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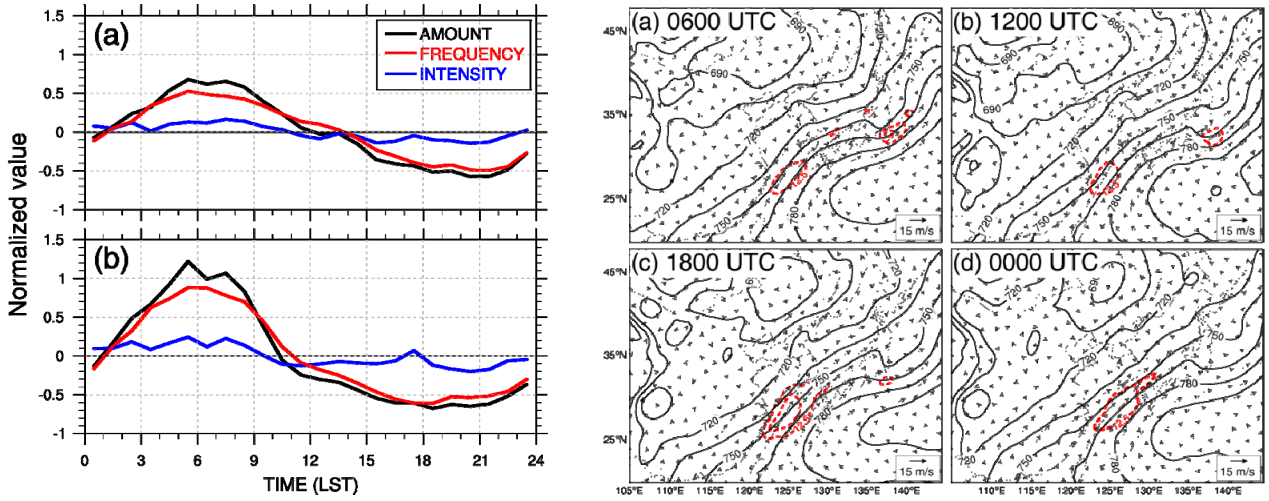
Plain Language Summary: An investigation has been carried out using rainfall observation data, National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) analysis and forecast data to explain the environment and processes that lead to heavy rainfall in the early morning over the Korean peninsula during episodes of cloud clusters (CCs) associated with mesoscale troughs (CCMTs). For this study, nine episodes with maximum hourly rainfall amount in the early morning (i.e., 0300–0900 LST) are selected from seventeen heavy-rainfall episodes associated with CCMTs during 2001–2011.



(Left) Diurnal variations of normalized mean rainfall amount, frequency, and intensity over south Korea for (a) the 17 CCMT episodes and (b) the 9 CCMT episodes in which maximum of hourly rainfall amount occurs in the early morning (i.e., 0300–0900 LST). All values are obtained using AWS data.
(Right) Composite fields at 925 hPa for (a) 0600 UTC, (b) 1200 UTC, (c) 1800 UTC, and (d) 0000 UTC. Geopotential height (m, black solid lines), wind vectors, and isotachs (m s^{-1}, red dashed lines) are obtained from CFSR 6-hourly analysis data. Composite fields are obtained by averaging the fields over the 9 episodes with maximum hourly rainfall amount in the early morning.

- Case studies on two episodes have revealed that, for both episodes, the growth of the strong southwesterly band (SWB; an area with wind speeds > 12.5 m s^{-1}) over the East China Sea is found to be the key processes for heavy rainfall in the early morning over the southwestern Korean peninsula. A mechanism for the SWB growth is presented in this paper.
- Furthermore, generality of the major results from the two case studies is verified using the results obtained for the composite fields of the 9 CCMT episodes.