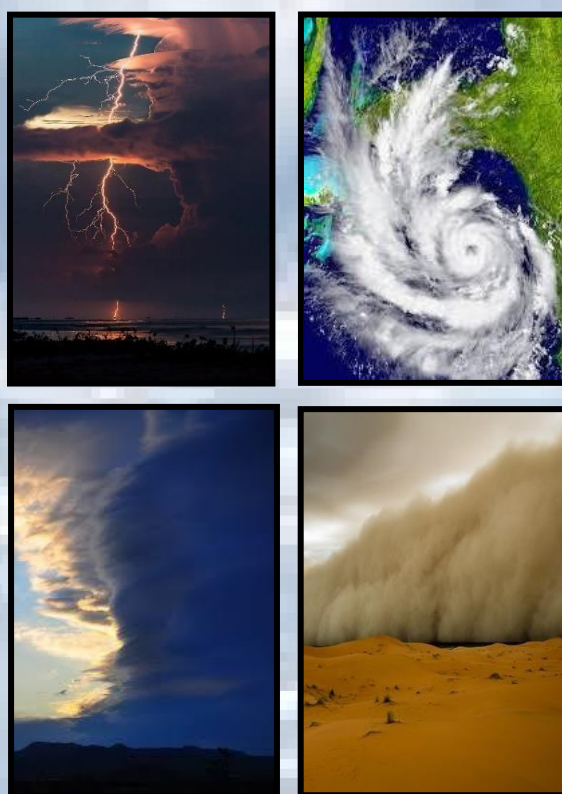# Department of Atmospheric Science
School of Earth Sciences

Annual Progress Report
2018-2019

Central University of Rajasthan

Bandarsindri, N.H. 8, (Jaipur Ajmer Highway)

Kishangarh - 305 817, Distt - Ajmer, Rajasthan (INDIA)

Contents

1. Introduction

The Department of Atmospheric Science was established at Central University of Rajasthan (CURAJ) in 2016 under the School of Earth Sciences with a 2-year M.Sc. program in Atmospheric Science. The Department also offers Ph. D. in Atmospheric Science. The objective of the programme is to promote interdisciplinary research in cutting-edge science & technology and public services. It encompasses numerical modeling of atmosphere and ocean, monsoon studies, high impact severe weather forecasting, air pollution, land-air-sea interaction, and climate change to understand its physical and social consequences. This program provides exposure to the students to a wide array of modeling from global to cloud resolving scale, regional climate modeling, monsoon, thunderstorms and cyclones, air pollution modeling, aerosol-climate interactions. The programme will also develop a strong research and capacity building in the area of climate science, a center for excellence in Severe Storms and Desert Meteorology. The department had only 2 faculties till June 2019. Three more faculties are recruited recently.

The department is in process of developing collaborations at National and International levels. Guest faculties are invited from Indian Institutes of Technology (IITs), India Meteorological Department, National Center for Medium Range Weather Forecasting, Indian Institute of Tropical Meteorology, Space Application Center, and other reputed institutions.

1.1 List of Core Faculties

Prof. Someshwar Das (Ph.D., IIT-Delhi)

Designation
Professor (Former HoD, Department of Atmospheric Science) and
Former Scientist-G, National Centre for Medium Range Weather Forecasting

Area of Specialization
Atmospheric Modelling; Cumulus Convection, Cloud Microphysics, Global Climate Modeling, Cloud Resolving Scale Modeling, Parameterization of Physical Processes in the Atmosphere, Numerical Weather Prediction, Severe Weather Systems, Medium Range Weather Forecasting.

Dr. Devesh Sharma (Ph.D., AIT-Bangkok)

Designation
Associate Professor
Present HoD, Department of Atmospheric Science

Area of Specialization
Hydrological Modelling, Climate Change and Water Resources, Climate Change Impact Studies.

Dr. Subrat Kumar Panda (Ph.D., IIT-Delhi)

Designation - Assistant Professor

Area of Specialization
Regional climate change modelling, Climate change, Indian Monsoon Studies, Climate analysis using observations and modelling output.

Dr. Chinmay Mallik (Ph.D., PRL-Ahmedabad)

Designation - Assistant Professor

Area of Specialization
Atmospheric Chemistry, Atmospheric oxidation and self-cleansing mechanisms, Air Pollution, Atmospheric Trace gases.

The Department is supported by other sister departments of the University. These are
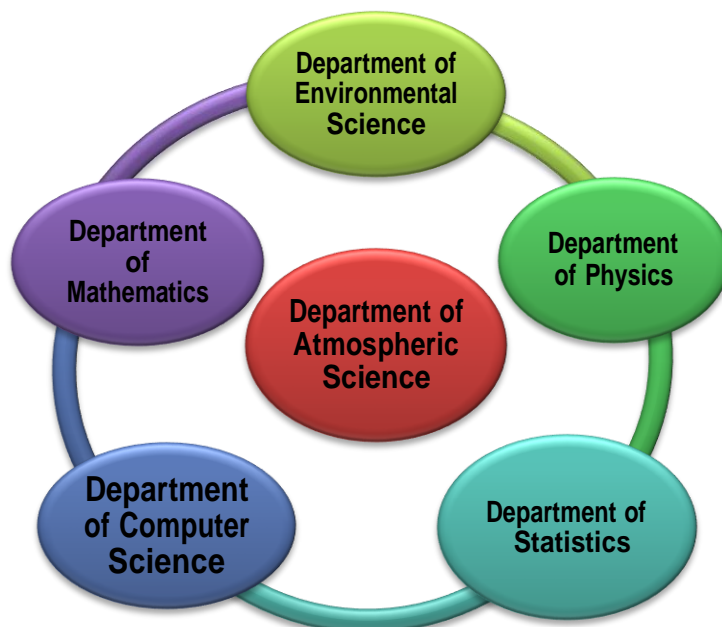
2. Board of Studies and the School Board

All academic and research activities of the department are guided by Board of Studies and School Board. Following are the members of the Board of Studies and the School Board.

Table 1: - Members of the Board of Studies of the Department

S.No.	Name	Address/ Affiliation
1	Prof. S. K. Dash	Emeritus Professor, IIT, Delhi
2	AVM (Dr.) Ajit Tyagi	Former Director General of Meteorology, India Meteorological Department & President, Indian Meteorological Society
3	Dr. L. K. Sharma	Dean, School of Earth Sciences, CURAJ
4	Prof. Someshwar Das	Head, Department of Atmospheric Science, CURAJ
5	Dr. Subrat Kumar Panda	Department of Atmospheric Science, CURAJ
6	Prof. J.K. Prajapat	Department of Mathematics, CURAJ
7	Mr. Ravi Saharan	Department of Computer Science and Engineering, CURAJ

Table 2: - Members of the Board of School of the Earth Sciences

S.No.	Name	Address/ Affiliation
1	Prof. U. C. Mohanty	IIT, Bhubaneswar
2	Dr. L. S. Rathore	Former Director General of Meteorology, IMD, Consultant (World Bank), Advisor (NDMA)
3	Prof. P. K. Joshi	School of Environmental Sciences, JNU
4	Prof. K.C. Sharma	MDS University, Ajmer
5	Prof. A. B. Gupta	MNIT, Jaipur
6	Dr. L. K. Sharma	Dean, School of Earth Sciences, (CURAJ)
7	Prof. Someshwar Das	Head, Department of Atmospheric Science, CURAJ
8	Prof. Manish D. Shrimali	Department of Physics, CURAJ
9	Prof. Vipin Kumar	Department of Pharmacy, CURAJ
10	Dr. Subrat Kumar Panda	Department of Atmospheric Science, CURAJ
11	Dr. Garima Kaushik	Department of Environmental Science, CURAJ

The meetings of the Board of Studies and the School Board is generally held once a year. The last meeting of the Board of studies was held on 18 Dec2017, and the last meeting of the School Board of Earth Sciences was held on 17 Feb 2018. Annexure-2 provides the syllabus of M.Sc. and Ph.D. programmes of the department as approved by both the boards.

3. Number of students admitted

During the Academic year 2018-2019, total seats for M.Sc students were increased from 10 to 15. Six students were admitted for M.Sc. programme during the year 2017-2018, which increased to 9 during the year 2018-2019. The number of students admitted in the department in different academic years is shown in Fig. 1.
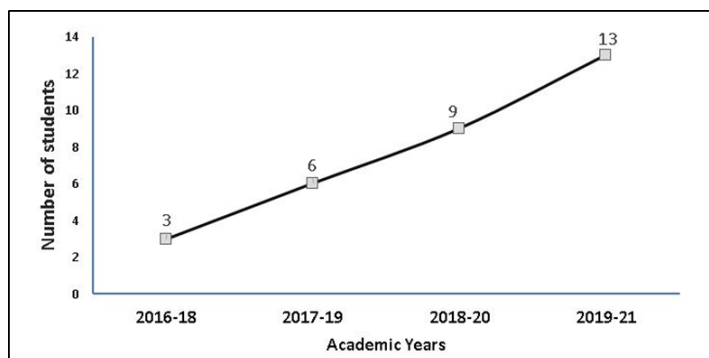
Figure 1: - Number of students admitted in M.Sc. (Atmospheric Science)

The list of students admitted during 2018-2019 are given in Annexure-1 (Table-A1.1). No students were admitted for Ph.D. programme during 2018-2019 as none were found suitable. Three stduents were admitted in academic year 2019-20.

4. List of Academic activities

4.1 International and National Workshops/ Conferences Organized

The department has organized four major events during the academic year 2018-2019, which are listed in Table-3. Fig. 2 shows the number of workshops/ seminars organized by the department in different academic years.
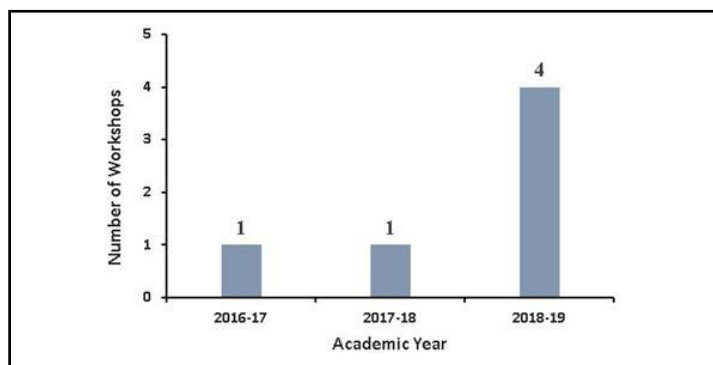
Figure 2: - Number of Workshops/ Seminars/ conferences organised in different academic years

The international conference listed in serial number 2 (Table-3) was a part of the multi-national, multi-institutional collaborative project involving India, Japan, Nepal and Bangladesh. The SERB School (S.N. 3) had 45 participants and 25 Resource Persons (experts who delivered lectures) from all over the country.

Table 3: - List of Conference/ Workshop/ Symposium organized

S.No.	Name of the Conference/ Workshop	National/ International	Sponsors / Co-Sponsors	Date
1	Special Session on "Extreme Weather Systems", 6th Rajasthan Science Congress held at Central University of Rajasthan.	National	Central University of Rajasthan, Indian Meteorological Society (IMS), and National Disaster Management Agency (NDMA)	13-15 Oct 2018
2	International Workshop on "Extreme Severe Storms and Disaster Management Strategies"	International	Disaster Prevention Research Institute (DPRI), Kyoto University, Japan	24-26 Dec 2018
3	SERB School on "Desert Storm and Cloudburst"	National	Science & Engineering Research Board (SERB), Department of Science & Technology, Govt. of India	11-23 Feb 2019
4	International Workshop on "Water-Energy-Food Nexus Perspective: Path Making for Sustainable Development Goals (SDGs) to Country Actions in Asia"	International	Asia Pacific Network for Global Change Research (APN)), Japan and Institute for Global Environmental Strategies (IGES), Japan	25-26 June 2019

4.2 Educational Tour

The department has conducted educational tour to the Meteorological Centre (India Meteorological Department), Jaipur for the students of the department of Atmospheric Science as follows.

Table 4: - Educational Tour

S.No.	Theme/event name	Organizer/coordinator if any	Date
1	Meteorological Centre (India Meteorological Department), Jaipur	Department of Atmospheric Science	11 April 2019

4.3 Special Day Celebration

The department celebrated the World Meteorological Day on 8th April instead of 23rd March 2018.

Table 5: - Special Day Celebration

S.No.	Theme/event name	Organizer/coordinator if any	Date
1	World Meteorological Day on the theme "The Sun, the Earth and the weather"	Department of Atmospheric Science	8th April instead of 23 March 2019

4.3 Short Training attended by the Students

The students of the department attended different trainings relevant to the subject onsite as well as online. Fig. 3 shows the number of trainings attended by the students in different academic years. The details are given the Table-5 for the academic year 2018-2019.
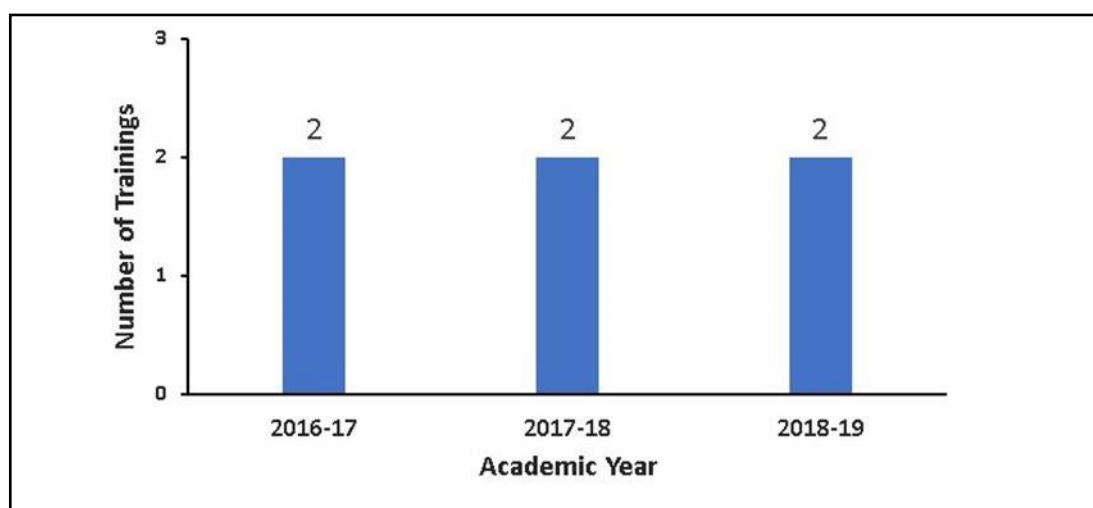
Figure 3: - Number of Trainings attended by students

Table 6: - Short Trainings of the Students

S.No.	Theme/event name	Organizer/coordinator (if any)	Date
1	International Workshop on Cloud Dynamics, Micro-physics and Small-Scale Simulation	Indian Institute of Tropical Meteorology, Pune	13 - 17 August 2018
2	Online training on "Basics of Remote Sensing, Geographical Information System and Global Navigation Satellite System"	Indian Institute of Remote Sensing (IIRS), Dehradun	20 Aug – 16 Nov 2018

4.4 Internships at Eminent Institutes/ Laboratories

The students of M. Sc. carried out their internships at the following eminent institutes during the summer vacation.

Table 7: - Internships carried out by students during summer vacation (15 May-15 July 2019)

S.No.	Name of the StudentS	Name of the Institutes	Title of Work	Scholarships (Yes/ No)
1	Ashish Ranjan	National Centre for Medium Range Weather Forecasting (NCMRWF), NOIDA-Delhi	Analysis of the tropical cyclone FANI using operational outputs of Regional-NCUM	No
2	Ankit Patel	Physical Research Laboratory (PRL), Ahmedabad	Characterization of atmospheric aerosol over a remote location, Port Blair	Yes
3	Vinay	India Meteorological Department (IMD), New Delhi	Doppler Weather Radar Image Interpretation & Study of WRF Data Assimilation	No
4	Suman Saurabh	National Centre for Medium Range Weather Forecasting (NCMRWF), NOIDA-Delhi	Simulation of ATMS brightness temperature using RTTOV	No
5	Sohan Pal Meena	National Centre for Medium Range Weather Forecasting (NCMRWF), NOIDA-Delhi	Spatial verification of Rainfall season 2018 over Indian region using CRA Method	No
6	Musaid P P	Advanced Centre for Atmospheric Radar Research (ACARR) Cochin University of Science and Technology Cochin, Kerala, India.	Investigation of influence of west Pacific Typhoons on the 2018 Kerala Flood using WRF Model	No
7	Saswat Dash	Indian Institute of Tropical Meteorology (IITM), Pune	Study to investigate the issues in model reanalysis at the time of cyclone landfall	No
8	Sanjukta Ghosh	Indian Institute of Tropical Meteorology (IITM), Pune	Simulation and analysis of Western disturbance	No
9	Sumitra Sharma	Physical research Laboratory (PRL), Ahmedabad	Investigation of Atmospheric boundary layer over Ahmedabad	Yes

4.5 M. Sc. Students Projects

The Final year (4th Semester) students of M.Sc. carried out their project work in the department during January – May 2019 on the following topics.

Table 7A: - Title of M.Sc. Projects by the students (Jan – May 2019)

| S.No.	Name of the Students	Title of the Projects	Supervisor/ Co-Supervisor
1	Ashish Shaji	Simulation of Series of Thunderstorms over Delhi During May 2018 using WRF Model	Dr. Subrat K. Panda/ Prof. Someshwar Das
2	Athul C. P.	Numerical Simulation of Cloudburst Event over Munsiyari, Uttarakhand using WRF Model	Dr. Subrat K. Panda/ Prof. Someshwar Das
3	Chandni Chandran	Simulation of Clear Air Turbulence for Mitigation of Aviation Weather Hazard Using Weather Research and Forecasting (WRF) Model	Prof. Someshwar Das/ Dr. Subrat K. Panda
4	Jigisha Dhakar	Simulation of a Severe Winter Hailstorm Event over Delhi using Weather Research and Forecasting Model	Dr. Subrat K. Panda/ Prof. Someshwar Das
5	Merlin Jestice	The Simulation of Heavy Rainfall Event over Kerala using WRF Model	Prof. Someshwar Das/ Dr. Subrat K. Panda
6	Midhun M	Sensitivity Analysis of Parameterization Schemes in the Simulation of Winter Fog Events over Delhi using WRF Model	Prof. Someshwar Das/ Dr. Subrat K. Panda
7	Rajni Prajapat	Analysis and Detection of Change Point on Daily Temperature data over four cities of Rajasthan: The role of Atmospheric-Oceanic Phenomena	Dr. Deepesh Bhati & Dr. Subrat Kumar Panda

In addition to above, 7 students of M.Sc. (Final year) from Department of Meteorology, University of Dhaka, Bangladesh also carried out their project works at the Department of Atmospheric Science, CURAJ as part of the MoU signed between CURAJ and University of Dhaka during 25 March to 27 June 2019. The title of their projects are listed in Table 7B.

Table 7B: - Title of M.Sc. Projects by the students of University of Dhaka, Bangladesh

S.No.	Name of the Students	Title of the Projects	Supervisor/ Co-Supervisor
1	Javed Meandad	Study on the Relationship between Lightning Flash Rate and Cloud Microphysical Parameters Derived Through WRF Model	Prof. Someshwar Das/ Dr. Subrat Kumar. Panda
2	K. M. Golam Rabbani	Study on Physical & Dynamical Properties of Pre-monsoon Thunderstorm over Bangladesh using WRF-ARW Model	Prof. Someshwar Das/ Dr. Subrat Kumar Panda
3	Tanzim Rahman Fariha	A Study on Tropical Cyclone Track and Intensity Forecasting Technique in the Bay of Bengal	Prof. Someshwar Das/ Dr. Subrat Kumar Panda
4	Saurav Dey Shuvo	A Study on the Application of Numerical Models for Analyzing Flash Flood Events in Bangladesh	Dr. Subrat Kumar Panda/ Prof. Someshwar Das
5	Syeda Sabrina Sultana	Simulation of Hailstorm Event During Pre-monsoon Period over Bangladesh	Dr. Subrat Kumar Panda/ Prof. Someshwar Das
6	Umme Farzana Siddiqua Ela	WRF Model Performance in Simulating the Interannual Variability of Summer Monsoon over Bangladesh: The Role of ENSO & IOD	Dr. Subrat Kumar Panda/ Prof. Someshwar Das
7	Zannatul Ferdoushi	Analysis of Active and Break phases of Southwest Summer monsoon over Bangladesh for the Year 2011, 2012, and 2013	Dr. Subrat Kumar Panda/ Prof. Someshwar Das

5. National/ International Collaborative Projects

Faculties of the department obtain extramural funding for their research. Fig. 4 shows the number of extramural funded projects and the budgets in different academic years.
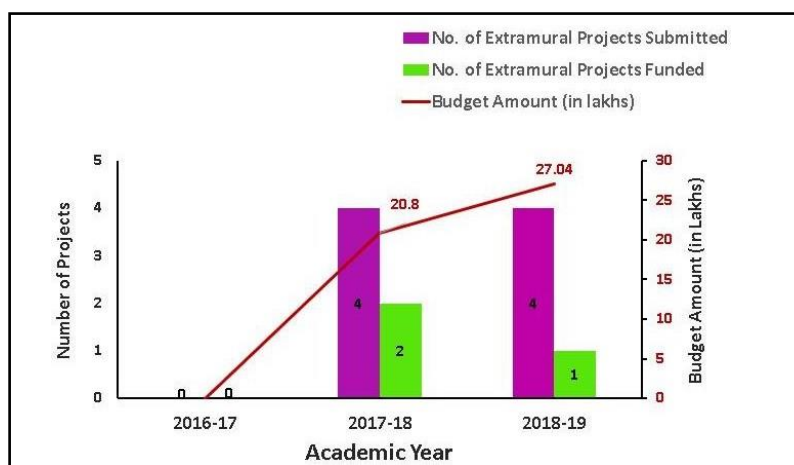
Figure 4: - Number of extramural projects and the budgets in different academic years

The department has developed multi-national, multi-institutional collaborative projects funded by the Disaster Prevention Research Institute (DPRI), Kyoto University involving Japan, India, Nepal, Bangladesh, and Vietnam. The projects are summarized below.

Table 8: - International Projects approved/ ongoing/ under submission

S.No.	Title of the project	Lead Collaborators/ PI	Duration	Funding Agency and Project Budget	Status
1	Towards the International Collaboration to the Implementation of the Early Warning System for the South Himalayan Cloudburst Disaster	Prof. Someshwar Das (CURAJ), and Collaborators from Japan, India Bangladesh and Nepal	April 2018 – April 2020	Disaster Prevention Research Institute, Kyoto University, Japan (3252,000 (YEN)	Ongoing
2	Water-Energy-Food Nexus Perspective: Path Making for Sustainable Development Goals (SDGs) to Country Actions in Asia	Dr. Devesh Sharma (CURAJ), and Collaborators from IGES, Japan, Bangladesh, Vietnam and India	2016 - 2019	Asia Pacific Network for Global Change Research (APN) 80,000 USD	Ongoing

Table 9: - National Projects ongoing / submitted

S.No.	Title of the project	Lead Collaborators/ PI/ Coordinators	Duration	Funding Agency and Project Budget	Status
1	Detection of Changes of Climate and its Extremes in the Different Eco-Regions of India	Dr. Subrat KumarPanda	2018 – 2021	U.G.C Start Up (Rs. 10 Lakhs)	Ongoing
2	Climate Change Impact Studies for Rajasthan (Area of Inland Drainage and Mahi basin)	Dr. Devesh Sharma with MNIT (Jaipur), and IIT-Delhi	2018 - 2021	INCCC (MoWR), Rs 30 Lakhs	Ongoing
3	Understanding and Prediction of Hot Spots of Severe Thunderstorms and Lightning over different Regions of India.	Prof. Someshwar Das and Dr. Subrat Kumar Panda	2019-2022	MoES (Rs. 85.8 Lakhs)	Submitted
4	Capacity building of Atmospheric Science at Central University of Rajasthan	HoD (Department of Atmospheric Science)	2019-2024	MoES	Being Revised

5	Numerical Modeling of Desert Storms and Cloudbursts (2 weeks Training workshop)	Prof. Someshwar Das and Dr. Subrat Kumar Panda	11-23 Feb 2019	SERB/ DST (Rs. 16.30 Lakhs)	Completed

6. Memorandum of Understandings (MoUs)

The Department has signed Memorandum of Understandings (MoUs) with national and international institutions to carry out joint research in different fields. Table-10 shows the list of MoUs signed by the department between CURAJ and different institutions.

Table 10: - Memorandum of Understandings (MoU)

S.No.	Name of the Collaborating University/ Institute	Lead Coordinators	Duration	Status
1	Central University of Rajasthan and University of Dhaka, Bangladesh	Prof. Someshwar Das & Prof. Tohida Rashid	2018 – 2023	Ongoing
2.	Indian Institute of Tropical Meteorology, Pune	Prof. Someshwar Das & Dr. S. D. Pawar	2019 – 2024	Approved

7. Research Contributions/ Highlights

Faculties and students of the department carry out many important projects relevant to the understanding of science and need of the country. Some of the important results are highlighted below.

7.1 Estimation of Wind Power Potential over Rajasthan by WRF Model
(M.Sc. project by Pradeep Attri; January to May 2018)

Fulfilling the requirement of electricity is an important act in supporting development of any nation. The requirement is mainly fulfilled by thermal and hydel power. In recent years India has moved from non-renewable energy resources to the clean and renewable energy. Different options are available to us like solar, wind and tidal etc. Solar energy which is obtained from sun is renewable and a reliable source but during the times of bad weather, cloudy conditions and night times it becomes difficult to rely on solar power. Wind power can be produced during cloudy conditions and night times as well. This study addresses this problem in India focusing on Rajasthan where companies like Suzlon Energy and Wind World are located. Here Estimation of Effective Wind Power Density at 50, 80, 100 metres height above ground level (AGL) are determined and 24hour forecast is generated with the help of Weather Research and

Forecasting (WRF) model. Fig. 5 shows the observed and forecast (24 hour) wind power density at 80 and 100 m above the ground over Rajasthan.

(C) Observation 80m   (D) Forecast 80m

(E) Observation 100m   (F) Forecast 100m
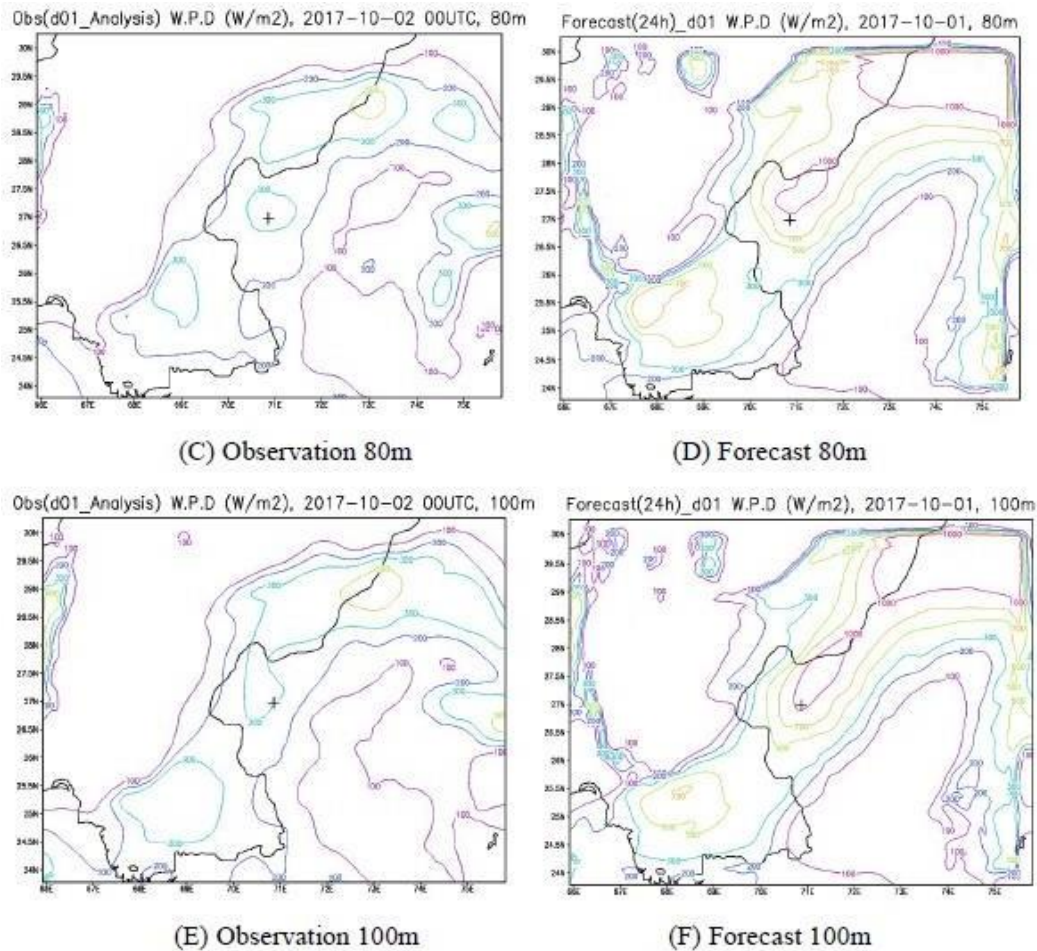
Figure 5: - Observed and predicted (24 hour) wind power density at 80 and 100 m above the ground over Rajasthan using WRF model

7.2 Impact of Dust on Cyclone Ockhi based on WRF-Chem Model
(M.Sc. project by Archana Tripathi, January to May 2018)

Ockhi was a Very Severe Cyclonic Storm (VSCS), which originated over southwest Bay of Bengal on 28th Nov 2017, crossed Sri Lanka coast, emerged into the Comorin area on 29th, and intensified into a Severe Cyclonic Storm over Lakshadweep area. It travelled across the Arabian Sea and crossed South Gujarat coast near Surat on 6th Dec. Ockhi also caused stirring up dust plumes after crossing the coast. The smog and haze caused air pollution in the northern India. Most of the aerosol particles were washed out of air by heavy rainfall and strong wind. Dust plumes and sand streams also blew out from Pakistan and Iran over the Arabian Sea. In this study the WRF) model (version 3.9.1.1) coupled with WRF Chemistry (3.9.1) is used to

understand the impact of dust on cyclone Ockhi during landfall. Fig. 6a shows the maximum sustained wind and the mean sea level pressure of cyclone Ockhi.
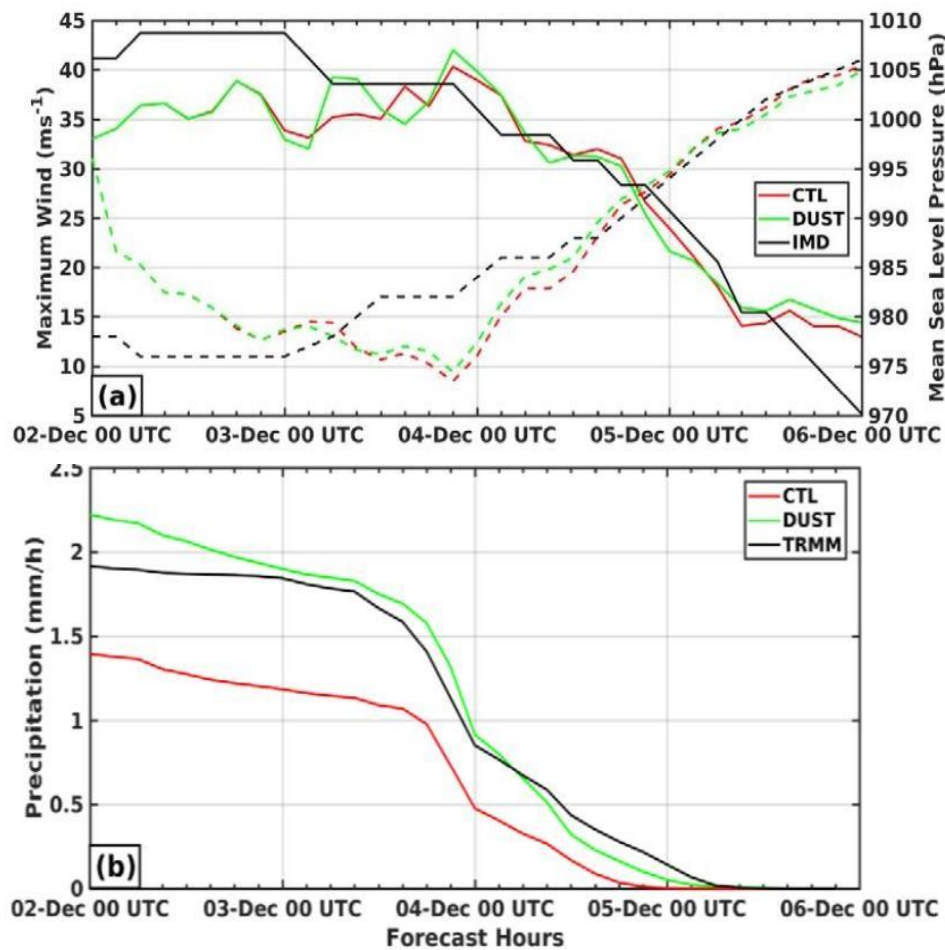
Figure 6: - (a) The bold lines represent maximum sustained wind (ms-1) and the dashed lines represent mean sea level pressure (hPa). Red is for CTL, green is for DUST and black is for IMD. (b) Domain averaged precipitation rate (mm/h) for CTL and DUST along TRMM data

The Figure shows 6 that DUST simulates a slightly stronger cyclone as compared to CTL. Inclusion of DUST simulates Mean Sea Level Pressure (MSLP) values closer to IMD data in Day 2 and Day 3 forecasts. Fig 6b shows that the inclusion of dust also yields better precipitation forecasts. It signifies the importance of the dynamical interactions between dusts that can act as a Cloud Condensation Nuclei (CCN) in severe weather events like cyclones. This study showed significant contribution of dust in modulating the cyclone's dynamics and thermodynamic properties and in enhancing the precipitation of the cyclone.

7.3 Numerical Simulations of Cloudbursts using the WRF Model
(M.Sc. projects by M. Ganesan, January to May 2018 and Athul C. P., January to May 2019)

Cloudbursts are most devastating phenomena that often lead to flash floods and landslides over the Himalayan region. These events are often difficult to forecast with sufficient lead time.

Many Cloudburst events occurred over Uttarakhand region (Tehri; 22-23 July 2015, Pithorogarh; 30th June-1st July 2016 & 13-14 Aug 2017, and Munsiyari; 2nd July 2018). In this study, the WRF model was used to simulate the cloudburst events over Uttarakhand region. The sensitivity of different cloud microphysics schemes (WSM3, WSM6 and TROPICAL Suite) in predicting the rainfall due to the cloudburst event of Munsiyari (2nd July 2018). Fig. 7 shows the Equitable Threat Scores of different cloud microphysics schemes for different threshold values of rainfall forecasts using the WRF model.
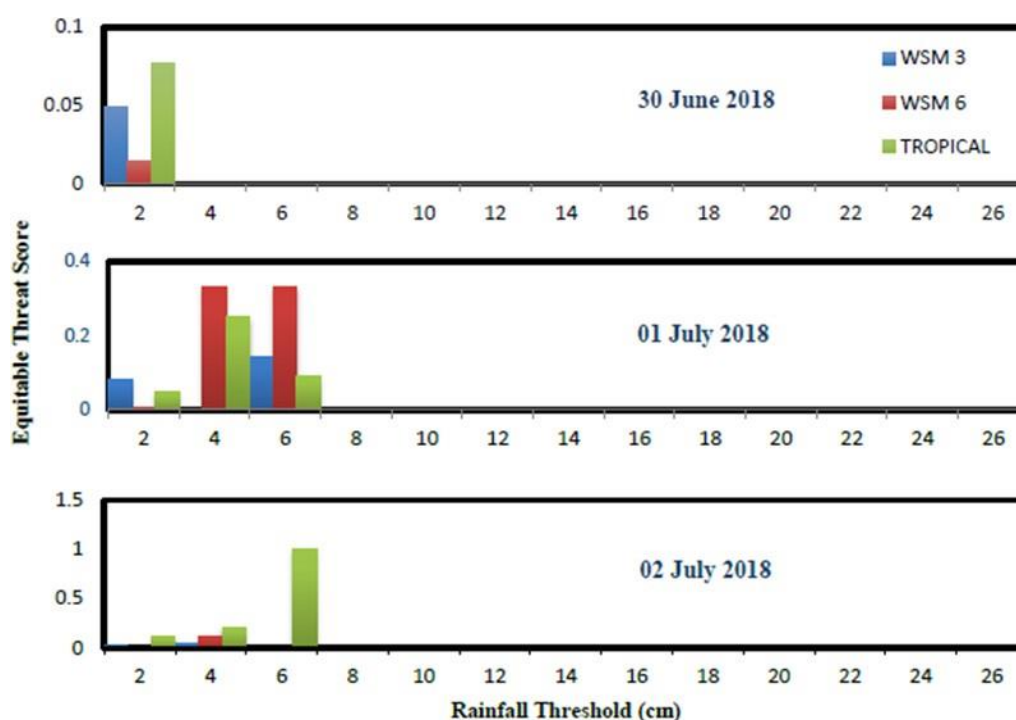
Figure 7: - Equitable threat Scores of the WSM3, WSM6 and TROPICAL suite from 30 June 2018 to 02 July 2018

7.4 Simulation of a series of Pre-Monsoon Thunderstorms and Dust-storms
   (M.Sc. projects by Ashish Saji; January to May 2019)

This study investigates a series of severe thunderstorms that affected the Indian capital Delhi and the adjoining regions such as Agra, western parts of Uttar Pradesh (UP), Eastern parts of Rajasthan, etc. during the month of May 2018. The chain of powerful thunderstorms pounded parts of north and north-west India on 2nd May 2018 killing at least 117 people and leaving a trail of destruction in at least six states (Uttar Pradesh, Rajasthan, Uttarakhand, Madhya Pradesh, Punjab and Haryana). Of the 75 deaths in UP, 46 were reported from the Agra division. The storms were simulated based on different using different cloud microphysical schemes (Milbrandts, Morrison 2-moment scheme and WSM3 Scheme) based on the WRF

model (version 4.0) at 1, 3 and 9 km resolutions. Fig. 8 shows the hourly wind speed and direction simulated by the model over NCR Delhi at 1 km resolution on 2nd May 2018.
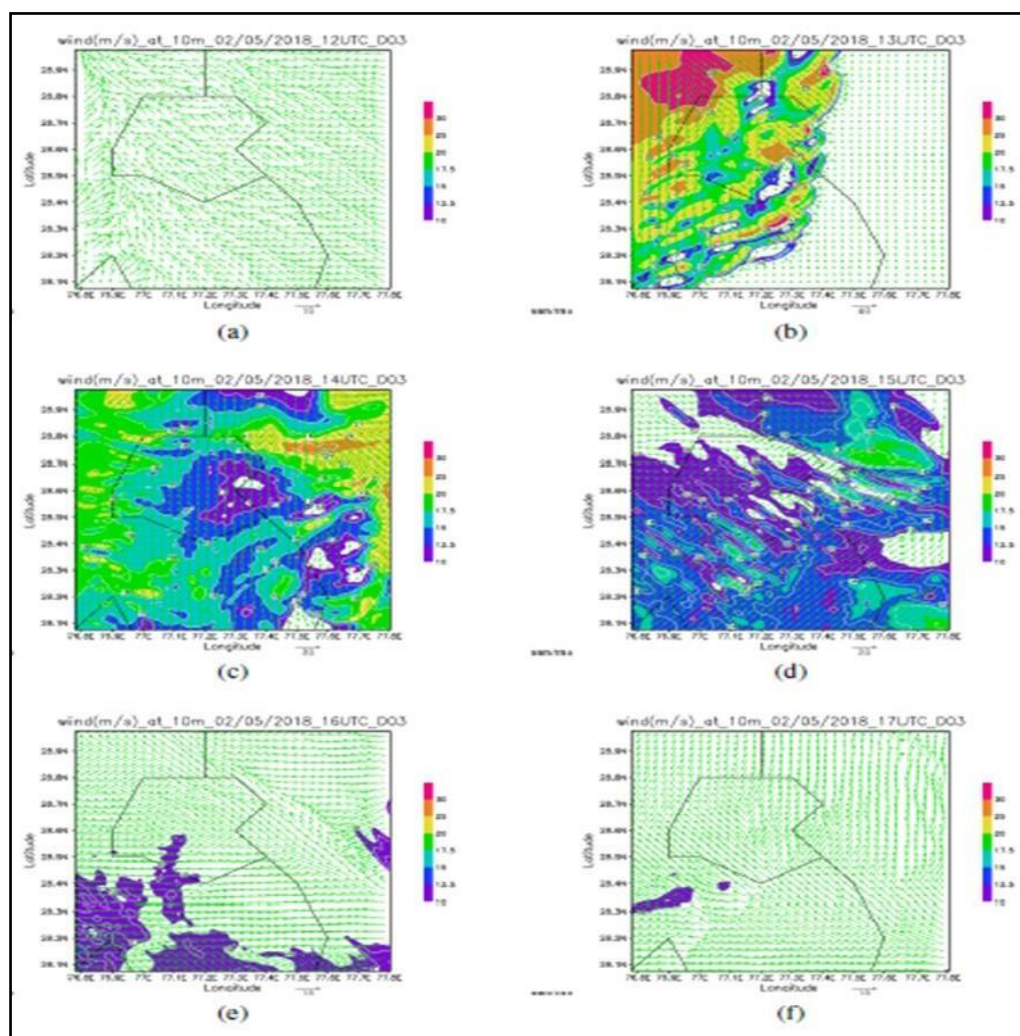
Figure 8: - Wind at 10m simulated over NCR Delhi region at 1 km resolution on May 2 using Milbrandt Scheme based on the WRF model

Results showed that the Milbrandts Scheme was able to predict these thunderstorms in a better way when compared to other schemes.

7.5 Simulation of severe Hailstorms over India and Bangladesh
   (M.Sc. projects by Jigisha Dhakar, January to May 2019 and Syeda Sabrina Sultana; March to June 2019)

Hailstorm is a mesoscale phenomenon, usually observed for a very short duration of time. If the magnitude of size and density of hailstone is large, it can cause severe damage to life and infrastructure as well as agricultural crops. In this study several cases of Hailstorms that occurred over NCR Delhi and Bangladesh were simulated using the WRF model at 2, 6 and 18 km resolutions. Fig 9 shows an event that occurred over NCR Delhi on 7th February 2019.

Figure 9: - Hailstorm over Delhi NCR on 7th February 2019 (10-12UTC, left panel) and as observed by the Doppler Weather Radar of Delhi (right panel)
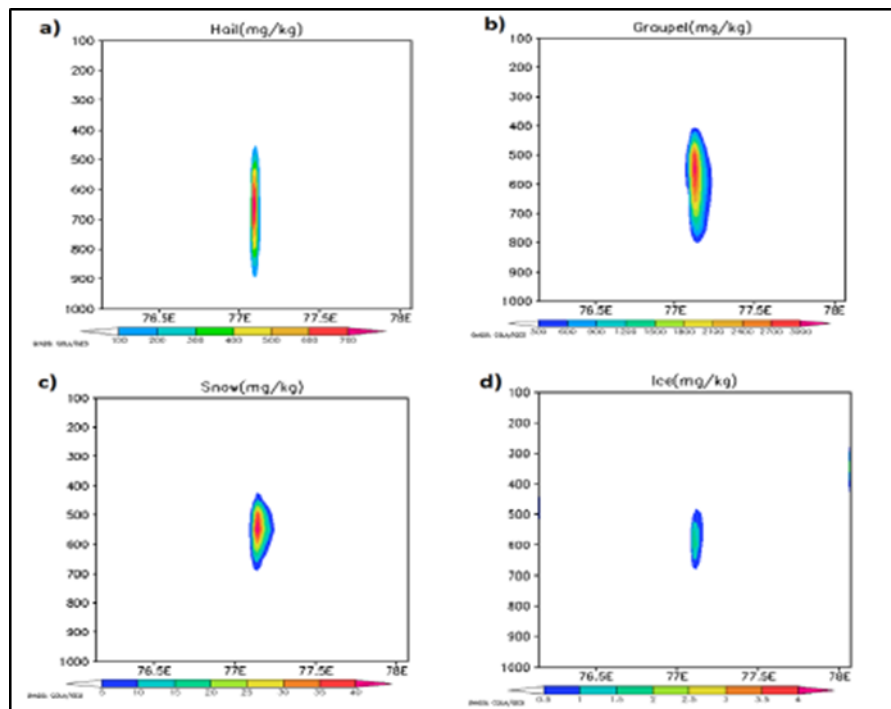
Figure 10: - Cloud hydrometeor mixing ratio (in mg/kg) valid on 10Z of 7th Feb 2019 at latitude 28.65N and varying longitude for (a) hail, (b) graupel, (c) snow, (d) ice

Figure 10 shows four hydrometeors: hail, graupel, snow, ice, simulated by the model. Hail is seen in between 900 – 450 hPa with peak value of 700 mg/kg. The height of the cloud can be determined by the lowest and highest pressure level at which these hydrometeors are simulated. It starts from 900hPa and extends up to 400hPa simulating the depth of cloud about 6km. These values must be validated based on observations.

7.6 Simulation of Heavy Rainfall over Kerala
(M.Sc. project by Merlin Jestice, January to May 2019)

The south Indian state of Kerala experienced a devastating flood during August 2018. It was the worst flood that the state experienced in 100 years. ERA- Interim data was used to find out the synoptic conditions that led to the heavy rainfall events. Numerical simulation of the event was carried out using the WRF model at single domain of 25 km resolution and different cloud microphysics schemes up to 120 hours. Fig. 11 shows the rainfall anomaly predicted by the model up to Day-1, Day-3 and Day-5 for 15 and 16 August 2018.
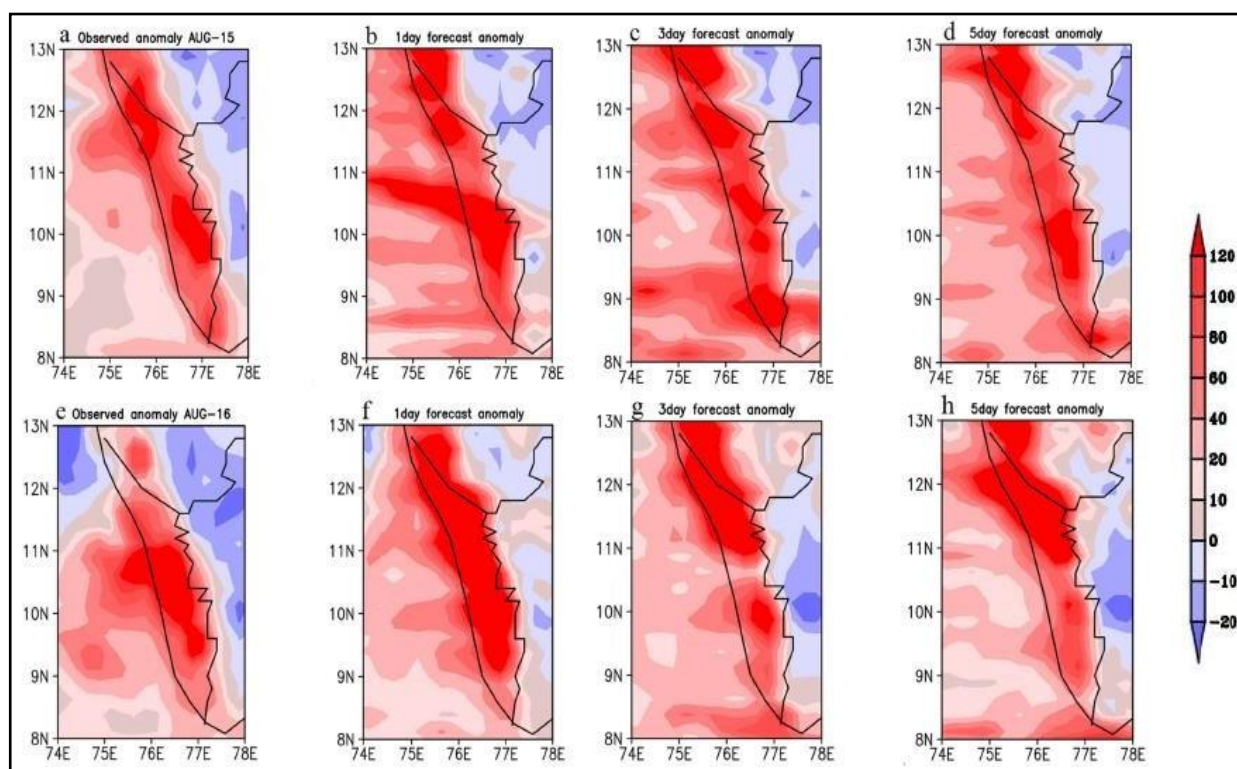
Figure 11: - Rainfall anomalies: Observed (a, e), 1day forecast (b, f), 3 day forecast (c, g), 5 day forecast (d, h) for 15 and 16 August 8 and August 2018

Ten years of TRMM rainfall data is used for the calculation of anomalies. Thompson Microphysics is used for plotting anomalies because this scheme provided better precipitation distribution compared to the observed. Results showed that the model predicted anomalies were higher than the observed values during 14-19 August 2018.

7.7 Simulation of Winter Fog over Delhi
(M.Sc. project by M. Midhun; January to May 2019)

Delhi and the entire Indo-Gangetic Plains are vulnerable to dense fog events, especially during winter season. Aviation sector is most affected by fog. The Ministry of Earth Sciences, Government of India initiated Winter Fog Experiment (WIFEX) in 2015-16 winter season with

an aim to develop a better nowcasting of fog. The numerical weather prediction of fog is still a mirage. Selection of microphysics scheme, PBL parameterization scheme and land surface model is very essential for the accurate prediction of fog.
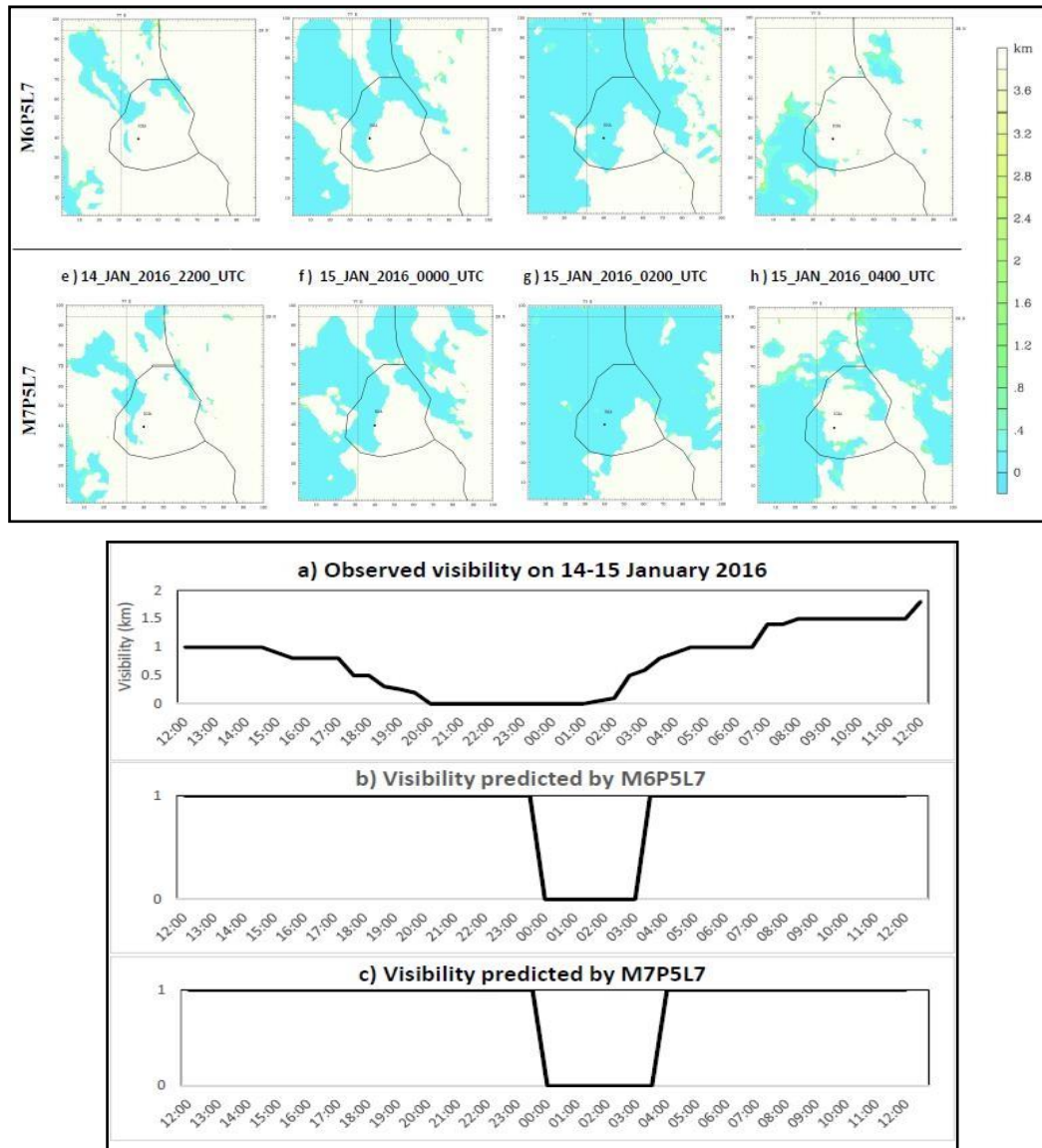
Figure 12: - Upper 2 panels show Model predicted spatial extent of fog on 14-15 January 2016; (a - d) Visibility (km) predicted by M6P5L7 and (e – h) Visibility (km) predicted by M7P5L7 at different time intervals (forecast starting from 14 January 2016, 1200 UTC). The lower 2 panels show Comparison of onset, duration and dissipation of dense fog at Delhi Airport (28.56N, 77.11E) on 14-15 January 2016. (for b and c, 1 = clear, 0 = dense fog)

In this study, we have attempted sensitivity tests with WRF model for microphysics, PBL and land surface parameterization schemes at 1, 3 and 9 km resolutions. The ability of WRF model to predict visibility is analysed by simulations of 4 dense fog events that occurred during January 2016 over Delhi. Fig. 12 shows the spatial distribution and time series of visibility predicted by the model at 1 km resolution over NCR Delhi.

7.8 Simulation of Clear Air Turbulence for Mitigation of Aviation Weather Hazards
(M.Sc. project by Chandni Chandran, January to May 2019)

Clear Air Turbulence (CAT) is the sudden severe turbulence occurring in cloudless region that causes violent buffeting effect in aircraft. CAT took life of thousands of people and caused many aircraft accidents because its forecasting is difficult. This study is aimed to simulate a turbulence event that occurred on 26th February 2019 on GoAir flight G8761. The WRF Model V 4.0 is used to simulate the turbulence at 2 and 6 km resolutions. Fig 13 shows the spatial distribution of CAT index simulated by the model at different forecast times at 350 hPa. The Figure also shows the time series of CAT index at Bhubaneswar, Kolkata and at the location where the aircraft encountered CAT (marked by 'K') during its flight.

Figure 13: - Upper panel shows the spatial distribution of CAT simulated by the model at different times. The dotted circle indicates the region where the aircraft encountered the CAT on 26 Feb 2019. Lower panel shows the time series of CAT index at Bhubaneswar, Kolkata and at the location where the aircraft encountered CAT (marked by 'K') during its flight

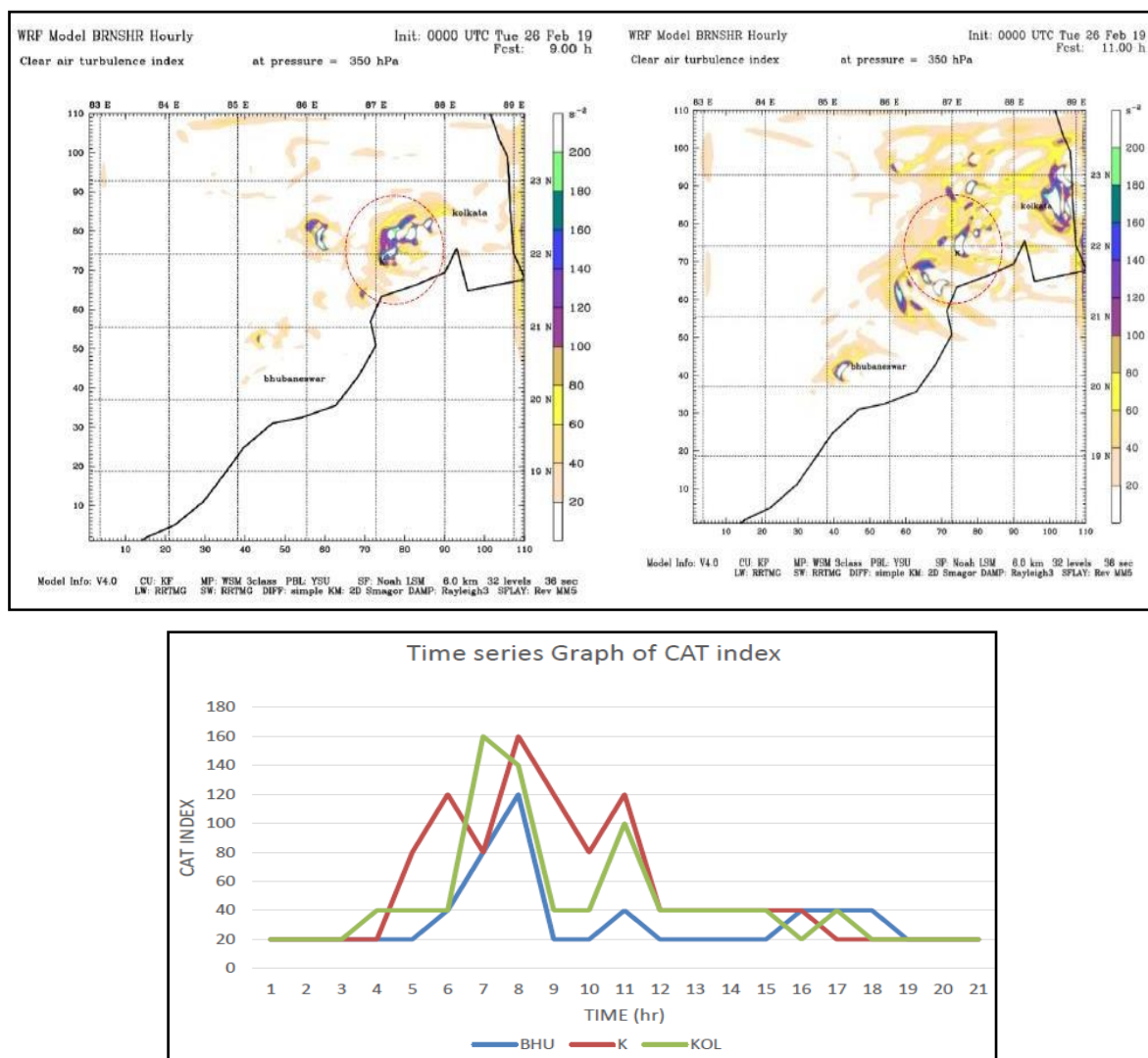**7.9 Analysis and prediction of Lightning flash density rate based on WRF Model**
  (M.Sc. project by Javed Meandad, March to June 2019)

Lightning is a massive spark of electricity that occurs in the atmosphere. Lightning can occur within clouds, cloud to cloud and cloud to ground. It is one of deadliest form of natural disaster. Study shows that almost 100 lightning flashes are occur every second over the globe. In this study WRF model is used to determine the relationship between lightning flash occurrences and simulated cloud microphysical parameters. Also lightning climatology based on last 20 years (1995-2015) are analyzed to locate the lightning hot spot over Bangladesh and its seasonal variation. Lightning flash rate shows highest magnitude over Sunamganj district of Bangladesh during pre-monsoon season. In this study, international Space Stations (ISS) Lightning Imaging Sensor (LIS) derived lightning flashes are compared with the model derived reflectivity, rainfall and CAPE. These variables have strong relations with the lightning occurrences. Results show that lightning is highly sensitive to cloud microphysical properties especially cloud, graupel, ice and snow mass. The correlation between lightning flash rate and vertically integrated cloud + graupel + ice + snow (kg/kg) ranges from 0.84 to 0.98 for different cases. A prediction model based on fitting probability distribution method has been constructed to forecast the probability of the lightning flash count based on 9 events of severe lightning flashes over Bangladesh.

For building a forecasting technique based on all nine cases, fitting of probability distribution (probability model) method was used. Here lightning flash count (say X) follows Relay distribution.

$$f(x|y) = \frac{2x}{\lambda y} e^{-\frac{x^2}{\lambda y}}$$

Where, $x > 0, \ y > 0, \lambda > 0$

And the vertically integrated hydrometeors (say Y) follows Exponential distribution.

$$g(y) = \frac{1}{\alpha} e^{-\frac{y}{\alpha}}$$

Where, $y > 0, \alpha > 0$

By fitting the model final function stand as follows:

$$f_1(x, y, \alpha, \lambda) = \frac{2x}{2\lambda y} e^{-\frac{x^2}{\lambda y} \cdot \frac{y}{\alpha}}$$

Maximum likelihood estimates (MLE) was used to calculate the following equation. By solving the equation, the estimated values are obtained.

$$\alpha = \sum_{i=1}^{n} \frac{y_i}{n} \quad ; \lambda = \frac{\sum_{i=1}^{n} \frac{x_i}{y_i}}{n}$$

For the calculation purpose y_i is multiplied by thousand. Then those estimated coefficient's values were used as input in an R-program and the probability of the lightning occurrence based on the vertically integrated hydrometeors (cloud + graupel + ice + snow) were calculated.
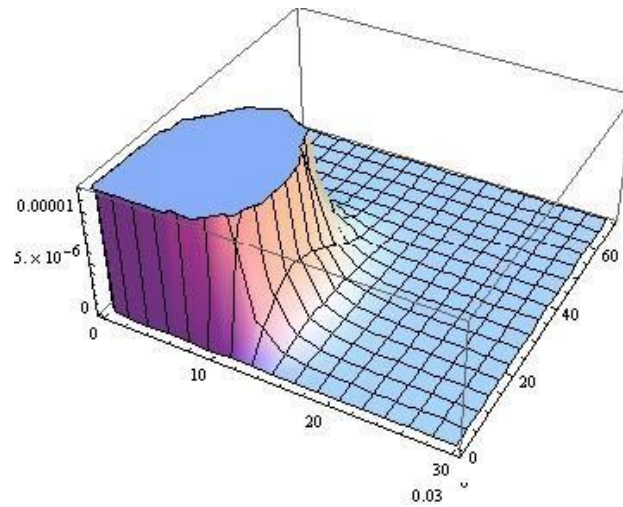
Figure 14: - 3D visualization of $f_1(x, y, \alpha, \lambda)$ where x direction represents vertically integrated hydrometeors (g/kg), in y direction lightning flash count (flashes/day) and in z direction sensitivity of lightning flash due to vertically integrated hydrometeors

Fig. 14 shows the 3D visualization of $f_1(x, y, \alpha, \lambda)$, where x direction represents vertically integrated hydrometeors (g/kg), in y direction lightning flash count (flashes/day) and in z direction sensitivity of lightning flash due to vertically integrated hydrometeors.

The graph shows that with the increase of Y (vertically integrated cloud + graupel + ice +snow), X will also increase. But after a certain point of X (45 (flashes/day)), it will start to decrease. Similarly, after a certain point of Y (19 gm/kg), it will start to decrease.

7.10 Role of ENSO and IOD on the Monsoon over Bangladesh
(M.Sc. project by Umme Farzana Siddiqua Ela, March to June 2019)

In this study, the interannual variability of summer monsoon (June-September) over Bangladesh is investigated. The observed rainfall data of 30 years (1988-2017) for 35 meteorological stations of Bangladesh Meteorological Department (BMD) are used. NCEP FNL data of 1°×1° resolution are used for simulating different parameters of monsoon for the

period of 10 years (2008-2017) using the WRF model. TRMM rainfall data and ERA Interim SLP & wind (850 & 200 hPa) data have also been used for comparing with model outputs. Besides, the possible teleconnection of monsoon rainfall variability with ElNino-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) has been investigated. Summer monsoon rainfall widely varies over the geographical areas with lowest in central-western part and highest in southeastern and northeastern part of Bangladesh. Figures are not shown here, but the results show that there is no one to one connection between summer monsoon rainfall over Bangladesh and ENSO & IOD.

7.11 Analysis and Forecasting of Flash Floods over Bangladesh based on observed and Model Simulated Rainfall
(M.Sc. project by Saurav Dey Shuvo,(March to June 2019)

Flash floods occur due to sudden torrential rainfall over mountainous regions. It also occurs frequently over Bangladesh due to varied topography and geomorphology of the country. In this study the WRF-Hydro and HEC-HMS models are utilized for analyzing the hydrological aspects of the events. The Hydrologic Engineering Center (HEC) - Hydrologic Modeling System (HMS) was run using the upstream rainfall observations obtained from TRMM, GPM and IMD gridded data. The HEC-HMS model converts observed precipitation excess in a catchment area to overland flow and channel runoff, while the WRF-Hydro model (configured at 27, 9 and 3 km resolutions) can provide longer lead time by forecasting the rainfall based on meteorological conditions. The NSE (Nash-Sutcliffe Efficiency (NSE) scores were computed for evaluating discharge rates. Table 11 shows the Peak Bucket inflow and outflow rates simulated by the WRF-Hydro model for one of the flash flood events.

Table 11: - Peak Bucket inflow and outflow rates simulated by the WRF-Hydro model

Date	Peak Bucket Inflow ($m^3 s^{-1}$)	Peak Bucket Outflow ($m^3 s^{-1}$)
22/10/2017	307.1	37.6
23/10/2017	351.0	59.9

Results showed that the WRF-Hydro model had NSE scores of -1.22; while the HEC-HMS had NSE scores of 0.36, -0.99 and 0.33 for TRMM, GPM and IMD gridded data respectively. The NSE can range from -∞ to 1. The threshold values in order to indicate a model of sufficient quality have been suggested between 0.5 and 0.65. From the results, it is obvious that HEC-

HMS model with TRMM and IMD data has better performance over the others. The WRF-Hydro model (with the present configuration) did not perform to the expected level.

8. Equipments Procured/ Under procurement

The department has been working for establishment of a High Performance Computer (HPC), Visualization Laboratory and Field Observatory for research and training of students. Allocation of Land for the Field Observatory is in process. Table-12 summarizes the list of equipment/ instruments being procured.

Table 12: - List of Equipment under procurement

S. No.	Name of the Equipment	Status
1	Lightning Detector	Received Two Lightning detectors have been received; (1) under the collaborative project with DPRI/ Kyoto University, Japan, and (2) through MoU with IITM, Pune
2	High Performance Computing (HPC)	Under process
3	Visualization Laboratory (High-end Graphic Server, display unit/ projector/ Mega screen/ PCs)	Under process
4	Field Observatory (with basic instruments; AWS, Max, Min Thermometer, Barometer, Hygrometer, Lightening detector, Sunshine recorder, Air quality monitor, Whirling psychrometer, GPS system, Digital Display Panel	Under process

9. Visiting faculties/ Scientists

Many National & International Scientists/ Academicians have visited the department and delivered lectures/ seminars for the benefits of students and faculties. Fig. 15 shows the number of visiting faculties/ scientists in the department in different academic years. Detailed list of the visiting scientists/ academicians is given in the Annexure-3 (Table-A3.1 & A3.2).
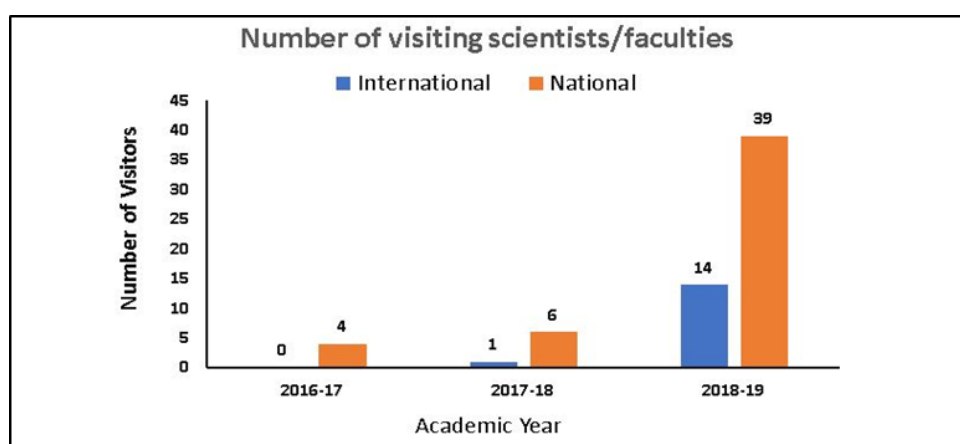
Figure 15: - Number of visiting faculties/ Scientists in the department

10. International Visits

Prof. Someshwar Das presented an invited talk at the International (SAARC) Youth Scientific Conference (IYSC) on Science and Technology for Prosperity: "Connecting Lives with Land, Water and Environment" organized by Tribhuvan University, Kathmandu, Nepal, during 5-6 June 2019.

11. Awards and Recognitions

Dr. Subrat Kumar Panda was selected as the Conference Scientific committee member in the Track 1: Atmospheric Sciences, Meteorology, Climatology, Oceanography of the 2nd Springer Conference of the Arabian Journal of Geosciences 25 – 28 November 2019 in Sousse, Tunisia.

12. Publications in the peer reviewed journals

Fig. 16 illustrates the number of publications in peer reviewed journals and those presented in seminars/ symposia during different academic years. Details of the publications are also given below.
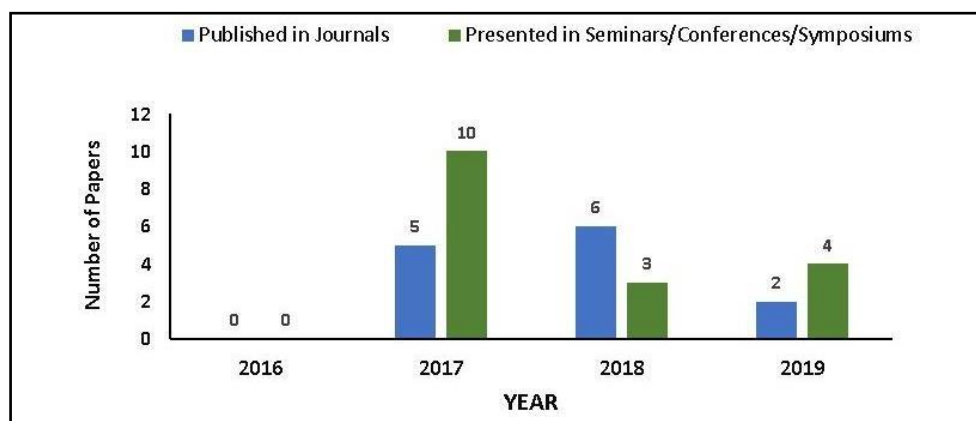
Figure 16: - Number of papers published in journals and presented in seminars/ symposia

2019

1. Kanhu C. Pattnayak, Subrat K. Panda,Vaishali Saraswat, Sushil K. Dash, 2019, How good is regional climate model version 4 in simulating the monsoon onset over Kerala?, Int J Climatol. (39), 2197–2208.

2. S. K. Dash, Manish Paliwal, S. K. Panda and Srinavas Rao Karri, 2019, Comparison of Indian summer monsoon rainfall anomaliesin response to changes in snow depths and SSTs in a GCM, Mausam, 70(1), 71-86.

2018

1. Rajani Kumar Pradhan, Devesh Sharma, S. K. Panda, Swatantra K Dubey, Aditya Sharma (2018) Changes of precipitation regime and its indices over Rajasthan state of India: impact of climate change scenarios experiments, Climate Dynamics, https://doi.org/10.1007/s00382-018-4334-9

2. *Sarkar Abhijit, Someshwar Das, and Devajyoti Dutta, 2018: Computation of skill of a mesoscale model in forecasting thunderstorm using Radar reflectivity. Modeling Earth Systems and Environment,* (2019), Vol 5, pp 443-454. https://doi.org/10.1007/s40808-018-0553-7

3. Sharma Aditya, Devesh Sharma, S. K. Panda, Swatantra K Dubey, Rajani Kumar Pradhan, 2018: Investigation of Temperature and its Indices under Climate Change Scenarios over Different Regions of Rajasthan State in India, Global and Planetary Change, 161, 82–96.

4. Srinivasarao Karri, S. K. Dash,S. K. Panda, Manish Paliwal, Saroj K. Mishra & Jai-Ho Oh, 2018, Relative role of sea surface temperature and snow on Indian summermonsoon seasonal simulation using a GCM, 2018, Arabian Journal of Geosciences,11: 210, https://doi.org/10.1007/s12517-018-3559-6.

2017

1. Das Someshwar, 2017: Severe Thunderstorms Observations and Modelling – A Review. Vayumandal (Bulletin of Indian Meteorological Society), Vol 43 (2), pp 1-29.

2. Das Mohan K., Someshwar Das, Samarendra Karmakar, A. K. M. Saiful Islam, Md. Jamal Uddin Khan and Md. Abdul Mannan Chowdhury, 2017: Simulation of Dynamical Features of Squalls over Bangladesh During the Pre-Monsoon Season. The Journal of NOAMI, 34(1): 39-55 (June 2017).

3. Choudhury Devanil and Someshwar Das, 2017: The sensitivity to the microphysical schemes on the skill of forecasting the track and intensity of tropical cyclones using WRF-ARW model. Journal of Earth System Sciences, Vol. 126, 57, 1-10, DOI 10.1007/s12040-017-0830-2.

4. Pattnayak K. C., S. K. Panda, Vaishali Saraswat, and S. K. Dash, 2017: Assessment of two versions of regional climate model in simulating the Indian Summer Monsoon over South Asia CORDEX domain. Climate Dynamics, DOI 10.1007/s00382-017-3792-9.

5. Sarkar Abhijit, Devajyoti Dutta, Paromita Chakraborty and Someshwar Das, 2017: Numerical diagnosis of situations causing heavy rainfall over the Western Himalayas. Modeling Earth Systems and Environment, Vol. 3, No. 2, 515-531, DOI:10.1007/s40808-017-0310-3.

13. Papers presented in Seminars/ Symposia (July 2018 – June 2019)

1. Das Someshwar and K.M. Golam Rabbani, 2019: Analysis and Simulation of the Recent Tornado of Bara-Parsa Districts of Nepal. *International (SAARC) Youth Scientific Conference (IYSC) on Science and Technology for Prosperity: "Connecting Lives with Land, Water and Environment" organized by Tribhuvan University, Kathmandu, Nepal*, 5-6 June 2019.

2. Das Someshwar and Ajit Tyagi, 2019: Extreme Rainfall associated with Severe Storms over the South Asian region and Disaster Mitigation Strategies. *4th WMO Workshop on Monsoon Heavy Rainfall, Shenzhen, China, 16-18 April, 2019.*

3. Das Someshwar, 2019: Modelling & Forecasting of Severe Storms over the Himalayas and adjoining regions. *International workshop on "Modeling Atmospheric - Oceanic Processes for Weather and Climate Extremes (MAPEX 2019)", IIT-Delhi, 28-29 March, 2019.*

4. Das Someshwar, 2019: Simulation of Lightning Threat by WRF Model – A Review. *International conference on Thunderstorm and Lightning in Tropics-2019 (ICTLT-2019), SOA University, Bhubaneswar, 17-19 Jan 2019*.

5. Das Someshwar, 2018: Desert Storms & Cloudbursts: A hypothetical linkage. *International Workshop on Extreme Severe Storms and Disaster Management Strategies, Central University of Rajasthan, 24-26 Dec 2018.*

6. Das Someshwar, 2018: Desert Storms & Cloudbursts: A hypothetical linkage, *Invited paper, TROPMET-2018, 24-27 Oct 2018, Banaras Hindu University (BHU), Varanasi, India.*

7. Das Someshwar, 2018: Desert Storms and Modelling of Extreme Weather Systems. *6th Rajasthan Science Congress, Central University of Rajasthan, 13-15 Oct 2018.*

8. Panda, S. K. 2018: Invited Lecture in *SERB School on "Numerical Modelling and Forecasting of Desert Storms and Cloudburst" at Department of Atmospheric Science, CURAJ (11-23 February 2019).*

9. Panda, S. K. 2018: Invited Lecture in *International Workshop on "Extreme Severe Storms and Disaster Mitigation Strategies" at Department of Atmospheric Science, CURAJ (24-26 Dec 2018).*

10. Panda S. K., 2018: Invited Lecture in *VI Rajasthan Science Congress on "Innovation in Science and Technology for Sustainable Development" at Central University of Rajasthan (13-15 October 2018).*

14. Extracurricular activities (Sports, Cultural, Clubs/ Magazine, Others)

The faculties of the department have actively participated and contributed in several extracurricular activities of CURAJ as members of different committees. They are summarized in the Annexure-4.

15. Alumni of the Department

The alumni of the department are listed in Annexure-5.

Annexure – 1

List of students admitted during 2018-2019 for the M.Sc. Programme

Table A1.1

S. No.	Enrolment Number	Name of the Student
1.	2018MSATS001	ASHISH RANJAN
2.	2018MSATS002	ANKIT PATEL
3.	2018MSATS004	VINAY
4.	2018MSATS005	SUMAN SAURABH
5.	2018MSATS006	SOHAN PAL MEENA
6.	2018MSATS008	MUSAID P P
7.	2018MSATS009	SASWAT DASH
8.	2018MSATS010	SANJUKTA GHOSH
9.	2018MSATS012	SUMITRA SHARMA

Annexure – 2 Syllabus

CENTRAL UNIVERSITY OF RAJASTHAN
Syllabus

Name of Programme: M.Sc. Atmospheric Science (4 Semesters)

Semester – I

S. No.	Course Code	Course Title	Type of Course (C/E)	L	I.L.	P	Credits
1	MSA-101	Fundamentals of Atmosphere, Land and Ocean	C	3			3
2	MSA-102	Physics of the Atmosphere	C	3			3
3	MSA-103	Dynamics of the Atmosphere	C	3			3
4	MSA-104	Weather Observations and Analysis	C	3		2	4
5	MSA-105	Mathematics and Statistical Methods for Earth Sciences	C	4			4
6	MSE-304	Science of Climate and Climate Change	C	3			3
Total							**20**

Semester – II

S. No.	Course Code	Course Title	Type of Course (C/E)	L	I.L.	P	Credits
1	MSA-201	Modeling of Atmospheric Processes	C	3			3
2	MSA-202	Satellite Meteorology and Oceanography	C	3			3
3	MSA-203	Statistical Analysis and Computer Programming	C	2		2	3
4	MSA-204	Simulation and Visualization in Earth Sciences	C	2		2	3
5	MSE-204	Remote Sensing and GIS (Common)	C	3		2	4
6	MSA-205	Advances in Instrumentations related to Atmospheric studies	C	3			3
7	MSA-206	Field Trip#	C	1			1
8	MSA-XXX	Elective-I*	E	3			3
Total							**23**

Semester – III

S. No.	Course Code	Course Title	Type of Course (C/E)	L	I.L.	P	Credits
1	MSA-301	Mesoscale Modelling and Extreme Weather Events	C	3			3
2	MSA-302	Arid Environment, and Desert Meteorology	C	3			3
3	MSA-303	Numerical Weather Prediction and Data Assimilation	C	2		2	3
4	MSA-304	Meteorological Applications	C	3			3
5	MSA-305	Research Papers Review and Seminar, Internship	C	2			2
6	MSA-306	Minor Project	C	3			3
7	MSA-YYY	Elective-II*	C	3			3
Total							**20**

Semester – IV

S. No.	Course Code	Course Title	Type of Course (C/E)	L	I.L.	P	Credits
1	MSA-401	Major Project	C				24
Total							**24**

Total: 87 Credits

Visit to research laboratories/minor project during winter and summer vacations one to two weeks.

* *Courses as per MOOCs (Massive Open Online Courses) availability.*
  Elective can be selected from any department of the university.

CENTRAL UNIVERSITY OF RAJASTHAN
Syllabus
Name of Programme: Ph.D. in Atmospheric Science (1 Semester)

S. No.	Course Code	Course Title	Type of Course (C/E)	L	I.L.	P	Credits
1	PATS 001	Research Methodology	C	4			4
2	PATS 002	Mathematical Modelling Simulation of Atmospheric Processes	C	4			4
3	PATS 101	Tropical Meteorology	E	4			4
4	PATS 102	General Circulation and Climate Modelling	E	4			4
Total							**12**

Total Credit Requirement: 12

Compulsory Course (8 credits): PATS 001 (4 credits), PATS 002 (4 credits)

Elective Course (4 credits): PATS 101/PATS 102 (any one course from list of elective course as per his/her requirement)

Annexure – 3 List of International Visiting Faculties/ Scientists in the Department

Table A3.1

S.No.	Name	Affiliation	Date
1	Prof. Hirohiko Ishikawa	Disaster Prevention Research Institute (DPRI), Kyoto University, Japan	24-26 Dec 2018 (Under international Workshop on ESSDMS)
2	Prof. Toru Terao,	International Consortium for Earth and Development Sciences (ICEDS), Kagawa University, Japan	24-26 Dec 2018
3	Dr. F. Murata	Kochi University, Japan	24-26 Dec 2018
4	Prof. T. Hayashi	Kyoto University, Japan	24-26 Dec 2018
5	Dr. A. Fukushima	Kobe Gakuin University, Japan	24-26 Dec 2018
6	Dr. Mandira Shrestha	International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal	24-26 Dec 2018 24-26 Dec 2018
7	Dr. Archana Shrestha,	Department of Hydrology & Meteorology (DHM), Govt. of Nepal, Kathmandu, Nepal	24-26 Dec 2018
8	Prof. Deepak Aryal	Central Department of Hydrology & Meteorology, Tribhuvan University, Kathmandu, Nepal	24-26 Dec 2018
9	Dr. Dibas Shrestha,	Tribhuvan University, Kathmandu, Nepal	24-26 Dec 2018
10	Prof. Towhida Rashid	Department of Meteorology, Dhaka University, Bangladesh	24-26 Dec 2018
11	Dr. Fatima Akter,	Department of Geography & Environment, Dhaka University, Bangladesh	24-26 Dec 2018
12	Prof. Nasreen Akter,	Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh	24-26 Dec 2018
13	Prof. D.A. Quadir,	NPI University of Bangladesh, Dhaka, Bangladesh	24-26 Dec 2018
14	Dr. Mohan K. Das,	Bangladesh University of Engineering and Technology	24-26 Dec 2018

| 15 | Dr. Bijon K Mitra, | Institute for Global Environmental Strategies, Japan | 25-26 June 2019 (Under international Workshop on Water-Energy-Food Nexus) |
| 16 | Dr. Pham Ngoc Bao | Institute for Global Environmental Strategies, Japan | 25-26 June 2019 |

Table A3.2: - List of Visiting Faculties/ Scientists in the Department from India

S.No.	Name	Affiliation	Date
1	AVM (Retd.) Prof. Ajit Tyagi	Former Director General of India Meteorological Department (IMD), President (Indian Meteorological Society) and Koteswaram Professor, Ministry of Earth Sciences, Delhi.	13-15 October 2018 (Under Rajasthan Science Congress, Special Session on Extreme Weather Events)
2	Dr. P. R. Rakhecha,	Former Dy Director, Indian Institute of Tropical meteorology (IITM), Pune	13-15 October 2018
3	Dr. Kamaljit Ray	Scientist-G, Ministry of Earth Sciences, New Delhi	15 October 2018
4	Dr. Saji Mohandas,	Scientist-F, National Centre for medium Range Weather Forecasting, NOIDA-Delhi	13 October 2018
5	Dr. Akhilesh Mishra	Amity University, Jaipur	13 October 2018, and 16-17 Nov 2018
6	Dr. Swagata Payra	Birla Institute of Science & Research, Jaipur	13 October 2018, 17-18 Nov 2018 and 21 Feb 2019
7	Prof. S.K. Dash	Centre for Atmospheric Sciences, IIT-Delhi	9-14 Nov 2018
8	Prof. P.V.S. Raju	Centre for Ocean-Atmospheric Science & Technology (COAST), Amity University Rajasthan	16-17 Nov 2018
9	Prof. A.P. Dimri,	School of Environmental Sciences, JNU, Delhi	24-25 Dec 2018 (Under international Workshop on ESSDMS)
10	Dr. P. Mukhopadhyay,	Scientist, Indian Institute of Tropical Meteorology, Pune, India	24-25 Dec 2018
11	Prof. S.S.V.S. Ramakrishna	Department of Meteorology, Andhra University, Waltair	24-26 Dec 2018

12	Dr. Ashish Routray	Scientist-E, National Centre for medium Range Weather Forecasting, NOIDA-Delhi	24-25 Dec 2018
13	Dr. Abhijit Sarkar	Scientist-E, National Centre for medium Range Weather Forecasting, NOIDA-Delhi	25-26 Dec 2018 and 22 February 2019
14	Mr. Anand Sharma,	Scientist, India Meteorological Department, New Delhi	24-26 Dec 2018
15	Prof. Ajay Gairola	Centre for Excellence in Disaster Management, IIT Roorkee	25-26 Dec 2018
16	Mr. Shubham Agarwal,	Department of Civil Engineering, IIT-Mandi	24-26 Dec 2018
17	Prof. H. J. Syiemlieh	Department of Geography, Northeastern Hill University (NEHU), Meghalaya	25-26 Dec 2018
18	Dr. R. Mahanta,	Department of Physics, Cotton University, Assam	24-26 Dec 2018
19	Ms. Jayshree Hazarika,	Department of Civil Engineering, Assam Engineering College, India	24-26 Dec 2018
20	Dr. Satheesh C. Shenoi	Director INCOIS, Hyderabad	11 February 2019 (During SERB School)
21	Prof. U.C. Mohanty	School of Earth Ocean and Climate Sciences, IIT, Bhubaneswar	11 February 2019
22	Dr. D. Pradhan (IMD)	Scientist-G, India Meteorological Department, New Delhi	12 February 2019
23	Prof. D.V. Bhaskar Rao	Department of Meteorology, Andhra University, Waltair	12-13 February 2019
24	Dr. Dilip Ganguly	Centre for Atmospheric Sciences, IIT-Delhi	13 February 2019
25	Dr. Suman Goyal	Scientist, India Meteorological Department, New Delhi	13 February 2019
26	Dr. V. S. Prasad	Scientist-G, National Centre for medium Range Weather Forecasting, NOIDA-Delhi	14 February 2019
27	Dr. Prashant Kumar	Scientist, Space Application Centre, Ahmedabad	14 February 2019
28	Prof. A. Chandrasekar	Indian Institute of Space Science & Technology (IIST), ISRO, Trivendrum	15 February 2019
29	Dr. Rajendra Jenamani	Scientist, India Meteorological Department, New Delhi	15 February 2019
30	Dr. S.D. Pawar	Scientist, Indian Institute of Tropical Meteorology, Pune	16 February 2019

31	Dr. Gopalkrishnan	Scientist, Indian Institute of Tropical Meteorology, Pune	16 February 2019
32	Dr. A.N.V. Satyanarayan	Centre for Ocean-River-Atmosphere-Land (CORAL), IIT-Kharagpur	16 February 2019
33	Dr. Thara Prabhakaran	Scientist, Indian Institute of Tropical Meteorology, Pune	18 February 2019
34	Dr. Ananda Kumar Das	Scientist, India Meteorological Department, New Delhi	18-20 February 2019
35	AVM (Retd.) Prof. Ajit Tyagi	Former DG, India Meteorological Department, and Koteswaram Professor, MoES, Delhi.	19 February 2019
36	Dr. Raghavendra Ashrit	Scientist, National Centre for medium Range Weather Forecasting, NOIDA-Delhi	19 February 2019
37	Dr. Sahidul Islam	Centre for Development of Advance Computing (CDAC), Pune	20 February 2019
38	Prof. Sutapa Choudhary	Centre for Atmospheric Sciences, University of Calcutta	21-26 February 2019
39	Dr. Randhir Singh	Scientist, Space Application Centre, Ahmedabad	21 February 2019
40	Dr. Pankaj Kumar,	Indian Institute of Science Education and Research, Bhopal	25-26 June 2019 (Under international Workshop on Water-Energy-Food Nexus)
41	Dr. Ritu Thakur,	ICLEI South Asia	25June 2019
42	Dr. Rani Saxena,	Sri Karan Narendra Agriculture University, Jobner-	25June 2019
43	Dr. Anindya Bhattacharya	The Celestial Earth, Gurgaon	25-26 June 2019
44	Mr. Avishek Rauniyar	The Celestial Earth, Gurgaon	25-26 June 2019
45	Dr. Sameer M. Deshkar	Visvesvaraya National Institute of Technology, Nagpur	25-26 June 2019
46	Dr. Subir Sen	Indian Institute of Technology, Roorkee	25-26 June 2019
47	Dr. Sapna Narula	TERI SAS, New Delhi	25-26 June 2019

Annexure – 4 Extracurricular activities by the faculties

Table A4

S.No.	Name	Members of Committee	Main Activities
1	Prof. Someshwar Das with the NSS team	NSS	Swachh Bharat Mission, Swachhta Pakhawara, National Youth festival, Van Mahotasav, etc
2	Prof. Someshwar Das and Dr. Subrat Kumar Panda with the Innovation Team	Innovation Cell	Exhibition on Science Day celebration, Identification of grass root innovator, Innovation Talk, etc.
3	Prof. Someshwar Das	University's Activities / Administrative Functioning	Member of Board of Studies, Dept. of Atmospheric Science, Member of School Board, (Earth Sciences, Physical Sciences and Computer Science & Engineering), Member of the Colloquium committee.
4	Dr. Subrat Kumar Panda	University's Activities and Administrative Functioning	Members for coordinating 'Anveshan'; Deputed as Central University Observer (CUO) to SUIIIT, Sambalpur University, Odisha for the CUCET; Organizing member of Convocation, President of games and sport clubs, member of Annual report committee, member of NAD and organizing member, Foundation Day of CURAJ .
5		Department and School Activities and Administrative Functioning:	Member, School Board, School of Earth Sciences, Member, Board of Studies, Dept. of Atmospheric Science. Member of school level purchase committee, Faculty in-charge of examination, time table and admission in the Department.

Annexure – 5 Alumni of Department of Atmospheric Science

S. No.	Name	Batch	Email	Mob. No.	Present Position with address
1	Archana Tripathy	2016-18	archanatripathychunu07@gmail.com	9166368609	Working in a Project at IIT-Delhi
2	Ganesan M	2016-18	ganeshvj13@gmail.com	9003195273	Working in a Project at IIT-Delhi
3	Pradeep Attri	2016-18	iamattri@gmail.com	9772748274	Studying Ph.D. at Central University of Hyderabad
4	Ashish Shaji	2017-19	ashishshaji333@gmail.com	8592051424	Graduated in June 2019
5	Athul C. P.	2017-19	athulcp8@gmail.com	7736657965	Graduated in June 2019
6	Chandni Chandran	2017-19	chandnichandran56@gmail.com	9745586969	Graduated in June 2019
7	Jigisha Dhakar	2017-19	jigishadhakar@rediffmail.com	7424914150	Graduated in June 2019
8	Merlin Jestice	2017-19	merlinjestice1997@gmail.com	7728810416	Graduated in June 2019
9	Midhun M.	2017-19	midhunmachary@gmail.com	9497256644	Graduated in June 2019

Annexure – 6 Photo Gallery

Participants and Dignitaries of the International Workshop on "Extreme Severe Storms and Disaster Mitigation Strategies" December 24-26, 2018

Participants and Dignitaries of the SERB School on Numerical Modeling & Forecasting of Desert Storms and Cloudburst from 11 to 23 February 2019

Education tour to India Meteorological Center, Jaipur with the students of M.Sc. Atmospheric Science on 11 April 2019

Participants and Dignitaries of the International Workshop on "Water-Energy Food Nexus Perspective: Path Making for Sustainable Development Goals (SDGs) to Country Actions in Asia'', 25-26 June 2019

VI Rajasthan Science Congress Special Session on Extreme Weather Events in Rajasthan & Atmospheric Modelling October 13-15, 2018
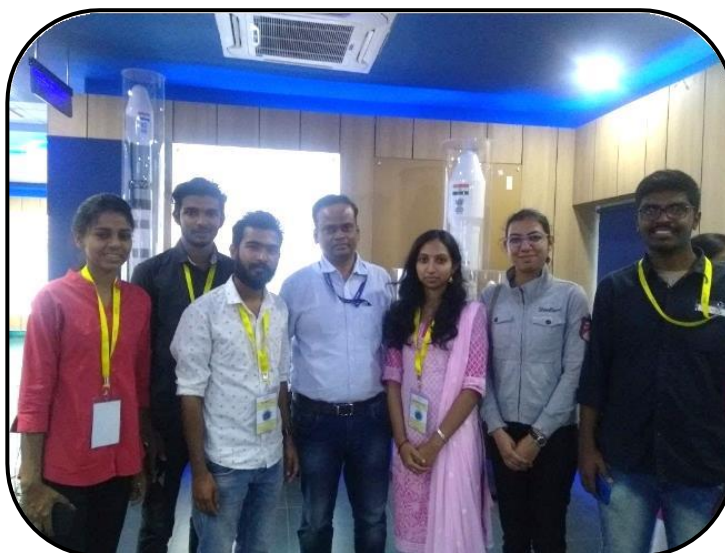

Intern M.Sc. Meteorology Students of University of Dhaka, Bangladesh (visit from March to June 2019)

Convocation 2018
M.Sc. Atmospheric Science
Batch – 2016-2018

M.Sc. Atmospheric Science Students (Batch- 2017-2019) attending SMART Training program at Space Applications Centre, Ahmedabad

Summer Internship of M.Sc. Atmospheric Science Students (Batch- 2017-2019) at INCOIS, Hyderabad

राजस्थान केन्द्रीय विश्वविद्यालय
Central University of Rajasthan

(संसद के अधिनियम क्रमांक 25 वर्ष 2009 द्वारा स्थापित)
(Established under the Central Universities Act, 2009)

150 YEARS OF CELEBRATING THE MAHATMA

**Department of Atmospheric Science
School of Earth sciences**

**Central University of Rajasthan
Bandarsindri, N.H. 8, (Jaipur Ajmer Highway)**

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