

The manuscript by Watts et al. provides a consistent overview carbon flux (CO<sub>2</sub> and CH<sub>4</sub>) measurements in the arctic and evaluated the potential of Terrestrial Carbon Flux model to represent site specific flux measurements at different time scales.

Up to date few studies integrating both, flux measurements and modeling approaches to determine the net ecosystem carbon balance of arctic ecosystems exist. Therefore the presented results contribute to the currently available knowledge on CO<sub>2</sub> and CH<sub>4</sub> exchange in the Arctic and also provides an outlook for ongoing and future research on this important topic.

The authors provide a very well structured and analyzed manuscript with an excessive material and methods paragraph (which seems appropriate for this integrative study) and a sometimes lengthy to read results section. I have only minor technical/structural comments and recommend this paper to be published in Biogeosciences.

As stated before I recommend to restructure the Results paragraph since the amount of information (numbers and abbreviations) make it rather difficult to follow. Therefore one step could either be moving some results in an additional table and only state the most important results.

As a second recommendation I would like to encourage the authors to be consistent with naming: e.g. TCF model instead of TCF only—please adjust this throughout the manuscript.

Technical comments:

P16493, l.9: TCF model simulations

P16495, l1: I would argue that this is not even a network yet, unfortunately more likely a dozen sites that are still or have been active.

P16495, l15: remove NECB

P16496, l6-9: This is correct, but why does the labile carbon increase CH<sub>4</sub> production? An additional sentence on the process could be useful.

P16496, l35-30: This is nice to read but is this actually needed in this manuscript, I suggest to delete this.

P16498, l.6: is -> are

P16498, l11-13: name an example

P16498, l14-16: try to combine the information with the previous sentence.

P16498, l17: Why? you should guide the reader towards and easy understanding, e.g. if the reader is a non ecologist or non-firm in arctic ecosystems one would not understand.

P16499, l19: recalcitrant? But you have a separate pool dealing with this.

P16500, l6-11: this is unclear to me, I see the need for this but can not follow the explanation of your multipliers – please improve

P16502, l20-21: F = Flux of what since F has been used before for CO<sub>2</sub>, this might be confusing.

P16509, l26: the word “where” seems not to fit in here.

P16513, l17-19: I disagree. The uncertainty can not be directly attributed to the partitioning of EC measured NEE into GPP and Reco. Certainly there are severe differences in flux partitioning but one could try different approaches which commonly results in a range of GPP and Reco. This range could be compared to the TCF model estimates.

P16515: I guess the larger discrepancies of the Barrow results are basically caused by the experimental manipulation.

P16515, l28: define similar, 20%, 80%? Unclear.

Figure 4: very difficult to see, this is either due to the typesetting at BGD if not please enlarge to the full page

Figure 8: Please include the years in the bars, since this is otherwise difficult to see within the figure.