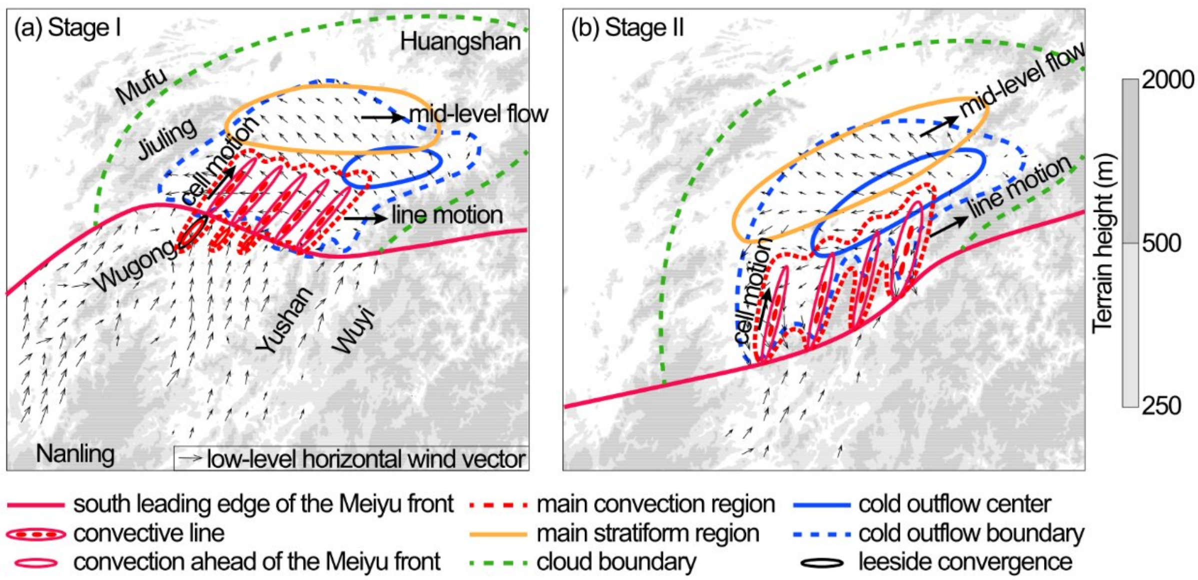
Landscape induced back-building thunderstorm lines along the mei-yu front

April 22 2021



The conceptual model of (a) stage I and (b) stage II convective line formation during 28 June 2013. Credit: Chinese Academy of Sciences

Thunderstorm development is not always dependent on atmospheric physics alone. Often, the surrounding landscape can influence convection, especially in regions with dramatic elevation changes. The Yangtze river basin in China's Jiangxi Province, which is surrounded by the Nanling Mountains, often experiences mesoscale convective systems (MCS) or squall line thunderstorms during the summer. These MCSs develop along the persistent mei-yu front, and often exhibit quickly developing parallel back-building, or training thunderstorms, resulting in torrential flooding. A research team led by Dr. Zhemin Tan, Professor at the School of Atmospheric Sciences of Nanjing University, analyzed the influences of the regional landscape that lead to consistent MCS back-building in the Yangtze river basin.

"Parallel back-building convective lines are often observed along the mei-yu front in China, and they can quickly develop into a stronger convective group of echoes, resulting in locally heavy rainfall within the mei-yu front rainband." said Dr. Tan.

"Mesoscale convective systems evolving along the mei-yu front induced cold outflow centered over the eastern side of the basin, which pushed the leading edge of the mei-yu front toward the mountains on the southeast side of the basin."

To better understand what initiates back-building convective lines, Dr. Tan and a group of researchers from the Key Laboratory of Mesoscale Severe Weather of Nanjing University, performed a high-resolution model simulation of a typical MCS event during 27-28 June 2013. Simulation results show that new convection along the convective lines is forced by intermittent interaction between the cold MCS outflow and the warm southerly airflow ahead of the mei-yu front. This process is enhanced by nearby terrain, especially the Nanling Mountains.

"The mountains along the way played a crucial role in supporting the rapid development of the convective lines to include torrential flood." said Dr. Tan. He, along with the study's coauthors, submitted their findings in *Advances in Atmospheric Sciences*. The journal published the noteworthy research as a cover article.

This mei-yu front MCS evolved from the western side of the basin. As it moved east, cold outflow centered over the eastern part of the basin. Strong southwest airflow ahead of the front passed the Nanling Mountains, merging with the cold outflow within the basin, sparking the erratic first stage of parallel convective line formation. Then, low mountains along the airmass boundary enhanced uneven storm development within the MCS.

"Knowledge of the effects of the mountains on the convective line formation can help to understand and predict the heavy precipitation events over the basin region during the mei-yu season in China," believes Dr. Tan.

In this case, the MCS quickly grew upscale from the first stage convective lines, resulting in apparent precipitation cooling. This process enhanced the cold outflow, shifting it southward. Stronger cold outflow then pushed the warm airflow farther south, impacting the mountains on the southeast side of the basin. Mountain valleys, or terrain gaps in the southeastern basin are then roughly parallel to the outflow and play a controlling role in a second stage formation of parallel convective lines.

More information: Qiwei Wang et al, A Case Study of the Initiation of Parallel Convective Lines Back-Building from the South Side of a Mei-yu Front over Complex Terrain, *Advances in Atmospheric Sciences* (2021). DOI: 10.1007/s00376-020-0216-2

Provided by Chinese Academy of Sciences