Mekong River Commission

Weekly Wet Season Situation Report in the Lower Mekong River Basin

11 -17 July 2023

Prepared by
The Regional Flood and Drought Management Centre
18 July 2023

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Key Messages

Key messages for this weekly report are presented below:

Rainfall and its forecast

- Rainfall focused in the areas from Chiang Saen in Thailand to Tan Chau and Chau Doc in Viet Nam, including the upper, middle and lower parts of the LMB covering Lao PDR and Cambodia, varying from 8.00 millimetres (mm) to 156.40 mm.

- There will be moderate and heavy rainfall for the next 5 days over the Mekong region from 17 to 23 July 2023 although there is no any movement of tropical storm moving towards the Mekong region.

Water level and its forecast

- According to MRC's observed water level at Jinghong, it showed fluctuated water levels from **535.80 m** and **537.30 m** during 11-17 July 2023. The current level is staying about 0.65 m higher than its LTA value. The outflow at Jinghong station varied between 1,220.00 m^3/s and 2,420.00 m^3/s during 11-17 July 2023.

- With the fluctuated outflow from Jinghong upstream and rainfall at catchment inflow, water levels of monitoring stations at Chiang Saen in Thailand decreased about 0.04 m from 11 to 17 July 2023, staying about 1.80 m lower than its LTA level. WLs at Xieng Kok upstream of Chiang Saen decreased about 0.89 m.

- Water level at Chiang Khan in Thailand from 11 to 17 July 2023 increased about 0.17 m and stayed about 2.00 m lower than its LTA value, while water level at Vientiane decreased about 0.56 m staying about 1.35 m lower than its LTA level. Water levels at Nong Khai decreased 0.50 m and stayed about 2.96 m lower than its LTA, while at Paksane it decreased about 0.90 m, staying about 3.54 m lower than its LTA value. Water levels at these stations are still considered low.

- Water levels from Nakhon Phanom to Pakse decreased from 0.22 m to 0.58 m, due to the contribution of low rainfalls and inflows from upstream. The current WLs at these stations are staying lower than their LTA value, considering low levels.

- From the stretches of the river from Stung Treng, Kratie to Kompong Cham, water level increased and still stayed lower than their LTA value, which was also considered low.

- The water volume of the Tonle Sap Lake was lower than its LTA (about 38%) during the same period from 11 to 17 July 2023, which is considered low.

- Water levels from downstream at Chaktomuk, Koh Khel on the Bassac and Phnom Penh Port to Prek Kdam in Cambodia increased and still staying lower than their LTA level.

- The current water levels for stations are lower than their LTA value. WLs at the 2 tidal stations at Tan Chau and Chau Doc were fluctuating and lower than their LTA value, due to tidal effect during this monitoring period, considered critical.

- Over the next five days, the water levels at the upper, middle and lower parts from Chiang Saen to Pakse and those in downstream from Stung Treng down to the Mekong floodplain area are expected to go up due to moderate rainfall and dam operation upstream.

Drought condition and its forecast

- During July 10-16, moderate and severe droughts took place over some areas from the eastern part to the southern part covering **Pailin, Banteay Meanchey, Phrea Vihear, Stung Treng, Luangnamtha, Oudomxay, Luang Prabang, Borikhamxay, Khammuane, Savannakhet, Saravane, Nong Khai, Nakhon Phanom, Ubon Ratchathani, Nong Bua Lamphu, Skon Nakhon, Yasothon, Amnat Charoen, Si Saket, Quang Tri, and Dak Lak**.

- The three-month forecast shows that **July** is likely to be moderately and severely dry over the northern and some southern parts of the LMB. They specifically cover **Chiang Mai, Chiang Rai, Phongsaly, Vientiane, Xaysomboun, Borikhamxay, Nong Khai, Chanthaburi, Pailin, Battambang, Pursat, Kampong Speu, Kom Tum, Gia Lai, Dak Lak, Kien Giang, and Ca Mau**. **August** is likely to be moderately and severely dry over some area of the north and south-eastern LMB. They cover **Vientiane, Khammuane, Savannakhet, Saravane, Sekong, Champasack, Attapeu, Kon Tum, Gia Lai, Ratana Kiri, Stung Treng, Kratie, Kampong Cham, Mondul Kiri, Dak Lak, and Lam Dong**. While in **September**, drought is forecasted to be from moderate to exceptional drought covering eastern and southeastern LMB including **Chaiyaphum, Nakhon Ratchasima, Burirum, Surin, Sa Kaeo, Ordar Meanchey, Banteay Meanchey, Siem Reap, Preah Vihear, Kampong Thom, Chantaburi, Pailin, Battambang, Pursat, Kampong Chhnang, Kampot, Kampong Spue, Takeo, Kandal, Prey Veng, Kampong Cham, Kratie, Prey Veng, Svay Rieng, Tay Ninh, Kien Giang, Ca Mau, Bac Lieu, and Soc Trang**.

1 Introduction

This Weekly Wet Season Situation Report presents a preliminary analysis of the weekly hydrological and drought situation in the Lower Mekong River Basin (LMB) for the period from **11 to 17 July 2023**. The trend and outlook for water levels are also presented.

This analysis is based on the daily hydro-meteorological data provided by the Mekong River Commission (MRC) Member Countries (MCs) – Cambodia, Lao PDR, Thailand, and Viet Nam – and on satellite data. All the water levels indicated in this report refer to an above zero gauge of each station.

The report covers the following topics that are updated weekly:

- General weather patterns, including rainfall patterns over the LMB
- Water levels in the LMB, including in the Tonle Sap Lake
- Flash flood and drought situation in the LMB
- Weather, water level and flash flood forecast, and
- Possible implications.

Mekong River water levels are updated daily and can be accessed from:
http://ffw.mrcmekong.org/bulletin_wet.php.

Drought monitoring and forecasting information is available at:
http://droughtforecast.mrcmekong.org

Flash flood information is accessible at: http://ffw.mrcmekong.org/ffg.php

2 General Weather Patterns

The weather outlook bulletins for three months (July, August and September) and the weather maps issued by the Thai Meteorological Department (TMD) were used to verify weather conditions in the LMB.

Since the beginning of July 2023, moderate rainfall has dropped over the LMB with increasing trend of water levels in both mainstream and tributaries. The data from the TMD predict that between July and August 2023, moderate high-pressure system from China will extend to upper Thailand and the East-Sea of Viet Nam. Moderate rains, strong wind and decreasing temperature are likely to take place in the upper part of LMB. Temperature will decrease in the northeast and then move to other places of the region. The monsoon trough lies across the middle and the lower parts of the south throughout the period with rainfall and isolated heavy rains in the south.

Figure 1 presents the weather map during 10-13 July 2023, indicating that a low-pressure cell was active in the East-Sea of Viet Nam, having rainfall impact on the LMB area. Generally, the Mekong region was influenced by the southwest monsoon wind with remote influence from the active low-pressure system in the Philippines. Under this weather condition, moderate to heavy rainfall occurred over most parts of central and southern LMB, especially over Vientiane area of Lao PDR, the 3S area, the whole of Cambodia, southern highlands of Viet Nam, and the delta area.

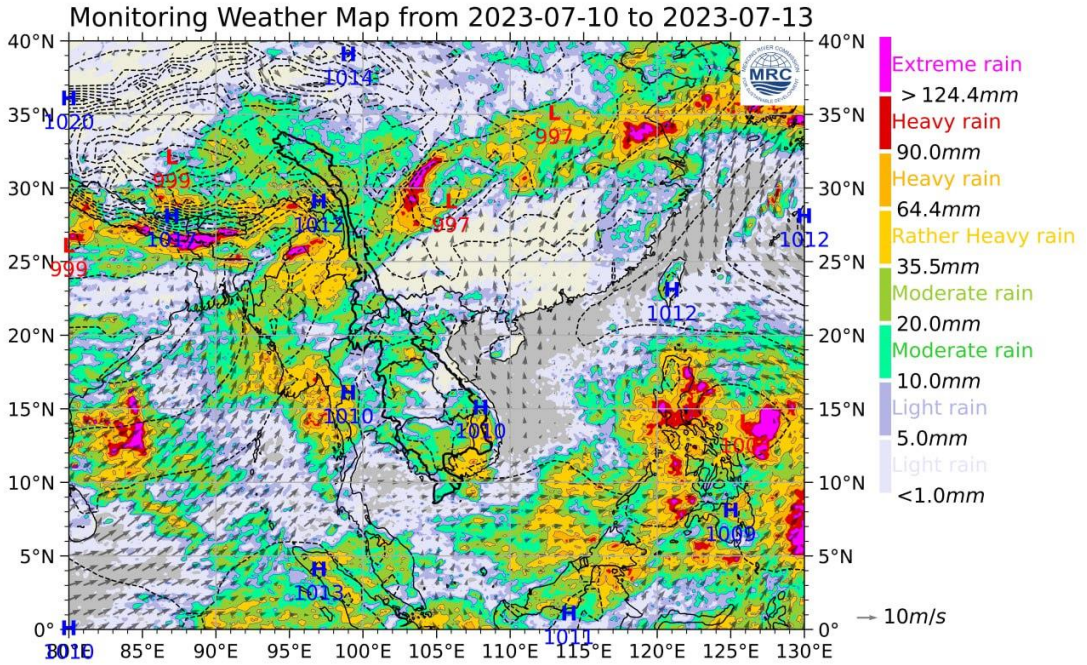


Figure 1. Summary of weather conditions over the LMB.

According to the ASEAN Specialised Meteorological Centre (ASMC), the highest probability of warm and wet conditions is predicted over the lower part of the Mekong region from 10 to 23 July 2023. Therefore, the Mekong region is likely dominated by warm conditions, which may bring more rainfall and warm temperatures in general to the upper and lower parts of the LMB. **Figure 2** shows the outlook of weather condition from 10 to 23 July 2023 in Southeast Asia based on results from the NCEP model (National Centres for Environmental Prediction).

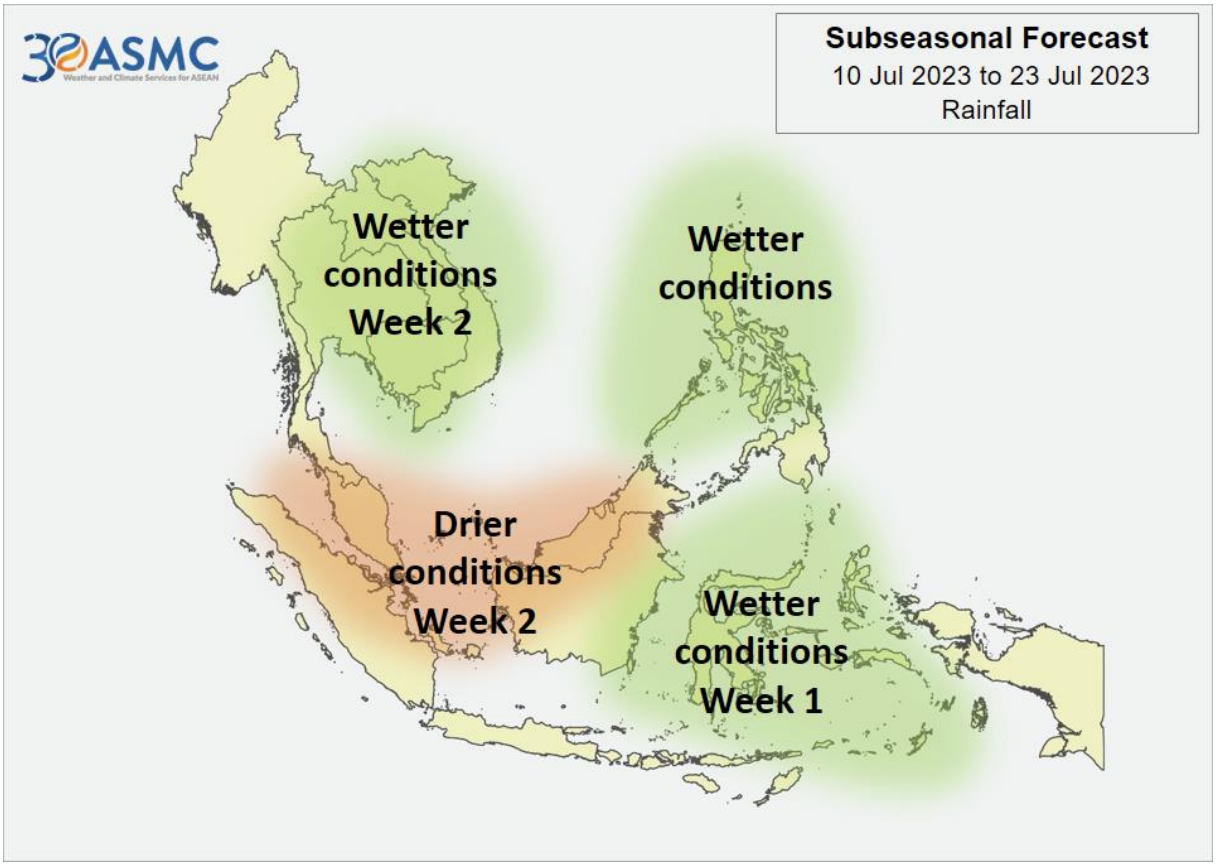


Figure 2. Outlook of wet and dry conditions over the Asian countries by ASMC.

2.1 Tropical depressions (TD), tropical storms (TS) and typhoons (TY)

There was no movement of any storm from the sea to the LMB between 11 and 17 July 2023. No low-pressure line was observed over the Mekong region as shown in Figure 1. The active system for the LMB on 17 July is displayed in Figure 3.

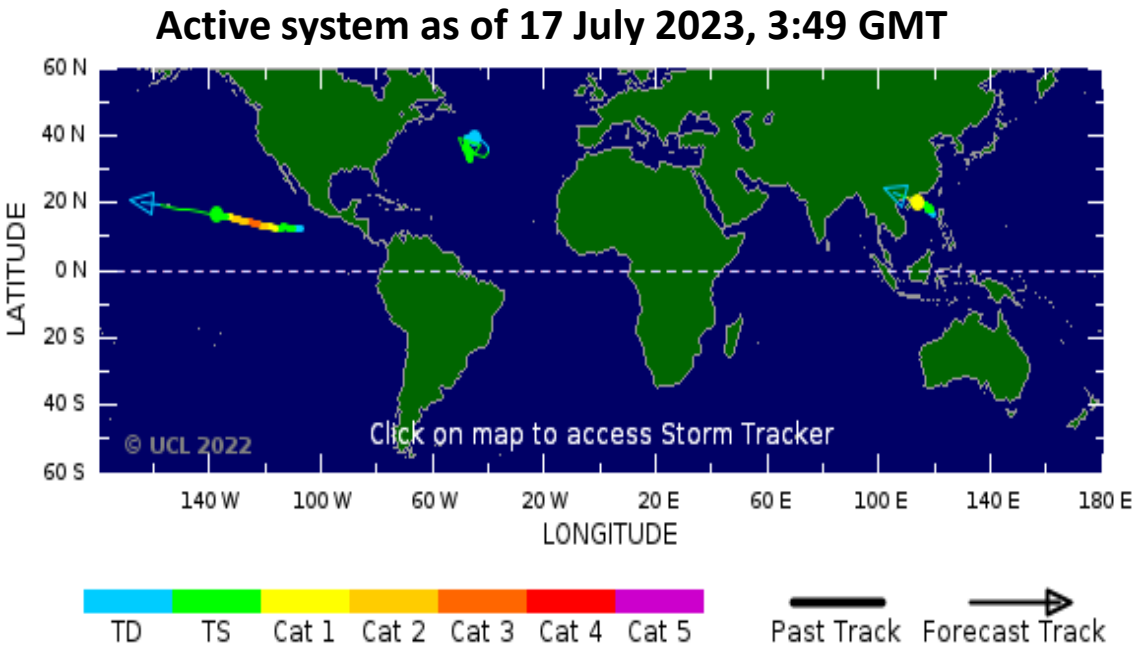


Figure 3. A tropical depression risk observed on 17 July 2023.

2.2 Rainfall patterns over the LMB

This week from 11 to 17 July 2023, rainfall was observed at the key stations along the mainstream from Chiang Saen in Thailand to the lower part at Stung Treng in Cambodia and Tan Chau and Chau Doc in Viet Nam of the Lower Mekong Basin, varied from 8.00 mm to 156.40 mm. The highest rainfall of this week report was recorded at Pakse in Lao PDR which reached to 156.40 mm. The total rainfall of this week report in the Mekong region, compared with last week and its long-term-average (LTA) is showed in Figure 4. The total rainfall of this week was considered high in some parts of the LMB, compared with its last week rainfall in most of the stations.

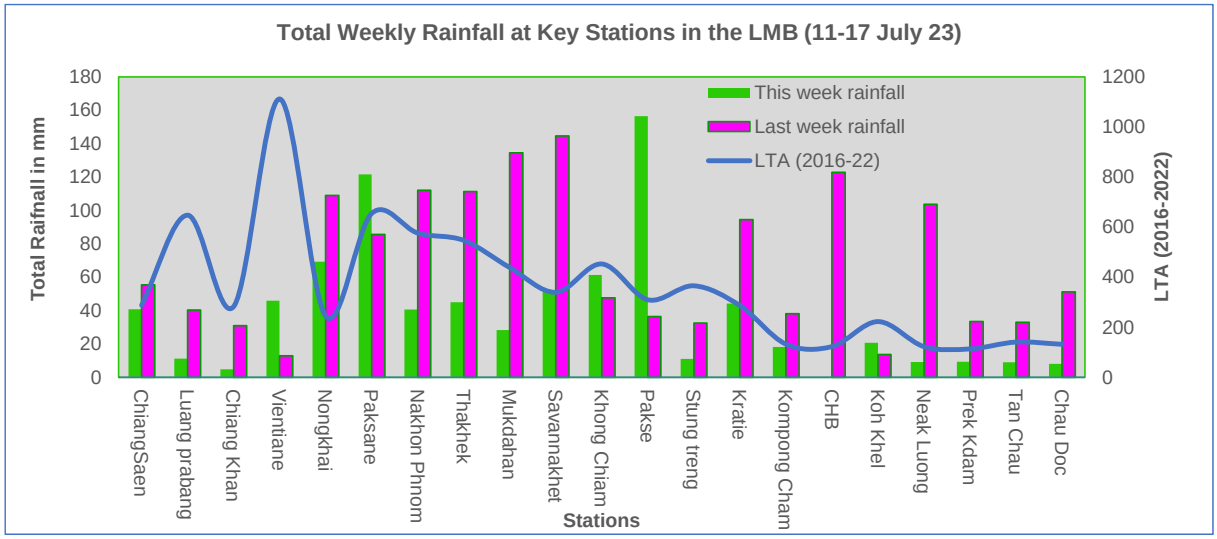


Figure 4. Weekly total rainfall at key stations in the LMB during 11-17 July 2023.

To verify area rainfall distribution, Figure 5 shows a map of the weekly accumulated rainfall based on observed data provided by the MRC Member Countries – Cambodia, Lao PDR, Thailand, and Viet Nam – from 11 to 17 July 2023.

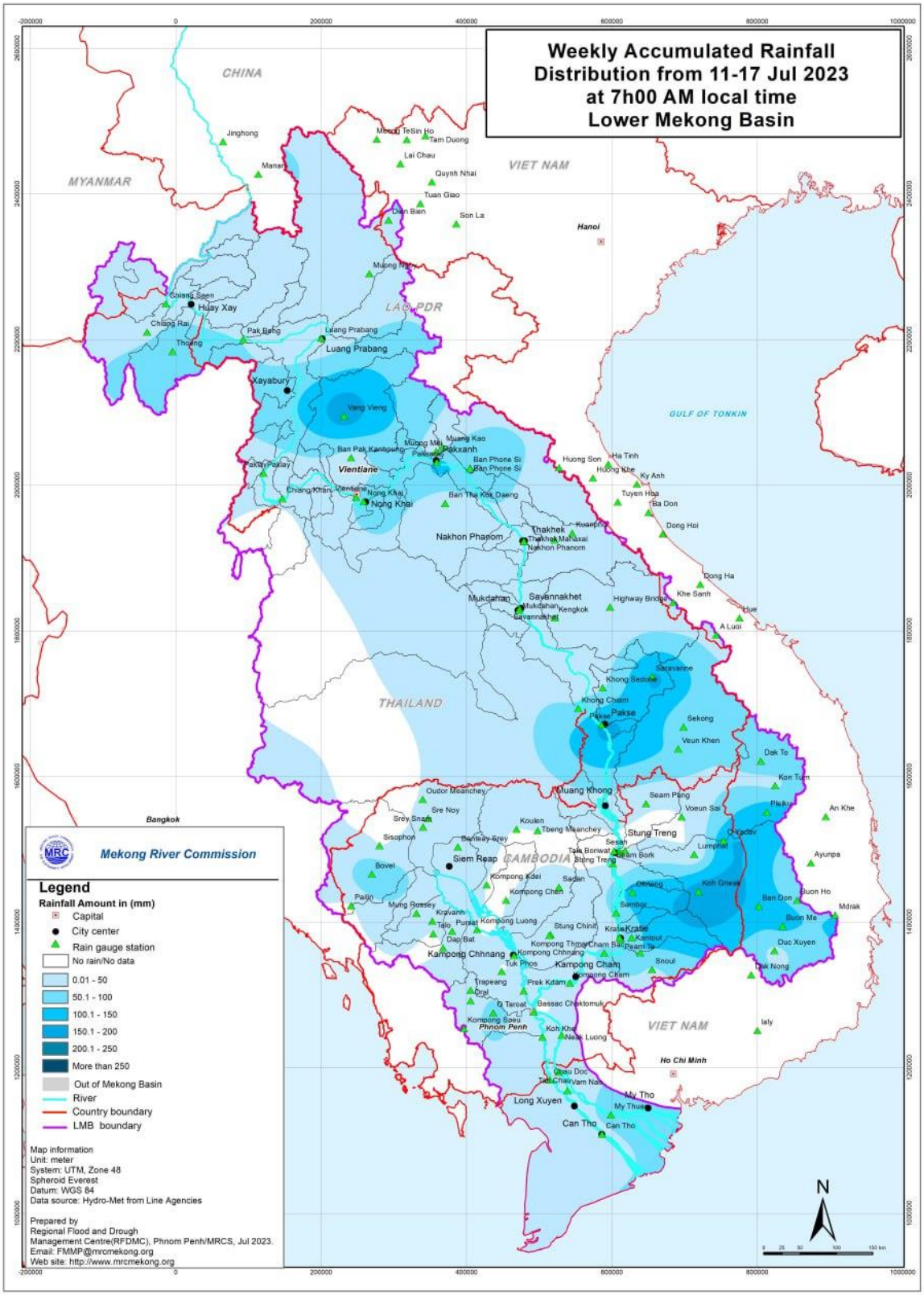


Figure 5. Weekly rainfall distribution over the LMB during 11-17 July 2023.

3 Water Levels in the Lower Mekong Basin

The hydrological regimes of the Mekong mainstream are illustrated by recorded water levels and flows at key mainstream stations: at Chiang Saen in Thailand to capture mainstream flows entering from the Upper Mekong Basin (UMB); at Vientiane in Lao PDR to present flows generated by climate conditions in the upper part of the LMB; at Pakse in Lao PDR to investigate flows influenced by inflows from the larger Mekong tributaries; at Kratie in Cambodia to capture overall flows of the Mekong Basin; and at Viet Nam's Tan Chau and Chau Doc to monitor flows to the Delta.

The key stations along the LMB and their respective model application for River Flood Forecasting during the wet season from June to October and River Monitoring during the dry season from November to May are presented in Figure 6. The hydrograph for each key station is available from the MRC's River Flood Forecasting: http://ffw.mrcmekong.org/overview.php. The weekly water levels and rainfall at each key station are summarised in Annex A.

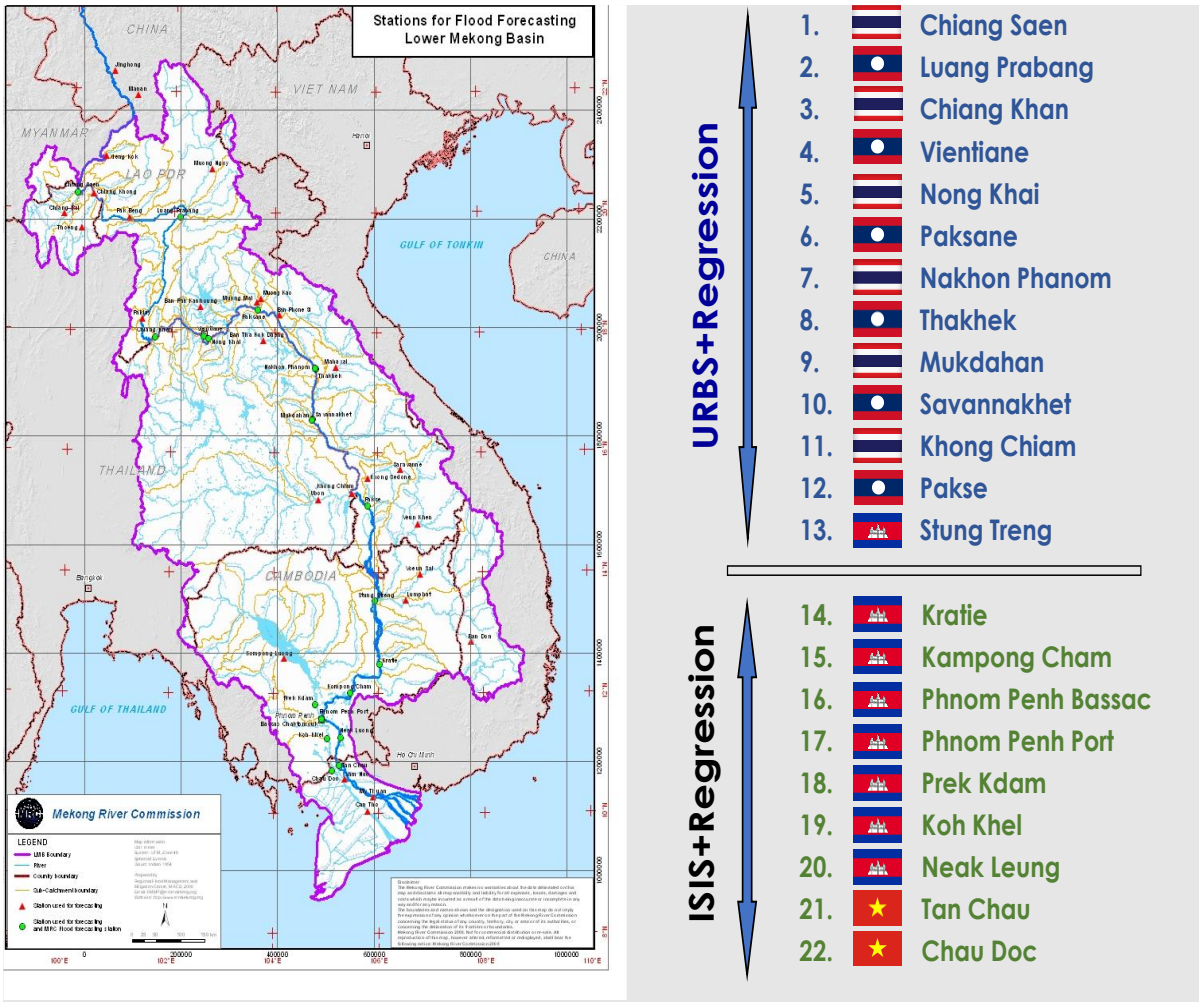


Figure 6. Key stations and model application for River Monitoring and Flood Forecasting.

According to MRC's observed water level at Jinghong, it showed fluctuated levels between **537.28 m** and **535.80 m** during 11-17 July 2023 (recorded on 7:00 am). The current level is staying about 0.44 m lower than its maximum level (max: 2015-2022) value. The outflow at Jinghong station varied from 1,220.00 m^3/s to 2,290.00 m^3/s between 11 and 17 July 2023. Figure 7 below presents water level that fluctuated at the Jinghong hydrological station[1], indicating the trend of fluctuating water level up to 17 July 2023.

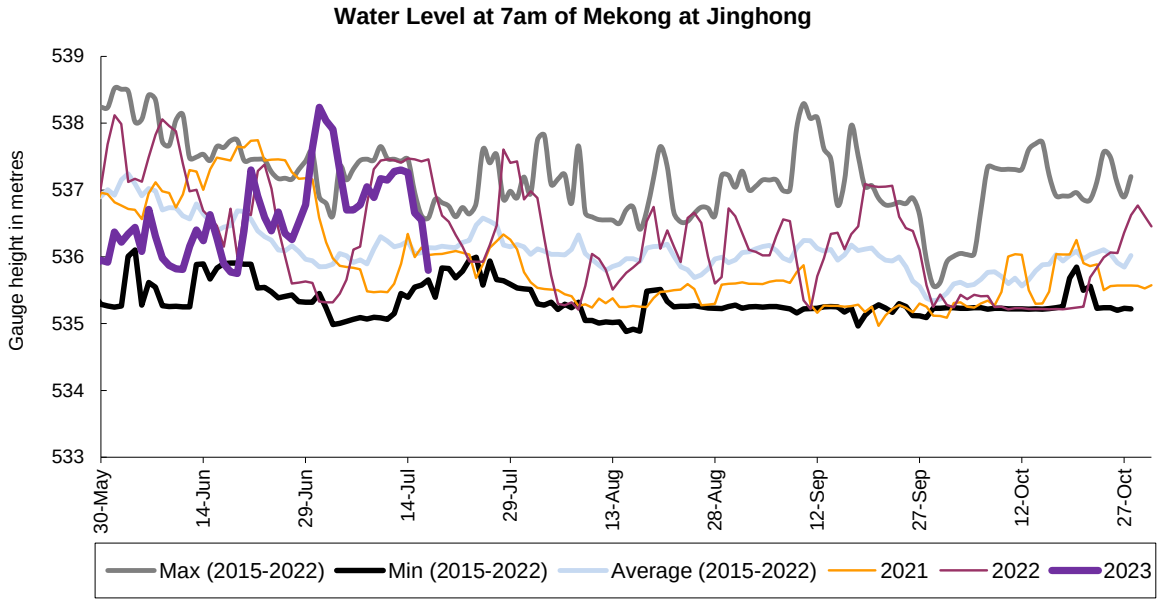


Figure 7. Water level at the Jinghong hydrological station up to 17 July 2023.

With the fluctuated outflow from Jinghong upstream, water levels of monitoring stations at Xieng Kok in Lao PDR, upper of Chiang Saen, significantly decreased about 0.89 m; while at Chiang Saen in Thailand it showed a decrease of about 0.04 m from 11 to 17 July 2023, staying about 1.80 m lower than its LTA level, which considered low.

Water level at Chiang Khan in Thailand from 11 to 17 July 2023, however, increased about 0.17 m and stayed about 2.00 m lower than its LTA value; while water level at Vientiane station decreased about 0.56 m and stayed about 1.35 m lower than its LTA level, which was still **considered a low water level**. Water levels at Nong Khai decreased 0.50 m and at Paksane it increased about 0.90 m, but still staying about 2.96 m and 3.54 m lower than their LTA value respectively, **which was considered low level**.

Water levels from Nakhon Phanom in Thailand to Pakse in Lao PDR decreased between 0.22 m and 0.65 m. The current WLs at these stations are staying lower than their LTA level, **considered low**. From the stretches of the river at Stung Treng, WL increased 0.07 m and stayed about 1.70 m lower than its LTA, while at Kratie water level was up about 0.04 m, staying 3.55 m lower than its LTA level, **considered low.**

Water level at Kompong Cham was up about 0.02 m and stayed 3.98 m lower than its LTA value. Water levels at Chaktomuk, Koh Khel, Phnom Penh Port and Prek Kdam in Cambodia

[1] Near-real time data of hydro-meteorological monitoring at the Jinghong hydrological station is available at https://portal.mrcmekong.org/monitoring/river-monitoring-telemetry.

were down between 0.18 and 0.47 m, but WLs at these stations were remaining lower than their LTA level, **considered low**.

Water levels at all stations along the Mekong River are staying lower than their LTA value, except at Luang Prabang the WL is staying close to its LTA value during this week report. The tidal stations at Chau Doc have WL lower than their LTA value, due to tidal effect during this monitoring period.

Based on hydrological phenomenon, the contribution of inflow water from the upstream of Lancang-Mekong in China to the Mekong mainstream is from 16% to 18% in total during the wet season from June to October. The whole inflow of water into the LMB is influenced by rainfall at the Mekong mainstream and its tributaries during the wet season.

Chiang Saen and Luang Prabang

The water level from 11 to 17 July 2023 at Thailand's Chiang Saen station decreased from 3.40 m to 3.36 m, showing 1.80 m lower than its Long-Term-Average (LTA) value, which considered low. The water level at Luang Prabang station in Lao PDR was up about 0.64 m from 9.44m to 10.08 m during the reporting period. This level shows 0.78 m lower than its LTA. The trend – sometimes higher or lower to its historical maximum and LTA values – has been observed since early of 2022. The phenomenon was potentially caused by upstream dam operations, downstream Xayaburi dam, and heavy rainfall in the surrounding areas. The water levels at Chiang Saen and Luang Prabang are shown in Figure 8 below.

Being situated between the upstream (Nam Beng, Nam Ou, Nam Suong, and Nam Khan) and downstream (Xayaburi) hydropower dams, the Luang Prabang station has a unique characteristic as it is influenced by the operations of all its surrounding dams. **Thus, the water level at this station can possibly change very rapidly during the early of wet and dry season**.

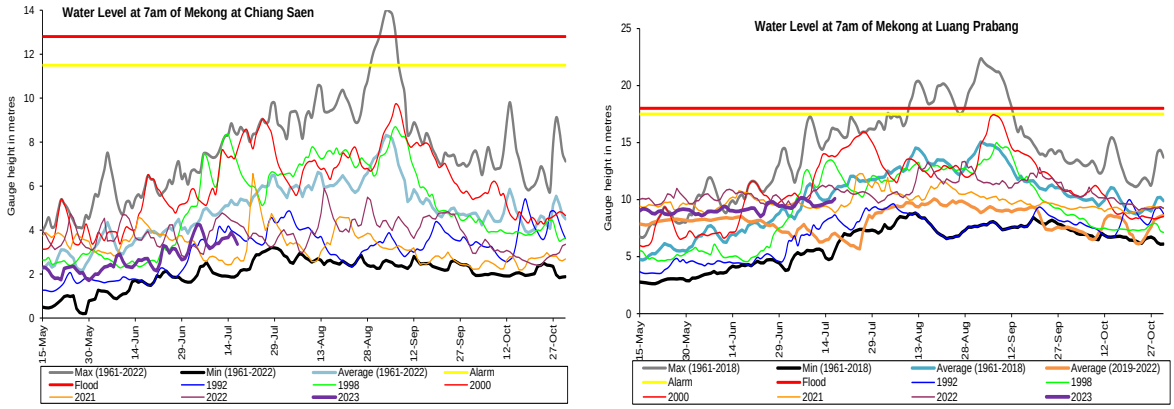


Figure 8. Water levels at Chiang Saen in Thailand and Luang Prabang in Lao PDR.

Chiang Khan, Vientiane-Nong Khai and Paksane

The water level at Chiang Khan in Thailand (downstream of the Xayaburi dam) increased about 0.17 m staying about 2.00 m lower than its LTA value, also at Vientiane in Lao PDR it decreased about 0.56m and showed about 1.35 m lower than its LTA during the reporting week of 11-17 July 2023. At Nong Khai station in Thailand, the water level was down about 0.50 m from 4.02

m to 3.52 m, staying about 2.96 m lower than its LTA value, during the reporting period. At Paksane in Lao PDR, water level significantly decreased about 0.90 m from 5.61 m to 4.71 m. The water level at this station was about 3.54 m lower than its LTA value. The recently decreased water levels were obviously due to the low-average rainfall contributed from the sub-catchment area along with the less inflows and water stored at upstream part. The water levels at Vientiane and Paksane are shown in Figure 9 below.

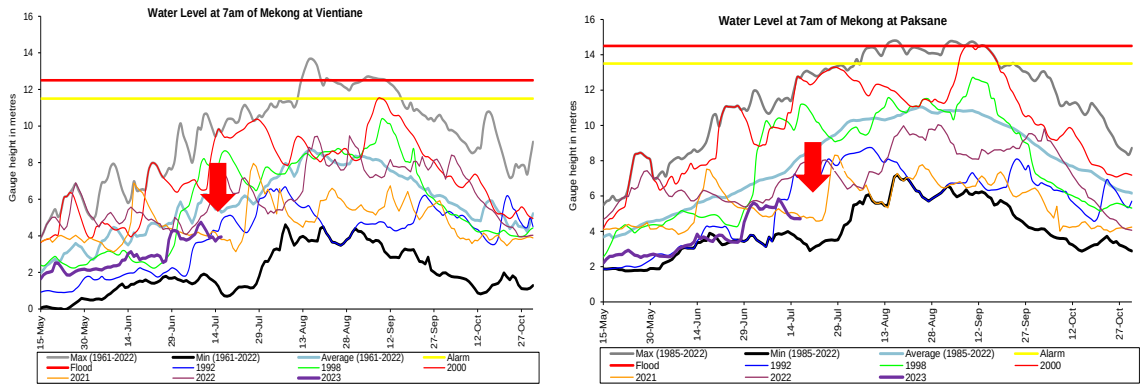


Figure 9. Water levels Veintiane and Paksane in Lao PDR.

Nakhon Phanom to Pakse

The water levels at Nakhon Phanom in Thailand to Pakse in Lao PDR decreased between 0.22 m and 0.65 m. Based on the observation, water levels at these stations are still staying lower than their LTA value, which **considered low levels**. Figure 10 shows the water levels at Nakhon Phanom and Pakse stations.

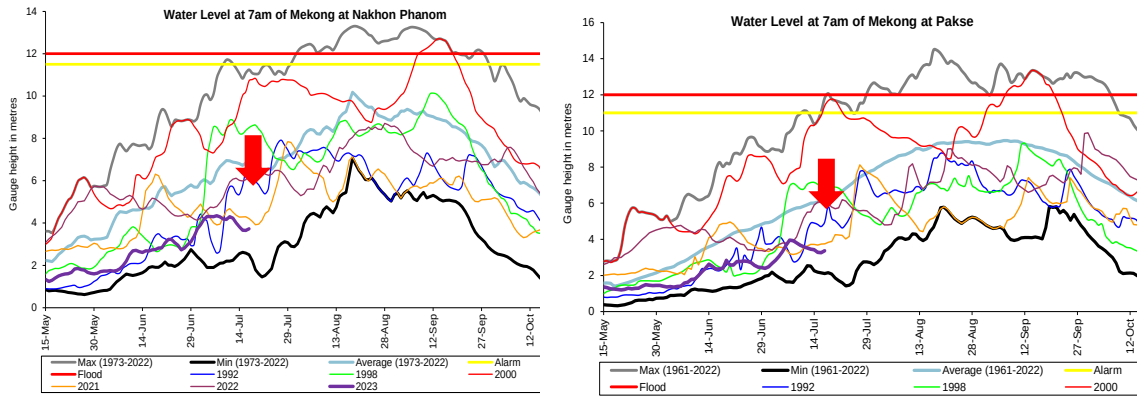


Figure 10. Weekly water levels at Nakhon Phanom in Thailand and Pakse in Lao PDR

Stung Treng to Kompong Cham/Phnom Penh to Koh Khel/Neak Luong/Prek Kdam

Following the same trend from the upstream part of the Mekong River and the 3S river (Sekong, Se San, and Sre Pok), the water levels from Stung Treng to Kratie in Cambodia were increasing during 11-17 July 2023. The water levels at Stung Treng increased about 0.07 m and stayed about 1.70 m lower than its LTA, while at Kratie it increased about 0.04 m, staying

about 3.55 m lower than its LTA (as showed in Figure 11). The water level at Kompong Cham station increased about 0.02 m and was about 3.98 m lower than its LTA. The water levels at these stations were influenced by rainfall in their catchment areas, including Sekong, Se San and Srepok river basins.

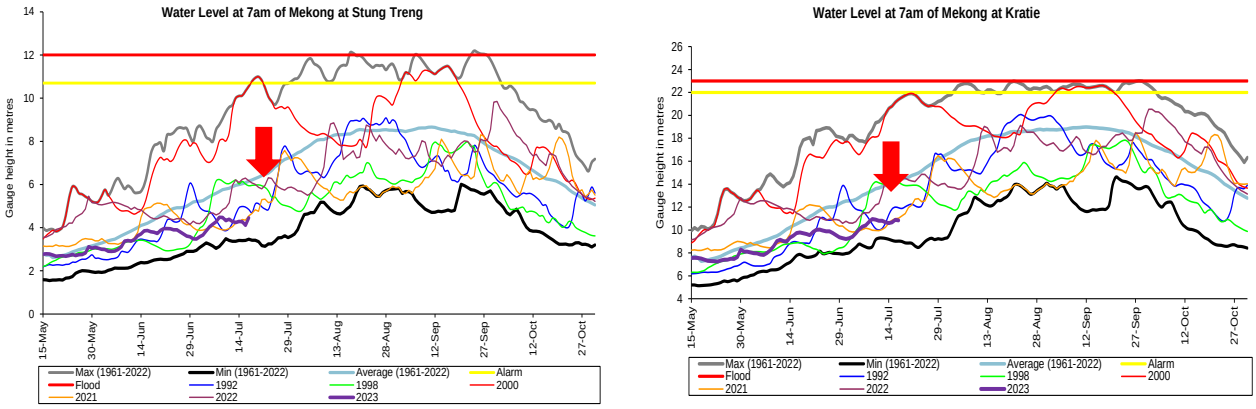


Figure 11. Water levels at Stung Treng and Kratie on the Mekong River.

At Chaktomuk on the Bassac River, due to less rainfall and contributed flows from upstream catchment, the water level decreased by about 0.20 m and stayed 2.86 m lower than its LTA value; while at Koh Khel, water level decreased about 0.32 m, staying 1.89 m lower than its LTA value. The water level at Prek Kdam on the Tonle Sap Lake decreased about 0.22 m and was about 2.63 m lower than its LTA value. The water level at the Tonle Sap Lake (observed at Kampong Luong) was similar to Prek Kdam station's water level. The recently increased water level at Prek Kdam was due to rainfall and inflow contributed from upstream of the Tonle Sap Lake area during the reporting period. The water level at the Tonle Sap Lake (observed at Kampong Luong) followed the same trend of Prek Kdam station's water level. From next week, **water levels at most of the stations will rise and is considered normal**.

Tidal stations at Tan Chau and Chau Doc

Like last week, the water levels from 11 to 17 July 2023 at Viet Nam's Tan Chau and Chau Doc were fluctuating due to daily tidal effects from the sea. The fluctuation levels were between -0.33 m and 1.17 m; they were below the range of their LTA level and were **considered normal**.

The Tonle Sap Flow

At the end of the dry season, when water levels along the Mekong River rise then the inflows of the Mekong River return to the Tonle Sap Lake. This phenomenon normally takes place from end of May to July. Based on flow observation at Prek Kdam, the reversed flow from the Mekong River into the Tonle Sap began between 06 and 10 July 2023.

The flows of the Tonle Sap Lake were calculated based on a formula of rating-curves by different water levels at Kompong Luong and Phnom Penh Port for slop and Prek Kdam as cross-section of the Lake. The formula of flows at the Tonle Sap Lake is as follows:

Flows = (WL at Prek Kdam)^1.2*SQRT (WL difference between PP port and Kampong Luong)

Where, WL is water level in m (msl).

Figure 12 shows the seasonal changes of the outflow and the inflow/reversed flow of the TSL at Prek Kdam in comparison with the flows of 2020, 2011, 2022 and their LTA level (1997-2022). Up to July 17 of this reporting period, **it was observed that the main outflow from the Tonle Sap Lake increased due to rainfall and inflows from upstream**. This increased inflow into the Tonle Sap Lake was most likely caused by inflows and rainfall from the catchment area. Up to present, the inflow from the Tonle Sap Lake condition in 2023 is higher than 2020 but lower than 2021, 2022 and its LTA (1997-2022) inflow conditions. For next week, moderate rainfall is forecasted for the Tonle Sap area; and the inflow into the Tonle Sap Lake is likely expected to go up from the current level.

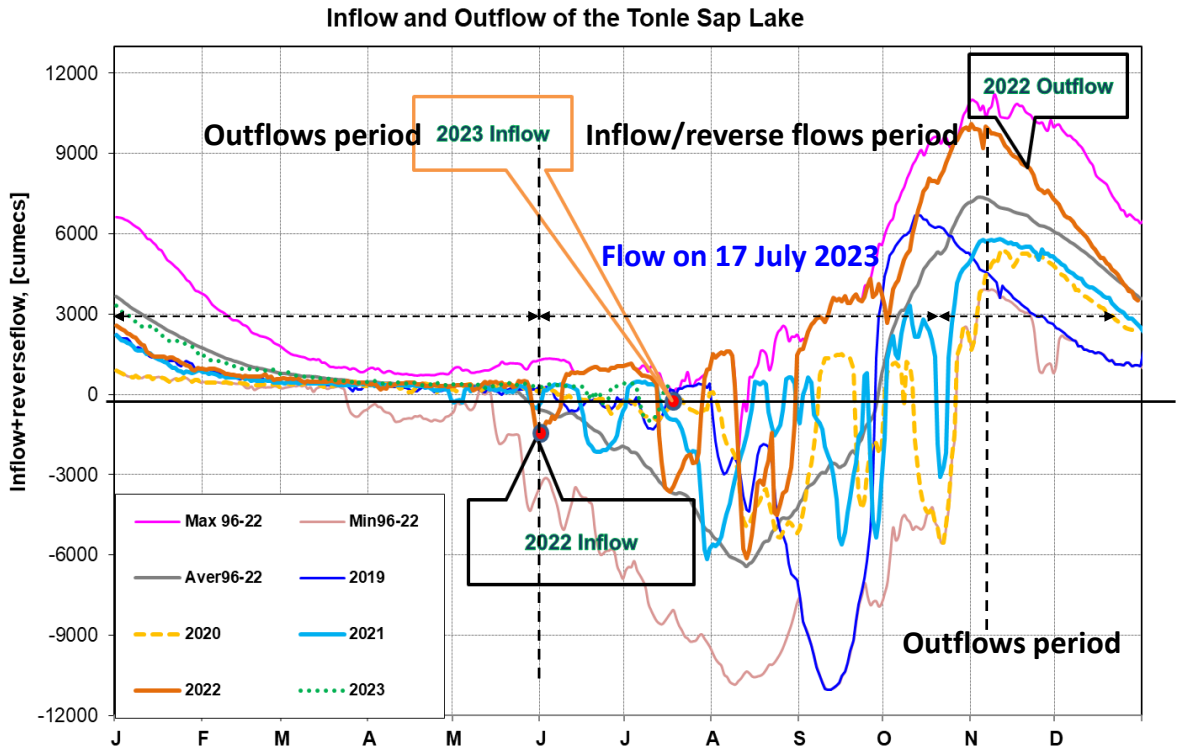


Figure 12. Seasonal change of inflows and outflows of Tonle Sap Lake

Figure 13 shows seasonal changes in monthly flow volumes up to 17 July 2023 for the Lake compared with the volumes in 2020, 2021, 2022 and their LTA, and the fluctuation levels (1997–2022). It shows that up to July 17, **the water volume of the Tonle Sap Lake was higher than 2020 but lower than 2021, 2022** and its **LTA (about 38%), during the same period**. The figure is displayed in Table 1, which indicates that the Tonle Sap Lake has been affected by water levels from the tributaries and rainfall in the surrounding sub-catchments and **considered normal situation**.

This demonstrates the influence of the relationships of the reverse and out flows, water levels of the Mekong River, inflows from tributaries, and the flow direction in the complex hydraulic environment of the Tonle Sap Lake during the wet and dry seasons. The data show that about half of the annual inflow volume into the Tonle Sap Lake has originated from the Mekong

mainstream. Thus, flow alterations in the mainstream could have direct impact on the Tonle Sap Lake water levels and on its hydrology.

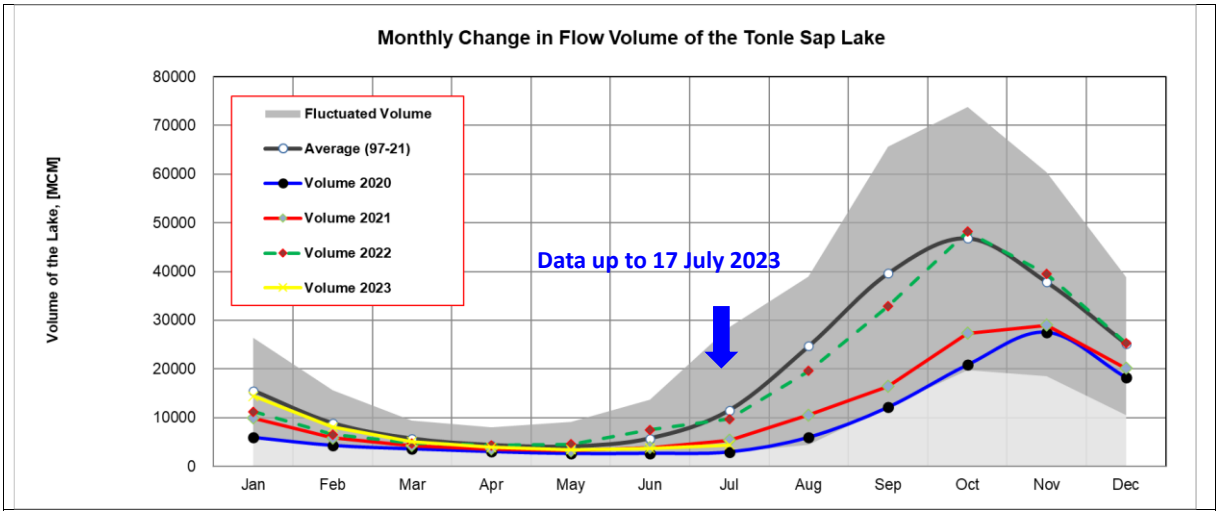


Figure 13. The seasonal change in monthly flow volume of Tonle Sap Lake.

Table 1. The monthly change in the flow volume of Tonle Sap Lake.

Month	LTA (97-22) [MCM]	Max Volume [MCM]	Min Volume [MCM]	Volume 2019 [MCM]	Volume 2020 [MCM]	Volume 2021 [MCM]	Volume 2022 [MCM]	Volume 2023 [MCM]	Volume in 2023 [%], compared with its LTA
Jan	15523.23	26357.53	5906.80	10285.31	5906.80	9923.80	11214.32	14422.11	92.91
Feb	8837.89	15596.22	4198.60	6019.30	4264.19	5832.97	6558.79	8069.29	91.30
Mar	5654.18	9438.24	3347.07	4354.62	3553.99	4264.88	4736.52	5080.64	89.86
Apr	4346.65	8009.14	2866.91	3667.47	2992.61	3556.68	4288.31	3884.16	89.36
May	4030.23	9176.93	2417.81	3266.43	2594.92	3240.78	4556.83	3438.66	85.32
Jun	5708.30	13635.01	2468.70	3517.06	2641.88	3798.29	7489.04	3689.97	64.64
Jul	11493.25	28599.56	2925.86	4001.99	2925.86	5346.73	9703.79	4415.58	38.42
Aug	24666.69	39015.12	4433.46	7622.71	5941.07	10547.80	19554.70		
Sep	39634.03	65632.35	12105.31	24194.19	12105.31	16382.34	32860.34		
Oct	46873.44	73757.23	19705.50	30358.38	20799.13	27318.21	48199.12		
Nov	37823.16	60367.33	18534.61	19112.65	27546.80	28982.93	39452.53		
Dec	25126.11	38888.95	10563.49	10577.29	18251.65	20170.76	25346.65		
	Critical situation, comapred with historical Min values								
	Normal condition, compared with LTA (Long term average)								
	Low volume situation, comapred with LTA values								
Unit: Million Cubic Meter (1 MCM= 0.001 Km^3)					LTA: Long-Term-Average				

4 Flash Flood in the Lower Mekong Basin

During the weekly monitoring period from July 11 to 17, the LMB was affected by the southeast monsoon and this condition caused small to heavy rain and isolated thundershowers in some areas of the LMB.

According to the MRC-Flash Flood Guidance System (MRC-FFGS) and analysis, low-risk of flash flood events were detected during the reporting period in several areas of Lao PDR, Cambodia and Viet Nam as shown in Figure 14 and Table 2.

Table 2. Detected low-risk flash flood in Lao PDR and Viet Nam during July 11-July 17.

Rate-risk and location of the flash flood may occur in the next 1, 3, and 6 hours in Viet Nam

Date of FFG products: 15/07/2023 00:00 UTC time

01-Hour Flash Flood Risk and Location				3-Hour Flash Flood Risk and Location in Vietnam				6-Hour Flash Flood Risk and Location in Vietnam			
Provinces	Districts	Region	Level Risks	Provinces	Districts	Region	Level Risks	Provinces	Districts	Region	Level Risks
Lai Chau	Muong Te	Northwest	Low-Risk	Lai Chau	Muong Te	Northwest	Low-Risk	Lai Chau	Muong Te	Northwest	Low-Risk

Rate-risk and location of the flash flood may occur in the next 1, 3, and 6 hours in Cambodia

Date of FFG products: 7/16/2023 6:00 UTC time

01-Hour Flash Flood Risk and Location					03-Hour Flash Flood Risk and Location					06-Hour Flash Flood Risk and Location				
Provinces	Districts	Villages	Region	Level Risk	Provinces	Districts	Villages	Region	Level Risk	Provinces	Districts	Villages	Region	Level Risk
Ratana Kiri	Lumphat	Sakmotr Kraom	Northeast	Low-Risk	NO ANY DETECTION OF FLASH FLOOD WITHIN NEXT 03-HOUR					Ratana Kiri	Lumphat	Sakmotr Kraom	Northeast	Low-Risk

Rate-risk and location of the flash flood may occur in the next 1, 3, and 6 hours in Viet Nam

Date of FFG products: 7/16/2023 6:00 UTC time

01-Hour Flash Flood Risk and Location				3-Hour Flash Flood Risk and Location in Vietnam				6-Hour Flash Flood Risk and Location in Vietnam			
Provinces	Districts	Region	Level Risks	Provinces	Districts	Region	Level Risks	Provinces	Districts	Region	Level Risks
Gia Lai	Duc Co	Central Highlands	Low-Risk	Gia Lai	Duc Co	Central Highlands	Low-Risk	Gia Lai	Duc Co	Central Highlands	Low-Risk
Gia Lai	Chu Prong	Central Highlands	Low-Risk					Gia Lai	Chu Prong	Central Highlands	Low-Risk
								Lao Cai	Bat Xat	Northwest	Low-Risk
								Hoa Binh	Ky Son	Northwest	Low-Risk

Rate-risk and location of the flash flood may occur in the next 1, 3, and 6 hours in Viet Nam

Date of FFG products: 17/07/2023 00:00 UTC time

01-Hour Flash Flood Risk and Location				3-Hour Flash Flood Risk and Location in Vietnam				6-Hour Flash Flood Risk and Location in Vietnam			
Provinces	Districts	Region	Level Risks	Provinces	Districts	Region	Level Risks	Provinces	Districts	Region	Level Risks
NO ANY DETECTION OF FLASH FLOOD WITHIN NEXT 01-HOUR				NO ANY DETECTION OF FLASH FLOOD WITHIN NEXT 03-HOUR				Kon Tum	Sa Thay	Central Highlands	Low-Risk
								Gia Lai	Ia Grai	Central Highlands	Low-Risk
								Gia Lai	Duc Co	Central Highlands	Low-Risk

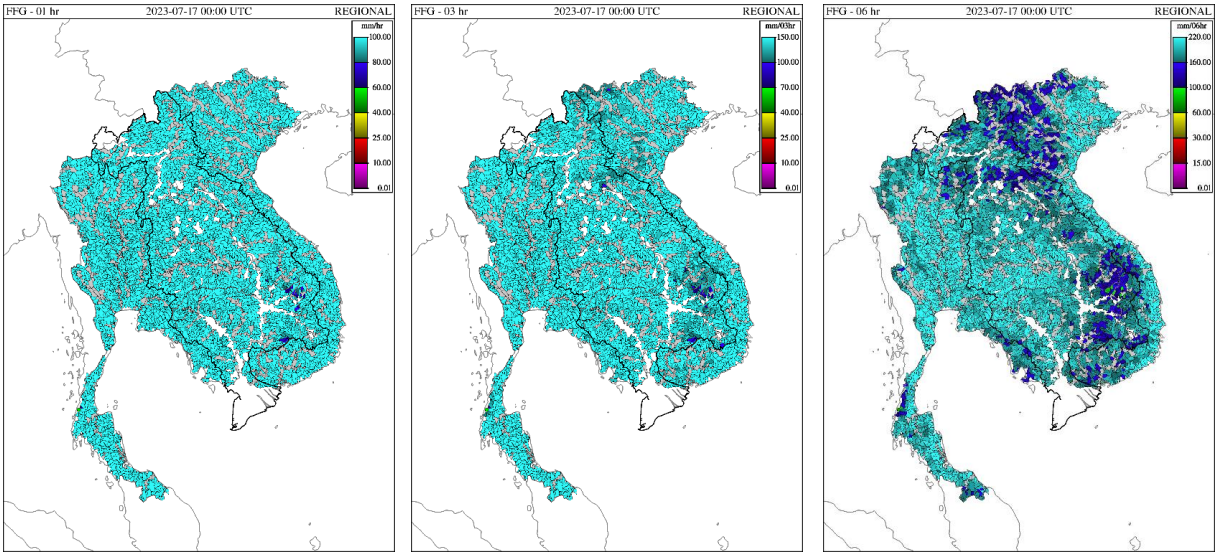


Figure 14. Flash Flood Guidance for the next 1-hr, 3-hr and 6-hr on July 17

5 Drought Monitoring in the Lower Mekong Basin

Weekly drought monitoring from 10 to 16 July 2023

Drought monitoring data in 2023 are available from Monday to Sunday every week; thus, the reporting period is normally delayed by two days compared to Flood and Flash Flood reports. We adopt the Index of Soil Water Fraction (ISWF) data obtained from FFGS to represent soil moisture of agricultural indicator for both dry and wet seasons.

- **Weekly Standardised Precipitation Index (SPI1)**

The meteorological drought indicator of SPI from July 10 to 16, as displayed in Figure 15, shows that the LMB was at moderately and severely dry over mainly the northern and eastern parts of the LMB. There were also some meteorological droughts in the southern part.

No.	Country	Province	Drought status		
			Moderate	Severe	Extreme
1		Pailin	Yes	Yes	
2		Banteay Meanchey	Yes	Yes	
3		Kampong Chhnang	Yes	Yes	
4		Preah Vihear	Yes	Yes	
5		Stung Treng	Yes	Yes	
6		Pursat	Yes		
7		Kampong Thom	Yes	Yes	
8		Luangnamtha	Yes		
9		Phongsaly	Yes	Yes	
10		Bokeo	Yes	Yes	
11		Luang Prabang	Yes	Yes	Yes
12		Xiengkhuang	Yes	Yes	
13		Xayaburi	Yes		
14		Xaysomboun	Yes		
15		Borikhamxay	Yes	Yes	
16		Khammuane	Yes	Yes	Yes
17		Savannakhet	Yes	Yes	
18		Saravane	Yes	Yes	
19		Champasack	Yes		
20		Chiang Mai	Yes	Yes	
21		Chiang Rai	Yes		
22		Nong Bua Lamphu	Yes	Yes	
23		Udon Thani	Yes	Yes	
24		Nong Khai	Yes	Yes	
25		Sokon Nakhon	Yes	Yes	
26		Nakhon Phanom	Yes	Yes	
27		Amnat Charoen	Yes		
28		Ubon Ratchathani	Yes	Yes	
29		Roi Et	Yes		
30		Quang Tri	Yes	Yes	
31		Dak Lak	Yes	Yes	

Drought Legend: Moderate | Severe | Extreme

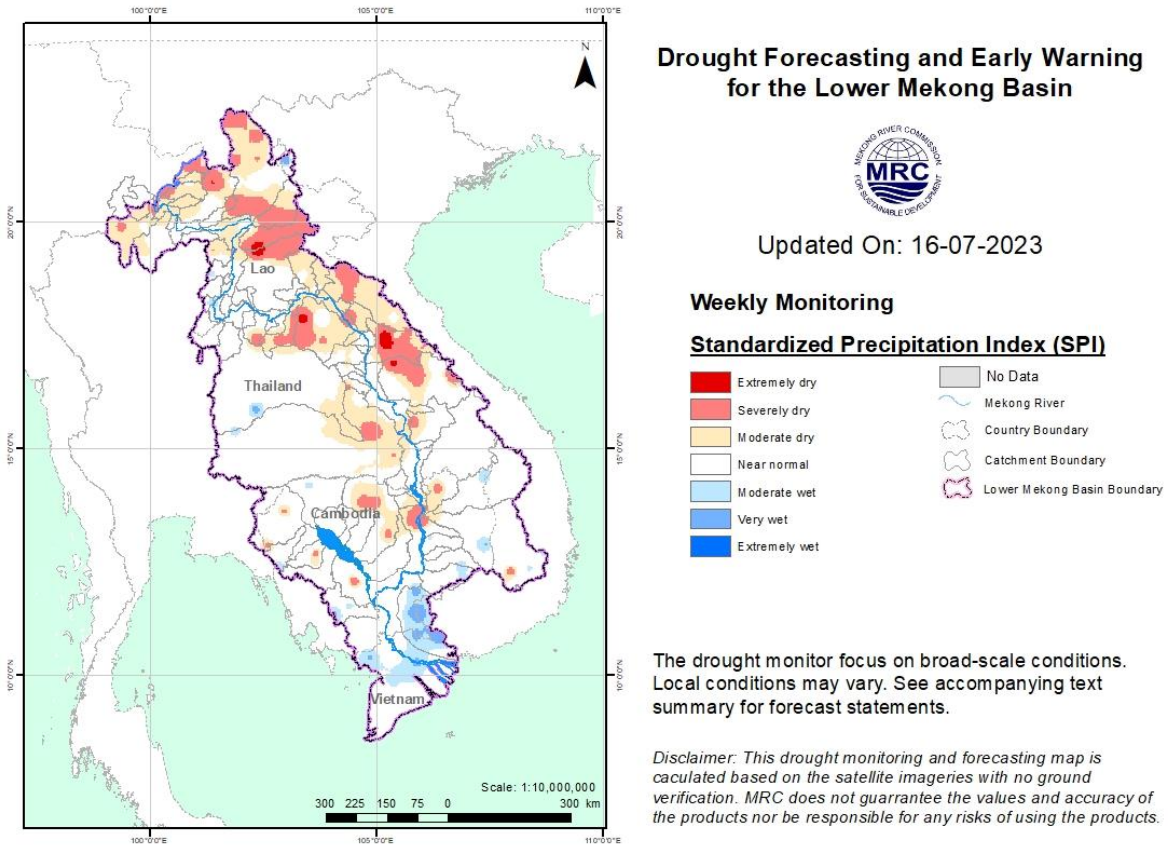


Figure 15. Weekly standardized precipitation index from 10 to 16 July 2023.

- **Weekly Index of Soil Water Fraction (ISWF)**

For the agricultural indicator, the nowcast this week from July 10 to 16 indicates that the region did not face any significant agricultural drought risk during the monitoring week. Figure 16 of weekly ISWF shows that most parts of the LMB were normal, except some areas in the eastern part which were moderately and severely dry.

No.	Country	Province	Drought status		
			Moderate	Severe	Extreme
1		Kampong Cham	Yes	Yes	
2		Kampong Thom	Yes		
3		Preah Vihear		Yes	
4		Borikhamxay	Yes	Yes	
5		Khammuane	Yes	Yes	
6		Savannakhet	Yes		
7		Nong Khai	Yes	Yes	
8		Sokon Nakhon	Yes		
9		Loei	Yes		
10		Nakhon Phanom	Yes		
11		Surin	Yes		
12		Si Saket	Yes		
13		Roi Et	Yes		
14		Dak Lak	Yes		
Drought Legend:					
		Moderate		Severe	Extreme

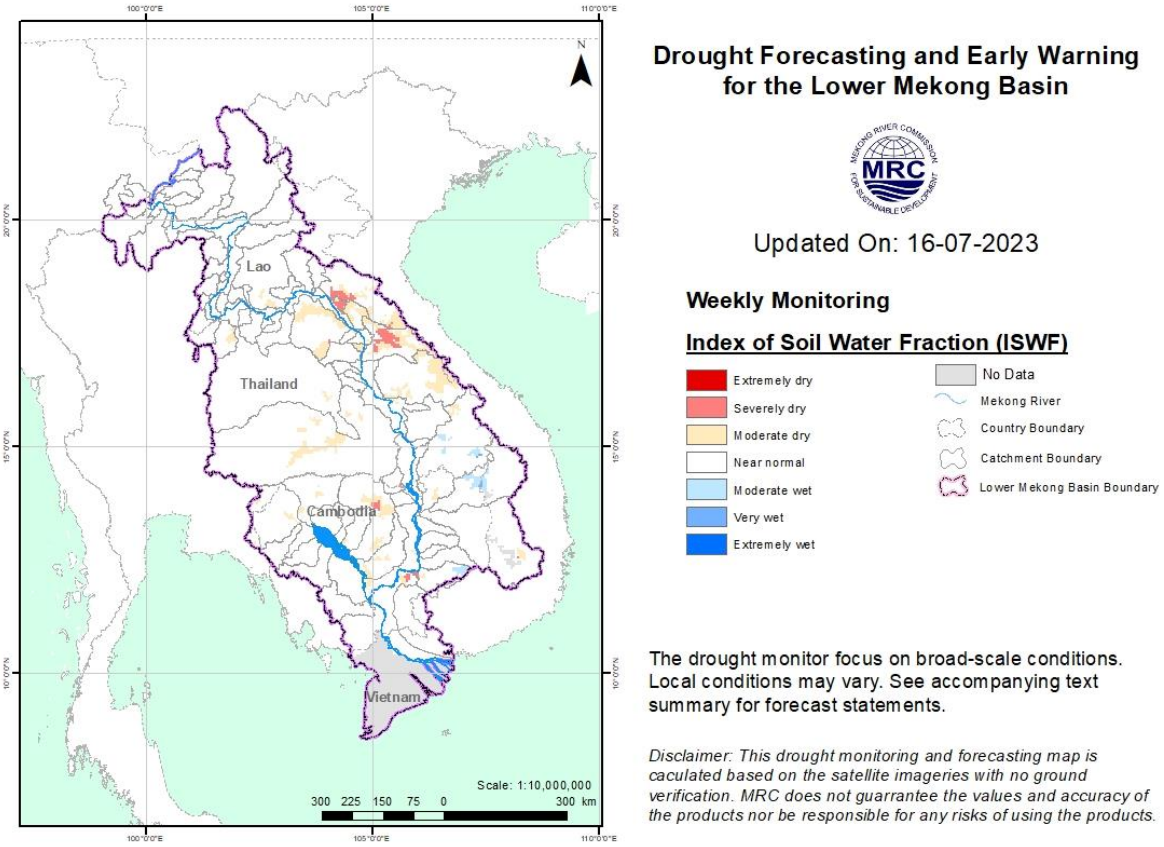


Figure 16. Index of Soil Water Fraction from 10 to 16 July 2023.

- **Weekly Combined Drought Index (CDI)**

The combined drought indicator from the meteorological and agricultural indices from July 10 to 16, as displayed in Figure 17, shows that moderate and severe droughts took place in the eastern, middle and lower parts of the LMB. Other areas were normal.

No.	Country	Province	Drought status			
			Moderate	Severe	Extreme	Except.
1		Pailin	Yes			
2		Banteay Meanchey	Yes			
3		Preah Vihear	Yes	Yes		
4		Stung Treng	Yes			
5		Luangnamtha	Yes			
6		Oudomxay	Yes			
7		Luang Prabang	Yes	Yes		
8		Borikhamxay	Yes	Yes		
9		Khammuane	Yes	Yes	Yes	
10		Savannakhet	Yes	Yes		
11		Saravane	Yes	Yes		
12		Nong Khai	Yes			
13		Nakhon Phanom	Yes			
14		Ubon Ratchathani	Yes			
15		Nong Bua Lamphu	Yes			
16		Sakon Nakhon	Yes			
17		Yasothon	Yes			
18		Amnat Charoen	Yes			
19		Si Saket	Yes			
20		Quang Tri	Yes	Yes		
21		Dak Lak	Yes	Yes		

Drought Legend: Moderate | Severe | Extreme | Exceptional

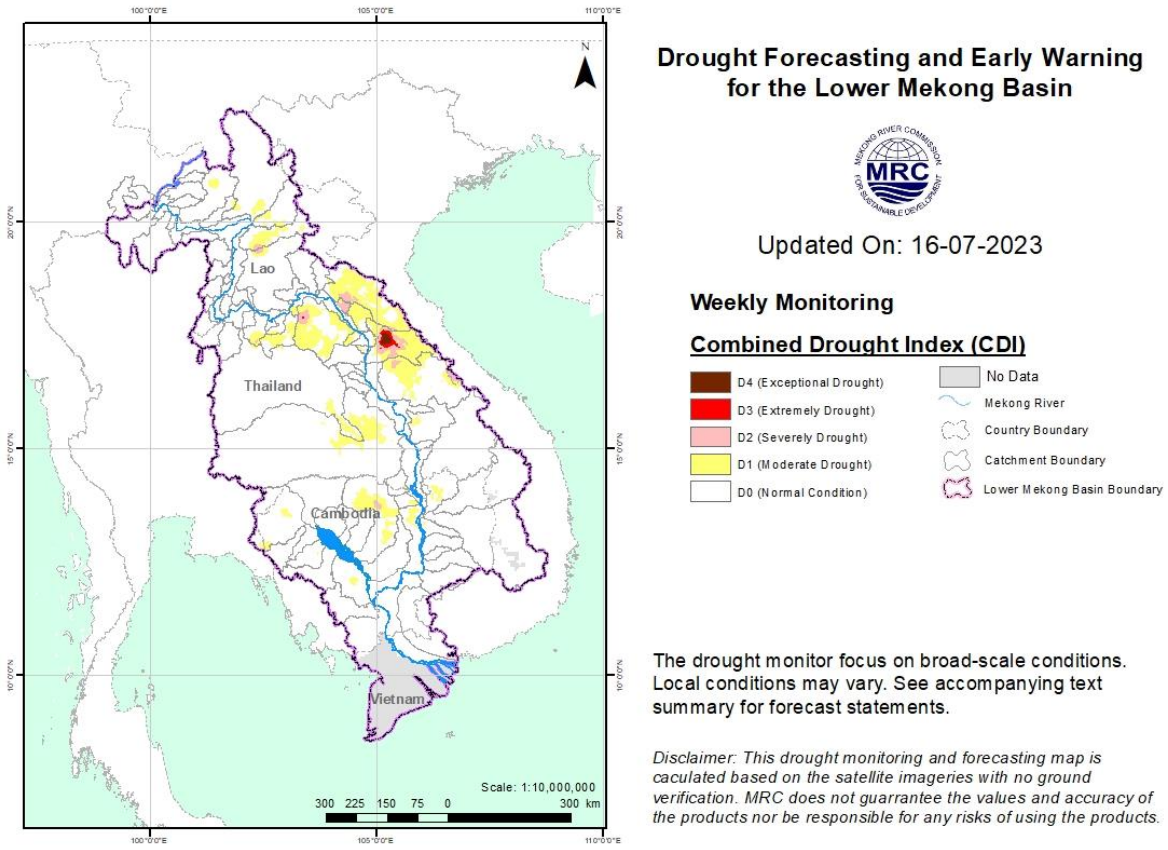


Figure 17. Weekly Combined Drought Index from 10 to 16 July 2023.

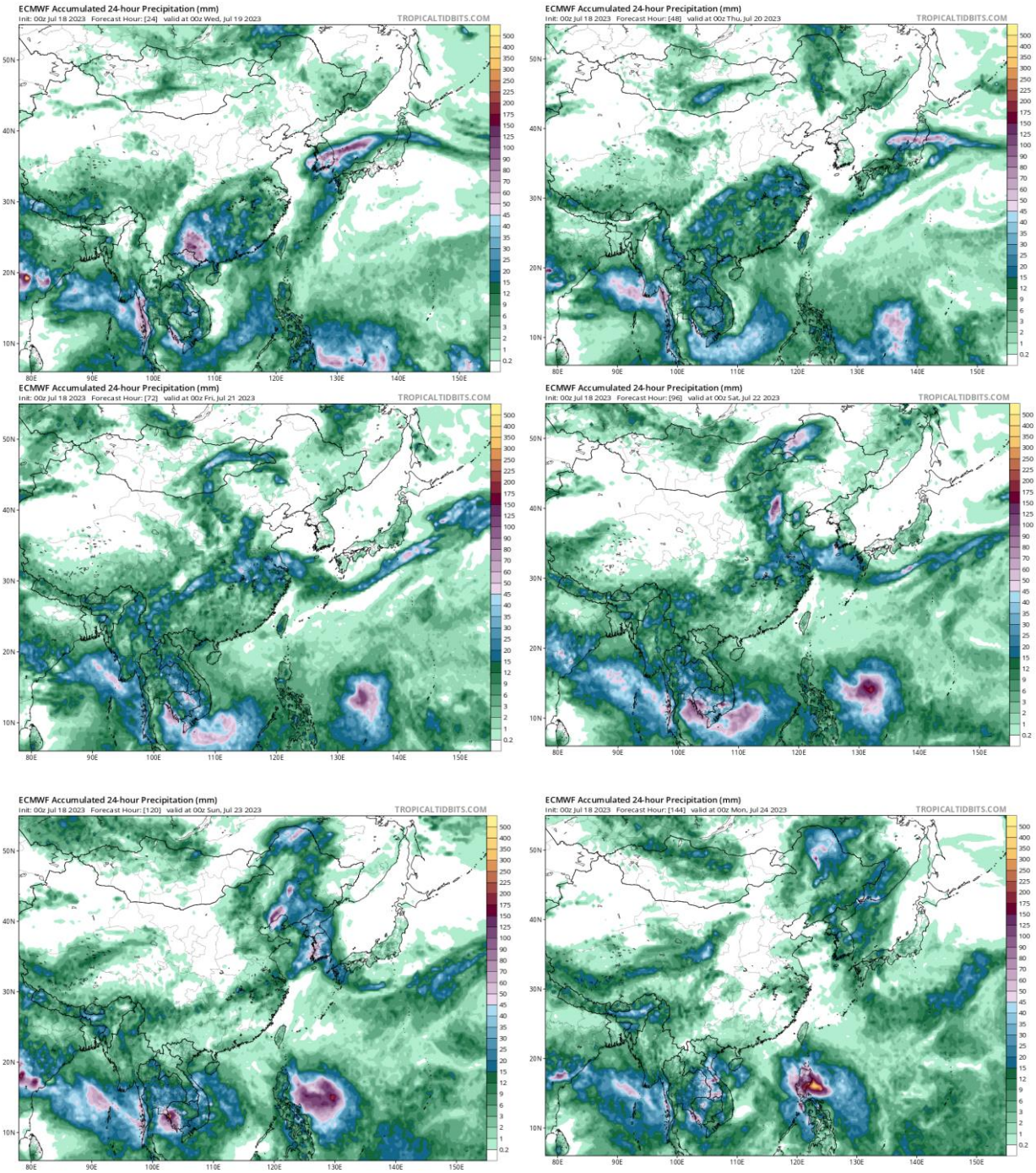
More information on Drought Forecasting and Early Warning (DFEW) as well as the explanation is available here: http://droughtforecast.mrcmekong.org/templates/view/our-product. DFEW provides not only weekly monitoring and forecasting information but also a three-month forecast of drought indicators with seasonal outlook which are updated every month based on international weather forecast models. Details on drought forecast are described in section 6.4 of this report.

6 Weather and Water Level Forecast and Flash Flood Information

6.1 Weather and rainfall forecast

Based on result from the European Center for Medium-Range Weather Forecasts (ECFMWF), in the coming week, the southwest monsoon will continue prevailing the LMB.

In general, during July 19-25, small to heavy rain (5-90 mm/24h) is forecasted for the LMB area. Figure 18 shows accumulated rainfall forecast (24 h) of the GFS model from July 19 to 25.



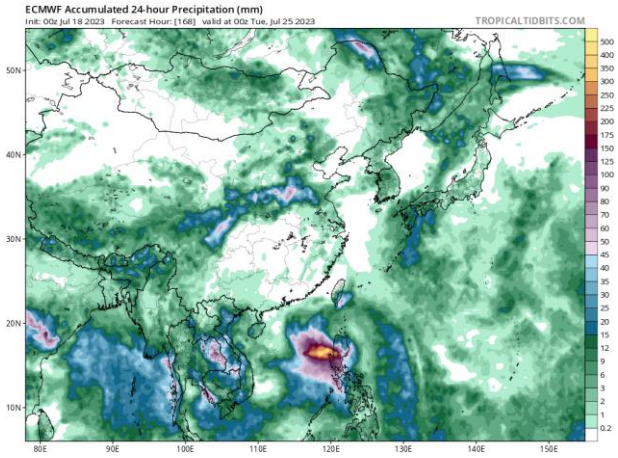


Figure 18. Accumulated rainfall forecast (24 h) based on the European Center for Medium-Range Weather Forecasts (ECFMWF).

6.2 Water level forecast

Chiang Saen and Luang Prabang

Based on July 17's daily flood forecasting bulletin, the daily forecasted water level at Chiang Saen in Thailand shows a decrease of water level between 3.36 m and 3.10 m over the next five days. The trend will keep the water level at this station lower than its LTA.

For Luang Prabang in Lao PDR, the water level will decrease about 0.76 m during the next five days. The current water level is higher than its LTA. Precipitation is forecasted for the area between Chiang Saen and Luang Prabang next week.

Chiang Khan, Vientiane-Nong Khai and Paksane

The water level at Chiang Khan in Thailand is forecasted to go down approximately 0.19 m, while water level at Vientiane in Lao PDR will increase about 0.21 m. Furthermore, in Nong Khai of Thailand the water level will increase about 0.24 m over the next five days; at Paksane in Lao PDR water level will increase about 0.29 m due to forecasted rainfalls and dam operation in the upper catchments. Rainfall is forecasted for the area of Paksane next week. The water levels at these stations will stay lower than their LTA value.

Nakhon Phanom to Pakse

The water levels from Nakhon Phanom in Thailand to Pakse in Lao PDR are forecasted to go up from 0.60 m to 1.00 m, because of above-average rainfall predicted in these areas. However, water level at these stations will stay lower than their LTA level. Rainfall is forecasted for the area next week.

Stung Treng to Kompong Cham/Phnom Penh to Koh Khel/Neak Luong

WL at Stung Treng and Kratie in Cambodia will go up from 0.85 m to 1.29 m, while at Kompong Cham along the Mekong River the water level will go up about 1.20 m over the next five days.

Precipitation is forecasted for the area between Stung Treng and Kompong Cham during next week.

The water levels of the Tonle Sap Lake at Prek Kdam and Phnom Penh Port as well as at Phnom Penh's Chaktomuk on the Bassac River will go up between 0.40 m and 0.56 m over the next five days.

Water levels at most of the stations will go up during next week, except from Chiang Saen to Chaing Khan. WLs at those stations will be still staying lower than their LTA value. From Vientiane to Paksane, Nakhon Phanom to Pakse and from Stung Treng, Kratie, to downstream part, water levels will be rising but still staying lower than their LTA value. Precipitation is forecasted for the low-lying area of Cambodia next week.

Tidal stations at Tan Chau and Chau Doc

For Viet Nam's Tan Chau on the Mekong River and Chau Doc on the Bassac River, the water levels will be staying lower than their LTA level, following daily tidal effects from the sea. Rainfall is forecasted for the Mekong Delta area next week.

The performance of the weekly flood forecast, with an accuracy and data input evaluation from 11 to 17 July 2023, is presented in **Annex 1**.

Table 2 shows the daily flood forecasting Bulletin issued on 17 July 2023. Results of the weekly river monitoring bulletin are also available at http://ffw.mrcmekong.org/bulletin_wet.php.

6.3 Flash Flood Information

With small to heavy rain for next week, flash floods might be detected in some areas in the LMB. And local heavy rain in a short period of time is possible with unpredictable short flash floods.

Detailed information on Flash Flood Warning Information as well as its explanation is available for download here.

6.4 Drought forecast

There are several climate-prediction models with different scenarios in the upcoming months until August 2023. The MRC's DFEWS adopts an ensemble model called the North America Multi-Model Ensemble (NMME), which averages all scenarios, and downscales the forecasts to the regional level. The Variable Infiltration Capability (VIC) is then used to generate soil moisture and runoff for the whole basin.

Figure 19 below shows the Combine Drought Indicator (CDI) forecast for July, August, and September 2023. CDI is a combination of meteorological and agricultural indicators.

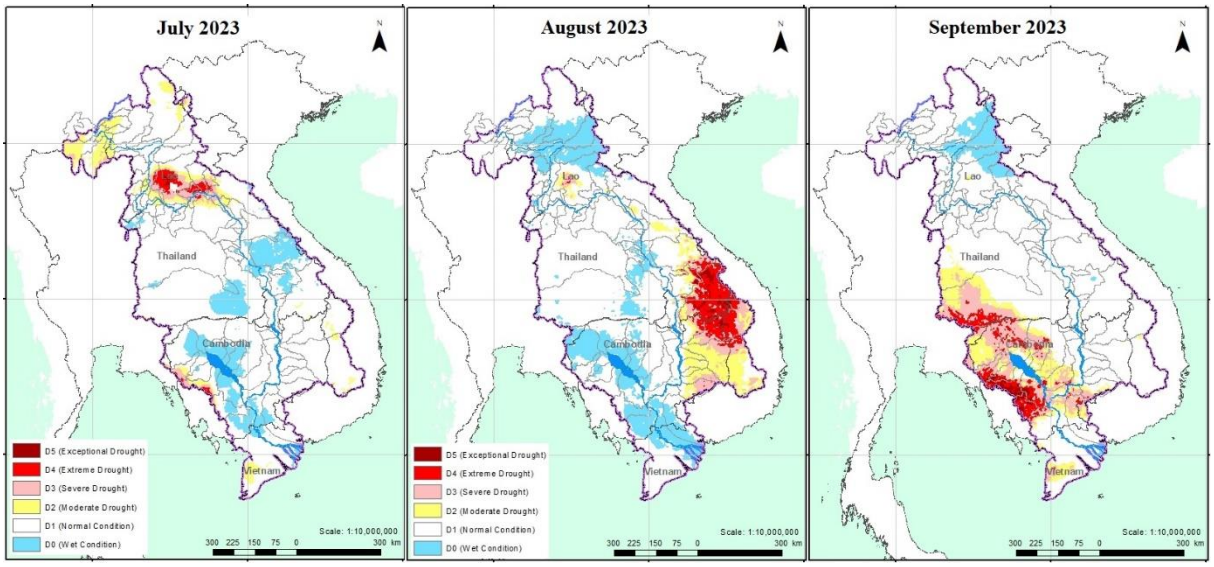


Figure 19. Monthly forecast of CDI for July, August, and September 2023.

Figure 19 above shows that **July** is likely to be moderately and severely dry over the northern and some southern parts of the LMB. They specifically cover **Chiang Mai, Chiang Rai, Phongsaly, Vientiane, Xaysomboun, Borikhamxay, Nong Khai, Chanthaburi, Pailin, Battambang, Pursat, Kampong Speu, Kom Tum, Gia Lai, Dak Lak, Kien Giang, and Ca Mau**. **August** is likely to be moderately and severely dry over some area of the north and south-eastern LMB. They cover **Vientiane, Khammuane, Savannakhet, Saravane, Sekong, Champasack, Attapeu, Kon Tum, Gia Lai, Ratana Kiri, Stung Treng, Kratie, Kampong Cham, Mondul Kiri, Dak Lak, and Lam Dong**. While in **September**, drought is forecasted to be from moderate to exceptional drought covering eastern and southeastern LMB including **Chaiyaphum, Nakhon Ratchasima, Burirum, Surin, Sa Kaeo, Ordar Meanchey, Banteay Meanchey, Siem Reap, Preah Vihear, Kampong Thom, Chantaburi, Pailin, Battambang, Pursat, Kampong Chhnang, Kampot, Kampong Spue, Takeo, Kandal, Prey Veng, Kampong Cham, Kratie, Prey Veng, Svay Rieng, Tay Ninh, Kien Giang, Ca Mau, Bac Lieu, and Soc Trang**.

Table 2. Weekly River Monitoring Bulletin.

Mekong Bulletin

Mekong River Commission Secretariat (MRCS)
Regional Flood and Drought Management Centre (RFDMC)
P.O. Box 623 #576, National Road #2, Chak Angre Krom, Meanchey, Phnom Penh, Cambodia
Tel: (855-23) 425353, Fax: (855-23) 425363, Email: floodforecast@mrcmekong.org

River Flood Forecast: 18 July - 22 July 2023

Date: 17 July 2023

Location	Country	24-hr Observed Rainfall (mm)	Zero gauge above M.S.L (m)	Flood level (m)	Alarm level (m)	Observed W. level against zero gauge (m)		Forecasted Water Levels (m)					There is currently no flood warning in place at monitoring sites on the Mekong					
		16-Jul				16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	17	18	19	20	21	22
Jinghong		0.0				536.55	535.80						↓	×	×	×	×	×
Chiang Saen		1.0	357.110	12.80	11.50	3.66	3.36	3.32	3.00	2.96	3.00	3.10	↓		↓			
Luang Prabang		0.0	267.195	18.00	17.50	9.82	10.08	9.90	9.66	9.62	9.35	9.32	↑	↓	↓		↓	
Chiang Khan		2.2	194.118	16.00	14.50	6.63	6.82	7.13	7.00	6.82	6.80	6.63	↑	↑	↓	↓		↓
Vientiane		0.0	158.040	12.50	11.50	3.90	3.94	4.15	4.50	4.37	4.18	4.15		↑	↑	↓	↓	
Nongkhai		0.4	153.648	12.20	11.40	3.44	3.52	3.75	4.11	4.00	3.80	3.76		↑	↑	↓	↓	
Paksane		1.9	142.125	14.50	13.50	4.72	4.71	4.78	4.95	5.20	5.13	5.00			↑	↑		↓
Nakhon Phanom		17.1	130.961	12.00	11.50	3.65	3.73	3.85	3.94	4.13	4.40	4.34		↑		↑	↑	
Thakhek		18.6	129.629	14.00	13.00	4.86	4.94	5.08	5.18	5.40	5.69	5.62		↑		↑	↑	
Mukdahan		0.0	124.219	12.50	12.00	3.76	3.87	4.02	4.20	4.33	4.56	4.87	↑	↑	↑	↑	↑	↑
Savannakhet		0.8	125.410	13.00	12.00	2.27	2.32	2.40	2.52	2.60	2.75	2.93			↑		↑	↑
Khong Chiam		2.5	89.030	14.50	13.50	4.31	4.29	4.44	4.62	4.82	4.98	5.23		↑	↑	↑	↑	↑
Pakse		29.4	86.490	12.00	11.00	3.26	3.37	3.55	3.70	3.86	3.98	4.20	↑	↑	↑	↑	↑	↑
Stung Treng		8.0	36.790	12.00	10.70	4.11	4.46	4.68	4.89	5.05	5.20	5.31	↑	↑	↑	↑	↑	↑
Kratie		nr	-0.101	23.00	22.00	10.89	10.84	11.23	11.49	11.74	11.95	12.13	↓	↑	↑	↑	↑	↑
Kompong Cham		1.5	-0.930	16.20	15.20	5.08	5.20	5.25	5.65	5.92	6.18	6.40	↑	↑	↑	↑	↑	↑
Phnom Penh (Bassac)		nr	-1.020	12.00	10.50	2.67	2.81	2.83	3.00	3.13	3.26	3.35	↑		↑	↑	↑	↑
Phnom Penh Port		-	0.070	11.00	9.50	1.65	1.79	1.81	1.98	2.12	2.25	2.35	↑		↑	↑	↑	↑
Koh Khel (Bassac)		20.7	-1.000	8.40	7.90	2.76	2.78	2.83	2.90	3.01	3.12	3.20		↑	↑	↑	↑	↑
Neak Luong		9.2	-0.330	8.00	7.50	1.69	1.71	1.78	1.81	2.00	2.12	2.22		↑	↑	↑	↑	↑
Prek Kdam		9.3	0.080	10.00	9.50	1.84	1.93	1.95	2.08	2.18	2.28	2.36	↑		↑	↑	↑	↑
Tan Chau		0.0	0.000	4.50	3.50	0.94	0.68	0.37	0.01	-0.10	-0.25	-0.33	↓	↓	↓	↓	↓	↓
Chau Doc		0.0	0.000	4.00	3.00	1.06	0.89	0.60	0.25	0.12	-0.06	-0.17	↓	↓	↓	↓	↓	↓

REMARKS:

-: not available.

nr: no rain.

LEGEND	
rising water level	↑
stable water level	
falling water level	↓
alarm stage	
alarm situation	
flood stage	
no data available	×

Note: Stable water level is defined as a daily change of less than 10cm from Chiang Saen to Savannakhet; less than 5cm at Pakse and Stung Treng; and no more than 3cm cm from Kratie downstream.
Flood stage is when the flood level exceeds. A flood level is determined by each Member Country.
Alarm stage is when the water level ranges between alarm and flood levels.
Alarm situation is when the water level is forecasted to reach the flood stage within the next three days.

River Flood Forecaster

KHEM Sothea

NOTE: Discharge at Luang Prabang may be influenced by hydropower operations (at both upstream and downstream).
For more info, please refer to this link:
http://www.mrcmekong.org/; http://ffw.mrcmekong.org/bulletin_wet.php; http://ffw.mrcmekong.org/reportflood.php

7 Summary and Possible Implications

7.1 Rainfall and its forecast

Rain was observed from Chiang Saen in Thailand to Tan Chau and Chau Doc in Viet Nam during July 11-17, including the lower part in Lao PDR and Cambodia, varying from 8.00 mm to 156.40 mm due to above-average rainfall over the LMB during the report period. This week rainfall was considered high in the LMB compared with last week rainfall.

Based on the forecasted satellite data, rainfall is forecasted for some areas of the LMB with the value range from 30.00 mm to 140.00 mm for the next seven days. The forecasting model using CHIRPS-GEFS data, moreover, shows significant rainfall (>100 mm) is likely to take place in the Mekong region from 18 to 24 July 2023.

7.2 Water level and its forecast

According to MRC's observed water level at Jinghong, it showed fluctuated water levels from 535.80 m to 537.30 m during 11-17 July 2023**.** The current level is staying about 0.44 m lower than its LTA value. The outflow at Jinghong station varied between 1,220.00m^3/s and 2,420.00 m^3/s between 11 and 17 July 2023.

With the fluctuated outflow from Jinghong upstream, water levels of monitoring stations at Chiang Saen decreased 0.04 m from 11 to 17 July 2023. However, at Chiang Khan the water level increased about 0.17 m, while at Valentine and Nong Khai it decreased between 0.50 m and 0.56 m due to the influence of dam operation upstream and rainfall. Water levels from Nakhon Phanom to Pakse decreased between 0.22m and 0.58 m. The current WLs at these stations are staying lower than their LTA level, **considered low water levels**. From the stretches of the river at Stung Treng, WL increased 0.07 m and stayed about 1.70 m lower than its LTA, while at Kratie water level was up about 0.04 m, staying 3.55 m lower than its LTA level, due to the contributed rainfall from upstream parts including Pakse and 3S area in Viet Nam.

The flow volume of the Tonle Sap Lake is lower than its LTA (about 38%) up to July 17. From next week, the flow is expected to increase due to average rainfall forecasted in the inflow catchments of the Tonle Sap Lake.

From Stung Treng to Kratie and Kompong Cham on the Mekong River, the water levels are expected to increase between 0.60 m and 1.20 m and will stay lower than their LTA value for the next 5 days. The water levels – at Prek Kdam to Phnom Penh Port on the Tonle Sap, and Chaktomuk to Koh Khel on the Bassac – are forecasted to increase but still stay lower than their LTA value.

The situation in Tan Chau on the Mekong River and Chau Doc on the Bassac River is expected to remain unchanged.

Since the third week of September 2022, water levels across most monitoring stations in the LMB have increased due to the above-average rainfall but still staying lower than their LTA

value (from middle to lower stretches within the LMB). The preliminary analysis of the hydrological conditions in the LMB over July–December 2020 and November 2020 to May 2021 was done as Situation Report, which can be used as reference for the trend of water level and flows of the Mekong River Basin.

The contribution to the Mekong River's flow from the UMB in China (Yunnan component) is about 16% by the time the river discharges through the Mekong Delta into the Sea. By far the major contribution comes from the two major 'left-bank' (Eastern) tributaries between Vientiane – Nakhon Phanom and Pakse – Stung Treng, which together contribute more than 40% of the flows.

7.3 Flash flood and its trends

With the predicted amount of rainfall for the coming week as mentioned earlier in section 6.1, flash floods are likely to be detected in some areas of the LMB during next week.

7.4 Drought condition and its forecast

During July 10-16, moderate and severe droughts took place over some areas from the eastern part to the southern part covering Pailin, Banteay Meanchey, Phrea Vihear, Stung Treng, Luangnamtha, Oudomxay, Luang Prabang, Borikhamxay, Khammuane, Savannakhet, Saravane, Nong Khai, Nakhon Phanom, Ubon Ratchathani, Nong Bua Lamphu, Skon Nakhon, Yasothon, Amnat Charoen, Si Saket, Quang Tri, and Dak Lak.

The three-month forecast shows that **July** is likely to be moderately and severely dry over the northern and some southern parts of the LMB. They specifically cover **Chiang Mai, Chiang Rai, Phongsaly, Vientiane, Xaysomboun, Borikhamxay, Nong Khai, Chanthaburi, Pailin, Battambang, Pursat, Kampong Speu, Kom Tum, Gia Lai, Dak Lak, Kien Giang, and Ca Mau**. **August** is likely to be moderately and severely dry over some area of the north and south-eastern LMB. They cover **Vientiane, Khammuane, Savannakhet, Saravane, Sekong, Champasack, Attapeu, Kon Tum, Gia Lai, Ratana Kiri, Stung Treng, Kratie, Kampong Cham, Mondul Kiri, Dak Lak, and Lam Dong**. While in **September**, drought is forecasted to be from moderate to exceptional drought covering eastern and southeastern LMB including **Chaiyaphum, Nakhon Ratchasima, Burirum, Surin, Sa Kaeo, Ordar Meanchey, Banteay Meanchey, Siem Reap, Preah Vihear, Kampong Thom, Chantaburi, Pailin, Battambang, Pursat, Kampong Chhnang, Kampot, Kampong Spue, Takeo, Kandal, Prey Veng, Kampong Cham, Kratie, Prey Veng, Svay Rieng, Tay Ninh, Kien Giang, Ca Mau, Bac Lieu, and Soc Trang**.

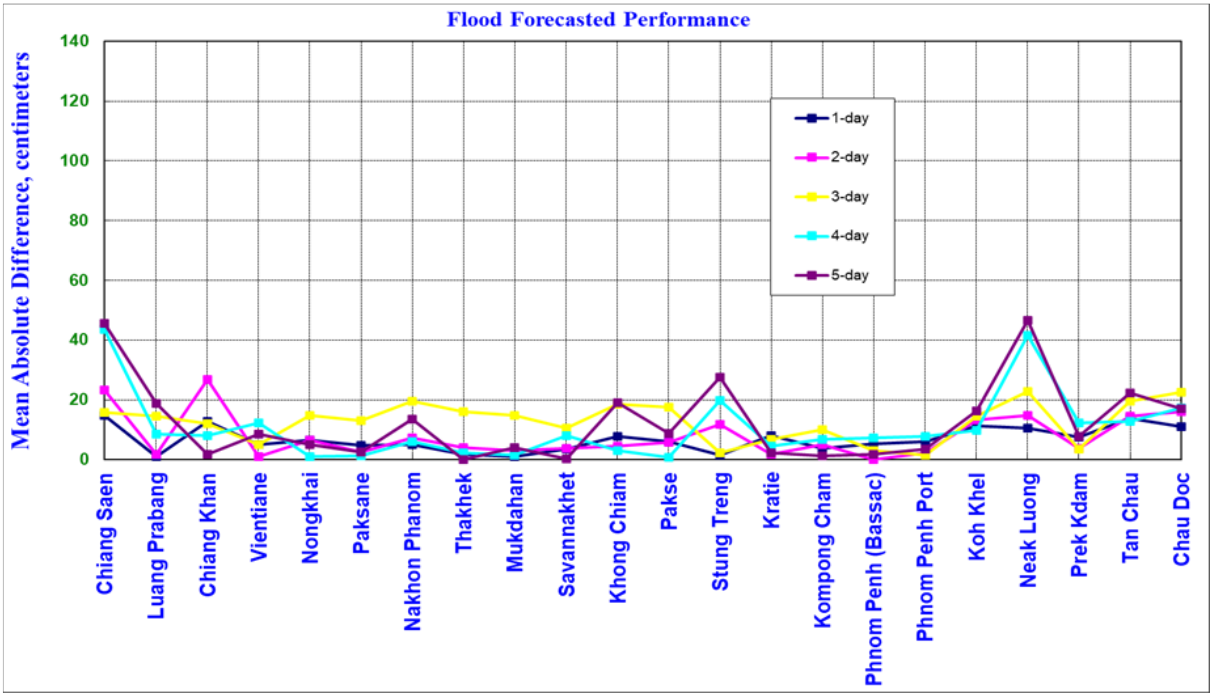
Annex 1: Performance of the weekly flood forecasting

Accuracy

"Accuracy" here refers to the state where data recorded in the MRC's Mekong River Flood Forecasting System are cleaned and verified.

The adjustment of flood forecasting outcomes from the flood forecasting system requires flood forecasters to have extensive knowledge in hydrology and statistical modelling for estimating the relationships between stations upstream and downstream in the Mekong River Basin. Flood forecasting performance presented in the graph below shows the average flood forecasting accuracy at each key station along the Mekong mainstream from 11 to 17 July 2023.

The forecasting values from 11 to 17 July 2023 show that the overall accuracy is fair for a four-day to five-day forecast in lead time (less than 40 cm) at stations in the upper part of the Mekong River at Chaing Saen station because of rainfall and reservoirs' operation in this area during the report period.



Note: The higher percentage of flood forecasting accuracy is due to several key factors as follows:

- Missing rainfall in Cambodia (DOM) data and data input are not sufficient to be used for inputting into the flood forecasting model system.
- Luang Prabang to Chiang Khan and Paksane to Stung Treng to Kratie have been influenced by hydropower operations upstream, tributaries inflows.
- The influence of heavy rainfall caused by storms and hydropower operations from upstream, tributaries inflows and the lower part of the Mekong floodplain, including the 3S (Stung Treng and Kratie).

- Fluctuations of the water levels at Tan Chau and Chau Doc stations were due to daily tidal effects of the sea in the Mekong Delta.
- Satellite rainfall data were not representative of the actual rainfall at ground stations in some areas of the Mekong region.

Performance based on data from the Member Countries

Flood forecasting performance is based on the hydro-met data received from the Member Countries. The flood forecasting achievement indicated in (%) and (cm) from 1 day to 5 days at each key station, against with Old Benchmark are presented in Table B1 and Table B2.

The evaluation of performance indicators, missing data and completion time for flood forecasting are presented in Table B3 and Figures B4, B5 and B6, respectively from 11 to 17 July 2023.

Table B1: The Mean Absolute Difference (Error) of Flood Forecasting base on old defined Benchmark from 11 to 17 July 2023 in cm

Lead-time Forecasted	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	15	1	13	5	7	5	5	2	1	4	8	6	2	8	4	5	6	11	11	8	14	11
2-day	23	2	27	1	7	2	7	4	3	4	5	6	12	2	5	0	2	13	15	4	15	16
3-day	16	15	12	5	15	13	20	16	15	11	19	18	2	7	10	3	2	15	23	4	20	23
4-day	44	9	8	12	1	1	6	2	2	8	3	1	20	5	7	7	8	10	42	12	13	17
5-day	46	19	2	9	5	3	14	0	4	0	19	9	28	2	1	2	4	16	47	8	22	17

Table B2: The Mean Absolute Difference (Error) of Flood Forecasting base on old defined Benchmark from 11 to 17 July 2023 in %

Lead-time Forecasted	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	57.1	28.6	71.4	28.6	42.9	28.6	57.1	14.3	0.0	42.9	71.4	28.6	14.3	71.4	42.9	57.1	28.6	57.1	71.4	71.4	71.4	71.4	***46.8***
2-day	66.7	33.3	83.3	0.0	66.7	33.3	83.3	33.3	16.7	33.3	0.0	33.3	50.0	0.0	66.7	0.0	0.0	33.3	50.0	0.0	33.3	33.3	***34.1***
3-day	60.0	80.0	20.0	20.0	60.0	60.0	100.0	60.0	40.0	20.0	20.0	80.0	20.0	0.0	40.0	0.0	0.0	20.0	40.0	0.0	60.0	40.0	***38.2***
4-day	100.0	50.0	25.0	25.0	0.0	0.0	50.0	50.0	0.0	0.0	25.0	0.0	50.0	0.0	25.0	0.0	0.0	50.0	25.0	50.0	50.0	50.0	***28.4***
5-day	66.7	100.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	33.3	0.0	33.3	0.0	33.3	0.0	0.0	66.7	33.3	33.3	100.0	66.7	***27.3***

Table B3: Overview of performance indicators for the past 7 days from 11 to 17 July 2023

	FF time sent				Arrival time of input data								Missing data (number-mainstream and trib.st.)							
2023	FF completed and sent (time)	Stations without forecast	FF2 completed and sent (time)	Weather data available (time)	NOAA data	China	Cambodia - DHRW	Cambodia - DOM	Lao PDR - DMH	Thailand - DWR	Viet Nam - SRHMC	Viet Nam - HMS	NOAA data/2dataset	China/2	Cambodia - DHRW/15	Cambodia - DOM/34	Lao PDR - DMH/25	Thailand - DWR/13	Viet Nam - SRHMC/6	Viet Nam - HMS/39
week	*10:37*	*#DIV/0!*	-	-	*08:15*	*07:10*	*07:04*	*09:25*	*08:40*	*08:36*	*07:17*	*08:17*	*0*	*0*	*68*	*0*	*0*	*0*	*0*	*0*
month	*10:40*	*#DIV/0!*	-	-	*08:15*	*07:10*	*07:26*	*09:58*	*08:43*	*08:31*	*07:12*	*08:15*	*0*	*0*	*238*	*36*	*17*	*0*	*0*	*61*

Fig. B4: Data delivery times for the past 7 days from 11 to 17 July 2023

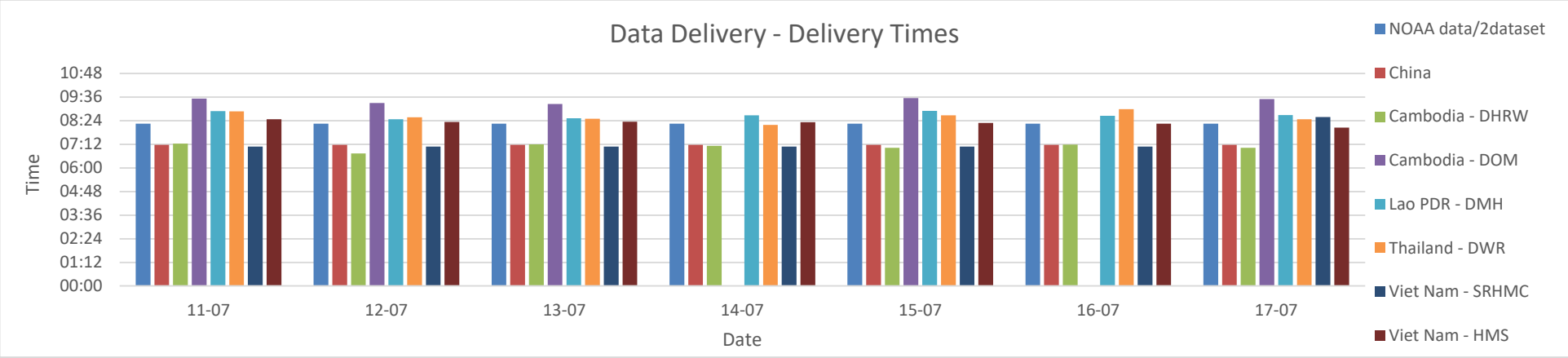


Fig. B5: Missing data for the past 7 days from 11 to 17 July 2023

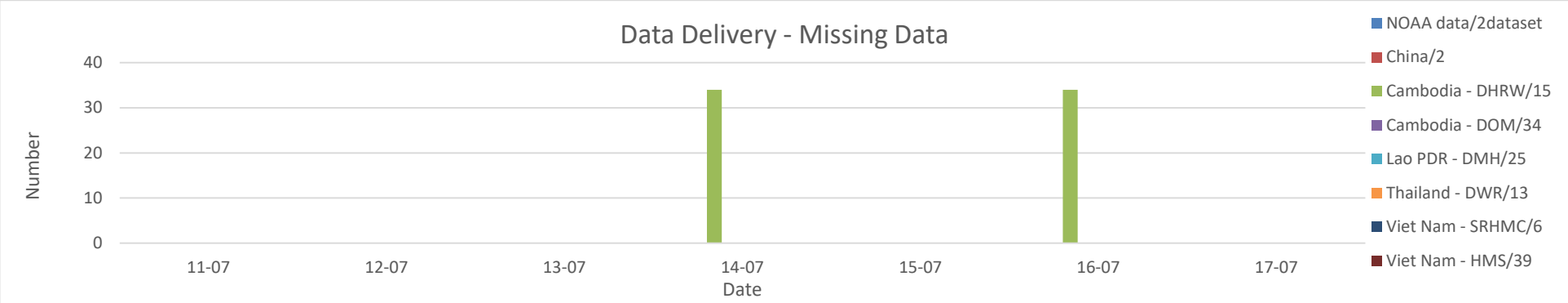
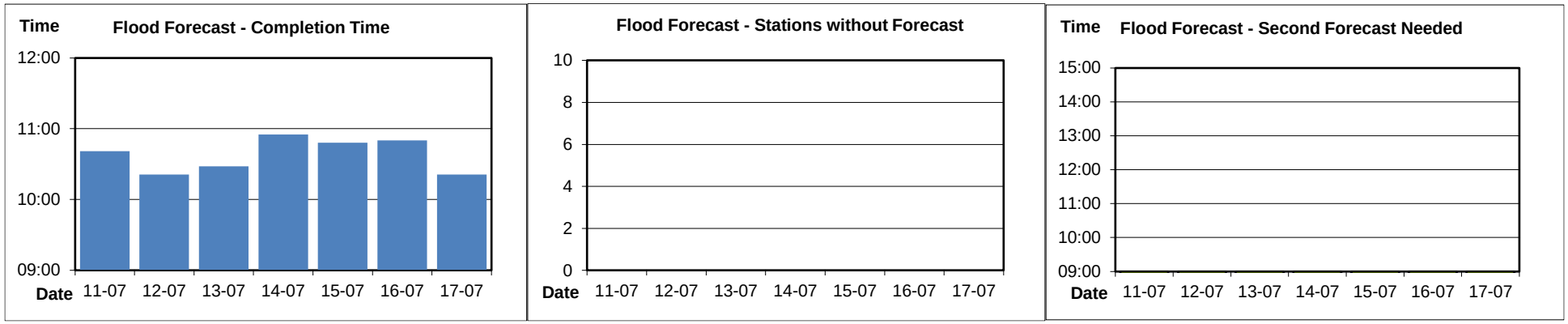


Fig. B6: Flood forecast completion time, stations without forecasts, and second forecasts need from 11 to 17 July 2023



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