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Global consistency in response of terrestrial ecosystem respiration to temperature

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Many studies have been carried out to quantify the trend of terrestrial ecosystem respiration (Re) in a warming world, but a conclusive answer has not yet been confirmed because the temperature sensitivity of Re was found inconsistent under different scales or regarding different types of respiratory flux. Aiming at clarifying the relationship between temperature and Re across different scales, we proposed a method to counteract the confounding effect and applied nine empirical models to a 1,387 site-years FLUXNET dataset. Regarding the temperature sensitivity of half-hourly Re records, we found a surprisingly consistent result that the sigmoid functions outcompeted other statistical models in almost all datasets (account for 82%), and on average, achieved a staggering R^2 value of 0.92, indicating the positive correlation between Re and temperature on fine time scale (within one site-year dataset). Even though Re of all biomes followed sigmoid functions, the parameters of the S-curve varied strongly across sites. This explains why measured Q_{10} value (an index denote temperature sensitivity) largely depends on observation season and site. Furthermore, on the interannual variation of Re, we did not find any relationship between mean annual temperature (MAT) and mean annual Re within any site, which implies that the small year-to-year variation of the sigmoid pattern is large enough to counteract the warming effect on Re. This study thereby put forward a conceptual model to integrate the relationship between temperature and Re under different scales. It also provided evidences to support the argument that the relationship between MAT and mean annual Re (i.e., respiration under global warming) should not be inferred from studies on other temporal or spatial scales.