LAI ESTIMATION OF AGRICULTURAL CROPS FROM OPTICAL DATA AT DIFFERENT SPATIAL RESOLUTION

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1. INTRODUCTION

The possibility of estimating Leaf Area Index (LAI) of agricultural crops at regional scale and at relatively low costs by remote sensing techniques is appealing for a variety of applications. For example, the monitoring of LAI during crop growth cycles is crucial to calibrate crop growth models [1], and to obtain improved yield predictions [2]. Methods to estimate LAI from visible and near-infrared (VIS-NIR) remote sensed data are principally based on three approaches, i.e. on the relationships of LAI with vegetation indexes, on the inversion of canopy reflectance models, or on the employment of semi-empirical models [3]. Moreover, the accuracy of the estimated LAI is related to other factors, such as the sensor characteristics and the pixel resolution. Therefore, the availability of data acquired from optical sensors with different temporal frequency and spatial resolution can lead to LAI estimations that need to be evaluated and compared to understand their applicability in the agronomical context. The objective of this work is to assess the accuracy of LAI maps derived from MERIS, SPOT and IKONOS data over an agricultural area located in the Capitanata plain, Southern Italy, mainly devoted to the cultivation of wheat, sugar beet and tomato.

2. EXPERIMENTAL DATA

The experimental site is an agricultural area of approximately 700 Km^2 located in the Capitanata plain, close to the Foggia town (Puglia region, Southern Italy). The area has a flat topography and is mainly devoted to wheat cultivation. According to the local crop management scheduling, durum wheat is usually sown between November and the end of December and harvested at mid June. Other annual main crops of the region are: sugar beet (sown in autumn and harvested in June), tomato (sown in April and harvested in August-September). On the other hand, permanent crops with a significant presence in the area are vineyards and olives. On selected experimental fields, ground data were intensively collected in the framework of an experimental campaign [4], through the 2006-2008 growing seasons. In particular, vegetation biomass, soil moisture profiles, surface soil moisture, soil temperature, and LAI measurements were acquired. Moreover, at the same time, multi-temporal and multi-sensor remote sensed data were collected, obtaining a data set of 30 MERIS level 1b data, at full resolution, acquired in the three years, 7 SPOT images acquired in 2006 and 2007, and 5 IKONOS data acquired in 2007 and 2008.

3. METHODOLOGY

The methodology employed to derive LAI maps are related to the sensor type. LAI maps derived from MERIS data were obtained by a semi-empirical algorithm, referred to as TOA_VEG ([5] Baret et al., 2006), implemented in the BEAM software ([6] Brockmann, 2007). The algorithm estimates LAI by means of a trained Neural Network (NN) that inverts MERIS reflectance. NN is trained on the base of simulated data obtained by the SAIL model for the canopy reflectance, coupled to the PROSPECT model for the leaf optical properties, and by the SMAC model used for the top of atmosphere reflectance. Whereas LAI maps derived from SPOT and IKONOS data were obtained by means of empirical approaches based on the estimation of Vegetation Indexes (VI) such as the NDVI, WDVI and the correspondent CLAIR model ([7] Clevers et al., 2002). In detail the VI, computed from the Red and Near-InfraRed reflectance, are related to LAI ground measurements by means of the inverse of an exponential function. To avoid the problem of mixed pixels, only wide fields have been selected. The obtained results have been compared for the three crops under investigation separately, i.e. wheat, sugar beet and tomato, on the base of updated land use maps of the area.

3. ACKNOWLEDGMENT

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4. REFERENCES

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