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Drought index forecasting using remote sensing and long-range forecast data based on machine learning techniques

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Three machine learning models based on Decision Tree, Random Forest, and Extremely Randomized Trees were developed and compared to spatial interpolation based on multiquadric spline to forecast drought indices of the 6-month Standardized Precipitation Index (SPI6) and the 6-month Standardized Precipitation Evapotranspiration (SPEI6) in ungauged areas. Input variables of the Normalized Difference Vegetation Index (NDVI), the Normalized Difference Water Index (NDWI), daytime Land Surface Temperature, and nighttime Land Surface Temperature were used to represent the initial condition and the Multivariate ENSO Index and the Arctic Oscillation Index were included in order to consider large-scale atmospheric circulation. Six-month accumulated precipitation and potential evapotranspiration ending the target month were also included as input variables. The long-range forecast data were used to fill the 6-month precipitation and potential evapotranspiration during future periods and compared to the cases that use climatological data as baseline results. Classification of drought categories were performed and evaluated for the locations of 61 of Automated Synoptic Observing System gauges in South Korea. In conclusion, machine learning-based methods performed better than the interpolation method, and the methods using climatology data outperformed the methods based on long-range forecast. Although the contribution of long-range forecast for drought forecasting was not yet large, the application of machine learning modelling using remote sensing data contributed to the enhancement of drought forecasting skill. Drought forecasting based on the long-range forecast is expected to outperform the performance based on climatological data as the skill of the long-range forecast improves.