



## **Responses of high latitude terrestrial ecosystems to global change: potential consequences for the climate system**

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While it is clear that changes in high latitude regions have consequences for the climate system via a number of possible pathways, we do not completely understand whether the net effect of changes will enhance or mitigate warming. Responses of water, energy, and trace gas exchange may result in either positive or negative feedbacks to both regional and global warming. Of particular concern is whether the net response of high latitude ecosystems could lead to positive feedbacks that greatly enhance the rate of regional and global warming. While the responses of carbon storage in high latitude ecosystems have important implications for the rate of CO<sub>2</sub> accumulation in the atmosphere and international efforts to stabilize the atmospheric concentration of CO<sub>2</sub>, it is important to understand how simultaneous changes in other trace gas exchanges and albedo of high latitude ecosystems also influence regional and global energy balance. For example, the reduction in radiative forcing associated with enhanced carbon storage from an expansion of the boreal forest may exceed the warming effects of lower albedo. Also, current responses of fire regimes to climate change suggest that fire is likely to increase in frequency and severity in the future, which has implications for both carbon storage and albedo of high latitude ecosystems. Increased delivery of freshwater from the high latitudes to the Arctic Ocean also has substantial implications for climate if it disrupts thermohaline circulation by weakening the formation of North Atlantic Deep Water, a response to warming that could ironically launch the Earth into another ice age. The exchange of water, energy, and trace gases among high latitude ecosystems, the atmosphere and the ocean are linked. Therefore, analyses of the response of high latitude ecosystems to global change will require an integrated understanding of how the response of these linkages will manifest them-

selves at a spectrum of spatial and temporal scales. Development of this integrated understanding will provide insight as to how climate change is affecting the high latitude ecosystems and is relevant to identifying the implications for how the responses of these ecosystems will influence climate change in other regions.