Chen, P-Y and C.-M. Wu, 2025: Identifying Cold Pool scales over Complex Topography using TaiwanVVM simulations. *J. Meteor. Soc. Japan*, **103**, http://doi:10.2151/jmsj. 2025-023.

Plain Language Summary: Our study aims to determine the optimal scale for identifying cold pools—areas of cooled air produced by thunderstorms—over Taiwan's complex mountainous terrain. Using detailed, semi-realistic simulations from TaiwanVVM, which cover the entire island, we explored this phenomenon, particularly during summer afternoons when local weather patterns dominate. Initially, applying a traditional large-scale definition for cold pools did not accurately align with observed rainfall locations due to the region's complex topography. However, we found that a smaller environmental scale (approximately 7 to 11 km, roughly three times the size of typical precipitation events) better captured the correspondence between cold pools and actual rainfall hotspots. At this scale, cold pools are clearly associated with evaporative cooling over the plains and heavier rainfall in mountainous regions. Furthermore, this approach effectively captures potential shifts in cold pool locations in global warming simulations using TaiwanVVM, emphasizing the importance of selecting an appropriate scale of cold pools for accurately analyzing local thunderstorms.

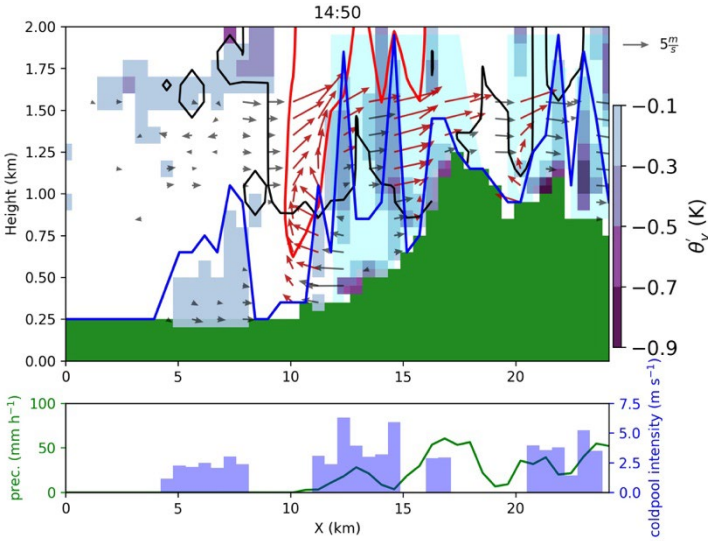

Figure 1. Vertical cross-section with the cold pool calculated using the 7–11 km environmental scale. In the upper portion, green bars represent terrain height (km), blue line indicates cold pool height (km), purple shading denotes the negative virtual potential temperature (K). Black contour represents cloud condensate mixing ratio, and bright shading highlights rainwater (g kg^{-1}). Purple vectors represent the horizontal wind anomaly and the red contour represents strong updraft (m s^{-1}). In the lower portion, blue bars depict cold pool intensity (m s^{-1}), and the green line represents precipitation rate (mm h^{-1}).

- The study finds that an optimal environmental scale (7–11 km) is more effective in identifying cold pools in Taiwan's complex terrain compared to the traditional approach.
- At this refined scale, cold pools align more accurately with observed rainfall patterns, showing clear associations with evaporative cooling over plains and intensified rainfall in mountainous regions.
- The method also captures potential shifts in cold pool locations under a warming climate, highlighting the importance of cold pools scale for accurately analyzing local thunderstorms.