Tracking biomass accumulation in southern California chaparral with remote sensing and ground-based measurements

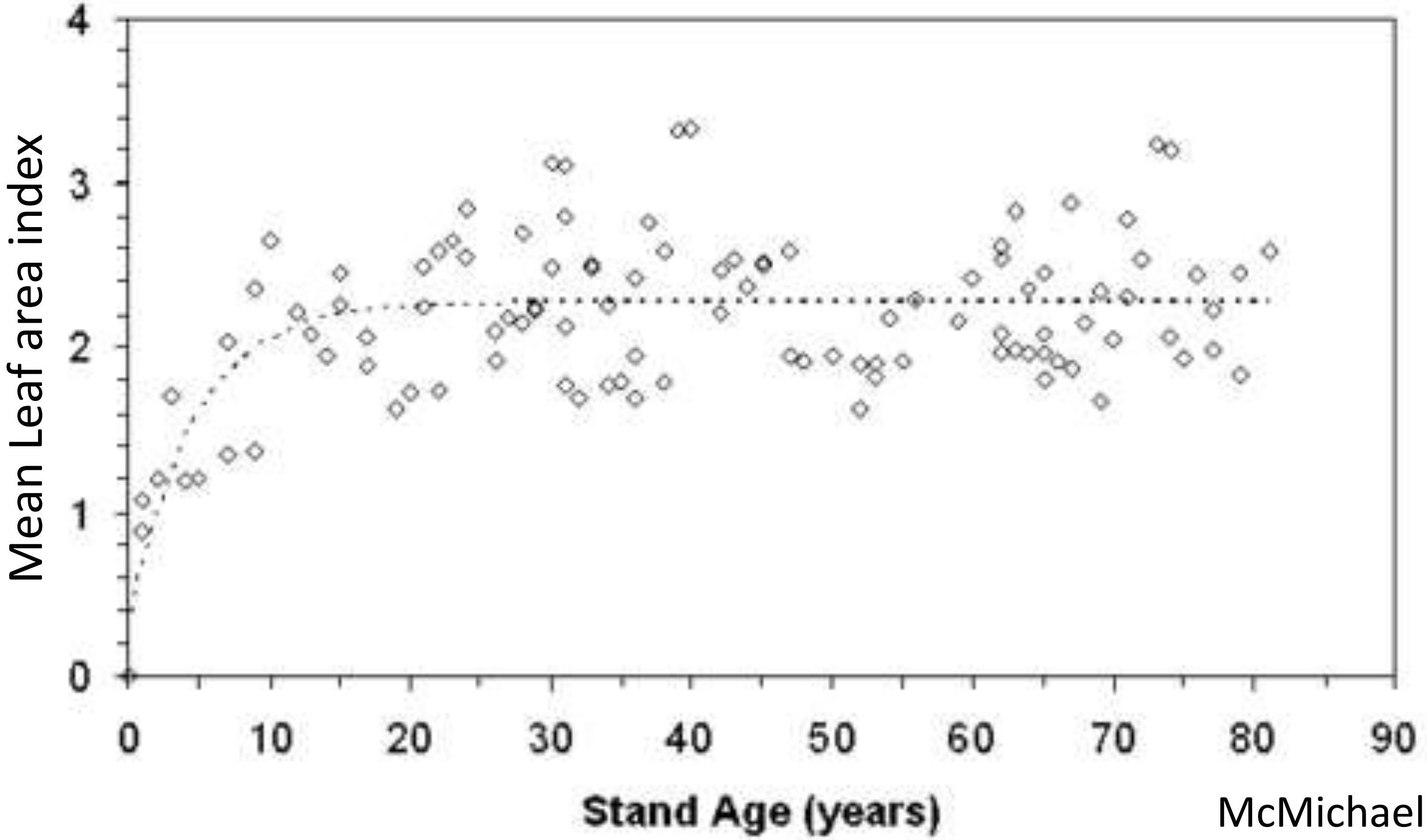
Dr. Kellie Uyeda

Post-doctoral researcher
San Diego State University

Research Associate
Tijuana River National Estuarine Research Reserve

Introduction – post-fire recovery

- Intense, stand-replacing fires
- Rapid recovery of vegetation cover in first 10 years following fire



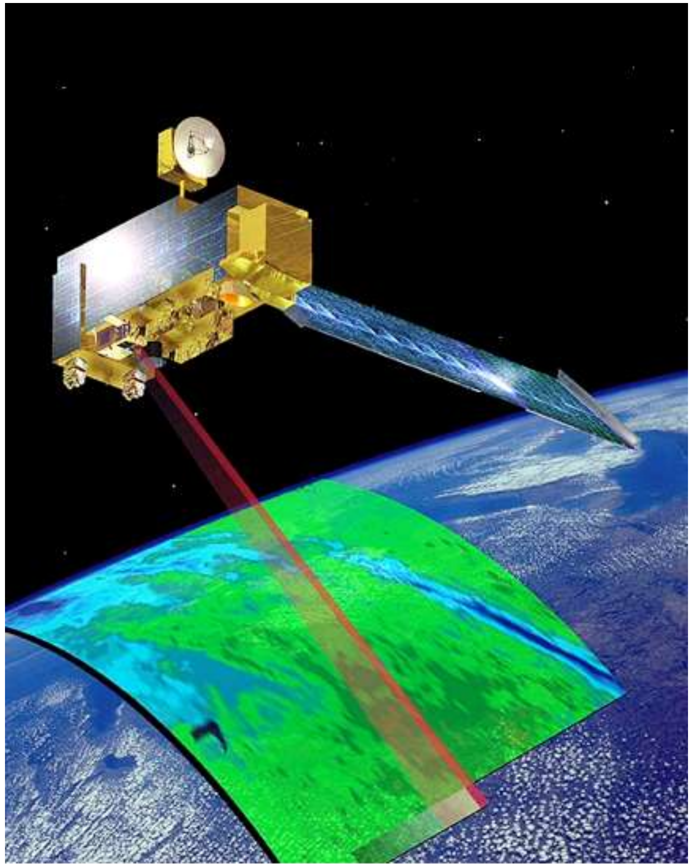
McMichael et al. 2004

Introduction – chaparral biomass

- Biomass properties change spatially, temporally
- Important for understanding carbon sequestration, ecosystem recovery, fuel loading

Scaling biomass estimates

- Challenge is to relate remotely sensed data to biomass:
  - Field measurements are most accurate, most difficult
  - Extend estimates of biomass across space and through time
  - Study patterns of recovery at relevant spatial and temporal scales



https://podaac.jpl.nasa.gov/Terra

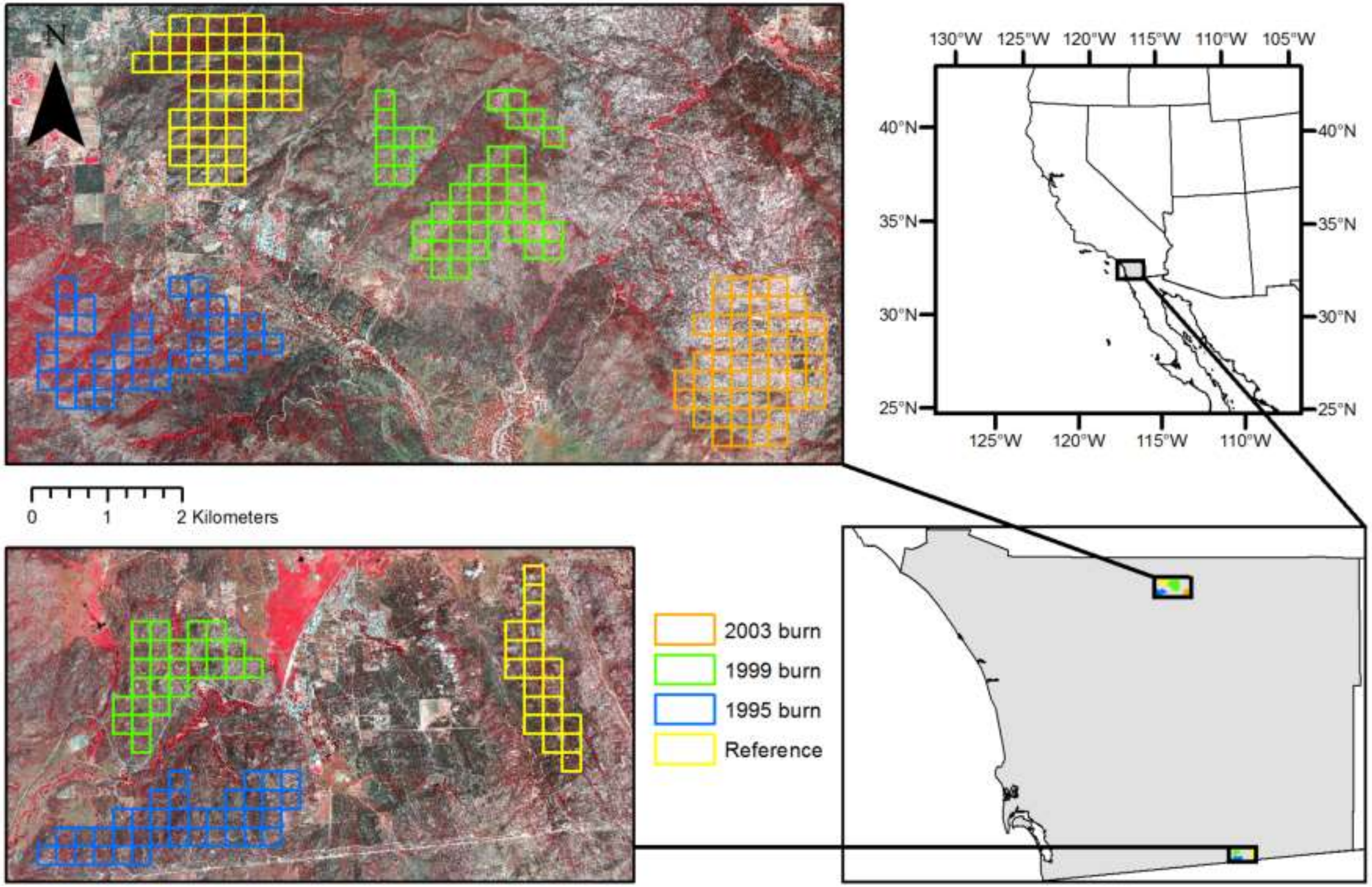
Part 1: Introduction

- Long time series of satellite imagery allows for tracking of single area through time, rather than chronosequence approach

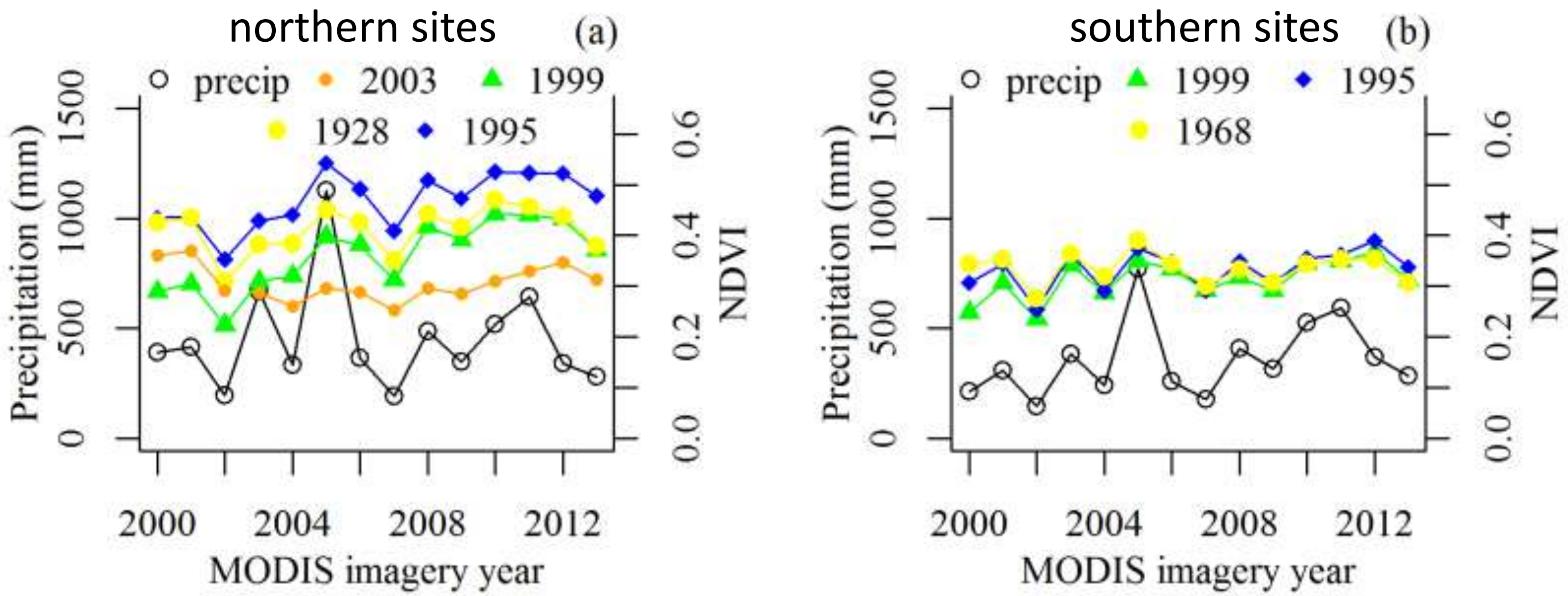
- Exploratory analysis:
  - Explore time series derived from satellite imagery for signal of chaparral growth and biomass accumulation

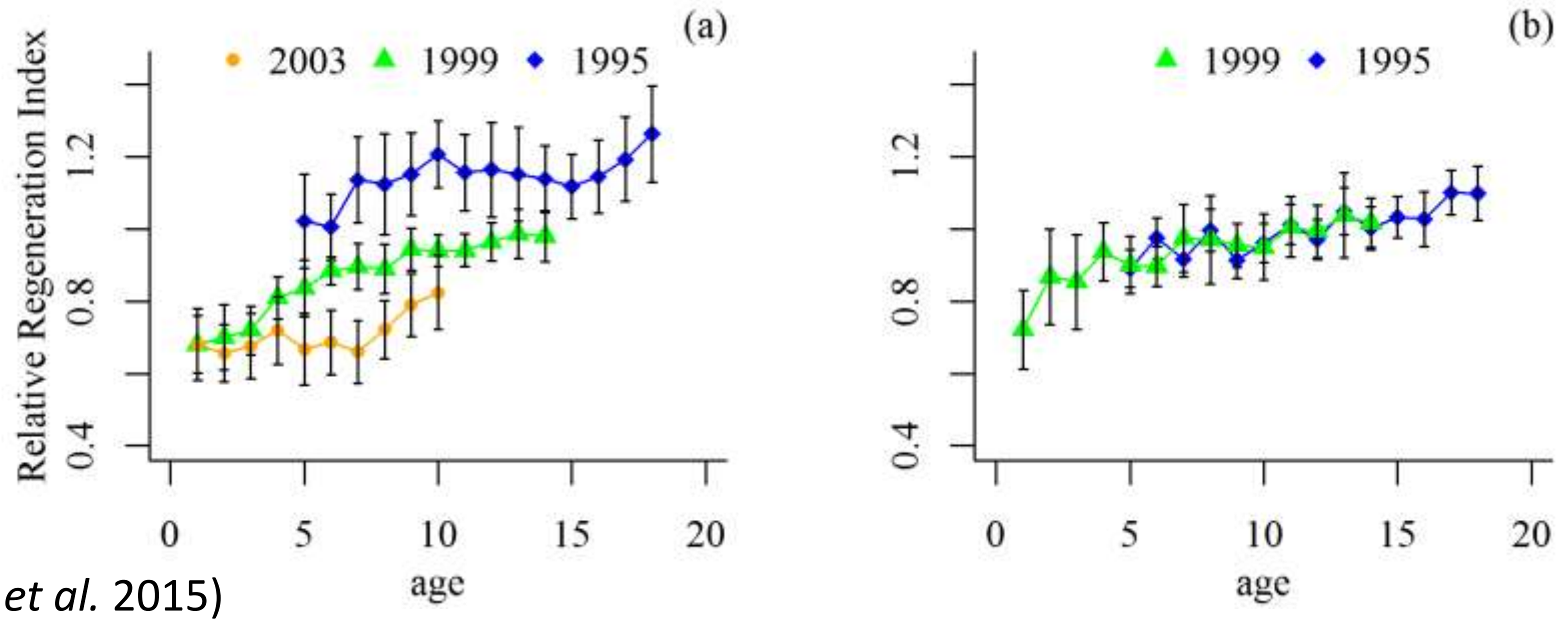
Part 1: Methods

- Track Normalized Difference Vegetation Index (NDVI) with satellite imagery (MODIS)



(Uyeda *et al.* 2015)





(Uyeda *et al.* 2015)

Conclusions

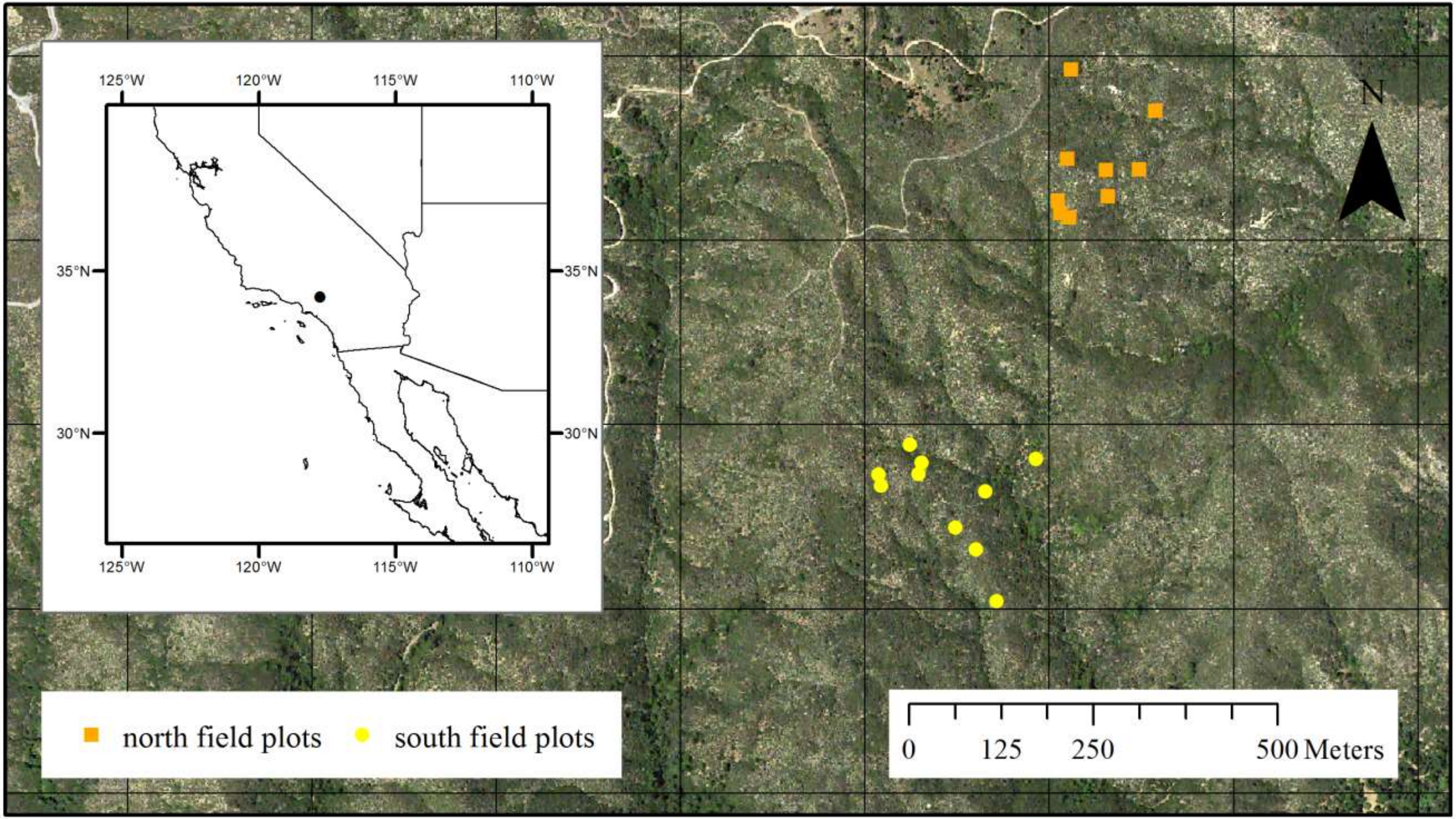
- Strong site differences
  - Within same mapped vegetation type
  - Within same stand age
- Need for field data
  - How is biomass actually changing as stands age?

Part 2: Shrub growth rings

- Challenge: post-fire biomass accumulation occurs over longer time periods than typical field studies
- Use growth rings as record of stem diameter at end of each growing season
- Past studies show potential for growth ring work, but focus on age of shrubs/stands (Stohlgren *et al.* 1984; Keeley 1993; Zammit and Zedler 1993)
- Best chance of success in early stage of post-fire recovery

Part 2: Research questions

- Do measurements of shrub growth ring change increments provide a useful metric of biomass accumulation?
- Is the relationship between satellite-based growth metrics and biomass sufficiently strong to indicate a potential for mapping biomass growth at regional scales?

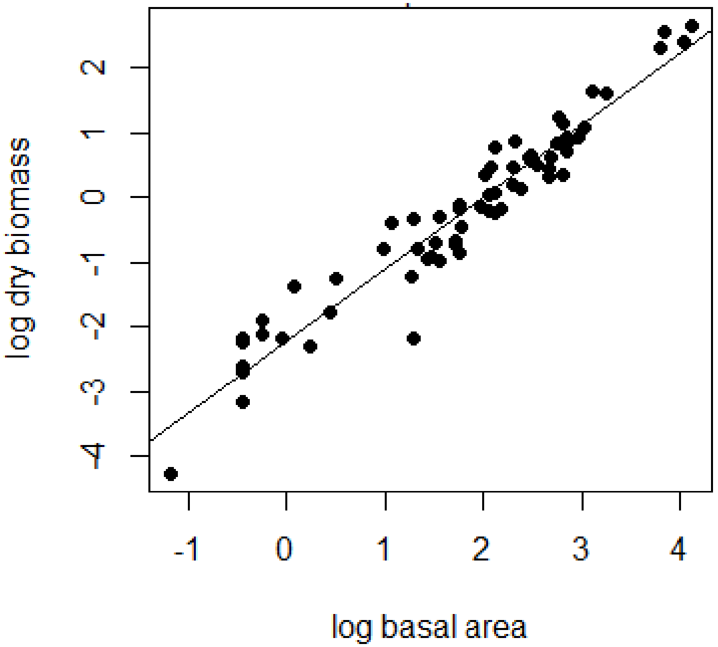


(Uyeda *et al.* in review)

Part 2: Field methods

Measure all stems within field plots

Harvest and measure shrubs



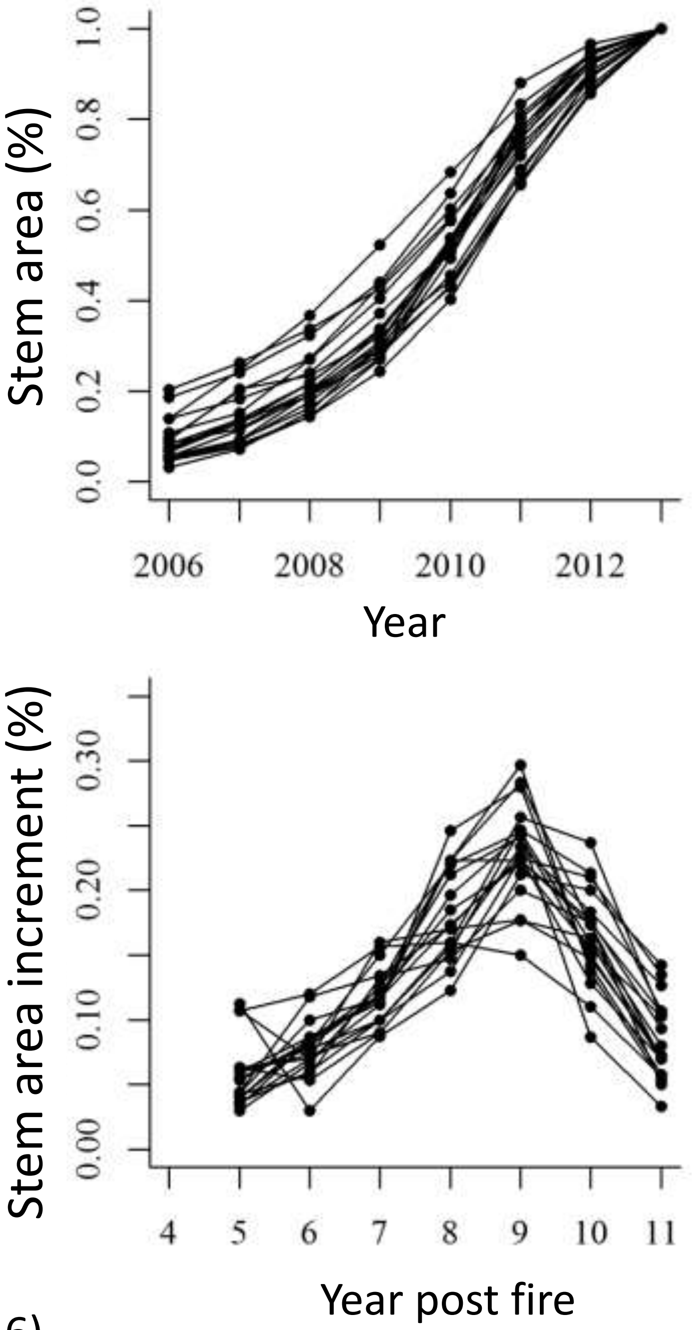
Calculate relationship, apply across plot

Part 2: Growth ring methods

- Harvest stem cross section from 5 randomly selected *Ceanothus spp*. shrubs
- Sand, photograph, and measure diameters in each year
- Estimate biomass increment per year, assume all live shrubs followed that pattern to estimate plot biomass

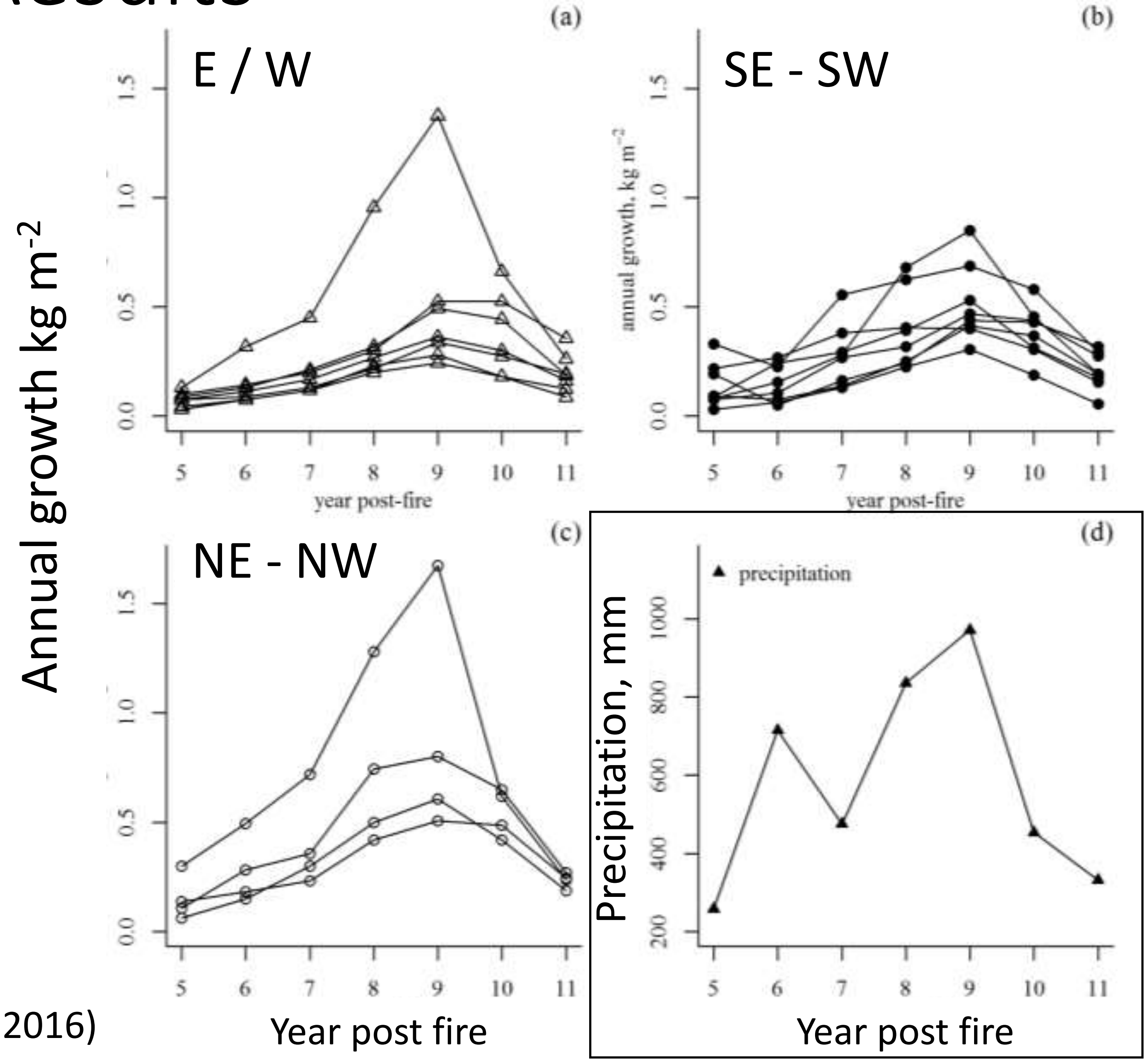
Part 2: Methods/results

- 19 of the plots had usable stem cross sections
- Started analysis in 2006 because some inner rings had heart rot / insect damage
- Calculated average stem area relative to total in each year, incremental growth



(Uyeda *et al.* 2016)

Part 2: Results

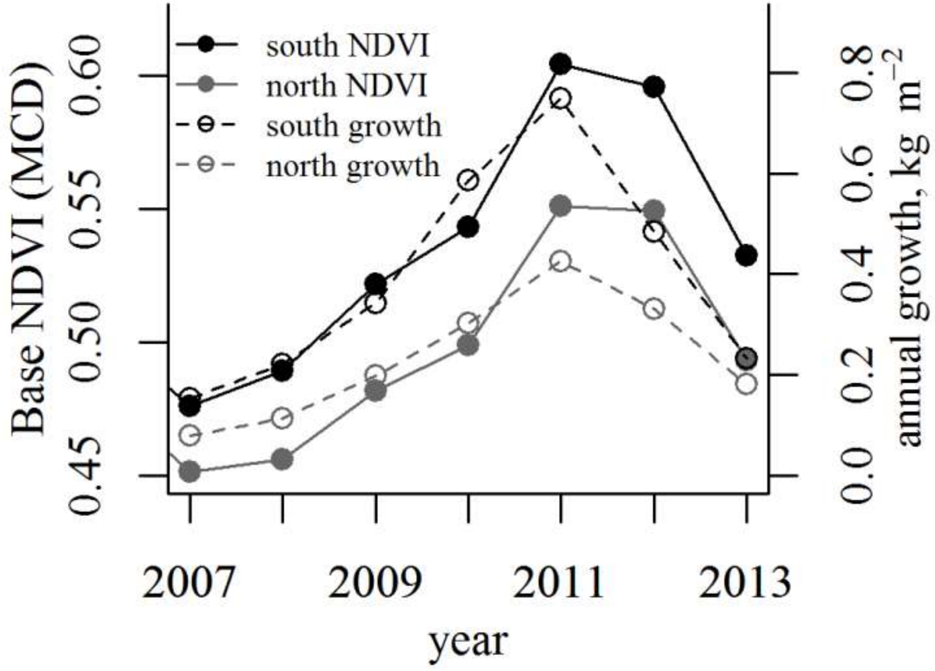


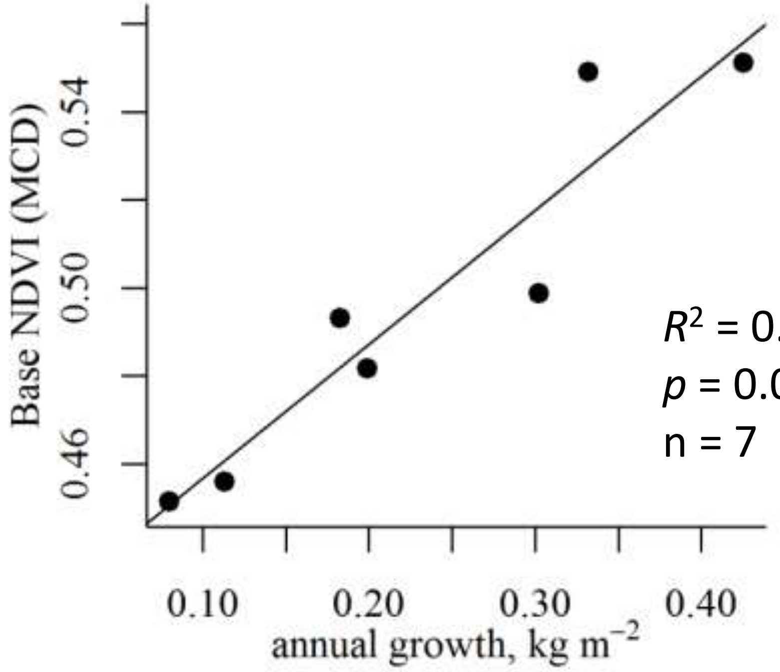
No significant variation with aspect

Average annual biomass growth correlation with precipitation
r = 0.75
p = 0.05,
n = 7

(Uyeda *et al.* 2016)

Part 3: Results





R^2 = 0.89
p = 0.001
n = 7

(Uyeda *et al.* in review)

Conclusions

- Precipitation has an important role in post fire biomass recovery patterns
- Biomass recovery is spatially variable
- Relationships between annual growth and satellite-based vegetation indices are promising
- Further development required to scale across larger areas
    - Potential for mapping regional biomass / carbon

Acknowledgements

- Committee: Dr. Doug Stow (chair), Dr. John O’Leary, Dr. Allen Hope, Dr. Naomi Tague, Dr. Dar Roberts
- Field assistance: J. O'Leary, I. Schmidt, D. Rachels, C. Riggan, P. Riggan, A. Brown, F. Uyeda, J. Jesu, B. Lo, M. Beland, B. Corcoran, D. Smith, J. McCullough, K. Walsh, Y. Granovskaya, A. Clark, J. Schichtel, L. Handa, M. Hartfelder, K. Hartfelder, E. Storey, R. Elliott, A. Lewis, D. Stow
- Site access: M. Oxford
- SDSU/UCSB Joint Doctoral program in Geography
- Funding for this project was provided by the USDA Forest Service through American Recovery and Reinvestment Act Agreement No. 10-JV-11279701-10: “Airborne remote sensing to enable hazardous fuels reduction, forest health protection, rehabilitation and hazard mitigation activities on Federal lands”, **Dr. Philip Riggan**, Principal Investigator


Questions?