Climate of the Past
An Interactive Open Access Journal of the European Geosciences Union

Clim. Past, 5, 431-440, 2009
www.clim-past.net/5/431/2009/

Climate and CO_2 modulate the C_3/C_4 balance and $\delta^{13}C$ signal in simulated vegetation

O. Flores[1], E. S. Gritti[1,2], and D. Jolly[2]
[1]CEFE, UMR 5175 CNRS, 1919, route de Mende, 34293, Montpellier cedex 5, France
[2]ISEM, UMR 5554 CNRS/Univ. Montpellier II, Case 61, 34095 Montpellier cedex 5, France

Abstract. Climate and atmospheric CO_2 effects on the balance between C_3 and C_4 plants have received conflicting interpretations based on the analysis of carbon isotopic fractionation ($\delta^{13}C$) in sediments. But, climate and CO_2 effects on the C_3/C_4 balance and $\delta^{13}C$ signal are rarely addressed together. Here, we use a process-based model (BIOME4) to disentangle these effects. We simulated the vegetation response to climate and CO_2 atmospheric concentration (pCO_2) in two sites in which vegetation changed oppositely, with respect to C_3 and C_4 plants abundance, during the Last Glacial Maximum to Holocene transition. The C_3/C_4 balance and $\delta^{13}C$ signal were primarily sensitive to temperature and CO_2 atmospheric partial pressure. The simulated variations were in agreement with patterns observed in palaeorecords. Water limitation favoured C_4 plants in case of large negative deviation in rainfall. Although a global parameter, pCO_2 affected the $\delta^{13}C$ signal differently from one site to the other because of its effects on the C_3/C_4 balance and on carbon isotopic fractionation in C_3 and C_4 plants. Simulated Plant functional types (PFT) also differed in their composition and response from one site to the other. The C_3/C_4 balance involved different competing C_3 and C_4 PFT, and not homogeneous C_3 and C_4 poles as often assumed. Process-based vegetation modelling emphasizes the need to account for multiple factors when a palaeo-$\delta^{13}C$ signal is used to reconstruct the C_3/C_4 balance.

Final Revised Paper (PDF, 854 KB) Discussion Paper (CPD)

Citation: Flores, O., Gritti, E. S., and Jolly, D.: Climate and CO_2 modulate the C_3/C_4 balance and $\delta^{13}C$ signal in simulated vegetation, Clim. Past, 5, 431-440, 2009. Bibtex EndNote Reference Manager