On the use of an upper-level vorticity for trough prediction over Indochina Peninsula (IP) Sub-region with a coupled WRF-ROMS model

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During rainy season, displacement of monsoon trough plays an important role in controlling an environment favorable for extreme rainfall events in tropical region. Thailand is situated in the tropic and regularly exposed to severe flood events caused by trough-induced heavy rainfall. Knowing trough displacement days or weeks in advance can yield benefit for early disaster preparedness and warning. This study aimed at validating a coupled WRF-ROMS model in capturing the monsoon trough. Upper-level vorticity computed from hourly ERA–5 winds at 300-hPa was used for determining the trough. Four heavy rainfall events in Thailand associated with trough during May-August 2022 were selected, as the observed rain band was relatively consistent with an elongated upper-level vorticity for all events. It was therefore reasonable to use the 300-hPa vorticity as an indicative variable for model comparison. The model was forced by 3-hr GFS for WRF and initiated ocean states with HYCOM for ROMS, and afterward momentum and heat fluxes were concurrently exchanged between the models. Prognostic upper-level vorticity maps estimated from predicted winds were depicted. For basis of comparison, 6-hr average of the observation and prediction were plotted along with forecasted high- and low-pressure system at sea level (SLP), then a visual comparison was made. The model well captured trough displacement in May and June, which was located over northern Thailand and contributed to heavy rainfall (up to 150 mm/day). It also showed good agreement with observation in the following months, when trough moved more southward and caused heavy rainfall in northeast and eastern sub-regions. Therefore, this study is valuable in pointing out the potential of the predicted vorticity and SLP for trough prediction over IP sub-region and is fundamental to further validating the model for longer time scale, especially week-to-week change of the trough.

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