Proposed changes to "Exploring the response of West Siberian wetland methane emissions to future changes in climate, vegetation, and soil microbial communities" by T. J. Bohn and D. P. Lettenmaier

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1. Proposed Changes to the Paper

1.1 Recalibration of methane emissions parameters

We will replace the set of methane emissions model parameters used in this study with a new set, as follows:

- Instead of our previous empirical division of the domain into northern and southern halves, we will divide the domain into sphagnum-dominated and non-sphagnum-dominated wetlands, based on the map of Peregon et al. (2008).
- We will replace the optimized Q10 values with average observed Q10 values from Lupascu et al. (2012), assigned by wetland type according to the map of Peregon et al (2008). In grid cells containing primarily sphagnum-dominated wetlands (primarily south of 63 N), the average Q10 of 8 for sphagnum-dominated wetlands from Lupascu et al (2012) will be applied. In grid cells containing primarily sedge-dominated wetlands, the average Q10 of 4.3 from Lupascu et al. (2012) will be applied. In all other wetlands, the average Q10 across all wetland types (approximately 5.6) from Lupascu et al. (2012) will be applied. It should be noted that this distribution of Q10 values will not differ dramatically from the distribution we used in the current version of the paper, other than exhibiting a slightly smaller difference between north and south.
- We will implement a parameterization for oxidation of methane in the water column under inundated conditions. Our model already simulates the physics of the standing water (energy balance, wind-driven mixing, etc) and can provide water depth, temperature, and mixing depth to the Walter-Heimann model, which can perform the appropriate chemistry. This feature should have a noticeable effect on the response of methane emissions to climate.
- Using a similar approach to that of Bohn et al (2013), we will recalibrate the Walter-Heimann model parameters, focusing on a new set of parameters (r0, xvmax, oxq10, rkm, P_{ox}, and V_{transp}), using fixed Q10 (the rq10 parameter) as a function of wetland type (described above), with random noise added to the Q10 to account for uncertainty in its value. If we see strong evidence for using separate parameter sets as a function of wetland type (aside from the

prescribed variation in the Q10 of methanogenesis), we will use them in our experimental cases; otherwise we will use a single parameter set across the entire domain.

1.2. New experimental cases

The new set of experimental cases is listed in Table 1. Aside from using the recalibrated methane parameters described above, our proposed changes primarily affect the soil microbial cases, as follows:

- Cases 1-5 are the same as in current manuscript, but with error bars due to climate and methane emissions parameter uncertainty added to the plots.
- Case 6 will replace the "Acc+NoShift" case of the current manuscript. It is similar to "Acc+NoShift" case, but instead of a single 10-year running mean, we will employ the formulation of Koven et al. (2011) for a 10-member ensemble of characteristic lengths ranging from 1 to 30 years. Error bars due to uncertainty in climate, methane parameters, and acclimatization will be shown in the plots.
- Cases 7-10, involving various forms of "wetland migration", will replace the "Acc+Shift" case. The "Acc+Shift" case is similar to the maximum end of the ensemble of wetland veg+soil migration cases, in which all parameters migrate the maximum extent northward.

To explore the northward migration of wetland types, we will link occurrence of each wetland type to June-July-August (JJA) air temperature. Our motivation for doing this is that the current distribution of wetland types in the wetland map of Peregon et al (2008) is almost entirely determined by JJA air temperature (Figure 1a): sedge- and grass-dominated wetlands occur where JJA air temperature > 17.5 C; sphagnum-dominated (with and without trees) wetlands occur where JJA air temperature falls between 13.75 and 17.5 C; and all other types (without explicit dominance by sphagnum or sedge) occur where JJA air temperature falls below 13.75 C. The distribution of wetland types does not correlate strongly with other variables we have examined, such as JJA precipitation or JJA inundated area (Figures 1b-c). Correlation with topographic index (not shown) is similarly poor. Error bars due to uncertainty in climate, methane parameters, acclimatization (cases 8 and 10), and migration of vegetation and soil parameters will be shown in the plots.

1.3. Summary of changes to the paper

The contents of the paper will change as follows:

- We will remove the sections of the paper discussing changes in seasonality (section 3.4, paragraph 2 of section 4, Figure 6), since this was only a minor result.
- We will remove our estimates of greenhouse warming potential, as these a) depend on estimates of other carbon fluxes computed in a previous study (Bohn et al., 2013), b) depend on the method of computation, and c) are not very useful when only computed for the wetland portion of the landscape, as we have done here.
- We will add descriptions of the new experimental cases to sections 2.5 and 3.3, and add these results to Figures 4 and 5. We will add a discussion of the results of these new cases to the discussion section (section 4).

- We will add a plot of wetland fractions as a function of environmental factors (similar to Figure 1, below).
- Our conclusions will reflect the results from our additional experimental cases.

2. References

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3. Tables

Table 1: Revised experimental cases for this study.

Case	**N**	**Climate**		**LAI**	**Wetland Migration**		**Microbial Acclimatization**
		Warming	**Drying**		**Veg parameters**	**Soil parameters**	
1	1 (historical climate) * 10 (CH4 param. Uncertainty)	-	-	-	-	-	-
2	1 (CMIP5 ensemble mean) * 10 (CH4 param. Uncertainty)	x	-	-	-	-	-

3	1 (CMIP5 ensemble mean) * 10 (CH4 param. Uncertainty)	x	-	x	-	-	-
4	32 (CMIP5 ensemble) * 10 (CH4 param. Uncertainty)	x	x	-	-	-	-
5	32 (CMIP5 ensemble) * 10 (CH4 param. Uncertainty)	x	x	x	-	-	-
6	32 (CMIP5) * 10 (window length) * 10 (CH4 param. Uncertainty)	x	x	x	-	-	x
7	32 (CMIP5) * 10 (CH4 param. Uncertainty)	x	x	x	x	-	-
8	32 (CMIP5) * 10 (window length) * 10 (CH4 param. Uncertainty)	x	x	x	x	-	x
9	32 (CMIP5) * 10 (CH4 param. Uncertainty)	x	x	x	x	x	-
10	32 (CMIP5) * 10 (window length) * 10 (CH4 param. Uncertainty)	x	x	x	x	x	x

4. Figures

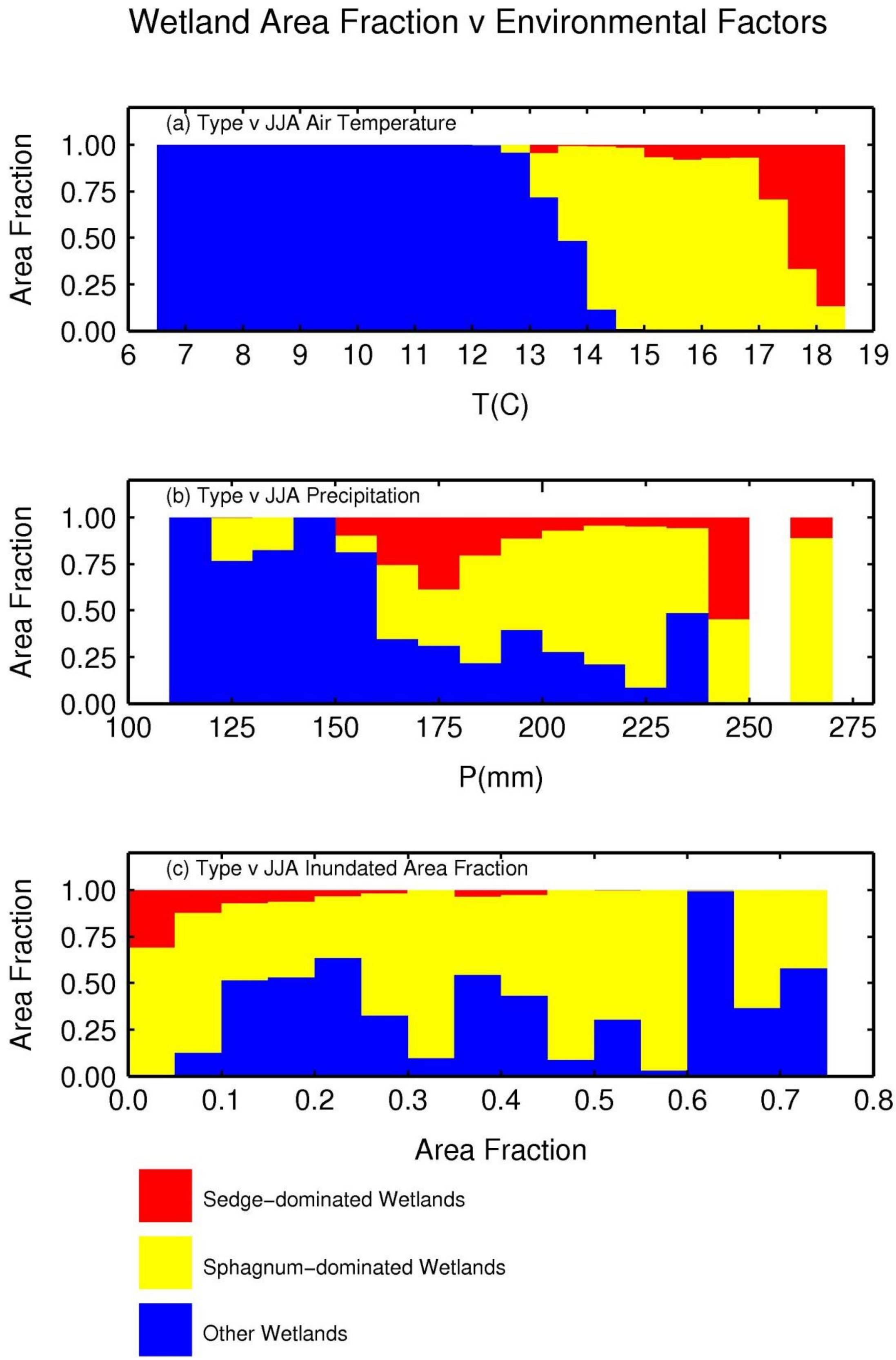

Figure 1. Wetland composition as a function of various environmental factors.