Drivers of carbon fluxes in high-altitude Alpine Critical Zone: a data-based model

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Scientific Aims

I) Provide empirical information on carbon controlling processes in high-altitude alpine tundra
II) Identify an empirical model which explains a large part of the CO2 flux variability, thus improving the representation of observed fluxes

Site: CZO@Nivolet

In 2017, a Critical Zone Observatory (CZO) was established at the Nivolet Plain (CZO@Nivolet, about 2700m asl) in the Gran Paradiso National Park in the western Italian Alps.

CO2 fluxes at the soil-vegetation-atmosphere interface were measured from July to October in 2017, 2018 and 2019 using a portable accumulation chamber. Net Ecosystem Exchange (NEE, i.e. net CO2 fluxes) and Ecosystem Respiration (ER, i.e. CO2 emissions) were sampled in randomly chosen points within three selected plots. Gross Primary Production (GPP, i.e. CO2 uptake) was obtained as the difference of NEE and ER (GPP=NEE-ER). The plots (Fig. 1) are characterized by soils developed over carbonate rocks (site A), glacial deposits (site B) and gneiss rocks (site C) embedded within the same watershed. Basic meteo-climatic variables, namely air moisture, air temperature, air pressure, solar irradiance, soil moisture and soil temperature were also measured during each campaign.

Results

1. The parametric model that we built, Equations (3) and (4), explained large inter- and intra-annual variations of the CO2 fluxes (Table 1)
2. The models were calibrated separately for the three sites and significant (P<0.05) differences were observed between the parameters of soil moisture, suggesting a possible effect of the parental material on the soil properties and, in turn, on the carbon fluxes.
3. Qualitative projections of fluxes under the expected warmer and drier climate suggest an attenuation of both CO2 emissions and uptake owing to the effect of decreased soil moisture. However, further studies are needed to obtain quantitative assessments of the combined effect of higher temperatures and lower soil humidity.


References