Environmental Change in the Great Basin, US

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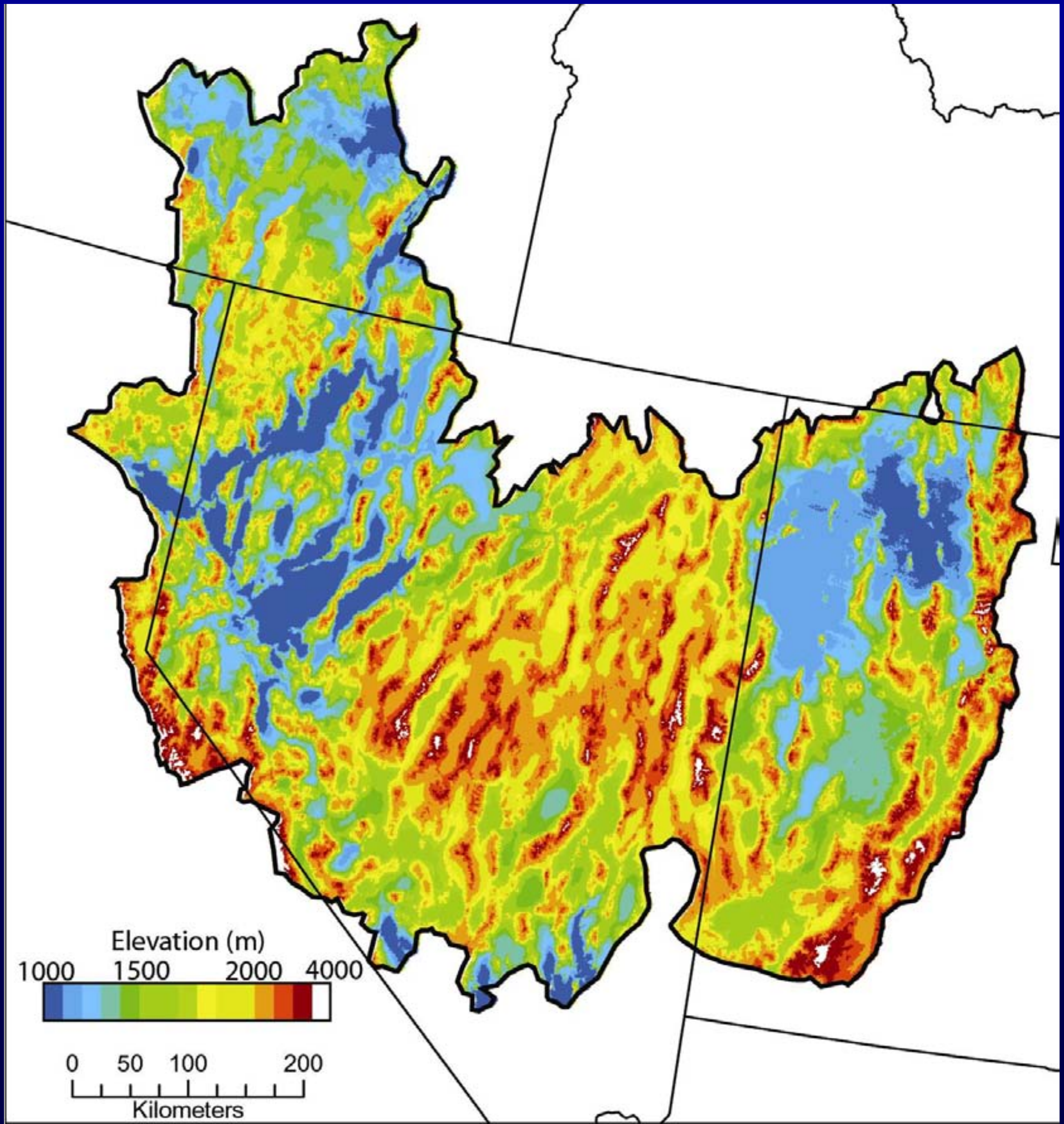


Major Questions

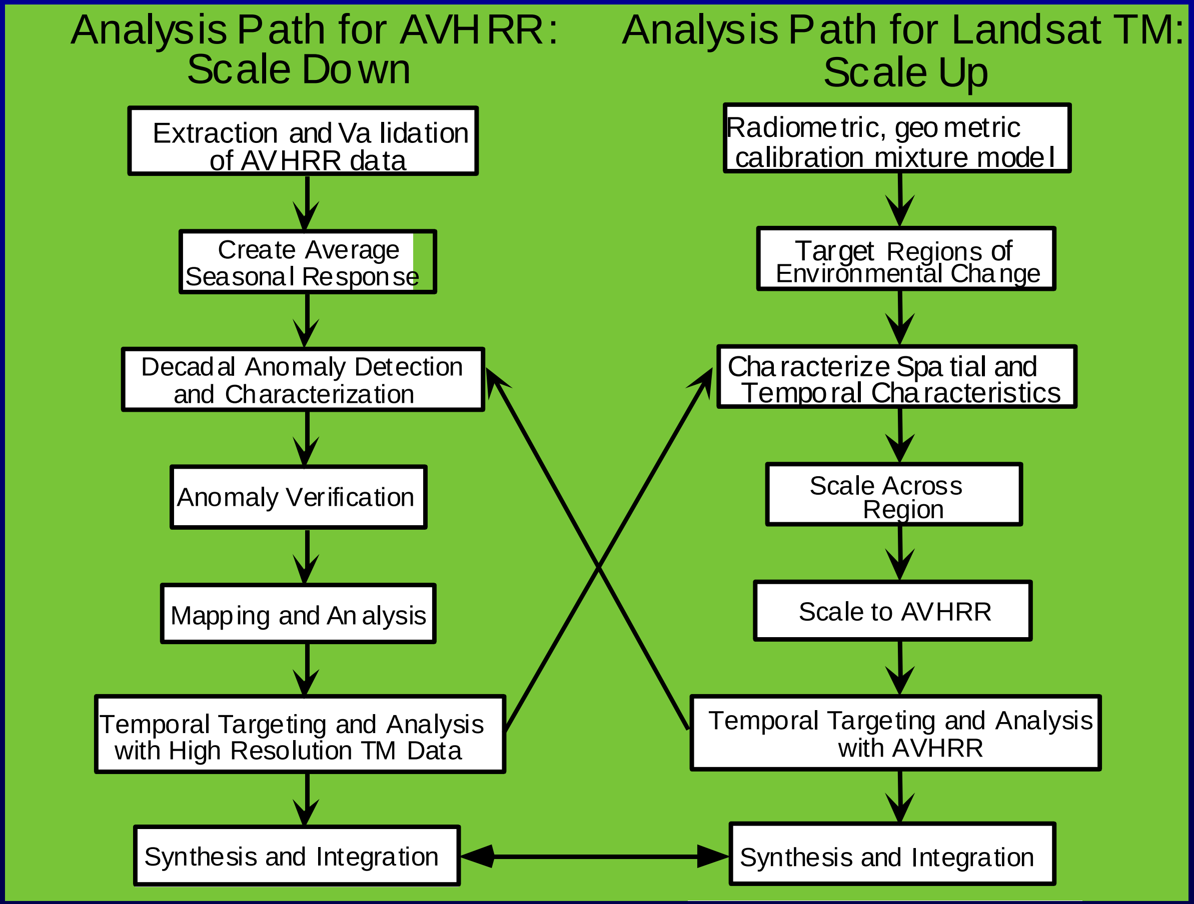
- How is land cover and land use in the Great Basin, US changing in response to climate forcing and anthropogenic activities?
- What are the legacies of land use and land management on the observed modern response?
- What are the possible outcomes for the Great Basin?

Important Pressure Points

- Water: local/regional use for domestic/ industrial/agriculture and external demands (e.g. Los Angeles)
- Ecosystem change through land management (e.g. pinyon juniper expansion) and introduced species (e.g. *bromus tectorum:*cheatgrass)
- Climate variability and possible change

Methodological Objectives: Spatial and Temporal Scaling

- Detection and mapping of an-omalous response
- Coarse spatial, high temporal resolution
- High spatial, coarse temporal resolution
- Cross referenced and integrated



Introduced Species:
Replacement of Native Ecosystems by Cheatgrass

Early 1900s

- Cheatgrass, Eurasian species, is accidentally introduced via hay bales
- Invasion begins along grazing routes and railroads (Mack, 1981)

1930s

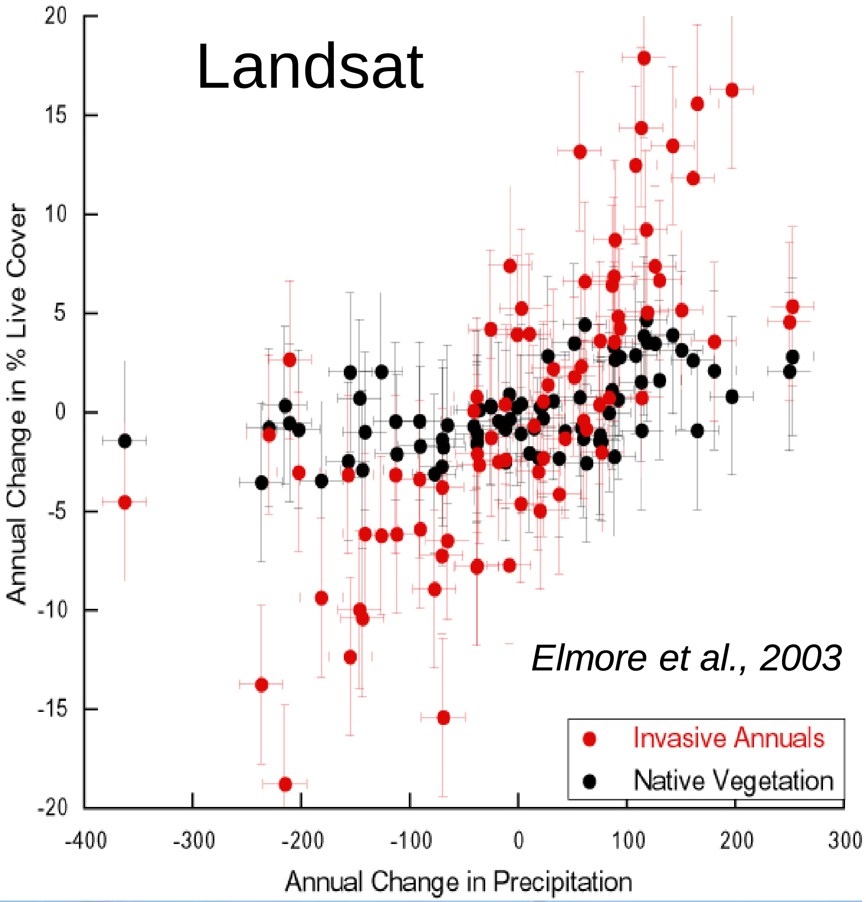
- Ecosystem transformation by cheatgrass is recognized as a growing problem (Stewart and Young, 1939)

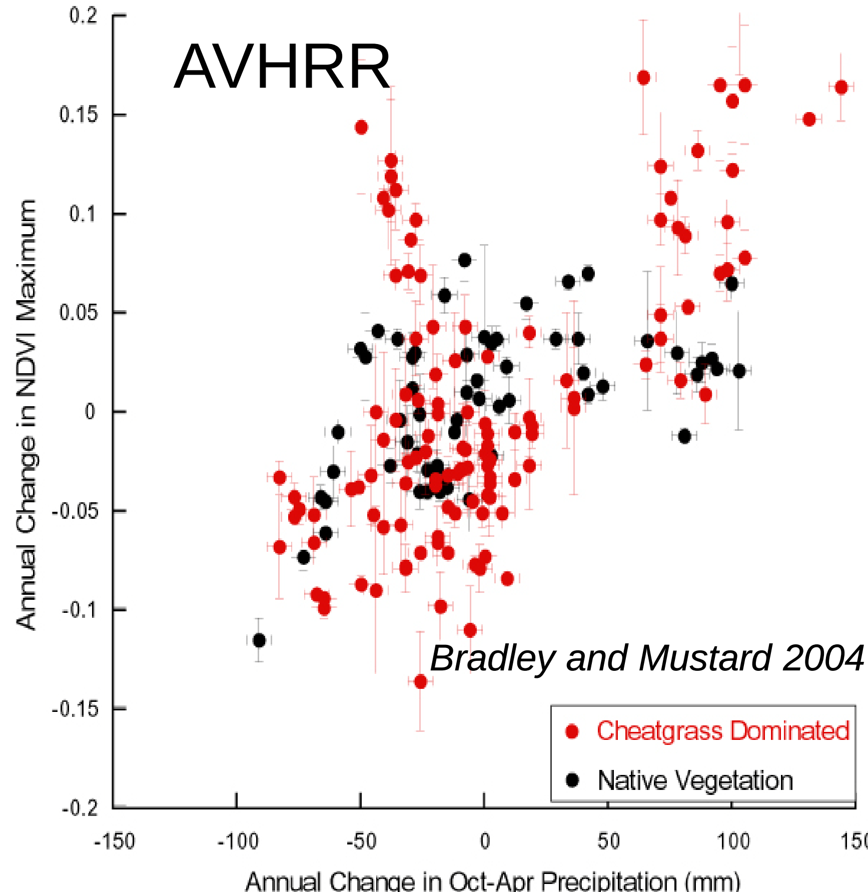
Late 1900s

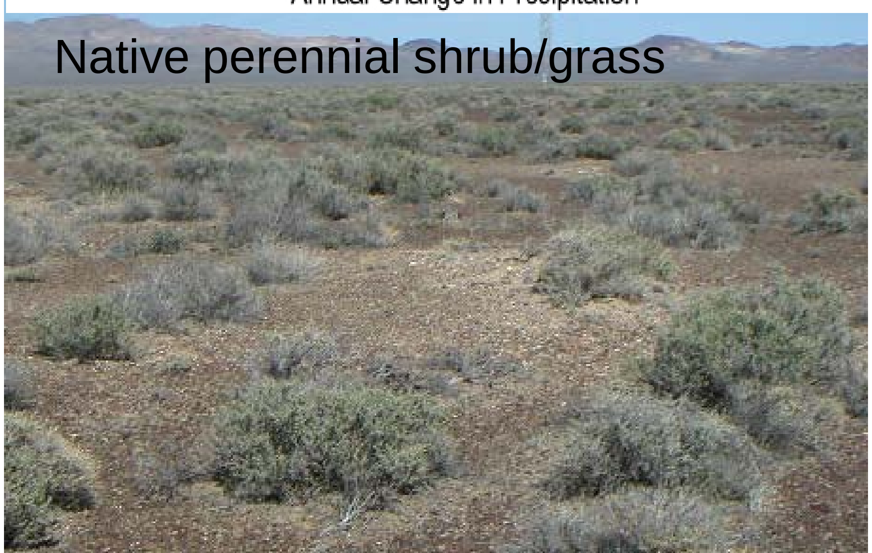
- Large, regional ecosystem transformation recognized
- Increased fire frequency maintains dominance (Whisenant, 1990)
- Cheatgrass monocultures are palatable during a very short period for grazing livestock (Young et al., 1972)
- Changes in nutrient cycling, carbon storage, biodiversity

Identification of Occurrence and Scaling

- Previous work identified an amplified response in greenness to interannual variations in rainfall of introduced species compared to natives species (Elmore et al., 2003)
- Regional Scale with AVHRR/MODIS
  - How much of the Great Basin is impacted?
  - Quantify amplified response in high temporal resolution data
- Ecosystem Scale with Landsat TM
  - By what processes and how quickly does cheatgrass move across the landscape?
  - AVHRR-MODIS used to target key dates with TM
  - Incorporate fire, management, agricultural data

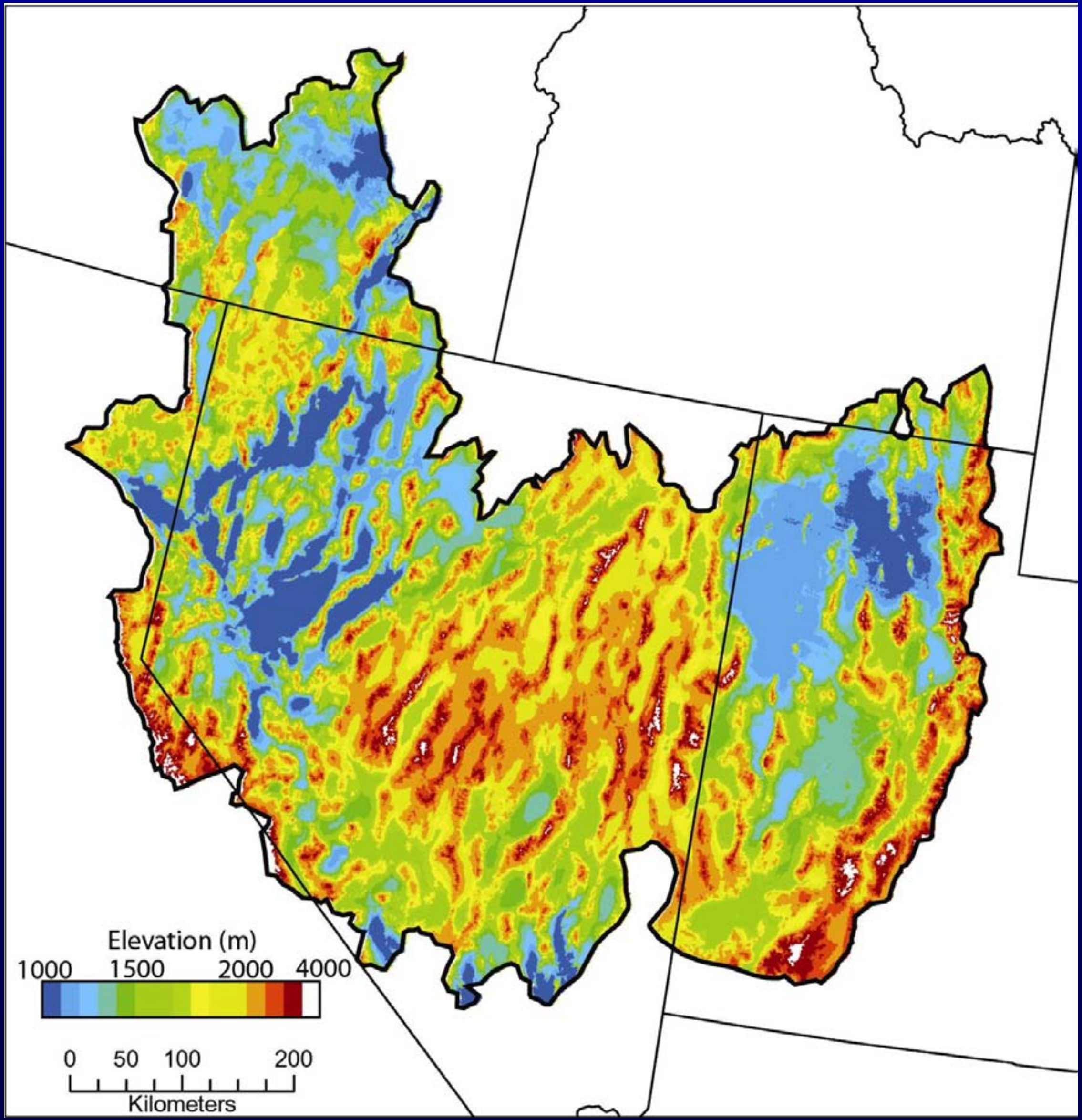

Landsat
Annual Change in % Live Cover
Annual Change in Precipitation
20
15
10
5
0
-5
-10
-15
-20
-400
-300
-200
-100
0
100
200
300
Elmore et al., 2003
Invasive Annuals
Native Vegetation


AVHRR
Annual Change in NDVI Maximum
Annual Change in Oct-Apr Precipitation (mm)
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-150
-100
-50
0
50
100
150
Bradley and Mustard 2004
Cheatgrass Dominated
Native Vegetation

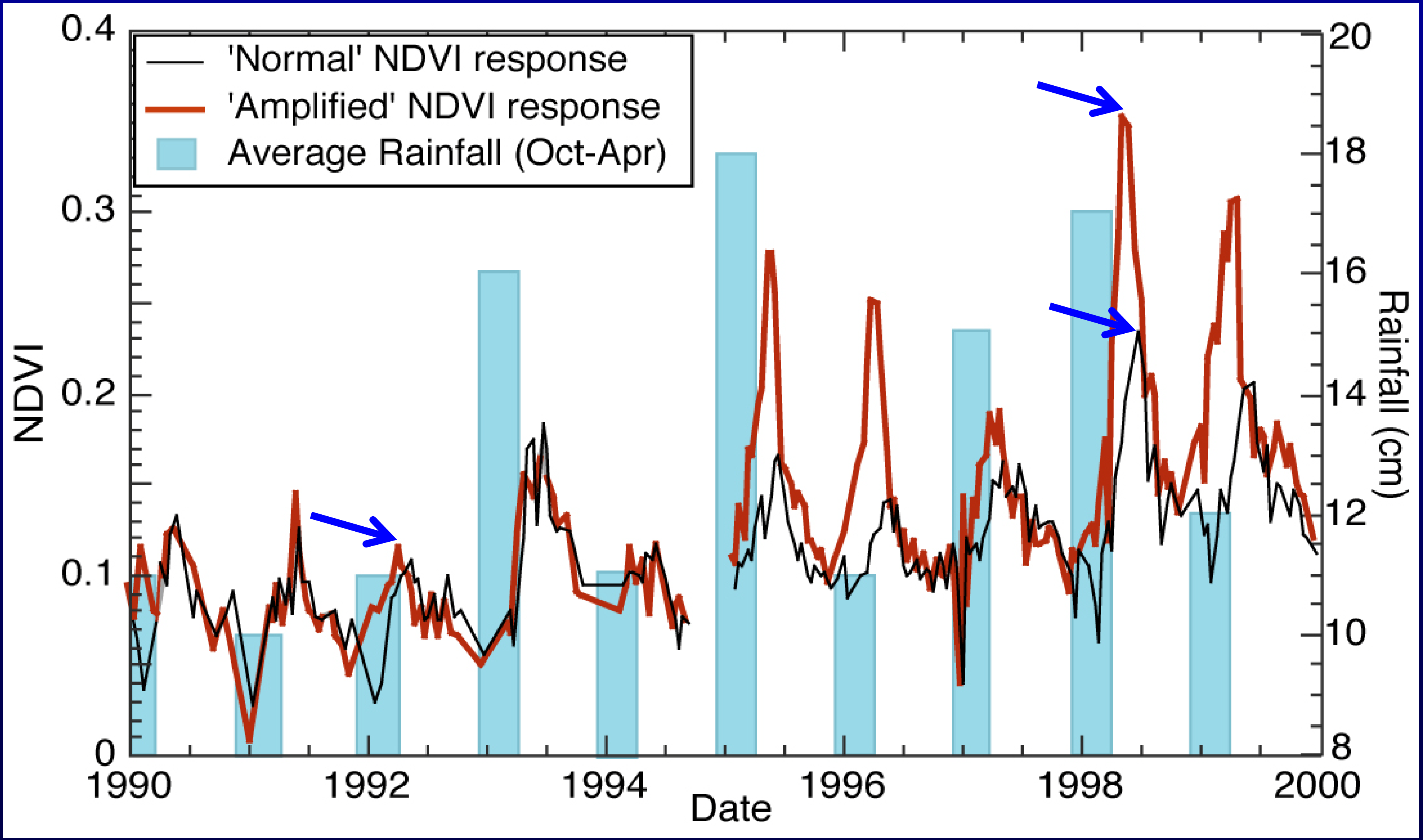

Native perennial shrub/grass


Cheatgrass monoculture

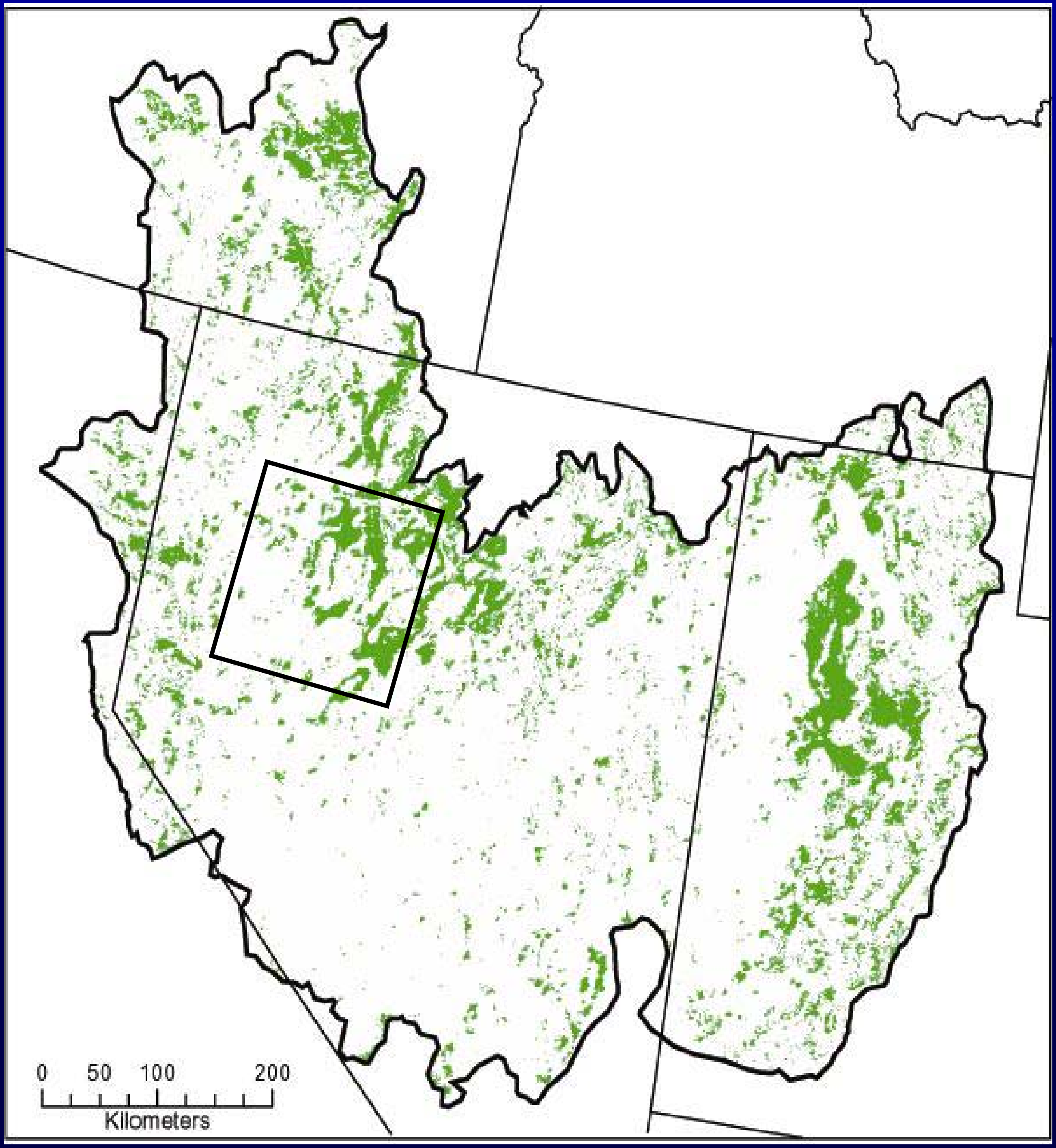
Great Basin

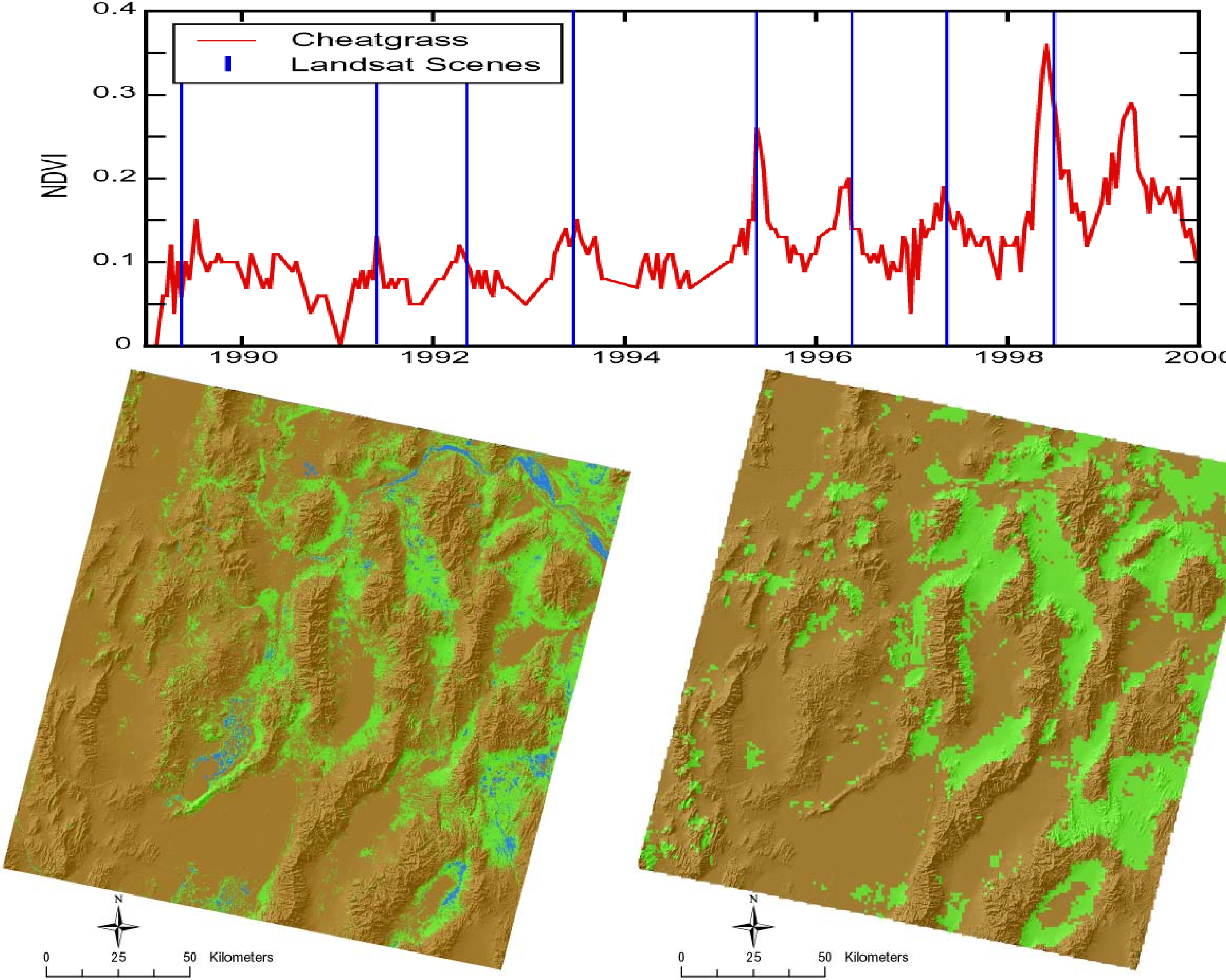


‘Normal’ and ‘Amplified’ AVHRR Time Series



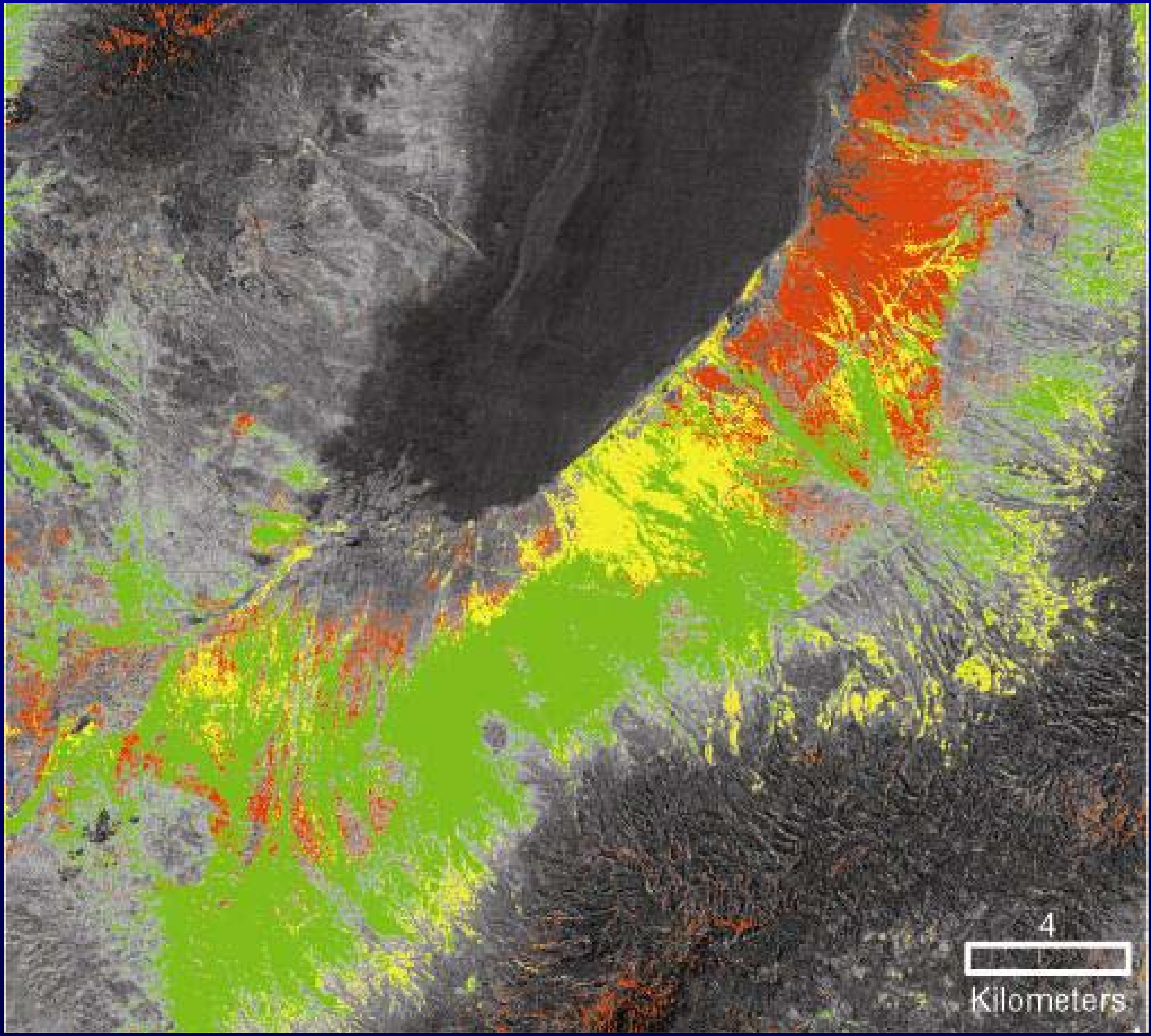
High Density Cheatgrass





Cheatgrass
Landsat Scenes
NDVI
0.4
0.3
0.2
0.1
0
1990
1992
1994
1996
1998
2000
N
0
25
50
Kilometers
N
0
25
50
Kilometers

Cheat-grass Invasion

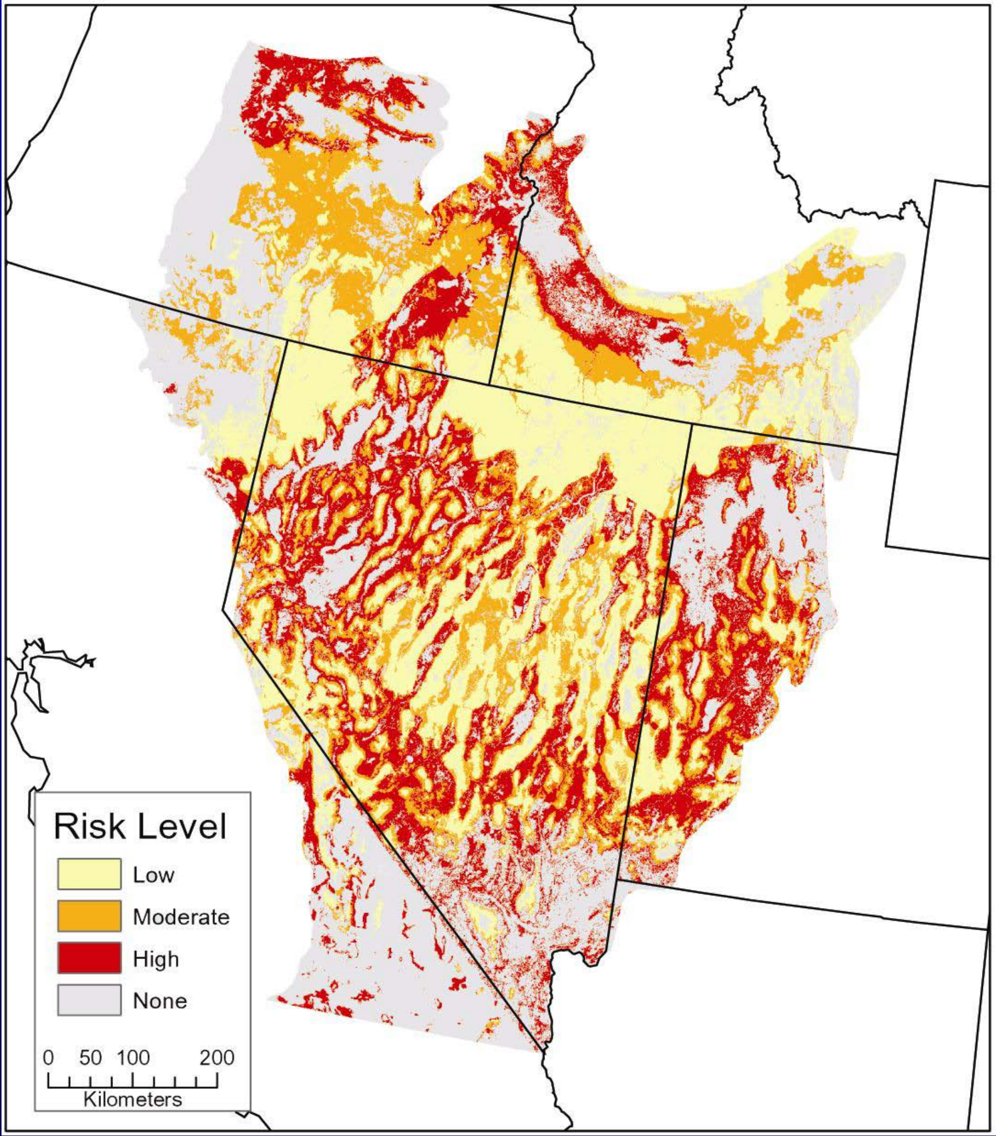


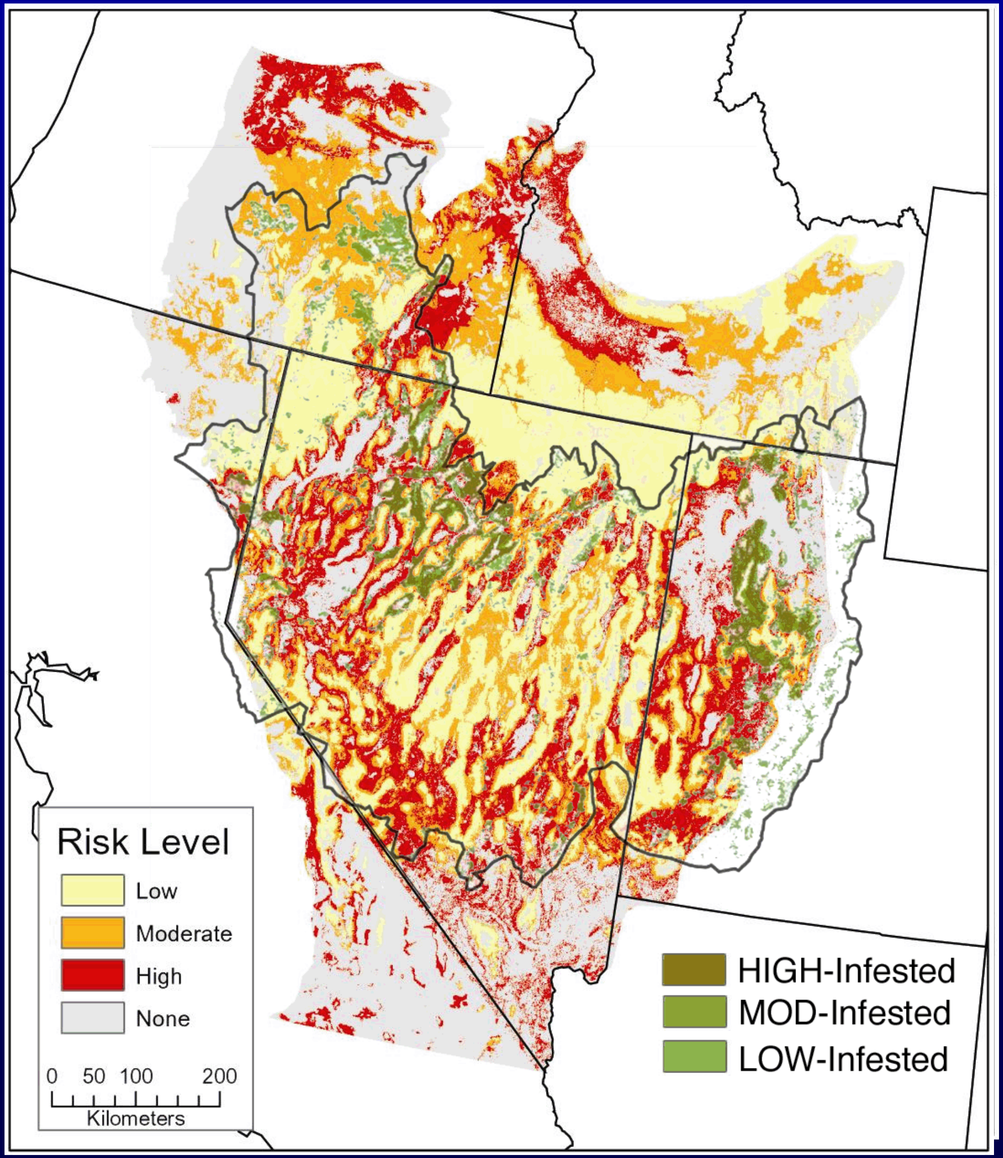
NDVI Difference

- 1988-1992 (green)
- 1995-1992 (yellow)
- 1998-1992 (red)

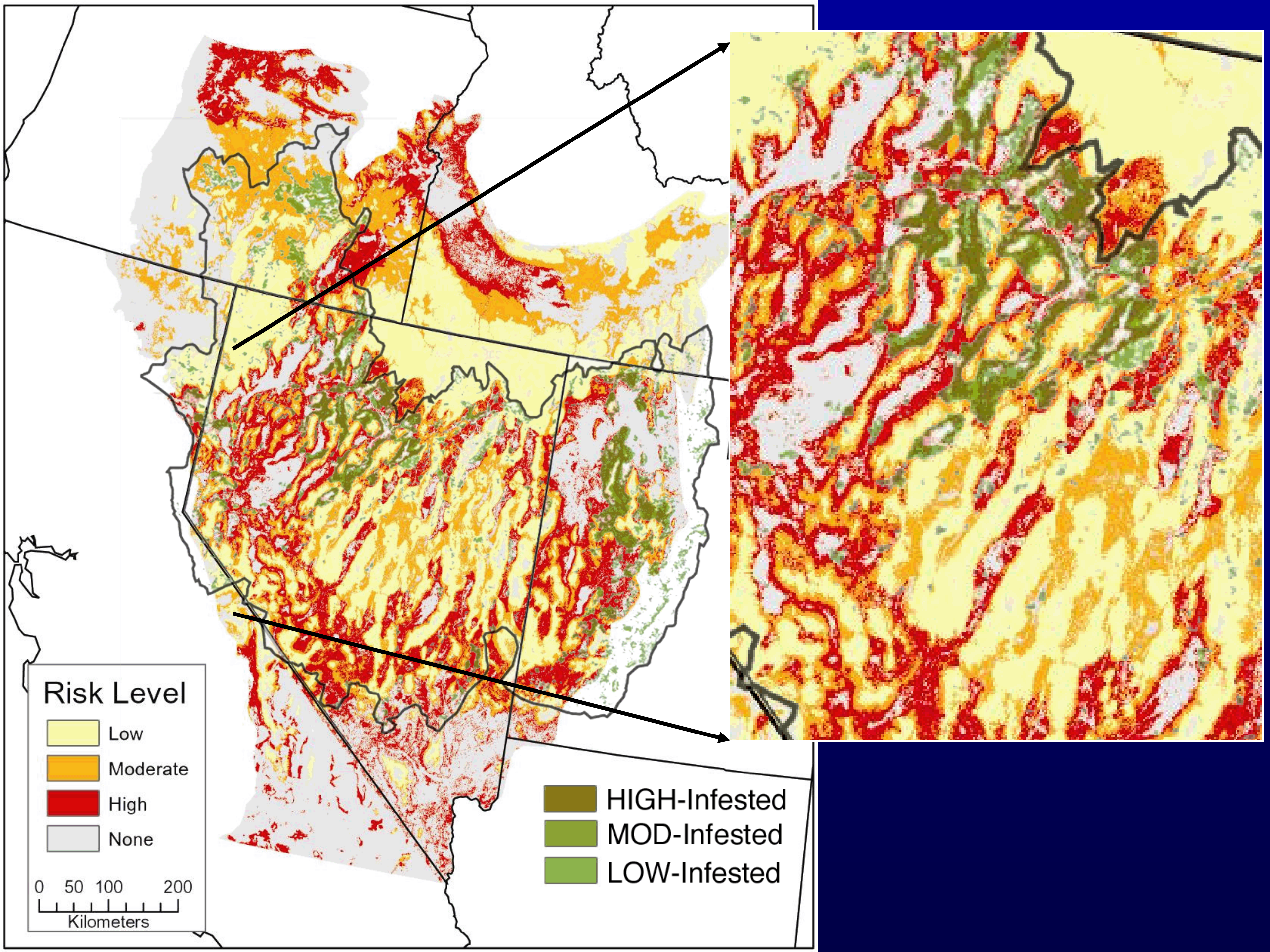
Risk of Cheatgrass Invasion

- Widsom et al (2003)
- Risk factors developed based on slope, aspect, elevation, soils
- Compare risk map with presence map





Risk Level
Low
Moderate
High
None
0 50 100 200
Kilometers
HIGH-Infested
MOD-Infested
LOW-Infested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Conclusions

- 20,000 km^2 of the Great Basin contain a high density of cheatgrass
- Methodology (regional to local multisensor scaling) will determine rates of cheatgrass invasion
- Integration of risk mapping, occurrence and processes will be factored into future management
- Future efforts will continue with wetland change, pinyon-juniper expansion
- 4 manuscripts published or in press, 2 in preparation