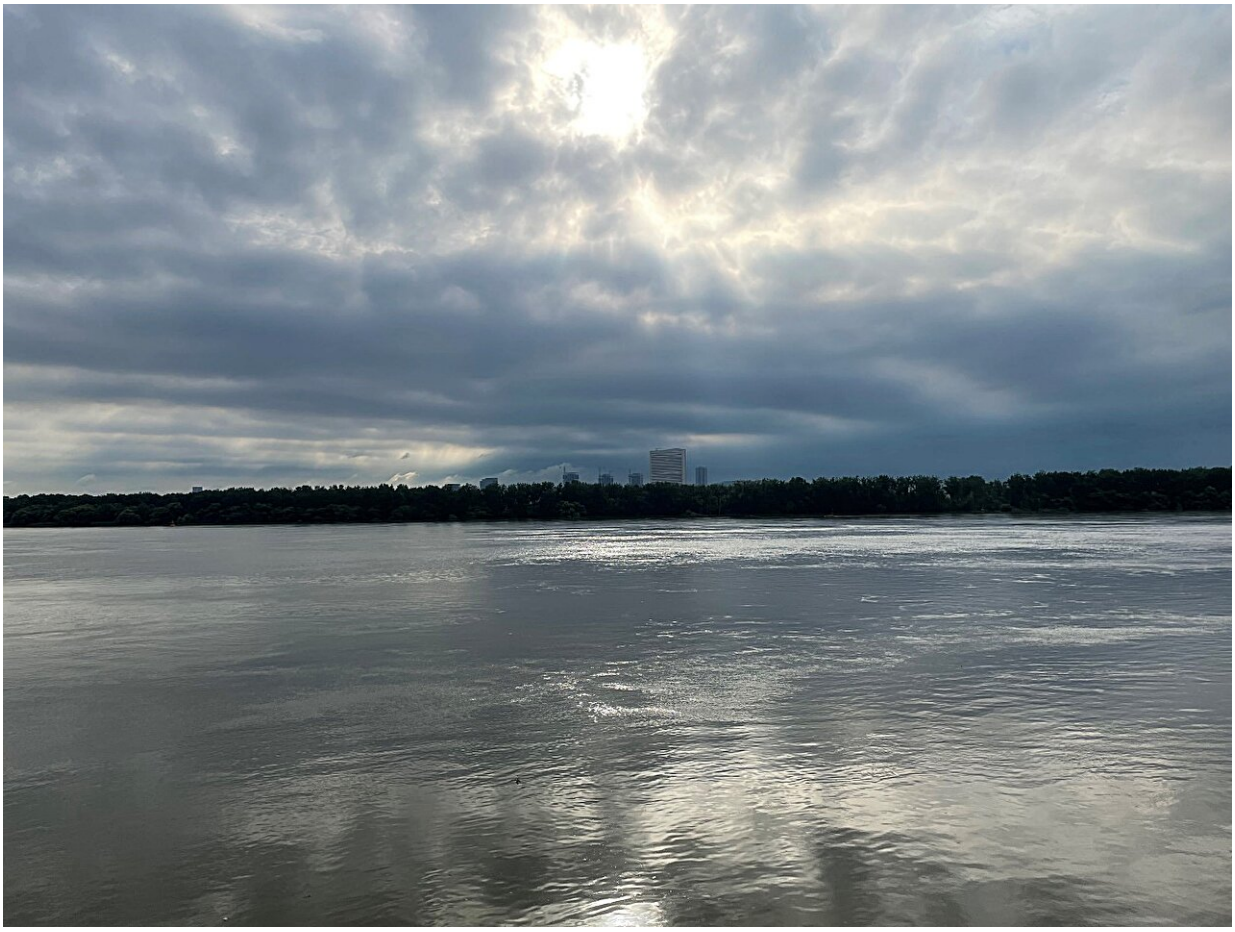
New study reveals contribution of mesoscale convective systems to floods in East Asia

July 22 2024



A storm during Meiyu season in 2024 in Nanjing. Credit: Guo Zhun

East Asia frequently faces floods, leading to significant economic losses,

casualties, and agricultural damage. Most summer floods in this region are caused by excessive rainfall. Mesoscale convective systems (MCS), large organized storms characterized by cumulonimbus clouds, play a significant role in these events. MCSs typically produce intense, concentrated, and long-lasting rainfall, which can trigger floods. Despite this, their contribution to major flood events in East Asia has received relatively little attention, largely due to a research gap between meteorology and hydrology fields. As a result, the quantitative relationship between MCS and major flood events at the climate scale has not been well established.

A study published in *Geophysical Research Letters* has addressed this gap. The researchers developed an "MCS-flood" linking algorithm, classifying MCS into four types and calculating the flood-causing efficiency of each. The study found that most large flood events and potential flood peak periods are dominated by MCS. Besides the land precipitation area and precipitation rate of MCS, the overlap area also plays a crucial role in their flood-causing efficiency.

"Previous researchers have only vaguely considered that MCS might play a role in heavy rainfall and flood events, but the extent of their impact and the mechanisms involved remained unclear," explained Ding Tian, the study's lead author and a Ph.D. candidate at the Institute of Atmospheric Physics (IAP) of the Chinese Academy of Sciences, and the University of Chinese Academy of Sciences. "We are attempting to provide a clear answer."

The research revealed that among the major floods that occurred during the summers of 2000–2021, 91% were related to MCS, and 66% were dominated by MCS. Type-1 MCS is the most efficient in causing floods due to its strongest precipitation rate, longest lifetime, and slowest movement. This increases the overlap area, boosting precipitation per area and reducing the proportion of rainfall absorbed by the soil. Type-2,

characterized by the second-largest precipitation volume and more numerous occurrences, especially over land, can induce floods relatively efficiently and more frequently than Type-1. Type-3 has a relatively small precipitation volume but a high convective precipitation rate. Type-4, which produces the smallest precipitation volume, is the most abundant and dominates the highest number of floods.

"MCS is an important factor controlling floods. However, how MCSs affect floods over East Asia remains less explored in existing studies," noted Prof. Zhou Tianjun, the study's corresponding author and a professor at IAP. "These findings are hoped to enhance our understanding of flood formation over East Asia."

More information: Tian Ding et al, Contribution of Mesoscale Convective Systems to Floods in the East Asian Summer Monsoon Region, *Geophysical Research Letters* (2024). DOI: 10.1029/2023GL108125

Provided by Chinese Academy of Sciences