# Monitoring of solar radiation interception in mountain grasslands from Sirnea village, Romania

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## Introduction

- Aerial dry matter accumulation (ADM) and qualitative parameters of forage are directly correlated to the amount of photosynthetically active radiation intercepted (PARi) by the canopy of species (Monteith 1977). Interception of light in homogeneous canopies is influenced by the leaf area index (LAI), the leaf area positioning (canopy layers) and absorption characteristics of the species (Campbell and van Evert 1994). Higher position of leaf layers determines increased rates of radiation absorption and reflectance compared to those located below them (Dunea and Dinca 2015). The light absorption characteristics of species depend on optical properties, thickness and goniometric distribution of leaves (McCree 1972). The leaf area distribution determines the amount of radiation absorbed per canopy unit of leaf area. McCree (1972) showed that planophile leaf species (e.g., legumes) capture light more efficiently than erectophile canopies (e.g., perennial grasses). However, the canopy photosynthetic efficiency will be significantly higher in erectophile than in planophile canopies at similar absorption rates of photosynthetic photon flux densities (PPFD) – quantum flux density. It is the number of photons in the 0.4-0.7 μm waveband incident per unit of time on a unit of surface (Varlet-Grancher et al. 1989).
- The study aims to establish some patterns of PAR interception in the *Agrostis capillaris* grasslands in various conditions of nebulosity.

## Material and Methods

- Fundata village administrative territory has an average altitude of 1199 m, and the grasslands occupy 2358 ha, representing 72% of the total area. Sirnea is a village of Fundata.
- Photosynthetically Active Radiation (PAR) was measured on-site with a Delta-T beam fraction sensor connected to a laptop to assess the light fluxes in the *Agrostis capillaris* grasslands canopies from Sirnea village (fig.1).

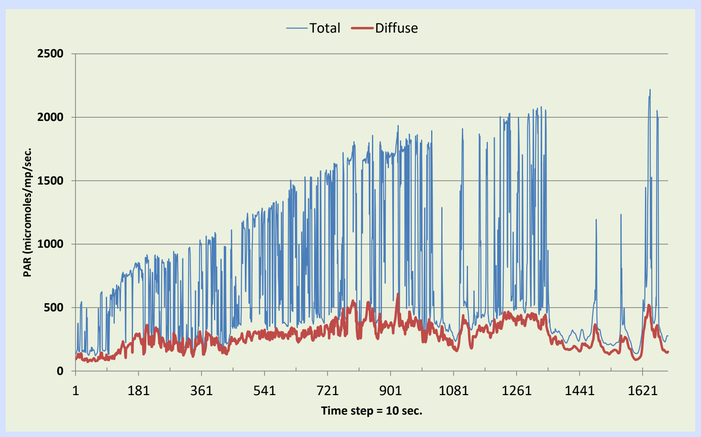
## Results

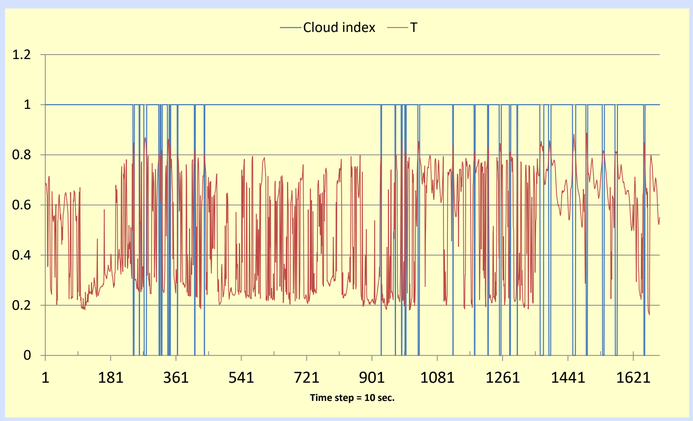
### PAR data collection

- Interception of light in *Agrostis* grassland canopies is presented for a 4 hours interval acquired between 10 a.m. and 2.00 p.m on 15 july 2018.

Figure 1. Beam fraction sensor (BF2) for PAR multilayer measurements (μmol $m^{-2}$ $s^{-1}$) in the canopy

| *Statistical indicator* | *Total PAR* | *Diffuse PAR* | *Cloud index (1=sun)* | *T* |
|---|---|---|---|---|
| Average | 716.9 | 272.2 | 0.9 | 0.5 |
| Median | 492.6 | 269.8 | 1.0 | 0.6 |
| Standard Deviation | 532.7 | 102.4 | 0.2 | 0.2 |
| Coeff. of Variation | 74.3 | 37.6 | 24.1 | 42.6 |
| Skewness | 1.0 | 0.2 | -3.9 | -0.1 |
| Kurtosis | -0.2 | -0.4 | 13.3 | -1.6 |
| Minimum | 121.5 | 72.0 | 0.0 | 0.2 |
| Maximum | 2219.8 | 609.1 | 1.0 | 0.9 |
| Range | 2098.3 | 537.1 | 1.0 | 0.7 |




### Solar radiation interception equations

Table 1. Main relations used to estimate the radiative balance in crop canopies (modified after Varlet-Grancher et al. 1989) - **I = EPAR or QPAR.*

| Indicator | Solar Radiation (*I*) |
|---|---|
| Incident radiation | $I_0$ |
| Transmitted radiation from canopy to soil | $I_t$ |
| Reflected radiation from the soil-canopy assembly | $I_r$ |
| Reflected radiation from soil | $I_{RS}$ |
| Absorbed radiation in the canopy | $I_a = I_0 - I_r - I_t + I_{RS}$ |
| Intercepted radiation in the canopy | $I_i = I_0 - I_t$ |
| Coefficient of radiation transmission in the canopy | $T = I_t / I_0$ |
| Reflectance of soil under the canopy | $I_s = I_{RS} / I_t$ |
| Efficiency of solar radiation absorption | $\varepsilon_a = 1 - I_0 - T + I_s \times T$ |
| Efficiency of solar radiation interception | $\varepsilon_i = 1 - T$ |

## Grassland typology

- The typology of grasslands in the area includes: *Agrostis capillaris* types including some subtypes such as: +various mesophile species, +*Brachypodium pinnatum*, +*Elymus hispidus*, +*Rhinanthus alectorolophus*, and +*Vulpia myuros*; *Agrostis capillaris* + *Festuca rubra* type; *Festuca rubra* type; *Festuca rubra* + *Nardus stricta* type; and *Nardus stricta* type.






**All photos were made by the authors © 2018*

## Conclusions

- Higher position of leaf layers determines increased rates of radiation absorption and reflectance compared to those located below them.
- The light absorption characteristics of species depend on optical properties, thickness and goniometric distribution of leaves.
- The leaf area distribution determines the amount of radiation absorbed per canopy unit of leaf area.

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