Introduction

- Thaw-induced \(\text{N}_2\text{O}\) emissions have been evaluated to account for 30-90% of annual \(\text{N}_2\text{O}\) emissions;
- Soil moisture content plays an important role on \(\text{N}_2\text{O}\) production;
- In addition, increased precipitation in fall and winter season is expected in near future due to climate change;
- Therefore, it is relevant to evaluate the \(\text{N}_2\text{O}\) release induced by soil thawing under various soil water contents.

Objectives

The main objective was to investigate the \(\text{N}_2\text{O}\) production and sources under elevated soil moisture contents in response to a simulated fall-freeze-thaw cycle. Specifically, this study aimed to explore the dynamics of the priming effect regarding the \(\text{N}_2\text{O}\) emitted during thawing from soils with different N management history and water contents.

Materials and Methods

1. Soil collection and preparation

   Collection:
   - Two Chernozem soils (0-20 cm) with contrasting management histories were collected from the same research field:
     - CT = the control soil without liquid manure addition
     - SW = the soil receiving repeated 2-year spring liquid manure additions

   Preparation:
   - 8-mm sieve and mixing
   - \(\rho_s = 1.1 \text{ g/cm}^3\) (similar to the field bulk density)

2. Wheat greenhouse growth + drying

   - Water: (~57% WFPS), 2-3 times/week
   - Fertilizer: ~51 kg N/ha per pot

3. A simulated fall-freeze-water-thaw-spring cycle

   - Fall (2°C): Urea and 2°C DI water added at the beginning of the fall stage
   - Freezing (-18°C): 2°C DI water was added three times to simulate the winter snow packs;
   - Thawing (23°C): soil pots were moved from -18°C to room temperature

4. \(\text{N}_2\text{O}\) measurements

   Mixing ratios of \(^{15}\text{N}-\text{N}_2\text{O}, \quad ^{15}\text{N}-\text{N}_2\text{O} \quad \text{and} \quad ^{15}\text{N}-\text{N}_2\text{O} \quad \text{in} \quad ^{15}\text{N}-\text{N}_2\text{O} \quad \text{and} \quad ^{15}\text{N}-\text{N}_2\text{O}:\quad \text{mid-infrared quantum cascade laser (Aerodyne Research, Inc., Billerica, MA, USA)}

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