

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 $ZHD = 1013 \cdot \exp(-0.000116 \cdot h)$ (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).

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.

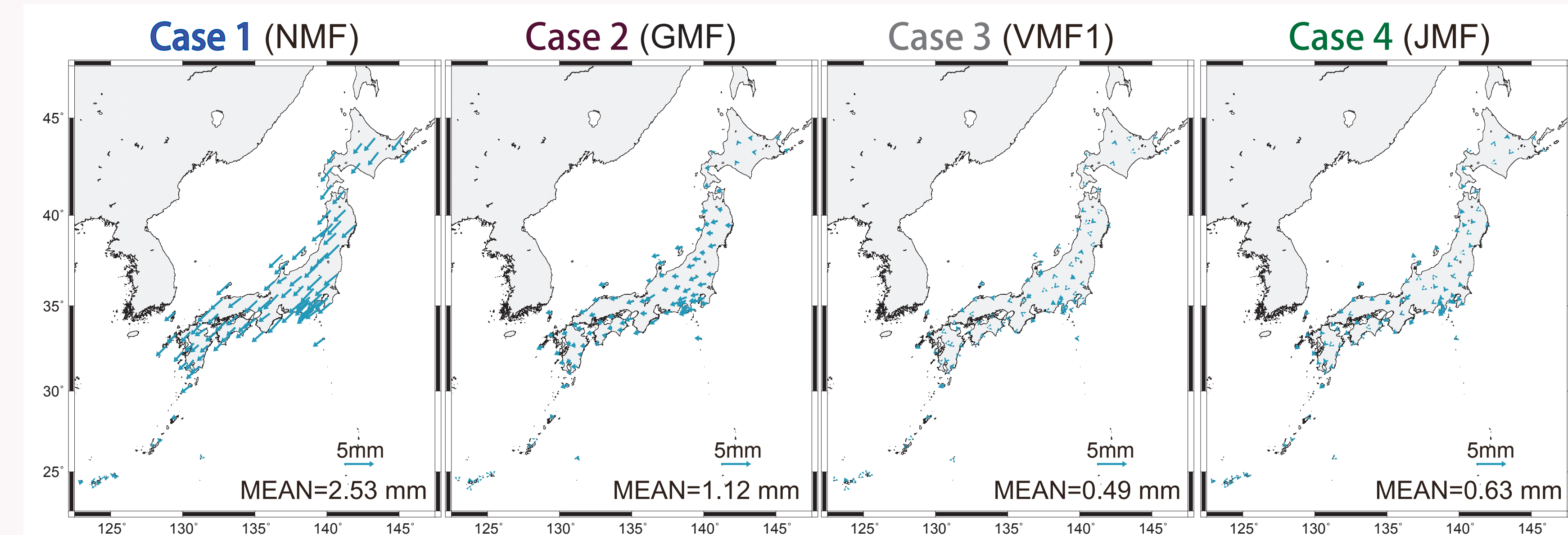


Fig. 1 Distribution of simulated annual vertical deformations. Arrows' angles clockwise from north correspond to DOY when deformations take maximum values.

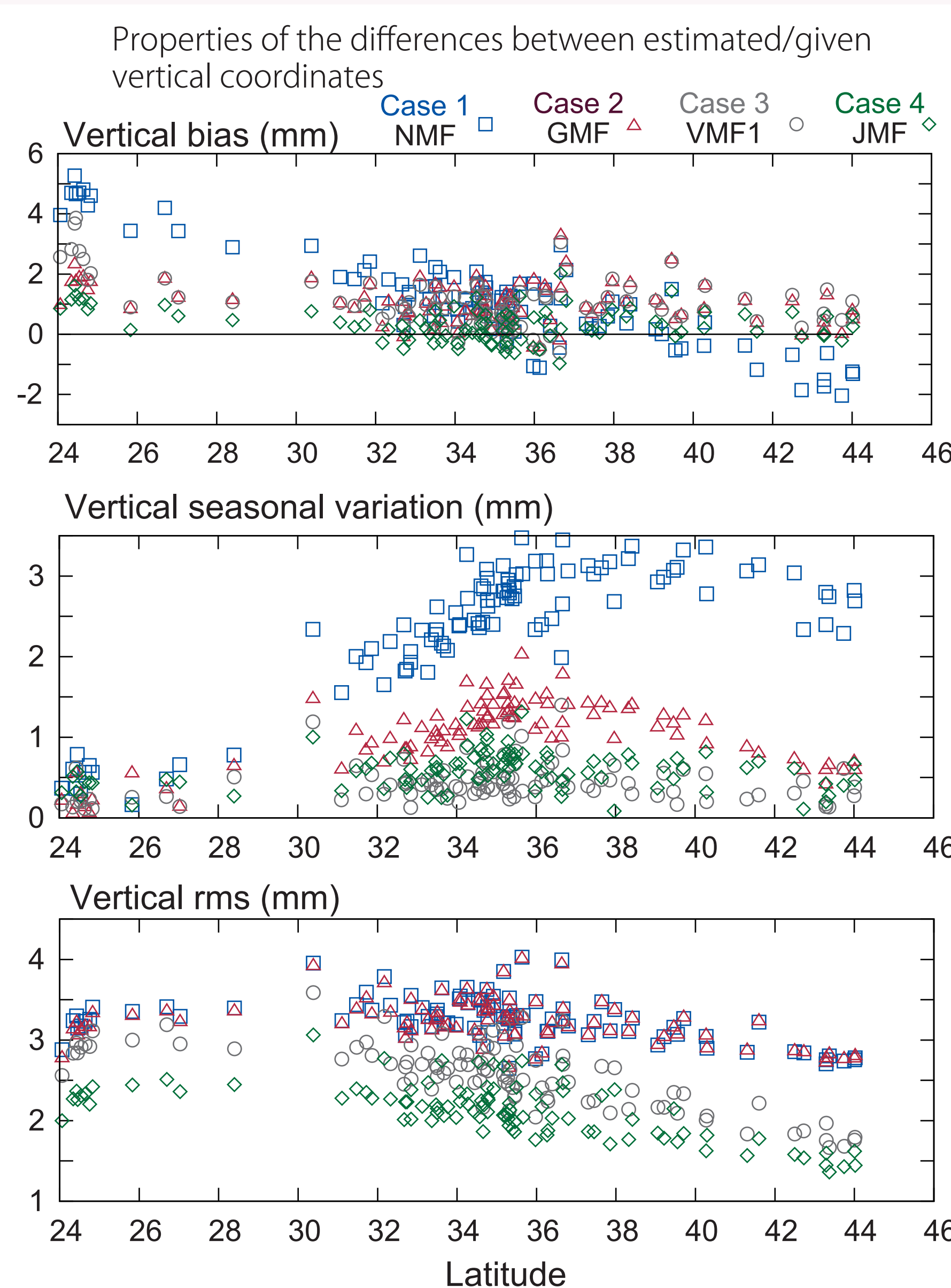


Fig. 2 Latitude dependence of the biases, seasonal variations and rms between the estimated/given vertical coordinates.

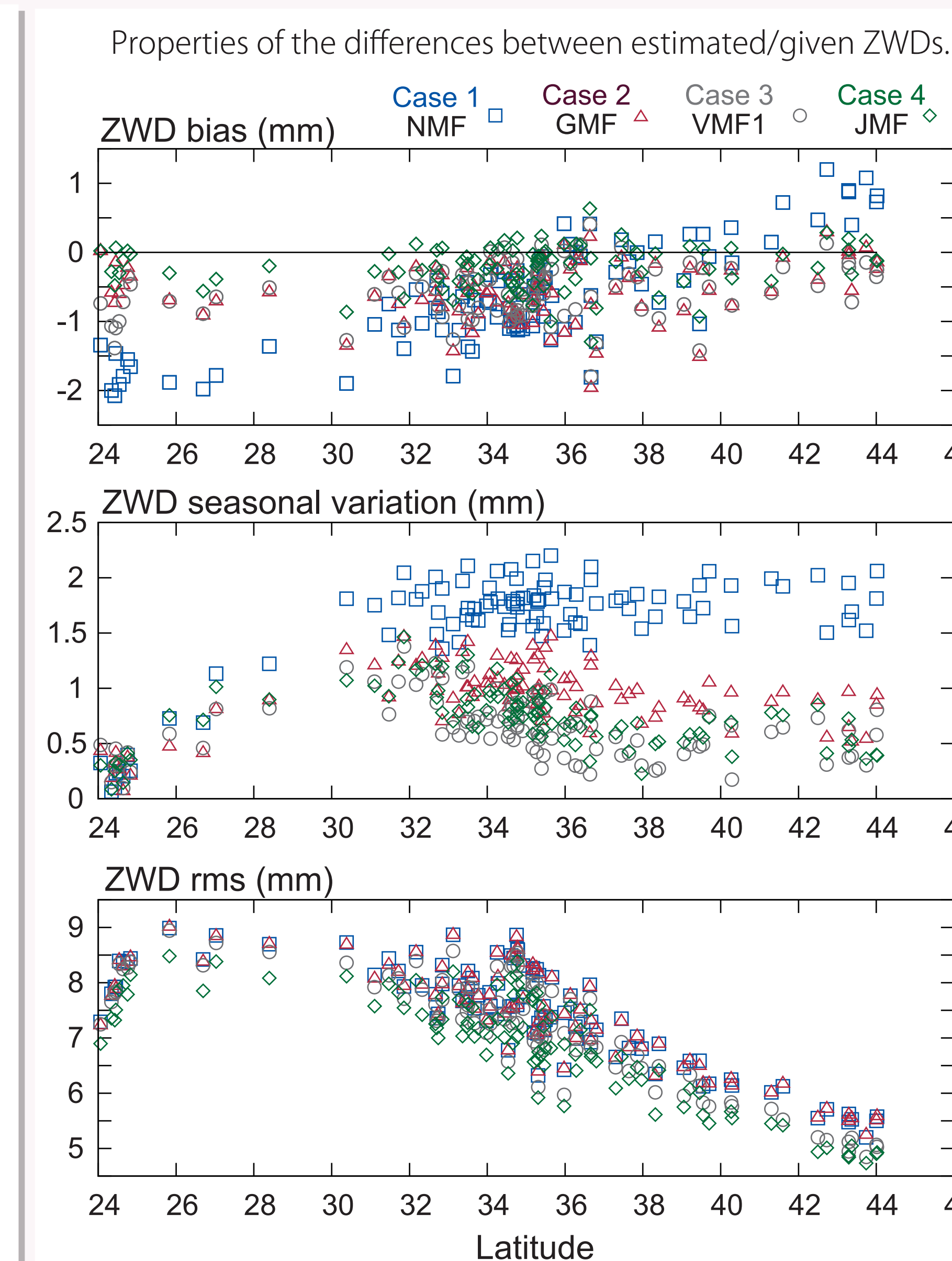


Fig. 3 Latitude dependence of the biases, seasonal variations and rms between the estimated/given ZWDs.

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).

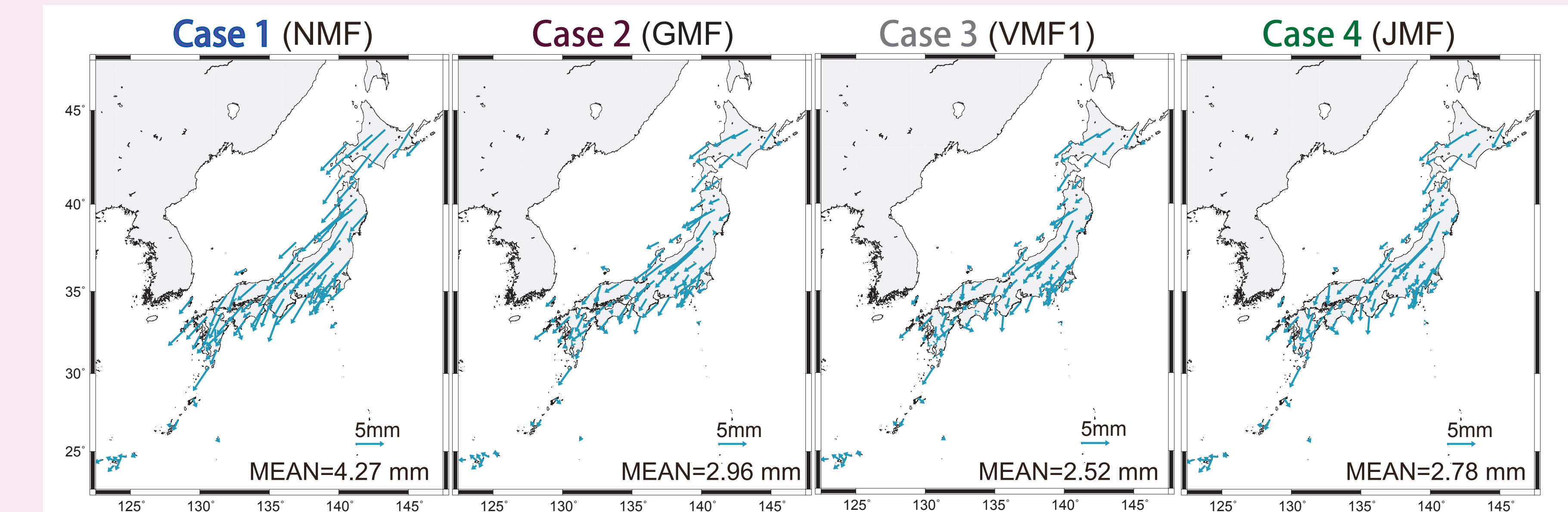


Fig. 4 Distribution of observed annual vertical deformations (after correction for atmospheric/oceanic loading deformations).

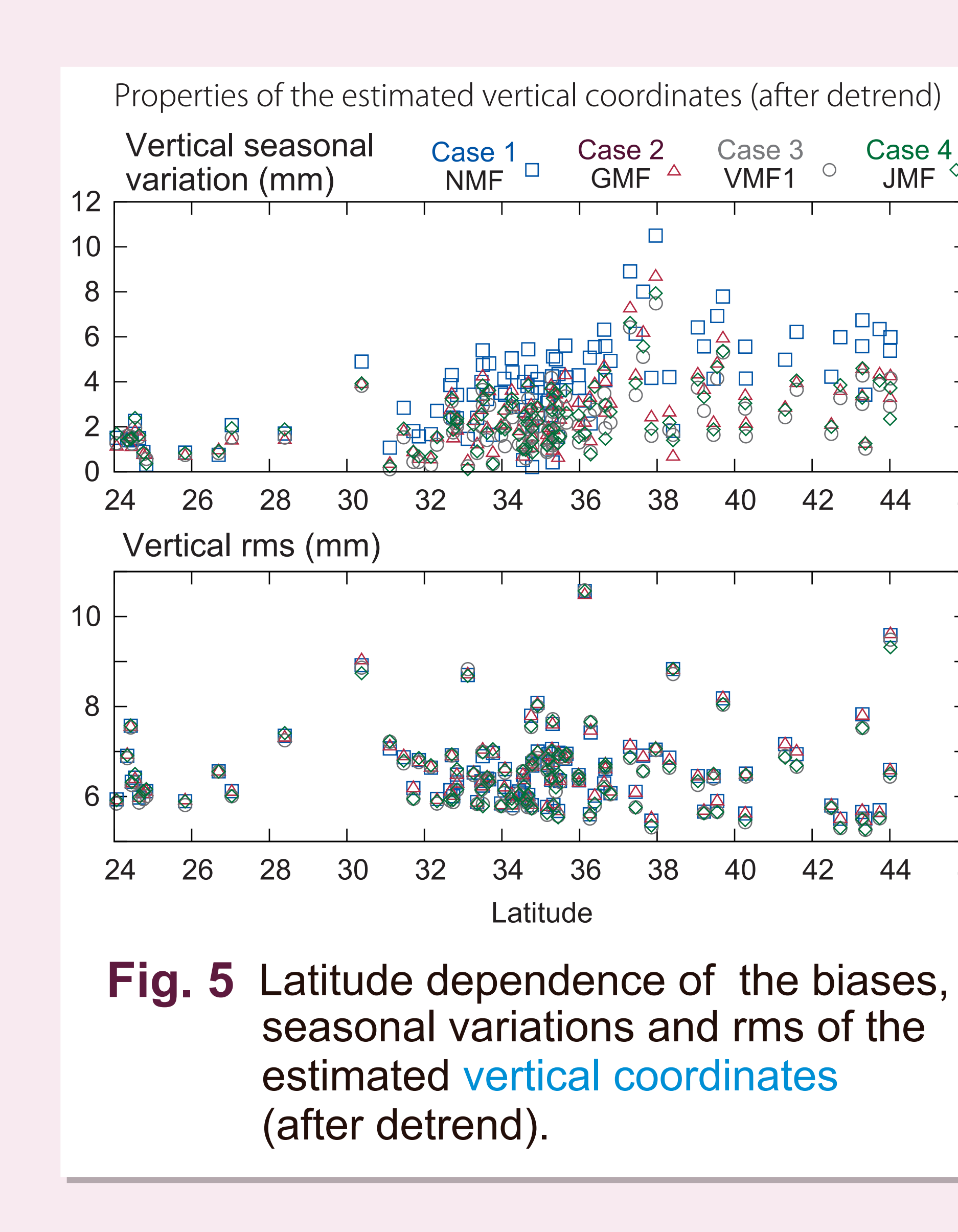


Fig. 5 Latitude dependence of the biases, seasonal variations and rms of the estimated vertical coordinates (after detrend).

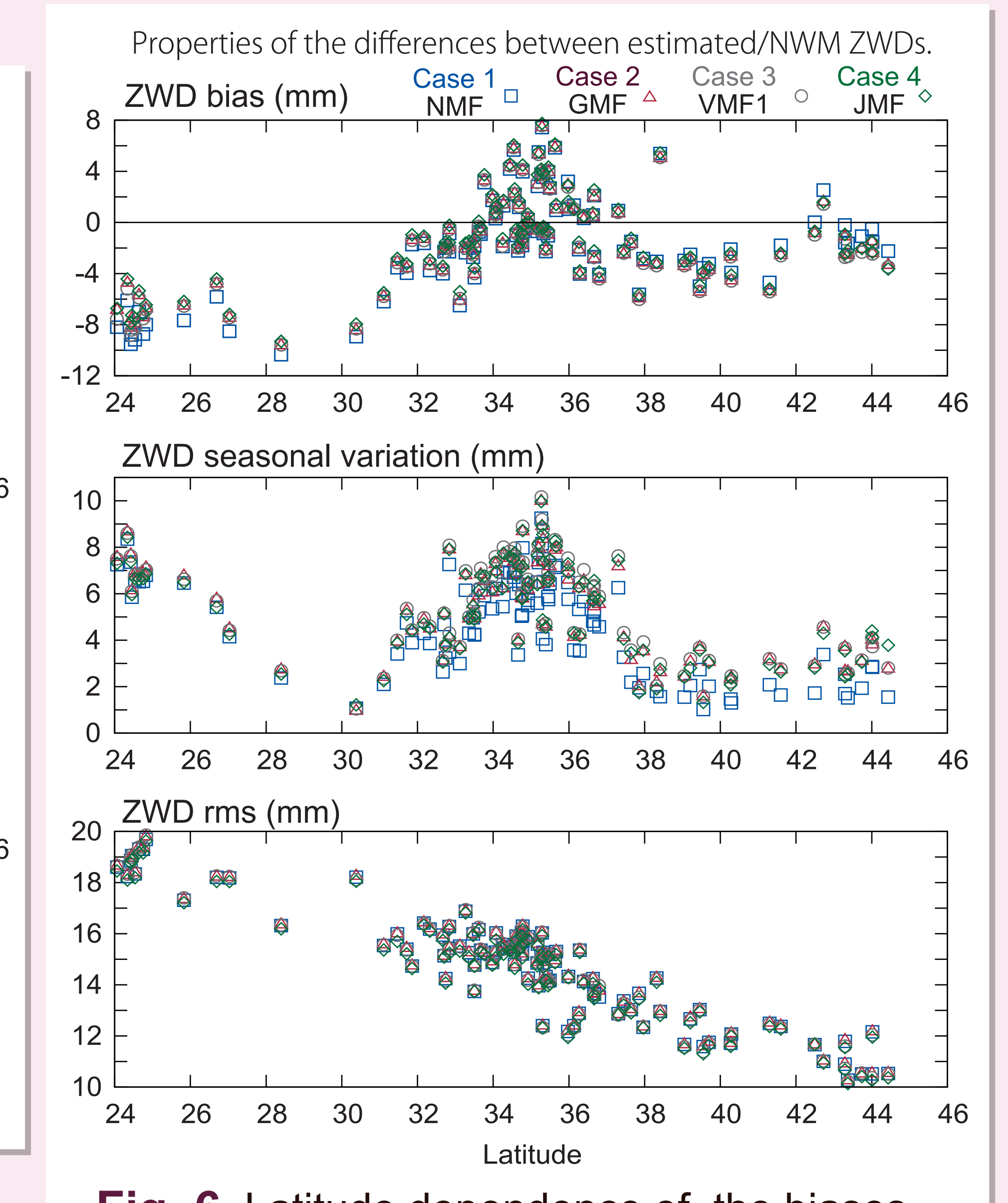


Fig. 6 Latitude dependence of the biases, seasonal variations and rms between the estimated/model-derived ZWDs.