Geophysical Research Abstracts, Vol. 9, 01733, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01733
© European Geosciences Union 2007

Neural network treatment of 3 years long NO measurement in temperate and tropical climates

R. Dupont (1), K. Butterbach-Bahl (2), C. Delon (1), N. Bruggemann (2), D. Serça (1)

(1) Laboratoire d'Aérologie, 14 avenue Edouard Belin, 31400 Toulouse, France , (2) Institute for Atmospheric Environmental Research, Garmisch-Partenkirchen, Germany

The nitrogen monoxide (NO) is essential in atmospheric chemistry as a precursor of tropospheric ozone, a major atmospheric oxidant. Globally, soil NO emission could represent nearly 40% of total NOx emission, an amount comparable to fossil fuel combustions. However, uncertainties are large since results are ranging between 5.5 and 21 TgN per year. NO emission dependency with soil humidity, soil temperature and other environmental parameters are well known, but present a high level of temporal variability, and are most of the time site specific. In order to get a more general relationship between NO emission and relevant environmental parameters, a neural network approach has been developed. By introducing a variety of meteorological parameters (temperature, humidityĚ.) and soil characteristics (texture, N total, organic materĚ.), the neural network generates a versatile non linear parameterisation to calculate NO fluxes. The goal of this study is to present NO flux parameterizations deduced from a temperate forest (South-Eastern Germany, Höglwald 1995-1997 and 2002-2003) database, and from a tropical forest (Queensland, Australia 2002-2003) one. The parameterization for Höglwald is based on air and soil temperatures, soil humidity and humus pH. High (daily) and low (seasonal) frequency flux evolution is well represented by the neural network ($R2=0.76$) with a good overall estimation of NO measurement (relative error $< 1\%$). For the Queensland database, NO flux is simulated with soil temperatures and humidity. It still performs properly in simulating both high and low frequency evolution of NO emission ($R2=0.69$) with a relative error $< 1\%$. These two parameterizations highlight the high efficiency of the neural network in representing NO biogenic fluxes. This tool is able to take into account the effect of several parameters in a single equation and to accurately describe soil NO

fluxes at a site or at regional scale. As a second step, and considering the good results obtained on temperate study, Höglwald site has been used to test the neural network approach as a predictive tool: parameterization deduced from the 1995-1997 database is used to estimate fluxes for the 2002-2003 period. High and low frequencies are well represented, but problems occur to evaluate the magnitude of unknown meteorological situation fluxes. Indeed, year 2003 is marked by an unusual heat wave (high air and soil temperatures), a situation that is not represented in 1995-1997 data. This exceptional event cannot be reproduced by the network because it is not part of the learning set of the database. NO fluxes are underestimated in 2003 by 10.77 gN/ha/day (annual mean = 28.5 gN/ha/day). When the 2002-2003 data are introduced in the learning set, neural network performs much better with a short overall difference of 0.04 gN/ha/day on a mean of 19.5 gN/ha/day. Finally, the neural approach has been compared with the biogeochemical model (PnET-DNDC) developed by IMK-IFU. Neural network seems to better perform than the biogeochemical model in simulating NO emissions for the Höglwald site. However, one needs to note that the biogeochemical model can work at multiple sites across Europe, whereas an universal parameterisation for NO emissions from forest soils for the neural network approach is still under development. Therefore, we will follow to possibilities of comparing performances of the two approaches: a) use some of the biogeochemical model input parameters as inputs in the network, and b) applying the network approach to other forest sites across Europe to develop a generalised parameterisation. Both approaches would allow estimating the weight or explained variance on NO emissions of these different parameters.