Contribution of Typhoons to the Summer-Autumn Precipitation in Taiwan

Chih-wen Hung and Ming-Fu Shih
Department of Geography, National Taiwan Normal University
Taipei, TAIWAN

Introduction

The contribution of typhoons takes up about half of the total rainfall during the summer-autumn typhoon season. However, the percentage of typhoon-related precipitation changes interannually, and the typhoon contribution usually occurs within a few days, showing that the major rainfall extracts from highly chaotic extreme rainfall events. Taiwan is an island featuring a north-south distance of only 394 km and precipitous mountainous topography. Being in the East Asian monsoon region, the island is characterized by a variety of seasonal rainfall patterns which are mainly influenced by a typhoon and a monsoon. This analysis explores the regional differences in typhoon contributions to summer-autumn precipitation in Taiwan, particularly utilizing the Taiwan ReAnalysis Downscaling data (referred to as TReAD) for its high-resolution advantages in both time and space. This allows for an understanding of the contribution ratio of typhoon-related precipitation to the original monsoonal rainfall across the island.

Summer

In low-altitude regions with higher summer precipitation in Taiwan, a significant amount of non-typhoon precipitation (e.g. the summer monsoon or regional thermal convective systems) reduces the impact of typhoon precipitation with lower contribution proportions, even though typhoons often bring tremendous rain in these areas. Conversely, typhoons are the primary and consistent sources of precipitation in areas with lower rainfall during the summer.

In the further analysis of individual months, similar precipitation patterns are seen in July and August. The contribution of typhoon rainfall is diluted in low-altitude regions with heavy overall summer precipitation, while the importance of typhoon rainfall significantly goes up in some drier places in these two months.

Autumn

As a northeasterly wind starts strengthening in autumn, the northeast monsoon brings considerable precipitation to the windward areas such as Yilan and the northeast coast, leading to a decrease in the proportion of typhoon precipitation contribution in these regions. Conversely, the western and central coastal areas, originally characterized by lower precipitation in autumn, see typhoons become the main and stable sources of precipitation during that season.

In September, the formation of the northeast monsoon has just begun, and typhoons still often invade Taiwan. Hence, the result of typhoon precipitation contribution during this month shows similarity to that in August. However, as the northeast monsoon significantly strengthens in October, the northeast coast receives much monsoonal rainfall which largely reduces the impact of typhoon precipitation. In contrast, typhoons provide essential water sources for monsoonal leeward sides such as western and central coastal regions where our result shows almost the least overall rainfall compared to other parts in Taiwan. Note that the contribution of typhoon precipitation in inland areas of southwestern Taiwan is negligible. It is because the diminishing summer monsoon may still have remnant impact on that region in October, which leads to a few non-typhoon precipitation dominating the regional overall rainfall.

Through this analysis, regional precipitation characteristics from typhoons and monsoons together with their relationships are clearly demonstrated. The relevant finding contributes to our understanding and comprehension of the overall contribution of typhoons to the summer-autumn precipitation in Taiwan. Additionally, it helps us comprehend the regional distribution differences in such contributions and the relationships with overall precipitation.

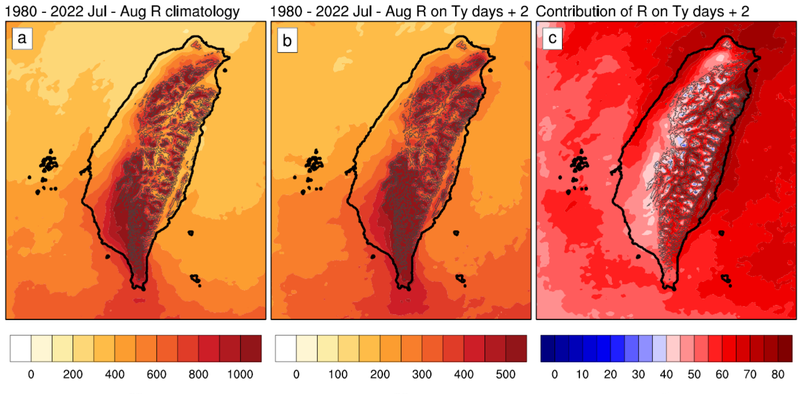

Fig.1 (a) Climatological rainfall (unit: mm), (b) mean rainfall during the typhoon period (plus 2 days after a typhoon leaves; unit: mm), (c) the contribution ratio of typhoon rainfall (unit: %) in summer (July and August).

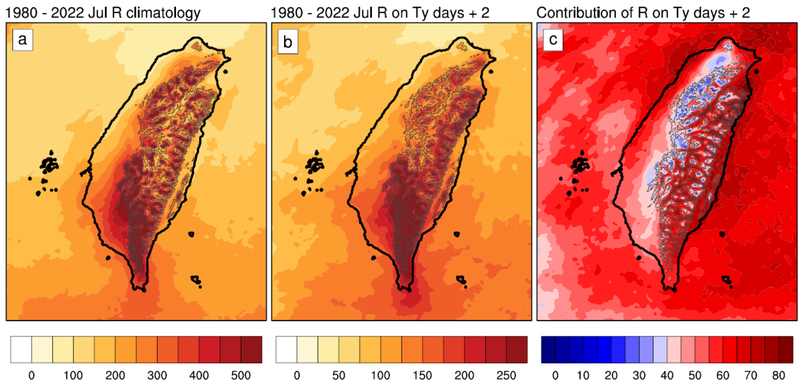

Fig.2 (a) Climatological rainfall (unit: mm), (b) mean rainfall during the typhoon period (plus 2 days after a typhoon leaves; unit: mm), (c) the contribution ratio of typhoon rainfall (unit: %) in July.

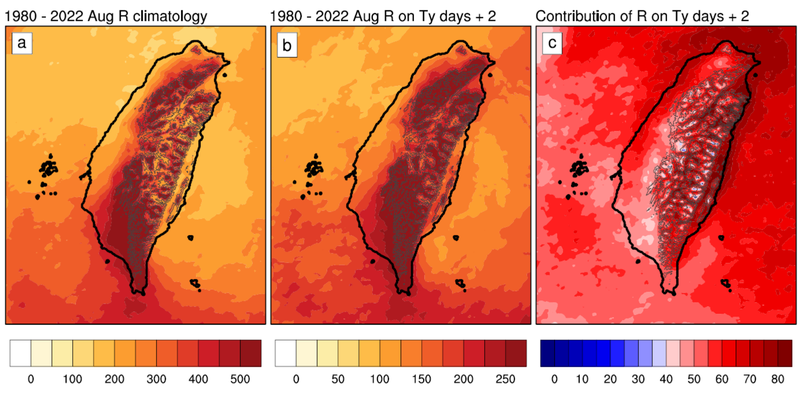

Fig.3 (a) Climatological rainfall (unit: mm), (b) mean rainfall during the typhoon period (plus 2 days after a typhoon leaves; unit: mm), (c) the contribution ratio of typhoon rainfall (unit: %) in August.

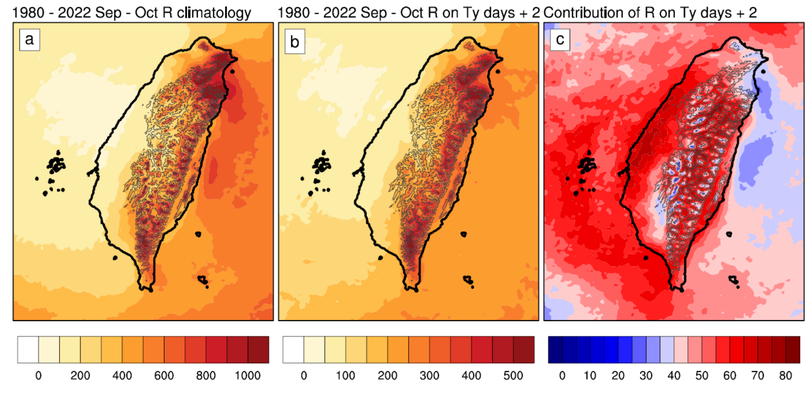

Fig.4 (a) Climatological rainfall (unit: mm), (b) mean rainfall during the typhoon period (plus 2 days after a typhoon leaves; unit: mm), (c) the contribution ratio of typhoon rainfall (unit: %) in autumn (September and October).

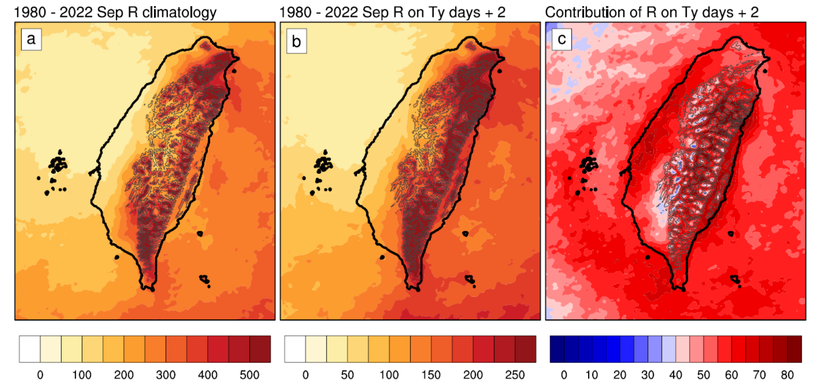

Fig.5 (a) Climatological rainfall (unit: mm), (b) mean rainfall during the typhoon period (plus 2 days after a typhoon leaves; unit: mm), (c) the contribution ratio of typhoon rainfall (unit: %) in September.

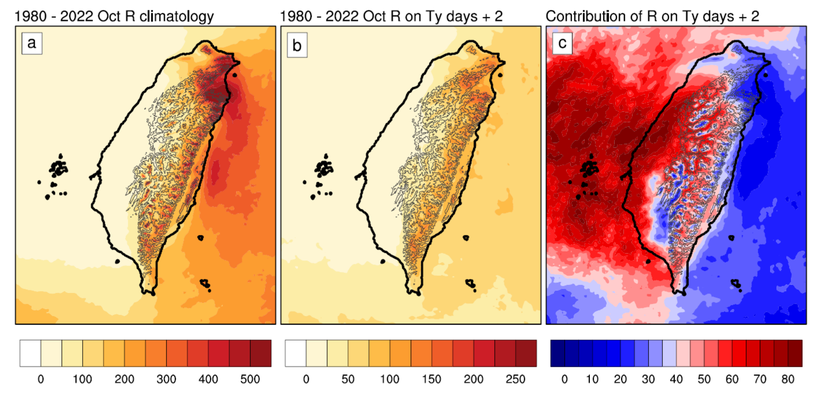

Fig.6 (a) Climatological rainfall (unit: mm), (b) mean rainfall during the typhoon period (plus 2 days after a typhoon leaves; unit: mm), (c) the contribution ratio of typhoon rainfall (unit: %) in October.