Atmospheric loading detection using regional GNSS network: case study of Polish GBAS system

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Figure. The simplified scheme of mechanism of atmospheric loading

Introduction

The recent precision of satellite geodesy techniques allows to study subtle geodynamical phenomena. While the Earth crust cannot be regarded as rigid body anymore one has to deal with atmospheric loading (ATML) effects in GNSS results which can be as big as few centimetres for height component. In this work we examine the results of GNSS data collected within ASG-EUPOS system – Polish national GBAS. We computed height time series of nearly hundred GNSS sites for almost one year time span. For this purpose we used Bernese 5.0 processing package utilizing the most recent models and IGS products. The coordinate variations were checked against the modelled atmospheric loading. We used the freely available data set provided by Leonid Petrov as well our own calculation. Our values were computed on the base of crustal properties (in terms of Greens functions) convolved along with global pressure field extracted from numerical weather models. We found an overall good agreement for height component was found while for the horizontal component comparison is ambiguous. The distinct diminish of height time series is clear for majority of selected sites when ATML correction were applied. At some sites we do not see significant reduction of variance which can be even more robust indicator of site specific noise level then before applying ATML correction. This allows to easy pinpoint the problematic sites. We also put a discussion of some problems of evaluating the global geodynamic signals in regional network. Some discrepancies between modelled and observed ATML can be attributed to the shortcomings of processing network with limited spatial coverage. Nevertheless this problem await for further investigations.

GNSS network

Figure. GNSS network used in this study. More than 120 stations were processed.

GNSS Data Processing

Table. GNSS data processing

Feature	Value
Software	Bernese GPS Software ver. 5.0
Orbits and ERPs	IGS
Elevation mask	5°
Satellite system	GPS
Ambiguity resolution	SIGMA L1&L2 ($L \leq 20$ km) SIGMA L5/L3 ($20 < L \leq 200$ km) QIF ($L > 200$ km)
Troposphere *a priori* model	Saastamoinen + NMF, dry part
Mapping function for corrections	wet NMF
Interval for troposphere parameters	1 hour
Tropo. horizontal gradients	yes
Ionosphere model	CODE global
Phase center offsets and variations	absolute (IGS05) + individual EPN
Reference frame	IGS05
Reference frame realization	NNT minimum constraints

General data information

Atmospheric loading

Table. Atmospheric loading datasets

Data set	Details
BOY (Jean Paul Boy)	A new and improved loading service for precise geodetic observations http://loading.u-strasbg.fr/
PET (Leonid Petrov)	Atmospheric pressure loading service http://gemini.gsfc.nasa.gov/aplo/
WUT (this study)	Surface pressure data from NCEP Reanalysis,

ATML comparison

Figure. Comparison of different ATML data sets for JOZE site

ATML comparison cont.

Figure. Comparison of different ATML data sets. Standard deviation of centred differences (above) and correlation coefficient (below) for subsequent pairs for all processed stations

Admittance factor

Figure. STD of ATML and admittance factors computed from ATML and NCEP surface pressure value (left). An exemple of regrresion of local atmospheric pressure with ATML for JOZE site

Comparison with GNSS results

Figure. An examples of good correlation between GPS and ATML time series

(No) improvement

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