1999). The CHAMP data are provided by GFZ.(Wickert et al 2000a) We appreciate them.

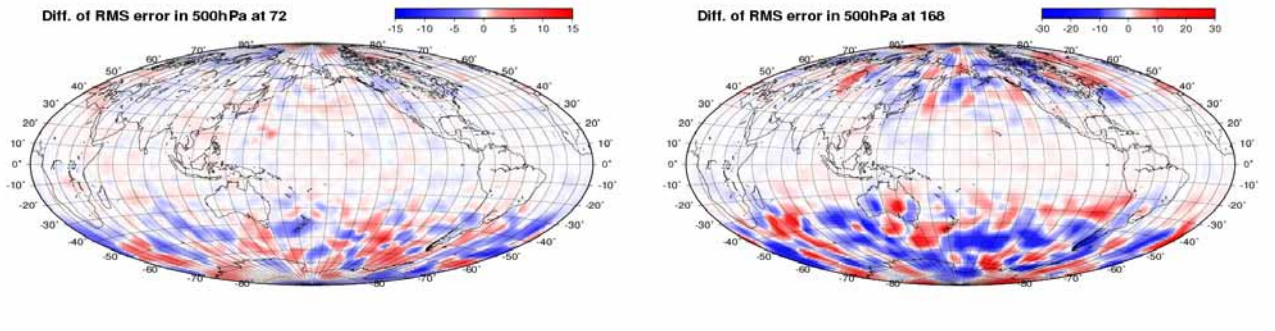

Fig.1 Difference RMS error of geo-potential height in 500hPa between TEST1 and CNTL using GSM 3D-Var system. Left figure shows FT=72. Right Figure shows FT=168. Blue and red means improved and deteriorated area of RMS error respectively (RMS_{TEST1}-RMS_{CNTL}).

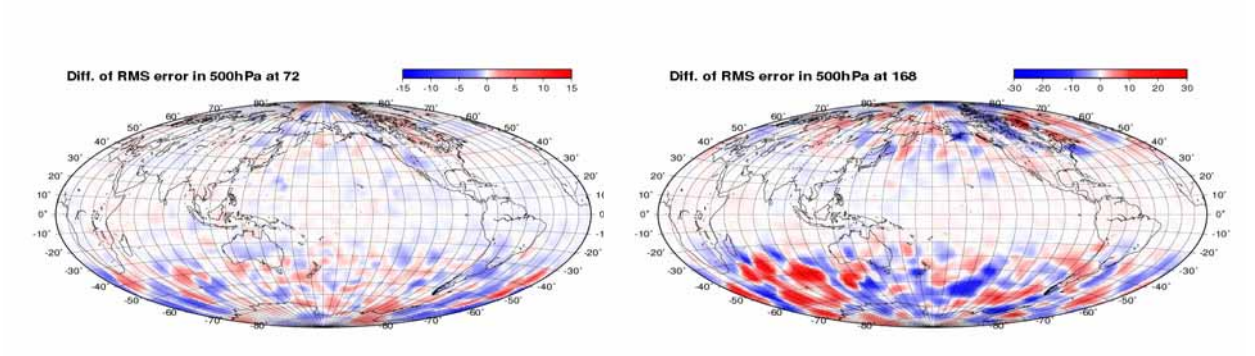

Fig.2 Same as Fig.1, but for TEST2(RMS_{TEST2}-RMS_{CNTL}).

Reference

Matsumura T., Jhon C. Derber, James G. Yoe, Francois Vandenberge, Xiaolei Zou(1999): The inclusion of GPS limb sounding data into NCEP's global data assimilation system, *NCEP office note*, **42.**

Wickert J. et al. (2000a), Atmosphere sounding by GPS radio occultation: First results from CHAMP, *Geophys. Res. Lett.*,28,**3263-3266.**

Zou, X., B. Wang, F. Vandenberghe, M.E.Gorbunov, Y.H.Kuo, S.Sokolovskiy, J.C.Chang and J.G.Sela (1998): Direct assimilation of GPS/MET refraction angle measurements PartⅡ: Variational assimilation using adjoint techniques. Submitted to *J.Geophys.Res.*.