Impact of mapping functions and a priori hydrostatic delays on GPS-derived vertical coordinates and wet zenith delays over Japan

Hiroshi Munekane (Geographical Survey Institute) munekane@gsi.go.jp Johannes Boehm (Vienna University of Technology)

EGU2009-2634

Introduction

Objective:

How will the choice of mapping functions/a priori hydrostatic delays affect the GPS-derived vertical coordinates and zenith wet delays (ZWDs) ?

Background:

Spurious subsidence in winter was found in the GPS-derived coordinate time series in the northern part of Japan that were obtained with the NMF mapping function/the GIPSY standard hydrostatic delays (Munekane et al., 2008).

Table 1 Mapping function/hydrostatic delay model

	Case 1	Case 2	Case 3	Case 4**
Mapping function	NMF	GMF	Gridded VMF1	JMF
Hydrostatic delay	GIPSY*	GPT	ECMWF	JMA

* A priori hydrostatic delay is given as ZHD = 1013 * exp(-0.000116*h) (m) where h is a station ellipsoidal height in m.

** Mapping function/hydrostatic delays are constructed using the Japan Meteorological Agency (JMA)' s mesoscale (10 km) model.

Conclusions

1. Spurious annual vertical deformations due to tropospheric delays are significantly reduced with the use of VMF1/ECMWF (Case 3)
   ➡ (Figs 1, 4).
2. The use of the locally optimized mapping function/hydrostatic delays (Case 4) results in marginal improvements of the GPS-derived vertical coordinates/ZWDs.
   ➡ (Figs 2, 3).
3. The GMF/GPT is sufficient for practical estimates of the vertical coordinates/ZWDs.
   ➡ (Figs 5, 6).

References

Munekane et al., GJI, 175, 831-836 (2008)

Numerical simulation

a) Simulated GPS data are generated with ray-traced tropospheric delays (Munekane et al., 2008).

b) Simulated GPS data are analyzed with GIPSY-OASIS II version 5.0 in PPP mode with four different combinations of mapping functions & a priori hydrostatic delays.

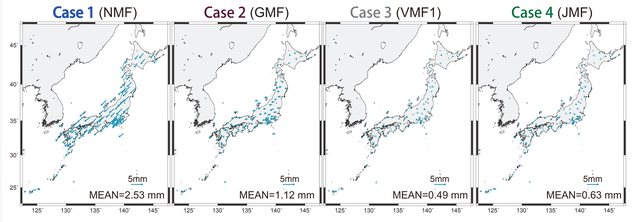

Fig. 1 Distribution of simulated annual vertical deformations. Arrows' angles clockwise from north correspond to DOY when deformations take maximum values.

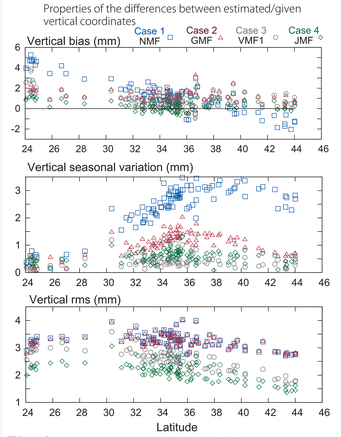

Fig. 2 Latitude dependence of the biases, seasonal variations and rms between the estimated/given vertical coordinates.

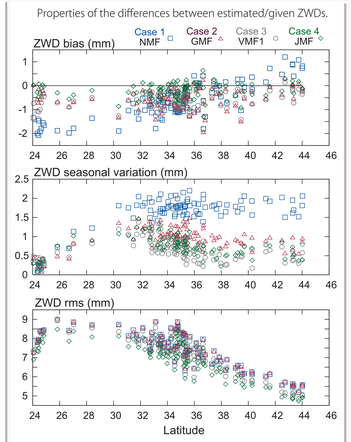

Fig. 3 Latitude dependence of the biases, seasonal variations and rms between the estimated/given ZWDs.

Observation

a) Observed GPS data are analyzed with GIPSY-OASIS II version 5.0 in PPP mode with four different combinations of mapping functions & a priori hydrostatic delays.

b) Resultant annual vertical deformations are corrected for atmospheric/oceanic loading deformations that were derived from GRACE data (Munekane et al., 2008).

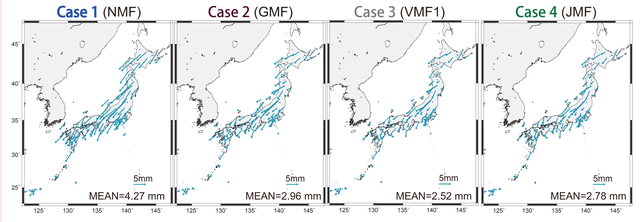

Fig. 4 Distribution of observed annual vertical deformations (after correction for atmospheric/oceanic loading deformations).

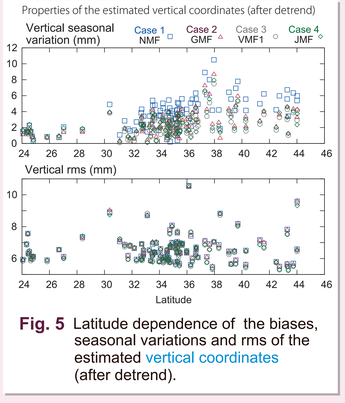

Fig. 5 Latitude dependence of the biases, seasonal variations and rms of the estimated vertical coordinates (after detrend).

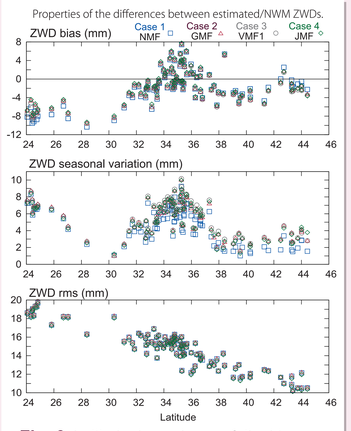

Fig. 6 Latitude dependence of the biases, seasonal variations and rms between the estimated/model-derived ZWDs.