Air pollutant concentrations in cities can be very high due to the heavy traffic load. Also, these concentrations vary on a small scale due to differences in traffic density, street lay-out and the surrounding land uses, leading to local hot-spots for air pollution. Some emitted compounds as nitrogen dioxide (NO2) and ammonia (NH3) can be taken up by tree leaves. Biomonitoring of morphological, anatomical, physical and physiological leaf properties are able to represent the way trees react to their specific environment. Leaf characteristics such as the spectral signatures and chlorophyll fluorescence give information about the physiological status of the leaf and can be measured at the leaf as well as the canopy level. In the BIOHYPE project, the overall objective to develop, test and validate a passive biomonitoring methodology based on measurements at three scales in urban areas: microscopic leaf properties, macroscopic leaf properties and tree crown properties, the last obtained from airborne hyperspectral observations which were acquired with CASI-1500 (VNIR) and AHS (SWIR and TIR) sensors during a first field campaign in Ghent, Belgium. At ten locations with a contrasting traffic impact a multi-scale data set was collected which will allow to assess the effects of urban pollution on trees by studying the propagation of fluorescence and reflectance properties from a single leaf, through a single crown, towards canopy level. On these sites, NO2 and NH3 were measured cumulated over one month by passive diffuse samplers. From several trees at each site, leaves were collected and spectral reflectance and transmittance measurements were performed with the ASD fieldspec and ASD leaf clip. From preliminary results, an impact of atmospheric nitrogen load, indicated by the passive sampler measurements, can be suggested at the leaf level. Some spectral indices will be evaluated to investigate the interaction between atmospheric NO2 and NH3 on one side and chlorophyll and nitrogen leaf content on the other side. In this way, we want look if leaf spectral characteristics can differentiate areas with contrasting nitrogen pollution emissions within a city environment.

Towards Archaeologically Interesting Hyperspectral Sampling

Geert J Verhoeven, Michael Doneus
Ludwig Boltzmann Institute, Austria

To date, the archaeological potential of airborne imaging spectroscopy is quite limited due to the generally insufficient Ground-Sampling Distance (GSD) during data acquisition. Although the common GSD of about 2-3 m might be sufficient for ecological or hydrological studies, airborne hyperspectral data useful for archaeological studies should have a limit of spatial resolution of at least 50 centimeters or less. The acquisition and technical processing of such data for archaeological aims is one of the key research lines of the recently found LBI for Archaeological Prospection and Remote Sensing (Vienna). After a short introduction onto this newly established LBI and its aims concerning archaeological airborne hyperspectral scanning, this presentation wants to focus on the first hyperspectral data sets that were flown with specific archaeological use in mind. Because they are characterised by a GSD between 65 cm and 40 cm, the spatial resolution of these data starts to become comparable with the results gained by digital airphoto coverage. Some real-world examples will highlight the information that can be extracted from such datasets, while some hints for future improvements will conclude this presentation.

Inversion of a radiative transfer model applied to hyperspectral imagery to predict chlorophyll concentration in a mangrove forest

Loise Wandera, Wout Verhoef, Martin Schlerf, Anas Fauzi, Andrew K. Skidmore
University of Twente/ITC

Inversion of radiative transfer models to retrieve plant biophysical and biochemical characteristics is an advanced remote sensing application in vegetation studies. However, the success of the inversion depends on a number of factors including the choice of model and the inversion strategy. In this study we use the Soil-Leaf-Canopy (SLC) model (Verhoef & Bach, 2007) to simulate Top of Canopy (TOC) reflectance. The SLC model integrates three sub models for the soil, for leaves and the canopy .Thus, its simulations of the reflectance at the TOC is very close to what would be observed in reality by the sensor at the TOC after eliminating the effect of the atmosphere. In the inversion process we apply a mosaic of hyperspectral images that have been geocoded and corrected to TOC reflectance. The aim of this study is to exploit the potential of coupling a hybrid radiative transfer model with hyperspectral imagery for the inversion process in order to predict chlorophyll concentration in a mangrove forest. The study area is in the East Kalimantan Province in Indonesia, consisting of two different mangrove forests of which one has been exposed to high levels of human activities while the second one is still considered to be in a pristine state. We expect different levels of foliar nutrients in the two different mangrove ecosystems for which leaf chlorophyll could be an indicator.

Estimation of leaf area index and chlorophyll content in grassland at MERIS level using the PROSPECT+SAIL model

Si Yali, Martin Schlerf, Andrew K Skidmore, Raul Zurita-Milla, Tiejun Wang
University of Twente/ITC

Accurate estimates of grassland properties are important for the understanding of the movement of migratory birds, as well as the potential role of migratory birds in infectious avian diseases. Due to the high spectral resolution, moderate spatial resolution and a three-day repeat cycle, the Medium Resolution Imaging Spectrometer (MERIS) is a promising sensor for measuring grassland leaf area index (LAI) and chlorophyll content. However, the multi-biome MERIS land products have limited consistency with in-situ measurements of LAI, while the multi-biome canopy chlorophyll content (CCC) has not been validated using in-situ data yet. This study proposes a single-biome approach using the inversion of PROSPECT+SAIL model to estimate grassland LAI, leaf chlorophyll content (LCC) and CCC from MERIS reflectance. Both multi-biome and single-biome approaches were validated using multi-season in-situ data sets. The single-biome approach showed a consistently better performance for estimating LAI (R2=0.70, RMSE=1.06, NRMSE= 17%) and CCC (R2=0.60, RMSE=0.36, NRMSE=22%) compared with the multi-biome approach (LAI: R2=0.36, RMSE=1.77, NRMSE=28%; CCC: R2=0.47, RMSE=1.33, NRMSE=84%). However, both single-biome and multi-biome approaches failed to retrieve LCC. The multi-biome LAI was overestimated at lower LAI values (< 2) and saturated at higher LAI values (ΓÊÑ 4), and the multi-biome CCC was consistently overestimated through the whole data range. Our results underline the potential of accurate estimation of grassland LAI and CCC at the MERIS level using the inversion of the PROSPECT+SAIL model.

Derivation of forest biodiversity parameters with imaging spectroscopy data

Anne Clasen, Michael Foerster, Birgit Kleinschmit
TU Berlin

The presented project aims at developing methods for aerial imaging spectroscopy and simulated EnMAP satellite data analysis in context with the acquisition of forest biodiversity indicators. It is part of the joint research project "ForestHype" that concentrates on the derivation of forest parameters such as tree species, biomass, vitality, biodiversity and silvicultural indicators for a range of different forest types. This paper focuses on woodlands in floodplains and wetlands which are an important source of biodiversity and are preserved by national as well as international directives.

The study site is situated within the Demmin test site for calibration and validation of remote sensing missions in the north eastern part of Germany. This location combines the advantage of an existing agro-meteorological network and the good availability of additional data.

In the course of this project the relation of the imaging spectroscopy signal and the biochemical and biophysical state of plants and plant communities are to be investigated closely by means of statistical classification methods like Support Vector Machines and Random Forest and by a combined geometric-optical and radiative transfer modeling. HyMap-data from the 2009 field campaign (20.08.2009) will be used for this purpose.

A stationary crane above the canopy will help providing detailed spectral and chemical information throughout the phenological course of the year. This data serves as input for the combined geome-tric-optical and radiative transfer modeling of the complex multi-layered canopy of forests as well as for the inversion of the model. A well calibrated model is the basis for the extraction of a number of forest parameters which might not be directly derivable from remote sensing data.