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Nitrogen-induced reduction in soil respiration of European forests

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Soil heterotrophic respiration is parameterized in vegetation models as a temperature-dependent decay function, and is usually spatially constant. We test this fundamental assumption with chamber-based observations of the soil carbon efflux along a >1,100km transect throughout European forests, where the latitude is kept constant to control for insolation.

We find a modest, but significant, inter-site linear correlation between air temperature and carbon efflux (r^2 = 0.32, p=0.02), but not at 5cm depth soil temperature (r^2 = -0.02, p=0.4). Average midday respiration increased West-East and correlates well with distance from the coast (r^2 = 0.55, $p<0.02$). Since soil carbon content proved to be a poor explanatory variable (r^2=0.04, p=0.5), we turn our attention to nitrogen deposition to find a strong inverse relationship (r^2=-0.5, $p<0.01$; linear model).

We are thus able to reject the null hypothesis that there is no spatial variation in soil efflux amongst comparable sites along the same latitude. Critically, we compliment our analysis with independently measured FLUXNET data that accord with our field observations. In both cases, nitrogen is a more reliable predictor of carbon efflux at the inter-site, grid-size scale than temperature. We explain the reduction in soil respiration as a result of nitrogen inhibition of decomposition.