Monitoring rice agropractices in North Africa: ~~a~~ comparison of MODIS and Sentinel-1 results

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Agro-monitoring systems need up-to-date information on where, when and how much a crop is cultivated, in particular in developing countries and for food security reasons. Such information can be derived from remote sensing imagery with fast revisiting cycles. In the past, only time series of optical moderate resolution data such as HVRR, SPOT-Vegetation and MODIS provided the necessary high temporal resolution for this kind of applications. These datasets have been successfully used for agro-monitoring activities and to perform retrospective and trend analysis. Due to their moderate to coarse spatial resolution (~ 250 – 1000 m) their applications are limited however to regional to continental scales. In this context, the advent of the Sentinel sensors opens new opportunities, since they provide time series of satellite imagery with decametric spatial resolution and revisit times of 5 days. Studies that fully exploit Sentinel imagery for crop monitoring are therefore needed to assess their potential contribution for i) performing high resolution crop-monitoring activities and, ii) extending time series of information derived from archive coarse resolution imagery with the aim of performing analyses of temporal trends over a reasonably long time span.

This contribution presents a comparison of MODIS or Sentinel1 time series for detection (cultivated area and number of seasons) and seasonal dynamics' analysis (sowing, harvesting and flowering dates) for irrigated rice cultivation in the Senegal River Valley (SRV)for the 2016 dry and wet rice seasons. MODIS time series analysis exploited the PhenoRice algorithm (Boschetti et al., 2017), a rule-based algorithm specifically designed for rice detection and seasonal dynamics monitoring and based on the use of time series of TERRA and AQUA 250 m resolution 16-day Composite Vegetation Indexes (MODIS products MOD13Q1 and MYD13Q1).

The SAR data analysis was instead based on analysis of Sentinel-1A time series acquired over the study area from January to December 2016. In particular, the RICEscape software was used for analysing the SAR backscatter (σ_0) temporal profiles both in the VV and in the VH polarization, to define a set of rules allowing to properly identify rice cultivated areas. The algorithm mostly exploits SAR data, although cloud free Landsat-8 Optical images were used to crosscheck and complement the information derived from SAR. This approach was applied to generate rice crop area and Start

of Season (SOS) maps for both the dry (sowing in February – April) and the wet (sowing in September – November) rice seasons.

Results showed a strong consistency between the thematic maps derived from the two data sources. We observed that, although the rice-classified area is rather different due to the large difference in spatial resolution, the main spatial patterns of estimated sowing dates and crop intensity are quite similar. A comparison between the average values of MODIS and SAR estimated dates after aggregation on a 2x2 km regular grid shows a strong correlation between the sowing dates derived from Sentinel-1 and MODIS data, for both the dry and the wet season of 2016. The comparability of MODIS and Sentinel results is encouraging for the development of innovative services for characterization and monitoring of crop systems. Such systems could in fact exploit both the sufficiently long MODIS time series to characterize the main characteristics of crop systems and their recent evolution, as well as the innovative Sentinel-1 time series for monitoring of present-day and future conditions.