Atmos. Chem. Phys. Discuss., 7, S4616–S4619, 2007
www.atmos-chem-phys-discuss.net/7/S4616/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "N_2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels" *by* P. J. Crutzen et al.

S. Rauh

stefan.rauh@wzw.tum.de

Received and published: 4 September 2007

Interactive comment on "N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels" by P. J. Crutzen et al.

written by: Stefan Rauh and Stefan Berenz; Technische Universität München; Centre of Life and Food Sciences Weihenstephan; Institute of Agricultural Economics and Farm Management

Crutzen et al. provide a new approach to estimate N2O emissions released from agricultural production. The results describe a net climate warming through the substitution of fossil fuels by biodiesel or ethanol. The applied conversion factor of 3-5 % is

acceptable even tough it is different from the IPCC (2006) assumptions, where 1.0 % of nitrogen input is assessed to be emitted as N2O-nitrogen.

However the authors Crutzen et al. assume a fertilizer uptake efficiency of 0.4 by the plant which is not appropriate for the presented model calculations. This value of 0.4 is correct for a nitrogen uptake referring to the complete nitrogen pool in soil. Usually the uptake efficiency is related to the fertilizer input concerning the vegetation period of the cultivated and accounted crop. Gutser et al. (2005) determine a higher value of 0.7 for nitrogen uptake efficiency. This theory is supported by own calculations creating a nitrogen balance of German agriculture based on data of European Commission (2006) and LfL (2007). By assuming the higher uptake efficiencies by the plants, the amount of nitrogen fertilized to rapeseed plants is not 337 kg/ha but 193 kg/ha. In Germany for example nitrogen fertilizer intensity of rapeseed is in the range of about 165 kg/ha (own calculation based on LfL (2007)). Associated with the decrease of fertilizer, N2O emissions decline in the same way (9-15 kg N2O/ha). In comparison Crutzen et al. calculate values in a range of 15 to 27 kg N2O per hectare rapeseed. Such high emissions contradict the measurements and results of a large number of field trials (e.g. Bouwman (1996) and Stehfest, Bouwman (2006)), which exceed the 15 kg line only in certain cases. Just assuming higher uptake efficiency, the relative warming (Meq/M) derived from rapeseed production for biodiesel is lowered to a range of 0.59-0.99, which already indicates a net climate cooling.

Crutzen et al. apply the same approach for evaluating ethanol from different agricultural commodities such as wheat, maize or sugar cane. Their results indicate that only sugar cane is a suggestive alternative raw material to produce ethanol. In that case Crutzen et al. calculate a relative cooling (cp. table 1), whereas ethanol from wheat is assigned a high level of climate warming (1.3-2.1). In addition to an increase of uptake efficiency from 0.4 to 0.7, a second factor should be modified. Converting wheat into ethanol can be managed with conversion rates at about 55 % (Schindler, Weindorf 2006) which is significant higher than the original assumed 37 %. A modification of both parameters

ACPD

7, S4616–S4619, 2007

leads to a net climate cooling (0.49-0.82).

In conclusion these comments show how difficult it is to address the problem of global warming. The new approach of Crutzen et al. estimating N2O emissions on a global basis cannot be denoted as wrong. But few parameters were chosen in an unfortunate way. By using a higher nutrient uptake level, calculated N2O emissions reach values which are in a comparable range to the field measurements. The mentioned methodical modifications change the original conclusions concerning global warming potential of biofuels completely. Never the less, the considerations include only the N2O emissions. Considering the complete processes of provision of biofuels further green house gas emissions have to be taken into account and impact the following conclusions again significantly.

References: Bouwman, A. (1996): Direct emission of nitrous oxide from agricultural soils. Nutrient Cycling in Agroecosystems 46 S. 53-70. Crutzen, P.; Mosier, A.; Smith, K.; Winiwarter, W. (2006): N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. Atmospheric Chemistry and Pysics Discussions (ACPD) 7 (4), S. 11191-11205 European Commission (Hrsg.) (2006): Eurostat - Daten. http://epp.eurostat.ec.europa.eu, (Download: 19.12.2006) Gutser, R.; Ebertseder, T.; Weber, A.; Schraml, M.; Schmidhalter, U. (2005): Short-term and residual availability of nitrogen after long-term application of organic fertilizers on arable land. Journal of Plant Nutrition & Soil Science 168 S. 439-446. LfL (Bayerische Landesanstalt für Landwirtschaft) (Hrsg.) (2007): Leitfaden für die Düngung von Acker- und Grünland. Freising Schindler, J.; Weindorf, W. (2006): Einordnung und Vergleich biogener Kraftstoffe - ĎWell-to-Wheel"-Betrachtungen. Technikfolgenabschätzung Theorie und Praxis 1 S. 50-60. Stehfest, E.; Bouwman, L. (2006): N2O and NO emission from agricultural fields and soils under natural vegetation: summarizing available measurement data and modeling of global annual emissions. Nutrient Cycling in Agroecosystems 74 S. 207-228.

Dipl. Ing. agr. Stefan Rauh Dipl. Ing. agr. Stefan Berenz Lehrstuhl für Wirtschaftslehre

ACPD

7, S4616–S4619, 2007

des Landbaues, TU München Alte Akademie 14, 85350 Freising - Weihenstephan Tel.: 08161-713458(Berenz) Tel.: 08161-713413 (Rauh) Fax: 08161-714426 E-Mail: stefan.rauh@wzw.tum.de berenz@wzw.tum.de

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 11191, 2007.