Geophysical Research Abstracts
Vol. 13, EGU2011-8376, 2011
EGU General Assembly 2011

Developments of Hyperspectral Remote Sensing Systems for Vegetation Research

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Currently the normal wavelength ranges for hyperspectral remote sensing of vegetation are VNIR (400 – 1000 nm), NIR (900 – 1700 nm), and SWIR (1000 – 2500 nm). Typically the most common wavelength range is the VNIR that can be used for example for vegetation index calculations and other basic parameter measurements. The NIR and SWIR ranges have been used for more detailed studies like plant pesticides detection.

The plant chlorophyll fluorescence has been a parameter for example for plant stress measurements. The measurement method with traditional spectrometers has been known and in use for some time in the laboratory with artificial illumination sources. During the last years, the method has also been applied in field conditions to measure the sun-induced fluorescence of the studied plants. The main reason for this has been the possibility to monitor the photosynthesis and also the amount of carbon absorbed in the process. Lately the possibilities of using plant fluorescence detection in precision agriculture and in detecting plants from other materials are found. However, there has been a clear need to extend the measurements of plant fluorescence from point spectrometers to imaging systems to cover larger measurement areas. Due to this, a project has been initiated for a new, novel imaging hyperspectral system that is designed for remote measurements of plant fluorescence, both from ground and airborne platforms. The system consists of a dedicated fluorescence sensor and a full range VNIR-SWIR (380-2500 nm) sensor with a common fore objective.

The topic of this paper is to present the method to detect sun-induced fluorescence from the remote sensing data, as well as the principles and technologies behind the new fluorescence imager. Also the requirements and concept for the full range VNIR-SWIR hyperspectral imager will be presented. In addition, the possibilities of using also the extended-NIR and thermal range hyperspectral remote sensing for vegetation research will be presented.