Geophysical Research Abstracts
Vol. 17, EGU2015-4079, 2015
EGU General Assembly 2015

Management and fertility control ecosystem carbon allocation to biomass production

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Carbon (C) allocation within the ecosystem is one of the least understood processes in plant- and geo-sciences. The proportion of the C assimilated through photosynthesis (gross primary production, GPP) that is used for biomass production (BP) is a key variable of the C allocation process and it has been termed as biomass production efficiency (BPE). We investigated the potential drivers of BPE using a global dataset of BP, GPP, BPE and ancillary ecosystem characteristics (vegetation properties, climatic and environmental variables, anthropogenic impacts) for 131 sites comprising six major ecosystem types: forests, grasslands, croplands, tundra, boreal peatlands and marshes. We obtained two major findings. First, site fertility is the key driver of BPE across forests, with nutrient-rich forests allocating 58% of their photosynthates to BP, whereas this fraction is only 42% for nutrient-poor forests. Second, by disentangling the effect of management from the effect of fertility and by integrating all ecosystem types, we observed that BPE is globally not driven by the 'natural' site fertility, but by the positive effect brought by management on the nutrient availability. This resulted in managed ecosystems having substantially larger BPE than natural ecosystems. These findings will crucially improve our elucidation of the human impact on ecosystem functioning and our predictions of the global C cycle.