Comparison of different sensing technologies to estimate LAI of managed grassland

Klingler A.[1], Schaumberger A.[2], Vuolo F.[3] and Poetsch EM.[2]

[1]DNW, BOKU-Vienna, Gregor-Mendel-Straße 33, A-1180 Vienna
[2]AREC Raumberg-Gumpenstein, Raumberg 38, A-8952 Irdning
[3]IVFL, BOKU-Vienna, Peter-Jordan-Straße 82, A-1180 Vienna

Introduction: Climate change induced shifts of grassland growth dynamics require comprehensive monitoring to support optimal grassland management. Leaf Area Index (LAI) represents one of the most promising biophysical remote sensing parameter to monitor grassland (Darvishzadeh et al., 2008). The objective of our study is to compare LAI time series of managed grassland derived from the earth observation satellite Sentinel-2 (S2), along with LAI from hyperspectral reflectance (HR) acquired by a field spectrometer (HandySpec/tec5) and in situ measurements from the AccuPAR LP-80.

Materials and methods: Sixteen HR measurements and twenty-four AccuPAR readings are obtained weekly at each of three subareas (20 x 20 m) within a cultivated grassland-field (4.6 ha) with four cuts per year. During the campaign, twenty-two cloud-free S2 images were acquired for the study site. The pre-processed images and products are downloaded from the 'Sentinel-2 value adder' (Vuolo *et al*., 2016). LAI from HR is calculated by a neural net algorithm with fixed weights using an eight band combination together with sun position information. This procedure is identical to the LAI calculation from S2 reflectance data.

Results: The Pearson correlation coefficient (*r*) between S2-LAI and HR-LAI *is 0.97 ($P < 0.001$)*, indicating a very strong positive linear relationship. Between S2-LAI and AccuPAR-LAI *($r = 0,88, P < 0.001$)*, as well as between HR-LAI and AccuPAR-LAI *($r=0,84, P < 0.001$)*, a slightly lower but still high correlation can be observed. In advanced growth stages the AccuPAR-LAI tends to increase stronger and subsequently saturates due to consistent low photosynthetically active radiation below the canopy (Figure1).

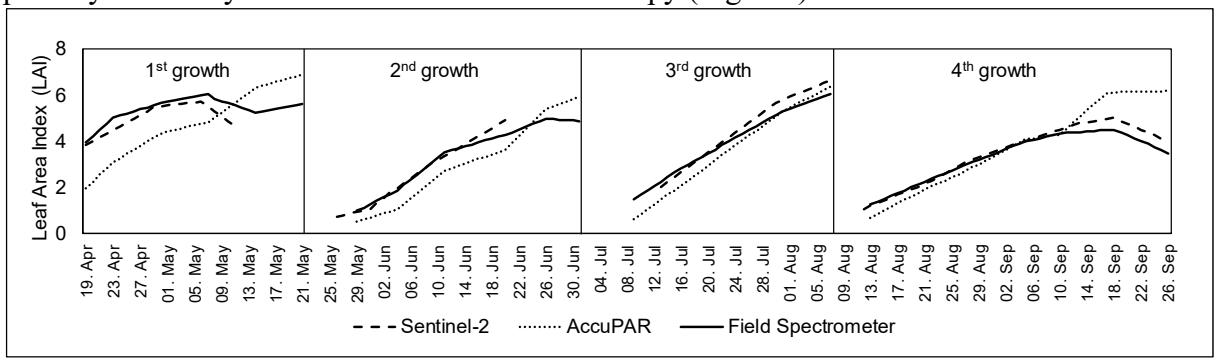

Figure 1. Development of LAI derived from different sensors for each cut in 2018

Conclusion: We conclude that LAI time series of managed grassland from all three sensors are highly correlated, especially at early growth stages. Our findings are of increasing importance regarding the applicability of different LAI sources for grassland monitoring.

Vuolo F., Żółtak M., Pipitone C., Zappa L.; Wenng H., Immitzer M., Weiss M., Baret F. und Atzberger C. (2016) Data Service Platform for Sentinel-2 Surface Reflectance and Value-Added Products: System Use and Examples. *Remote Sensing* 8 (11), 938, 16p.
Darvishzadeh R., Skidmore A., Schlerf M., Atzberger C., Corsi F. und Cho M. (2008) LAI and chlorophyll estimation for a heterogeneous grassland using hyperspectral measurements. *ISPRS Journal of Photogrammetry and Remote Sensing* 63 (4), 409-426.