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Cyclogenesis recognition using communication, ocean, and meteorological satellite images and machine learning approaches

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About one hundred of tropical cyclones (TCs) annually influence human habitats, causing lots of socioeconomic losses. TCs are generated in the low latitude ocean, and move toward higher latitudes with more intensity. Mid-latitude countries typically have a longer time to prepare TCs, while subequatorial countries have only about 1-2 days for preparation since the detection of TCs. Thus, detection of TCs at earlier stages (i.e. disturbance stage) is crucial to decrease socioeconomic losses. However, only a few disturbances develop into TCs among thousands of disturbances per year. Thus, accurate detection whether a disturbance turns into a TC is really important. Although numerical weather prediction models perform well for various atmospheric phenomena, they don't work well on TC-related simulation, because there is no proved mechanism of the TC generation. Recently, several TC early detection studies are conducted using satellite data, such as Wood et al (2015) and Park et al (2017). Those studies are focused on symmetric patterns of the wind or clouds to detect TCs. However, a symmetric pattern is usually found from almost developed disturbances. Thus, in this study, along with the symmetric pattern-based indices of clouds, homogeneity indices, which are distinguishable variable in early stages of disturbances, are used to identify developing disturbances over the Northeast Pacific. Two machine learning approaches—decision trees and random forest—were used for TC detection. The Communication, Ocean and Meteorological Satellite (COMS) Meteorological Imager (MI) level-1b images were used as input variables to the machine learning approaches. Combined joint typhoon warning center (JTWC) best track with national centers for environmental prediction final (NCEP FNL) data were used as reference data of the developing and non-developing disturbance tracks. Preliminary results showed that 9 developing disturbance cases in 2015 through hindcast validation were well detected from the decision trees model, but 18 cases of the 38 non-developing disturbances were falsely detected with a 24-hour lead time. The random forest approach yielded a high detection rate (100%) but a relatively high false alarm rate (~47%) More optimized input variables and feature selection may further improve the TC detection.