AGU 100 FALL MEETING
Washington, D.C. | 10–14 Dec 2018

GC33C-06: A New Urban Ecohydrological Model to Quantify the Effect of Vegetation on Microclimate and Water Fluxes in Cities

Wednesday, 12 December 2018
15:05 - 15:20
Walter E Washington Convention Center - Salon A

Growth in urbanization and the projected rise in global temperature are likely to intensify the urban heat island (UHI) effect; Concurrently, a decrease in pervious surfaces can result in elevated runoff production. Urban vegetation is often proposed as a mitigation strategy for both problems. However, the effects of vegetation on the urban climate and hydrology remain difficult to quantify as both urban climate models and computational fluid dynamic approaches only include a simplistic representation of vegetation. We develop a mechanistic urban ecohydrological model (UEHM) combining an existing ecohydrological model (Tethys-Chloris) with principles of urban canopy modelling. The UEHM considers detailed plant biophysical and ecophysiological characteristics, and models evapotranspiration as a function of photosynthesis, vapour pressure deficit and soil moisture. It accounts for plant canopy interception, infiltration through pervious surfaces and soil water storage. The UEHM can account for different urban densities, surface properties and values of anthropogenic heat flux. It allows for an explicit representation of short ground vegetation, street trees, and green roofs as well as different plant types. Accordingly, it can be used to investigate the impact of different urban landscape configurations on urban climate and hydrology. Data and boundary conditions from urban flux towers in Singapore and Melbourne are used to force the model and evaluate its performance. Furthermore, we analyse the sensitivity of the simulated variables to the vegetated ground cover fraction in Singapore and find that, at maximum vegetated ground cover, mean air temperature is modified by 1.5 - 2°C. Partition of incoming precipitation in runoff, evapotranspiration, and deep ground leakage is profoundly modified by the presence of vegetation. These initial results for a tropical city suggest that an increase in short vegetation cover, as for example grass or shrubs, can only partially mitigate the UHI but has significant effects, as expected, on storm water retention and subsequent evapotranspiration.

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