

# Extreme Rainstorms that Caused Devastating Flooding across the East Coast of Peninsular Malaysia during November and December 2014

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## ABSTRACT

During the early boreal winter (northeast) monsoon (November–December), cold air frequently bursts out from intense Siberian highs toward the Chinese coast in response to the development and movement of a 500-hPa trough. The resultant strong low-level northwesterlies turn into northeasterlies across the South China Sea as “cold surges.” On interacting with the near-equatorial trough, mesoscale convective systems form north of the trough, normally giving rise to heavy downpours and severe flooding, mainly along the coastal stretch in the east coast states of Peninsular Malaysia. In November 2014, a 1-week-long episode of heavy downpours, producing more than 800 mm of rain, occurred along the coastal stretch of northeastern Peninsular Malaysia. However, during December 2014, two episodes of extreme rainfall occurred mostly over inland and mountainous areas of the east coast of Peninsular Malaysia, in particular across its northern sector. These two unusual events, which lasted a total of 11 days and delivered more than 1100 mm of precipitation, resulted in extreme and widespread flooding, as well as extensive damage, in many inland areas. Analysis shows that the stronger wind surges from the South China Sea due to very intense cold-air outbreaks of the Siberian high developed under ENSO-neutral conditions. In addition, the mesoscale convective systems that developed across the northeastern Indian Ocean (near northern Sumatra) in response to the propagation of a 500-hPa short-wave trough across the Indian subcontinent toward China were the combined factors for these unusual extreme rainfall and flooding events along the east coast of Peninsular Malaysia.

## 1. Introduction

Heavy rain with its associated flooding is an annual occurrence along the east coast of Peninsular Malaysia (Fig. 1) during the northeast monsoon. In November 2014, an episode of heavy rainfall and ensuing flooding

occurred along the coastal stretch of northeastern Peninsular Malaysia. However, from mid-December onward, two episodes of extreme rainfall caused widespread flooding in Kelantan, Terengganu, and Pahang on the east coast of Peninsular Malaysia. The unusual situation was that these long-lasting extreme rainfall events were concentrated over the catchment areas in the upper reaches of the Kelantan and Pahang River basins instead of near the lower reaches, as normal. A

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