



Overview of Recent Mekong River Basin Floods

Third Annual Flood Forum
Vientiane, Lao PDR
7-8 April 2005

Main Objectives

1. To provide a preliminary overview on the recent floods based on limited data and information received so far
2. To initiate the invitation for increasing timely data and information sharing among the countries in the region for a better understanding of floods occurrence and their impacts in the region

Today's Topics

1. Data Used and Analytical tools

2. Wet season and flood analysis

3. Rainfall conditions

4. Conclusion and Recommendations

4 - 10 - 2003

1. Data Used and Analytical Tool



Data Used

- Archiving and operational data
- Daily data up to **Mar 05**
- Rainfall from **16 sta.**
- Flows and water level from **8 sta.**

Analytical Tool

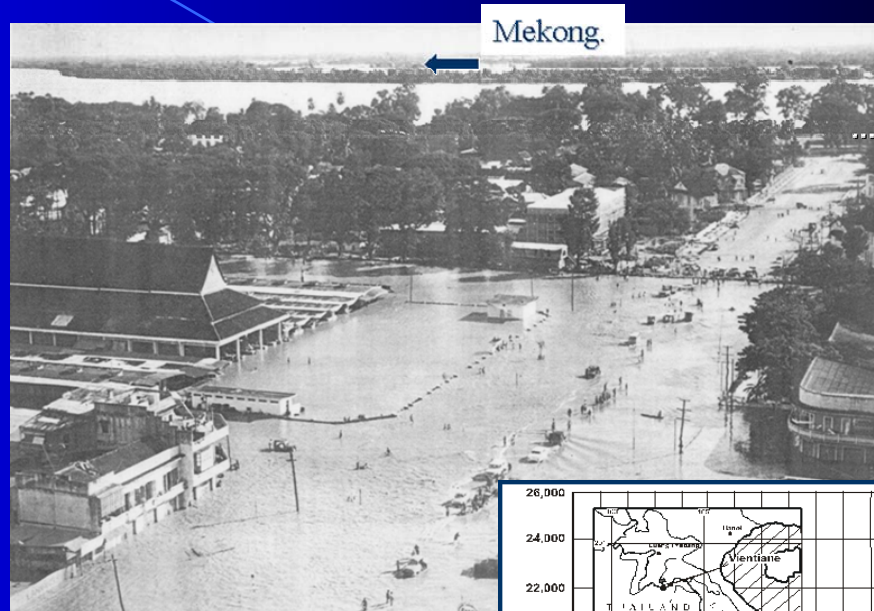
- Decision Support Framework (**DSF**)



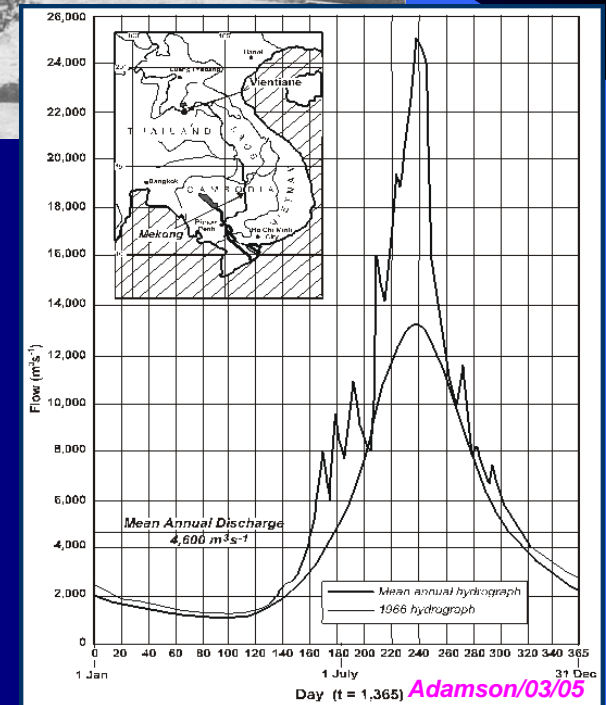
2. Wet season and flood analysis



- o Hydrographs
- o Wet season duration
- o End date and start date
- o Annual flood peak
- o Flood frequency analysis
- o Flow volume



Vientiane City Centre. September. 1966.
Central Business Area under water for 5 weeks.
Floodpeak = 26 000 cumecs. (approximately a 1 in 100 year event.)



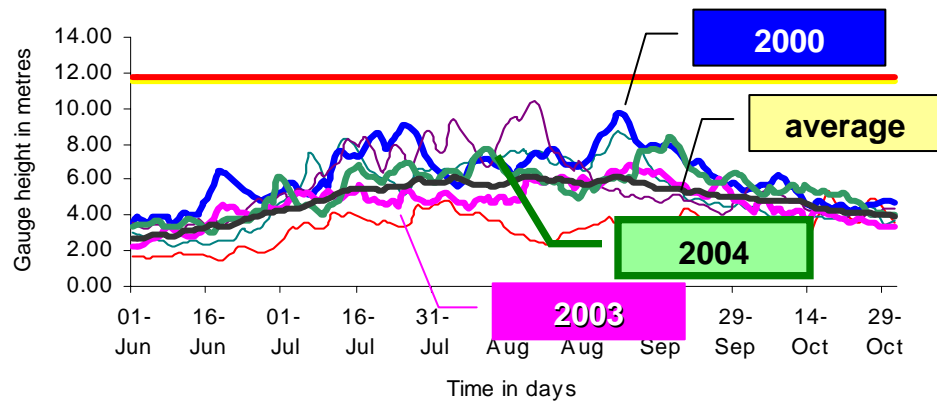
Hydrograph



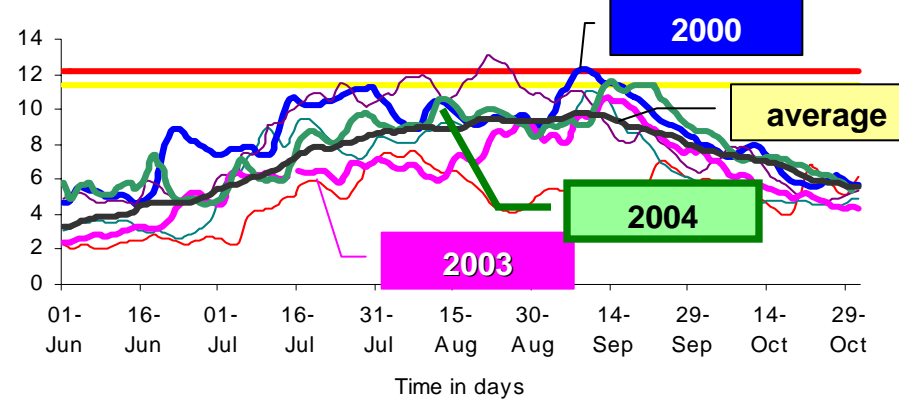
Chiang Saen-Pakse

June-October

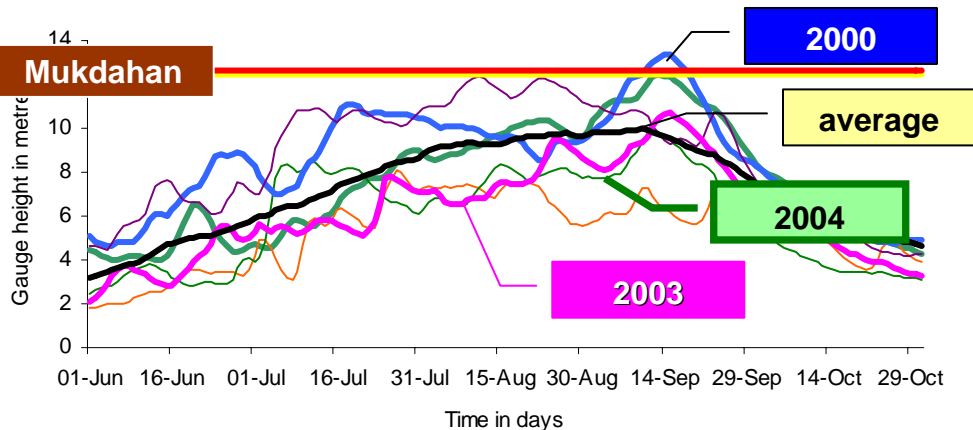
Chiang Saen Water level of Mekong at Chiang Saen



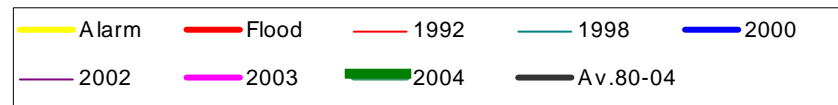
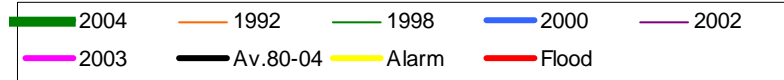
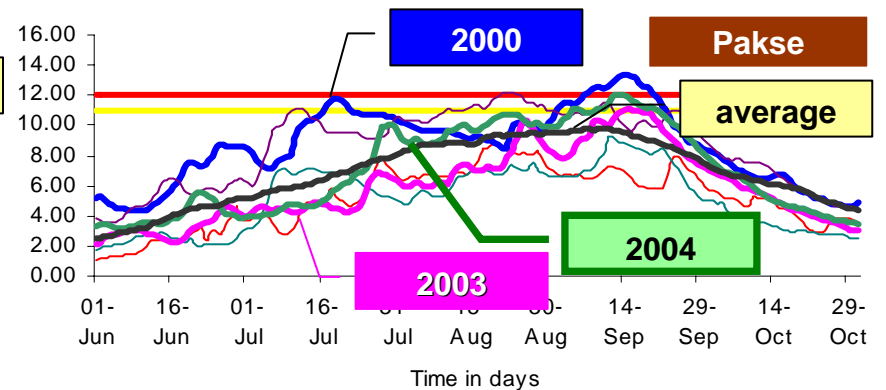
Water level of Mekong at Nong Khai **Nongkhai**



Water level of Mekong at Mukdahan



Water level of Mekong at Pakse

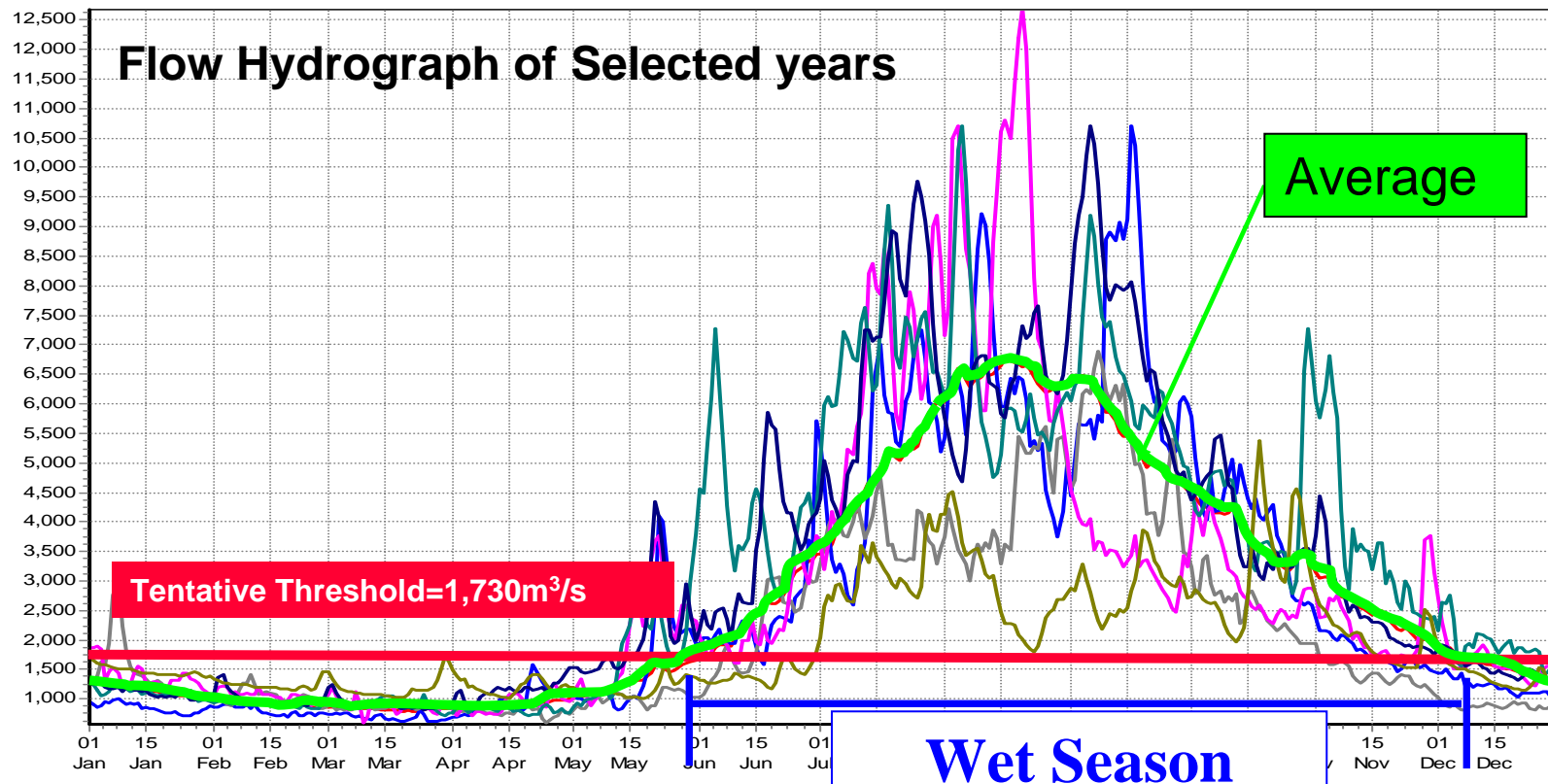


Wet Season Duration



Flood Event Analysis Tool used to define tentative threshold value and wet season

- Average_AllID_Var1
- 2004_Var1
- 2003_Var1
- 2002_Var1
- 2001_Var1
- 2000_Var1
- 1966_Var1
- 1992_Var1



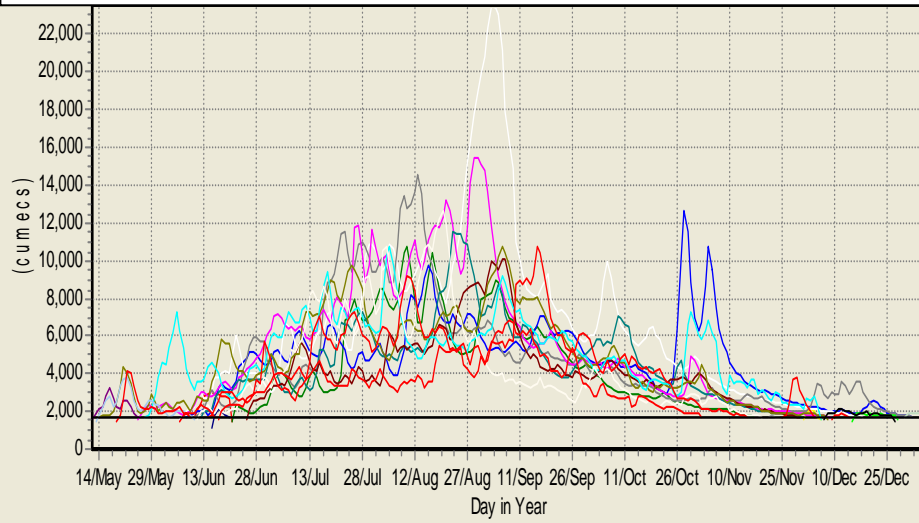
Threshold value= e.g. 50% of flow values over a period of 01/01/1960-28/03/2005

Wet Season Duration



Chiang Saen

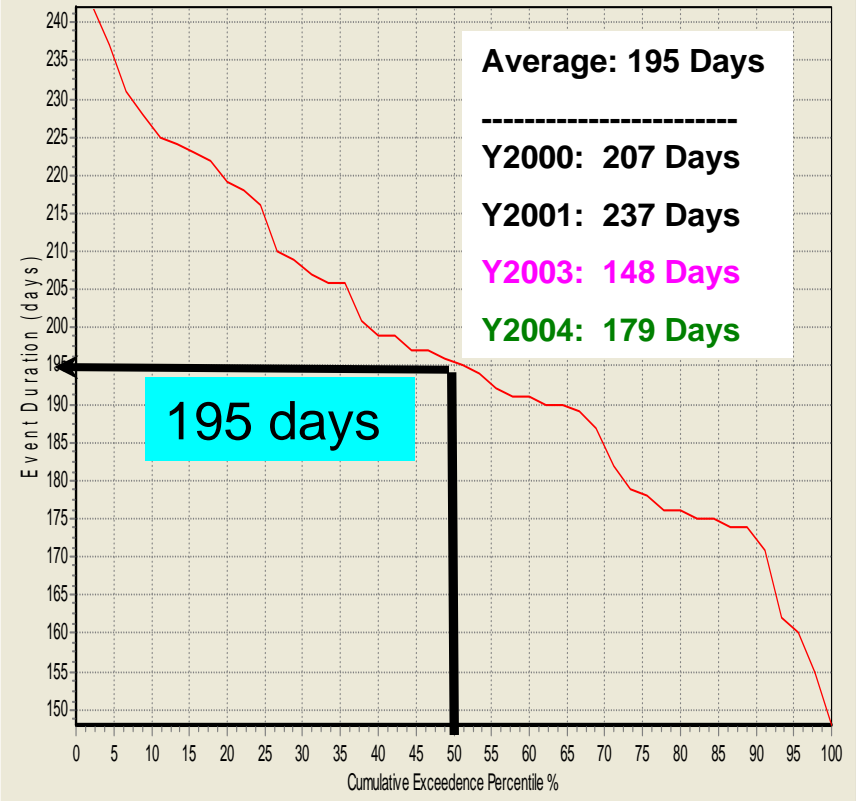
Flow event over threshold



- | | | |
|---------------------------------|---------------------------------|---------------------------------|
| ✓ — Chiangsen_obs (11/Jun/1960) | ✓ — Chiangsen_obs (22/Jun/1960) | ✓ — Chiangsen_obs (02/Dec/1960) |
| ✓ — Chiangsen_obs (09/Jun/1965) | ✓ — Chiangsen_obs (07/Jun/1966) | ✓ — Chiangsen_obs (11/Jun/1970) |
| ✓ — Chiangsen_obs (26/May/1971) | ✓ — Chiangsen_obs (13/Jun/1980) | ✓ — Chiangsen_obs (16/Jun/1993) |
| ✓ — Chiangsen_obs (26/Jun/1993) | ✓ — Chiangsen_obs (16/Dec/1993) | ✓ — Chiangsen_obs (15/May/2000) |
| ✓ — Chiangsen_obs (13/May/2001) | ✓ — Chiangsen_obs (28/May/2001) | ✓ — Chiangsen_obs (08/Dec/2001) |
| ✓ — Chiangsen_obs (31/Dec/2001) | ✓ — Chiangsen_obs (14/May/2002) | ✓ — Chiangsen_obs (12/Jun/2002) |
| ✓ — Chiangsen_obs (22/Nov/2002) | ✓ — Chiangsen_obs (26/Nov/2002) | ✓ — Chiangsen_obs (10/Dec/2002) |
| ✓ — Chiangsen_obs (06/Jan/2003) | ✓ — Chiangsen_obs (07/Jun/2003) | ✓ — Chiangsen_obs (15/Jun/2003) |
| ✓ — Chiangsen_obs (20/May/2004) | ✓ — Chiangsen_obs (18/Jun/2004) | |

[Th=1730cumecs, MinEvLen=1, MinIntLen=0]

Wet Season Duration Analysis



✓ — Chiangsen_obs.[Th=1730cumecs, MnEvLen=30, MinIntLen=30].Period: (60-04)

Start Date and End Date

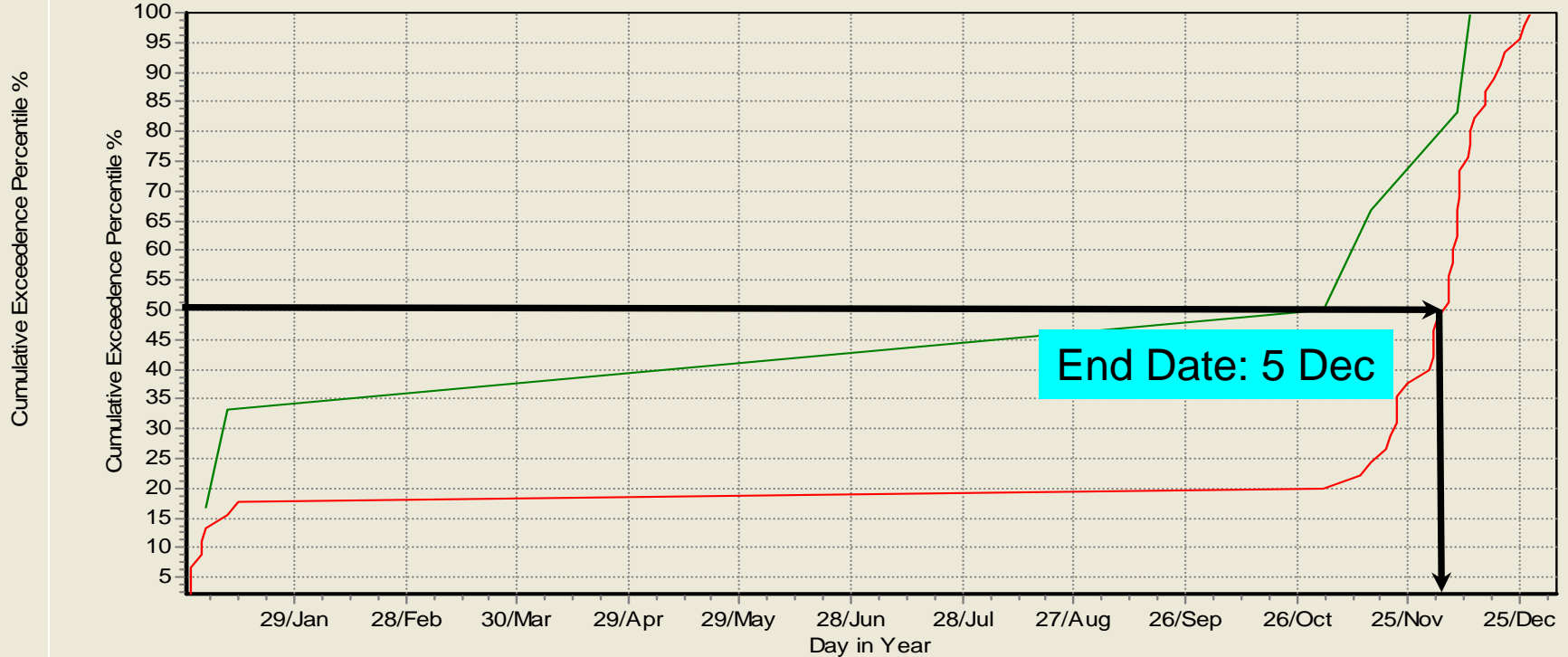


Chiang Saen

· Event Start Date Analysis

: Event End Date Analysis

Chiangsen_obs: [Th=1730cumecs, MinEvLen=30, MinIntLen=30], Period: Freq. Distribution:
Chiangsen_obs: [Th=1730cumecs, MinEvLen=30, MinIntLen=30], Period: Freq. Distribution:



- Chiangsen_obs:[Th=1730cumecs, MinEvLen=30, MinIntLen=30],Period: (60-04)
- Chiangsen_obs:[Th=1730cumecs, MinEvLen=30, MinIntLen=30],Period: (99-04)

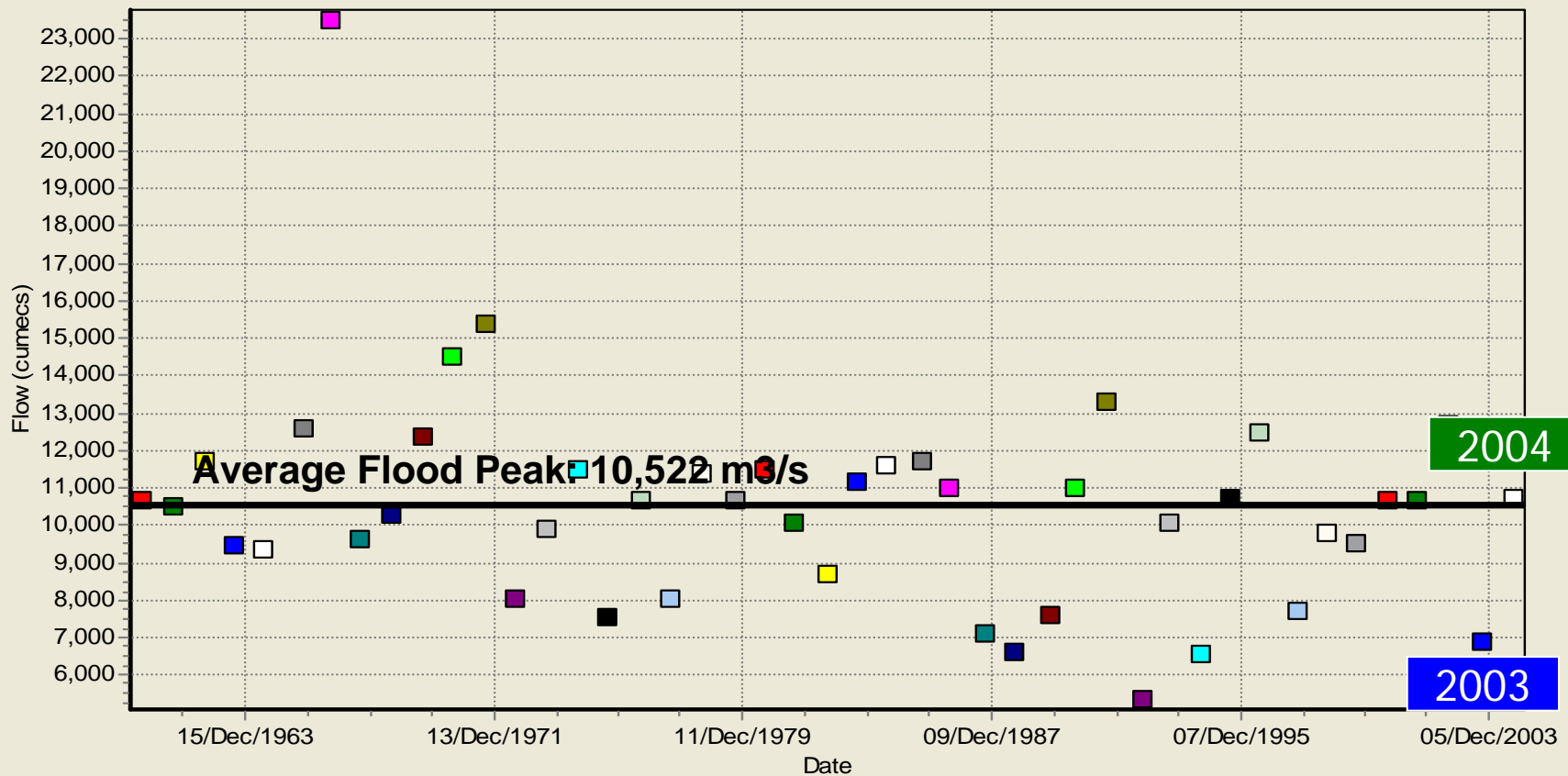
Annual Flood Peak



Chiang Saen

: Peak Value Data

Chiangsen_obs: [Th=1730cumecs, MinEvLen=30, MinIntLen=30], Period: Freq. Distribution:



Chiangsen_obs:[Th=1730cumecs, MinEvLen=30, MinIntLen=30], Period: (60-04)

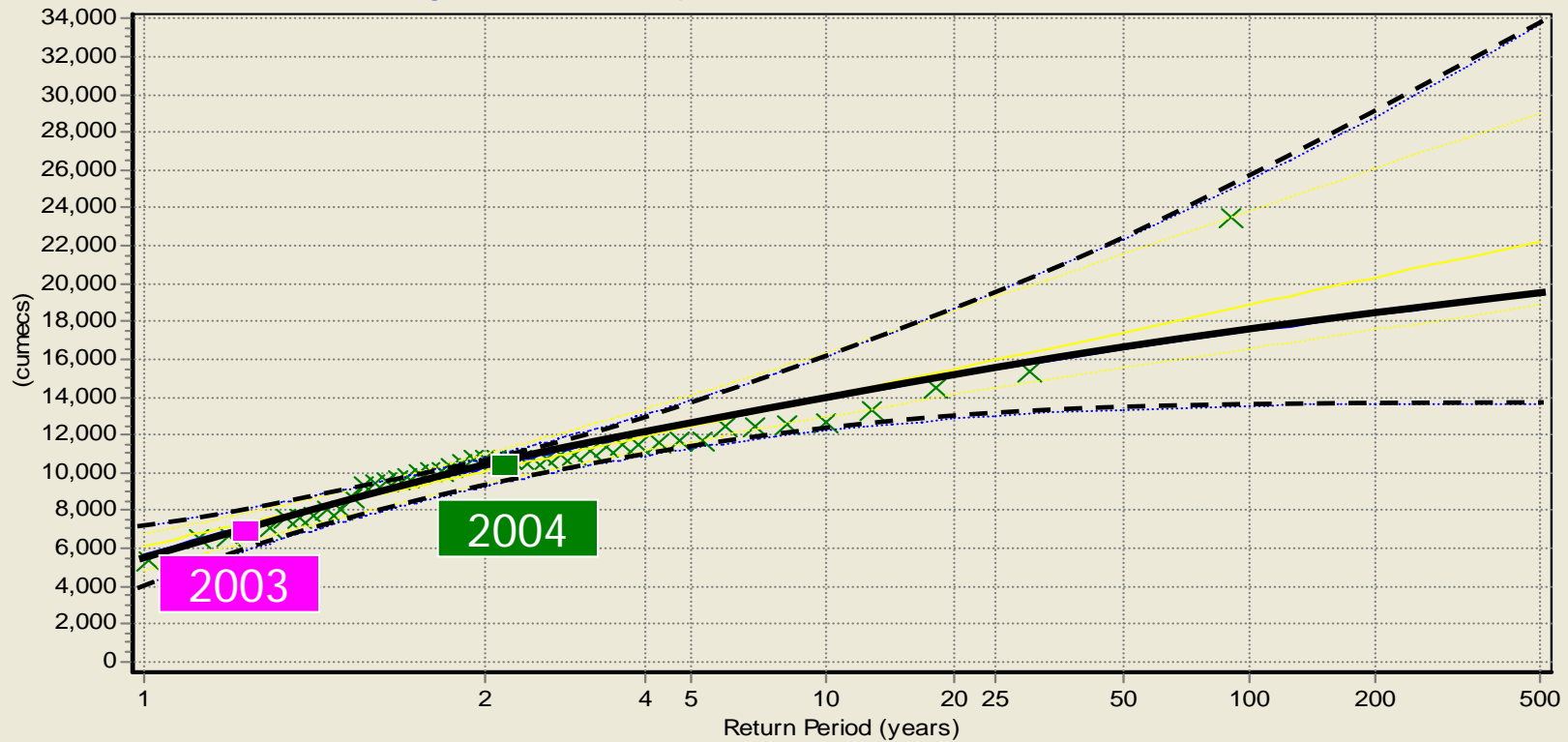
Flood Frequency Analysis



Chiang Saen

Annual Flood Frequency Analysis

Chiangsen_obs - Freq. Distribution: Gumbel (EV1) & GEV



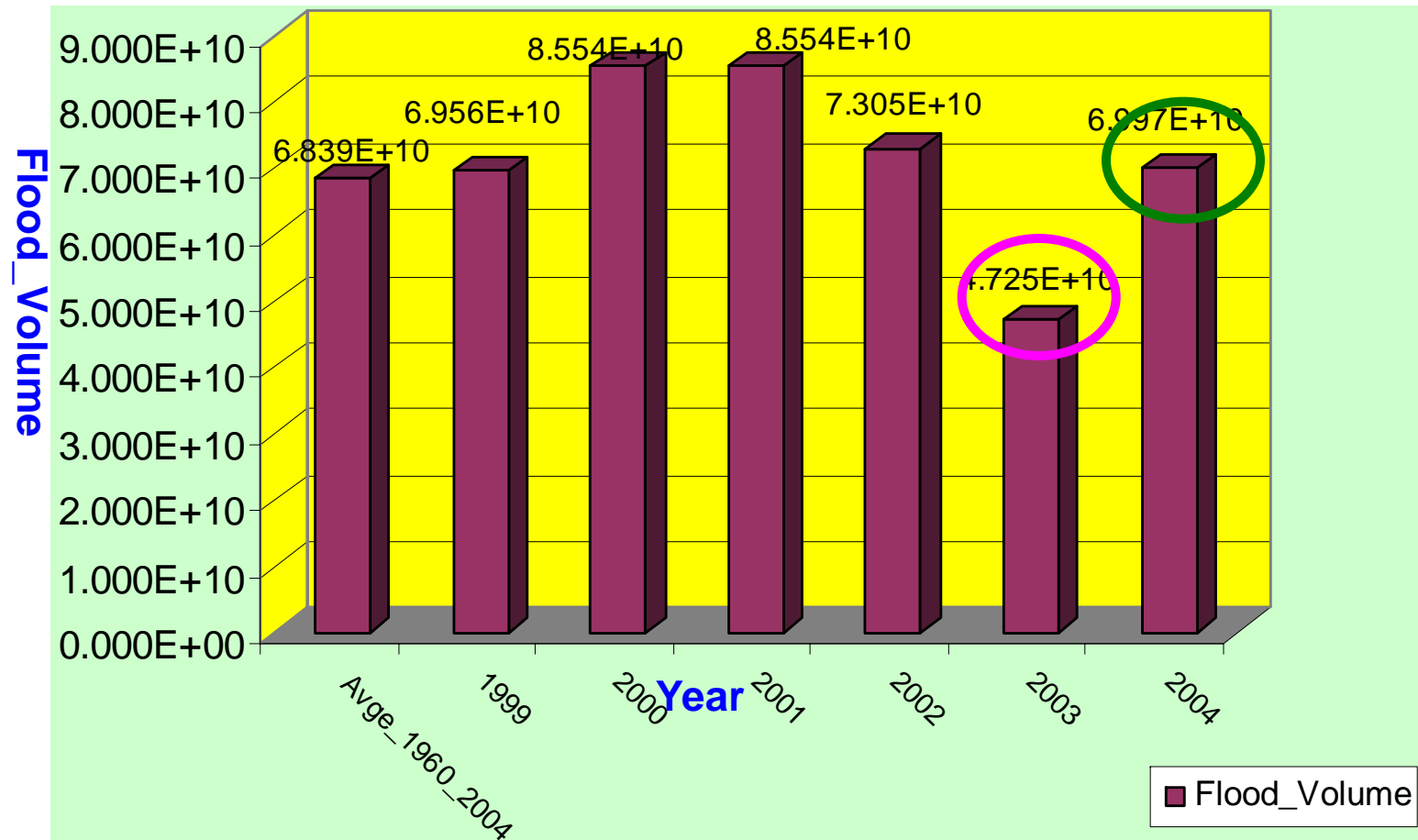
- X Chiangsen_obs - Hazen (1960-2004)
- EV1 Chiangsen_obs - Hazen
- GEV Chiangsen_obs - Hazen

Flow Volume



Chiang Saen

Comparison Wet Season flow Volume at Chaingsen



Summary



Station	Indicators	Avg.	1978	2000	2001	2002	2003	2004
Chiang Saen	Duration (Days)	196	189	207	237	242	148	179
	Start Date	30-May	15-May	15-May	13-May	14-May	07-Jun	20-May
	End Date	05-Dec	20-Nov	08-Dec	05-Jan-02	11-Jan-03	02-Nov	15-Nov
	Peak (cms)	10,522	11,400	10,700	10,700	12,700	6,880	10,715
	Tr (yr)		3	2	2	4	<2	2
	Volume(m3)	6.84E+10	8.58E+10	8.55E+10	8.54E+10	7.31E+10	4.73E+10	7.00E+10
Pakse	Duration (Days)	187	188	202	203	207	161	170
	Start Date	04-Jun	28-May	14-May	26-May	23-May	03-Jun	29-May
	End Date	05-Dec	02-Dec	02-Dec	15-Dec	16-Dec	11-Nov	15-Nov
	Peak (cms)	36,807	56,000	45,148	42,318	39,343	34,159	38,556
	Volume(m3)	3.20E+11	4.02E+11	4.01E+11	3.88E+11	3.97E+11	2.59E+11	3.09E+11

Kratie	Duration(Days)	183		216	206	213	174	162
	Max. WL (m)	21.45		23.08	23.37	22.97	20.98	21.19
Phnom Penh	Duration(Days)							
	Max. WL (m)	8.6		11.21	10.77	10.09		

Seasonal Flood Hydrograph Volume

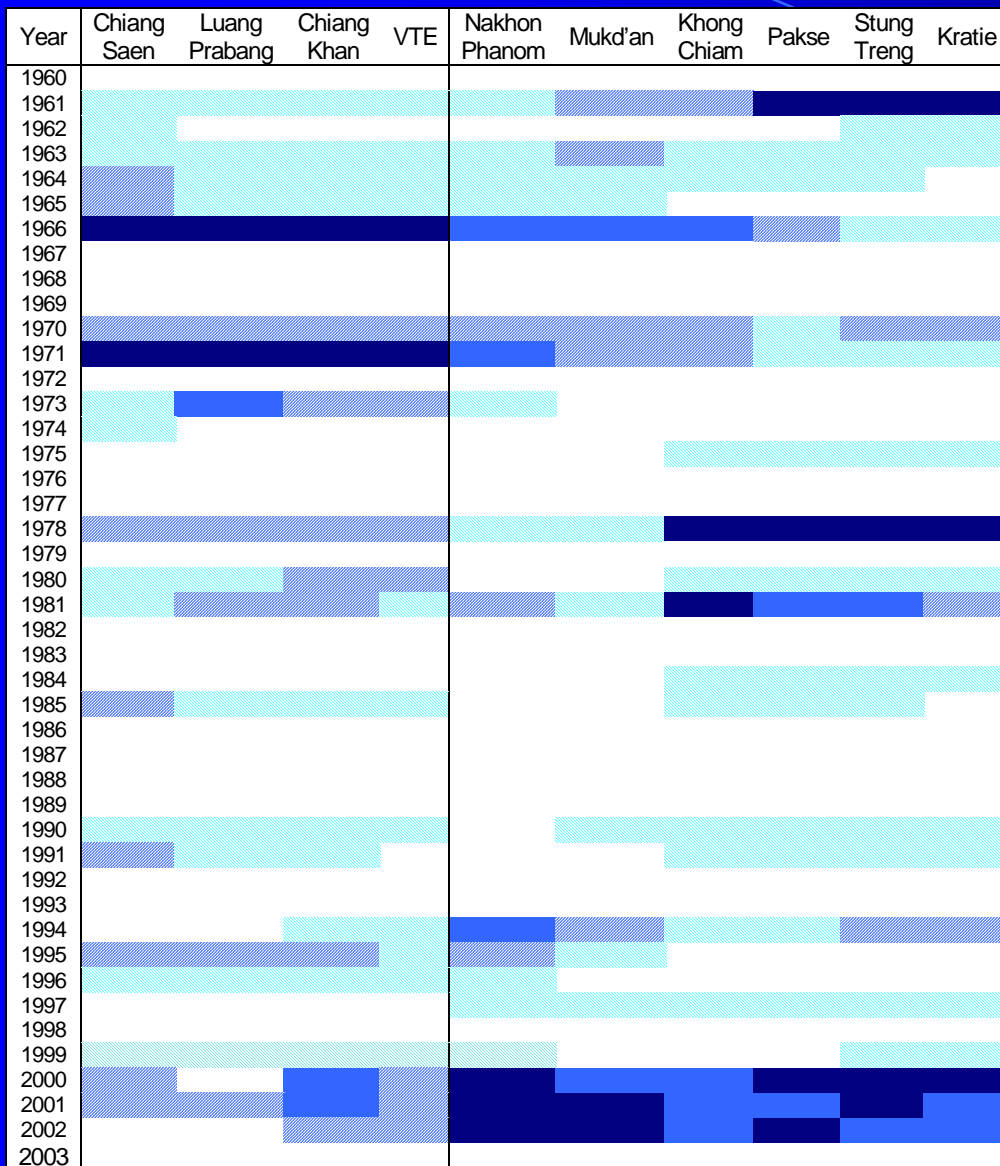


Figure 5.1 The flood history of the Lower Mekong Basin 1960 to 2003. The analysis is based on a statistical analysis of the annual volumes of flow during the six flood months (June to November).

Seasonal flood hydrograph volume (SFHV)

- SFHV below "normal", less than the 1:2 yr ARI
- SFHV > 2 and < 5 yr ARI
- SFHV > 5 and < 10 yr ARI
- SFHV > 10 and < 20 yr ARI
- SFHV > 20 yr ARI

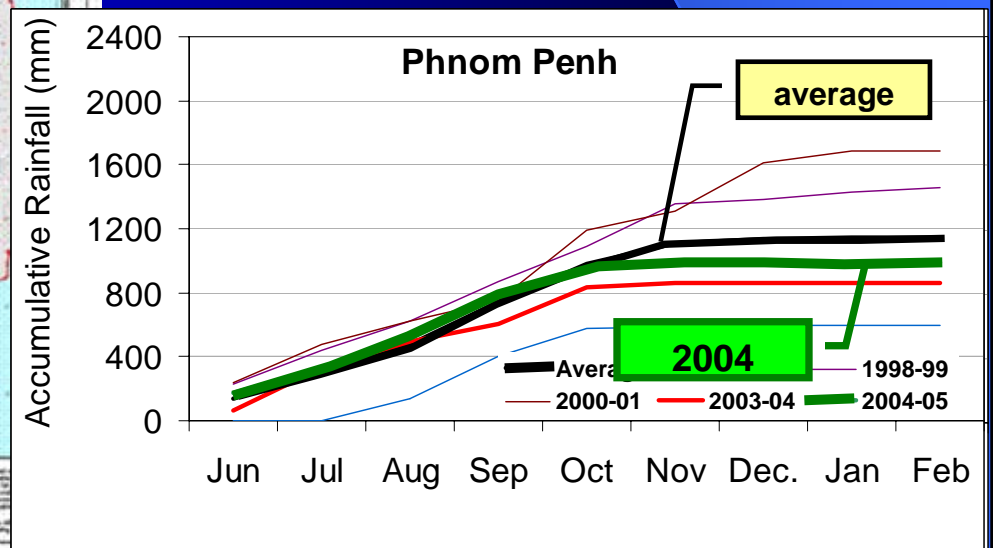
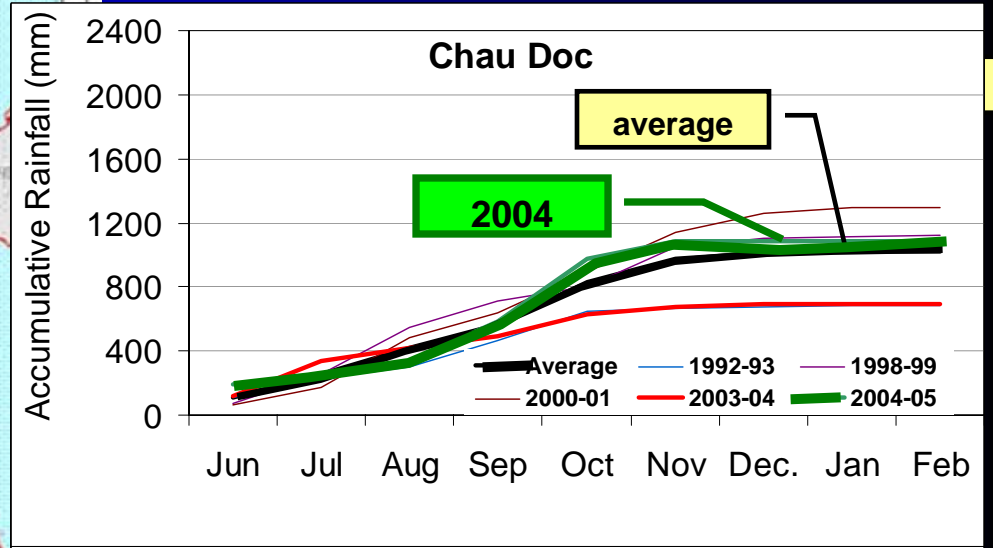
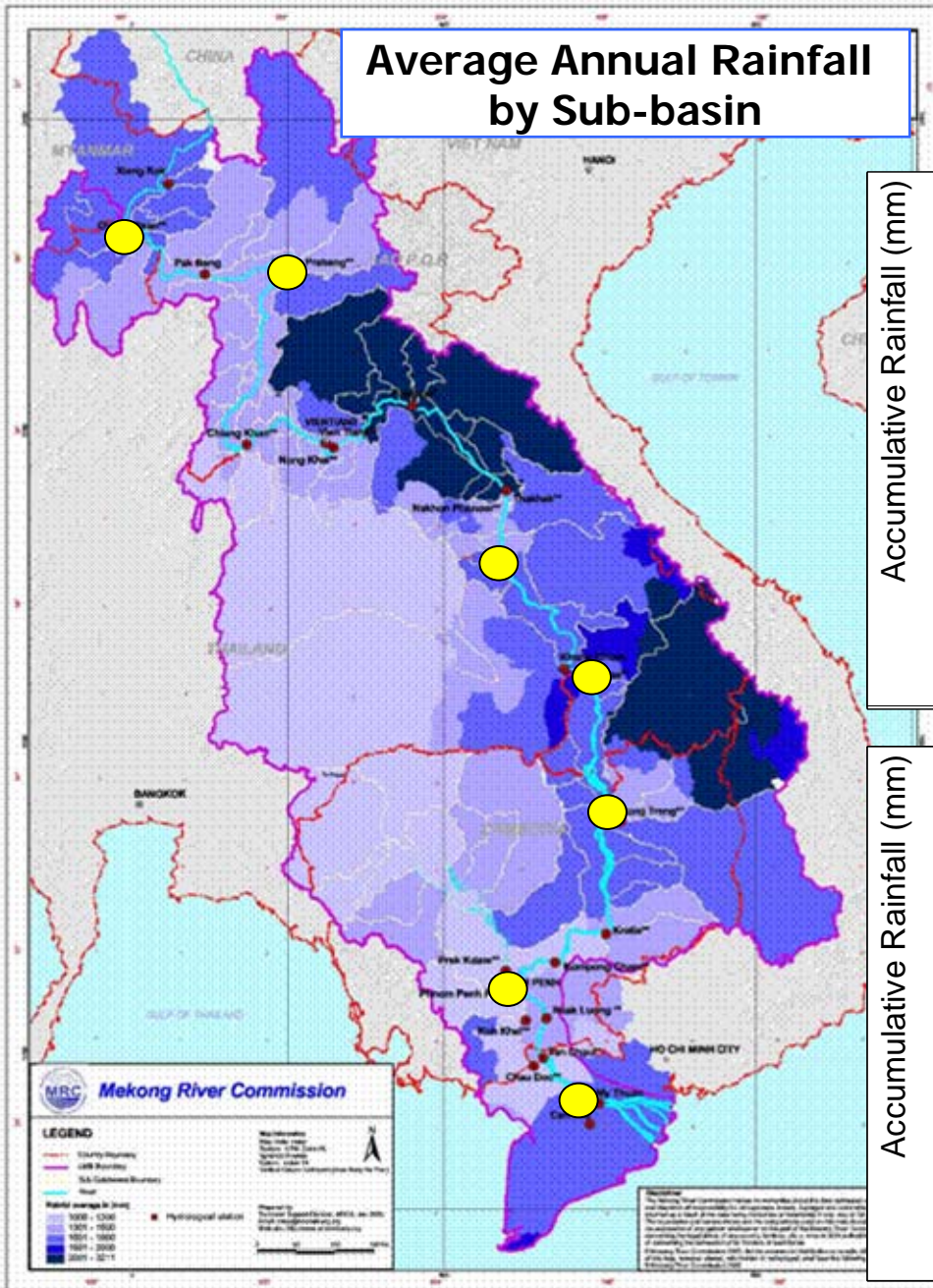
Overview Mekong Hydrology, November 2004, p.35

3. Rainfall conditions

Rainfall Conditions

Jun-Feb

Average Annual Rainfall by Sub-basin



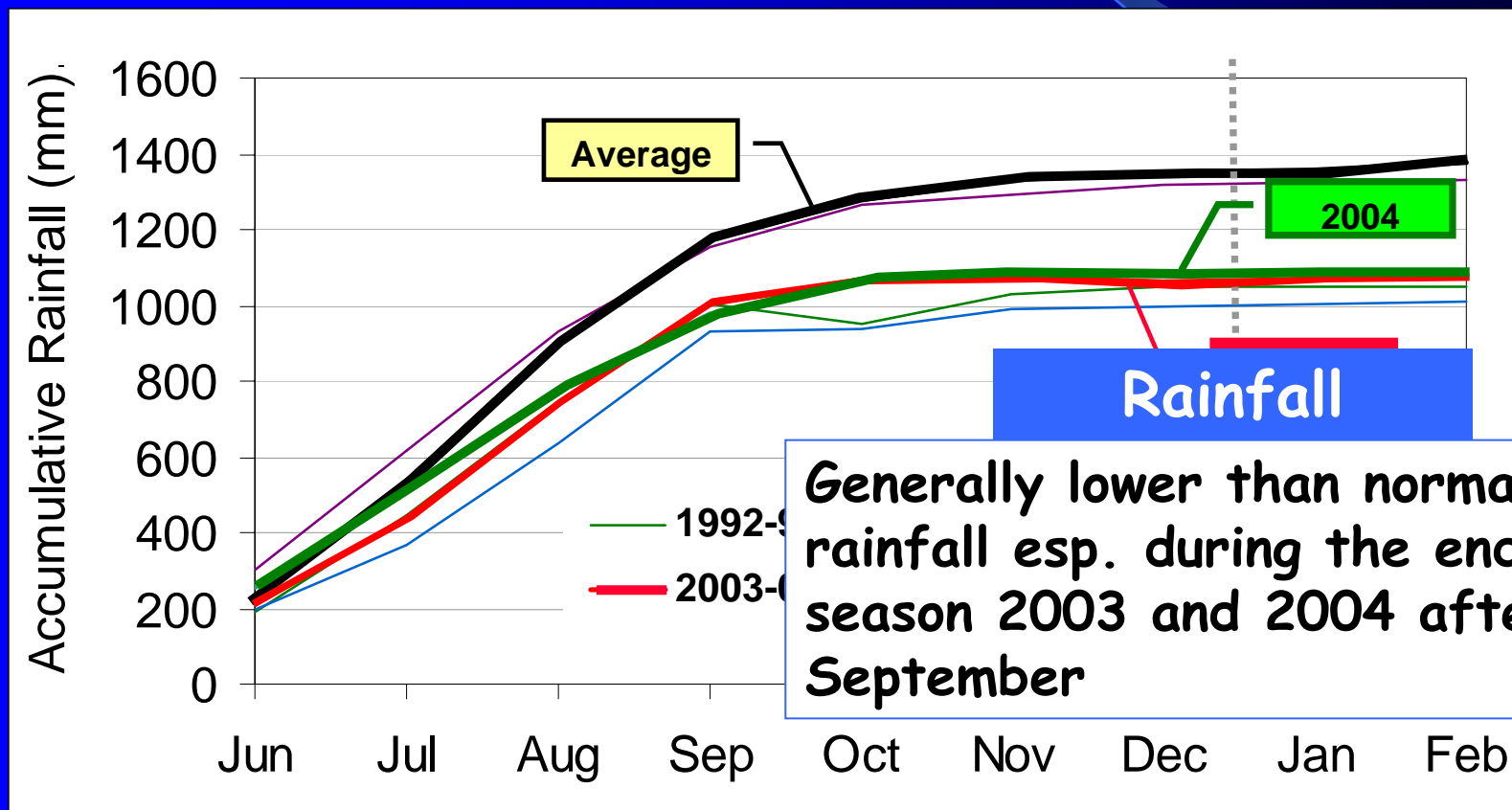
Rainfall Conditions (con't)



Jun-Feb

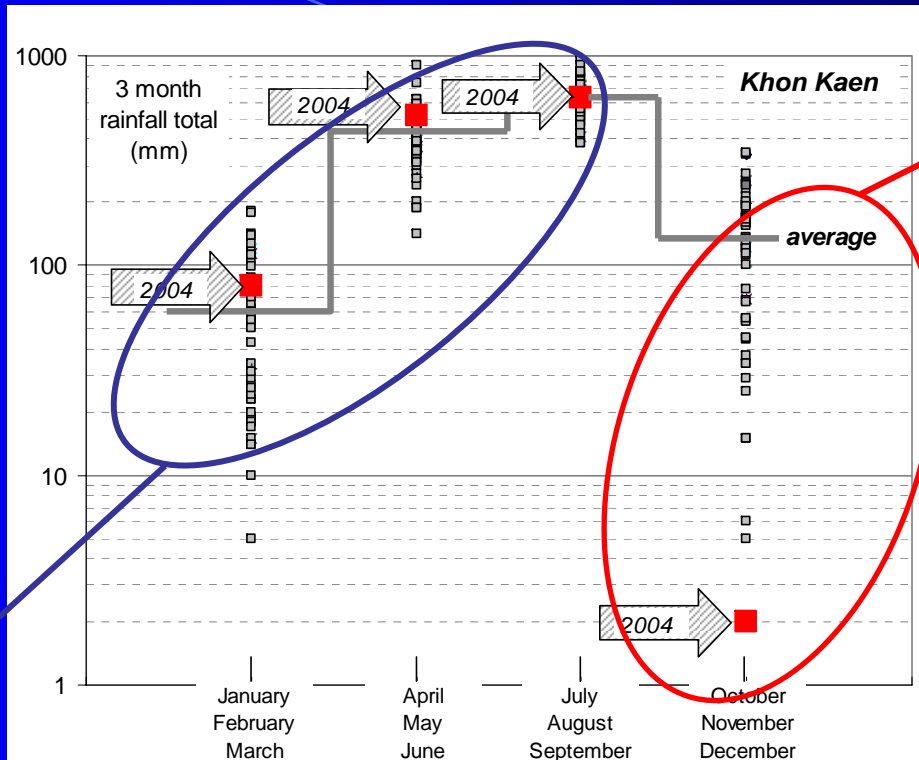
Over the Basin

- Rainfall average from 16 sites across the lower Mekong Basin



- 2004-05 rainfall (averaged from 9 stations)

KHON KAEN : Historical context of rainfall in 2004



Regionally during 2004, rainfall during the first 9 months of the year was generally above average

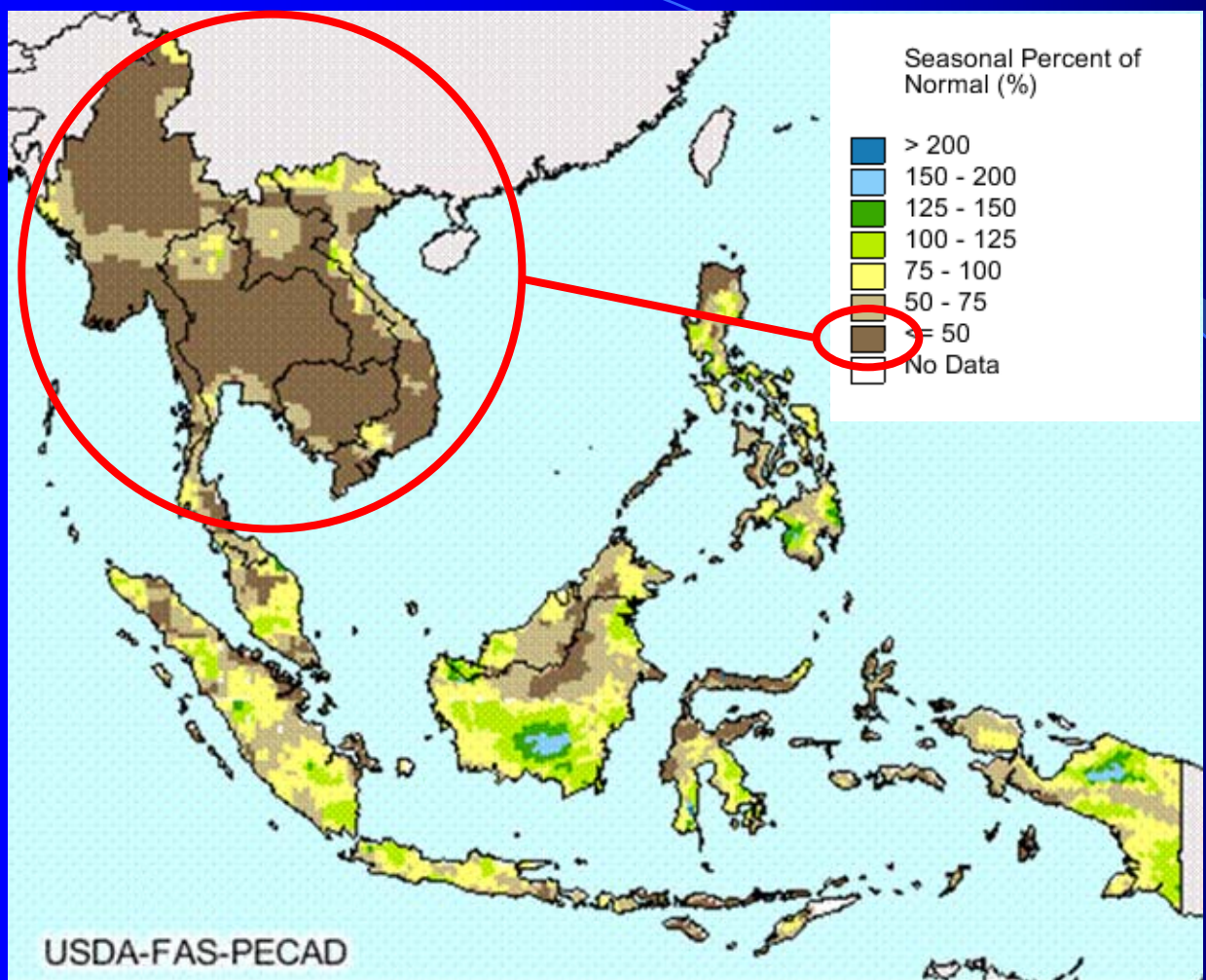
However, during the 4th quarter of the year there was little or no rainfall, indicating an uncharacteristically early end to the 2004 wet season.

Taking the year as a whole, however, total rainfall during 2004 was average.



Rainfall (mm)	1 st quarter Jan - Mar	2 nd quarter Apr – Jun	3 rd quarter Jul – Sep	4 th quarter Oct – Dec	Year
Average 1950 -2004	60	410	620	130	1220 mm
2004	80	520	625	2	1227 mm
% average	133%	127%	100%	<2%	100 %

Seasonal percentage of normal rainfall: Oct 2004-Mar 2005



Seasonal % of normal rainfall

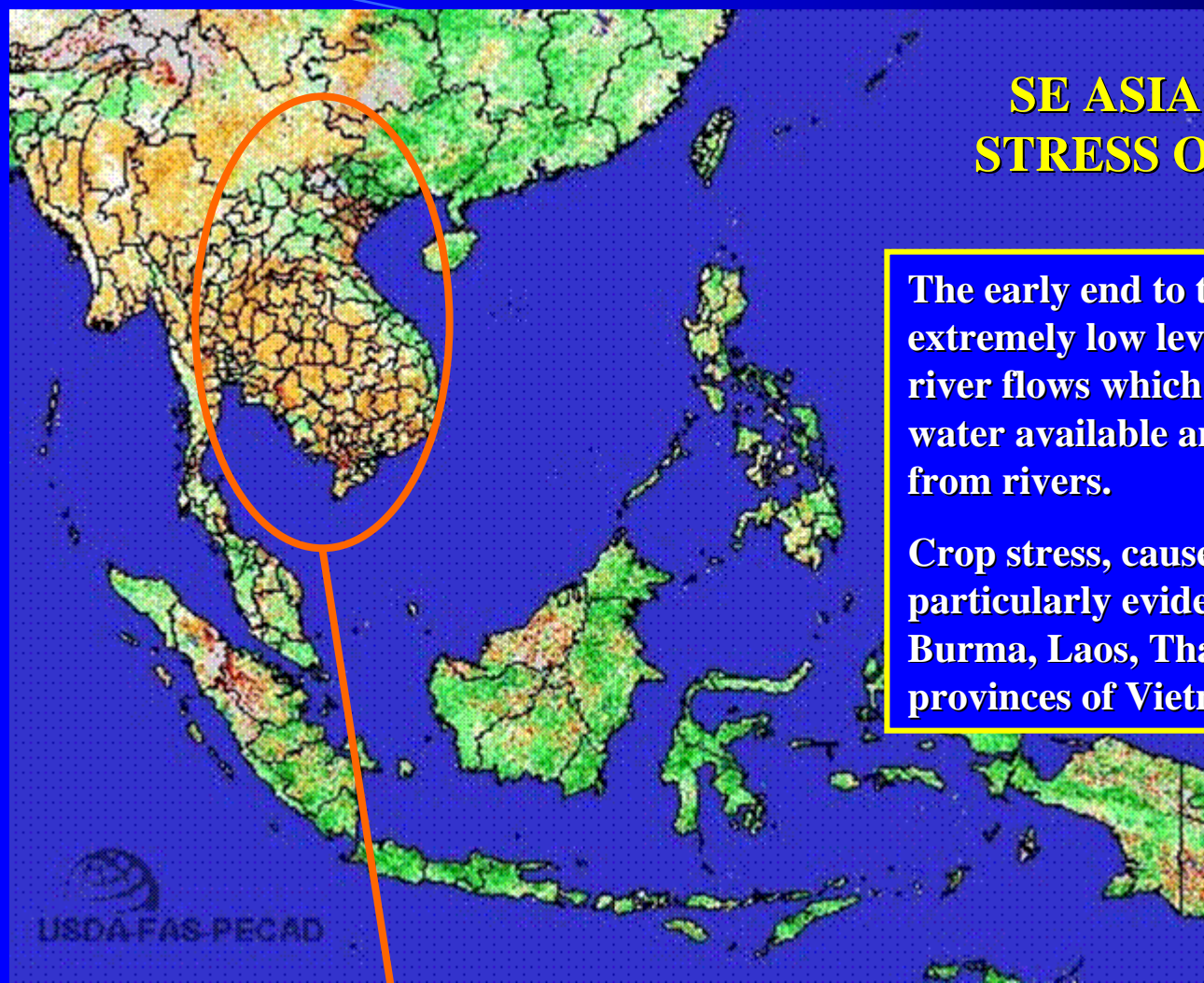
October 1st 2004 to March 30th 2005

Although the image indicates less than 50% of normal seasonal rainfall.....

....over most of NE Thailand and Central Laos the proportion was in fact between 0% and 10% of normal

Source: USDA Website: www.fas.usda.gov

SE ASIA : INDEX OF CROP STRESS ON MARCH 20TH 2005



The early end to the 2004 wet season caused extremely low levels of reservoir storage and river flows which reduced the irrigation water available and increased pumping costs from rivers.

Crop stress, caused by a lack of water is particularly evident in Bangladesh, Yunnan, Burma, Laos, Thailand and the southern provinces of Vietnam

USDA FAS-PECAD



SPOT-veg NDVI Departure from 4-yr Average (derived from satellite imagery) March 20, 2005

Source: USDA Website: www.fas.usda.gov

<http://www.fas.usda.gov/pecad/highlights/2005/03/sedrought/seasiadrought.htm>

4. Conclusion and Recommendations



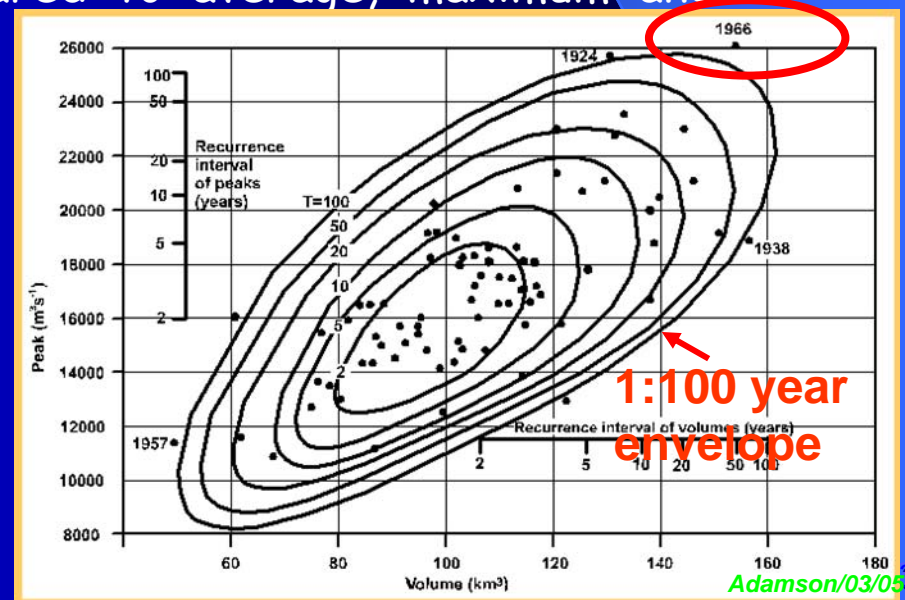
- **Timely data and information sharing** among the countries in the region is indispensable for further detailed studies of flood occurrence and their impacts.
- During 2003 wet season, Mekong water levels are **lower than the average while fluctuate around the normal** during the wet season in 2004.
- **Flood peaks and flow volumes** in 2003 and 2004 wet seasons are slightly below or comparable with the average value.
- **Rainfall in basin was found to be lower than the normal** esp. during the end of wet season after September in 2003 and 2004, possibly resulting the lower than normal flows in the consequent dry seasons.

4. Conclusion and Recommendations



- Time series analytical tool in DSF is useful to analyse flood characteristic.
- For a better understanding in the flood occurrences and their impacts, more comprehensive studies should be carried out on:
 - o Bivariate distribution of annual flood peak and volume
 - o Spatial rainfall distribution
 - o Flood duration map, flood depth map, salinity intrusion map and etc.
 - o Status of reservoir lake as compared to average, maximum and minimum level
 - o etc...

Mekong at Vientiane: Bivariate distribution of annual flood peak and volume. Note the 1966 event compared to the 1: 100 year bivariate relationship between peak & volume



THANK YOU

4. Dry Season and Low flow analysis

- o Hydrographs
- o Low flow frequency analysis

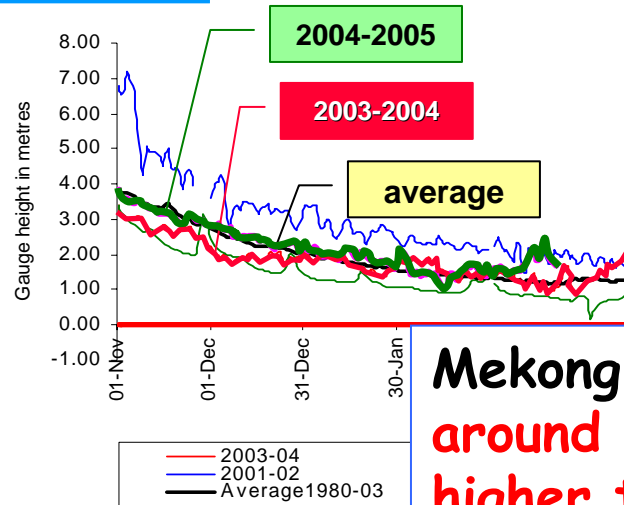
Hydrograph



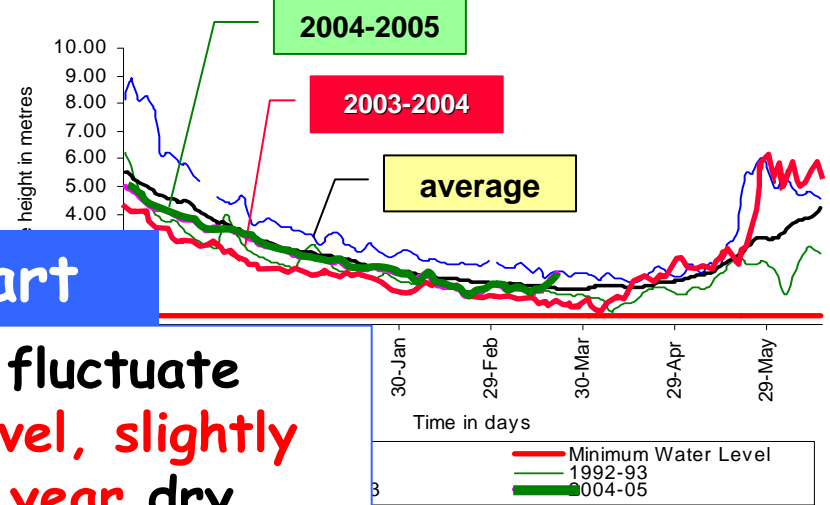
Chiang Saen-Pakse

November-May

Chiang Saen Water level of Mekong at Chiang Saen



Water level of Mekong at Nong Khai

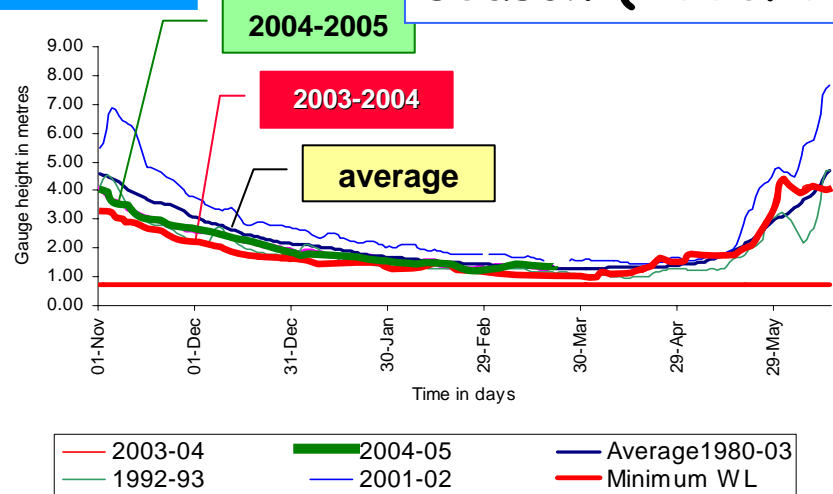


Nongkhai

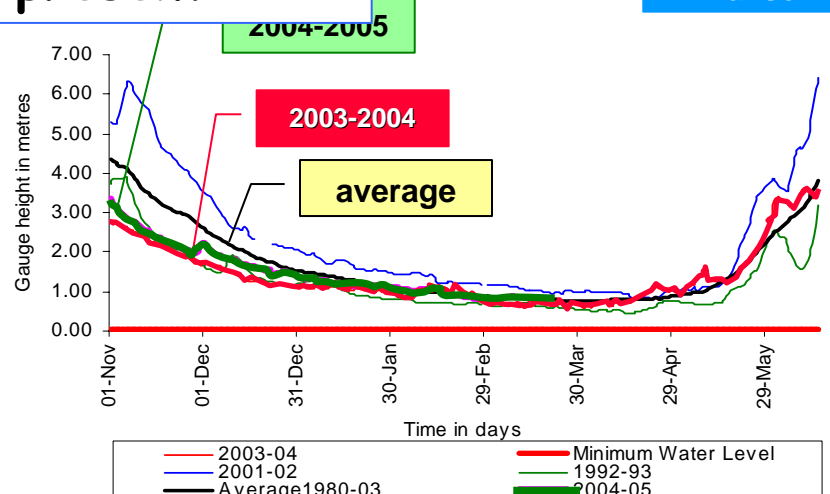
Upper Part

Mekong water levels fluctuate around the normal level, slightly higher than previous year dry season (2003/04) at present

Mukdahan



Water level of Mekong at Pakse



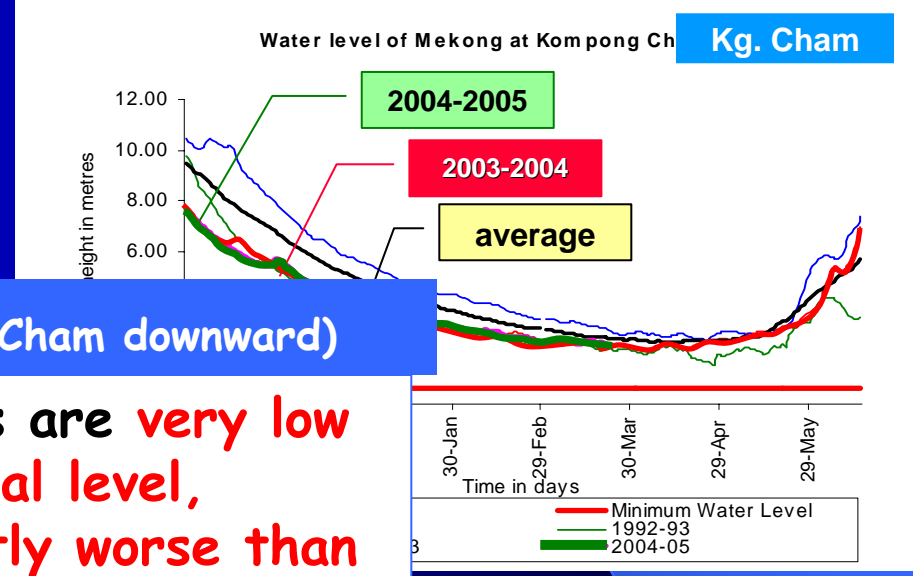
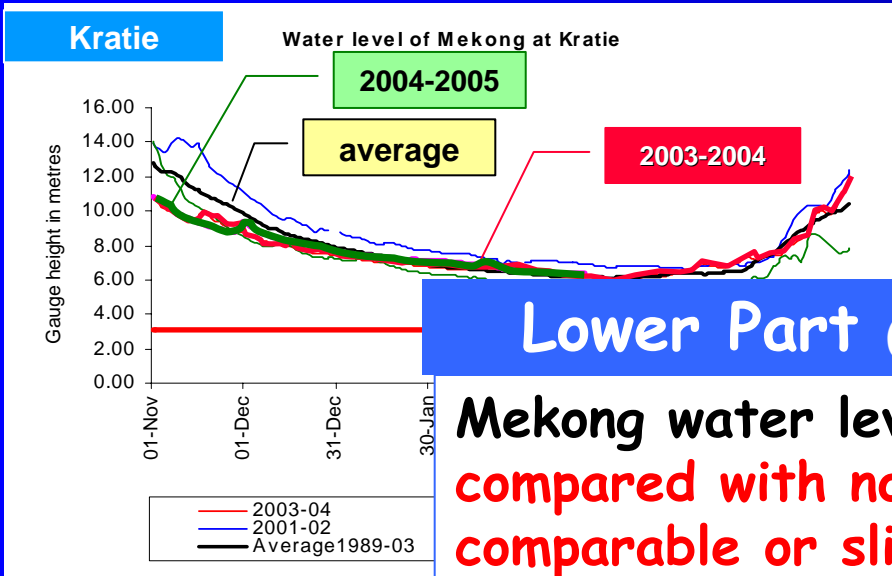
Pakse

Hydrograph



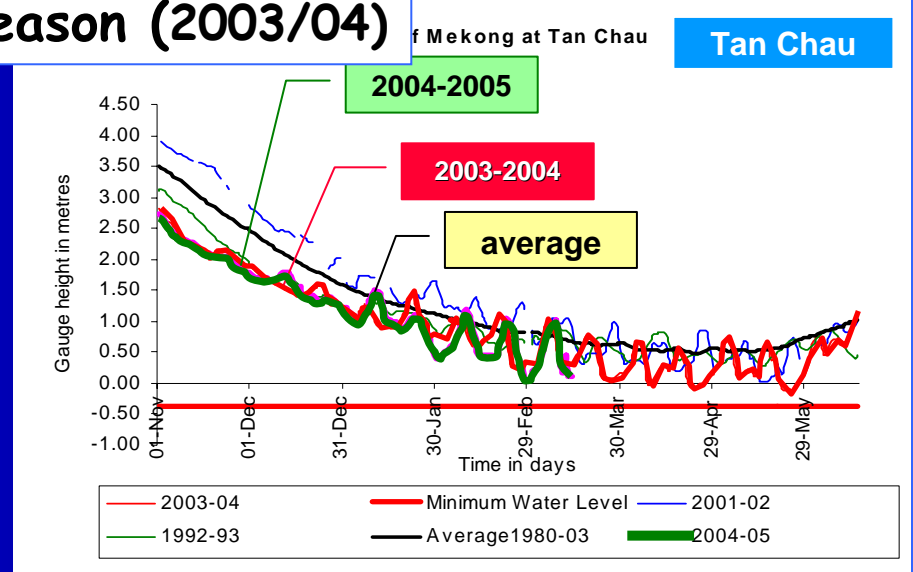
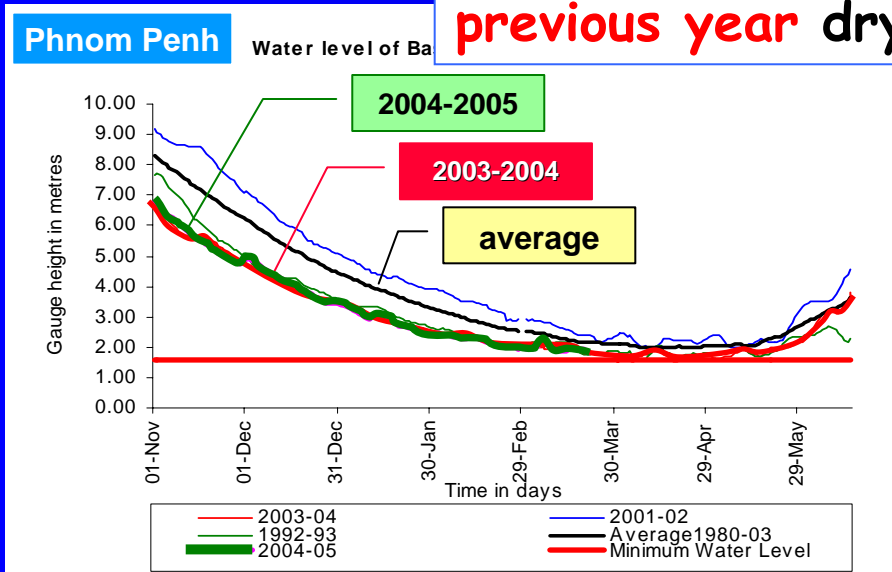
Kratie-Tan Chau

November-May



Lower Part (Kg.Cham downward)

Mekong water levels are **very low** compared with normal level, comparable or slightly worse than previous year dry season (2003/04)



Frequency Analysis

Water Level

Return periods for low water levels in February 2005

Station	Data	Water Level in February	
		Min	Mean
Chiang Saen	1961-2004	< 2	< 2
Nongkhai	1960-2004	9	3
Mukdahan	1960-2004	4	3
Pakse	1960-2004	2	< 2
Kratie	1980-2004	< 2	< 2
Kg.Cham	1960-2004	8	7
Phnom Penh	1960-2004	23	29
Tan Chau	1980-2004	49	16

Unit: Year

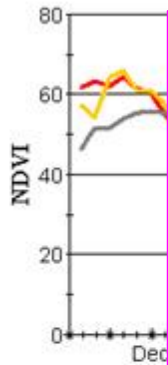
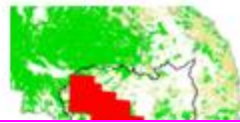
Conclusion

- Water levels in upper part (from Chiang Saen to Kratie) fluctuate around the normal level while very low compared with the normal level in lower part (from Kompong Cham downward)
- Comparing with previous year, water level at present is slightly higher in the upper part (Chiang Saen to Kratie) but comparable or slightly worse in the lower part (from Kompong Cham downward).
- More intensive rainfall data are indispensable for detailed analysis. Low flows are possibly a result of low rainfall especially during the end of 2004 wet season

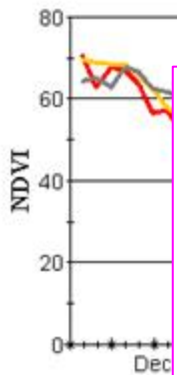
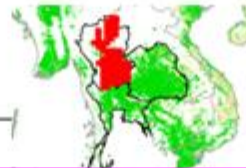
Vegetative Index (Vins)-NDVI



Cambodia: SPOT-VEG



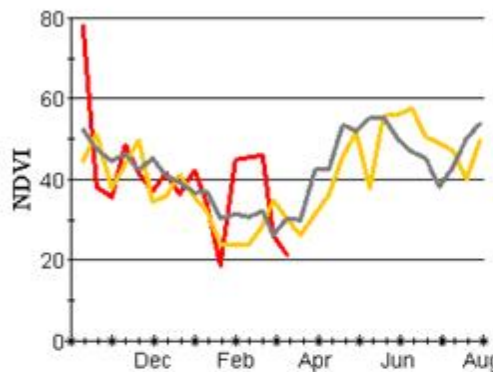
Northern: SPOT-VEG



Northeastern: SPOT-VEG

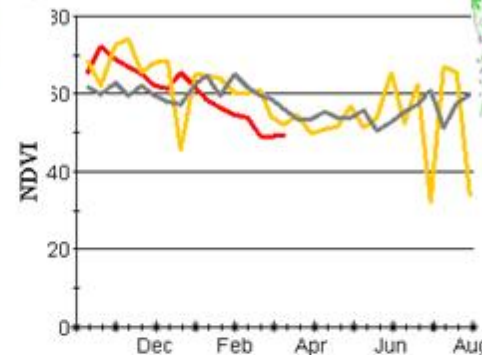
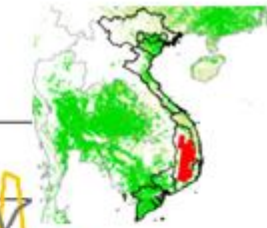


Red River Delta: SPOT-VEG



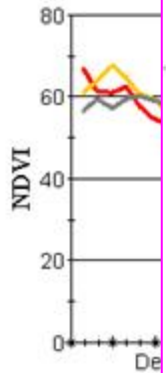
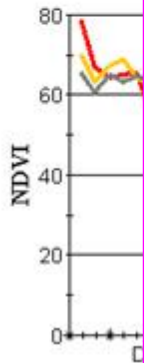
USDA-FAS-PECAD

Central Highland: SPOT-VEG

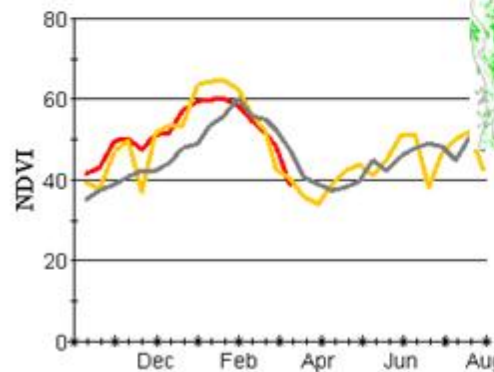
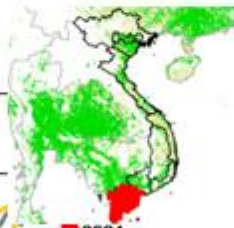


USDA-FAS-PECAD

Central: SPOT-VEG



Mekong Delta: SPOT-VEG



USDA-FAS-PECAD

Vietnam:

Vins in the north (Red River valley) are mixed. Declining vins in the central highlands reflect drought conditions. Yields in the Mekong were very good in 2004, current vegetation conditions are similar to last year.