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Predicting Vegetation Condition from ASCAT Soil Water Index over Southwest India

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In India, extreme water scarcity events are expected to occur on average every five years. Record-breaking droughts affecting millions of human beings and livestock are common. If the south-west monsoon (summer monsoon) is delayed or brings less rainfall than expected, a season's harvest can be destroyed despite optimal farm management, leading to, in the worst case, life-threatening circumstances for a large number of farmers. Therefore, the monitoring of key drought indicators, such as the healthiness of the vegetation, and subsequent early warning is crucial.
The aim of this work is to predict vegetation state from earth observation data instead of relying on models which need a lot of input data, increasing the complexity of error propagation, or seasonal forecasts, that are often too uncertain to be used as a regression component for a vegetation parameter.
While precipitation is the main water supply for large parts of India's agricultural areas, vegetation datasets such as the Normalized Difference Vegetation Index (NDVI) provide reliable estimates of vegetation greenness that can be related to vegetation health. Satellite-derived soil moisture represents the missing link between a deficit in rainfall and the response of vegetation. In particular the water available in the root zone plays an important role for near-future vegetation health. Exploiting the added-value of root zone soil moisture is therefore crucial, and its use in vegetation studies presents an added value for drought analyses and decision-support.
The soil water index (SWI) dataset derived from the Advanced Scatterometer (ASCAT) on board the Metop satellites represents the water content that is available in the root zone. This dataset shows a strong correlation with NDVI data obtained from measurements of the Moderate Resolution Imaging Spectroradiometer (MODIS), which is exploited in this study. A linear regression function is fit to the multi-year SWI and NDVI dataset with a temporal resolution of eight days, returning a set of parameters for every eight-day period of the year. Those parameters are then used to predict vegetation health based on the SWI up to 32 days after the latest available SWI and NDVI observations.
In this work, the prediction was carried out for multiple eight-day periods in the year 2015 for three representative districts in India, and then compared to the actually observed NDVI during these periods, showing very similar spatial patterns in most analyzed regions and periods. This approach enables the prediction of vegetation health based on root zone soil moisture instead of relying on agro-meteorological models which often lack crucial input data in remote regions.