FLUORESCENCE MONITORING – A NEW CHALLENGE FOR THE REMOTE SENSING TECHNOLOGIES

A. Krumov[1], V. Vassilev[2], A. Nikolova[2]
[1]LaboraXpert Ltd., Sofia, Bulgaria, alexandar.krumov@laboraxpert.org
[2]Space and Solar-Terrestrial Research Institute, Bulgarian Academy of Sciences
corresponding author: vassilev@stil.bas.bg

The preservation of the biological environment on our planet is one of the most important contemporary goals of the humanity, guaranteeing the existence and the evolution of our civilization. This problem especially concerns the vegetation ecosystems, which are of the most significant components of the terrestrial biosphere. The outbalance of these ecosystems could lead to catastrophic consequences for the Earth. Such dangers cause the growing interest in search for more effective and more reliable technologies for remote sensing monitoring of the global vegetation systems.

The commonly existing methods for remote sensing of the vegetation bio-activity, based on measurement of reflected solar radiation in visible and near infrared spectral ranges, do not yet allow development of technologies for collecting reliable information about the plant bio-status. In these methods, the reflectance signatures are used to discriminate the vegetation from other objects or used as indicators for long-term stress on the vegetation when the chlorophyll content is significantly reduced.

A new concept for vegetation monitoring is in the focus of the remote sensing methodologies in the recent years. These new approaches are based on the well studded during the last several decades relation between the chlorophyll fluorescence intensity and the photosynthesis activity. Extensive experimental and theoretical studies in laboratory and field conditions have demonstrated that the vegetation fluorescence can be successfully used as a highly informative instrument for assessment of the plant vitality. It was also shown the possibility the fluorescence signal to be detected from space orbits. As a result, a new important scientific project called “Fluorescence Explorer (FLEX) mission” was included in the Earth Observation Program of the European Space Agency (ESA), which is close related with the GMES Program. However, the extension of the passive fluorescence measurement techniques to applications from space is very difficult task. This innovative method still needs additional R&D efforts which would allow adequate interpretation of fluorescence data variations. Many factors that are playing significant role in the plant photosynthetic process still need to be evaluated – season/weather changes, natural conditions as heat, moisture, light exposure, plant species differences, anthropogenic influence etc. There are still many unknowns related to the measurement, analysis and exploitation of natural fluorescence, which require essential theoretical and experimental ground-based, in-situ studies, supported with highly informative, accurate and reliable methods and instrumentation.

In this relation, the presented poster provides information about the capacity of the Videometric and Optoelectronic Research Group at the Space and Solar-Terriestrial Research Institute of the Bulgarian Academy of Sciences, in cooperation with LaboraXpert Ltd., for large scale investigations of plant fluorescence in on-ground conditions, using conventional and designed by the authors specialized instrumentation. These studies include the assessment of the influence of various natural and anthropogenic factors on vegetation fluorescence by simulation in laboratory environment with defined parameters, where the biological condition of the plant samples is registered by their fluorescence emission and additional spectral reflectance imaging methods. Fluorescence images illustrating the impact of different stressors on the plant bio-status are included in the poster.

The accumulated experience in the group in plant fluorescence imaging could be useful for adequate interpretation of fluorescence emission data acquired at future earth monitoring missions from space, and for developing of new, high-effective early warning technologies for remote sensing of vegetation ecosystems.