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Advanced methodology to determine plant stresses using in-situ spectral data

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Fluorescence method in remote sensing has long been a traditional method estimating plant state. Vegetation indices (VIs) are tool for assessment plants' state based on its spectral characteristics. During the last half-century, in this domain were developed many vegetation indices and even more modifications of these indices. Nowadays, visible range across electromagnetic waves allows assessing plants' health and calculating its physical parameters. One of the VI's capabilities is detecting stress in plants. This approach has application in different areas. For discerning external environment (unnatural) stress from features of plant's development most of VIs have border values for greenness and health. This is the reason for these methods to be superficial and insufficient detecting and estimating stresses on the early stages. This limits plays especial importance in agriculture. Late stress detection leads to irreversible damage in crops and yield loss.
We propose new principle of VI analysis for determination unnatural stress on early stages. Novelty of this method is common consideration several VIs related to plant's pigmentation: chlorophyll, carotenoids and anthocyanins.
We have tasted this method on two agriculture fields: tomatoes and cotton. The goal of study was to determinate water crop stress at its beginning. A single VI shows reactions on emergence growth stage, fruit producing and ripening phase. It was hard to isolate crops' reaction on water from reaction on growth changes. Nevertheless, we have noted that there is correlation between chlorophyll VIs and carotenoid VIs. The correlation strength was depended on stress type. Based on common VIs analysis we were able to identify dryness and over irrigation stress. In addition, we have determine reaction on fertilizers input.
Common VIs analysis can improve existing fluorescence method of remote sensing monitoring. It can find application in areas where the early plant's stress detection is very impotent (e.g. agriculture). Another advantage of this method is identifying stress type. It can increase the role of spectral data for design making.