HYPERSPECTRAL UNMIXING AS AN ANALOG FORECASTING METHOD DURING STRONG MONSOON EVENTS IN THE PHILIPPINES

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The Philippines experiences two distinct monsoon seasons: the southwest monsoon (Habagat) and the northeast monsoon (Amihan). The interaction between monsoon and terrain results in rainfall along the coastal regions of both western and eastern Philippine in the Habagat and Amihan season, respectively. Also, this interaction can lead to heavy rainfall events which occur during days with strong monsoonal flow. Strong Habagat is characterized by strong westerlies along northwest Philippines, while strong Amihan is characterized by strong northerlies along the northeast Philippines. Strong monsoons carry moisture laden winds towards the Philippines that can lead to flash floods, drowned crops, landslides, and property damage caused by heavy rainfall. The destructive capabilities of strong monsoon events necessitate an efficient and computationally cheap complement to our current rainfall forecasting methods.

This study aims to apply the analog forecasting method in predicting strong monsoonal rain for both seasons. In the analog forecasting method, if today's weather patterns look similar to weather patterns obtained from a day years ago, then their rainfall distributions should also look alike. Analog forecasting can be separated into three phases: (1) extracting weather patterns, (2) scanning for analogous patterns, and (3) predicting. To perform the first two phases, we use hyperspectral unmixing, a technique typically applied in satellite image processing, to create an ensemble of synoptic weather forecasts. Hyperspectral unmixing follows three general steps: (1) reducing data dimension, (2) unmixing the patterns' characteristic signatures, and (3) estimating the corresponding weights. The weights are applied to their corresponding ensemble members which dictate what weather pattern dominates during the strong monsoon day.

For this study, we apply a two-level analog forecasting. The method performs the first step of analog forecasting twice, each with a different parameter: mean sea-level pressure (first level) and relative humidity (second level) obtained from the JRA-55 dataset from 2001-2018, and use GPM rainfall to construct a rain forecast map. To verify the results, following forecasting skill scores are used: root mean square error, mean absolute error, and a contingency table. This work introduces a new forecasting system for strong monsoon events in the Philippines using nontraditional but well-proven and reliable techniques—analog forecasting and hyperspectral unmixing.

Keywords: strong monsoon events, analog forecasting, hyperspectral unmixing