



Mekong River Commission

Weekly Wet Season Situation Report in the Lower Mekong River Basin 14-19 June 2023

Prepared by
The Regional Flood and Drought Management Centre
20 June 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 1.00 millimetres (mm) to 202.40 mm.
- There will be moderate rainfall for the next 5 days over the Mekong region from 20 to 26 June 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 decreased water levels from **536.24 m** to **535.75 m** during 14-19 June 2023. The current level is staying about 0.64 m lower than its LTA value. The outflow at Jinghong station decreased between 1,550.00 m³/s and 1,180.00 m³/s during 14-19 June 2023.
- With the decreased outflow from Jinghong upstream and rainfall at catchment inflow, water levels of monitoring stations at Chiang Saen in Thailand decreased about 0.03 m from 14 to 19 June 2023, staying about 1.48 m lower than its LTA level. WLS at Xieng Kok upstream of Chiang Saen also decreased about 1.53 m.
- Water level at Chiang Khan in Thailand from 14 to 19 June 2023 decreased about 0.46 m but stayed about 1.48 m lower than its LTA value, while water level at Vientiane decreased about 0.21 m staying about 1.25 m lower than its LTA level. Water levels at Nong Khai decreased 0.27 m and stayed about 2.04 m lower than its LTA, while at Paksane it decreased about 0.41 m, staying about 2.52 m lower than its LTA value. Water levels at these stations are still considered low.
- Water levels from Nakhon Phanom in Thailand and Pakse in Lao PDR increased from 0.20 m to 0.35 m due to the contribution of above-average 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 normal.
- The water volume of the Tonle Sap Lake was lower than its LTA (about 63%) during the same period from 14 to 19 June 2023, which is still considered normal.

- Water levels from downstream at Chaktomuk, Koh Khel on the Bassac and Phnom Penh Port to Prek Kdam in Cambodia have increased but still staying lower than their LTA level.
- The current water levels for most of the stations are lower than their LTA value, except at Luang Prabang. 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 **June 12-18**, the LMB was at normal condition. No drought threat was found during the monitoring week.
- In **June** the central and eastern parts covering mainly Thailand and the 3S areas are likely hit by severe and extreme droughts. They specifically cover Phongsaly, Vientiane, Xaysomboun, Borikhamxay, Chaiyaphum, Khon Kaen, Maha Sarakham, Roi Et, Surin Burirum, Nakhon Ratchasima, Sa Kaeo, Banteay Meanchey, Battambang Pursat, Otdar Meanchey, Saravane, Champasack, Stung Treng, Ratanakiri, Gia Lai, Kon Tum, Attapeu, and Sekong. In **July** the upper and 3S areas are likely experiencing some extreme and severe droughts. They cover Phongsaly, Luangnamtha, Bokeo, Chiang Ria, Phayao, Oudomxay, Luang Prabang, Xayaburi, Vientiane, Xaysomboun, Borikhamxay, Nongkhai, Saravane, Sekong, Attapeu, Champasack, Ratanakiri, Kon Tum, Gia Lai, Pursat, Battambang, Kampong Speu, Kien Giang, Ca Mau, Bac Lieu, Soc Trang, and Dak Lak. While in **August** from moderate to extreme droughts are forecasted for Vientiane, Borikhamxay, Xaysomboun, Nong Khai, Saravane, Sekong, Attapeu, Champasack, Ratanakiri, Kon Tum, Gia Lai, Dak Lak, Mondul Kiri, Kratie, and Stung Treng.

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 **14-19 June 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 (June, July and August) and the weather maps issued by the Thai Meteorological Department (TMD) were used to verify weather conditions in the LMB.

Since the beginning of June 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 June and July 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 of LMB. Temperature will decrease in the Northeast first and 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 13-15 June 2023, indicating that a low-pressure cell was active in the East-Sea of Viet Nam, but did not impact the LMB. Generally, the Mekong region was influenced by the southwest monsoon wind with an active low-pressure cell located over Northern Viet Nam and southern China. Under this weather condition, moderate to extreme rainfall occurred over eastern part of the basin which is more orographic rainfall, northern Lao PDR, southern part in Cambodia and southern Viet Nam.

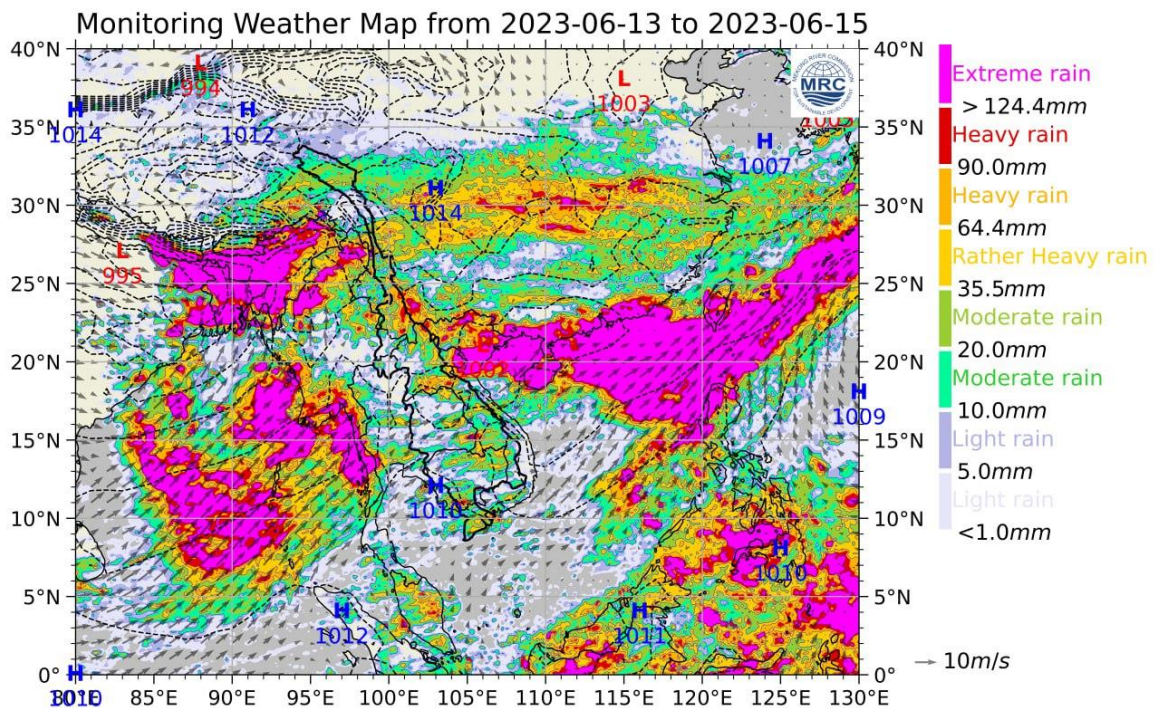


Figure 1. Summary of weather conditions over the LMB.

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 12 to 25 June 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 12 to 25 June 2023 in Southeast Asia based on results from the NCEP model (National Centres for Environmental Prediction).

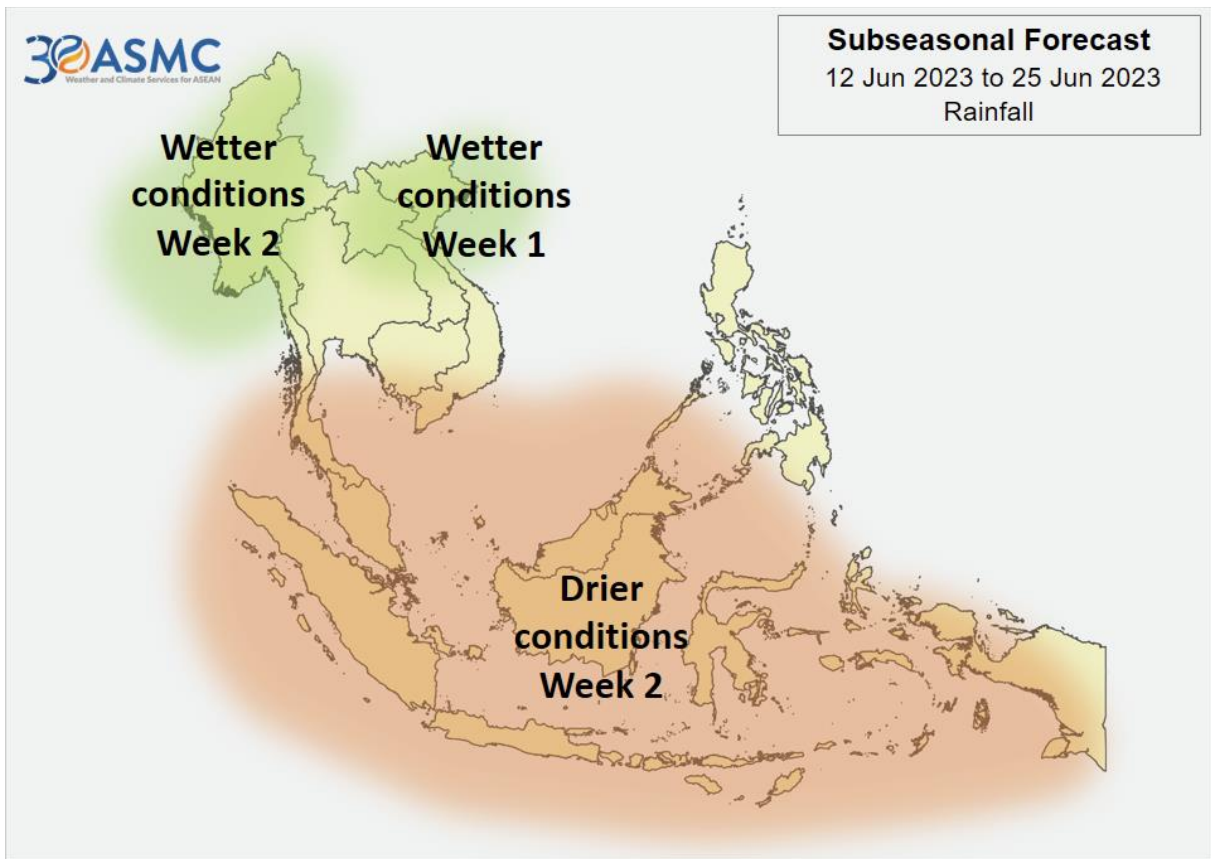


Figure 2. Outlook of wet and dry conditions over the Asian countries by ASMC.

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 14 and 19 June 2023. No low-pressure line was observed over the Mekong region as shown in [Figure 1](#). The active system for the LMB on 6 June is displayed in [Figure 3](#).

Active system as of 19 June 2023, 4:14 GMT

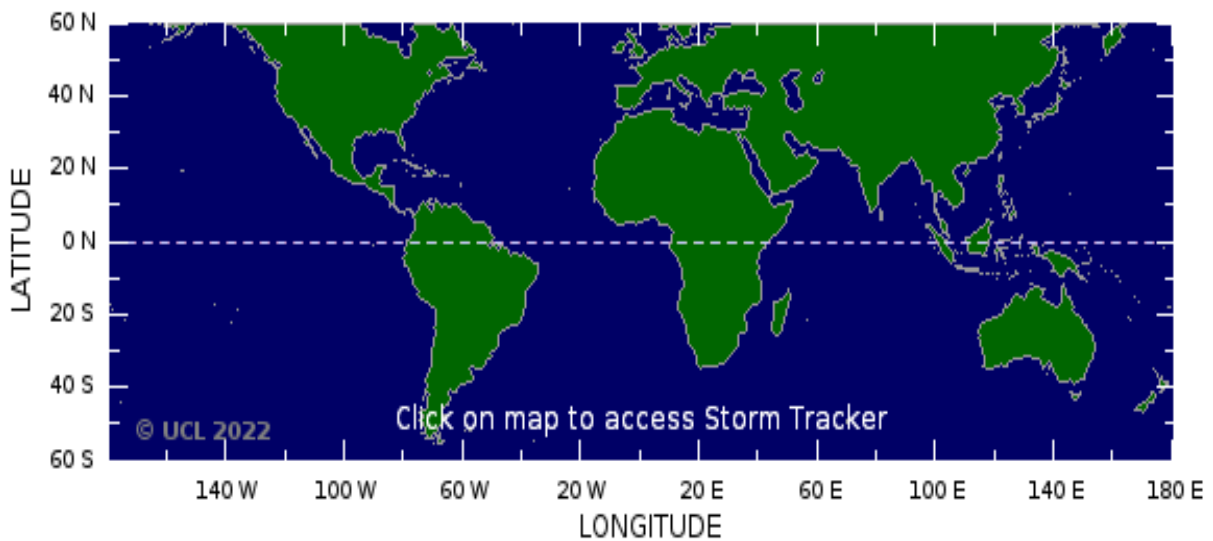


Figure 3. A tropical depression risk observed on 19 June 2023.

2.2 Rainfall patterns over the LMB

This week from 14 to 19 June 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 1.00 mm to 202.40 mm. The highest rainfall of this week report concentrated Khong Chaim in Thailand and Pakse in Lao PDR which reached up to 202.40.00 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 low, compared with its LTA and last week rainfall in most of the stations.

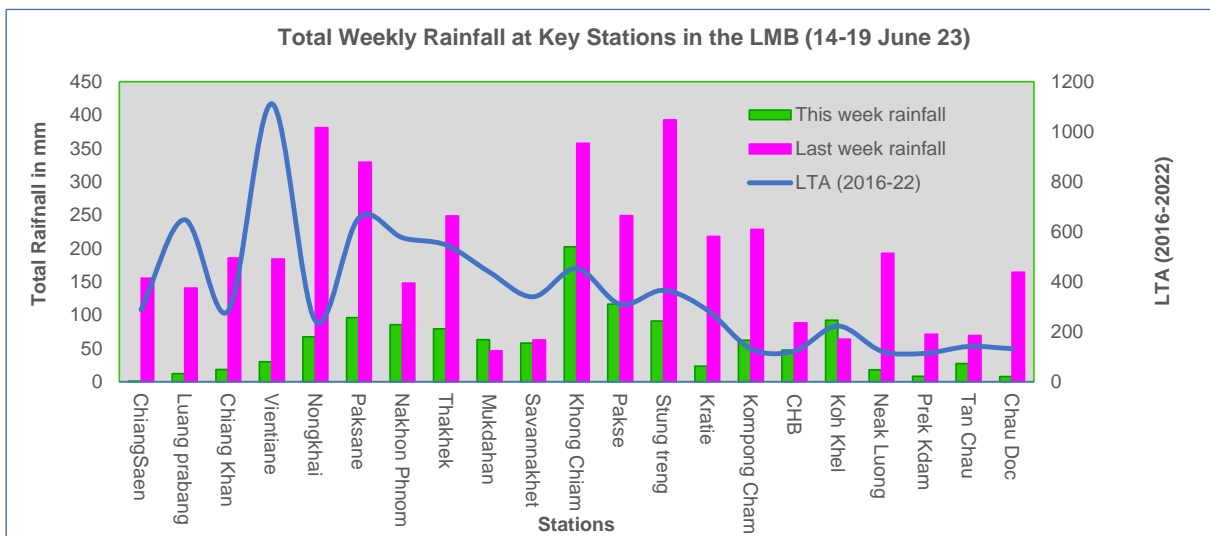


Figure 4. Weekly total rainfall at key stations in the LMB during 14-19 June 2023.

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 14 to 19 June 2023.

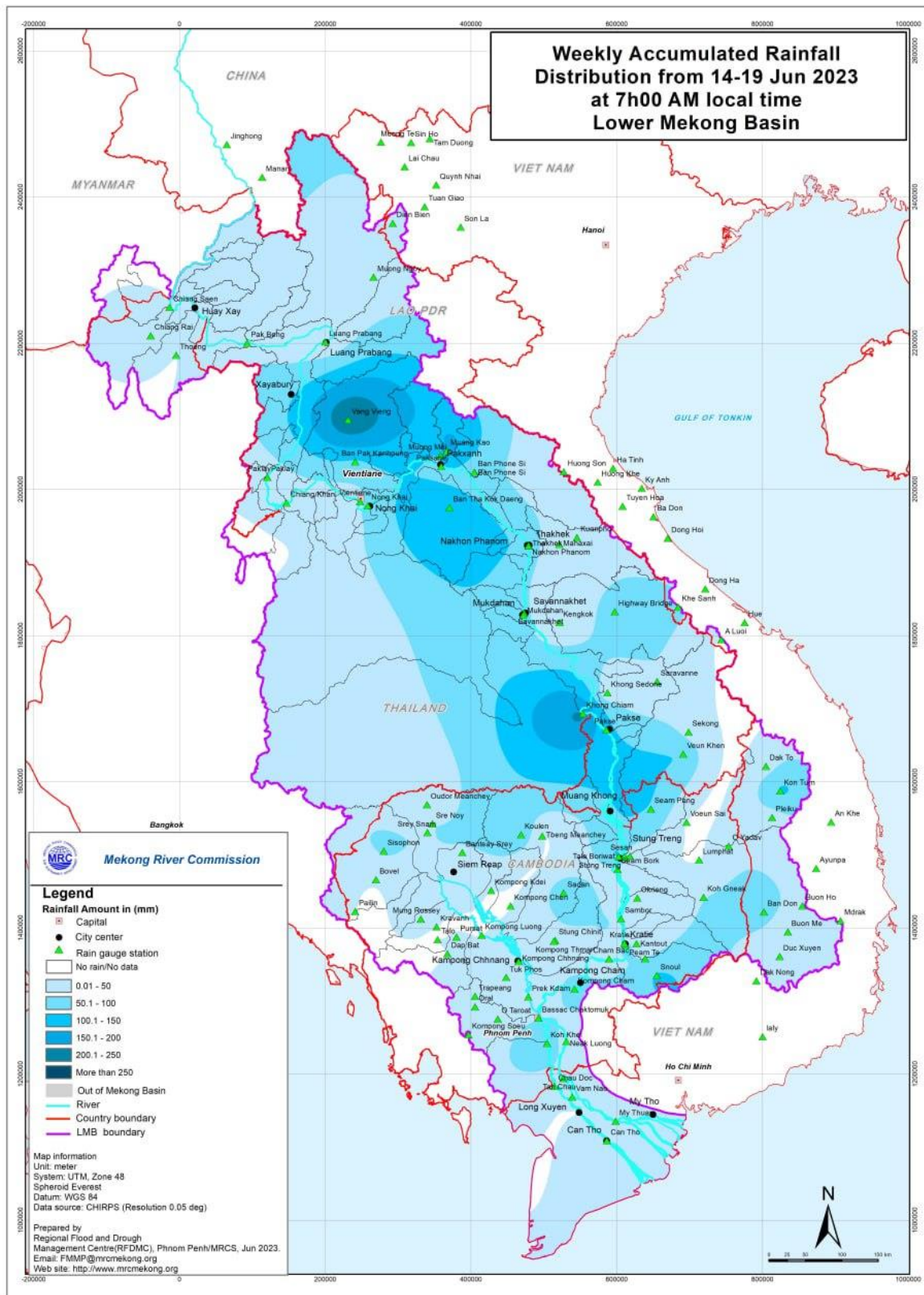


Figure 5. Weekly rainfall distribution over the LMB during 14-19 June 2023.

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](#).

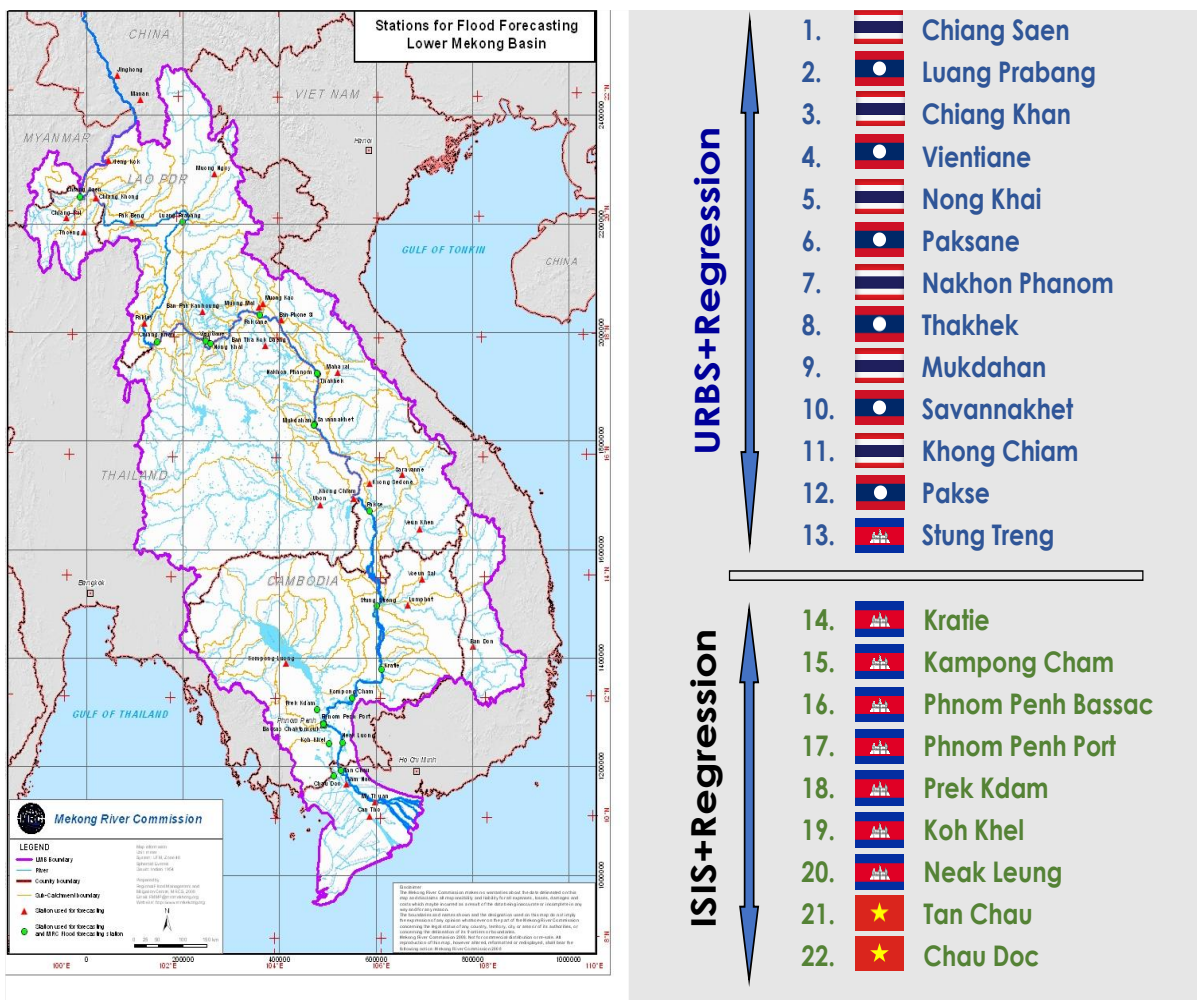


Figure 6. Key stations and model application for River Monitoring and Flood Forecasting.

According to MRC’s observed water level at Jinghong, it showed a decreased water levels from **536.40 m to 535.75 m** during 14-19 June 2023 (recorded on 7:00 am). The current level is staying about 0.64 m lower than its Long-Term Average (LTA: 2015-2022) value. The outflow at Jinghong station decreased from 1,550.00 m³/s to 1,180.00 m³/s between 14 and 19 June 2023. [Figure 7](#) below presents water level that fluctuated at the Jinghong hydrological station¹, indicating the trend of fluctuating water level up to 19 June 2023.

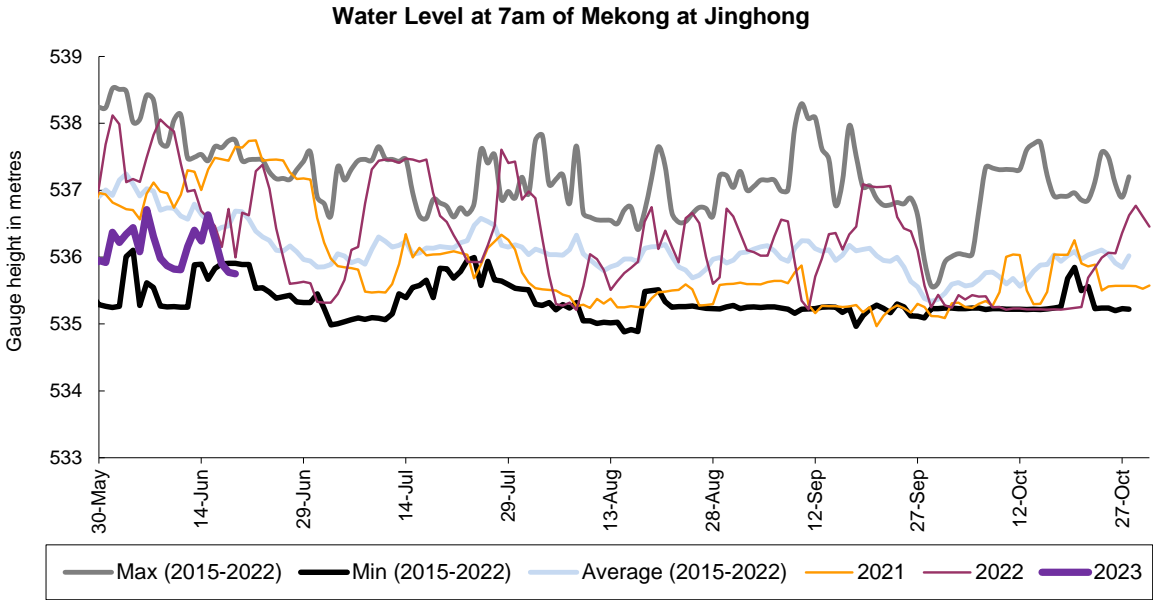


Figure 7. Water level at the Jinghong hydrological station up to 19 June 2023.

Along with the decreased outflow from Jinghong upstream, water levels of monitoring stations at Xieng Kok in Lao PDR, upper of Chiang Saen, decreased about 1.53 m, while at Chiang Saen in Thailand it showed a decrease of about 0.03 m from 14 to 19 June 2023, staying about 1.48 m lower than its LTA level, which considered low level.

Water level at Chiang Khan in Thailand from 14 to 19 June 2023, however, decreased about 0.46 m and stayed about 1.48 m lower than its LTA value, while water level at Vientiane station decreased about 0.25 m and stayed about 1.25 m lower than its LTA level, which was still **considered a low water level**. Water levels at Nong Khai decreased 0.27 m and at Paksane it decreased about 0.41 m, staying about 2.04 m and 2.52 m lower than their LTA value respectively, **which was considered a low water level**.

Water levels from Nakhon Phanom in Thailand to Pakse in Lao PDR increased from 0.15 m to 0.35 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 0.02 m and stayed about 0.75 m lower than its LTA, while at Kratie water level was down about 0.32 m, staying 1.30 m lower than its LTA level, **considered low**.

Water level at Kompong Cham was up about 0.55 m and stayed 1.89 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 up between 0.28 and 0.43 m, but WLs at these stations were still 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 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 14 to 19 June 2023 at Thailand’s Chiang Saen station decreased from 2.45 m to 2.42 m, showing 1.48 m lower than its Long-Term-Average (LTA) value, which considered low level. The water level at Luang Prabang station in Lao PDR was up about 0.14 m from 9.02 m to 9.16 m during the reporting period. This level still shows 1.44 m higher 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.**

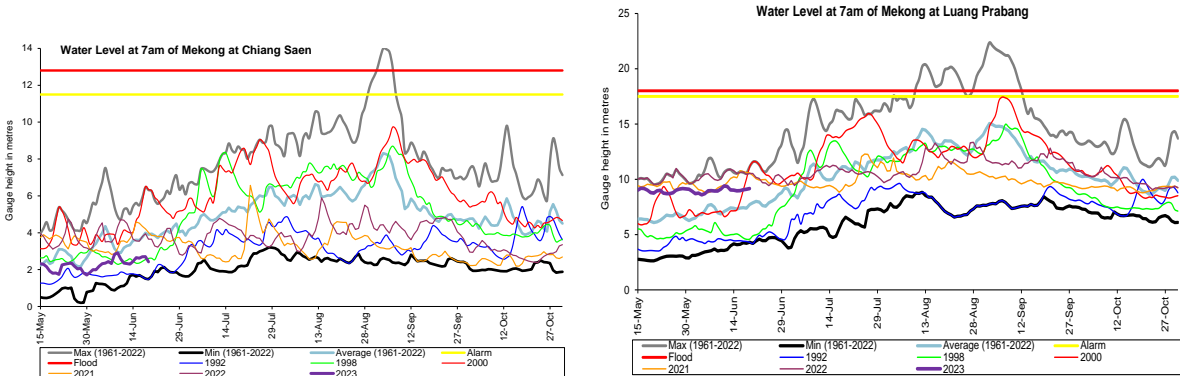


Figure 8. Water levels at Chiang Saen in Thailand and Luang Prabang in Lao PDR.

Chiang Khan, Vientiane-Nong Khai and Paksane

The water level at Chiang Khan in Thailand (downstream of the Xayaburi dam) decreased about 0.46 m staying about 1.48 m lower than its LTA value, while at Vientiane in Lao PDR it decreased about 0.25 m and showed about 1.25 m lower than its LTA during the reporting week of 14-19 June 2023. At Nong Khai station in Thailand, the water level was also down about 0.27 m from 2.52 m to 2.25 m, staying about 2.04 m during the reporting period. At

Paksane in Lao PDR, water level decreased about 0.41 m from 3.84 m to 3.43 m. The water level at this station was about 2.52 m lower than its LTA value. The recently increased water levels were obviously due to the moderate rainfall contributed from the sub-catchment area along with the less inflows and water stored at upstream parts. The water levels at Vientiane and Paksane are shown in [Figure 9](#) below.

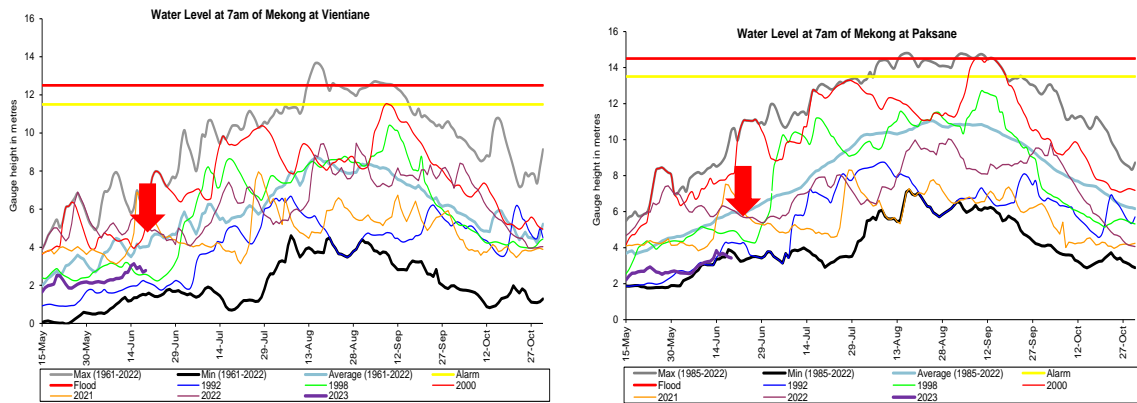


Figure 9. Water levels Veintiane and Paksane in Lao PDR.

Nakhon Phanom to Pakse

The water levels from Nakhon Phanom in Thailand to Pakse in Lao PDR increased between 0.11 m and 0.32 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.

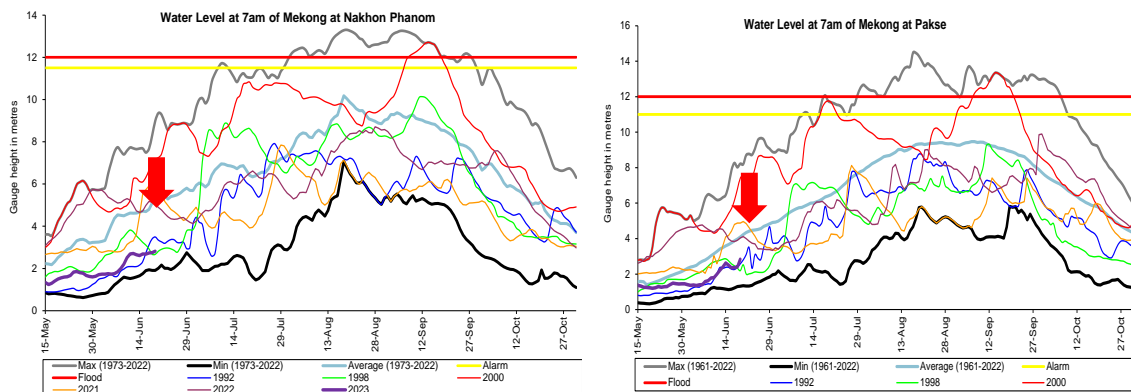


Figure 10. Weekly water levels at Nakhon Phanom in Thailand and Pakse in Lao PDR

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 14-19 June 2023. The water levels at Stung Treng increased about 0.02 m and stayed about 0.75 m lower than its LTA, while at Kratie it increased about 0.32 m, staying about 1.30 m lower than its LTA (as showed in [Figure 11](#)). The water level at Kompong Cham

station also increased about 0.55 m and was about 1.89 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.

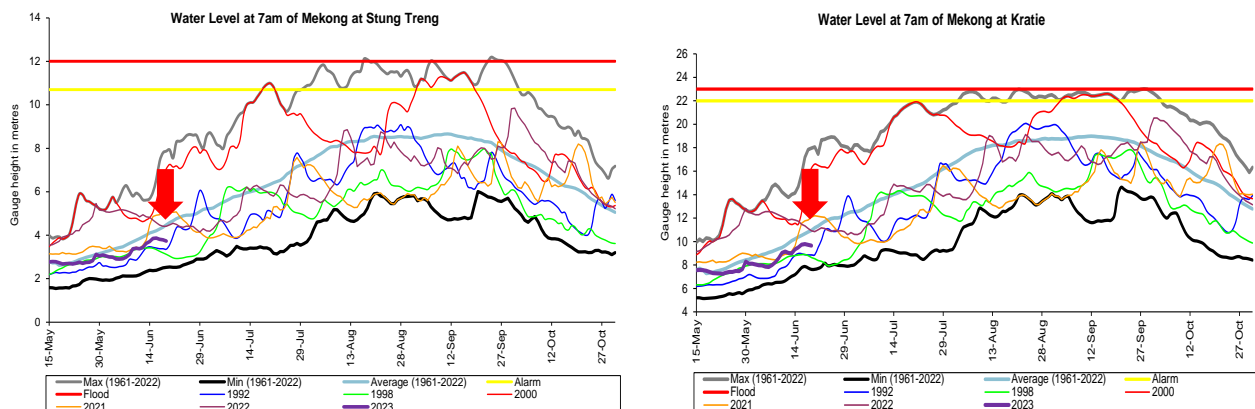


Figure 11. Water levels at Stung Treng and Kratie on the Mekong River.

At Chaktomuk on the Bassac River, due to accumulated rainfall and contributed flows from upstream catchment, the water level increased by about 0.29 m and stayed 1.36 m lower than its LTA value; while at Koh Khel, water level increased about 0.40 m, staying 0.64 m lower than its LTA value. The water level at Prek Kdam on the Tonle Sap Lake increased about 0.43 m and was about 1.23 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 continue to rise and is considered normal.**

Tidal stations at Tan Chau and Chau Doc

Like last week, the water levels from 14 to 19 June 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 0.42 m and 1.11 m; they were below the range of their LTA levels 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 inflow of the Tonle Sap Lake is nearly taking place up to 19 June 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:

$$\text{Flows} = (\text{WL at Prek Kdam})^{1.2} * \text{SQRT} (\text{WL difference between PP port and Kampong Luong})$$

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, 2021, 2022 and their LTA level (1997-2022). Up to June 19 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 outflow into the Tonle Sap Lake was most likely caused by inflows and rainfall from the catchment area. Up to present, the outflow from the Tonle Sap Lake condition in 2023 is higher than 2020, 2021 and 2022 but lower than its LTA (1997-2022) inflow conditions. For next week, moderate rainfall is forecasted for the Tonle Sap area; and the outflow into the Tonle Sap Lake is likely expected to go up from the current level.

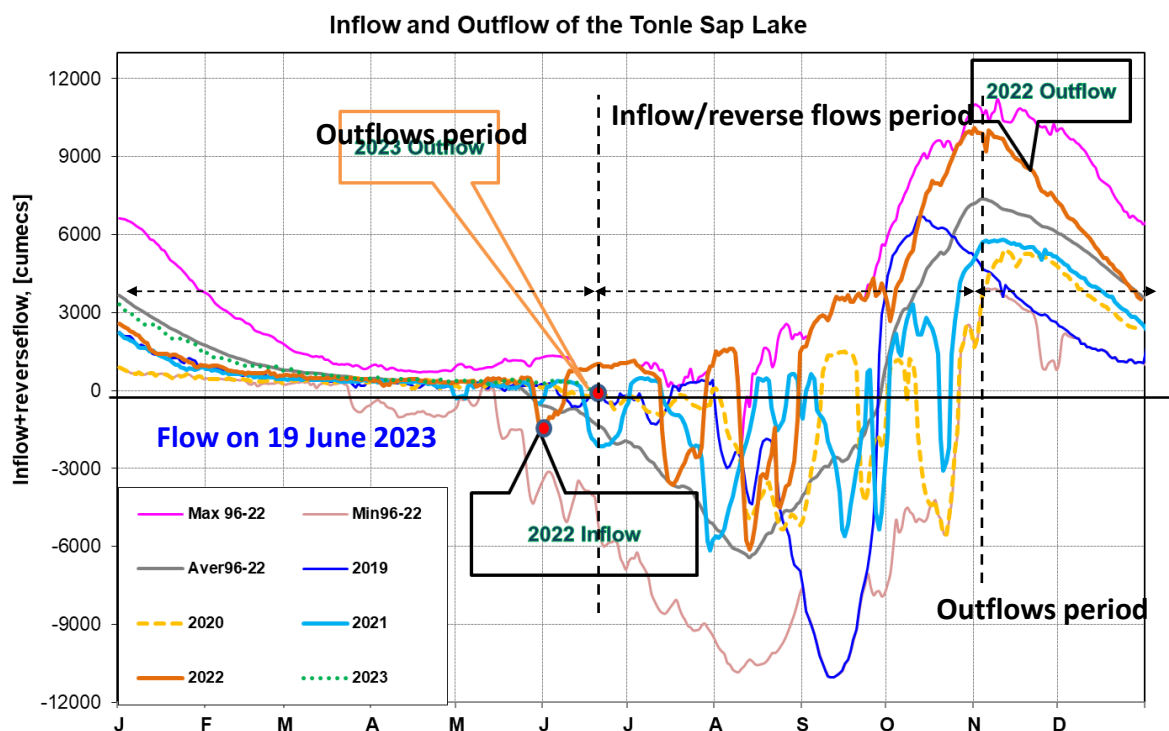


Figure 12. Seasonal change of inflows and outflows of Tonle Sap Lake

[Figure 13](#) shows seasonal changes in monthly flow volumes up to 19 June 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 June 13, **the water volume of the Tonle Sap Lake was slightly higher than 2020, 2021, 2022 but lower than its LTA (about 63%), 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.

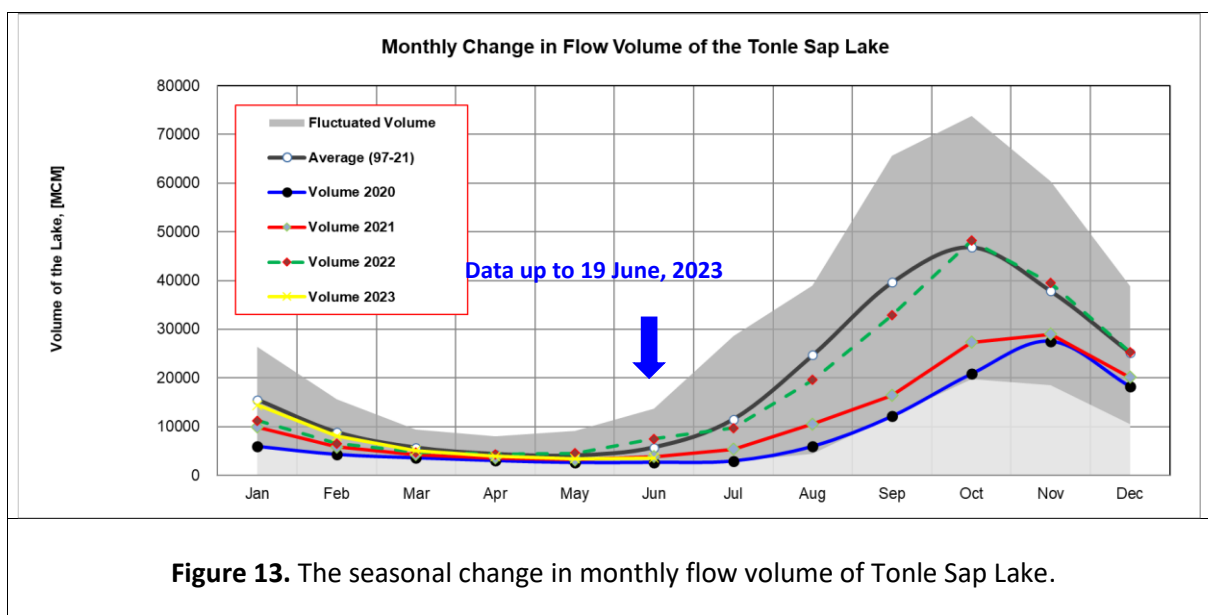


Figure 13. The seasonal change in monthly flow volume of Tonle Sap Lake.

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 | 3581.85 | 62.75 |
| Jul | 11493.25 | 28599.56 | 2925.86 | 4001.99 | 2925.86 | 5346.73 | 9703.79 | | |
| 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, compared with historical Min values | | | | | | | | |
| | Normal condition, compared with LTA (Long term average) | | | | | | | | |
| | Low volume situation, compared 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 June 14 to 19, the LMB was affected by two main weather factors being (1) the moderate Southeast monsoon and (2) and the low-pressure cell. These conditions 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 and moderate-risk of flash flood events were detected during the reporting period in several areas of Lao PDR 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 June 14-19.

| 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: 14/06/2023 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 | Provinces | Level Risks |
| Lao Cai | Thanh Uyen | Northwest | Low-Risk | Lao Cai | Thanh Uyen | Northwest | Low-Risk | Lao Cai | Thanh Uyen | Northwest | Moderate-Risk | | |
| Thanh Hoa | Muong Lat | North Central | Low-Risk | Thanh Hoa | Muong Lat | North Central | Low-Risk | Hoa Binh | Da Bac | Northwest | Low-Risk | | |
| | | | | | | | | Lao Cai | Sa Pa | Northwest | Low-Risk | | |
| | | | | | | | | Lai Chau | Muong Te | Northwest | Low-Risk | | |
| | | | | | | | | Bac Kan | Ba Be | Northeast | Low-Risk | | |
| | | | | | | | | Nghe An | Tuong Duong | North Central | Low-Risk | | |
| | | | | | | | | Thanh Hoa | Muong Lat | North Central | Low-Risk | | |

| Rate-risk and location of the flash flood may occur in the next 1, 3, and 6 hours in Lao PDR | | | | | | | | | | | | | | |
|--|-----------|---------------|----------------|---------------------------------------|-----------|-----------|-----------|---------------------------------------|------------|-------------|-----------|-----------|----------------|------------|
| Date of FFG products: 14/06/2023 00:00 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 |
| Khammuane | Hinboon | VANG TA KHONG | Center of Laos | Low-Risk | Huaphanh | Xamtay | HOUAYKHAY | Eastern | Low-Risk | Bolikhramay | Vienthong | KOKKIEN | Central Laos | Low-Risk |
| Huaphanh | Xamtay | HOUAYKHAY | Eastern | Low-Risk | | | | | | Khammuane | Hinboon | VANG TAI | Center of Laos | Low-Risk |
| | | | | | | | | | | Khammuane | Hinboon | MOUANG | Center of Laos | Low-Risk |
| | | | | | | | | | | Huaphanh | Xamtay | HOUAYKHAY | Eastern | Low-Risk |
| | | | | | | | | | | Huaphanh | Xamtay | GNORT-H | Eastern | Low-Risk |
| | | | | | | | | | | Huaphanh | Viangxay | ONGKHA | Eastern | Low-Risk |
| | | | | | | | | | | Huaphanh | Xamtay | PANG NUL | Eastern | 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 product: 15/06/2023 0:00 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 | Provinces | Level Risks | |
| NO ANY DETECTION OF FLASH FLOOD WITHIN NEXT 01-HOUR | | | | NO ANY DETECTION OF FLASH FLOOD WITHIN NEXT 03-HOUR | | | | Hoa Binh | | | | Da Bac | Northwest | Low-Risk |
| | | | | | | | | Lao Cai | Thanh Uyen | Northwest | Low-Risk | | | |
| | | | | | | | | Lai Chau | Muong Te | Northwest | Low-Risk | | | |
| | | | | | | | | Son La | Muong La | 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: 16/06/2023 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 | Provinces | Level Risks | |
| NO ANY DETECTION OF FLASH FLOOD WITHIN NEXT 01-HOUR | | | | NO ANY DETECTION OF FLASH FLOOD WITHIN NEXT 03-HOUR | | | | Lao Cai | | | | Thanh Uyen | Northwest | Low-Risk |
| | | | | | | | | Thanh Hoa | Muong Lat | North Central | Low-Risk | | | |

| Rate-risk and location of the flash flood may occur in the next 1, 3, and 6 hours in Lao PDR | | | | | | | | | | | | | | |
|--|-----------|--------------|-----------|---------------------------------------|-----------|-----------|--------------|---------------------------------------|------------|------------|-----------|----------|-----------|------------|
| Date of FFG products: 19/06/2023 00:06 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 |
| Vientiane | Feuang | HUAYDOK MAI | Northwest | Low-Risk | Vientiane | Feuang | MOUANGFOUANG | Northwest | Low-Risk | Xienghuang | Morkmay | KHANGVI | Northeast | Low-Risk |
| Vientiane | Feuang | MOUANGFOUANG | Northwest | Low-Risk | | | | | | Vientiane | Feuang | MOUANG | Northwest | Low-Risk |
| Vientiane | Feuang | NAMOUANG | Northwest | Low-Risk | | | | | | Vientiane | Feuang | NAMOUANG | Northwest | Low-Risk |
| | | | | | | | | | | Huaphanh | Viangxay | ONGKHA | Eastern | 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: 19/06/2023 00:06 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 | Provinces | Level Risks |
| Lao Cai | Thanh Uyen | Northwest | Low-Risk | Son La | Moc Chau | Northwest | Low-Risk | Dak Lak | Dak Nong | Central Highlands | Low-Risk | | |
| Son La | Moc Chau | Northwest | Moderate-Risk | Son La | Moc Chau | Northwest | Low-Risk | Hoa Binh | Da Bac | Northwest | Low-Risk | | |
| Son La | Moc Chau | Northwest | Low-Risk | Thanh Hoa | Muong Lat | North Central | Low-Risk | Hoa Binh | Da Bac | Northwest | Low-Risk | | |
| Son La | Moc Chau | Northwest | Low-Risk | Lai Chau | Dien Bien Dong | Northwest | Low-Risk | Lao Cai | Van Ban | Northwest | Low-Risk | | |
| Thanh Hoa | Muong Lat | North Central | Low-Risk | | | | | Lao Cai | Thanh Uyen | Northwest | Low-Risk | | |
| Lai Chau | Dien Bien Dong | Northwest | Low-Risk | | | | | Lao Cai | Thanh Uyen | Northwest | Low-Risk | | |
| Lai Chau | Dien Bien Dong | Northwest | Low-Risk | | | | | Son La | Moc Chau | Northwest | Low-Risk | | |
| | | | | | | | | Son La | Moc Chau | Northwest | Low-Risk | | |
| | | | | | | | | Son La | Moc Chau | Northwest | Low-Risk | | |
| | | | | | | | | Hoa Binh | Mai Chau | Northwest | Low-Risk | | |
| | | | | | | | | Thanh Hoa | Muong Lat | North Central | Low-Risk | | |
| | | | | | | | | Lai Chau | Dien Bien Dong | Northwest | Low-Risk | | |
| | | | | | | | | Lai Chau | Dien Bien Dong | Northwest | Low-Risk | | |
| | | | | | | | | Son La | Song Ma | Northwest | Low-Risk | | |
| | | | | | | | | Thanh Hoa | Muong Lat | North Central | Low-Risk | | |
| | | | | | | | | Thanh Hoa | Quan Hoa | North Central | Low-Risk | | |
| | | | | | | | | Thanh Hoa | Quan Son | North Central | Low-Risk | | |

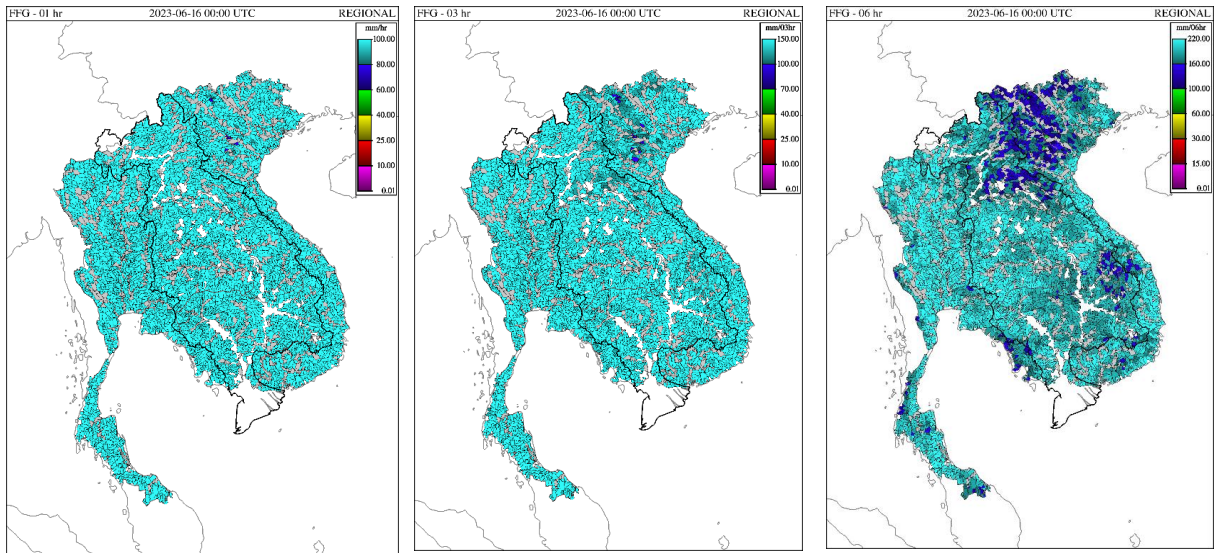


Figure 14. Flash Flood Guidance for the next 1-hr, 3-hr and 6-hr on June 19

5 Drought Monitoring in the Lower Mekong Basin

Weekly drought monitoring from 12 to 18 June 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 June 12 to 18, as displayed in [Figure 15](#), shows that the LMB was at normal condition all over the region except Chiang Rai and Kammuane in the north where some severe meteorological drought took place. No other threat was found during the monitoring week.

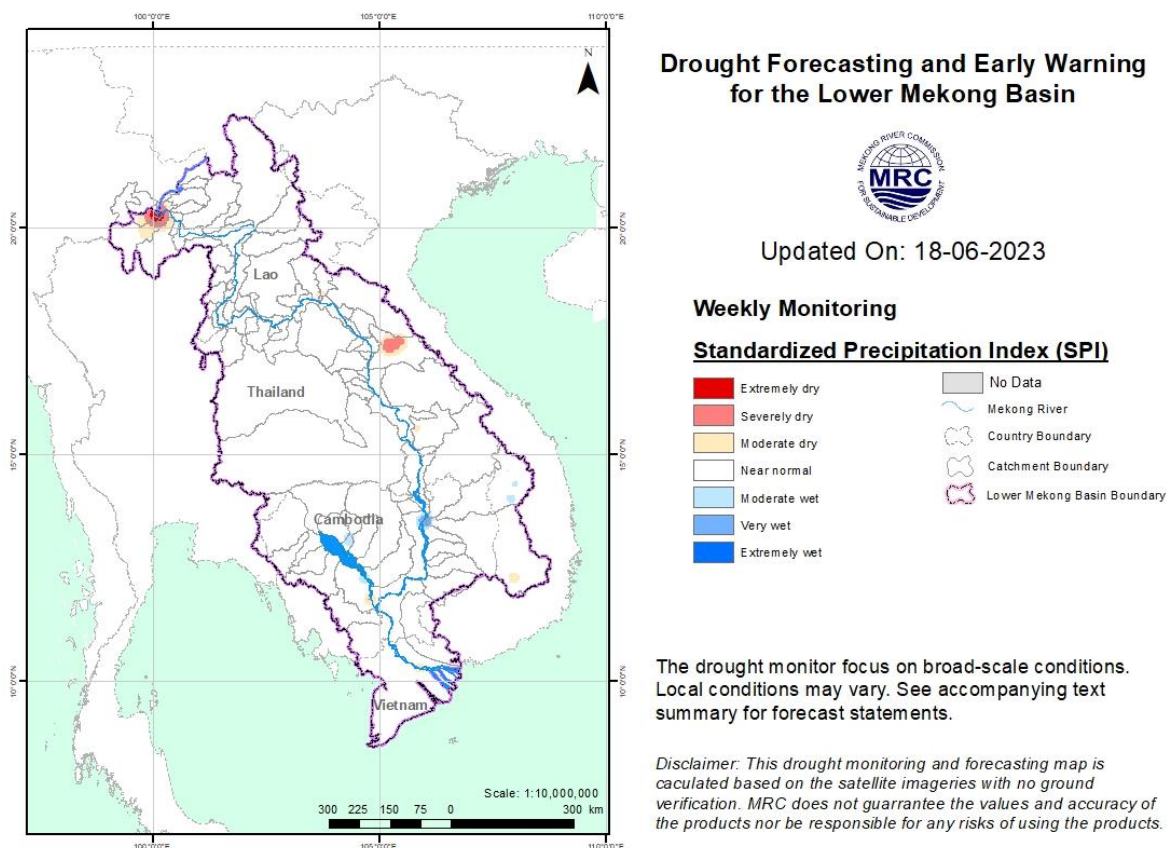


Figure 15. Weekly standardized precipitation index from 12 to 18 June 2023.

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

For the agricultural indicator, the nowcast this week from June 12 to 18 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 mostly normal or wet, except some areas of Loei, Nong Bua Lamphu, Nakhon Ratchasima, Burirum, Batabang, Pursat, Mondul Kiri, and Dak Lak where some moderate and severe agricultural drought took place but over small extent only.

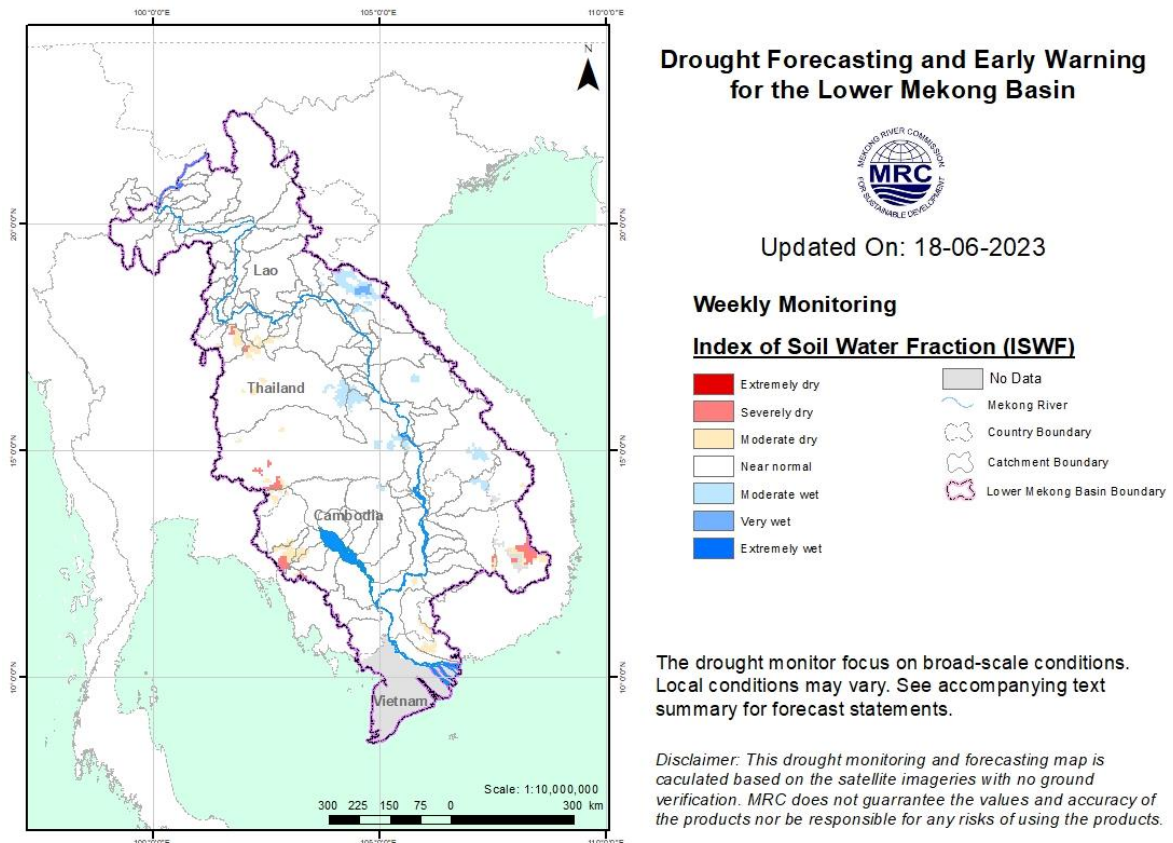
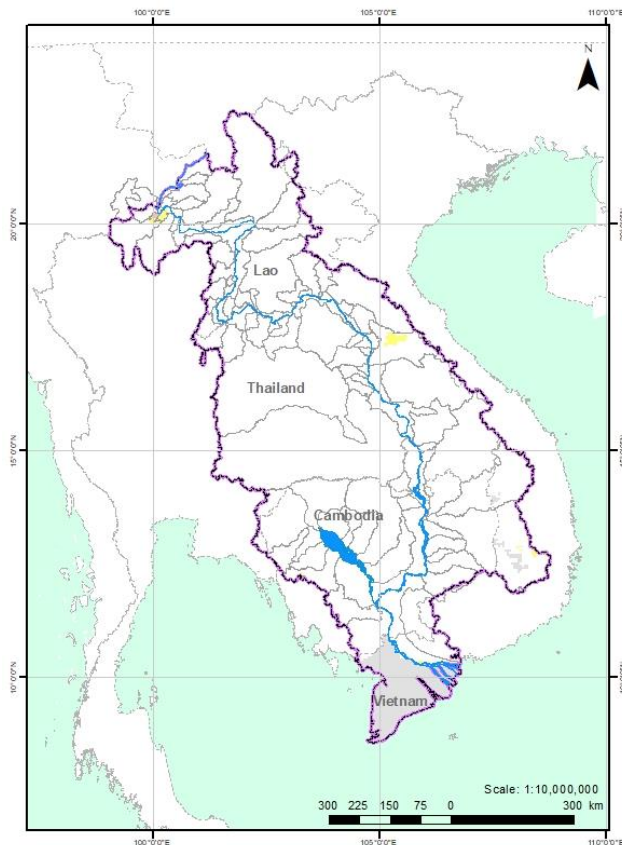


Figure 16. Index of Soil Water Fraction from 12 to 18 June 2023.

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

The combined drought indicator from the meteorological and agricultural indices from June 12 to 18, as displayed in [Figure 17](#), shows that no drought threat took place in the LMB during the monitoring week.



Drought Forecasting and Early Warning for the Lower Mekong Basin



Updated On: 18-06-2023

Weekly Monitoring

Combined Drought Index (CDI)

| | |
|--------------------------|-----------------------------|
| D4 (Exceptional Drought) | No Data |
| D3 (Extremely Drought) | Mekong River |
| D2 (Severely Drought) | Country Boundary |
| D1 (Moderate Drought) | Catchment Boundary |
| D0 (Normal Condition) | Lower Mekong Basin Boundary |

The drought monitor focus on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Disclaimer: This drought monitoring and forecasting map is calculated based on the satellite imageries with no ground verification. MRC does not guarantee the values and accuracy of the products nor be responsible for any risks of using the products.

Figure 17. Weekly Combined Drought Index from 12 to 18 June 2023.

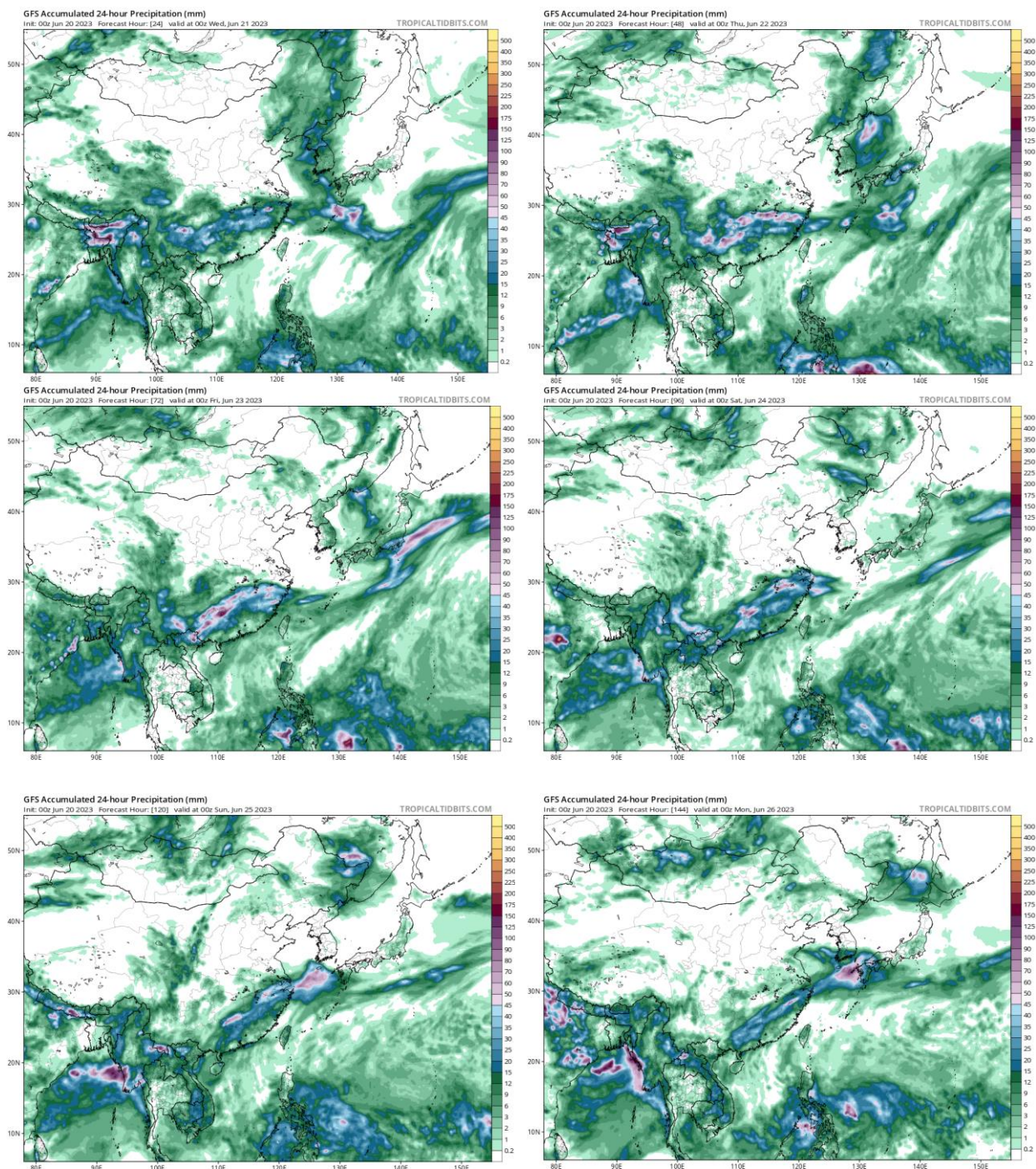
More information on Drought Forecasting and Early Warning (DFEW) as well as the explanation is available here: <http://droughtforecast.mrcmekong.org/templates/view/our-product>. DFEW provides not only weekly monitoring and forecasting information but also a three-month forecast of drought indicators 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 the analysis of the synoptic meteorological information and result from the Global Forecast System (GFS) model, in the coming week, the moderate southwest monsoon and the low-pressure cell will continue prevailing over the LMB.

In general, during June 21-27, small to moderate rain (5-45 mm/24h) and isolated heavy rains will likely occur in the LMB. [Figure 18](#) shows accumulated rainfall forecast (24 h) of the GFS model from June 21 to 27.



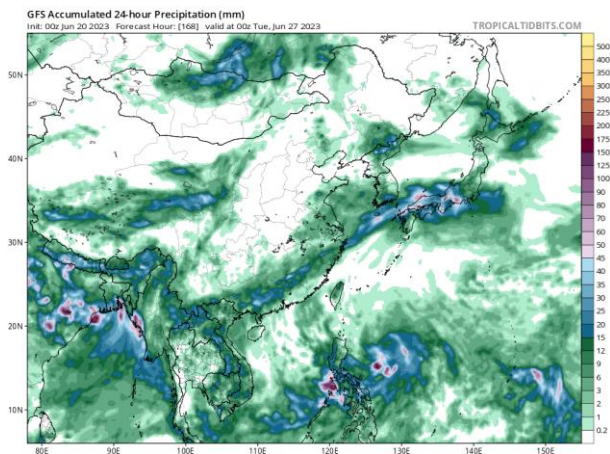


Figure 18. Accumulated rainfall forecast (24 h) based on a GFS model.

6.2 Water level forecast

Chiang Saen and Luang Prabang

Based on June 19's daily flood forecasting bulletin, the daily forecasted water level at Chiang Saen in Thailand shows an increase of water level between 2.42 m and 2.65 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 0.20 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 0.20 m, while water level at Vientiane in Lao PDR will decrease about 0.09 m. Furthermore, in Nong Khai in Thailand the water level will decrease about 0.08 m over the next five days; at Paksane in Lao PDR water level will increase about 0.20 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 0.50 m to 1.35 m, because of above-average rainfall predicted in these areas. Water level at Khong Chaim and Pakse 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 about 1.00 m, while at Kompong Cham along the Mekong River the water level will also go up about 0.60 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 in between 0.05 m and 0.30 m over the next five days.

Water levels at most of the stations will go up during next week. However, those WLS will be still staying lower than their LTA value, particularly in the upper part of the region from Chiang Saen to Paksane. From Khong Chiam down to Pakse, Stung Treng, Kratie, and Kompong Cham, water levels will be 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 Delta area next week.

The performance of the weekly flood forecast, with an accuracy and data input evaluation from 14-19 June 2023, is presented in **Annex 1**.

[Table 2](#) shows the daily flood forecasting Bulletin issued on 19 June 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 moderate rain and isolated heavy rains forecasted 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 June, July, and August 2023. CDI is a combination of meteorological and agricultural indicators.

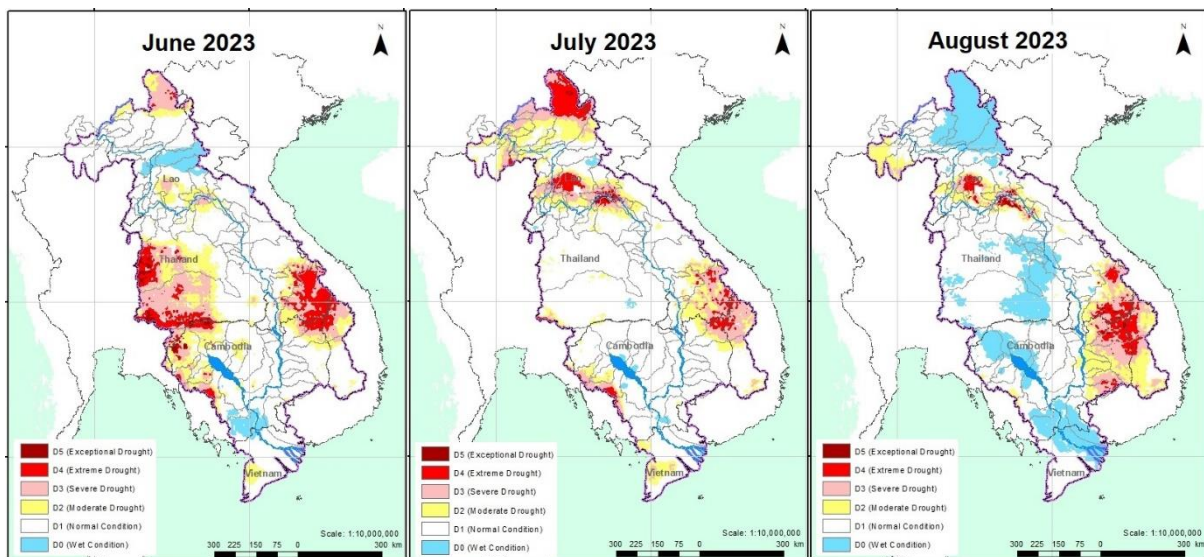


Figure 19. Monthly forecast of CDI for July, August, and September 2023.

Figure 19 above shows that in **June** the central and eastern parts covering mainly Thailand and the 3S areas are likely hit by severe and extreme droughts. They specifically cover Phongsaly, Vientiane, Xaysomboun, Borikhamxay, Chaiyaphum, Khon Kaen, Maha Sarakham, Roi Et, Surin Burirum, Nakhon Ratchasima, Sa Kaeo, Banteay Meanchey, Battambang Pursat, Otdar Meanchey, Saravane, Champasack, Stung Treng, Ratanakiri, Gia Lai, Kon Tum, Attapeu, and Sekong. In **July** the upper and 3S areas are likely experiencing some extreme and severe droughts. They cover Phangsaly, Luangnamtha, Bokeo, Chiang Ria, Phayao, Oudomxay, Luang Prabang, Xayaburi, Vientiane, Xaysomboun, Borikhamxay, Nongkhai, Saravane, Sekong, Attapeu, Champasack, Ratanakiri, Kon Tum, Gia Lai, Pursat, Battambagn, Kampong Speu, Kien Giang, Ca Mau, Bac Lieu, Soc Trang, and Dak Lak. While in **August** from moderate to extreme droughts are forecasted for Vientiane, Borikhamxay, Xaysomboun, Nong Khai, Saravane, Sekong, Attapeu, Champasack, Ratanakiri, Kon Tum, Gia Lai, Dak Lak, Mondul Kiri, Kratie, and Stung Treng.

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 June 14-19, including the lower part in Lao PDR and Cambodia, varying from 1.00 mm to 202.40 mm due to above-average rainfall over the LMB during the report period. However, this week rainfall was considered low 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 45.00 mm to 180.00 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 20 to 26 June 2023.

7.2 Water level and its forecast

According to MRC's observed water level at Jinghong, it showed decreased water levels from 536.24 m to 535.75 m during 14-19 June 2023. The current level is staying about 0.64 m lower than its LTA value. The outflow at Jinghong station decreased between 1,550.00 m³/s and 1,180.00 m³/s between 14 and 19 June 2023.

Along with the decreased outflow from Jinghong upstream, water levels of monitoring stations at Chiang Saen decreased 0.03 m from 14 to 19 June 2023. Furthermore, at Chiang Khan and at Vientiane stations water levels decreased from 0.40 m to 0.25 m from 14 to 19 June 2023 due to the influence of rainfall and dam operation upstream. Water levels from Nakhon Phanom in Thailand to Pakse in Lao PDR increased from 0.20 m to 0.35 m. However, 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 0.02 m and stayed about 0.75 m lower than its LTA, while at Kratie water level was up about 0.32 m, staying 1.30 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 up to June 19 (63%). 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 about 0.35 m but will stay lower than their LTA value. 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 June 12-18, no significant drought threat was detected over the LMB. The whole region was at normal condition.

The three-month forecast shows that in **June** the central and eastern parts covering mainly Thailand and the 3S areas are likely hit by severe and extreme droughts. Those affected areas specifically are Phongsaly, Vientiane, Xaysomboun, Borikhamxay, Chaiyaphum, Khon Kaen, Maha Sarakham, Roi Et, Surin Burirum, Nakhon Ratchasima, Sa Kaeo, Banteay Meanchey, Battambang Pursat, Otdar Meanchey, Saravane, Champasack, Stung Treng, Ratanakiri, Gia Lai, Kon Tum, Attapeu, and Sekong. In **July** the upper and 3S areas are likely experiencing some extreme and severe droughts. They cover Phangsaly, Luangnamtha, Bokeo, Chiang Ria, Phayao, Oudomxay, Luang Prabang, Xayaburi, Vientiane, Xaysomboun, Borikhamxay, Nongkhai, Saravane, Sekong, Attapeu, Champasack, Ratanakiri, Kon Tum, Gia Lai, Pursat, Battambagn, Kampong Speu, Kien Giang, Ca Mau, Bac Lieu, Soc Trang, and Dak Lak. While in **August** from moderate to extreme droughts are forecasted for Vientiane, Borikhamxay, Xaysomboun, Nong Khai, Saravane, Sekong, Attapeu, Champasack, Ratanakiri, Kon Tum, Gia Lai, Dak Lak, Mondul Kiri, Kratie, and Stung Treng.

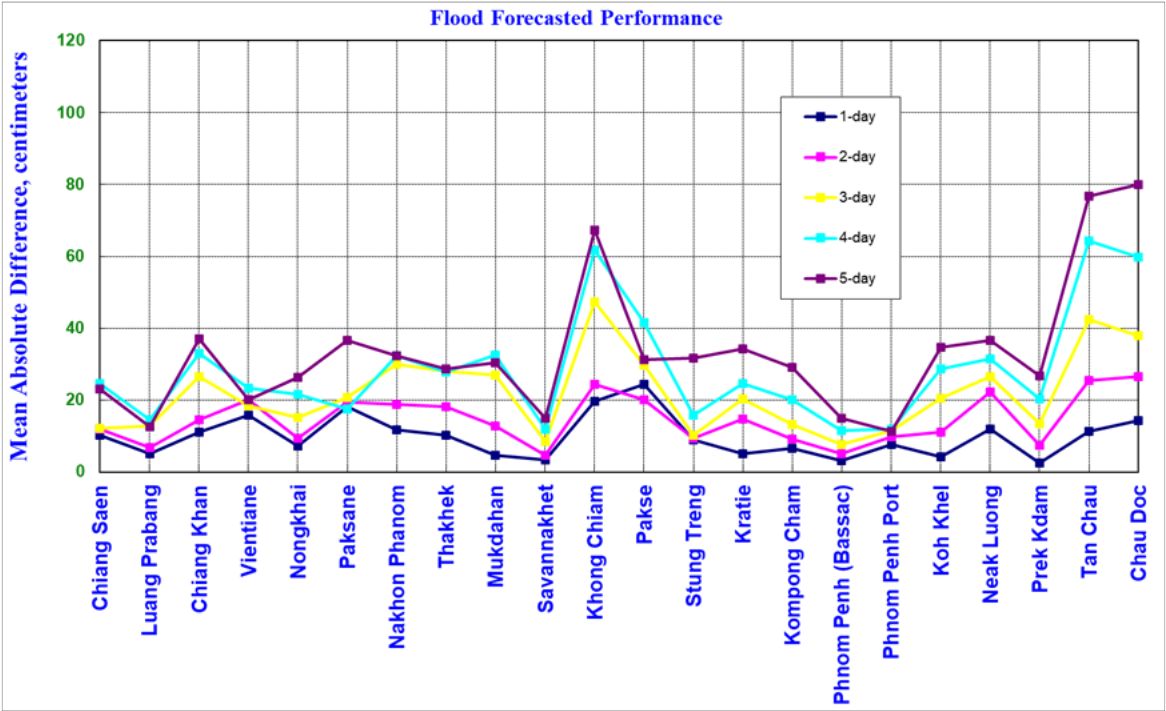
Annex 1: Performance of the weekly flood forecasting

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 14 to 19 June 2023.

The forecasting values from 14 to 19 June 2023 show that the overall accuracy is fair for a four-day to five-day forecast in lead time (less than 85 cm) at stations in the upper part of the Mekong River at Paksane station because of rainfall and dams' 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 14 to 19 June 2023.

Table B1: The Mean Absolute Difference (Error) of Flood Forecasting base on old defined Benchmark from 14 to 19 June 2023 in cm

| Lead-time Forecasted | Chiang Saen | Luang Prabang | Chiang Khan | Vientiane | Nongkhal | 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 | 10 | 5 | 11 | 16 | 7 | 18 | 12 | 10 | 5 | 3 | 20 | 24 | 9 | 5 | 7 | 3 | 8 | 4 | 12 | 2 | 11 | 14 |
| 2-day | 12 | 7 | 15 | 20 | 9 | 20 | 19 | 18 | 13 | 5 | 24 | 20 | 9 | 15 | 9 | 5 | 10 | 11 | 22 | 7 | 26 | 27 |
| 3-day | 12 | 13 | 27 | 18 | 15 | 21 | 30 | 28 | 27 | 8 | 47 | 30 | 10 | 20 | 13 | 8 | 12 | 21 | 27 | 13 | 42 | 38 |
| 4-day | 25 | 15 | 33 | 23 | 22 | 18 | 32 | 28 | 33 | 12 | 62 | 42 | 16 | 25 | 20 | 12 | 12 | 29 | 32 | 20 | 64 | 60 |
| 5-day | 23 | 13 | 37 | 20 | 26 | 37 | 32 | 29 | 30 | 15 | 67 | 31 | 32 | 34 | 29 | 15 | 11 | 35 | 37 | 27 | 77 | 80 |

Table B2: The Mean Absolute Difference (Error) of Flood Forecasting base on old defined Benchmark from 14 to 19 June 2023 in %

| Lead-time Forecasted | Chiang Saen | Luang Prabang | Chiang Khan | Vientiane | Nongkhal | 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 | 71.4 | 71.4 | 57.1 | 57.1 | 57.1 | 42.9 | 57.1 | 57.1 | 57.1 | 42.9 | 57.1 | 42.9 | 85.7 | 57.1 | 71.4 | 71.4 | 57.1 | 57.1 | 57.1 | 71.4 | 57.1 | 57.1 | 59.7 |
| 2-day | 83.3 | 66.7 | 83.3 | 50.0 | 50.0 | 50.0 | 33.3 | 50.0 | 50.0 | 50.0 | 66.7 | 66.7 | 66.7 | 50.0 | 66.7 | 33.3 | 83.3 | 50.0 | 33.3 | 50.0 | 50.0 | 50.0 | 50.0 | 56.1 |
| 3-day | 60.0 | 60.0 | 80.0 | 60.0 | 40.0 | 60.0 | 40.0 | 40.0 | 40.0 | 60.0 | 60.0 | 60.0 | 60.0 | 40.0 | 60.0 | 60.0 | 60.0 | 40.0 | 40.0 | 60.0 | 40.0 | 60.0 | 60.0 | 53.6 |
| 4-day | 25.0 | 50.0 | 50.0 | 50.0 | 50.0 | 75.0 | 75.0 | 50.0 | 50.0 | 25.0 | 50.0 | 50.0 | 75.0 | 75.0 | 50.0 | 25.0 | 50.0 | 25.0 | 50.0 | 75.0 | 75.0 | 50.0 | 50.0 | 52.3 |
| 5-day | 66.7 | 33.3 | 33.3 | 66.7 | 66.7 | 66.7 | 66.7 | 66.7 | 66.7 | 33.3 | 33.3 | 66.7 | 66.7 | 33.3 | 66.7 | 33.3 | 66.7 | 66.7 | 33.3 | 33.3 | 33.3 | 33.3 | 33.3 | 51.5 |

Table B3: Overview of performance indicators for the past 7 days from 14 to 19 June 2023

| 2023 | FF time sent | | | | Arrival time of input data | | | | | | | | Missing data (number-mainstream and trib.st.) | | | | | | | |
|-------|------------------------------|---------------------------|-------------------------------|-------------------------------|----------------------------|-------|-----------------|----------------|---------------|----------------|------------------|----------------|---|---------|--------------------|-------------------|------------------|-------------------|--------------------|-------------------|
| | 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 | 10:30 | #DIV/0! | - | - | 08:15 | 07:10 | 07:47 | 09:23 | 08:46 | 08:37 | 07:05 | 08:24 | 0 | 0 | 0 | 68 | 9 | 0 | 0 | 22 |
| month | 10:40 | #DIV/0! | - | - | 08:15 | 07:10 | 07:37 | 10:11 | 08:44 | 08:34 | 07:05 | 08:28 | 0 | 0 | 0 | 136 | 0 | 0 | 0 | 22 |

Fig. B4: Data delivery times for the past 7 days from 14 to 19 June 2023

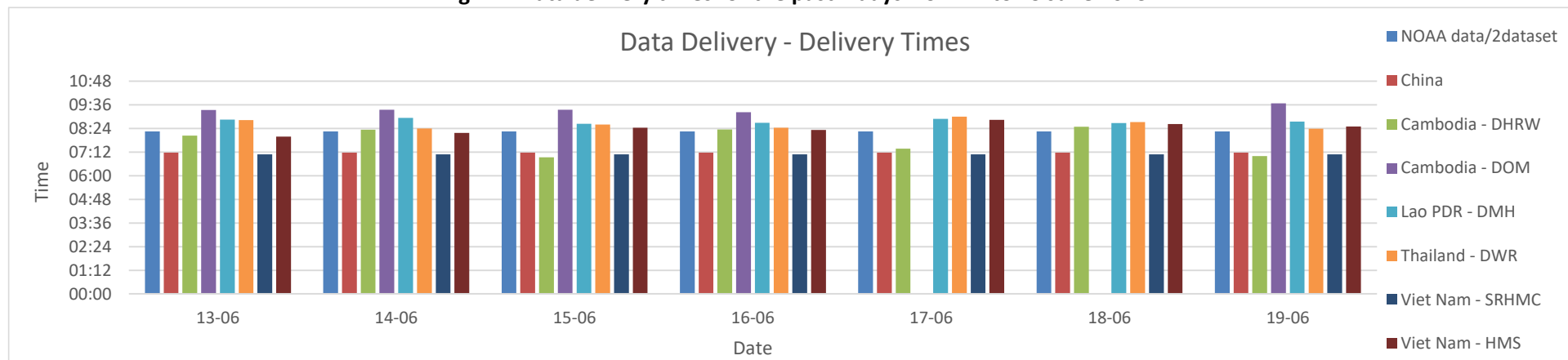


Fig. B5: Missing data for the past 7 days from 14 to 19 June 2023

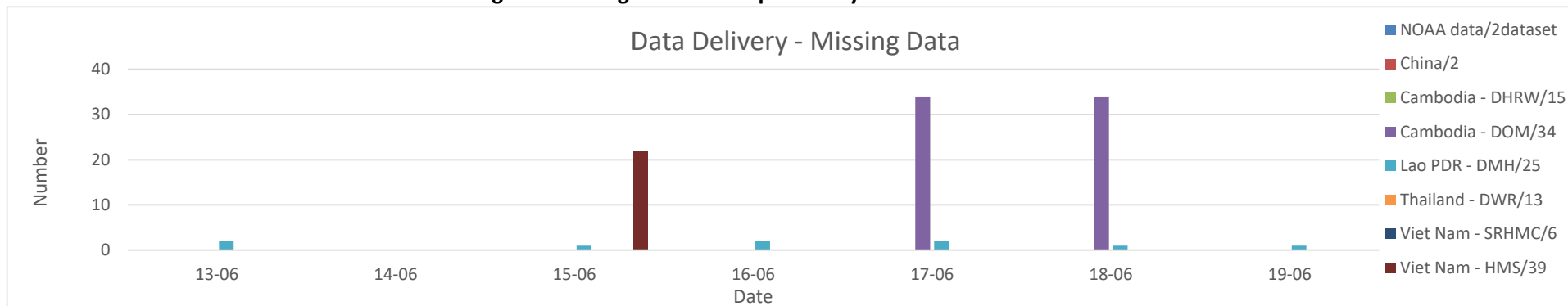
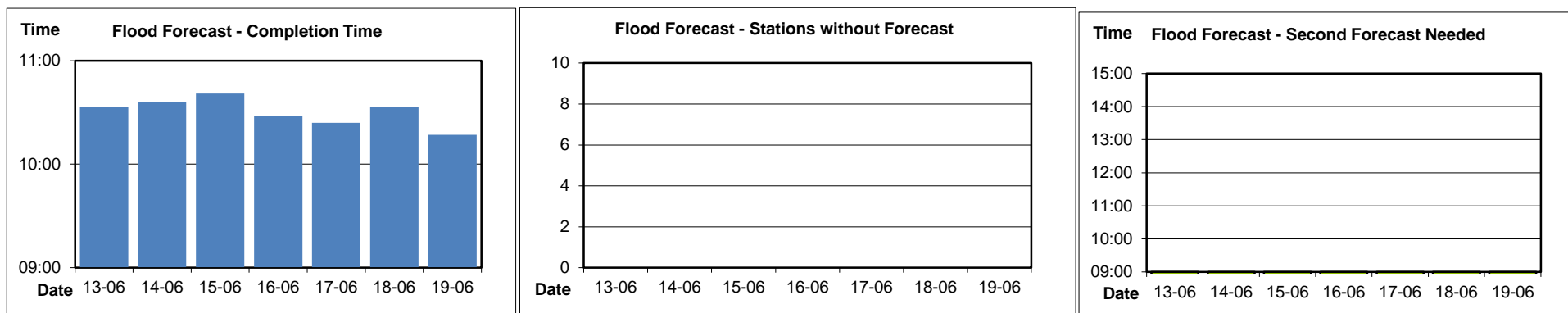


Fig. B6: Flood forecast completion time, stations without forecasts, and second forecasts need from 14 to 19 June 2023





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