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