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**BÜLENT ECEVİT
UNIVERSITY**

Determination of the Most Applicable Precipitable Water Vapour Model for Turkey using GNSS

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Outlines

- Introduction
- GNSS Meteorology
- Derivation of Regional T_m and Q_{BEU}
Models for Turkey
- Validation of Models
- Conclusions



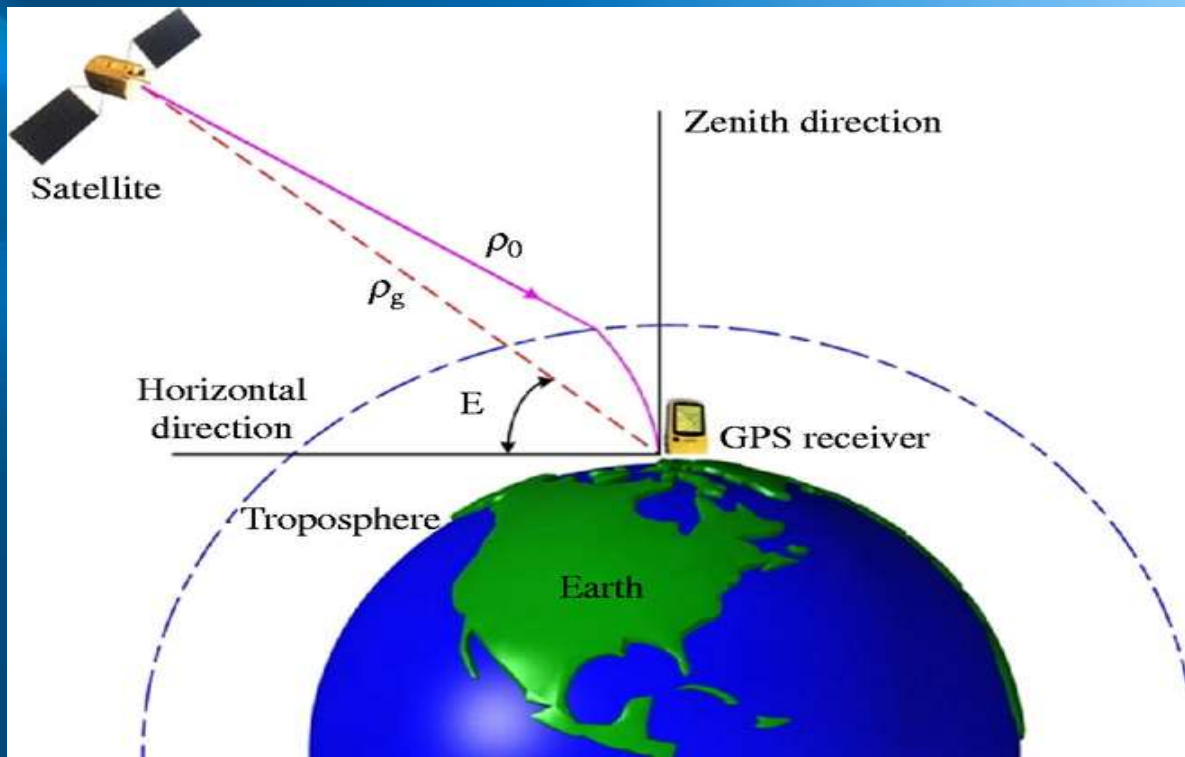
Introduction

- Atmospheric water vapor
 - important greenhouse gas
 - primary factor in the occurrence of weather events
 - an independent source for detecting climate changes

- Radiosondes



GNSS Meteorology



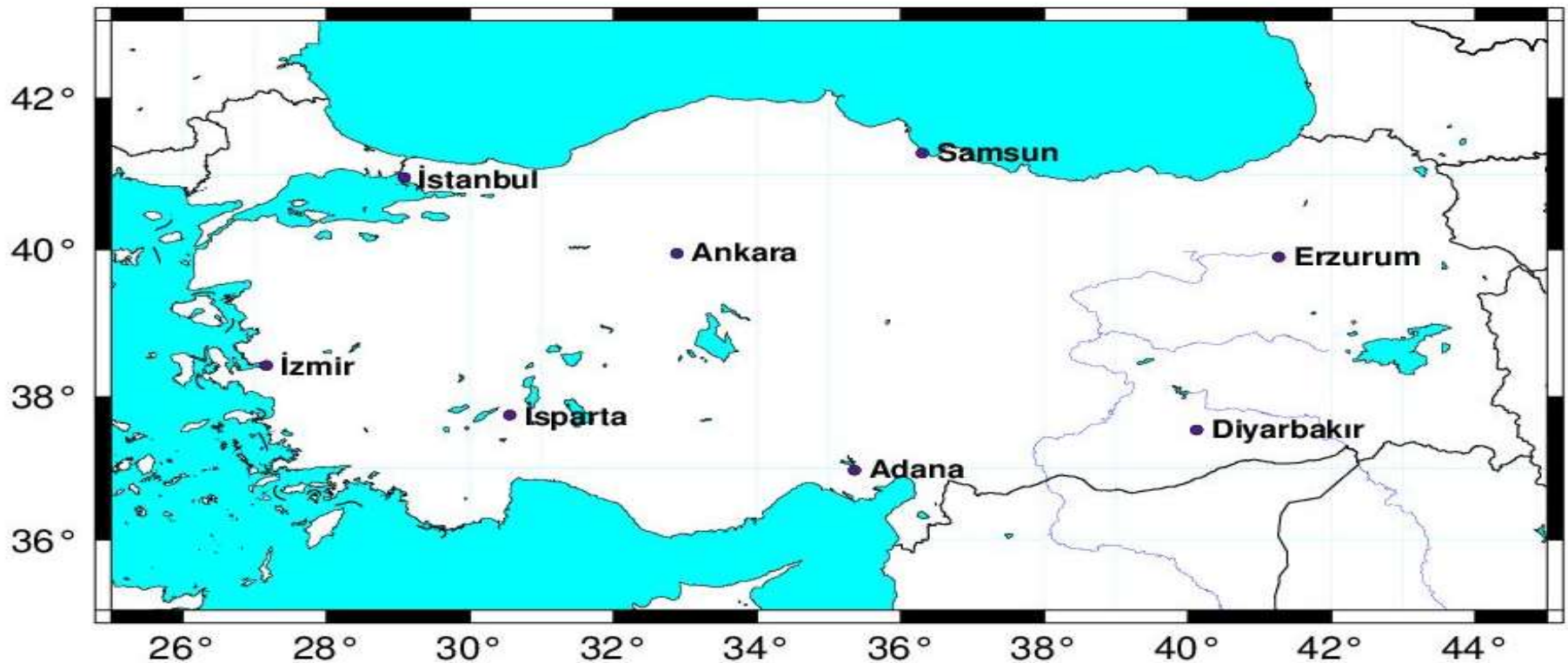
$$PWV = \frac{ZWD}{Q}$$

$$ZWD = ZTD - ZHD$$

$$Q = 0.0046 \left(\frac{373.900}{T_m} + 22.1 \right)$$



GNSS Meteorology



4,103 radiosonde profiles from 8 Turkish radiosonde stations are analyzed with the radiosonde analysis algorithm in the context of the “The Estimation of Atmospheric Water Vapour with GPS” Project which is funded by the Scientific and Technological Research Council of Turkey (TUBITAK) (Project No: 112Y350).



GNSS Meteorology

Temperature,
Pressure,
Humidity,
Dew point
temperature



Radiosonde
profile
analysis
algorithm



T_m ,
Q

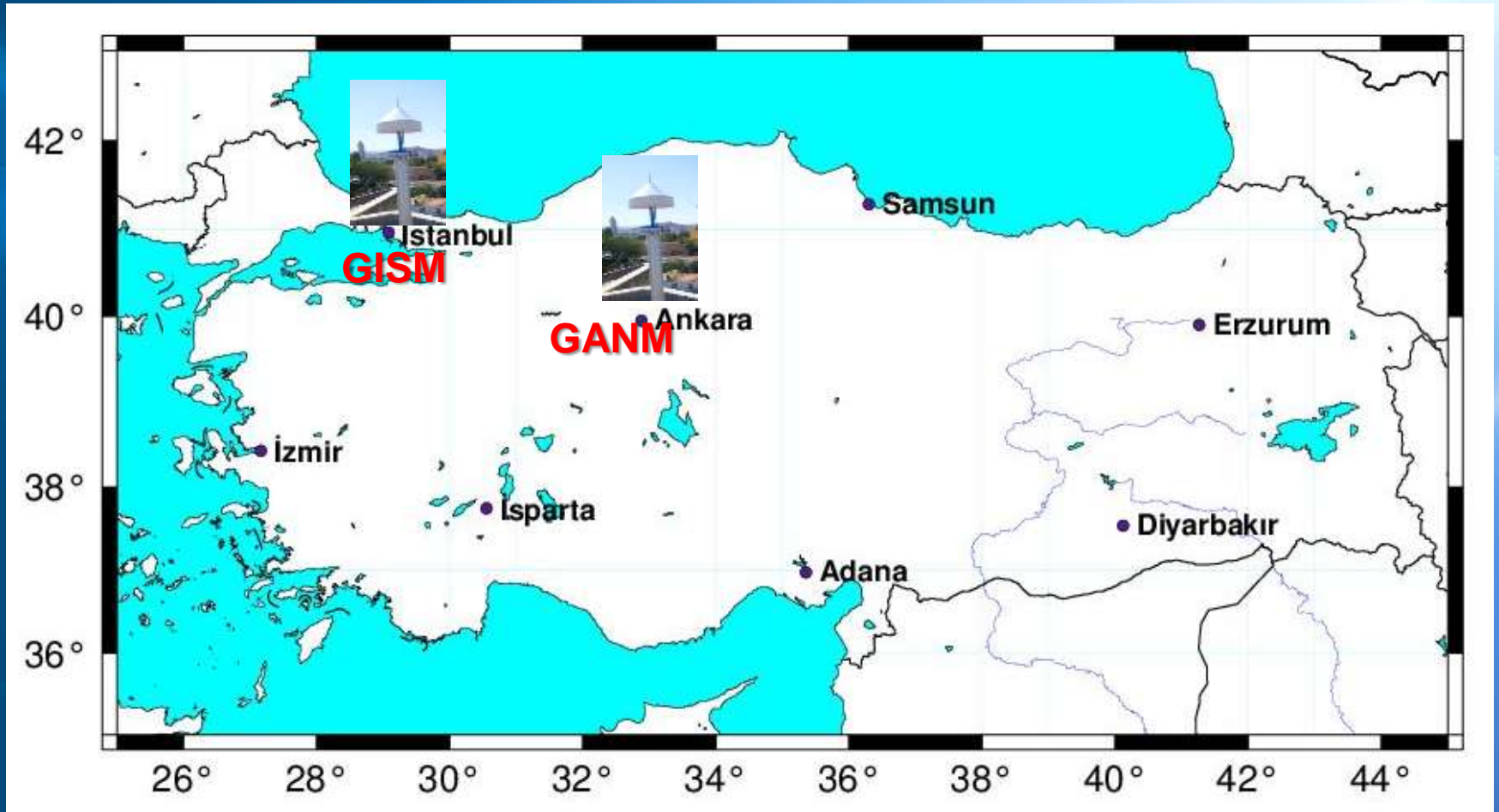


T_m and Q conversion models for Turkey:

$$T_m = 48,546 + 0,796 T_s$$

$$Q_{BEU} = [5.7053 - 0.0067 (T_s - 287.7620) + 0.0130 \theta + 0.0833 H + 0.0709 \sin\left(2\pi \frac{t_D}{365}\right) + 0.1195 \cos\left(2\pi \frac{t_D}{365}\right)]$$

Validation of Models



Validation of Models

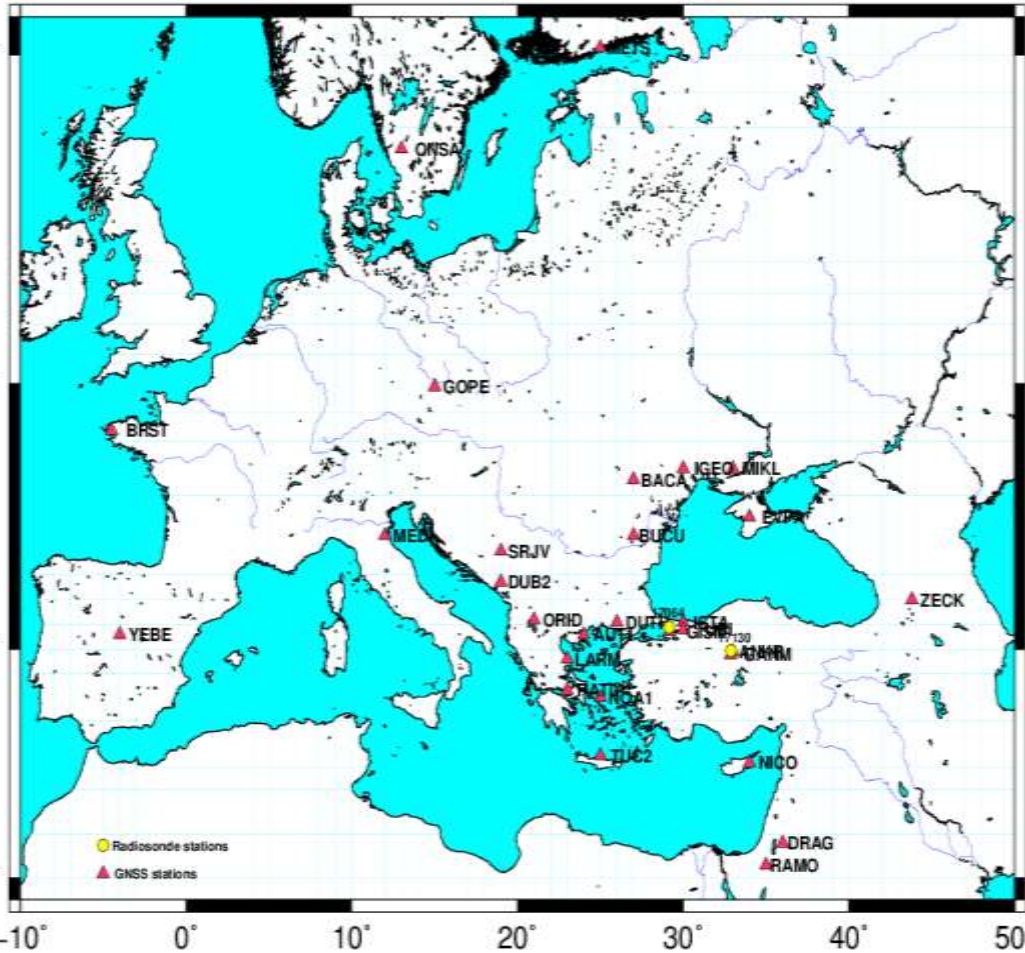
October 2013 - December 2014

GNSS and meteorological data

Bernese GNSS Software v5.0
and GAMIT/GLOBK

Total tropospheric delay

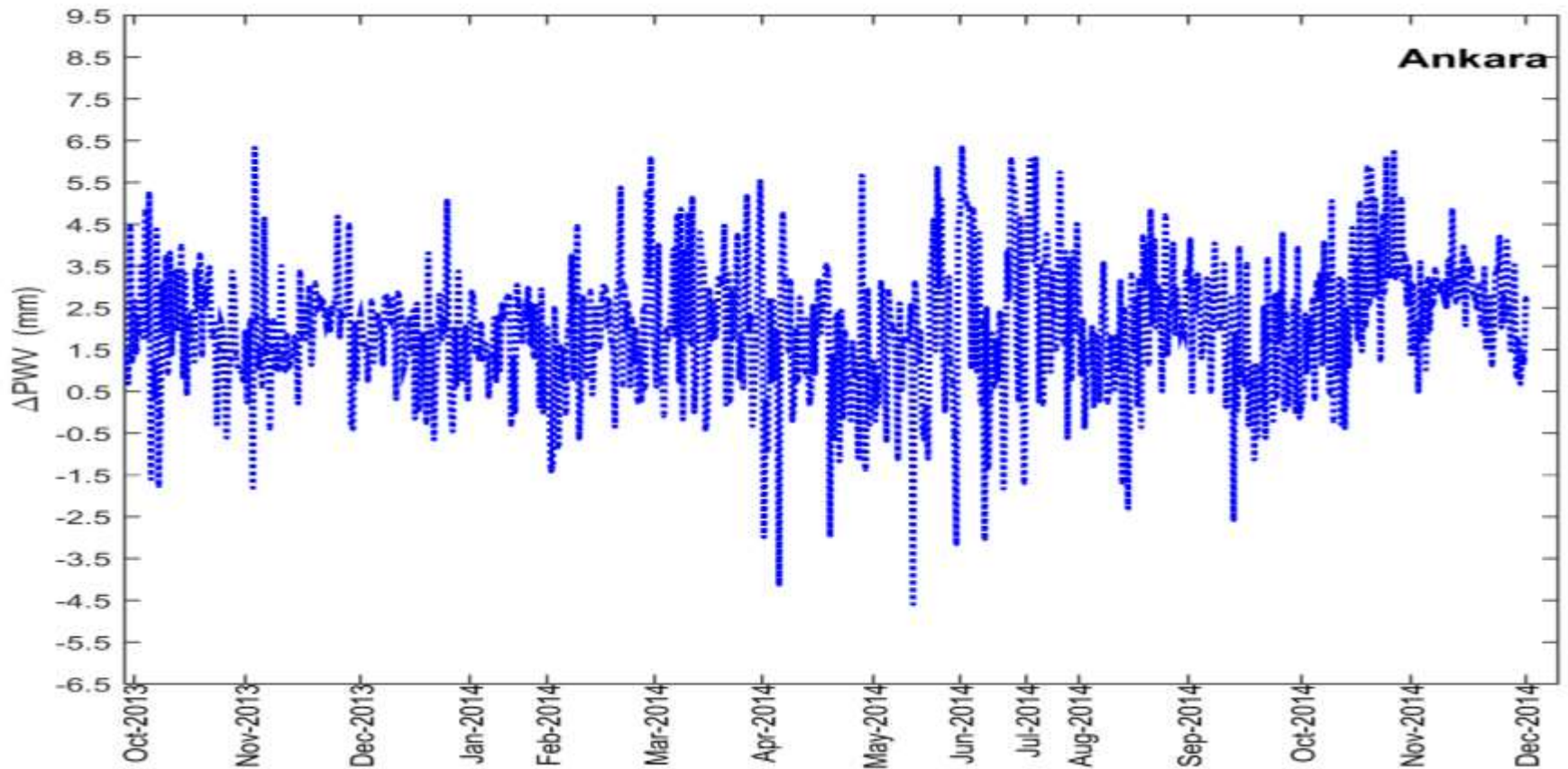
Water vapor with
the regional T_m and Q_{BEU} model



GNSS Network for PWV Estimation

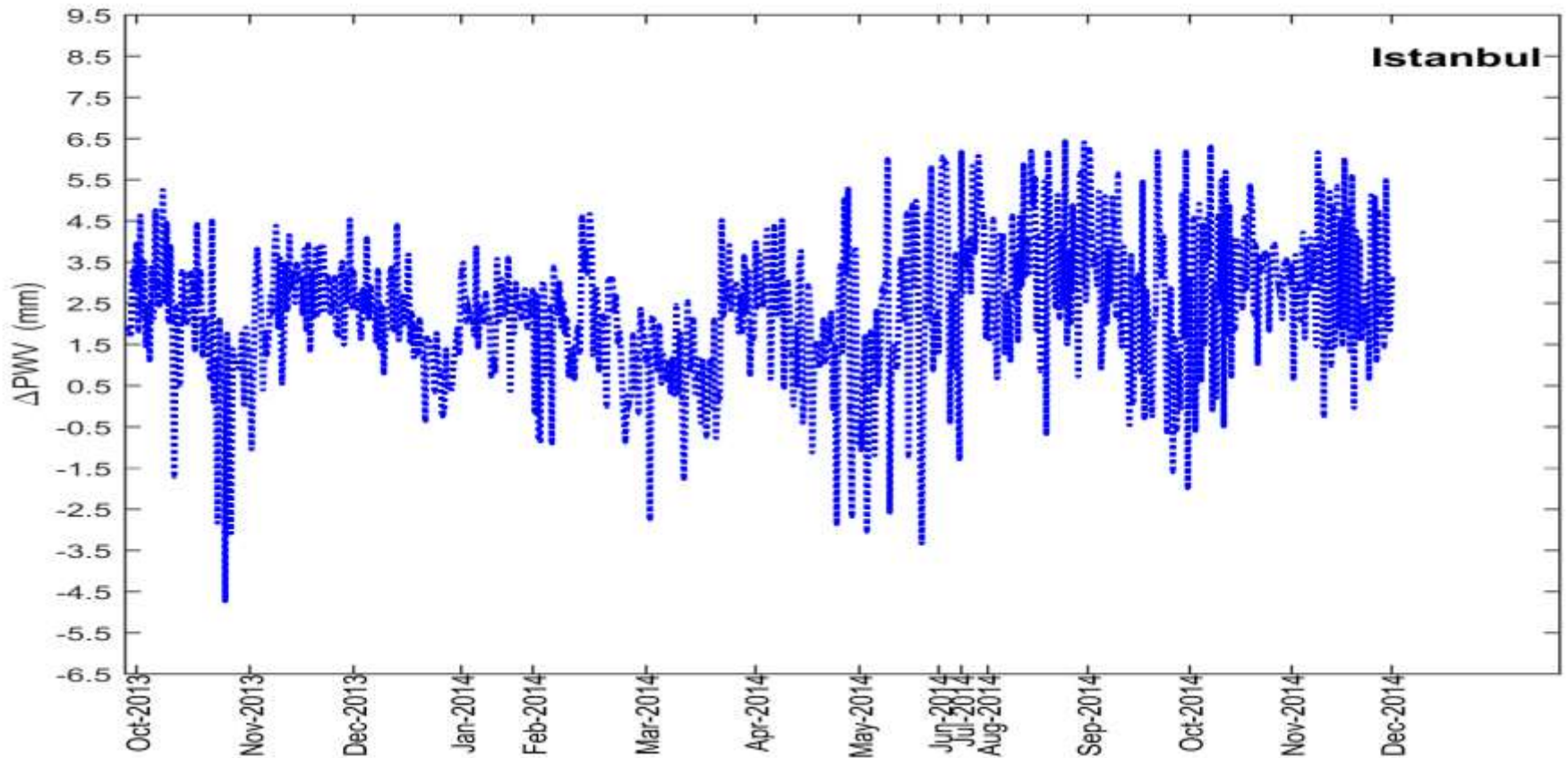
Validation of Models

The differences of PWV_{GNSS} derived using Bernese ZTD estimates and the annual T_m from PWV_{RS} at Ankara station



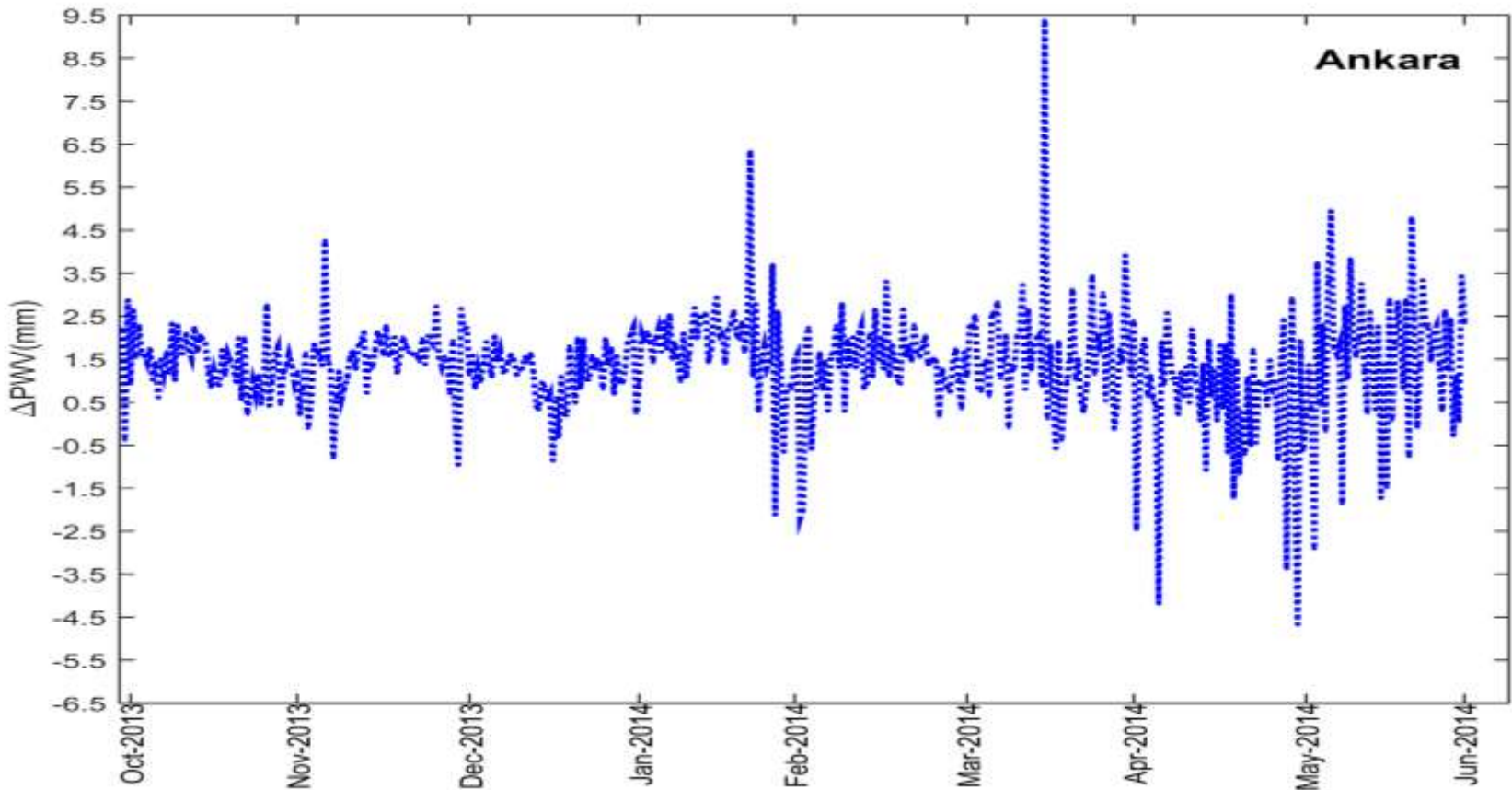
Validation of Models

The differences of PWV_{GNSS} derived using Bernese ZTD estimates and the annual T_m from PWV_{RS} at Istanbul station



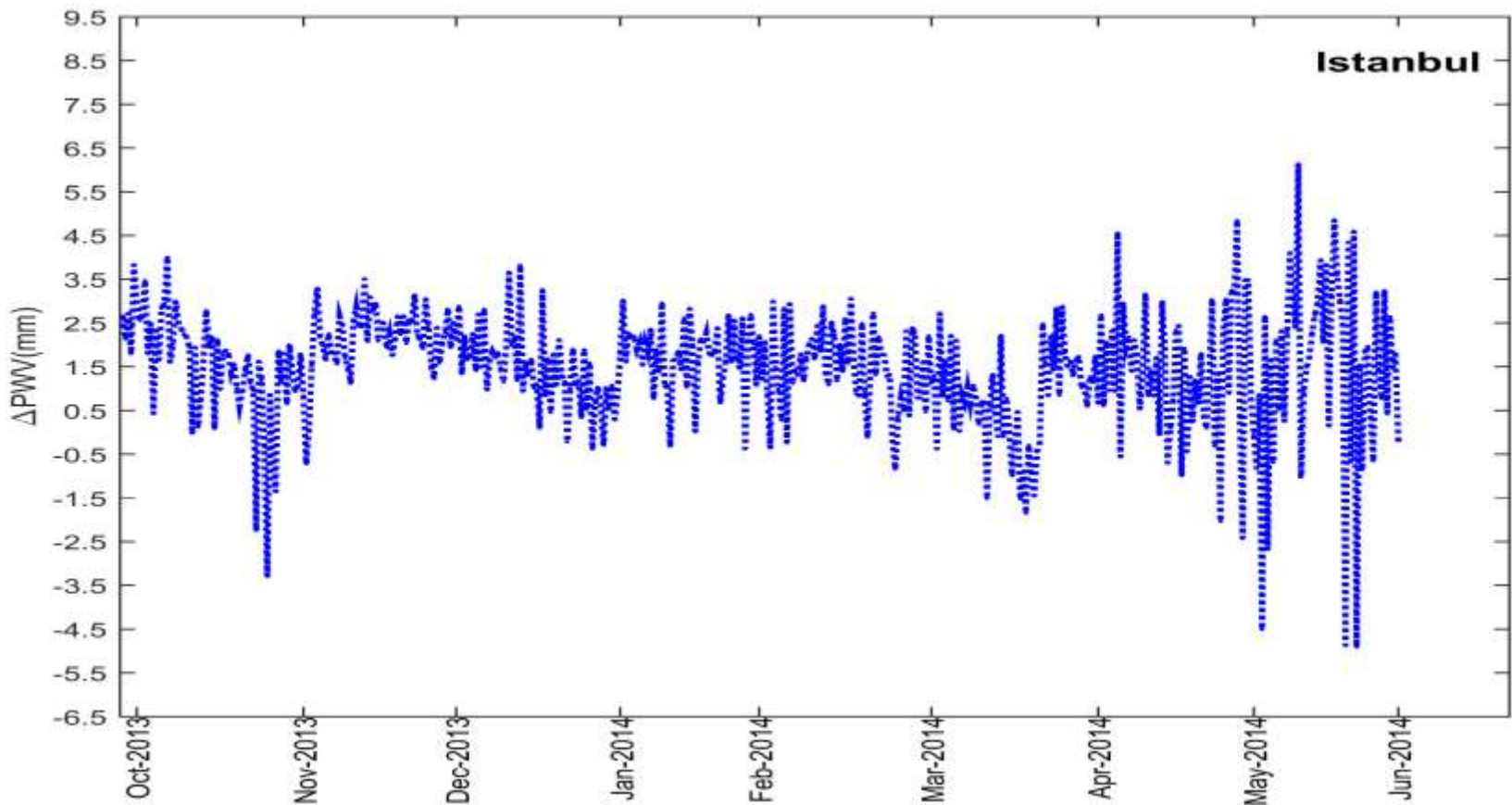
Validation of Models

The differences of PWV_{GNSS} derived using GAMIT ZTD estimates and the annual T_m from PWV_{RS} at Ankara station



Validation of Models

The differences of PWV_{GNSS} derived using GAMIT ZTD estimates and the annual T_m from PWV_{RS} at Istanbul station



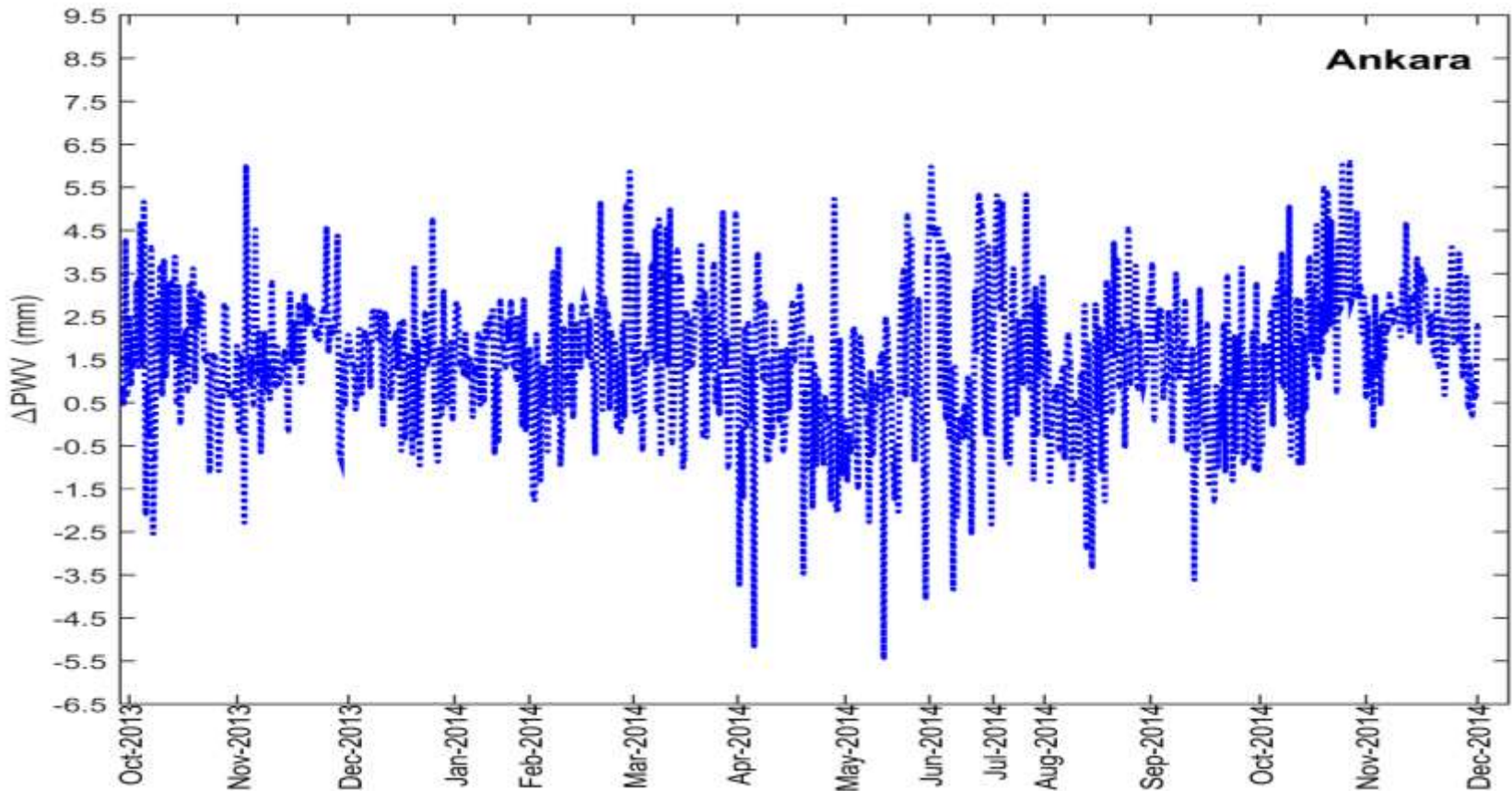
Validation of Models

The statistics of the comparison of PWV_{RS} and PWV_{GNSS} computed by applying the annual T_m model to the Bernese ZTD and GAMIT ZTD estimates

Processing software	GNSS station	min. (mm)	max. (mm)	mean (mm)	std. (mm)
Bernese	Ankara 743 profiles	-4,60	6,35	2,02	1,60
	Istanbul 671 profiles	-4,74	6,45	2,33	1,72
GAMIT	Ankara 484 profiles	-4,67	9,37	1,37	1,17
	Istanbul 460 profiles	-4,90	6,13	1,48	1,31

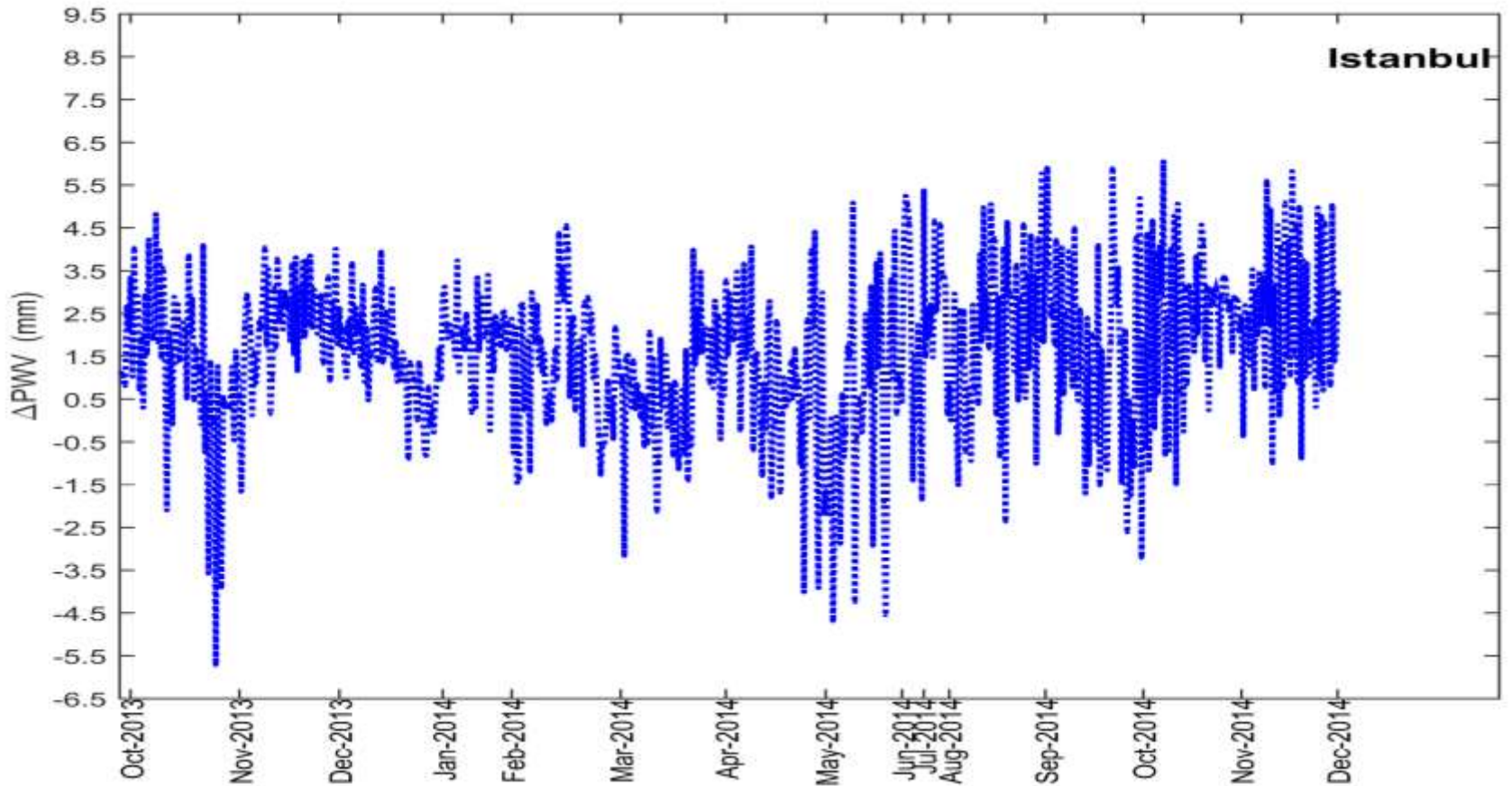
Validation of Models

The differences of PWV_{GNSS} derived using Bernese ZTD estimates and Q_{BEU} from PWV_{RS} at Ankara station



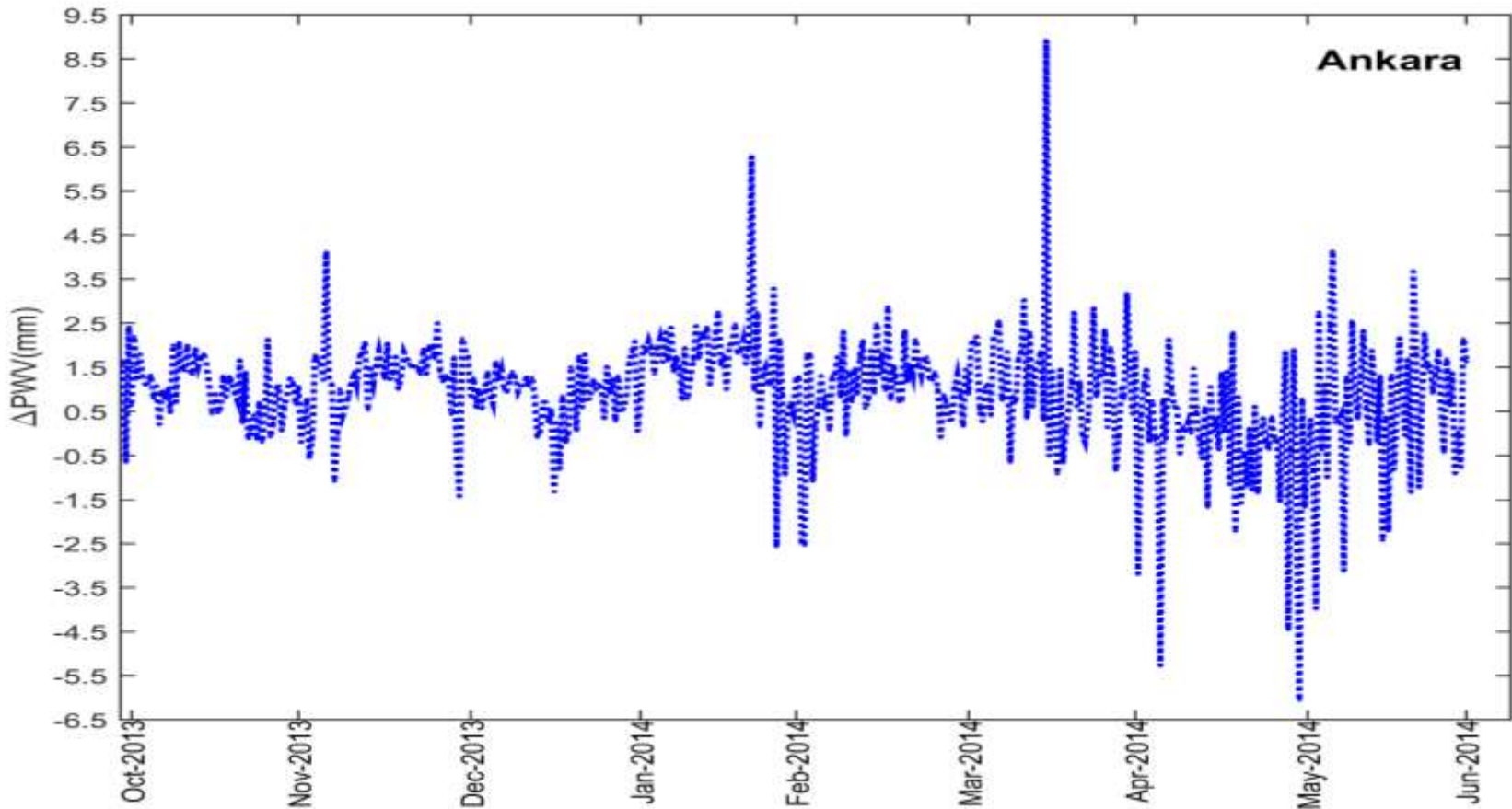
Validation of Models

The differences of PWV_{GNSS} derived using Bernese ZTD estimates and Q_{BEU} from PWV_{RS} at Istanbul station



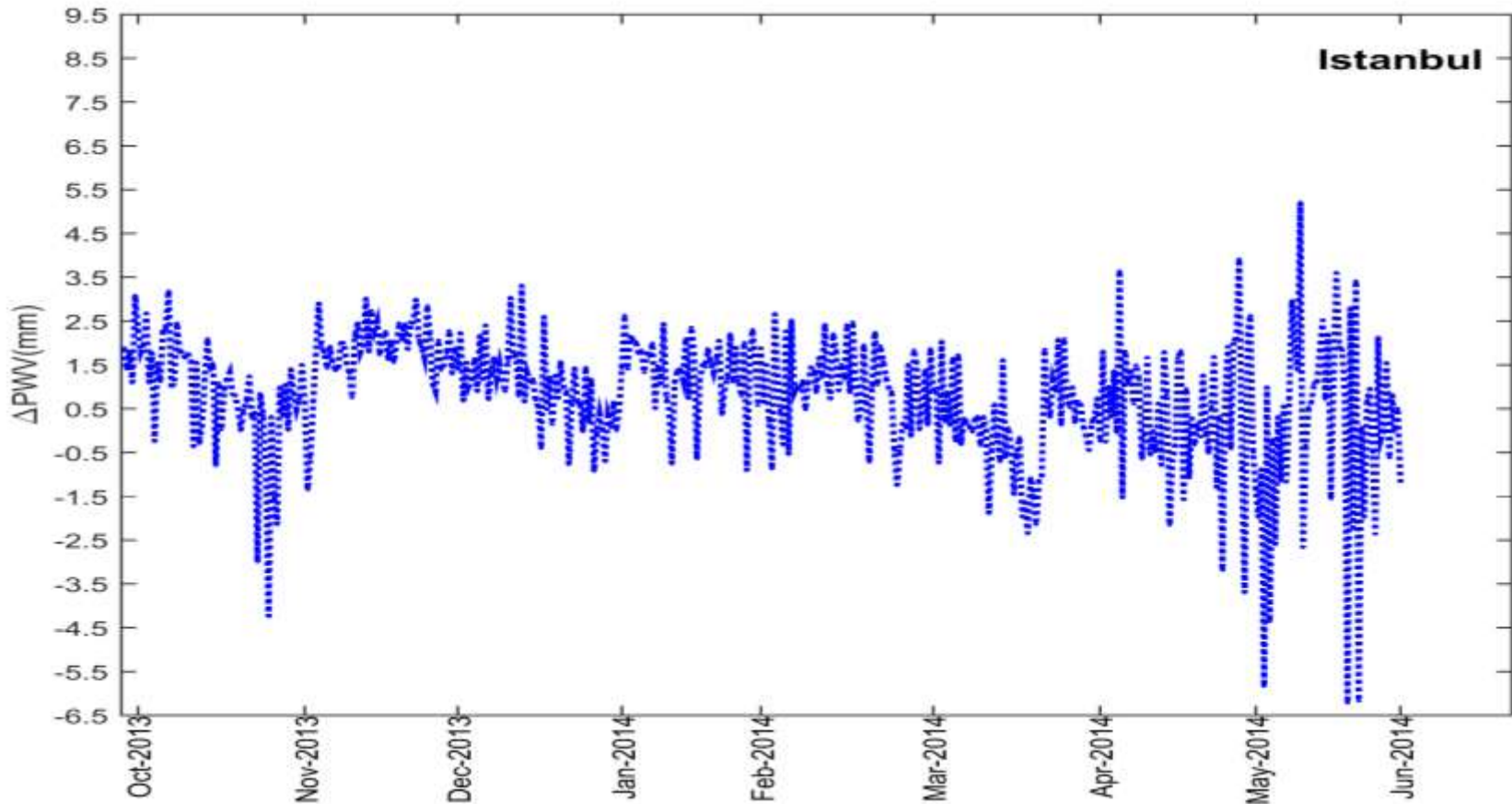
Validation of Models

The differences of PWV_{GNSS} derived using GAMIT ZTD estimates and Q_{BEU} from PWV_{RS} at Ankara station



Validation of Models

The differences of PWV_{GNSS} derived using GAMIT ZTD estimates and Q_{BEU} from PWV_{RS} at Istanbul station



Validation of Models

The statistics of the comparison of PWV_{RS} and PWV_{GNSS} computed by applying Q_{BEU} model to the Bernese ZTD and GAMIT ZTD estimates

Processing software	GNSS station	min. (mm)	max. (mm)	mean (mm)	std. (mm)
Bernese	Ankara 743 profiles	-5,44	6,09	1,52	1,71
	Istanbul 671 profiles	-5,72	6,07	1,59	1,78
GAMIT	Ankara 484 profiles	-6,05	8,92	0,92	1,24
	Istanbul 460 profiles	-6,21	5,20	0,82	1,38

Conclusions

- PWV_{GNSS} values computed applying T_m and Q_{BEU} models to the ZTD estimates derived by Bernese and GAMIT/GLOBK software at Istanbul and Ankara GNSS stations show high agreement with PWV_{RS} from October 2013 to December 2014.
- The differences of PWV_{GNSS} from PWV_{RS} results demonstrated that the annual T_m model is so close to Q_{BEU} and both models can be used in the determination of PWV.

THANK YOU...



Let's Meet in Istanbul

