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Preface

Soil respiration has been studied by biologists for many years. More recently, it has been identified as the major source of carbon dioxide respired from terrestrial ecosystems, calling for advancing understanding of the key mechanisms and incorporating this new understanding into ecosystem process models.

The workshop identified information needed to build an understanding of the belowground carbon cycle: (1) the mechanisms that control the coupling of canopy and belowground processes; (2) the responses of root and heterotrophic respiration to environment; (3) plant carbon allocation patterns, particularly in different forest developmental stages, and in response to treatments (warming, CO2, nitrogen additions); and (4) coupling measurements of soil respiration with aboveground processes and changes in soil carbon.

This special issue begins with an overview (Ryan and Law) of the role of soil respiration in determining ecosystem carbon balance, and the conceptual basis for measuring and modeling soil respiration with examples from papers in this issue. To advance the science, the paper recommends that multi-factor experiments should be sufficiently long to allow systems to adjust to the treatments, and it provides a list of core measurements for comparisons across sites. It suggests that new technologies will be necessary to reduce uncertainty in estimates of carbon allocation, soil carbon pool sizes, and different responses of roots and microbes to environmental conditions.

The issue includes several multi-site investigations of biotic and abiotic controls on soil CO2 efflux (Hibbard et al., DelGrosso et al., Hubbard et al.), and some used climatic/vegetation/disturbance gradients to quantify controls on effluxes (Campbell et al., Gough et al., Martin and Bolstad, Tang and Baldocchi, Yuste et al.). The issue includes results from experimental manipulations of litter inputs and roots (Sulzman et al.), winter and summer precipitation rates (Chimner et al.), and partial water availability to roots on individual trees (Irvine et al.).

This special issue was prompted by a workshop held October 2002 on measurement and analysis of soil CO2 efflux. We thank the National Institute for Global Environmental Change, (NIGEC) and Shashi Verma for funding the workshop and contributing to the development of the special issue. We hope the workshop and the papers published here will serve as a catalyst to advance efforts to quantify and understand controls on soil respiration.

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