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Conference Abstract

Grasslands as life support systems for mountain ungulates: the Critical Zone observatories at the Gran Paradiso National Park, Italy

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Abstract

The Gran Paradiso National Park (GPNP), Western Italian Alps, is the oldest National Park in Italy and extends over about 710 square km with an elevation range between 800 and 4,061 m asl. In its mountain environment, it hosts a large population of wild ungulates, such as the Alpine Ibex (*Capra ibex*) and the chamois (*Rupicapra rupicapra*). GPNP includes five main valleys in the Valle d'Aosta and Piedmont regions, surrounding the Gran Paradiso Massif. The treeline is at about 2,000 m asl, above which there are Alpine grasslands. Higher up, the landscape becomes rocky, and several glaciers are still present, albeit shrinking rapidly. Grasslands are the life support systems of alpine ungulates and provide support to pastoralism. In the Park, open semi-natural areas result from centuries of human activity and are characterized by a high biodiversity. The Park is part of the LTER network since 2006 and is a site of a large number of research activities devoted to species, biodiversity and habitat conservation (Baneschi 2024).

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Owing to the importance of understanding the role of anthropic pressures and of climate change on the natural and semi-natural habitats of the Park, for informing conservation and management strategies, we identified a number of sites at different locations and hosting diverse habitats within the Park (Fig. 1). In these sites we started a long-term monitoring programme of the primary productivity (GPP), Ecosystem Respiration (ER), Net Ecosystem Exchange (NEE=GPP-ER) and Evapotranspiration (ET) at the interface between soil, vegetation and atmosphere, mainly focused on high altitude grasslands, and aimed to extract the most important drivers that influence the magnitude of the fluxes under different climatic and environmental conditions. The longest dataset has been acquired at the grasslands of the Nivolet plain, at 2,600-2,800 m asl, where CO_2 and water fluxes have been recorded since 2016 at 4 sites characterized by different bedrock, elevation and aspect (Fig. 2) (Parisi et al. 2024). Since 2018, the site hosts an Eddy Covariance station affiliated to the ICOS network (IT-NIV) and, from 2020, two fixed chambers aimed at measuring NEE and ER. Empirical models revealed the drivers of NEE, ER and ET and described both their spatial and interannual variability (Magnani et al. 2020, Lenzi et al. 2023, Vivaldo et al. 2023).

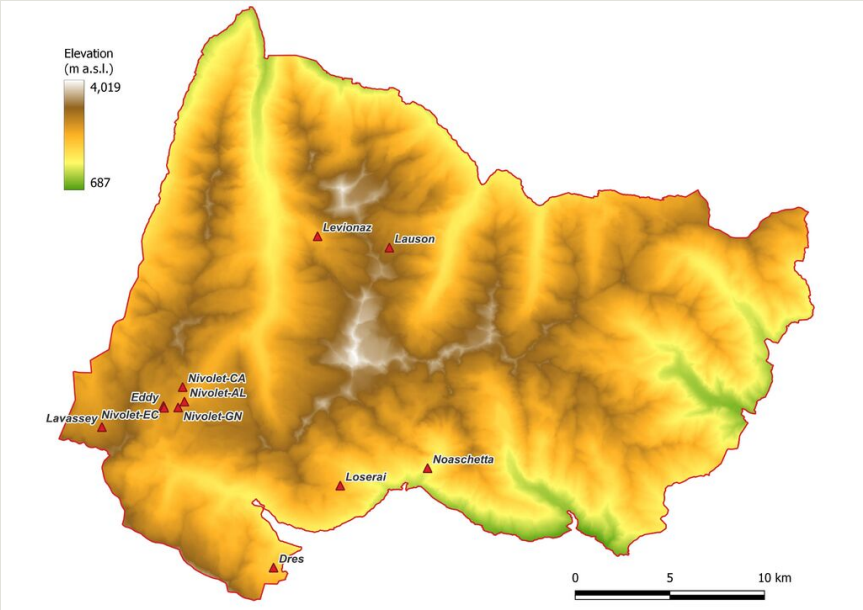

Figure 1. doi

Map of sites within GPNP.

From 2022, in the lower grasslands of the Levionaz valley, at 2,380 m a.s.l, the Park management irrigated, using natural methods, a small area, to evaluate the long-term effect of water availability on the phenology. We selected oe irrigated and one non-irrigated areas with different community composition, where we compared the CO_2 fluxes responses with varying drought conditions (2022–2024; in 2022 the Western Alps experienced a particularly dry summer) (Fig. 3).

Figure 2. doi

Nivolet plain: measuring CO_2 fluxes with flux chambers and Eddy Covariance.

Figure 3. doi

Levionaz plateau: artificial irrigation.

High-altitude peatlands are also potentially affected by climate change and, in particular, summer droughts. In 2024 we measured CO_2 and ET fluxes at the Dres peatland in the Orco Valley (2,000 m asl) (Fig. 4), to determine the sink/source behavior of this area. Drone surveys allowed a full characterization of the area with different sensors (RGB, thermal, multispectral, LiDAR) (Fig. 5).

Figure 4. doi

Measuring CO_2 fluxes at the Dres peatland.

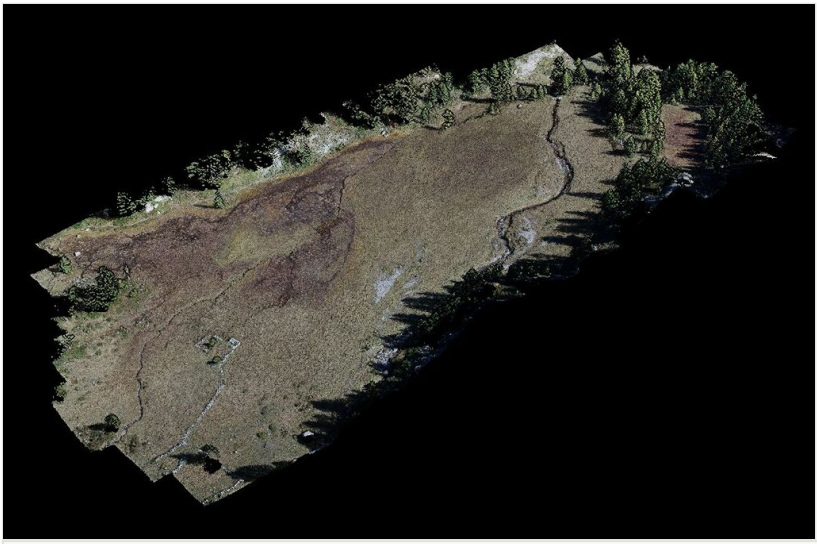

Figure 5. doi

LiDAR image of the Dres peatland.

At lower altitude, many grasslands are subject to bush and tree encroachment, and it is important to understand the role played by grazing by domestic cattle and donkeys. An experiment on exclusion plots in Noaschetta valley is running since 2016 about the different capacity of grazed and non-grazed grassland to retain carbon and nutrients in the soil (Fig. 6).

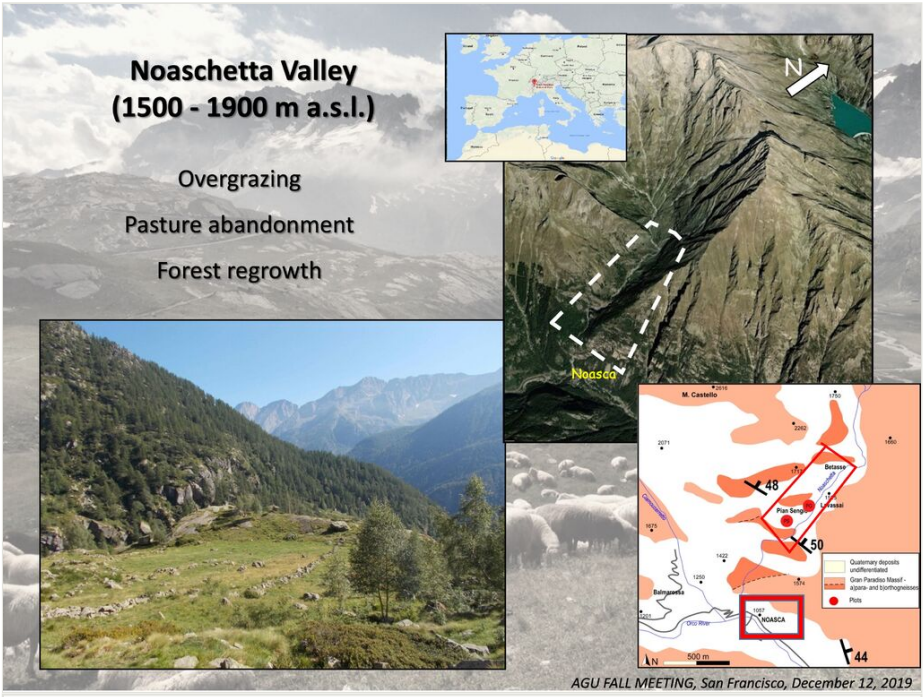

Figure 6. doi

Noaschetta valley.

In proglacial areas, soil formation and vegetation colonization are rapidly taking place. Here, we explore under which conditions these areas are CO_2 sinks or sources. In 2023 we identified two sites, one in front of the Lauson (Cogne valley) and of the Lavassey (Rhêmes valley) glaciers, where we measured CO_2 and water fluxes and meteo-climatic parameters at different distances from the snout of the retreating glaciers.

In the presentation, we will describe the results obtained so far and discuss how monitoring and modelling can inform the identification of threats and management strategies.

Keywords

Grasslands, habitat, Ibex, CO2 fluxes, carbon sink, encroachment, ecosystem service

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Conflicts of interest

The authors have declared that no competing interests exist.

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