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Simultaneous Observation of GPS and Radiosonde

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Bangladesh is one of the countries of very heavy rain in the world. National mean of annual rainfall is as large as 2000 mm and the rainfall exceeds 5000 mm/yr locally in the northeastern part of the country. In this study we compare precipitable water estimated from fixed continuous GPS observations (GPS-PW) with that obtained from radiosonde measurements (sonde-PW) and also with the daily precipitation at the surface. GPS observations were conducted at Bangladesh Meteorological Department in Dhaka (DHAK) and Sylhet (SYLT) for about 100 days from May 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 zenith tropospheric wet delay (ZWD) was estimated every five minutes together with three components of coordinates. The ZWDs were converted to GPS-PWs by using a constant coefficient of 0.16 and then averaged to produce an hourly mean. Radiosonde systems were provided by International Met Systems. iMet 1-AA radiosondes were launched at 0000UTC at DHAK, and iMet 1-AB radiosondes were launched at 0600UTC and 1200UTC for one week in the beginning of May. GPS-PW and sonde-PW are consistent with each other at SYLT; the difference of them is about 2.6 mm in rms. On the other hand sonde-PW is systematically larger by about 10 mm than GPS-PW at DHAK. Since two GPS-PW estimates at DAHK and SYLT are very similar, the difference is smaller than 5 mm in rms, we need to check sonde-PW measurements at DAHK. GPS-PW time series at two sites show an increase of about 20 mm in the first one month during the pre-monsoon and then remain almost flat at around 60 mm during the monsoon. This change represents a transition from the pre-monsoon season to the monsoon season. GPS-PW shows spike-like peaks synchronizing to the rainfall.

Vertical component of the coordinates at DHAK shows a subsidence of about 4 cm in about three months. The subsidence may be caused by a decrease of groundwater level near DHAK (Steckler et al., 2010). The term of GPS observation corresponded to a rainy season from pre-monsoon to monsoon but there is a time-lag between rainfall and increase of groundwater level. We interpret that ground uplift that occurred in the dry season before the observation turned to a delayed subsidence. In contrast no subsidence was observed at SYLT. It can be explained that heavy rainfall at SYLT throughout the year preserves a high groundwater level without a significant fluctuation. Steckler et al. (2010) have reported annual variation of vertical component with amplitude larger than 6 cm near DAHK. The subsidence of about 4 cm in three months at DAHK may show a partial seasonal variation. Observations in longer time span are needed to quantify seasonal to annual variation.