PREDICTION OF CROP YIELD AND SUB-FIELD HETEROGENEITY: A COMPARISON OF THREE MODELS

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Global change forces agricultural production to increase yield and optimize management strategies. Remote sensing has become a very important source of information for modelling and forecasting agricultural crops, which has great potential to optimize agricultural management. Numerous crop models have been developed with varying degrees of complexity and input requirements. In general, crop models can be divided into three groups with increasing complexity: Indices and index based models, light use efficiency (LUE) models and biophysical crop growth models. The aim of our study is to compare the three model types according to accuracy on field and sub-field scale, data requirement, transferability, and data pre-processing requirements.

Yield measurements taken on nine summer barley fields in Germany were available. The data were covering each entire field and allowed analysis of sub-field heterogeneity. We used five SPOT 4 and SPOT 5 scenes, covering the complete growing season of barley, as data basis. The three model types were represented by: (1) the integral of vegetation cover over the growing season as an indicator for crop yield, (2) fAPAR (fraction of absorbed photosynthetic active radiation) , calculated based on vegetation indices; and (3) the biophysical model APSIM into which the SPOT data were integrated through data assimilation by applying a particle filter.

Our results indicate that all three models captured the sub-field heterogeneity. The biophysical model was less accurate in yield prediction according to the small scale heterogeneity, but is requiring only one appropriate satellite image and no in-situ data to estimate the yield. The LUE model outperformed well, but relied heavily on the selected vegetation index to calculate fAPAR. The index based model showed also good performance, but is restricted by the need of in-situ data and, like the LUE model, requires a high number of remotely sensed images.

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