Spatio-temporal comparison of the vegetation anomalies products used in the agricultural monitoring systems: West Africa case

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Early warning systems (EWS) play a fundamental role in food security at the global, regional and national scales. Yet, after more than 45 years of Earth Observation, the use of these data by agencies in charge of global food security remains uneven in its results, and discrepancies in crop condition classification regularly occur (Becker-Reshef et al., 2020). It seems more than necessary to strengthen the confidence of decision makers and politicians. Fritz et al. (2019) identified through a survey, different gaps in methods. They highlighted the need to better understand where the input data sets (precipitation and vegetation indices) have discrepancies, and the need to develop tools for automated comparison.

This study aims to respond partially to this need by conducting a comparative experiment of a set of vegetation growth anomalies produced by four Early Warning Systems in West Africa for the 2010-2020 period.

We first reviewed the crop monitoring systems of the Early Warning Systems in West Africa (Nakalembe et al., 2021), with a focus on the vegetation anomalies indices. Four systems were studied: FEWS-NET (Famine Early Warning Systems Network) developed by USAID (US Agency for International Development), the VAM (Vulnerability Analysis and Monitoring) seasonal explorer of the WFP (World Food Program), ASAP (Anomaly hot Spots of Agricultural Production) developed by the JRC (Joint Research Center) and GIEWS (Global Information and Early Warning System on Food and Agriculture) developed by FAO (Food and Agriculture Organization of the United Nations). These four systems contribute to the international CM4EW (Crop Monitoring for Early Warning) which is the GEOGLAM component devoted to countries-at-risk (Becker-Reshef et al., 2020).

Then, a set of vegetation growth anomaly indicators (one per EWS) was selected (NDVI-based), harmonized (standardized), then classified (9 anomaly classes) and compared in time and space. The extreme classes corresponding to less than 15% and more than 85% of the rank percentile values over the 2010-2020 period were respectively labelled as "negative alarm" and "positive alarm" classes (the other classes were grouped under the label "absence of alarm").

This exploratory work revealed that, despite a common satellite image data set (mainly MODIS NDVI), there are spatio-temporal divergences of the anomaly classes, especially when the seasonal variations are considered. Considering the alarm classes (positive, negative, absence), the use of a cropland mask slightly strengthens the annual similarities between the four EWSs, and thus was used in the following comparisons. The "two by two" analyses displayed similarity between 52% (FEWS-NET and GIEWS) to 70% (VAM and ASAP). The four systems together displayed similarity between 24.5% to 33.7%. In terms of trend over the 2010-2020 period, the systems show no significant trends in terms of percentage of the negative alarm class, except FEWS-NET (p-value < 0.05).

The spatio-temporal divergences could be explained by the diversity of methods used by the different EWSs for NDVI anomaly calculations (products, smoothing, spatial and temporal resolution). In order to go further in the interpretation of these divergences, next step will be

to compare these anomalies to other spatial sources of data, such as anomalies of vegetative biomass currently simulated by the AGHRYMET-CIRAD agrometeorological model SARRA-O, or in the longer term to textual information extracted from local newspaper articles using automatic language processing tools.

To conclude, this exploratory study provides new perspectives in the comparison of anomaly products of EWS in West African which remains a challenge in the current environment where more and more products are emerging.

References:

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