ASSIMILATION EXPERIMENTS WITH GPS/MET REFRACTIVITY

Paul Poli* and Joanna Joiner
NASA Goddard Data Assimilation Office, * also at Météo France
ppoli@dao.gsfc.nasa.gov, jjoiner@dao.gsfc.nasa.gov

The Global Positioning System (GPS) represents a free source of stable electromagnetic L-band signals available for radio occultation purposes around our planet [*Kursinski et al.,* 1997]. The proof-of-concept GPS/MET experiment has collected observations of atmospheric refractivity in 1995-1997. These observations have been combined with a 6-hour forecast background in a one dimensional variational analysis (1DVAR) to yield profiles of atmospheric temperature and humidity [*Poli et al.,* 2001]. Comparisons with close radiosondes have shown that the 1DVAR retrieved profiles of temperature present smaller bias and standard deviation than the background information.

In order to perform an impact study of the GPS/MET refractivity data on a global circulation model, we use the Data Assimilation Office (DAO) state-of-the-art Finite Volume Data Assimilation System (FVDAS). The FVDAS is used to assimilate GPS/MET observations *via* the 1DVAR analysis.

The setup of the assimilation experiment is as follows. We use GPS/MET refractivity data from June 21st to July 4th, 1995 to perform GPS 1DVAR analyses using the latest available 6-hour forecast background. The GPS temperature retrievals are then assimilated like the other observation types (radiosondes, TOVS interactive retrievals) in the FVDAS using the Physical-space Statistical Analysis System (PSAS). The aim is to improve the analyzed state of the atmosphere before issuing the next 6-hour forecast. The run of the FVDAS for the two-week time period with this setup constitutes the assimilation experiment 'GPS'. As a comparison, we also ran one experiment without assimilating the GPS data ('CONTROL').

We then compare the results of the two runs 'CONTROL' and 'GPS' for the two-week time period. One way to assess the impact of the GPS observations is to look at differences between 6-hour forecasts and conventional observations. Smaller differences indicate that the GPS/MET observations help the forecast fit with independent observations. Figure 1 shows the standard deviation of such differences for the meridional wind measured by radiosondes in the Southern hemisphere. The 'GPS' run presents smaller differences than the 'CONTROL' run in the upper troposphere-lower stratosphere.

Another way to evaluate the impact of the GPS observations is to issue five-day forecasts from two different initial states. Looking at several days we find mixed results. Clearly, we need more GPS observations to fully assess the impact of the GPS refractivity on 5-day forecasts.

The assimilation experiments presented here used a limited number of observations (total of 797 profiles for a two-week time period). Current GPS missions (Champ, SAC-C) collect larger amounts of observations and we look forward to performing similar studies with these datasets.

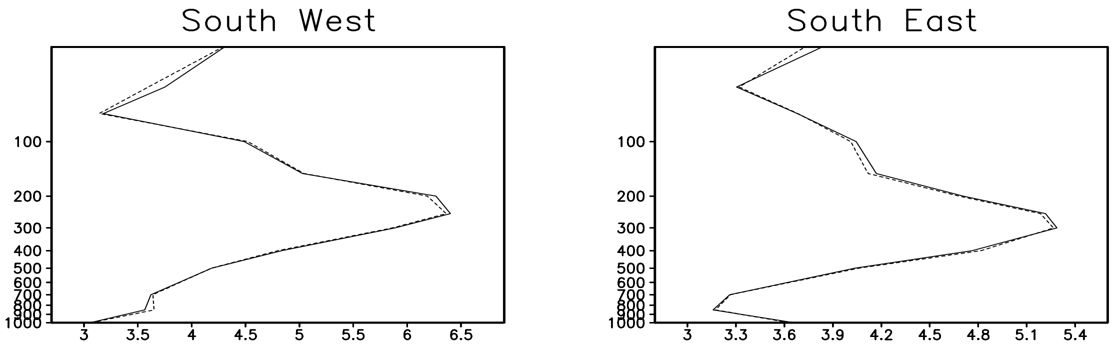

Figure 1: Standard deviation of differences between 6-hour forecast meridional wind and radiosonde observations, Southern hemisphere. Solid curve is 'CONTROL', line with dashes is 'GPS'.

Kursinski, E. R., G. A. Hajj, J. T. Schofield, R. P. Linfield, and K. R. Hardy, Observing Earth's atmosphere with radio occultation measurements using the global positioning system, *J. Geophys. Res. 102,* 23,429-23,465, 1997.

Poli, P., J. Joiner, and E. R. Kursinski, 1DVAR analysis of temperature and humidity using GPS radio occultation refractivity data, *Submitted to J. Geophys. Res.*, 2001.