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Burn Severity Trends and Elevation

A Temporal Analysis from 1984-2011 in Arizona and New Mexico

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School of Geography and Development,
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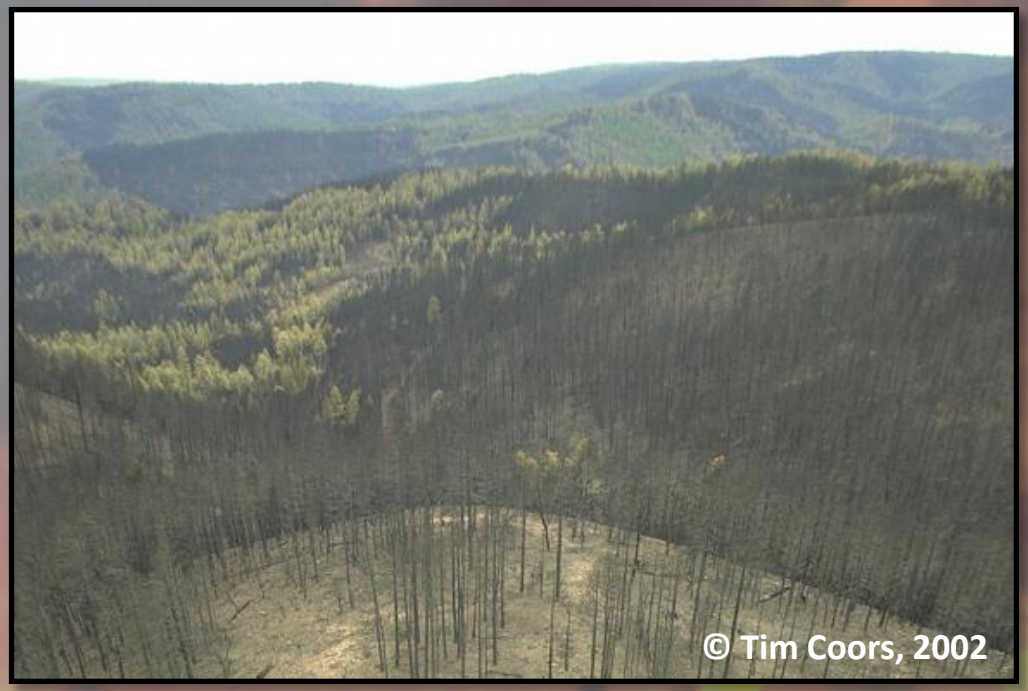
Burn Severity & Elevation

- **Prior Studies: Burn Severity & Area Burned**
  - Holden et al. 2007, Dillon et al. 2011
  - Greater proportion high burn severity in large fires
- **This Study: Burn Severity & Elevation**
  - ***Are fires burning higher as years progress?***
  - Does trend exist?
  - Driving Factors?
  - Future Implications?



Rodeo-Chediski Fire
2002

Wallow Fire
2011

Burn Severity & Elevation

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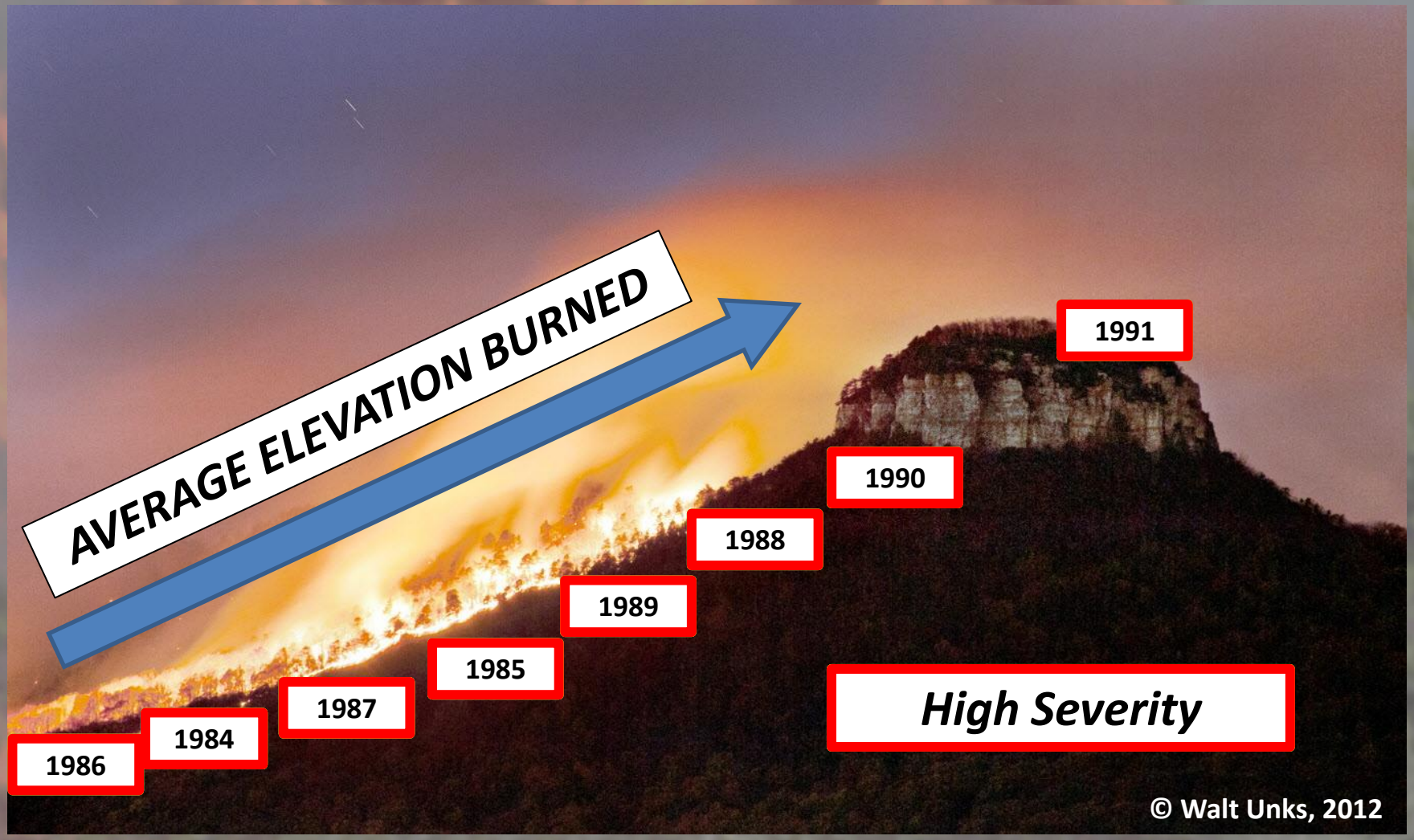
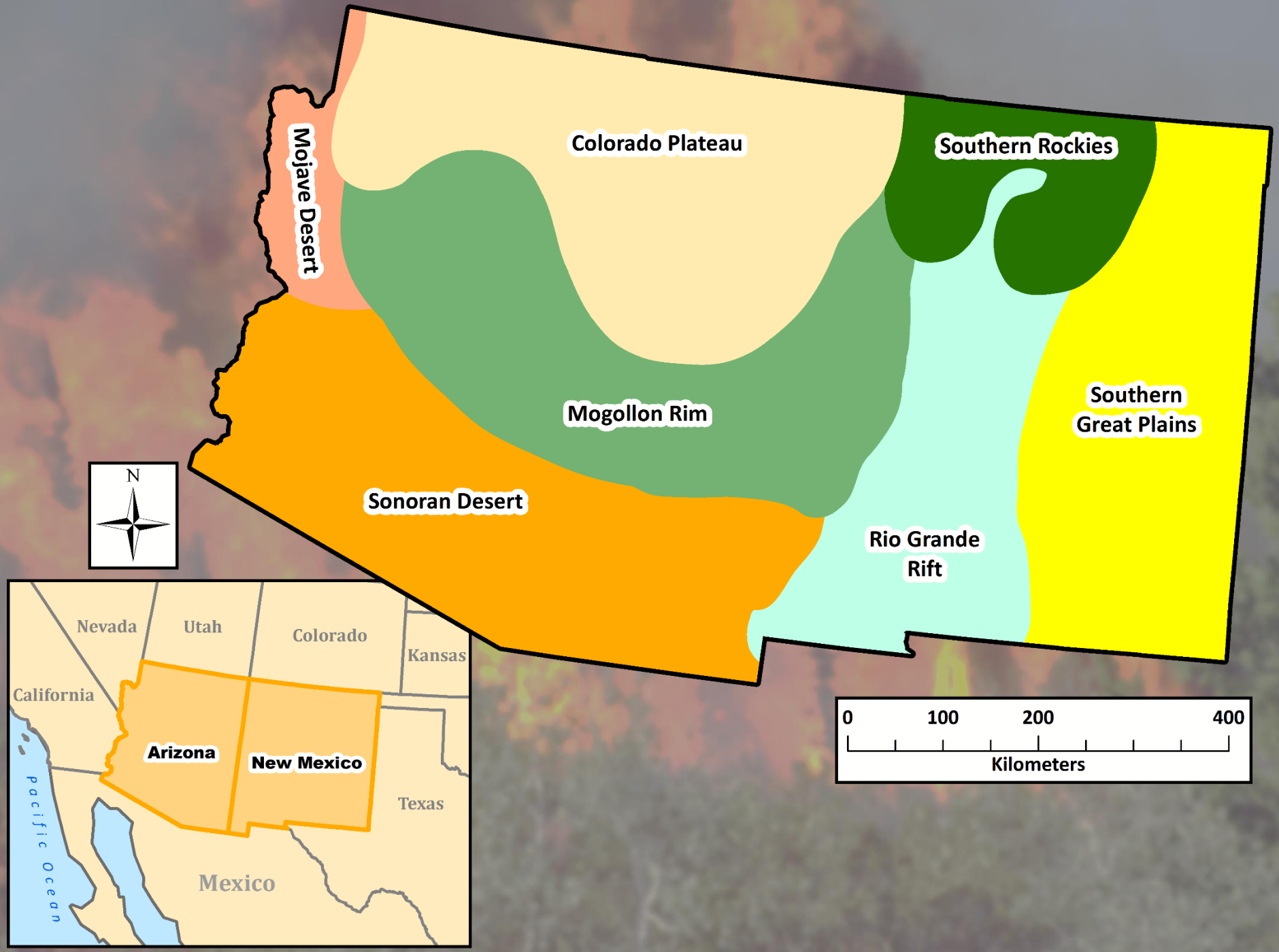
Burn Severity & Elevation



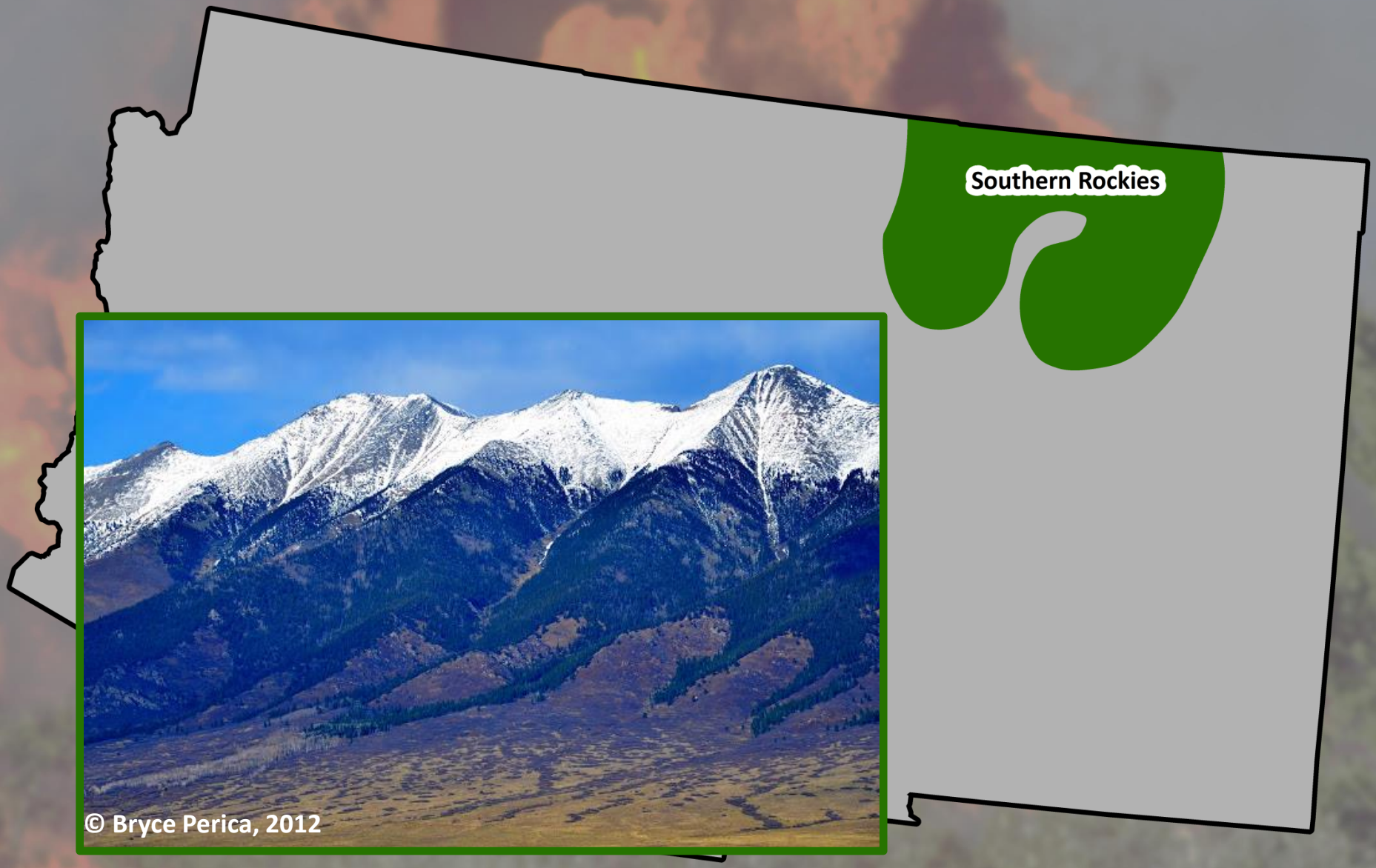

Mojave Desert
Colorado Plateau
Southern Rockies
Mogollon Rim
Southern Great Plains
Sonoran Desert
Rio Grande Rift
N
0
100
200
400
Kilometers
Nevada
Utah
Colorado
Kansas
California
Arizona
New Mexico
Texas
Pacific Ocean
Mexico

Sonoran Desert
© Tomas Castelazo, 2007

Mogollon Rim

© Daniel Mauz, 2010

© Andreas F. Borchert, 2006



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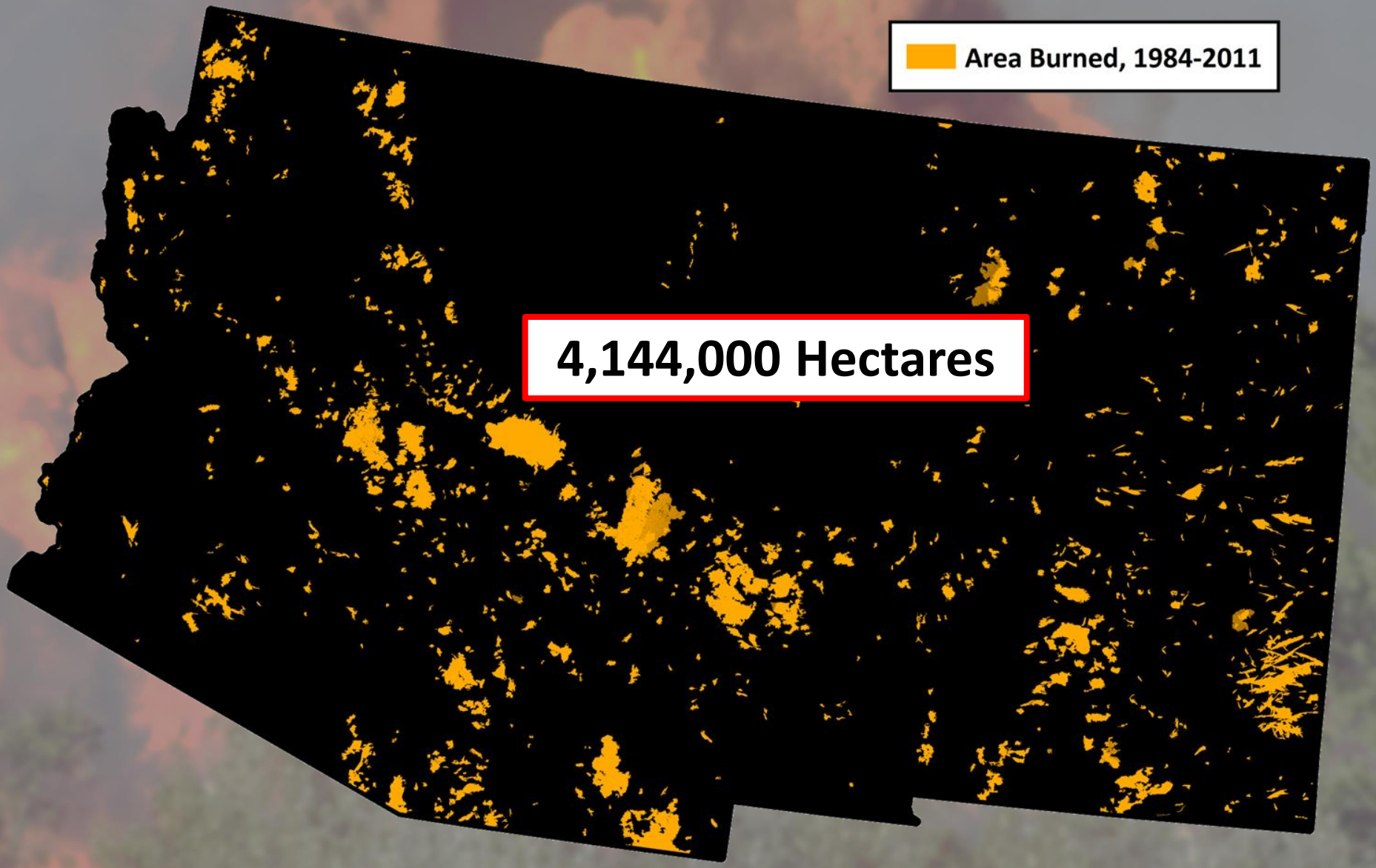
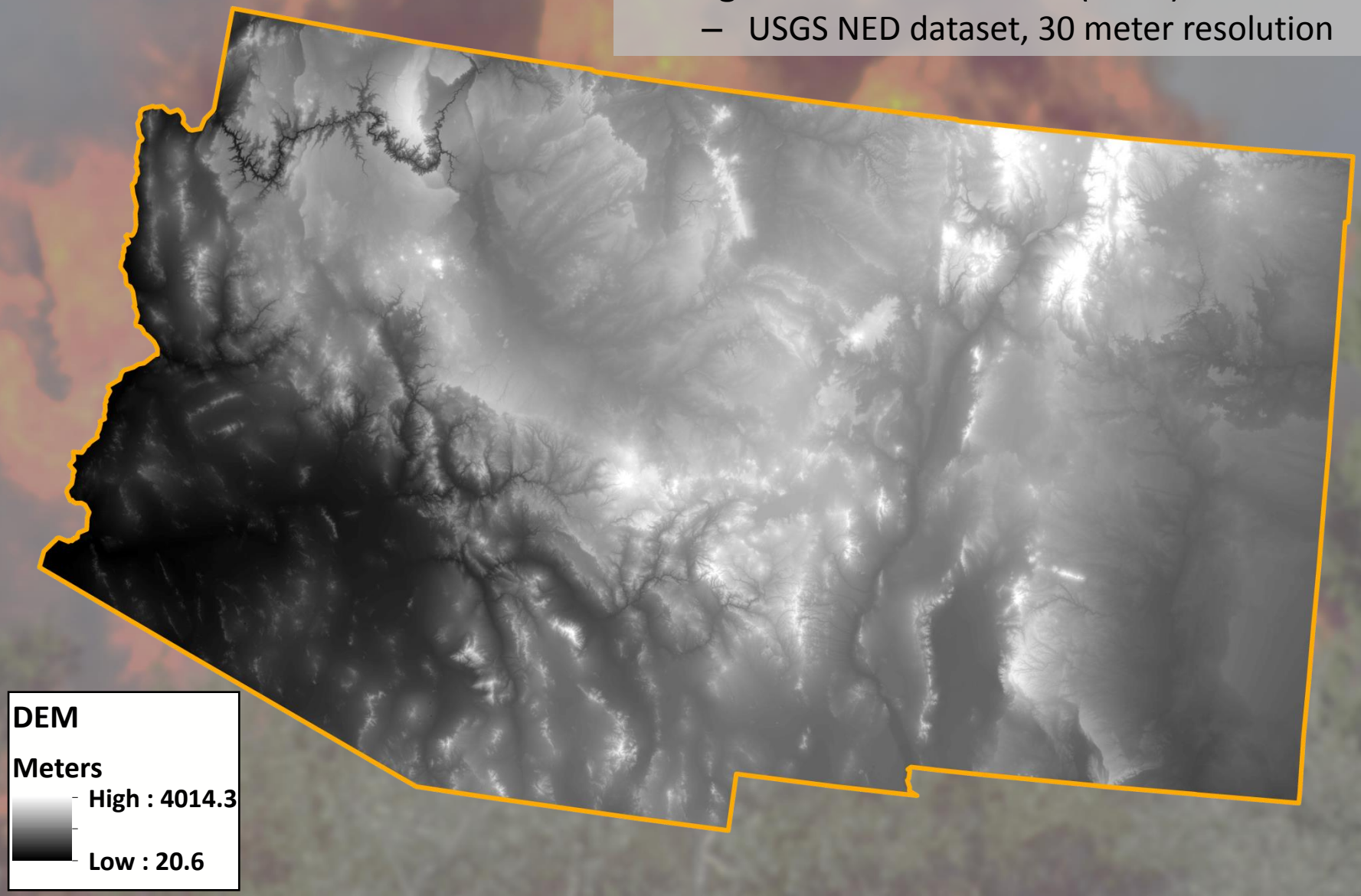

Area Burned, 1984-2011
4,144,000 Hectares

Data

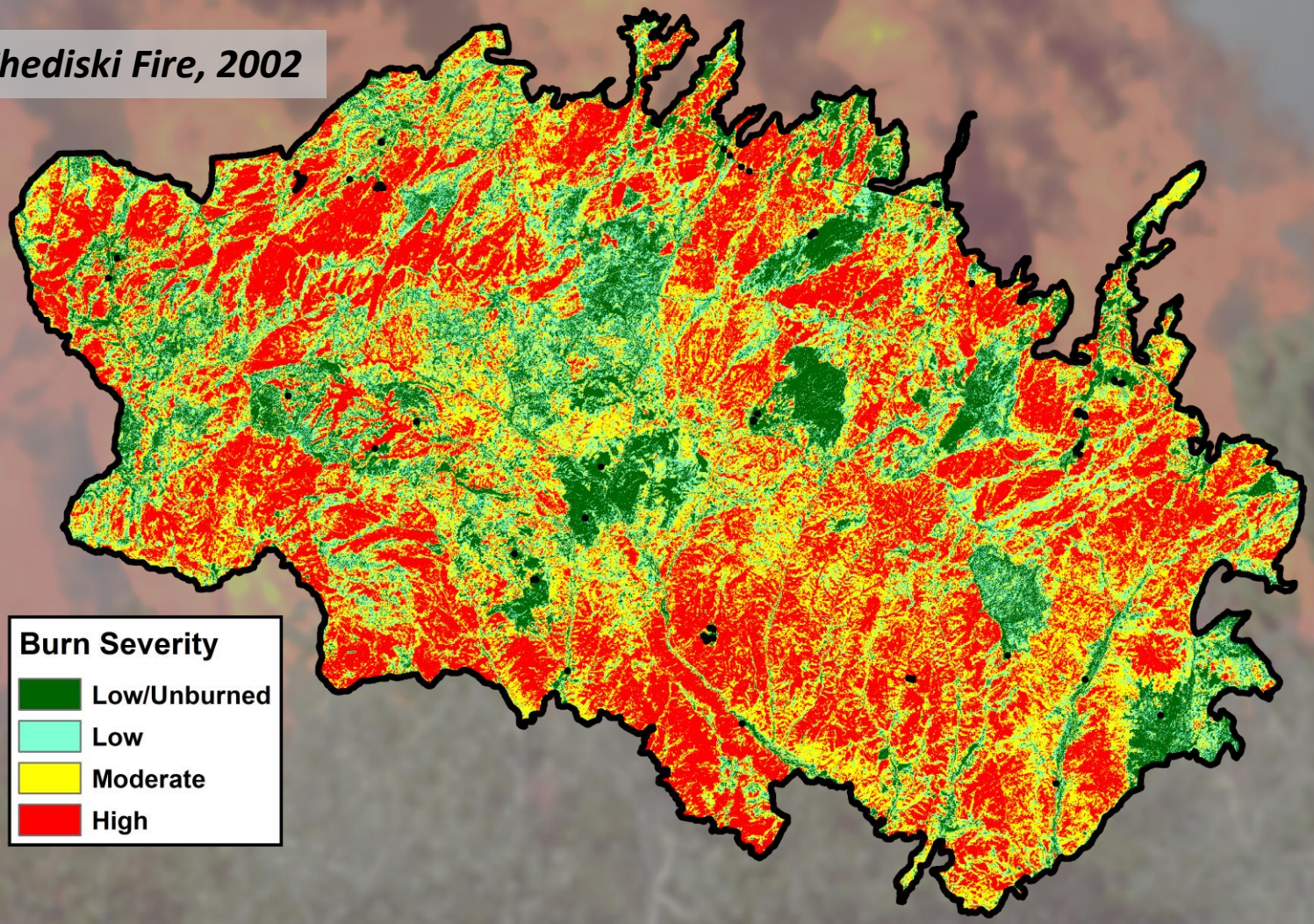
- Digital Elevation Model (DEM)
  - USGS NED dataset, 30 meter resolution



Data

- Monitoring Trends in Burn Severity (MTBS)
  - Landsat derived, 30 meter resolution

Rodeo-Chediski Fire, 2002



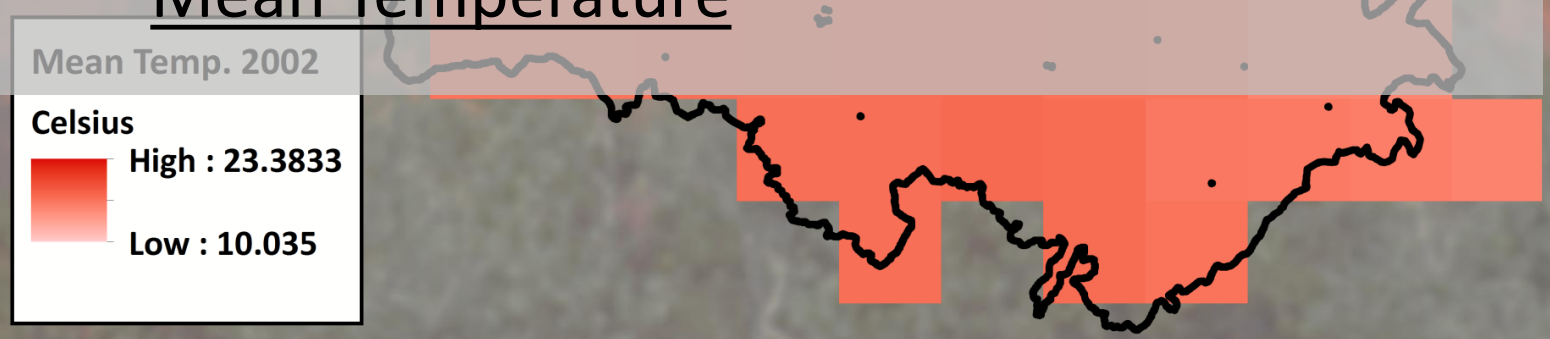
Data

- Prism Climate Data
  - 4 kilometer resolution

- **Prism Climate Data (4km Resolution)**

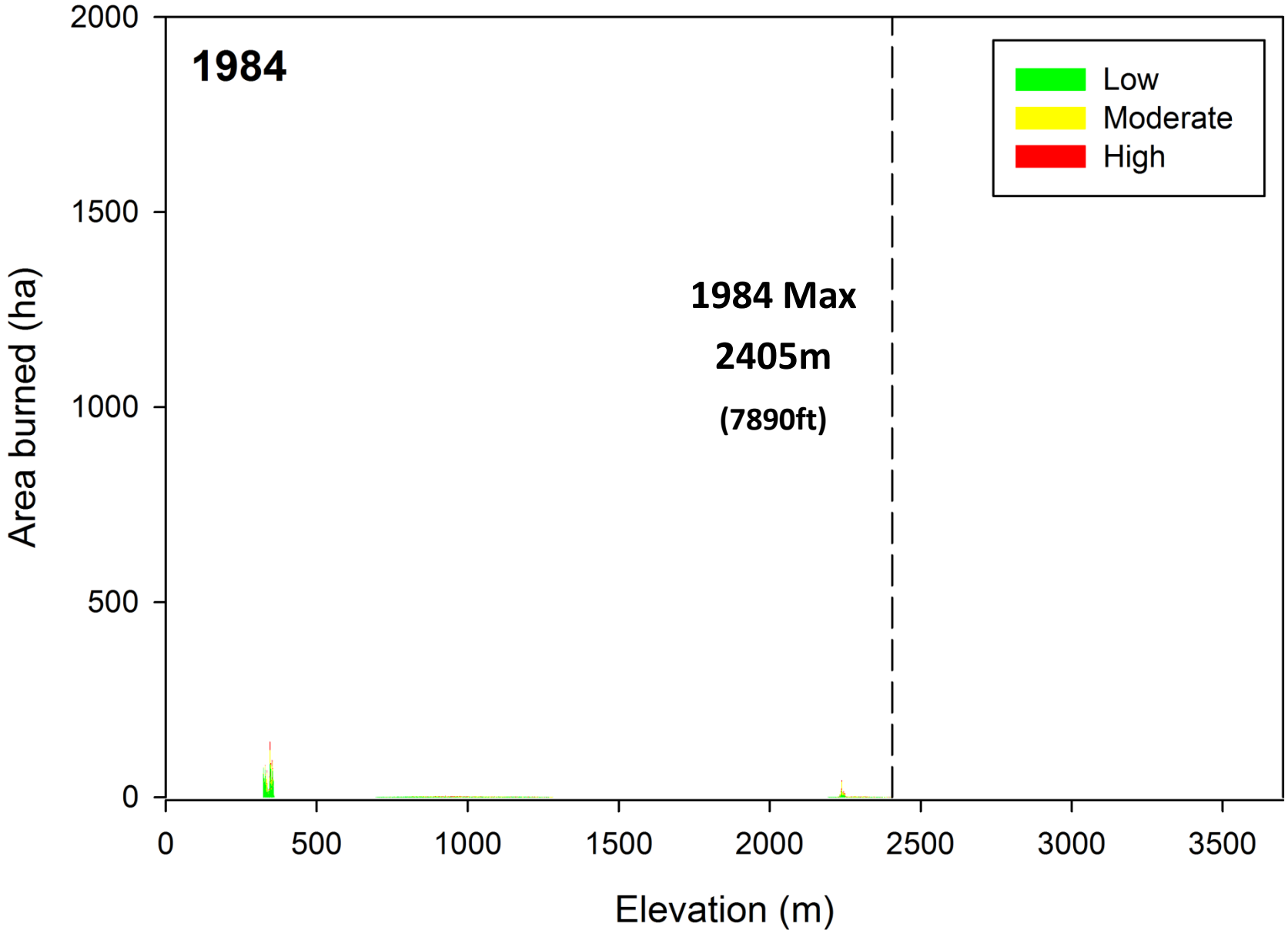
Rodeo-Chediski Fire, 2002

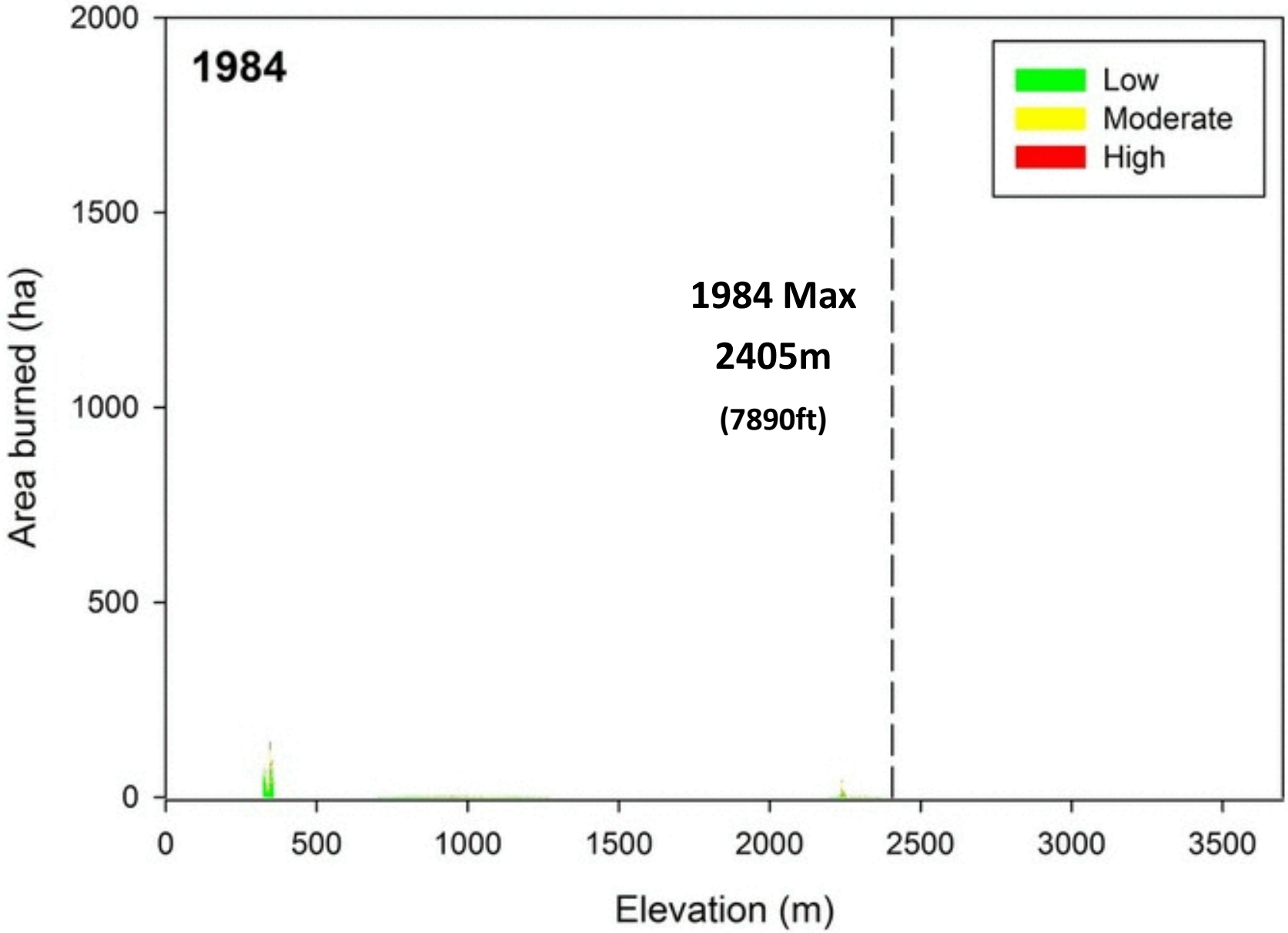
  - Mean Precipitation
    - *Antecedent Precipitation*
      - (Oct-Dec prior year, Jan-April current year)
  - Mean Minimum Temperature
    - *Prior Months*
      - (April-June)
  - Mean Maximum Temperature
  - Mean Temperature



Methodology

- Determine if trends in burn severity exist for time period and study area.
  - Combine DEM and MTBS for time series values.
- Compare these values with climate derived time series values.


1984
Low
Moderate
High
1984 Max
2405m
(7890ft)
Area burned (ha)
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
3500
Elevation (m)


1984
Low
Moderate
High
1984 Max
2405m
(7890ft)
Area burned (ha)
2000
1500
1000
500
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0
500
1000
1500
2000
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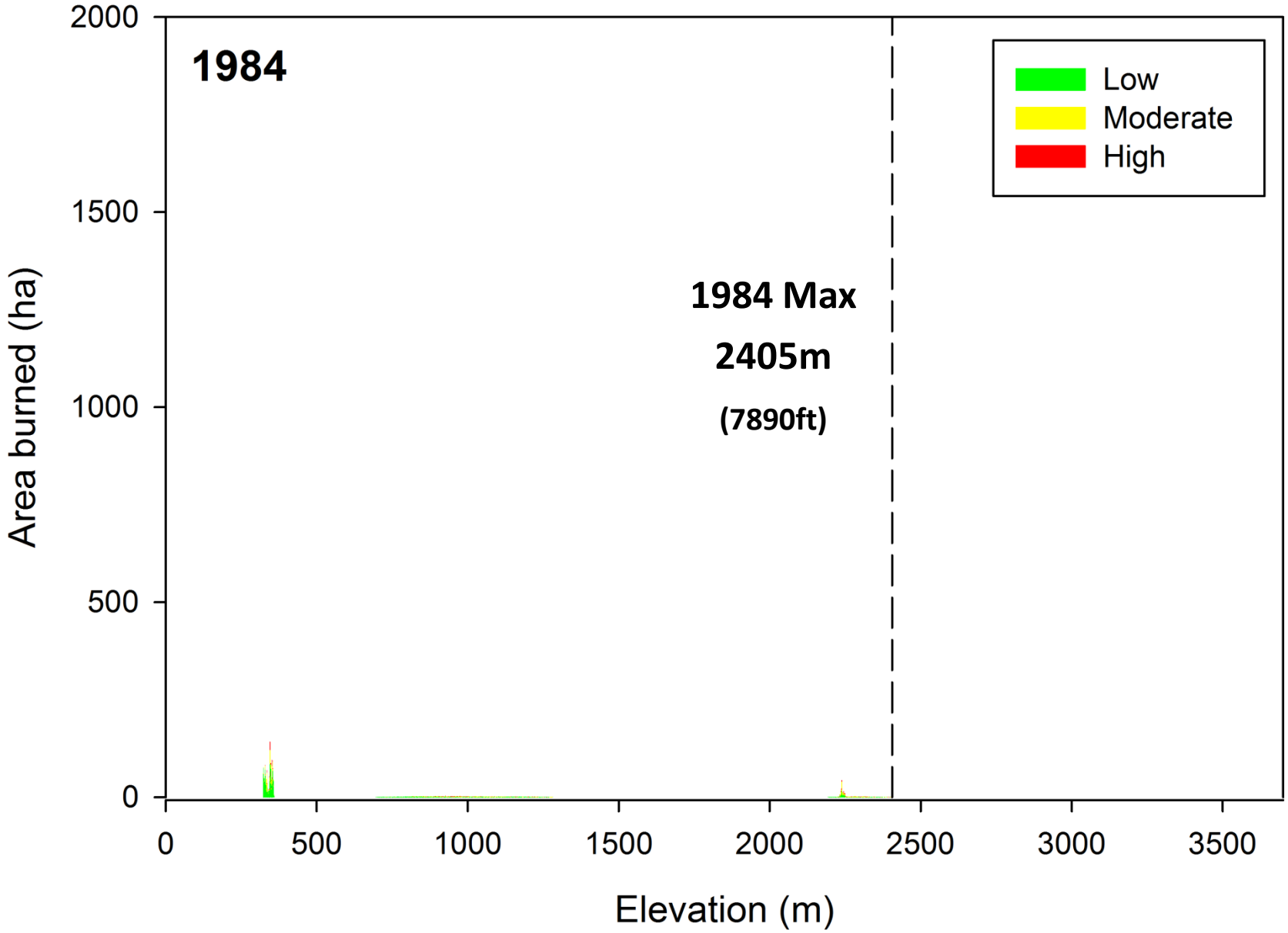
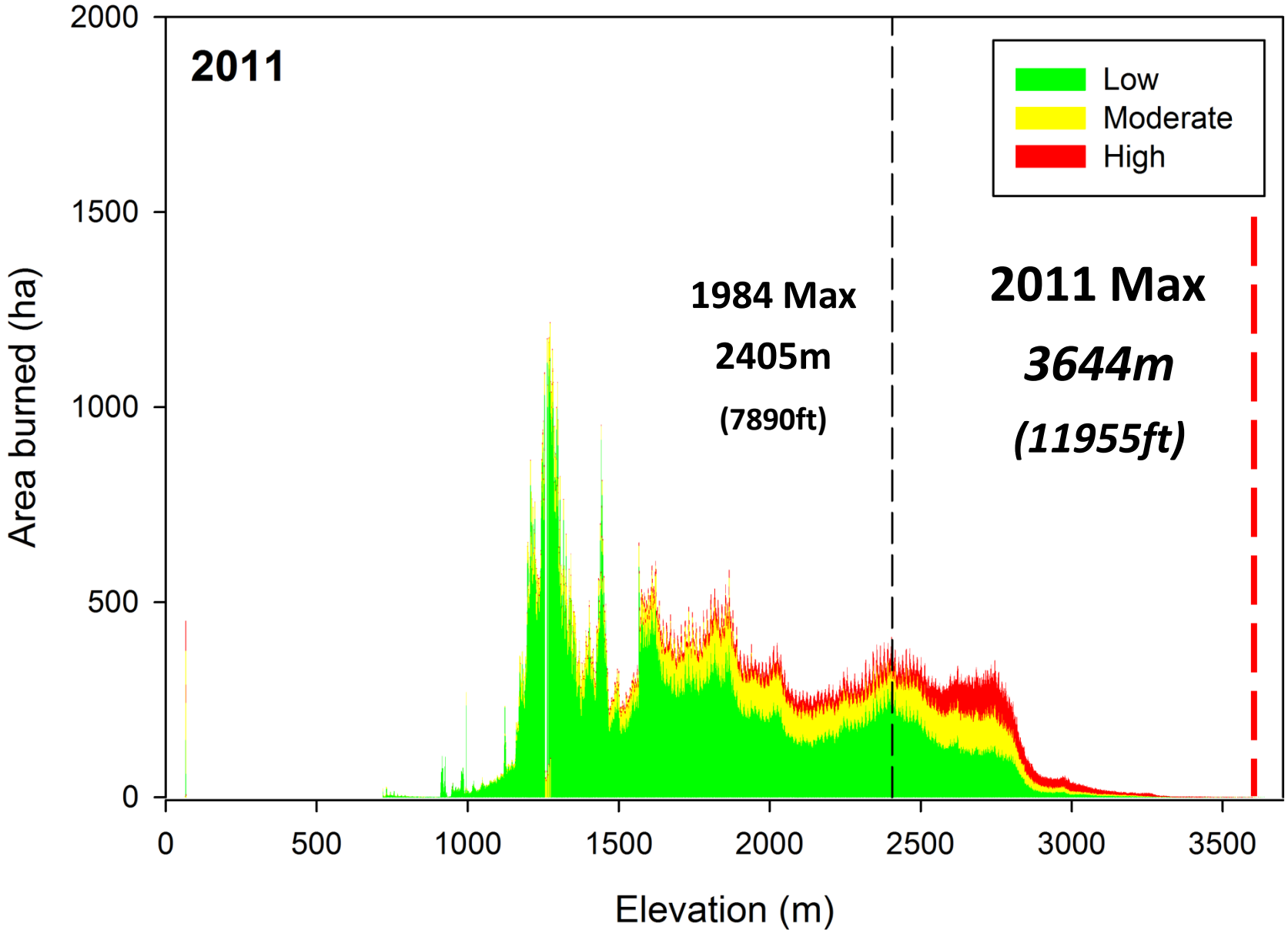
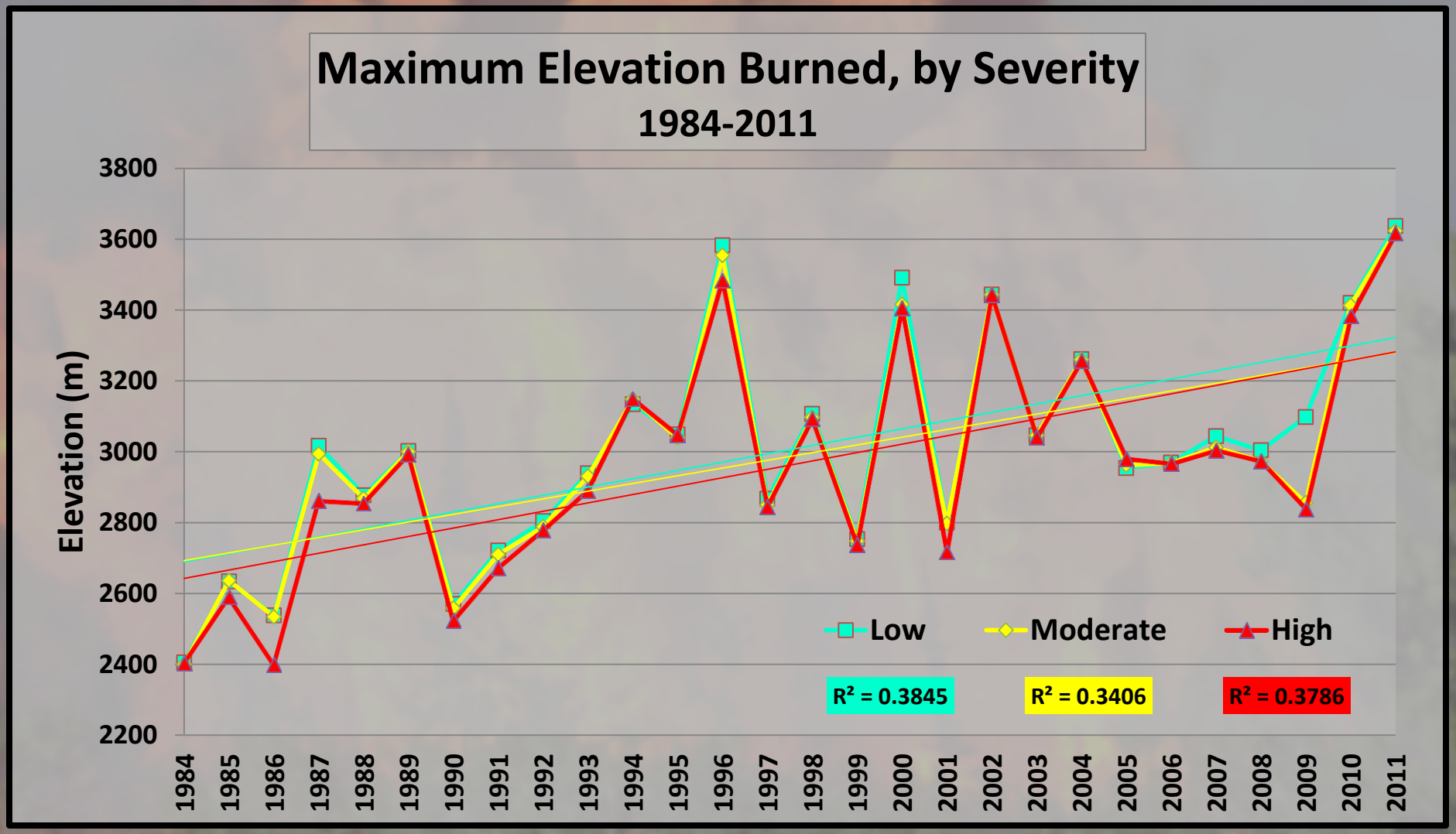
3000
3500
Elevation (m)

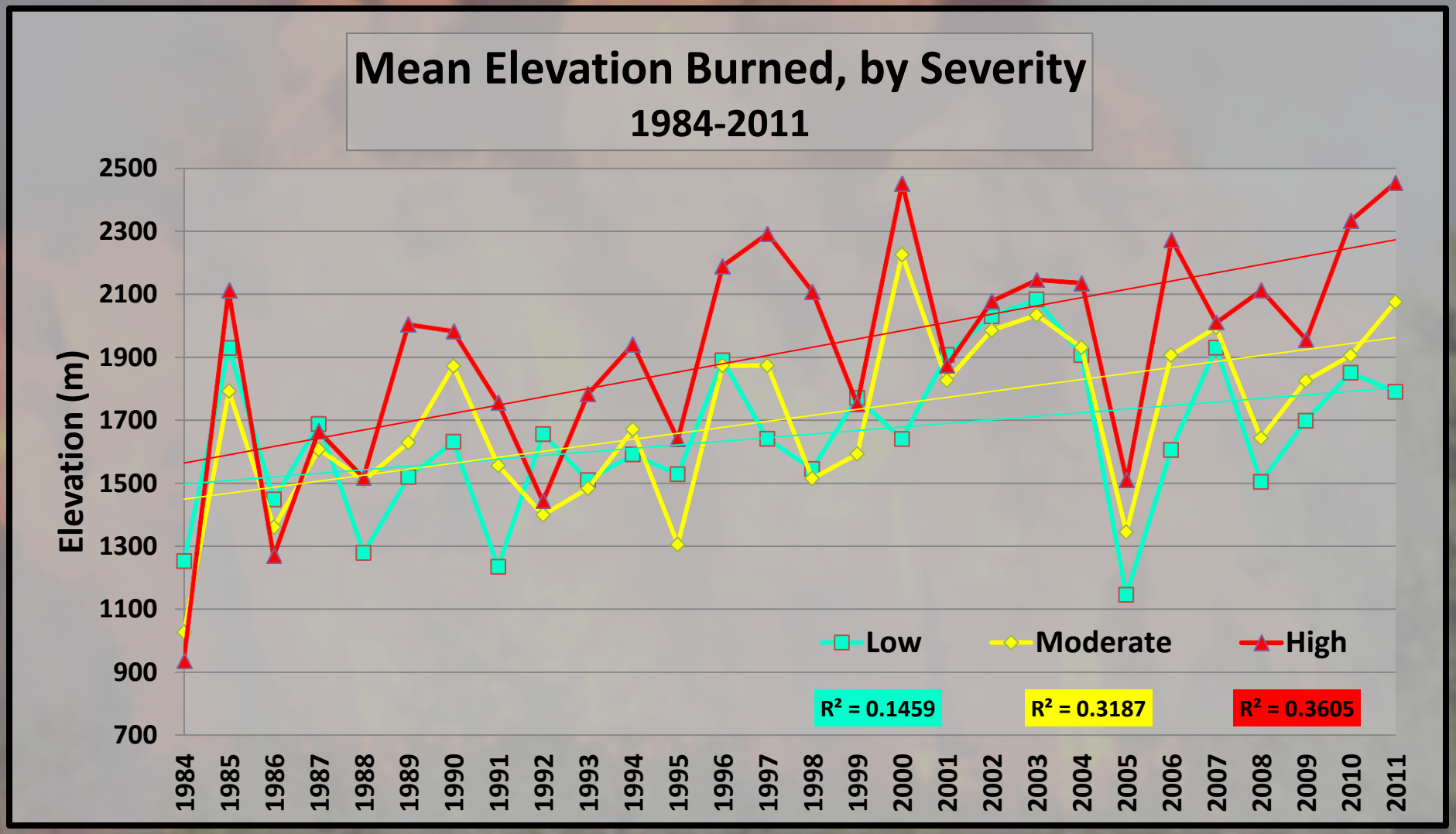

1984
Low
Moderate
High
1984 Max
2405m
(7890ft)
Area burned (ha)
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
3500
Elevation (m)


2011
Low
Moderate
High
1984 Max
2405m
(7890ft)
2011 Max
3644m
(11955ft)
Area burned (ha)
Elevation (m)
0
500
1000
1500
2000
2500
3000
3500

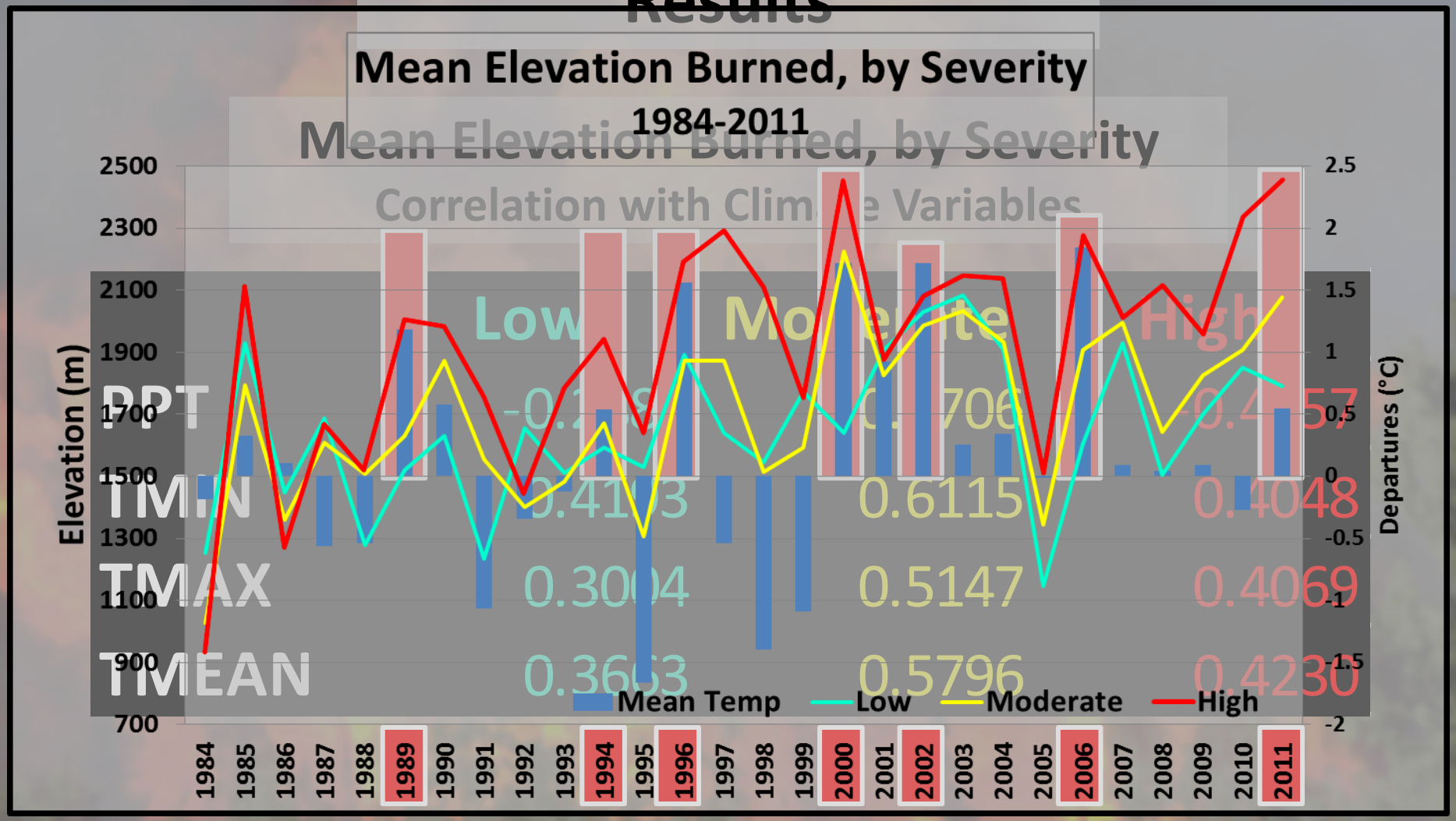
Results


Maximum Elevation Burned, by Severity
1984-2011
Elevation (m)
3800
3600
3400
3200
3000
2800
2600
2400
2200
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Low
Moderate
High
R² = 0.3845
R² = 0.3406
R² = 0.3786

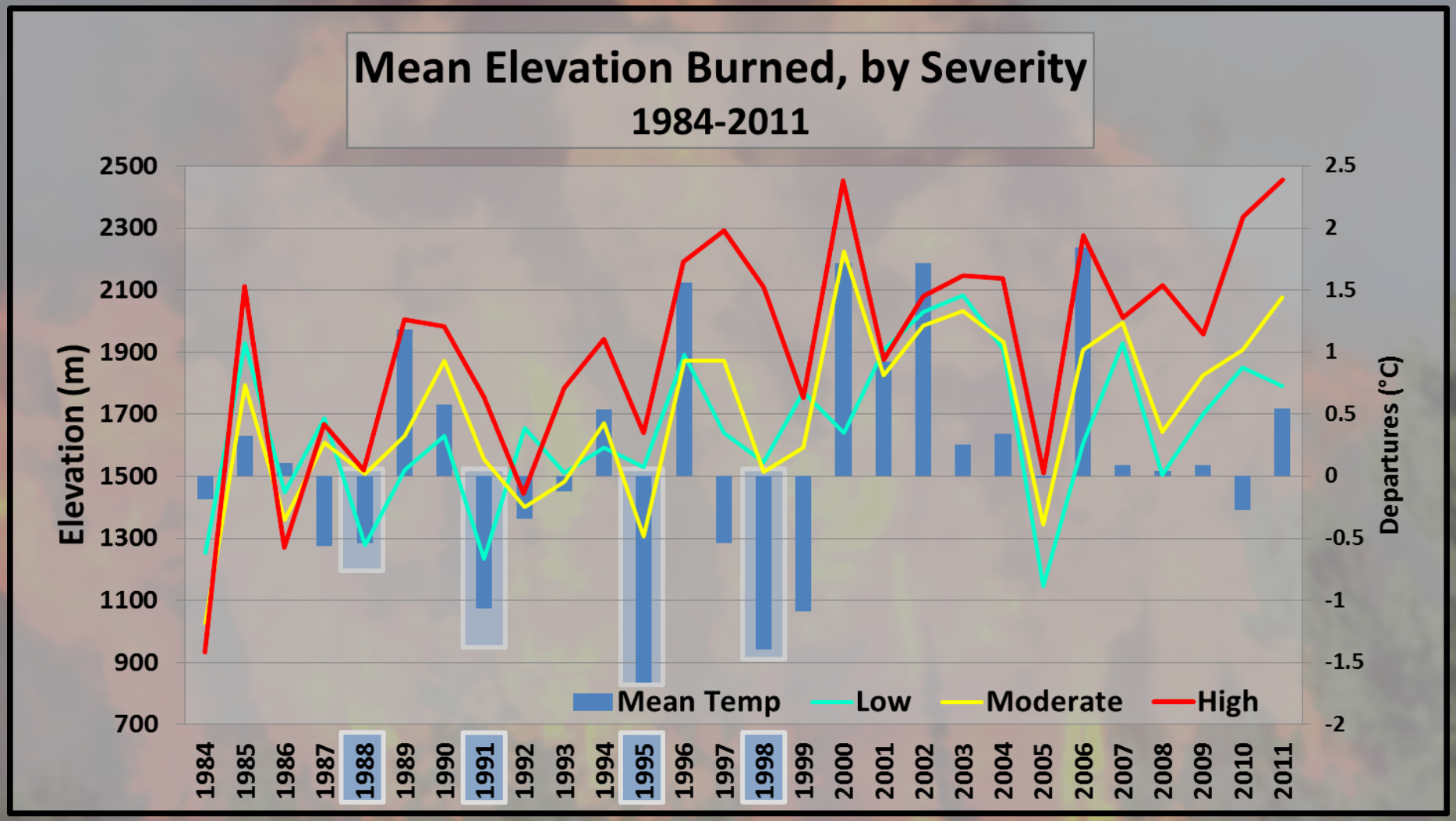
Results


Mean Elevation Burned, by Severity
1984-2011
Elevation (m)
2500
2300
2100
1900
1700
1500
1300
1100
900
700
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Low
Moderate
High
R² = 0.1459
R² = 0.3187
R² = 0.3605

Results

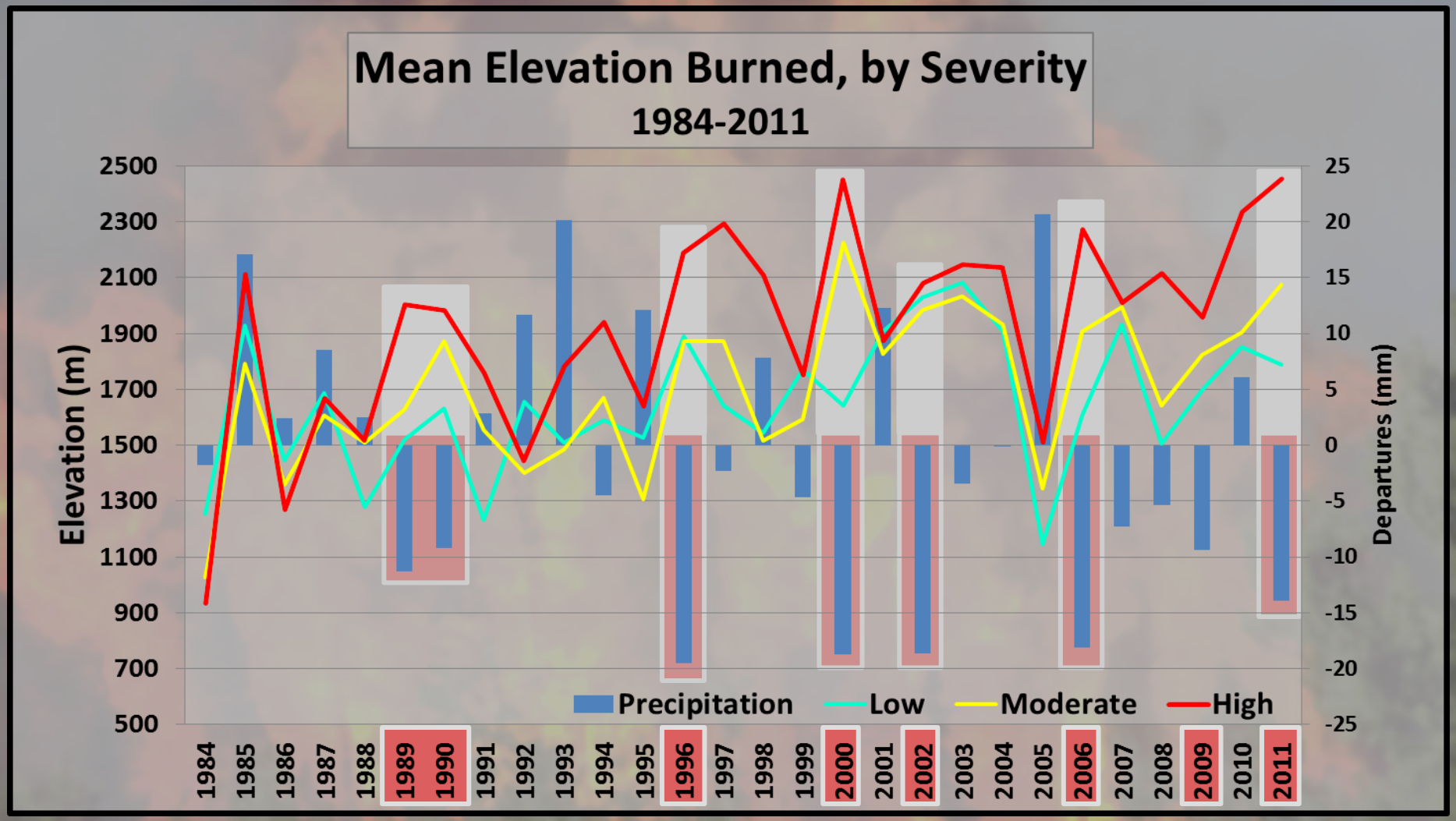


Higher Average Temperature, Higher Elevation Burned



	Low	Moderate	High
PPT	-0.2880	-0.5706	-0.4657
TMIN	0.4193	0.6115	0.4048
TMAX	0.3004	0.5147	0.4069
TMEAN	0.3663	0.5796	0.4230

Lower Average Temperature, Lower Elevation Burned



	Low	Moderate	High
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TMIN	0.4193	0.6115	0.4048
TMAX	0.3004	0.5147	0.4069
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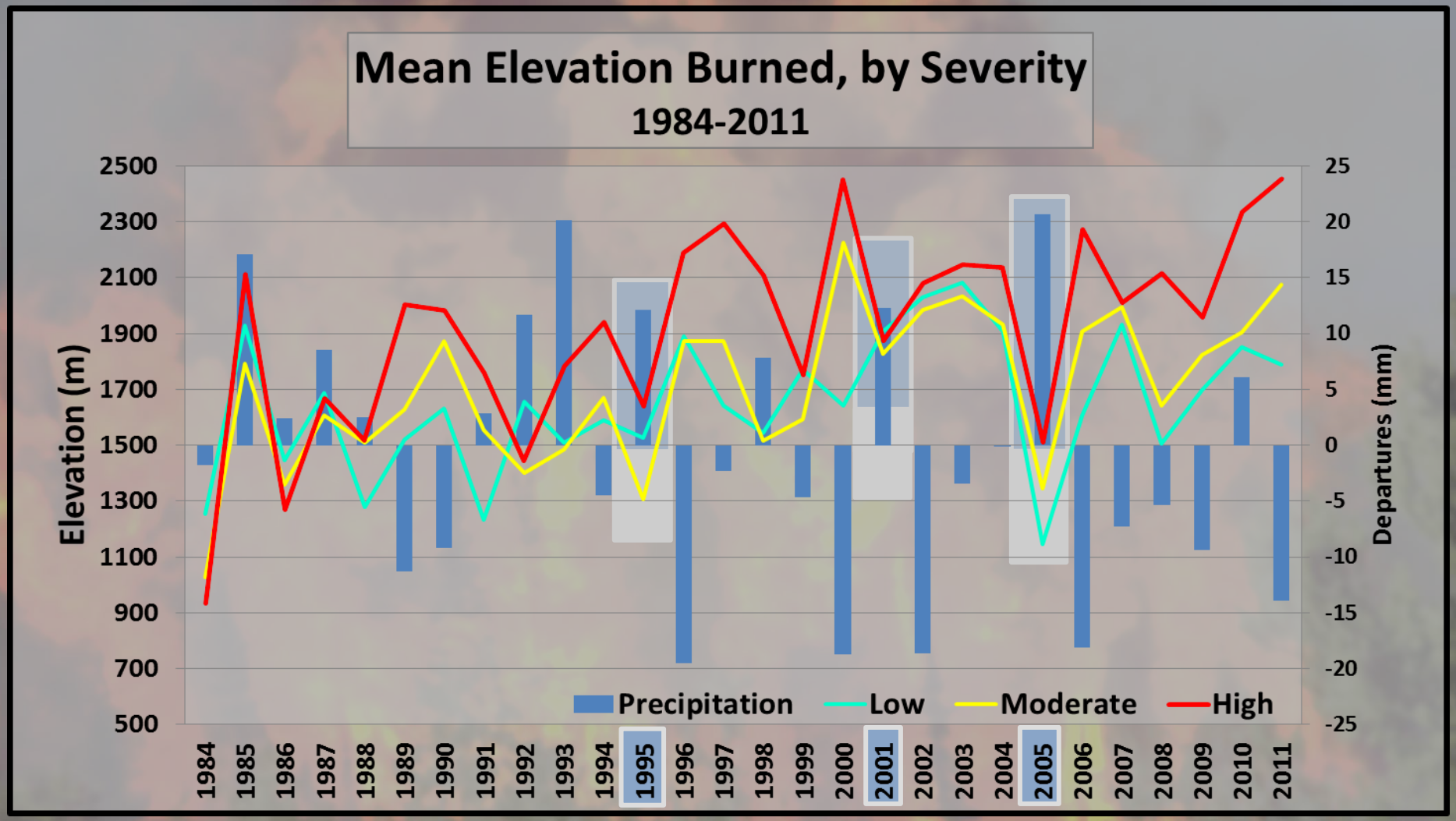
Lower Average Precipitation, Higher Elevation Burned



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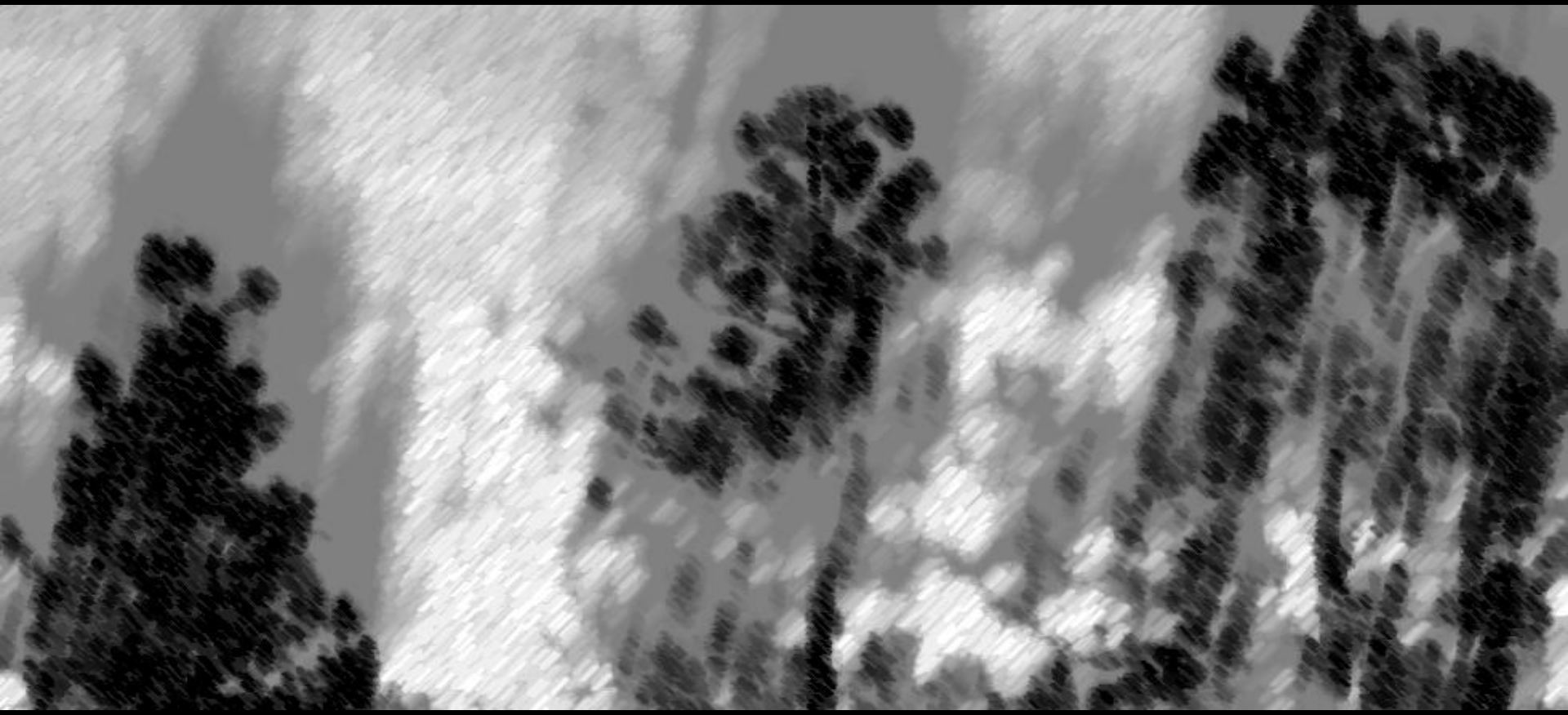
Higher Average Precipitation, Lower Elevation Burned

Conclusion

- Elevation burned in the Southwest is increasing on an annual scale.
- Climate is a driving factor contributing to increasing elevation burned.
- ***Bottom Line:***
  - Increasing high burn severity in upper elevations.
  - Ecological, hydrological, social stability impacts.
  - Upper elevation forests vulnerable to elimination if trend continues.

Questions?



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