Geophysical Research Abstracts
Vol. 13, EGU2011-3594, 2011
EGU General Assembly 2011

The effect of soil aggregates on peak emissions of N2O

Petra Stolk (1), Rob Hendriks (2), Cor Jacobs (1), and Eddy Moors (1)

(1) Earth System Science and Climate Change Group, Wageningen University and Research Centre, Wageningen, The Netherlands, (2) Integrated Water Management Group, Wageningen University and Research Centre, Wageningen, The Netherlands

Nitrous oxide (N2O) emissions are characterized by a huge temporal variability, with low background emissions interspersed with high peak emissions that last from one to several days. Denitrification is one of the main N2O producing processes in soils, causing peak emissions after rainfall or fertilization. Production of N2O by denitrification requires anaerobic conditions, located mainly in the water-saturated parts of the soil. The main transport mechanism of N2O to the surface is gaseous diffusion through the air-filled pores. In aggregated soils, the implication is that N2O production takes place mainly inside the water-saturated aggregates, whereas transport takes place in the pore space between the aggregates. With longer travel times between the site of production and the air filled pores, the probability increases that N2O reduces further to nitrogen gas (N2). As a result, N2O emissions are both lower and later than N2O emissions in a soil without aggregates.

In our study we investigate the effect of the incorporation of aggregates on the production and emission of N2O from denitrification. For this we used the process-based hydrological-biogeochemical model combination SWAP-ANIMO. In other simulation models the effect of aggregates has been accounted for by decreasing the diffusivity of N2O or by increasing the rate of reduction of N2O. We simulated the effects of aggregates introducing a mobile and immobile zone in the N2O module. In the immobile zone, which represents the interior of the aggregates, no vertical transport takes place. This zone is completely filled with water and all denitrification (production and reduction of N2O) takes place here. In the mobile zone, which represents the space in between the aggregates, both air and water-filled pores exist and here all vertical transport takes place. Exchange between the mobile and immobile zone is calculated with a first-order mass transfer coefficient, representing diffusion into and out of the aggregates.

We studied the effect of aggregates on the production and emission of N2O by denitrification and we compared the simulated emissions, with and without aggregates, with observed daily N2O emissions. We compared the effect of aggregates, simulated with the concept of distinct mobile and immobile zones, with the effects simulated with simpler options.