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Synergy of Remote Sensing and Modeling for Estimating Ecophysiological Processes in Plant Production

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Abstract: Information on the ecological and physiological status of crops is essential for growth diagnostics and yield prediction. Within-field or between-field spatial information is required, especially with the recent trend toward precision agriculture, which seeks the efficient use of agrochemicals, water, and energy. The study of carbon and nitrogen cycles as well as environmental management on local and regional scales requires assessment of the spatial variability of biophysical and ecophysiological variables, scaling up of which is also needed for scientific and decision-making purposes. Remote sensing has great potential for these applications because it enables wide-area, non-destructive, and real-time acquisition of information about plant ecophysiological conditions. With recent advances in sensor technology, a variety of electromagnetic signatures, such as hyperspectral reflectance, thermal-infrared temperature, and microwave backscattering coefficients, can be acquired for both plants and ecosystems using ground-based, airborne, and satellite platforms. Their spatial and temporal resolutions have both recently been improved. This article reviews the state of the art in the remote sensing of plant ecophysiological data, with special emphasis on the synergy between remote sensing signatures and biophysical and ecophysiological process models. Several case studies for the optical, thermal, and microwave domains have demonstrated the potential of this synergistic linkage. Remote sensing and process modeling methods complement each other when combined synergistically. Further research on this approach is needed for a wide range of ecophysiological and ecosystem studies, as well as for practical crop management.

Keywords: Crop model, Diagnosis, Monitoring, Precision agriculture, Prediction, Remote sensing

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