

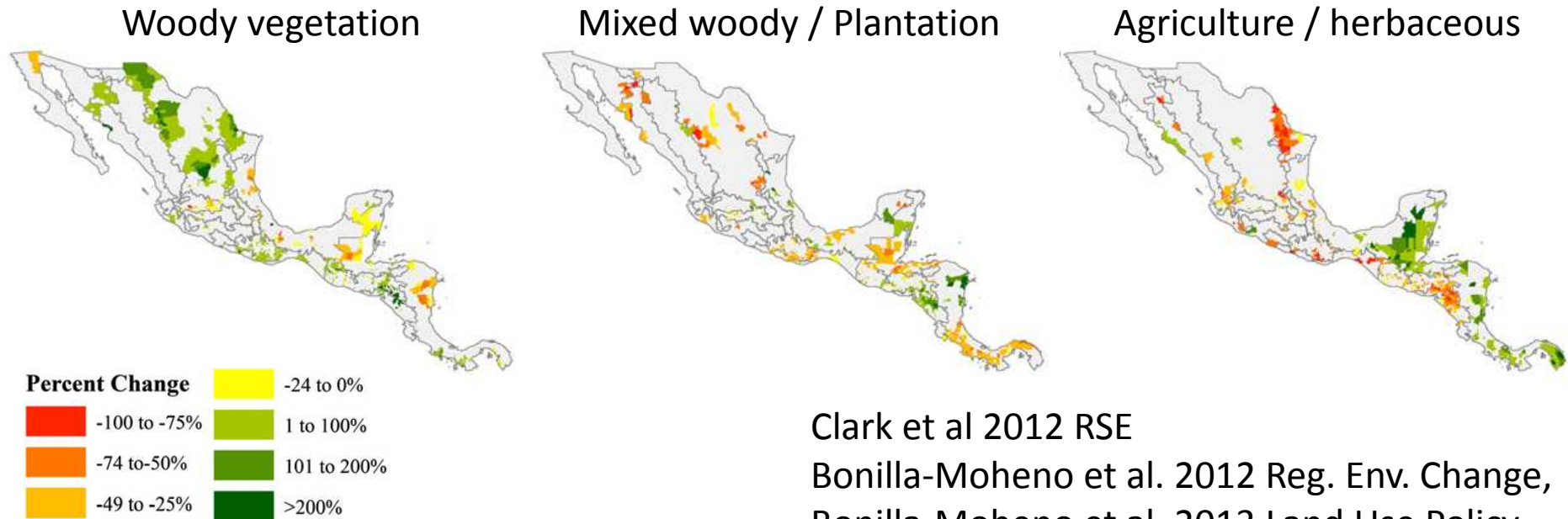
# Trends in 15-year MODIS NDVI time series for Mexico

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Rainer A. Ressler



# Motivation

- Detection of distinct patterns of land cover change in Mexico at municipality level
  - 250m MODIS MOD13Q1 product from 2001-2010



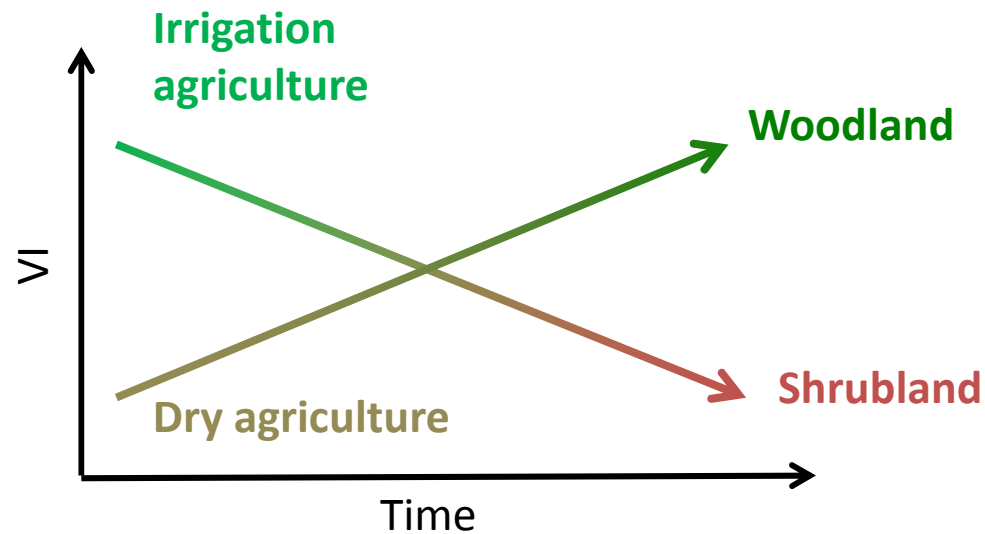
Clark et al 2012 RSE

Bonilla-Moheno et al. 2012 Reg. Env. Change,

Bonilla-Moheno et al. 2013 Land Use Policy

# Hypothesis

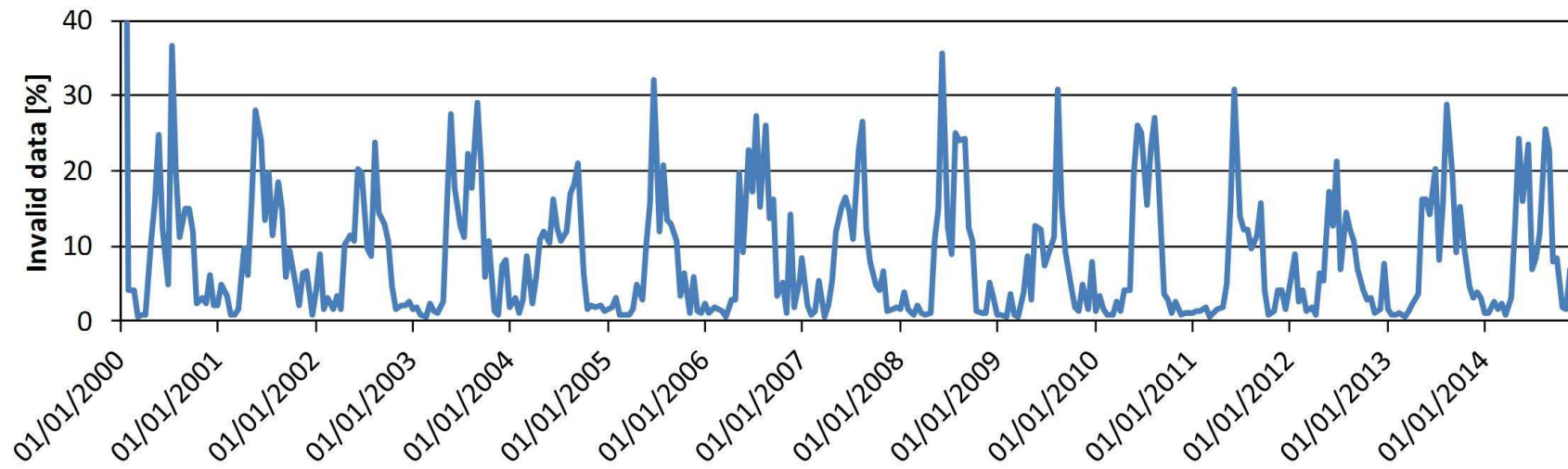
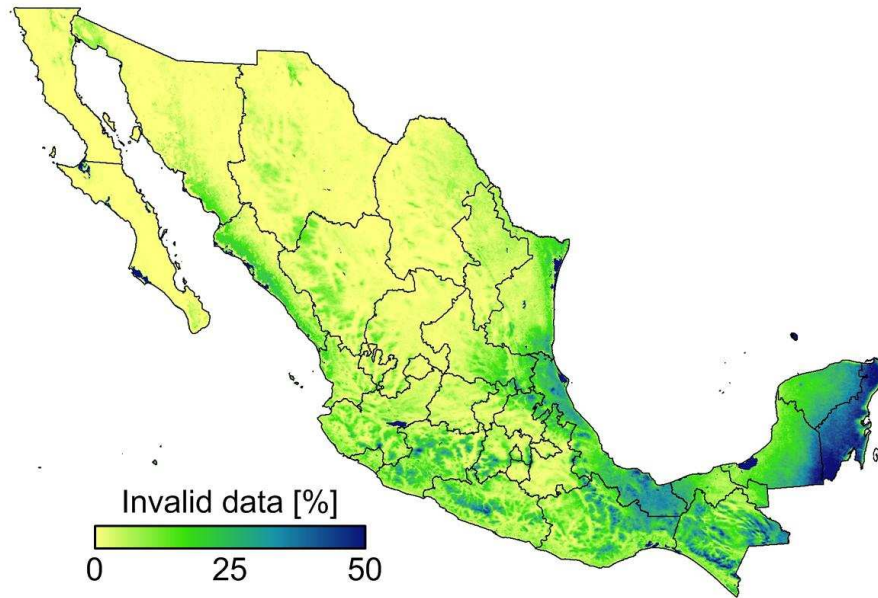
- Trends in VI time series match trends in land cover change
- But:



# Data and Methods

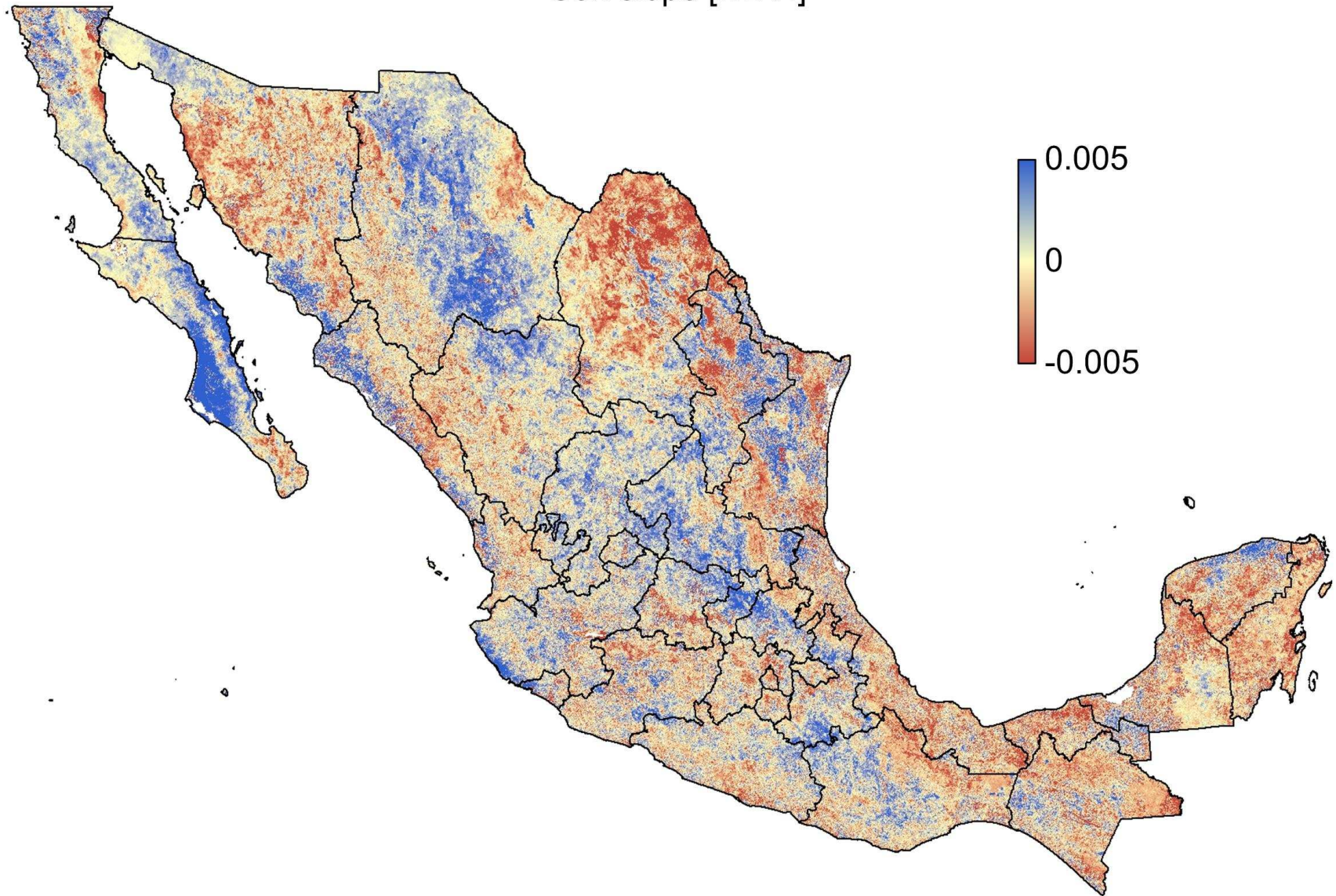
- 250m, 16-day MODIS NDVI from Terra
  - 9 tiles (entire Mexico)
  - 2000-2014
- Projection to LCC
- Quality analysis
- Annual and seasonal averages
- Temporal regression and statistical test
  - Parametric: Linear least-squares and F-test
  - Non-parametric: Theil-Sen and Mann-Kendall test

# Quality analysis



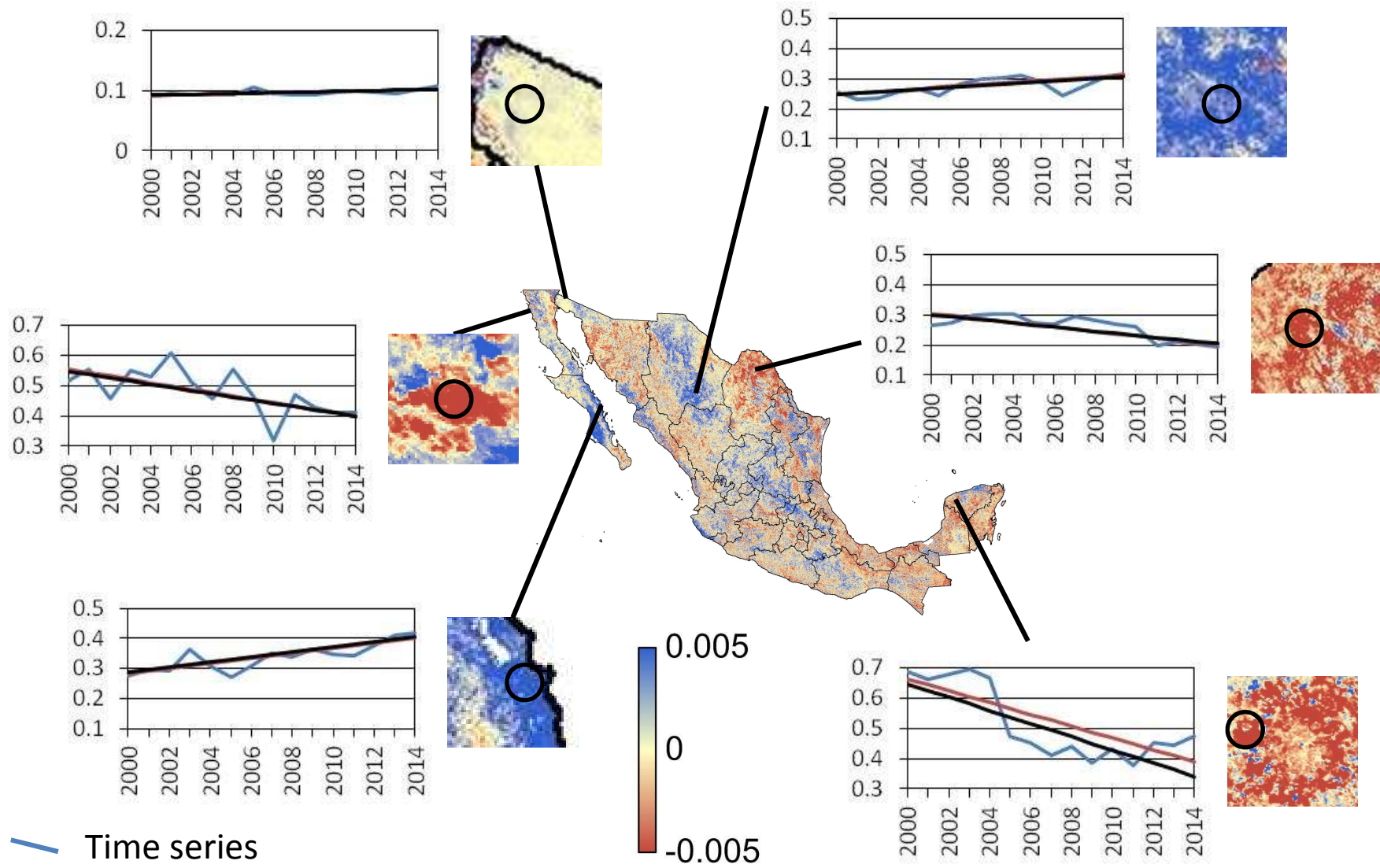
# Trends

Sen slope [NDVI]





# Trends for selected pixels

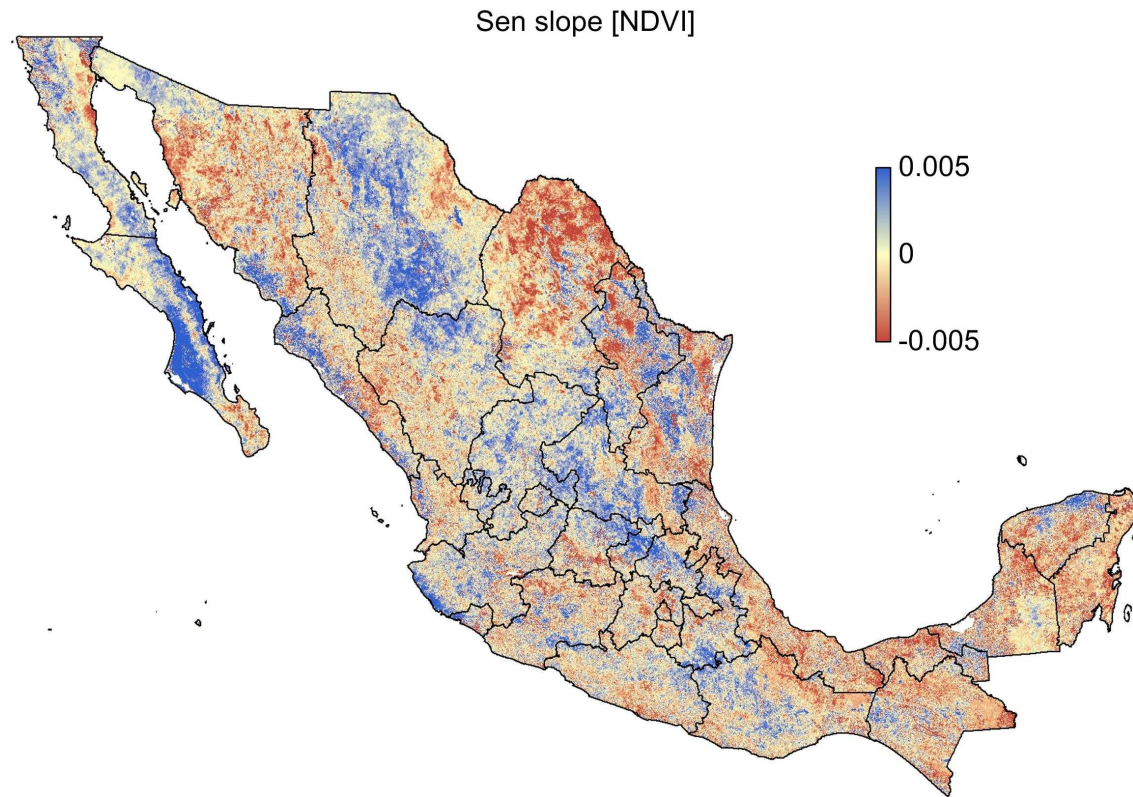


— Time series  
— Theil-Sen  
— Linear least squares

All trends are significant ( $p < 0.05$ )

# Trends – Northern Mexico

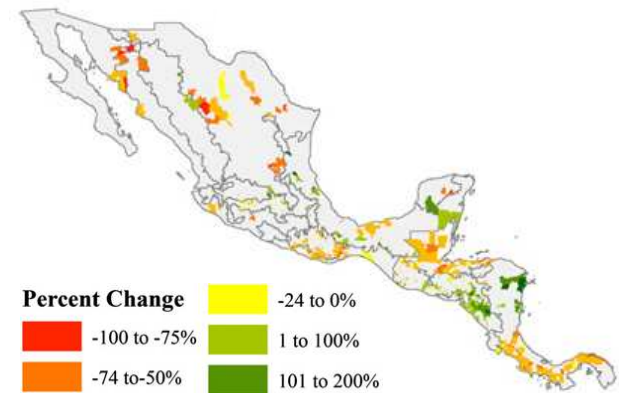
## Widespread land cover trends



### Woody vegetation



### Mixed woody / Plantation

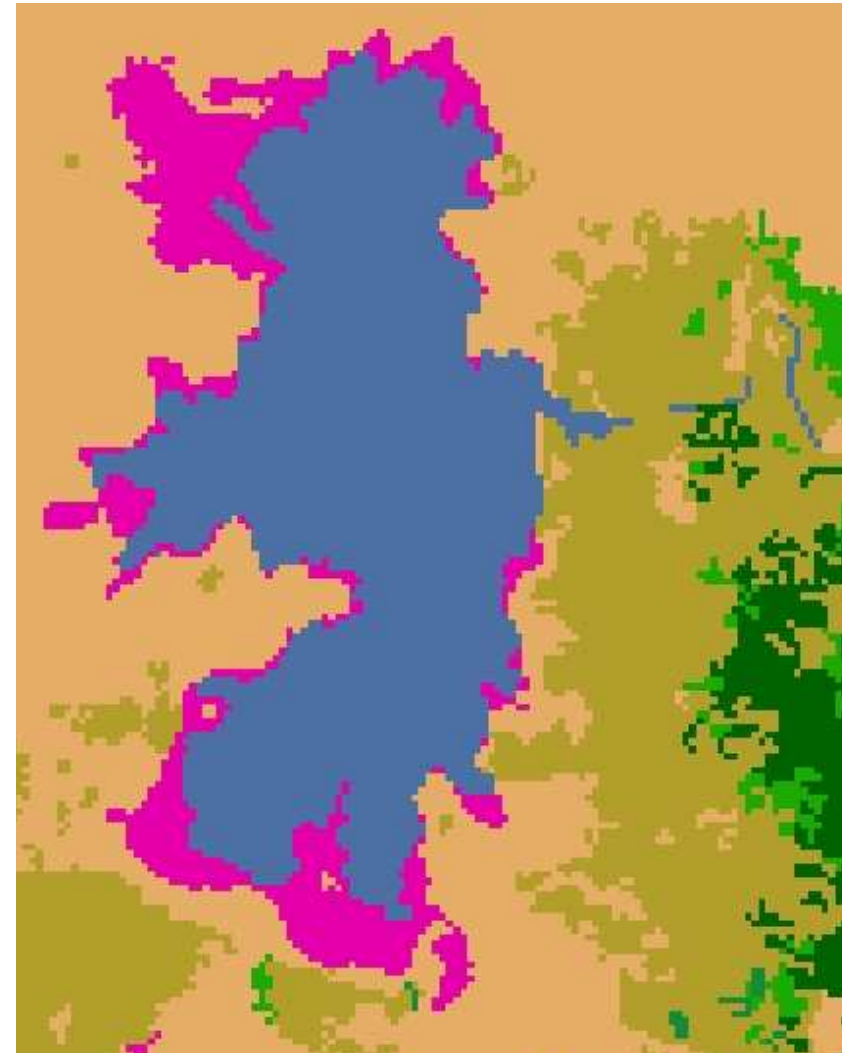
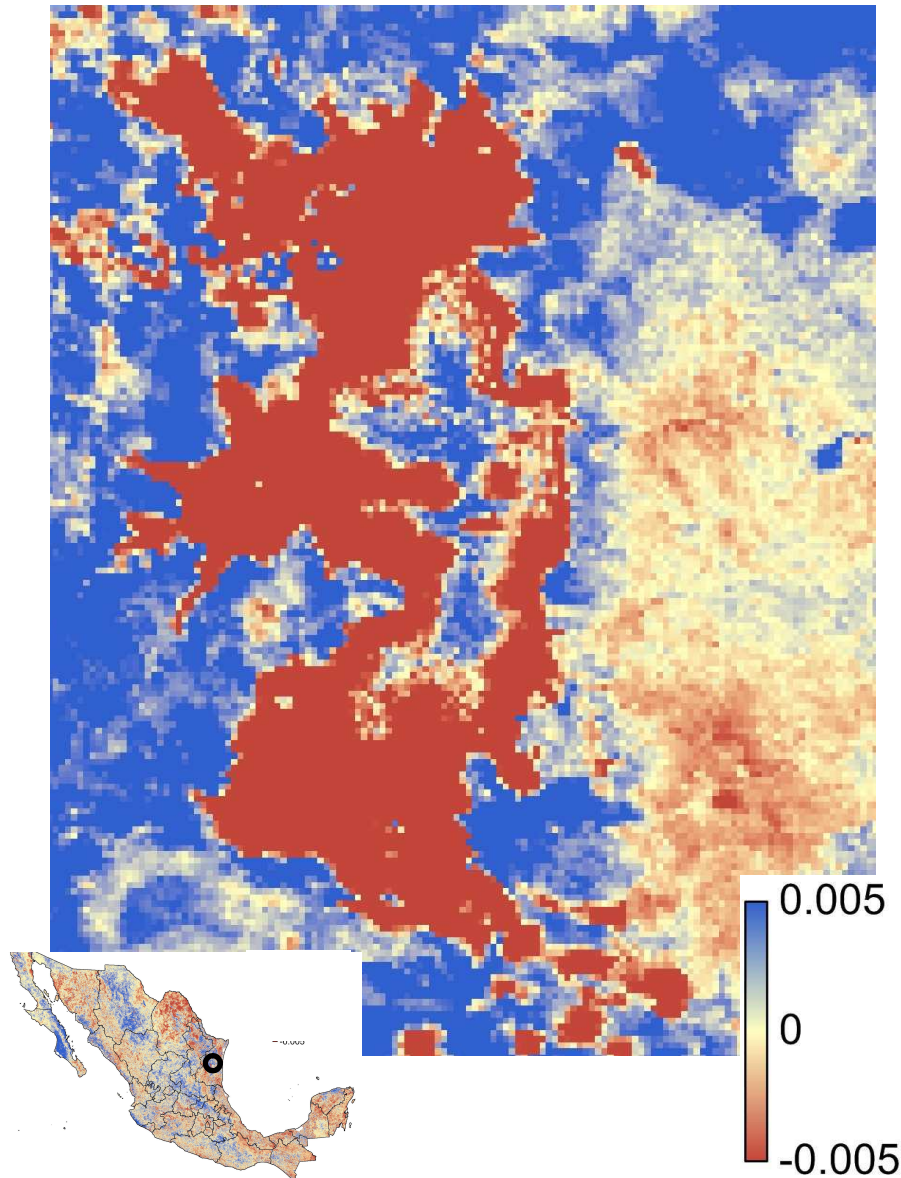


Clark et al 2012 RSE



# Trends – Northern Mexico

## Vicente Guerrero Reservoir

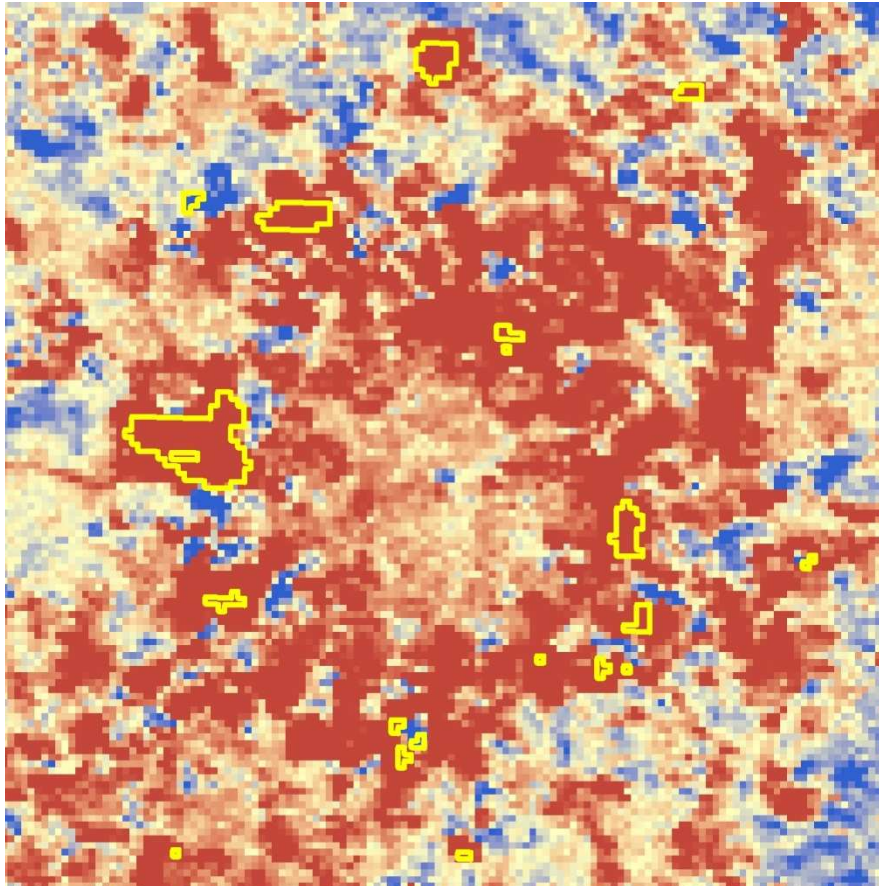



Change between 2005 and 2010  
Colditz et al. 2014, PE&RS



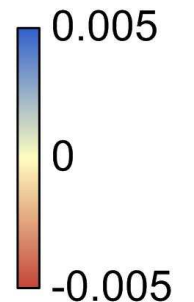
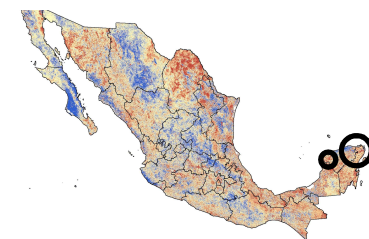
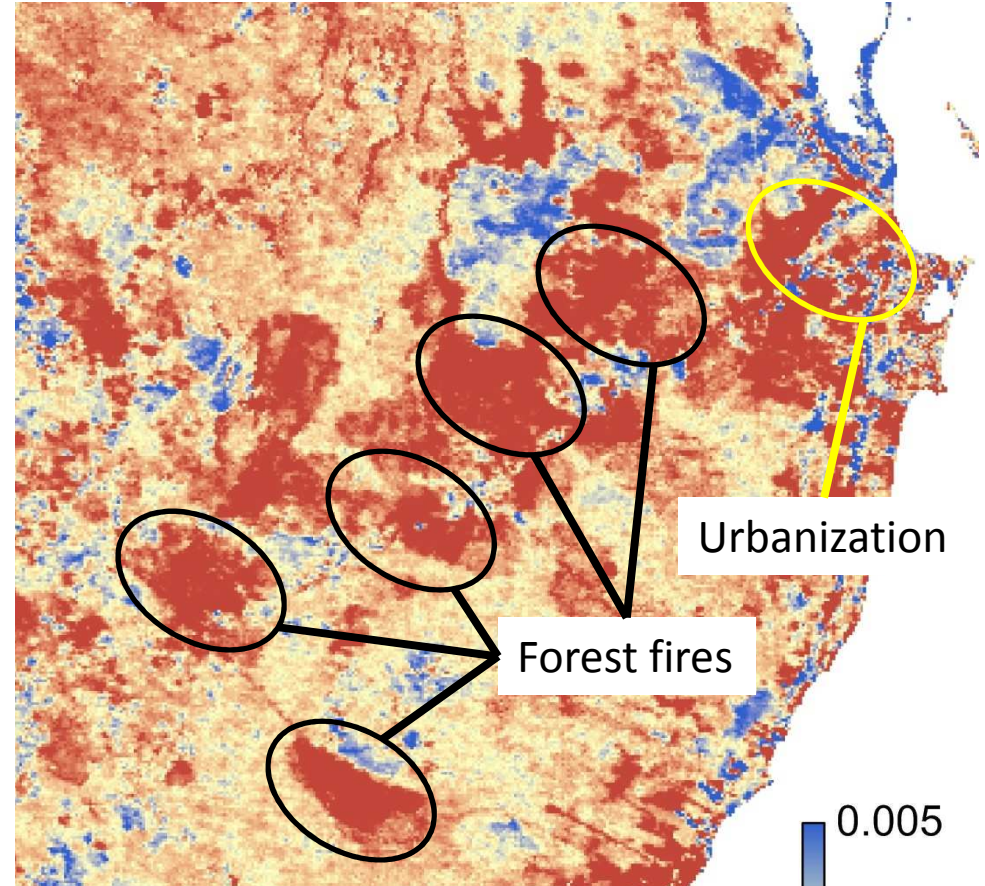
# Trends – Southern Mexico

## Merida



 Change between 2005 and 2010  
Colditz et al. PE&RS, 2014

## Cancun

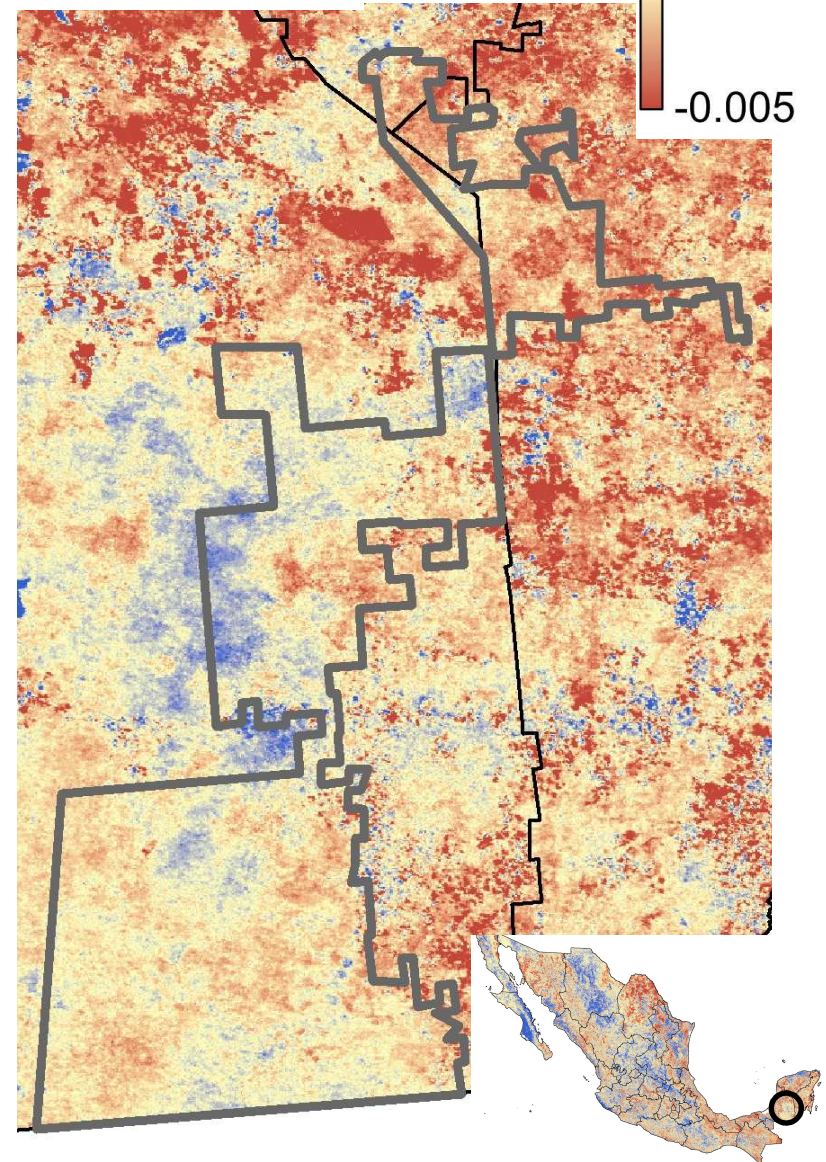
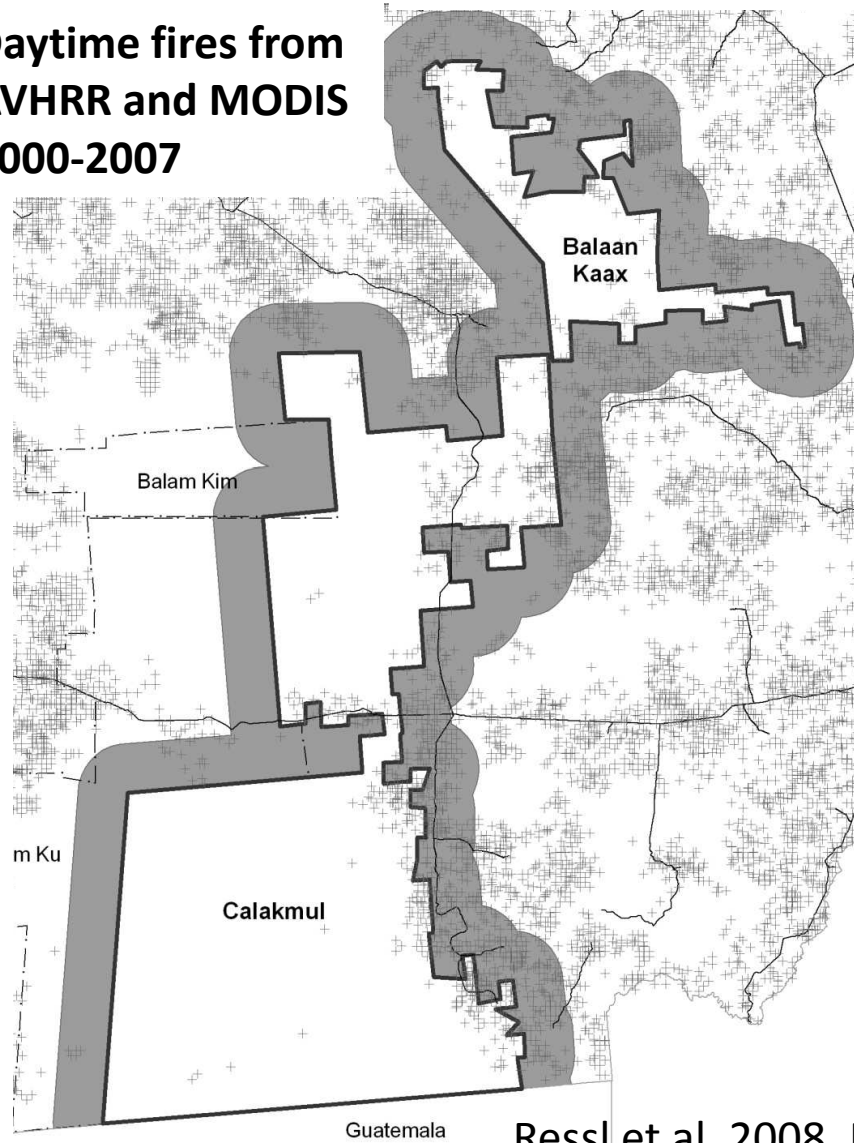




# Trends – Southern Mexico

## Natural Protected Area of Calakmul

Daytime fires from  
AVHRR and MODIS  
2000-2007

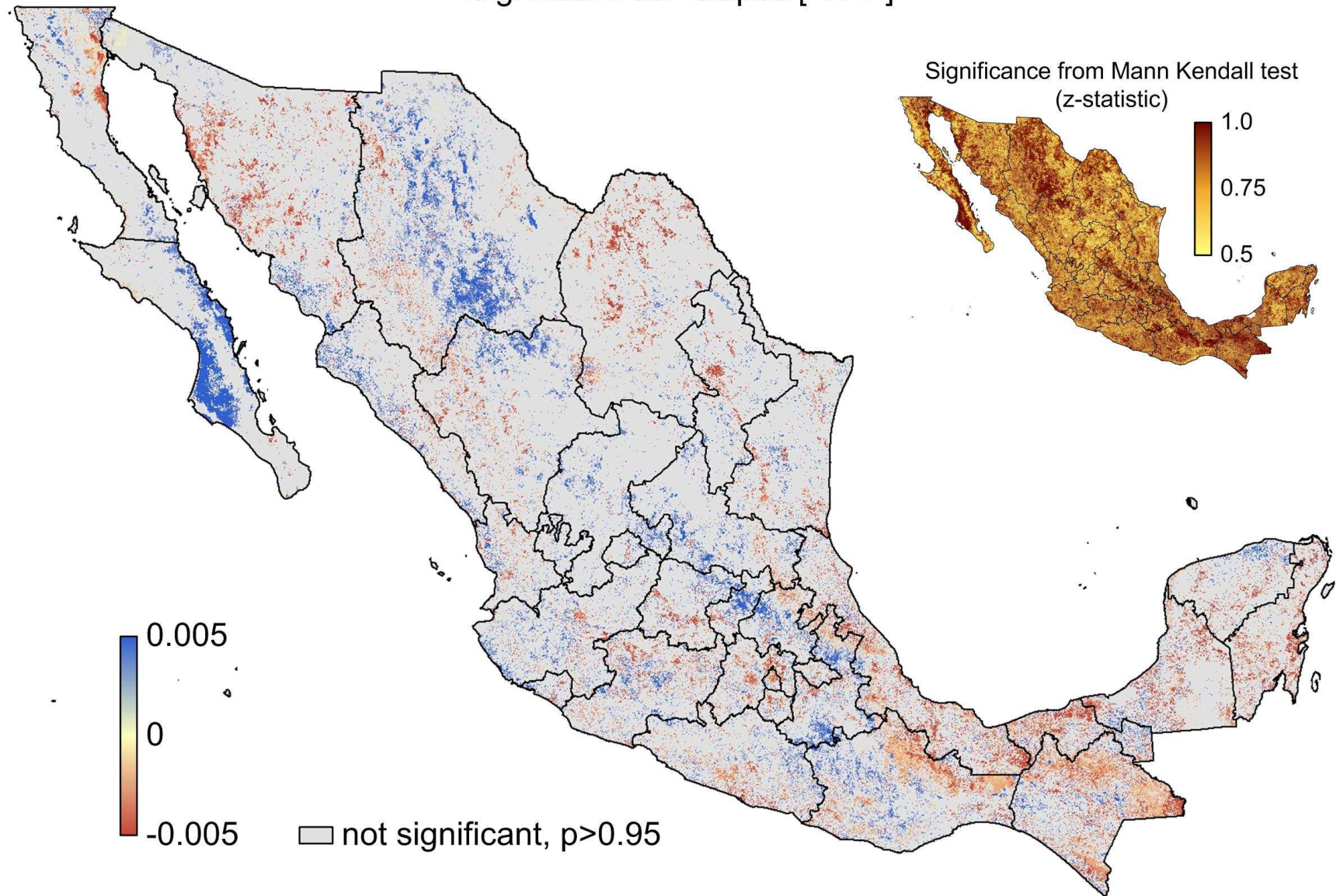


Ressl et al. 2008, RSE

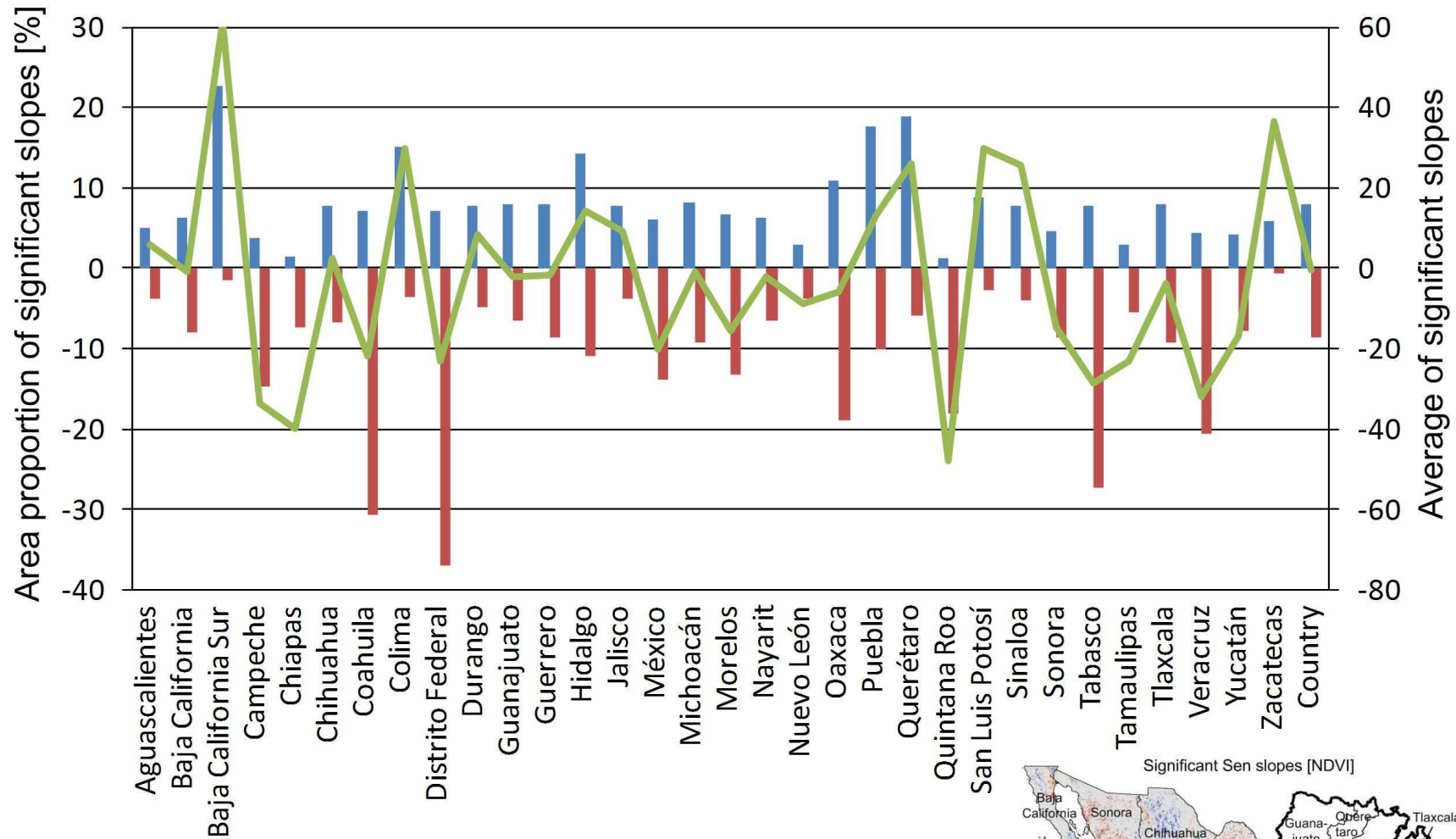


# Slope significance

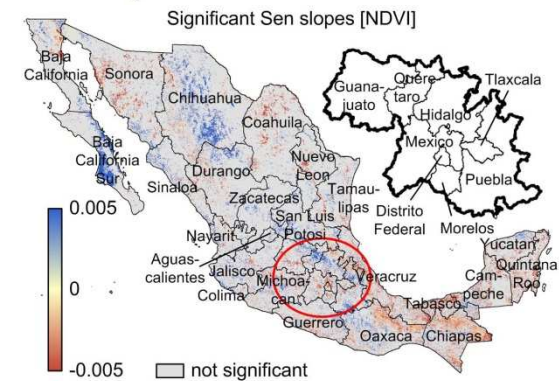
Significant Sen slopes [NDVI]



# Area and mean trend



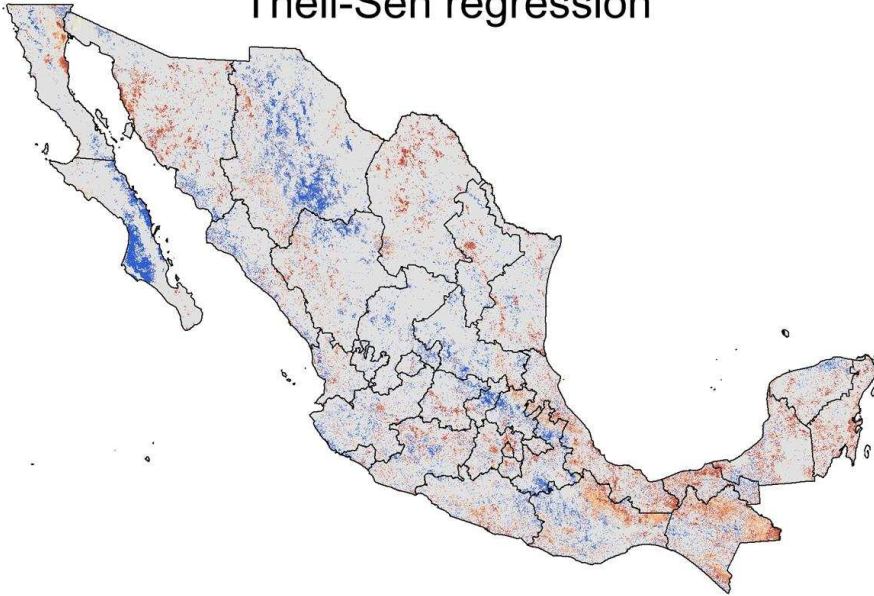
- Area proportion of significant positive slopes
- Area proportion of significant negative slopes
- Average of significant slopes



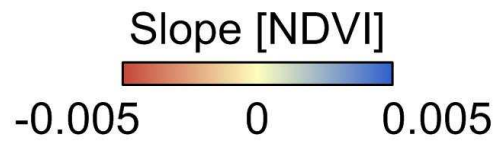
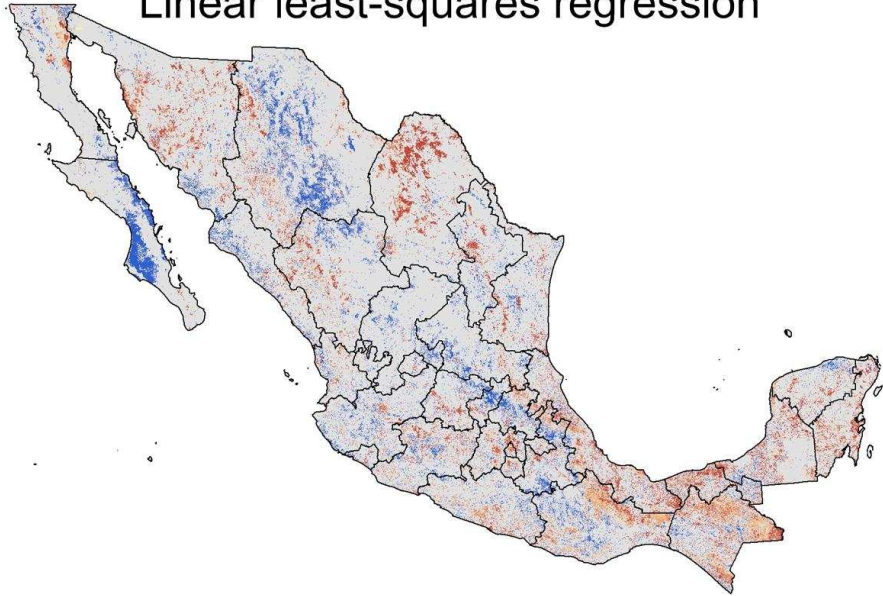


# Sen-slope vs. Least-squares

Theil-Sen regression

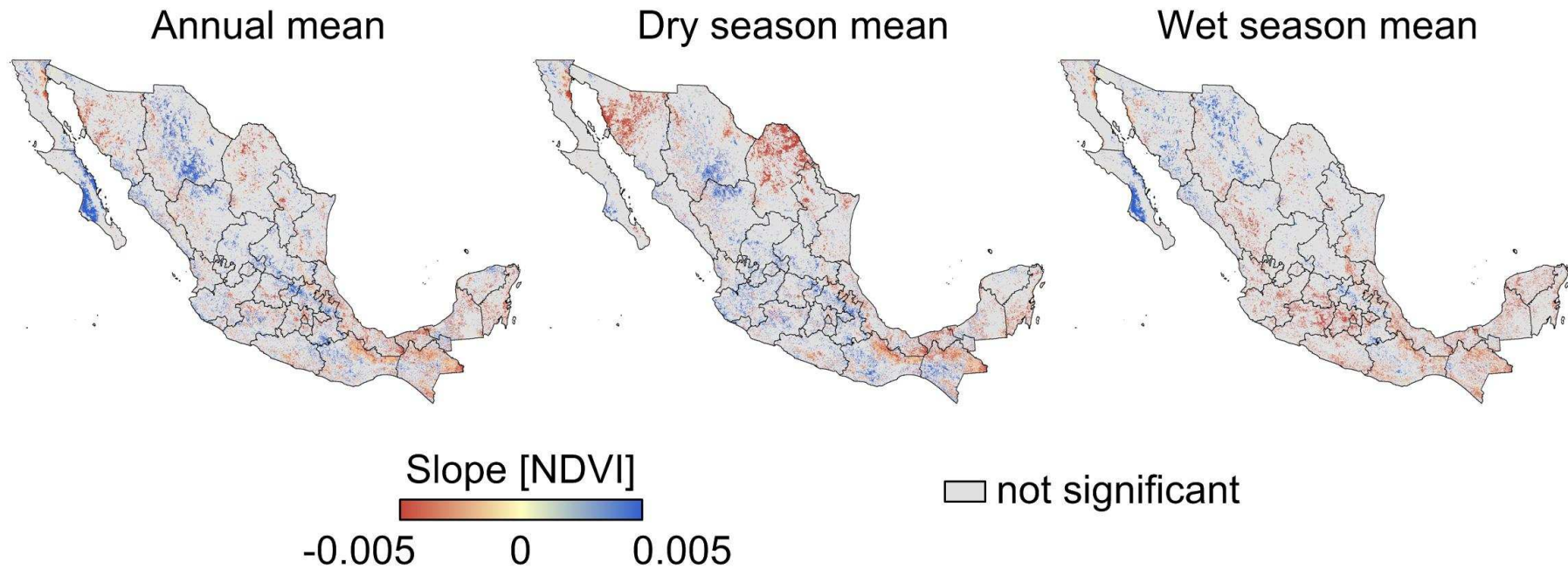


Linear least-squares regression



not significant

# Seasonal differences



# Conclusions

- Trends relate to changes in land cover
  - Land abandonment in Northern Mexico
  - Tendencies in precipitation
  - Fires and Urbanization
  - Natural Protected Areas
- Few differences between linear least-squares and Theil-Sen regression
- Seasonal analysis supports finding change drivers

# The road ahead

- Exploring further methods
  - Non-linear regression
  - Pre-whitening to remote AR1 processes
- Build statistical link to land cover changes
- Extend study area to entire Latin America