PROSPECT-PRO: a leaf radiative transfer model for estimation of leaf protein content and carbon-based constituents

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Introduction

• Monitoring leaf nitrogen content (N) is key for applications in agriculture and ecology
• Leaf chlorophyll content is used as proxy for N when using remote sensing, while leaf protein content appears as more relevant for N monitoring
• Increasing availability of imaging spectroscopy from proximal sensors to satellites: access to leaf constituents otherwise unreachable

➔ We developed a new version of the leaf model PROSPECT splitting leaf dry matter (LMA) into proteins and carbon-based constituents (CBC)

Calibration

• Calibration & validation samples selected from fresh & dry samples of the LOPEX dataset (50/50)
• Calibration designed to distribute the absorption from leaf dry matter between proteins and CBC

➔ Specific absorption coefficients show expected absorption features

Identifying optimal spectral domain

• Estimation of LMA improved when using spectral subdomains [1]
• We identified which spectral subdomains result in optimal estimation of leaf proteins and CBC

Proteins: from 2125 to 2175 nm
CBC: from 2025 to 2350 nm

Validation: estimation of leaf protein content, C/N ratio & compatibility with PROSPECT-D

➔ Accurate estimation of leaf proteins and CBC for both fresh and dry samples
➔ Accurate estimation of Carbon / Nitrogen ratio from fresh & dry leaves
➔ Improved estimation of LMA computed from PROSPECT-PRO inversion

Conclusions

• PROSPECT-PRO is able to accurately estimate leaf protein content and CBC from leaf optics in the SWIR domain, for both fresh and dry leaves
• PROSPECT-PRO is fully compatible with PROSPECT-D: no decrease in performances when computing LMA = Proteins + CBC
• PROSPECT-PRO is able to accurately estimate C:N ratio of vegetation based on the CBC: Proteins ratio
• A manuscript has been submitted to RSE [2] and the new version of the model is available here: https://gitlab.com/jbferet/prospect_pro_matlab
• A new R package prospect to be released soon, including latest versions, inversions procedures and more: https://jbferet.gitlab.io/prospect/

References


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