

HKO Research Forum 2019

Landslides Hazards Associated with Super Typhoon Mangkhut and Severe Historical Rainstorms

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










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Content

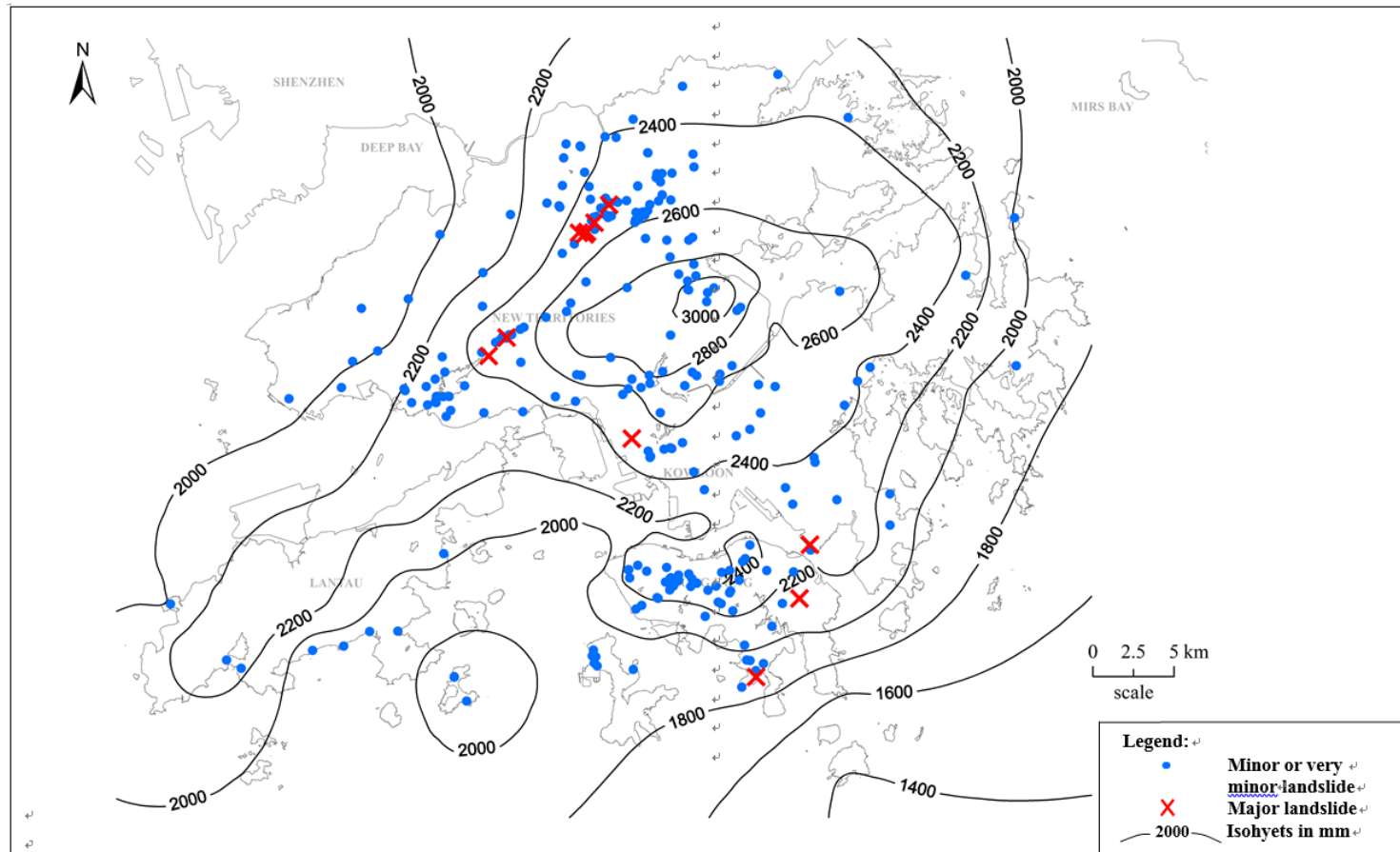
- Landslide hazards associated with Super Typhoon Mangkhut and other rainstorms in 2018
- Counterexamples of historical tropical cyclones causing heavy rainstorms and severe landslide hazards
- Previous extreme rainfall scenario-based study
- Further study of characteristics of tropical cyclones leading to severe rainfalls

Landslip Warnings Issued in 2018

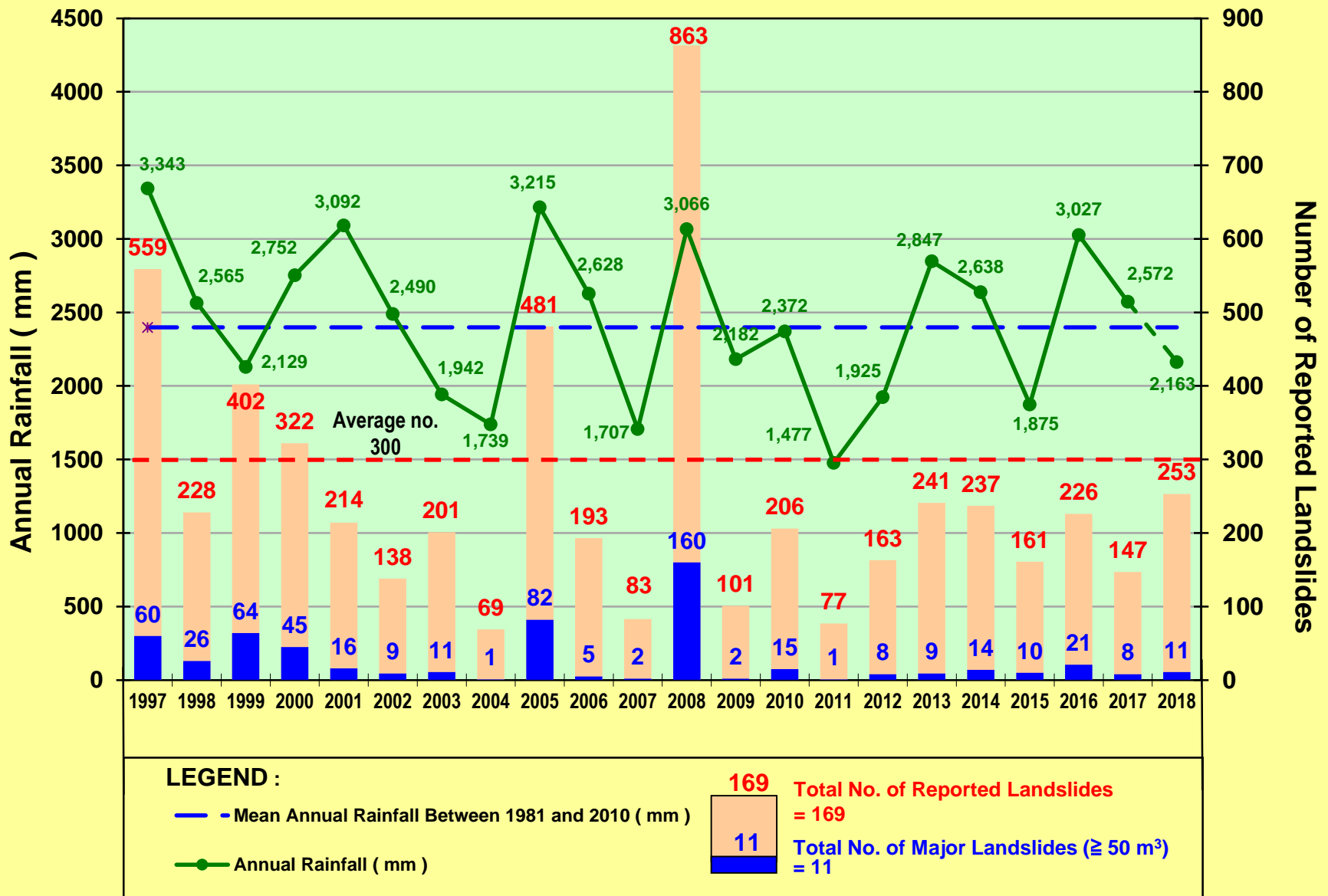
Rainstorm	Warnings Issued	Highest Max Rolling 24hr Rainfall	Number of Landslides Reported
07 June 2018	   	323 mm (N41, Tai Po)	13
29 August 2018	  	381.5 mm (N05, Fanling)	65
16 September 2018	      	343.5 mm (N37, Tsuen Wan)	29

Annual Rainfall Distribution and Locations of Reported Landslides in 2018

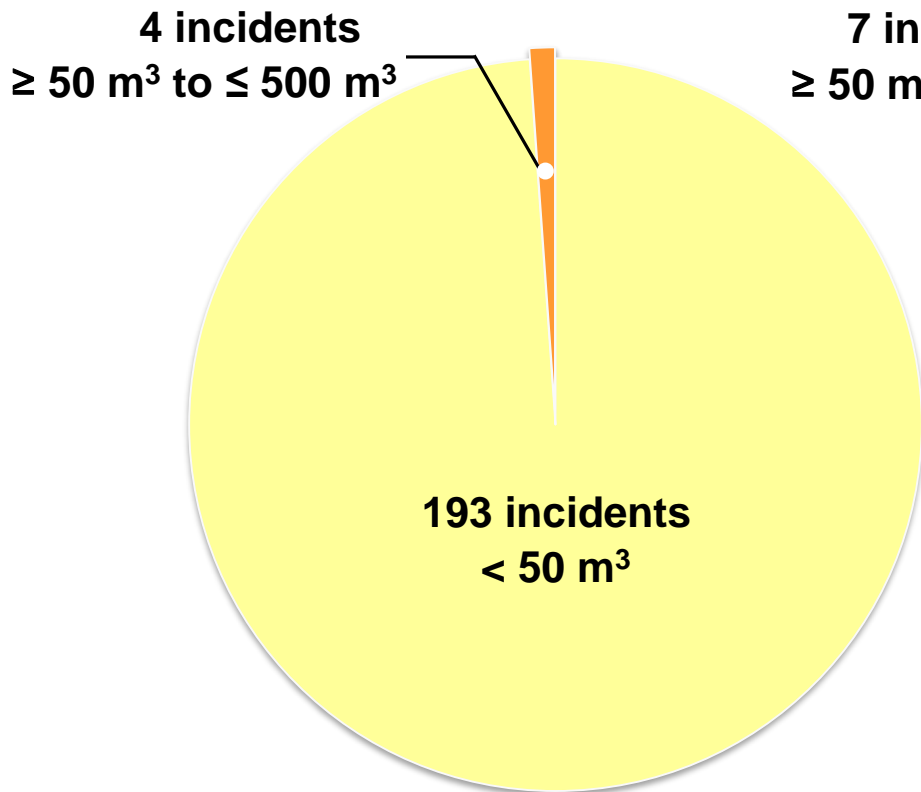
- Total number of landslides: 253
- Total number of major landslides: 11



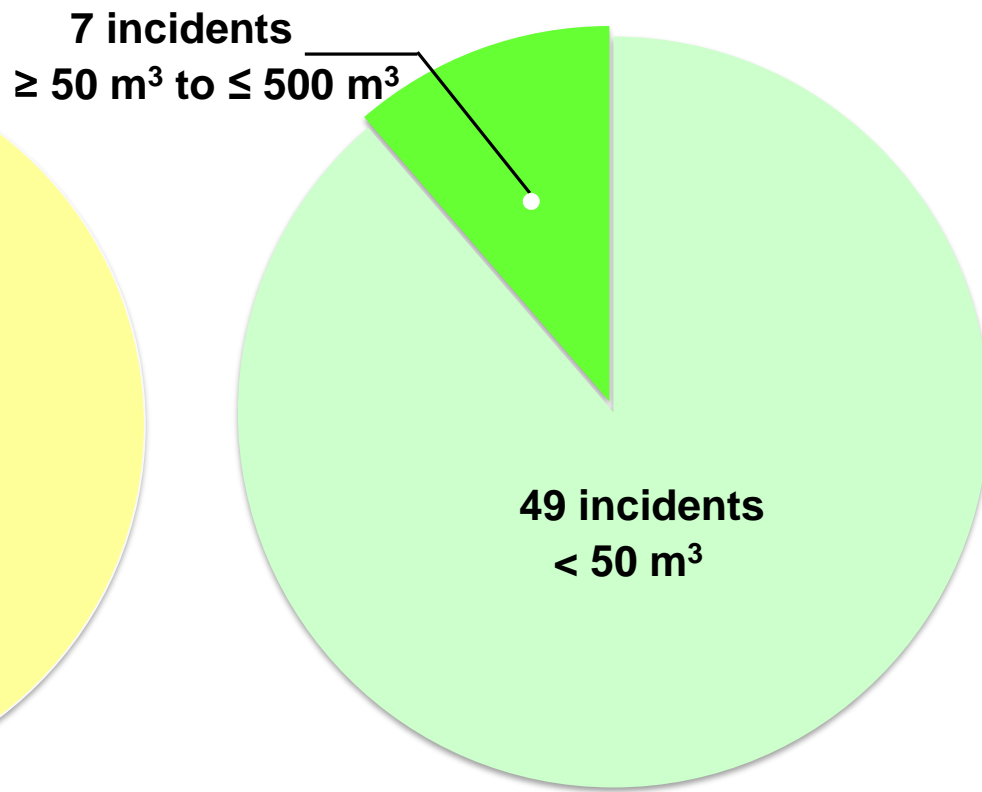
Reported Landslides (1997–2018)



Distribution of Landslides in 2018



**Landslides on Man-made slope
(Total number = 197)**



**Landslides on Hillside
(Total number = 56)**

Total No. of Landslides in 2018 = **253**

Landslides Associated with Super Typhoon Mangkhut

- Chung Hom Kok, Stanley Bay
 - Landslide on natural hillside
 - Failure volume: 80 m³
 - Consequence:
 - Emergency action not necessary because the landslide was located at a relatively remote area away from the footpath and existing buildings
- Pai Tau Village, Shatin
 - Landslide on a 2.5 m high cut slope (70° inclined)
 - Failure volume: 1.5 m³
 - Consequence:
 - Permanent evacuation of a squatter

Landslides in August 2018

- 3 landslide clusters at Fan Kam Road
 - Sourced from steep terrain typically inclined at 30° to 40°
 - Source volume of 250 - 500 m³
 - Open hillslope failure and channelized debris flow
- Landslides along Fan Kam Road
 - Road section inundated by landslide debris
 - Vehicles and container pushed downstream
 - Storage structure adjoining a village house reported to have been entirely washed away
 - Abandoned structure partially demolished with the remnant wall observed at about 20m downstream

Landslides Associated with Historical Tropical Cyclones

Typhoon Sam in August 1999

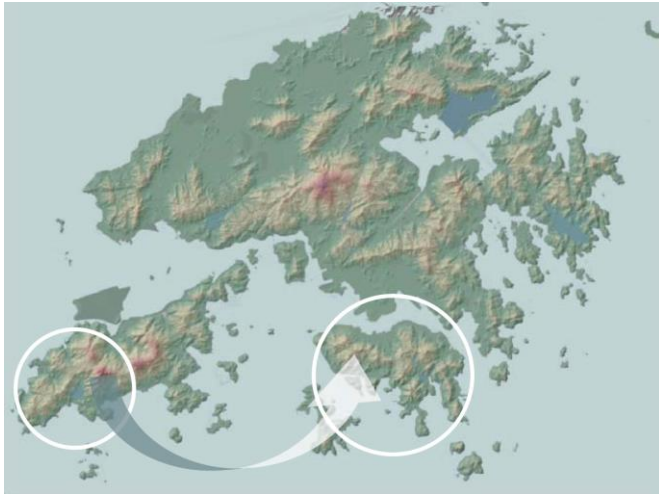
- No. of landslides: 303
- No. of major landslides: 52
- Major landslide incidents:
 - Sham Tseng San Tsuen
 - Failure volume up to 600m³
 - 1 fatality and 13 injuries
 - Shek Kip Mei
 - Failure volume of 2,500m³
 - No fatality and injury

Typhoon Helen in August 1995

- No. of landslides: 109
- No. of major landslides: 16
- Major landslide incidents:
 - Fei Tsui Road
 - Failure volume of 14,000m³
 - 1 fatality and 1 injury
 - Shum Wan Road
 - Failure volume of 26,000m³
 - 2 fatalities and 5 injuries

Previous Extreme Rainfall Scenario-based Analysis

Scenario 1 - June 2008 Lantau rainstorm striking Hong Kong Island



- About 2,000 landslides
- 200 to 300 impacting on buildings or roads
- Consequence:
Emergency system stretched to limit
- Solution:
Streamline emergency system

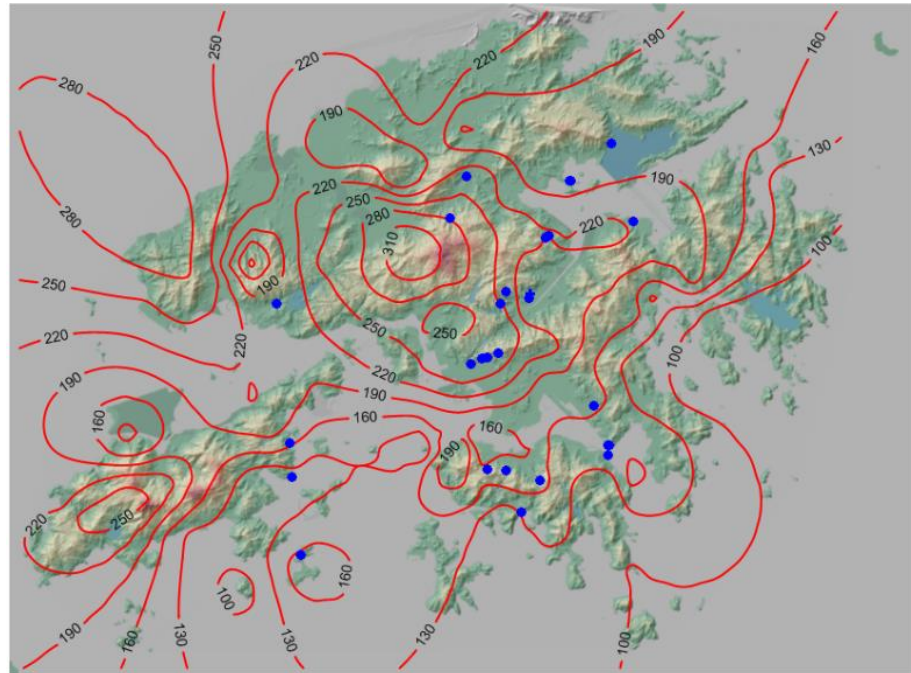
Scenario 2 - 2009 Typhoon Morakot striking Hong Kong Island



- About 50,000 landslides
- 4,000 to 9,000 impacting on buildings or roads
- Consequence:
Existing system completely overwhelmed
- Solution:
Non-engineering approach

Further Study on Characteristics of Tropical Cyclones and Rainfalls

- Serious landslide incidents occurred due to Typhoon Sam in 1999 and Typhoon Helen in 1995
- However, no serious landslide incidents occurred due to Super Typhoon Mangkhut in 2018
- What characteristics of tropical cyclones would deliver large amounts of rainfall and cause substantial landslide impacts?
 - Typhoon magnitude
 - Typhoon size
 - Wind speed
 - Track speed
 - Eyewall size at landfall
 - Track direction
 - Track location



Thank You