44% of the flash flood in Klang Valley occurred coincidentally during the typhoon period: A review on 2015

Ummi Hajidah Mohamad Asri[1], Mohd. Rizaludin Mahmud[1,2]

[1]Dept. of Geoinformation, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia.
[2]Geoscience & Digital Earth Centre, Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia.

Corresponding author: ummimohamad@graduate.utm.my

Abstract. This paper reviewed the occurrences of all the flood events that happened in the Klang Valley of Malaysia in 2015. The aim is to identify the sources of the heavy and extreme rainfallthat triggered the flood; either it was attributed to the seasonal monsoon flows or other plausible factors. The major concern of flash floods is that many of them had frequently occurred regardless of the seasonal monsoon period; as it seems to be influenced by other factors. Therefore,besides the three monsoonal seasons with common heavy and extreme rainfall in Klang Valley which includes the NortheastMonsoon (Nov. – Feb.), Inter-monsoon 1 (Mar.-Apr.), and Inter-monsoon 2 (Oct.), this studyalso takes into account the typhoon season which occurred from April to December. There are 43 flash flood cases and most of them occurred during the wet period of the Northeast monsoon (Nov. – Feb.). 44% of the flash flood events did occur during the typhoon season (Apr. – Dec.) with itsdistribution varied via different monsoon seasons. The majority of the flash flood during the dry season (Southwest Monsoon) and wet season (Northeast Monsoon) happened during the same period of strong typhoons. Severe flash flood cases that occurred coincidentally with strong typhoons (category 4 and above) during the NortheastMonsoon had impacted larger spatial coverage, increased rainfall intensity and longer duration. The hypothetical explanation offered is that the occurrence of strong typhoons (category 4 and 5) with trajectory near the Philippines in the South China Sea could affect the regional weather of Peninsular Malaysia; in which resulting in stronger wind flows and accelerating the transportation of moist air parcels from regional ocean or seas to land areas. Such information is required for adaptation, mitigation and preventive actions including early warning systems.

Keywords monsoon seasons; extreme rainfall; In-Fa; flooding events; tropical storm; cyclone

1. Introduction

Klang Valley of Kuala Lumpur, the main metropolitan area of Malaysia is facing prominent series of floods especially flash floods in recent years. These floods caused problems, particularly congested traffic, property damage, and public safety; and its subsequent implication for the economy was massive. The annual physical and infrastructure losses in Klang Valley caused by flash floods could reach 3 mil USD [1]. Moreover, the severe large-scale flood last year in 2021 has an estimated loss of around 350 mil USD [2]. Besides the fast-changing landscape and increment of impervious surfaces, the major contributing factor is the heavy thunderstorm that increased its intensity and frequency as well as occurred at indiscernible seasonal patterns. Understanding the present rainfall & thunderstorm characteristics in Klang Valley could be the key to anticipating the flood issue.

Klang Valley was located in the central west part of Peninsular Malaysia; where the upper part is bounded by the lower part of Titiwangsa fringes while the lower part is facing the Straits of Malacca. Occasional floods on an unparalleled scale in Klang Valley are deduced to occur due to catastrophic weather patterns driven by climate change where when there is an accumulation effect, the longer-term outcome is a sudden torrent of rain in some localized places. An occurrence that ought to be normal in the future is the escalation of events where total rainfall of days in over a few hours happens which overwhelmed the current drainage system, making it unable to handle the high-water flow capacity. Rainfall has become more erratic where it does not follow the normal pattern; normally, the monsoon season begins towards the end of the year, but the city has already witnessed rain during the dry season in recent years [3].

The evidence of the increasing frequency of extreme rainfall is present but inadequate elaboration was explained especially the contributing factors) [4] concerning a specific season. It is well understood that monsoon flow especially the Northeast Monsoon (Nov. – Feb.) and Inter-Monsoon period (Mar.- Apr. & Sep. – Oct.) would characterize a significant heavy thunderstorm [5]. This occurred as the moist air parcels were transported from the regional seas or ocean to the land due to the monsoon flows. It also takes place as well as during the monsoon interchange, especially in the mountainous part of Klang Valley. The current major concern is the heavy thunderstorm that occurred outside of the wet season which primarily able to cause floods especially flash floods.

Without the presence of the external moist air parcel flows to Klang Valley, the intense rainfall could be a result of the convective thunderstorm, especially single or multi-precipitation cells. The moist air parcel from the Straits of Malacca was likely capable to fuel such phenomena. Hence, there is evidence indicating the impact of urbanized landscapes could alter local rainfall patterns as it creates low-pressure cells and increase evaporation [6,7]. Another plausible source of heavy rainfall is sudden synoptic scale atmospheric events such as typhoons or hurricanes. Although west Malaysia was not in the typhoon zone; strong winds during heavy thunderstorms and small tornadoes in northern Peninsular have been reported [8,9]. More evidence and investigation were needed to clarify this perspective.

Before the aforementioned issue, this paper reviews the occurrences of flood in Klang Valley whether it is associated either with the seasonal monsoon, tropical cyclone season or both. By identifying the potential sources of the heavy downpour, further investigation and studies can be done in determining the appropriate methods and techniques for forecasting an early warning, mitigation and prevention framework for the flood. That includes the determination of an accurate time frame, data, and algorithm for early heavy rainfall detection. The review will take into consideration three major information sources; (1) the flood report conducted by the Department of Irrigation and Drainage, Malaysia, (2) the scientific typhoon report released by specific organizations including the Philippines Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Japan Meteorological Agency (JMA), and (3) scientific studies related to the hydro-climatology characteristics in Klang Valley.

2. Materials & Study Settings

2.1 Study site description

The research is conducted at Klang Valley which is a Malaysian urban conglomeration centred in Kuala Lumpur and encompassing the state of Selangor's surrounding cities and villages. The Titiwangsa Mountains to the north and east, and the Strait of Malacca to the west, form the geographical boundaries of the Klang Valley. Rawang is located in the northwest, Semenyih is located in the southeast, and Klang and Port Klang are located in the southwest (Fig. 1). The conurbation is Malaysia's industrial and commercial heartland. With an average daily maximum temperature of 33 degrees Celsius, Selangor is one of Malaysia's warmest states. High humidity and scorching temperatures make the weather pleasant at times, yet tropically humid at others. The weather is mild to hot all year, and the average water temperature is 29 degrees. From April through December, the majority of the precipitation falls. The climate is humid tropics with two wet seasons: predominantly due to monsoon flows. The first one occurred from March to May and the second one take place from October to December. The annual rainfall is about 2200mm Figure 2 showed the hydroclimatology of Klang Valley.

Flash floods are common occurrences in Klang Valley and they are caused by a variety of sources. Rapid growth results in the degradation of green and forested areas that act as water absorption zones, producing drainage-related problems, as well as outdated drainage designs that require costly maintenance. The city is situated in the heart of a valley, in the river basins of the Klang River. As a result, flooding is an unavoidable occurrence throughout the city. Although flash flood is not usually associated with monsoon seasons, it occurs more commonly during this time of year in the city. However, Klang Valley is witnessing more flash foods than in the past and with greater severity over a wider spatial scale. This situation can be attributed to the increased intensity and frequency of extreme rainfall events and storms over the years.

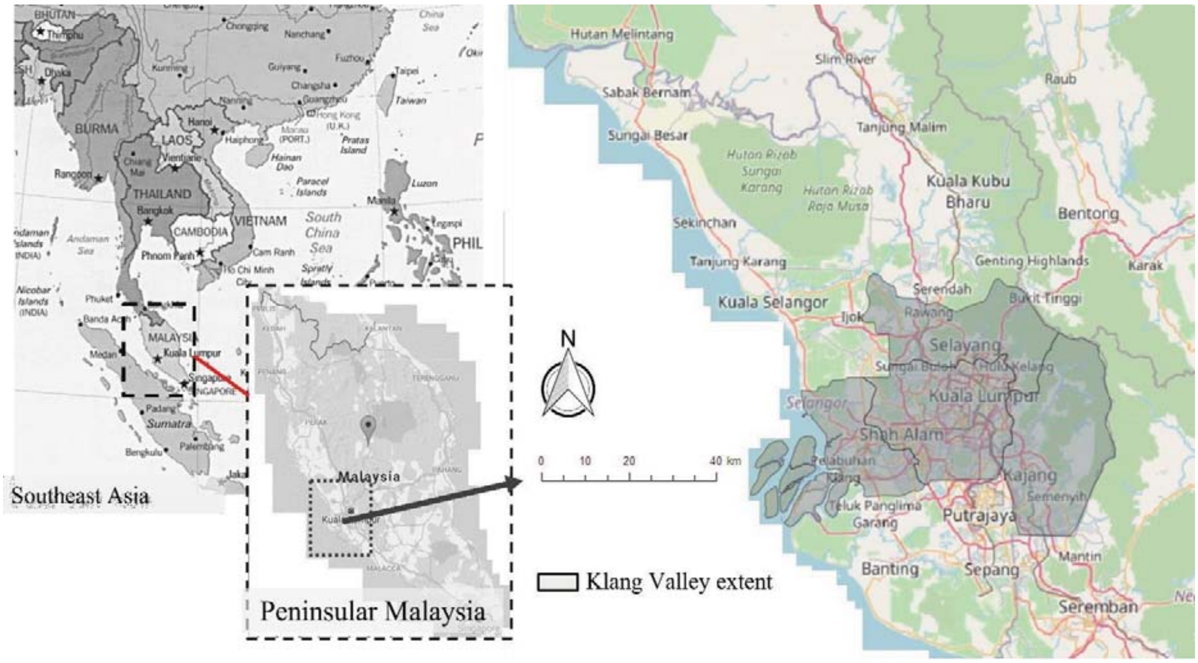

Figure 1. Location of the study site

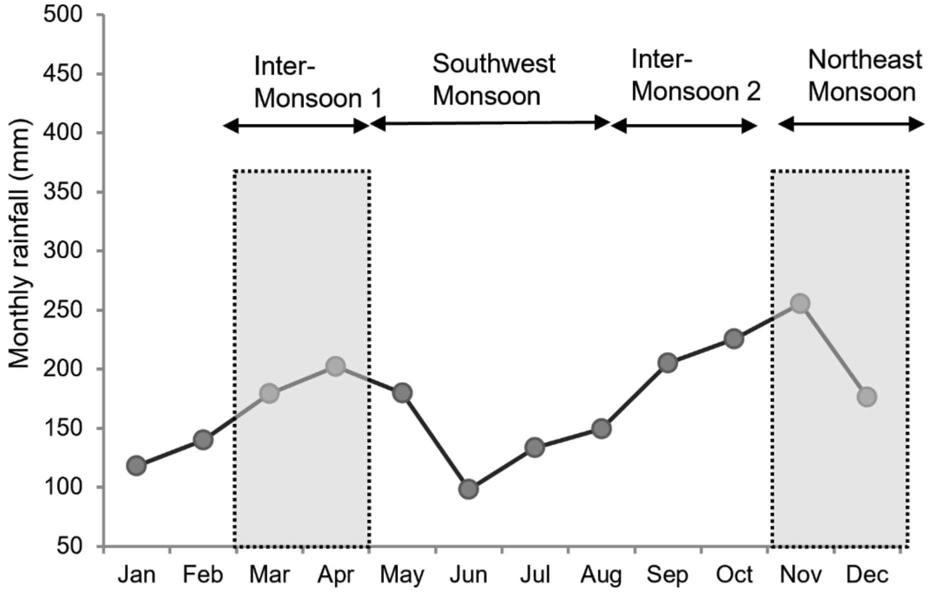

Figure 2. Hydro-climatology properties of Klang Valley

2.2 Source of review materials

2.2.1 Flood reports

The primary and only source of information on flood occurrences was obtained from the annual flood report released by the Department of Drainage and Irrigation, Malaysia. This flood report provides details on floods that occurred in each state in Malaysia. The details involved date, period, location, average rainfall intensity, as well as the estimated areas that experienced floods. We assumed that the detail provided in this report accurately represents the actual flood characteristics in Klang Valley. In this paper, we selected the year 2015 with 43 flood events as samples as mentioned in the report [10]. The areas which were accounted for included Gombak, Hulu Langat, Klang and Kuala Langat. The rest of the areas were belonged to a different river basin (Sg. Bernam and Sg. Tengi for the Hulu Selangor) and considered to be outside of the Klang Valley.

2.2.2 Typhoon reports
The information about the typhoon was acquired from the official typhoon reports released by two major agencies: (1) Philippine Atmospheric, Geophysical and Astronomical Services Administration or known as PAGASA, and (2) Japan Meteorological Agency (JMA). Both are the most active meteorological agencies in Asia that produced comprehensive typhoon reports and it is assumed that the information provided was credential. The annual corresponding typhoon reports were (1) DOST-PAGASA Annual report on Philippine tropical cyclones [11], and (2) Annual report on the activities of the RSMC Tokyo – Typhoon Center 2015 [12].

3. Results and Discussion

3.1 Flood events and distribution based on monsoon and typhoon season
Details of the 43 flood events in Klang Valley in 2015 are tabulated and presented in Appendix 1. From the information, Table 1 is deduced to summarize the major findings. Out of 43 flood events, 44% (19 flood events) coincided with typhoon season (TYP) (Apr.-Dec.). It was indicated that the flood events largely occurred during the wet season of the northeast monsoon season (NEM) (58%). The rest of 42% of the flood events were fairly distributed in the three monsoon seasons, intermonsoon 1 (IM1)(Mar. – Apr.), southwest monsoon (SWM)(May – Aug.) and inter-monsoon 2 (Oct.). The trend of the flood seems to follow the hydro-climatology of the Klang Valley (Fig. 2), except during the SWM where 21% of floods occurred during this period. According to the hydroclimatology trend (>30 years), May to August is supposed to be the dry period.

Table 1. Summary of the flash flood events in Klang Valley based on monsoon & typhoon season

Seasons	Period	Flood Cases	
		Number	Percentage (%)
Northeast Monsoon (NEM)	Nov. - Feb.	25	58
Inter-Monsoon 1 (IM1)	Mar. - Apr.	4	9
Southwest Monsoon (SWM)	May - Aug.	9	21
Inter-Monsoon 2 (IM2)	Oct.	5	12
Total			100
Typhoon (TYP)	Apr. - Dec.	19	44

To explain this phenomenon, statistics on the percentage of flood events that coincide with typhoon for every monsoon season is calculated and presented in Figure 3. It shows that the percentage of flood events that coincides with typhoon occurrence is considerably high during the Northeast Monsoon season (47.4%), in comparison with other seasons. This could indicate that the heavy rainfall which caused the flood might be attributed to the seasonal monsoon changes as this monsoon period normally resulted in larger rainfall. In addition, the flash flood that occurred during NEM impacted many locations and lasted just several hours (1-5 hours) (Appendix 1).

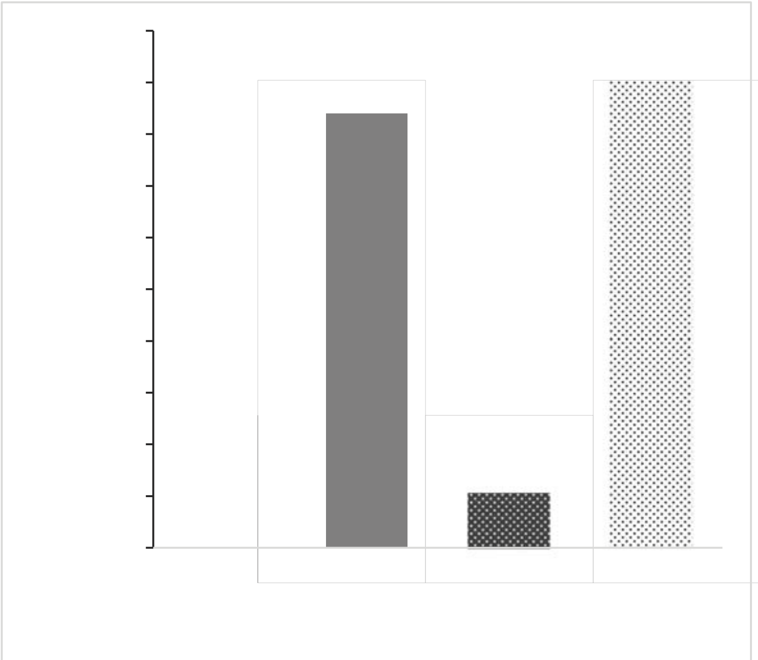

Figure 3. Percentage of flood events that coincides with specific typhoon based on monsoon season preferences.

From the tabulated information in Appendix 1 too, it is identified that 44% of the flood events occurred coincidentally with typhoons; with various degrees of intensity (Category 2-5). Another important finding notified is that the flood events which occurred during the wet season (NEM) and coincided with strong typhoons have impacted larger areas, series of flash floods over several days until the typhoon is over. This is indicated in mid-November and early December when a series of flash flood events lasted more than one week following the period of typhoon In-fa and Melor.

3.2 Rainfall intensity, duration and coverage of flooded areas

Table 2 showed that the flood events which occurred coincidentally with specific typhoons had higher rainfall intensity compared to one with no typhoon occurrences. The average intensity of the rainfall during the coincidence period was 71mm/hr compared to 53mm/hr; about a 34% increment. In addition, the duration of the rainfall also was longer, about 1.9 hours compared to 1.7 hours. The flood with typhoon influences also impacted larger spatial coverage, hitting 65 locations in comparison to 62 locations. The average scale of the typhoon cases that coincided with the flood was 4. The two most severe flood events occurred in Klang Valley, the first event happened on 16th – 26th November and the second one took place on 10th – 14th December 2015. During both flood periods, two typhoons of category 4 had hit the area namely In-fa and Melor.

Table 2. Rainfall intensity, duration, and coverage of flood areas

Flood types	Rainfall intensity (mm)		Duration (hour)	Typhoon scale (1 to 5)	Affected ar (no. of plac
	Avg.	d.Dev			
	71	22	1.9	4	65
No typhoon influence	53	32	1.7	-	62

During the first flood period coincided with typhoon In-fa, a series of flood events including flash floods occurred in 21 locations in the district of Petaling Jaya, Kuala Langat and Gombak. The average intensity of the recorded rainfall is 80.5mm/hr. The highest rainfall was identified in Merbau Sempak with 152mm/hr.

The 16th and 17th of November are the peaks of the flood period where 16 locations experienced flash floods. During this period, a tropical depression and subsequently tropical storm intensity associated with typhoon In-fa was reported by the JMA and PAGASA. During the flood on 16th-17th November, the average intensity rainfall is 87mm/hr and the flood submerged 14 locations. The centre of Klang Valley including Taman Mutiara Subang, Taman Subang Intan, Taman TTDI Jaya, and Jalan Batu 3 experiencing extreme rainfall of over 103mm/hr. During the second period of the flood that occurred on 20th November, the In-fa reached its mature stage to category 4 typhoon with a wind speed of about 172km/h [12] and moved towards the east coast of the Philippines before growing weaker on 26th November. The flood in Klang Valley also ended on the exact date with a minor flash flood caused by heavy rainfall (55mm/hr) but lower than the peak period. The second severe flood period from 10-14th December affected 14 locations in three major districts including Gombak, Petaling Jaya and Kuala Langat. Typhoon Melor hit at the exact flood period. The trajectory of the typhoon was from Guam and later moved towards Visayas and Luzon of the Philippines. It caused a series of landfalls over the Philippines with strong winds (100-230km/h), particularly from 13th-14th December [11].

3.3 Hypothetical explanation of the typhoon influence and its subsequent impact for future flood studies

The best hypothetical explanation for the previous findings from our review is that during specific flood events that happened during the same period as strong typhoons might be influenced by them; at least indirectly. This is because the trajectories of all the typhoons were relatively far from Klang Valley which is estimated at around 3000km. Nonetheless, the presence of the strong typhoon was associated with the sudden establishment of a high low-pressure system which may influence the regional wind patterns. Significant pressure gradients would lead to a strong wind blowing towards the typhoon 'eyes' where the low-pressure system is centralized. This interaction is common for any typhoon event and is likely to occur with a depreciating effect from the centre to the typhoon tail. Such a phenomenon had been discussed over the impact of typhoon Ketsana on Peninsular Malaysia by [13] and)[14]. To clarify the severe flood during the Northeast monsoon which occurred with typhoon influences, the strong wind blows could initiate these two events; first is the faster transportation of moist air parcels from the regional seas to the land and directly influenced the source of precipitation to the low-level cloud system. Secondly, the subsequent effects of the first event with the orographic factors [15] and active convective system in urbanized tropics. As more moist air parcels are transported to the land areas within a short period combined with rapid uplifting due to active convection and orographic effects of Titiwangsa fringes; intense thunderstorm is likely to occur. A continuous cycle of this process would result in a series of heavy and intense thunderstorms in a week; just what we observed during both flood events involving In-fa and Melor typhoons. Nonetheless, there is still a gap in understanding of what typhoon stages this tail effect would impact at Klang Valley. The statistics showed that heavy torrential rainfall could occur during the end of the typhoon, mature and early formation.

Considering that the typhoon effects were likely to cause heavy rainfall during the wet season (Nov.–Feb.), this information could be useful for future flood prevention, mitigation and warning. As near real-time typhoon alert information was effectively and operationally provided by many respective agencies such as Japan Meteorological Agency, Malaysian Meteorological Agency, and Philippine Atmospheric, Geophysical, and Astronomical Services Administration. Therefore, warnings can be issued to the respective agencies to take precautions and also informed the public. Because this review is only limited to secondary reports, it is best to properly analyse the spatial pattern of the precipitable cloud, particularly from radar to obtain greater pictures of how this typhoon affects the production of a heavy thunderstorm. Nonetheless, the information obtained from this review is useful as guidance for respective future studies.

4. Conclusion

There are 43 flash flood cases in Klang Valley in 2015 and most of them occurred during the wet period of the Northeast monsoon (Nov. – Feb.). 44% of the flash flood events did occur during the typhoon season (Apr. – Dec.) with its distribution varied via different monsoon seasons. The majority of the flash floods during the wet season (Northeast Monsoon) happened during the same period of strong typhoons. Severe flash flood cases that occurred coincidentally with strong typhoons (category 4 and above) during the Northeast Monsoon had impacted larger spatial coverage. In addition, the intensity and duration of the rainfall had increased and became longer respectively. The hypothetical explanation offered is that the occurrence of strong typhoons (category 4 and 5) with trajectory near the Philippines in the South China Sea could affect the regional weather of Peninsular Malaysia; in which resulting in the stronger wind flows and accelerating the transportation of moist air parcels from regional ocean or seas to land areas. The outcome of this review would provide us with valuable knowledge on the flash flood details in Klang Valley and its plausible association with strong typhoons. Such information is required for adaptation, mitigation and preventive actions including early warning systems.

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Appendix 1 - Flood and typhoon details in Klang Valley (2005).

No.	Flood information					Typhoon formation			
	Date	District	Location	Intensity (mm/ per event)	Flood duration (hours)	Name	Scale	Category name	Period
1	8.1.2015	Gombak	Bandar Baru Kundang	13	2.5	-	-	-	-
			Kg. Bunga Raya Kuang	57	2.0				
			Jalan Maxwell & Jln Market Pekan Rawang	22	Not Stated				
2	9.1.2015	Petaling Jaya	Laluan Motosikal Lebuh Raya Persekutuan	31	1.5	-	-	-	-
3	26.1.2015	Petaling Jaya	Laluan Motosikal Lebuh Raya Persekutuan	38	2.0	-	-	-	-
4	29.1.2015	Petaling Jaya	Persiaran Jubli Perak Batu 3	38	1.0	-	-	-	-
			Seksyen 13	75	0.5				
			Laluan Motosikal Lebuh Raya Persekutuan	41	2.0				
5	31.03.2015	Klang	Kg. Budiman, Per. Hamzah Alang	121	3.0	Maysak	Category 5	Super typhoon	26.03.2015 - 07.04.2015
			Kampung Air Kuning	98					
			Taman Melawis, Teluk Pulai	64					
			Sungai Kandis	98					
			Kampung Melayu Subang	50	2.0				
			Kg. Bukit Lanchong	82	1.7				
		Petaling Jaya	Laluan Motosikal Lebuh Raya Persekutuan	41	2.0				
			Taman Mutiara Subang	41	1.5				
			Kg. Sri Aman Bistari	92	2.0				
			Kuarters KTM	41	2.0				
6	12.4.2015	Petaling Jaya	Taman Mutiara Subang	75	1.5	-	-		-
7	14.4.2015	Gombak	Kg Lasmana	30	0.5	-	-	-	-
			Kg Sg Kertas	30	0.5				
			Kg Nakhoda	30	0.5				

Appendix 1 - Flood and typhoon details in Klang Valley (2005). (cont.)

No.	Flood information					Typhoon information			
	Date	District	Location	Intensity (mm/ per event)	Flood duration (hours)	Name	Scale	Category name	Period
8	22.4.2015	Gombak	Kg Chempedak (Kuang) Per. Emerald East	46 46	0.5 0.5	-	-	-	-
9	12.5.2015	Petaling Jaya	Jalan berdekatan Menara Jam Subang Jaya Persiaran Sukan berhampiran Kolej PTPL	71 71	2.0 3.0	Noul (Dodong)	Category 5	Super typhoon	2.5.2015 - 12.5.2015
10	19.5.2015	Gombak	Lebuhraya MRR2	22	0.5	Dolphin	Category 5	Super typhoon	6.5.2015 - 20.5.2015
11	8.6.2015	Gombak	Sg Batu Puncak Atheneum	18 86	0.5 0.5	-	-	-	-
12	25.7.2015	Gombak	Jln Timur Kg Selayang Pandang	54	0.5	Halola (Goring)	Category 2	Tropical storm	13.7.2015 - 26.7.2015
13	11.8.2015	Petaling Jaya	Kg Kubu Gajah	68	2.0	Soudelor (Hanna)	Category 5	Super typhoon	29.7.2015 - 11.8.2015
14	13.8.2015	Gombak	Belakang UIA Gombak Desa Aman Kg India Settlement Pers. Bukit Botak Taman Seirra One	72 72 72 72 72	1.0 0.5 1.0 1.0 1.0	Molave	Category 2	Tropical storm	6.8.2015 - 14.8.2015
15	16.8.2015	Petaling Jaya	Kg Melayu Subang	68	1.0	Atsani	Category 5	Super typhoon	14.8.2015 - 25.8.2015
16	4.9.2015	Gombak	Kg Batu 8 Jln Gombak Jalan Maxwell	48 36	1.0 0.3	Kilo	Category 2	Tropical storm	1.9.2015 - 11.9.2015
17	21.9.2015	Petaling Jaya	Stesen Komuter Serdang	75	1.5	Krovanh	Category 3	Severe tropical storm	13.9.2015 - 21.9.2015
18	9.10.2015	Gombak	Country Homes Taman Tun Teja	48 97	1.0 1.0	-	-	-	-
19	10.10.2015	Gombak	Jln Kg Simpang Tiga Greenwood	33	1.5	-	-	-	-
20	11.10.2015	Gombak	Kg Kerdas 2 Kg Mahkota Taman Tun Perak Jalan Maxwell	56 56 56 21	3.0 1.0 1.0 2.0	-	-	-	-
21	14.10.2015	Petaling Jaya	Kg Budiman	46	1.5	Champi	Category 4	Typhoon	13.10.2015-25.10.2015

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Appendix 1 - Flood and typhoon details in Klang Valley (2005). (cont.)

	Flood information					Typhoon information			
No.	**Date**	**District**	**Location**	**Intensity (mm/ per event)**	**Flood duration (hours)**	**Name**	**Scale**	**Category name**	**Period**
21	14.10.2015	Petaling Jaya	Kg Budiman	46	1.5	Champi	Category 4	Typhoon	13.10.2015 - 25.10.2015
		Gombak	Country Homes	29	1.0				
			Kg Melayu Sri Kundang	56	1.0				
			Paya Jaras	51	1.0				
			Bandar Baru Kundang	56	3.0				
			Taman Rahmat Jaya	29	2.0				
			Jalan Raya 6, Serdang Raya	78	2.0				
			Kg Sungai Pelong	51	Not Stated				
22	31.10.2015	Petaling Jaya	Jalan Batu Tiga Lama	62	3.5	-	-	-	-
			Laluan Motosikal Lebuh Raya Persekutuan	62	3.5				
		Gombak	Bandar Baru Kundang	29	2.5				
			Bukit Antarabangsa	65	1.0				
			Puncak Atheneum	58	1.0				
			Kg Kuala Sg Baru, Puchong	120	1.0				
			Kg Sri Aman	120	2.0				
23	1.11.2015	Petaling Jaya	Lorong Ikan Keli	120	2.0	-	-	-	-
			Stesen Komuter Serdang	105	1.5				
24	3.11.2015	Petaling Jaya	Seri Kembangan	105	3.0	-	-	-	-
25	9.11.2015	Petaling Jaya	Kg Kuala Sg Baru, Puchong	13	2.0	-	-	-	-
			Kg Sri Aman	13	2.0				
26	13.11.2015	Gombak	Sg Batu	44	1.8	-	-	-	-
			Sg Selangor / Taman Tun Teja	32	1.8				
			Jalan Indah 19 Tmn Selayang Indah	44	0.5				
27	14.11.2015	Petaling Jaya	Kg Sri Aman	59	2.0	-	-	-	-

Appendix 1 - Flood and typhoon details in Klang Valley (2005). (cont.)

No.	Flood information					Typhoon information			
	Date	District	Location	Intensity (mm/ per event)	Flood duration (hours)	Name	Scale	Category name	Period
			Lorong Ikan Seluang Kg Bukit Lanchong	59	2.0	-	-	-	-
28	15.11.2015	Kuala Langat	Pekan Banting	50	0.3	-	-		
		Petaling Jaya	Merbau Sempak	152	2.0			-	
			Bandar Baru Kundang	63	3.0				
			Kg Damai (Lorong Melur)	58	3.0				
		Gombak	Mukim Gombak Setia	45	Not Stated				
			Taman Rahmat Jaya	63	3.0				
			Kg Sg Bakau	63	1.0				
29	16.11.2015	Petaling Jaya	Stesen & Kuarters KTM	103	Not Stated	In - Fa (Marilyn)	Category 4	Typhoon	16.11.2015 - 27.11.2015
			Lorong Ikan Keli Kg Bukit Lanchong	65					
			Stesen KTM	103					
			Sunway South Quay	103					
			Taman Mutiara Subang	103					
			Taman Subang Intan	103					
			TTDI Jaya	103					
			Jalan Batu 3 Lima	104					
30	17.11.2015	Petaling Jaya	Stesen & Kuarters KTM	100	Not Stated	In - Fa (Marilyn)	Category 4	Typhoon	
			Taman Mutiara Subang	100					
			Seksyen 13	100					
31	20.11.2015	Gombak	Bandar Baru Kundang	54	4.0	In - Fa (Marilyn)	Category 4	Typhoon	
			Kg Bunga Raya	54	4.0				
			Kg Orang Asli Kuang	54	4.0				
			Jln 62 & 63 Selayang Baru	61	1.0				
			Taman Rahmat Jaya	88	4.0				
			Taman Tun Perak	110	1.0				
32	23.11.2015	Petaling Jaya	Seksyen 7	48	Not Stated	In - Fa (Marilyn)	Category 4	Typhoon	

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Appendix 1 - Flood and typhoon details in Klang Valley (2015). (cont.)

No.	Flood information					Typhoon information			
	Date	District	Location	Intensity (mm/ per event)	Flood duration (hours)	Name	Scale	Category name	Period
33	26.11.2015	Kuala Langat	Kg Asli Paya Rumput	54	Not Stated	In - Fa (Marilyn)	Category 4	Typhoon	16.11.2015 - 27.11.2015
			Kg Asli Bukit Serdang	69					
34	29.11.2015	Kuala Langat	Batu 9 Kebun Baru	52	Not Stated	-	-	-	-
35	30.11.2015	Gombak	Jalan Batu Arang	27	1.0	-	-	-	-
		Kuala Langat	Sg Langat / Dengkil	6					
			Batu 7 Sijangkang	14	Not Stated				
			Banda Baru Saujana	99	2.0				
			Puchong Drop	99	4.0				
			Sg Langat / Dengkil	31	4.0				
		Petaling Jaya	SK9 Jalan Kuyuh	99	Not Stated				
36	2.12.2015	Gombak	Kg Changkat	24	2.0	-	-	-	-
37	5.12.2015	Gombak	Desa Aman	19	1.0	-	-	-	-
			Kg Damai (Lorong Melur)	19	1.0				
38	9.12.2015	Petaling Jaya	Stesen KTM & Parking KTM	77	Not Stated	-	-	-	
39	10.12.2015	Petaling Jaya	Kg Sri Aman	59	1.5	Melor (Nona)	Category 4	Typhoon	
40	11.12.2015	Gombak	Bandar Baru Kundang	51	1.5	Melor (Nona)	Category 4	Typhoon	
41	13.12.2015	Kuala Langat	Bukit Changgang	62	Not Stated	Melor (Nona)	Category 4	Typhoon	10.12.2015 - 17.12.2015
			Kg Tali Air	38					
			Batu 7 Sijangkang	46					
			Kg Bukit Cherakah	46					
			Kg Baru HICOM	68	3.0				
		Petaling Jaya	Kg Budiman	83	2.0				
			Kg Kubu Gajah	83	2.0				
			Kg Melayu Subang	83					
			Kg Sri Aman	83	2.0				
			Kg Tengah	83	Not Stated				
			Seksyen 7	46					

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Appendix 1 - Flood and typhoon details in Klang Valley (2015).

No.	Flood information					Typhoon information			
	Date	District	Location	Intensity (mm/ per event)	Flood duration (hours)	Name	Scale	Category name	Period
42	14.12.2015	Petaling Jaya	Kg Budiman	83	3.0	Melor (Nona)	Category 4	Typhoon	10.12.2015 - 17.12.2015
		Kuala Langat	Kg Asli Paya Rumput	62	Not Stated				
43	20.12.2015	Petaling Jaya	Merbau Sempak	31	5.0	-	-	-	-