

Quaternary climate - Terrestrial Biosphere Interaction: amplifying or stabilizing?

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According to the Gaia hypothesis, interaction between climate and biological processes tend to homeostatically maintain, on a global scale, conditions favourable for life. Does the idea of homeostatic interaction between terrestrial biosphere and climate hold for the Quaternary glacial – interglacial changes? Interpretation of palaeoclimate and palaeobotanic evidence by using climate and Earth system models yields an interesting picture. The synergy between the sea-ice albedo - climate feedback and the taiga-tundra – climate feedback is suggested to amplify the orbitally forced climatic precession. This effect seems to be strong at regional scale, but small at global scale. Various simulations indicate that biogeophysical processes amplify the difference of some 4 to 6 K in global mean temperature between glacial and interglacial climate by some 10 percent. The combined effect of biogeophysical and biogeochemical processes, i.e. processes with involve carbon stored in biomass and soil, is less clear. Theoretical studies suggest that in pre-industrial, interglacial climate, a reduction in boreal and extratropical forests tend to cool the climate and a reduction in tropical forest, to warm the climate. Recent estimates in changes in organic carbon stored under ice sheets and in permafrost point at the possibility that the sum of all terrestrial biogeochemical processes might almost “carbon neutral” to the climate system. If corroborated, this observation would favour the assumption of a dominance of biogeophysical processes amplifying orbitally forced Quaternary climate variations.