Hydrostatic and wet signal delays calculated from a network of 23 GNSS stations in northwestern Argentina between 2010-2021

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1. Licence

2. Citation

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3. Data Description

This dataset provides information about the hydrostatic and wet signal delays from a network of 23 GNSS stations in northwestern Argentina between 2010-2021. It is based on Global Navigation Satellite System (GNSS) remote sensing techniques for the estimation of the atmospheric total delay and its gradients. Additionally, the hydrostatic counterpart and its gradients were calculated from the ERA5 dataset of the European Centre for Medium-Range Weather Forecasts (ECMWF) [1] with ray-tracing algorithms. The wet delays, as well as their gradients, were calculated by subtracting the hydrostatic fraction from the total proportion. Lastly, the wet signal delays were also computed using solely the ERA5 dataset.

3.1. Sampling method

The GNSS data are provided by independent institutions. The University of Potsdam (UP) and the GFZ installed and maintained the CAFJ and PUNJ stations, with the GFZ being in charge of processing them. UNAVCO [2-14] and Argentina's National Geographic Institute (Instituto Geográfico Nacional - IGN) [15] deployed the other stations. These data were analyzed by the Nevada Geodetic Laboratory (NGL) [16].

Meteorological information was obtained from the ERA5 hourly data on pressure levels from 1979 to 2021 [1], using the native temporal and spatial resolution (0.25°).

3.2. Analytical procedure

The GNSS software provided the Slant Total Delays (STDs), which consists of the hydrostatic and wet counterparts. Considering that the focus is on the signal delays to the zenith direction (Zenith Hydrostatic and Wet Delay – ZHD and ZWD), the STDs were projected to the vertical with the use of mapping functions. Moreover, the azimuthal asymmetry of the atmosphere was considered for the improvement of the results. The observation equation of the STDs is provided by Kačmařík *et al.* [17] as follows:

$$S_{total} = m_{dry}Z_{dry} + m_{wet}Z_{wet} + m_{grad}(G_{NS}\cos(a) + G_{EW}\sin(a))$$

where:

a	azimuth
Z_{dry}, Z_{wet}	Zenith Hydrostatic and Wet Delay
m_{dry}, m_{wet}	mapping functions for the dry and wet component
m_{grad}	mapping function of the gradient parts
G_{NS}, G_{EW}	gradients in the N-S and E-W directions

The ZHDs are very stable, and they were calculated from the ERA5 dataset [1] with ray-tracing algorithms. Thus, the unknown parameters of this equation are the ZWD (Z_{wet}) and the gradients of the Zenith Total Delay (G_{NS} and G_{EW}), which were estimated in a least-squares adjustment by observing multiple same-epoch measurements at different elevation angles and azimuths. In addition, ray tracing was utilized for the estimation of the gradients of the ZHDs, as well as the corresponding information about the wet delays. The prior was used for the calculation of the gradients of the ZWDs from a GNSS-ray tracing approach. The latter is used for comparison because the calculation of the wet delays of the atmosphere from reanalysis data is not a conventional approach. Lastly, the integrated water vapour was derived from the ZWDs using the equations described by Bevis *et al.* [18]

4. File description

4.1. File inventory

Each station is identified by a four-characters abbreviation, and the corresponding time serries are stored in the homonym tab-delimited "*.txt" file. The coordinates of the stations are found in the table below.

Station Name	Latitude	Longitude	Height (m)	Source	Analysis Centre
ABRA	22°43’19.32"S	65°41’50.31"W	3530.1	IGN	NGL
ALUM	27°19’24.33"S	66°35’47.86"W	2736.94	IGN	NGL
CAFJ	26°10’51.22"S	65°52’49.17"W	1702.36	UP/GFZ	GFZ
CATA	28°28’15.54"S	65°46’26.83"W	547.15	IGN	NGL
CBAA	22°44’46.92"S	68°26’53.33"W	3514.84	UNAVCO	NGL
CJNT	23°01’38.96"S	67°45’38.06"W	5074.05	UNAVCO	NGL
COLO	22°10’02.57"S	67°48’14.32"W	4376.93	UNAVCO	NGL
GOLG	24°41’26.11"S	65°45’38.80"W	2381.15	UNAVCO	NGL
JBAL	27°35’03.86"S	65°37’21.89"W	409.16	IGN	NGL
LCEN	25°19’33.81"S	68°36’09.36"W	4270.94	UNAVCO	NGL
PUNJ	24°42’46.96"S	66°47’37.27"W	3802.58	UP/GFZ	GFZ
SALC	24°12’47.11"S	66°19’20.83"W	3841.62	UNAVCO	NGL
SOCM	24°27’16.60"S	68°17’42.59"W	3969.45	UNAVCO	NGL
SRSA	24°26’59.24"S	65°57’11.85"W	3153.8	UNAVCO	NGL
TAVA	26°51’10.72"S	65°42’36.02"W	2036.74	IGN	NGL
TERO	27°41’57.30"S	64°10’42.17"W	222.63	IGN	NGL
TIL2	23°34’37.70"S	65°23’42.26"W	2517.78	IGN	NGL
TRNC	26°13’48.77"S	65°16’55.82"W	816.08	IGN	NGL
TUCU	26°50’35.71"S	65°13’49.26"W	485.02	IGN	NGL
TUZG	24°01’53.82"S	66°30’59.56"W	4338.67	UNAVCO	NGL
UNSA	24°43’38.84"S	65°24’27.51"W	1257.79	IGN	NGL
UTUR	22°14’31.21"S	67°12’19.94"W	5184.09	UNAVCO	NGL
YCBA	22°01’01.56"S	63°40’47.94"W	659.66	IGN	NGL

Table 1: Geographic coordinates of the stations that are used for the water-vapour analysis. The institutions that were responsible for the installation of the facilities are listed in the column Source and are the Argentina’s National Geographic Institute (Instituto Geográfico Nacional - IGN), UNAVCO, the University of Potsdam (UP), and the German Research Centre for Geosciences (Deutsches GeoForschungsZentrum - GFZ). The column Analysis Centre shows where the data processing was carried out: either at the GFZ or the Nevada Geodetic Laboratory (NGL).

4.2. Description of data tables

The time series that were exclusively produced from the reanalysis data are distinguished by the word "Model" in the column name. In the remaining time series, the reanalysis data were used only for the calculation of the counterparts that are related to the dry delays.

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