Geophysical Research Abstracts
Vol. 13, EGU2011-14211, 2011
EGU General Assembly 2011

Management effects on net ecosystem carbon and GHG budgets at European crop sites

Eric Ceschia (1), Pierre Béziat (1), Jean-François Dejoux (1), Marc Aubinet (2), Christian Bernhofer (3), Bernard Bodson (4), Nina Buchmann (5), Arnaud Carrara (6), Pierre Cellier (7), Paul Di Tommasi (8), Jan Elbers (9), Werner Eugster (5), Thomas Grünwald (3), Cor Jacobs (9), Wilma Jans (9), Mike Jones (10), Werner Kutsch (11), Gary Lanigan (12), Enzo Magliulo (8), Olivier Marloie (7), Eddy Moors (9), Christine Moureaux (4), Albert Olioso (13), Bruce Osborne (14), Maria-Jose Sanz (6), Matthew Saunders (14), Pete Smith (15), Henri Soegaard (16), and Martin Wattenbach (17)

(1) CESBIO, UMR 5126 - CNES-CNRS-UPS-IRD- 18 avenue Edouard Belin 31401 Toulouse cedex 9, France, (2) University of Liege – Gembloux Agro-Bio Tech, Unit of Biosystem Physics, BE–5030 Gembloux, Belgium, (3) Technische Universität Dresden, Institute of Hydrology and Meteorology, Pienner Str. 23, D-01737 Tharandt, Germany, (4) University of Liege – Gembloux Agro-Bio Tech, Crops Management Unit, BE–5030 Gembloux, Belgium, (5) ETH Zurich, Institute of Animal, Plant and Agroecosystems Sciences, Universitaetsstrasse 2, CH–8092 Zurich, Switzerland, (6) CEAM, Fundación de la Comunidad Valenciana Centro de Estudios Ambientales del Mediterraneo, C/ Charles R. Darwin, 14, 46980 Paterna, Spain, (7) INRA Research Unit "Environment and arable crops" F78850 Thiverval-Grignon, France, (8) ISAFoM-Institute for Mediterranean Agricultural and Forest Systems, National Research Council, Via Patacca 85, 80056 Ercolano (NA), Italy, (9) Wageningen UR, Alterra, PO Box 47, 6700 AA Wageningen, The Netherlands, (10) Botany Department, Trinity College, University of Dublin, Dublin 2, Ireland, (11) Max-Planck-Institute for Biogeochemistry, Jena, Germany, (12) Johnstown Research Centre, Teagasc, Johnstown Castle, Co Wexford, Ireland, (13) INRA, UMR 1114, Environnement Méditerranéen et Modélisation des Agro-Hydrossytèmes, Domaine Saint-Paul, Site Agroparc, F-84914 Avignon, France, (14) University College Dublin, School of Biology & Environmental Science, Belfield, Dublin 4, Ireland, (15) Institute of Biological & Environmental Sciences, School of Biological Sciences, University of Aberdeen, Cruickshank Building, St Machar Drive, Aberdeen, AB24 3UU, Scotland, UK, (16) Institute of Geography and Geology, University of Copenhagen, Oster Voldgade 10 1350 Copenhagen K, (17) Institut für Meteorologie, Carl-Heinrich-Becker-Weg 6-10, 12165 Berlin, Germany

The greenhouse gas budgets of 15 European crop sites covering a large climatic gradient and corresponding to 41 site-years were estimated. The sites included a wide range of management practices (organic and/or mineral fertilisation, tillage or ploughing, with or without straw removal, with or without irrigation, etc.) and were cultivated with 15 representative crop species common to Europe. At all sites, carbon inputs (organic fertilisation and seeds), carbon exports (harvest or fire) and net ecosystem production (NEP), measured with the eddy covariance technique, were calculated. The variability of the different terms and their relative contributions to the net ecosystem carbon budget (NECB) were analysed for all site-years, and the effect of management on NECB was assessed. To account for greenhouse gas (GHG) fluxes that were not directly measured on site, we estimated the emissions caused by field operations (EFO) for each site using emission factors from the literature. The EFO were added to the NECB to calculate the total GHG budget (GHGB) for a range of cropping systems and management regimes. N_2O emissions were calculated following the IPCC (2007) guidelines, and CH_4 emissions were estimated from the literature for the rice crop site only. At the other sites, CH_4 emissions/oxidation were assumed to be negligible compared to other contributions to the net GHGB. Finally, we evaluated crop efficiencies (CE) in relation to global warming potential as the ratio of C exported from the field (yield) to the total GHGB. On average, NEP was negative (-284 $\pm$ 228 g C m^{-2} yr^{-1}), and most cropping systems behaved as atmospheric sinks, with sink strength generally increasing with the number of days of active vegetation. The NECB was, on average, 138 $\pm$ 239 g C m^{-2} yr^{-1}, corresponding to an annual loss of about 2.6 $\pm$ 4.5 % of the soil organic C content, but with high uncertainty. Management strongly influenced the NECB, with organic fertilisation tending to lower the ecosystem carbon budget. On average, emissions caused by fertilisers (manufacturing, packaging, transport, storage and associated N_2O emissions) represented close to 76% of EFO. The operation of machinery (use and maintenance) and the use of pesticides represented 9.7 and 1.6% of EFO, respectively. On average, the NEP (through uptake of CO_2) represented 88% of the negative radiative forcing, and exported C represented 88% of the positive radiative forcing of a mean total GHGB of 203 $\pm$ 253 g C-eq m^{-2} yr^{-1}. Finally, CE differed considerably among crops and according to management practices within a single crop. Because the CE was highly variable, it is not suitable at this stage for use as an emission factor for management recommendations, and more studies are needed to assess the effects of management on crop efficiency.