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A general framework for nitrogen deposition effects on soil respiration in global forests

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Soil respiration (*SR*) is one of the largest land-atmosphere carbon fluxes. Since the industrial revolution, human activities have altered atmospheric nitrogen (N) deposition in forests, potentially affecting biotic activities and changing *SR*. However, this is highly uncertain, as mixed effects of N inputs on *SR* (i.e., increasing vs. decreasing) were observed in global forests. Here we synthesized data from global N addition experiments to quantitatively analyze how N increases or decreases *SR*. The revealed patterns were consistent with the observed *SR* changes across the natural N deposition gradient, providing a general framework to explain the diverse effects of N input on *SR* in global forests. Using a novel probabilistic approach, we estimated that N deposition decreased *SR* in 2.9% of global forests, mostly N-saturated forests in eastern China, western Europe, and eastern USA. But the net effect of N deposition increased the global forest *SR* budget

by 5.1% (1.7 PgC yr^{-1}). If N pollution could be effectively controlled, global forest *SR* and its variability would decrease, thereby reducing the uncertainty in the projected terrestrial carbon dynamics.