

Drought and Water Content Analysis of Semiarid Riparian and Upland Vegetation Communities with Remotely Sensed Data and Eddy-Flux Measurements



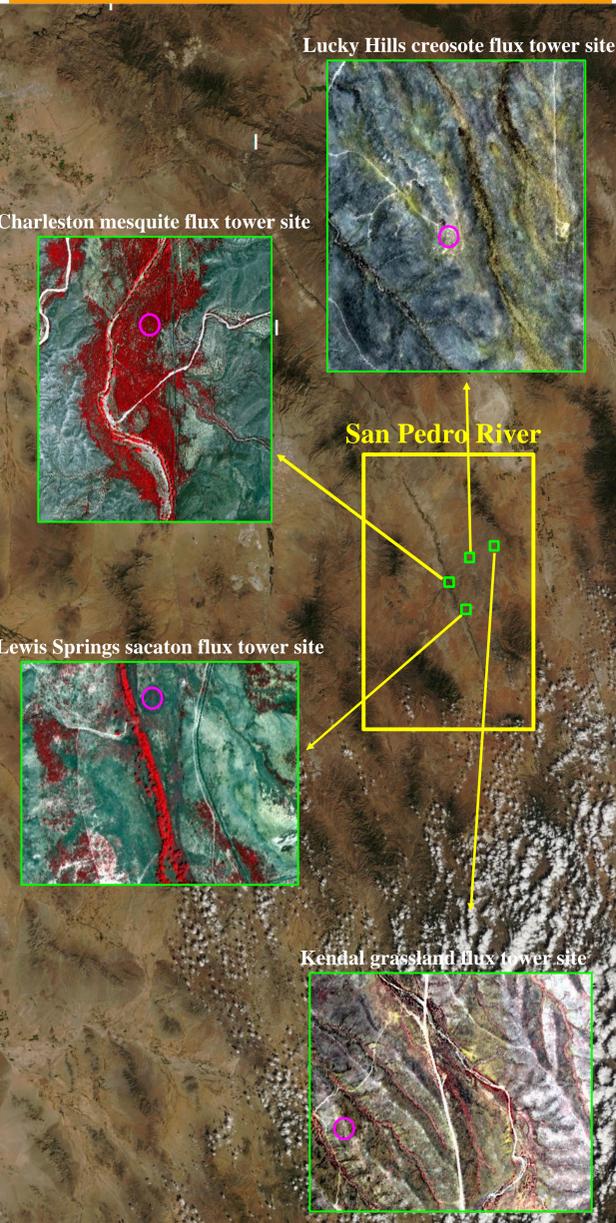
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MODIS image of San Pedro Riparian National Conservation Area and surrounding upland region - October 23, 2004



1. INTRODUCTION

- Riparian vegetation communities are increasingly threatened by climate variability and competing human demands for water in semiarid regions.
- Along the San Pedro River, riparian/ upland vegetation and hydrology are tightly coupled and susceptible to environmental change.
- Remote sensing provides an effective methodology for the spatial and temporal monitoring of such fragile ecosystems and their response to various forcings.
- The Terra-MODIS sensor acquires imagery near-daily at 250m, 500m, and 1km pixel resolutions and enables the monitoring and mapping of seasonal and spatial patterns of vegetation variability.

2. OBJECTIVES

We utilized the Terra- MODIS products as indicators of vegetation activity in order

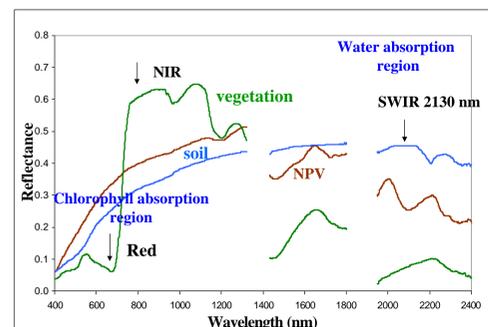
- to track the seasonal and inter-annual biologic response of vegetation communities within riparian and upland ecosystems and
- to assess the role of vegetation and water indices to track evapotranspiration

3. VEGETATION AND WATER INDICES

We used 250 m MODIS, continuous 8-day and 16-day composited enhanced vegetation index (EVI) and the land surface water index (LSWI),

$$EVI = G \times \frac{r_{NIR} - r_{Red}}{L + r_{NIR} + C_1 \times r_{Red} - C_2 \times r_{Blue}}$$

$$LSWI = \frac{r_{NIR} - r_{SWIR(2130\text{ nm})}}{r_{NIR} + r_{SWIR(2130\text{ nm})}}$$



Time Series Analysis

- Time series profiles of MODIS VI data were extracted for all study sites every 16 days from March 2000 through December 2003.
- Seasonal profiles were generated for all study sites.

MODIS Time Trajectories Year t1

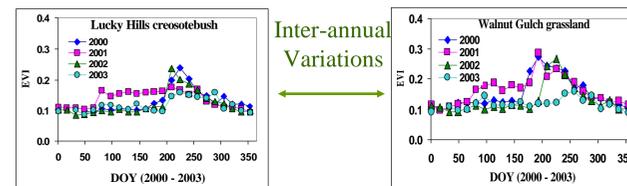
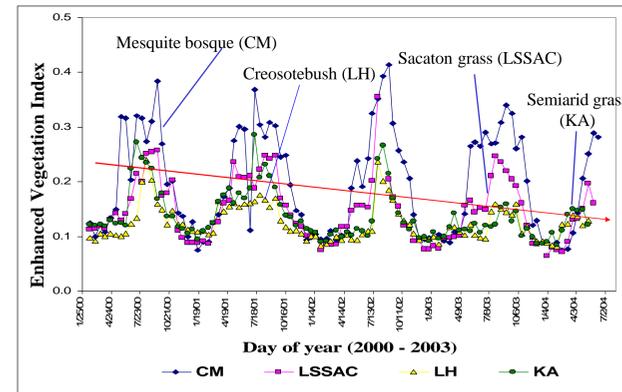
MODIS Time Trajectories Year t2



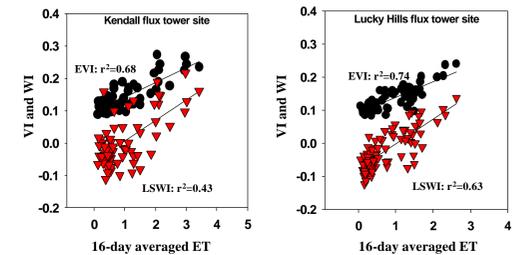
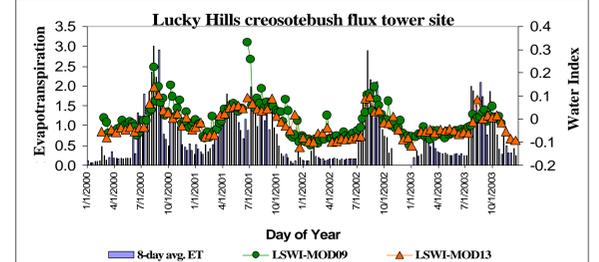
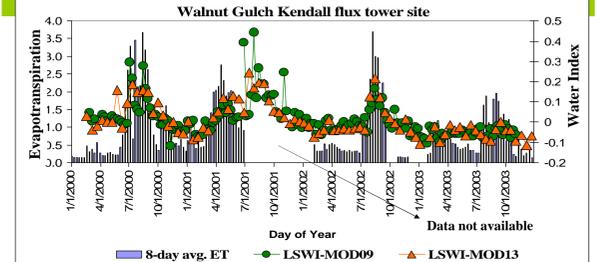
Goal: Investigate the changes in pattern, mean, and standard deviation among the physiognomic, site-dependent time trajectories

4. RESULTS

Seasonal histogram vegetation dynamics



Evapotranspiration and Land Surface Water



- The MODIS data show land surface moisture condition follows evapotranspiration in upland land cover types.
- LSWI water index shows more sensitivity to evapotranspiration, but lower regression relationship

5. CONCLUSIONS

The MODIS seasonal profiles provide valuable information of use in the extraction of vegetation water use features

- They are useful in drought detection and studies on the sustainability of semiarid riparian areas and upland ecosystems,
- They exhibit great utility as input to water studies, phenology studies, and land cover conversion studies.

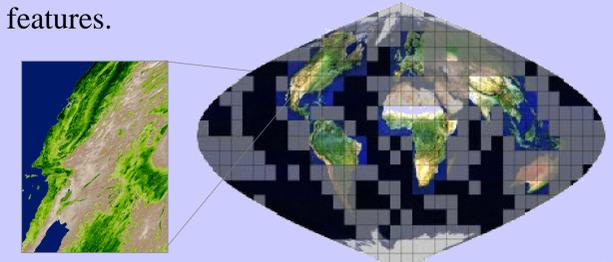
Future Work is needed to:

- Quantify changes in vegetation cover,
- Couple higher resolution sensor data for validation of MODIS results for water usage & management, stress and drought detection studies.

Acknowledgements; We thank Dr. Russell Scott (USDA-ARS, Tucson) for providing climate and eddy-flux data. We also thank Yuan Yin (U of Arizona, TBRS lab) for processing the MODIS data

Terra - MODIS SENSOR

The MODIS sensor is a 36 channel spectroradiometer designed for daily monitoring of land, ocean, snow/ice, and atmosphere features.



- The MODIS seasonal profiles depict vegetation shifts in phenology associated with land cover and species types.
- The riparian communities green-up first, followed by the sacaton grass and then the upland areas.
- The MODIS data show significant inter-annual variations from 2000 to 2003 with a general decline in vegetation productivity with climate forcings (drought).