

Risk zoning of Tornado occurrences in Bangladesh: A spatial and temporal analysis between 1975 and 2009

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Overview of the Presentation

- General overview of Bangladesh
- **Objective and Methodology**
- Distribution of Tornadoes in Bangladesh
- **Overview of the BMD Recorded and Newspaper reported Tornado Events**
- **Context of Vulnerability: spatial and temporal aspects**
- Lessons learnt from this research

General overview of Bangladesh

- Located between 20°34' to 26°38' North Latitude and 88°01' to 92°42' East Longitude
- Area is 147.57 Thousand KM²
 - 80 percent is floodplain
 - 12 percent constitutes hilly area
 - 8 percent is Pleistocene Terrace;
- Total population is about 140 million with very low GDP, 360 US\$ per capita;
- Climate is characterized by:
 - high temperature, heavy rainfall, often-excessive humidity, seasonal variation is higher

Methodology

- The study has been conducted by exploring the historical events, duration and damage information;
- Spatial and attribute data for 35 years thunderstorm and tornado events were collected from a number of major dailies;
- Long term 3 hourly daily synoptic observations of Bangladesh was obtained from Bangladesh Meteorological Department (BMD);
- **Geostationary satellite data** of Meteosat-5 has been collected from SPARRSO to supplement the analysis.

Tornadoes in Bangladesh

Reasons for Tornadoes Occurrences

- Tornadoes form in unusually violent thunderstorms when there is sufficient:
 - (1) **instability**, and
 - (2) **wind shear present in the lower atmosphere.**
- Instability refers to warmer and more humid than usual conditions in the lower atmosphere, and possibly cooler than usual conditions in the upper atmosphere.
- Wind shear in this case refers to the **wind direction changing**, and the **wind speed increasing** with height.

4 March 2006

Tornado struck six villages in southern Bangladesh. 4 people killed; 50 injured; 17 seriously injured. Approximately 500 houses were destroyed, many trees were uprooted and damage occurred to agricultural crops.

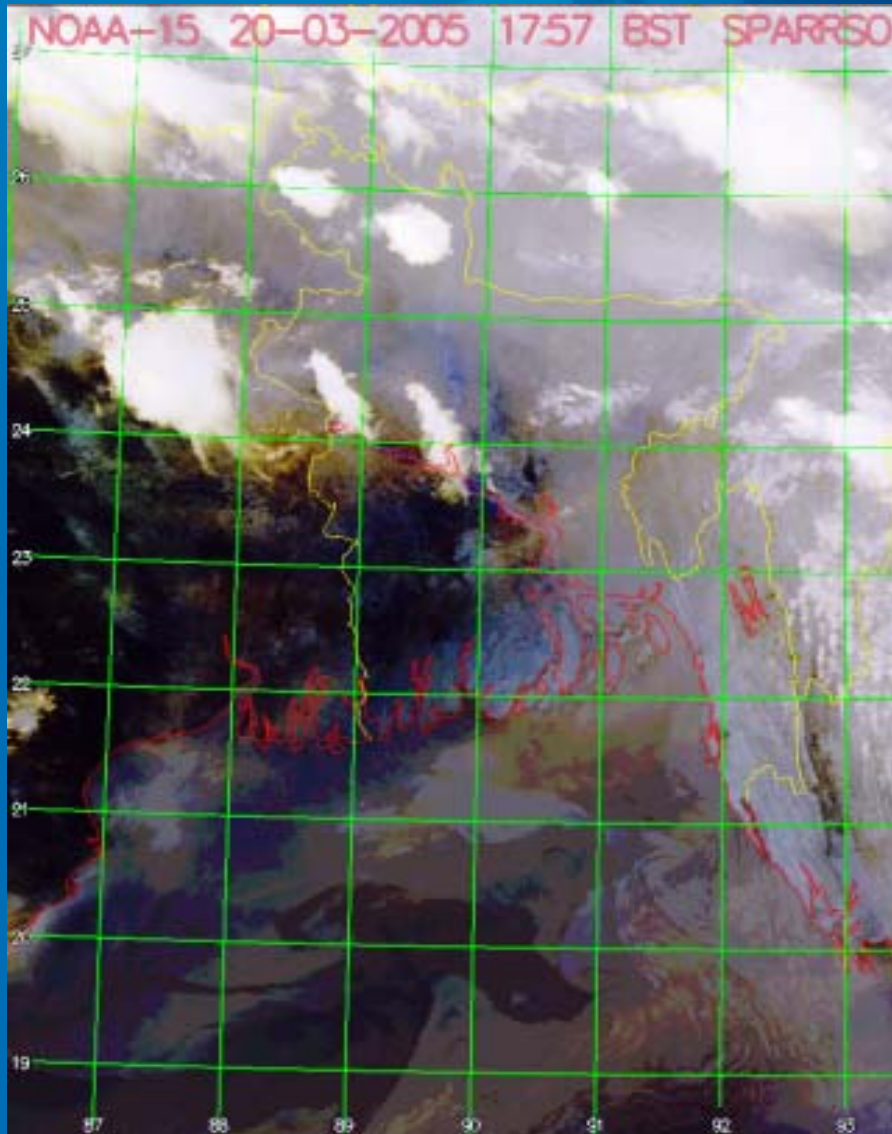
20 March 2005

Tornado swept over Gaibanda and Rangpur district. The devastation lasted for 5 minutes. Loss of lives were 43 , Injured people 4688 and damage of houses were 8786.

14 April 2004

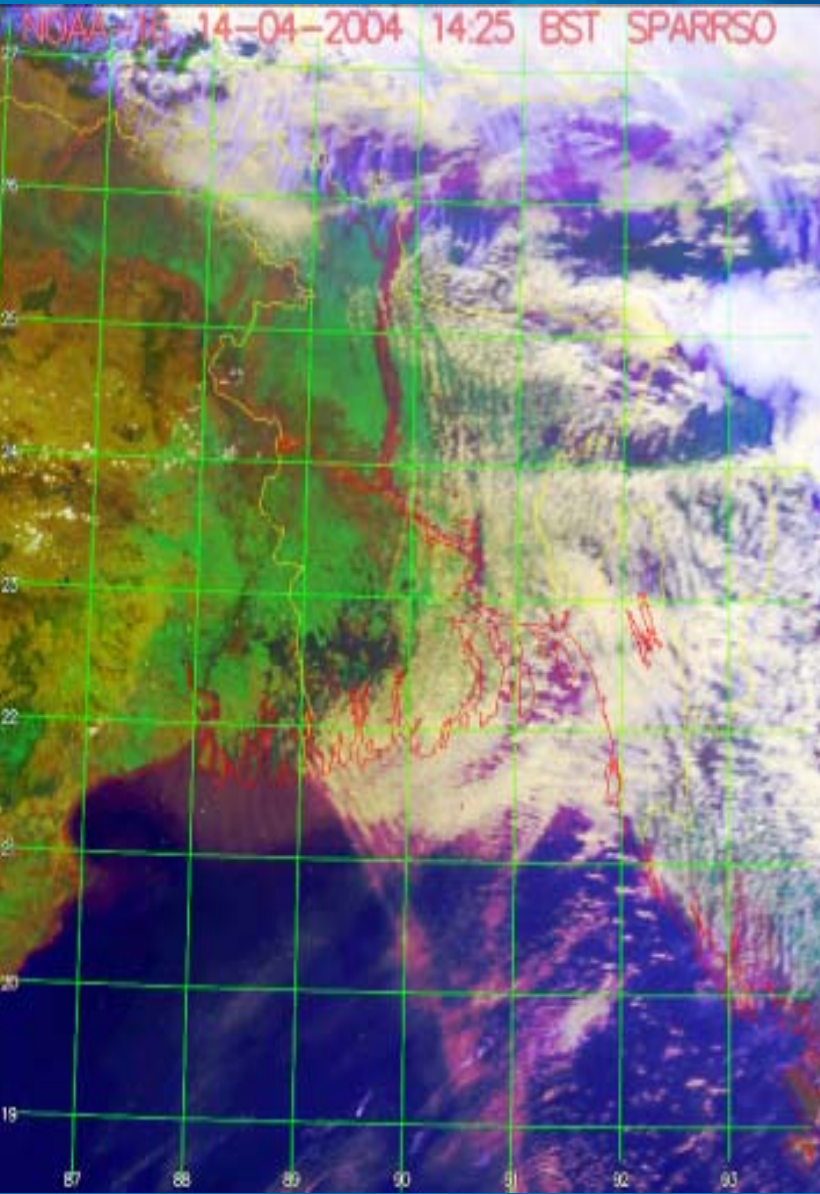
Tornado occurred in Mymensing and Netrokona districts in Bangladesh. It lasted for about 10 minutes. The loss of lives are 66 , around 1700 people were injured and 23 villages were affected.

NOAA-AVHRR satellite data 20th March, 2005



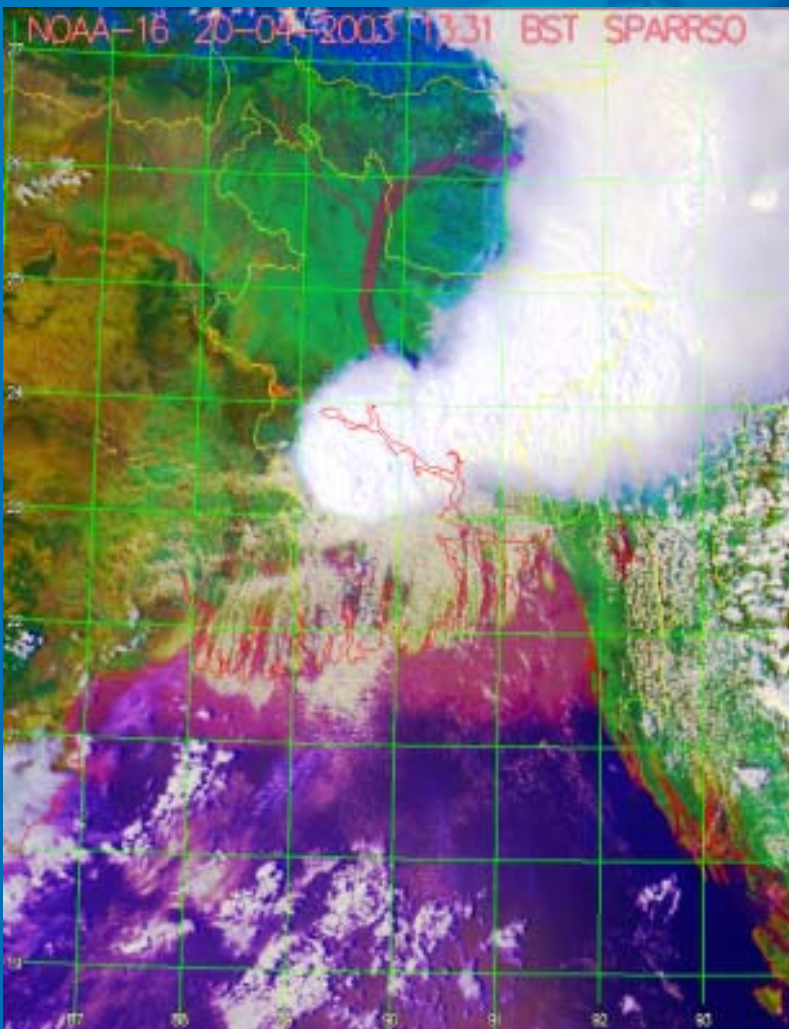
- On 20th March, 2005 the devastating tornado hits over **Gaibandha** district.
- The NOAA- AVHRR picture provided an **indication of the probable occurrences of this severe storm.**
- This shows the **formation of a convective system** with some clouds in the northwestern part of Bangladesh. The severe destruction occurred at the bulging side of the clouds.

NOAA – Satellite Image of 14th April, 2004



- Shows many cloud systems moving east, south-eastward **had elliptical shapes** with their major axes being parallel to the direction of the movement of systems.
- Many meso-scale disturbances developed over the **northern slope of the Meghalaya mountains** in Indian side.
- The system at somewhat to the **southwest** (Mymensingh and Netrokona districts) induced tornadoes in 2004.
- This may imply that the system develops **near the interface of two air masses** with somewhat different characteristics.

Satellite Image of 20 April 2003 Tornado



- The image of 20 April 2003 shows that a **tornado cells developed** over Bangladesh over North east area and affected in Magura, Faridpur, Lakhshampur and Jessore.
- Four clearly defined **Tornadic cells with strong southwest bulging clouds and anvils** being spread to the northeast area of Bangladesh and Kishoreganj affected severely.
- A number of **thunderstorms accompanied by nor'westers** had occurred on that day over Brahmanbaria, Sherpur and other areas

Difference between BMD Recorded and Newspaper Reported Tornado Events

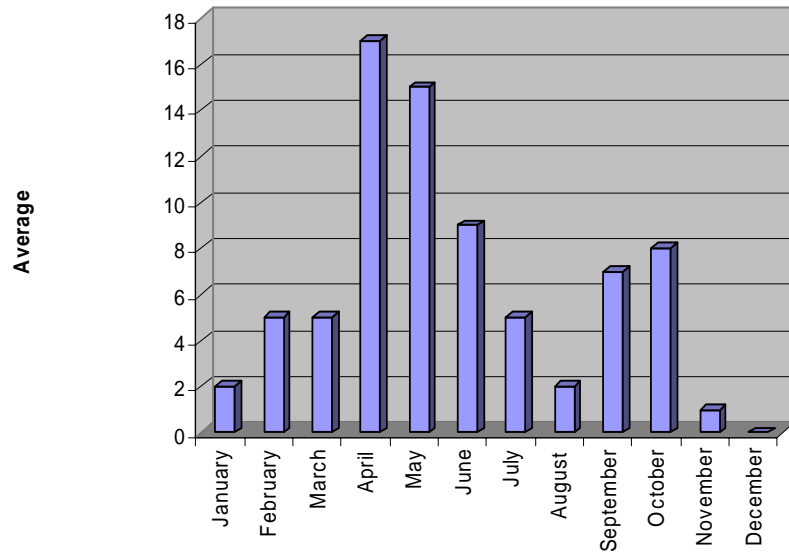
- Total 147 tornado reported in 35 years
- Annual average reported tornado from the newspaper is 4.3
- BMD has the severe tornado records is only 12
- The other reported tornado events is shown as severe thunderstorm events.

Reasons behind the information differences

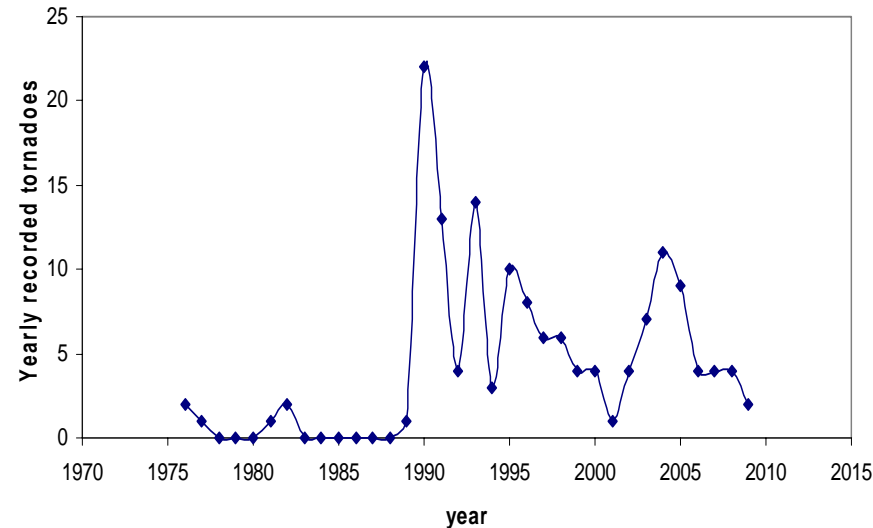
- Absence of weather station in the locality to identify the very locally formed small scale tornado
- **Wrong reporting.** May be a whirling nature of severe thunderstorm they reported as Tornado.

Tornado distribution in last 35 years

Total Monthly Reported Tornadoes in 35 years

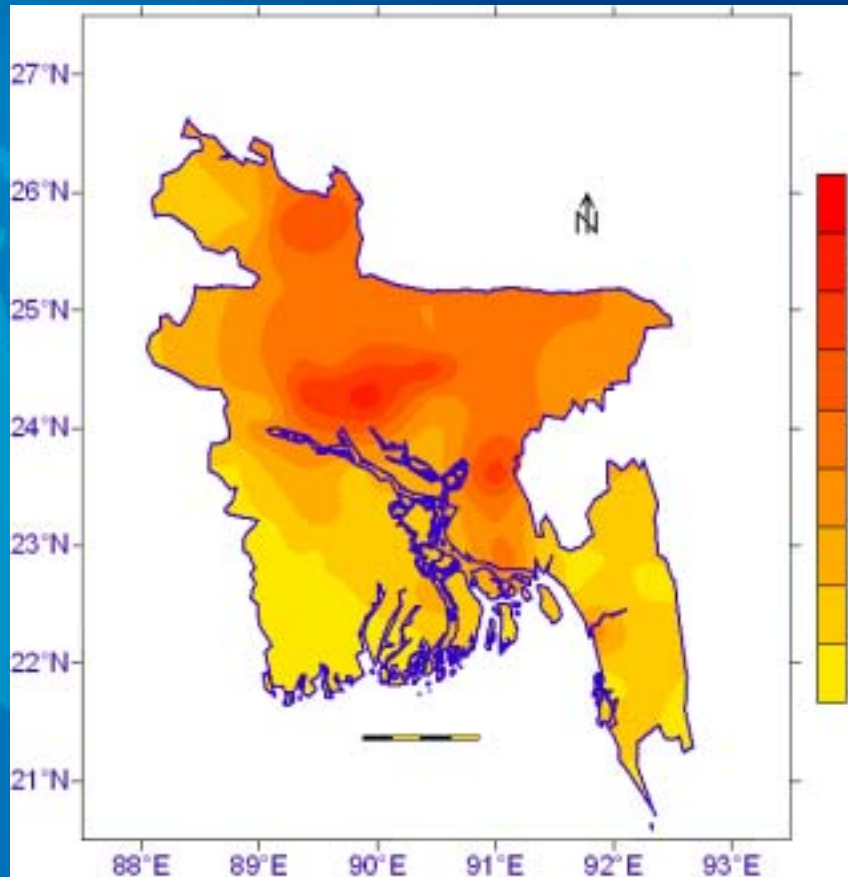


Yearly Distribution of Tornadoes



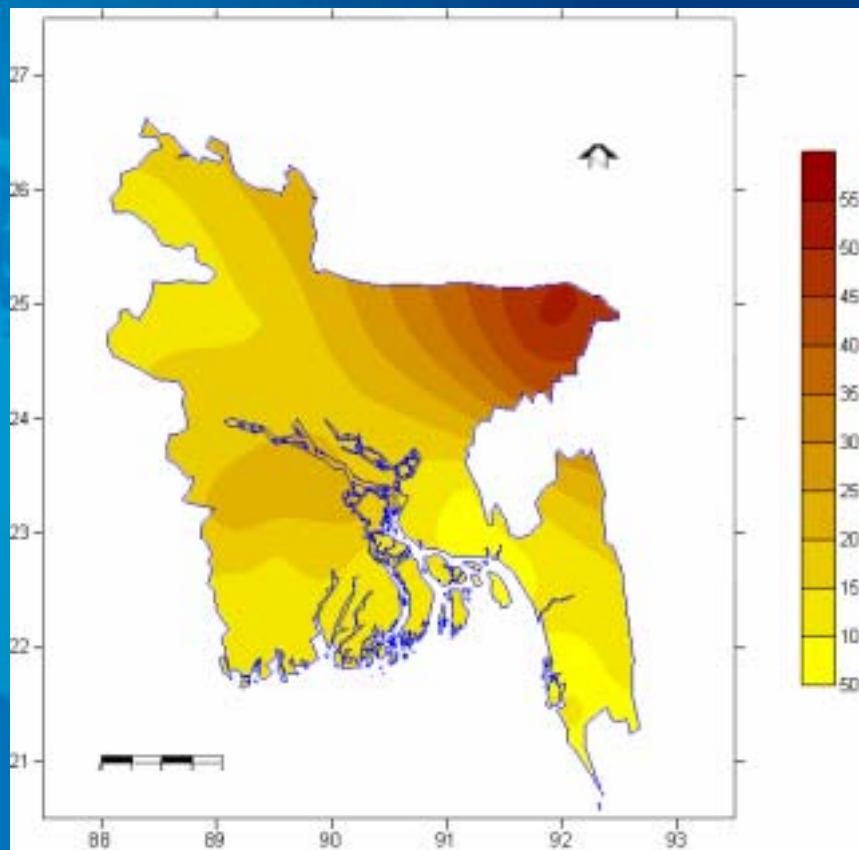
- Maximum occurrences are observed in **April, May, June, October and September**, respectively
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- In **January** there were 2 events and in **December** there were no record for Tornado

Tornado affected areas in the last 35 years



- Highest tornado occurrences recorded in Tangail, Shirajgonj, Netrokona, Brahmanbaria.
- **2nd highest** occurrences in Gaibandha, Rangpur, Bogra, Noakhali and Lakshmipur
- Medium occurrences in Mymensingh, Jamalpur, Sherpur, Sylhet, Comilla, Chandpur, Gazipur, Manikgonj, Munshiganj, Rajshahi,
- **Few occurrences** found in Chittagong, Barishal, Khulna and Jessore region

The annual average thunderstorm distribution



- The **maximum annual thunderstorm** frequency is in Sylhet.
- Then the 2nd highest frequency have seen in the **west-central** region.
- The lesser frequencies of thunderstorm events are observed in the **northwestern and southern parts** of the country;
- The lowest frequencies are observed in **Noakhali** region.

Context of Vulnerability: spatial aspects

- Due to the orographic effect and meeting of warm and cold air masses, Sylhet is more vulnerable to **thunderstorms** occurrences but not to Tornadoes;
- Tangail, Shirajgonj, Netrokona, Brahmanbaria are more vulnerable to **tornadoes**, mostly the meeting place of warm and cold air masses. Factors like presence of big rivers, open vast flat land may also favor the tornadic events.

Lessons Learnt

- **Good data can play a vital role to plan the national level development activities in the disaster prone areas for tornado disaster mitigation.**
- **Where, when and duration including the frequency of occurrence of Tornadoes are very important for the planners and as well as for the decision maker to mitigate the Tornado damage and casualties.**



Thanks for your kind attention