From the NAM Macrosystems project webpage: http://cals.arizona.edu/research/macrosystems/content/home

“we are studying climate-biosphere interactions in the Western United States and Northern Mexico that are determined by spatial and temporal dynamics in the North American Monsoon System. The principal question that we are addressing is: what are the forcings that provide spatial coherency and temporal synchrony to the ecosystems that occupy this geographic region and how do those forcings influence the propagation of ecological perturbations within the system? We are focusing on processes that cross ecosystem boundaries, creating connectivity among the ecosystems and producing a synergy that we refer to as an ecological macrosystem. The issues we are studying include the spread of summer-active invasive grasses through rangelands and deserts, and the movement of wildfires from lower elevation, grassland ecosystems into higher elevation, forest ecosystems.”

From the Macrosystems proposal

http://cals.arizona.edu/research/macrosystems/sites/cals.arizona.edu.research.macrosystems/files/NSFMacrosystems2010.pdf

“We propose to study a set of climate-biosphere interactions in the western United States and northern Mexico that function with synchrony entrained to the North American Monsoon System (NAMS).

“In one application of the model we will study connections among precipitation, patterns in net primary production (NPP) in the native vegetation, the spread of invasive species, and regional synchronization of wildfire regimes.”

“The overarching question that we will address is: what are the forcings, both external and internal, that provide spatial coherency and temporal synchrony to the system and how do those forcings influence the spatial and temporal propagation of ecological perturbations within the system?”

***3. Will the combination of climate change and spread of invasive species change the frequency of***

***wildfires and patterns of connectivity in wildfire regimes across the domain and how will that***

***perturbation disrupt those forcings that induce synchrony in regional ecological processes?***

**H6. Invasive species and wildfire connectivity.** Increases in the spread of winter-active invasive

grasses in the western part of the domain and summer-active invasive grasses in the central part of the

domain will increase the dry fuel load of lower elevation ecosystems, increase synchrony in the wildfire

regimes across elevation gradients, and generally increase the frequency of wildfire across the domain.

**H7. Paleoclimate and fire.** Dendrochronological phases with high fire frequency coincide with domainwide spatiotemporal patterns of winter and summer precipitation that are deduced, from modeling with the land-atmosphere RCM, to be correlated with anomalies in Pacific SST that favor high winter precipitation (fuel build-up at lower elevations) and low summer precipitation (dry fuel at higher elevations).

**VII. Testing the Hypotheses**

In order to address the hypotheses associated with Question 3, we will develop a modeling

framework for predicting wildfire frequency across the domain. We will develop new ways to link 'ignition

probability' to 'fire damage (area burned)' within the existing wildfire component of CLM4 (see Kloster et al.2010). Gill et al. (2010) used a pasture production model to predict grass production and the distribution of live and dead biomass in Australia as inputs to the Grassland Fire Danger Index (GFDI) model and thus predict the probability of fire on any single date at any single site. We propose to use the ECOTONE model in much the same way, but to focus on invasive grasses in the western US. The ECOTONE model provides estimates of biomass production, recruitment and mortality for grasses and shrubs. We will use the model to provide direct inputs to the GFDI Model in selected grids of the NAMS domain at different times of the year in order to predict fire danger probability. Using these grids, we will overlay timedependent maps of fire danger with the geographic distribution of daily fire starts from the National Fire Occurrence Database and the Monitoring Trends in Burn Severity database to determine probabilities of wildfire in the grass-invaded grids (Bartlein et al. 2008). Maps of live fuel moisture will be constructed for grasslands and woodlands in the NAMS domain using the National Fuel Moisture Database that is a component of the Real-Time Observation Monitor and Analysis Network (a consortium effort between the US Forest Service, the Department of the Interior and the National Weather Service). We will test H6 by using the coupled WRF-CLM-ECOTONE-CATHY models to estimate fire frequencies for pinyon-juniper woodlands located in specified grid domains that border desert grasslands, and test for the influence of the spread of invasive grasses on fire frequency in both systems. We will test the sensitivity of this relation to different locations in the NAMS domain and during different climate regimes. We will test H7 by comparing the modeling results from H6 against reconstructed fire regimes from the tree ring record using analyses of fire scars. In this latter analysis we will search for relationships between fire frequency and distributions of winter and summer precipitation after cross-correlation between fire scar chronologies and climate chronologies constructed from the early- and late-wood ring analyses.