



Future temperate and boreal terrestrial carbon sink reduced due to plant phenological responses to climate warming

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Controlled experiments show that temperate and boreal trees require chilling in winter for rapid leaf out in spring. If the amount of chilling falls below a species specific threshold then an exponentially increasing amount of warming is required to initiate leaf out – potentially actually delaying it in a future warmer climate. The boreal areas are particularly interesting as there the largest warming is predicted and currently a large part of the land carbon sink is located in temperate and boreal regions. We incorporated the chilling requirements into a coupled land-surface carbon cycle model based on JULES (the Joint-UK-Land Environment Simulator). The simulations show that in future the chilling requirements reduce the rate of advance of the start of the growing season to earlier times compared to advance rates in the recent decades. Carbon uptake is correspondingly lower than in simulations where the start of the growing season as simply modeled as only responding to warming. Thus the phenological response in effect provides a positive feedback to global warming.