

Thunderstorm and Disaster Management in Bangladesh



A Dissertation for the Degree of Masters in Disaster
Management

By-

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Abstract.....	Page 3
Acknowledgement	Page 3
Acronym	Page 3
Content	
Chapter 1: Introduction.....	Page 4
1.1 General Background	Page 4
1.2 Statement of the Problem	Page 4
1.3 Literature Review	Page 5
1.4 Searching for a Research Gap.....	Page 6
1.5 Research Question.....	Page 6
1.6 Thunderstorm Assumption.....	Page 6
1.7 Data Source and Methodology.....	Page 7
1.8 Data and Analysis	Page 8
1.9 Theoretical Aspects of the Study.....	Page 8
Chapter 2: Thunderstorm Scenario in Bangladesh	Page 12
2.1 Spatial and Temporal Pattern.....	Page 12
2.2 Seasonal Distribution.....	Page 15
2.3 Dynamics of Aerosol.....	Page 16
2.4 Understanding the Lever Wind	Page 16
Chapter 3: Setting the Scene of Disaster Management....	Page 19
3.1 Dual Management of Disaster Management.....	Page 22
Chapter 4: Conclusion and Recommendation.....	Page 24
4.1 Major Findings	Page 24
4.2 Conclusion	Page 24
4.3 Recommendation	Page 24
References	Page 25

Figure

1.1....	Page 10
1.2....	Page 11
2.1....	Page 12
2.2....	Page 13
2.3....	Page 14
2.4....	Page 15

Table

1 ...	Page 9
2.1..	Page 15
2.2..	Page 16

Abstract

This study will help to inform the existing parameter on Thunderstorm. The available parameter will introduce with limitation & needed future study. This way we will know the recent scenario of thunderstorm, specially the technical aspect as much possible from this effort. Then come to set it in disaster management. The disaster management sets by United Nations & Intl. Federation of Red Cross and Crescent. This study starts when thunderstorm was not a disaster but in completing is become one by Bangladesh Government, with the help of both institutes. This study is focus on international management to set a disaster management; I don't include the Bangladesh matter.

Acknowledgement

I prefer to convey my gratitude to Dr. Justin Roberts-Pierel of NASA, for the tech support. Also I am grateful to Dr. Abdul Baqee & Dr. Md. Humayun Kabir from PPDM, BRAC University for their continuous guidance, value and constructive advices to the work towards the successful completion of this dissertation paper.

Acronym

AOD/T= Aerosol Optical Depth/Thickness

ANN= Artificial Neural Network

Aeronet=Aerosol Robotics Network

Cirrus=Cloud properties studied by radiation

Chapter 1

Introduction

1.1 General Background

In the global perspective and in Bangladesh the occurrence of thunder storm is not yet consider as disaster but it creates problem. Scientists consider it as one of the threats for human life and also as climate anomaly. This attempt will create an option for DM. Also this work will try to find aerosol actors for thunderstorm. Bangladesh is tropical climate with a regular rainy season; this is an attempt to find Thunderstorm activity here (Bishop et.al.,1995; Koelemeijer et.al.,2006; Levy et.al.,2007; Rahman et.al.,1993 and references in those article therein). This paper is using mainly satellite image from MODIS, AIRS, TRMM, GPM, MERRA and many. This assessment is mainly observation basis. At beginning this paper is limited because Bangladesh has no proper ground monitoring data. So the aerosol here is full with haze, fume, steam and many. But my interest is for finding the thunderstorm prone area that we can manage this disaster.

Aerosol, particle matter in wind, is ever changing so the impact of atmospheric aerosols on climate is uncertain. The cloud is another factor, especially cumulus clouds-all these are major source of uncertainty (Zhang et.al.,2014). The elements of this uncertainty is all types of clouds, war and heat in aerosol top and low layer, precipitation and thermal exchanging, dryness, component mixing, chemical reaction (Lu et.al.,2015).

1.2 Statement of the Problem

As Disaster management the UN standard cycle is emphasizing to early warning that we start to turn disaster into development option. My work is intended to do introduce parameters of climate to track possible Thunderstorm. This also include in network that inform all & help to develop parameter.

This way a network of ANN establishes to use for Disaster Management. The result is a network that performs well on the training set and actual operation. Also we have to think of disaster management because with tech we have to confirm in remit of disaster management.

Part of the Cluster Working Group on Early Recovery, the United Nations Population Fund (UNFPA) and UNDP are leading a project to develop THUNDERSTORM-aware profiles for countries at risk of disaster and conflict. UNDP has advocated for and facilitated technical support for mainstreaming like gender sensitive disaster risk reduction in climate change adaptation, UNDAF, PRSP and national policies in many countries.

Also IFRC have a respond The International Committee of the Red Cross, the ICRC (*Comité international de la Croix-Rouge, CICR*) is a private, independent humanitarian organization, with its headquarters in Geneva, Switzerland. The ICRC bases its activities on the provisions of International Humanitarian Law, and is

neutral in politics, religion and ideology. The International Committee upholds and disseminates the Fundamental Principles of the Movement, recognizes newly established or reconstituted National Societies which fulfill conditions for recognition, works for the observance, development and dissemination of International Humanitarian Law, endeavors to assist and to ensure the protection of military and civilian victims of armed conflict and internal strife and their direct results. Within these roles, it may take any humanitarian initiative as a neutral and independent intermediary.

This both international entities are best for any disaster management approaches; we have to put THUNDERSTORM in a management. There are some ways to do it; here define in scientific and disaster management.

1.3 Literature Review

There is no potential study in Bangladesh about THUNDERSTORM. This study is an attempt to study the THUNDERSTORM over Bangladesh. This experiments has recently been completed with NASA's newly developed coupled ocean-atmosphere climate model CM2.1. (Delworth et al. 2006), the coupled model consists of newly developed atmosphere, ocean, land, and sea ice component models. The horizontal resolution of the atmospheric model is 2.5° longitude by 2.0° latitude, with 24 levels in the vertical. The horizontal resolution of the ocean model is 1° in the extratropics, with meridional grid-spacing in the Tropics gradually reducing to 1/3° near the Equator. The ocean model has 50 levels in the vertical, with 22 evenly spaced levels over the top 220 m. This set is referred to as "AEROSOL". Additional details on the formulation of these experiments, including the specifications of the climate change forcing agents (Delworth et. al., 2005) and (Knutson et. al., 2006). The time evolution of the prescribed CO₂ and sulfate aerosols is shown in auxiliary material

1.4 Searching for a Research Gap

AOD, Aerosol Optical Depth, has many measures like length, tile, weight and many. Now in my work I use only length because resource is limited here. Common neural networks architecture have three layers of neurons: input layer, hidden layer and output layer. Each one of these layers can have one or more than one nodes or neurons. Figure 1 provides a schematic of such a network used in the current study with eight nodes (i.e., input parameters) in input layer and two nodes (i.e., PM_{2.5} for hourly and 24 h average) in the output layer. The input layer consists of eight nodes; namely, latitude, longitude, month, AOT, wind speed (WS), relative humidity (RH), Height of the Planetary Boundary Layer (HPBL), and surface temperature (TMP). The input layers are connected to the hidden and output layers by a linear combination of functions.

Layers between the input layer and output layer are usually called hidden layers and work toward minimizing the error by modifying weights through the training process. Nodes or neurons of a neural network are connected by output signal and weights, which are modified by a simple nonlinear transfer or activation function- MODIS Level 2 aerosol data (MOD04, Collection 5 Level 1 and Atmosphere Archive and Distribution System at NASA's Goddard Space Flight Center (GSFC). Each MOD04

granule contains the aerosol properties both over land and ocean retrieved from 5 minutes of MODIS observations using updated collection 5 operational algorithms.

1.5 Research Question

What are the existing parameters of Thunderstorm? This will help to define clouds, AOD and suggest any further study.

The next one is disaster management. International body is needed to do this. The United Nation and IFRC are the main players of international process to disaster management. They have a way to set for disaster management.

1.6 Thunderstorm Assumption

I'm using terra and Aqua with MODIS, AIRS and many instruments for this study. These included observational estimates of changes in well-mixed greenhouse gases, land use, solar irradiance, and volcanic aerosols. Also incorporated were changes in troposphere and stratospheric ozone, as well as tropospheric and stratospheric aerosols (direct effect only), using estimates based on the output of a chemical transport model forced with observed emissions estimates.

Satellite remote sensing of aerosols can be used to assess surface level PM_{2.5} (PM_{2.5} or PM_{2.5}, aerodynamic diameter less than 2.5 μ m) mass concentration at high spatial and temporal resolutions (Al-Saadi et.al.,2005). Estimating the columnar sulfate concentration will be (μ m₂) over a few locations on the east coast of the United States using Aerosol Optical Thickness (AOT) retrievals from the Visible Infrared Spin-Scan Radiometer (VISSR) onboard Geostationary Operational Environmental Satellite (GOES). More recently, a study by Wang and Christopher (2003) showed that under certain conditions, PM_{2.5} mass measured at the surface and the 550 nm AOT from the Moderate Resolution Imaging Spectro Radiometer (MODIS) are well correlated ($R > 0.7$). Although PM_{2.5} and AOT have different units, they are related to each other through the following equation:

$$\begin{aligned} \text{AOD}/T &= \text{PM}_{2.5} H f(RH) (3Q_{\text{ext,dry}})/4Pr_{\text{eff}} \\ &= \text{PM}_{2.5} H S \end{aligned}$$

Where, $f(RH)$ is the ratio of ambient and dry extinction coefficients, r is aerosol mass density (μ m₃), H is the boundary layer height, $Q_{\text{ext,dry}}$ is the Mie extinction efficiency, and r_{eff} is the particle effective radius. S is the specific extinction efficiency ($\text{m}^2 \text{g}^{-1}$) of the aerosol at ambient relative humidity (RH) (Koelemeijer et.al.,2006). Since the study by Wang and Christopher (2003), several papers have been published that have utilized AOT as a surrogate for estimating PM_{2.5} mass shows that most of these studies were largely focused on the United States and used MODIS satellite data to estimate surface level PM_{2.5} mass concentration.

The MODIS was designed specifically for aerosol studies with good calibration and state of the art aerosol retrieval algorithms to convert measured radiances to AOT. Other studies (Rashki et. al., 2011) also analyzed the MODIS AOT over other parts of

the world such as India, Hong Kong, Australia, and Europe. Bangladesh has no such study.

MISR on board Terra also provides reliable AOT retrievals and this data has been also used to characterize PM_{2.5} mass over the selected regions in the United States (Liu et. al., 2004). Study use available MISR data.

1.7 Data Source and Methodology

All sources are provided by NASA.gov and NOAA.gov. The complexity of a problem and its understanding decides what type of modeling system is required. A full physically based numerical model would be most suitable for forecasting PM_{2.5} mass if we have the required data sets (especially emission inventories) and a good understanding of PM_{2.5} formation and removal processes. However, given the complexity of the problem, a statistical approach is a good compromise (Liu et. al., 2004).

ANN is an information processing archetype that was inspired by the way biological nervous systems, such as the brain, process information (Zhang et. al., 2009). In other words, ANN is a set of computer algorithms designed to simulate biological neural network in terms of learning and pattern recognition. ANN has been used in many scientific disciplines to identify patterns and extract trends in imprecise and complicated nonlinear data.

ANN has been used for studying various Earth science problems including cloud detection for Polar Regions where traditional methods that employ thresholding algorithms often fail (Zhang et. al., 2009). ANN has also been used to specifically investigate forecasting pollution levels in urban areas (Torres et. al., 2005 and reference therein).

1.8 Data and Analysis

A study by Rashki et. al., (2011) in London used ANN to successfully demonstrate the prediction of NO_x and NO₂ by providing meteorological inputs and traffic flow data. Daily mean PM_{2.5} mass was forecasted in El Paso (United States) and Ciudad Juarez (Mexico) using TERRA and AQUA satellite, this will be follow to study the satellite based data with linear equation. Results from this study again confirm that ANN performed extremely well. These studies concluded that ANN-based modeling systems perform more efficiently when compared to linear regression models for particulate matter air pollution monitoring and forecasting. The ANN is a NASA product

Three satellite ensemble conduct over the period 2013-4 using subsets of the changes in radiative forcing agents. These are denoted as: "ANTHRO" (all anthropogenic terms), "NATURAL" (volcanic and solar changes), "WMGGO3" (well-mixed greenhouse gases plus stratospheric ozone), and "AEROSOL" (anthropogenic aerosols). The specific satellite for Bangladesh is MOD02HKM data to calculate the TOA reflectance, to obtain the solar and view angles, MOD09GA to retrieve the daily surface reflectance and AERONET data to obtain the single scattering albedo and asymmetric factor for the day of the retrieval (the AERONET station is used for this

purpose).MODIS AOT/D. Recall that AOT/D is an optical property which is function of light scattering from the aerosol particle and it increases in summer time due to particle growth under high humid conditions. Therefore, the same aerosol mass can produce large AOT/D values during summer months compared to winter months. On the other hand, aerosol mass does not change significantly due to growth of particles as TEOM (System full: Total Electrometric observation Machine) make measurement of dry particles under about 40% relative humidity conditions. MODIS AOT/D also shows overall decreasing trend in annual mean values over study period.

1.9 Theoretical Aspect of the Study

Using terra and Aqua with Modis, Airs and many instruments for this study. These included observational estimates of changes in well-mixed greenhouse gases, land use, solar irradiance, and volcanic aerosols. Also incorporated were changes in troposphere and stratospheric ozone, as well as tropospheric and stratospheric aerosols (direct effect only), using estimates based on the output of a chemical transport model forced with observed emissions estimates. The sources are from NASA. PM mass measured at the surface and the 550 nm AOD from the Moderate Resolution Imaging SpectroRadiometer (MODIS) are well correlated ($R > 0.7$). Although PM and AOT have different units, they are related to each other through the following equation:

$$\text{AOD}(\lambda) = \int_0^{\text{TOA}} \beta_{\text{ext},p}(\lambda, z) dz \text{ by Perez et.al.,(2006)}$$

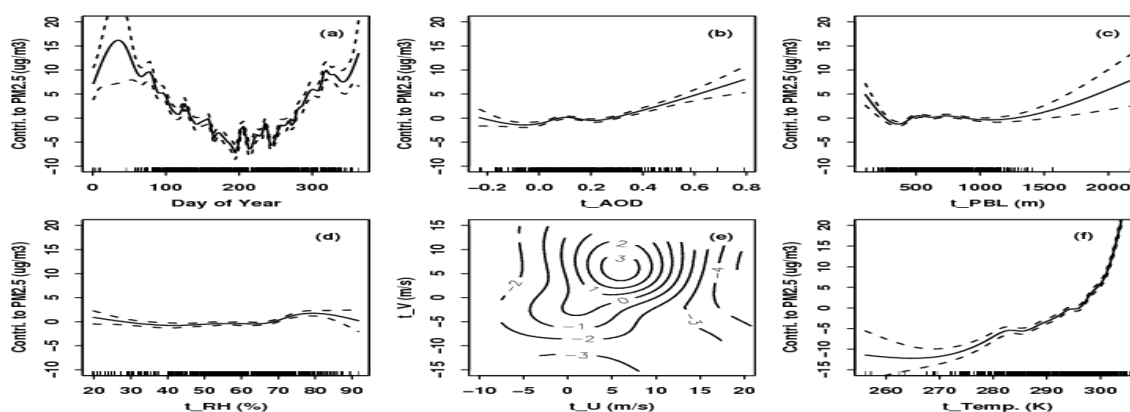
Here p=Particle Density

AERONET, Sky-radiometer, and Microtops II Sun photometers. Instrument AERONET Sky-radiometer Microtops II (NN-Neutral Network)

Wavelength (μm)

	0.500	0.870
0.340	0.440	0.675
0.440	0.675	1.020
0.340	0.675	1.020
0.380	0.500	0.870
0.500	0.870	0.940

Uncertainty (error root square):	0.01–0.02	0.01–0.025
Field-of-view: 1.2° 1.0°	2.5°	



Perez et.al.,(2006) Table 1

$\rho_{TOA}(\lambda)$ = satellite received TOA spectral reflectance, $L_{TOA}(\lambda)$ = satellite received TOA spectral radiance, $ESUN\lambda$ = mean solar exoatmospheric radiation as a function of MODIS band number, d = the earth–sun distance in astronomical unit and μ_s = cosine of solar zenith angle. The satellite received TOA spectral reflectance is defined as a function of atmospheric path reflectance (scattering of solar radiation within the atmosphere), and surface function (reflection of the solar radiation from the surface that is directly transmitted to the TOA). The TOA spectral reflectance, $\rho_{TOA}(\lambda)$, a function of solar and view zenith and azimuth angles, can be estimated using Justin Roberts-Pierel, 2015

python (press enter)

python "system algo" '($\rho_{TOA}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$)'

Python read "($\rho_{Aer}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$ | $\rho_{Ray}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$ | $T(\theta_s, \theta_v)$ | $\rho_{ps}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$ | $1 - \rho_{ps}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$)"

(here θ_s = solar zenith angle, θ_v = view zenith angle, ϕ = relative azimuth angle, $\rho_{Aer}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$ = aerosol reflectance resulting from multiple scattering in the absence of molecules, $\rho_{Ray}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$ = Rayleigh reflectance resulting from multiple scattering in the absence of aerosols, $T(\theta_s, \theta_v)$ = transmission of the atmosphere on sun-surface path, $T(\theta_v, \theta_s)$ = transmission of the atmosphere on the surface-sensor path, $\rho_{ps}(\lambda; \theta_s; \theta_v; \phi; \mu_s)$ = surface reflectance, and $S(\lambda)$ = atmospheric backscattering).

This is a good python os 3.4.2.1 system input for NN; now it call AERONET(Aerosol Robotic Network).

Author: Justin Roberts-Pierel, 2015; Sr. Scientist, GSFC, NASA

Organization: NASA ARSET

Programming Language: Python

Purpose: To extract AOD data from a MODIS HDF4 file and create a map of the resulting data

Required Python packages: pyHDF, numpy, basemap, matplotlib

1. Create a (tab delimited) .txt file containing the names of the files you would like to analyze

2. In order to use this python script, make sure that the script, any files you plan to analyze, and the list of file names are in the same folder (i.e. Downloads or Desktop).
3. Open the command prompt and navigate to the folder containing the .py, .hdf, and fileList (.txt) files
4. Once in the folder, run the script with the command: `python read_and_map_mod_aerosol.py`
5. Follow the prompts to execute the script
6. If you choose to save the map created, it will save as a .png file in the same folder as this script and the HDF4 file(s)

There are full details of os writer and system requirement.

The aerosol scattering phase function $P(\theta, \phi)$ represents the angular distribution of light scattered by particles and can be determined using the single-term Henyey–Greenstein method (Eq. 10, Rahman et.al.,1993):

System input is: $P(\theta, \phi)$;

$$\begin{array}{lll} \theta & 1-g^2 & \cos\theta = \mu_0 \mu_s \\ \phi & 1 + g^2 - 2g & \phi = \phi_s \end{array}$$

Where θ is the scattering phase angle (Zhang et.al.,2007). The asymmetry parameter g indicates the relative dominance of forward/back scattering and it remains constant for the most of the aerosol models. The same way can be input to AERONET. AOD/T image of fraction of World;

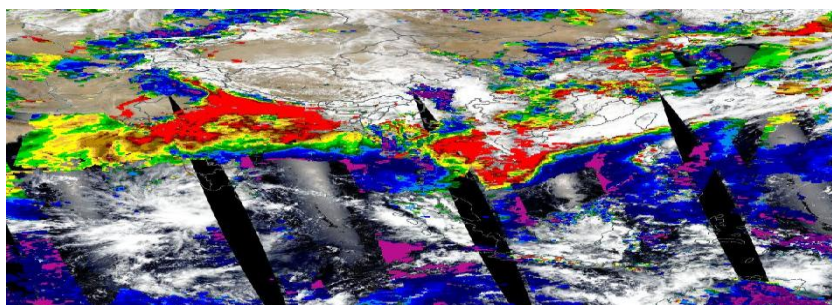
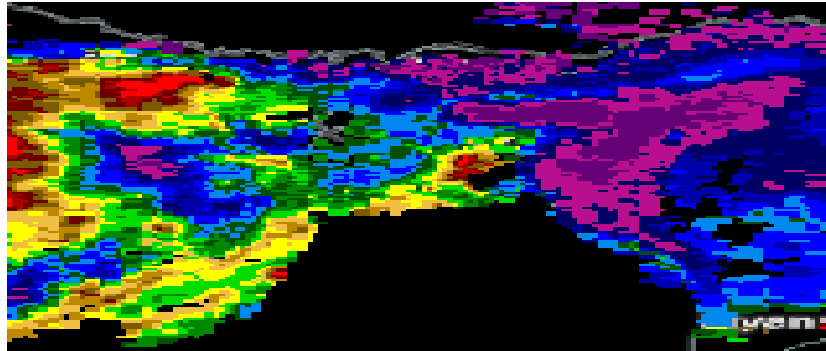


Fig. 1.1

NASA.gov image Fraction of world AOD TERRA and AQUA MODIS; covers Eurasia, Indian and Pacific ocean.

At the end of each day, any parcels that have descended below the 355 K level are removed since we consider those parcels to have reentered the troposphere. The upper boundary is ~ 2200 K isentrope (~ 1 hPa or ~ 50 km), and parcels reaching the top are also removed. After a few years of integration, the system reaches quasi steady state with 250,000 parcels. Methane oxidation is included as described in SD11, but it has no impact on the analysis in this paper. We initiate the model in the year 2000, and we focus on analyzing the model results in 2008/2009 in order to compare the results to MLS, High Resolution Dynamics Limb Sounder (HIRDLS), and CALIOP observations.



NASA.gov image Bangladesh AOD; combined AQUA and TERRA Modis.

Both Figure 1.1 & 1.2 the RED is carbon other hues are yet to recognize by scientist.

Chapter 2

Thunderstorm Scenario in Bangladesh

2.1 Spatial and Temporal Pattern

Also for spatial and temporal pattern of wind velocity is with k-vector analysis. The root mean square error (RMSE) used to measure the differences between satellite retrieved AOD and Sun photometer measured. AOD is sensitive to both systematic and random errors. The RMSE can be defined as follow;

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (AOD_{\text{satellite}} - AOD_{\text{sunphotometer}})^2}$$

Where AOD satellite is the satellite retrieved AOD and AOD sunphotometer is the Sun photometer measured AOD. This gives a measurement that can be distribute in raster format with help of layers between the input layer and output layer are usually called hidden layers and work toward minimizing the error by modifying weights through the training process. Nodes or neurons of a neural network are connected by output signal and weights, which are modified by a simple nonlinear transfer or activation function.

MODIS AOT values at NN/ Aeronet, nine different criteria are applied (below pic of wind map). Mean AOT for each day and each criterion is obtained over almost a seven year time period. The spatial resolution of one MODIS AOT pixel is approximately $10 \times 10 \text{ km}^2$, whereas surface measurements are point values thereby making intercomparisons difficult. Even if the MODIS pixel was small enough, it does not represent the same viewing conditions due to differences between observation areas, varying path lengths through the atmosphere, and sensor sensitivity to aerosol properties averaged level 2 MODIS AOT pixels using a 5×5 pixel box over the surface measurement locations and 15-min observations over one hour to represent a similar air mass as observed by MODIS. This was justified by examining the normal speed of aerosol transport (50 km/h) using animation of the Total Wind Mapping Spectrometer (TWMS) imagery over the Bangladesh and neighbor. This method is used by most satellite aerosol retrieval comparisons without ground measurements.

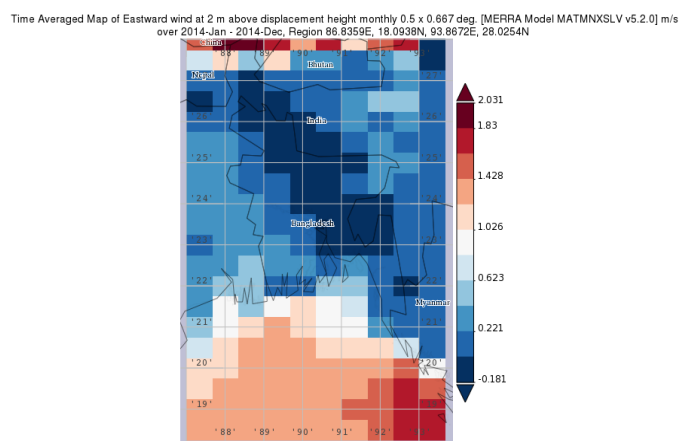


Fig. 2.1

The Lever wind circulation is not only an atmospheric system that has a significant environmental impact in the South Asian basin, but is also one of the least studied

meteorological phenomena. The Lever wind is modulated by the intense solar the formation of an intense near-surface low-pressure system over South Asia. The frequency of occurrence PM2.5 in all seasons except summer, the largest frequency is observed for values between 20 and 30 $\mu\text{g m}^{-3}$, while in summer, the largest frequency shifts towards lower values (10–20 $\mu\text{g m}^{-3}$), heating of the South Asian landmass in summer months. It develops as a result of industrial activities. A study by NASA; Rashki et. al., (2011)

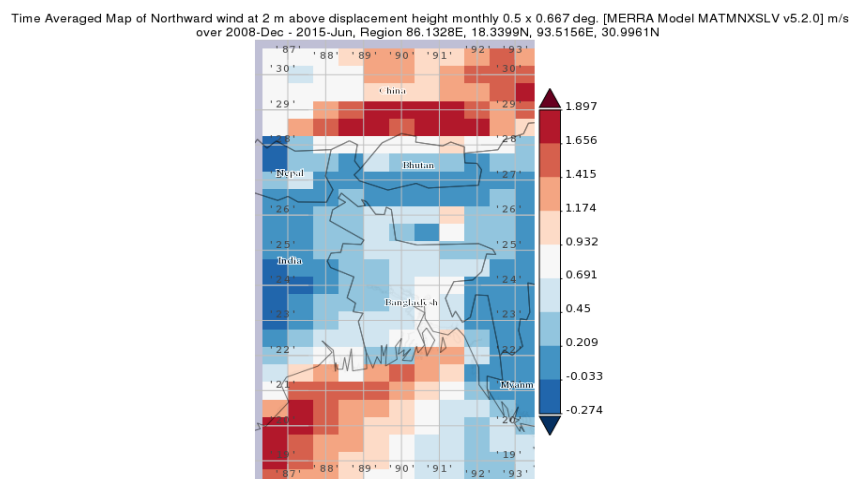


Fig.2.2

The background colors denote the air quality conditions as defined by USEPA based on mass concentration of aerosol particles that are smaller than $2.5\mu\text{m}$ in aerodynamic diameter. The horizontal red line corresponding to $15\mu\text{gm}^{-3}$ and $35\mu\text{gm}^{-3}$ are the annual and 24 h mean national standards set by USEPA under National Ambient Air Quality Standards (NAAQS), while the previous (prior to prior to December 2008- Jun 2015) 24 h standard of $65\mu\text{gm}^{-3}$ is also plotted for comparison purposes (Fig.1 and 2). Our analysis indicates that NBHM often experiences moderate to unhealthy air quality conditions for sensitive groups, but rarely reaches the unhealthy category even under the new guidelines. The maximum 24 h mean and mass concentration of $75.3\mu\text{gm}^{-3}$ was observed in Sea and Northern Indian part, whereas the average of all daily mean values is $18.7\pm 9.7\mu\text{gm}^{-3}$.

The thick gray line presents the monthly mean and mass concentration calculated using daily mean values. The monthly mean values clearly show a seasonal trend with high values in spring-summer and low values in fall-winter months. High spring-summer values partially correspond to increase in gas to particle conversion in the atmosphere with increasing available solar radiation, enhancing the photo chemical reactions responsible for such particle production.

Same analysis with 10 m above wind map: Total aerosol mass is computed from the volume mixing ratio and the density of particles at the temperature of the parcel. The particle effective radius (R) is determined by dividing the ice mass among the N particles assuming they are pheres. N and R are dynamic, but only a single size mode is allowed. We save the ice and water vapor mixing ratios, as well as R and N at each CM time step.

The processes of vapor deposition, sublimation, and sedimentation can be very rapid; the particle operates independently of the trajectory model. For each parcel, the temperature and pressure are computed for each 6 month analysis period then the THUNDERSTORM is run over the same period. The THUNDERSTORM output is then interpolated back onto the coarser time grid of the trajectory model.

MERRA generates convective clouds using a relaxed Arakawa-Schubert (RAS) scheme (Moorthi et.al., 1992) that estimates convective mass fluxes as a sequence of idealized convective plumes. The adaptation of RAS to GEOS-5 (the core of MERRA) is described in Rienecker et.al.,(2011). MERRA outputs two relevant cloud ice products: stratiformor large-scale ice and convectively produced anvil ice.

Time Averaged Map of Eastward wind at 10 m above displacement height monthly 0.5 x 0.667 deg. [MERRA Model MATMNXLV v5.2.0] m/s over 2008-Dec - 2015-Jun, Region 86.1328E, 18.3399N, 93.5156E, 30.9961N

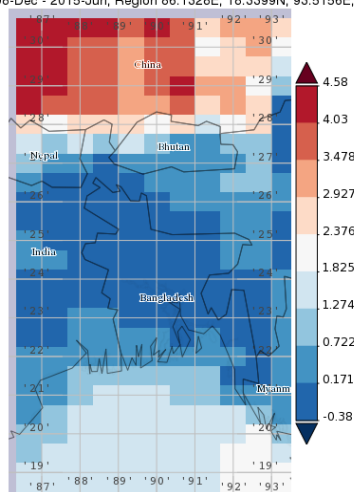


Fig. 2.3

This is a MERRA model data image picture of 89 terra bytes size of data-shows displacing wind over Bangladesh. This wind carries cloud and all atmospheric matter. Cloud initial saturation levels to >100% RH since there is good laboratory and observational evidence that cloud formation not connected to convection occurs at supersaturation levels greater than 100% RH (Koop et.al.,2000; Jensen et.al.,2013). Setting the supersaturation limit to a higher value produces more rapid initial ice particle growth compared to lower supersaturation levels because once ice particles form, there is relatively more rapid vapor deposition and more rapid particle growth. The more rapid ice particle growth increases parcel dehydration by about 3% because of increased gravitational sedimentation.

Saturation RH is increased, the stratospheric water vapor will increase because wetter parcels will on the average make it into the stratosphere without undergoing dehydration. For example, in a run where ID is used, if the saturation level is set to 120% RH, then stratospheric water vapor increases about 0.2 ppmv. Setting the ID threshold to 120% is, of course, different from setting the nucleation threshold to 120%, and this difference needs to be explored further. Also this station orbiting time is 5 minutes. Supersaturation levels for the onset of nucleation reduce the model cloud fraction mostly because fewer nucleation events occur.

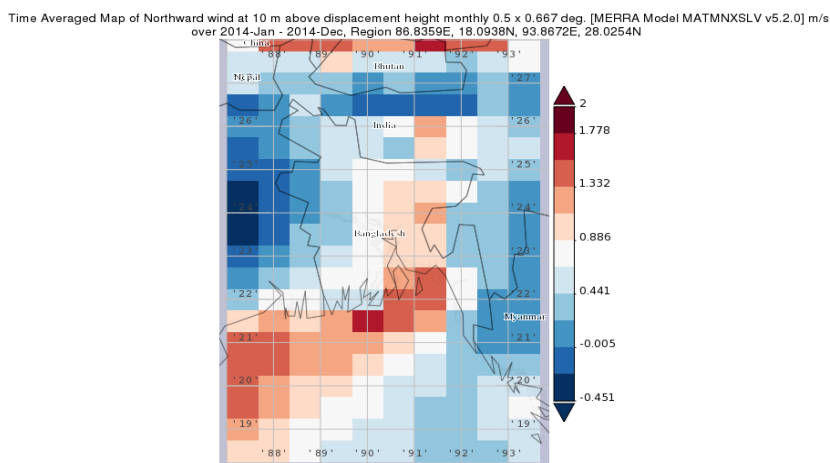


Fig. 2.4

This is MERRA model image of 88 terra bytes east ward displacement wind over Bangladesh.

2.2 Seasonal Distribution

The concentrate zone is in Sea and Northern India. The lever wind is a factor for seasonal distribution. The thunderstorm is dense in rain season but dry weather has tendency of THUNDERSTORM. The data mean by year and month basis:

Deriving data: Slope Intercept R Counts MODIS combine TERRA_AQUA _ AOT _

Retrieve Component (ANNUM) from AERONET in 2016- operating instrument MODIS, Table 2.1

Year\ Colour Spectrum (μm)	Red	Green	Blue	Albedo	Inferred	Y ray	X ray	Gama ray
2008	35.81	16.62	0.58	147	25.09	12.63	0.24	0.21
2009	28.95	16.39	0.50	181	22.02	10.95	0.20	0.19
2010	21.27	14.78	0.51	167	19.50	9.35	0.22	0.22
2011	22.36	15.43	0.50	165	19.88	9.65	0.20	0.22
2012	25.52	16.18	0.46	158	20.16	10.41	0.16	0.19
2013	32.13	16.33	0.57	169	22.67	11.71	0.20	0.21
2014	26.36	13.67	0.60	103	18.23	21.20	0.17	0.20
2015	34.01	15.42	0.50	178	21.20	8.58	0.16	0.3
Mean	27.48	15.63	0.53	156	21.08	—	0.20	—

For the experiments shown in this paper, a condensation threshold of 100% RH is used, and the sensitivity to the nucleation threshold RH will be explored in future work. Parcel moistening by convection or convective hydration is an input parameter to the model. There are several approaches to including convective hydration. This is a multi years average (climate analysis), so it contained no information about year-

to-year variability. An alternative approach is to separately compute the particle & rays based on the observing THUNDERSTORM.

Retrieve Component (Month) from AERONET in 2016- operating instrument MODIS,
Table 2.2

Month\ Colour Spectrum (μm)	Red	Green	Blue	Albedo	Inferred	Y ray	X ray	Gama ray
Jan.	18.34	13.28	00.29	92.00	14.93	07.60	00.09	00.12
Feb	08.55	14.04	00.08	73.00	14.78	07.35	00.09	00.07
Mar.	12.03	14.43	00.17	110.00	15.91	07.73	00.12	00.11
Apr.	29.11	14.33	00.44	109.00	19.18	09.59	00.17	00.15
May	24.91	15.43	00.51	92.00	21.59	08.80	00.25	00.18
June	19.10	18.08	00.46	82.00	24.45	09.74	00.33	00.23
July	25.82	05.20	00.57	73.00	26.31	10.61	00.43	00.24
Aug.	20.54	19.13	00.49	87.00	27.87	09.52	00.43	00.23
Sep.	28.81	19.61	00.56	90.00	26.52	11.47	00.24	00.23
Oct.	50.59	18.72	00.64	101.00	26.60	13.03	00.17	00.16
Nov.	47.90	16.02	00.49	94.00	20.35	11.52	00.09	00.12
Dec.	14.34	17.98	- 0.11	87.00	17.14	08.17	00.06	00.07
Mean	22.61	16.35	00.38	91.00	21.30	09.59	00.20	00.16

2.3 Dynamics of Aerosol

The maximum positive difference of $6.1\mu\text{gm}^{-3}$ was obtained during February 2000 since Terra-MODIS started observations on December 2008- Jun 2015 days of data available during this month. Averaging each month separately over the entire seven year time period we find that January has minimum negative difference of $-0.5\mu\text{gm}^{-3}$ whereas February has a positive difference of $0.6\mu\text{gm}^{-3}$. Again, summer months have large negative differences compared to winter months, which corresponds to more number of available days in winter and less during summer months. The solid line with dots in Fig. 4b shows the yearly mean values, which are always negative. The maximum difference ($-3.0\mu\text{gm}^{-3}$) in annual mean was in 2008 whereas minimum difference ($-1.2\mu\text{gm}^{-3}$) was during 2009. Also $\text{pm } 2.5$ is absent so the root error is more than anticipated but MODIS accuracy is better with altitude measure of particle almost 80% accurate Bishop (1995). So spatial distribution is possible but measuring in economic parameter is not possible.

2.4 Understanding the Lever Wind

The Lever wind circulation is not only an atmospheric system that has a significant environmental impact in the Arab & South Asia but is also one of the least studied meteorological phenomena. It is modulated by the intense solar heating of the Arab

Peninsula and South Asian landmass in summer months. It develops as a result of the formation of an intense near-surface low-pressure system over South Asia associated with strong positive turbulent sensible heat flux of Thor desert. Other studies suggest that the Lever might be a limb of the return flow of the Indian monsoon circulation. However, the physical mechanism involved has not yet been satisfactorily explained. Despite the above, the Lever wind contributes significantly to dust storms and degradation of air quality over the study region Rashki et al (2011).

Some studies conducted in other urban environments, in winter, both by monthly concentrations were higher, which was attributed to larger use of fossil fuels in winter. Reported monthly mean concentrations in Athens ranging from $60.3 \mu\text{g m}^{-3}$ (January) to $88.9 \mu\text{g m}^{-3}$ (December), with an annual mean value of $75.5 \mu\text{g m}^{-3}$, in Barcelona, Spain, the ambient PM₁₀ and PM_{2.5} were in the range of 39 to 42 and 25 to $29 \mu\text{g m}^{-3}$, respectively, over the period 2003–2006 with 97 daily values exceeding $50 \mu\text{g m}^{-3}$ (Perez et.al.,2008), while the mean annual PM₁₀ concentration ranges from 20 to $37 \mu\text{g m}^{-3}$ in Rio de Janeiro, Brazil (Godoy et.al.,2009). Comparing the present results with those of the above-mentioned studies, it is concluded that the city of Zahedan, Iran experiences much higher Particle concentration levels. This is not only the case for summer, when the area is affected by natural phenomena, but also for winter. This emphasizes the fact that PM concentrations over Zahedan, Iran can be regarded as a real environmental problem that poses a serious risk to quality of life and endangering human health. (Rashki et al, 2011).

This is a global phenomenon but Bangladesh has no ground observation, also data is not qualified as scientific evidence. Now for observing over Bangladesh we need to know that meteorological parameters, such as air temperature and RH, the effect of wind speed and direction on AQI levels was found to be significant. Thus, the highest AQI values are found in summer (season with the highest temperature, lowest RH, and highest sunshine duration) and are cLEVERely associated with strong northerly winds from the Sistan desert. During the period May to August, monthly mean AQI values were above 90, reaching up to 130 in June–July. This is in contrast to findings over the Greater Athens Area where, due to complex topography and the accumulation of pollutants, the AQI was larger during calm days and days with weak seabreeze circulation and lower when strong northeasterly winds dominate. However, the present results reveal that the wind speed over Zahedan in summer acts as an additional tool for enhancing PM levels and deteriorating the air quality.

We need to observe Systematic PM concentrations (PM₁₀, PM_{2.5}, and PM_{1.0}) from Arab to South Asia, where measured in the arid environment of Zahedan in southeast Iran covering the period July 2008 to March 2010. To the best of our knowledge, this dataset represents the longest record of simultaneous PM measurements in Zahedan (Rashki et al, 2011). The present study must focused on analyzing the daily, monthly, and seasonal variability of PM levels and to establish the role of the northern “Lever” wind in deteriorating the air quality in summer. The results show that the PM₁₀ concentrations were considerably higher than the corresponding EU air quality annual standard and the mean PM_{2.5} concentration ($32 \mu\text{g m}^{-3}$) also overcame the AQI annual PM_{2.5} standard.

My recommend some effective study specific Bangladesh I don't find any PM data, so availability of technology is another drawback. This THUNDERSTORM study must count Lever wind otherwise it will not complete. This study is not complete, because of limitation of data and equipment. Also I have suggestion for my next who study; to find Barotropic Tidal Energy, this need oceanographic data, no availability of this. The actual reason is not clear why THUNDERSTORM, Also India and many countries will not share data, which is another problem. Purpose of this work is to try and further reduce the uncertainty and constrain the parameterizations but lack of data is making it impossible.

Chapter 3

Setting the Scene of Disaster Management

Our overarching goal is to contribute to building the disaster resilience for THUNDERSTORM in order to achieve sustainable development. This research proposal's specific objectives are to:

- Increase understanding of THUNDERSTORM with tech and other;
- Develop government capacity to address THUNDERSTORM issues in disaster risk reduction;
- Encourage other to take action to integrate THUNDERSTORM perspectives into disaster risk reduction legislation, policies and programmes, for sustainable development.

There has recently been a critical shift THUNDERSTORM frequency, world-focused many new disaster and yet to debate the reason, based on the premise that the roles and relationships of Climate change in DRR should be analyzed within the overall tech basis socioeconomic and cultural context. On top of this shift, the strategic focus of disaster management has changed from reactive disaster response to long-term proactive disaster risk and vulnerability reduction, where THUNDERSTORM and DRR are considered necessary to achieving sustainable development. But there is not much work to raise this issue. May be we have to go the reactive mode for THUNDERSTORM.

Some regional inter-governmental level policies and strategies focusing on disaster management and DRR have also come into place over the last five years or so. Unfortunately, commitment to THUNDERSTORM issues never stated; rather, it can only be assumed to be an implicit part of larger commitments to the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. At the programme or operational level, implementation is ad hoc and inconsistent, and progress is largely due to the dedicated work of a handful of organizations, particularly NGOs. But without any knowledge just rely on indigenous and not scientific way; the THUNDERSTORM is yet to consider in Disaster management.

Unfortunately in most of the level does not have any idea to THUNDERSTORM; also hazards, risks, and disasters in society include environmentally related catastrophes within concentrations of human development that can be interpreted in terms of historical, political, and economic context? Such as, one rationale underlying this volume is that development largely determines the way in which hazards impact on people, whereas disasters alter the scope of development. A summative overview of the more recent state of this perspective is already outlined in some detail in disaster and development's other sources. The collection of chapter contributions in Hazards, Risks, and disasters in society reflects how personal and corporate exposure factors, short term reactions, and longer term responses mediate the manner in which people get understood as vulnerable, resilient.

Societies that strengthen themselves are mitigating towards decline and resultant further exposure to what are largely human-induced cycles of environmental, social, and economic changes. In this change may be THUNDERSTORM experienced as improvement by billions of people in economically advantaged or advancing societies who become more capable to protect against environmental hazards, but unknown for billions of other people who are exposed to THUNDERSTORM. The demarcation between those more or less at risk of disaster has been the focus of a long tradition of studies of disaster vulnerability. Which is absence in here; also this study of THUNDERSTORM would be too much technical so it will mound with tech and management and other branches- towards disaster management.

By hazard categories we therefore emphasize critical processes and outcomes that significantly disrupt human well-being over both brief and long time frames. Although hazards, risks, and disasters impact society, individuals, groups, institutions, and organizations offset the effects by becoming strong, organized, healthy, resilient, caring, and creative. Alternatively, political processes and societies become corrupt, inept, and dangerous, exacerbating the impacts of environmental changes on people who are forced to become more vulnerable. Corruption in particular is increasingly recognized as a cause of disaster.

The situation is dynamic such that disruptive innovations can arise from social organization that is challenged during times of crisis, as well as during times of relative calm. The process of learning an innovation in disaster management is part of the 'development' in disaster and development studies. A role of developing prevention and response activities is to "get development out of disaster," otherwise expressed by the United Nations in the following:

"A disaster with all its negative consequences offers a good opportunity to formulate forward-looking policy concepts pertaining to social development and equity, economic growth, environmental quality and justice, i.e. sustainability."

Living with Risk, UNISDR, 2002 p.21

Across the range of contributions, it is accepted that multiple approaches exist to the quantification and qualification of "risk." Although "disaster discourses" the context here is where the likelihoods and impacts of disruptive events are real, wide ranging, and large scale. Away from the challenge of definition, it is known that people around the world are exposed to hazards by force, coercion, or choice, being more or less vulnerable or resilient to the effects of environmental hazards on those terms. But there is rising question about human induce actors, which is very important and will take place for THUNDERSTORM.

In light of these global-level discussion, can be seen that progressive advocacy and awareness-raising have contributed to the increased understanding of DRR and other as cross-cutting matters that must be factored into all development sectors. These issues cannot be dealt with by isolating them from socioeconomic development. My belief is THUNDERSTORM will be the place among it; also it will get light for discussion and many.

3.1 Dual Management of Disaster Management

All UN agencies have incorporated many policies and strategies for mainstreaming many subjects into their respective development and humanitarian mandates. Since DRR cuts across all mandated areas of UN agencies, from development to post-disaster relief and recovery, this has provided an enabling environment for gender mainstreaming in DRR. Compared with other UN agencies, UNDP and UNISDR have clear DRR mandates. While UNDP focuses more on capacity building and integration of DRR into development planning and programming, particularly at country level, UNISDR has the mandate for coordinating the implementation of the International Strategy for Disaster Reduction (ISDR) and Hyogo Framework within UN agencies and governments. Following the January 2005 World Conference on Disaster Reduction, both UNDP and UNISDR have increased their efforts to support governments in mainstreaming gender into DRR.

1999 Geneva The 27th Conference adopted a Plan of Action for work by States and the Movement over the next four years. The plan contains specific tasks in three main areas:

- ___ the protection of victims of armed conflicts through the respect of humanitarian law
- ___ humanitarian action in times of armed conflicts and other disasters, and
- ___ strategic partnership to improve the lives of vulnerable people.

This IFRC could be an option for global respond. They have a status/structure commonly follow; they work with everyone in specific GENEVA CONVENTION:

1. Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field.
2. Geneva Convention for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea
4. 3. Geneva Convention relative to the Treatment of Prisoners of War
5. Geneva Convention relative to the Protection of Civilian and Persons in Time of War.

Geneva Convention could be a way to present THUNDERSTORM at global level, Organizations have assessment procedures or contingency plans including provisions for assessments, develop them so that are ready for the next emergency. If organization does have assessment procedures, improve them for the next emergency by adding any lessons identified. This way the organ works towards any hazards and disaster to manage.

IFRC could be attained the THUNDERSTORM as organ assessment for disaster management. Action plan could be this way from global level, then country level, keep space for regional partnership for research and implication. Framework discussed in this section connects LEVERs and damage from climate-related stressors to vulnerability, risk management, impacts, coping strategies, adaptation, and limits and constraints of adaptation. Academic debate might elaborate but not support disaster management.

Coping strategies are short-term responses to the impacts of sudden or unusual events. Adaptation refers to longer-term adjustments to permanent changes in the climate. Coping and adaptation, a third type of response involves the preventive measures, risk reduction. Households and other asset adopt in response to normal distinctiveness (including variability) of the climate and environment; now this all might go to climatic debate. Problem is how to use this disaster management. A management body like IFRC and United Nation works; problem is introducing new subject will not turn any stone for disaster management.

All resolutions, including establishing a working group to develop a solution to issues related to use of the emblems. Some States and National Societies have problems with the use of the emblem of the Red Cross or Red Crescent. The Council of Delegates gathers the representatives from the ICRC, the Federation and all other recognized National Societies. Government councils do not participate in its proceedings. The Council of Delegates meets every two years and focuses on issues of recent events and developments.

This take prolong way towards disaster management. The bureaucratic and other system need to work. At management level of government, NGOS and other cluster; need to be specific. The European Union (EU) is one of the Federation's major donors. It provides funding for the Federation's emergency relief operations, as well as for refugee, rehabilitation and development programmes, and disaster preparedness. The EU political organisation includes the **European Council**, the **European Commission** and the **European Parliament**. The Council is the institution in which the governments of the EU Member States are represented. This way THUNDERSTORM will get disaster status and get fund for research. So develop contacts with the European Union, the Federation and the EU National Societies established in 1983 the **Red Cross-EU Office** (previously **Liaison Bureau**) in Brussels. The Office works on behalf of the Federation Secretariat and the EU National Societies to ensure effective co-operation with the European Union and in particular the ECHO-Humanitarian AID Office, on activities and issues of common interest focusing on EU proposals, policies and priorities. In particular, this involves assisting in the formulation and coordination of requests for co-operation and financing in relation to disaster programmes.

Now we have to get data about THUNDERSTORM's destruction. Then in policy review local IFRC and BDRC can present for regular review, this will create option for discussion. Then the DM cycle and other will start rolling but the office also has other roles with regard to promoting co-operation between the National Societies within the European Union on a number of domestic areas, such as refugees, asylum seekers and migrants, youth, volunteering and first aid. Now THUNDERSTORM doesn't have this type of destruction. THUNDERSTORM is very much local and prompt. So it has to define as a disaster that is possible to response.

Chapter 4

Conclusion and Recommendation

5.1 Major Findings

Zonal and meridional winds were inferred from the LEVER winds, after somewhat indirect wind fitting. It was found that horizontal neutral wind vector fields estimated by both methods were still in good agreement and oscillations similar to those present in LEVER wind were also present in estimated wind components. The neutral wind behavior observed here was consistent with numerous studies. Also the LEVER wind has to be studied for Bangladesh Atmospheric Model.

5.2 Conclusion

This attribution to convection is higher than the ~30–36% lower limit from previous estimates (Torres et.al., 2005 and references therein). The reason for the higher value is that excess water vapor injected by the convective process can produce cirrus elsewhere—cirrus not obviously connected to active convection to THUNDERSTORM. The number and rate are dynamic, but only a single size mode is not enough to spatial and Map.

5.3 Recommendation

We save the ice, cloud, convective, zeta potential and water vapor mixing ratios, as well as number and rate at each climatic model time step. But it distributes where over Bangladesh is not surveyed so with fund from IFRC and UN we need to start those study. This time this is possible with meager capacity. Also if possible then any center status is very much welcome from any entities inside Bangladesh, because the local data is not proper as scientific work get support. We have to develop those. Both instruments observed additional short-period fluctuations in the LEVER winds. There were many instances when both instruments observed similar short-period fluctuation at the same time. This suggests that these fluctuations have atmospheric origin. The amplitude fluctuation of THUNDERSTORM was substantially higher than those observed AERONET. These short-period fluctuations are likely related to the existence of atmospheric gravity waves caused by auroral activity or gravity waves propagating from below.

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