Review of *Determination of zenith hydrostatic delays and the development of new global long-term GNSS-derived precipitable water vapor* by Wand, Zhang, Wu, He, Cheng and Li, AMT-2016-264

Overview

To derive precipitable water (PW) from GNSS zenith total delay (ZTD) data, an estimate of the zenith hydrostatic delay (ZHD) is needed at the location of the GNSS reciever antenna in order to obtain the zenith wet delay (ZWD) from which PW can be deduced. ZHD is easily deduced given the location of the GNSS receiver antenna and the pressure at the same location.

This short, but interesting paper address the problem that often no pressure sensor data are available at GNSS sites and consider two alternative sources of pressure estimates. One is the empirical Global Pressure and Temperature 2 wet model (GPT2w), the other numerical weather prediction re-analysis data in the form of ERA-Interim data at 6 hourly time resolution, 80 km horisontal resolution and 60 vertical levels. Based on offset statistics for 108 GNSS sites at which pressure sensor data are available, it is concluded ERA data are best. This is not surprising, given GPT2w is derived from ERA data and neglects the daily variations, but here are numbers to detail it in various ways. Further it is concluded that of the two, only ERA data are of sufficient quality to provide PW estimates of the quality necessary for climate monitoring on global scale, whereas GPT2w might be used in the tropics.

Obviously a more throughrough analysis could have been made doing this type of analysis for all sites with available pressure sensor data of decent quality, without restriction to GNSS sites. However, the number and distribution of sites included in this analysis is high enough to merit the conclusions.

Overall the paper is worthy of publication. A number of small issues which ought to be improved are listed in the detailed comments below.

Detailed comments

There is a mismatch between use of numbers and symbols in equations, like 4 and 5 versus 14 and 15. I recommend use of symbols throughout. List in the text which values you used for the symbols when you cranked out numbers.

Regarding equation 16 T_m is the inverse of the water vapour weighted inverse temperature. Is does not read well, but it is not the same as the water vapour weigthed mean of temperature. You also need to specify the coordinate system (pressure levels or height levels; is Pv_i halfway between top and bottum of gridbox in pressure space or height space?).

An analysis is provided of the pressure offset statistics as function of the altitude of the sites. I recommend to show instead (or also) the offset statistics as function of the absolute offset between the model altitude (GPT2w or ERA) versus the GNSS antenna altitude. The higher such offsets, the more the short commings due to model resolution, and of the interpolation/extrapolation methods on page 3 and 4, can be expected to show up.

It is difficult to read the global maps properly. When zooming in on a computer screen, one realizes that a significant part of the sites appear in a few site dense regions, the overall color of which are dominated by the symbols plotted last, on top of the other ones. Some sites may even not be visible. When different symbols are used, fig 5 and 6, it becomes even more difficult.

Consider turning most of the global maps into figures of the same type as figure 16, which is easy to read on an A4 printout. As an alternative consider to plot on the global maps the average for the sites for the regions in which the sites are not visible individually on the global maps at present.