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Climate of the Past Discussions

Interactive comment on "The Plio-Pleistocene climatic evolution as a consequence of orbital forcing on the carbon cycle" *by* Didier Paillard

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First, I would like to thank the referee for his comments and encouragements. His main point concerns the role of petrogenic organic carbon, which represents a significant contributor to the long-term carbon cycle with also a significant role on the isotopic budget.

Indeed, my model considers only three sources and sinks of carbon : volcanic carbon (V) which is always a source ; carbonate precipitation (D) which always represents a net sink, though both dissolution and accumulation are considered through carbonate compensation; and finally organic carbon (B) which corresponds both to sinks (burial of recent organic matter), but also possibly to sources (oxidation of old organic car-

bon). Though this was not explicitly detailed in the manuscript, this last possibility (ie. a negative contribution to B, or "negative" burial) can be in part interpreted as a petrogenic organic carbon source. So implicitly, the model does already include petrogenic organic carbon. But, as explained by reviewer #1, this point needs to be discussed more precisely in a revised manuscript, since the negative contributions to B were only described as Âń net "old" soil erosion and remineralization Âż in the original submitted paper. Clearly, this was misleading.

As summarized by reviewer #2 (doi:10.5194/cp-2017-3-RC2) , the model is based first of all, on a rather standard steady-state equation for carbon. From the isotopic balance equation (2b), we deduce that the baseline (long-term) value B0 for all organic fluxes, including petrogenic ones, should be about 20% of the volcanic flux, that is B0 = V/5, in order to account for observed isotopic compositions. This baseline value B0 represents the sum of positive terms, mostly due to the burial of recent organic matter, but also negative ones that correspond to the oxidation of "old" soils and indeed "petrogenic" or "fossil" organic matter. As underlined by reviewer #1, the absolute magnitude of each term is currently not well constrained and positive and negative contributions to B0 are, individually, possibly comparable to V: indeed, if V is taken in the range of 40 to 175 TgC/yr âĂŤ(Burton et al., 2013), the estimate for petrogenic organic carbon from Blair et al. (2003) [36 to 48 TgC/yr] corresponds to the lower range of V. This certainly needs to be explained in the revised manuscript.

Still the main point of the paper was not about the detailed steady state balance of the carbon system, but about its possible dynamics over the last 4 million years. For my model equations, only the net values of B0 (or B) are relevant. As explained by reviewer #1, the dynamics of petrogenic organic matter fluxes will depend on erosion and continental runoff. It will therefore contribute to the generic situation described in the manuscript, or "Amazon-like" situation, with enhanced organic carbon oxidation when precession maxima favours more precipitation and erosion. More precisely, when including precessional forcing through B = B0 - a F(t) with the numerical values B0 =

25 TgC/yr , a = 50 TgC/yr (see legend of Fig.2), then the “net burial” B does change sign through time, and becomes temporarily a carbon source when negative: it is then dominated by the oxidation of organic matter (soil, but also fossil or petrogenic. . .).

This will be discussed in more details in the revised manuscript.

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