WETLANDS OF GLACIAL DRIFT AREAS AS HOT SPOTS FOR GREENHOUSE GASES WITH CONTINENTAL IMPORTANCE

Sommer M., Augustin J., Kalettka T.

Temporary water filled depressions (kettle holes, potholes) are typical wetlands of the younger glacial drift area. In the northern hemisphere their catchments are intensively used for agricultural purpose. Land use as arable land might have converted the margins of these depressions into small areas of very high biogeochemical fluxes due to permanent lateral inputs of solids and solutes. Therefore we studied the unit area emissions of the greenhouse gases methane and nitrous oxide in two remote regions of glacial drift areas in Germany (Brandenburg, Allgäu). Secondly, we developed a GIS-based upscaling procedure to estimate long-term emission rates at regional and continental scale.

Our study sites include margins of wetlands (eutrophic and polytrophic potholes) surrounded by arable land and grassland. Trace gas flux measurements were carried out by the closed chamber method in connection with gas chromatographic system (detectors: ECD, FID). For regional upscaling the riparian areas of ponded/wet depressions were calculated with the buffer command in ARC/INFO® after delineation of depressions on basis of the DEM 50 and the software package SARA. Continental up-scaling procedure are based on the selection of the glacial drift area from the digital version of FAO–UNESCO—"Soil Map of the World" (lithology = 'glacial till', 'glacial drift','moraine') combined with cool humid climates and a coverage of field crops. Methane and nitrous oxide emissions from these margins were calculated by multiplying the median annual flux rates of unit areas with the acreage of the margins.

Contrary to the surrounding agricultural area depressional margins represent very vigorous sources for nitrous oxide (0.3–13 g N2O-N m-2 y-1) and methane (2–222 g CH4 m-2 y-1). In the long run the gas flux rates were mostly controlled by eutrophication, flooding gradient (groundwater level), depth of a colluvial layer, and vegetation zonation. First conservative estimates for methane yielded annual emissions of 2.5 Tg (northern hemisphere) from colluvial margins. This number corresponds to 1–7% of the annual emissions from other important methane sources like rice paddies or "natural wetlands". Nitrous oxide emissions from the depressional margins are of similar importance for continental scale budgets. Therefore, any assessment of greenhouse gas emissions from land use disregarding the margins of wet depressions must result in misleading statements.