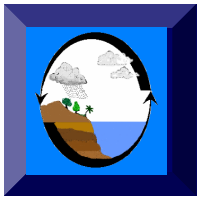


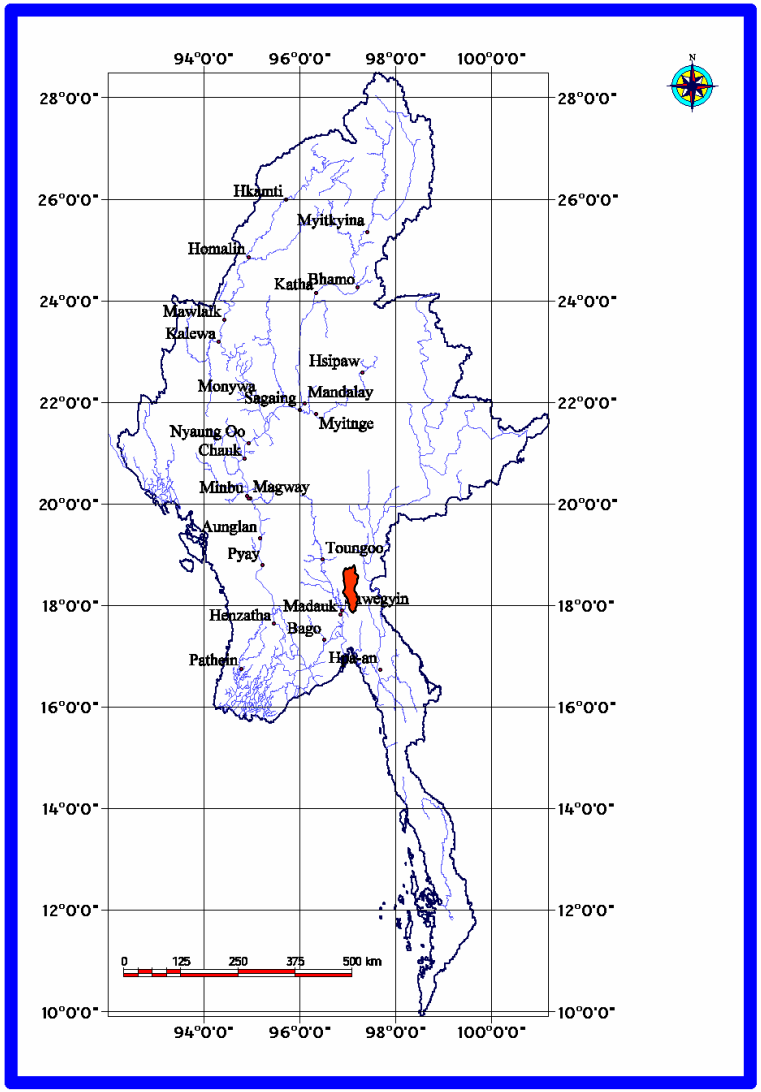
Country Report

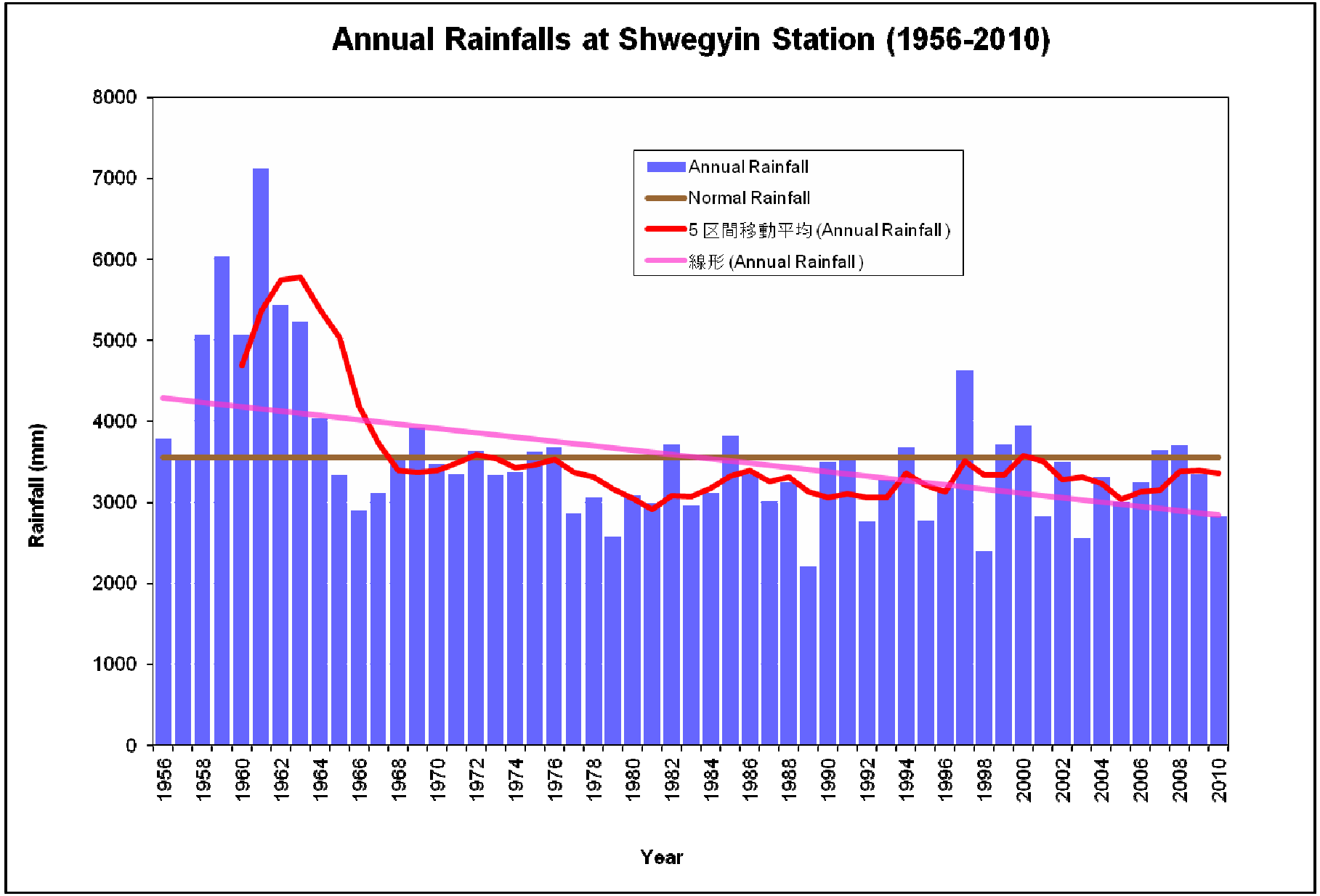
Myanmar

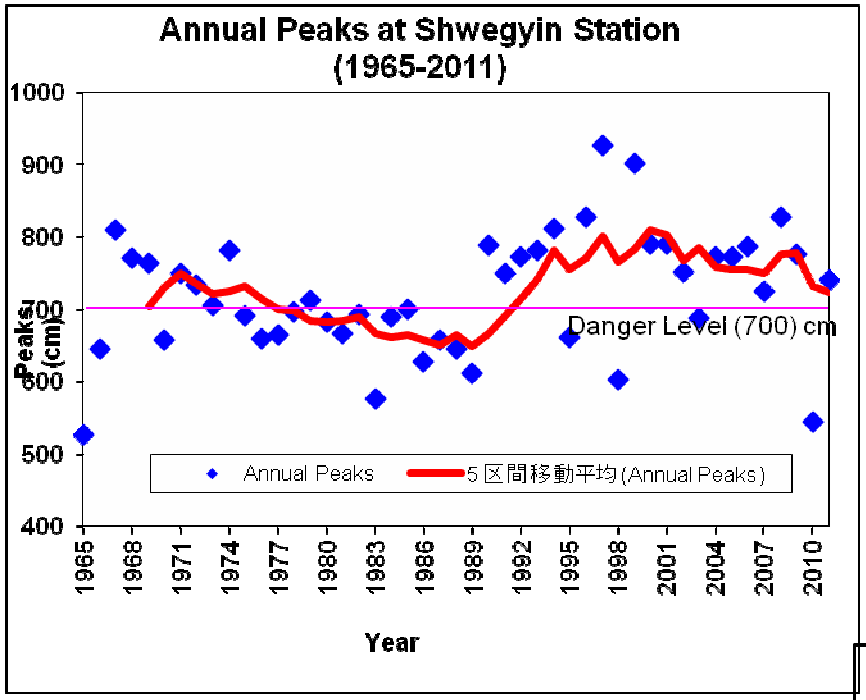
Tin Yi (Assistant Director)
DMH
MYANMAR

DP (Shwegyin Basin) in Myanmar

- Shwegyin township in Bago division is geographically located between 17° 44' to 18° 14' N and 96° 44' to 97° 14' E.
- It stretches for about 42 miles from North to South and 19 miles from east to west
- Outlet of the Shwegyin catchment is located at 17° 55' N and 96° 52' E and Shwegyin town is situated on the mouth of shwegyin river
- Shwegyin catchment is about (1697.9) km^2
- Topography of the basin is varying from 10 m to 1827 m above m.s.l
- the high mountains are formed in northern and eastern part with plain areas in western and southern part of the basin.
- There are 5 rivers which flowing through the township including shwegyin river.
- There is one Met and Hydro station (rf, wl, ds, sediment ds, wt, evp., wind speed/ direction, RH)



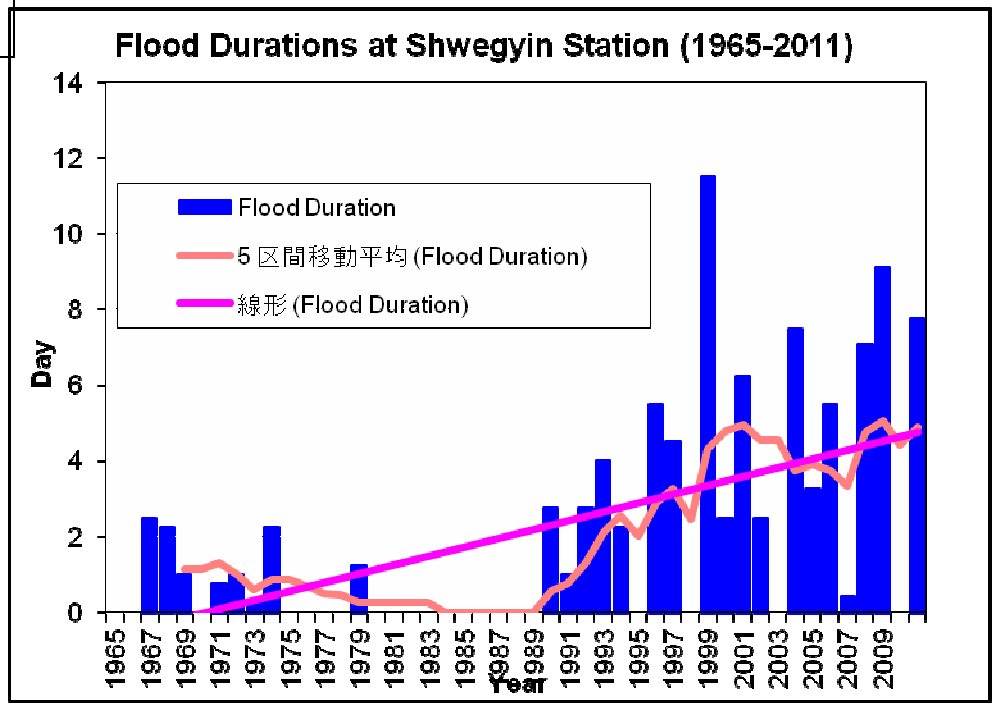

Annual Rainfalls at Shwegyin Station (1956-2010)
Rainfall (mm)
8000
7000
6000
5000
4000
3000
2000
1000
0
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Year
Annual Rainfall
Normal Rainfall
5 区間移動平均 (Annual Rainfall)
線形 (Annual Rainfall)



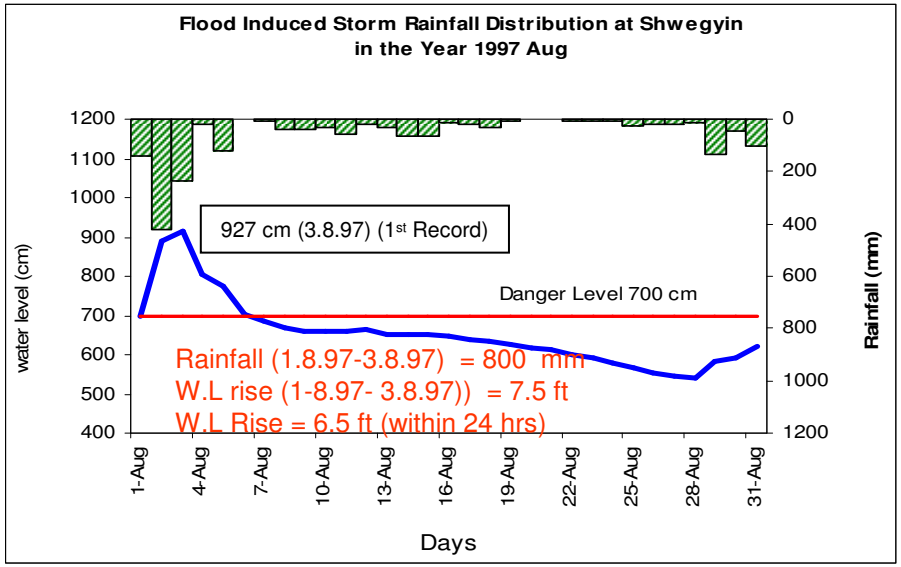
Flood Analysis

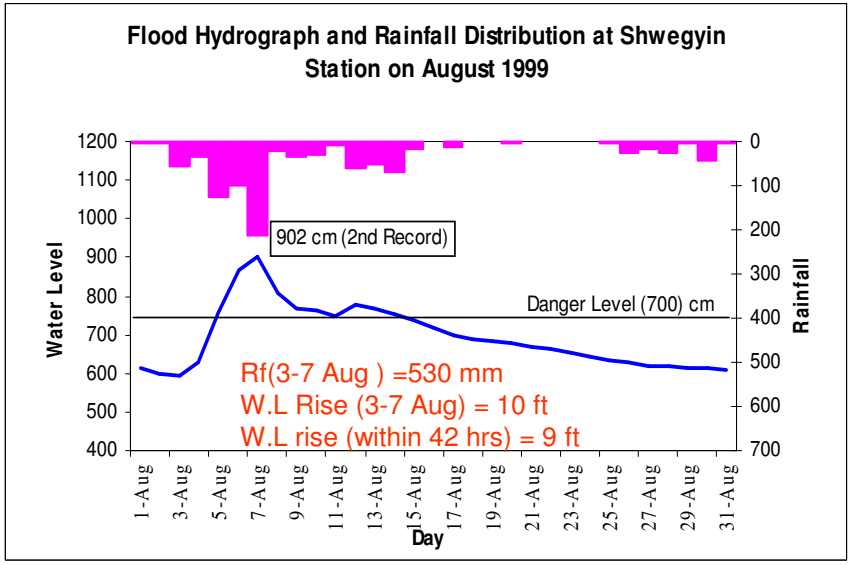
- During 1965-2011 (47 years), no flood year is 20 years, the floods exceeded 1m above D.L occurred in 5 years (1994,1996,1997,1999 & 2008)
- During 1967-1974 and 1990 - 2011, flood mostly occur in every year, but 1975-1989 generally no floods occur
- The record floods occurred after 1995

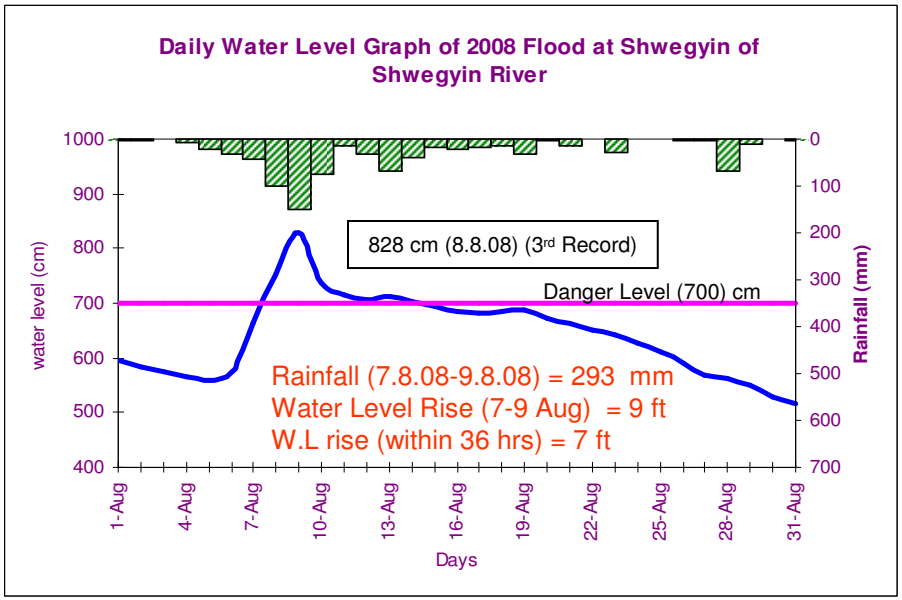
- Flood Duration range is 6 hrs to 2 ½ Days during 1966-1979
- Flood Duration range is 6 hrs to 12 Days during 1990-2011

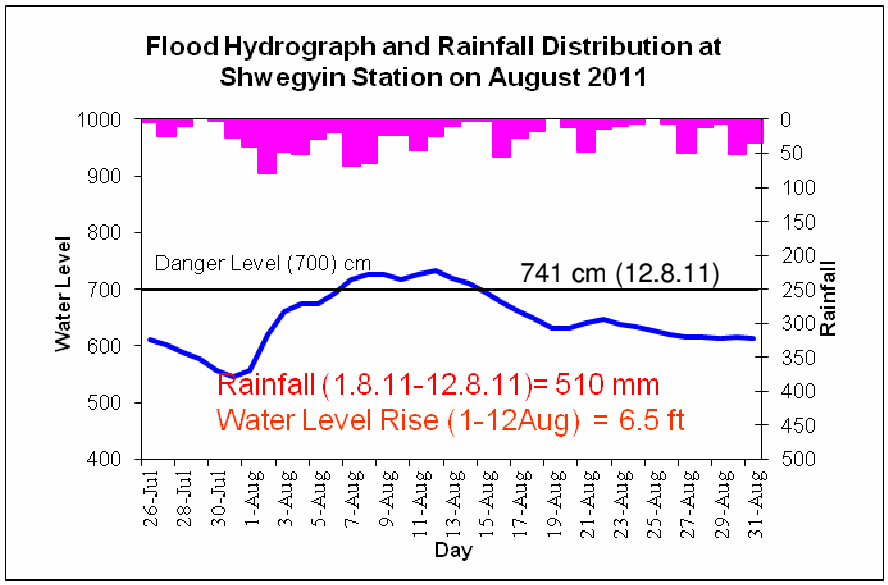


Flood Induced Storm Rainfall Distribution at Shwegyin in the Years









Damages due to 1997 Flood in Shwegyin

- Flood covered 6 wards out of 8 wards (4/5 area) in town level
  - 2 m flood depth at the low lying areas along the river bank and (215) houses flooded

- Flood covered (1/4 area) in township level
  - (504) houses flooded

Affected population	Lost of life	Death of cattle	Crop damages
30870	3	26	6050 acres (paddy)

Objectives of Demonstration Project (DMH)

Main goal- To promote the flood forecasting system for the basin

- To install the telemetry system in upstream of the DP basin, in order to get early warning system
- To develop forecasting technique for flash flood

  Requirement:-

  Advance technology for satellite rainfall estimation

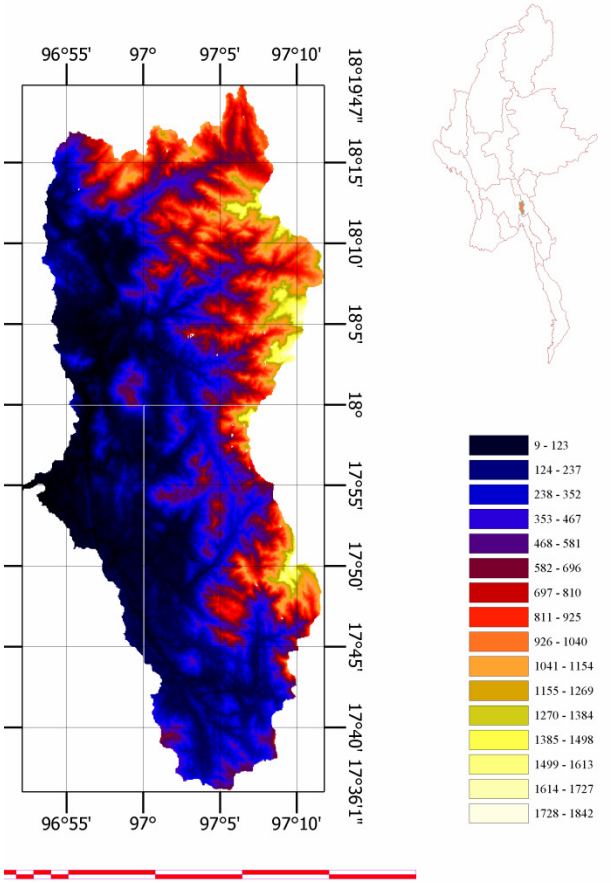
  Advance technology transfer for flash flood forecasting
- To display the hydrological behavior of watersheds after estimation the geomorphologic parameters from digital elevation model
- To develop the design flood and design rainfall for different return periods and probable maximum precipitation for duration of one to three days
- To produce the unit hydrograph, which is of great use in the development of flood hydrograph for extreme rainfall magnitudes for use in design of hydraulic structure and development of flood forecasting and warning systems based on rainfall
- To develop accurate flood risk maps based on flows the hydrologic model using all available data including GIS data sources

Determination of Geomorphologic parameters

- the geomorphological parameters was determined by using River Tools Software

The results calculated using GIS Technology are as follow.

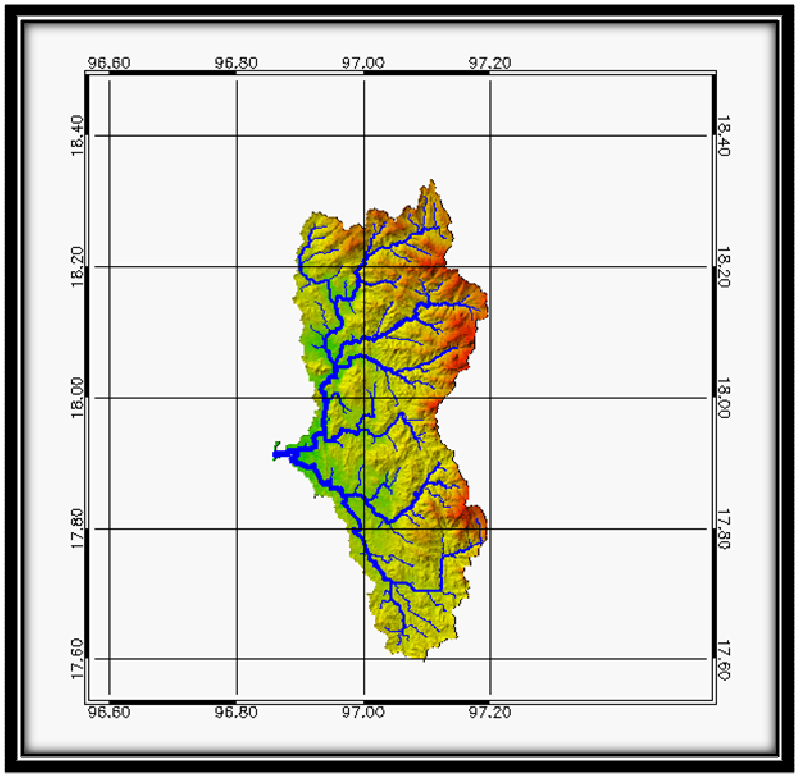
✓	Outlet location	17.92° N 96.87° E
✓	Outlet elevation	10 m
✓	Basin area	1697.9 km^2
✓	Basin relief	1.87 km
✓	Strahler order	9
✓	Longest channel length	81.9 km
✓	Total channel length	21890.1 km
✓	Drainage density	12.89 km^{-1}



Digital Elevation Model of Shwegyin Catchment

Geomorphological Parameters of Shwegyin Catchment

RIVER NETWORK IN SHWEGYIN



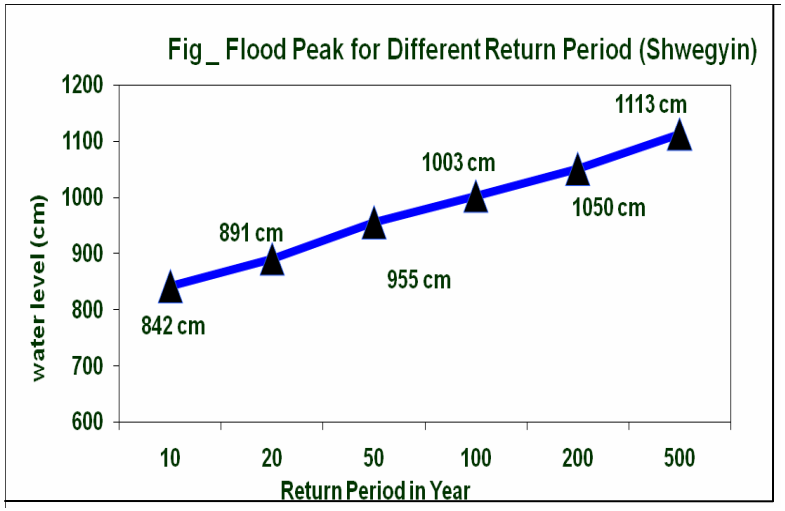
River Order	Total Channel length (km)	Longest Channel (km)	Area (km^2)	Basin Relief (km)	Drainage Density (Km^{-1})
1	0.2	0.2	0.0	0.053	12.994
2	0.8	0.5	0.1	0.128	13.014
3	3.9	1.1	0.3	0.234	13.005
4	18.1	2.3	1.4	0.385	12.963
5	81.7	5.1	6.3	0.583	12.942
6	319.1	10.5	24.6	0.883	12.963
7	1676.9	25.2	129.6	1.265	12.956
8	6239.8	58.6	483.1	1.691	12.930
9	21890.1	81.9	1697.9	1.870	12.892

Probable Maximum Precipitation for duration of one to three days

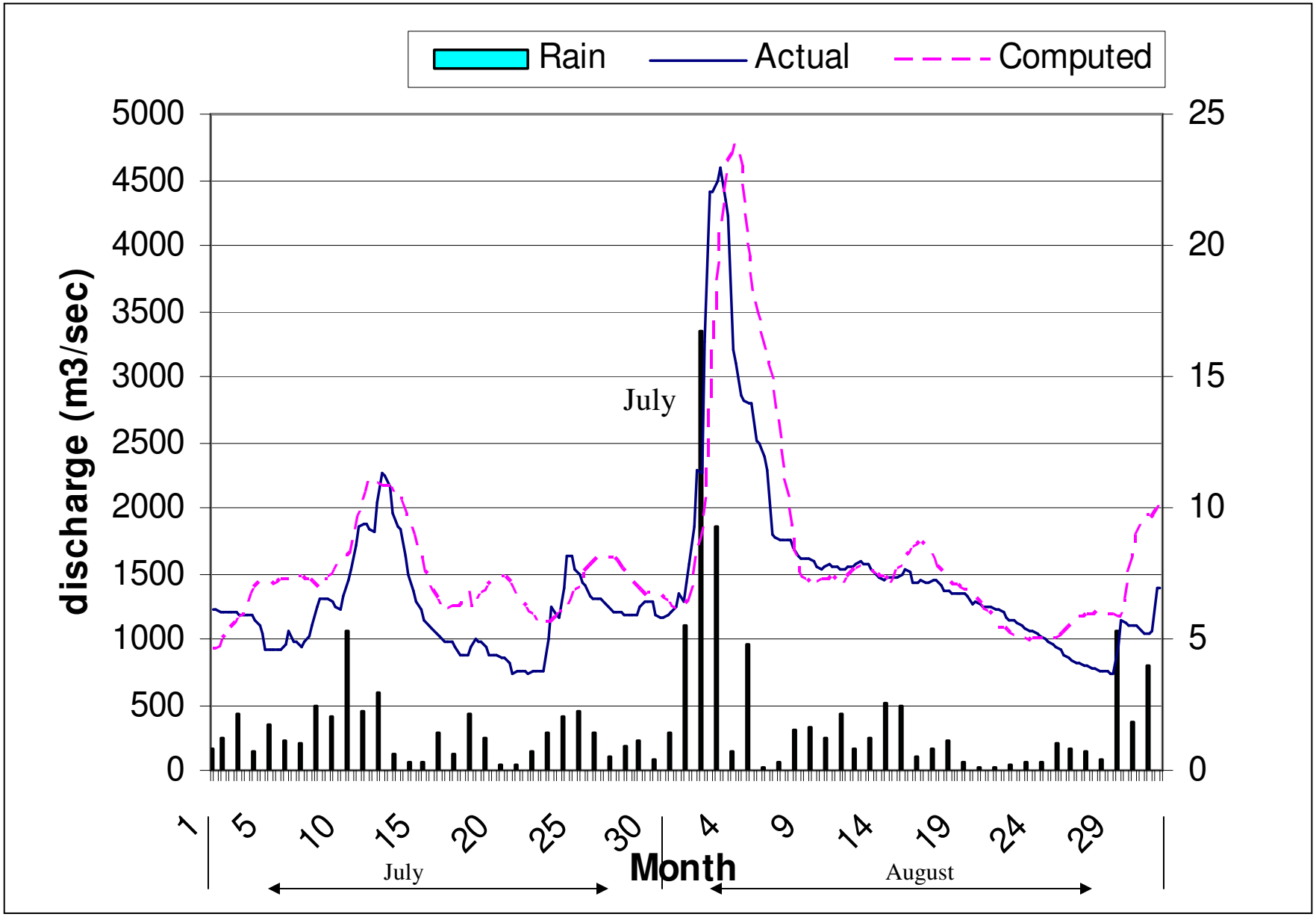
Return Periods	1 day Max RF (mm)	2 day Max RF (mm)	3 day Max RF (mm)
10	233	343	431
20	268	398	499
50	313	470	587
100	346	524	653
200	380	577	719
500	424	648	807

Design Flood for different return periods

Return Period	Flood (cm)
10	842
20	891
50	955
100	1003
200	1050
500	1113



Actual and Computed Discharge graph (using UG) with rainfall on Shwegyin River at Shwegyin for July and August 1997.



Capacity Building Activities

- Purchased the GIS softwares (River tools and TNTmips Image Processing Software)
- Made the training to develop the GIS application
- Trained the IFAS model to use in flood forecasting system during June 2010

Needs

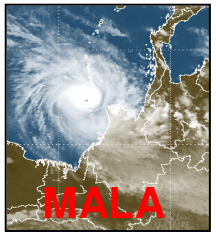
- More Training for advance and effective flood forecasting model and also GIS based/ advanced rainfall runoff simulation modeling techniques practically used for the flood forecast
- Update topographic map and Digital Elevation Model with high resolution in order to get the more accurate geomorphologic parameters, flood forecast and flood risk map

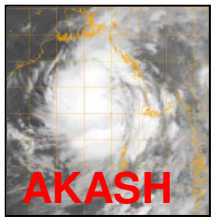
Data Integration and Sharing

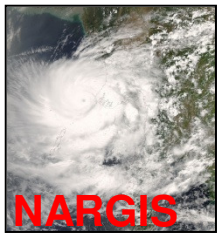
Station	**-**	**One Station (Shwegyin)**
I. Data / Period	**-**	**Discharge, Water level, rainfall (Daily Observation Data)/ 2003, 2004**
II. Data / Period	**-**	**Daily Water Level (1991-2010)**

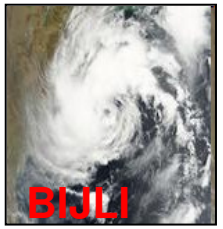
Impacts of Climate Change in Myanmar

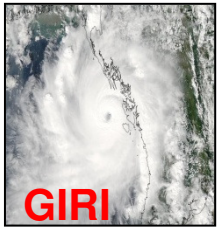
- Late monsoon onset after 1977
- Early monsoon withdrawal after 1977
- Shorter monsoon duration after 1977
- Retardation of monsoon advancement increased in 1990s
- The monsoon strength were weak in 1951, 1953, 1957, 1977,1979,1996 ,1998 and 2003 where the impacts of EL Nino were evident in some years.
- Heat and drought indices increased after 1977
- Annual rain decreased after 1977
- Normal monsoon breaks disappear in 1990s
- The Monsoon depressions become less significantly in 1980s and 1990s
- The abnormal synoptic situations occurred in 1980s and 1990s.
- Sea surface temperatures rise, which is causing storms, including cyclones and hurricanes, to intensify.











New records of Temperature and rainfall in 2010 and 2011

- Highest Temps were recorded at 1 station in March, 4 stations in April and 20 stations during 9-17 May 2010 and among these, 7 stations recorded 2 times in May.
- Heaviest rainfalls were also recorded at 1 station in June and 11 stations during Oct. and Dec. 2010
- Heaviest rainfalls were also recorded at 5 stations during January and 9 stations during March 2011
- Heaviest rainfalls were also recorded at 14 stations during July and Aug 2011

Activities for Climate Change Assessment and Adaptation (DMH)

- *Observing Meteorological & Hydrological data and Analyzing data*
- *Monitoring the changes of climate condition*
- *Cooperating with related organizations and neighboring countries*
- *Researching climate phenomena*
- *Issuing Global and Local Climate Change*
- *Organizing the International & Local seminars, meetings, workshops*
- *Public education for Climate Change effects*
- *In Myanmar, the project (INC) under UNFCCC had already done and also NAPA is commencing for Vulnerability Assessment and Measured for reduction of impact and strategy for adaptation*

Climate Change Scenario for Myanmar (2001-2020, 2021-2050, 2051-2100)

MAGICC 5.3 model parameters

Forcing Controls

Carbon Cycle Model
High Mid Low User

C-cycle Climate Feedbacks
On Off

Aerosol Forcing
High Mid Low

Climate Model Parameters

Sensitivity (ΔT_{2x}) 3.0 °C

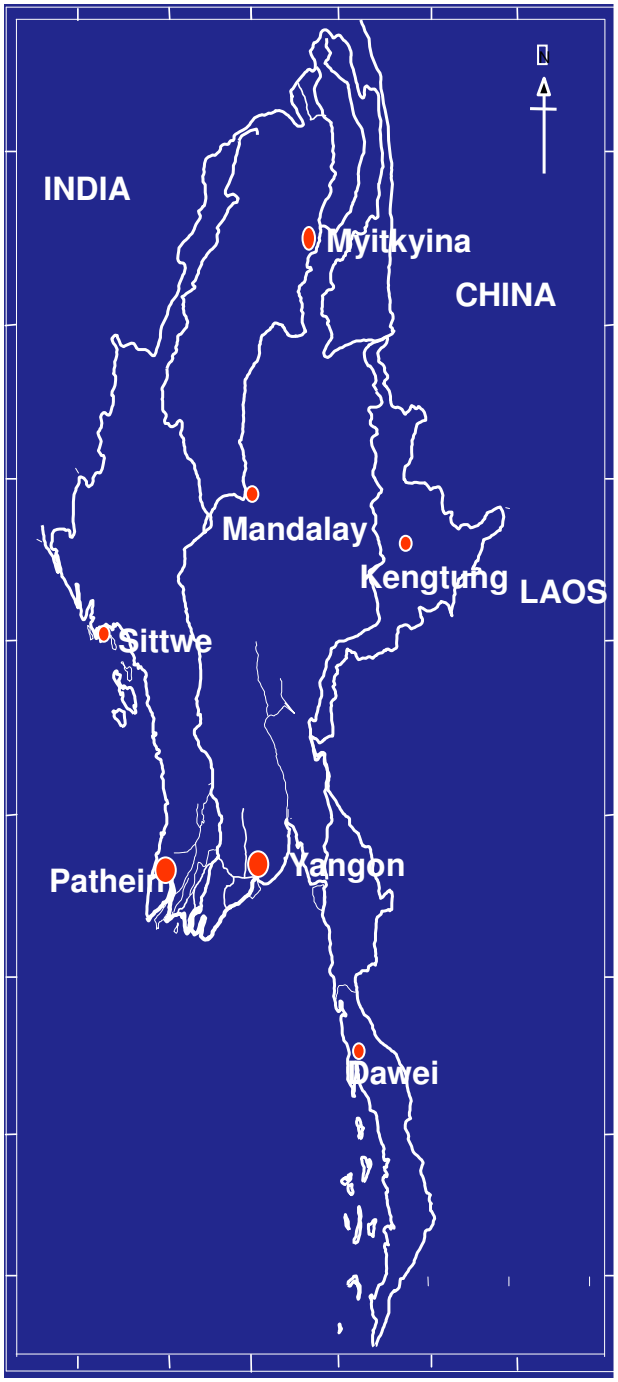
Thermohaline Circulation
Variable Constant

Vert. Diffus. (K_z): 2.3 cm^2/s

Ice Melt
High Mid Low

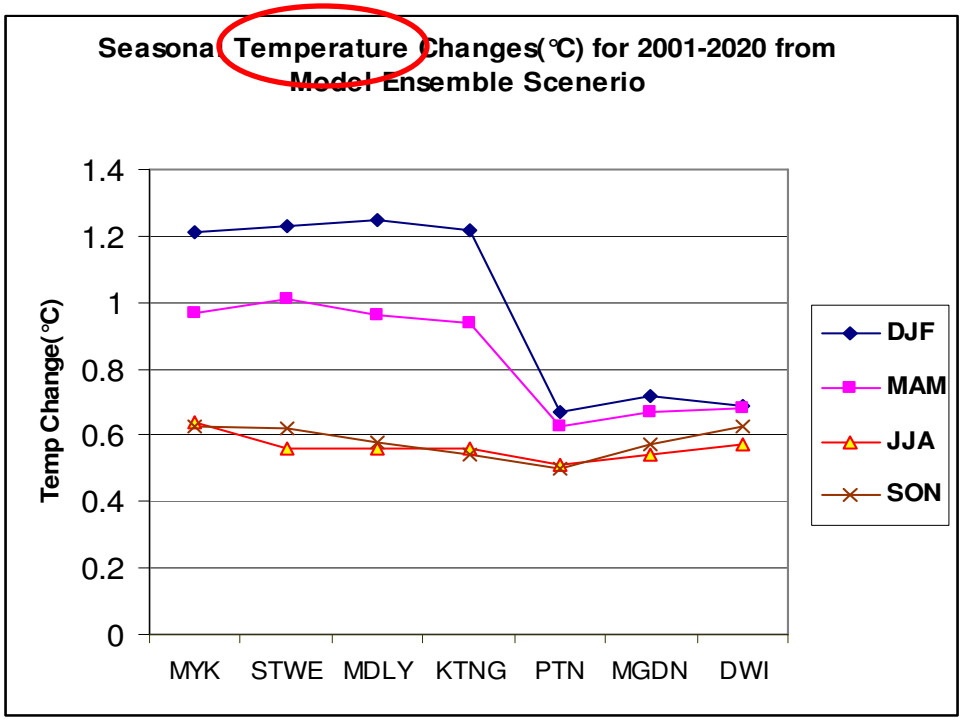
Model: User

OK Help

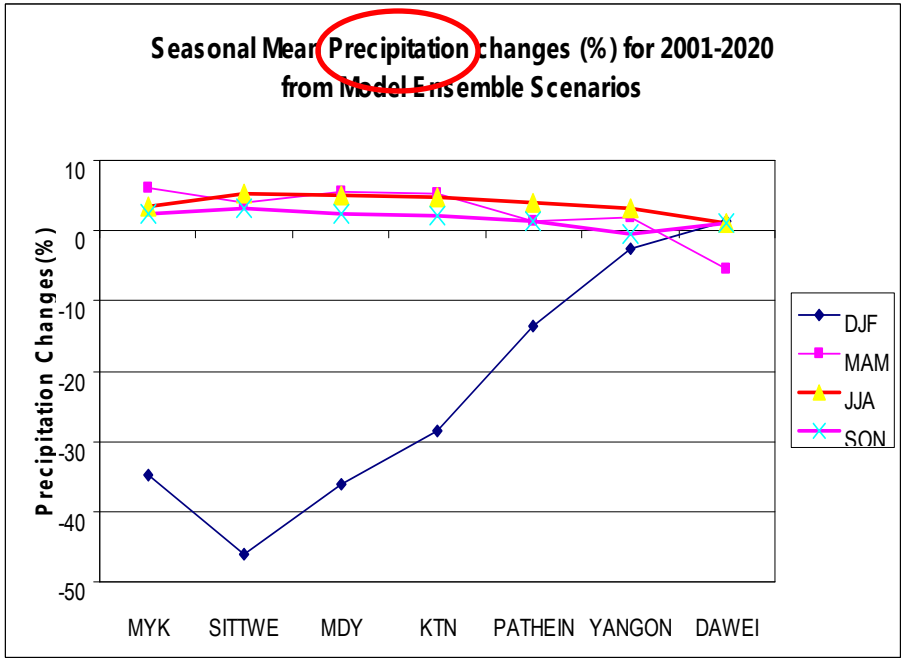


Climate scenario for 2001-2020

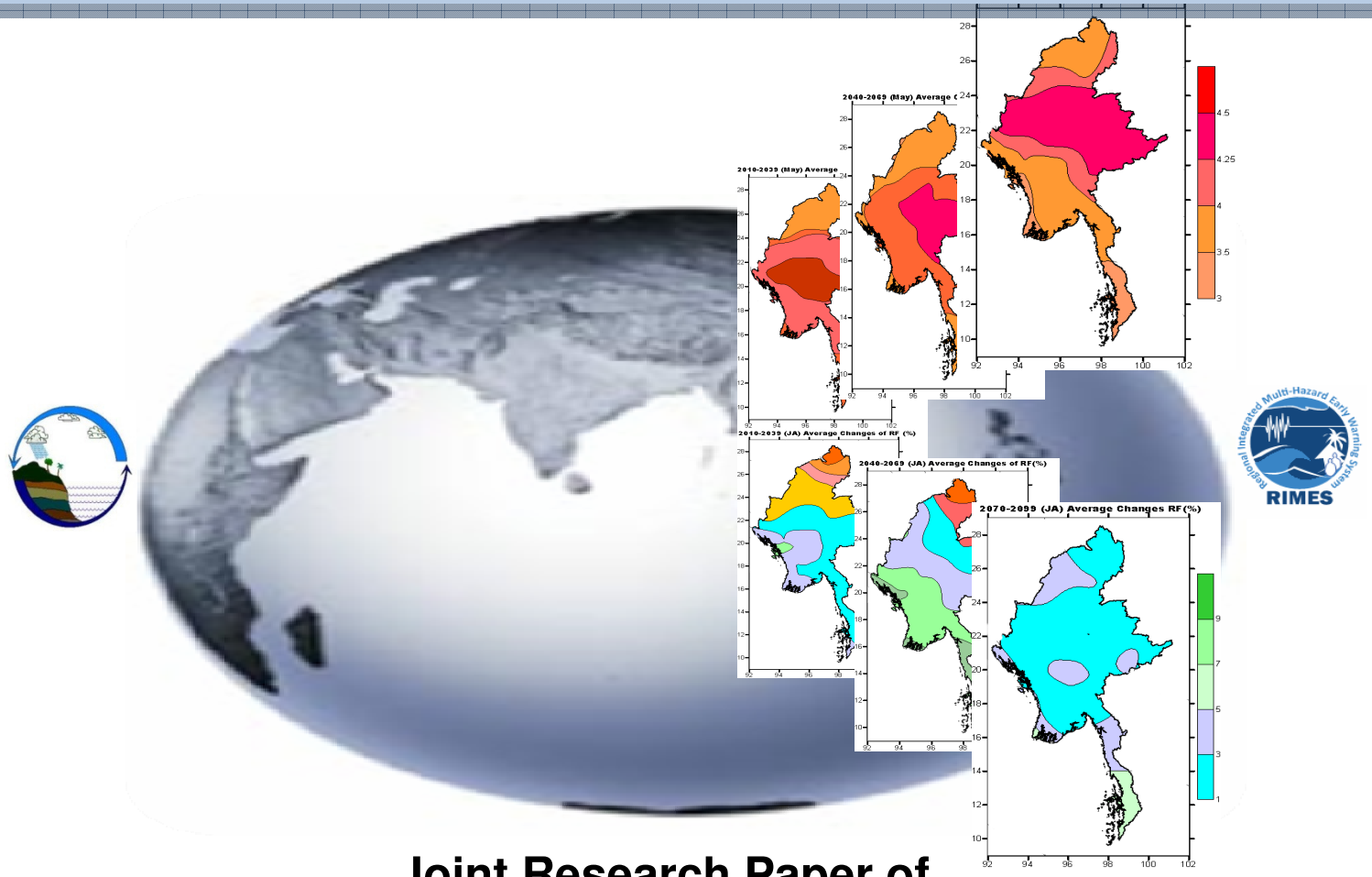
- *The scenario of **TEMPERATURE** shows slight warming (0.5 C) during June to November in the whole country. In other months warming increases to (0.7-1.2 C) in the country except the delta and southern parts of the country where the warming is (0.6 C)*



*The scenario of **PRECIPITATION** shows about 5% increase of rain during March- November through out the country but in the remaining months which constitutes only 5-10 % of the annual value, the deltaic areas and the southern region will receive about normal precipitation and it will be deficit up to 45 % elsewhere*



Climate Changes of Myanmar During 21st Century By ECHAM5 Model with Global Warming Experiment



Joint Research Paper of
Department of Meteorology and Hydrology (DMH), Myanmar.
&
Regional Integrated Multi-Hazard Early Warning System for Asia and Africa (RIMES), Bangkok, Thailand.

Data

- **Initial boundary condition data of ECHAM5/MPI-OM model (which was developed from Max Plank Institute for Meteorology) output for future period 2010-2099 (for IPCCAR4).**
- **EH5OM was run by MPI at Hamburg data available 1941-2100, horizontal resolution is $1.875^{\circ} \times 1.875^{\circ}$ with T63 and 17 levels. Data are available from the web of http://users.ictp.it/~pubregcm/RegCM3/globedat3.htm**
- **Reanalysis data 1960-2009 are gathered from NCEP/NCAR.**
- **The observational rainfall (May, June, July, August, and September), monsoon onset date, withdrawal dates and monsoon intensity during 1960-2009 are collected from Data Record Section of DMH.**

Methodology

- **The RCM3 employed in the present study is the Abdus Salam International Centre for Theoretical Physics (ICTP) Regional Climate Model, namely RegCM3 by Giorgi et al. (1993a, b) and Pal et al. (2007)**
- **RegCM3 will be run to downscale into 60Km resolution with the initial boundary data sets of ECHAM5 model output for future period 2010-2100.**
- **Analyze the model projected early(2010-2039), Mid (2040-2069) and End (2070-2099) of 21st Century temperature and rainfall.**
- **Stepwise Regression equations will be developed based on 1960-1996 by the application of NCEP/NCAR data (Oo.S.M,2007).**
- **Predict the Monsoon onset, withdrawal date, Monsoon intensity, length of rainy season for 2010-2100.**
- **Base line data considered the period 1961-1990.**

Average Changes of mean Temperature (C) under SRES A2 Scenarios over all states and divisions of Myanmar

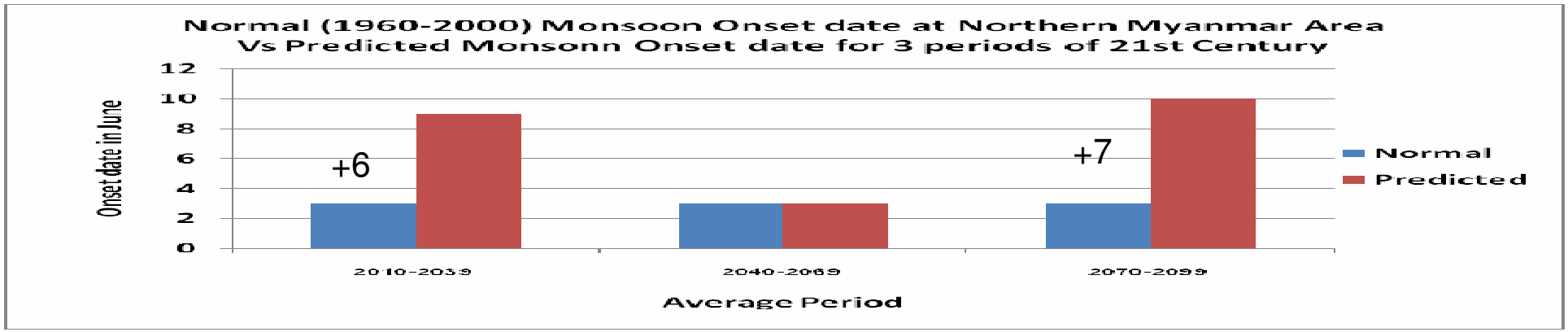
	April	May	Annual
2010-2039	**+0.62 to +1.60**	**+0.8 to +1.59**	**+0.63 to +0.98**
2040-2069	**+1.63 to +3.2**	**+1.7 to +2.6**	**+1.49 to +2.18**
2070-2099	**+3.34 to +5.27**	**+3.29 to +4.23**	**+2.99 to +4.04**

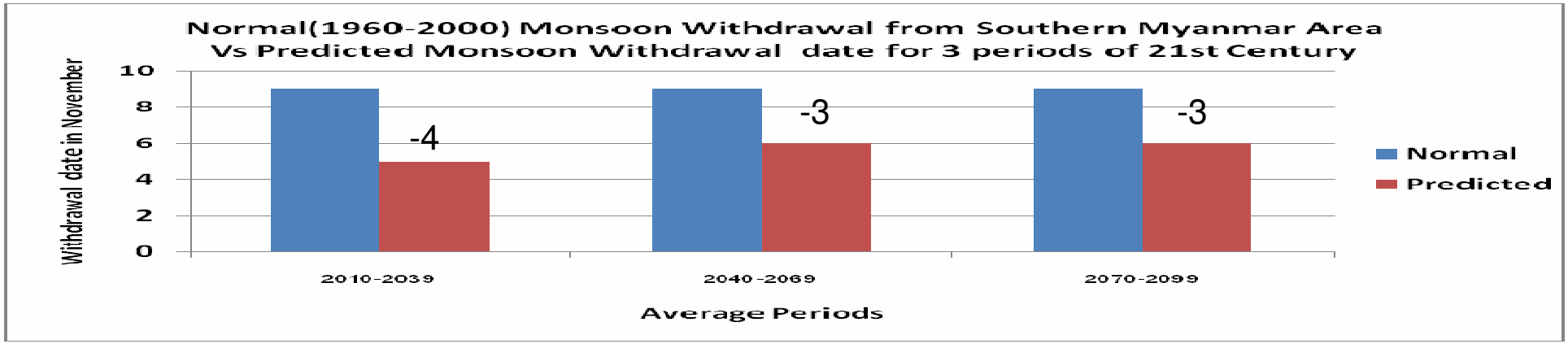
Average Changes of Rainfall (%) during monsoon period under SRES A2 Scenarios over all states and divisions of Myanmar

	2010-2039	2040-2069	2070-2099
Peak monsoon period (JA)	Model projected that 10% to 26 % increase except northern Myanmar areas	Up to 40% increase except northern areas of Myanmar	Generally decrease 20% except Northern Myanmar areas and Some Northern Shan State areas

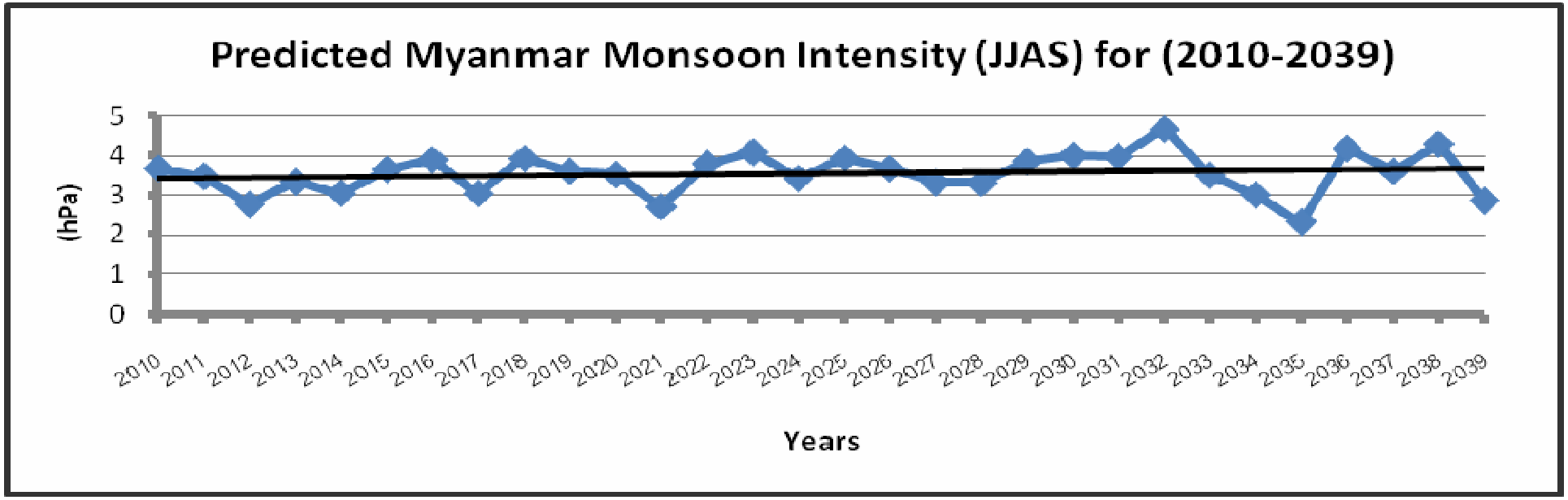
Average Changes of Surface air Temperature and Rainfall under SRES A2 Scenarios over Myanmar from relative to the baseline (1961-1990).

	2010-2039	2040-2069	2070-2099
Temperature(Annual)	+0.81C	+1.85C	+3.57C
Rainfall(MJJAS)	+10.0%	+15.9%	+9.24%

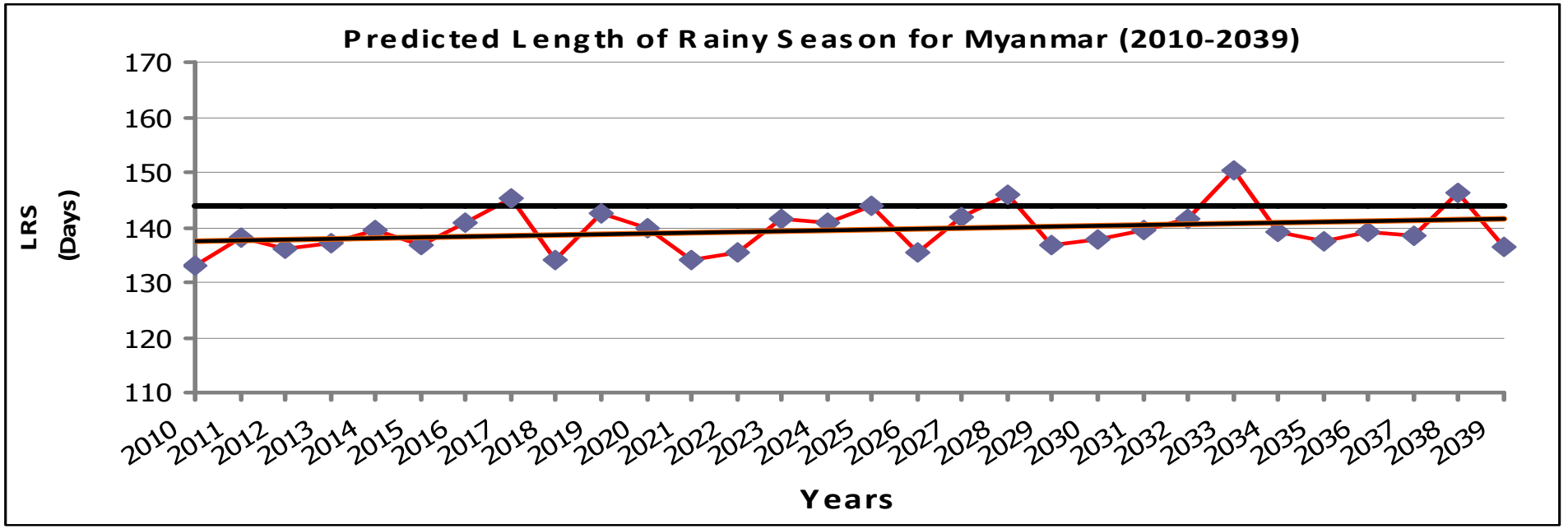




Early Withdrawal from Myanmar



Generally Moderate



Shorter than 144 Days (Normal)

Results

- (Annual,April,May) temperature of Myanmar will be increased throughout the 21st century.
- At the same time, Model projected Rainfall for SW Monsoon period also expected to increase for Myanmar during 21st Century.
- Late Onset will be at Deltaic area, Central Myanmar and Northern Myanmar and Early withdrawal from Whole country during 21st Century.
- Predicted Length of Rainy Season (L.R.S) showed that the L.R.S will be shorter than Normal(144 Days) during Early 21st Century, Middle 21st Century and End period of 21st Century.
- Monsoon Intensity will be generally moderate along Myanmar coast in 21st Century.

Ideas and views of possible country involvement and contribution to the next stage of AWCI

The current availability and use of Data in Decision Making in the Basin

- Main water related disaster is the flood in this basin. *In 2010, one hydro-power plant has been constructed in the upstream of the basin. So it applies to the flood control for the basin.*
- In-situ met. and hydro. data (only 1 station) are used and simple rainfall and runoff model is still used for flood forecasting.
- Difficulties are encountered in using only above one station data. More observed data stations at the upstream of the basin are required.
- Our basin copes for the flood if more observation stations at the upstream of the basin will be installed and also the advance and more accurate flood forecasting model will be used for flood forecasting system.

Pilot project Benefits and Involvements

- According to this DP project of Myanmar, the some research works and capacity buildings were done to upgrade the flood forecasting system for the basin
- Impacts of Climate change and Elnino and Lanina events on this basin will be analysed. Climate change assessment and adaptation in this basin will also be studied. For some of these studies, the trainings concerning with the CCAA are also needed for our country.
- Share and provide the data of the basin under our DG's agreement.
- Cooperate and contribute to the next stage of AWCI.

Thanks for your kind attention !

http://www.moezala.gov.mm