

Estimation of Biophysical Parameters for Winter Wheat Using Remote Sensing Data

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ABSTRACT

Remote sensing applications in agrometeorological studies have become a good tool in order to determine production areas for different crops and prediction of crop biophysical parameters such as Leaf Area Index (LAI) and biomass provided by the observations of growth stages, hence much more effective usage of croplands all over the country is provided. Besides of the crop growth observations, spectral vegetation indices can be used to evaluate crop's condition. Normalised Difference Vegetation Index (NDVI) is one of the mostly used and well accepted indices that is used to evaluate both growth stages, water content and health situation of the crop. NDVI is calculated by using following formula $NDVI = (NIR - VIS) / (NIR + VIS)$ which is based on chlorophyll absorption in the red part of the electromagnetic spectrum whereas NIR radiation is scattered due to the mesophyll leaf structure. Aim of this study is to show the relations of satellite derived NDVI and biophysical parameters of crops such as LAI, biomass. Within the projects supported by TUBITAK (The Scientific and Technological Research Council of Turkey) under the titles of "Investigation of Possible Effects of Climate Change to Crop Growth by Crop Growth Models" and "Determination of CO₂, H₂O and Energy Fluxes of Wheat", Normalised Difference Vegetation Index (NDVI) values of winter wheat (*Triticum aestivum* L.) in Kırklareli are obtained using hand-type spectroradiometer. Additionally, dry biomass and LAI were measured in field studies. 16-days composite NDVI product from Aqua/MODIS with 250 m spatial resolution is used in an effort to estimate dry biomass and LAI of winter wheat during the first growing season. In order to eliminate the cloud-contaminated and abnormal data The Savitzky-Golay filter is used to smooth 16-day composite NDVI product. Relations between in situ measurements and smoothed Aqua/MODIS NDVI values are also investigated. Measured NDVI and MODIS NDVI are linearly correlated with a determination coefficient of $R^2 = 0.82$. The whole growing season was represented by a 2nd order polynomial relation with $R^2 = 0.82$ between MODIS NDVI and biomass whereas higher and linear relations were obtained when growing season is divided into planting to bolting (09.10.2009-02.04.2010) and earing to harvest (29.04.2010-06.07.2010) with $R^2 = 0.98$ and $R^2 = 0.87$, respectively. MODIS NDVI and LAI however were not satisfactorily related when considering whole growing season. Nevertheless, high linear correlations were obtained with $R^2 = 0.85$ and $R^2 = 0.88$ when above mentioned two separate growing stages are taken into account. The results showed that using MODIS-NDVI is an accurate, practical and easy way to estimate frequently used biophysical parameters like biomass and LAI of vegetation. Using satellite data crop growth can be followed and using this data yield can be estimated. However, it is necessary to evaluate the satellite data by considering its relation with ground truth data for longer periods.

Keywords: MODIS, NDVI, LAI, Biomass, Winter Wheat, Biophysical Parameters.

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