

COUNTRY REPORT

On

Review of the year 2005 flood, operational flood forecasting and warning system at DMH Lao PDR

The 4 th Annual Flood Forum of MRC

(Siem Reap , CAMBODIA 18 - 19 May 2006)

Prepared: by Ms. Souvanny PHONEVILAY DMH Lao PDR

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- **Meteorological and Hydrological conditions in year 2005**
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Historic flood

- In last 37 years (1966 – 2002) Laos experienced 27 floods
- Among of 27 historic floods , 6 year were large floods: 1966,1971,1978,1995,1996 and 2002
- These large floods caused by combination of tropical cyclones from China sea and strong southwest monsoon from bay Bengal

INTRODUCTION

Flood in 2005 affected by the following condition:

- The onset of monsoon took place similarly normal (mid – May), where the strong SW monsoon from Andaman sea frequently prevailed over Laos between mid – July and August
- Almost 5 tropical cyclones best tracks over Laos.
- Heavy rainfall of 100 – 150 mm per 24 hours in 2 – 3 consecutive days were recorded at many stations in Laos.

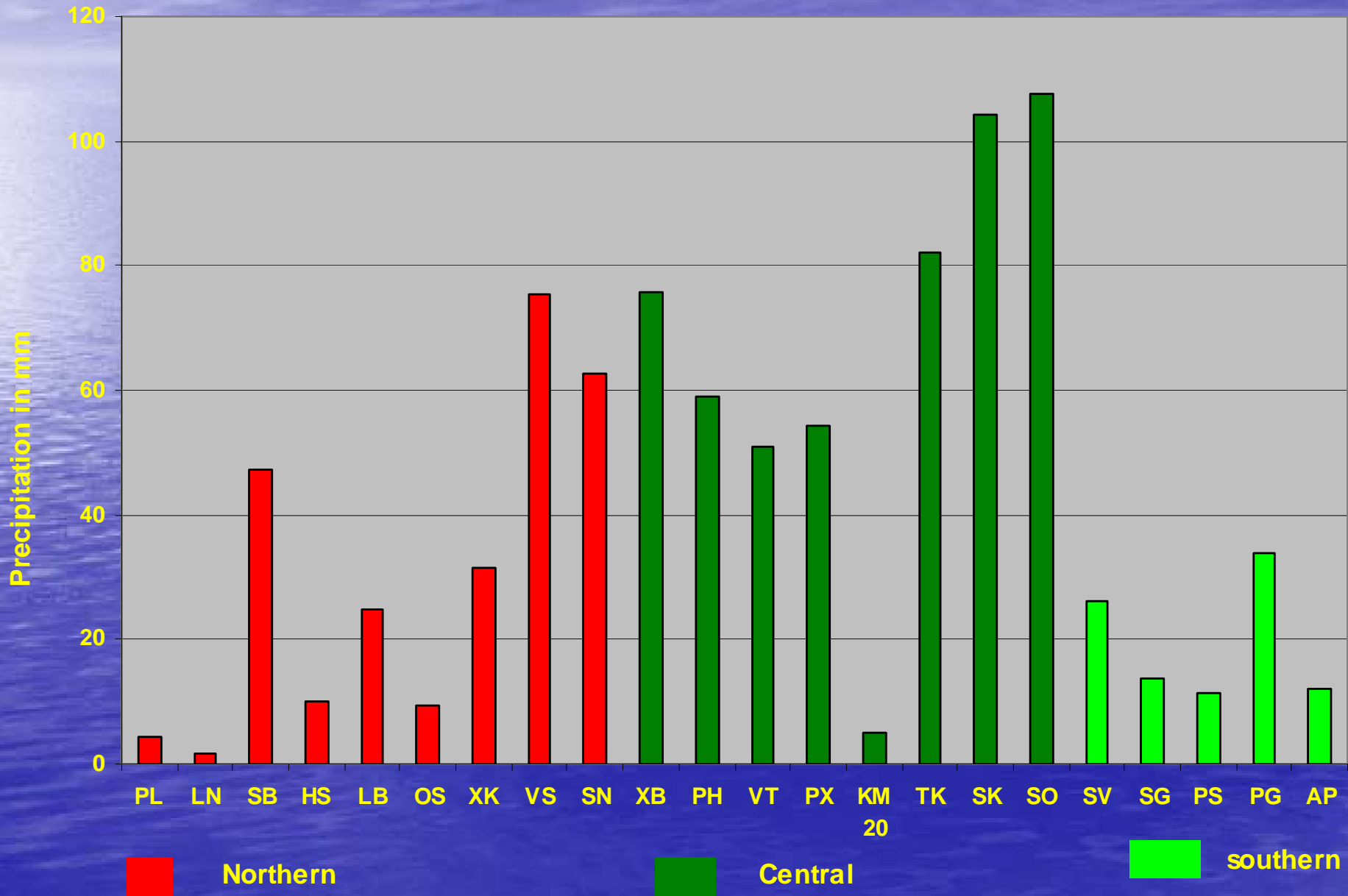
Distribution (%) of total rainfall caused by TCs in August 1991- 2004

Total rainfall (mm)	50 <	100 - 200	201- 300	301 - 400	400 - 500	< 501
Affected When TCs approach to Indochina	<i>28.57</i>	14.29	<i>28.57</i>	14.29	14.29	0
During TCs best tracks over Laos	14.29	<i>28.57</i>	0	14.29	<i>28.57</i>	14.29

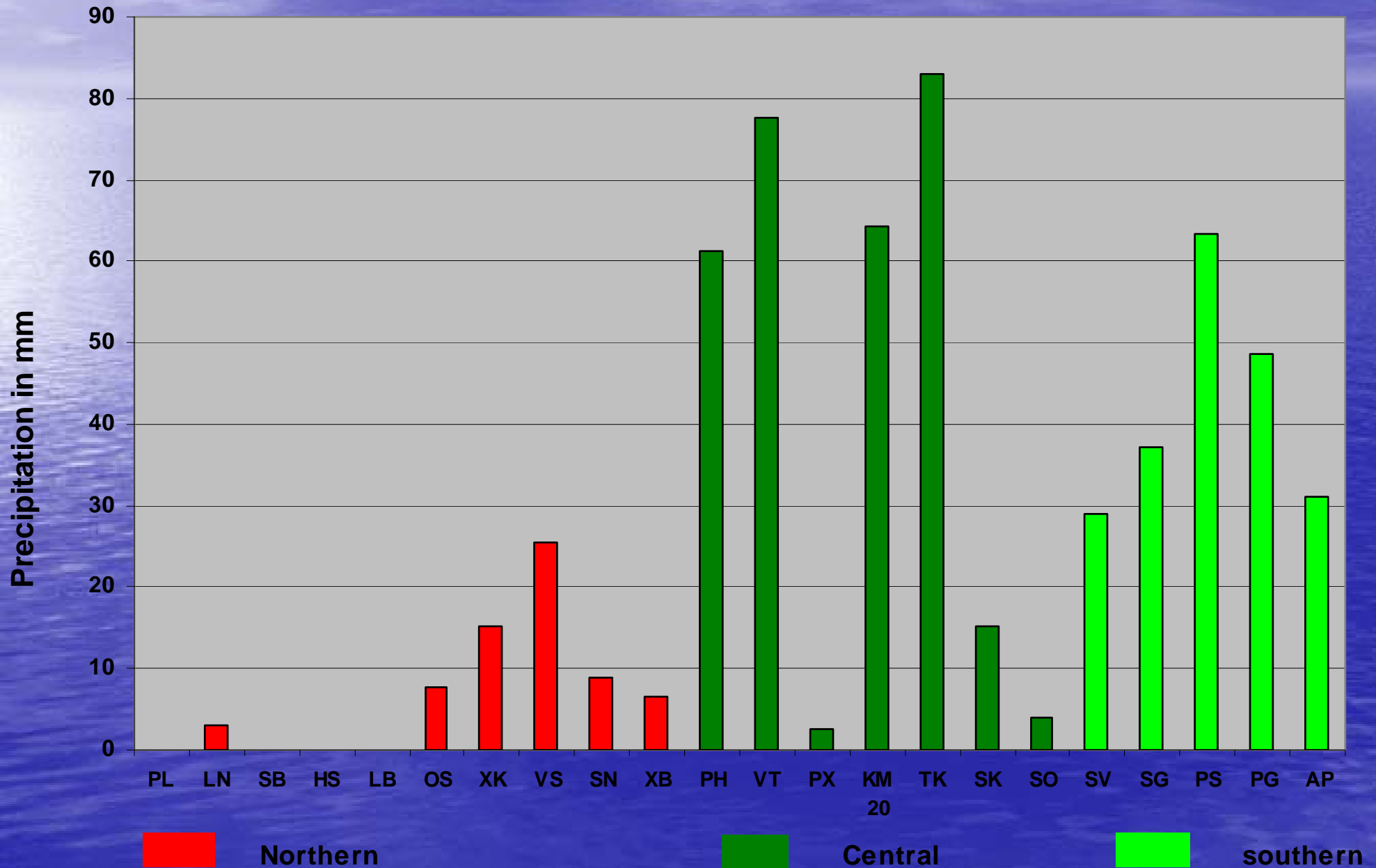
METEOROLOGICAL & HYDROLOGICAL CONDITIONS in YEAR 2005

Name of Tropical Cyclones	Duration Beginning - ending	Time / Location during the passage of TCs		Pressure (hPa)	Max. wind (Kt)	Grade
		Time (UTC)	(°N)/(°E)			
TS 0508 WASHI	26 Jul – 31 Jul	Jul 31/18	20.0/103.0	998	----	TD
TS 0516 VICENTI	17 Sep – 18 Sep	Sep 18/00	16.8/108.4	985	40	TS
		18/06	17.0/106.2	----	----	TS
		18/18	19.3/102.4	998	----	TD
		18/21	20.0/101.0	1000	----	TD
TY 0518 DAMREY	21 Sep – 27 Sep	Sep 27/06	19.7/105.0	-----	-----	TS
		27/18	19.0/103.0	1000	----	TD
		28/00	18.2/102.0	1004	----	L
TY 0521 KAI-TAK	29 Oct – 02 Nov	Nov 02/00	19.0/106.6	990	30	TS
		02/12	19.0/105.0	1004	----	TD
		02/15:30	20.0/107.0	-----	----	L
		02/17	-----	-----	-----	Dissip
Depression	Passed over central of Laos on 30 August 2005					

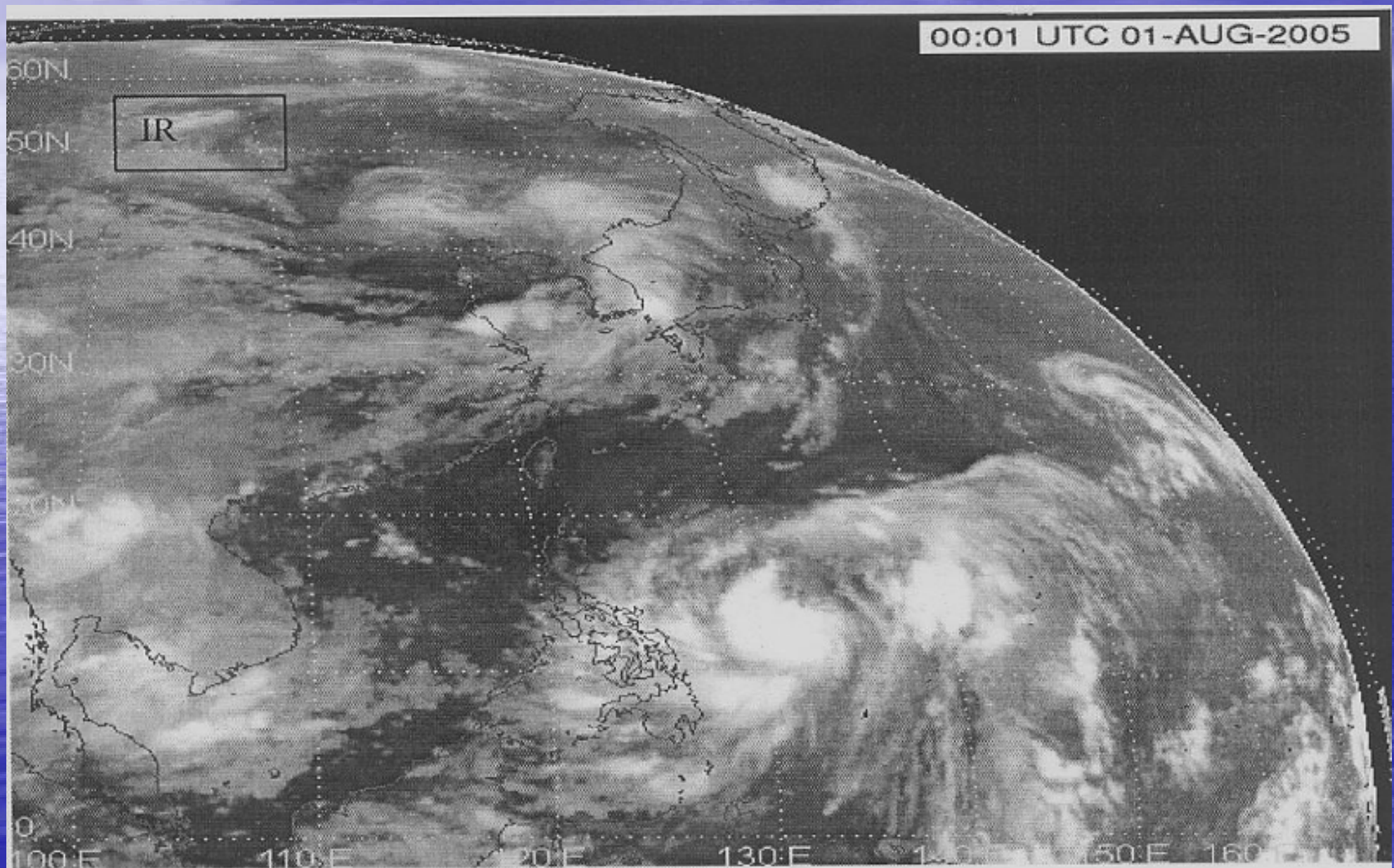
Daily rainfall distribution by tropical storm VICENTI (0516) on 18 September, 2005



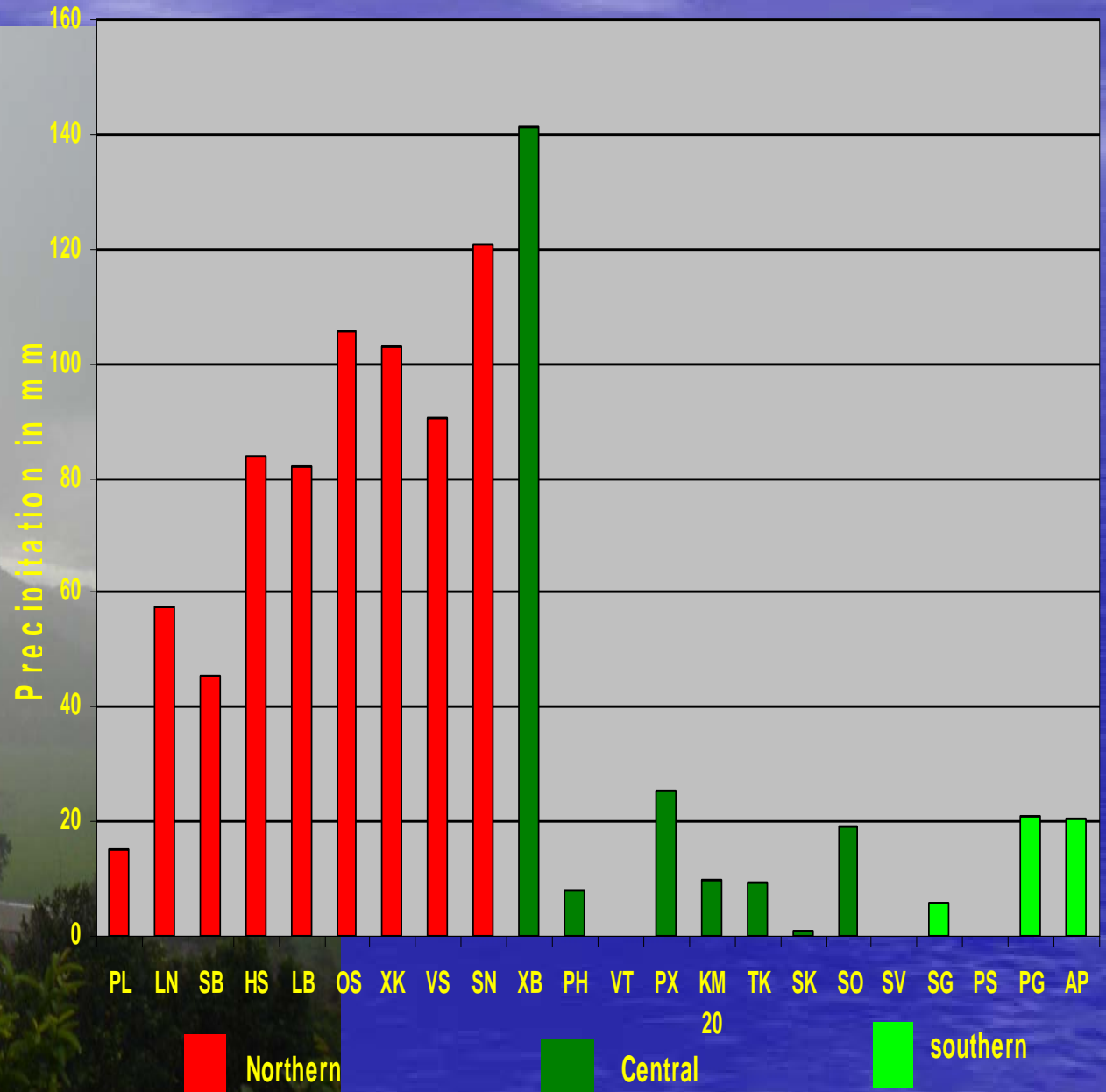
Daily rainfall distribution by Depression on 30 August , 2005



MTSAT -1R IR image of TS WASHI 0508
at 00:01 UTC 01/8/2005



Daily rainfall distribution by TS WASHI (0508) on 31 July, 2005



Flooded picture by Tropical cyclone WASHI
(0508) at Oudomxay province on 31 July ,2005



Road affected by landslide of TC WASHI 0508



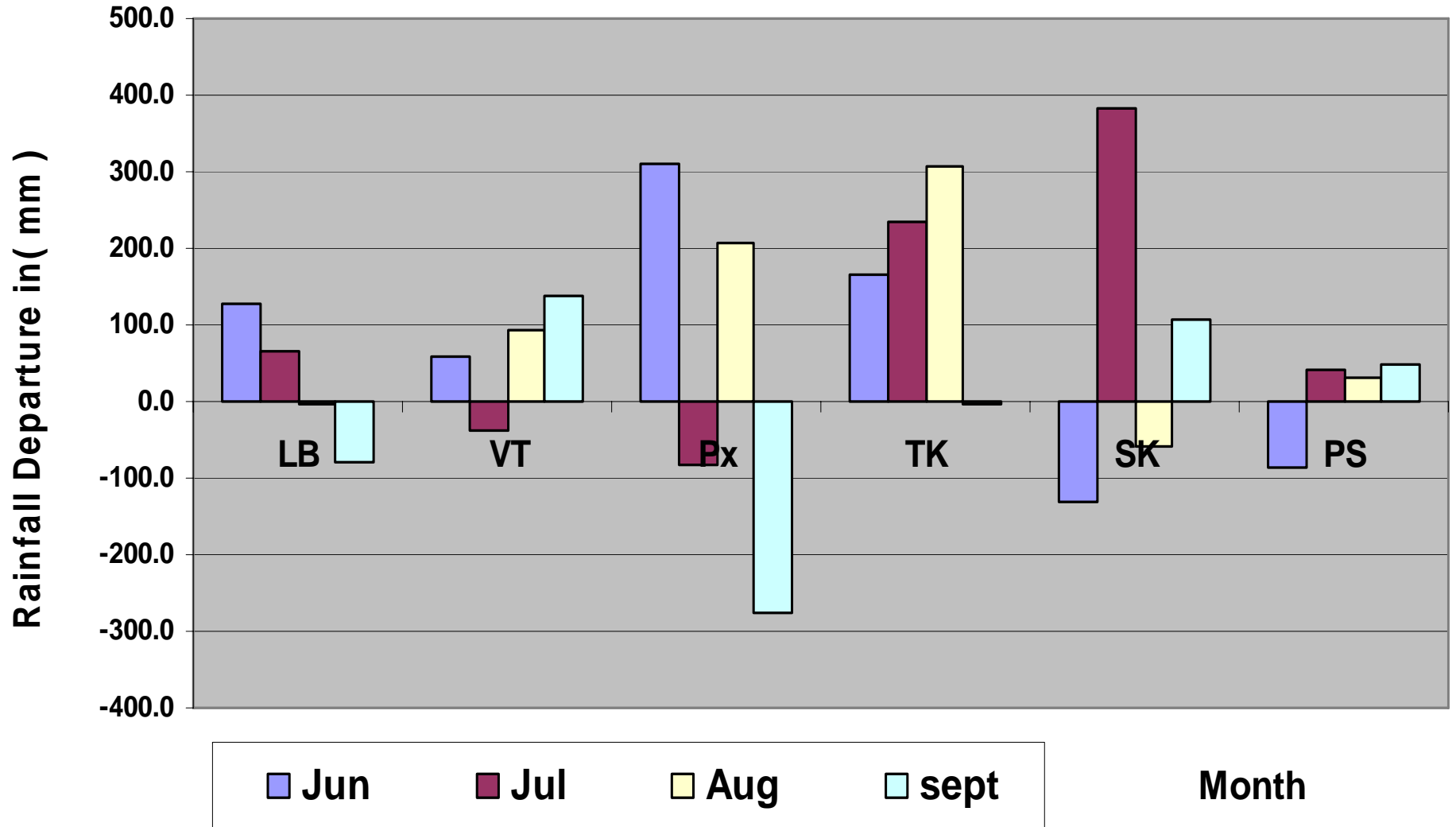
Road and irrigation channel damaged



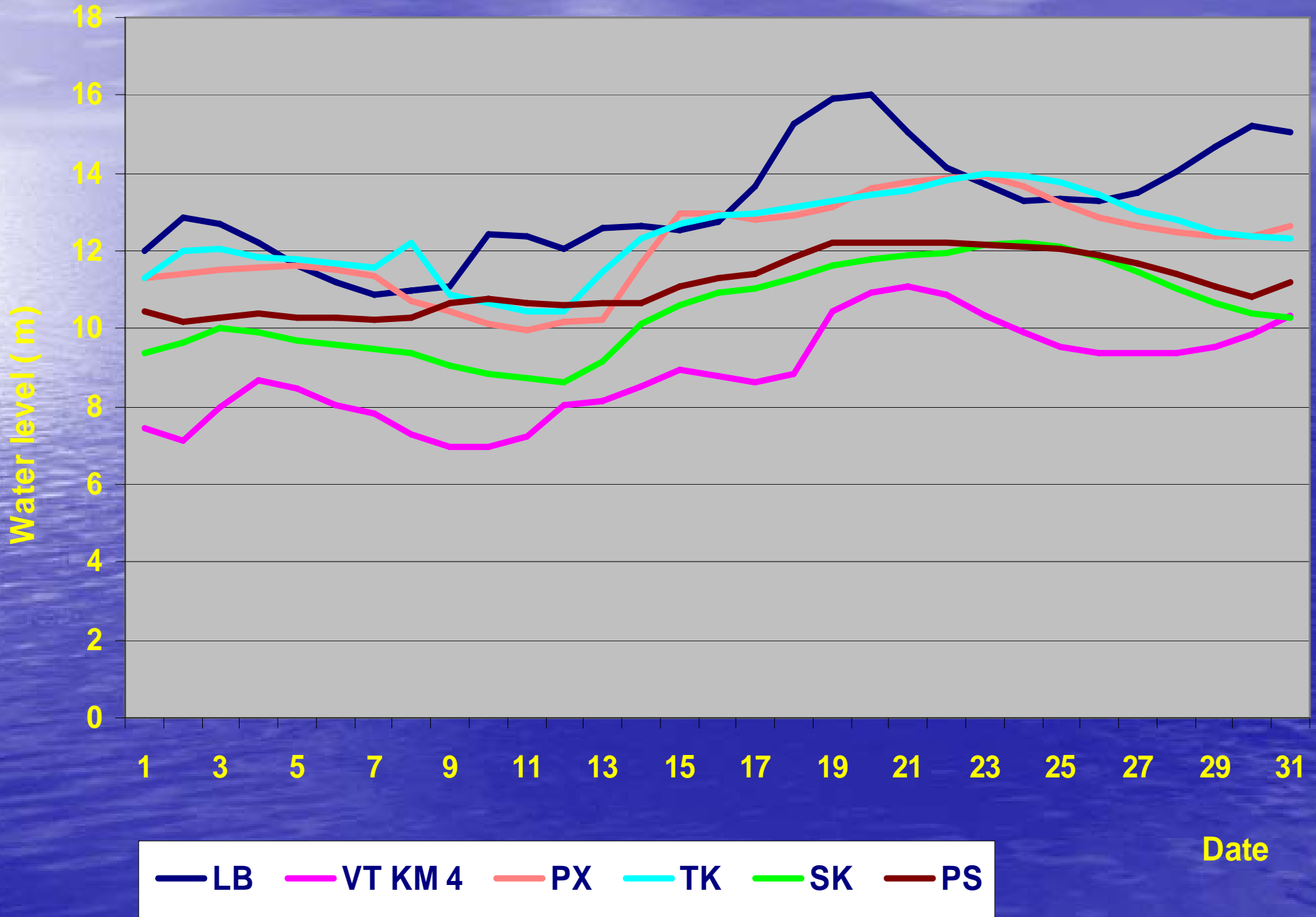
Tropical Cyclone WASHI 0508 cause huge damages
to Oudomxay province (31 July,2005)

Irrigation affected	Rice fields affected	Fishry affected
7 Districts		
46 villages	31 villages	12 villages
Irrigation damaged 22 schemes	Rice fields 319 ha Flooded (Damaged 51 ha)	Fish ponds 78 sites flooded
Irrigation chanel affected by landslide 675 m	Other planting areas 203 ha damaged	27 fish ponds damaged (18 ha)
Damaged cost : 1.576.000.000 kip (157.600 USD)		

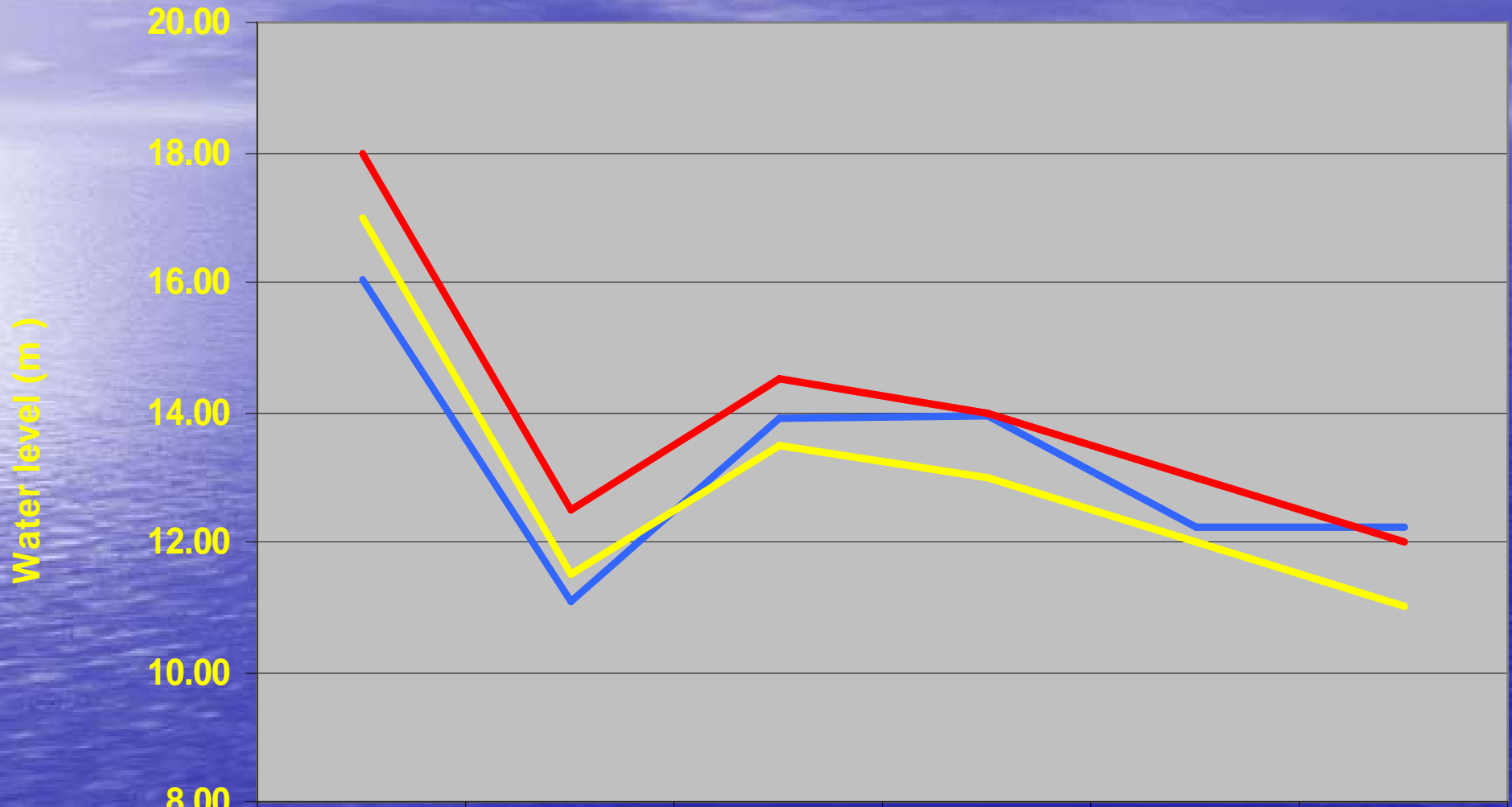
The monthly rainfall Departure in (mm) at main station of Mekong River during June to September year 2005



The Water Level at Main Stations of Mekong River in August, 2005



The maximum Water Level at Main Stations of Mekong River in August, 2005



	LB	VT KM 4	PX	TK	SK	PS
Max. level	16.02	11.08	13.92	13.96	12.22	12.22
Critical level	17.00	11.50	13.50	13.00	12.00	11.00
Danger level	18.00	12.50	14.50	14.00	13.00	12.00

Flood pictures Khammuane province

Families , people affected at Mahaxay district on August 2005



Households affected at Mahaxay district on August 2005



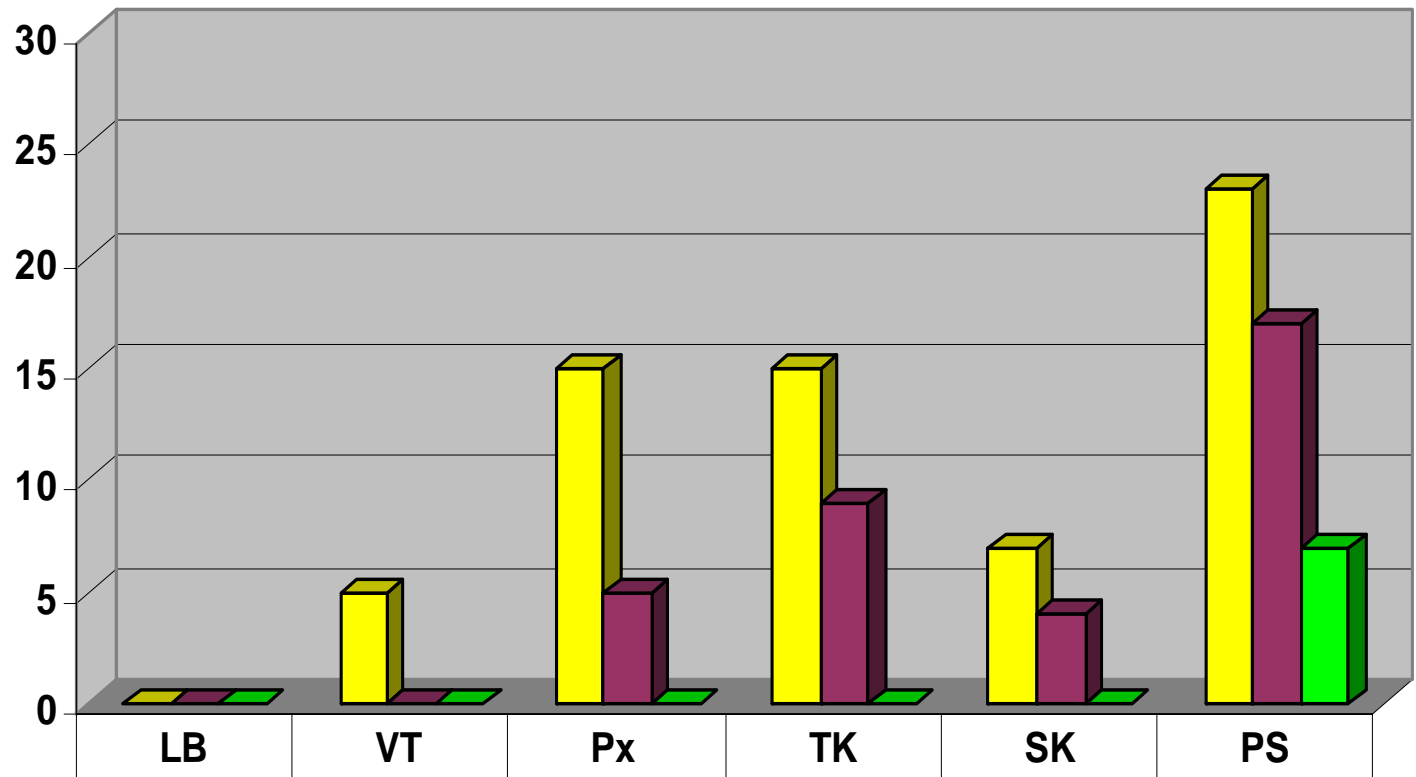
Rice fields flooded at Thakhek district

Hinbounne district

along Namdon



Period with water level exceeding peak value at mainstreame of Mekong River in Lao PDR Year 2005



■ 1.00 m under warning stage	0	5	15	15	7	23
■ warning stage	0	0	5	9	4	17
■ Flood stage	0	0	0	0	0	7

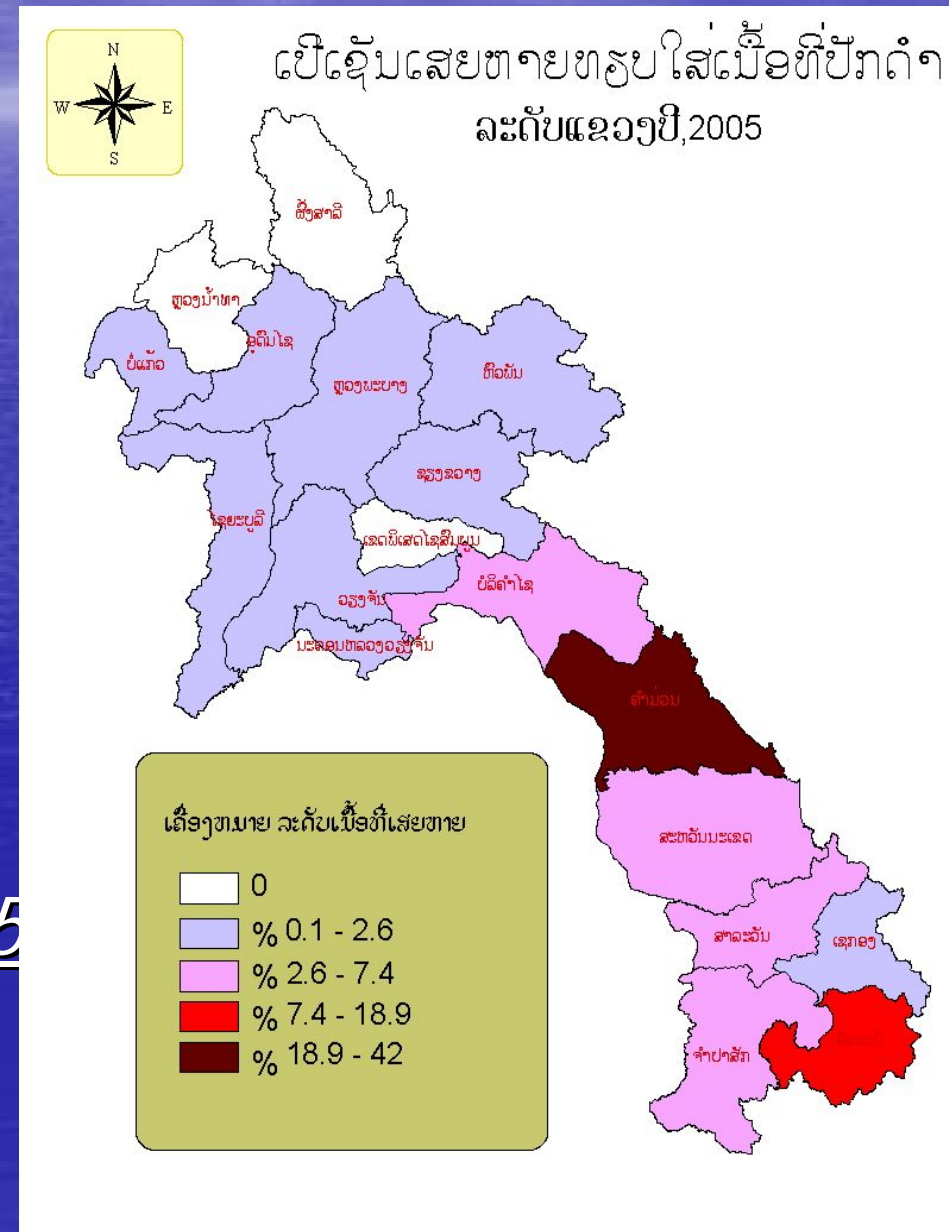
Impact on Disaster to Agricultural Sector in year 2005

Cultivated areas: 684.55 ha

- Flooded areas: 87.725 ha
(Damaged areas) : 54.775 ha
- Damaged areas from drought: 1.125 ha
- Damaged from pest disease: 55 ha

Total damaged areas: 55.955 hectares.

Data sources from MAF, October 2005

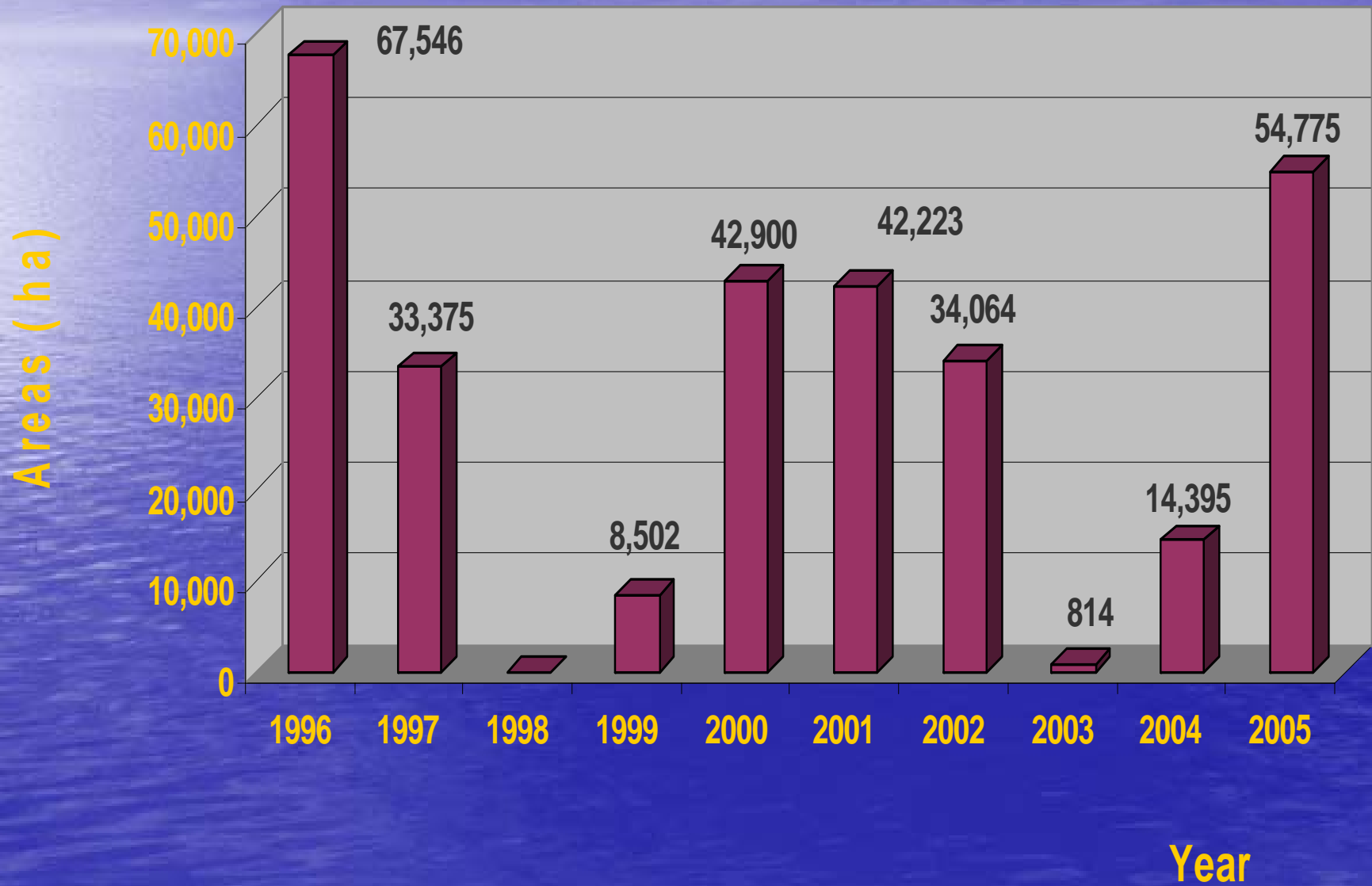


Flood Damages in 2005 reported by MAF and NDMO

Damaged Cost: 218.304 USD

No	Description	Damages in 2005
1	Provinces	8
2	Districts / Villages	84 / 2510
3	Family / People affected	85.533 households / 450.910 persons
4	Rice field affected	87.725 ha flooded (planting areas in 2005 is 684.555 hectares)
5	Damaged rice field	54 .775 hectares damaged
6	Livestock damaged	14 . 941 heads (buffalo, cattle, pigs & poultry)
7	Fish ponds damaged	4289 Schemes = 609 ha
8	Irrigation affected <i>Irrigation channels</i>	1.421 project sites (117 Schemes damaged) <i>15.124 meters affected by landslide</i>
9	School affected	102 schools affected
10	Route affected	225.726 kilometers

Rice field damaged statistic by flood in Laos from 1996 - 2005



Disaster management in Laos year 2005

- Since 1999 Laos established an Inter – Ministerial NDMC & consists of the representatives from 11 ministries and 2 agencies.
- NDMC is acting on behalf of government on Disaster in Laos
- NDMC play role: preparedness, emergency assistance and mitigation.
- During August 2005 flood ,Lao Red cross Agency had distributed for dried food , rice, pure water and medicines to flood victims.
- For replanting after flood MAF had distributed organic fertilizers vegetable, rice and corn seeds to various villages affected by floods.

Lessons learned

- Hydro – meteorological networks should be rehabilitated every year before rainy season .
- Before rainy season DMH should be equipped the rain gauge, staff gauge telecommunication facilities and permanent hydrologist at the remote stations to make ensure the data transmission in real time to DMH.
- DMH well organized the group on flood monitoring during rainy season.
- The long – range weather forecasts , as well as seasonal out look is needed to prepare for Agriculture sector and flood management program and other agencies concerned in Laos .

Lessons learned

- One month before rainy season , the NDMC concerned 13 ministries should be organized meeting for underline of each responsibility.
- The NDMC should be organized meeting two times per year(before rainy season for flood preparedness and after rainy season for flood impact assessments)
- Coordination between DMH and mass – media and line ministries concerned should be ready prepared.
- The weather and flood forecasts information, warnings and dissemination at DMH should be in proper and timely manner.

CAPACITY of PREPARATION the WEATHER & FLOOD FORECASTS at DMH in LAO PDR.

DMH in Lao PDR is a governmental organization under the MAF and is assigned as national service provider of both fields Meteo - Hydrological monitoring and products

DMH 's administrative structure is divided into 2 levels:

- **The Headquarter level (74 staffs) :** looks after strategic plans , principles, regulations for the whole country. Data collection, processing, analysis, archiving and disseminating for services are also roles of Headquarter level .
- **The Provincial level (132 staffs):** is responsible for routine operational duties of all stations.

Hydro - meteorological Network in Laos



METEOROLOGICAL NETWORK:

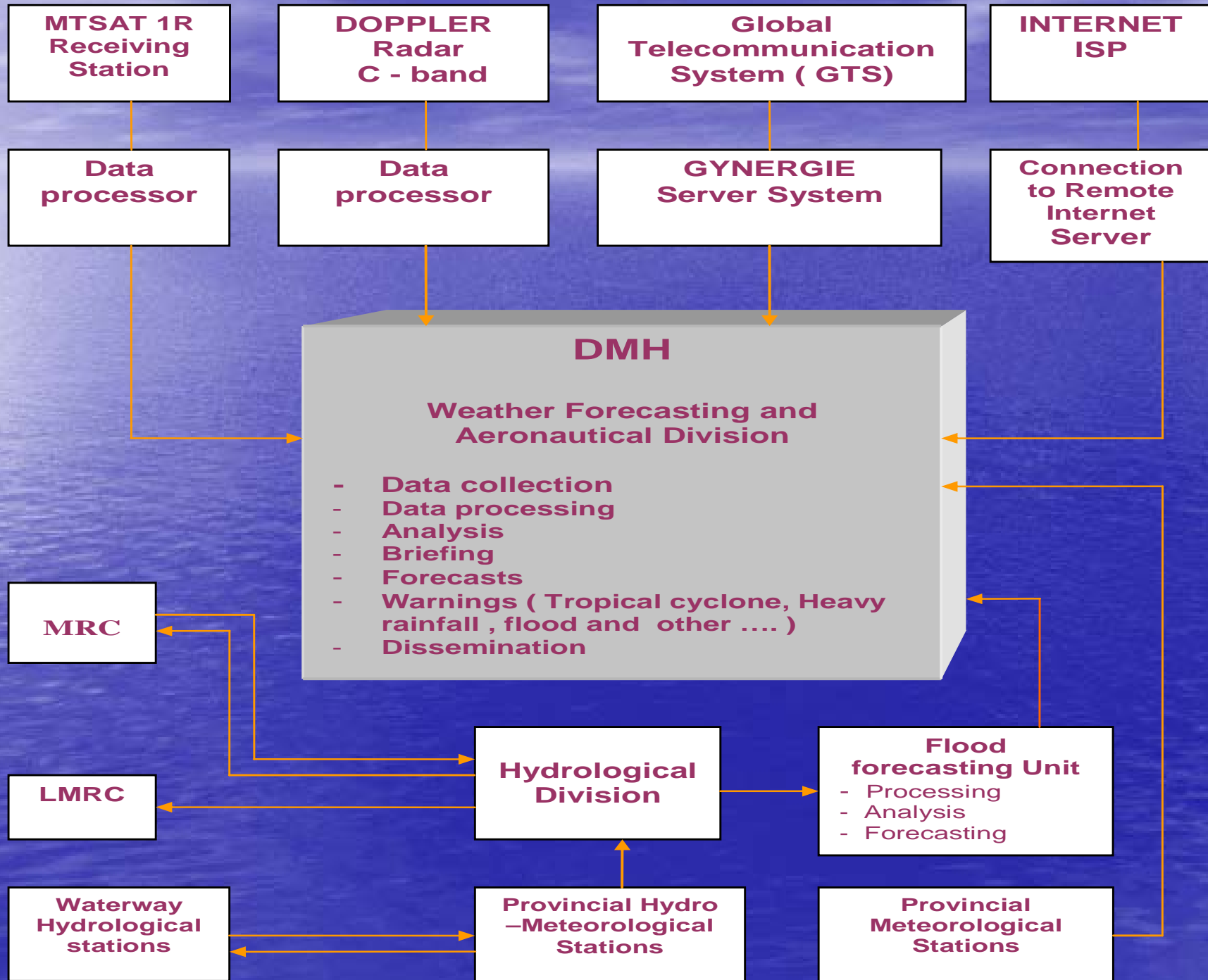
- Main synoptic station = 17
- Secondary synoptic station = 33
(monthly data recording only).
- Rain gauges = 113 stations.

HYDROLOGICAL NETWORK:

- Staff gauges = 109 stations
- Discharge = 49 stations

C – Band Doppler Radar
and MTSAT 1R receiving
station at DMH

Structure of Data Collection in DMH Lao PDR



Flood forecasting and Warning systems in Laos

- The flood forecasting was set up in July 1966 after severe flooding 1995 in Vientiane plain.
- From July 2000 the flood forecasting unit established
- From 2004 up to date the product of flood forecasting was upgrade from 24 to 48 hours.
- The flood forecast along Mekong River in Lao PDR usually commence during rainy season, which period from July to September of the year .
- Specially DMH assigned the working team on weather ,flood monitoring and forecasting in rainy season.

Real – time data collection for flood forecasting

Necessary information: Real – time data (water level and rainfall) observed at 7:00 am is collected from 7 stations, which located along the Mekong River in Lao PDR.

No	Station code	Mekong River station name	Communication for Data collecting	Data Types
1		Pakbeng	HF/SSB Radio & telephone	H , RR
2	019594	Luangprabang	HF/SSB Radio & telephone	H , RR
3	019801	Vientiane (KM 4)	HF/SSB Radio & telephone	H , RR
4	012703	Paksane	HF/SSB Radio & telephone	H , RR
5	013102	Thakhek	HF/SSB Radio & telephone	H , RR
6	013401	Savannakhet	HF/SSB Radio & telephone	H , RR
7	019802	Pakse	HF/SSB Radio & telephone	H , RR

Additional Real time information

- Additional Real - time rainfall, synoptic, climatic data, weather situation and other information are received from the Weather Forecasting Division for adding in to flood forecasting .
- Supplementary information: Real – time data (water level and rainfall) observed at 7:00 am is collected by E – mail from the two upstream stations of the Mekong River in China (Yanjinghon 92980 and Hana 92600).
- DMH exchange data with MRC and receive the result of flood forecasting bulletin from MRC

Flood Forecasting formulation

The stage correlations equation between upstream and downstream stations by using the lag time for the Mekong mainstream. For example: From Luangprabang to Vientiane, there is 426 Km of length and about 48hours or 2 days of flood propagation time.

Statistical formula are used as the following :

$$H_{VT,forecast} = (H_{LB, yesterday} - H_{LB, day\ before\ yesterday}) * 0.35 + H_{VT, today}$$

The basin run – off and depth run – off model for Numgnum dam.

Stations	Distance between two stations	Velocity (m/s)	Flood propagation time (hours)
Houeisai - Luangprabang	302 KM	2.5	33.555
Luangprabang - Vientiane	426 KM	2.4	49.306
Vientiane - Paksane	225 KM	2.2	28.408
Paksane - Thakhek	133 KM	2.0	13.899
Thakhek - Savannakhet	90 KM	1.8	13.899
Savannakhet – Pakse	257 KM		
(Savannakhet – Sebanghieng)	(100 KM)	(1.7)	(16.34)
(Sebanghieng - Pakse)	(157 KM)	(1.6)	(26.43)
Houeisai - Pakse	1433 KM		186.401 = 8 days

Data processing and Flood Forecasting

- After receiving all necessary information, the data is processed and analyzed. Then the data is entered in to the flood - forecasting model PC at the Forecasting unit.
- The preparation of flood forecast bulletins have be completed at 10:00 am every day.
- The duration of flood forecast time for Mekong River in Lao PDR is only 48 hours (from 07:00 am today to 07:00 am day after tomorrow) and update every day .

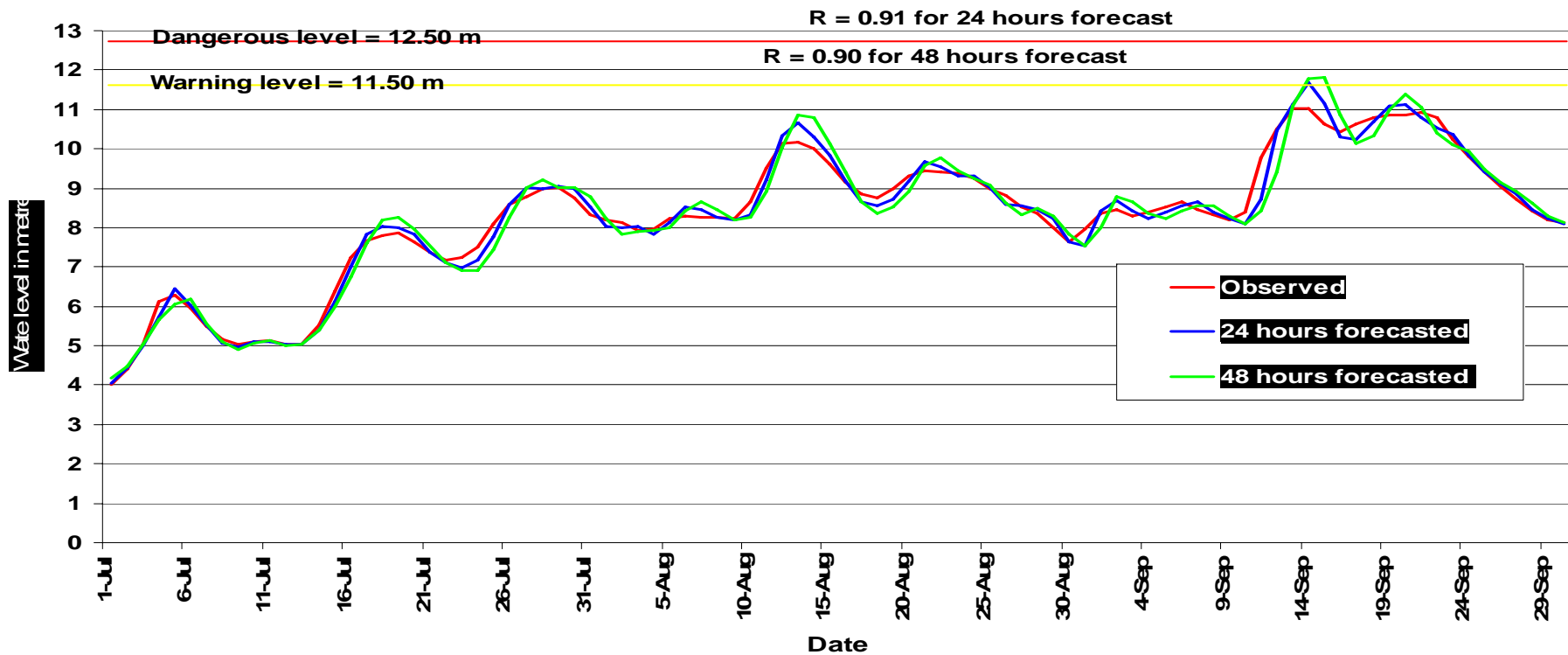
The main contain of the forecasts are water levels and forecast includes 6 stations:

- Luangprabang
- Vientiane
- Paksane
- Thakhek
- Savannakhet
- Pakse
- Water level in front of Numngnum dam

Flood forecasting Verification

The average bias of flood forecasting of Mekong river mainstream in Lao PDR ranges between -10 cm to $+10$ cm. All the above mentioned relationships are under estimated in general, but adjustments from local rainfall between stations are needed in some circumstances.

Comparison between observed and forecasted water level at Vientiane station for period 1/7- 30/9/2004



Sample flood Forecast Bulletin

LAO PEOPLE'S DEMOCRATIC REPUBLIC
Peace Independence Democracy Unity Prosperity

Ministry of Agriculture and Forestry
Department of Meteorology and Hydrology

FORECASTS BULLETIN

Forecast issued at: 10:00 am August 19, 2005

No	Stations / River	Rainfall in (mm)	Water level In (m)			Warning	Danger	Forecasted Water level	
		18 Aug	18Aug	19Aug	Diff.			20Aug	21Aug
1	Pakbeng (Mekong)	2.5	21.12	23.01	1.89	29.00	30.00		
2	Luangprabang (Mekong)	24.5	15.25	15.93	0.68	17.50	18.00	16.88	17.35
3	Vientiane (Mekong KM 4)	19.8	8.82	10.43	1.61	11.50	12.50	11.43	12.35
4	Paksane (Mekong)	14.5	12.89	13.15	0.26	13.50	14.50	13.96	14.46
5	Thakhek (Mekong)	40.0	13.12	13.29	0.17	13.00	13.50	13.42	13.82
6	Savannakhet (Mekong)	54.0	11.30	11.60	0.30	12.00	13.00	11.69	11.75
7	Pakse (Mekong)	57.5	11.82	12.22	0.40	11.00	12.00	12.37	12.37
8	NamNgum Dam Upstream	77.0	211.06	211.52	0.46	212.00	212.31	211.98	212.48
9	Nam Ngum Dam (downstream)		169.40	169.70	0.30				
10	Inflow (Q in m3/s) to reservoir		2408.126	2179.187	-228.9				
11	Turbine (Q in m3/s)		448.221	445.421	-2.80				
12	Spil Way (Q in m3/s)								

Remarks: 0.00 : No Rain
Opening Spill Way

Vientiane, 19/08/2005
Director General of DMH

LAO PEOPLE'S DEMOCRATIC REPUBLIC
Peace Independence Democracy Unity Prosperity

Ministry of Agriculture and Forestry
Department of Meteorology and Hydrology

WARNING No03.....

Tropical Cyclone and flood Warnings

Warning issued by DMH at: 10:00 am 18 August , 2005

The strong SW monsoon from Bay Bengal over Laos and is associated with TD over Gulf of Tonkin (20.0 N/107.2E) at 07:00 am 18/8/2005 is forecast to move northwest about 8 kts and estimated over land of Vietnam this afternoon and move over northern of Laos at 20.0N/103.0 E in mid – night.

Heavy rain with speed winds 10 – 15 mps will be expected at Bolikhamxay and Khammuane areas. Light rain with thunders over Vientiane, XK, SN, VS, OS and LB. Therefore inhabitants within these above mentioned areas are advised to be aware of damages which may be caused by flash flood .

For today water level at 07: 00 am at Pakxan station is 13.15 m (warning level is 13.50 m and Danger level is 14.50 m). In addition by local heavy rainfall the water level forecast must be exceeded warning level on tomorrow morning . The latest water level forecast for tomorrow morning at Pakxan station is 13.96 m and for day after tomorrow is 14.46 m. Therefore inhabitants who lives at low – lying areas are advised to be aware of damages which may be caused by flood.

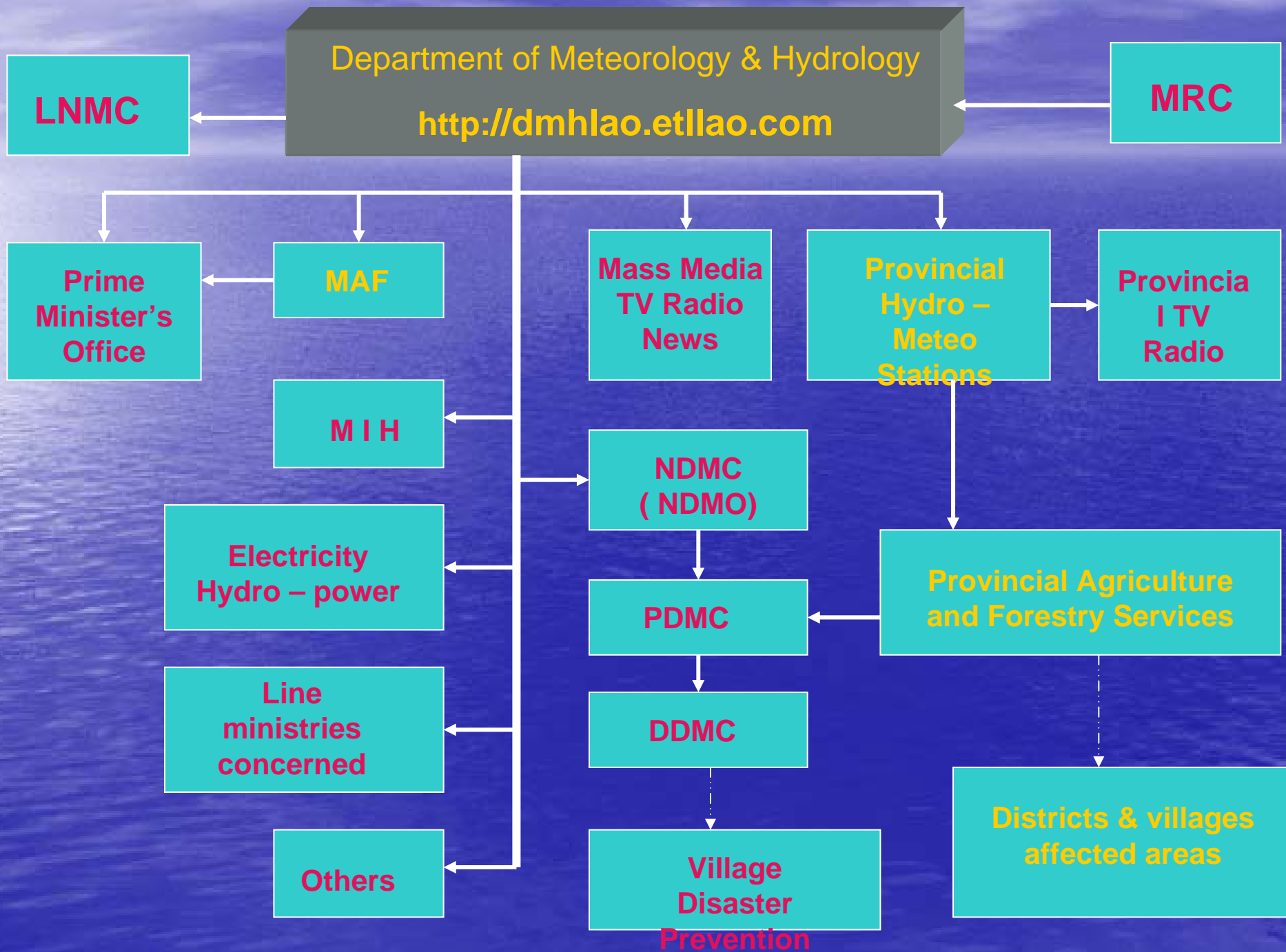
Please follow next warning for the necessary action taking.

**Vientiane, 18/08/2005
Director General of DMH**

Mains users of Meteorological and Hydrological products are:

- Aviation.
 - Agriculture sectors.
 - Electricity Hydro - power .
 - construction projects.
- Regarding service to public , Meteorological and Hydrological data, weather and flood forecasts are disseminated to ministries and organizations concerned such as :
 - TV, Radio stations, newspapers.
 - Ministry of Agriculture and Forestry.
 - Prime Minister office.
 - NDMO
 - Ministry of Industry and Handicraft.
 - Line ministries concerned
 - Provincial Authorities concerned.
 - Internatinal Organizations.
 - Private sectors.
 - The HF/SSB Radio transceivers network, Public telephone, Facsimile and E – Mail are used for delivering the weather and flood forecasts and Tropical Cyclone Warnings to public.

Forecast & Warning Dissemination in Laos



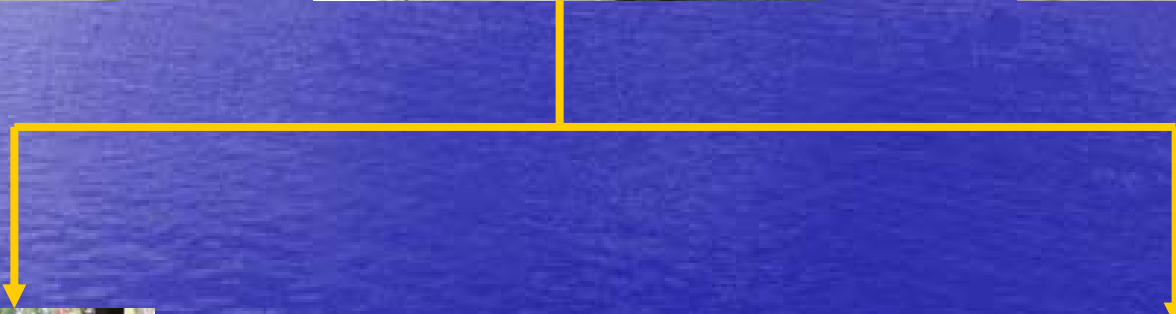
CONCLUSION

- In 2005 the SW monsoon heavy rainfall from Andaman sea and is associated with 5 TCs Best tracks over Laos caused flashflood, landslide, flood from Mekong River and its tributaries .
- Over 8 provinces , 84 districts , 2510 villages , 8.533 households , 480.913 persons were affected and caused of damage to properties and infrastructure.
- Flood from Mekong River and its tributaries in 2005 was considered as the highest affecting at central and southern low – laying rice production areas such as: Khammuane and Savannakhet provinces .
- The extreme weather monitoring and accurate of forecasts and warnings at DMH of Laos is a great importance to assist the government and public users to take prevention activities.

Aspect of DMH & Community Relationship that must be strengthened

- *Improvement of tropical cyclone monitoring capability.*
- *Upgrade of precision rainfall monitoring under coverage areas of Radar.*
- *Improvement of accurate weather, flood forecasts and warnings information and dissemination in proper and timely manner.*
- *Increase of issuance of forecasts and warnings during severe weather condition.*
- *Especially this rainy season , DMH plan to disseminate directly the early warnings to community at some flood risk areas of Khammuane and Savannakhet provinces.*

DMH Headquarter in Lao PDR



Recommendation

- For today real - time of hydro - meteorological data from main tributaries for flood forecasting of Mekong River in Laos are very limited .Means hydro - meteorological networks as well as telecommunication need to be extended.
- *National flood forecasting center should be established at DMH LAO PDR and flood forecasting site need to be implemented at some main tributaries.*
- Mechanism, methodology, human capacity and facilities for flood preparedness, flood forecast and warning systems need to be improved
- *Communication and awareness on utilize the hydro – meteorological information to the community at flood risk areas need to be improved.*
- Telecommunication for early warning dissemination need to be extended at flood risk areas (district to village) .
- *Flood mapping is very necessary at flood risk areas should be established.*
- The DMH suggestion is to have the FMM (MRCs) medium and long – range flood forecasting for prevention activities .

Thank you

