

Monitoring and mitigation of N₂O emissions from Tuscany agriculture: the LIFE+IPNOA project

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Introduction

Agricultural activities are co-responsible for the three most important greenhouse gases: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Besides, the agricultural sector accounts for around 70% of N₂O emissions at national level. N₂O emissions have been shown to respond to agricultural management practices such as application of N fertilizer, tillage, irrigation and their relative importance varies in space and time due to influences of site-specific factors such as crop type, soil organic carbon (SOC) content and soil texture. However, the monitoring of N₂O emissions presents some difficulties due both to the wide temporal and spatial variability and to the different methodology of chamber measurement. Until recently, soil N₂O fluxes have been measured based on static chambers and analyzing air samples on a gas chromatograph (CG). Detecting small changes of N₂O concentration is difficult with a CG, and thus in many cases, the analysis of gas concentrations has been the largest source of error in soil N₂O flux estimations. Recently N₂O LASER instrumentation has become available practically eliminating this problem of random error when estimating the flux for a single chamber.

The LIFE+IPNOA (LIFE/11 ENV/IT/302, www.ipnoa.eu) project aims to improve the monitoring of emissions of this gas from agricultural soils and to identify the agricultural practices that can help in reducing N₂O production.

Methodology

A mobile and a fixed instrument have been realized and validated in order to improve the GHG flux monitoring from cropland. The mobile prototype is equipped with a LGR N₂O/CO detector for N₂O, and a LGR CO₂/CH₄ Ultraportable detector, a probe for soil moisture and temperature linked by Bluetooth connection. The fix station is equipped with a Thermo 46i for N₂O emissions. The chamber is a flow-through non-steady state of 10 cm height and a diameter of 30 cm. Experimental field trials have been set up in two sites on the most representative crops of Tuscany (Central Italy): durum wheat, clover and faba bean for the winter crops and maize, sunflower, tomato for the summer crops. The two sites are: CIRAA, Centre for Agro-Environmental Research "E. Avanzi" located in San Piero a Grado (Pisa) and CATES, Centre for Agricultural Technologies and Extension Services located in Cesa, (Arezzo).

The field trials have been realized in order to test the effect on N₂O emissions of different tillage options, nitrogen fertilizer levels and irrigation. The monitoring started in November 2013 on durum wheat in both sites and will last until October 2015. A monitoring protocol has been elaborated, flux samples have been taken every 15 days, and intensified up to two samplings per week for two/three consecutive weeks depending on meteorological conditions after nitrogen fertilization events.

Results and Conclusions

For the growing season 2013-2014, we present preliminary results on N₂O fluxes of durum wheat cultivated at CIRAA under different soils, tillage practices and nitrogen fertilization intensities. Daily flux from November 2013 to July 2014 and the cumulated emissions are showed. In order to have the cumulative annual budget for each GHG, the whole year will be monitored, thus including both the cropped and the fallow periods.