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Climate of the Past Discussions

Interactive comment on "The importance of Northern Peatlands in global carbon systems during the Holocene" *by* Y. Wang et al.

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We thank Dr. Ruddiman for his review and comments. As discussed by Dr. Ruddiman, the cause of the ∼20 ppmv CO2 anomaly has generated interests, analysis, and discussion in the paleoclimate community since its first discovery from the Antarctic Taylor Dome Ice Core. No less than four hypotheses have been proposed to explain the origin of this CO2 anomaly, namely, 1) a terrestrial carbon source, 2) deep oceanic adjustment, 3) coral reef buildup, and 4) anthropogenic land use land cover changes with potential strong feedbacks from the Southern Ocean.

The common feature of previous modeling studies is the neglect of the slow but persistent development of the Northern Peatlands (NPs) sine the last deglaciation (around 12-13 thousand years before present). There are many reasons why NPs have not

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yet been included in this type of analysis. First, a complete initial dating/mapping of NPs is still under development. Second, the carbon density of NPs seems very inhomogeneous. Third, the growth rate of NPs âĂŤ both vertical accumulation and lateral spreading (paludification) âĂŤ may be highly sensitive to climatic forcings, so a feedback mechanism is important but a dynamically-coupled peatland simulator in a global climate model is not yet fully developed.

As pointed out by Dr. Ruddiman, our line of reasoning does not fully resolve the issue of Holocene carbon cycle dynamics. We notice that anthropogenic land use and land cover perturbation to global carbon cycle dynamics is not considered in our analysis. In particular, the potential Southern Ocean amplification to human carbon perturbation becomes the key to solve the missing carbon source in Ruddiman's line of reasoning. Since our marine carbon cycle component is still under development and testing, we could not evaluate this Southern Ocean Hypothesis.

The last point made by Dr. Ruddiman further illustrates the complexity nature of glacial-interglacial carbon cycle dynamics in the past. While a natural cause of this Holocene CO2 anomaly is still arguable, we will see how the modeling study by Kutzbach et al. can shed new lights on this critical anthropogenic hypothesis of Dr. Ruddiman.

In response to Dr. Ruddiman's two minor comments/suggestions:

1) In our revised Figs. 1 and 8, we have utilized the new gas-age Dome Concordia CO2 data as derived in Parrenin et al. (2007, Climate of the Past) and Loulergue et al. (2007, Climate of the Past), and available in Luthi et al. (2008, Nature) supplementary material. 2) We agreed with Dr. Ruddiman that the radiative effect of global methane is not small. We have modified our paper, removing the statement about "quite small impacts", and instead reporting the recent estimate by Frolking and Roulet (2007) of the magnitude of the radiative effect of northern peatland methane emissions through the Holocene (roughly 0.05-0.1 W/m2).

Interactive comment on Clim. Past Discuss., 5, 1231, 2009.