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ABSTRACT VOLUME

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Keynote Speech

Quantifying the Impacts of Climate Change on Extreme Weather Hazards

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Abstract

Extreme weather phenomena such as strong typhoons and heavy rainfalls have severely affected human lives, social infrastructures, economic and industrial activities in recent years. Under global warming in the future, the impacts of extreme weather are anticipated to become severer. Adaptation to climate change is important from a viewpoint of disaster prevention and mitigation. In order to design climate change adaptation strategies, physically reasonable and reliable information regarding the impacts of extreme weather is required. At Disaster Prevention Research Institute, we have conducted a series of the research projects on climate change impact assessment since 2007. From this year, we have launched a new project entitled with "Development of an Integrated Hazard Projection Model" under the support of "Program for the Advanced Studies of Climate Change Projection (SENTAN)" from the Ministry of Education (MEXT), which is a 5-year project (from 2022 to 2027). In this talk, I will introduce our research activity on assessing the impacts of climate change on extreme weather at local-scales by using a regional meteorological model. In order to quantitatively assess the impacts at local-scales, high-resolution modeling with complex topographical features well reproduced is critically important. A case study on an extreme rainfall in the rainy season in Japan indicates that the fine-scale structure of a complex terrain affects the quantitative representation of the amount of rainfall. High-resolution modeling is beneficial for quantifying the extreme weather hazard through better representations of both complex topographical features and convective-scale processes.

Keywords *Extreme weather, Climate change, Dynamical downscaling, Climate change adaptation*

Speech of Plenary Session

Impacts of climate change on the pre-monsoon and monsoon rainfall pattern over the Northeastern Indian subcontinent

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Abstract

High moist static energy airmass in the lower troposphere around the Northeastern Indian subcontinent including the Bengal Plain may play an intrinsic role in the onset process of whole Asian monsoon system. From this perspective, we are chasing the production, advection, and dissipation processes using the high-quality reanalysis datasets. It clarified the accumulation process of upper tropospheric high dry static energy airmass, corresponding with the establishment of the Asian monsoon circulation, where production of the lower tropospheric high moist static energy airmass corresponds with the prominent regime shift of Asian circulation. Thus, we have plan to make in situ observation of the production process of high moist static energy airmass over the Northeastern Indian subcontinent. Further, the impact of climate change on this monsoon onset process should be a critical importance in the future projection of the climate change over this region. We analyzed a climate model output to show that the climate model reproduces a peculiar seasonal rainfall pattern over the Northeastern Indian subcontinent. Rainfall over this region peaks in the pre-monsoon season, and the monsoon rainfall reduces quickly below the climatological observational status. All these results indicate that we do not fully understand the pre-monsoon and monsoon rainfall process in this region. We should clarify the impact of climate change on

the rainfall pattern in this area. Especially, Northeastern part of the Bengal Plain is a flash flood prone area including pre-monsoon season. We will conduct observational research in this region upcoming several years to decadal period. In the near future, this activity will be one of the most important sub-regional components of AsiaPEX and their new observational and modeling initiative Asian Monsoon Year-II.

Keywords *Northeastern Indian subcontinent, pre-monsoon, monsoon, climate change, AsiaPEX.*

ICCC-001

Severe Storms in Changing Climate: Speculations, Uncertainty and Reality

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Abstract

Severe storms have profound impact on the human lives and economy. The changing climate can influence the intensity and frequencies of the storms. While the climate change is a reality, its various impacts on the nature is uncertain. According to IPCC AR6, the proportion of intense Tropical Cyclones (TCs), and peak wind speeds of the most intense TCs will increase on the global scale with increasing global warming (*high confidence*), but the total global frequency of TC formation will decrease or remain unchanged with increasing global warming (*medium confidence*). Future wind speed changes are expected to be small. There is *low confidence* in past trends in characteristics of severe convective storms, such as hail and severe winds, beyond an increase in precipitation rates.

The link between local severe storms/ tornadoes and climate change is currently not fully understood. Challenges remain that prevent clearer attribution, including limited data collection methods, high year-to-year variability, and difficulty modelling key physical elements that help local severe storms and tornadoes form as well as directly modelling them due to their small size. Phenomena associated with severe thunderstorms such as large hail (greater than 2 cm), damaging winds (greater than 90 kmph), and tornadoes pose a global threat, yet there are limitations of observational records for assessing past trends. The response of severe thunderstorms to a changing climate is a rapidly growing area of research. As there are limitations in directly simulating the nature of severe storms due to climate change, many scientists have used proxy methods for assessment using the environment conditions, and or conditions favorable to the development of thunderstorms. In this presentation, the uncertainties, and challenges in predicting the severe storms in the changing climate will be discussed.

Keywords *Severe storms, Climate change, uncertainty, reality*

ICCC-002

Rainfall Characteristics in Bangladesh using more than 100-years record

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Abstract

South Asian countries are recognized as a vulnerable area of water-related disasters. Due to the recent climate change, the precipitation trends have been changed in some regions. Of course, it is important to examine changes in heavy precipitation because it will cause a flood, but it is also important to describe variation in weak precipitation because weak rainfall is one of the important water resources in agriculture sectors during non-monsoon seasons. Recently Endo et al. (2015) analyzed the precipitation trends in Bangladesh from 1950 to 2008. They showed that as for the total amount of precipitation and the number of the wet day appeared to be increasing over the country. Heavy rain was also increasing in some stations. During the pre-monsoon, seasonal total rainfall, the number of the wet days and weak precipitation were increasing. Heavy rainfall indices showed that inter-annual and decadal variations dominated. The objective is to analyze the long-term rainfall data (1891-2016) and detect the time series variation in Bangladesh and compare with the previous studies.

The results were generally matched with the previous one. By analyzing the short-term trend, it was showed that significant change detected in the research is due to the recent rainfall characteristics change. It implies recent climate change is significant. Trends showed spatial characteristics. Both rainfall amount and intensity are increasing mainly in southern Bangladesh. It will suggest that more active ITCZ could move southward, and this trend will continue. There were different changing trends among seasons. Also, we expand to analyze in Sri Lanka.

Keywords *rainfall, long term trend, data rescue, water resources, climate change*

ICCC-003

A Study on Thunderstorms Days Pattern of Twin City of Odisha

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Abstract

The two highest populous city of Odisha is named as twin city (Cuttack and Bhubaneswar). Thunderstorms are one of the most hazardous climatic phenomena which responsible for adverse losses in agriculture and infrastructure. In this paper, thunderstorm days obtained in two cities of Odisha since more than five decades (1969 to 2019) are analysed. Mann Kendall and Spearman's rho test is applied for calculating trend in thunderstorm days at the spatiotemporal scale. It is known that El Nino and La Nina are well associated with significant atmospheric anomalies at many places around the world. So, an attempt is made in this paper to analyses the variability in thunderstorm days for the same period. The correlation coefficients of the time series of seasonal and annual thunderstorm frequencies with rainfall and minimum and maximum temperature have been computed. The graphical representation of data is also given. The distribution of frequencies of normal thunderstorm days over cities is also shown in the form of map.

Keywords *Thunderstorms, Variability, El Nino, La Nina*

ICCC-004

Upper oceanic response to the super cyclonic storm Amphan in the northern Bay of Bengal from ROMS model

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Abstract

There are lack of observational data in the northern part of the Bay of Bengal (BoB), which makes it challenging to resolve upper oceanic responses during tropical cyclone. To observe the response of different oceanic parameters and the mechanisms of ocean response during cyclone, a high resolution ocean model is very important. We observed the upper ocean response in the northern BoB due to the super cyclonic storm, *Amphan* over the BoB from May 16 to 20, 2020, using the better boundary (FIO-COM as the boundary condition) and atmospheric forcing (ERA5 data as atmospheric forcing). The upper ocean responses to *Amphan* in the northern BoB is well captured by the regional ROMS model. On the right side of the cyclone track, SST cooling (4 °C) and increased sea surface salinity (0.5 psu) are well reproduced. The primary oceanic triggering forces have intensified the cyclone as a result of extraordinarily high SST (>31°C) and deep ILD. TCHP was high (over 100Kj cm^{-2}) during the early stages of the cyclone, which aided in the transformation of a depression into a super cyclonic storm. Vertical entrainment (0.04 °Cday^{-1}) and horizontal advection (0.12 °Cday^{-1}) had a major influence in the pronounced cooling within the mixed layer.

Keywords *ROMS model, model validation, tropical cyclone, upwelling, northern Bay of Bengal*

ICCC-005

Characteristics of rainfall and atmospheric condition during the heavy rainfall event on 14-16 June 2022 in the southern Meghalaya Plateau

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Abstract

The towns in southern slope of the Meghalaya Plateau, Cherrapunji and Mawsynram, are known as the heaviest rainfall place in the world. The India Meteorological Department announced Cherrapunji recorded the 24-hour rainfall of 972 mm ending on 03 UTC of 17 June 2022, and it was the 3rd highest in last 122 years. The 3 days rainfall of 15-17 June was 2457.2 mm. The downstream area, Sylhet, Bangladesh was heavily submerged due to the flush flood. The case study of the excess rainfall event will help to consider the mitigation measures for flush floods and understand the mechanisms of heavy precipitation. Our automatic weather station Vaisala WXT520 in Cherrapunji and a Parsivel2 disdrometer in Sylhet observed the event. This study analyzes the characteristics of the rainfall and the atmospheric condition during the heavy rainfall event using in-situ observation data, satellite derived rainfall dataset and reanalysis data. The impact-type precipitation sensor of WXT520 in Cherrapunji observed 24-hour rainfall of 830, 646, and 935 mm ending on 00 UTC of 15, 16 and 17 June. During the event, rainfall observed by the disdrometer in Sylhet continues throughout the period, but rainfall intensity was weak. The radiosondes in Kolkata in the upstream of the Meghalaya showed the precipitable water with around 60 mm, the level of free convection with 1.5-3.0 km, CAPE with 1500-3500 J/kg, and the equivalent level with near tropopause. The vertical wind profile was southerly with 15-30 kt below 1 km, and westerly to northerly between 4-10 km, and easterly above 10 km. The Global Satellite MApping of Precipitation (GSMaP) dataset showed the rainfall area with above 60 mm of 24-hour accumulated rainfall was confined only over the southern Meghalaya Plateau. The rainfall at

Cherrapunji in the GSMaP was 100-150 mm on 14- 15 June, and above 600 mm on 16 June 2022.

Keywords *Heavy rainfall event, in-situ observation, orographic rainfall, Meghalaya*

ICCC-006

Relation between rainfall and soil moisture variability during dry and wet extremes over core monsoon zone of India

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Abstract

Monsoon variability plays a major role in soil moisture dynamics, distribution and variability over the Indian subcontinent. Though monsoon rainfall and soil moisture are tightly coupled, the patterns evolve distinctly each year. Using high resolution observational and reanalysis estimates of rainfall and soil moisture, we investigate how soil moisture responds to persistence and intensity of rain spells. For this purpose, we diagnose the general association between them and specifically analyze two recent cases of contrasting monsoon years, i.e. 2015 (deficit) and 2019 (excess) rainfall. Spectral analysis reveals that the modes of soil moisture variability are concurrent with rainfall variability. The monsoon of 2015 (2019) exhibits zonally (meridionally) propagating ISOs with major contributions from high (low) frequency components which modulates moisture content in the soil, and leads to shorter (longer) persistence over an extended period. The soil moisture memory time scales are found to be 40-50 days during 2015 (deficit year), while it exceeds 60 days during 2019 (excess year). Our study indicates concurrent correlations between soil moisture and rainfall variability over the core monsoon zone of India.

Keywords *Rainfall extremes, Soil moisture, Core Monsoon zone, Spectral analysis, Soil moisture memory.*

ICCC-007

Interannual variation of rainfall related to low pressure system over the north and east coast of the Bay of Bengal

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Abstract

Northern head of the Bay of Bengal is well known for the formation of synoptic scale low pressure system (LPS) during monsoon season (Jun-Sep). The north and east coast of the Bay of Bengal are the most hazard prone area of the earth and vulnerable to recent climate change in the context of heavy rainfall and associated hazards. The synoptic scale low pressure system is a common and major rainfall bearing phenomena during monsoon season for this area. The present study endeavors to find out the interannual variation of rainfall related to LPS during monsoon season of 1958-2015 in this area. The method developed by Hatsuzuka et al. (2014) has been used to detect the LPS. After the objective detection, LPS was classified into strong and weak LPS considering the relative vorticity at the center of the LPS. The present study found that rainfall over the Ganges Delta during monsoon season was controlled by the rainfall related to LPS. The north and east coast of the Bay of Bengal was affected much by the LPS related heavy rainfall. Inter-annual variation of the heavy rainy day's rainfall rate over the two coasts was regulated by the heavy rainy day's rainfall rate related to strong LPS days. Total column precipitable water and the vertical wind shear over the Ganges Delta strongly regulated the number of strong LPS days. The strong LPS did not show linear decreasing trend during monsoon season since 1958-2021.

***Keywords**: Indian monsoon, Bay of Bengal, Low pressure system, Heavy rainfall, Climate change.*

ICCC-008

Assessment of MPAS-A model against WRF model results and observations in forecasting high impact weather events over Bangladesh

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Abstract

This work documents the performances of the Model for Prediction Across Scales-Atmosphere (MPAS-A) and the Weather Research and Forecasting (WRF-ARW) model in forecasting selected high-impact weather events over Bangladesh. Three thunderstorm events that occurred on 31 March 2019, 17 May 2019 and 20 May 2021 were examined to evaluate the forecasting capability of each model. For MPAS-A, the model was integrated using a standard regional domain with 10 km voronoi meshes and the WRF model was integrated using a regional domain with 10 km horizontal grid spacings. In both cases, the model was run for 24-h using 3-hourly GFS dataset as the initial and lateral boundary conditions on 0.25 degree by 0.25 degree latitude-longitude grid. The characteristics and intensity of the clouds were investigated based on INSAT 3DR satellite and Doppler weather radar observations. The spatial distribution of precipitation structure is compared against the observations from NASA's GPM multi-satellite precipitation dataset. The lightning flashes are analyzed using the Earth Networks Total Lightning Network and the NASA Lightning Imaging Sensor (LIS) dataset. The qualitative and quantitative results show that in most of the studied cases, there is a good agreement between the observations and the model-based simulations. Performance diagram analyses were included to provide a better illustration of how simulations performed in predicting precipitation. With some limitations, the MPAS-A predicts precipitation better in terms of timing and area coverage. The findings of this study provide an important conclusion regarding the alternatives to the existing numerical models of the operational prediction system in Bangladesh and northeast India.

Keywords *MPAS-A, WRF, GFS, Thunderstorm, NASA GPM*

ICCC-009

Heat Wave in Bangladesh and its Future Projection

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Abstract

Heat wave (HW) is a period of high temperature. It endangers human health and makes the human body not to adapt with the environment, causes aggravation of disease, even death. HW mainly occurs during the pre-monsoon season. In the recent times it appears in other seasons also. HW condition has been searched utilizing the records maximum temperature data from 34 stations of Bangladesh Meteorological Department (BMD) for the period of 1981-2021. Considering the operational definition of BMD, the annual no. of HW days have been calculated at each of divisional cities of Bangladesh and at Jashore station. It is found that HW days have significant increasing trend at all locations but it is highly significant at Khulna, Jashore, Rajshahi and Sylhet. To find out the future situation of HW two climate models of ACCESS-CM2 and ACCESS-ESM under CMIP6 scenario are selected primarily. Daily maximum temperature at each of the BMD locations are collected from the models history period of 1950-2014 and future scenario period of 2015-2100. Then linear bias correction has been conducted for the models value considering the period of 1981-2021. The corrections has then been applied to the future values. Based on the existing definition future HW situation has then been calculated and summarized. Analysis reveals that the HW situation is likely to be more dominant in future over the selected locations as well over Bangladesh region. Similarly, some more parts of Bangladesh are likely to be under its threat.

Keywords *ACCESS-CM2, ACCESS-ESM, heat wave, linear bias correction and projection.*

ICCC-010

Precipitation and temperature changes in Bangladesh based on CMIP6 GCMs

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Abstract

Due to considerable spatiotemporal variations, temperature and precipitation are the most important climatic indices, and their projections are essential for evaluating environmental dangers and long-term planning. In this study, 18 Global Climate Models (GCMs) from the most current Coupled Model Intercomparison Project phase 6 (CMIP6) dataset were used to examine the future changes in Bangladesh's rainfall, maximum temperature (Tmax), and lowest temperature (Tmin). Additionally, the GCM forecasts used the Simple Quantile Mapping (SQM) bias-correction method. Then, in relation to the historical era (1985-2014), the anticipated changes were examined by evaluating the bias-corrected Multi-Model Ensemble (MME) dataset for the near (2015-2044), mid (2045-2074), and distant (2075-2100) futures. Under the SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios, the anticipated average annual precipitation was increased by 9.48%, 13.63%, 21.07%, and 30.9%, respectively. Under SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5, respectively, it was predicted that the average Tmax (Tmin) across Bangladesh will rise by 1.09 (1.17), 1.60 (1.91), 2.12 (2.80), and 2.99 (3.69) °C during the course of the long term. SSP5-8.5 forecasts that in the distant future, the post-monsoon season will see a 41.6% rise in precipitation, whereas SSP3-7.0 predicts that in the mid-future, winter would see a 15.0% drop in precipitation. Tmax (Tmin) is anticipated to increase under SSP5-8.5 in the far future by 3.44 (4.26) °C in the winter, 3.22 (3.71) °C in the pre-monsoon, 2.98 (4.22) °C in the post-monsoon, and 2.33 (1.28) °C in the monsoon season. Using MME lowered the degree of uncertainty in the anticipated temperature and precipitation across Bangladesh. For more accurate climate forecasts, further study is needed, such as the selection of the top models from the CMIP6 for the regional climate across Bangladesh and the use of ensemble techniques that distribute weight depending on each model's performance.

Keywords *CMIP6, Bangladesh, Precipitation, Temperature, Climate change*

ICCC-011

Effect of climate change: Rainfall trend analysis for Bangladesh

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Abstract

Climate change is one of the most pressing issue of our time as it threatens lives and livelihoods of human population and also threatening earth biodiversity. Climate change on a global scale does not necessarily have the same effect in different regions. It happens over many years so it might be hard to notice dramatic changes over just one human lifetime. Climate variability, particularly that of the annual air temperature and rainfall, has received a great deal of attention worldwide. For Bangladesh rainfall is the most important natural factor that determine the agriculture production of the country. Rainfall is a crucial weather element related to climate change. So, rainfall trend analysis is an appropriate step in assessing the impact of climate change on water availability and food security. Rainfall variations and changes of seven rainfall stations of Bangladesh i.e. Dhaka, Chattogram, Jashore, Rajshahi, Sylhet, Teknaf and Dinajpur are tested by Mann-Kendall (M-K) trend test and Sens Slope Estimator (SSE) test. Data set consisting of seven observed raingauge stations with the length of data series of as much as 62 years (1960-2021). As expected, rainfall trends show a large variability –three stations have shown a decreasing but insignificant trend in annual rainfall exceptions in Rajshahi, where the decreasing trend is statistically significant with Man-Kendall test. In Chattogram and Teknaf rainfall trend are significantly increasing with Sen's slope estimate 11.566mm/year and 15.00 mm/year respectively. This study found overall rainfall trend is increasing towards south of the country and decreasing in the northwest part of the country. Which is quite noteworthy.

Keywords *Climate change, rainfall, Bangladesh*

ICCC-012

Future Floods in Bangladesh under different Global Warming Scenarios

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Abstract

Bangladesh is located at the delta of the Ganges–Brahmaputra–Meghna (GBM) river system, which is the second-largest delta in the world by area. This study assesses the future changes in the possibilities of flood peak synchronization of nearby large rivers. The aim of the study is to assess the changes in floods in Bangladesh caused by global warming of 1.5°C, 2°C, and 4°C. Riverine floods and pluvial floods were looked at separately. The future changes in the possibilities of peak synchronization of nearby large rivers were assessed for the first time. Peak synchronization is critical for flood assessment in low-lying delta regions like Bangladesh. Results from this study indicate that peaks of the Ganges–Brahmaputra rivers, as well as the GBM rivers, with large combined discharges, are projected to coincide more in the future.

Keywords *Flood; GBM; Climate change; SWAT model.*

ICCC-013

Challenges of Projecting Rainfall for Dhaka City

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Abstract

Dhaka, with more than 13 million residents, is one of Southern Asia's fastest-growing cities. Due to its rapid growth and unplanned development, it is particularly susceptible to severe waterlogging under medium to heavy rainfall. The unpredictability of anthropogenic climate change factors, in particular rainfall, exacerbates this vulnerability to such water-borne hazards. This paper investigates open-source Coordinated Regional Climate Downscaling Experiment (CORDEX) models' capability to project future rainfall trends and capture peak monsoon characteristics in Dhaka. Observed precipitation data (1976-2005) sourced from the Bangladesh Meteorological Department (BMD) was used as the basis to analyze the 17 RCM under the CORDEX dataset. The initial selection was made based on the models' ability to capture the monsoon rainfall pattern of Dhaka. However, 2 out of the 17 models were discarded due to data availability within the reference period of 1976-2005. The Taylor diagram showed the remaining 15 models to have significant variations in daily precipitation value from observed BMD data. Therefore, Quantile Mapping (QM) was applied to bias correct the projected data as it does not modify the original data trend and can effectively capture extreme rainfall events due to anthropogenic climate change. Five QM techniques - PTF, DIST, RQUANT, QUANT, and SSPLIN- are applied to the raw output of the CORDEX RCM models as correction techniques to investigate its ability to bias correct the datasets. The study's results suggest RQUANT performs the best for precipitation data having the same standard deviations as the observed dataset and preserves the variation pattern and amplitude. However, none of the bias correction methods could establish a significant correlation with the observed BMD data, indicating high uncertainty of CORDEX models for precipitation data projection.

Keywords *Climate Change, Precipitation, Quantile Mapping, CORDEX, Bias-correction*

ICCC-014

Assessing CORDEX-SA in representing Indian summer monsoon rainfall

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Abstract

This study evaluates the performance of different model experiments of Coordinated Regional Climate Downscaling Experiment- South Asia (CORDEX-SA) modelling suite in representing precipitation during Indian Summer Monsoon (ISM). CORDEX-SA has a spatial resolution of 0.44° x 0.44° and consists of 19 global model circulation and regional model circulation combination. Models are evaluated on the basis of spatial and temporal distribution, interannual variability, intraseasonal oscillation during historical period of 1979-2005. Our analysis shows REMO downscaled from MPI-ESM-LR shows least mean bias. RegCM forced from CanESM has highest grid specific correlation (0.5) with corresponding Indian Meteorological Department (IMD) observation when averaged over monsoon core zone whereas over India REMO forced from MPI-ESM-LR has highest grid specific correlation (0.7). Interannual comparison illustrates model ensemble shows a wide range of ambiguity Active and break spells are well simulated by model ensemble. REMO model experiment better represent ISM.

Keywords *CORDEX-SA, Indian summer monsoon, precipitation.*

ICCC-015

Inter-annual variation in chlorophyll-a and its relationship with Indian Ocean Climate Variabilities in the northern Bay of Bengal.

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Abstract

Chlorophyll-a concentration in northern Bay of Bengal (BoB) shows variations from surface to subsurface, zone to zone, and even with time. Chlorophyll-a concentration positively correlates with primary production in the ocean. The variation in oceanic chlorophyll-a has been studied on a geographical, seasonal, and inter-annual basis. Many researchers investigated the inter- relationship between chlorophyll-a and environmental forces (physical or chemical) on a global orregional scale. Only a few studies have looked at the combined effect of physicochemical forcingon chlorophyll-a. Hence, this study investigates a comprehensive basin-wide framework of the inter-annual variations in the chlorophyll-a concentration and their possible physicochemical forcing and Indian Ocean Dipole (IOD). Geospatial mapping and statistical analysis were used tounderstand the relationship between inter-annual variation in chlorophyll-a and their physicochemical forcing. Temperature, salinity, current velocity, nitrate, phosphate, silicate,dissolved oxygen, and iron data were used in the analysis as probable forcing factors. The Indian Ocean Dipole is a physical process that influences chlorophyll-a variation by enforcing the surrounding forcing. Chlorophyll-a shows an increasing trend with 0.007 mg m^{-3} yr^{-1} in northern Bay of Bengal for a period of 10 years, from 2011 to 2020. The nutrient upwelling in the north eastern coastal region caused by Ekman pumping may have influenced this rise. The inter-annualvariation of temperature in subsurface shows a negative correlation with chlorophyll-a variation, while there is a positive correlation with the surface layer. This indicates that the effect of sea- surface temperature is weak, as high nutrients are seen to influence the chlorophyll-a levels to rise.In 2016, a strong negative IOD was observed, while in 2019, a strong positive IOD occurred. Theseevents have an effect on the inter-annual variation of chlorophyll-a by slowing and speeding up the increase, respectively.

Keywords *Climate variabilities, Chlorophyll, Bay of Bengal, Indian Ocean*

ICCC-016

Sea surface temperature anomalies in the Bay of Bengal from space since 1871 for climate projections

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Abstract

The water's temperature at the ocean's surface is known as the sea surface temperature (SST), sometimes known as the ocean surface temperature. An essential physical characteristic of the world's seas is sea surface temperature, or the temperature of the water at the ocean's surface. There are several elements that affect the ocean's water temperature. Ocean water temperature is affected by the following factors: orientation, unequal distribution of water and land, length of the day, oceanic currents, a clear sky, the earth's distance from the sun, and the number of sunspots. The world's oceans' surface temperatures mostly depend on latitude, with the hottest waters being found close to the equator and the coldest waters being found in the Arctic and Antarctic. Sea surface temperatures are rising due to the seas absorbing more heat as a result of greenhouse gas emissions, and the sea level is also rising. Ocean temperatures and currents will vary due to climate change, which will cause global climate patterns to change as a result. The implications of increasing ocean heat content include sea level rise, ocean heat waves, coral bleaching, and the melting of glaciers and ice sheets encircling Greenland and Antarctica, which terminate the ocean. The release of trapped heat in the oceans will cause future surface warming on Earth. The aim of the study is to use R programming to extract a time series analysis of Sea Surface Temperature (SST) data at the 5m depth from satellites for the Bay of Bengal from 1871 to 2010. This research shows that the lowest SST is in 1871 at approximately 27.80281 ^{0}C and the maximum SST is in 2010 at about 29.14829 ^{0}C, showing a 1.34548 ^{0}C increase in sea surface temperature. Because of the progressively rising sea surface temperature over the past 140 years, low-lying coastal areas may drown owing to sea level rise, and agricultural lands may be badly impacted by saline water intrusion. Ocean heat waves, sea level rise, glacier melting, and ocean acidification are effects that follow an increase in sea surface temperature. It may also serve as a point for more complex studies on possible climate projections.

Keywords Satellite data, R programming, Sea Surface Temperature (SST), Bay of Bengal

ICCC-017

Impacts of Climate Change on Public Health in Bangladesh

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Abstract

Bangladesh is the most threatened and vulnerable on climate change issues. Because of its geographic location, it has already started experiencing the effects of climate change on public health. The objective of this study is to determine how public health of Bangladesh has been affected by climate change. In recent years, the rapid emergences of climate change in Bangladesh have been threatening public health along with poverty, inequity, infectious and non-communicable diseases. This study is based on relevant literature on climate change and public health issues. In Bangladesh, temperature related illness, food, water, and vector-borne infections are the mostly experienced health impacts that are caused by climate change. Comparing with other developing countries, greenhouse gas emission rate is quite modest in Bangladesh. However, human health issues are at risk because of climate change issues. If effective steps are not taken immediately addressing the consequences of climate change, Bangladesh will have to be prepared to high price in terms of productivity and human lives.

Keywords *Climate Change, Public Health, Bangladesh*

ICCC-018

Climate Change and Riverbank Shifting Utilizing GIS Technology Upstream of the Padma River, Bangladesh

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Abstract

Rivers is a valuable source of blessing yet cause of different calamities for many parts of Bangladesh, due to the ongoing alteration of river flows, it undergoes multiple natural disasters each year, including regular riverbank erosion. The mighty River Ganges is one of the world's great rivers that supports the lives and livelihoods of thousands of Bangladeshi and Indian people. However, river bank erosion is a regular phenomenon in this river basin because of the alluvial sediments containing riverbank. This study presents an outline of the trend of riverbank erosion in the Bangladesh part of this river basin i.e., the river Padma starting from Rajshahi district to Manikganj district between 1971 to 2020. The primary objective of this study is to determine if there is a correlation between river bank erosion, climate change factors on this river. In order to illustrate the pattern and extent of channel movement and bank erosion on the Padma River, USGS satellite photography and some old historical photographs were employed. The climatic data (temperature and precipitation) between 1972-2019 was collected from Bangladesh Meteorological Department. This exhaustive investigation was conducted utilizing cutting-edge GIS technologies to determine the bank shift change. The migration rates are calculated on the differences in 1972–1977, 1977-1980, 1980-1989, 1989-2000, 2000-2005, 2005-2010, 2010-2015 and 2015-2020. The data reveal that the accretion rate has been much greater than the erosion rate during the past decades. Interestingly, the study finds that there is no substantial relationship between climatic parameters and river bank shifting.

Keywords *Soil erosion, Padma River, GIS, Temperature and Precipitation, Anthropogenic activities*

ICCC-019

Assessing the Impact of Climate Change on the Coastal Aquaculture Ponds in Noakhali, Bangladesh

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Abstract

Climate change has brought concerns to the marine and freshwater ecosystems and the survival of species, by changing physiological processes and the structure of the food webs. Bangladesh is no exception and the changing climate has already begun to take its toll. The frequent cyclone and rising temperature has created a challenging condition for the aquaculture sector in Bangladesh. Noakhali being a coastal district is at a high risk of salt water intrusion, temperature fluctuation that ultimately results in the poor aquaculture production. Phytoplankton are microscopic organisms constitutes the base of an aquatic ecosystem by transferring food and energy to the higher trophic levels. Additionally, phytoplankton assemblages on a lentic and lotic ecosystem directly impact the productivity and have a vital influence on sustainable aquaculture. However, climate change results in extreme temperature in the coastal regions have resulted in plankton bloom and fluctuation in physicochemical parameters. Therefore, the present study was conducted to evaluate the current status of aquaculture ponds in the Noakhali district to better understand the potentiality of coastal aquaculture in this area. Phytoplankton samples were collected from the surface layer of the water body through plankton net (mesh size: 20 μm) and preserved in a 250 ml plastic container with 5% formaldehyde. Phytoplankton were identified at 16×10 and 16×40 magnification using a light microscope in sedge wick-Rafter plankton counting cell. Numerous phytoplankton groups include Chlorophyta, Cyanophyta, Bachillariophyta, Euglenophyta were identified. The dominance of Chlorophyta species in the study indicate moderate to high productive environment for aquaculture. The study also emphasizes the importance of coastal aquaculture and suggested meticulous actions for future development.

Keywords *Phytoplankton, Aquaculture, Climate change, Algal bloom*

ICCC-020

Analysis of climatology of Cold Wave variation and its possible mechanism over Rangpur region in Bangladesh

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Abstract

Extreme weather events such as cold wave have disastrous effect on the health of people, especially vulnerable groups in developing countries. This study intends to analyze the climatology of cold wave (CW) condition and its possible mechanism in Bangladesh. The minimum temperature (MinT) datasets of cold wave-affected Rangpur region for the period 1981–2021 are used for this purpose. CW has been defined as per the definition of Bangladesh Meteorological Department (BMD) and the frequencies of days with MinT in the range of 10°C have been considered and their future trends are being investigated to depict the CW condition. The result shows that the CW follows a decreasing trend with a rate of decrement of -0.164/year during the study period. Winter follows a decreasing trend under the condition of maximum temperature MaxT of ≤25°C and MinT with ≤15°C for 90th percentile, with a decrement rate of 0.249/year in the winter season from 1981 to 2021. Under the condition of the maximum temperature of 20°C (MaxT≤20°C) and minimum temperature of 12.5°C (MinT≤12.5°C) for 95th percentile, the extreme winter persists on an average period of 5 days in the winter season. The maximum continuation of winter in the winter season under MaxT≤25 & MinT≤15 is 72 days, which happened in the 1984-1985. This study is also found that as a whole, the deviation of winter from 15th December follows a decreasing trend with a rate of 0.0816/year. In the winter season, a centre of high pressure (an anticyclone) lies over the northwestern part of India and from this high pressure a stream of cold air flows eastward that enters the country through its northeast corner by changing its course clockwise, and it initiate the cold wave situation over the Bangladesh. The study also reveals that the coldest region is found in the northwestern and north-northeastern parts of Bangladesh because of the geographic position

of those areas and the location of the Himalayas foothills. From the large-scale synoptic condition perspectives, cold waves are found to shift from the southwest to northern part.

Keywords *Cold waves, Extreme cold waves, Climatology, Trend, Season*

ICCC-021

Hybrid Prediction (Statistical/Dynamical) Scheme for Bay of Bengal Cyclone Season Activity

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Abstract

The post-monsoon (October–November–December) tropical cyclone (TC) over the Bay of Bengal where 80% of the TCs of the North Indian Ocean are originated is one of the most devastating natural disasters causing economic and human losses over India and its neighboring countries. This study discusses a hybrid statistical/dynamical model developed to forecast the post- monsoon cyclone activities over the Bay of Bengal. We identified three concurrent predictors (ocean heat content over the Bay of Bengal, sea surface temperature over the Indian Ocean, and SST over the tropical central Pacific regions) and two precursor predictors (low-level wind at equatorial Indian ocean and strength of upper-level easterly jet over African coast) influencing the cyclonic disturbance frequencies over the Bay of Bengal. In our proposed hybrid model, the concurrent predictors from the CFSv2 output and the precursor predictors from the reanalysis data are used whereas the principal component regression model is used to relate these indices with the TC frequency. As the predictors influencing the cyclonic disturbance over the Bay of Bengal are also influencing the cyclonic storms, the same predictors are used for developing a hybrid model for cyclonic disturbance and storm frequencies. The hybrid model achieved a significant skill for seasonal cyclone forecast over the Bay of Bengal. Results suggest the potential for using the hybrid model for the operational seasonal forecasting of post-monsoon cyclone activity over the Bay of Bengal.

Keywords *CFSv2, Principal Component Regression Model, seasonal prediction, tropical cyclone*

ICCC-022

Assessment of future changes in climate extremes of Bangladesh using CMIP6 models

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Abstract

This Study assesses the projected spatio-temporal changes in temperature and precipitation extremes of Bangladesh for the period 2015-2100 using the outputs from 15 bias-corrected global climate models ensemble from the Coupled Model Inter-comparison Project Phase 6 (CMIP6). Raw model simulated daily precipitation; maximum and minimum temperature data have been derived from ESGF (Earth System Grid Federation) data portal for both historical (1986-2014) and projected (2015-2100) periods. To validate the reproducibility of the climate models, the observed dataset from Bangladesh Meteorological Department (BMD) has been used for the period 1986-2014 considering it as the baseline period. As the model outputs are in coarse resolution and includes systematic biases, they were statistically downscaled and bias corrected against the observed data from 30 Meteorological stations by employing a 'Simple Quantile Mapping (SQM)' method. The study uses a subset of extreme climatic indices taken from the extreme climatic indicators suggested by the 'Expert Group on Climate Change Detection and Indices (ETCCDI)' which are projected under 4 emission scenarios- SSP1.26, SSP 2.45, SSP-3.70 and SSP-5.85. The results suggest that all the extreme indices change substantially over the course of time; however, the change is more robust at the end of the century under the higher emission scenarios. Both the temperature and precipitation extremes demonstrated an increasing trend, except for CDD (Consecutive Dry Days) which showed a decreasing trend under higher emission scenarios. The changes in precipitation extremes are more pronounced at the northwestern part of Bangladesh while the changes in temperature extremes are prominent at both northwestern and southern coastal islands. Understanding the Spatiotemporal variability and the future changes of these indices is crucial to anticipate future extreme climate-induced natural disasters like flood, drought, heat waves, urban heat islands, etc. The results of this study can help the policy makers develop rigorous climate change

adaptation and mitigation strategies.

Keywords *Climate Extremes, CMIP6 models, Downscaling, Bias Correction, Trend*

ICCC-023

Assessing Future Drought Characteristics in Bangladesh using bias-corrected CMIP6 data

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Abstract

Drought is usually defined as a prolonged period of dry weather with a deficit in rainfall compared to long-term average with a period of high temperature, low humidity, high evapotranspiration and high wind speed. The lengthier period of drought negatively affects agriculture, stream flow, ground water level, soil moisture, environment and economy. Global warming is altering the seasonal temperature and rainfall pattern of Bangladesh and increasing the probability of extreme climatic conditions like drought. This study therefore aims to assess the future drought characteristics of Bangladesh using bias-corrected CMIP6 data. ERA5 reanalysis dataset has been used in this study for correcting bias of CMIP6 data using SQM method. Then drought index SPEI is estimated at 3-month timescale to determine three drought properties namely frequency, duration and severity for two future periods: S1 (2020-2059) and S2(2060-2099) under SSP2-4.5 and SSP5-8.5 and for base period (1985-2014). It has been found that drought frequency in S1 interval (2020-2059) will reduce by 2.79% in SSP2-4.5 and 13.57% in SSP5-8.5. And then frequency will rise in S2 interval (2060-2099) by 11.55% in SSP2-4.5 and 16.82% in SSP5-8.5. The spatial distribution shows that frequency will rise by as much as 10% in the north-eastern Bangladesh during S1 interval for both SSPs. In S2 interval the frequency will rise by 20-40% in northwestern Bangladesh for SSP5-8.5. The long duration droughts will increase in S2 interval and the concentration will shift from north-western region to the central and southern part of the country in future. The drought severity will increase by 2-4% in northwestern region and decrease by 2% in the north-eastern as well as south-central region under SSP2-4.5 during S1 interval. In S2 interval, the maximum increase in severity

(4-8%) will be observed at the northern and central part of the country for both SSPs.

Keywords *Drought, Global Climate Model, SPEI index, SSP, Drought severity*

ICCC-024

Collection, quality control and curation of ground data, for continued development of the satellite-based crop area monitoring system for Bangladesh

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Abstract

Agriculture is one of the important earning sources of our country. Our food security and national economy largely depends on it. According to FAO, 50 percent of Bangladesh's population is primarily employed in agriculture. More than 70 percent land in Bangladesh is dedicated to growing crops. Apart from economic and food security, agriculture also has environmental importance. Agriculture plays an important role in maintaining ecosystem. Agriculture has importance in environmental balance and national nutrition balance. So, agriculture has a very important role to play in national planning. Satellite crop identification can be a good tool for that purpose. Remotely sensed data are very useful nowadays, these data can be extracted without field visit. So, it will save money and time for the government to make good planning measures. Also, it will introduce a procedure to estimate crop production and also help in proper budget management as agriculture has a very significant part in national budget. National budget has a separate segment for agriculture where estimations of different crops will play a vital role in proper budget implication.

Keywords *Satellite data, Curation, Agriculture, Bangladesh*

ICCC-025

Characteristics of Severe Local Convective Storms observed by Doppler weather radar and their simulations using cloud resolving scale model over Bangladesh

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Abstract

The study represents the radar reflectivity pattern for severe local convective storms weather over Bangladesh. Severe local convective storms frequently occur during the pre-monsoon season from March to May, peaking in April (Fatima et al. 2009). Understanding the thermodynamic and physical mechanisms of STS is essential and can be achieved by simulating these systems with the help of high-resolution non-hydrostatic mesoscale models with sophisticated parameterization schemes (Weiss et al. 2006) like Global cloud-resolving models (GCRMs). Improved prediction of severe thunderstorms (STS) is important but remains a challenge for the operational and research community alike. In this research Radar data from Doppler Weather Radar of Bangladesh Air Force (BAF) is assessed and used as observational data. Next simulation with NWP (Numerical Weather Prediction) models is done for assessment of the dynamical features by comparing both radar and model derived products along with the ground station observation and synoptic data. To find out the threshold reflectivity to be used as precursor for presence of vortices, strong updraft and downdraft, microburst and hail; 3-hourly comparison had been done by computing skill scores for five different cases (from march 2018 to april 2021) with ten different schemes and it was found that the maximum reflectivity is more than 45 (dbZ) in average for severe local convective storms over Bangladesh specially for those which are formed during pre-monsoon season. Later an ensemble forecast system is formulated for predicting the expected weather scenarios within the severe local convective storms (SLCS) in Bangladesh region.

Keywords *Severe local storms, Doppler Weather Radar, BAF*

ICCC-026

Change in crop water requirement and yield of *Boro* rice in Mymensingh under future climatic condition

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Abstract

Agriculture plays a vital role in Bangladesh's economy. The economy of Bangladesh is growing fast where the contribution of agricultural sector is 11.50% in GDP growth. The sub-sector of Agricultural area, Grains and vegetables, has the contribution of 5.37% in GDP growth (Bangladesh Economic Review, 2022). Almost 85% of rural population is directly or indirectly involved in agriculture. Of all crops, rice plays the leading role by contributing 95% of total food production (GoB, 2010). Due to the massive improvement in agricultural sector in the recent past, Bangladesh has ranked third globally in producing rice (Bangladesh Economic Review, 2022). But Bangladesh has imported rice worth of 851 million US dollar in fiscal year 2020-21 which indicates Bangladesh is lagging behind to satisfy the need of rice and the main reason behind this unanticipated production is climatic calamities. Bangladesh has faced not less than 185 climatic events in between 2000 to 2019 (Harmeling, D. Eckstein, 2021).

Rice, the dominant staple food in Bangladesh, is highly susceptible to climate change and climate related extreme events such as floods and droughts. For 1°C temperature rise, life span of BRRI dhan28 which is a verity of *Boro* rice, is shortened by 6.4 days and grain yield reduced by 695 kg along with reduction in estimated Crop Water Requirement (CWR) by 14 mm (Hossain *et al.*, 2021). Elevated temperature shortened the crop growth duration and reduced the crop water requirement. In response, the reduced crop water requirement will decrease the irrigation demand and, consequently, the number of irrigation days (Hossain *et al.*, 2021). Due to the climate change, pre-monsoon rainfall is showing increasing trend and because of the high temperature in winter, Growing Degree Days for crop become shortened. Thus, CWR for *Boro* rice has changed.

So, a comprehensive analysis of crop water requirement (CWR) of rice in case of future climatic scenario, including irrigated rice yield, is necessary to understand the impacts of future climatic condition on irrigated rice cultivation for future planning and management. In this regard, this study was undertaken

to determine the effect of future climatic condition on crop water requirement and grain yield of irrigated rice.

Keywords *Crop water requirement, Boro rice, BRRI dhan28, Mymensingh*

ICCC-027

Scaling Irrigation Advisory System (IRAS) nationally and developing messaging systems for integrating IRAS advisories within BAMIS

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Abstract

North eastern part of Bangladesh is well known for BORO rice cultivation as well as heavy rainfall. But excess irrigation is very common in Boro rice cultivation. Due to intensive pumping of water for excessive irrigation during dry season requires awareness of optimal on-field water allocation requirements that is now being provided to farmer cellphones through an operational Irrigation Advisory System (IRAS). Irrigation Advisory System (IRAS) is a key component for modern agriculture specially for BORO rice production in Bangladesh. By comparing evapotranspiration from Satellite based monitoring on-field water consumption (evapotranspiration-ET) over cropped areas with crop water demand from Penman-Monteith (FAO56) technique represent the state of a lands surface water condition which give a pathway to develop an IRAS service. Considering rainfall forecast make this IRAS service more useful efficient. Department of Agricultural Extension (DAE) has been trying to develop a IRAS system since 2019 for whole Bangladesh. As they set target to reach in root level farmer, how accurate this advisory system is very important to know. HSS, FAR etc., statistical analysis will help to find out accuracy level. This study proposed enhanced IRAS allow continuous monitoring of farmer behavioral change in reducing overirrigation and long-term impact on groundwater resources with need-based irrigation practices via follow up assessment during dry season.

Keywords *Penman-Monteith technique, Irrigation Advisory System (IRAS), Northeastern Bangladesh*

ICCC-028

Climatology of Western Disturbances and Associated Precipitation over Bangladesh and Adjacent Areas

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Abstract

Western disturbances (WDs) are mid-tropospheric cyclonic circulations that typically originate over the western Eurasia before propagating downstream across the subtropical westerly jet-stream and northern India and Bangladesh where they can be responsible for catastrophic rainfall. The present study aims to analyze the behavior of WDs' climatology for the north-eastern part of Bangladesh (23-27°N, 88-91°E) during winter months (December, January and February) using the European Centre for Medium-Range Weather Forecasts (ECMWF) (ERA-5) reanalysis data set. The composite areal mean of precipitation, geopotential height, relative vorticity, wind at several pressure level (300 hpa, 500 hpa, 700 hpa, 850 hpa) from 1979 to 2020 has been considered in this regard. The climatology reveals that the northern part of India receives the most precipitation during winter months due to WDs. Bangladesh and its surrounding regions also receive significant amount of precipitation during winter.

Keywords *Western disturbances, ECMWF data, ERA-5 data, Climatology*

ICCC-029

Projection of Future Temperature and Precipitation over Bangladesh using RegCM Model

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Abstract

Projection of future temperature and precipitation over Bangladesh is studied using RegCM Model, version 4.7. The RCP8.5 scenario of HadGEM2-ES RCM data over Bangladesh is downscaled at 25 km grid spacing for the study. Two simulations have been conducted- Historical simulation (over base-line period (1977-2005)) and Future simulation (over projection period (2006-2050)). Climate Research Unit (CRU) data is used as observed data to be compared to the simulated historical data. The primary model output shows aberation in historical temperature and precipitation from the observed data. The Quantile Mapping Method is used to rectify the discrepancy between observed and downscaled data. The research indicated that the model overestimated historical temperature throughout most part of the country, except the eastern section of the country, whereas the general bias in temperature and precipitation was quite small once the corrections are applied. A similar procedure is used to rectify the future simulated data, which is then predicted in three stages: near future (2021-2030), mid future (2031-2040), and distant future (2031-2040). The average temperature is expected to rise by more than 3°C in the near future and by 4.3°C by the end of the distant future. A huge increase in monsoon and post-monsoon precipitation is predicted in the future. Although the monsoon's total precipitation is expected to increase by about 30% in the near future, it is expected to increase by over 230% in the mid and distant future. When it comes to long-term forecasts, the annual estimate predicts a gain of over 80% in near future, while the mid future scenario displays ups (over 100%) as well as downs (less than 50%). the distant future scenario shows an upward trend in the increase which will be around 100% by the end of the 2050.

Keywords *Simulation, Projection, Temperature, Rainfall, Bias Correction*

ICCC-030

Intercomparison and hydrological validation of satellite-based rainfall estimates over the Meghna River basin

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Abstract

This study first compares five products of satellite-based rainfall estimates, TRMM/PR, CHIRPS, GSMaP-G, TMPA-G, and MSWEP, for four sub-regions of the Meghna River basin (as the catchment of Bhairab Bazar), Barak, Meghalaya, Tripura, and Sylhet, and for the eight-year period from 2009 to 2016 (or the 16-year period from 1998 to 2013 only for the TRMM/PR product). Through the intercomparison, it is demonstrated that there is a significant variance between mean annual rainfall estimates, particularly over the Meghalaya region. The area of the Meghalaya region is 18 % as a percentage of the entire Meghna River basin. However, the total amount of rainfall over the region ranges from 21 % to 37 % as a percentage of rainfall over the entire basin. This clear uncertainty in rainfall estimates over the Meghalaya region cannot be ignored for better management of water-related disasters or water resources particularly in the downstream country, Bangladesh. Variances between rainfall estimates can be seen from such intercomparisons, but true values of rainfall are still unknown. Therefore, the long-term total volume of river flow and total amounts of rainfall over catchments are also compared at two locations, Amalshid and Bhairab Bazar. At Amalshid, the total volume of river flow is smaller than the total amounts of rainfall over the Barak region in all the rainfall products. It is consistent with the situation that the component of the river flow from the Barak River into the Surma River is not included in river flow estimates at Amalshid along the Kushiyara River. At Bhairab Bazar, the total

volume of river flow agrees with the total amounts of rainfall over the entire Meghna River basin in the TRMM/PR and GSMaP-G products. Through this kind of hydrological validation, rainfall estimates can be examined from the viewpoint on regional water balance.

Keywords *Meghna River, rainfall, satellite, river flow, water balance*

ICCC-031

Traditional Weather/ Climate Knowledge of Farmers in Bangladesh: Need for Strengthening Agro-Meteorological Advisory Services

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Abstract

Due to changing climate, the extremities of weather have been observed in Bangladesh over last few years. Historically, crop-weather relation has always, to a great extent, determined the harvest from the field. There is no denying the fact that mainstream agriculture in Bangladesh especially the crop production under open sky is badly impacted by different types of weather. Most farmers of Bangladesh are not familiar with the application of weather forecasts/climate predictions for agricultural production. The reach of agrometeorological advisory services in Bangladesh lacks adequacy without any doubt. Nonetheless, Bangladeshi farmers rely mostly on their experience and traditional knowledge on weather/climate for farming decision making. The traditional knowledge of farmers on weather/climate are primarily what they have inherited from their ancestors and what are shared by their fellow farmers over the years during their farming practices. Experts of agro-meteorological advisory services are not fully aware of such capabilities and practices of the farmers. In additional to their shallow knowledge on weather/climatic pattern, farmers use various natural indicators like the assemblage of stars in the sky, animal/birds behavior, croak by frogs, cloud shaping and approaching direction, sound of thunder, blossoming of certain trees/plants, shedding of leaves by trees, appearance and disappearance of reptiles, migration of some species of birds and many others. It is assumed that such short-range traditional predictions, if successfully coupled with science-based agro-meteorological advisory services, would largely contribute in boosting crop production. The ever-increasing complexities of a changing climate make this even more necessary in Bangladesh.

Keywords *Farmers' traditional knowledge on weather, changing climate, short-range weather predictions, agrometeorological advisory services, crop-weather relations*

ICCC-032

The Influence of Indian Ocean Dipole on the Variability of Mesoscale Eddies in the Bay of Bengal

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Abstract

This study investigates the variability of mesoscale eddies in the Bay of Bengal (BoB) utilizing the satellite altimeter throughout a 29-year period. The mesoscale eddies in the BoB have been identified from high resolution daily sea level anomaly (SLA) data employing an automated detection algorithm. The wavelet coherence analysis was conducted to find a statistically significant relationship between the eddy properties and climate indices, which suggests that the properties of anticyclonic eddies are strongly influenced by both the El Nino Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) compared to the properties of cyclonic eddies. Additionally, the EICC dynamics, the monsoon onset, and Rossby waves across the BoB were inhibited as the second downwelling coastal Kelvin wave (dCKW) was absent during the autumn due to the equatorial zonal wind anomalies. Consequently, the combined effect of El Nino and positive IOD significantly reduced the eddy activities, particularly during the spring season of the following years. The stronger correlation and anti-correlation between mesoscale eddies and climate indices suggest that eddying intensifies following the La Nina and negative IOD years, whereas eddy activity diminishes subsequently after the El Nino and positive IOD years because the former event intensifies the second dCKW, whereas the second dCKW weakens or becomes completely absent during the latter episodes. Generally, mesoscale features are not comprehensively considered in large-scale ocean models. Nevertheless, these mesoscale features are responsible for around 90% of oceanic kinetic energy. Hence, the finding has implications for validating ocean-climate interactions and therefore can be incorporated into forecasting models.

Keywords *Second downwelling Kelvin wave, Rossby wave, EICC, Monsoon, equatorial zonal wind*

ICCC-033

Evaluating and Mapping of Atmospheric Air Quality in the Coastal Area of Bangladesh by Using Remote Sensing and GIS Techniques

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Abstract

Coastal region of Bangladesh is increasingly suffering from air pollution in recent years. This study represents an analysis of the mean atmospheric column nitrogen dioxide (NO_2), Sulphur di oxide (SO_2), Ozone(O_3) and carbon monoxide (CO) over the coastal area of Bangladesh during 2018-2022 period. Measurements of nitrogen dioxide (NO_2), Sulphur di oxide (SO_2), Ozone(O_3) and carbon monoxide (CO) obtained from the recently launched Sentinel-5 Precursor spacecraft with TROPOspheric Monitoring Instrument (Sentinel-5P TROPOMI) have been used. The aim of this study was to use relatively high-resolution satellite data for evaluating and visualize the coastal air quality. $PM_{2.5}$ was analyzed during 1998-2019 year and data was collected from the SEDAC website. The NO_2, SO_2, O_3, $PM_{2.5}$ and CO satellite data were then interpreted in Google Earth Engine (GEE) and ArcGIS 10.7 software for further analysis and retrieval of the atmospheric data. The findings showed significantly high values for Khulna, Jessore, Satkhira and Narail districts. From the NO_2 observation, high values were identified in the Chandpur, Shariatpur, and Lakshmipur with a highest average value of 74.2 μmol/m^2. It was found that the SO_2 and O_3 was present significantly high over the Khulna, Bagerhat and Satkhira, Narail region. Particulate Matter $PM_{2.5}$ was exceeded BNAAQS value in every year since 1998 all over the coastal District with an average value of 56 μg/m^3. The year 2020 and 2021 was found much cleaner than the other study year might be due to the Covid-19 Lockdown all over the country. From the trend analysis it was found that most of the air pollutants showed an increasing trend. The interior coast found more polluted than the exposed coast. The overall results of this study confirmed the capability of Sentinel-5P TROPOMI data to be used in monitoring the air quality over coastal area of Bangladesh.

Keywords *Air Pollution, Coastal Region, Remote Sensing, Sentinels 5p TROPOMI*

ICCC-034

Simulation of Thunderstorm and its Characteristics over Dhaka, Bangladesh using WRF-ARW Model

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Abstract

An attempt has been made to regenerate the severe thunderstorms of 01 May, 2016 over Dhaka, Bangladesh using WRF-ARW model. The model was run on a single domain of 9 km horizontal resolution using WRF Yonsei University (YSU) scheme for planetary boundary layer, Kain-Fritsch scheme for cumulus physics and Single-Moment 5-class scheme as microphysics. The NCEP high resolution 6-hourly GFS data is used for initial and lateral boundary condition in version 4.3.3. Grid Analysis and Display Systems (GrADS) is used for visualization of different weather parameters. The model's predicting capability is evaluated by analyzing mean sea level pressure, wind pattern, temperature, relative humidity, vertical wind shear, vorticity, MCAPE, TTI, K-index, LI and rainfall distribution. The values of MCAPE, TTI, K-index and LI for four cases were found to be about 2500 Jkg^{-1}, 54, 40°C and -9 at the time of the selected thunderstorm respectively and the values of MSLP, RH, temperature, vertical wind shear, vorticity are found to be about 1002.5 hPa, 60%, 29.5°C, 35-40 ms^{-1} and 10x10-5 to -10x10-5 s^{-1} respectively. Model simulated parameters were compared with observed data of BMD and theoretical threshold values. It can be concluded that WRF-ARW model's performance in making time and location specific forecasting for the selected event was proficient up to 48 hours advance though with some biases.

Keywords *Wind shear, vorticity, cumulus physics, Lifted Index and MCAPE*

ICCC-035

Coastal vulnerability mapping and analysis over southeastern coast of Bangladesh

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Abstract

On the northern side of the Bay of Bengal (BoB), Bangladesh is endowed with both natural resources and natural disasters at the same time. The Mapping of the coastal vulnerability of a calamities-induced coast aid in declining resource demolition and loss of life by notifying people of forthcoming disasters and making it easier to take preventative action. The study has aimed to make a combined coastal vulnerability index (CCVI) for the southeastern coast of Bangladesh, combining physical and social vulnerability indexes-PVI and SVI respectively. The Coastal vulnerability mapping was done by using six physical parameters, namely (a) Coastal Elevation, (b) Coastal Slope, (c) Rainfall, (d) Storm Surge Height, (e) Rate of SLR, (f) Mean Tidal Range and three social parameters namely (a) Literacy rate, (b) Land Use Land Cover (LULC), (c) Population Density. With the aid of field and secondary data, thematic layers of each physical and social parameter were prepared by defining five distinct vulnerability classes and assigning vulnerability ranks for each of them. For final coastal vulnerability mapping, geographical techniques such as GIS and RS had been used and relevant values were categorized into five distinct groups as before. According to the results, the southeastern region such as Kutubdia, Chakaria, Maheshkhali, and Cox's Bazar Sadar, are extremely vulnerable to disasters. In contrast, Ramu, and Ukhia have been labeled as moderately vulnerable, and the remaining regions which are in Hathazari, Mirsharai, Sitakunda, Sandwip, and Chittagong City Corporation (CCC) show that they are very low vulnerable to such calamities. For the aforementioned regions, the percentage of CCVI represents 26%, 22%, and 52% respectively and the CCVI score ranges from a minimum of 0.39 to a maximum of 4.6. The output of the study indicates the difference in the degree of vulnerability in different coastal areas of the southeastern coast which can be used by policymakers and disaster management ministry or other government agencies for disaster preparedness and to prevent excessive damage to very vulnerable areas along with its communities. Besides, it can be used for community resilience and developing their adaptation

strategies to overcome the ultimate outcomes of recent climate change.

Keywords *CCVI, Southeastern Coast, LULC, resilience, adaptation*

ICCC-036

Developing an integrated coastal vulnerability index (ICVI) for the south-central and south-western coastal districts of Bangladesh

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Abstract

The coast of Bangladesh is a suitable test-bed for evaluating coastal vulnerability under complex land use systems and climatic conditions including sea level rise, heavy rainfall, storm surge, salinity intrusion and so on. Besides, considering both the social and physical parameters is crucial to understanding the susceptibility of a coastal region. Therefore, this present study has attempted to develop an Integrated Coastal Vulnerability Index (ICVI) for the most dynamic and non-uniform south-central and south-western coastal districts of Bangladesh based on geospatial techniques using both conventional and remote sensing database. Preliminarily, for assessing the ICVI, a total of eight physical parameters namely elevation, slope, storm surge height, rate of sea level rise, rainfall, wind speed, soil salinity, and soil permeability have been used to calculate Physical Vulnerability Index (PVI); at the same time, about four social variables like population density, literacy rate, household structure and land use land cover have been considered to evaluate the Social Vulnerability Index (SVI). Finally, using the PVI and SVI results, an Integrated Coastal Vulnerability Index has been developed applying the square root of the product mean equation that was proposed by Gornitz et al. in 1997. The ICVI result revealed that a large portion of Barguna, Patuakhali, Noakhali, Bhola, Shariatpur districts and some part of Barishal, Jhalakati and Feni districts is very highly vulnerable in consideration to the socio-physical variables covering approximately about 28.5% of the total study area while western regions like Satkhira, Khulna, Bagerhat, Jashore, and Narail has been identified as very low to low vulnerable districts. This study believes that it is the first attempt of this kind to develop an integrated coastal vulnerability index for the low lying

deltaic south-central and south-western coastal districts of Bangladesh and simultaneously this approach can be used efficiently for assessing coastal vulnerability and developing a holistic strategy to coastal conservation, management, and policy making.

Keywords *ICVI; PVI; SVI; management; policy making; Bangladesh*

ICCC-037

Assessing the efficacy of quantile mapping as a bias correction method for remotely sensed precipitation products over Bangladesh

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Abstract

Remotely sensed precipitation data, though considered a viable alternative to gauge station readings in regions where data scarcity persists, often show considerable bias when compared to existing station-observed values over the Bangladesh region. For such instances, bias correction is required. Quantile mapping (QM) is a bias correction technique that has recently become popular in climate science. However, its efficacy in dealing with global rainfall data sets such as the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is yet to be determined. This study aims to correct the bias for daily precipitation from the CHIRPS (v2.0) dataset at 0.25° spatial resolution against existing station-observed rainfall provided by Bangladesh Meteorological Department (BMD), over a period of 2011-2021. The results of the study show that both the empirical quantiles (QUANT) and robust empirical quantiles (RQUANT) methods reduce the bias for the remotely sensed datasets by a considerable margin and perform better for the rainfall-heavy North-Eastern region as compared to other regions. A similar approach may help to reduce the bias of other remotely sensed precipitation products over Bangladesh, providing a more improved quality of data for further research.

Keywords *Quantile mapping, bias correction, CHIRPS, remote sensing, Bangladesh*

ICCC-038

Evaluation of Bias Correction Techniques for Precipitation: A case study for Agroecological Zone (AEZ) of Bangladesh

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Abstract

During the last few decades, hydro-meteorological hazards are increasing in frequency, magnitude, and intensity of extreme events. These hydro-meteorological extremes (i.e., storms, floods, and hydrological droughts) have always been a threat to human society. Therefore, the projection of future climate with fidelity is of immense importance for supporting the impact and adaptation assessment and planning. The demand for high-resolution modeling is increasing but the major constraint for failing to predict these seasonal events is the imperfect representation of land-atmospheric presentation. Bias errors between climate models and observations can be caused by imperfect conceptualization, discretization, and spatial averaging within grid cells. To overcome the large biases in climate models, a range of bias correction methods have been developed. However, studies attempting to assess the skill of bias correction methods in correcting daily rainfall are limited. Most of the studies are often limited to GCMs, which due to their coarser-resolution do not provide the heterogeneous representation of rainfall characteristics over the Indian subcontinent. The objective of the study is to evaluate the performance of different bias correction techniques over different Agroecological Zone (AEZ) in Bangladesh. The daily precipitation and monthly average dataset from CMIP are deployed for analysis. As the climatic condition in these regions varies it is unlikely that one method applied to a region can be transferable to another region. Therefore, the bias correction techniques namely linear scaling, local intensity scaling, Power Transformation, Gamma distribution, and quantile mapping are applied in the study. The performance of these bias correction techniques is assessed using several statistical measures. Bangladesh has varying topography

and rainfall pattern, so there is a need for more region-specific information about the choice of correction methods and the simulation model. The findings can be employed to generate region-specific impact studies that can help in policy and decision-making in agriculture and other fields.

Keywords *hydro-meteorological hazards, AEZ; Bias; CMIP*

ICCC-039

Use of Geographic Information System (GIS) and Remote Sensing (RS) in Flood Management

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Abstract

The specific goal of this study is to understand how Geographic Information System (GIS) and Remote Sensing (RS) concepts are applied in the field of flood management in a four phases of disaster management, while the study's overall goal is to motivate readers to create cutting-edge tools and techniques to deal with the particular disaster more quickly and effectively. This study is both qualitative and quantitative in character and secondary data based. To create the maps, I utilized the tools ArcGIS and Erdas Imagine. The findings show that flood hazard map can be used to evaluate flood risk as it can be ranked by flood affected frequency. Four phases data are generally collected to draw a risk map using GIS, they are- hydrologic, geomorphic, hydraulic and land use. From the early monsoon flood mapping stated below, the areas in high risk zone can be warned for the time between early-June and mid-July so that they can be prepare for harvesting and can prevent themselves to planting seeds in the vulnerable boundary areas which are prone to flood. USGS has developed a tool which is an extension of ESRI's ArcGIS software that helps in the development of pedestrian evacuation plans for natural hazards such as volcanoes or floods. MSS band 7 (0.8-1.1) shows water body properly as its near-infrared (NIR) range provides data about water and soil moisture. Flooded and non-flooded area can easily be delineated by remote sensing as this two type of surface will have different pixel values. Depth of water of every space within the flood affected area can be computed by its altitude with respect to the height of closest flood boundary location. The limitations include cloud overcast and dense canopies with some insightful recommendations.

Keywords *vulnerability, risk map, monitoring inundation, flood response, spatial analysis.*

ICCC-040

Designing an Effective Flood Forecasting Model for South Asian Flood Plains with a Particular Emphasis on Bangladesh.

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Abstract

Other than India, most South Asian nations-including Bangladesh, operate a conventional and traditional flood forecasting system that seems inefficient and incompatible in handling today's challenging climatic and environmental circumstances- implied in flood disasters under influences of global climatic changes. A timely and effective flood forecast about water level or abnormal large discharge, that threatens safety of structures and flood plain activities, is necessary in this age of global climate change. An advance warning of this stature, helps authorities adopt a series of measures to minimise adverse impacts of flood on lives and economy. Unlike several other disasters, approaching flood can be forecast ahead of its occurrence with advance collection of hydro-meteorological data, and its transformation into flood water level or flood hydrograph. However, selection of a particular method or model, and its accuracy for a given site is largely governed by three factors - data availability; forecaster's knowledge and experience with the basin or catchment area and- importantly, forecaster's familiarity with the software to be used in the forecasting process. In this paper, efforts have been given to develop a theoretical framework to be used in designing a plausible and effective Flood Forecasting Model that can be applied in Tropical watersheds- including Bangladesh. The approach is relied and based mainly on local hydro-meteorological and topographical data and also physical and cultural environmental perspectives. Nonetheless, we should remember that Bangladesh is ranked seventh among the most climate vulnerable countries in the world, whereas its contribution to global warming is negligible. It contributes only 0.36 percent of all greenhouse gas emissions.

Keywords *Flood forecast, climate change, advance warning, hydro-meteorology, flood hydrograph*

ICCC-041

Introduction to the observational system of land-air interaction on the Tibetan Plateau and its related results

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Abstract

The environmental change of the Tibetan Plateau is closely related to the westerly monsoon process. The main body of the "roof of the world" Tibetan Plateau is located in the middle of the troposphere. It is an important "source of influence" of the mid latitude atmospheric circulation and a key area for the convergence and strong interaction of the westerly and monsoon circulation systems. The thermal and dynamic effects of the Tibetan Plateau and its atmospheric water cycle process have an important impact on the weather and climate of China and Asia, as well as the global atmospheric circulation. Based on this, our group has conducted field observation and experiment, satellite remote sensing and numerical model research on the Plateau atmospheric boundary layer process on various underlying surfaces of the plateau in the past 20 years. Our research achievements include: 1) Aiming at the complexity of the Plateau atmospheric boundary layer, we mainly participated in the design and establishment of the Plateau atmospheric boundary layer comprehensive observation network on different underlying surfaces; 2) Based on first-hand observation data, the variation characteristics and mechanism of surface radiation and energy balance on the typical underlying surface of the plateau, which is the most representative of the boundary layer process, are revealed; 3) It has broken through the bottleneck of the previous satellite remote sensing and simulation of the plateau surface heat flux initial field lack and verification difficulties, and its work has promoted the development of China's observation of the Plateau atmospheric boundary layer energy and water exchange process, providing a detailed, objective and accurate observation basis for the study of the impact of the plateau atmospheric boundary layer process

on the atmospheric circulation.

Keywords *Tibetan Plateau, Land surface heating field, heat flux, Land-air interaction*

ICCC-042

Dependence of the tourism industry on the climate resources

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Abstract

This study explores the climate resources of mountain ski resorts in the Ile-Alatau mountains (part of the Northern Tian-Shan) and in the Altai mountains (the east part of Kazakhstan). Features of snow accumulation and duration of snow cover on mountain resorts with different territorial and zonal distributions were compared. Snow cover change is a complex indicator of climate change in the cold season, which is the result of changes in temperature, precipitation, frequency of thaws, etc. Climate change significantly effect on the functioning of ski resorts, especially if they are located in areas with relatively high air temperatures in winter, as those which have lower altitudes.

Snow cover for winter recreation is a key climate resource. Information about the duration of snow cover is necessary for making decisions about the opening and closing of the ski season. Compared resorts have different accumulation conditions of the main snow layer. The intensity of snow falling is one of those characteristics. Changing features of climate resources, seasonality of snow cover occurrence is the reason of challenges for one of the sectors of the tourism industry which require diversification of resort services for tourism activity.

Keywords *climate resources, snow cover; mountains, ski resort, tourism*

ICCC-043

Simulation of Bihar lightning event using an Ensemble of WRF modeling configurations: Performances of Lightning Potential Index and Lightning Flash Count

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Abstract

Lightning is a hazardous meteorological phenomenon that occurred over the Northern part of India (Bihar) on 25th June 2020, killing 83 people in Bihar. Lightning events are studied using ground-based lightning observational data and Weather Research and Forecasting (WRF) model. The updraft and ice particle concentration play essential roles in the initialization of lightning inside the thundercloud. The charge generation and separation inside the clouds play an essential role in the severity of lightning. The Lightning Potential Index (LPI) measures the potential of charge generation and separation inside the clouds. It plays a significant role in determining lightning-prone zones.

Lightning simulation is carried out using an ensemble of different WRF model configurations during an active phase of the monsoon over the Indo-Gangetic plains. The model is integrated from 24th June 00 UTC to 26th June 06 UTC with an ensemble of 9 members. The ensemble consists of 1 control + 8 member with different configurations of the WRF model. LPI is calculated using the model-derived parameters. The results are analyzed using the IITM ground-based observation data and INSAT-3D 3D Brightness Temperature (BT) data. All ensemble member's results are distinct from each other. This shows the sensitivity of every configuration. Member 2 (M2) is the triple nested member; it uses the same physics option as M1. In addition, M2 shows comparatively better spatial agreement with observation than M1. M4, M8, and M9 have captured the lightning well in terms of observation using the lightning parameterization scheme. The probability of lightning threat indicated (90–100%) threat, and IITM lightning data have represented the same maximum over the Gopalganj district (northwestern part of Bihar) (825 CG) lightning flashes in 24 hr. The skill scores of simulated lightning flash count in M2, M8, and M9 showed reasonably good POD values (0.6, 0.5, and 0.69, respectively).

Keywords *Simulation, WRF model, Lightning Potential Index, Lightning flash count, Ensemble*

ICCC-044

Accuracy assessment of weather forecasting in Nepal

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Abstract

Accurate weather forecasting is important for water resource management as well as disseminating early warning information to the communities to prevent from disasters related losses. High resolution (3 km horizontal resolution) Weather Research Model (WRF) is being used for daily weather forecasting by the Department of Hydrology and Meteorology (DHM), Government of Nepal. This study evaluates the accuracy of forecasted precipitation and temperature (maximum, minimum, and mean) data generated by WRF model using in-situ measurements for 2021 over Nepal. Several, statistical indices were used to quantify the accuracy of forecasted weather variables on temporal and spatial scales. Based on statistical indices, it was found that WRF simulation underestimated (overestimated) the observed precipitation during the wet (dry) season, however it shows very consistent performance for temperature over Nepal. The WRF simulation shows small negative bias for precipitation (–0.43 mm/day), and mean temperature (–0.48^{o}C/day), with higher correlation (>0.50), exhibiting overall satisfactory performance. Among the variables, forecasted minimum temperature is more reliable (lower bias and higher correlation) than the maximum temperature and precipitation. Further, several categorical scores used to access the skill of the model shows that WRF forecasting is capable to capture the true precipitation events (Probability of Detection values >0.50), with low error when there are no-precipitation events (False Alarm Ratio values <0.40). Overall, forecasted precipitation is able to detect observed precipitation and no-precipitation events accurately (accuracy > 0.70). The simulation used to forecast meteorological variables are not bias corrected, thus we recommend to used reliable bias-correction scheme to produce more accurate or reliable forecast system. Moreover, accuracy evaluation should be conducted in regular basis so that weather forecasting will be more accurate and reliable that would help to save lives and reduce property damage in Nepal.

Keywords *Nepal, WRF simulation, precipitation, temperature, accuracy*

ICCC-045

Projection and evaluation of extreme temperatures across Bangladesh using CMIP6 multi-models

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Abstract

Climate change continues to increase the intensity, frequency, and impacts of weather and climate extremes all over the globe. To this end, this work uses a bias-adjusted coupled model intercomparison project phase six (CMIP6) 13 models to understand the future spatiotemporal changes and trends of 8 extreme temperature indices under two Shared Socioeconomic Pathways (SSP) 245 and 585 scenarios with the near-future (2021–2060) and far-future (2061–2100). Results show significant persistent warming days and nights throughout the 21st century, increasing with the increase in radiative forcing. In contrast, the projected reduction in cold days (TX10p) and cold nights (TN10p), with the decrease in cold nights exceeding the decline in cold days. Notably, the warm spell duration index (WSDI) and growing degree days (GDD) have a positive trend in both timelines. The results also revealed a significant increasing trend in temperature in the near and far futures for SSP245 all over Bangladesh during a significant temperature year (2035-2100). The multi-model shows that GDD will increase much faster than the previous year's temperatures in Bangladesh. The expected increase of WSDI over the northern part of the northern and the northeastern areas is higher compared to other climatic zones of the country. A significant warming was noticed in the SSP585 scenario, with a maximum increase of up to 4.5 °C towards the end of the twenty-first century. Analysis of spatial and temporal variations of GDD and WSDI, showed an increase of 5-6 and 6-7 days or decades to more than 85% under the SSP585 scenario compared to the baseline period. This study projected an increase in mean annual Tmax over Bangladesh of 1.79 °C in near-future and 2.30 °C in the far-future for SSP245 compare to the baseline period. These outcomes indicate a possible increase in drought severity and create the possibility of devastating flash floods with harmful impacts on agriculture in Bangladesh.

Keywords *Extreme temperatures, climate change, projections, CMIP6, SSP, GCMs*

ICCC-046

Assessment of Spatio-Temporal Changes in Temperature of Bangladesh under Emission Scenarios of CMIP6 models

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Abstract

In recent years, it has been noticed that the monthly average temperature of major cities of Bangladesh is increasing. The aim of this study is to investigate the spatial (district wise) and temporal (daily time scale) variability of maximum (Tx) and minimum (Tn) temperature changes over Bangladesh. In this study a multi-model ensemble methodology comprising five general circulation models and two emission scenarios from the CMIP6 framework were used to evaluate the impact in the decadal time period. A synthesis analysis with annual maxima (minima) and minima value from observed data was used to quantify extreme temperatures variability in terms of 10 years return period. It is found that there is a significant spatial increase of maximum temperature which signifies a uniform shift for the extremes of the distribution. Also, there is a tendency to have a greater estimate of extremes in the far future than the near future over Bangladesh. The greater estimate is also perceived under the high emission scenario in comparison to the medium emission scenario. The findings are expected to assist in the spatio-temporal evaluation of climate change impacts.

Keywords *CMIP6, emission scenarios, temperature, spatio-temporal changes*

ICCC-047

Forecast-based Action: A Tool to Reduce Cyclone Risk for Vulnerable Communities in Bangladesh's Coastal Region Based on Weather Forecast and Climate Predictions

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Abstract

In two cyclone seasons, cyclones caused severe impact making landfall in Bangladesh coast and affected more than a million people over the last 10 years. From 1891 to 2015, 89 cyclones made landfall on of which 47 and 53 percent were cyclonic and severe cyclonic storms respectively. As one of the major hazards, cyclones cause loss of life and livelihoods in the coastal areas of Bangladesh. The population is vulnerable to cyclones associated with tidal surges, particularly in the pre-monsoon and post-monsoon months. The Cyclone Early Action Protocol (EAP) of Forecast-based Financing/Action (FbF/A) for the Bangladesh Red Crescent Society (BDRCS) is a tool to guide timely and effective implementation of early actions when certain weather or climate forecast shows a high likelihood of impacting population. For Jhalokati and 13 sea-facing coastal districts, the EAP is being implemented by BDRCS with support from International Federation of Red Cross and Red Crescent Societies along with other partners. It does not work in isolation. It is connected to existing Disaster Risk Reduction and Management Plans and Contingency Plans. When BMD issues a Signal 7 or above warning with a lead time of 30 hours or more and BMD/IMD/ECMWF/ GFDS/JTWC forecasts wind speeds of 125 km/h or more in the coastal districts of Bangladesh with a lead time of 30 hours or more and with a potential damage of 25 per cent household asset of the respective Unions along with 3.5 meter of storm surge probability the trigger the be activated in vulnerable unions. The impact and intervention areas are analyzed using GIS models using risk analysis based on poverty, household structure, population, exposure, and vulnerability index data etc. After the activation, defined early actions are executed following the governments Standing order on Disaster such as early warning dissemination and transport arrangement for people and livestock evacuation, including household movable assets; distribution of food and drinking water as well as basic

first aid service at cyclone shelters etc. So, this tool enables BDRCS to support around 40,000 vulnerable people till now with an activation budget of 530000 CHF from Disaster Response Emergency Fund of IFRC in the 14 coastal districts of Bangladesh.

Keywords *Cyclone; Forecast-based Financing; Anticipatory Action; Early Action Protocol, Humanitarian Actions*

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Effects of climate changes on the acidification in the Bay of Bengal

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Abstract

Anthropogenic CO2 increases are producing fundamental and unprecedented changes in ocean chemistry. The research will look at how climate change is affecting the acidification of the Bay of Bengal, which is located in the northeastern region of the Indian Ocean. The combination of ocean acidification and climate change puts enormous strain on the environment. Ocean acidification, in conjunction with climate change, greatly stresses marine animals spanning from tropical to high latitude environments, and is especially harmful to species that make their skeletons and shells from calcium carbonate, diminishing the chances of their progeny surviving. Because the contribution of fossil fuels to CO2 emissions is a major concern in climate change, replacing fossil fuels with marine renewable energy is required to minimize ocean acidification.

Keywords *Ocean acidification, Bay of Bengal, climate change, PCO2, PH*


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