Peatlands are one of the world's most important ecosystems because they serve as enormous storage of carbon. However, the remoteness of a majority of peatlands and their difficult terrain make them very challenging to study. Therefore, remote sensing is a welcomed help in monitoring and understanding the peatland vegetation. Although significant progress in remote sensing of peatlands has been made in the last years, new signals, like Sun-Induced Fluorescence (SIF), are getting more important and need to be incorporated in peatland monitoring. Unlike widely used reflectance-based vegetation indices (VIs), SIF uses the light emitted by plants to examine the physiological status of plants. That makes it more suitable to assess the impact of stress on plants. Despite few species can grow in the waterlogged, low pH, and low nutrient content conditions of peatlands, the spatial heterogeneity of vegetation is huge. In addition, the vegetation consists of two distinct layers: mosses and vascular plants, which have different morphology and physiology; hence reflectance and SIF emission properties differ. To understand the reactions of different plants to climatic variables, we first need to know their contribution to remotely sensed parameters throughout the year. The reflectance of various peatland inhabiting species and SIF of peatland communities have been examined, but the one-day studies are not enough for all-year-round monitoring. The best way to obtain information about the plants' physiology from reflectance and SIF is through radiative transfer models (RTMs) inversion. In this way, we can model photosynthetic activity or stress-related processes from the spectrum of light reflected by plants. However, utilization of RTMs for mosses, which are the most important plant functional group (PFG) of peatland vegetation, is very challenging, as RTMs are developed for vascular plants, which have different morphology and physiology. Thanks to the novel approach proposed in this project, **the use and reliability of** two very advanced RTMs, Soil-Canopy Observation of Photosynthesis and Energy (**SCOPE**) **and** multi-layer SCOPE (**mSCOPE**) **for peatland mosses can be tested for the first time**. To improve and verify the models, data about different species and PFGs must be collected. Yet, the data about the SIF and reflectance-based vegetation indices (VIs) from single species or PFG canopy cannot be obtained from natural vegetation as there are not big enough patches of single species or PFG in nature. Therefore, a **new approach, based on growing monocultures of individual species and PFGs**, is proposed in this research proposal to estimate the contribution of canopy level SIF and VIs of different PFGs to mixed vegetation signals and to obtain data for reliable verification of models. Additionally, chlorophyll content and leaf-level chlorophyll fluorescence-based parameters will be measured **to correlate the physiological status of plants with** remotely sensed signals (**SIF and VIs**). Thanks to this combination of techniques, we will be able to understand not only **species contribution to mixed vegetation canopy signals but also the dependency of each PFG's SIF and VIs on plant physiology**. However, remotely sensed signals (SIF and VIs) measured from PFG monocultures may differ from the signals from the same PFG growing in the mixed canopy due to competition, shading, or different nutrient availability. To address this issue, we will make use of a very sophisticated automatic phenotyping platform, which makes it possible to measure reflectance and chlorophyll fluorescence and calculate VIs and photosynthetic parameters from single points as well as an average of whole vegetation. In this way, we will be able to measure **VIs from PFGs grown in mixed vegetation and compare them with monocultures**. To our best knowledge, this will be **the first time when automatic phenotyping is used for peatland vegetation**. Automatic ecosystem phenotyping, in general, is very unusual due to the large dimensions of plants in many ecosystems and the lack of suitable infrastructure. The advantage of peatland vegetation is that the plants are of small dimensions, and species with very different physiology and morphology coexist in a small area. Therefore, it is a perfect model ecosystem for automatic ecosystem phenotyping. **The proposed research will contribute to development of automated phenotyping in controlled environmental conditions for peatland vegetation.**