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The Nivolet Critical Zone Observatory: exploring relationships between carbon fluxes and geology

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In high mountains, the Critical Zone (CZ) is a thin and potentially fragile layer at the borders of life. To study CZ dynamics in such extreme conditions, in 2017 we established a new Critical Zone and Ecosystem Observatory in the high-altitude environment of Pian del Nivolet in the Gran Paradiso National Park (Western Alps, NW Italy), a highly-protected, closed hydrological basin between about 2500 and 2700 meters amsl. This area usually is covered with snow from November to June and much of it hosts alpine pastures. The Pian del Nivolet area is characterized by typical glacial landforms and the bedrock geology consists primarily of orto- and para-gneiss, calcschist, metabasites, marbles and dolostones, variably covered by glacial and alluvial deposits.
Here we explore and discuss whether and how CO_2 fluxes are modulated by the characteristics of the underlying bedrock and by the soil physical and chemical conditions (temperature, humidity and TOC). To this end, four study plots have been selected on the basis of the main geological and geomorphological features of the area. CO_2 fluxes at the soil-atmosphere interface (respiration and net ecosystem CO_2 exchange) were measured by a portable accumulation chamber. Measurements were performed during the day in light and dark conditions, in order to estimate CO_2 absorption due to photosynthesis and CO_2 emissions due to soil activity and root respiration. A total of 10 surveys from July to October 2017 and 2018 were carried out, with more than 25 individual replicas for each plot (covering about 250 m-2) during each survey. Statistical tests were then performed to assess the significance of the observed variability inside each plot and across plots, using multiple nonlinear regressions on soil parameters and underlying bedrock characteristics. This work has been done in the framework of the European H2020 project ECOPOTENTIAL (Grant Agreement n. 641762).