Flood Forecasting and Early Warning System in Mekong River Commission

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4th Annual Flood Forum
18 - 19 May 2006
Siem Reap, Cambodia

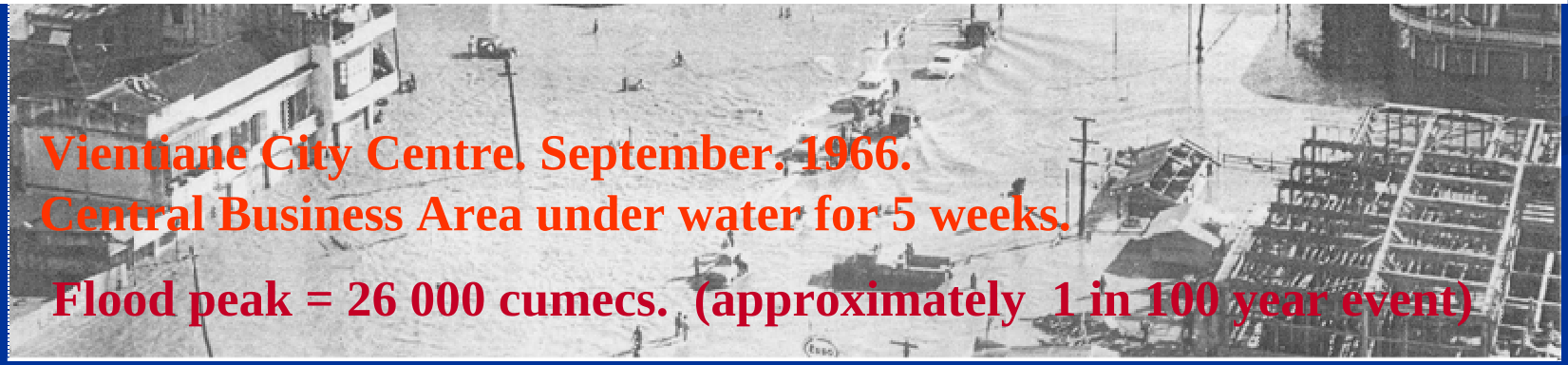
Outline

- Background on flood forecasting
- Flood forecasting system
- Flood dissemination system
- Problems encountered
- Improvement and Future plan

1. Background of flood forecasting

- The basin-wide river forecast since 1970, called by severe flood in 1966, carried out mainly by Hydrology Group

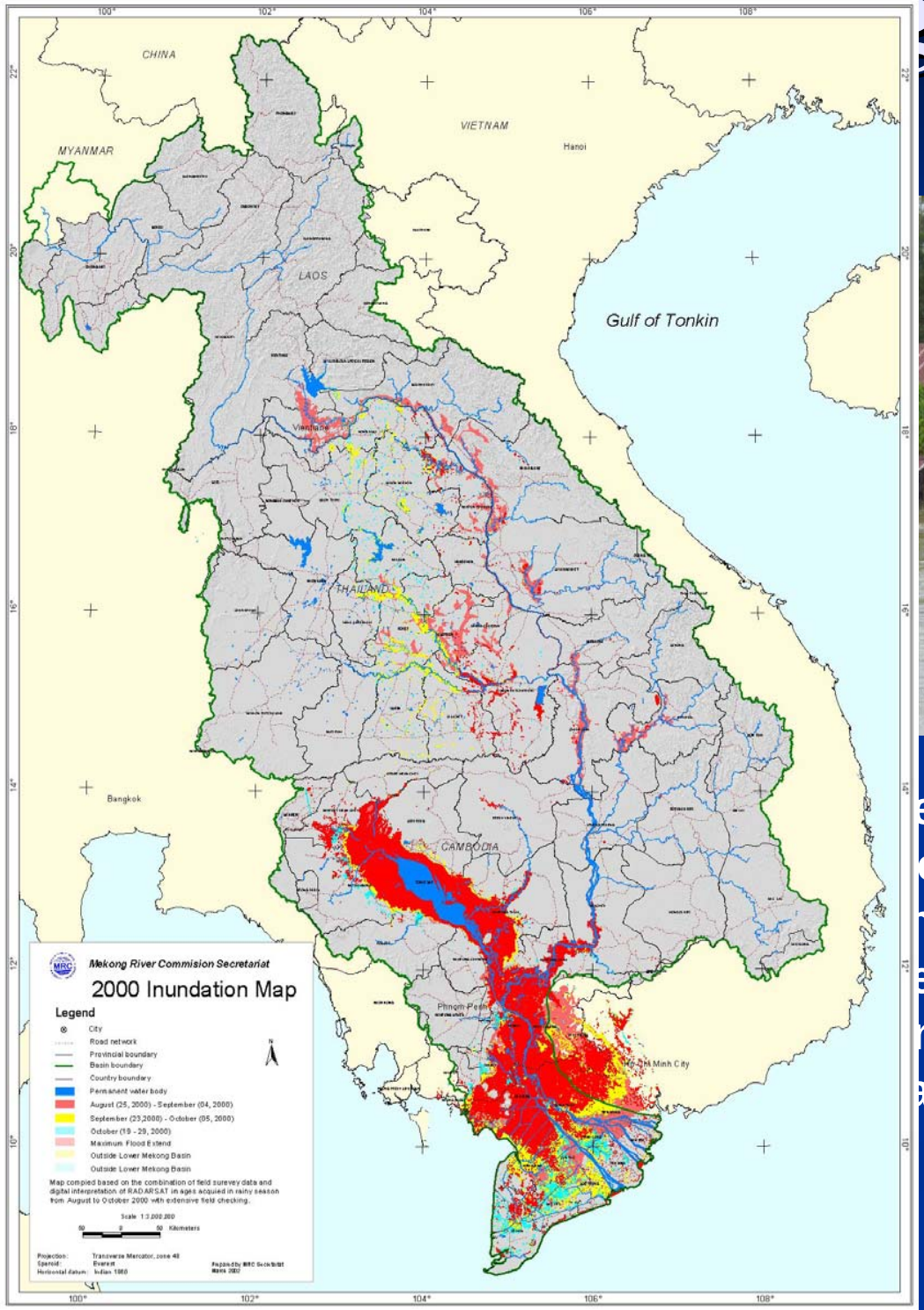
River Monitoring	Flood Forecasting
7-day River Monitoring	5-day Flood Forecasting
Nov. – Jun.	Jun. – Oct.
Weekly forecast	Daily forecast
Update weekly on MRC webpage, e-mail to NMCs and concerned line agencies	Update daily on MRC webpage, e-mail to NMCs and concerned line agencies



Vientiane City Centre. September. 1966.
Central Business Area under water for 5 weeks.

Flood peak = 26 000 cumecs. (approximately 1 in 100 year event)

Background

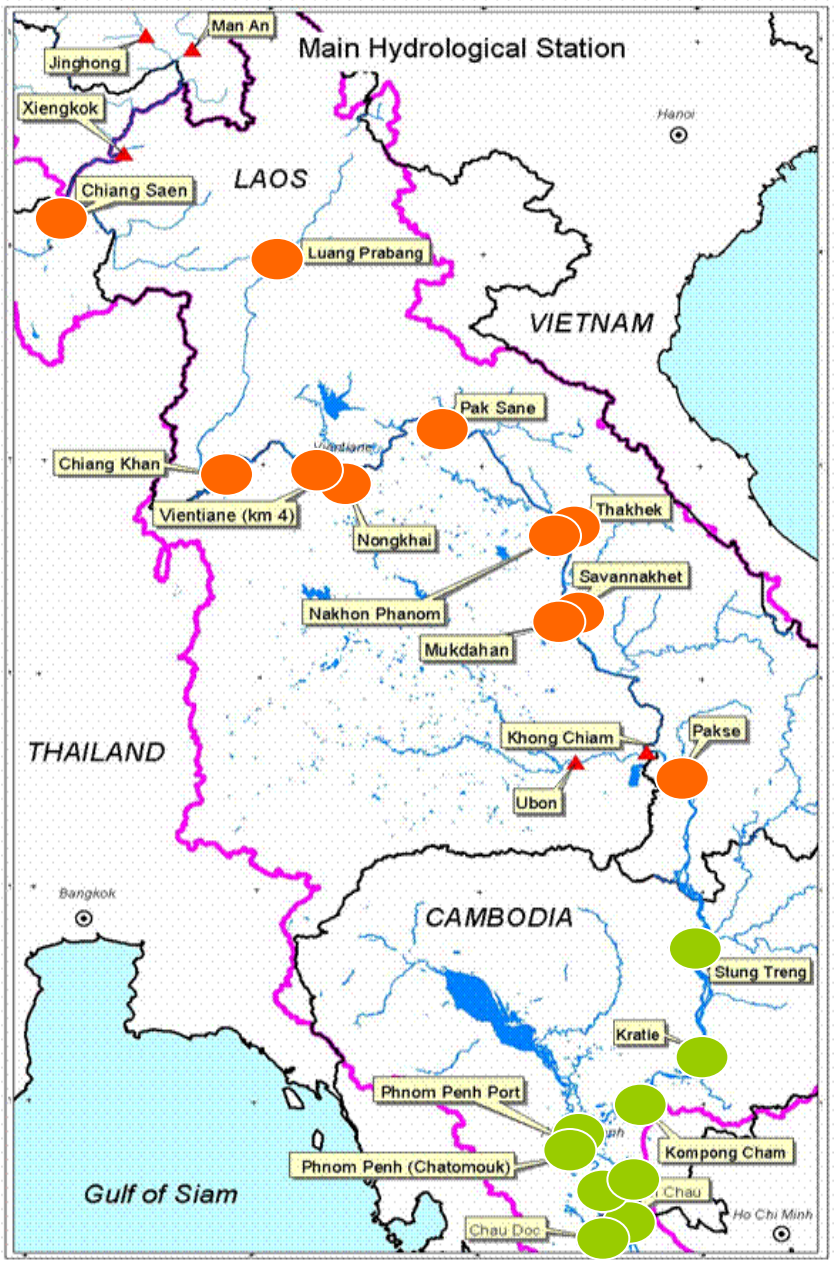


ently, in 2000, 2001, and 2002, the
ong floods have caused huge
nomic damage in the MRC member
es (Cambodia, Lao PDR, Thailand,
nam)
amage worth about US$ 1 billion

Many lives have been lost

(on the order of 2,000)

2. MRCS Flood Forecasting System



SSARR model

regres
model

Forecasting Stations

-Flood forecasting: 21 sta.

-River Monitoring: 19 sta.

Three main components:

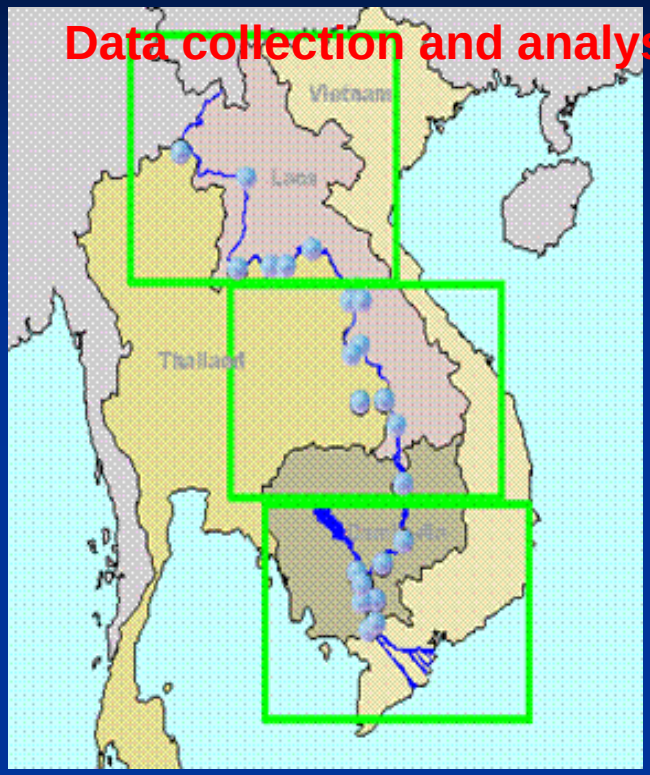
Data collection/processing

Forecast Preparation

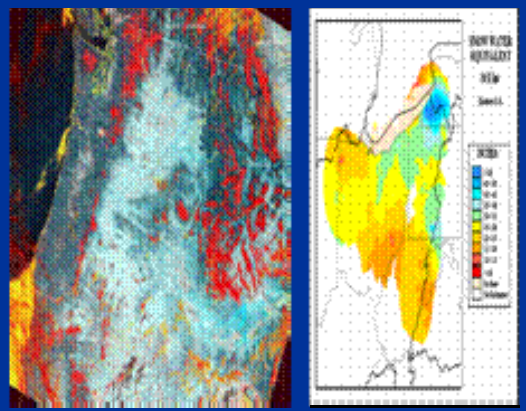
Forecast Dissemination

Flood Forecasting System

Data collection and analysis



Hydrological Stations



Rainfall Estimation/ Forecast
(Satellite-based data)

Provision of Forecasts

Forecast Dissemination

Web site, bulletin, e-mail, fax, radio, telephone, etc.

Through partner Network (NMCs, National line agencies, Red Cross)

2.1 Data collection, processing and transmission

1. Historical data (hydro-met data)

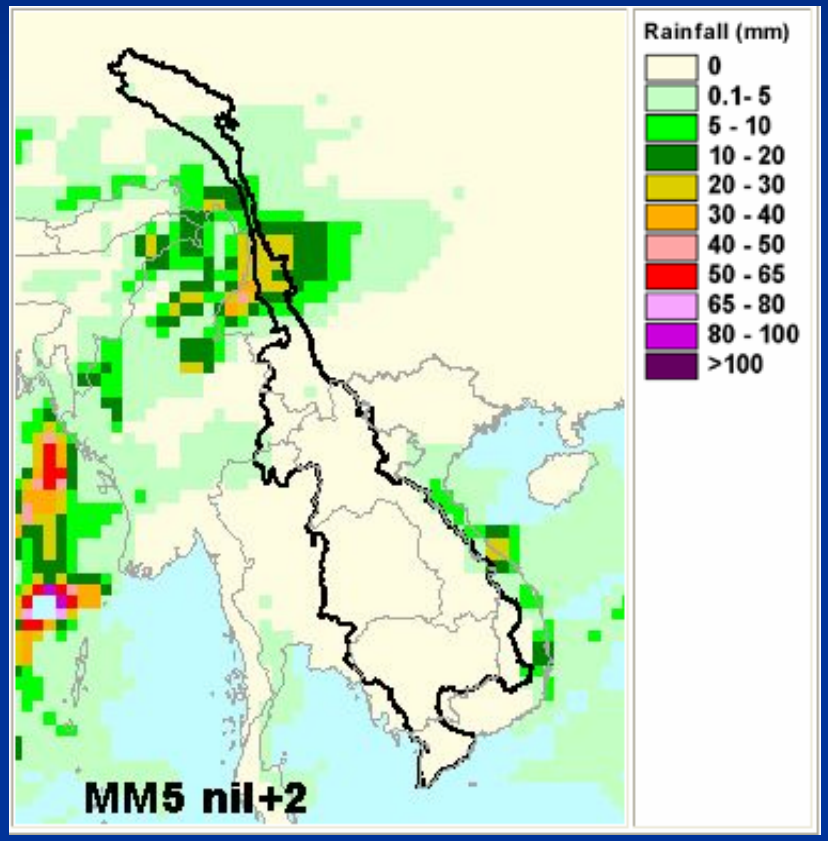
- Historical meteorological data in HYMOS database
- Historical hydrological data in HYMOS database

2. Near real time data (at 7 AM)

(water level and rainfall)

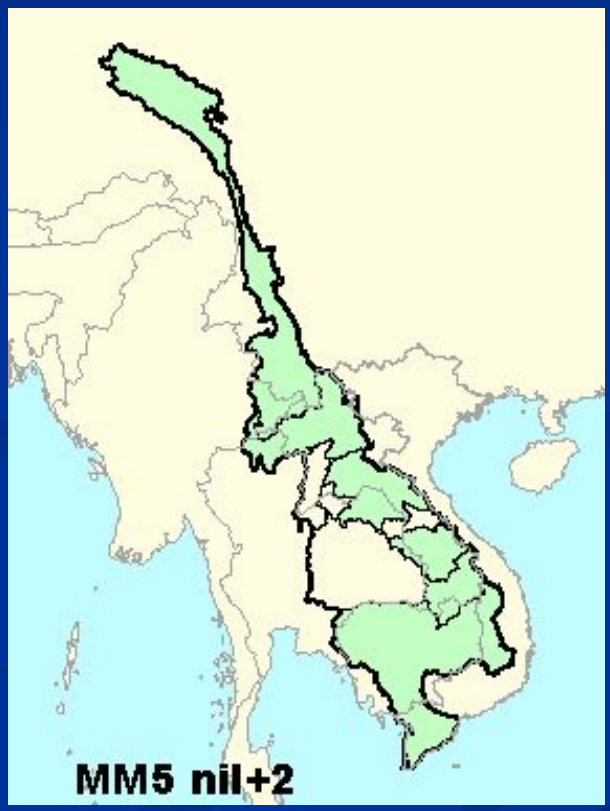
- 19 stations in LMB and 2 stations in China, June-October, sending by e-mail to MRCS
- 19 stations in LMB, November-June, sending by email to MRCS
- Rainfall estimation and forecast from other sources; e.g. USGS/NOAA,

An interpretation and analysis of all available weather data like satellite images, rainfall estimation, forecasts from various sources, including those from USGS/NOAA



Rainfall estimation and forecast from USGS/NOAA

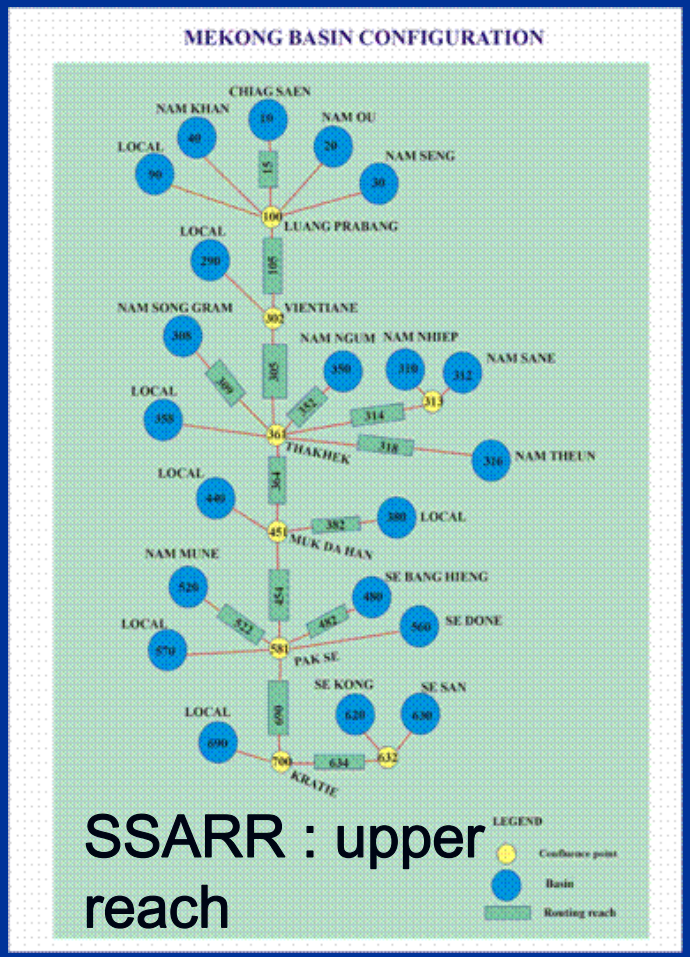
Mekong sub-basin



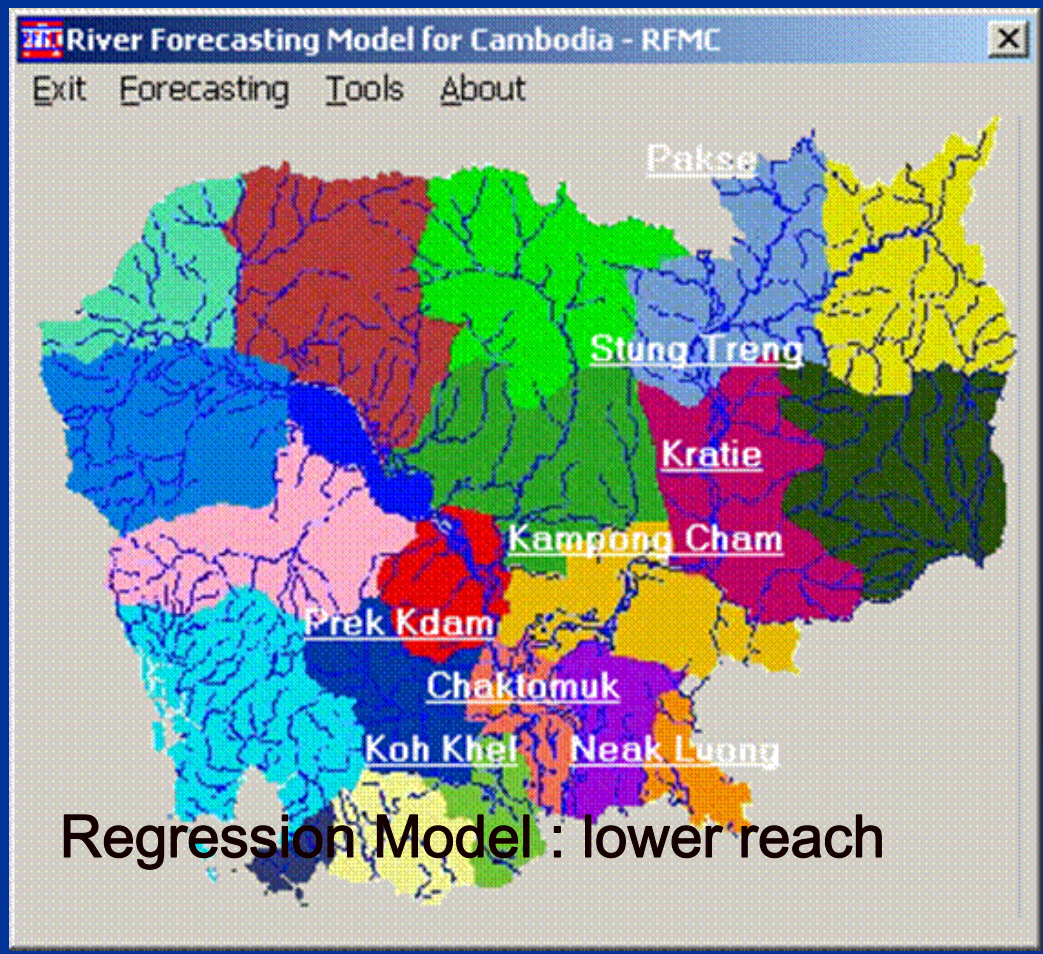
Rainfall by sub-basin (used as input for flood forecast model)

2.2 Forecast preparation

- SSARR (Streamflow Synthesis And Reservoir Regulation) model used for upper part (from Chiang Saen to Pakse)
- Regression models used for the lower reach of the delta with over bank flow (from Stung Treng to Tan Chau/Chau Doc)



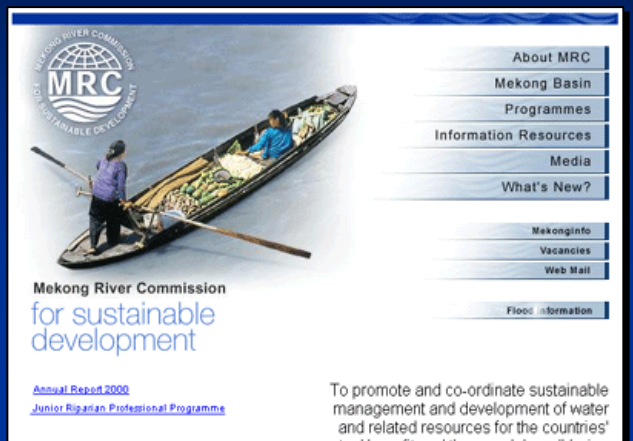
SSARR : upper reach

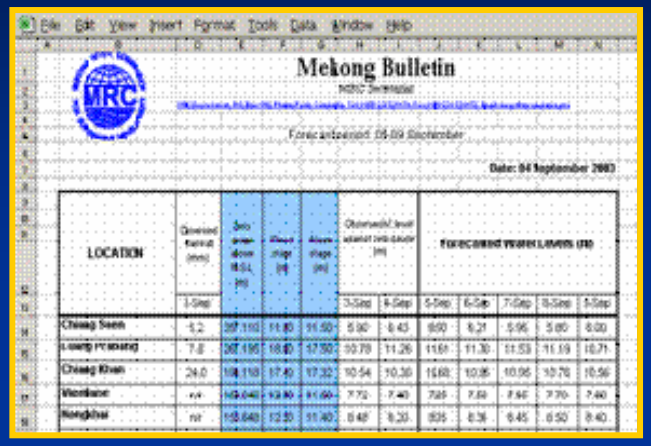


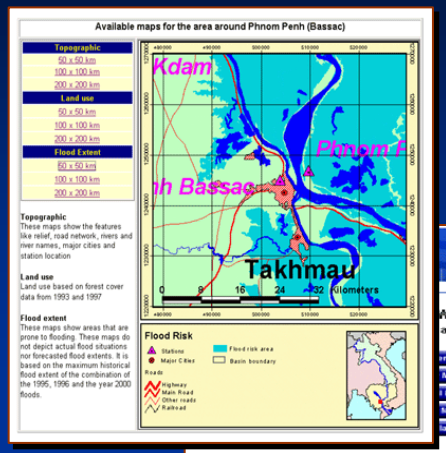
Regression Model : lower reach

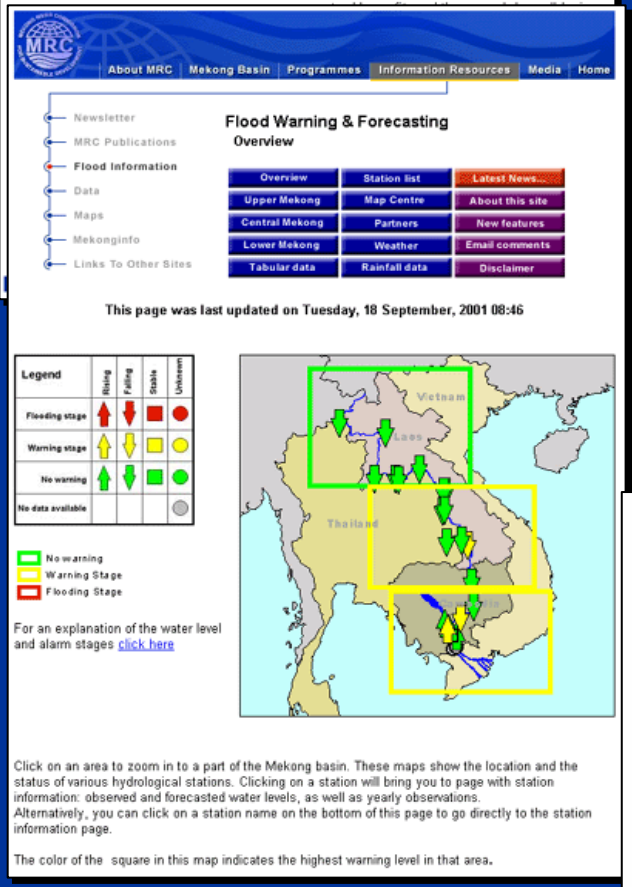
3 Forecast dissemination

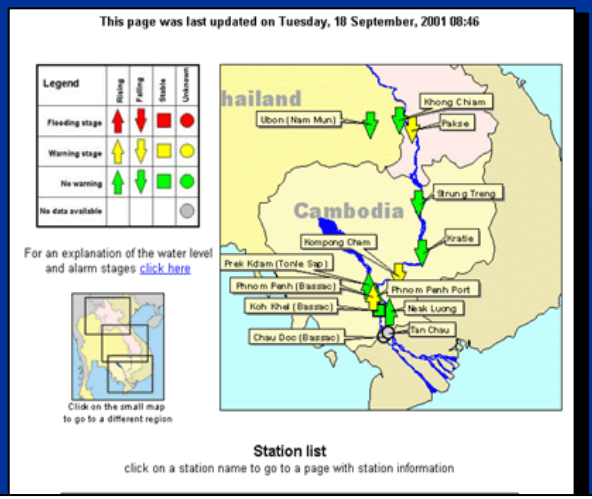
www.mrcmekong.org

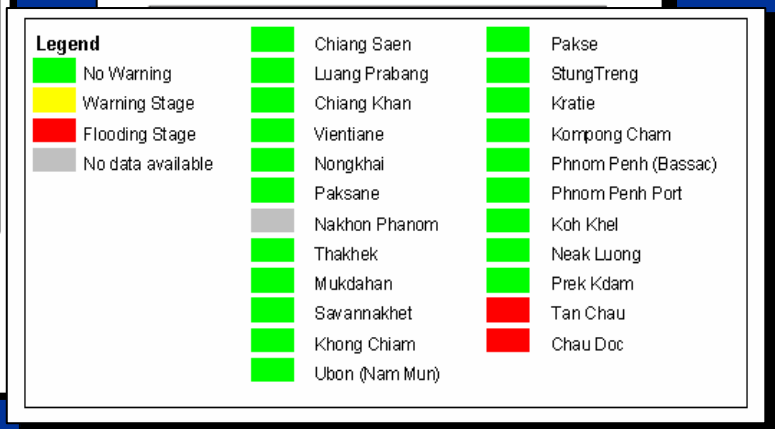


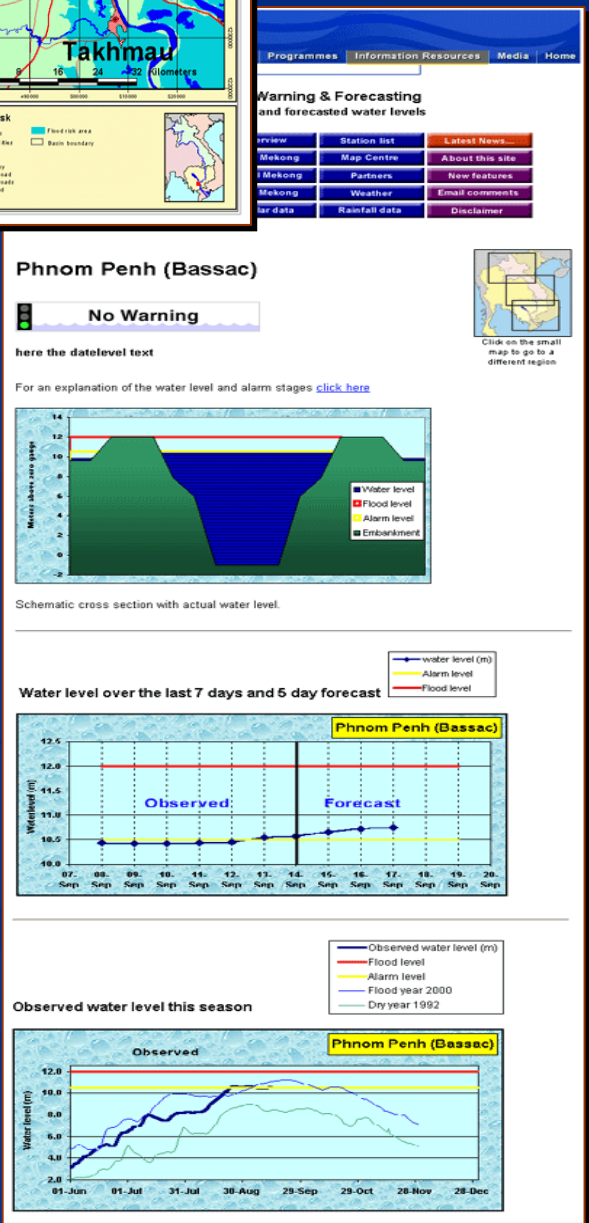












Mekong Bulletin

MRC Secretariat

MRC Secretariat. P.O. Box 6101 Vientiane 01000, Lao PDR. Tel: (856-21) 263263, Fax: (856-21) 263264, Email: mrcs@mrcmekong.org

RIVER MONITORING

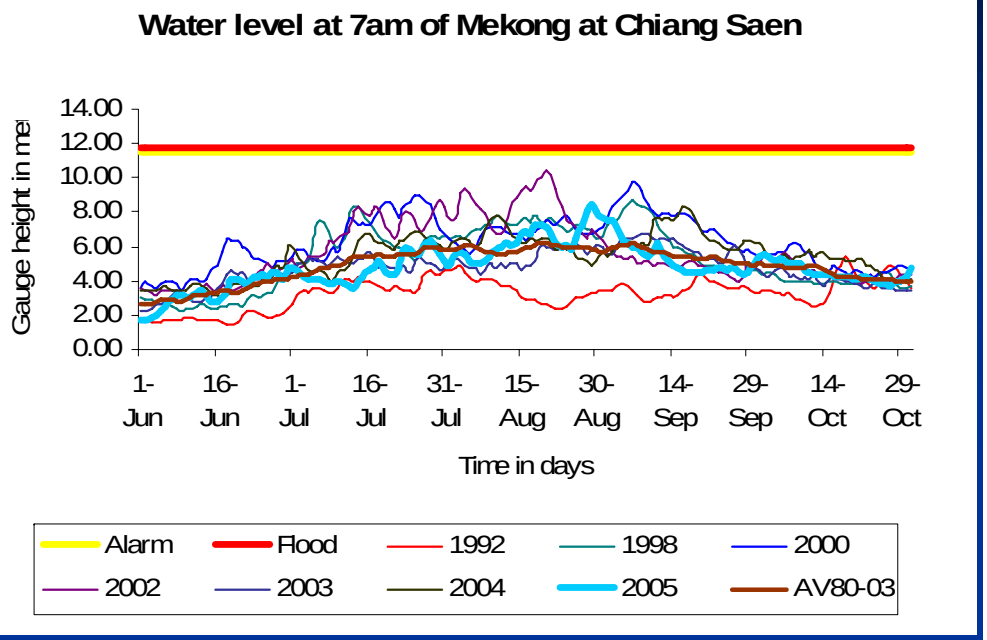
Date: 13 March 2006

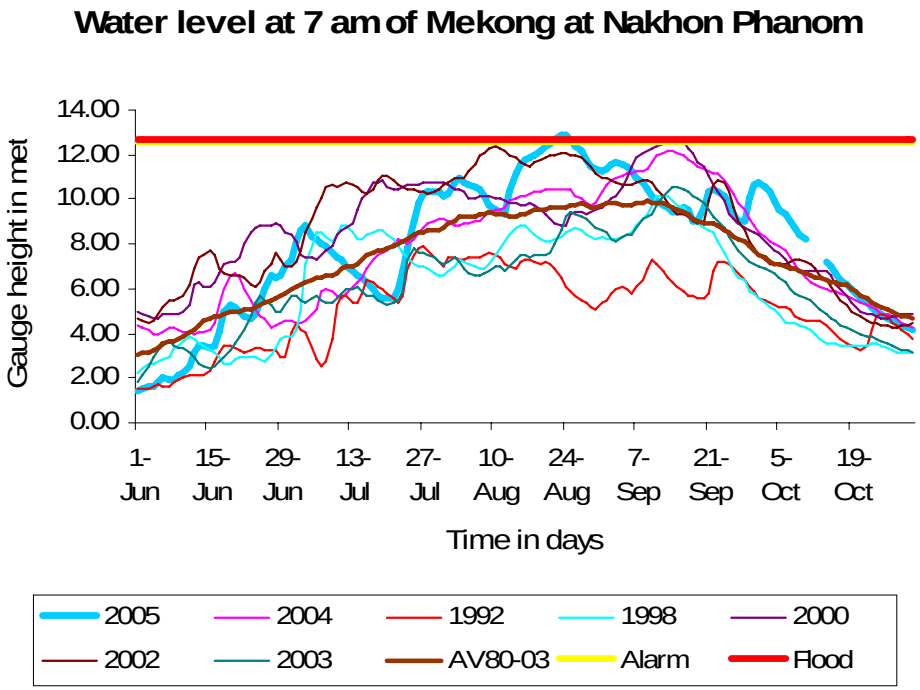
LOCATION	Observed Rainfall (mm)	Zero gauge above M.S.L (m)	Min of minimum W.level against zero gauge (m)	Observed W. level against zero gauge (m)		Forecasted Water Levels (m)						
	12-Mar			12-Mar	13-Mar	14-Mar	15-Mar	16-Mar	17-Mar	18-Mar	19-Mar	20-Mar
Chiang Saen	nr	357.110	0.00	1.61	1.62	1.59	1.54	1.47	1.36	1.25	1.16	1.08
Luang Prabang	nr	267.195	2.53	3.33	3.41	3.28	3.15	3.00	2.83	2.66	2.51	2.35
Chiang Khan	nr	194.118	1.91	3.02	3.02	3.01	2.95	2.86	2.74	2.60	2.44	2.28
Vientiane	nr	158.040	-0.28	0.83	0.72	0.70	0.64	0.56	0.46	0.35	0.23	0.10
Nongkhai	nr	153.648	0.33	1.54	1.45	1.43	1.37	1.29	1.19	1.08	0.96	0.83
Paksane	nr	142.125	0.10	2.78	2.76							
Nakhon Phanom	nr	130.961	0.18	0.92	0.95	0.91	0.88	0.84	0.79	0.73	0.67	0.59
Thakhek	nr	129.629	1.38	2.29	2.31	2.27	2.24	2.20	2.15	2.09	2.03	1.95
Mukdahan	nr	124.219	0.72	1.32	1.35	1.36	1.35	1.35	1.34	1.32	1.30	1.28
Savannakhet	nr	125.410	-0.65	0.03	0.02	0.02	0.01	0.01	0.00	-0.02	-0.04	-0.06
Khong Chiam*	-	89.030	1.02									
Ubon *(Nam Mun)**	-	105.074	1.19									
Pakse	1.0	86.490	0.03	0.93	0.87	0.87	0.86	0.85	0.85	0.84	0.84	0.83
Stung Treng	nr	36.790	0.32	2.32	2.32	2.32	2.31	2.30	2.30	2.29	2.29	2.28
Kratie	nr	-1.080	3.06	6.77	6.80	6.81	6.80	6.80	6.79	6.78	6.78	6.77
Kompong Cham	nr	-0.930	0.65	2.62	2.59	2.57	2.55	2.53	2.51	2.50	2.49	2.48
Phnom Penh (*Bassac*)	nr	-1.020	1.58	2.00	1.94	1.89	1.85	1.83	1.81	1.79	1.78	1.77
Phnom Penh Port	nr	0.000	0.14	1.11	1.06	1.01	0.97	0.95	0.93	0.91	0.90	0.89
Koh Khel	nr	-1.000	1.52	2.06	2.00	1.99	1.98	1.97	1.97	1.97	1.97	1.97
Neak Luong	nr	-0.330	0.81	1.42	1.38	1.34	1.30	1.27	1.25	1.23	1.21	1.19
Prek Kdam	nr	0.080	0.58	1.12	1.06	1.04	1.03	1.02	1.01	1.00	0.99	0.98
Tan Chau	nr	0.000	-0.37	0.63	0.78							
Chau Doc	nr	0.000	-0.60	0.60	0.76							

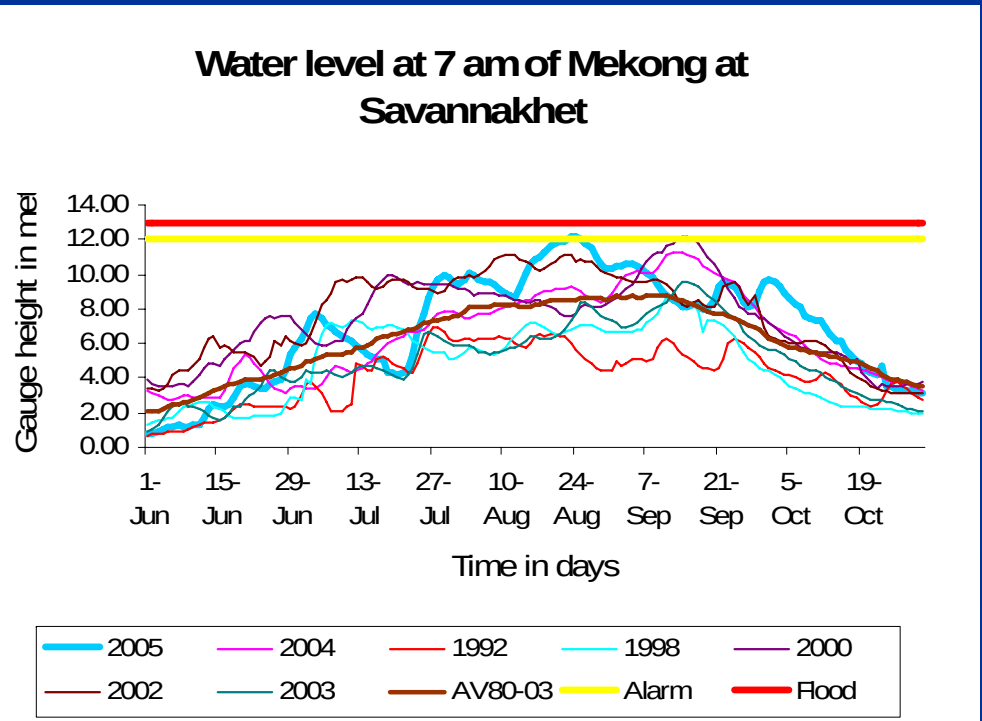
REMARKS: -: not available. *: reference stations without forecast.

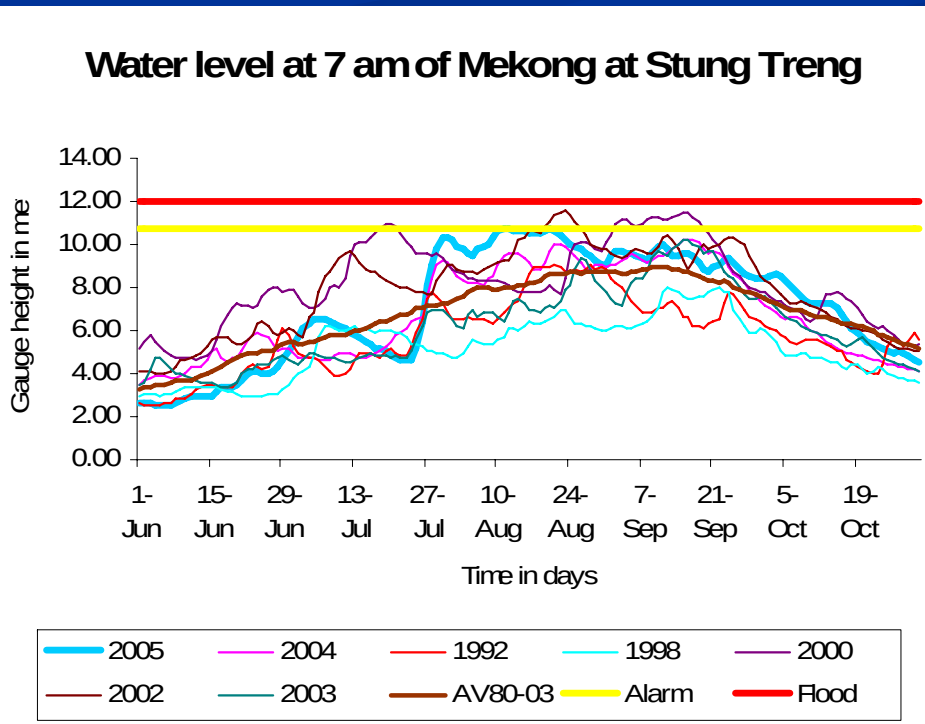
Flood bulletin

Hydrograph at stations along the mainstream

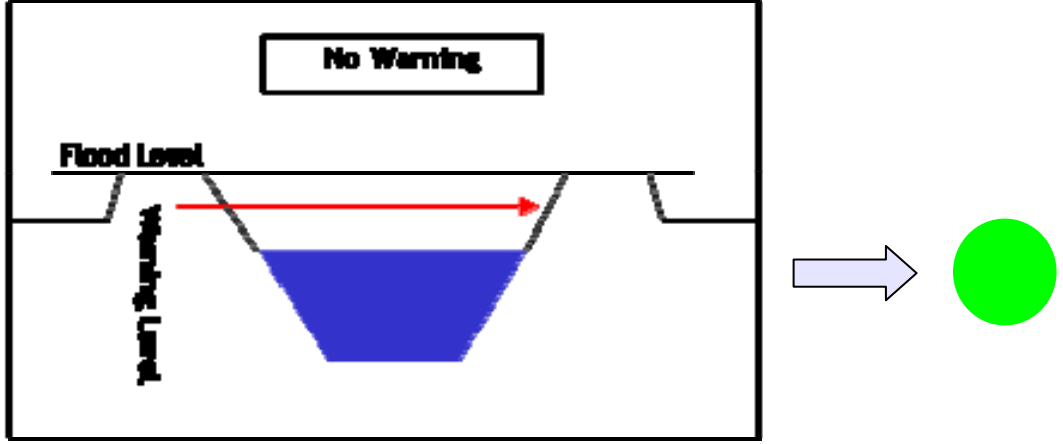




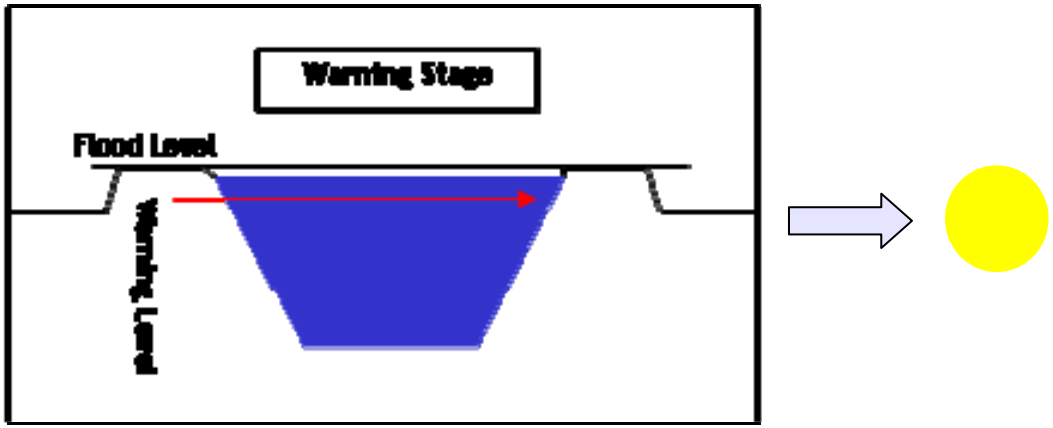




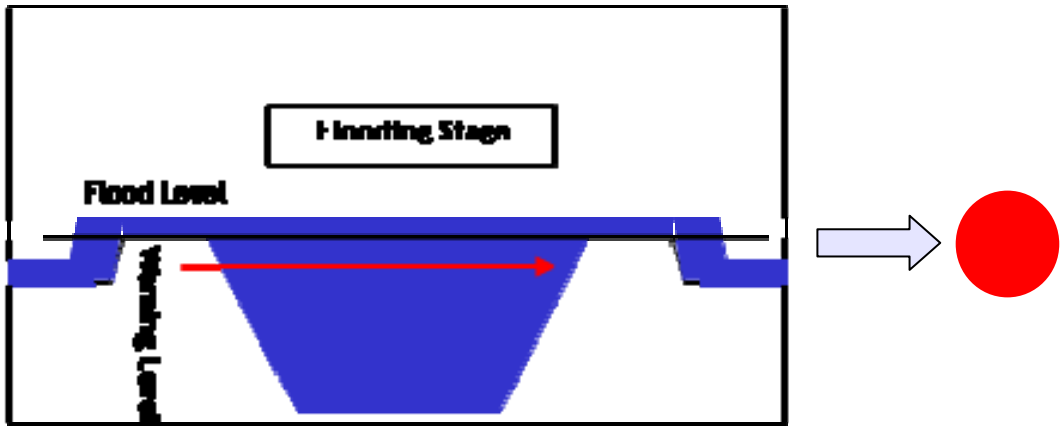
Three different stages in Flood warning system



The height of the water is below the alarm level. No risk of flooding.

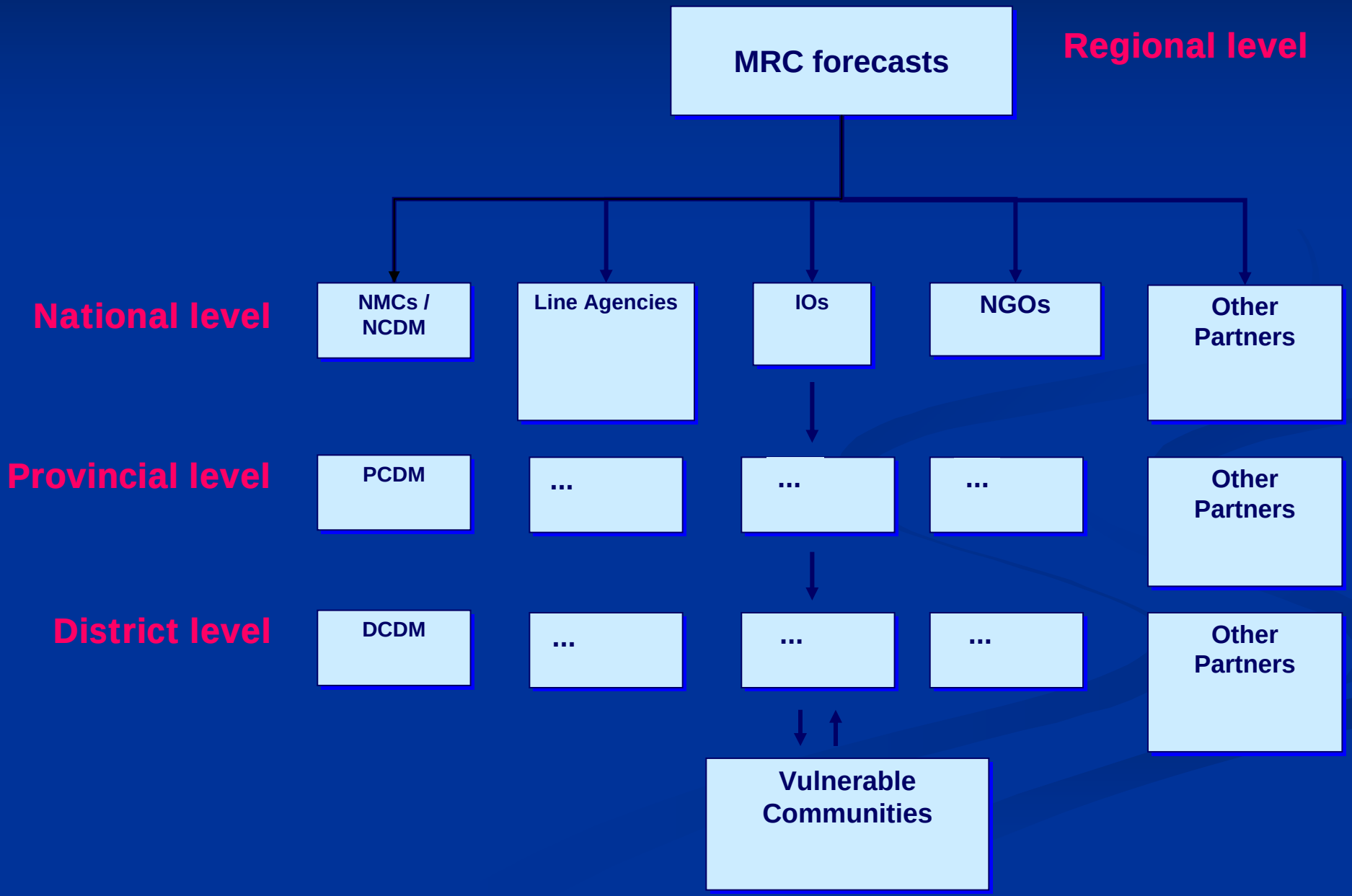


The height of the water is equal or higher than the alarm level but lower than the flood level.



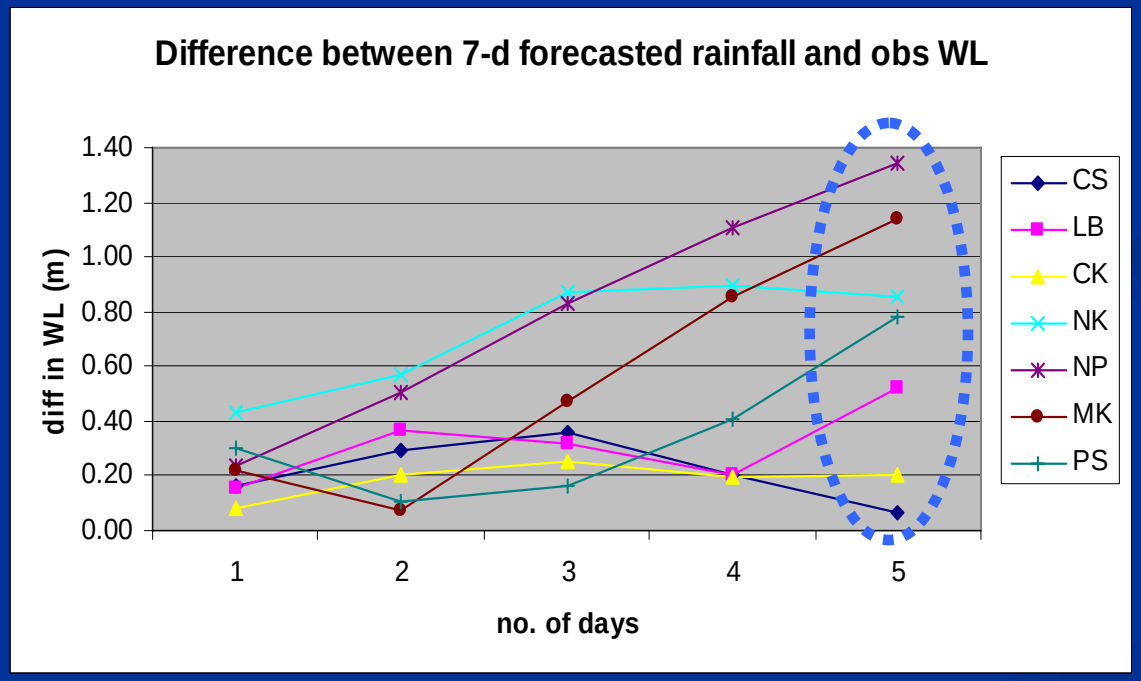
The water level equal or higher than the flood level.

Flood Information Flow from MRC to Vulnerable Communities



Problems encountered

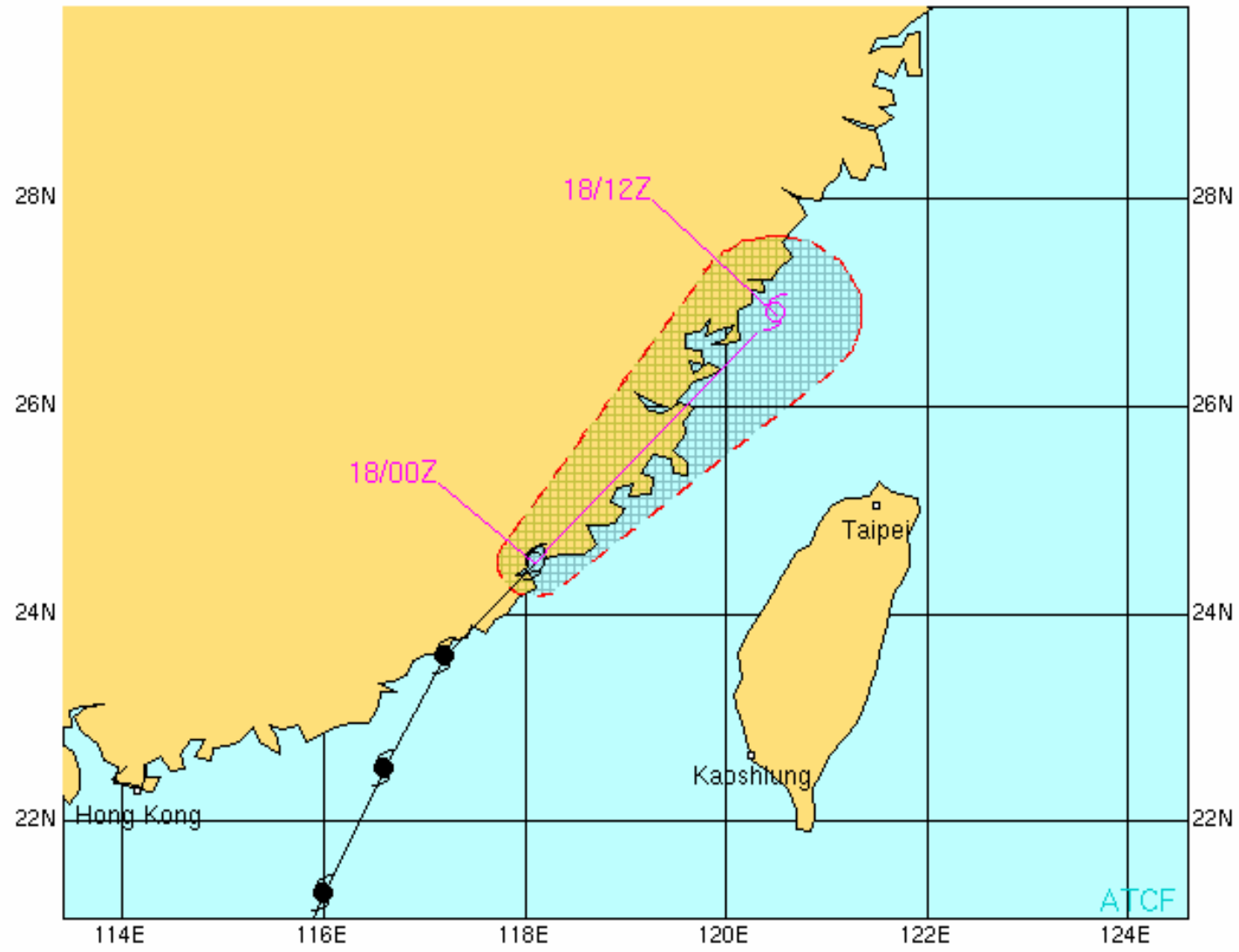
- Outdated flood forecasting model
- Accuracy of forecast rainfall used as input for flood forecasting



Difference between SSARR model forecast water levels and observed water level from staff gauges
Simulation Date : 2nd September 2005

Accuracy of forecast water level decreases with the number of advance forecast days

3 Plan for Improvement



TROPICAL STORM 02W (CHANCHU) WARNING #38
FINAL WARNING
180000Z POSIT: NEAR 24.5N 118.1E
MOVING 040 DEGREES TRUE AT 12 KNOTS
MAXIMUM SIGNIFICANT WAVE HEIGHT: 17 FEET
18/00Z, WINDS 045 KTS, GUSTS TO 055 KTS
18/12Z, WINDS 035 KTS, GUSTS TO 045 KTS

CPA TO:	NM	DTG
KADENA_AB	391	18/12Z
TAIPEI	112	18/09Z

BEARING AND DISTANCE	DIR	DIST (NM)	TAU (HRS)
KADENA_AB	275	392	12
TAIPEI	334	121	12

- TROPICAL DEPRESSION
- TROPICAL STORM
- TYPHOON

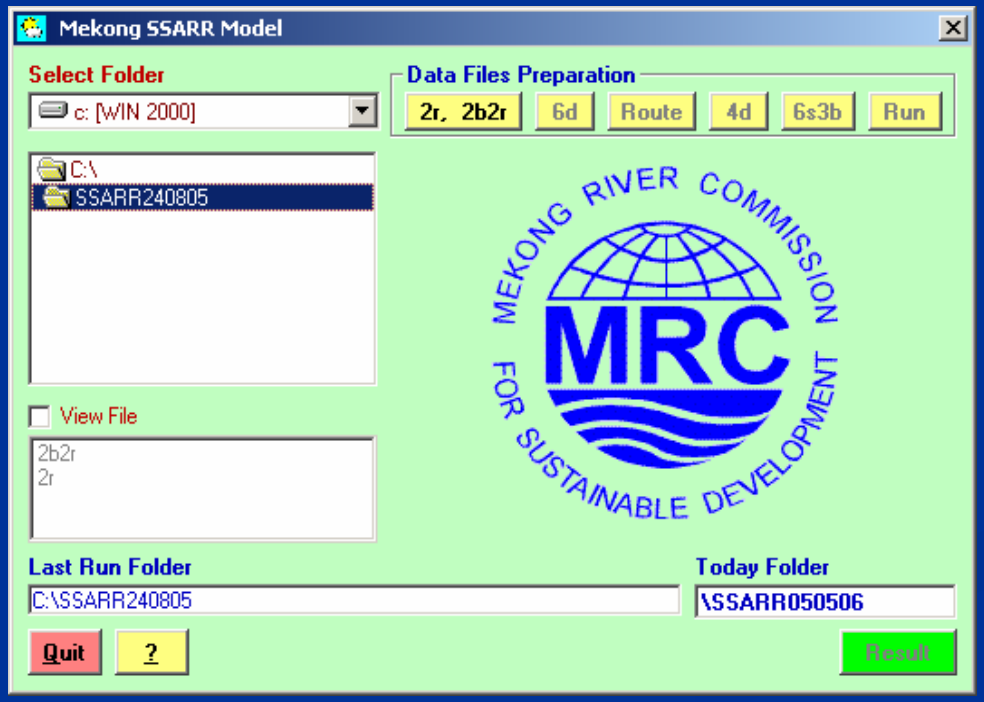
PAST 6 HOURLY CYCLONE POSITS IN BLACK
FORECAST CYCLONE POSITS IN COLOR

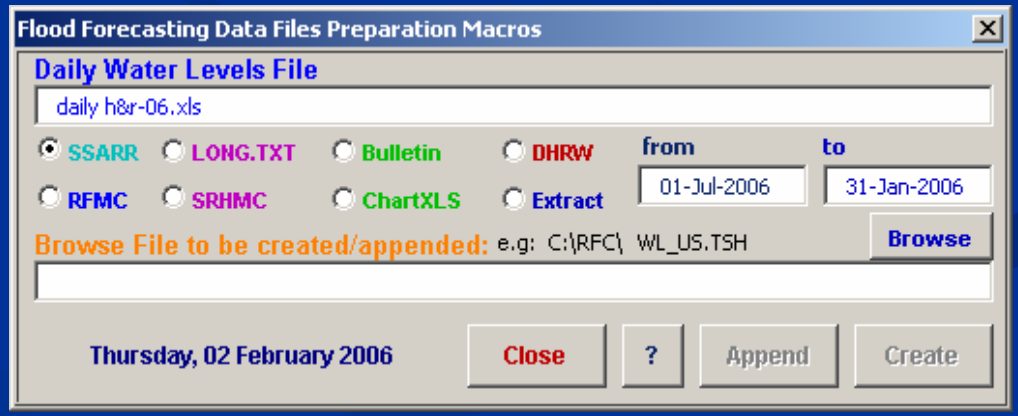
Source : Naval Pacific Meteorology & Oceanography Center

3 Plan for Improvement

3.2 Improved operational forecasting:

- Re-calibration and modification of existing models with new updated additional real-time data
- New forecasting tools : effective tools coupled with GIS and mapping facilities
- Increasing accuracy and lead time
- New user-interface for flood forecasting model : reduce times and error of data preparation including model processing





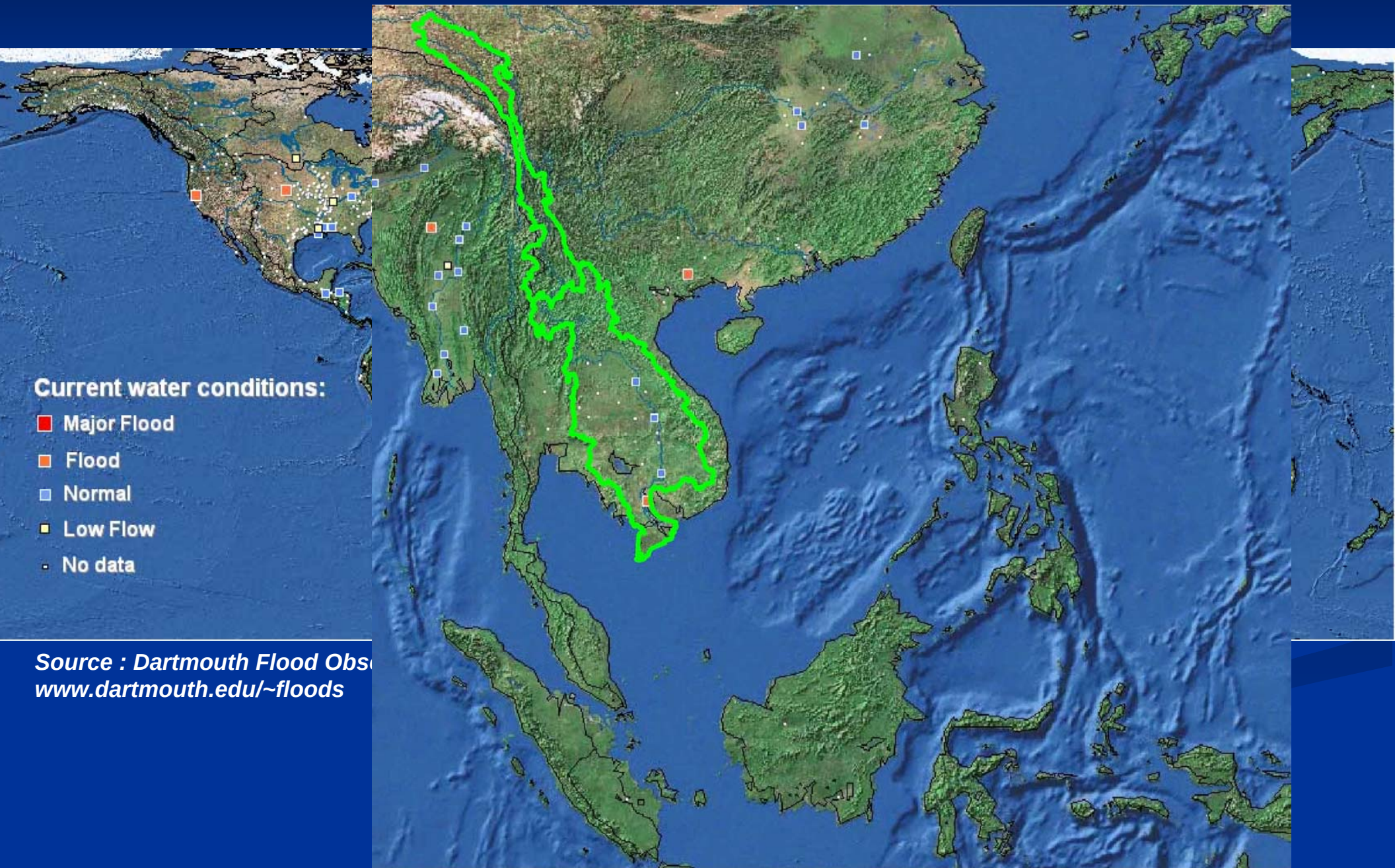
3 Plan for Improvement

3.3 Improved dissemination:

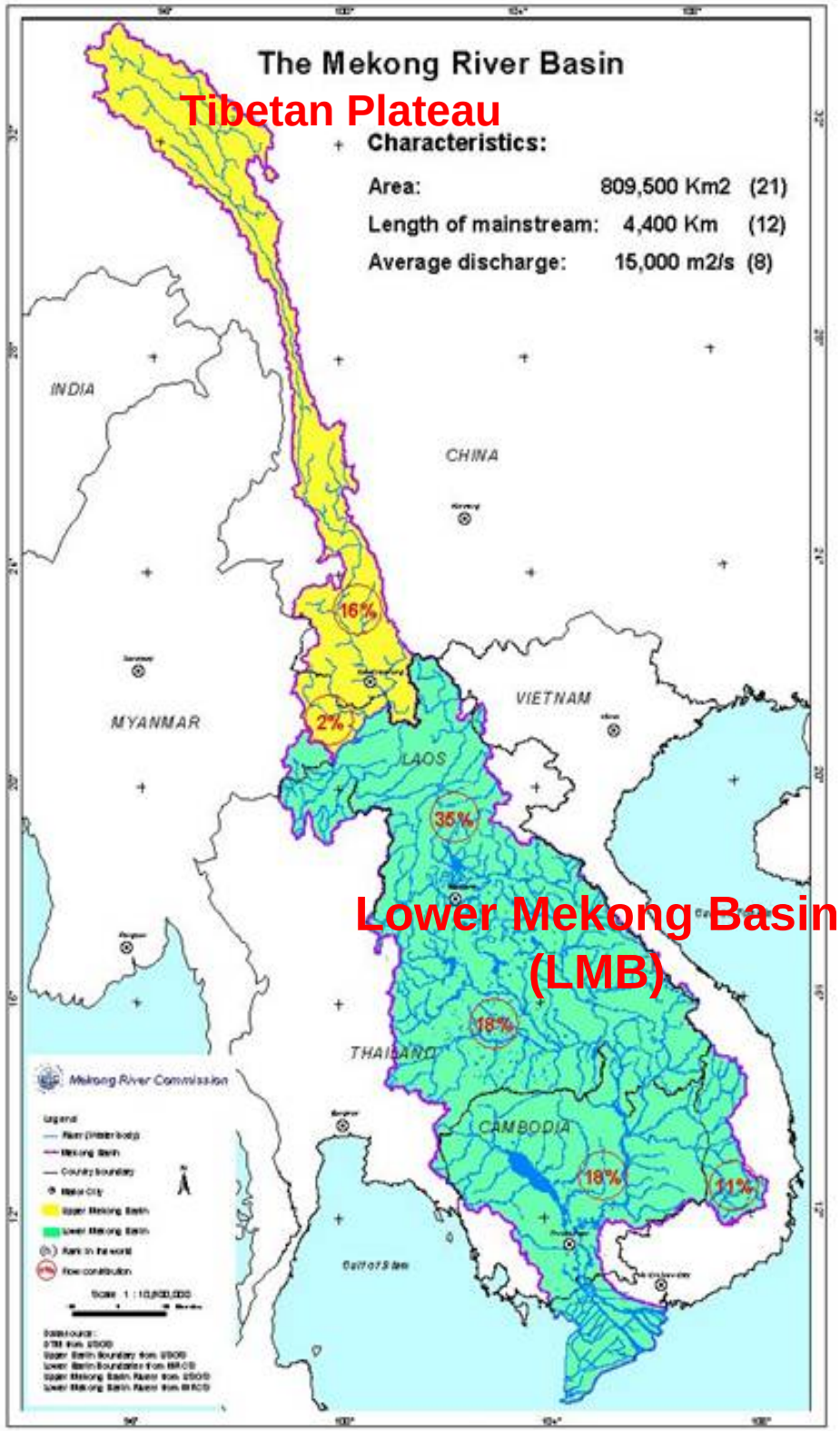
- Provide flood forecasts information: river, flood plain water level, flow, inundation map, etc. by fax, email, web pages, radio (RANET from AFN)
- Warning messages related to evacuation, protection, using all available tools, including MRC-OFDA flood-related project, ECHO and other projects (capacity building).

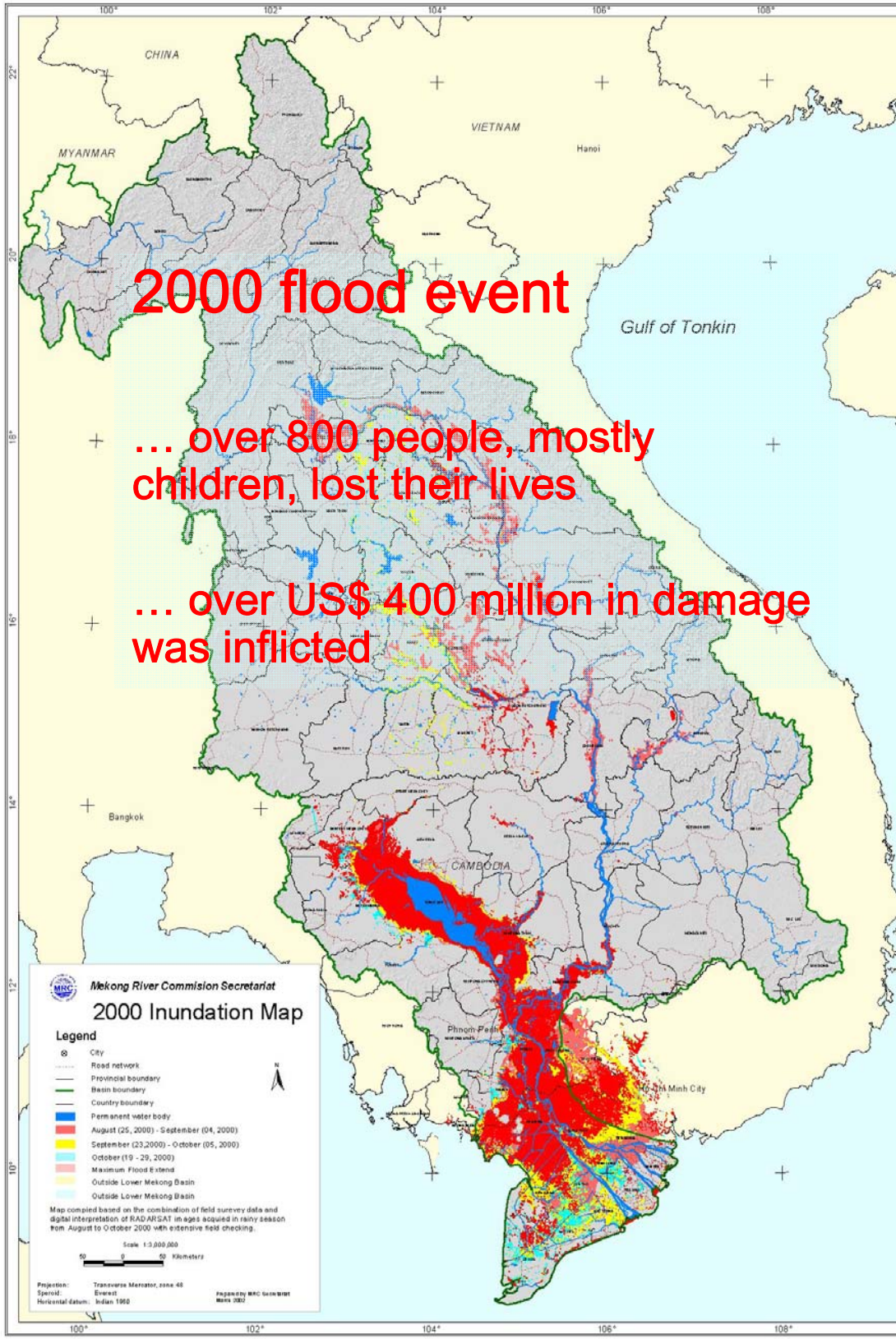

Thank you very much
for your attentions

Mekong River Basin



Source : Dartmouth Flood Obs
www.dartmouth.edu/~floods


The Mekong River Basin
Tibetan Plateau
Characteristics:
Area: 809,500 Km2 (21)
Length of mainstream: 4,400 Km (12)
Average discharge: 15,000 m2/s (8)
INDIA
CHINA
MYANMAR
VIETNAM
LAOS
THAILAND
CAMBODIA
16%
2%
35%
18%
18%
11%
Lower Mekong Basin
(LMB)
Mekong River Commission


2000 flood event
… over 800 people, mostly children, lost their lives
… over US$ 400 million in damage was inflicted
CHINA
VIETNAM
MYANMAR
Hanoi
Gulf of Tonkin
Bangkok
CAMBODIA
Phnom Penh
Ho Chi Minh City
Mekong River Commision Secretariat
2000 Inundation Map
Legend
City
Road network
Provincial boundary
Basin boundary
Country boundary
Permanent water body
August (25, 2000) - September (04, 2000)
September (23,2000) - October (05, 2000)
October (19 - 29, 2000)
Maximum Flood Extend
Outside Lower Mekong Basin
Outside Lower Mekong Basin

Introduction

Recently, in 2000, 2001, and 2002, the Mekong floods have caused huge economic damage in the MRC member states (Cambodia, Lao PDR, Thailand, Vietnam)

- **Damage worth about US$ 1 billion**
- **Many lives (of the order of 2000) have been lost**

Call for the establishment of basin-wide Flood Management and Mitigation Programme (FMMP) in the MRC

Introduction

FMMP Objective

People's suffering and economic losses due to floods are prevented, minimized, or mitigated, while the environmental benefits of floods are preserved.

Introduction

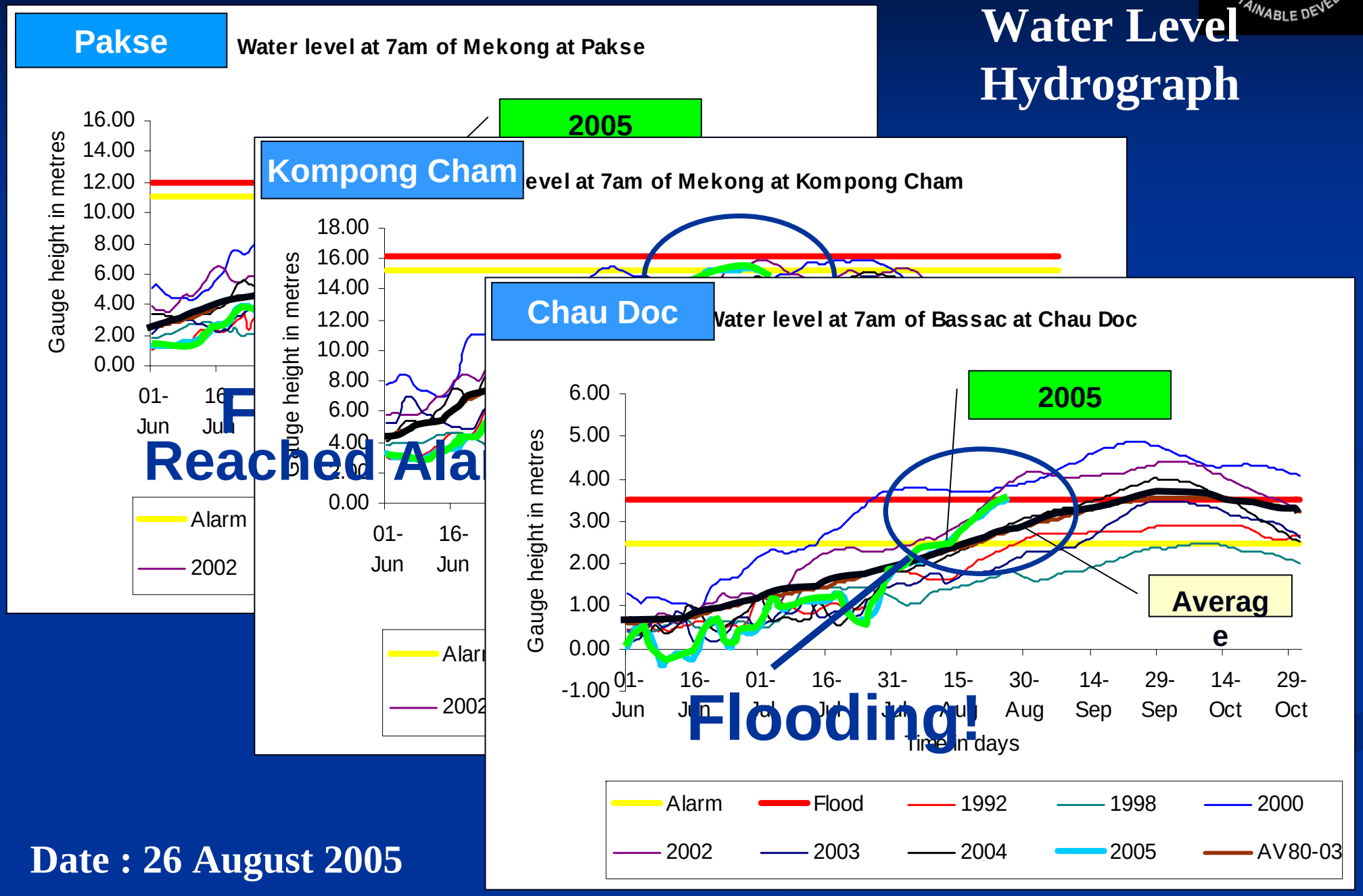
5 Components

FMMP

- **1. Regional FMM centre**
  - Capacity Building (Training Unit)
  - Data Collection & Processing
  - Forecasting, Warning & Dissemination
  - Annual Flood Forum, Workshops, Communications
- 2. Structural Measures & Flood Proofing
- 3. Trans-boundary mediation
- 4. Flood Emergency Mngmt
- 5. Land Use management

3 Forecast dissemination:

Water Level Hydrograph

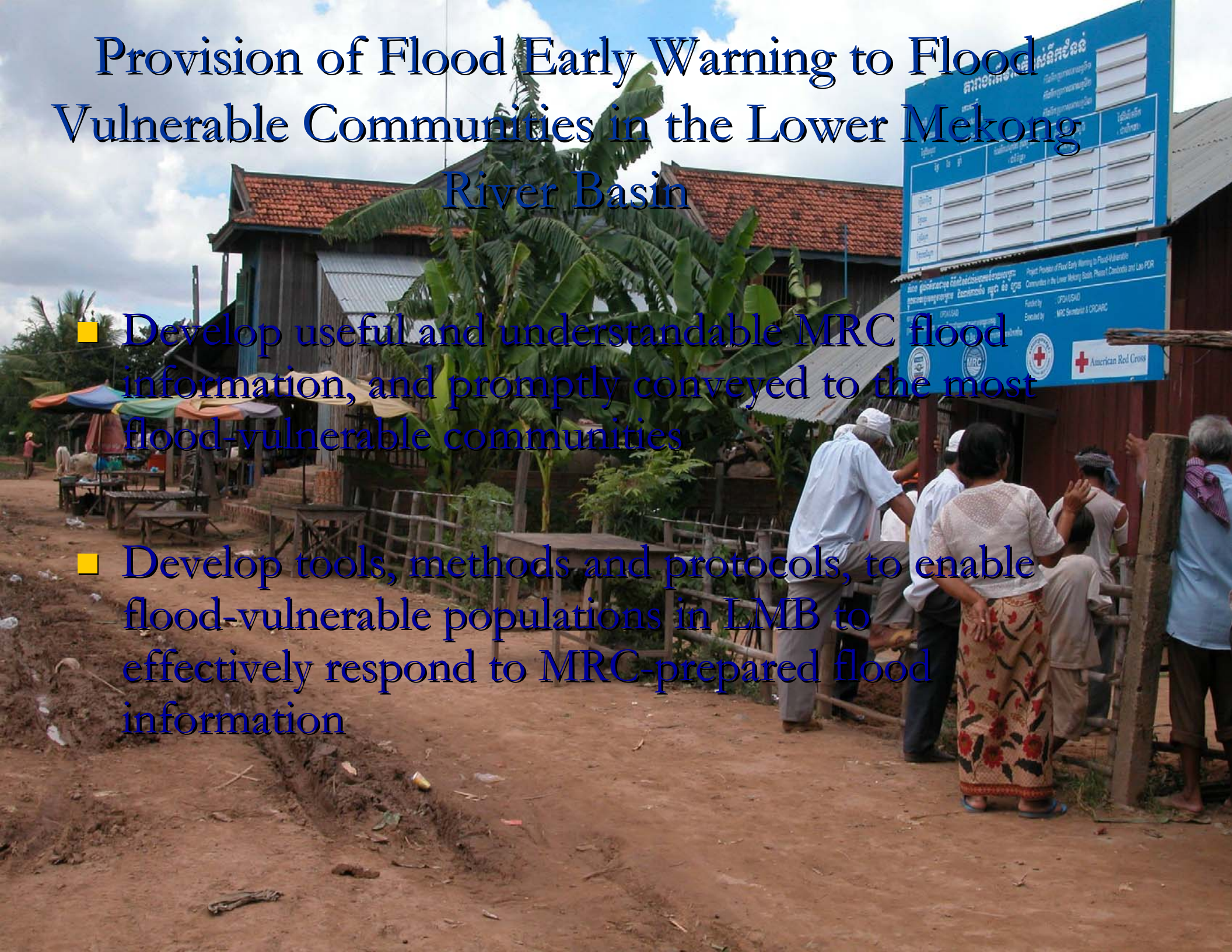


Reached Alar

Flooding!

Date : 26 August 2005

Provision of Flood Early Warning to Flood Vulnerable Communities in the Lower Mekong River Basin



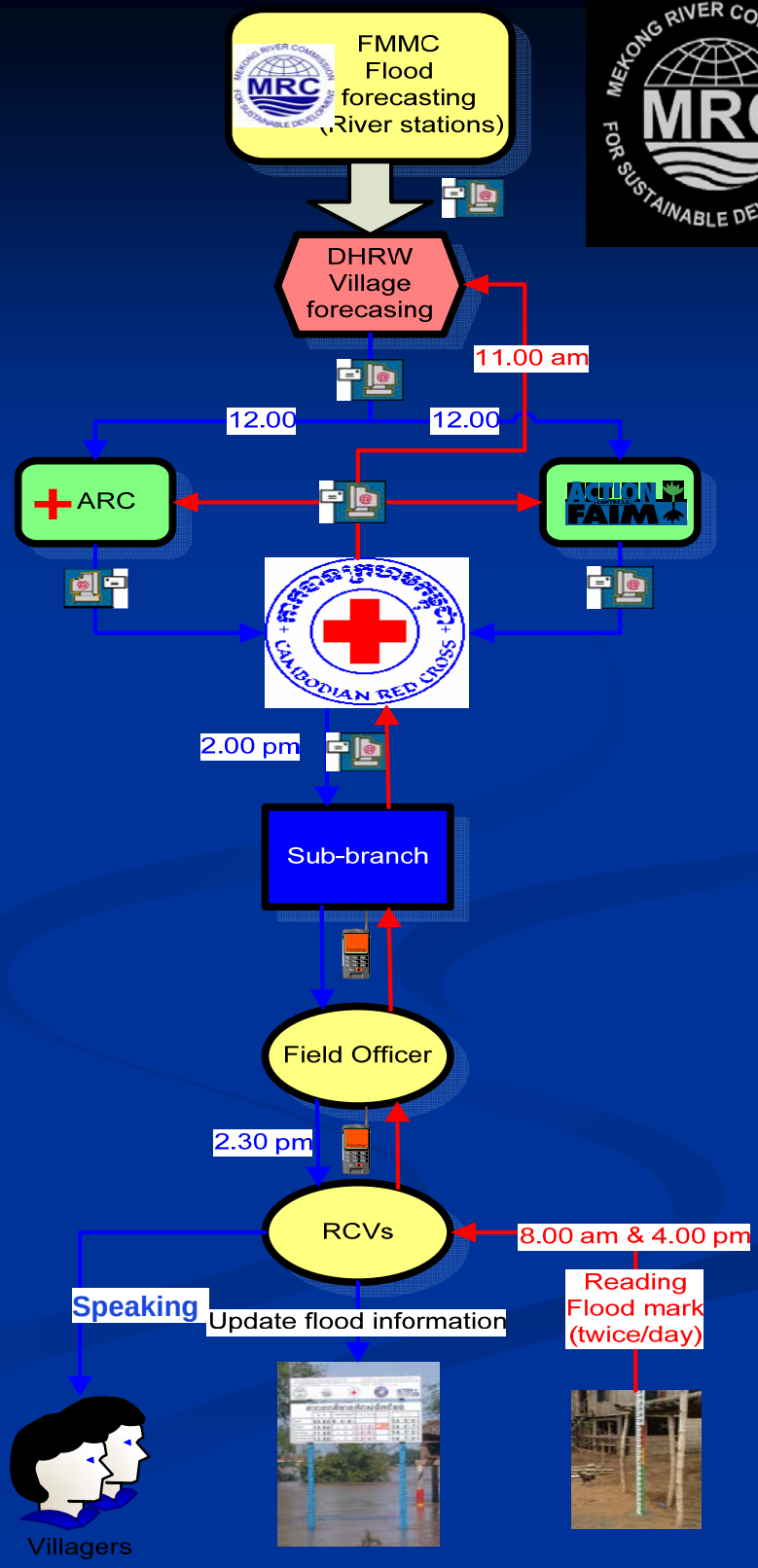
- Develop useful and understandable MRC flood information, and promptly conveyed to the most flood-vulnerable communities

- Develop tools, methods and protocols, to enable flood-vulnerable populations in LMB to effectively respond to MRC-prepared flood information

FLOOD EARLY WARNING SYSTEM
In the Lower Mekong Basin

Information flow

DURING FLOOD SEASON

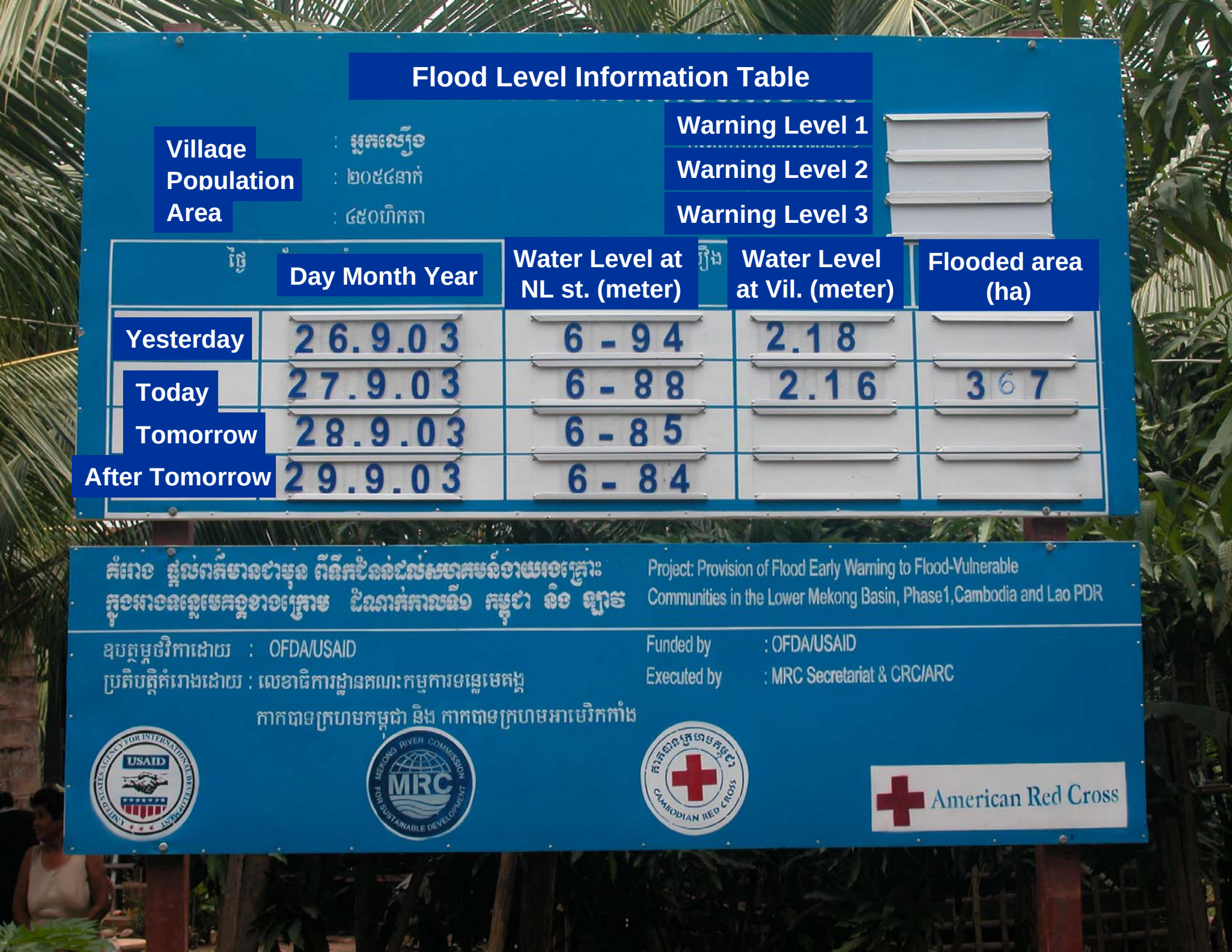


FLOOD EARLY WARNING SYSTEM
In the Lower Mekong Basin

MEKONG RIVER COMMISSION FOR SUSTAINABLE DEVELOPMENT
MRC

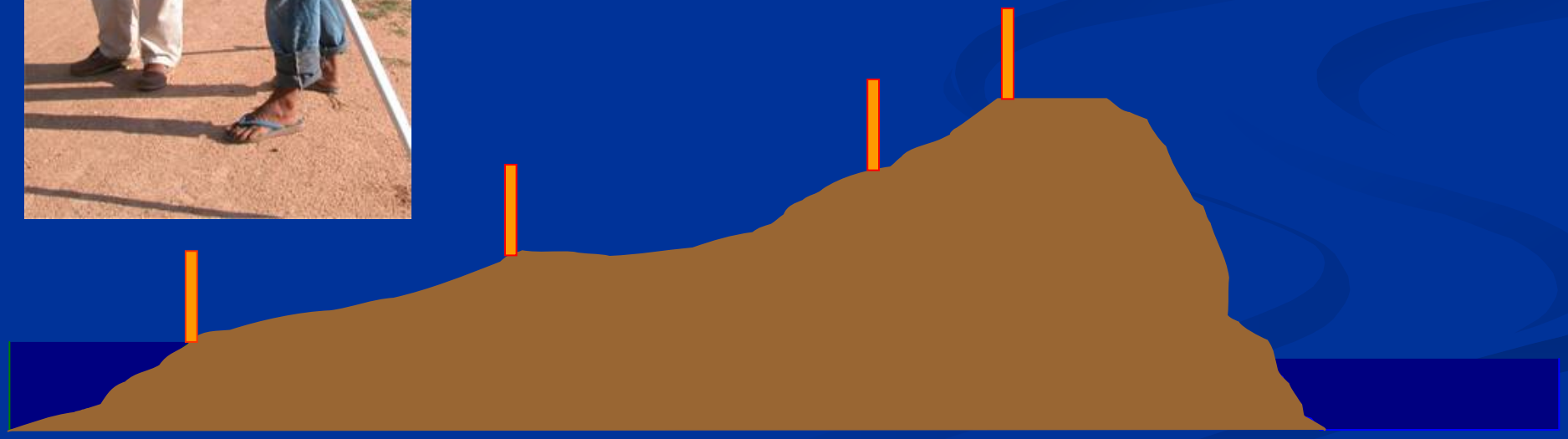
Flood billboard at commune level

Flood Alarm States


Flood Level Information Table
Village : អូរតេឡើង
Population : ២០៥៨នាក់
Area : ៤៥០ហិកតា
Warning Level 1
Warning Level 2
Warning Level 3
Day Month Year
Water Level at NL st. (meter)
Water Level at Vil. (meter)
Flooded area (ha)
Yesterday 26.9.03 6 - 94 2.18
Today 27.9.03 6 - 88 2.16 367
Tomorrow 28.9.03 6 - 85
After Tomorrow 29.9.03 6 - 84
Project: Provision of Flood Early Warning to Flood-Vulnerable Communities in the Lower Mekong Basin, Phase1,Cambodia and Lao PDR
Funded by : OFDA/USAID
Executed by : MRC Secretariat & CRC/ARC
USAID
MRC
American Red Cross

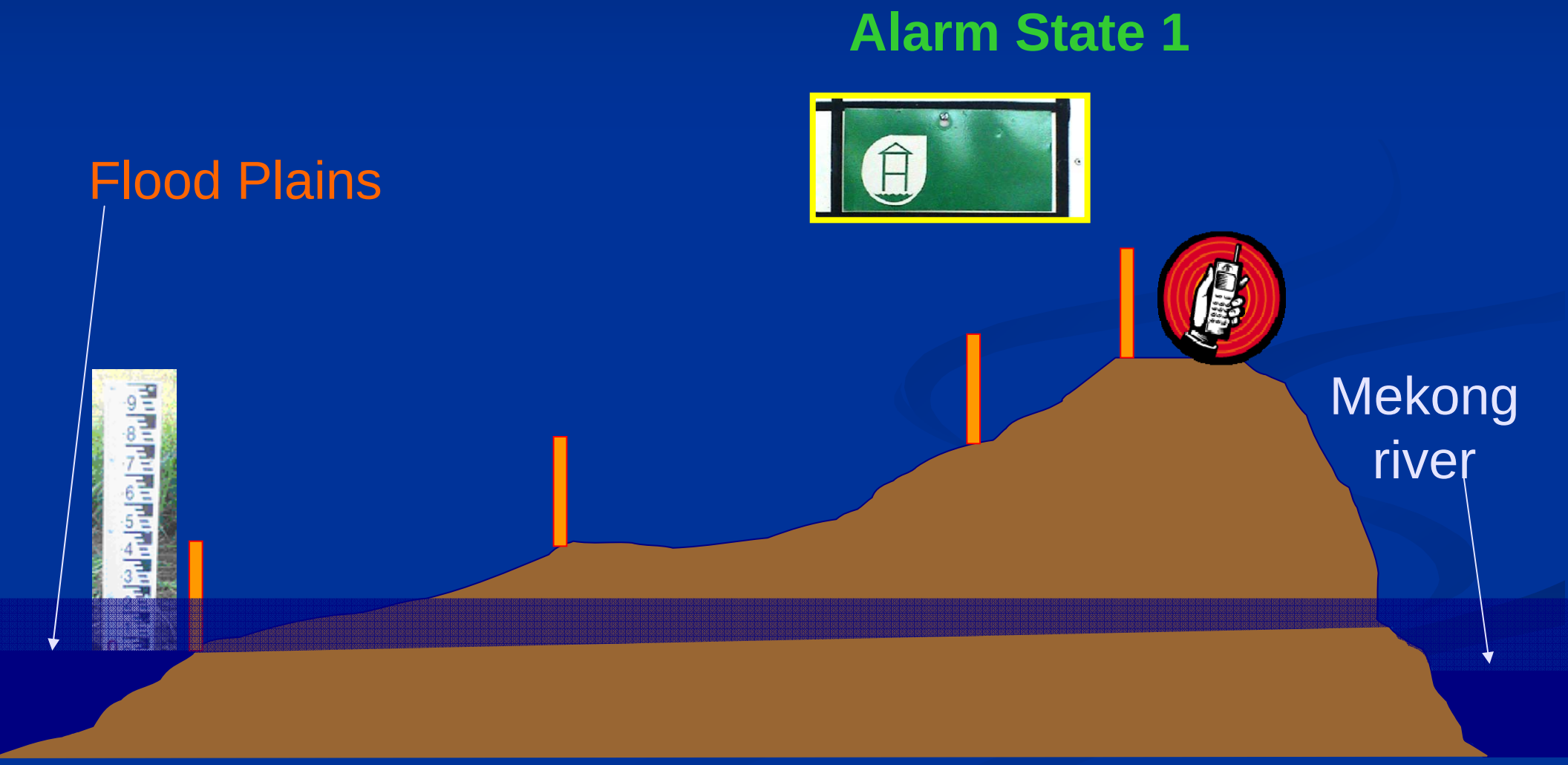
FLOOD EARLY WARNING SYSTEM
In the Lower Mekong Basin

Flood Mark Installation



FLOOD EARLY WARNING SYSTEM
In the Lower Mekong Basin

MEKONG RIVER COMMISSION FOR SUSTAINABLE DEVELOPMENT
MRC

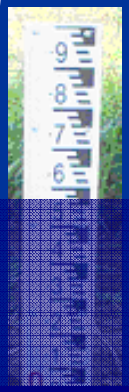


Village Profile

FLOOD EARLY WARNING SYSTEM
In the Lower Mekong Basin

Alarm State 2

Flood Plains



Mekong river

Manithaphone

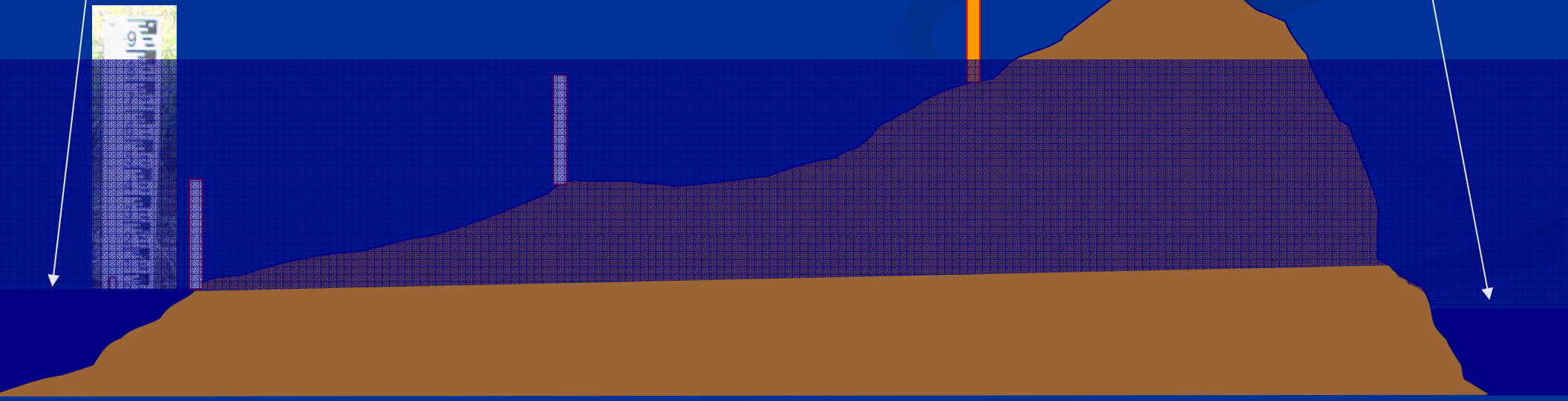
Village Profile

FLOOD EARLY WARNING SYSTEM
In the Lower Mekong Basin

Alarm State 3

Mekong river

Flood Plains



Village Profile