VIEWpoint 新观点

Tibetan Plateau Vortices: a comparison of tracking methods

Tibetan Plateau, Image: Unsplash

Explainer

Accessible research from Climate Science for Service Partnership (CSSP) China, for decision-makers No.03

Focus

Tibetan Plateau Vortices (TPVs) can develop into storms that can cause heavy rainfall and catastrophic flooding over the Yangtze River Basin. TPVs are often identified too late to issue effective warnings, therefore reliable tracking and detection methods are needed. As part of CSSP China, automated TPV tracking methods were investigated in comparison with manual tracking methods to understand the evolution process of TPVs and their impact.

Importance

TPVs are a type of weather system that originates over the Tibetan Plateau during the extended summer season (April–September). Some move off the plateau to the east and cause heavy rainfall, leading to catastrophic flooding in the Yangtze River Basin ,home to one third of China's population. For instance, a series of TPV-triggered heavy rainfalls in mid-June 2008 (Chen et al., 2015) forced 1.3million people in South China to evacuate and caused an economic loss of more than 10billion RMB (MCA of China, 2008). Therefore, accurate prediction of TPV tracks has been a key concern of Chinese researchers for decades.

Currently, it is difficult to identify and track TPVs, especially at the early phase of their lifecycle. This difficulty is mainly due to lack of observational data over the west Tibetan Plateau, where TPVs originate. Rapid and reliable detection methods are needed urgently to allow more time to give effective flood warnings.

Approach

Current tracking methods include manual and automated tracking: the former relies on case-by-case observation-based analysis by experts while the latter makes use of climate model outputs.

A thorough comparison between manual and automated tracking was carried out as part of the CSSP China project and revealed that the automated method can identify TPVs further west at their crucial earlier stages compared with manual tracking (Curio et al., 2018).

In addition, along with global climate model outputs, automated tracking can benefit understanding of the spatial distribution and annual cycle of TPVs. Using automated tracking, Curio et al (2019) found TPV-associated precipitation can account for up to 40% of the total precipitation in Sichuan Province in July, confirming that TPVs can have a strong influence on the precipitation downstream of the Plateau.

Next steps

Compared to manual methods, automated tracking is more objective and reproducible; more over it allows for earlier detection of TPVs. There is potential for the automated method to be incorporated in NWP-based workflows to improve the forecast skill of TPVs and to increase the lead time for TPV-related flood warnings. Meanwhile, the experience and in-depth knowledge of TPVs acquired from the skill of conventional manual methods can inform and refine automated methods to improve automated TPV tracking.

This research is the first time TPV events have been examined in a high-resolution global climate model, helping to deepen knowledge of the mechanisms and patterns of TPVs, enabling better understanding and prediction.

References:

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