Geophysical Research Abstracts,
Vol. 11, EGU2009-6069, 2009
EGU General Assembly 2009


# Differential responses to anthropogenic N on the C balance of tropical lowland and montane forests in Panama

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N deposition is projected to double in tropical forests but consequences for the carbon balance are severely understudied. We used N-addition experiments (125 kg Urea-N $ha^{-1}$ $yr^{-1}$) to obtain N-enriched conditions in contrasting lowland and montane tropical forests with the following goals: 1) to evaluate how increased anthropogenic N affects net primary production, NPP (stem growth, litterfall, fine root production) and 2) to evaluate how increased anthropogenic N affects soil C cycling. The experiment in the lowland forest was conducted in a species-rich, old-growth forest on a Cambisol with a relatively high buffering capacity. The experiment in the montane forest was conducted in a species-rich, old-growth forest on an Andisol with low buffering capacity.

In the lowland forest NPP was neither N- nor phosphorus-limited. Stem diameter growth, fine root biomass, and fine litterfall were not significantly effected by 4, 5 and 6 years of N addition, respectively. Soil $CO_2$ efflux and total belowground C allocation (TBCA) in this lowland forest did not differ after 9-10 yr N addition from the control, suggesting that chronic N input to this nutrient-rich tropical lowland forests did not affect the C balance. In the montane forest, overall stem diameter growth and above-ground woody biomass production (AWBP) were influenced by the disparity of responses to N fertilization of the different DBH classes and/or species. Stem growth of trees in 10-30 cm DBH class tended to be stimulated quickly by N addition while trees >30 cm DBH showed a slower response. Among the most abundant species, stem diameter growth of *Eschweilera panamensis* in 10-30 cm DBH class was higher in the N-fertilized than the control plots in the first year. Stem growth of other species showed no reaction to N addition. Fine litterfall, of which 67 % was leaf litter, increased with N fertilization. ANPP (AWBP + fine litterfall) increased with N addition in the first year, to which 66 % was contributed by fine litterfall. Production and turnover of fine roots were not affected by N fertilization after 1.5 years, but the fine root biomass allocated to the 10-20 cm mineral soil depth in the N-fertilized plots was increased two-fold compared to the control. In the montane forest, 1-yr N addition did not affect soil $CO_2$ efflux but annual $CO_2$ efflux was reduced by 16% in the second year N addition compared to the control. This reduced soil $CO_2$ efflux in combination with higher litterfall suggests an increase in soil C storage following N enrichment.

The combined results suggest that if projected increases in N deposition to the montane forest occur, species with N-limited productivity may gain advantage over species which are adapted well to the inherent N availability. Furthermore, N deposition may lead to enhanced C sequestration both in plant biomass and in the soil. In contrast, we found no evidence that on decadal time scale increased N deposition to the lowland forest will affect species composition and C sequestration.