

June 27, 2025

Author's response to the review of:

## **Environmental drivers constraining the seasonal variability of satellite-observed methane at Northern high latitudes**

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Submitted to Biogeosciences

First, we would like to thank the handling Associate Editor and both reviewers for their positive feedback and constructive comments. We have now implemented the changes outlined in our detailed response letter and carried out the additional analysis using two model configurations with the atmospheric inversion model CarbonTracker Europe CH<sub>4</sub>.

The most substantial changes have been made in the *4 Results and Discussion* section, which has now been divided into two separate sections: *4 Results* and *5 Discussion*, in order to improve clarity and readability. In Section *5.1 Links between environmental variables and XCH<sub>4</sub>*, we have reorganized the content and introduced subheadings to make the discussion more coherent and easier to follow, now that the model results have been added.

We have also made minor changes in the figures and tables to improve clarity. Additionally, partial dependence plots have been added to the results to strengthen the interpretation and support our conclusions.

We hope that the revisions and additions sufficiently address the request to broaden the scope of the manuscript and that the updated version meets the requirements for publication.

Sincerely,

Ella Kivimäki and co-authors