Geophysical Research Abstracts
Vol. 18, EGU2016-8761, 2016
EGU General Assembly 2016

Remote sensing and modelling of vegetation dynamics for early estimation and spatial analysis of grain yields in semiarid context in central Tunisia

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In arid and semi-arid areas, population growth, urbanization, food security and climate change have an impact on agriculture in general and particular on the cereal production. Therefore to improve food security in arid countries, crop canopy monitoring and yield forecasting cereals are needed. Many models, based on the use of remote sensing or agro-meteorological models, have been developed to estimate the biomass and grain yield of cereals. Through the use of a rich database, acquired over a period of two years for more than 80 test fields, and from optical satellite SPOT/HRV images, the aim of the present study is to evaluate the feasibility of two yield prediction approaches.
The first approach is based on the application of the semi-empirical growth model SAFY, developed to simulate the dynamics of the LAI and the grain yield, at the field scale. The model is able to reproduce the time evolution of the leaf area index of all fields with acceptable error. However, an inter-comparison between ground yield measurements and SAFY model simulations reveals that the yields are under-estimated by this model. We can explain the limits of the semi-empirical model SAFY by its simplicity and also by various factors that were not considered (fertilization, irrigation,...).
To improve the yield estimation, a new approach is proposed: the grain yield is estimated in function of the LAI in the growth period between 25 March and 5 April. The LAI of this period is estimated by SAFY model. A linear relationship is developed between the measured grain yield and the LAI area of the maximum growth period.This approach is robust, the measured and estimated grain yields are well correlated. Following the validation of this approach, yield estimations are proposed for the entire studied site using the SPOT/HRV images.