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Effects of non-stationarity in fAPAR time-series on the detection of drought events in a monitoring system

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Remotely sensed fraction of Absorbed Photosynthetically Active Radiation (fAPAR) have been widely used for the monitoring of agricultural drought from regional to global scale. Commonly, divergences from a reference climatology are used to identify periods with limited vegetation activity compared to historical data, which can be considered a proxy of the occurrence of drought events. However, the approach adopted to derive the reference condition strongly affects the outcome of a drought analysis. In the simple case of a stationary phenomenon, the standardized z score values can be used to detect anomalous statuses, but this conditions is usually quite rare in nature and the likely non-stationarity in the time-series needs to be accounted.
In this study, time-series of fAPAR maps collected by the MODIS Terra satellite between 2001 and 2016 has been analyzed at global scale in order to identify possible areas interested by non-stationarity (i.e. linear temporal trend), with the aim of quantifying the effects on drought events based on 10-day fAPAR standardized anomalies (z values). The impact of trends on standardized anomalies has been formally expressed as a linear function of two quantities: 1) the z value itself, and 2) the year under investigation.
This function highlights that in the case of negative z values (of greatest interest for drought analyses) and the most recent years on the time-series (of greatest interest for operational monitoring systems), the use of a stationary reference tends to underestimate both severity and extension of the areas interested by drought compared to the non-stationary reference. The areas mostly interested by significant differences in the outputs of stationary and non-stationary analyses are the Indian subcontinent, eastern China and the Mediterranean Countries.