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Remote-Sensing of Carbon Exchange

PROJECT FACT SHEET

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Introduction: Precise and accurate estimation of carbon dioxide net ecosystem exchange (NEE) is critical to improve our understanding of vegetation productivity and the global carbon cycle. Remote sensing may offer the best techniques for assessing the magnitude of carbon sources and sinks in terrestrial ecosystems.

Objectives of this study:

- To develop quantitative techniques for remote estimation of NEE of crops, at the scales of leaf, canopy, field and entire region.
- To establish a remote sensing system for monitoring crop development, biomass production and yield.

Methods: Remote sensors are used to analyze reflectance of the target species at different scales, from leaves to entire regions

Leaf scale (Figure 1): the absorption and scattering properties of leaves in the visible and near infrared regions of the electromagnetic spectrum can be used to infer biophysical characteristics such as the amount and composition of absorbers (e.g. pigments).

Canopy scale (Figure 2): Crop reflectance and absorption of radiation at canopy scales can be used to infer various biophysical characteristics, including the amount and composition of absorbers, canopy architecture, health status, growing stage and NEE.

Field scale (Figure 3): CALMIT's hyperspectral AISA imaging spectrometer onboard a Piper Saratoga aircraft is used to collect reflectance spectra of entire fields (at a spatial resolution of 1-3 m/pixel). This data provides a way of up-scaling the algorithms developed at canopy scale to entire fields, providing a view of the crop biophysical characteristics of interest, including NEE.

Regional scale (Figure 4): Data acquired by multispectral imaging sensors on board satellites (e.g. Landsat ETM, MODIS, AVHRR) are also used to upscale the algorithms developed at canopy scale to entire regions.

Results: Models that relate crop reflectance with crop biophysical characteristics (e.g. Green Leaf Area Index, Green Leaf Biomass, and Mid-day NEE) were developed. Validation of these models also showed that the procedures could be successfully applied to crops with different canopy architectures, such as Maize and Soybean.

Conclusions: Primary productivity of crops (and thus their carbon sequestration potential) can be accurately estimated using remote sensors. In addition, the remote sensing algorithms developed can also be used to infer the developmental stages of a crop during the growing season, as well as the overall status of a crop; thus, they can be used for stress monitoring.

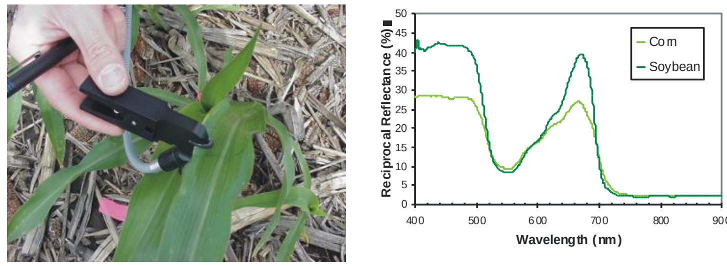

Figure 1. Leaf scale measurements.

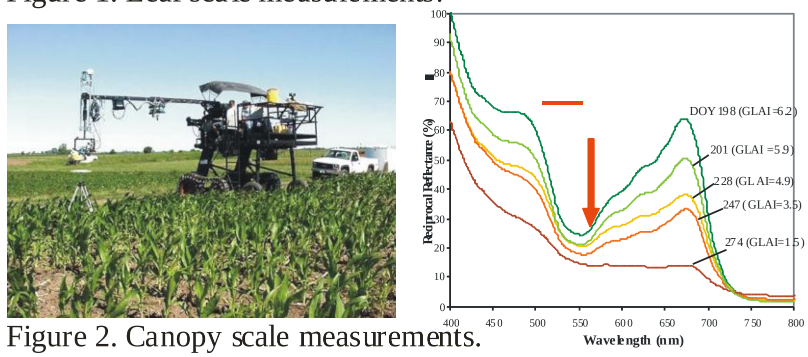

Figure 2. Canopy scale measurements.

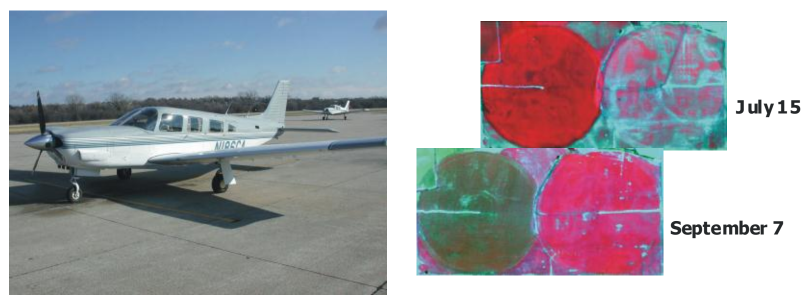

Figure 3. Field scale measurements.

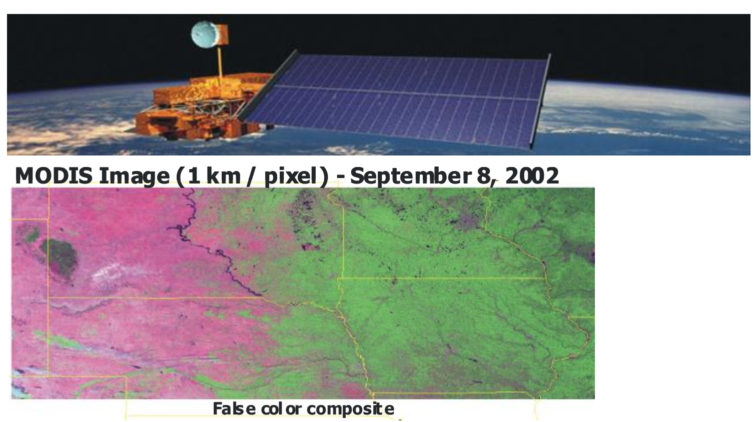

Figure 4. Regional scale measurements.

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