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Global convergence in the temperature sensitivity of respiration at ecosystem level

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The release of CO_2 from the land surface—the “terrestrial ecosystem respiration”—constitutes a major flux in the global carbon cycle, counterbalancing photosynthetic CO_2 uptake. Understanding the dynamics of the underlying processes, in particular, determining the sensitivity of respiratory processes to temperature is central for quantifying the climate–carbon cycle feedback. However, retrieving the “intrinsic” temperature response of ecosystem respiration is complicated by the fact that observed CO_2 fluxes and meteorological drivers vary on multiple time scales. This multiscale variability induces confounding effects that hamper the investigation of such temperature sensitivities in conventional model–data synthesis approaches. We demonstrate how a multiscale approach is needed to overcome problems of process identification when confounding factors operate on different time scales and apply it to the widely used empirical Q_{10} model. Here we approximate the “intrinsic" temperature sensitivity (Q_{10}) of terrestrial ecosystem respiration across 60 FLUXNET sites in different ecosystems. Our results suggest that Q_{10} is largely temperature invariant, does not depend on plant functional types and is confined to values around 1.5. These results resolve the long standing debate how to parameterize the temperature sensitivity of respiratory processes in current terrestrial biosphere models. We expect the presented model–data fusion strategy to be of relevance for understanding various ecosystem–atmosphere feedback systems.