Regional modelling of atmospheric CO$_2$ concentrations over the Netherlands

L.F. Tolk (1), A.G.C.A. Meesters (1), W. Peters (2) and A.J. Dolman (1)

(1) VU University Amsterdam, Amsterdam, the Netherlands

(2) Wageningen University and Research Centre, Wageningen, the Netherlands

We applied the regional atmospheric modeling system (RAMS) to simulate the CO$_2$ concentration over the Netherlands at a high resolution. The Netherlands is a highly urbanized and industrialized region, and is located near some large cities like London and industrial areas like the Ruhr Area. Local fossil fuel fluxes are an important contributor to the CO$_2$ concentrations in the area and are expected to give rise to concentration peaks that depend on the wind direction. Along the Dutch coast sea breeze circulations develop which may cause large variations in the CO$_2$ concentration. In the north of the Netherlands the coastline is formed by a number of islands around the Wadden Sea, which may further affect coastal circulations. For example, the CO$_2$ concentrations observed at the Lutjewad sampling station, which is located near the coast, are affected by sea breeze circulations. A high resolution model can be used as a tool to interpret a CO$_2$ signal that is likely to be affected by mesoscale phenomena, and may thus improve the signal-to-noise ratio of CO$_2$ concentration observations. The results of the simulations are compared to observations of CO$_2$ concentrations, boundary layer height, wind speed and direction and other meteorological variables. When the simulated and the observed concentration deviate we indicate which part is likely to be due to transport errors and which part appears to be related to an incorrect simulation of the CO$_2$ surface fluxes, both biogenic as anthropogenic.