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The integrated CH_4 grassland project: Aims, coherence and site description

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Abstract

The integrated CH_4 grassland project aims to understand and quantify methane formation and consumption in grasslands on peat soils, and the resulting net fluxes of methane between grassland and atmosphere. In two subprojects methane production and consumption are studied in the laboratory. Field fluxes and major environmental variables are monitored in a third subproject. In a fourth subproject methane production and consumption is related to methane fluxes via a process based model. Both intensively managed, drained grasslands and extensively managed grasslands in a nature preserve with a water table near the surface are studied.

1. INTRODUCTION AND AIMS

Soils can act both as a source and as a sink of methane. The contribution of soils to the global methane balance is significant (19-39% of the total source (rice paddies excluded) and 3-9% of the total sink; IPCC, 1992). The uncertainty about net fluxes is large as, with the current knowledge, it is difficult to relate methane fluxes quantitatively to management factors and basic environmental variables, like water table, temperature, electron acceptors and vegetation (e.g. Hogan, 1993).

The integrated CH_4 grassland project aims to understand and quantify the methane formation and consumption in grasslands on peat soils, and the resulting net fluxes of methane between grassland and atmosphere. To achieve this aim a case study was done on peat soil at both intensively managed, relatively well-drained grasslands and extensively managed grasslands in a nature preserve with a water table near the surface.

This paper describes the coherence of the four subprojects. Furthermore, the main characteristics of the five study sites are described.

2. COHERENCE

In Figure 1 the set-up of the integrated CH_4 grassland project is given. Methane production is studied at the department of Microbiology (Wageningen Agricultural University, WAU) by laboratory experiments with soil samples (Kengen and Stams, this volume). Methane oxidation is studied at the department of Industrial Microbiology (WAU) by laboratory experiments with soil samples (Heipieper and De Bont, this volume). Field fluxes and major environmental variables are monitored by the department of Soil Science & Plant Nutrition (WAU) and NMI (Van Dasselaar and Oenema, this volume). Using the results of the small scale laboratory experiments, the department of Theoretical Production Ecology (WAU) develops process based models to describe production and oxidation. Transport models are used to relate the small scale models to field fluxes (Segers and Leffelaar, this volume).

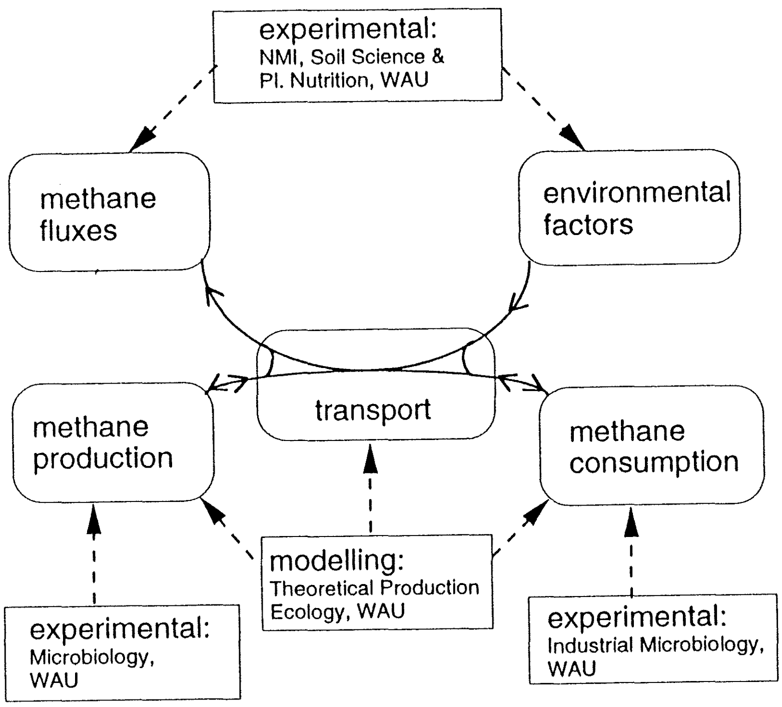

Figure 1. Set-up of the integrated CH_4 grassland project.

The project participants cooperate via the integrated CH_4 grassland working group. There is also cooperation with scientists working on nitrous oxide emissions at the intensively managed, drained sites, as the same soil physical and biological processes affect the fluxes of both trace gases. Besides, research methods show similarities.

3. SITE DESCRIPTION

3.1. Introduction

Grasslands cover more than 35% of the total surface area in the Netherlands. About 30% of the grasslands are situated on peat soils. Our study sites include both intensively managed, drained grasslands and extensively managed grasslands in a nature preserve. They are located in the major peat area of the western part of the Netherlands, around Zegveld (52°07'N, 4°52'E). In the Netherlands average air temperatures vary from 1 °C in January to 17 °C in July and August. Precipitation is distributed homogeneously over the year, with an average of 60-70 mm $month^{-1}$ (Können 1983).

3.2. Intensively managed, drained grasslands on peat soil

At the experimental farm R.O.C. Zegveld, two typical sites have been chosen:
- one with a mean ground water level of 35 cm (site 8B);
- one with a mean ground water level of 50 cm (site Bos 6).

The vegetation of the sites is dominated by perennial ryegrass (*Lolium perenne* L.). Ground water levels vary greatly during the year. The soil of both sites consists of clayey peat (Table 1). More information about these sites is given by Schothorst (1982) and Otten (1985).

Table 1
Chemical and physical properties of the 0-20 cm layer of the soils at Zegveld (Velthof and Oenema, 1994 and Van Dasselaar, not published). site 8B: relatively high ground water level; site Bos 6: relatively low ground water level.

Property	Site 8B	Site Bos 6
Loss on ignition, %	38	45
Clay, %	28	29
Total C content, g kg^{-1}	156	223
pH-KCl	5.0	4.7
Ground water level, cm, mean	35	50
range	2-70	15-85

At both sites there were three different treatments: (i) mowing, no nitrogen (N) application; (ii) mowing, N application; and (iii) grazing, N application. Fertilizer N was applied as calcium ammonium nitrate in six or seven dressings. Cumulative application rates were on average about 400 kg N ha^{-1} yr^{-1} for site 8B and about 350 kg N ha^{-1} yr^{-1} for site Bos 6.

3.3. Extensively managed grasslands on peat soil in a nature preserve

In the Nieuwkoopse Plassen area (a nature preserve close to Zegveld) three typical sites have been chosen: Koole, Brampjesgat and Drie Berken Zudde (Table 2). The vegetation of these sites is dominated by grass, moss, sedges, rushes and reed. It is mown once every year in summer. The sites Koole and Drie Berken Zudde have not been fertilized for more than 20 years and before that have only received incidentally some farm yard manure. Brampjesgat receives every second year some farm yard manure.

Table 2
Characteristics of the 0-20 cm layer of the sites in the Nieuwkoopse Plassen area in the period January - June 1994 (Van Dasselaar, not published).

Property	Koole	Brampjesgat	Drie Berken Zudde
Ground water level, cm, mean	5	10	15
range	0-15	5-20	10-20
pH-H_2O	4.7	5.3	3.9
Loss on ignition, %	55	50	90

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