Tracking forest seasonal physiology using Hyperion images for a boreal forest in central Finland

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Seasonal physiological changes regulate the growth and productivity of the forest.

Physiological indicators:
Physiological processes at different scales

- Forest structure (Tree heights, diameters of the crowns, DBH)
- Leaf Area Index
- Pigment composition (Cab, Car)
- Cycling pigment dynamics (*xanthophylls*)
- Fluorescence
- Photosynthesis
- Light Use Efficiency
Remotely sensed spectral bio-indicators to analyze seasonal changes in boreal forest.

Narrow band vegetation indices (VIs): quantifying biophysical and biochemical vegetation parameters from VIs.
The main objective of this research was to evaluate the annual seasonal changes based on *in situ* physiological measurements and different narrowband spectral vegetation indices related with the physiological condition of the vegetation, taking into account the potential influence of forest structure, species and composition.
Material and Methods

Study site:

The study area is located at SMEAR II Station in Hyytiälä, southern Finland (61°51’N, 24°18’E).

Meteorological data (Air temperature, air humidity, PAR)

Carbon fluxes rates at the shoot level.

Pigment composition.

Forest inventory: canopy structure and LAI, the total of plots was 63, covering different boreal forest stand structure and species composition (Scots pine (Pinus silvestris L.), Norway spruce (Picea abies L.) and birch (Betula pendula Roth).
### Material and Methods

**Hyperion data acquisition and processing:**

#### Level 1 B HDF Hyperion image (242 bands)

#### Destriping Desmile

#### Atmospheric Correction

#### Geocorrection

#### Hyperion 196 band HDRF georeferenced image

<table>
<thead>
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<th>DOY</th>
<th>Time</th>
<th>Day</th>
<th>Month</th>
<th>Year</th>
<th>Solar Azimuth</th>
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<th>Look angle</th>
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*Backscattering
Narrowband vegetation indices and time series analysis:

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<tr>
<th>Ecophysiological variable</th>
<th>Vegetatio Index</th>
<th>Formulation</th>
<th>Reference</th>
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<tr>
<td>Chlorophyll content estimation</td>
<td>CI</td>
<td>p752/ p711</td>
<td>Zarco-Tejada et al. 2004</td>
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<td>Carotenoids content estimation</td>
<td>SR&lt;sub&gt;Car&lt;/sub&gt;</td>
<td>p569/ p518</td>
<td>Hernández-Clemente et al., (2012)</td>
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<td>Xanthophyll cycle</td>
<td>PRI&lt;sub&gt;570&lt;/sub&gt;</td>
<td>(p529- p569)/( p529+ p569)</td>
<td>Gamon et al. 1997</td>
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<td>Fractional Vegetation Cover (FVC)</td>
<td>NDVI</td>
<td>(p864- p671)/( p864+ p671)</td>
<td>Rouse et al. (1974)</td>
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Results

NDVI

DOY 125  DOY 153  DOY 161  DOY 192  DOY 210

Red edge

DOY 125  DOY 153  DOY 161  DOY 192  DOY 210
- A better understanding of both physiological indicators and the spectral vegetation indices (VI) variations during the year is needed in order to evaluate seasonal changes based on remote sensing data.

- There is a wide range of remotely sensed physiological variables sensitive to variations produced during the growing season.

- The dynamic in biochemical indicators are linked to some narrowband vegetation indices as CI, SRCar, and PRI, and therefore, it may have potential in determining growing season length.

- Mapping chlorophylls, carotenoids and xanthophyll’s cycle using narrowband vegetation indices derived from Hyperion images may contribute to a better understanding of seasonal variations in boreal forest.
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THANKS!!

KIITOS!!