Mekong River Commission

Flood Management and Mitigation Programme

Seasonal Dry Situation Report for the Lower Mekong River Basin for the Dry Season 2013/14 (from 11st November 2013 to 26th May 2014)

Prepared by:
Regional Flood Management and Mitigation Centre
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Certification of Approval
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Seasonal Dry Situation Report for the Lower Mekong River Basin for the Dry Season 2013/14 (From 11st November 2013 to 26th May 2014)

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List of Acronyms

FFS	Flood Forecast System
LMB	Lower Mekong Basin
LTA	Long Term Average
NOAA	National Oceanographic and Atmospheric Administration
NWP	Numerical Weather Prediction
SRE	Satellite Rainfall Estimate
URBS	Unified River Basin Simulator

1. INTRODUCTION

The Mekong River Commission (MRC)'s Mekong River Monitoring normally covers the period from 1 November to 31 May that is defined as the "dry season". During that period the Regional Flood Management and Mitigation Center (RFMMC) has the responsibility to monitor water levels at all mainstream stations along the Lower Mekong Basin (LMB). River monitoring bulletin is produced once a week, and on the Monday.

At present, MRC Mekong River Flood Forecasting System (FFS) uses Satellite Rainfall Estimation (SRE) and Numerical Weather Prediction (NWP) obtained from the National Oceanic and Atmospheric Administration of the US (NOAA) as the current and forecast-rainfall data input for its river monitoring forecasting.

This is a 1st Dry Season Situation Report which is produced by the flood forecasting team to describe the general dry season situation and characteristics for the dry season 2013 - 2014, and assess the performance in terms of the quality of both the river monitoring bulletin and the hydro-meteorology data transfer between national Line Agencies (LAs) and RFMMP for dry season monitoring operations.

2. DRY SEASON 2013-2014

2.1 Rainfall situation

During the seven months dry season (November 2013 – May 2014) rainfall in the Lower Mekong Basin was concentrated around the middle of May just before of the flood season. In general, the total rainfall during the dry season 2013 – 2014 for all the mainstream stations along the LMB was less than the long term average (LTA) and less than the total rainfall in the previous dry season 2012 – 2013 (see Table 2-1). However an exception is made for Chiang Saen and Luang Prabang stations where the total recorded rainfall was a bit higher than the LTA, while at Vientiane station the total rainfall was much lower than the LTA (see Figure 2-1).

Table 2-1 Total of rainfall in dry season of LMB.

Unit: millimetre (mm)

	Upper part	**Middle part**	**Downstream part**
2012-2013	1388.6	2495.5	2346.7
2013-2014	962.6	1048.9	1297.6
Average rainfall	1268.4	2105.6	2013.4

The spatial and time variation shows that rainfall happened during this period, except for January and February when there was no rain. During November and December heavy rainfalls occurred in the upper and lower part of LMB, while more rainfall occurred in lower part of LMB in March and April. By the end of the season more rainfall occurred in the upper part of LMB (Annex A: Graphs and Tables for monthly observed rainfall distribution during dry season).

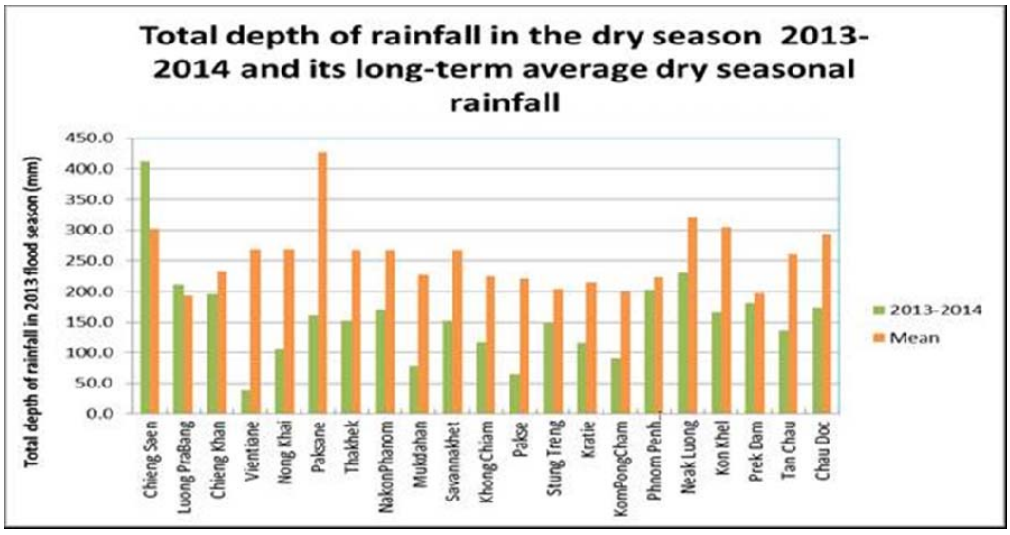


Figure 2-1 Total depth of rainfall in the dry season from 2000-2001 to 2013- 2014 and its long-term average dry seasonal rainfall.

2.2 General Behaviour of the Mekong River

The flood season in the Lower Mekong Basin (LMB) extended from 31 October until 10 November 2013. The starting date of dry season river monitoring period was therefore 11 November 2013 while the end date was 26 of May 2014.

During the dry season the water levels of the stations from Chiang Sean to Kampong Cham were above the LTA while these were about the LTA for the stations from Phnom Penh Chaktomuk to Prek Kdam. Water levels at Tan Chau and Chau Doc fluctuated around the LTA (See annex C: Dry Season Water Level Graph).

In general terms, the average monthly water levels from Chiang Saen to Tan Chau and Chau Doc stations in LMB started above the long-term average (LTA) from the beginning to the end of the dry season (See Figure 2-2).

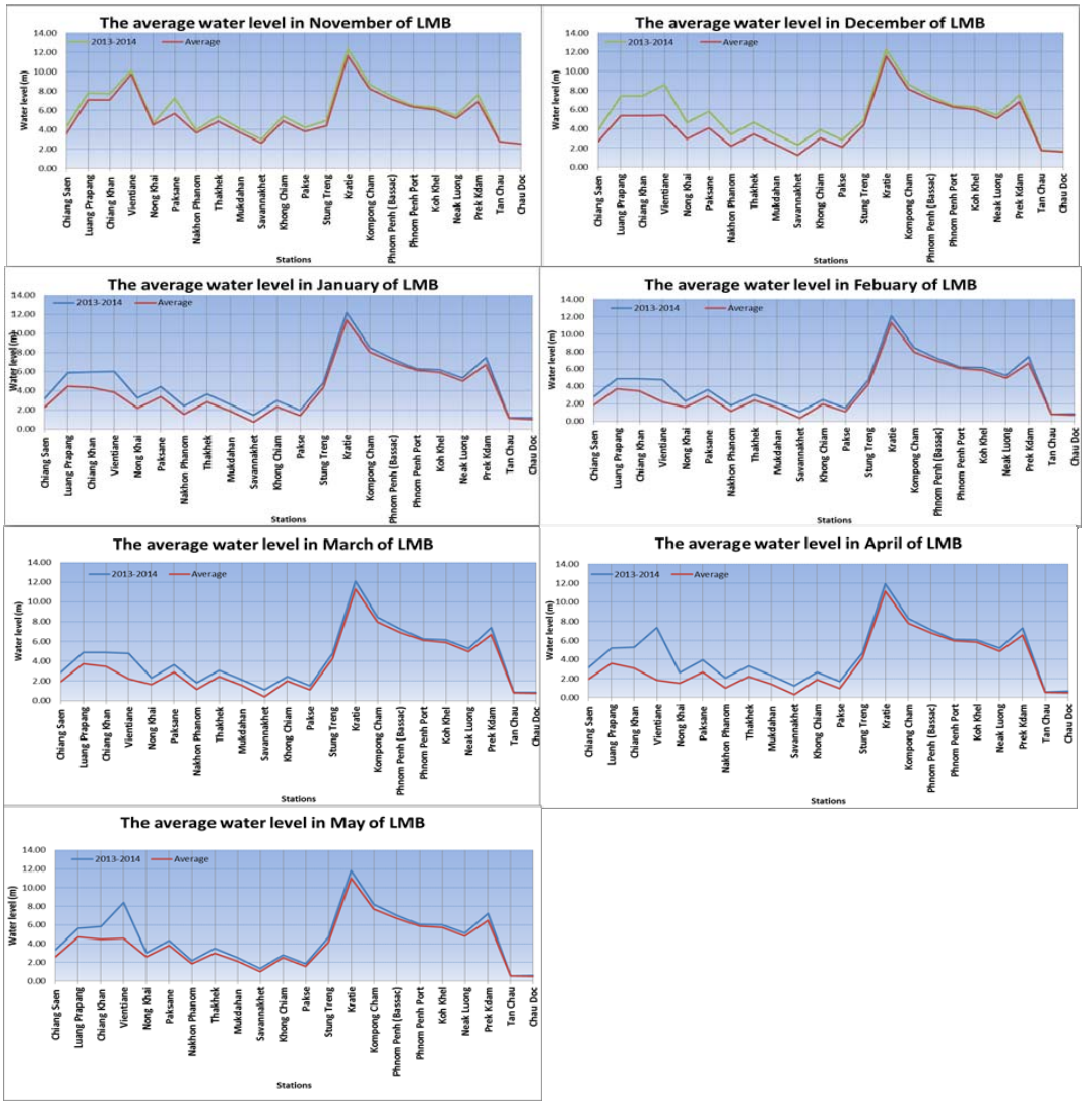


Figure 2-2 Monthly average water level of LMB.

During the period from 13 to 23 December 2013 one heavy rainfall happened in the upstream of Chiang Saen and caused a single large hydrograph that later routed downstream of the LMB. The main hydrological situations along the Mekong River are presented in more detail below.

For stations from Chiang Saen to Vientiane/Nong Khai

During the dry season 2013 – 2014, compared to the LTA the water level at these stations were above the LTA. By mid of December 2013 at Chiang Saen the water level increased from a relatively constant level of 3.84 m on 14 December to 6.87 m on 17 December. At Luang Prabang the water level changed from 6.66 m on 15 December to 11.72 m on 18 December. At Chiang Khan, the water level changed from 6.96 m on 15 December to 10.69 m on 18 December. At Nong Khai the water changed from 4.08 m on 16 December to 7.79 m on 19 December (see Figure 2 - 3).

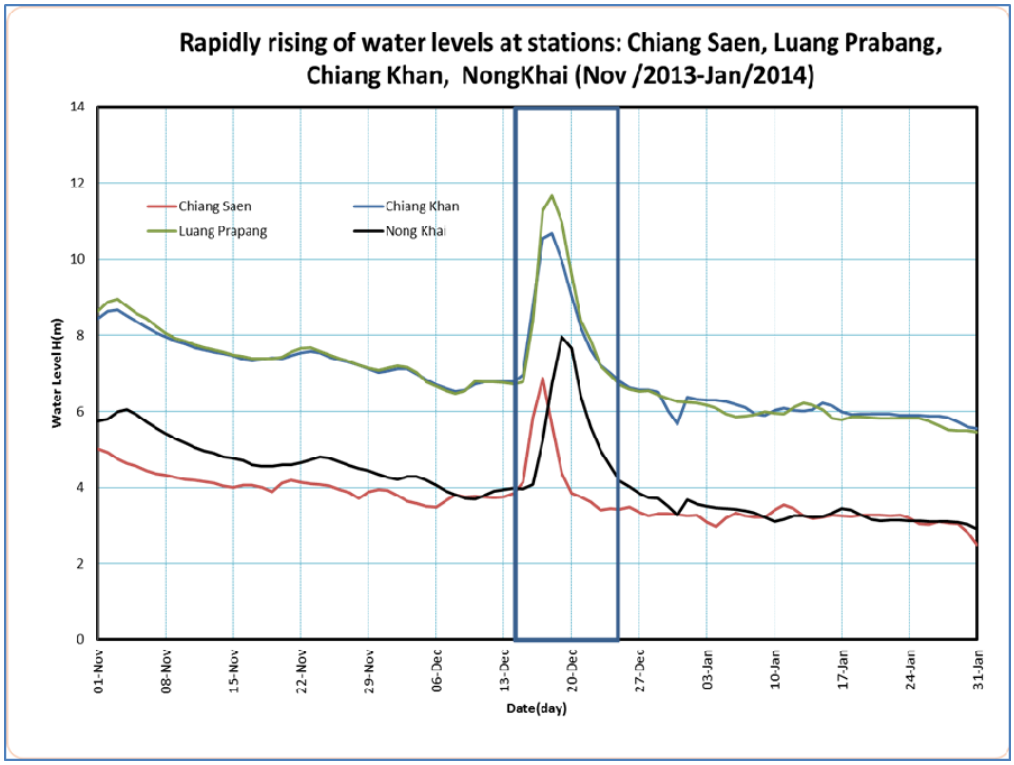


Figure 2-3 Rapidly rising of water levels at stations: Chiang Saen, Luang Prabang, Chiang Khan, Vientiane and Nong Khai.

For stations from Paksane to Pakse

During the dry season 2013 – 2014, the water levels at stations from Paksane to Pakse were above LTA. By mid of December 2013, the water level increased at Paksane from 5.19 m on 18 December to 8.35 m on 22 December. At Nakhon Phanom the water level increased from 3.78 m on 19 December to 5.43 m on 21 December. At Thakhek, the water level increased from 4.28 m on 22 December to

6.36 m on 25 December. At Mukdahan, the water increased from 2.98 m on 17 December to 5.43 m on 21 December (see Figure 2-4).

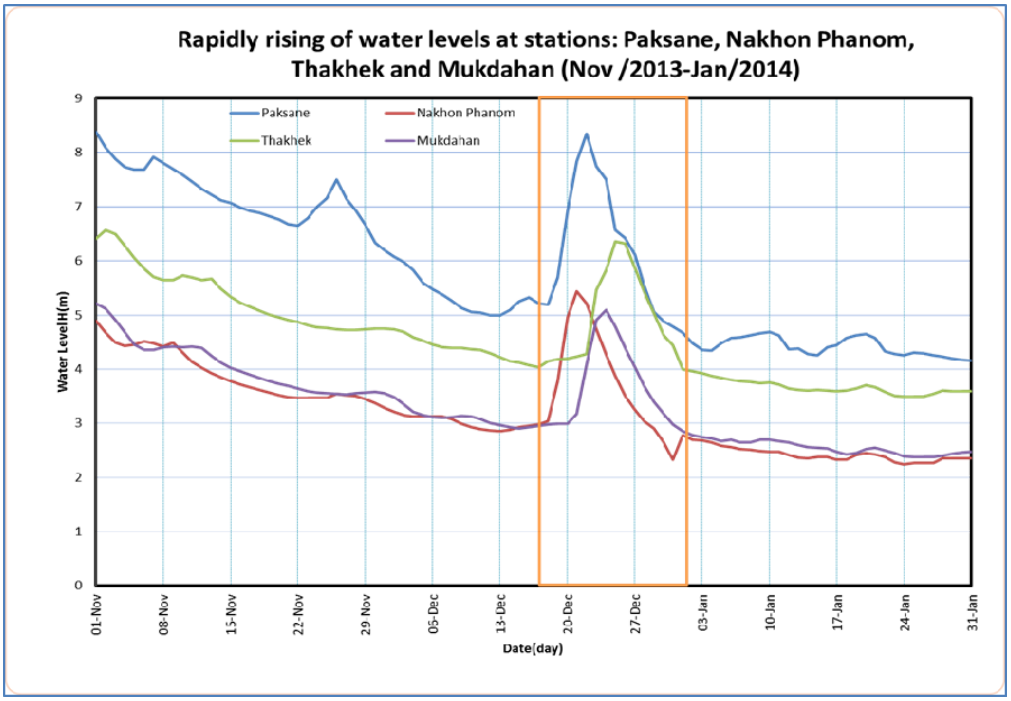


Figure 2-4 Rapidly rising of water levels at stations: Paksane, Nakhon Phanom, Thakhek, Mukdahan, Savannakhet, Khong Chiam and Pakse.

For stations from Stung Treng to Kampong Cham

During the dry season 2013 – 2014, compared to the LTA the water levels at these stations were above the LTA (see annex C).

For stations from Phnom Penh to Koh Khel/Neak Luong

During the dry season 2013 – 2014, compared to the LTA the water levels at these stations were about the LTA (see annex C).

Tan Chau and Chau Doc

During the dry season 2013 – 2014, compared to the LTA the water levels at these stations fluctuated around the LTA (see annex C).

3. DRY SEASON FORECAST IN 2013 – 2014

3.1 Data collection for models and River Monitoring bulletin dissemination

Daily data collection consisted of hydrological and meteorological data (observed water level and rainfall) by HydMet from Line Agencies, and Satellite Rainfall Estimate (SRE), and Numerical Weather Prediction (NWP) obtained from NOAA which served as inputs for the Mekong Flood Forecasting System (FFS). The forecast for the dry season is performed once a week, at every Monday. The performance indicators are shown in the Tables and Graphs of the forecast achievement (see Annex B, Table B-3, Figure B-2 to Figure B-4).

The Mekong FFS is based on URBS (hydrologic model), which uses observed and forecast rainfall and observed water levels as the primary input. At the current time, the system uses historical satellite rainfall SRE and forecast grid rainfall (GFAS); and observed rainfall from ground truth stations. Manual water level observations are primary sources of water levels utilized by URBS while there is an increasing trend to use telemetry data from the MRC Hydromet Network (AHNIP and HYCOS stations) to substitute manual data in the future.

The results of the evaluation show that the data from most of LAs normally arrived before 9:00 AM (see Annex B, Table B-3 and Figure B-2). The manual data collected by HydMet was checked by LAs; hence, the quality of data is in general terms fairly good. However, there are a number of unavoidable problems in data transmission such as the late transfer of data, errors and especially missing data during seven months of this dry season (see more detail in Table B-3 and graphs in Performance, Annex B).

Performance indicators of bulletin delivery (see Annex B, Table B-3 and Figure B-4) shows that the river monitoring bulletins containing dry season situation information were disseminated timely to the registered national Line Agencies, MRC website, and other interested users around 10:30 AM, which is a prescribed time in the Operational Manual. It can be seen that the time of river monitoring bulletin delivery in November 2013 to May 2014 of the dry season was slightly later than 10:30 AM.

During the dry season 2013 - 2014, the data of several stations was sometimes not updated by national Line Agency. For more details showed in Figure B-5 in Annex B.

3.2 Accuracy and limitations in forecasting

Since 2008, the MRCFFS has utilized the URBS model for locations in the Upper and Middle reaches of LMB between Chiang Saen (Thailand) and Pakse (Lao PDR), while the hydrodynamic model ISIS and Regression model are applied for locations in downstream part between Strung Treng (Cambodia) and Tan Chau/Chau Doc (Viet Nam). Since ISIS model was under recalibration and no new results were available, the evaluation for dry season 2013-2014 is based on forecast results of URBS – Regression, with SRE as input.

The Mean Absolute Error (MAE) has been adopted as the major measure of forecasting performance since it is a) a reliable indicator of error magnitudes and b) a robust measure. In order to achieve the forecasting goal, a set of Benchmarks of Success for 1 to 7 day forecast lead time (Indicator of accuracy is mean absolute error in centimeters) is shown in Annex B, Table B-2 is utilized for comparison. The performances were rather good for all stations except those of Phnom Penh port to Chau Doc where affected by tidal fluctuation. (See Annex B, Table B-1).

The Mean Absolute Error of River monitoring performance, based on URBS-Regression using SRE during the dry season 11 November 2013 – 26 May 2014, is shown in Annex B, Figure B-1.

3.3 Lesson learned and actions to be taken

The following lessons have been drawn from the 2013 - 2014 dry season, which can serve as the main factors that need to be taken into account by the flood forecasting team of the RFMMC in improving the forecast results:

- The availability and quality of both meteorological (rainfall) and hydrological data as inputs for models are always the highest priority because these are the deciding factors for forecast results and accuracy. A Senior International Satellite Precipitation Expert was engaged by the RFMMC in 2010 to develop a tool of bias correction of SRE to produce corrected SRE-rainfall. The product depends very much on observed rainfalls provided by the national Las, which contained a lot of missing data. See Annex B, Table B-3 and Figure B-3. Correct SRE can provide better results if less missing data.
- The data from stations in the upstream of the Mekong River system in China is very important for analysing and forecasting/monitoring in the LMB, not only during the flood season but also during the dry season. Hydrological and meteorological data from stations belonging to China need as much and as often as possible to be shared during dry season of 2013-2014.
- Strengthening the relationship and cooperation with national Line Agencies in exchanging and collecting observed water level and rainfall data at stations

on the Mekong mainstream in order to collect daily data on time and to minimize the missing and incorrect data.

- Improving model calibration by updating the rating curves and other parameters at stations in the MRC's member countries to be supported by LAs.
- Performance of the ISIS model in the Cambodian Floodplain and the Mekong Delta should be compared with that of the Regression Model during the 2014 - 2015 dry season. It is found that the discharges generated in ISIS are not consistent with the observed water levels. It is recommended to replace the old version in the MRC Mekong Flood Forecast System with the latest version of ISIS.
- Like the situation at last dry season have a heavy rain on mid-December 2013 which steeply increased the water level in the upper stations of the LMB. Therefore, the close watching of situations of sudden increasing water levels of left bank tributaries in the upper, middle part of the LMB, like Ban Mixay and Muong Ngoy, Moung Mai, Moung Kao, Ban Phone Si, Se Kong River at Vuen Khen and Se Bang Fai River at Mahaxai is of vital importance. One can learn more about the weather products of rainfall forecast published on the websites of the World Meteorological Organization (WMO) and their practical applications.
- Study the possibility of having 2nd run of daily flood forecast and medium-term forecast (6-10 days) – data availability and other requirements of the system by having further evaluation of the system's performance by using historically similar rainfall patterns.

For more details see the following Annex:

Annex A:

- Graphs and Tables for monthly observed rainfall distribution during dry season 2013-2014
- Graphs for monthly rainfall in dry season from 2000 to 2013 and long-term average along the Mekong River

Annex B:

- Graph for dry forecast accuracy along the Mekong mainstream
- Table of forecast achievement
- Tables and graphs for performance

Annex C:

- Seasonal Water Level Graphs

4. References

MRC, FMMP, 2014: Report on data collection and transfer performance evaluation report for dry season 2013/2014

MRC, 2013: Signed MOU and TOR for the Hydro-Meteorological data collection and transfer from MRC MCs NLAs to RFMMP for 2103-2015/2016,

MRC, FMMP, RFMMC, weekly report 2013 - 2014

Annex A Graphs and Tables

1. Graphs and Tables for monthly observed rainfall distribution during dry season 2013 -2014

Table A-1 Monthly observed rainfall in dry season 2013 - 2014

Unit in mm

2013-2014	Chiang Saen	Luong Prabang	Chiang Khan	Vientiane	Nong Khai	Paksane	Thakhek	Nakhon Phanom	Mukdahan	Savannakhet	Khong Chiam	Pakse	Stung Treng	Kratie	Kompong Cham	Phnom Penh Bassac	Neak Luong	Koh Khel	Prek Kdam	Tan Chau	Chau Doc
Nov	69.6	12.2	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	8.2	0.0	33.0	27.0	64.1	162.5	89.8	112.9	145.6	50.0	71.4
Dec	94.3	51.2	27.4	4.8	60.0	25.2	20.9	19.5	16.4	20.9	53.8	65.3	51.2	64.2	20.2	21.0	55.0	40.2	24.5	32.7	53.3
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	22.7	11.4	23.8	6.8	13.1	10.6	12.8	6.5	0.6	12.8	21.5	0.0	0.0	26.8	54.2	0.0	20.6	0.0	0.0	10.9	0.0
Apr	39.2	44.0	82.1	68.3	74.8	100.9	70.7	30.4	132.1	70.7	125.0	1.0	256.5	79.4	223.9	72.3	187.7	54.6	62.9	220.8	0.0
May	247.4	148.4	168.6	33.1	45.6	134.1	131.6	151.0	62.5	131.6	56.1	0.0	65.5	24.8	6.6	19.9	85.4	12.8	11.4	53.1	49.2

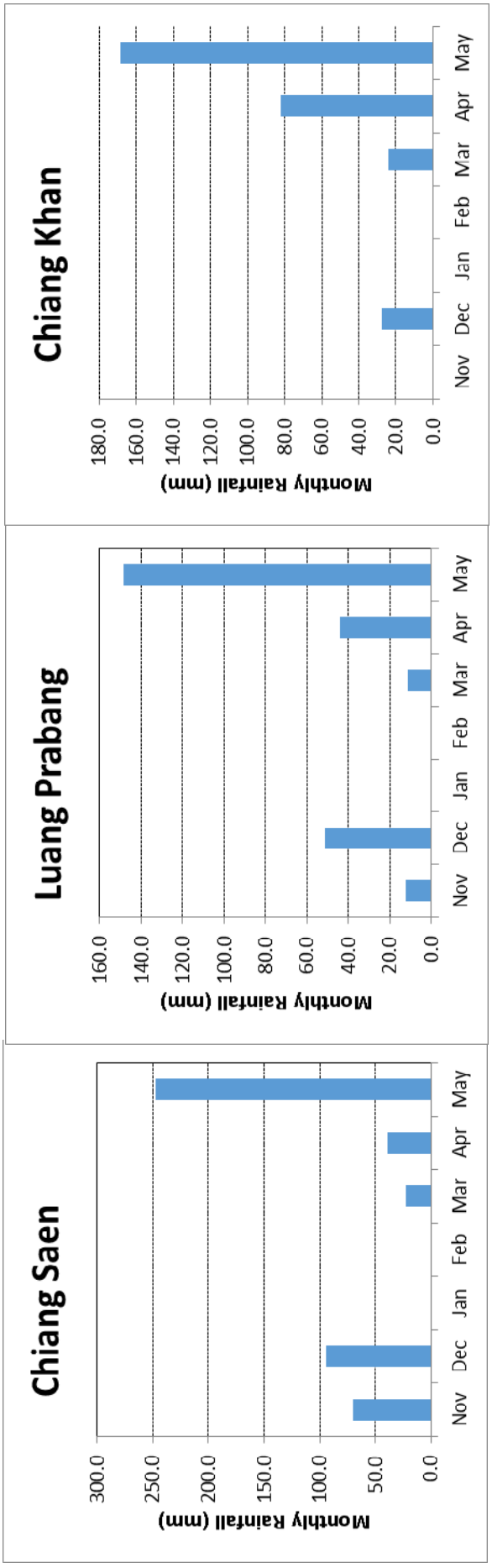


Figure A-1 Monthly rainfall distribution from Chiang Saen to Chiang Khan.

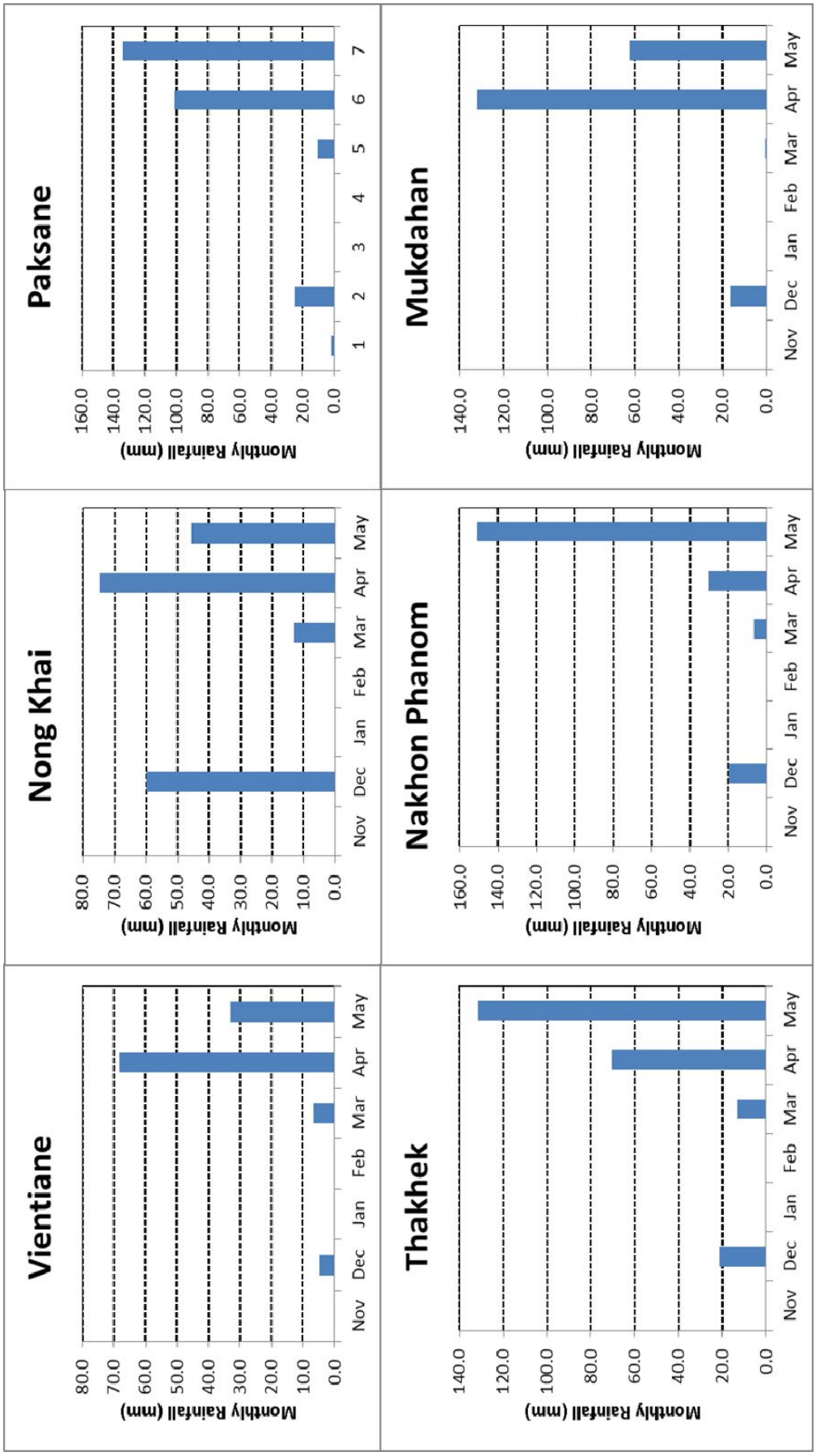


Figure A-2 Monthly rainfall distribution from Vientiane to Mukdahan.

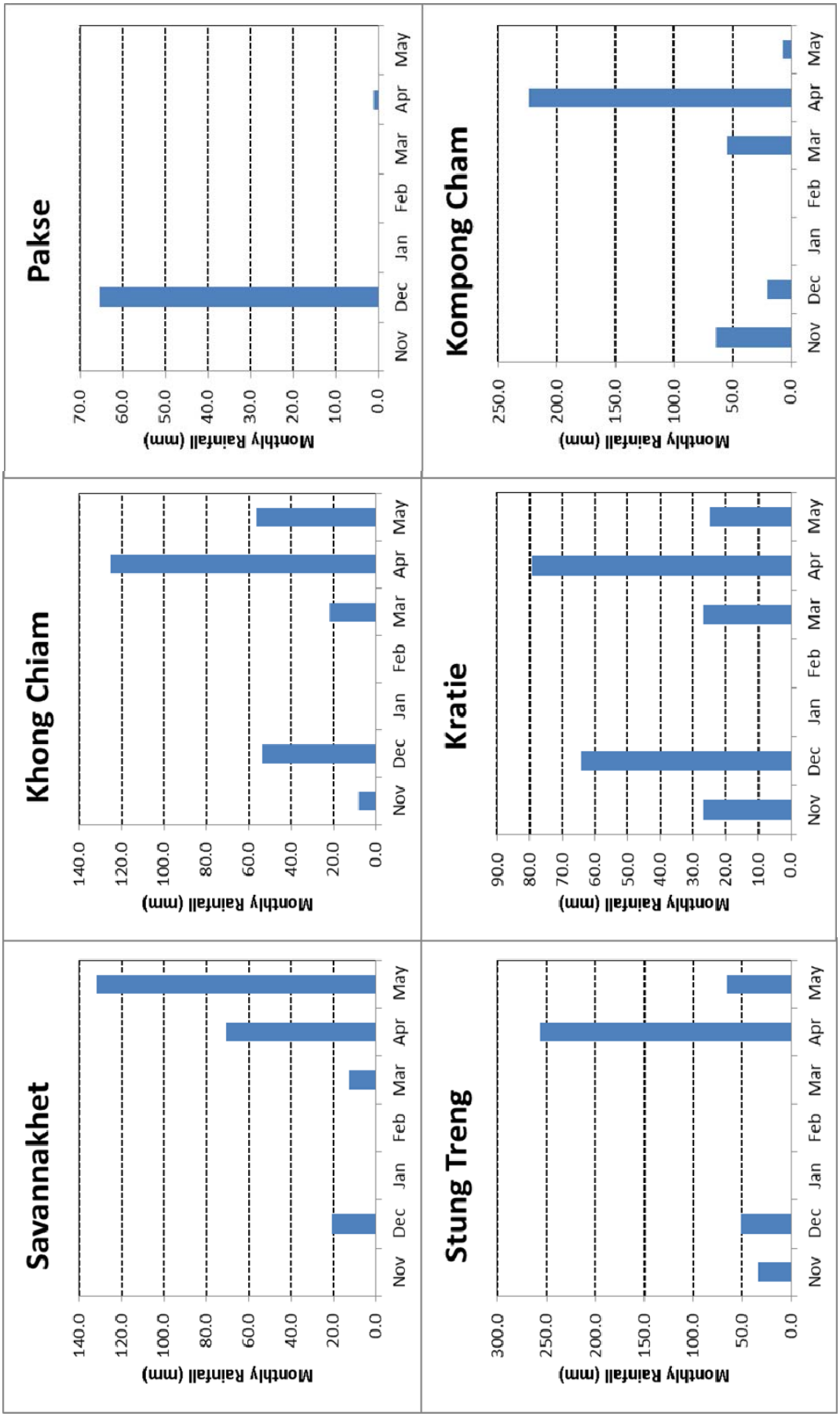


Figure A-3 Monthly rainfall distribution from Savanakhet to Kampong Chan.

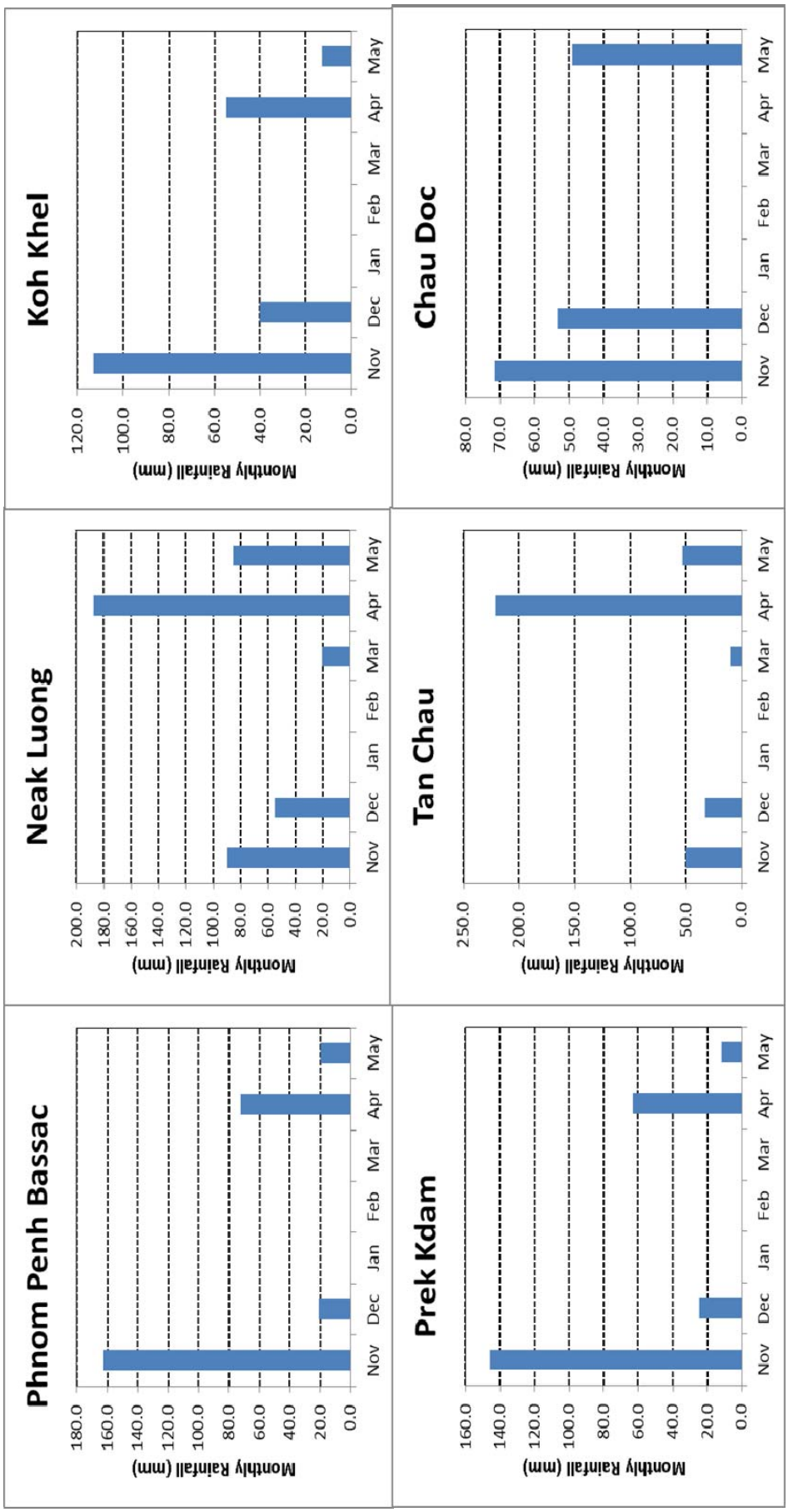


Figure A-4 Monthly rainfall distribution from Phnom Penh Bassac to Chau Doc.

2. Graphs for monthly rainfall in dry season from 2000 to 2013 and long-term average along the Mekong River.

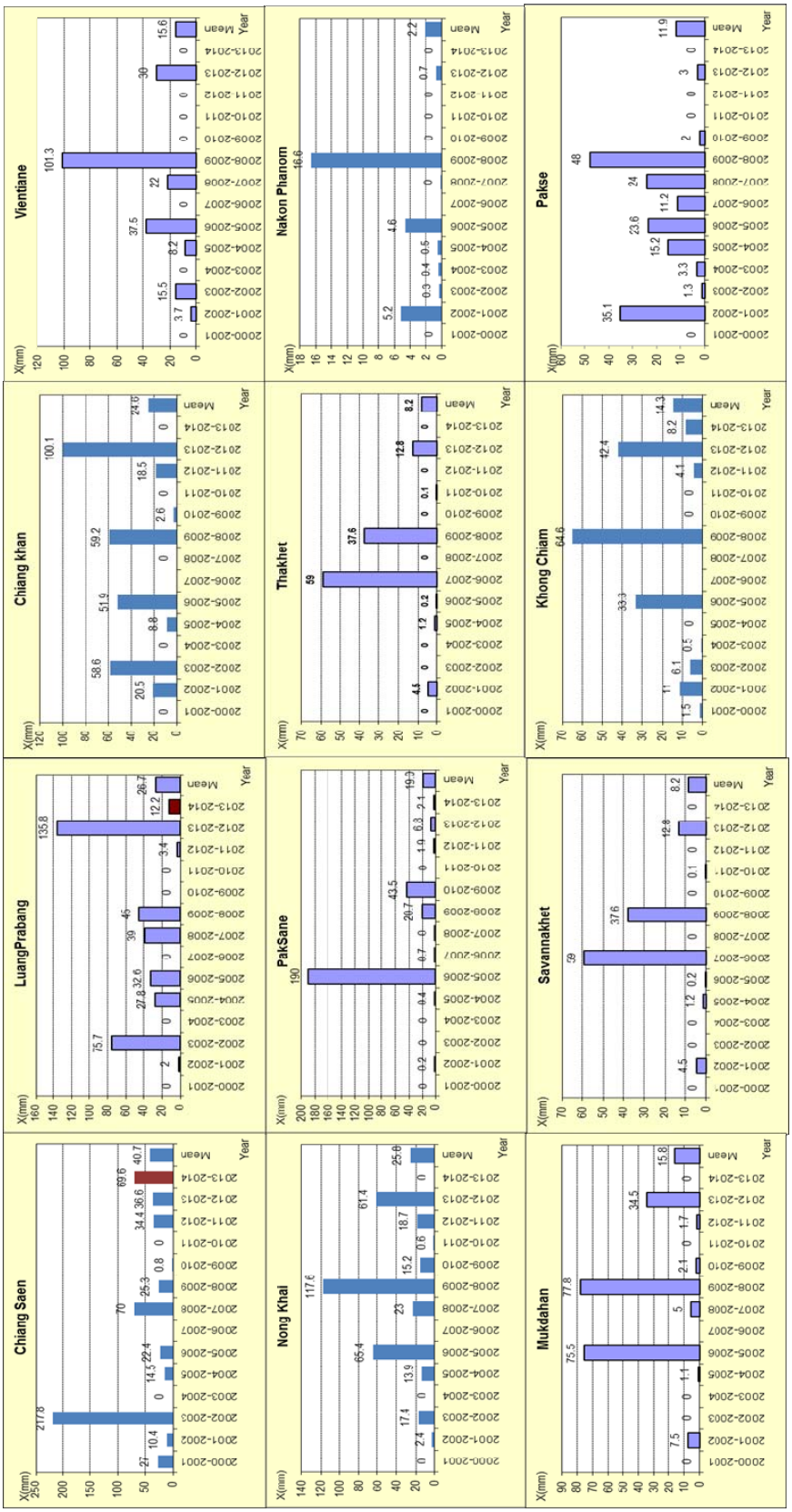


Figure A-5 Monthly rainfall in November for main stations along the Mekong River.

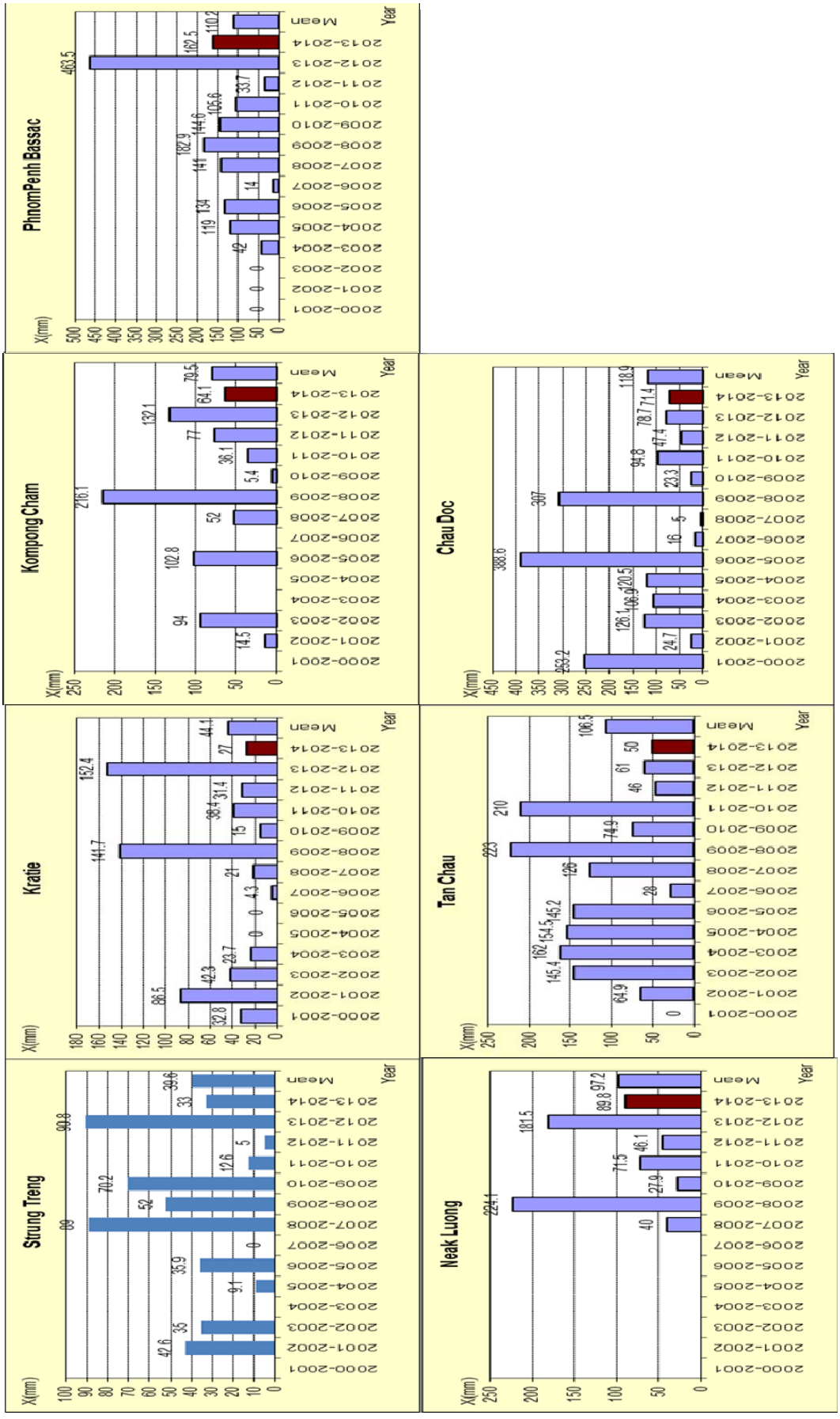


Figure A-5 (cont.)

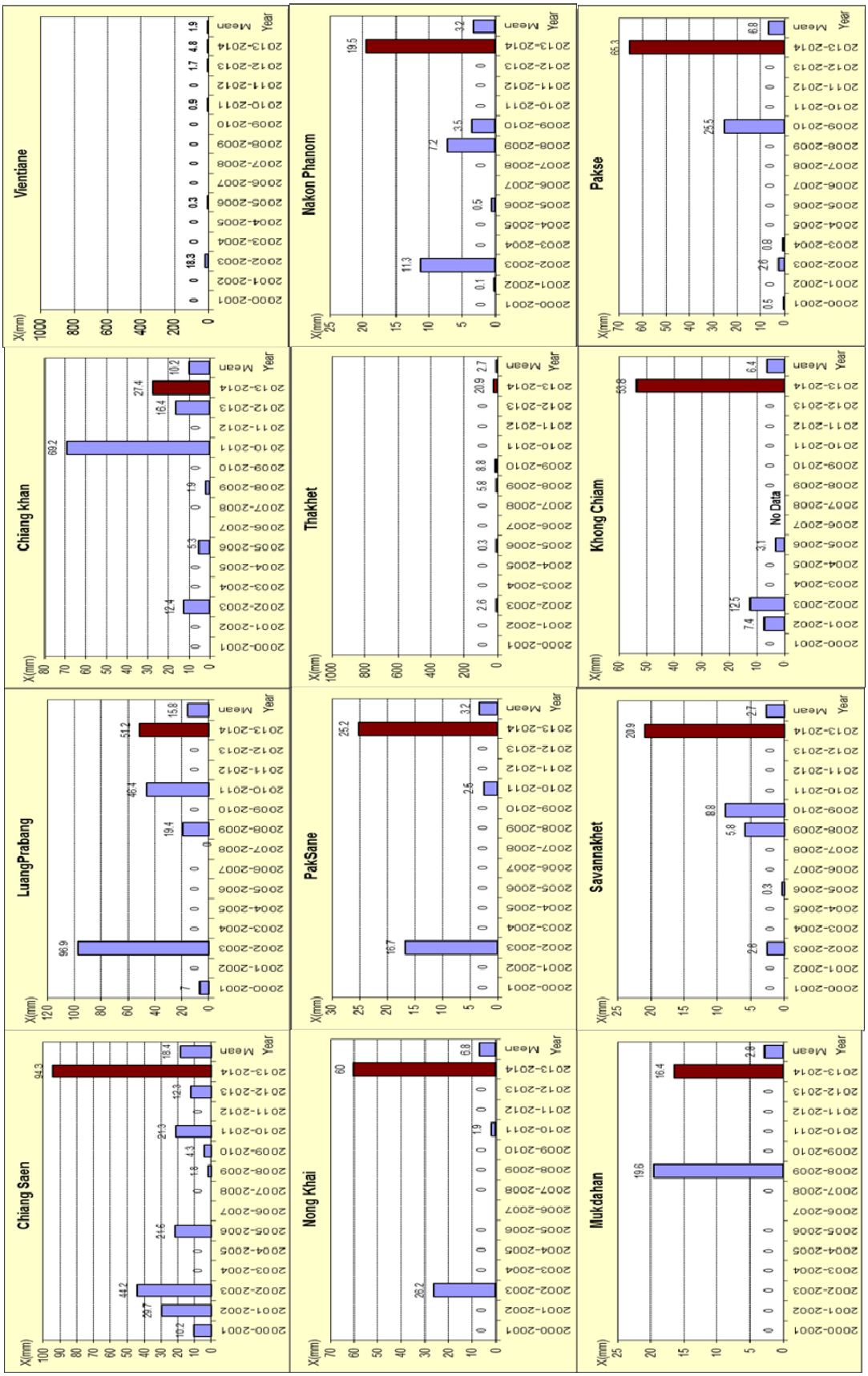


Figure A-6 Monthly rainfall in December for main stations along the Mekong River.

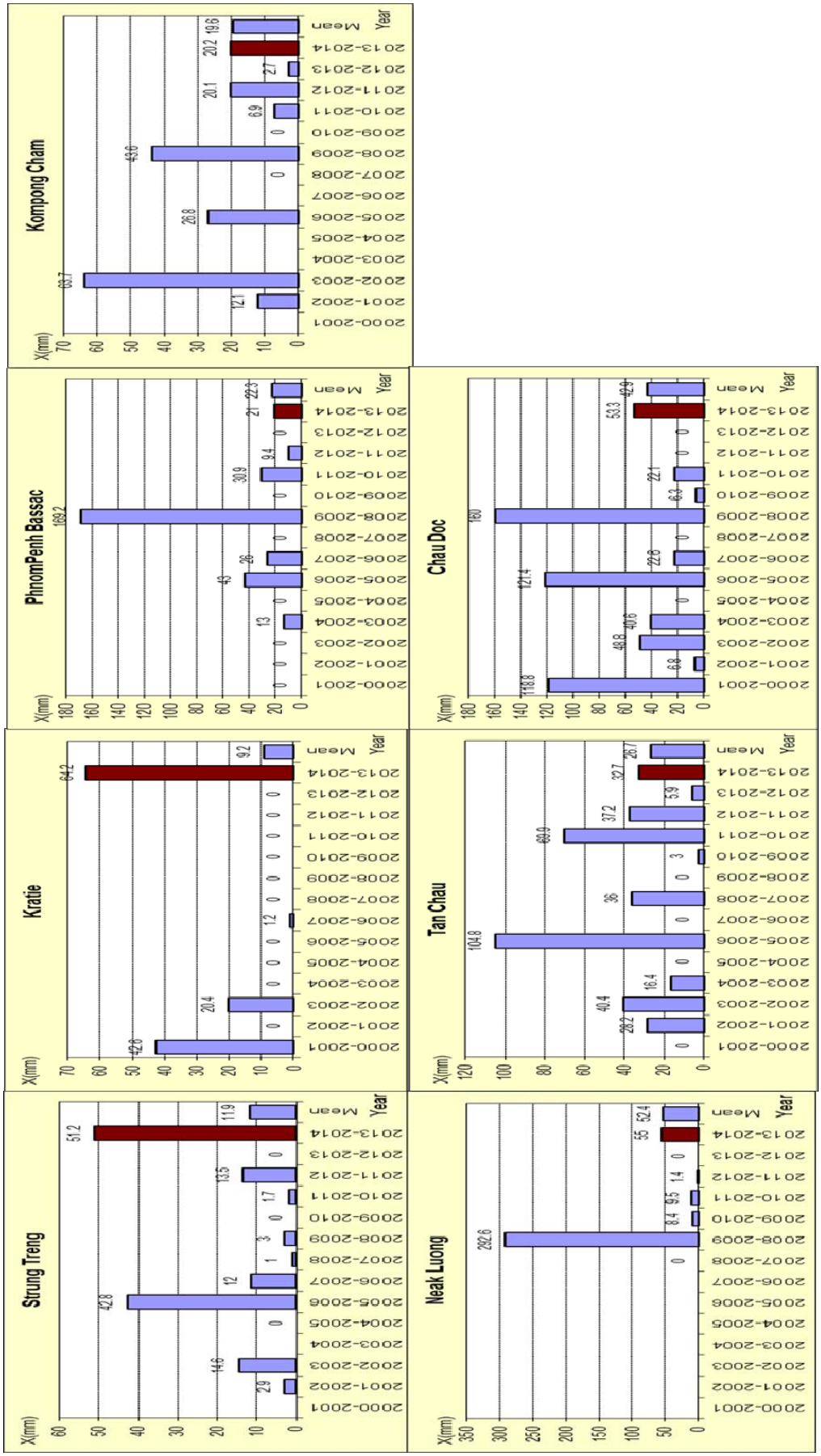


Figure A-6 (cont.)

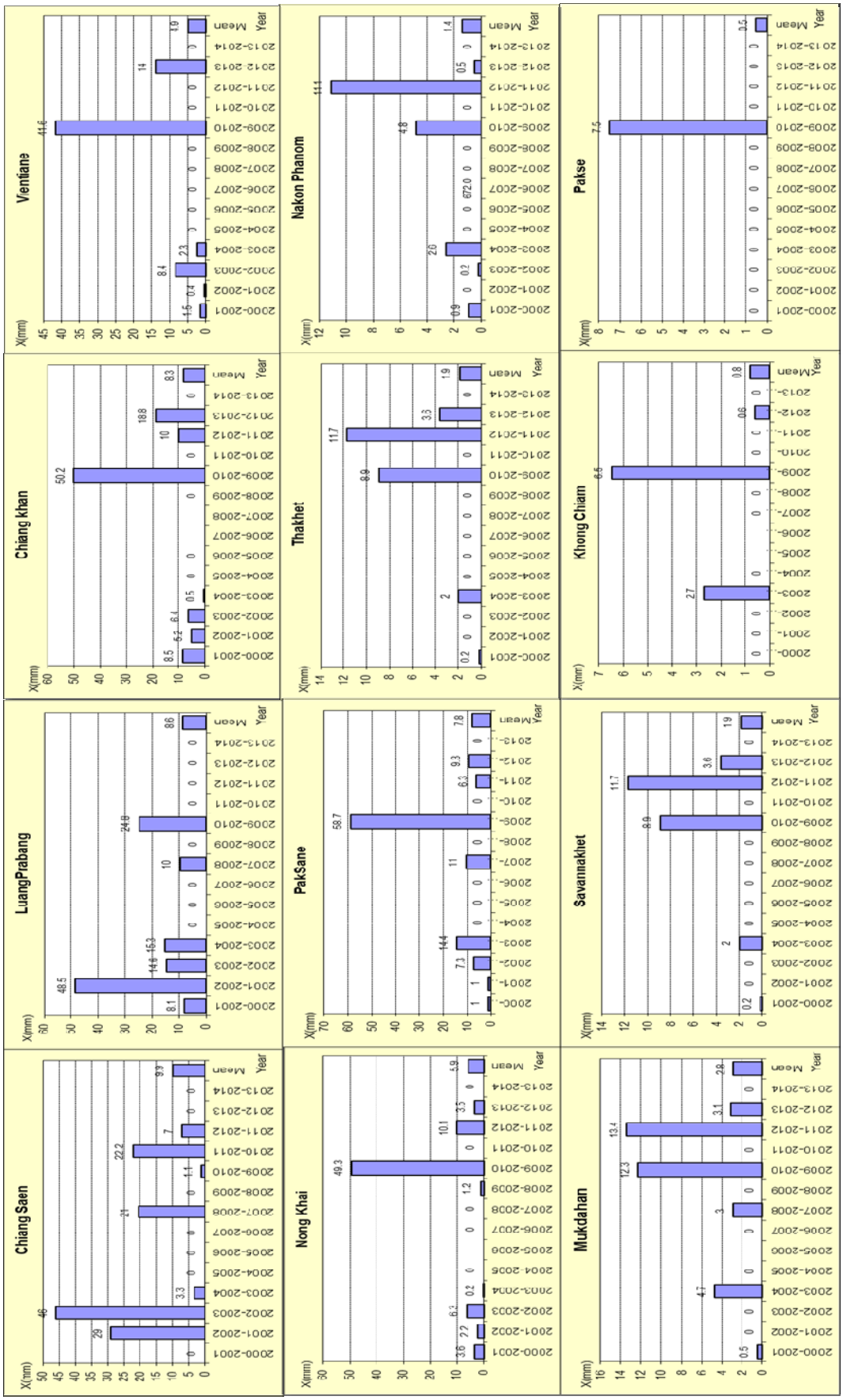


Figure A-7 Monthly rainfall in January for main stations along the Mekong River.

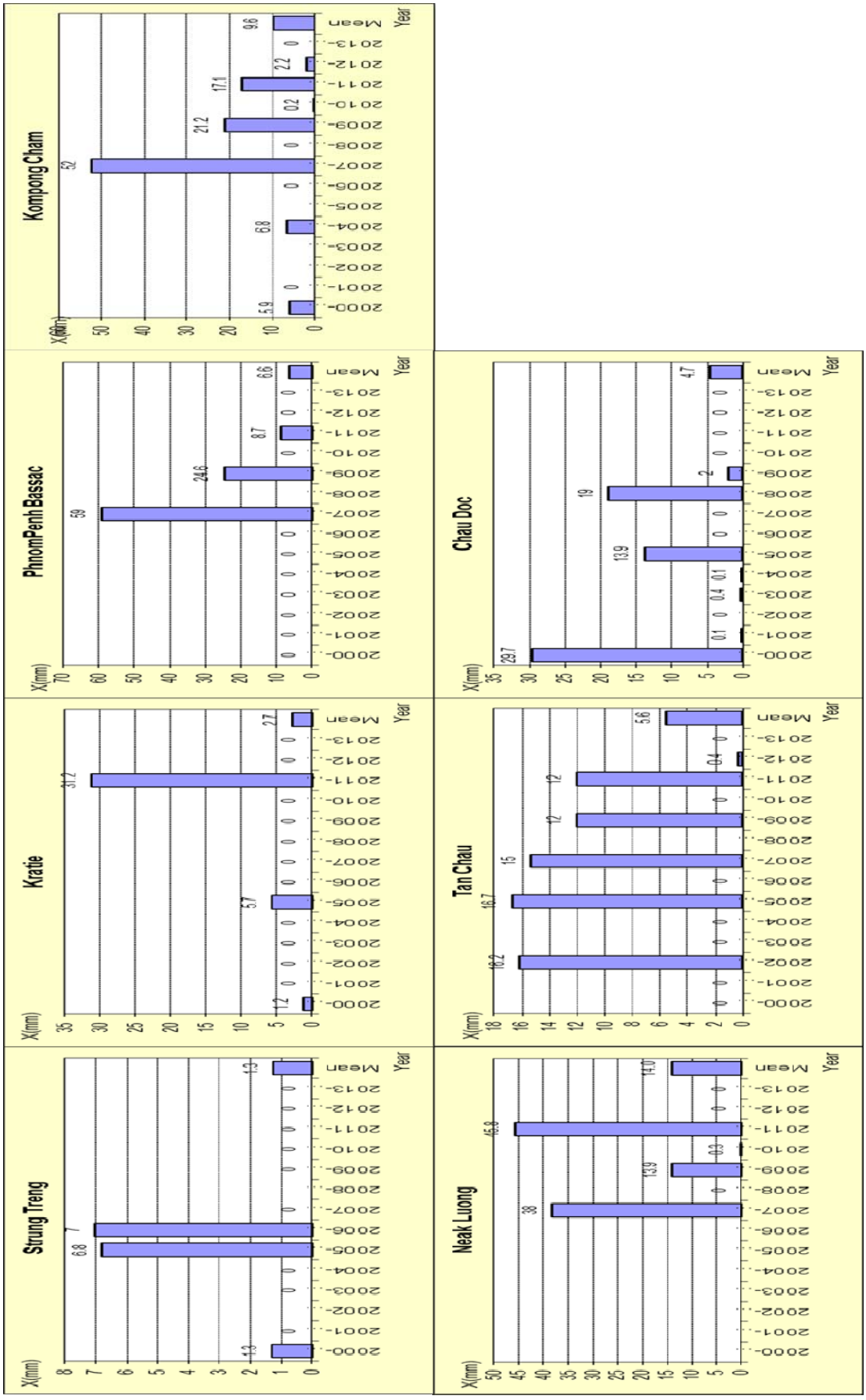


Figure A-7 (cont.)

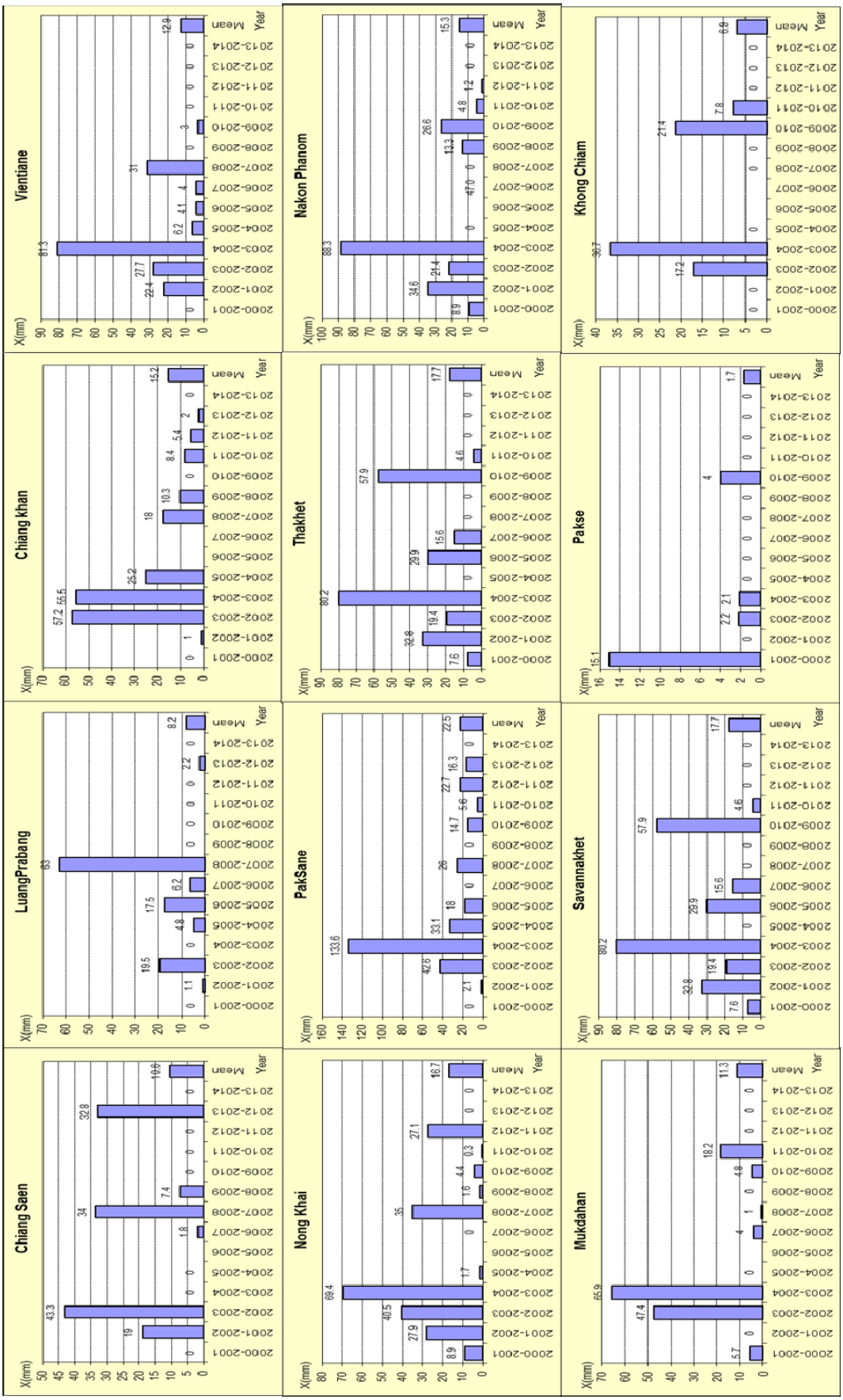


Figure A-8 Monthly rainfall in Febuary for main stations along the Mekong River.

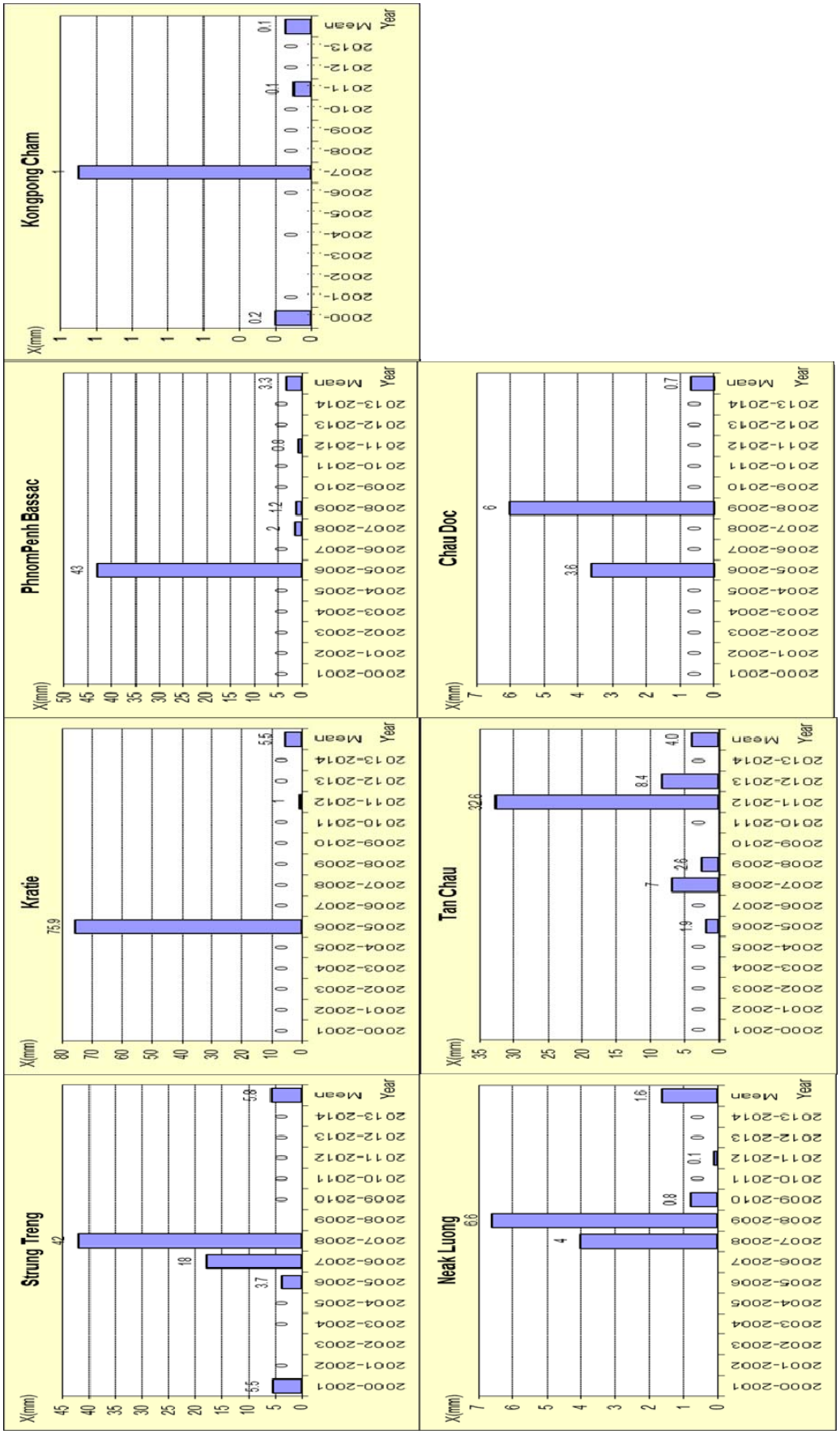


Figure A-8 (cont.)

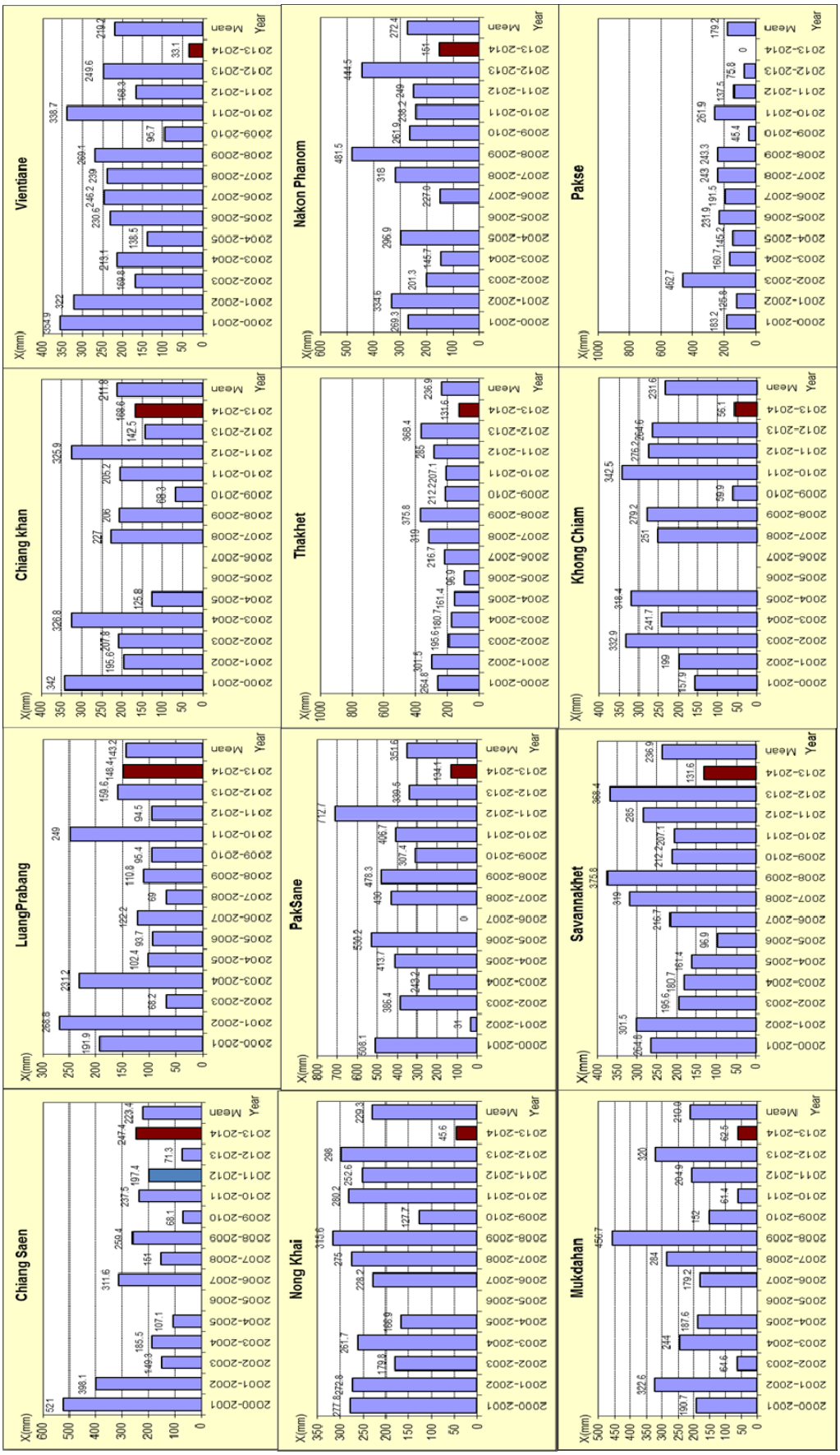


Figure A-9 Monthly rainfall in March for main stations along the Mekong River.

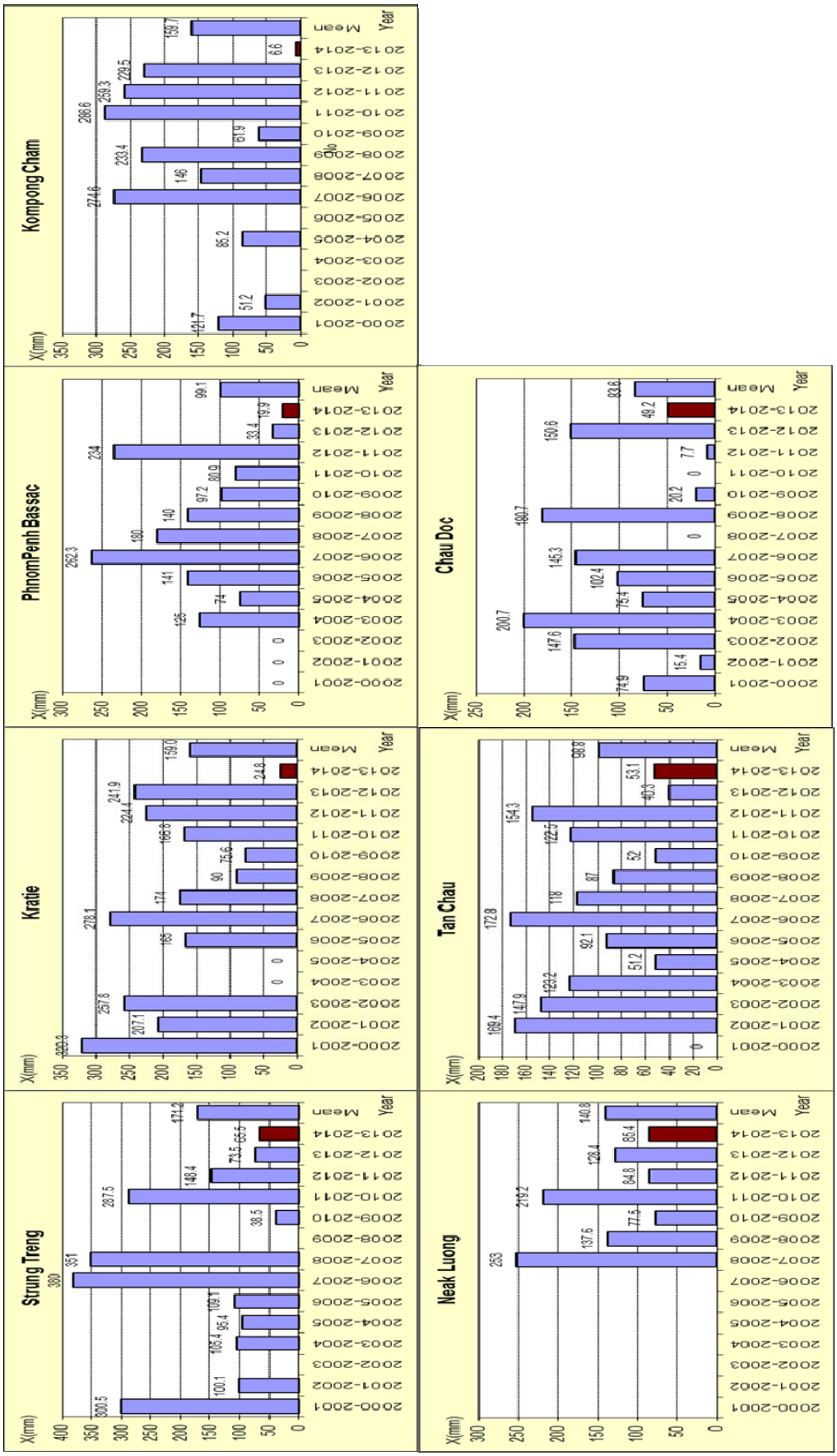


Figure A-9 (cont.)

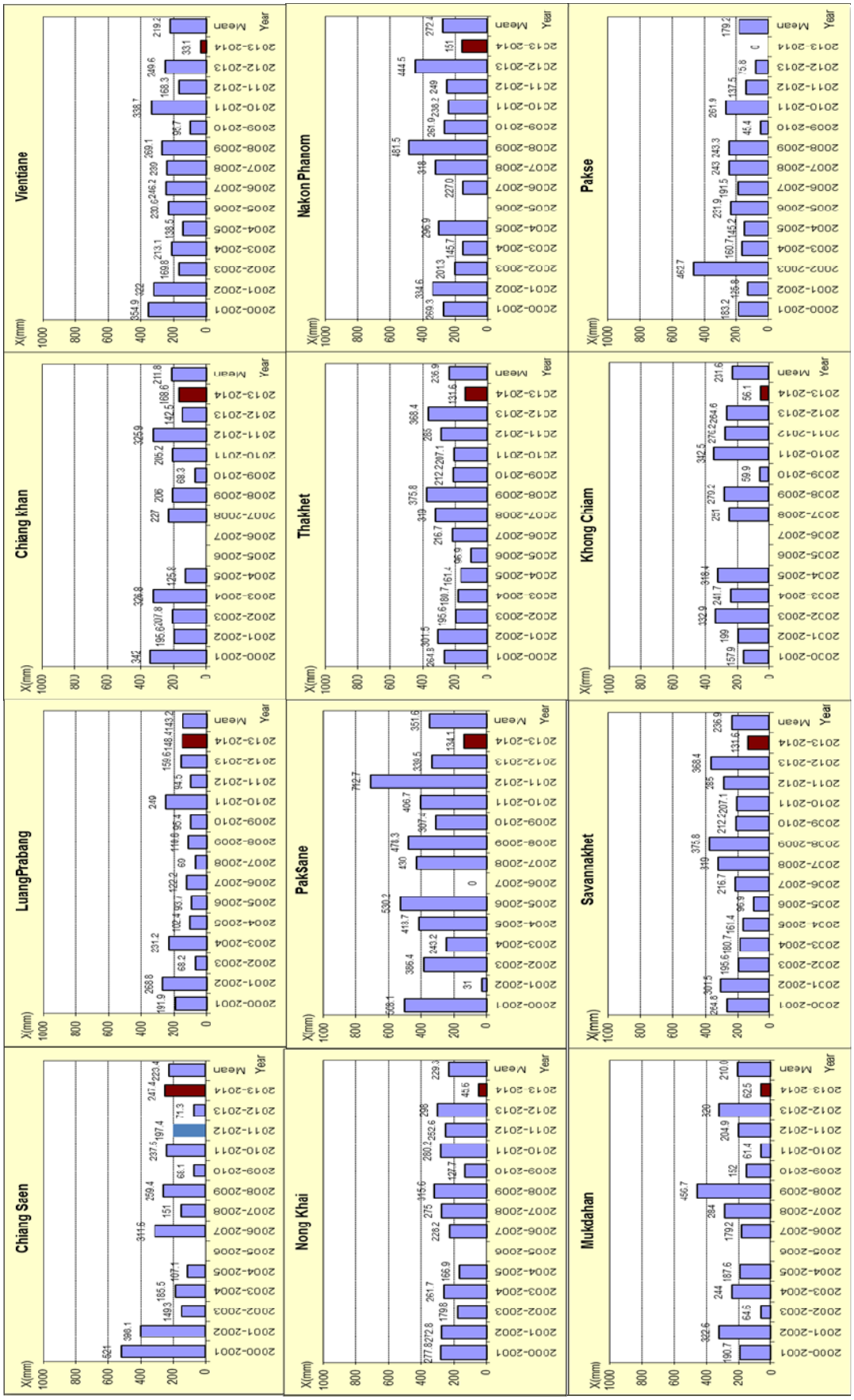
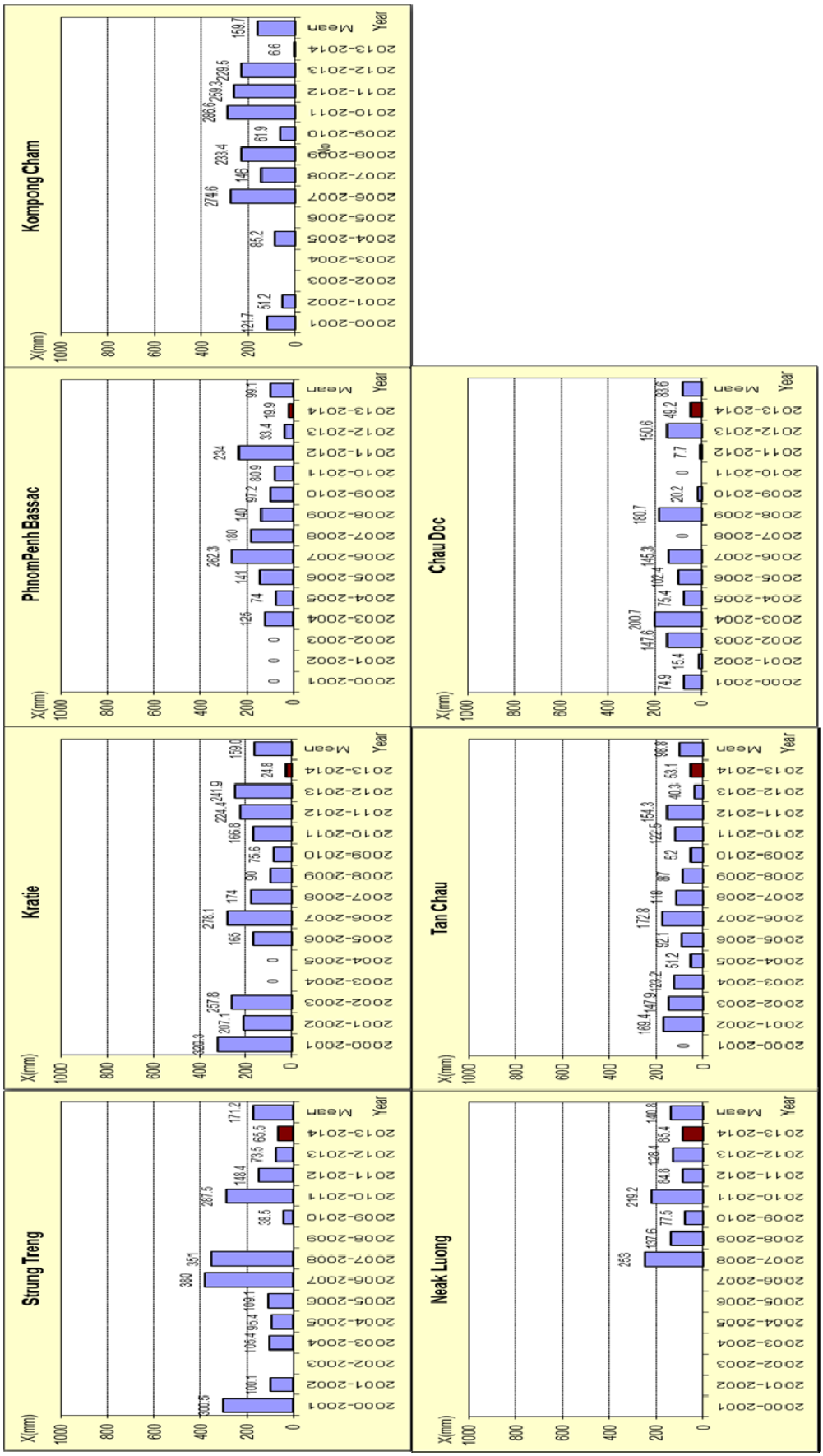


Figure A-10 Monthly rainfall in April for main stations along the Mekong River.



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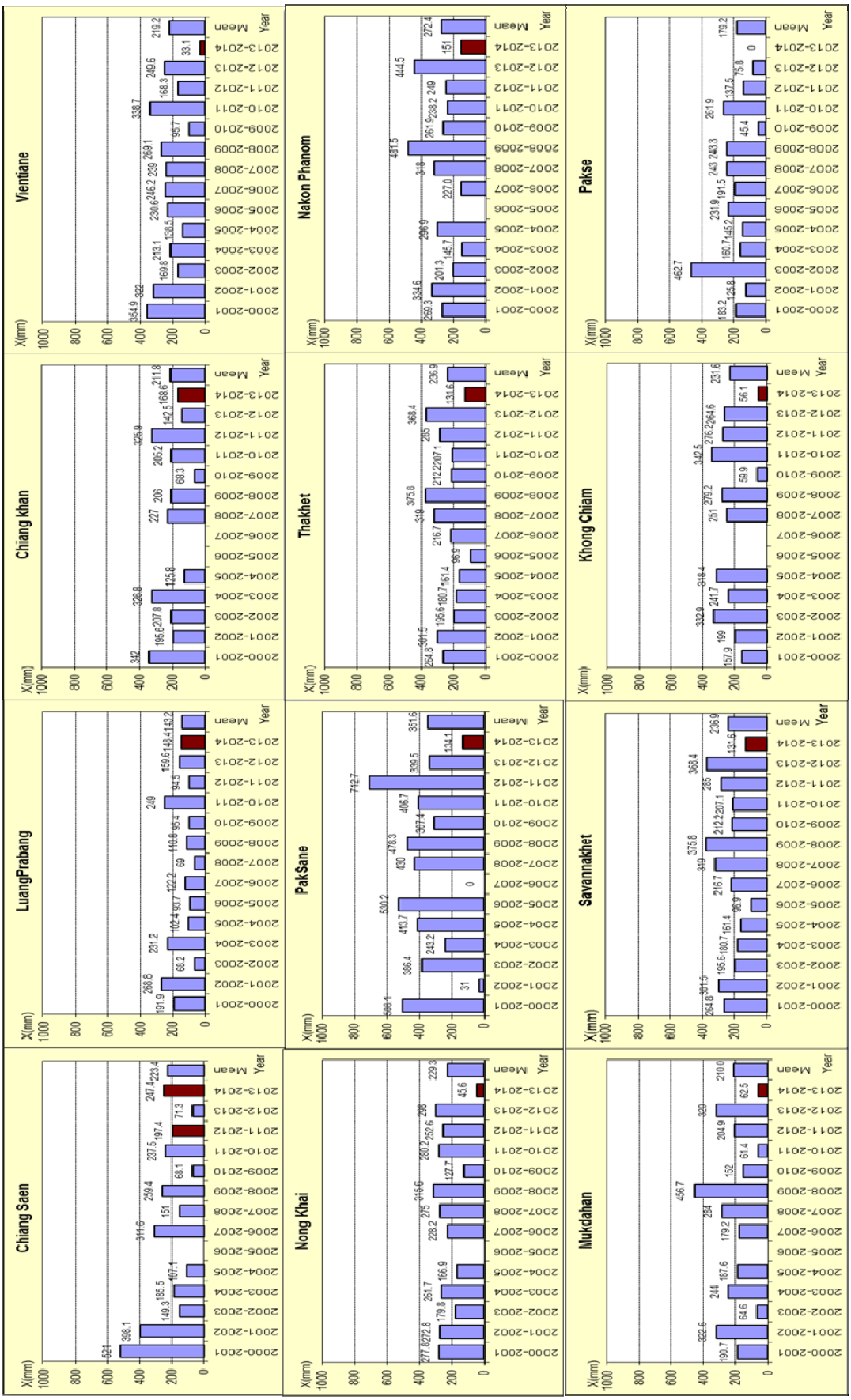


Figure A-11 Monthly rainfall in May for main stations along the Mekong River.

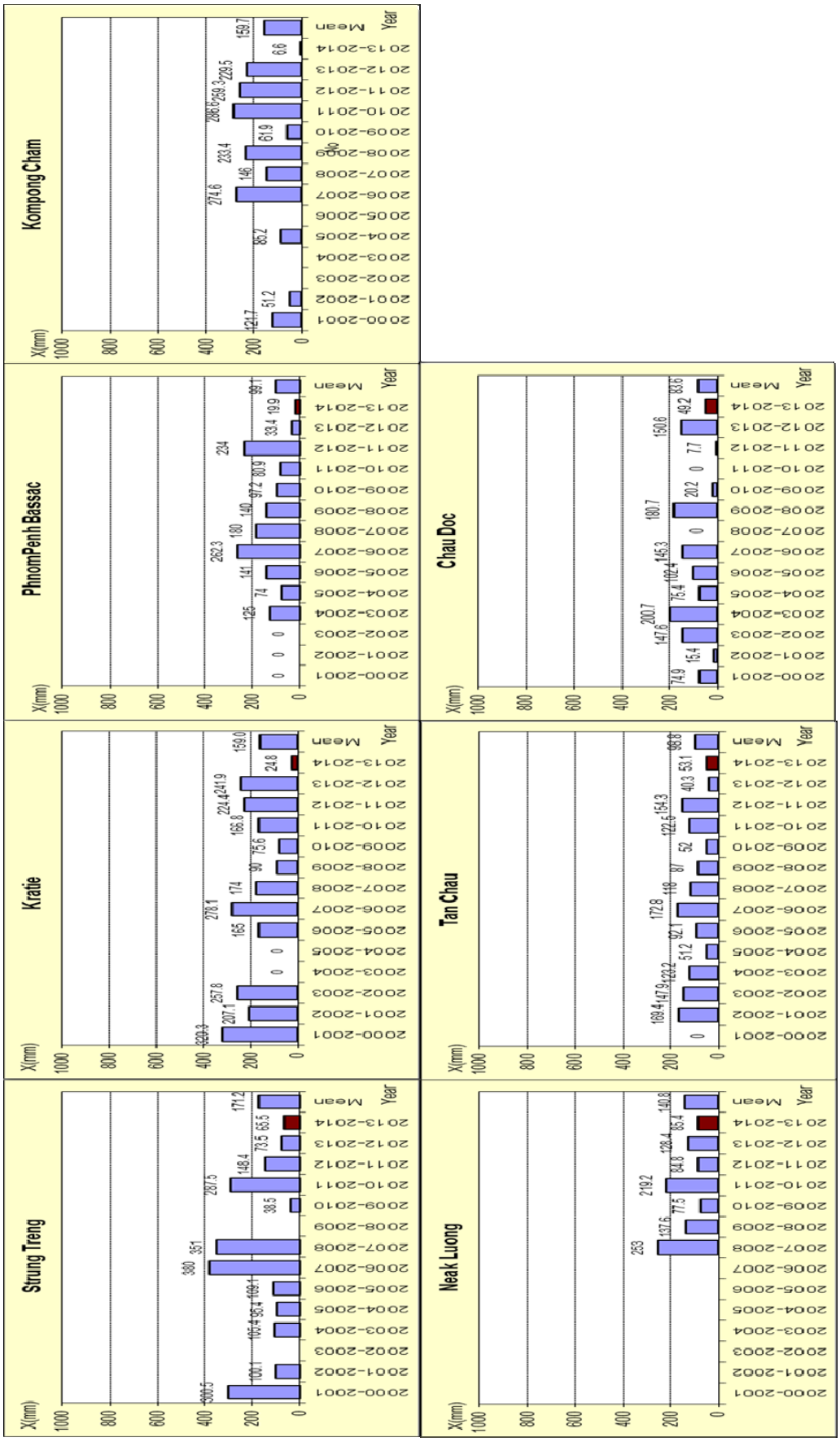


Figure A-11 (cont.)

Annex B Accuracy and performance

Accuracy

"Accuracy" describes the accuracy of the adjusted and published forecast, based on the results of the MRC Mekong Flood Forecasting System, which are then adjusted by the Flood Forecaster in Charge taking into consideration known biases in input data and his/her knowledge of the response of the model system and the hydrology of the Mekong River Basin.

The information is presented as a graph below, showing the average dry forecasting accuracy along the Mekong mainstream.

The graph of average difference between forecast and actual water levels for the whole dry season from the 1st November 2013 to the 31st May 2014 shows the normal pattern.

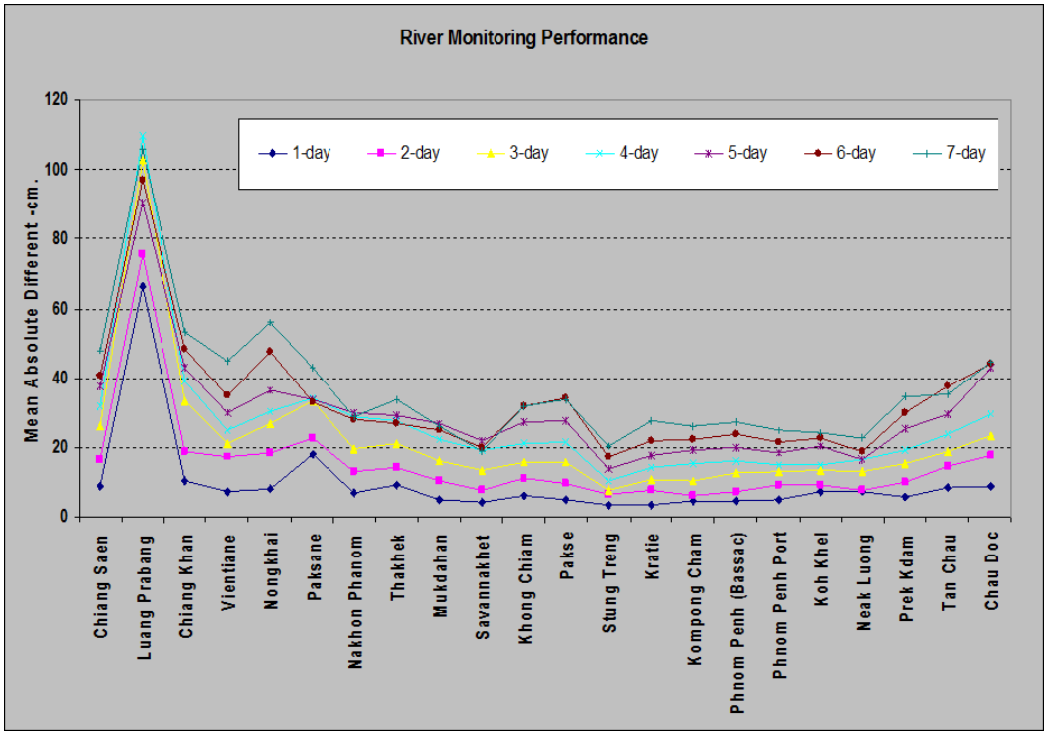


Figure B-1 Mean Absolute Error of River monitoring performance based on URBS-Regression using SRE during 11 November 2013 – 26 May 2014 Dry-seasons.

Forecast Achievement

The forecast achievement indicates the % of days that the forecast at a particular station for a lead-time is successful against a respective benchmark (Table B-2).

Table B-1 Achievement of daily forecast against benchmarks.

Unit in %

	Chiang Saen	Luang Prabang	Chiang Khan	Vientiane	Nongkhai	Paksane	Nakhon Phanom	Thakhek	Mukdahan	Savannakhet	Khong Chiam	Pakse	Stung Treng	Kratie	Kompong Cham	Phnom Penh (Bassac)	Phnom Penh Port	Koh Khel	Neak Luong	Prek Kdam	Tan Chau	Chau Doc	Average
1-day	96.6	72.4	93.1	72.4	79.3	58.6	72.4	82.8	89.7	89.7	86.2	82.8	96.6	89.7	89.7	93.1	89.7	89.7	75.9	93.1	69.0	69.0	**83.2**
2-day	96.6	75.9	86.2	79.3	75.9	75.9	75.9	82.8	89.7	96.6	89.7	89.7	96.6	96.6	100.0	75.9	65.5	58.6	72.4	58.6	48.3	48.3	**78.8**
3-day	93.1	65.5	86.2	72.4	62.1	65.5	75.9	72.4	82.8	82.8	82.8	79.3	93.1	93.1	96.6	55.2	55.2	48.3	51.7	41.4	44.8	27.6	**69.4**
4-day	96.6	65.5	79.3	89.7	75.9	69.0	82.8	82.8	89.7	93.1	93.1	93.1	96.6	93.1	96.6	37.9	79.3	44.8	86.2	69.0	27.6	13.8	**75.2**
5-day	93.1	72.4	75.9	89.7	75.9	75.9	79.3	79.3	89.7	89.7	82.8	86.2	96.6	89.7	93.1	65.5	69.0	55.2	75.9	51.7	62.1	48.3	**77.1**
6-day	93.1	75.9	75.9	89.7	79.3	82.8	93.1	93.1	96.6	100.0	89.7	93.1	96.6	93.1	93.1	65.5	62.1	55.2	65.5	37.9	44.8	34.5	**77.7**
7-day	89.7	69.0	82.8	82.8	72.4	86.2	96.6	93.1	96.6	100.0	96.6	93.1	93.1	89.7	93.1	51.7	55.2	58.6	62.1	41.4	51.7	24.1	**76.3**

Table B-2 Benchmarks of success (Indicator of accuracy in mean absolute error).

Unit in cm

	Chiang Saen	Luang Prabang	Chiang Khan	Vientiane	Nongkhai	Paksane	Nakhon Phanom	Thakhek	Mukdahan	Savannakhet	Khong Chiam	Pakse	Stung Treng	Kratie	Kompong Cham	Phnom Penh (Bassac)	Phnom Penh Port	Koh Khel	Neak Luong	Prek Kdam	Tan Chau	Chau Doc
1-day	25	25	25	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2-day	50	50	50	25	25	25	25	25	25	25	25	25	25	25	25	25	10	10	10	10	10	10
3-day	50	50	50	25	25	25	25	25	25	25	25	25	25	25	25	10	10	10	10	10	10	10
4-day	75	75	50	50	50	50	50	50	50	50	50	50	50	50	50	10	25	10	25	25	10	10
5-day	75	75	50	50	50	50	50	50	50	50	50	50	50	50	50	25	25	25	25	25	25	25
6-day	100	100	75	75	75	75	75	75	75	75	75	75	75	75	50	25	25	25	25	25	25	25
7-day	100	100	100	75	75	75	75	75	75	75	75	75	75	75	50	25	25	25	25	25	25	25

Performance

Performance is assessed by evaluating a number of performance indicators, see Table B-3 and Figure B2 – B6.

Table B-3 Overview of performance indicators for dry season 2013 -2014

Dry season 2013 - 2014	Flood Forecast: time sent				Arrival time of input data (average)							Missing data (number)						
	FF completed and sent (time)	stations without forecast	FF2 completed and sent (time)	Weather information available (number)	NOAA data	China	Cambodia - DHRW	Cambodia - DOM	Lao PDR - DMH	Thailand - DWR	Viet Nam - NCHMF	NOAA data	China	Cambodia - DHRW	Cambodia - DOM	Lao PDR - DMH	Thailand - DWR	Viet Nam - NCHMF
Novemver - 2013	11:04	1	-	-	09:15		07:58	07:02	09:06	08:04	07:18	0		2	13	58	0	21
December - 2013	11:43	0	-	-	09:15		09:04	06:59	10:09	09:20	06:59	0		2	0	49	0	80
January - 2014	11:54	1	-	-	09:15		08:34	06:56	09:33	07:08	07:00	0		4	46	560	0	42
Febuary -2014	10:49	5	-	-	09:18		08:55	06:48	09:26	07:11	07:18	1		37	79	736	0	290
March - 2014	10:31	0	-	-	08:30		08:29	07:03	09:03	08:02	07:02	0		14	80	735	0	4
April-2014	10:22	0	-	-	08:12		08:23	06:35	08:52	08:27	08:15	0		19	40	810	0	9
May -2014	10:17	0	-	-	08:07		08:32	07:29	08:24	07:52	07:20	1		27	0	475	0	362
Dry season	10:57	7	-	-	08:50		08:33	06:59	09:13	08:00	07:19	2		105	258	3423	0	808

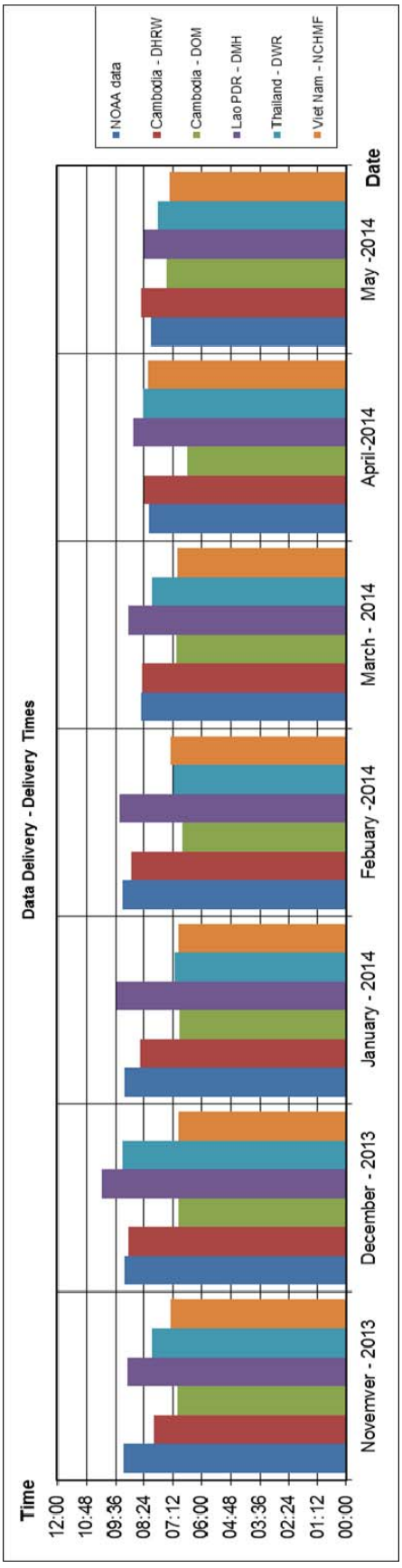


Figure B-2 Data delivery times for dry season 2013 – 2014.

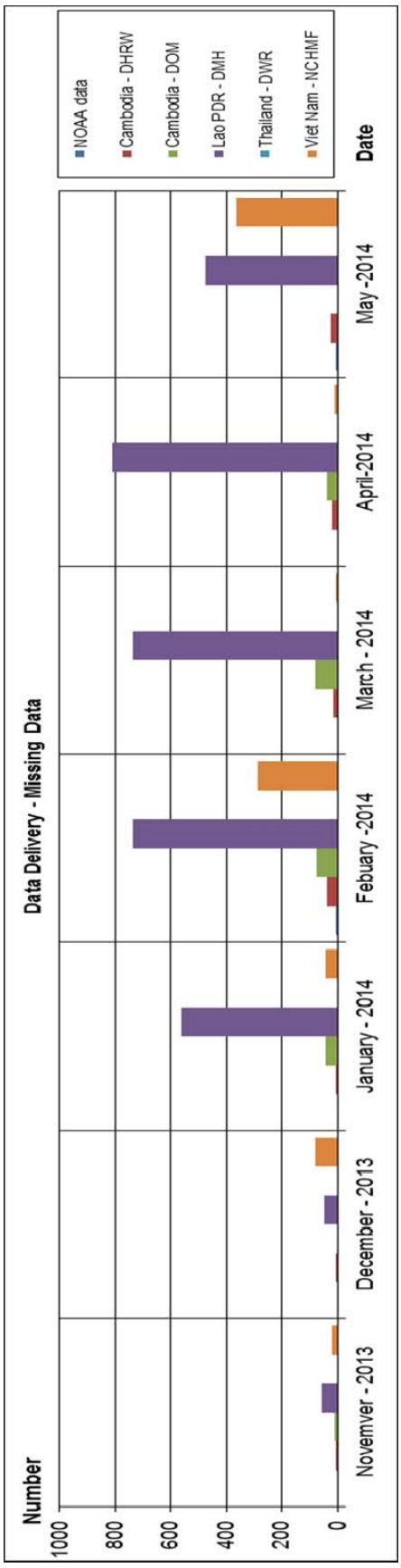


Figure B-3 Missing data for dry season 2013.

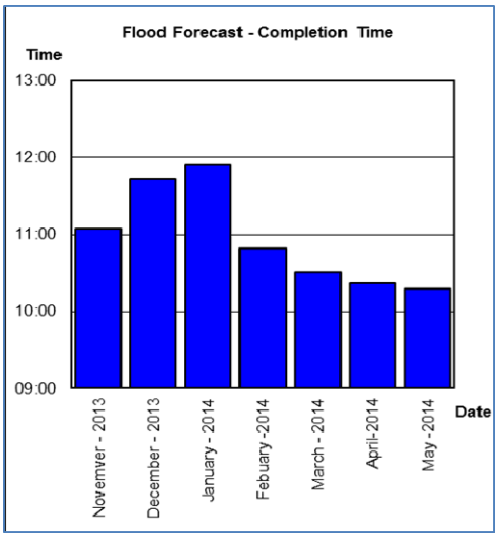


Figure B-4 Dry forecast completion time.

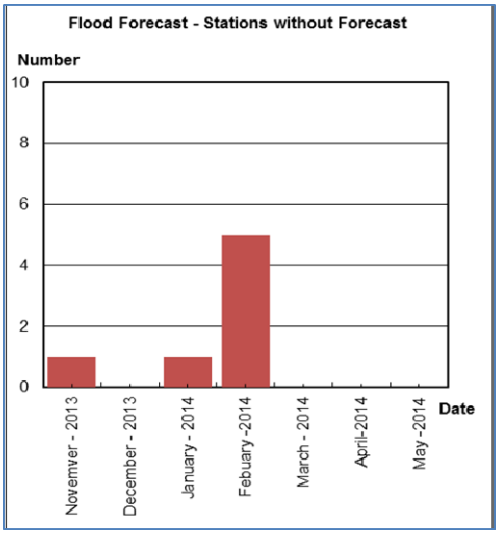


Figure B-5 Dry forecast stations without forecast.

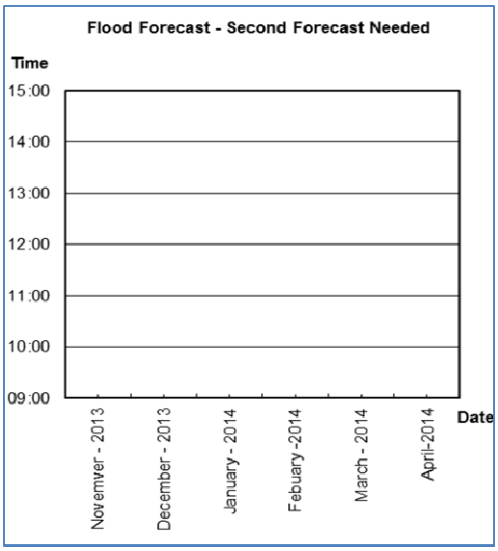
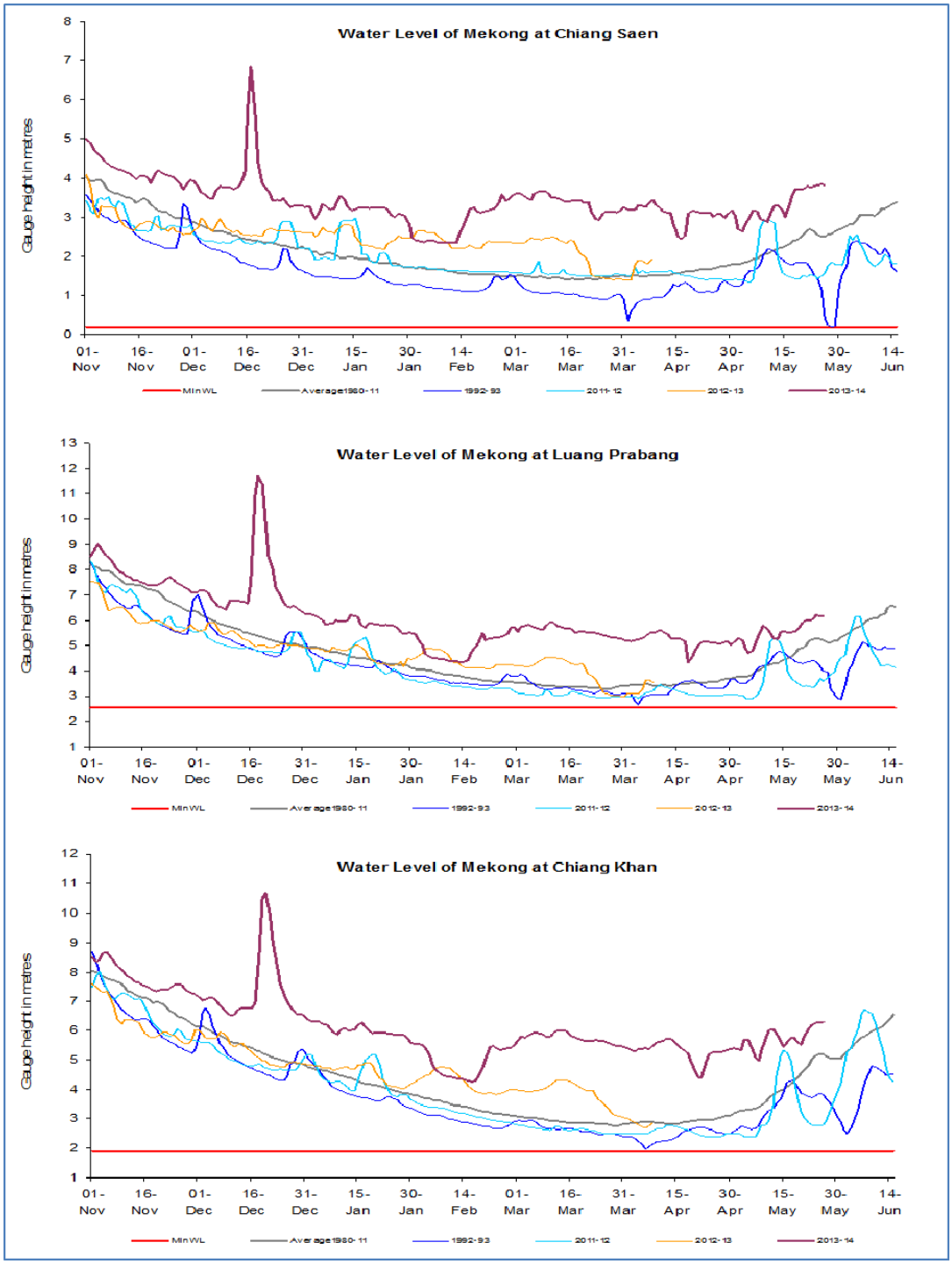
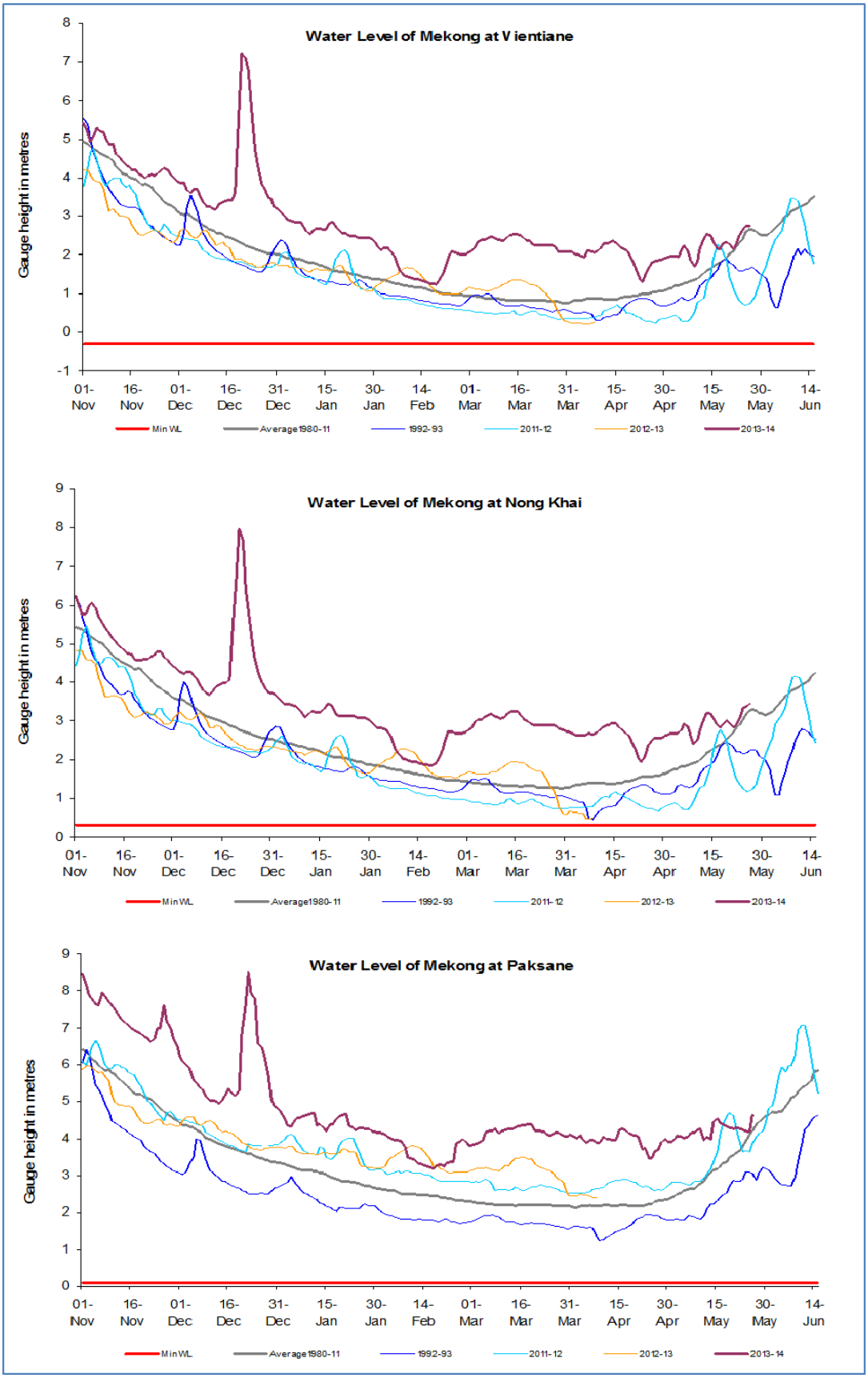


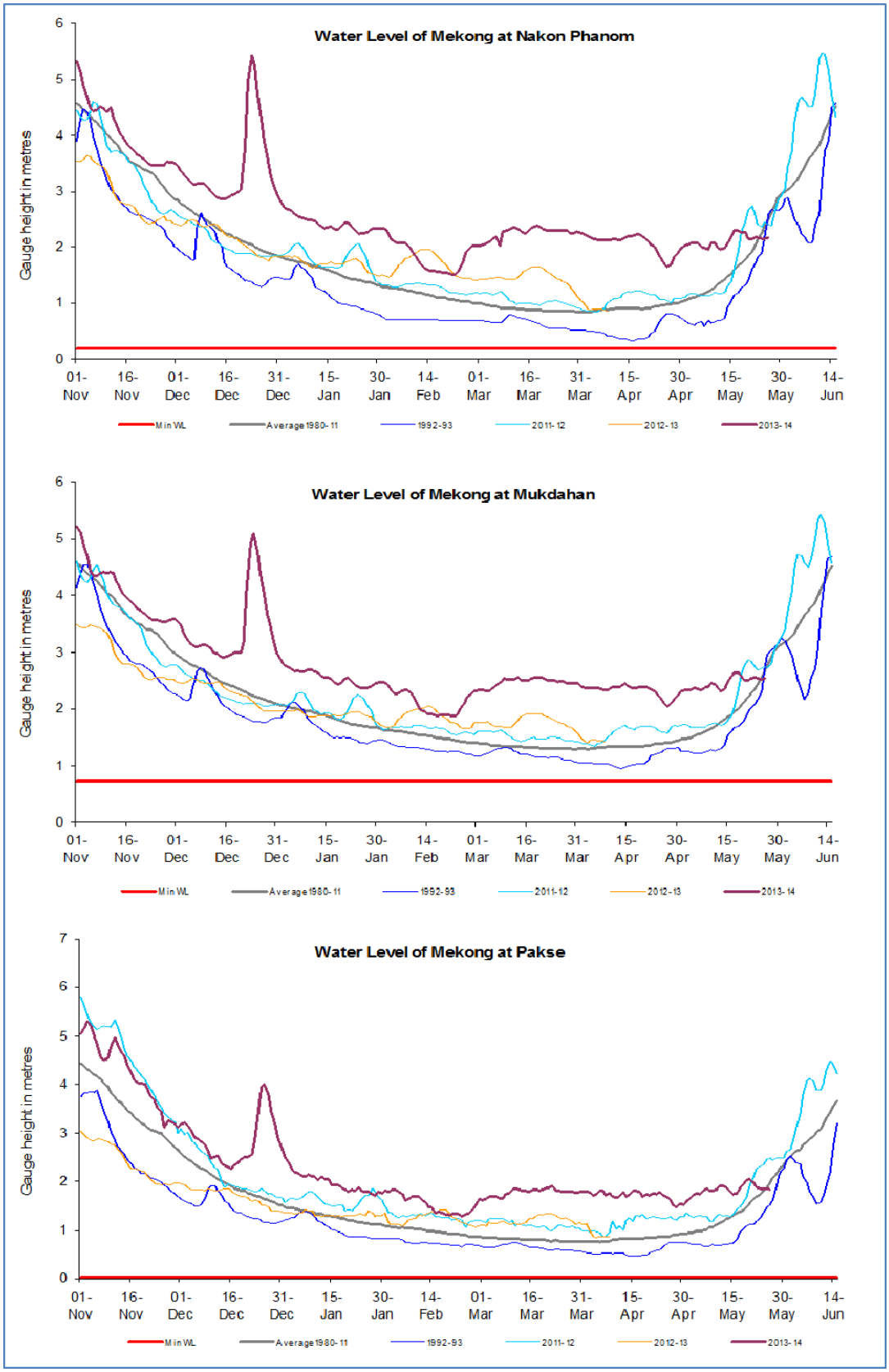
Figure B-6 Second forecast needed.

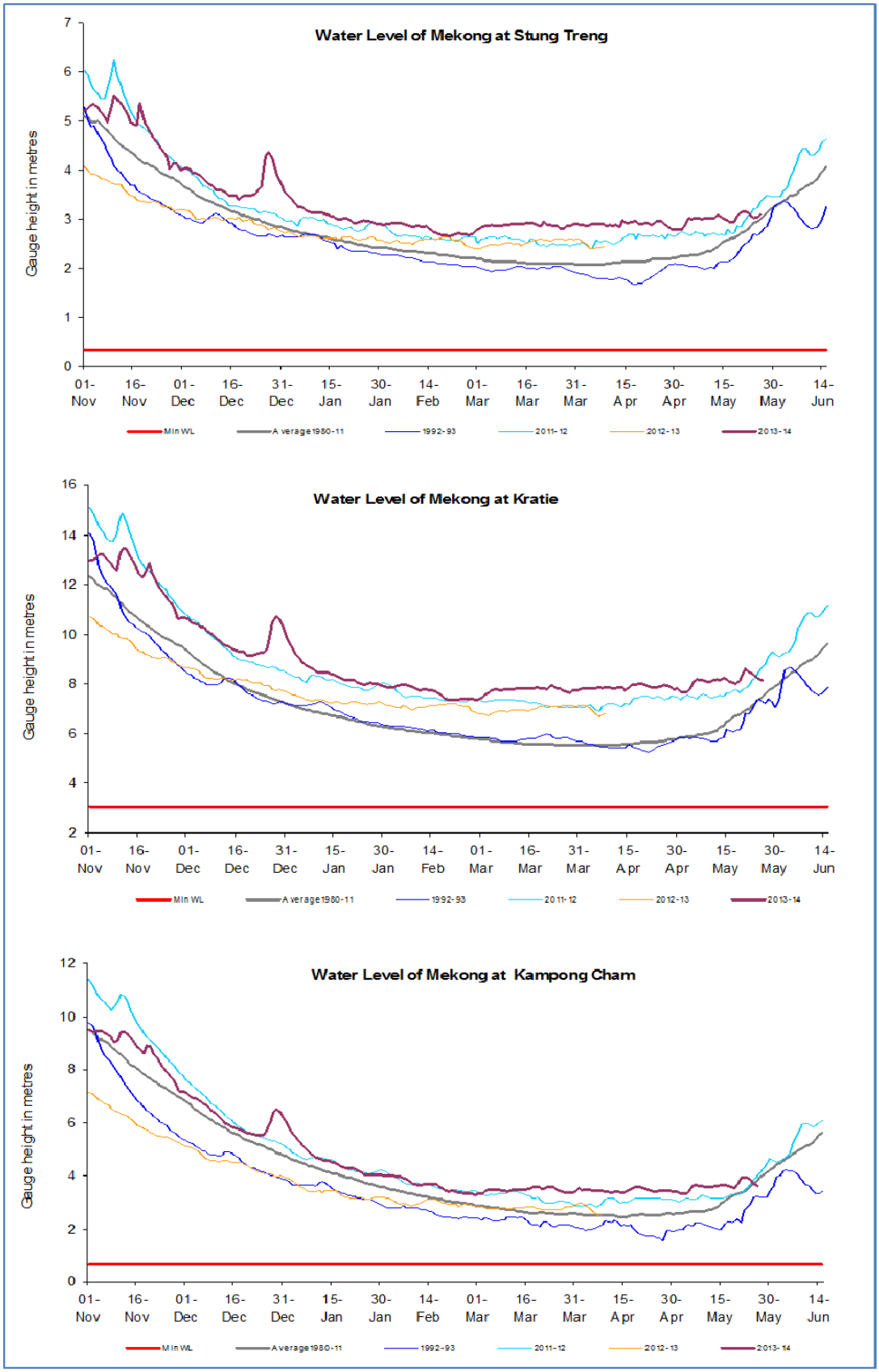
Annex C Season Water Level Graphs

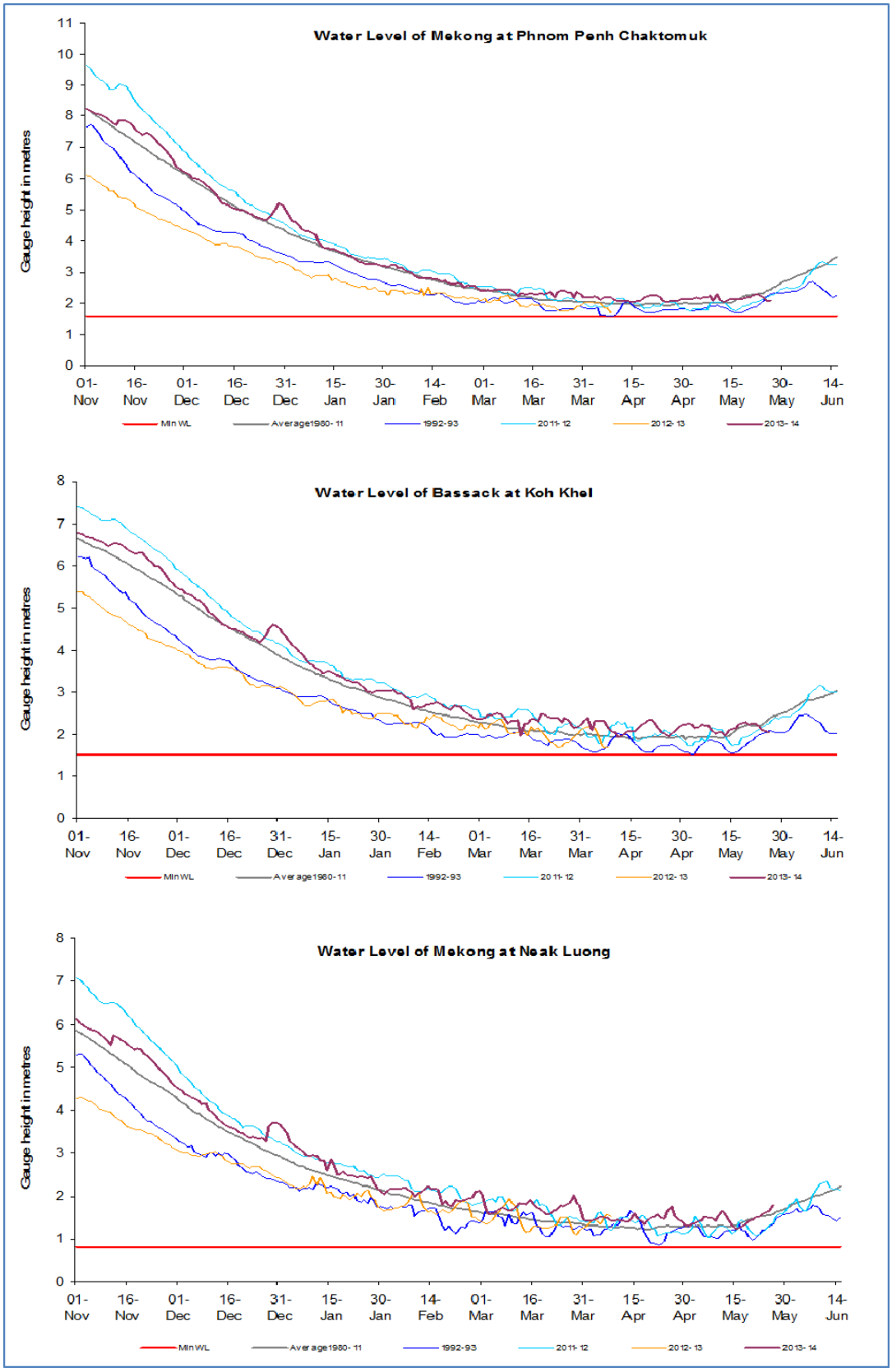
Dry Seasonal Water Level Graphs at Forecast Stations along The Mekong River Mainstream

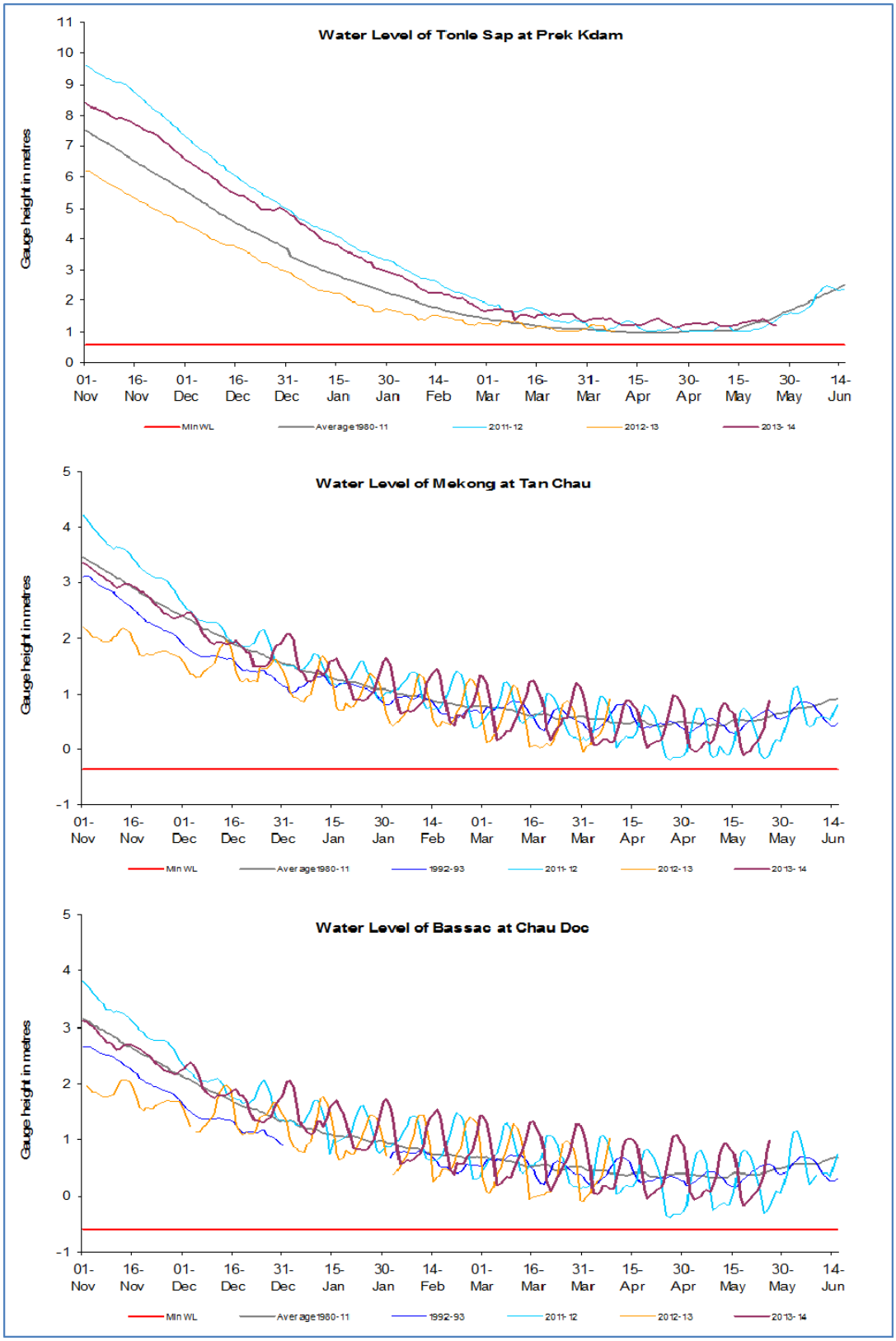



Water Level of Mekong at Vientiane
Gauge height in metres
8
7
6
5
4
3
2
1
0
-1
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Mekong at Nong Khai
Gauge height in metres
9
8
7
6
5
4
3
2
1
0
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Mekong at Paksane
Gauge height in metres
9
8
7
6
5
4
3
2
1
0
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average1980-11
1992-93
2011-12
2012-13
2013-14


Water Level of Mekong at Nakon Phanom
Gauge height in metres
0
1
2
3
4
5
6
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Mekong at Mukdahan
Gauge height in metres
0
1
2
3
4
5
6
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Mekong at Pakse
Gauge height in metres
0
1
2
3
4
5
6
7
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14


Water Level of Mekong at Stung Treng
Gauge height in metres
0
1
2
3
4
5
6
7
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Mekong at Kratie
Gauge height in metres
2
4
6
8
10
12
14
16
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Mekong at Kampong Cham
Gauge height in metres
0
2
4
6
8
10
12
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14


Water Level of Mekong at Phnom Penh Chaktomuk
Gauge height in metres
0
1
2
3
4
5
6
7
8
9
10
11
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Bassack at Koh Khel
Gauge height in metres
0
1
2
3
4
5
6
7
8
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Mekong at Neak Luong
Gauge height in metres
0
1
2
3
4
5
6
7
8
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average1980-11
1992-93
2011-12
2012-13
2013-14


Water Level of Tonle Sap at Prek Kdam
Gauge height in metres
11
10
9
8
7
6
5
4
3
2
1
0
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
2011-12
2012-13
2013-14
Water Level of Mekong at Tan Chau
Gauge height in metres
5
4
3
2
1
0
-1
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14
Water Level of Bassac at Chau Doc
Gauge height in metres
5
4
3
2
1
0
-1
01-Nov
16-Nov
01-Dec
16-Dec
31-Dec
15-Jan
30-Jan
14-Feb
01-Mar
16-Mar
31-Mar
15-Apr
30-Apr
15-May
30-May
14-Jun
Min WL
Average 1980-11
1992-93
2011-12
2012-13
2013-14