



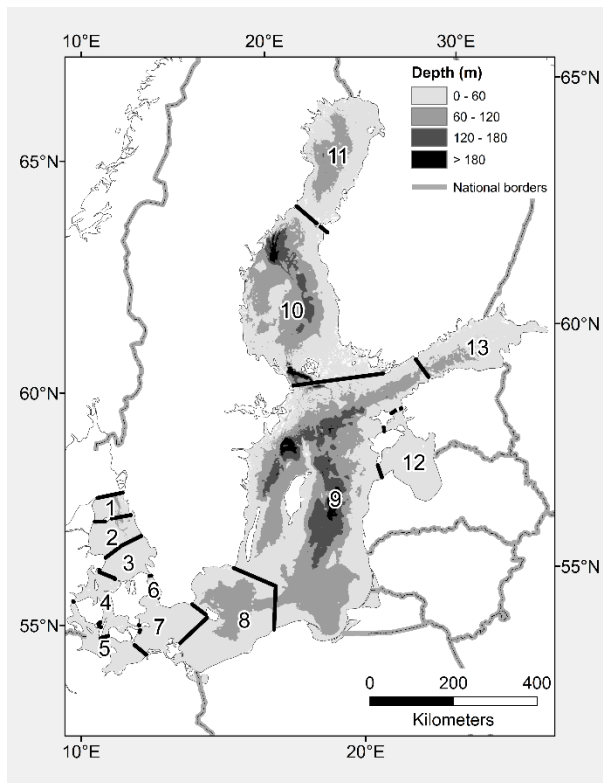
*Supplement of*

**Methane dynamics in the Baltic Sea: investigating concentration, flux, and isotopic composition patterns using the coupled physical–biogeochemical model BALTSEM-CH<sub>4</sub> v1.0**

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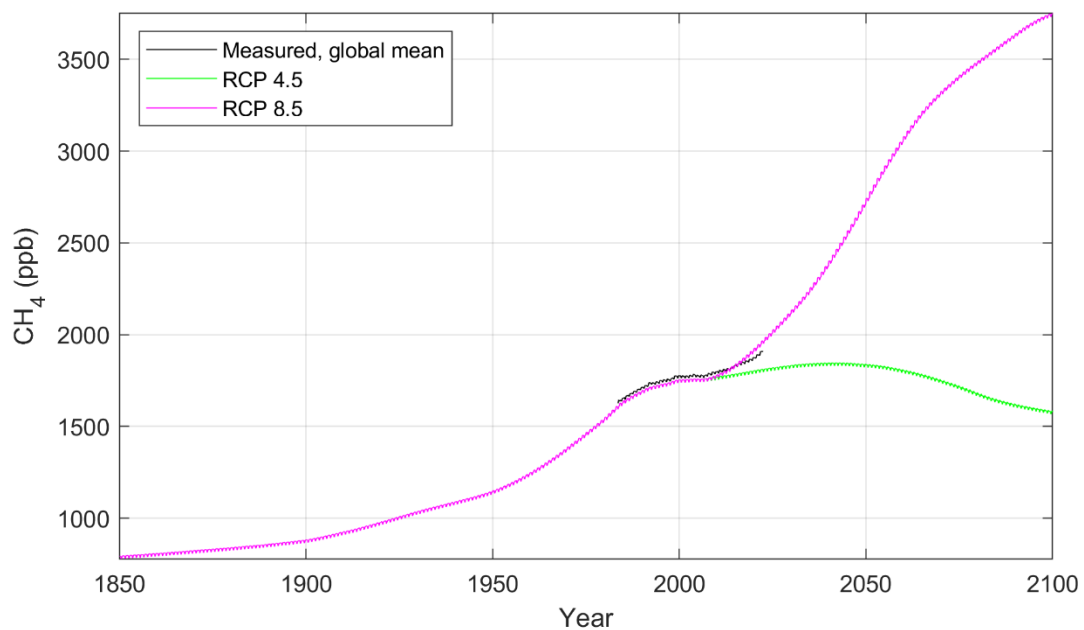
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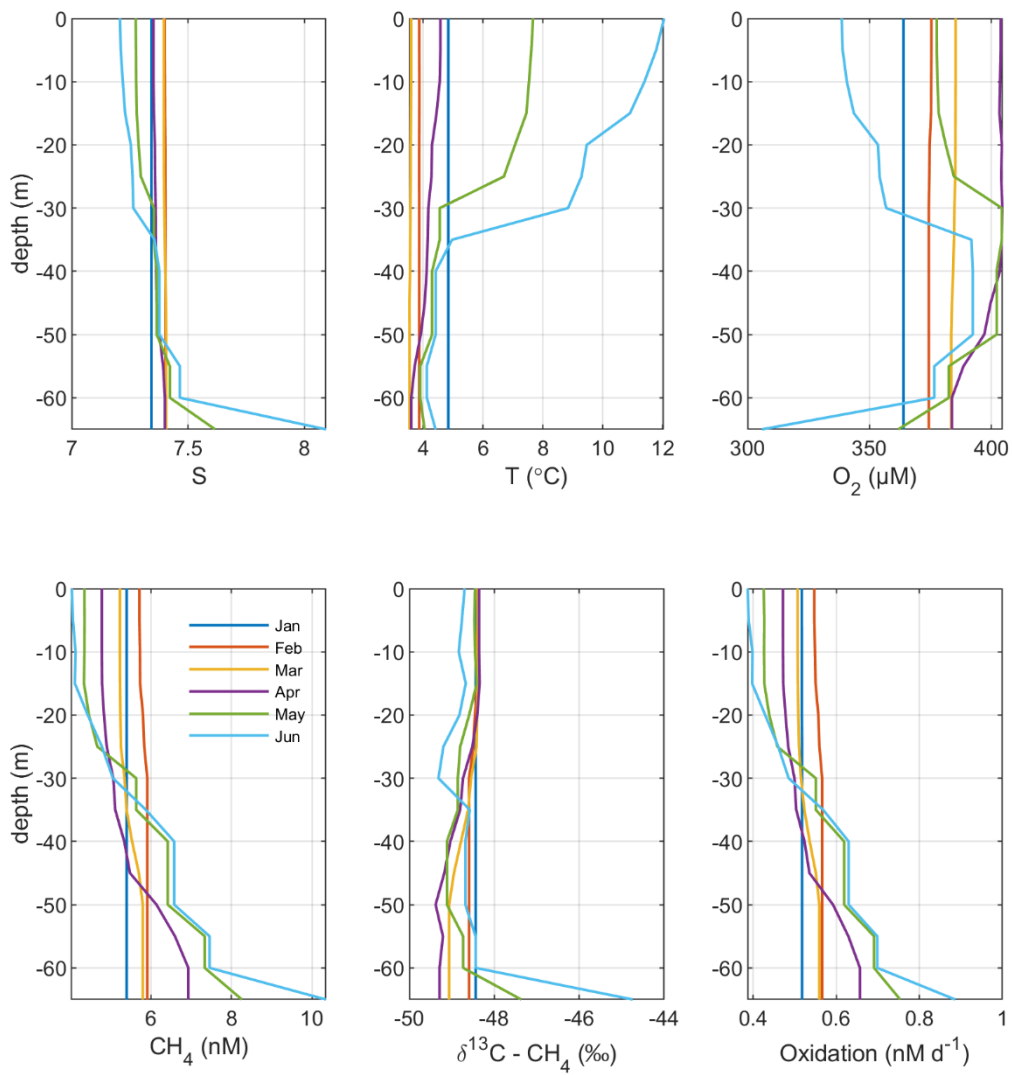
**Figure S1: Sub-basin division of the Baltic Sea in BALTSEM: 1. Northern Kattegat (NK), 2. Central Kattegat (CK), 3. Southern Kattegat (SK), 4. Samsø Belt (SB), 5. Fehmarn Belt (FB), 6. Öresund (OS), 7. Arkona Basin (AR), 8. Bornholm Basin (BN), 9. Gotland Sea (GS), 10. Bothnian Sea (BS), 11. Bothnian Bay (BB), 12. Gulf of Riga (GR), 13. Gulf of Finland (GF).**

Table S1. Geometric characteristics of BALTSEM sub-basins.

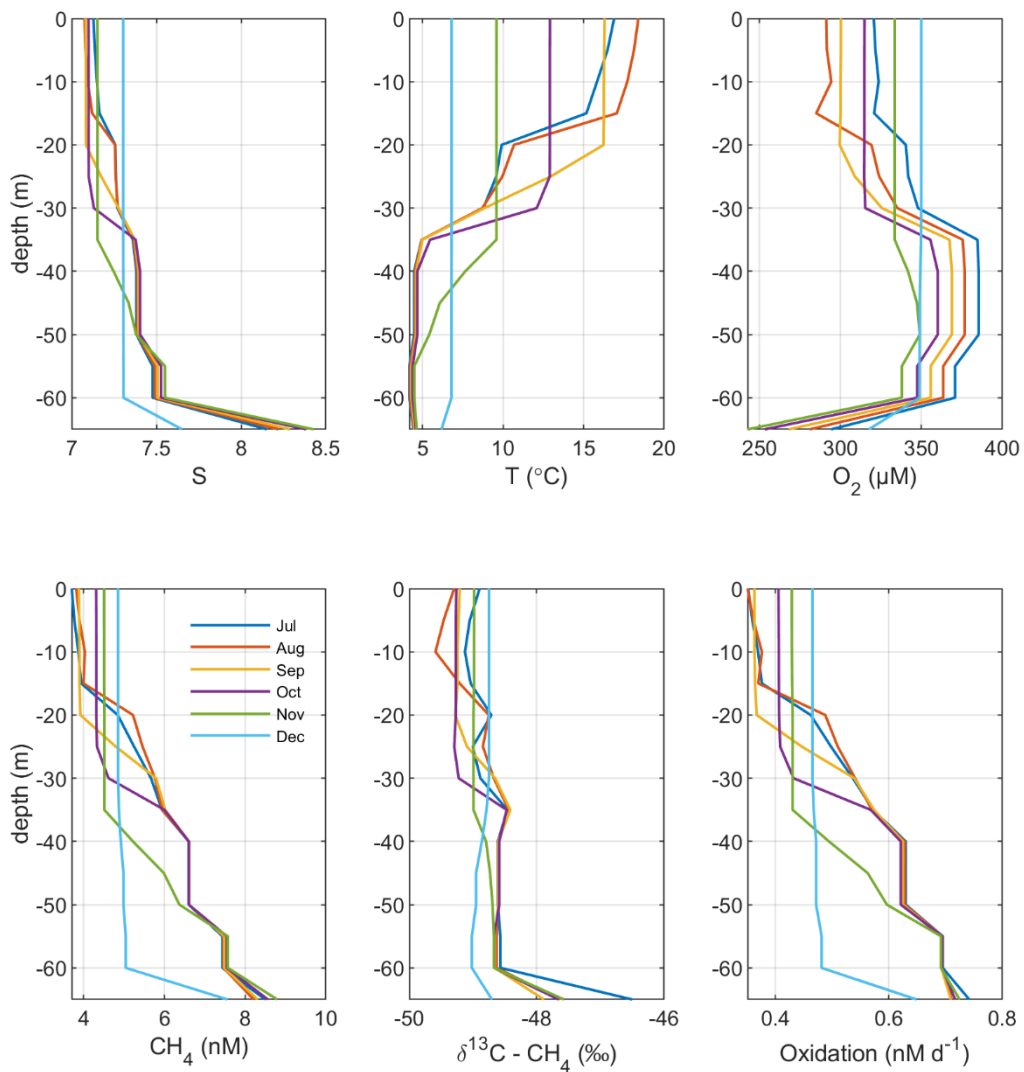
Index	Name	Area (km <sup>2</sup> )	Volume (km <sup>3</sup> )	Mean depth (m)	Max depth (m)
1	Northern Kattegat	4428	139	31.5	110
2	Central Kattegat	8462	166	19.6	129
3	Southern Kattegat	9358	209	22.4	71
4	Samsø Belt	8307	108	13.0	57
5	Fehmarn Belt	10088	164	16.2	66
6	Öresund	936	11	11.6	45
7	Arkona Basin	14586	379	26.0	51
8	Bornholm Basin	39806	1722	43.3	98
9	Gotland Sea	173176	11620	67.1	250
10	Bothnian Sea	67001	4253	63.5	220
11	Bothnian Bay	36559	1424	39.0	112
12	Gulf of Riga	17509	414	23.6	53
13	Gulf of Finland	23729	775	32.7	87



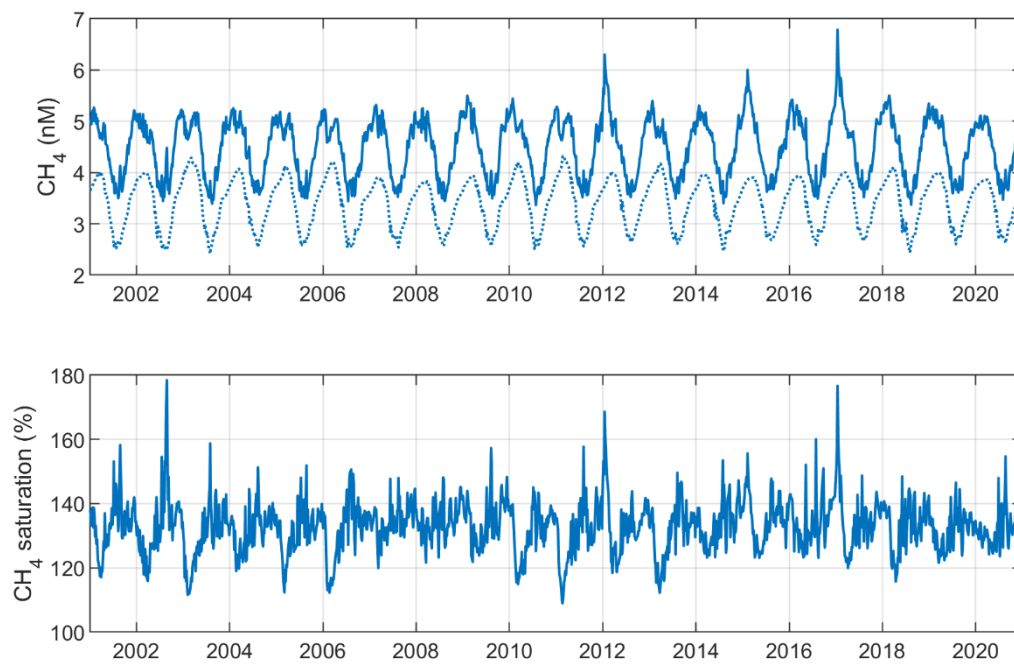
**Figure S2: Global mean atmospheric CH<sub>4</sub> level (ppb) expressed as mole fraction of dry air (data available at <https://gml.noaa.gov/dv/data/> (observed) and <https://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=download> (RCP), respectively).**



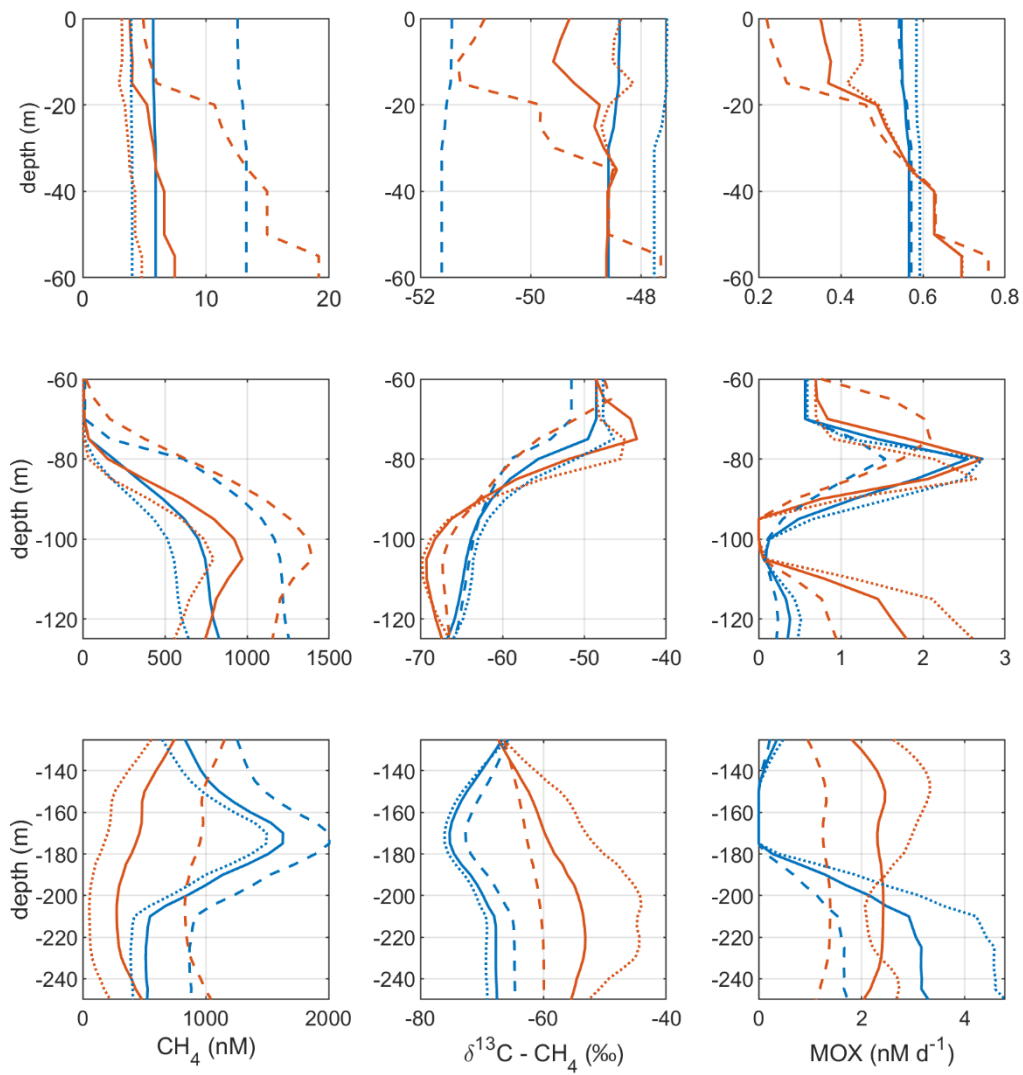
**Figure S3: Model output from the standard model run, showing simulated monthly mean profiles of S, T (°C), O<sub>2</sub> (μM), CH<sub>4</sub> (nM), δ<sup>13</sup>C-CH<sub>4</sub> (‰), and aerobic oxidation rates (nM d<sup>-1</sup>) from 0 to 65 m in the Gotland Sea sub-basin (cf. Figure S1) year 2015 (January to June).**



**Figure S4: Model output from the standard model run, showing simulated monthly mean profiles of S, T (°C), O<sub>2</sub> (μM), CH<sub>4</sub> (nM), δ<sup>13</sup>C-CH<sub>4</sub> (‰), and aerobic oxidation rates (nM d<sup>-1</sup>) from 0 to 65 m in the Gotland Sea sub-basin (cf. Figure S1) year 2015 (July to December).**

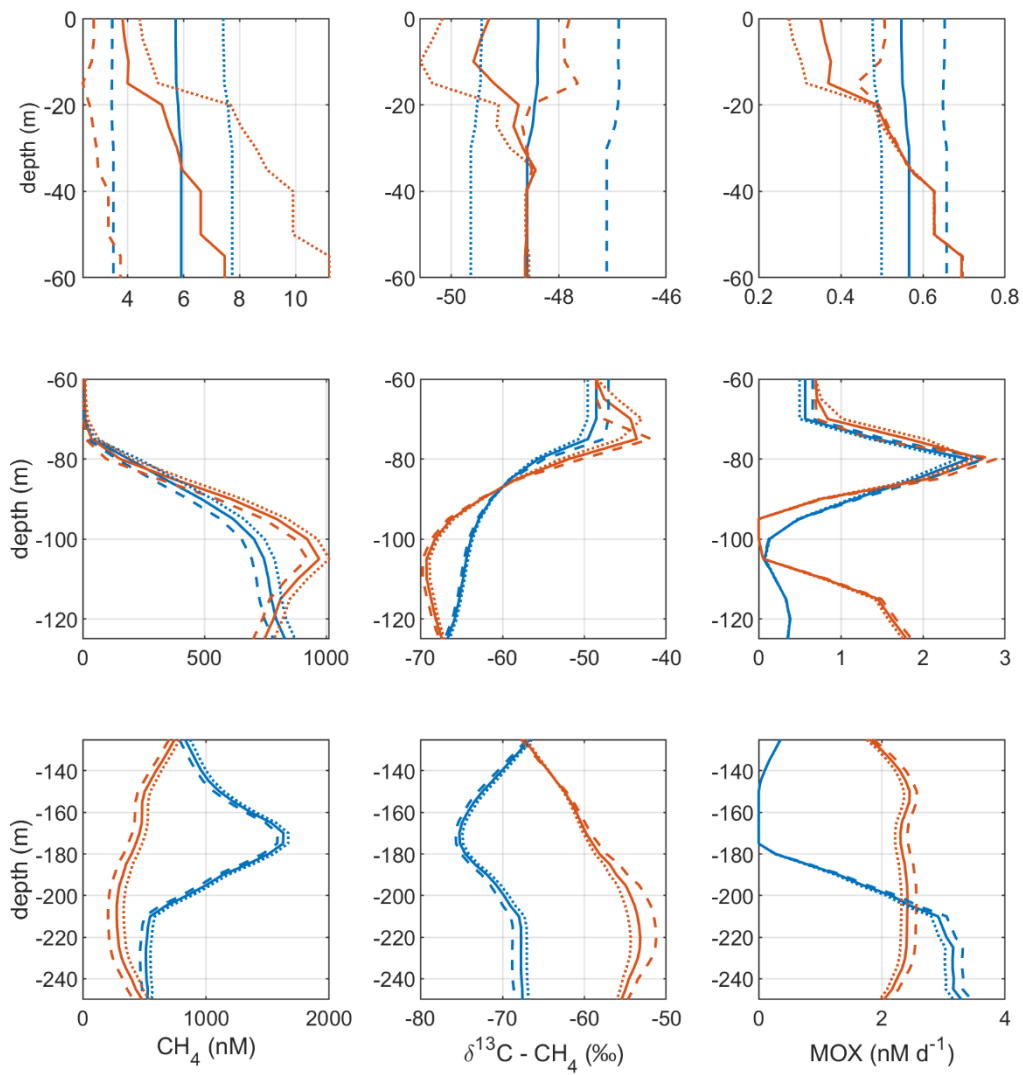


**Figure S5: Simulated surface water CH<sub>4</sub> concentration (nM; full line) and equilibrium concentration  $CH_{4eq} = K_0 \cdot pCH_{4a}$  (nM; dots) in the Gotland Sea sub-basin (upper panel), as well as surface water CH<sub>4</sub> saturation level (%) (lower panel).**

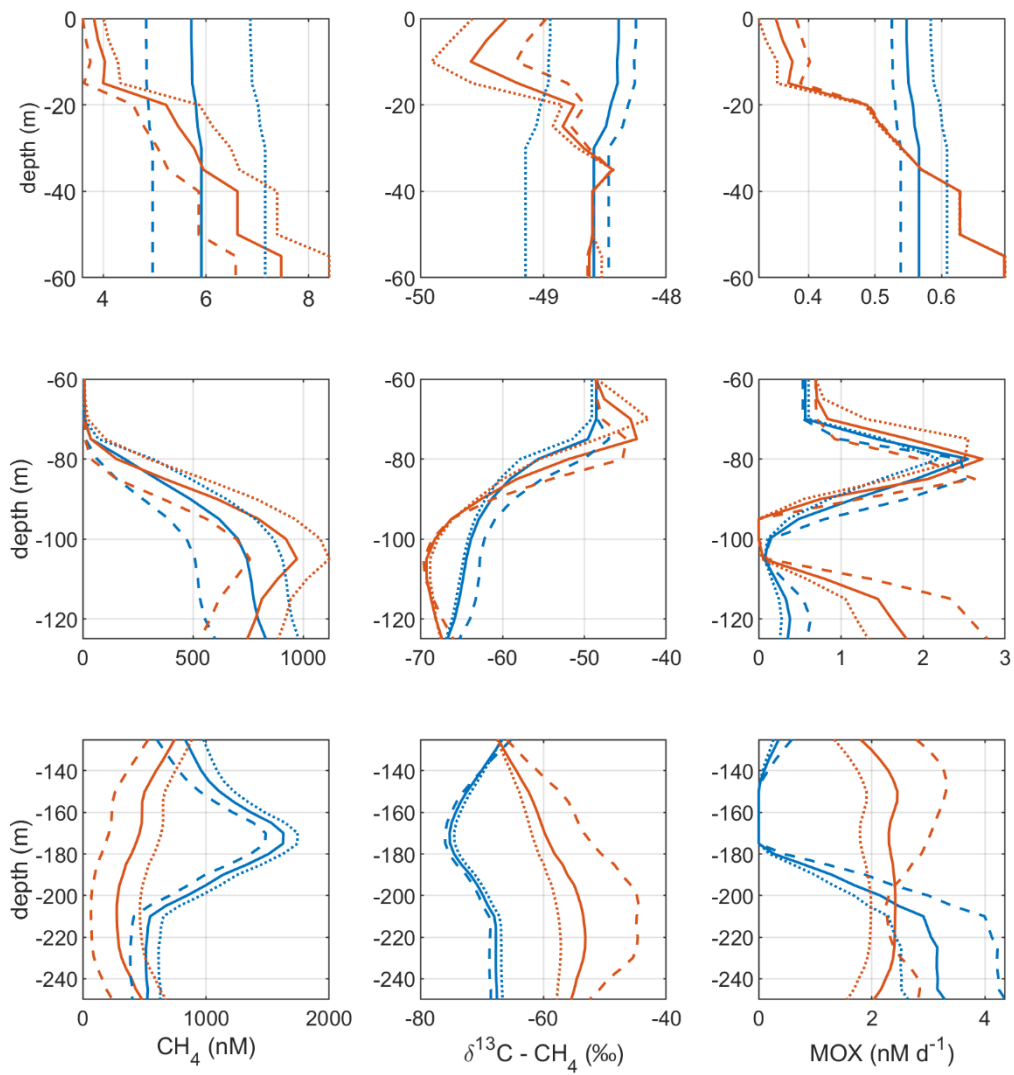


**Figure S6: Monthly mean profiles of  $\text{CH}_4$  (nM),  $\delta^{13}\text{C}-\text{CH}_4$  (‰), and  $\text{MOX}$  ( $\text{nM d}^{-1}$ ) in the Gotland Sea sub-basin (see Figure S1) in February (blue) and August (red) in year 2015: comparison between the standard (full lines), test 1 ( $v_{\text{WCH}_4\text{O}_2}$  -50%; dashes), and test 2 ( $v_{\text{WCH}_4\text{O}_2}$  +50%; dots) runs, respectively (see Table 3 in main article).**

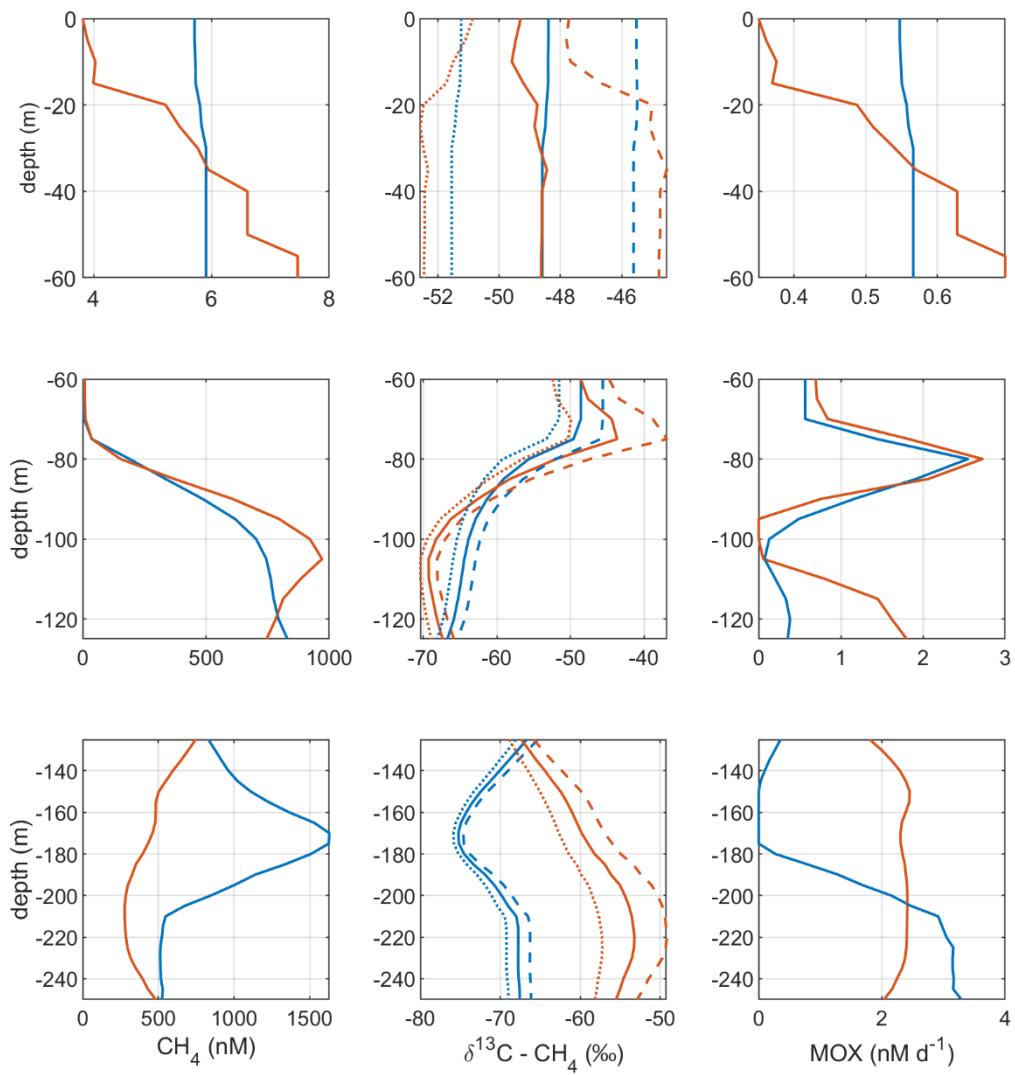




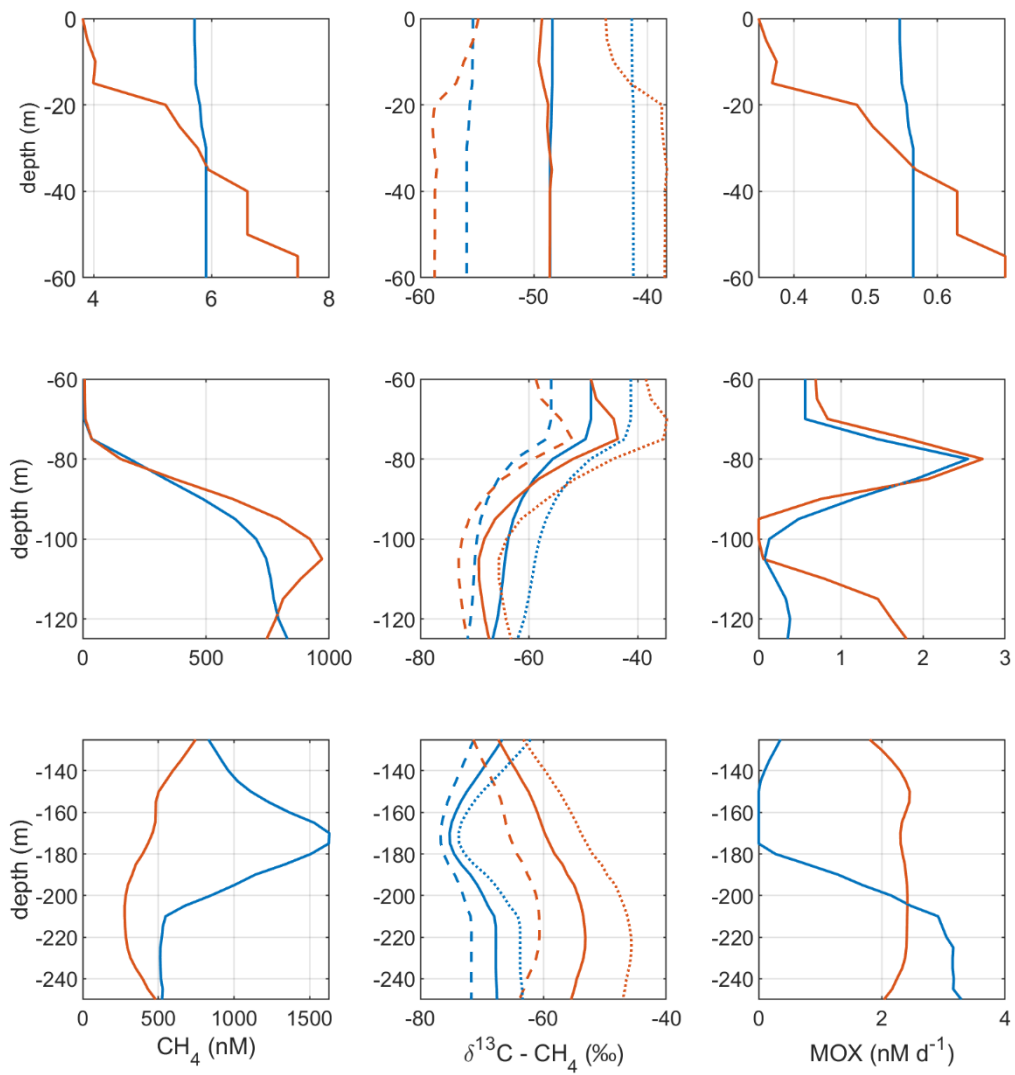
**Figure S7: Monthly mean profiles of  $\text{CH}_4$  (nM),  $\delta^{13}\text{C}-\text{CH}_4$  (‰), and  $\text{MOX}$  ( $\text{nM d}^{-1}$ ) in the Gotland Sea sub-basin (see Figure S1) in February (blue) and August (red) in year 2015: comparison between the standard (full lines), test 3 ( $h_{\text{CH}_4}$  -50%; dashes), and test 4 ( $h_{\text{CH}_4}$  +50%; dots) runs, respectively (see Table 3 in main article).**



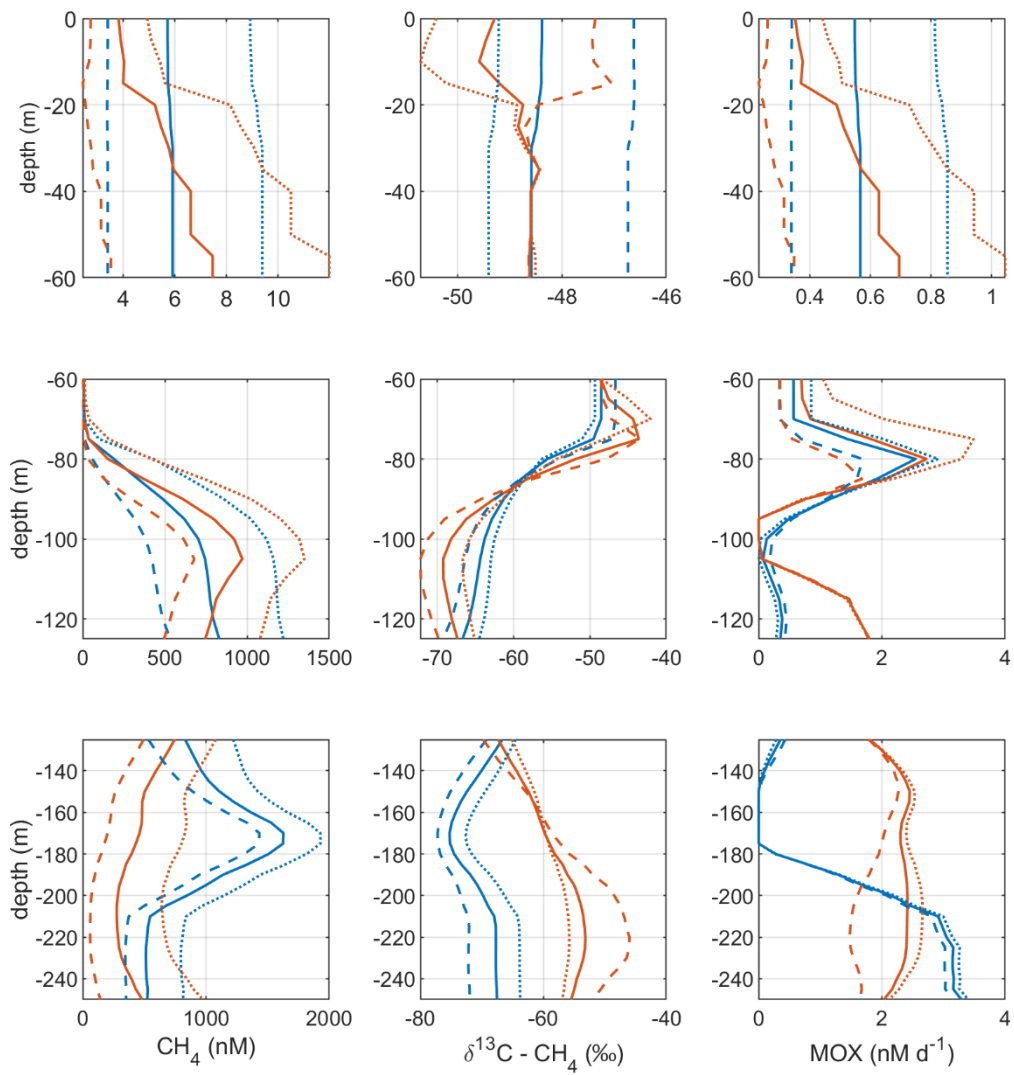
**Figure S8: Monthly mean profiles of  $\text{CH}_4$  (nM),  $\delta^{13}\text{C}-\text{CH}_4$  (‰), and  $\text{MOX}$  ( $\text{nM d}^{-1}$ ) in the Gotland Sea sub-basin (see Figure S1) in February (blue) and August (red) in year 2015: comparison between the standard (full lines), test 5 ( $h_{\text{O}_2}$  -50%; dashes), and test 6 ( $h_{\text{O}_2}$  +50%; dots) runs, respectively (see Table 3 in main article).**



**Figure S9: Monthly mean profiles of  $\text{CH}_4$  (nM),  $\delta^{13}\text{C}-\text{CH}_4$  (‰), and  $\text{MOX}$  ( $\text{nM d}^{-1}$ ) in the Gotland Sea sub-basin (see Figure S1) in February (blue) and August (red) in year 2015: comparison between the standard (full lines), test 7 ( $\alpha_{oxi}$  -4‰; dashes), and test 8 ( $\alpha_{oxi}$  +4‰; dots) runs, respectively (see Table 3 in main article).**



**Figure S10: Monthly mean profiles of  $\text{CH}_4$  (nM),  $\delta^{13}\text{C}-\text{CH}_4$  (‰), and MOX ( $\text{nM d}^{-1}$ ) in the Gotland Sea sub-basin (see Figure S1) in February (blue) and August (red) in year 2015: comparison between the standard (full lines), test 9 ( $\delta^{13}\text{C}-\text{CH}_{4\text{sed}} -10\%$ ; dashes), and test 10 ( $\delta^{13}\text{C}-\text{CH}_{4\text{sed}} +10\%$ ; dots) runs, respectively (see Table 3 in main article).**



**Figure S11: Monthly mean profiles of  $\text{CH}_4$  (nM),  $\delta^{13}\text{C}-\text{CH}_4$  (‰), and MOX ( $\text{nM d}^{-1}$ ) in the Gotland Sea sub-basin (see Figure S1) in February (blue) and August (red) in year 2015: comparison between the standard (full lines), test 11 ( $r_{sed} -50\%$ , oxic water; dashes), and test 12 ( $r_{sed} +50\%$ , oxic water; dots) runs, respectively (see Table 3 in main article).**