EGU2020-6647
https://doi.org/10.5194/egusphere-egu2020-6647
EGU General Assembly 2020

Forecasting vegetation condition to mitigate the impacts of drought in Kenya.

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Droughts are a major threat globally as they can cause substantial damage to society, especially in regions that depend on rain-fed agriculture. Acting early based on alerts provided by early warning systems (EWS) can potentially provide substantial mitigation, reducing the financial and human cost. However, existing EWS tend only to monitor current, rather than forecast future, environmental and socioeconomic indicators of drought, and hence are not always sufficiently timely to be effective in practice. In Kenya, the National Drought Management Authority (NDMA) provides monthly bulletins assessing food security in the 23 arid and semiarid regions using current biophysical (e.g., rainfall, vegetation condition) and socio-economic (production, access, and utilisation) factors. One key biophysical indicator used by the NDMA drought phase classification is based on the Vegetation Condition Index (VCI).

In this study we explore machine-learning techniques to forecast (up to six weeks ahead) the 3-month VCI, commonly used in the pastoral areas of Kenya to monitor droughts. we specifically focus on Gaussian Process modelling and linear autoregressive modelling to forecast this indicator, which are derived from both Landsat (every 16 days at 30m resolution) and the MODerate resolution Imaging Spectroradiometer (MODIS - daily data at 500m resolution).

Our methods provide highly skillful forecasting several weeks ahead. As a benchmark we predicted the drought alert marker used by NDMA (VCI3M< 35). Both of our models were able to predict this alert marker four weeks ahead with a hit rate of around 89% and a false alarm rate of around 4%, or 81% and 6% respectively six weeks ahead.

The forecasts developed here could, for example, help establish a new drought phase classification (`Early Alert') which, along with adequate preparedness actions developed by the disaster risk managers, would minimise the risk of a worsening drought condition.