A Sentinel-based Agriculture Monitoring Scheme

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Abstract:

Agriculture monitoring, for the purposes of food security, control of the implementation of sustainable agriculture policies and the improvement of the overall agricultural productivity, is a top priority for the European Union, but also global initiatives such as GEOGLAM.

The present work deals with the satellite based monitoring of agriculture, and specifically using Sentinel data, for the purposes of food security monitoring in South Korea. The suggested monitoring scheme is motivated by and exploits the technological legacy of the European Commission H2020 projects RECAP and EOPEN. In RECAP we have developed a fully automated earth observation system to assist the Paying Agencies of the Common Agricultural Policy in their inspection process, while at the same time offer farmers and agri consultants a tool to support them in understanding and complying with the rules. Later and within the context of the EOPEN project we look at agriculture monitoring not only from the remote perspective but we also introduce the dimension of big data handling via incorporating mature ICT solutions for system applications at national scales. We address the big data notion in multiple dimensions with respect to the area of application, the spatial resolution of thematic information, the volume of data and the computational efficiency.

Based on the mentioned experiences we have started developing a comprehensive agriculture monitoring system that starts from data acquisition up until it ends as actionable information to the user. The system consists of four tiers, forming a low to high level information pyramid: i) the ingestion Sentinel data from an in house developed Umbrella API that functions as a single point access for Sentinel data, ii) the information extraction tier where through machine learning techniques we accurately classify crop types, iii) the knowledge tier where through semantic reasoning techniques we extract higher level information that can be straightforwardly used by end users as ready to use and actionable knowledge.

We have implemented a distributed Random Forest classifier using Spark in a High Performance Data Analytics environment, provided by the High Performance Computing Center Stuttgart. The input data to the classifier comprise of long time-series of Sentinel-1 and Sentinel-2 images, but also pertinent vegetation indices. This is a binary classifier, identifying with more than 85% accuracy, rice fields in Northwestern South Korea. Future work includes the exploitation of the rice-mapping product to accurately estimate rice yield at national scale, through global regression models on time-series of vegetation indices.

Keywords: Sentinels, machine learning, random forest, high performance data analytics, food security