Rapid laboratory measurement of the temperature dependence of soil respiration.

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Soil respiration is extremely sensitive to changes in moisture and temperature and small changes in these variables can have a major influence carbon cycling. Determining the temperature dependence of soil respiration is crucial to improving predictive models of daily through to annual time scales. Current methods are often limited in the number of temperatures at which respiration is measured and frequently have long incubation times that can both decrease the precision of fitted models. We developed a laboratory method to rapidly determine soil respiration rate at a wide range and number of temperatures. A temperature block (1400 long x 130 wide x 190 mm high), cooled at one end (~2°C) and heated at the other (~50°C), allowed for the simultaneous incubation of 44 soil samples measurements of soil respiration rates at approximately 1°C increments. Gas samples were taken after 5 h and analysed for CO_2. Resultant temperature response data were fitted with the macromolecular rate theory (MMRT) that allows calculation of a temperature optimum (Topt) and the temperature at which absolute temperature sensitivity is maximal (Tinf). This method was used to measure temperature response of three soils at seven moisture contents and demonstrated that the absolute rate and sensitivity of respiration was dependent on adjusted moisture content. Also measured were potential seasonal changes in the temperature dependence of respiration for three different soils collected at one site. Tinf ranged from 43 and 51°C and was not dependent on soil type collected within season but was partly dependent on season of collection suggesting microbial function was similar between soils at one location but adapted their temperature responses to seasonal cycles. The method was robust, rapid and repeatable allowing for the testing of different models and exploring existing theories of temperature and moisture interactions controlling biochemical processes.