Mangrove forest functioning in response to hurricane disturbance

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The goal of this project is to investigate the effects of hurricane disturbance on carbon and energy budgets of a mature mangrove forest. The study takes place in the Everglades National Park along the Gulf of Mexico where three species of mangroves form extensive canopies reaching an average height of 15 m. To accomplish the project goal, field investigations of the short-term effects of hurricane Wilma (Category 3, 2005) will be conducted over the next two years. These data will add to the measurements which have taken place at this site since 2006. The field data will be used to improve computer models of this system, which will then be used to simulate the short- and long-term recovery patterns in the forest and responses to the potential changes in hurricane frequency due to global climate change. Investigations of the short-term effects of Wilma on forest carbon assimilation will utilize eddy covariance systems designed to measure carbon dioxide fluxes at the top of a 30 m tower and below the forest canopy. Also, carbon dioxide concentrations between the canopy top and the forest floor will be measured to monitor changes in the amount of carbon dioxide stored within the canopy air mass. These profiles will be necessary to provide reliable estimates of the net ecosystem exchange of carbon dioxide with the atmosphere at hourly intervals. Measurements of carbon dioxide efflux from the peat surface and from coarse woody debris will also be carried out periodically to investigate the contributions of these components to overall respiratory losses of carbon from the system. The soil respiration studies are also intended to increase the current understanding of the processes governing changes in peat surface elevations following the hurricane. Annual estimates of net carbon assimilation derived from the flux tower data will be compared to estimates derived from changes in tree stem diameter, forest stand density, litter fall, and peat accretion measured around the flux tower site. Two types of numerical modeling studies will be pursued to estimate the impact of Wilma on the carbon dynamics in the mangrove forest. First, a process based soil-plant-atmosphere model which includes energy balance will be used to simulate carbon dioxide assimilation by the mangroves. This model will be validated using the flux tower data. Second, an individual-based gap model coupled to a soil cohort model will be used to simulate stand dynamics, net primary production, and peat accretion. The coupled model will then be used to examine the effects of potential changes in hurricane frequency on the long-term carbon balance of mangroves in the Florida Everglades.