1. Introduction:
Flood is the most frequent natural disaster of Bangladesh. Bangladesh is visited by flood almost every year. Some of them are very catastrophic. Damage of flood is very crucial for the agriculture based economy of Bangladesh. Climate change is the hottest issue now in natural science and many reports show that the numbers of flood disaster events are increasing globally. As per IPCC report, Bangladesh will be one of the major victims of sea level rise caused by climate change. So it is very essential to study the changing characteristics of flood for effective decision making for future planning of flood management.

In this study, the historical hydrological data of three major river system of Bangladesh were studied to identify the characteristics of flood caused by these rivers and attempt has been made to find correlation of flood discharges with global Indices like Southern Oscillation Index (SOI) and Indian Ocean Dipole Mode Index (IODMI).

2. Study area:
Bangladesh is a great delta formed by the alluvial deposits of the three mighty Himalayan Rivers: the Ganges, the Brahmaputra and the Meghna. The total catchment area of this river system is 1721300 Km² of which only 120400 Km² (7%) lies within Bangladesh whereas major flow of this river system falls into Bay of Bengal via the lower single outlet inside Bangladesh. The average land elevation is so low that a big flood inundates more than 60% area of total country. The river bank erosion during flood is another crucial problem of flood damage. For this study Hardinge Bridge Station of Ganges (also known as Padma inside Bangladesh), Bahadurabad station of Brahmaputra (known as Jamuna inside Bangladesh) and Sylhet station of Surma (Surma is one of the two upstream rivers of Meghna) were selected to analyze the hydrological data.

3. Methodology:
To identify the flood characteristics three types of analysis were done in this study. (a) Analysis of water level data above danger level to characterize the historical flood trend, (b) Probability of joint flooding of any two rivers as severe floods of Bangladesh is caused by joint flooding from any of the two rivers of this river system and (c) Try to relate the local flood with global phenomena by correlation analysis of discharge data with SOI and IODMI.

4. Data Used:
Daily water level and discharge data of selected three stations are used for hydrological analysis and those data are collected from Bangladesh Water Development Board (BWDB). Collected data duration of Water level is 1973 to 2008 (for Ganges 1979 to 2008) and for discharge is 1972 to 2006 (for Surma 31 years within 1964-2006). SOI data are collected from the website of Bureau of Meteorology (BOM), Australia (http://www.bom.gov.au/climate/current/soihtm1.shtml) and IODMI data (SST-DMI dataset, monthly) are collected from the website of Japan Agency for Marine-Earth Science and Technology (JAMSTEC) (http://www.jamstec.go.jp/frcgc/research/dl/iod/HTML/Dipole%20Mode%20Index.html).

5. Results and discussions:
From the statistics of Flood Forecasting and Warning Centre (FFWC) of BWDB, it is found that the number of flood events of Bangladesh is reduced in recent years in terms of inundation area but flood events are becoming more extreme in recent years. From 1954 to 1986 (33 years) there were only two floods when more than 30% (maximum 36%) of area of Bangladesh were flooded but during next 22 years (1987 to 2008) five floods inundated more than 30% of the country of which 1988 and 1998 flood inundates 61% and 68% respectively creating two severe most flood of the century within a gap of just 10 years. The year wise flooded area is presented in figure 2. For the rivers of Bangladesh, danger level (DL) at a river location is defined as the level above which it is likely that the flood may cause damages to nearby crops and homesteads. The analysis of water level data for Bahadurabad station of Jamuna shows that the year wise exceedence event of DL is decreasing but once WL exceeds DL it stays more days above DL then before. For Hardinge bridge station of Ganges, both frequency and durations of WL above DL decreased but for Sylhet station of Surma, it shows a clear increasing trend both for number of events and duration above DL. The year wise duration of WL above DL for selected three river stations are presented in figure 3.
Probability of joint flooding was checked by correlation analysis (Pearson correlation coefficients) of every month discharge data for each pair of rivers. The correlation between Ganges and Surma is not significant. A little significant correlation exists between Ganges and Jamuna discharge for the month of June and August. But the Surma discharge is highly correlated (level of significance is 0.01 in two tailed student’s-t test) (Maidment, 1993) with Jamuna. The correlation values for June, August and September are 0.73, 0.65 and 0.69 respectively. SOI is a worldwide well known phenomenon to describe many climatic variables all over the world. IODMI is another indicator which has relation with some climatic variables. Previous study shows that the discharge of major rivers of Bangladesh is correlated with rainfall outside of Bangladesh (Chowdhury and Ward, 2004). As the outside rainfall data is not available, so it would be better if we can correlate the global indices directly with discharges. Pearson correlation coefficients of each month discharges with monthly SOI and IODMI values of current, previous (pre) and next year (post) are calculated. SOI and IODMI have opposite correlation with discharges and some of them are significant. The correlation is relatively high for SOI with a lag/lead of 0 to 3 months whereas it extends up to 7 months in case of IODMI. Correlation of IODMI with Jamuna discharge is presented in figure 5 which shows an interesting periodic pattern. Correlation coefficients for seasonal (Jul-Sep) discharge with monthly SOI values are presented in Table 1.

| Table 1: Correlation of seasonal Discharge(Jul-Sep) with SOI |
|------------------|-----------------|-----------------|-----------------|
| SOI months       | Ganges          | Jamuna          | Surma           |
| June             | 0.320           | 0.049           | 0.214           |
| July             | 0.491**         | 0.357*          | 0.341           |
| August           | 0.453*          | 0.326           | 0.462**         |
| September        | 0.320           | 0.260           | 0.435*          |

* significance ≤ 0.05  
** significance ≤ 0.01

5. Conclusion:

By analyzing the data of major three rivers it is found that the flood pattern is changing and extreme peaks are increasing. Significant correlation exists between flood season discharge of Surma and Jamuna. Monthly and seasonal discharge values have some significant correlations with SOI and IODMI. This should be studied more to predict flood in advance of 3 to 6 months.

References:


Key words: Correlation coefficient, Danger level, Flood, Indian Ocean Dipole Mode Index, Southern Oscillation Index