Irrigating the urban semi-arid environment: effects on land surface and hydrologic fluxes

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Abstract. Urban irrigation is often overlooked in hydrologic studies of urban basins. Yet, irrigation is a significant input to urban watersheds, especially those located in semi-arid climates where it may total 50% or more of natural precipitation. This irrigation can alter land surface properties including increases in evapotranspiration (ET) and latent heat flux and a decrease in land surface temperatures along with a wide range of effects on the hydrologic cycle. Building upon work that captured some of the heterogeneity in urban land cover within integrated land surface/hydrologic models, the research presented here provides an analysis of the addition of this important anthropogenic flux. Our goals with this study are to (1) provide a sensitivity analysis for urban irrigation in an integrated hydrologic model (PF.CLM), (2) assess the hydrologic and energy budget effects of urban land cover irrigation, and (3) analyze irrigations potential impact to urban groundwater systems. First, a sensitivity analysis of the volume and timing of irrigation is conducted. We find that the timing of irrigation can have as a large of an effect as volume of irrigation among other results. Next, we simulate a 49.3-km^2 domain near downtown Los Angeles in Ballona Creek watershed at a 30-m spatial resolution and hourly time step with the inclusion of irrigation. A comparison of these results and meteorological and remotely sensed observations (Landsat and MODIS) is conducted to understand spatial impacts and watershed modeling impacts. Our analysis provides critical information on the degree to which urban irrigation has an impact and should be represented in high-resolution, semi-arid urban land surface and groundwater modeling. This research yields robust upper-boundary conditions for further analysis and modeling in Los Angeles.