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GRASSLANDS MONITORING IN WALLONIA USING SENTINEL-2 IMAGES

Cozmin Lucau Danila, Yannick Curnel, Viviane Planchon | Walloon Agricultural Research Centre (CRA-W) | Belgium
Aline Dejonckheere | Public Service of Wallonia - Natural Resources and Environmen | Belgium

> Copernicus will improve grassland management and enabling fair compensation for drought-related grass yield losses
>
> **Véronique Dewasmes**
> *Director of RD, Nat. Res. and Env.*
> *Public Service of Wallonia*

Grasslands in Wallonia | Own Work

The joint use of Sentinel-2 images and a grass growth model allows daily monitoring and prediction of grass growth and quality in Wallonia. A decision support system has been designed to assist farmers in their daily management and public authorities for the assessment of extreme weather events impact on annual yields.

THE CHALLENGE

With 47% of the Utilized Agricultural Area (UAA), grasslands represent the major agricultural land cover in Wallonia. This ecosystem is essential as it provides a wide range of services such as for instance food/feed/ fiber products, climate-related services (e.g. carbon and water storage), biodiversity or landscape aesthetic value.

Grassland yields is influenced by several factors such as for instance the floristic composition, the pedoclimatic region or the level of intensification. Managing grasslands fields is therefore complex and challenging especially in the climate change context. In grazing systems, farmers must for example continuously adjust their practices based on the spatial and temporal distribution of available feed biomass.

The grasslands monitoring system developed in Wallonia has been designed to cope with these challenging issues by providing daily data on grasslands biomass and quality.

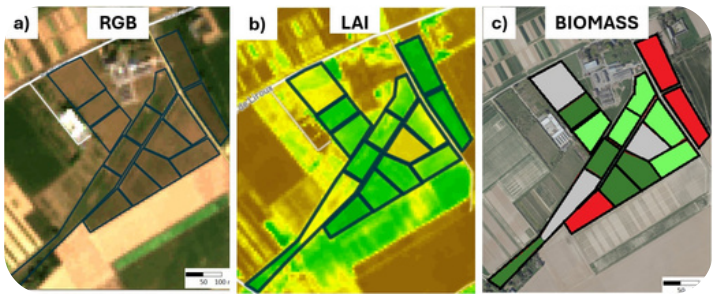
THE SPACE SOLUTIONS

The grasslands monitoring system in Wallonia is based on a multi-approach concept combining a robust reference field data set, Sentinel-2 images and ModVege grass growth model (https://doi.org/10.1111/j.1365-2494.2006.00515.x). The system has been constructed following an agile method by continuously integrating end-users needs into decision support tool. Semi-directive interviews with farmers and advisors were held to develop a first prototype which was tested and redesigned later, through focus groups.

Extensive field campaigns were conducted in 2022 and 2023 within the framework of the SUNSHINE project, monitoring 71 permanent grasslands. Compressed sward height was measured weekly using an electronic plate meter, while fresh and dry biomass was recorded monthly.

Cloud cover conditions in Wallonia unfortunately hampers the development of an efficient monitoring system based on optical data. To cope with this issue but also to enable predictive capabilities, ModVege model has been calibrated for Wallonia.

With a view to reduce model errors, LAI S2 based biomass estimates are assimilated within ModVege. The LAI values were calculated using S2ToolBox algorithms on cloud free available images. A validation on independent datasets resulted in a Root Mean Square Error (RMSE) of 370 kg DM/ha for all grasslands parcels monitored for the study (annual yields between 5 to 9.4 t DM/ha).



Examples of grass biomass estimation at paddock scale using Sentinel 2 image (28/08/2022)
a) True-color image
b) Leaf Area Index (LAI)
c) Estimated grass biomass class

THEMATIC AREA
Agriculture, Food, Forestry and Fisheries

REGION OF APPLICATION
Walloon Region

SENTINEL MISSION USED
S2

COPERNICUS SERVICE USED
-

THE BENEFITS AND THE BENEFICIARIES

The implementation of the grassland monitoring system and the associated decision support system has environmental, economic and societal impacts both for farmers and public authorities.

From an environmental perspective, it increases forage autonomy. Optimizing forage resource (both in quantity and quality) reduces external inputs (such as concentrates and nitrogen for legume-rich grasslands) and lowers the direct and indirect environmental impacts associated with their import (e.g., reduced greenhouse gas emissions from production and transport). Additionally, by preserving grassland ecosystems, it helps to increase carbon sequestration, prevents soil erosion, protects water resources, and supports biodiversity.\

Forage autonomy also brings tangible economic benefits by reducing dependence on external market fluctuations, particularly in feed prices.

It also contributes to an impartial assessment of yields losses and of associated compensations in case of agricultural calamities.

From a societal perspective, farmers who actively seek to produce their own livestock feed, minimizing reliance on commercial concentrates, tend to have a better public image. Animal welfare, a key consumer concern, is enhanced through increased grazing. Moreover, the decision support tool strengthens farmers' independence in decision-making, contributing to the overall attractiveness of the profession.

For public authorities, the proposed method improves objectivity in assessing yield losses from extreme weather events such as droughts and simplifies procedures for quantifying agricultural damage.

	TIER 1 SERVICE PROVIDER	TIER 2 PRIMARY USER	TIER 3 SECONDARY USER	TIER 4 END USER BENEFICIARIES
SERVICES AND BENEFITS	Sentinel 2	Biophysical variables (LAI) and indices (NDVI, NDWI, ...) as well as grassland yield estimation and (short-term) prediction at paddocks level	Grassland biomass estimation	Estimation of available grass biomass at parcel/paddock level helping farmers for grazing optimisation and grass yield less during drought events
BENEFICIARIES	Walloon Agricultural Research Centre (CRA-W)	Walloon Public Administration - Agriculture, Natural Resources and Environment	Agricultural advisors	Farmers (breeders) and public authorities (agricultural calamities)

EU POLICY / DIRECTIVE

Other

TYPE OF SERVICE PROVIDER

Public Service

TYPE OF FUNDING SOURCE

National or regional non space Programme

USAGE MATURITY LEVEL

4

A FUTURE WITH COPERNICUS

The continued development of Copernicus Sentinel-based monitoring tools will significantly enhance grassland management by providing accurate, timely, and scalable insights. Integrating multi-source remote sensing data with process-based models and AI-driven analytics will further optimize grazing strategies, improve climate resilience, and support sustainable agricultural policies. Using the recent Grassland Mowing Dates product will help improve the results. The upcoming Copernicus Hyperspectral Mission CHIME will offer complementary data to enhance the assessment of grass quality.

DID YOU KNOW?

The integration of Copernicus Sentinel-2 imagery with a grass growth model enables the estimation and prediction of grassland yields at the paddock level. Utilizing information extracted from Sentinel-2 temporal series acquired since 2015 provides a robust assessment of the impact of climate change on permanent grasslands at regional scale.

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Contacts

Cozmin Lucau Danila | c.lucau-danila@cra.wallonie.be
Yannick Curnel | y.curnel@cra.wallonie.be
Viviane Planchon | aline.dejonckheere@spw.wallonie.be
Aline Dejonckheere | v.planchon@cra.wallonie.be

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