Title: Mapping Poaceae grasses with MODIS

Goal: Map palatable grasses in Mongolian steppe using moderate resolution imagers like MODIS

Objectives:

1) Determine method to isolate Poaceae grasses from soil, forbs, and shrubs
2) Develop method to predict Poaceae grasses coverage from mixel-assumed in-situ spectral signals

Methods:

Exploit spectral information content of multispectral reflectance data via the development of band ratios/veg. indices based on field spectroscopy.

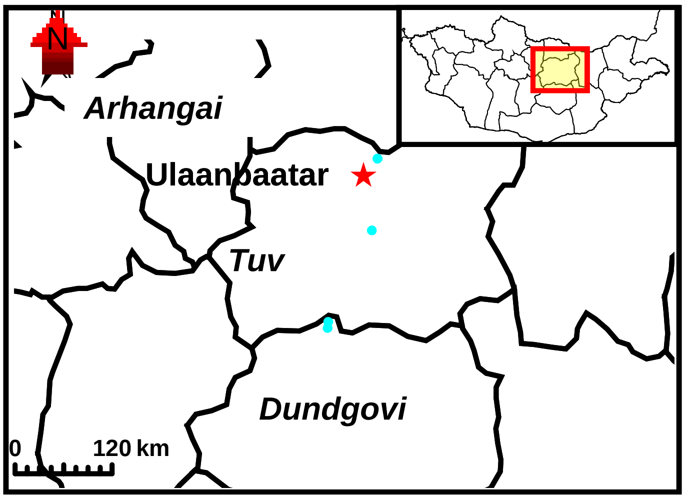


Fig.1. Mongolian grassland study site locations.

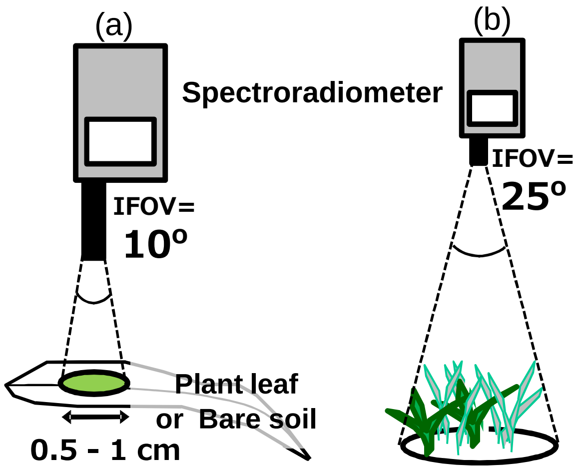


Fig. 2. Schematics of nadir radiometry (a) individual plant leaf or bare soil (pure pixel) and (b) in situ land surface (mixel).

Poaceae Intensity Index (PII)

$$PII = \frac{1}{\sqrt{2}}\left(NGBDI - NGRDI - NNBDI + NDVI\right)$$

Where,

$NGBDI = (R_{green} - R_{blue}) / (R_{green} + R_{blue})$

$NGRDI = (R_{green} - R_{red}) / (R_{green} + R_{red})$ (cf. Hunt et al., 2005)

$NNBDI = (R_{nir} - R_{blue}) / (Rnir + R_{blue})$

$NDVI = (R_{red} - R_{nir}) / (R_{red} + R_{nir})$

R_{blue}, R_{green}, R_{red} and R_{nir} are reflectance in blue, green, red and near-infrared bands, respectively

Results (pure pixel analysis):

1) Poaceae grass is characterize by larger values in both (NGBDI - NGRDI) and (NNBDI - NDVI).
2) Poaceae Intensity Index (PII) was demonstrated to be a good metric for Poaceae grass detection from the pure spectral signals.

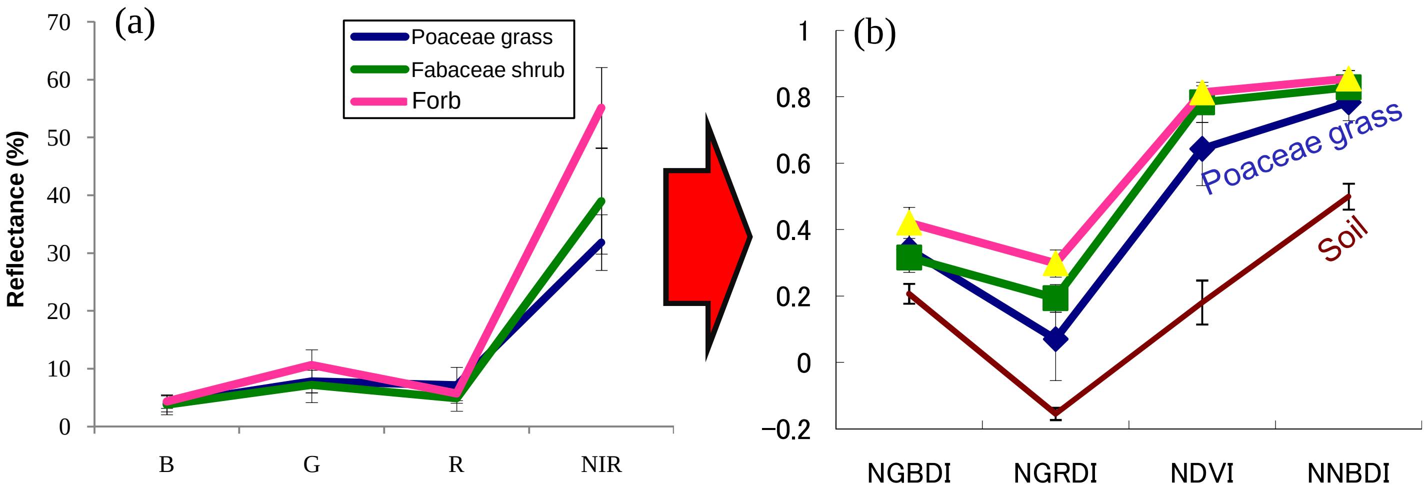


Fig. 3. Curves of (a) reflectance vs. spectral band and (b) normalized difference indices for plant leaves and soil surface.

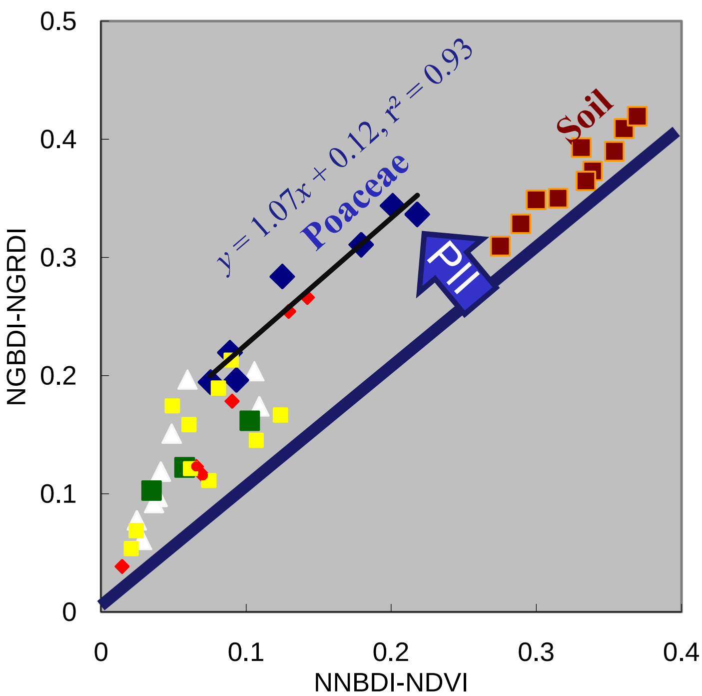


Fig. 4. Image of Poaceae Intensity Index (PII) in the space of (NGBDI - NGRDI) vs. (NNBDI - NDVI).

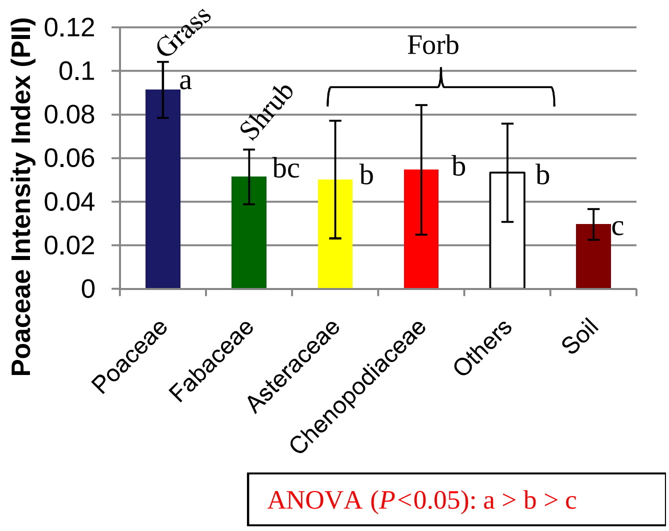


Fig. 5. Poaceae Intensity Index (PII) for each plant type or soil surface. Letters illustrated by the box indicate the result ANOVA with post hoc test. The same letters are not significantly different at the P<0.05 significance level.

Results (mixel analysis):

3) The adequacy of PII for separating Poaceae grass was lower (Coverage estimation r^2=0.21 and 0.48 for over all and veg. cover > 80%, respectively) for in-situ spectral data, that was contaminated by other spectral signals..

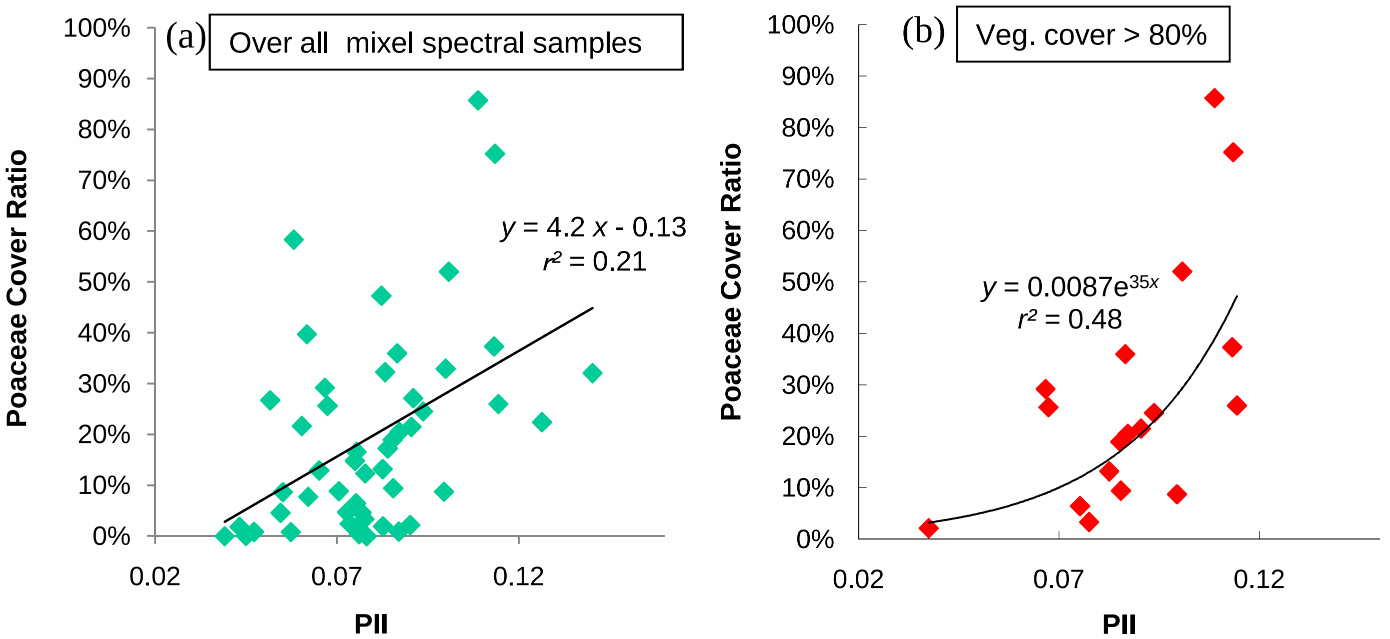


Fig. 6. Plotted measured in-situ data values for (a) over all samples and (b) those modified only the vegetation exceed 80% in coverage.

Conclusions:

- Developed new index (PII) can be used to detect Poaceae grass spectral signals.
- Mixels are a problem; further research is needed.

Perspective:

- Applying of Un-mixing method [e.g., Pattern Decomposition Method (Muramatsu et al., 2000)] to the NDI curves.

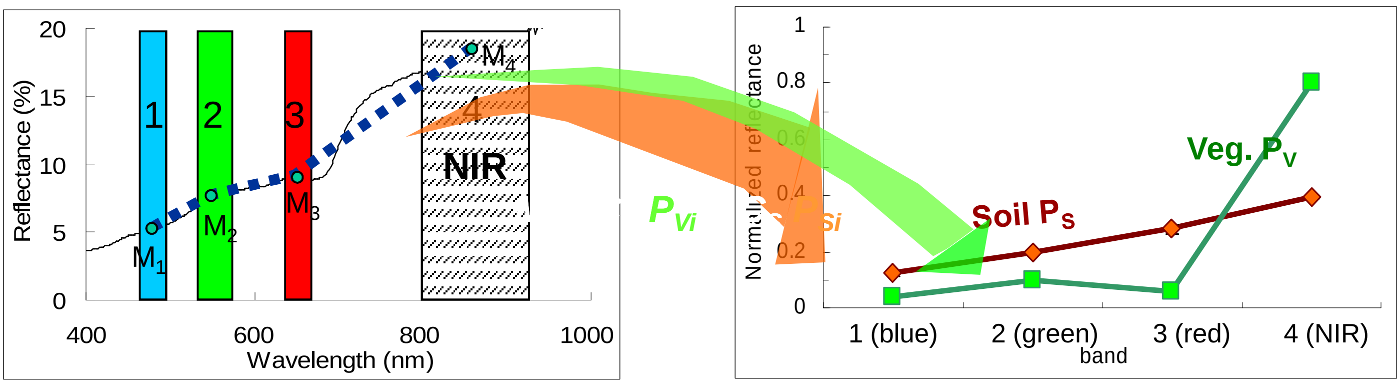


Fig. 7. Conceptual image of Pattern Decomposition Method (Un-mixing of soil and veg.)

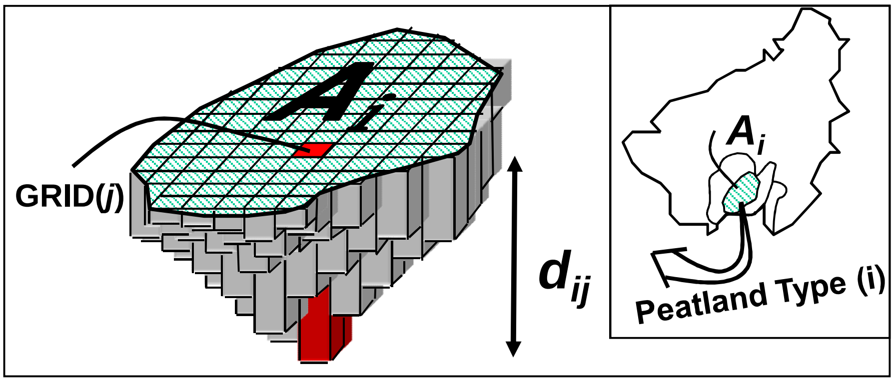
Title: <u>Mapping Peat Swamp Forests with AVHRR</u>

Goal: Provide accurate carbon (C) mass distribution map of Peat Swamp Forests (PSF) in Kalimantan, Indonesia in order to evaluate the importance of the PSF conservation and management.

Objective: Derive an operational methodology to predict the thickness of peat layer in tropical PSFs at a regional scale.

Methods:

Exploit phenological characteristic contents as an implication of peat thickness standing on the hypothesis that vegetation on the shallower peat effects more hydrological stress than that on the deeper peat layer.



$$TC = \sum_{i=1}^{n} A_i \sum_{j=1}^{m} d_{ij} \sum_{k=1}^{l} CD_{V\,ijk}$$

$$CD_V = BD\ CC$$

TC	: Carbon Pool
A	: Peatland Area
d	: Peat Thickness
BD	: Bulk Density
CC	: Carbon Content
CD_V	: Carbon Density (at unit volume)

Fig. 8. Scheme and equation to estimate carbon mass (TC) at a regional scale.

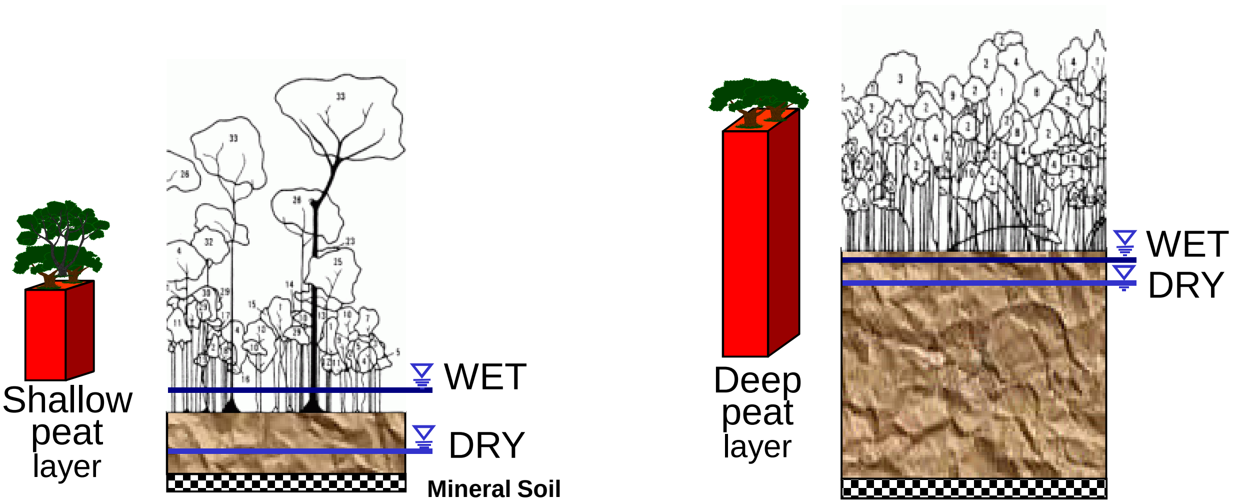


Fig. 9. Hypothesis scheme of the difference in the hydrology between shallow (left) and deep (right) peat layers.

$$\mathrm{TAVI} = \frac{\mathrm{NDVI}}{\mathrm{T_S}} \times 100 \quad \begin{cases} \mathrm{NDVI} = \dfrac{\mathrm{NIR} - \mathrm{Red}}{\mathrm{NIR} + \mathrm{Red}} = \dfrac{Ch2 - Ch1}{Ch2 + Ch1} \\[2ex] \mathrm{T_S} = \dfrac{[\mathrm{T}_{Ch4} + 3.3(\mathrm{T}_{Ch4} - \mathrm{T}_{Ch5})](5.5 - \varepsilon_{Ch4})}{4.5 - 0.75\mathrm{T}_{Ch4}(\varepsilon_{Ch4} - \varepsilon_{Ch5})} \end{cases}$$

Results:

1) The peat swamp forest of Central Kalimantan was classified into six major phenology types from the fluctuation pattern of TVI over three seasonal periods (WET1, WET2, DRY).
2) The classified map of phenology types was found to be a good indicator (RMSE=2.66 m) to estimate the thickness of the peat layer.
3) A rough estimate map of the peat volume distribution can be derived by assigning the mean peat thickness value associated with each phenology type, and the estimated C mass was estimated to be 3.5 Gt / 1.9 Mha over the PSFs in Central Kalimantan region.

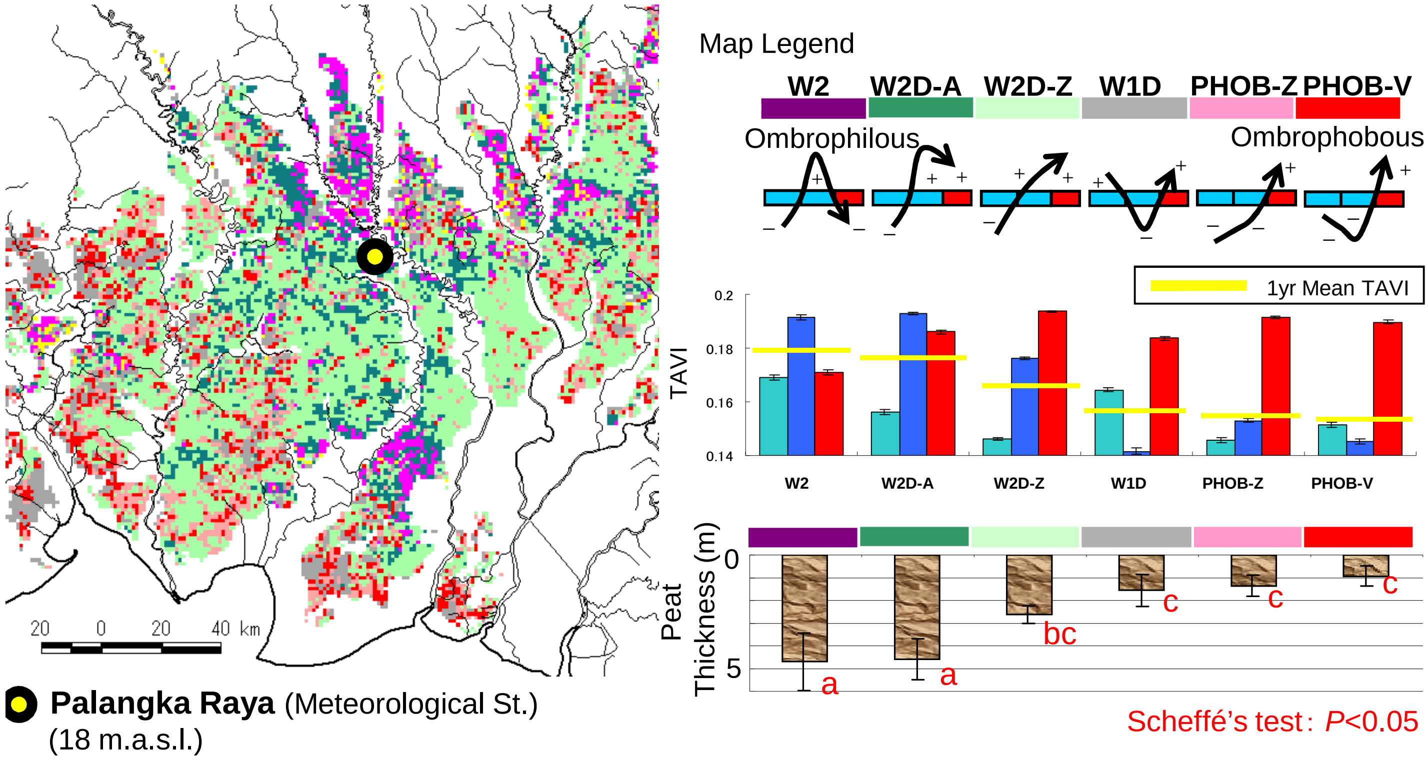


Fig. 10. Classified map of phenology types within the peat swamp forests (left) and the mean peat thickness value for each phenology type (bottom right). The results that the ombrophobous forest type tends to occur on shallower peat while relatively ombrophilious forest type occur on thicker peat layer supported the hypothesis of this study.

Conclusion:

- Phenological characteristics of peat swamp forests from multi-temporal remote sensing data can be used as the predictor of the peat thickness.