Decision Support for Western Weed Management

R. Carruthers[1], D. Spencer[1], D. Bubenheim[2], C. Potter[2], M. Kramer[3], L. Johnson[4]
[1]USDA-ARS, [2]NASA-Ames, [3]UC Santa Cruz, [4]Cal State Monterey Bay

NASA remote sensing, mapping, modeling, and visualization technology is being adapted for critical USDA invasive species management programs. Several prominent species are targeted due to their significant environmental, social, and economic impacts.

USDA intensive study sites listed by research focus. Boxes represent larger areas of regard, where regional assessments are performed based on remotely sensed and simulated datasets.

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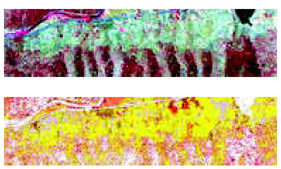

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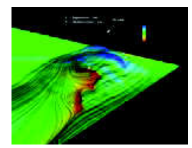

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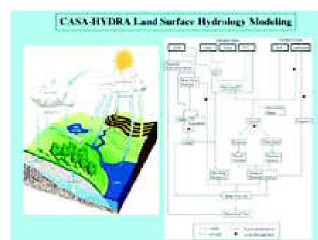

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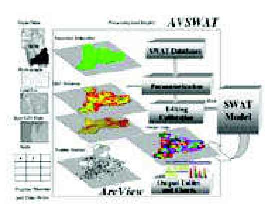

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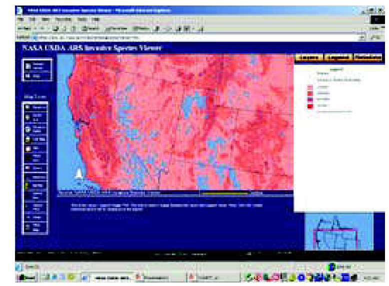

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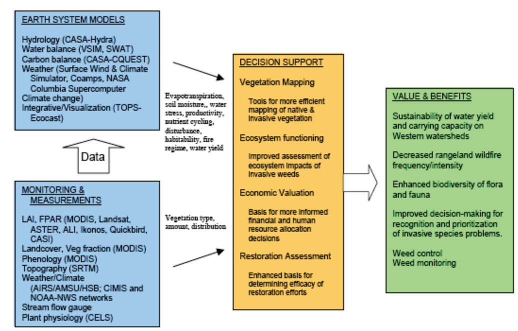

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POSTER NUMBER 1

Hydrologic Impacts of a Native to Exotic Vegetation Transition in a Semiarid Grassland

Zachary Sugg

zsugg@email.arizona.edu

University of Arizona Dept. of Geography and
USDA-ARS Southwest Watershed Research Center

Introduction

Semiarid grasslands such as those in southeastern Arizona are sites of rapidly shifting vegetation patterns, and key drivers of change in the region are invasive transplanted African grasses such as buffelgrass, Boer lovegrass, and Lehmann lovegrass. These species are well-adapted to take advantage of scarce resources, enabling them to often out-compete native grasses following disturbances such as drought and fire.

In this and other arid and semiarid ecosystems, the availability of water (or lack thereof) largely governs biological productivity. Yet despite decades of research on various ecological aspects of the presence of these alien species in the landscape, relatively little is known about the hydrological changes wrought by these invasions. Recent studies comparing natives to Lehmann lovegrass have begun to increase our understanding of these impacts on ecosystem gas exchange (Huxman et al., 2004) and evaporation and transpiration (Yepez et al., 2005). These studies have been conducted on test-plots and we know little about how these factors are changed by naturally occurring invasions.

During the period 2005-2007 the Kendall grassland site at USDA-ARS Walnut Gulch Experimental Watershed underwent a change from an assemblage of native grasses to the invasive alien *E. lehmanniana* (Lehmann lovegrass). The transition followed a multi-year drought that resulted in the mortality of the native grasses in 2005. In 2007 Lehmann lovegrass became the dominant species. The site was not subject to grazing or other human disturbance.

This transition presented an opportunity to investigate the effect the invasion had on ecosystem response to individual pulse precipitation events using recorded hydrometeorological measurements. This analysis compares pulse storm response among different vegetation types in different phases of the transition as a way to learn about the concomitant changes in water balance. More specifically, analyzing immediate post-storm hydrologic dynamics provided insight into the effects that the invasion had on evaporation (E) and transpiration (T) dynamics, and the relationship between the two. This is important because changes in these variables will have implications for ecological functions such as carbon and nutrient cycling, and may favor the persistence of Lehmann lovegrass in the landscape.

Study Site and Measurements

Kendall grassland in the Walnut Gulch Experimental Watershed

- Located in the Upper San Pedro Watershed
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- Semi-arid, sparse vegetation, sandy soils
- Historically dominated by diverse native bunchgrasses.
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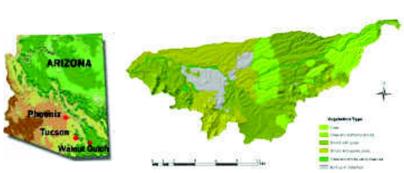

USDA-ARS Walnut Gulch Experimental Watershed

References

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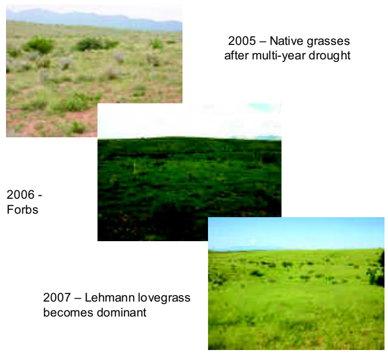

2005 – Native grasses after multi-year drought

2006 - Forbs

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We devised criteria that would allow for meaningful comparison of the response of different vegetation assemblages to storms of similar magnitude.

These criteria were: a minimum 8 mm storm depth, a dry-down period of at least 3 days of no major precipitation events,similar immediate post-storm soil moisture, and similar post-storm PET in order to flag days when conditions may have resulted in unusually low PET (such as a cool, cloudy day).

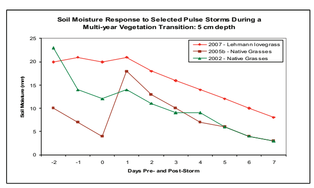
We searched the hydrometeorological data for the Kendall site based on these criteria and selected monsoon storms from before the drought (2002), the year of the native die-off (2005), the interim forb year (2006), and the dominance of new Lehmann lovegrass in 2007. We created a MatLab data query program to extract the daily hydrometeorological data recorded at Kendall, and calculated partitioned daily E and T from recorded ET measurements, as well as soil moisture response at 5 and 15 cm depths.

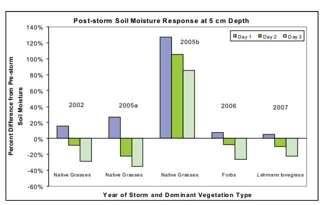
We plan to extend the analysis to incorporate 2008 and 2009 storm events, which will capture stages of Lehmann lovegrass maturity and different amounts of leaf area and root biomass that may affect ET response.

RESULTS

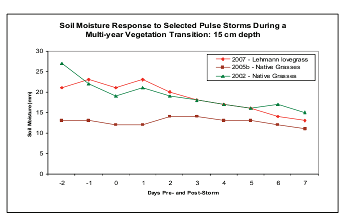
Surface & Deep-Soil Moisture Response:

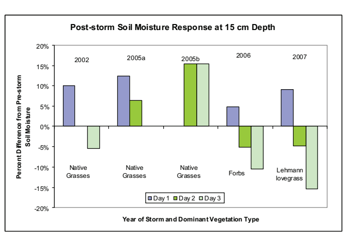
Both shallow and deep soil moisture responses are similar for Lehmann lovegrass (2007) and native grasses (2002). However, the 2005b storm produced the largest single-day jump in surface soil moisture for the whole monsoon season. This may be related to low total ET in the 24 hours following the storm.





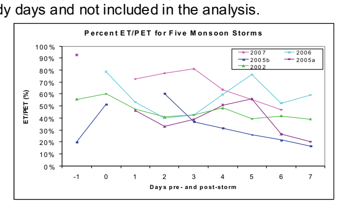
Despite the influx of moisture, deep soil moisture response was delayed and lower for 2005b compared to storms in 2007 and 2002. This weak response may be related to more rapid plant water uptake and transpiration at shallow root depth.



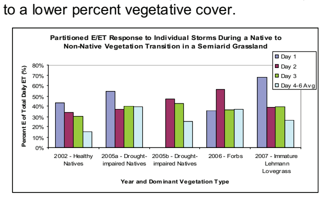


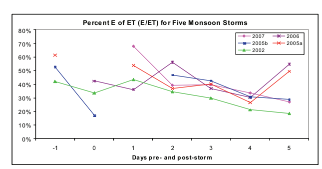
Partitioned Evaporation & Transpiration:

The ET/PET ratio trended from high to low values following the storm. Missing values in the figure below were associated with cloudy days and not included in the analysis.



Comparison of the selected storm events indicated the dominance of Lehmann lovegrass resulted in a "flashier" E/ET response than the native vegetation during the first day following the storm. On day 1, E comprised 70% of total ET. If this is the typical response, there may be a net increase in E in this ecosystem due to Lehmann lovegrass invasion. It may also be related to a lower percent vegetative cover.





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Concluding Remarks

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2. The next steps will be to 1) analyze a much larger number of storms during the transition to see whether and to what extent this E/ET response persists and 2) investigate E/ET response in summer 2009 to see how plant maturity might alter these relationships.

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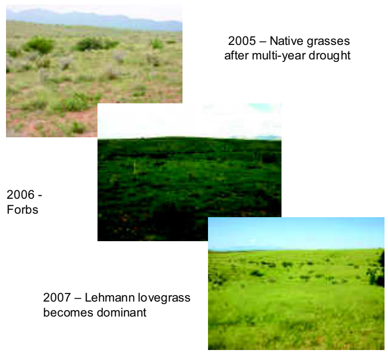

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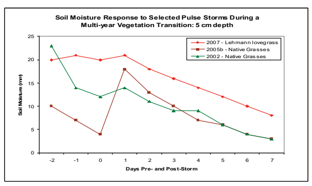

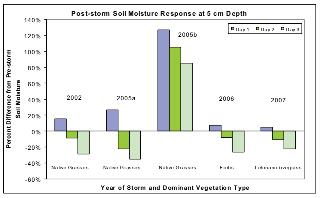

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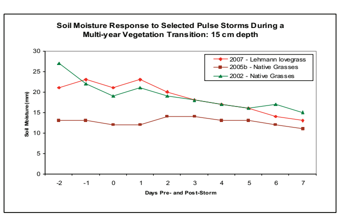

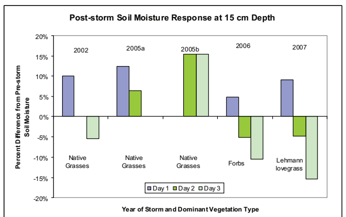

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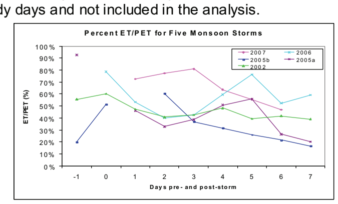

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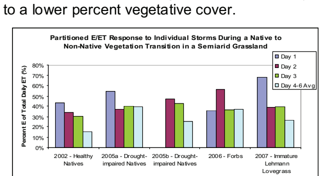

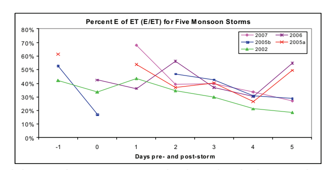

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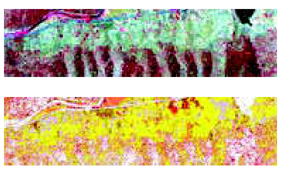

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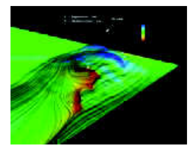

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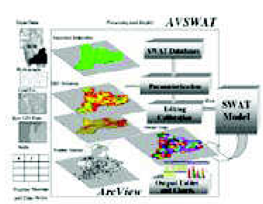

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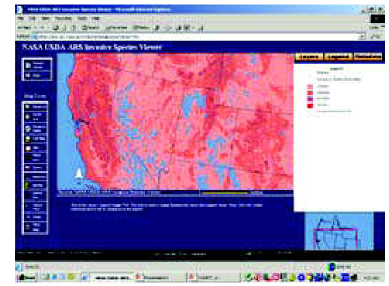

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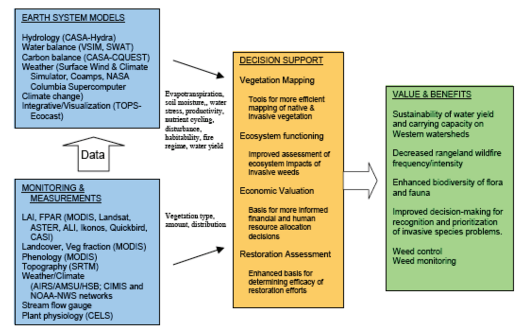

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