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Relative Importance of Radar Variables for Nowcasting Heavy Rainfall A Machine Learning Approach

Abstract

Highly short-term forecasting, or nowcasting, of heavy rainfall due to rapidly evolving mesoscale convective systems (MCSs) is particularly challenging for traditional numerical weather prediction (NWP) models. To overcome such a challenge, a growing number of studies have shown significant advantages of using machine learning (ML) modeling techniques with remote sensing data, especially weather radar data, for high-resolution rainfall nowcasting. To improve ML model performance, it is essential first and foremost to quantify the importance of radar variables and identify pertinent predictors of rainfall that can also be associated with domain knowledge. In this study, a set of MCS types consisting of convective cell (CC), mesoscale CC, diagonal squall line (SLD), and parallel squall line (SLP), was adopted to categorize MCS storm cells, following the fuzzy logic algorithm for storm tracking (FAST), over the Korean Peninsula. The relationships between rain rates and over 15 variables derived from data products of dual-polarimetric weather radar were investigated and quantified via five ML regression methods and a permutation importance algorithm. As an applicational example, ML classification models were also developed to predict locations of storm cells. Recalibrated ML regression models with identified pertinent predictors were coupled with the ML classification models to provide early warnings of heavy rainfall. Results imply that future work needs to consider MCS type information to improve ML modeling for nowcasting and early warning of heavy rainfall.

Keyword

Machine learning

Reference

Wang, Y. V., S. H. Kim, G. Lyu, C.-L. Lee, G. Lee, K.-H. Min, and M. C. Kafatos, 2023: Relative Importance of Radar Variables for Nowcasting Heavy Rainfall: A Machine Learning Approach. *IEEE Trans. Geosci. Remote Sensing*, **61**, 1 – 14, <https://doi.org/10.1109/TGRS.2022.3231125>.