Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGD21-P01 Room:Convention Hall Time:May 23 18:15-19:30

Diagnosis system of troposphere-induced positioning errors for GEONET

Masayoshi Ishimoto[1*]

[1]GSI of Japan

In the routine analysis of GEONET, positioning errors caused by the meteorological disturbance have been occasionally observed, which make the crustal deformation monitoring a difficult task. We have been working on the development of the diagnosis system of the positioning errors induced by meteorological disturbance.

In the previous studies, we generated the high-resolution numerical weather model while assimilating JMA meso-scale analysis data and estimated positioning errors using this generated model. In the case study, we found that the estimated positioning errors reproduced the positioning errors in the routine analysis of GEONET and the induced mechanism of errors was reproduced. But the estimation using the above method is not always correct.

In this study, we investigated the conformity between the estimated positioning errors and the routine analysis data of GEONET with no significant crustal deformation. As a result, we found that the conformity become high on specific conditions and the results can be used as reliability of the estimated positioning errors. Using these results in the event of earthquakes, we could diagnose positioning errors induced by meteorological disturbance properly.

In presentation, we will report on these results and the diagnosis system of the positioning errors induced by meteorological disturbance for GEONET.

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGD21-P02 Room:Convention Hall Time:May 23 18:15-19:30

Seasonal variation of atmospheric water vapor and hydrologic loading effect on ground deformation in Bangladesh

Mikito Tanaka[1*], Takao Tabei[2], Fumie Murata[2]

[1]Kochi University, [2]Faculty of Science, Kochi University

Bangladesh is one of the countries of tremendous rainfall in the world. The nation has suffered from frequent meteorological disasters such as cyclones and floods due to tropical unstable atmosphere and heavy rain. In this study we estimate temporal variation of atmospheric water vapor using precipitable water from fixed continuous GPS observations (GPS-PW). Then we discuss correlation of GPS coordinate time series with the seasonal variation of hydrologic loading.

We conducted GPS observations at Dhaka (DHAK) and Sylhet (SYLT) for about 100 days from April to August, 2011. SYLT is located about 200 km northeast of DAHK. GPS data were processed with the precise point positioning method of GIPSY-OASIS II Ver.6.0 and three components of daily coordinates and zenith tropospheric wet delay (ZWD) every five minutes were estimated. ZWD time series at two sites show different patterns before and after the middle of June. In the first half ZWD showed an increase of about 0.15 m per month with temporal fluctuations of large amplitudes and short periods. In the second half ZWD remained at a high level around 0.4 m but amplitudes of fluctuations were smaller and periods were longer. These patterns are considered to represent a transition from the severe atmospheric disturbance in pre-monsoon season to the high-level but rather stable atmosphere in monsoon seasons. Then ZWDs were converted to GPS-PWs by using a constant coefficient of 0.16 and averaged to produce an hourly mean to compare with the precipitable water estimated from radiosonde measurements (sonde-PW). Radiosonde data were steadily collected at 0000UTC at DHAK, and at 0600UTC and 1200UTC for one week in the beginning of May at SYLT. GPS-PW and sonde-PW are well consistent with each other at SYLT; the difference of them is about 2.6 mm in rms, which is about 7 percent of the entire PW. On the other hand sonde-PW at DHAK is systematically larger by about 10-15 mm than GPS-PW. Since radiosonde measurements at DAHK frequently recorded relative humidity of more than 100 percent, we think a wet bias of humidity sensor caused an overestimate of sonde-PW at DAHK.

Vertical component of the GPS coordinate time series at DHAK and SYLT show subsidence of about 30 mm and 20 mm in about 100 days, respectively. A previous study revealed a large annual variation of vertical deformation, about 60 mm in amplitude, which may be caused by seasonal variation of hydrologic loading. The above subsidence at DAHK and SYLT may represent a part of the annual variation. To decompose seasonal ground deformation more precisely from the stationary deformation, we processed continuous GPS data obtained by UNAVCO at 11 sites in 2007. First we determined stationary deformation (annual velocity) from the entire period of the data. Next we subtracted it from the seasonal velocity determined from the May-August data. Vertical component shows a subsidence of up to 20 mm in about 100 days. Then we estimated hydrologic loading distribution using a formula of areal loading and vertical ground deformation by Becker and Bevis (2004). We divided the 600 km x 600 km region into 9 square segments and estimated the loadings. The result shows that the seasonal loading is 2500-4500 Pa, which is equivalent to the mass increment of 37-67 GT. This result is consistent with that of the previous study, a seasonal increment of 50 GT in the whole of Bangladesh. To determine ground deformation and hydrologic loading distribution more precisely, longer time span and denser network of GPS observations are needed.

Keywords: GPS Meterology, Bangladesh, hydrologic loading

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGD21-P03 Room:Convention Hall Time:May 23 18:15-19:30

Development of the correlation processing technology in space-time information justification verification

Toru Kajiwara[1], Tatsuhiro Muto[1], Fujinobu Takahashi[1*], Ryuichi Ichikawa[2], Kazuhiro Takashima[3], Toshimichi Otsubo[4], Yasuhiro Koyama[2], Mamoru Sekido[2], Kazuhiro Takefuji[2], Thomas Hobiger[2]

[1]Yokohama National University, [2]National Institute of Information and Communications Technology, [3]Geospatial Information Authority of Japan, [4]Hitotsubashi University

In recent years, practical use of position information is spreading by the spread of information terminals, such as a GPS cellphone and a smart phone.

In connection with it, the cases where position information is asked for fixed reliability and justification are also increasing in number.

Then, development of the system which can verify the justification of the ”space-time information” on a fourth dimension which united the time which acquired position information and its position information is performed now.

Moreover, a space-time information justification verification system is 2 of data acquisition and data post-processing. It is divided into a group and research and development are performed.

This research is research on the latter data post-processing technology.

Space-time information justification verification is performed by receiving electric waves, such as GNSS, ground digital broadcasting, and a quasi-stellar object, at two points.

Two points are a user office using justification verification, and a standard office which the precision position understands.

At least four radio sources are needed for justification verification (since it is fourth dimension information).

In this research, justification verification can be performed by a large number’s existing in the same frequency band, and not being bound in the area, but asking for the arrival time interval of the electric wave of a receivable GNSS satellite, converting delay time into distance, and comparing with a theoretical figure.

In this research, the processing technique corresponding to a short baseline and each long baseline was developed.

Since there was the feature that the search range of delay time and a rate of change is small in a short baseline, the rough determination processing technique in which more efficient 2D-FFT than the conventional VLBI type correlation processing was used was developed.

By this processing technique, the correlation peak of all the satellites can be once observed by processing.

However, this processing technique can apply only about 200 km or less of base length’s case.

Since the problem that peak width spreads would arise about a long baseline if rough determination processing of a short baseline is applied as it is, the rough determination processing technique of achieving results at high speed was developed separately, performing the compensation.

Unlike the short baseline, this processing technique could observe only the correlation peak of one satellite by processing once, but delay time accuracy almost equivalent to the rough determination of a short baseline was able to be secured.

Moreover, performing more precise compensation, since the search unit of delay time has a weak point of being restricted by bit, delay time could be searched with the fine particle size, and rough determination performed prolonged integration and development of the possible energy determination processing technique.

By energy determination, accuracy has been greatly improved from rough determination.

Introduction of GPU was also carried out to these processings for processing time shortening.

This research is done in response to support of the kaken expense base research A (subject number 21241043).

Keywords: VLBI, GNSS, GPS, QZS, Space-time information, Attestation

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGD21-P04 Room:Convention Hall Time:May 23 18:15-19:30

Development of software for precise LLR data analysis

Ryosuke Nagasawa[1*], Toshimichi Otsubo[1]

[1]Hitotsubashi University

For the purpose of determining the lunar orbital and rotational motion using lunar laser ranging (LLR) observation data, analysis software is being developed.

As the first step of this study, we construct an LLR observation model, combining the newest physical models. The model consists of the lunar orbit and libration obtained from DE421 (provided by NASA Jet Propulsion Laboratory), Earth orientation, solid Earth/Moon tides, and some factors affecting propagation delay such as aberration of light, atmospheric effects, and relativistic effects. In order to calculate these components precisely, we use the modules of the geodetic data analysis software ”c5++” (Otsubo et al., JpGU, 2011). LLR observation data are provided by Crustal Dynamics Data Information System (CDDIS), from which 2029 normal points from June 1996 to December 2011 are obtained.

Comparing the observed and predicted one-way range, the mean of the residuals is about 0.18 meters, and the standard deviation is about 0.09 meters. Although there seems to be room for improvement, the error of DE421 itself is unknown to us. Therefore, the estimation of lunar orbit and libration parameters might improve the fit.

We will report a result of the above-mentioned modeling and comparison, and our future plan of the software development.

Keywords: lunar laser ranging, analysis software, ephemeris

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGD21-P05 Room:Convention Hall Time:May 23 18:15-19:30

Excitation of the motion of a cylindrical outer core

Chuichi Kakuta[1*]

[1]none

Wen(2006) showed that the Earth's inner core radius enlarged locally beneath middle Africa by 0.98 to 1.75 kilometers in 2003 than 1993 by using the arrival time differences of the P waves. We study the equatorial fluid motions and the rotational motions of the outer core associated with thermally upward motions at the inner core boundary (ICB). We assume, for simplicity, the outer core to be a thin cylinder around the Earth's rotational axis. Deformation of the ICB is expressed by the associate spherical function of the degree 1, Y11i (i =1,cos fai; i= 2, sin fai), and is assumed to move as a progressive wave with the period of 24 years. Fluid motions are discussed by using the sub-seimic approximation (SSA) derived from Smylie and Rochester (1981). The SSA alllows for the compressibiliy of the outer core. Only the vertical component of the pressure contibutes to the divergence of the velocity in the SSA.The outer core is assumed to be unstable. The normal displacement Ur at the surface of the thin outer core (CMB) is assumed to be the same value as the Ur at the ICB. Suppose the density of the eastern hemisphere rises up, the center of gravity of the thin cylinder moves 2Ur towards the eastern hemisphere. Non-asymmetric zonal flow couples with the density distribution of the 1st order,Y11i and induces the 2nd order angular momentum around the rotation axis. The magnitude of this angular momentum is of order 10 -11 of the rotaional angular momentum of the thin cylinder. Coupling of the second order of the equatorial flattening of the outer core and the shift of center of gravity of the thin cylinder can excite the outer core and the inner core libration.

Keywords: outer core, thin cylindrical outer core, inner core, density distribution, angular momentum, libration