Diverse synoptic patterns of warm-season heavy rainfall events in South Korea

Chanil Park[1], Joowan Kim[2], Seok-Woo Son[1*], Joon-Woo Roh[3], Eun-Chul Chang[2], Dong-Hyun Cha[4], Jung-Hoon Kim[1], and Enoch Jo [5]

[1]*School of Earth and Environmental Sciences, Seoul National University, Seoul, South Korea*

[2] *Department of Atmospheric Sciences, Kongju National University, Kongju, South Korea*

[3] *The Research Institute of Basic Sciences, Seoul National University, Seoul, South Korea*

[4] *School of Urban and Environmental Engineering, Ulsan National Institute of Science and Technology, Ulsan, South Korea*

[5] *Department of Atmospheric Sciences, Illinois State University, Urbana, Illinois, United States*

Synoptic circulation patterns associated with warm-season (June-September) heavy rainfall events (HREs) in South Korea are classified based on ERA-interim mean sea-level pressure data using the self-organizing map algorithm. The HREs are defined as rainfall events, by excluding ones due to direct impacts by typhoons, with at least 110 mm of accumulated precipitation over 12-hours. HREs observed during 19979-2018 have two subseasonal frequency peaks corresponding to the first (late June to July) and second (late August to September) Changma periods and are generally associated with a mid-latitude cyclone from west, an expanded North Pacific high, and a baroclinic trough with low-level and upper-level jets. However, the detailed synoptic patterns behind HREs vary widely. The warm-season HREs in South Korea can be effectively summarized into six clusters; 1. Continental lows (19.2 %), 2. Synoptic-scale cyclones (15.4 %), 3. Confluent systems (20.4 %), 4. Local instability on the edge of the North Pacific high (21.3 %), 5. Mesoscale cyclones surrounded by anticyclones (13.5 %) and 6. Subtropical rainfall systems in September (10.0 %). Clusters 1 and 3 are dominated by strong southwesterly low-level jet and are the most frequent during the first Changma period. Clusters 5 and 6 are characterized by strong upper-level jet and mainly occur during the second Changma period. Clusters 2 and 4, characterized by baroclinic and local instabilities respectively, are frequent during both Changma periods. This study is expected to provide useful information for diagnosing and forecasting HREs within largely diverse weather regimes.