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# A Simplified Grass Growth Model for Pasture Biomass Assessment

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## Introduction

In order to optimize pasture management, farmers need specific support in monitoring and predicting vegetation growth at a daily time scale. In this regard, simulation models proved to be an effective tool for understanding and predicting biophysical processes of rangelands. Nevertheless, the complexity of process-based models can hinder their wide application. Therefore, the development of simplified models can represent a valuable option for grazing system management.

The aim of this work is to present the first results of a developed simplified model (VISTOCK model) for grassland aboveground biomass simulation, based on process-based algorithms and remote sensing data requiring a minimum number of inputs.

## Materials and Methods

The VISTOCK model simulates daily dry matter production and biomass of grassland with few weather and soil inputs integrated with NDVI data (from Sentinel-2) for LAI estimation. Potential aboveground dry matter production, simulated from the fraction of photosynthetically active radiation intercepted by grass cover, is rescaled to the actual value ($ADM_{daily}$) considering thermal limitation and water stress. Simulations of biomass (B) at day n consider the difference of LAI ($DELTA_{LAI}$) between day n and n-1 as it follows:

$$\text{If } DELTA_{LAI} > 0 \qquad B_n = B_{n-1} + ADM_{daily}$$

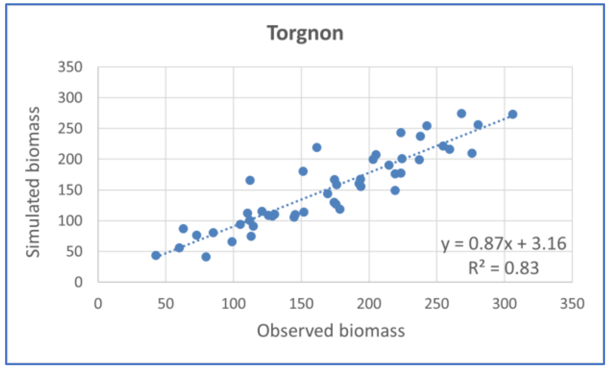
$$\text{If } DELTA_{LAI} < 0 \qquad B_n = B_{n-1} + B_{n-1} \cdot (DELTA_{LAI}/LAI_{n-1})$$

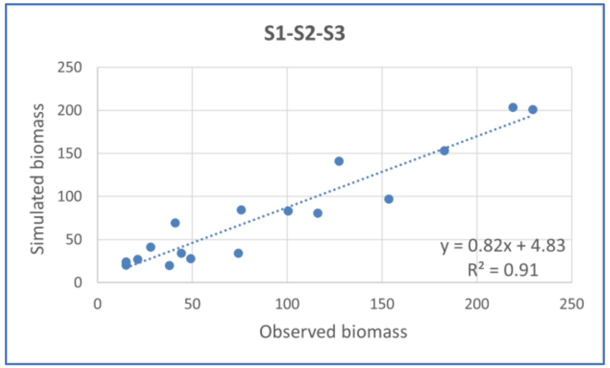
The model was calibrated on a natural alpine grassland (Torgnon site, Aosta Valley) against a 3-years dataset of daily dry matter production, evapotranspiration and FTSW (fraction of transpirable soil water). Then, it was validated over 4 years of the same test site. Model was then tested, with the adjustment of optimal temperatures for grass growth, against three differing study areas in Mugello (North Tuscany): a recently sown pasture (S1), a meadow-pasture (S2) and a semi-natural pasture (S3). In order to verify model performances in diverse conditions, these three sites were selected according to different altitude, botanical composition, pedoclimatic characteristics and management.




## Results

Preliminary results in simulating biomass (g·m-2) for the natural grassland site (Torgnon) indicate the robustness of the model in above ground biomass assessment, showing an $R^2$ = 0.83 and RRMSE = 19.18%. Regarding instead the simulation performed for S1, S2 and S3, overall results ($R^2$ = 0.91 and RRMSE = 24.21%) suggest the ability of the model to be used in different grasslands and management (grazing and mowing activity) conditions.




## Conclusions

The model presented in this work represents a first step for the development of a new simplified tool to monitor and predict grass aboveground biomass. Considering the few inputs required, the use of this model shows promising results for aboveground biomass estimation in different biogeographical conditions. The potential use in pasture management will be further investigated in a context of rotational grazing coupled with virtual fencing technologies.

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