

This manuscript by Werner and co-authors presents a large dataset on soil CO₂, N₂O, CH₄ and O₂ concentrations and ancillary variables (soil moisture, temperature and standard soil characteristics) in space (vertical soil gas-profiles, three hillslope transects and a seepage zone) and time (almost bimonthly measurements over one year) in a watershed forest ecosystem, New Hampshire, USA. Based on correlations among soil gas concentrations and soil moisture and temperature the authors try to find out how topography and climate influence soil gas concentrations, especially in deeper soil layers. Additionally, they try to identify thresholds (hotspots/hot-moments) of production and consumption of soil CO₂, N₂O and CH₄.

I like the manuscript very much, because it is another step forward to identify the role of deeper soil layers for soil trace gas dynamics in natural forest ecosystem. It is hard field work to get such a dataset that is presented in the manuscript and I would love to see much more of such interesting datasets from tropical forest ecosystems (I encourage the first author of this manuscript to look for other very interesting ecosystems).

General comments:

It would be very nice to link soil gas concentration profiles with soil surface chamber flux measurements! Despite the fact that it is hard work to get the soil gas concentration data, I would like to know, why the authors did not measure surface fluxes at the same time? It would be very interesting to see the influence of different soil layers on the overall surface flux. Such a paper would be of great interest for the soil trace gas flux community. Furthermore, the authors write that there have been other soil trace gas flux studies at the same site. Did these studies also include the same soil types that were chosen in this study? May be the authors could compare and discuss such results in the discussion section?

In their introduction the authors describe the importance of measuring consumption and production of soil trace gas fluxes. They also use both terms throughout the text. However, they did not measure fluxes but concentration profiles at a single time-point. Even if gas concentrations are below an ambient level, there can be production at the same moment. So, I would be careful in using the terms production and consumption and better write potential production and potential consumption. Along with this problem I would like to address another point. I doubt if it is enough to identify the location of hotspots and hot-moments by just single concentration measurements. Furthermore, there is considerable uncertainty in the timing of such hot phenomena and there should be high-time resolution measurements, if someone wants to identify hotspots or hot moments and discuss their impact on trace gas dynamics. Hence, I would not put so much emphasis on the hot phenomena in the introduction and only make suggestions in the discussion section.

Figure 9 is the major figure of the manuscript, where a conceptual model of N₂O production/consumption relative to CH₄ production/consumption across the investigated soil types is presented. I would like to emphasize once again that the authors did not measure fluxes of trace gases but single gas concentrations. Hence, their conceptual model bases on a very weak approximation and their interpretations as well. I encourage the authors to clarify that in the manuscript. However, I like the idea of using PC-analysis (Figure 9) because it gives a quick and nice overview about the main patterns.

The main goal of the manuscript is to identify the relationship between landscape patterns and trace gas dynamics and how this relationship is influenced by soil moisture and temperature. I emphasize the authors not to present too much figures and especially not such figures (Figure 5,7,8), where trace gas concentrations are not separated between soil types/landscapes. Otherwise the red line of the manuscript will suffer from that.

Minor comments:

I largely agree on the specific comments by reviewer 1. Here are some additional comments:

P10862/L3: 'vertical profile sampling'

P10862/L9-L19: In this paragraph goals are determined, then explained but thereafter in L17 another objective is suddenly mentioned again. I would recommend to be more concise and to decide whether to use goals or objectives.

P10872/L1-13; L21-29: This is simply too much description for a discussion section. Make it shorter and discuss your own results!

P10872/L21: The idea of anoxic microsites is still of theoretical origin. So don't say that the presence of anoxic microsites was apparent!

P10873/L6: 'However, because of such...'

P10887: It would be much better to see the standard error and the sample size (n) instead of the standard deviation!

P10888: What is the sample size (n)?