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Soil air and soil flux measurements of ^{222}Radon and CO_2: A soil flux parametrization at Lutjewad (NL)

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Atmospheric ^{222}Radon concentration measurements are used as a valuable transport tracer verifying the transport part of Carbon Cycle and Greenhouse Gas models. The production rate of the radioactive noble gas ^{222}Radon ($T_{1/2}$ = 3.8 days) by radioactive decay of ^{226}Radium in the soil is constant, the absolute quantity depending on the local soil Radium concentration. The flux of ^{222}Radon to the atmosphere (the soil exhalation, or effective atmospheric production rate), however, is not constant. It strongly depends on soil texture, soil humidity, precipitation and other parameters, but is nearly constant if these parameters stay unchanged. Recently, an effort has been done to predict this flux rate with widely available γ-dosimetry measurements (Szegvary et al., Predicting terrestrial ^{222}Rn-flux using gamma dose rate as a proxy, ACP 7, 2789-2795, 2007), but real ^{222}Radon-flux measurements are sparse.

^{222}Radon undergoes the same transport processes on the way from soil to atmosphere as any other soil-derived (greenhouse) gas. This makes ^{222}Radon an ideal tracer to separate variations in e.g. soil CO_2-production from changes in the soil-atmosphere CO_2-transport, both being reflected in the total soil-atmosphere CO_2-flux.

At the atmospheric measurement site Lutjewad in the north of the Netherlands (53N24'18", 6E21'13", www.rug.nl/ees/onderzoek/cio/projecten/atmosphericgases) we started in 2006 with the measurements of the soil ^{222}Radon and CO_2 concentration through soil probes as well as the Radon and CO_2 soil fluxes by means of an automatic soil chamber. While there are up to eight soil air measurements per day, the soil chamber is automatically closed twice per day.

The station is situated directly on the Waddensea dike at an elevation of 1 m a.s.l. on seaclay soil. The groundwater table shows variations between 0.5 m and 2 m below terrain.

From our measurements we find that in the dryer summer season, from April to July, the mean ^{222}Radon-flux can be up to 40 % higher than the during the rest of the year, but the variability is generally very high. Short-term flux minima are mainly due to precipitation events.

First results will be shown of the parameterization of the ^{222}Radon and CO_2 fluxes with the groundwater level, soil temperature and humidity, rain events and atmospheric pressure changes.