Geophysical Research Abstracts,
Vol. 11, EGU2009-4999, 2009
EGU General Assembly 2009

Canopy conductance decrease in Florida as a result of anthropogenic CO2 increase

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Precipitation is one of the main factors controlling vegetation cover, but in turn vegetation has a considerable effect on regional climate by modifying the atmospheric energy and water budget. In Florida approximately 20% of the annual precipitation originates from local evapotranspiration. Transpiration is in large parts controlled by the stomatal conductance of the vegetation. Stomatal conductance of trees in turn is influenced by the atmospheric CO2 concentration ([CO2]), which has increased by 100ppmv since the industrial revolution. The potential consequences of the anthropogenic [CO2] increase on stomatal conductance, however, are not well quantified yet, which hampers parameterization of this variable in models.

In this study we assess the change in transpiration rates in Florida by calculating the canopy conductance over the [CO2] increase of the past century. Past and present stomatal conductance levels are calculated from stomatal density and dimensions measured on modern leaves and historical herbarium specimen for the in Florida most common canopy taxa. These values are consequently upscaled to canopy level by calculating the relative abundance of the taxa in the various vegetation units providing an indication of the general change in canopy conductance in each unit. A significant negative correlation of stomatal conductance and [CO2] over the past century is found in various Florida tree taxa leading to a decrease of up to 40% in canopy conductance for major forest types.

For Florida, where extreme land-use changes and urbanization significantly alter the hydrological system, the vegetation adaptation to increasing [CO2] levels may amplify the disturbance of the water budget. Our results may help to improve model attempts to quantify the past, present and future hydrological conditions by providing more accurate assessments on the biosphere-atmosphere feedback. The description of the undisturbed, pre-industrial state will also provide more realistic input data for models reconstructing palaeo-climate.