The optimization of the crop chlorophyll content indices based on a new LAI determination index[1]

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Abstract:

The chlorophyll content is an important factor in the field of biology, ecology, botany, agriculture for estimation of the crop health status and vigor. With estimation the chlorophyll content of plant we can monitor the crop growth and plant diseases, predict yield. Remote sensing is a fast, low-cost and wide-area method to estimate chlorophyll content .The semi-empirical relationship between the chlorophyll content and leaf spectral feature have been studied. And several chlorophyll content indices have been described in the previous researches based on the chlorophyll absorption and shift of red_edge such as MCARI (Modified Chlorophyll Absorption Ratio Index) TCARI (Transformed Chlorophyll Absorption Ratio Index), and so on.

However, these indexes are always sensitive to other vegetation factors changing such as leaf area index (LAI), when applied in the canopy scale (Driss Haboudane 2008). That results in that the evaluation of the chlorophyll content is influenced by LAI changing: overestimation when LAI is high and underestimation when LAI is low. Some well known LAI related indices are also sensitive to chlorophyll content. However, the sLAIDI (standardized LAI Determining Index) developed by S.Delatieux (S.Delatieux et al, 2008), is insensitive to variation of leaf chlorophyll content, and can effectively measure the canopy LAI changing. Therefore, it can be considered as an optimization parameter of eliminating LAI impact on the chlorophyll content indices.

The purpose of this paper is to combine the different chlorophyll content indices with sLAIDI for the purpose of reducing influence of LAI on these indices for chlorophyll content determination, based on stimulated and measured dataset. The measured dataset containing the chlorophyll content and canopy reflectance ratio of the corn were collected in the Zhangye district of the GanSu province of the China in the summer of 2008. PROSPECT-SAIL physical transform model is chosen to simulating the leaf optical property and spectral reflectance of canopy for different chlorophyll content and different LAI. The chlorophyll content indices such as MCARI, TCARI, MTCI (Moderate Resolution Imaging Spectrometer Terrestrial Chlorophyll), DD (Double Difference Index), R-M (Red-edge Model), and TCL (Triangular Chlorophyll Index), GM are chosen for combination with sLAIDI. The normalized standard errors of these indices for the same chlorophyll content, which are caused by different LAI, are calculated to estimate the result of reducing LAI influence. We firstly stimulate the canopy spectral ratio of different chlorophyll content and different LAI. Then we divide the chlorophyll indices with different

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exponent and logarithm of the sLAIDI .So when LAI is high, sLAIDI is high, modified chlorophyll indices become low. When LAI is low, sLAIDI is low, modified chlorophyll indices become high. At last the measured dataset is used to test and verify the result from stimulated datasets.

The result shows that LAI influence on the chlorophyll content indices can been effectively reduced with combination of sLAIDI. The normalized standard error of the indices for MCARI,TCARI,MTCI,DD,R-M,TCI,GM decrease from 0.14, 0.072, 0.18, 0.31, 0.23, 0.12, 0.29 to 0.074, 0.053, 0.023, 0.19, 0.070, 0.060, 0.048. In the meantime different chlorophyll indices with different combination with sLAIDI can achieve the best effect, due to the different relativity with LAI.

Keywords: sLAIDI**,** PROSPECT-SAIL, chlorophyll content indices, LAI

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