We thank both referees for providing helpful comments to improve and clarify the manuscript. The suggestions were carefully considered and implemented in the text.

Comments to Referee 1

Referee 1 comment:

This study deals with an important issue for Northern permafrost affected wetland soils, the mechanisms involved in the methane cycle. This manuscript fits perfectly to Biogeosciences as the studied fundamentals of the oxidation and diffusion of methane in water saturaded soils are also of great interest for methane dynamics at larger scales.
Furthermore, the manuscript represents a well planned and scientifically sound study.
There are only minor flaws which should be considered by the authors.
The tense should be checked and kept consistent throughout the manuscript.

Author's response:

The tense was checked and corrected when necessary.

Referee 1 comment:

There are also some sentences which are a bit complicated to read, in this respect it would be nice if a native speaker would look over the manuscript.

Author's response:

This was done as suggested and included in the Acknowledgments:

The authors would like to thank the members of the joint Russian-German expeditions LENA 2009 and 2010 and the staff of the Alfred Wegener Institute, Research Unit Potsdam, for logistical, technical and administrative support. Special thanks go to Susanne Liebner for the O_2 profile measurements and to Svetlana Evgrafova for additional pore-water sampling in 2010. Birgit Schwinge, Volker Kleinschmidt and Stephanie Langer from the Institute of Soil Science are acknowledged for their help with laboratory analyses and Benjamin Runkle for editing the English. This project is funded by the German Science Foundation through the Cluster of Excellence "Integrated Climate System.

Referee 1 comment:

One major concern is the representativeness of the sampled spots, was there any preassessment before the samples were taken? It would be nice if the authors could back up the choice of the sampled soils/spots, e.g. by C and N contents or distribution of the distinct land forms and/or soil types on the studied Island (just a sentence would do it), just to give the reader an idea of the representativeness.

Author's response:

We considered this important comment in the section Materials and Methods in the part describing the study area. The text was changed accordingly (see next comment).

Referee 1 comment:

The authors state in line 25 (page 17004) "most active" in concert with representativeness for modern delta landscapes. What is meant by that - active in case of sedimentation and erosion or what? And is the aim really to be representative for delta landscapes or could it be more general polygonal Tundra ecosystems?

Author's response:

Indeed, the youngest terrace is the most active part of the Lena River Delta in terms of sedimentation and erosion. We agree with the referee that in this context, it is more important to stress the study site's representativeness for polygonal tundra ecosystems – as mentioned in line 6 page 17005 – than for modern delta landscapes. The sentence was deleted and the paragraph was changed as follows:

With its 32,000 km^2 the Lena River Delta is the largest delta of the circum-arctic land masses. Situated at the north coast of Siberia, it belongs to the area of continuous permafrost with an Arctic continental climate characterized by both low temperatures and precipitation (Boike et al., 2008). Investigations were carried out on Samoylov Island (72.22°N, 126.30°E) situated in the southern-centra l part of the delta. Samples were taken during two expeditions in 2009 and 2010 in the eastern part of the island which is characterized by wet polygonal tundra, a permafrost feature typical for extensive areas of Arctic lowland tundra (French, 1996). Its microrelief consists of homogeneously spread soil units of depressed centers of low-centered ice wedge polygons (hereinafter 'polygon center') and their elevated surrounding rims. The soils only thaw in the upper part (< 60 cm) during the summer (active layer) and are rich in organic matter (Zubrzycki et al., this issue). According to the land cover classification of Schneider et al. (2009), the land cover class wet sedge-and moss-dominated tundra (WT) is the most important source of CH_4 in the Lena River Delta. It consists of the sub-classes dry sites (62.2 % cover), very wet sites (7.8 %), overgrown water (14.8 %) and water (15.2 %) (Schneider et al., 2009). This study investigated four polygon centers with differing water table representing all sub-classes except the open water bodies: a polygonal pond with a permanent water level above soil surface, two saturated polygon centers (A and B) with a changing water level close to the soil surface and an unsaturated polygon center with a distinctly lower water level.

Referee 1 comment:

Line 15 (17005): So just the active layer was sampled? Please add this information. Please also add that you sampled per horizon, one could think you sampled depth layers.

Author's response:

Suggestions were adopted and sentence changed to:

Soil samples were taken from every identified pedogenic horizon from the active layer of four polygon centers in pits which had been excavated to the frozen ground.

Referee 1 comment:

Line 6 (17006): Where did you take the samples, in the soil pits? Please state this in more detail.

Author's response:

Samples were not taken in the soil pits, but in the polygon center minimizing disturbance by using the steel tubes. "in the polygon center" was added:

For CH_4 concentration and stable isotope (SI) profiles pore-water samples were taken at several depths in the polygon center via perforated stainless steel tubes (Ø 1/8"),..

Referee 1 comment:

Line 4 (17008): At what exact hPa (pF 1.8 or 2.5)?

Author's response:

"0.3 kPa" was added:

To analyze the effective diffusion coefficient for each soil horizon, the water content in the three undisturbed soil cores collected from each horizon of the polygon centers were adjusted to field capacity (0.3 kPa) on a sand bath.

Referee 1 comment:

Line 8 (17012): Here and also in the tables you give everything in wt %, please use SI like e.g. as mg*g-1.

Author's response:

This change was performed as suggested.

Referee 1 comment:

Line 12 (17012): Please write out the word WRB.

Author's response:

This change was performed as suggested.

Referee 1 comment:

Line 8 (17019): Please write "microbial degradation".

Author's response:

This change was performed as suggested.

Referee 1 comment:

Line 18-19 (17020): This sentence sounds a bit awkward, please re-phrase.

Author's response:

Rephrased to:

On the contrary, isotopic fractionation factors associated with oxidation differ strongly between sites and need to be determined for all oxic horizons of interest.

Referee 1 comment:

Line 13 (17022): Please write " at temperatures occuring in-situ".

Author's response:

This change was performed as suggested.

Referee 1 comment:

Table 1: Please also give the depth ranges and not just the mean depths of the horizons.

Author's response:

This change was performed as suggested.

Referee 1 comment:

And as mentioned before, please give the Corg in mg*g-1 (SI unit).

Author's response:

This change was performed as suggested.

Comments to Referee 2

Referee 2 comment:

This manuscript examines the influence of methane oxidation and diffusion on the isotope ratio of CH4 emitted from polygonal tundra. The authors make the scientific argument that fractionation due to diffusion is not often measured and they show that it can have a considerable effect on the 13C-CH4 of emitted CH4, thus improving our understanding of sources and sinks of CH4 in these environments. The paper is thorough and well written, and although I cannot say I am an expert in the field of isotopic fractionation and CH4 oxidation, the arguments and data seem well organized and justifiable.

The conclusions seem to flow directly from the data and I do not think they are overstating their case. The only two comments I have are the following.

First, on page 17019, the authors do not consider the importance of anaerobic methane oxidation in either the change in concentration or 13C of CH4 with depth. What affect could anaerobic methane oxidation have on either of these patterns?

Author's response:

To our knowledge, anaerobic oxidation of methane (AOM) has been mainly reported for marine environments with sulphate as electron acceptor and only in few studies also in freshwater sediments with nitrate and ferric iron. AOM depends on sufficiently high concentrations of electron acceptors such as sulphate, nitrate or ferric iron. Since concentrations of these electron acceptors are low in the organic rich soils studied here, it is unlikely that AOM plays an important role. The paragraph was changed as follows:

The observed decrease in CH_4 concentration between the lower and the upper horizons of the saturated polygon center A cannot be explained by oxidation since no oxygen was available in these depths. Anaerobic oxidation of methane (AOM) was not considered, since it is coupled to the reduction of electron acceptors such as sulfate, ferric iron, nitrate, and nitrite (Blazewicz et al., 2012) and concentrations of these electron acceptors are too low in the organic rich soils studied (Fiedler et al., 2004). In addition, AOM would cause a change in isotopic signatures which was not detected here. Thus, the decrease in CH_4 concentration must originate from the different transport mechanisms (diffusive, advective or ebullitive with α_{trans} =1).

Referee 2 comment:

Second, the discussion is repetative (around pages 17019/20), and could be 'tightened up' a bit.

Author's response:

The discussion was thoroughly checked and shortened.