Geophysical Research Abstracts, Vol. 7, 05664, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05664

Terrestrial Productivity Feedbacks on High Latitude Warming

S.A. Cowling (1), C.B. Jones (2), and P.M. Cox (2)

(1) Department of Geography, University of Toronto, Canada, (2) UK Met Office, Exeter

Vegetation-climate feedbacks can be facilitated via changes in surface radiation balance (i.e. surface albedo) or via changes in atmospheric moisture (i.e. stomatal conductance). An increase in terrestrial productivity promoted by global warming and increases in atmospheric CO_2 are predicted to have strong consequences for surface albedo in northern latitudes. We used the fully-coupled Hadley GCM (HadCM3LC), however, to determine whether the independent effect of increased productivity on atmospheric transport of heat (latent energy) would also promote positive vegetation-climate feedbacks in polar regions. Our idealized experiment (we forced all plants to photosynthesize with the C_4-pathway) resulted in a substantial warming (up to 3˚C in DJF) in mid- and high Northern latitudes. Global terrestrial productivity more than doubled, caused in part by large increases in leaf area index (LAI increases >2 m^2m^{-2}). Particularly within regions of highest increases in LAI, latent heat production and convective rainfall were substantially greater than controls. Three latitudinal peaks in increased rainfall were observed: (1) the ITCZ region ($\sim$ 10˚S - 10˚N), (2) monsoons ($\sim$ 15˚N), and (3) a fairly wide range across the mid-latitudes (30-60˚N). The possibility that a greening of the Northern Hemisphere causes positive feedbacks on polar warming should be of concern, considering recent remote sensing studies have shown that the North Hemisphere has “greened” over the past couple decades.