S M R C
NEWSLETTER

Vol. 9 No. 2 **July-December 2002**

Research activities of Synoptic Division:

Climate Variation in Pakistan

Synoptic Division has been continuing research in the field of climate change over Pakistan. The report on the topic "The status of climate variation in Pakistan and its impact" will be completed soon. The time series data of temperature for 23 stations and of precipitation for 25 stations have been used to study the inter-annual variability and trends of temperature and precipitation of Pakistan.

The data of annual and seasonal mean T_{min}, T_{max} and T_{mean} and precipitation have been analyzed. The time series analysis have been used to investigate the inter-annual variation and trends of these parameters for all the selected stations. The spectral analysis, which comprises the transformation of the time series data from temporal domain to frequency domain, has been used to identify the dominant modes of periodic variations in the country average temperature and precipitation. The trends of temperature and precipitation during the period 1951-2000 have been estimated. The analysis shows that in Pakistan, warming over some areas and cooling over the others have taken place during the period 1951-2000. In general warming seems to be highly dominating over the southwestern and south-central part of Pakistan and also over the relatively small area in the northwest.

The areas, which show cooling, lie mostly over the eastern, northeastern and some areas of northwestern part of Pakistan. The southwestern coastal zone also shows cooling. The variation and trends of the country average temperature of Pakistan have also been studied using the area weighted country average temperature. The spectrum analysis of the country average temperature showed the existence of the distinct peaks in the periodic cycles at the time period around 2-4 years, 5-6 years, and around 16-20 years. The modes with T=3-4 years and 8-20 years contain larger portion of the spectral power.

The temporal variation and the trends of annual precipitation shows that the linear trends of precipitation is spatially and temporally inhomogeneous. Out of 25 stations 17 stations show increasing trends and 8 stations show decreasing trends.

The spatial distribution of linear trends of annual precipitation shows that precipitation is increasing almost all over Pakistan to the north of about 26.5ºN. The increasing trend is very small between 26.5º-32.0ºN. The trend increases to the areas further north with a few exceptions such as Parachinar and Balakot.

The highest increasing trend of precipitation is observed in the northern region at Dir, Islamabad, Peshawar, Jhelum at the rate of 98, 90, 39 and 72 mm/decade respectively. The decreasing trends at Balakot and Parachinar are also high -167 mm and -53 mm/decade respectively. The desert areas of southwestern and western Balochistan including the coastal zone and part of southern Sindh show decreasing trends of precipitation.

The annual and seasonal country average precipitation has been calculated for the period 1951-2000. Time series data show that the variations in the time scale of 2-3 years and 4-6 years is most common. The variation with higher time scale of 10-20 years is also found in the precipitation.

The results of the spectrum analysis of the country average annual precipitation show that the spectral peaks are concentrated within the

frequency cycle with period T=2-3, 5-8 and 17-25 years. The country average annual precipitation has shown a net increasing trend. The country average precipitation has increased about 28 mm (10%) during the period of 50 years (1951-2000).

Climate Variation and its change over Bhutan:

A study is being carried out on the Climate of Bhutan. For this purpose, a computer database has been prepared. Verification, correction, interpolation of data have been made during the period from July-December, 2002. Spatial analysis of the maximum, minimum and mean temperature and precipitation have been performed on monthly, seasonal and annual basis.

The annual profile of temperature has been shown in Fig. 1 for Sipsco and Chazam. It is found from the analysis of the data that the highest and lowest monthly maximum temperature is 33.2ºC at Phuntsholing in May and 6.0ºC at Gasakhatey in January and minimum temperature is 24.9ºC at Daifam in July and –5.7ºC at Phobjikha in January. It is also found that extreme highest maximum temperature is 37.2ºC at Phuntsholing and the extreme lowest minimum temperature is –8.2ºC at Drukgyl Dzong during the period 1990 -1999.

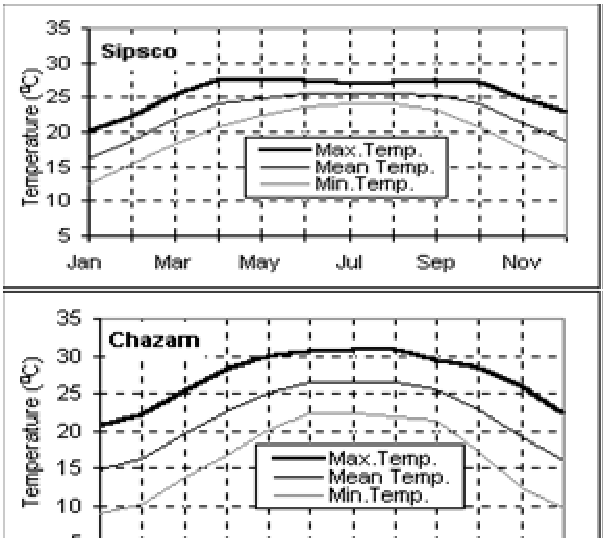


Figure 1: Annual profile of monthly maximum, minimum and mean temperature for two stations of Bhutan.

has been shown in Fig. 2 for Sipsco and Chazam. The figure shows that Bhutan receives high monsoon precipitation in Sipsco but low precipition in Chazam.

The annual highest precipitations (5865 mm) is obtained at Sipsco and lowest precipitation (628 mm) at Gidakom. More than 70 % precipitation occurs in monsoon season for most of the stations.

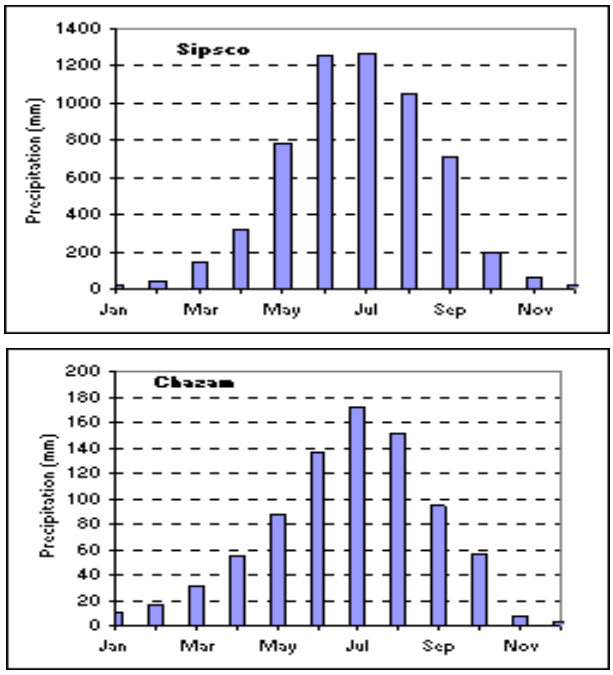


Figure 2: Annual profile of monthly precipitation of two selected Stations of Bhutan.

Bangladesh

Special Weather Phenomena during the Period July-December, 2002

During the period July- December, 2002, one monsoon depression and two post- monsoon cyclonic storms formed in the Bay of Bengal out of which one cyclonic storm (11-12 November, 2002) hit the Sundarbans coast near the Raimongal river and moved over Bangladesh.

1. Monsoon depression (22-24October, 2002)

The well marked low over west central Bay of Bengal and adjoining area concentrated rapidly into a depression at 1200 UTC of 22 October, 2002. The depression moved NW-wards up to 22 October, 21 UTC. Then it remained practically stationary up to 23

October, 0900 UTC. Then it recurved and moved NE-wards at 23 October, 1800 UTC. Then it was found stationary. The depression became weakened into a low pressure over the same area at 1200 UTC on 24 October, 2002.

2. Cyclonic storm (11–12 November, 2002)

The well marked low over South-West Bay and adjoining west central Bay, concentrated rapidly into a depression at 0300 UTC of 11 November, 2002. Initially it moved northwards. Then it started to move NE-wards.

On 12 November, 2002 at 0000 UTC, it concentrated into a deep depression over west central Bay of Orissa coast and adjoining area. It rapidly concentrated into cyclonic storm at 12 November, 0300 UTC over north Bay off Orissa coast. It continued to move NE-wards till crossing the coast. The cyclonic storm moved in northeasterly direction and crossed the Sundarban coast near the Raimongal river at 12 November, 1500 UTC. The system moved over Bangladesh and weakened slowly by giving rain.

Significant Rainfalls (in 48 hours: 11 and 12 November, 2002).

Rangamati	:	289 mm
Sylhet	:	119 mm
Dhaka	:	206 mm
Faridpur	:	111 mm
Jessore	:	112 mm
Cox's Bazar	:	132 mm
Khulna	:	148 mm

Country Rainfall was 183% above normal.

3.Cyclonic Storm (24-29 November, 2002)

The well marked low over southeast Bay and adjoining southwest Bay concentrated into depression over the same area at 1800 UTC of 23 November, 2002. The depression moved northwards and concentrated into a deep depression over west central Bay and adjoining east central Bay at 0000 UTC of 25 November, 2002. Then it concentrated in to cyclonic storm over the same area at 0600 UTC on the same day. The cyclonic storm over east central Bay and adjoining west central Bay moved slowly NE-wards and weakened into a depression at 27 November, 0000 UTC and further weakened into a well marked low at 0300 UTC of 29 November, 2002 over east central Bay off Mayanmar coast. It remained stationary & gradually weakened and became unimportant eventually.

India

1.METSAT-An Indian Satellite for Meteorological Applications

India has launched its first dedicated Meteorological Satellite (METSAT) successfully on 12th September 2002 using its own launch capabilities. This mission is the first of its kind as the earlier INSAT class of satellites were multipurpose, while METSAT is totally for meteorological applications. METSAT is renamed Kalpana-1 in memory of Indian Astronaut Ms. Kalpana Chawla, who died in the Columbia Space Shuttle crash on February 1, 2003.

Kalpana-1 satellite has two paylodads viz. Very High Resolution Radiometer (VHRR) and Data Relay Transponder (DRT). The VHRR is meant for imaging the earth's cloud cover over India and adjoining areas in 3 channels i.e. Visible, Infrared and Water Vapour. The imagery will have a resolution of 2 Km for Visible channel and 8 Km for Water Vapour and Infrared channels and will be available in Full Frame, Normal and Sector Scan Modes.

Indian satellite imagery is available on the IMD Internet website (www.imd.ernet.in) along with weather charts and other important information.

2.Depressions and Cyclone Strom over Bay of Bengal

During the period from 1 July to 31 December, 2002, four systems formed over the Bay of Bengal, out of which two (23-28 November and 21-25 December, 2002) attained the cyclonic storm intensity and dissipated over the sea. The third system (10-12 November, 2002) attained the intensity of a severe cyclonic storm for a short duration (two hours only) and finally weakened into a cyclonic storm before crossing West Bengal coast. The only one depression (22-23 October, 2002) formed during this season was very sluggish in its movement and had the shortest track of the season, though it was active for two days out at sea. This system also dissipated over the sea off Andhra Pradesh coast.

2.1 Severe Cyclonic storm over the Bay of Bengal (10-12 November, 2002)

A depression formed over southwest Bay of Bengal in the morning of 10 November and lay centred near lat. 12.0°N and long. 82.5°E at 0300 UTC. Remaining practically stationary, it intensified into a deep depression at 1200 UTC on the same day. Moving in a north-northeasterly direction, it further intensified into a cyclonic storm at 1200 UTC on 11th over west central Bay of Bengal (Fig. 3) and remained stationary till the night and further intensified into a severe cyclonic storm at 0600 UTC on 12th and lay centred near lat. 21.0°N and long. 87.5°E. Thereafter, it weakened into a cyclonic storm and crossed West Bengal coast south of Kolkata around 0900 UTC. Moving in a north-easterly direction the system further weakened into a depression over Bangladesh in late night of 12 November.

Under the influence of the system, widespread rainfall with scattered heavy falls occurred over Orissa coast.

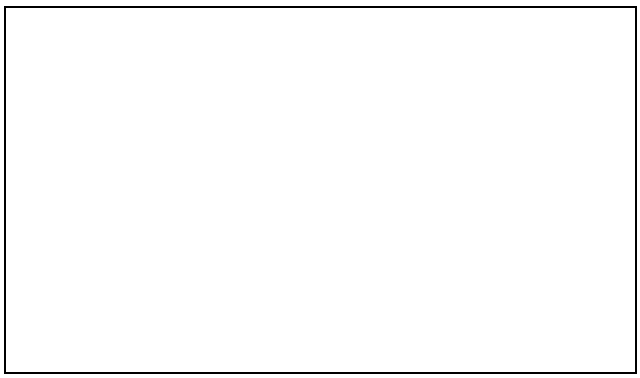


Figure 3: Metsat-1 image of 0900 UTC 11 November 2002 showing the cyclonic storm of the Bay of Bengal.

Maldives

Severe weather events July –December 2002 – Maldives

Severe weather started on 5th of July in the form of a low-level circulation in the west of Huvadhu atoll. The stormy system caused widespread rain and thundershowers over the country. Figure 4 shows the satellite imagery of 10 July-2002.

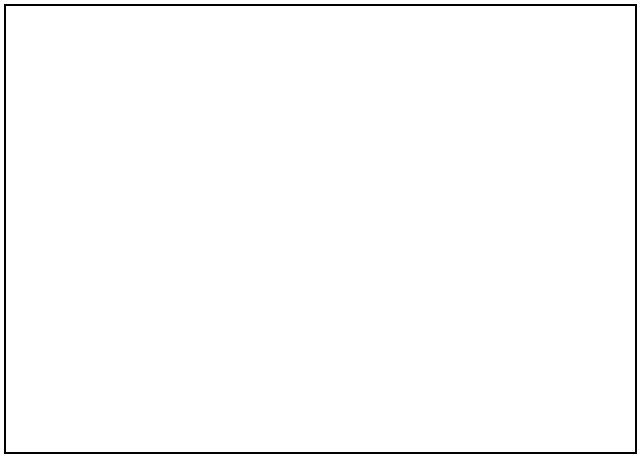


Figure 4: Satellite imagery of 10 July 2002 showing wide spread convective activities over the Indian Ocean.

The heaviest ever recorded rainfall in the Maldives for a day has been registered at the Meteorological Office, Kaadedhdhoo (WMO# 43588) as 219.8 mm on 09 July 2002. During this rainstorm, some islands belonging to southern and as well as central Maldives were flooded.

Landslides were reported from Huvadhu atoll. Building and other properties were severely damaged.

Figure 5 shows one of the flooded islands (GDH Thinadhoo).

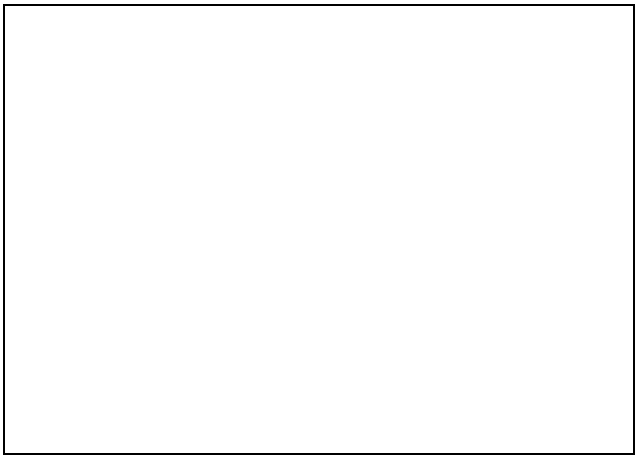


Figure 5: Thinadhoo was flooded due to heavy rain, 9 July 2002.

On 8 July 2002, frequent thunderstorms occurred over-night at Addu atoll. Several house-hold luxury appliances such as TV, Radio, Video & Audio systems and refrigerators were destroyed by lightning.

The second phase of monsoon which began in late September caused flooding in some of the islands in southern atolls again. Fuvah-mulah, the only island of Gnaviyani atoll recorded 140 mm of rain on 24 September 2002. Uprooting of many trees and damage to some of their properties were reported.

In December, 2002, a trough of low pressure appeared over the Maldives. The unusual behavior of this system brought frequent heavy rain and thunderstorms to the county. Kaadehdhoo (WMO # 43588) received daily totals of 109.4 mm and 93.5 mm on 12 and 18 December respectively. It was reported that Mulah, the capital of Meemu atoll and Hithadhoo/Addu atoll, the second-most heavily populated island of Maldives were damaged. Residents from the flooded houses were transferred to other locations.

Meteorological Telecommunications

The 75-baud GTS link between Male' and New Delhi did not operate satisfactorily. To overcome the problems with speed and reliability of the 75 Baud circuit, Department of Meteorology, Maldives is now looking into establish a TCP/IP GTS link via the internet. Negotiation are going on with the local Telecom Company (Dhiraagu) and India Meteorological Department, New Delhi.

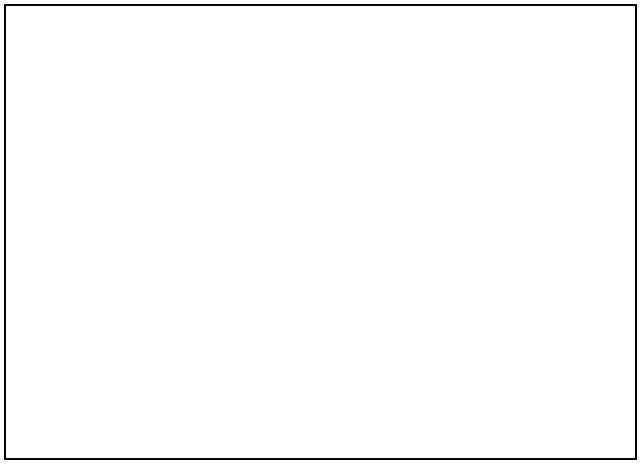


Figure 6: Existing GTS terminal at NMC of Maldives.

Nepal

The main highlights in the weather condition over Nepal for the period from July to December 2002 are informed here.
This year summer monsoon played a chaotic role since its arrival in the country. Spatial variability of the monsoon conditions brought natural calamity like the devastating flooding and landslides in the eastern and central regions, whereas severe drought conditions prevailed in the western region.
Some of the important features observed in the weather condition are presented here.

- Monsoon 2002 was considerably mild. Sluggish condition flows as well as its activity was noticed this year causing delay in the progressing of monsoon over the country. But the chaotic behaviour of the monsoon in the month of July witnessed massive rain-induced catastrophes in the central and

eastern part, while the western part suffered severe spells of drought.

- The monsoon this year, commenced into the country on 15th June and retreated from the country by 30th September. The normal duration of monsoon over Nepal is 106-day (10th June-23rd September).

- Vigorous monsoon on the third and last week of July resulted in heavy torrential rain leading tremendous flooding and landslides in the central and eastern regions. The rainfall activities were confined mainly in the central and eastern regions. It was reported that this adverse weather had taken more than 300 human-lives, many live-stocks and a heavy loss of properties.

- On 23rd July Kathmandu Airport recorded 177.0 mm rain which exceeds the past three decade rainfall records and on the same day Bharatpur (Chitawn District) recorded 455.0 mm of rain. This year July precipitation was observed highest at Pokhara, Kathmandu and Dhankuta, which is 1815 mm respectively breaking all their past records. At the same time the far and mid-western regions were badly affected by prolonged dry spells causing severe drought conditions.

- Due to prolonged dry spells from the month of June to July in the far and mid-western regions, many stations of these areas reported highest monthly temperatures breaking their past records.

- Thick foggy weather prevailed over the terai region in the last week of December which resulted in severe cold condition. The severe cold weather caused unusual hardship for the people as well as destroyed the winter crops in the terai region.

Pakistan

Up-gradation of Karachi-New Delhi communication link

The meteorological Data Exchange circuit between Karachi and RTH New Delhi has been up-graded to a high speed 64 KBPS Leased Data circuit using TCP/IP protocol. The hardware and software installation was completed on 03 October, 2002, followed by a series of successful tests; the data exchange has begun since 14 October, 2002. Locally designed TCP Server/Client applications along with necessary hardware are working to exchange the data with RTH New Delhi as per WMO/IP Socket procedures. Before the new high-speed link, the data received was insufficient for plotting, analysis and other research work. Not only a rich amount of data is now being received but it can also be utilized in meteorological plotting / analysis / forecasting as well as in numerical weather predictions.

Establishment of high-speed circuit between NMCC, Karachi and RTH Tehran

Establishment of a 64 KBPS circuit between NMCC, Karachi and RTH Tehran is in the initial stages. All the procedural information regarding equipment and its relevant software / hardware to be used has been provided to RTH Tehran for their facilitation.

Establishment of six (6) new Synoptic stations

Six new synoptic observatories have been established at Jhang (41636), Malam Jabba (41525), Kalam (41510) Dera Ghazi Khan (41652), Upper Atmospheric Research Stations Peshawar (41529) and Gawadar (41757).

Rainfall Pattern in 2002

Pakistan is basically an agricultural country and in spite of recent industrialization, it has still agro-based economy. As such, seasonal rainfall has significant economic and social consequences over the country. Seasonal rainfall during winter and summer 2002 has been largely below normal i.e. –43% and –53% respectively. Percentage departure area weighted winter and summer rainfall during the last six years (1997-2002) has been shown as bar-diagram figure 7.

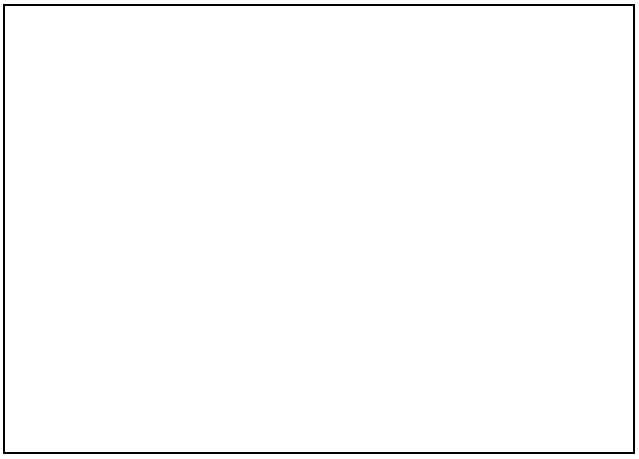


Figure 7: Percentage departure area weighted rainfall of Pakistan.

Up-Gradation of Agro-met Activities

In order to upgrade the Agro meteorological activities in the country, National Agro met Centre (NAMC) of Pakistan Meteorological Department is continuously collaborating with the Agriculture-related agencies. As a consequence of such endeavors, the following activities were under-taken.

(a) Establishment of Agro met Observatories

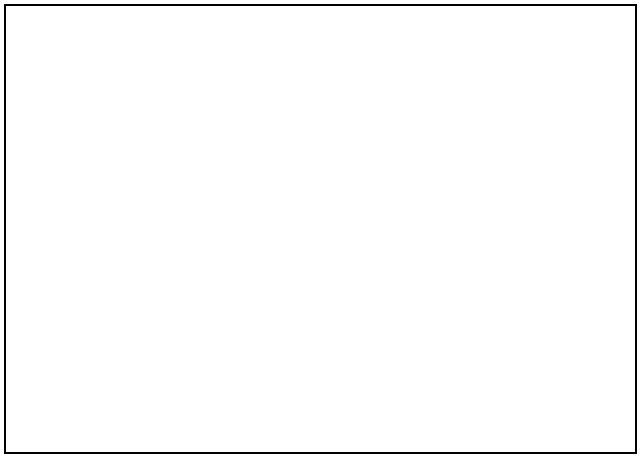
(i) At Chakwal in the premises of Soil and Water Conservation Research Institute (SAWCRI) during July 2002.

(ii) At Noorpu, Thal in the office of Deputy District Agriculture Officer during September-2002.

(iii) At Mandi Bahauddin during November 2002. Signing of MOU with the Director General, Agriculture Extension, Balochistan during December 2002 regarding collaboration between the two organizations.

Seminar in SMRC

A seminar on "Climate variability in the South Asian Region and its impacts" was organized by SMRC at Dhaka, Bangladesh during 10-12 December, 2002. There were twenty five participants from the SAARC member states.



Participants attended the SMRC Seminar from the SAARC member states

There were ten sessions in total. Twelve papers were presented during the sessions. Detail discussions were made about the every presented papers. After the sessions, warm discussions were made to prepare the recommendation of the seminar. Recommendations of the seminar are given below:

(i) National and International data exchange between the SAARC Member States for research work should be free of charge.

(ii) Study on climate change and its impact should be carried out in collaboration with SAARC Member States about different aspects having common natural problems.

(iii) One of the major aspects of climate change study should be to project the future climate change scenario. This is usually performed using high-resolution regional

climate models. In this region, IITM Pune, India processed a number of climate models. As a result, it is recommended that collaborative programme may be developed with IITM to conduct climate change studies of the SAARC Member States for generating scenarios of future climate for the individual country.

(iv) It is known from the seminar that high resolution regional models are available to run in the PCs. As a follow up of this seminar, the necessary steps may be undertaken to make such models available for the member states.

(v) Climate change is a recognized fact and its impacts on the countries of this region would be alarming. So, the study of climate change, vulnerability and adaptation should be conducted in greater details. It is recommended for training Programme to develop suitable human resource for conducting such studies. For climate change research, mechanism is needed to minimize the adverse impacts.

(vi) The climate change process should be continuausly monitored.

(vii) Programme should be taken up for the visit of scientist of SAARC region for exchange of views and sharing resources.

Presentation of two papers from SMRC in the seminar

Following two paper were presented by Dr. Dewan Abdul Quadir, Head, Synoptic Division, SMRC, and Md. Amirul Hussain, Scientist, Synoptic Division, SMRC in the seminar on "Climate variability in the South Asian Region and its impacts" held in Dhaka during 10-12 December 2002.

(i) The papers entitled "Climate change and its impacts on Bangladesh floods over the past decades" was presented by Dr. D.A. Quadir.

(ii) Another paper named "Aridity condition over Bangladesh" was also presented by Md. Amirul Hussain. In the paper "Climate change and its impacts on Bangladesh floods over the past decades" the variability of precipitation and its impact on Bangladesh floods have been studied using the data of Bangladesh, India and Nepal. The data covered the period 1961-1999 for Bangladesh, 1961-1990 for India and 1965-1996 for Nepal. The meteorological stations selected for the study covered the major portion of the basin area of the Ganges, Brahmaputra, and Meghna (GBM) river system. The time series plots and regression analysis were applied to investigate the long term variability and trends of the pre-monsoon and monsoon period. The analysis shows that the precipitation over the study area has strong inter-annual variability. In the years of strong monsoon activity over GBM basin inside or outside Bangladesh, severe floods occur in the basin area. The analysis also shows that the monsoon precipitation has the increasing trends over most parts of Bangladesh and in the upper basin of GBM system adjacent to Bangladesh. The temperature over Himalayan region has been increasing at a high rate during monsoon season which is supposed to enhance the melting of snow and glaciers over Himalayas during the time. The extreme precipitation events of monsoon on top of the increased level of precipitation over the vast basin areas of the GBM system has increased the intensity and duration of the severe floods of Bangladesh. The melting of snow and glaciers in Himalaya at a higher temperature than before further contributed to the runoff enhanced the flow in the GBM systems and their tributaries. The time series plot of inundated area due to monsoon floods shows that the inundation area increasing since 1974. At the same time the return period of floods of such intensity has decreased in the recent decades. The water level and duration of the floods have also increased. The seasonal distribution of mean tidal levels (sea levels) shows that sea level is highest in Bangladesh coast during monsoon season. It has also been

shown that the sea level increases at a higher rate during the south west monsoon and post-monsoon seasons. This effect retards the discharge of the flood water to the Bay of Bengal. Thus among many reasons of the increase of flood intensity and duration, the sea level rise and enhanced back water effect due to stronger monsoon wind on top of this increased sea level have been identified as important additional factor. The socio economic aspect of the damages caused by floods has also been discussed in this paper.

In the paper "Aridity condition over Bangladesh" the temperature and rainfall data during the period 1949-2000 has been used. The formulae for monthly aridity $i = \frac{12p}{t+10}$ and annual aridity $I = \frac{P}{T+12}$ has been used, where p=monthly rainfall in mm, P=annual rainfall in mm, t=monthly mean temperature in ^{O}C and T=annual mean temperature in ^{O}C. Index value less than 20 is considered as aridity. From the paper it has been concluded that there is no aridity condition over Bangladesh annually. Also for individual months of May-October there is no aridity condition in Bangladesh. Only for individual months of November, December, January and February Bangladesh falls in aridity condition. Trend analysis shows that the index value are decreasing i.e. either rainfall is decreasing or temperature is increasing or both may occur simultaneously and increasing for rest of year.

Participation in SAARC-Japan Training Seminar in Kathmandu, Nepal

Dr. Dewan Abdul Quadir, Head, Synoptic Division, SMRC, Dhaka attended the SAARC-Japan Training seminar on "Summer Monsoon and its prediction Technique" held at Kathmandu, Nepal during 17-20 December 2002 as a resource person. He presented the following papers in the seminar:

(i) Weather Prediction Experiment using the FSU Spectral Global Model and Nested Spectral Regional Model.

(ii) Predictability of monsoon based on El Nino Southern Oscillation (ENSO).

(iii) Study of the impact of enhanced SST due to Global warming on the tropical cyclones using Numerical Model.

Audit of SMRC for the FY-2001 (1st January – 31st December 2001)

The Joint Audit Team (JAT) carried out the audit of SMRC during 16-17 September 2002.

Eighth Governing Board Meeting

The 8th Governing Board Meeting of SMRC was held during 8-10 October 2002 in Dhaka, Bangladesh. All the members/delegates from the SAARC Member States and SAARC Secretariat attended the meeting, which was chaired by Mr. Adarsha Prasad Pokhrel, the outgoing Chariman of the Governing Board, SMRC. The Governing Board chalked out new programs of SMRC to be carried out during the FY-2003.

The 8th Governing Board Meeting of SMRC (8-10 October 2002) held in Dhaka, Bangladesh.

Recruitment in SMRC

Professionals, Synoptic Division: Mr. Md. Amirul Hussain, Assistant Director of Bangladesh Meteorological Department, Government of Bangladesh Joined SMRC on 14-10-2002 as the Scientist of Synoptic Division. He has 25 years experience in Meteorological service. He has published a number of research papers and attended several seminars at home and abroad.

Appointment of three Research Assistants

As per the decision of the 8th Governing Board Meeting, 3 (three) Research Assistants have been selected by the recruiting committee and two of the Research Assistants: Mr. Md. Nazmul Ahasan and Mrs Romee Afroz have already joined in SMRC.

Meteorological scientists of SAARC Member States are requested to contribute SMRC Newsletter by sending success stories of their research. The writeups/article, if found suitable will be printed under the authorship of the writer(s). The contributors are requested to preserve copies of their dispatches. Unacceptable writeups/article shall not be redirected to the contributor.

Contribute to SMRC Newsletter

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