A trial of the assimilation of CHAMP occultation data into the Global Spectral Model in JMA

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1 INTRODUCTION

GPS occultation data have a high potential to improve the initial field of global atmospheric prediction models. We are developing a method to assimilate GPS occultation data into the JMA-Global Spectral Model (GSM). This project is supported by the Special Coordination Funds for Promoting Science through the period from 2002 to 2004. In 2002, as a joint project between JMA and RASC, Kyoto Univ., we carried out the experiments to assimilate temperature-retrieved data of CHAMP into JMA 3D-Var global assimilation system which is utilized as an operational assimilation scheme for the GSM. As a result, a slight improvement appeared on the forecast skills on geopotential height and temperature in the Southern Hemisphere. In the meanwhile, NPD-JMA developed a ray trace scheme of microwaves including its Tangent Linear (TL) and Adjoint (AJ) operators in order to assimilate bending angle and refractivity observations directly. We referred Matsumura et al. (1999) to develop the source codes to be used in a series of the experiments. Recently, we have just started a preliminary direct assimilation experiment of the refractivity data retrieved from CHAMP.

2 ASSIMILATION OF REFRACTIVITY (RETRIEVED)

The Global Spectral Model (GSM) of JMA with reduced T106 resolution (about 120km) is used for the refractivity assimilation experiments. At the first step of the experiments, we estimated the spatial distribution of the atmospheric refractivity N by the following equation, applied to the first guess of the GSM atmosphere, which is compared to the observed value.

N=n1-1=c1P/T+c2e/T2,c1=77.6x10e-6,c2=0.373

Where n is a refractive index, P, T and e correspond to pressure, temperature and water vapor pressure respectively of the first guess at each grid point of the GSM atmosphere. To assimilate refractivity, we have to calculate the AJ of temperature and specific humidity from the departure of observed refractivity against the first guess values. Though it is relatively a simple method compared with that assimilating bending angles directly into prediction models, as a result, the forecast skills of temperature and geopotential height slightly improved in the Southern Hemisphere, while the score of the Northern Hemisphere became worse. Further investigation will be needed to clear the problems.

3 DIRECT ASSIMILATION OF BENDING ANGLES

We have been developing another scheme to assimilate bending angles as well as refractivity into the same model; GSM-T106 as mentioned above. We simulated ray tracing of microwaves to calculate bending angles in the model atmosphere to get departures of the observed values against the first guess of the GSM. Uncertainty of the observation is also considered in a proper way. Through these procedures, we have got a plausible distribution of the AJ of temperature and specific humidity after assimilating the observation of bending angle. We have also confirmed the smooth and rapid convergence of the cost functions in the variational assimilation process.

4 SUMMARY AND FUTURE PLANS

We have obtained reasonable structure of atmospheric increment field to assimilate the refractivity and bending angle observations respectively. One of the preliminary experiments of assimilating refractivity for July 2002 brought us a slight improvement in the forecast skills of geopotential height and temperature in the Southern Hemisphere, while the forecast skills of the Northern Hemisphere became rather worse. We need to further investigation. And we are also planning to start the experiments to assimilate bending angles directly into the 3D-variational assimilation system of the JMA-GSM. We would like to inform the progress of the ongoing and future experiments if opportunity permits.

REFERENCE

Matsumura T., J. C. Derber, J. G. Yoe, F. Vandenberge, X. Zou 1999: The inclusion of GPS limb sounding data into NCEP's global data assimilation system, NCEP office note, 426