Undercanopy and below ground microclimate patterns at the North Desert Village: 2007-2009

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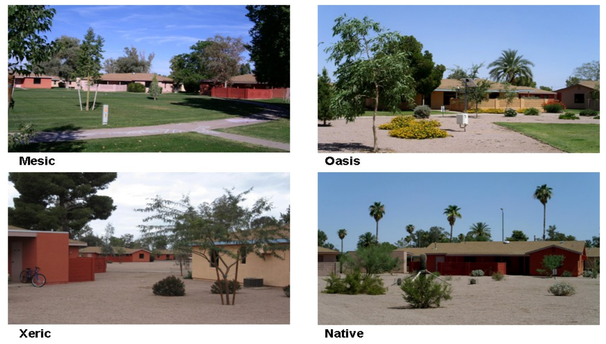
Introduction

Residential landscape cover characteristics and ensuing microclimates created by the interactions of landscape surfaces with local atmospheres are predicated upon the designed arrangement of landscape elements, principally vegetation and ornamental hardscape features. In Phoenix there exists a wide range in the proportion of vegetation and ornamental hardscape features for any given residential landscape. At the CAP LTER North Desert Village experiment site on the ASU Polytechnic campus, I am studying the long-term effects of residential landscape design and ensuant above ground microclimates on below ground thermodynamics. Here I present a summary of landscape surface and below ground thermodynamics for the years 2007 through 2009.

North Desert Village landscape design treatments



Summary of Results

During all years, soils underneath turf covered surfaces were generally cooler. DG covered surfaces at the oasis treatment generally had the highest soil heat flux (downward movement of heat) during the summer months. During 2008, the sharp drop in soil heat flux during at JD 143-146 coincides with a similar unseasonable sharp decline in mean air temperature. Periodic spikes in soil moisture content in the xeric and desert treatments during the summer of 2008 show surface moisture penetration to 30-cm depth from the episodic intense precipitation of summer monsoon storms. During the mid and later parts of 2009, overall soil dryness in the xeric and desert treatments reflect the general failure of the summer monsoon. In summary, these data show the importance of immediate landscape surface cover type on annual patterns of soil thermal and moisture dynamics at NDV and support the role of irrigation and vegetative cover in mitigating urban heating.

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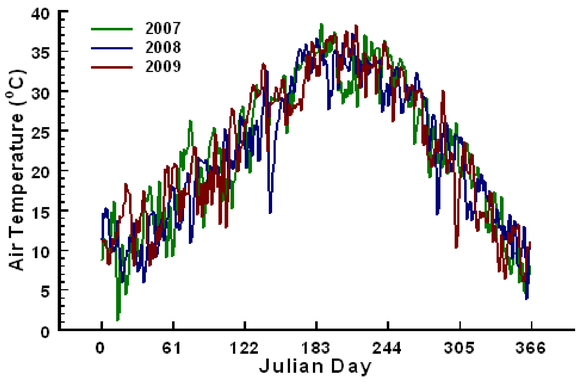
IPA: Climate Ecosystem Interactions

Methods

Above and below ground microclimate conditions are continuously being monitored at the North Desert Village (NDV) long-term experiment at the center of each treatment site by solar-powered micrometeorological stations located approximately at the center point of each treatment site. The four treatment sites at NDV (see above image plate) average 6177 m2 area in size and are called 1) mesic (spray irrigated turf grass), 2) oasis (a mixture of spray irrigated turf and drip irrigated trees and shrubs), 3) xeric (drip irrigated trees and shrubs), and 4) desert native (non-irrigated trees and shrubs). All landscape surfaces without turf grass are covered with 5 cm of light beige-colored decomposing granite (DG) mulch. In this report, annual patterns for the years 2007-09 of air, surface, and soil temperatures, soil heat fluxes, and volumetric water content at 30-cm depth are shown. All sensors record data every 5 minutes. Data were averaged hourly by a CR1000 datalogger (www.campbellsci.com). The pairs of soil thermocouples, heat flux plates and volumetric water content sensor at the mixed oasis treatment were positioned under both turf and DG surface covers.



Daily air temperature at NDV derived as the mean value of micrometeorological stations in each treatment area, n=4.