Using weather pattern recognition to classify and predict summertime heavy rainfall occurrence over the Upper Nan river basin, northwestern Thailand

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In Thailand and the Asian monsoon region in general, water-related disasters have taken many lives and devastated infrastructure such as bridges, roads, buildings, electrical grids and telecommunication. To mitigate damaging effects of such severe events, precise and timely rainfall prediction is crucial. In addition to dynamical approach, various statistical techniques have been proposed to improve the prediction of rainfall. Typically, in the case of statistical rainfall prediction, a perfect prognosis (PP) method in which a statistical relationship is established between a local-scale observed ‘predictand’ (i.e., rainfall) and simultaneously observed large-scale ‘predictors’ (e.g. temperature, humidity, wind or geopotential height) is taken and then applied to predicted ‘predictors’ derived from a global model to yield forecasts of the ‘predictand’. The weather pattern (WP) recognition such as the Self Organizing Map (SOM), developed by Kohonen (1982; 2001), is one of the widely used methods to determine this relationship. Nguyen-Le et al. (2017) recently uses SOM in combination with the K-means clustering to objectively classify the anomalous WPs causing heavy rainfall days over northern Kyushu, southwestern Japan, during the Baiu season. The classification results are then implemented with the PP and analogue method (Lorenz, 1969) to predict the occurrence (yes/no) of heavy rainfall days in the region. The forecast skill of this relative new method ASOM (combination of Analogue forecast and SOM) up to 7-days lead times is significantly improved than that from the traditional method using only the predicted rainfall intensity from an operational global model. Here, a work extending Nguyen-Le et al. (2017) to summertime (May–June, MJ, and July–August–September, JAS) heavy rainfall over the Upper Nan river basin (17.375° –19.375°N, 99.875° –101.125°E) in northwestern Thailand is conducted.
First, it shows that in MJ, intensive rainfall over the Upper Nan is mainly brought by the remarkable enhancement of westerly summer monsoon. Meanwhile, westward-propagating tropical disturbances including tropical cyclones are the primary factors reproduce heavy rainfall over the Upper Nan in JAS. It also suggests that the occurrence time of local heavy rainfall is strongly related to the seasonal transition of summer monsoon in the Indochina Peninsula.
These classification results are then used to predict the occurrence of heavy rainfall days in the studied basin in summer 2008–2017 using prognostic WPs from the operational Japan Meteorological Agency Global Spectral Model (GSM). In general, the forecast skills of ASOM up to 3-day lead times are significantly improved, in which it not only outperforms GSM with same forecast ranges but also its 3-day forecast is better than
1–2-day forecasts from GSM. However, the false alarms ratio is still high, particularly in JAS. In addition to overall results, the differences in the performance of ASOM between years and heavy rainfall-inducing WPs are evaluated. It is shown that it strongly depends on the WPs that bring heavy rainfall events. More specifically, the skill is higher if the WP is limited to one phenomenon such as intensified westerlies or tropical disturbances. In contrast, ASOM has more difficulties to capture the WP imposing the interaction between the monsoon westerlies and the trade easterlies or northeasterly winds. It is also suggested that the performance of ASOM (for the heavy rainfall occurrence) and GSM (for the prognostic WPs) is roughly in phase.

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