

1 Our responses are in black, marked as **[Response]**, and the comments of the Editor
2 are in purple, marked as **[Comment]**. In our responses, we mark the changes in the
3 manuscript with shading and separate comments using "*****".

4 Editor (Remarks to the Author):

5 While the latest revisions in response to reviewer comments have helped to
6 clarify the manuscript, further clarifications in some instances would be helpful (see
7 specific comments attached). I recommend that the authors re-read the manuscript
8 carefully with particular attention to clarity to make it as easy as possible to the reader
9 to follow.

10 We thank Dr. Zickfeld for taking the time to read the manuscript and providing
11 additional comments to improve it. We have followed the recommendation, gone
12 through the manuscript and made small changes to make it easier for the reader to
13 follow. We hope that the revised manuscript is now ready for publication in *ESD*.

14 *****

15 **[Comment 1]**

16 I. 41: A reference to this recent study is missing:

17 Nzotungicimpaye et al., 2023, Delaying methane mitigation increases the risk of
18 breaching the 2°C warming limit. *Communications Earth and Environment* 4, 250,
19 <https://doi.org/10.1038/s43247-023-00898-z>

20 **[Response]**

21 Thank you for pointing out the study that we missed. We added the reference.

22

23 **[Comment 2]**

24 I. 58-60: Nzotungicimpaye et al., 2023 also discusses the effect of methane mitigation
25 on the carbon cycle

26 **[Response]**

27 We added the summary of research findings of Nzotungicimpaye et al., 2023 to the
28 introduction as follows:

29 Using intermediate-complexity Earth System Climate Model simulations,
30 Nzotungicimpaye et al. (2023) showed that delaying methane mitigation has
31 implications both for meeting the stringent temperature targets and for the climate over
32 many centuries.

33

34 **[Comment 3]**

35 l. 69 “nonlinearity in the system”: cite Schwinger et al., 2014; Zickfeld et al., 2011 again
36 here.

37 **[Response]**

38 Citation is now added.

39

40 **[Comment 4]**

41 l. 157 “Three ensemble members...”: Clarify whether three ensemble members are
42 run for each experiment.

43 **[Response]**

44 Clarification added: “For each experiment, three ensemble members”. We have also
45 added the following clarifying text:

46 We note that the use of three members is not ideal, but it is a common compromise
47 between computational cost and sampling the uncertainty due to climate variability.

48

49 **[Comment 5]**

50 l. 175-176: “The beta feedback reflects the strengthening...”: This is only true for rising
51 atmospheric CO2 concentrations. I suggest to word this in a neutral way that applies
52 to both increasing and decreasing atmospheric CO2.

53 **[Response]**

54 We agree and simplified the text to:

55 The β feedback reflects the changes in land and ocean carbon pools driven by
56 the changes in CO₂ concentrations.

57

58 **[Comment 6]**

59 l. 176 “positive response”: Avoid value judgements in this context as there is a risk of
60 confusion with the sign of the feedback.

61 **[Response]**

62 We removed the sentence from the revised manuscript.

63

64 **[Comment 7]**

65 l.180-181: “The gamma feedback reflects the weakening...”: This is only true for rising
66 temperature. As for beta, I suggest to word this in a neutral way that applies to both
67 warming and cooling.

68 **[Response]**

69 We agree and simplified the text to:

70 The γ feedback reflects the changes in the land and ocean carbon pools due to
71 the changes in climate.

72

73

74 **[Comment 8]**

75 l. 267-268: This sentence is confusing. Why not say “Radiative forcing alone ([CO₂rad]
76 experiment) leads to a slightly higher global temperature increase compared to the
77 coupled [CO₂] experiment, which includes the combined effect of CO₂ physiology and
78 radiative forcing”.

79 **[Response]**

80 We think the Editor refers to lines 257-258. We agree that the suggested change
81 makes the statement clearer. Changed accordingly.

82

83 **[Comment 9]**

84 I. 314: Fig. 3 caption: Point out that vertical axes differ between panels e, g and i, j.

85 **[Response]**

86 We added clarification to the caption: Note that vertical axes differ between panels e,
87 g and i, j.

88

89 **[Comment 10]**

90 I. 322: "... ocean carbon sink". I think this should read "ocean carbon source".

91 **[Response]**

92 Corrected.

93

94 **[Comment 11]**

95 I.323-324: "It is nearly equivalent ...". I wonder if the difference between land and
96 ocean is merely due to the different vertical scales used in Fig. 3 panels e, g?

97 **[Response]**

98 We understand the Editor's concern. With only a three-member ensemble, it is
99 challenging to confirm differences statistically. The quantified differences for χ , as
100 shown in Tables 2 and S1, suggest a larger difference for the ocean, partly due to the
101 higher uncertainty associated with the land. We have revised the text as follows for a
102 more careful statement to avoid misinterpretation:

103 The χ feedback is positive (larger carbon sink) in the land and negative (larger carbon
104 source) in the ocean (Table S1). There is no significant difference between CO₂ and
105 non-CO₂ χ feedback at similar ERF levels (Fig. 3e-j, Fig. 4 f-g, Tables 2 and S1).

106

107 **[Comment 12]**

108 I.324: Should refer to panels e, g (not f, g).

109 **[Response]**

110 Originally, we refer to panels f, g of Fig. 4 (showing spatial variation). We guess that
111 the Editor refer to panels e, g of Fig. 3. We agree that panels e, g (also i and j) are
112 relevant to our statement. We changed text to have all: (Fig. 3e-j, Fig. 4 f-g, Tables 2
113 and S1).

114

115 **[Comment 13]**

116 I. 334-335 “greater reduction in the climate-driven carbon sink”: In my mind this should
117 read “greater reduction in the CO₂-driven sink”. Climate (warming) drives a source,
118 whereas rising atmospheric CO₂ drives a sink.

119 **[Response]**

120 We agree, changed accordingly.

121

122

123 **[Comment 14]**

124 I. 350-352. Clarify which experiment you are referring to. I suppose it's [CO₂-BGC]
125 and [non-CO₂]?

126 **[Response]**

127 We refer to [CO₂] – [CO₂bgc] and [nonCO₂], clarified in the revised manuscript.

128 ... (compare red and black lines in Fig. 3, corresponding to $[\text{CO}_2] - [\text{CO}_2\text{bgc}]$ and
129 $[\text{nonCO}_2]$ experiments) ...

130

131 **Edits/typos:**

132 l. 64 and elsewhere: “over the ocean” should read “in the ocean”.

133 l. 100: “runup for” à “runup to”

134 l. 278: delete extra “in”.

135 l. 335: delete extra “driven”.

136 l. 413: “priority to” à priority over”.

137 l. 413: insert “they” before “provide”.

138 **[Response]**

139 Corrected.