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Crop phenology monitoring from Landsat 8 and Sentinel-2 green LAI time series at the Nile Delta

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Monitoring of crop phenology significantly assists agricultural managing practices and plays an important role in crop yield predictions. Multi-temporal satellite-based observations allow analyzing vegetation seasonal dynamics over large areas by using vegetation indices or deriving biophysical variables. The Northern Nile Delta represents about half of all agricultural lands of Egypt. In this region, intensifying farming systems are predominant, which translates into a pressure on water supply demand. Moreover, double cropping rotations schemes are increasing, requiring a high temporal and spatial resolution monitoring for capturing successive crop growth cycles. This study presents a framework for crop phenological characterization based on high spatial and temporal resolution time series of green Leaf Area Index (LAI). Particularly, NASA's Harmonized Landsat 8 and Sentinel-2 (HLS) surface reflectance dataset was used. The HLS dataset provides seamless products from both satellites, enabling global land observations every 2-3 days at 30m. A green LAI retrieval model was originally trained using ground-based LAI measurements with Gaussian processes technique and validated for Sentinel-2 (R2: 0.7, RMSE= 0.67m2/m2) (Amin et al., 2020). Given the compatible spectral bands configuration of both sensors, a new model for Landsat 8 was adapted from the original one. Both models were implemented in an HLS image based automated retrieval chain obtaining therefore two different LAI time series, which were spatially averaged per crop parcel according to the ground data at disposal. The subsequent analysis was performed based on the time series phenological pre-processing and modelling implemented in the in-house developed scientific time series toolbox DATimeS (Belda et al., 2020). The proposed framework permitted to determine the crop patterns for four consecutive years (2016-2019), identifying one or two seasons per year, for single (e.g. grape, citrus) or double-cropping (e.g. maize-onion, maize-wheat, rice-clover), respectively. Alongside, each detected crop was characterized by retrieving a selected set of phenological parameters, which were contrasted with respect to the established crop type calendar (planting and harvesting dates) and for each crop type, the annual mean value was computed and the intra annual variability within the four years was assessed.

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