

The Forest as an Integral Component of the Climate System

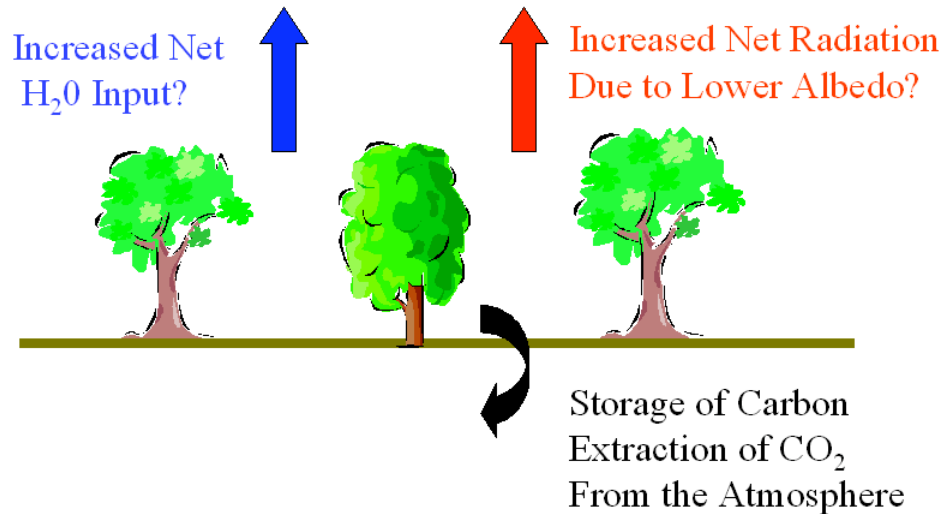
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The prevailing perspective that the climate system evolves independently of forest (and other ecosystem) dynamics is becoming recognized as flawed. Rather than a prescribed surface boundary for atmospheric-ocean general circulation models, for example, the earth's surface involves complex, nonlinear interfacial fluxes. These fluxes involve physical, chemical, and biological transfers (Pielke 2001a).

In my talk, coupled atmospheric-ecosystem function model results are presented which illustrate this interaction. Carbon dioxide concentrations in the atmosphere are shown to significantly influence the transpiration of water and the growth of transpiring leaf area. Storage of carbon in the soils and release of carbon dioxide from soils and vegetation are affected as a result (Pielke 1998).

The complex interaction associated with carbon dynamics makes the issue of carbon sequestration a multi-faceted problem (Pielke 2001b). If the goal is to reduce carbon dioxide in the atmosphere, in order to reduce the greenhouse gas warming potential of this gas, an associated darkening of the surface, as carbon is stored in the upper soil layers could actually result in a net radiative warming (Figure 1).



Carbon sequestration as an integrated Earth system issue.

The alteration of the landscape in order to sequester carbon could have other climate consequences. Tropical deforestation not only results in the input of CO₂ to the atmosphere, but also can alter the regional and global hydrological cycle (Chase et al. 2000; Pielke 2001c) as tropical thunderstorm patterning is changed. Reforestation and afforestation would also have a regional and global effect on the hydrological cycle (e.g. see Xue and Shukla 1996).

Since carbon dynamics interacts with water, energy, and other trace gas dynamics within the earth's climate system, an integrated assessment is required to determine the costs and benefits to the environment of deliberate carbon sequestration.

References

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