A framework for predicting post-wildfire trajectories with desired conditions using NDVI time series

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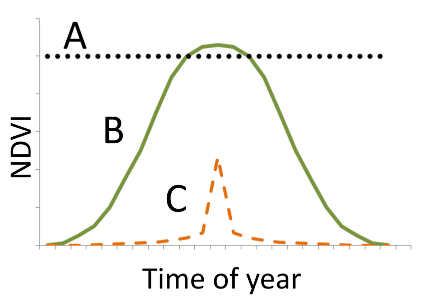
THE NEED—Immediate and long-term wildland fire effects need to be evaluated in terms of desired conditions, as do areas subjected to prolonged fire exclusion. This requires the identification of broadly applicable, regularly updated disturbance and recovery sensitive measures that correspond to coarse desired conditions.

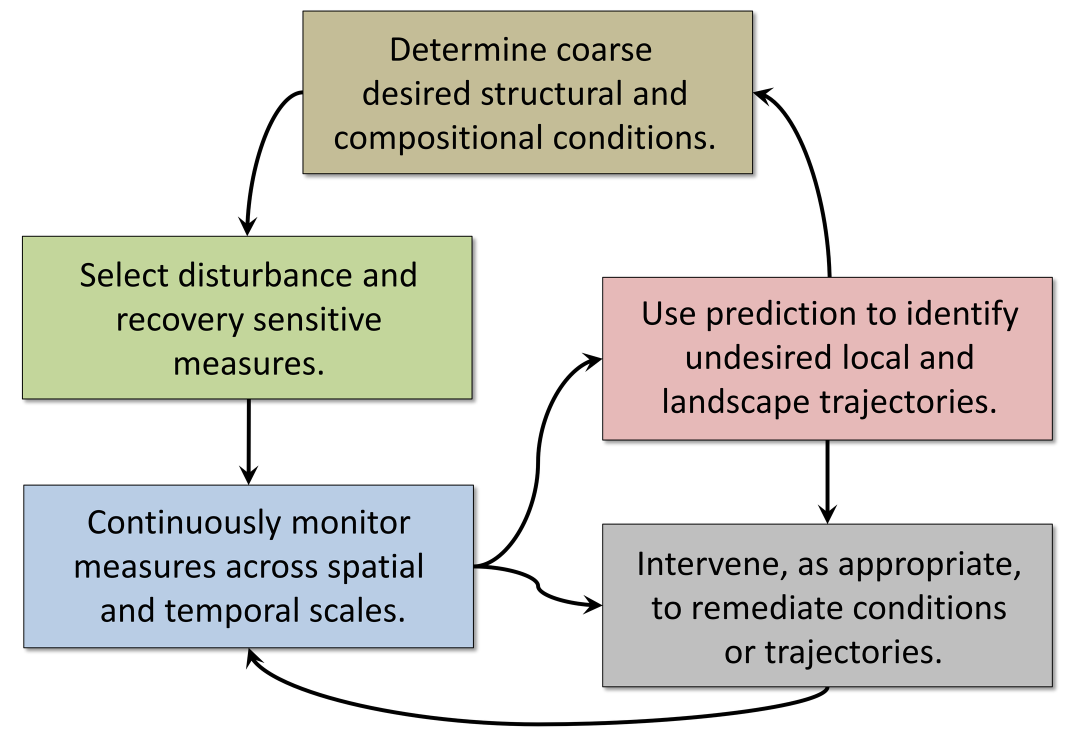
THE DATA AND METHODOLOGY—NASA-Stennis and the US Forest Service have developed a MODIS-based, 8-day NDVI time series for 2000 to present as part of the ***ForWarn*** forest disturbance recognition and tracking system (*forwarn.forestthreats.org*). To track coarse scale compositional and structural attributes associated with resource management objectives, we derived three measures from this time series that assess living biomass, "evergreenness" and "grassiness".

(1) LIVING BIOMASS
(median annual NDVI or 50th %ile)
(2) EVERGREEN COMPONENT
(25th %ile of annual distribution)
(3) GRASS COMPONENT
(peakedness of upper distribution; namely, the difference between the 85th and 100th %ile)



The figure at left shows idealized annual NDVI profiles for evergreen forest, A, deciduous forest, B, and grass, C. The 25th percentile of annual 8-day values discriminates evergreen from deciduous components. As grass is sensitive to annual climate variation, multiple years must be averaged to detect successionally meaningful change.

THE ADAPTIVE MANAGEMENT FRAMEWORK



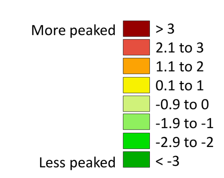
DEFINING DESIRED CONDITIONS—decades of fire exclusion have altered forest structural and compositional attributes across much of the conterminous US. In the Interior West, such changes include an increase in stand density at the expense of grass cover, and restoration efforts often use these attributes as measures to predict extreme fire behavior and effects. In the east, such change is often measured by a transition from xeric to mesophytic species or from pine to hardwood.

Where compositional or structural restoration is the objective, desired conditions can be defined with historical data even when few reference sites survive. Where more contemporary pre-fire conditions are the desired state, nearby unburned stands can be used, or, when fires have occurred since 2001, pre-fire measures for each location are available.

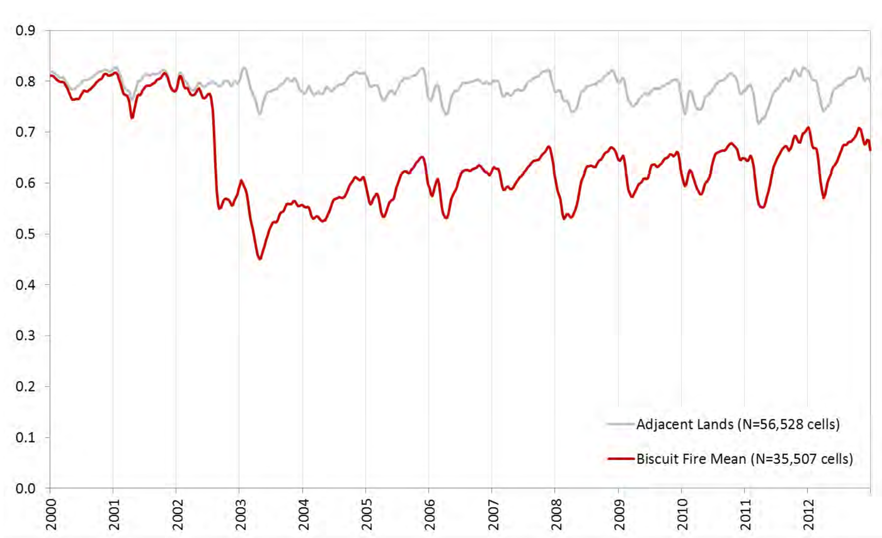
The recovery maps shown at the lower right define desired conditions based on the unique pixel-by-pixel pre-fire NDVI percentile means for 2000-2001. If wildfire is expected to contribute to more open stands with more grass as part of a program of stand restoration, different desired conditions could be utilized.

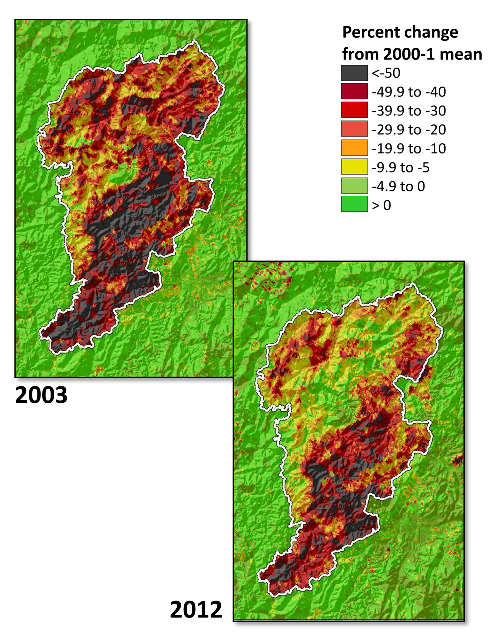
IMPLICATIONS—With this framework, short and long-term wildfire effects can be tracked and placed in a management context regardless of whether effects are historically consistent or novel. Such knowledge can help land resource managers track many types of regional disturbances to help focus management efforts more successfully and efficiently.

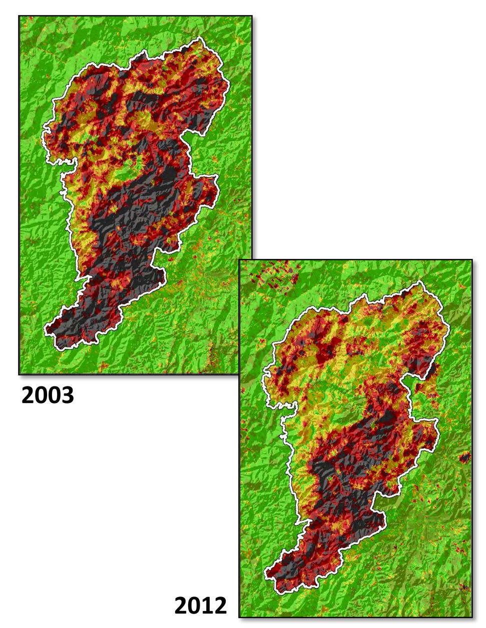
Change in Biomass (50th percentile) | **Change in Evergreen Component (25th percentile)** | **Change in Multi-Annual Mean Grassiness (100th-85th percentiles)** | **Predicted years to recovery to 2000-2001 reference conditions**

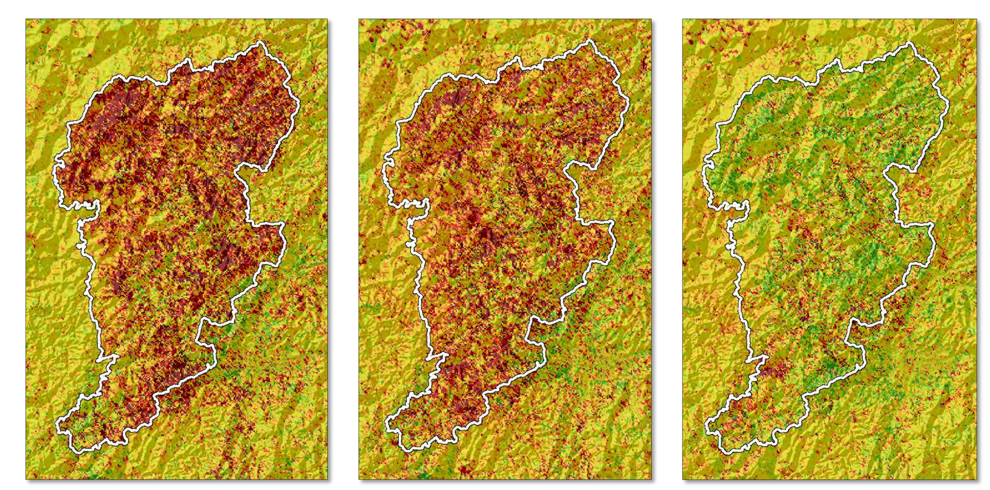


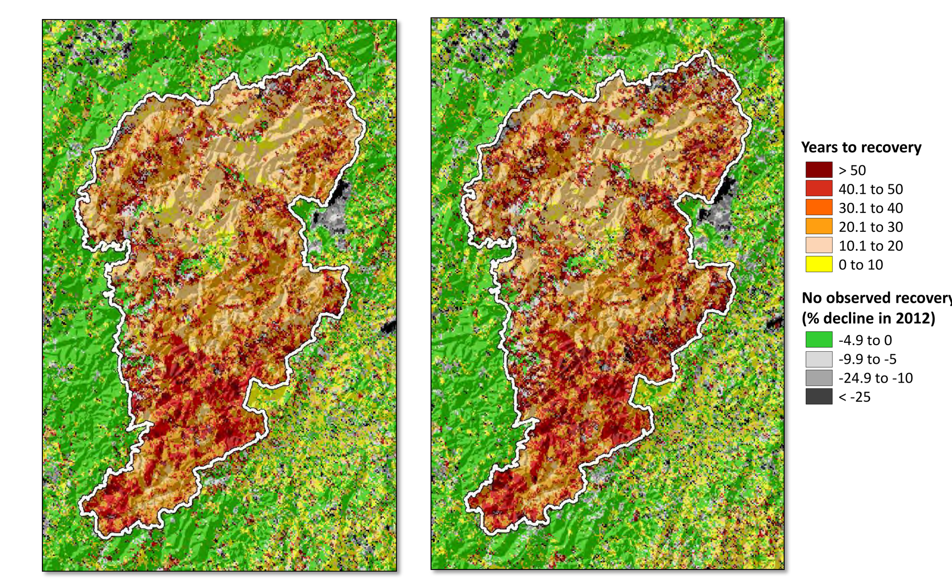
2002 Biscuit Fire, Oregon-California





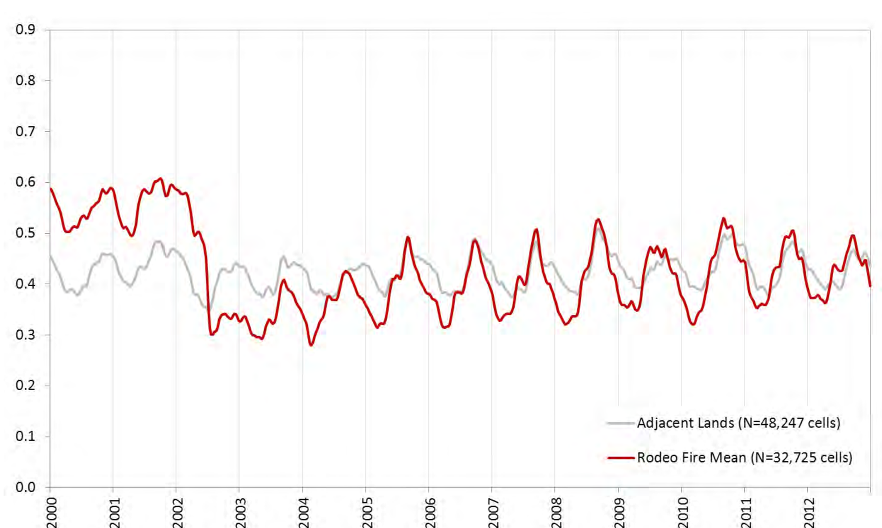


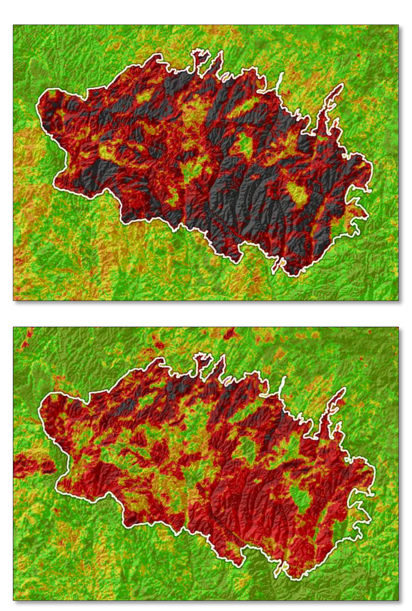


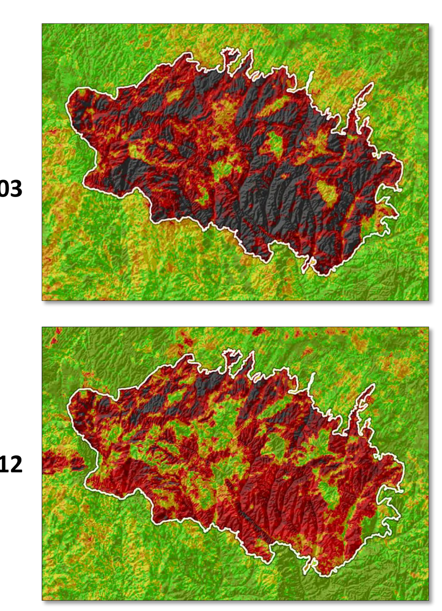


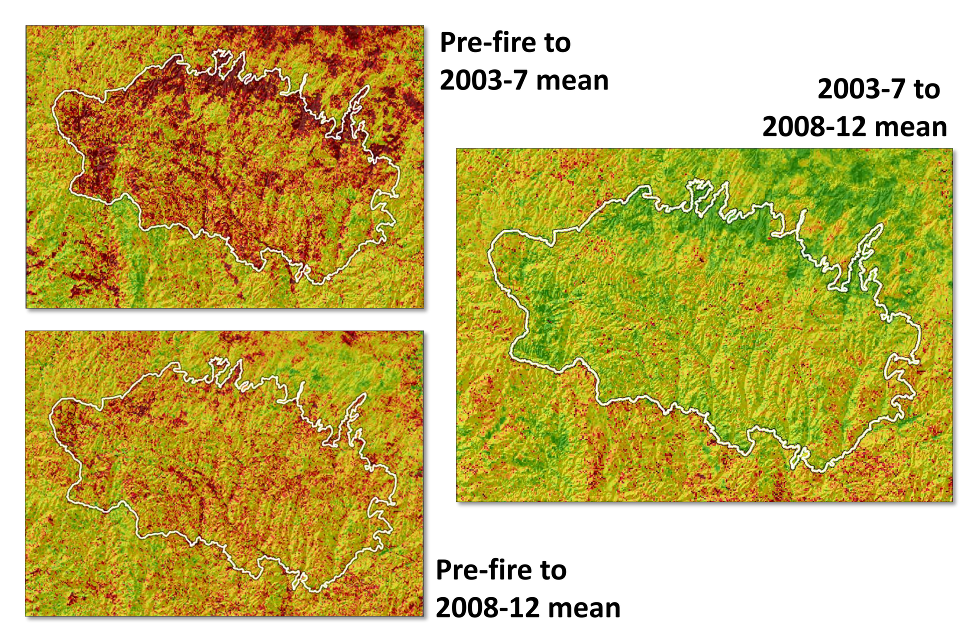
The **Biscuit Fire** scorched nearly 500,000 acres of Oregon and California for months after its mid July ignition. Grass was seeded in certain high severity areas and some salvage logging occurred. Some of this landscape includes resprouted vegetation that recovered quickly after the burn. Seeding Douglas fir takes longer, but much of this landscape's evergreen component is recovering, as shown at far right.

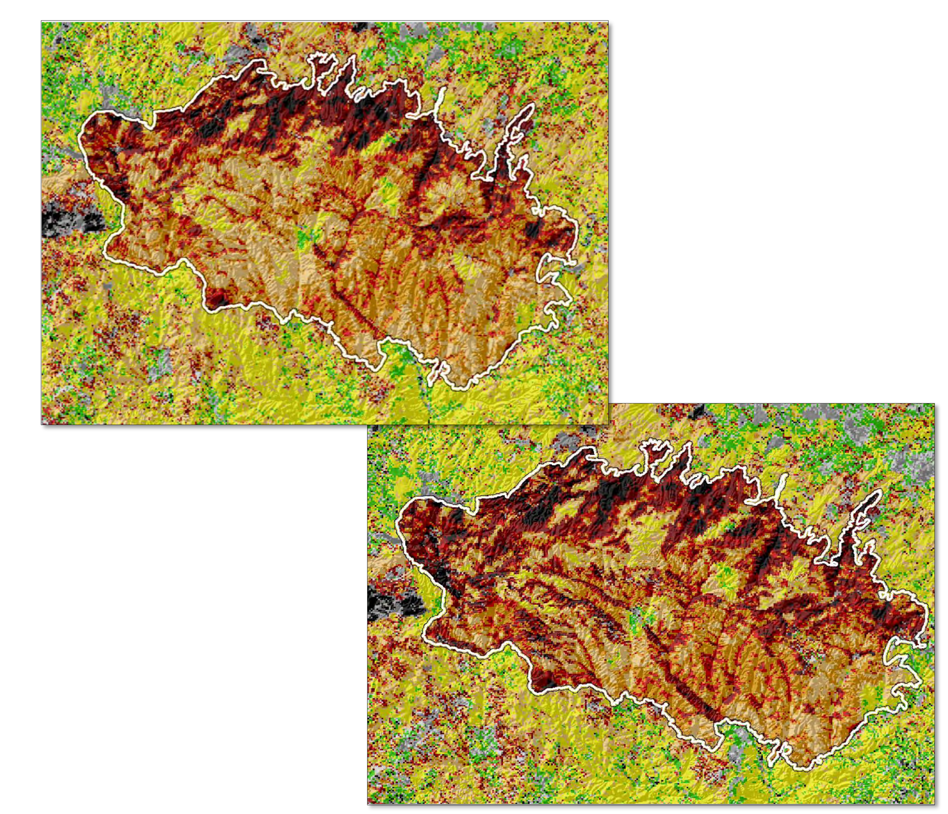
2002 Rodeo-Chediski Fire, Arizona





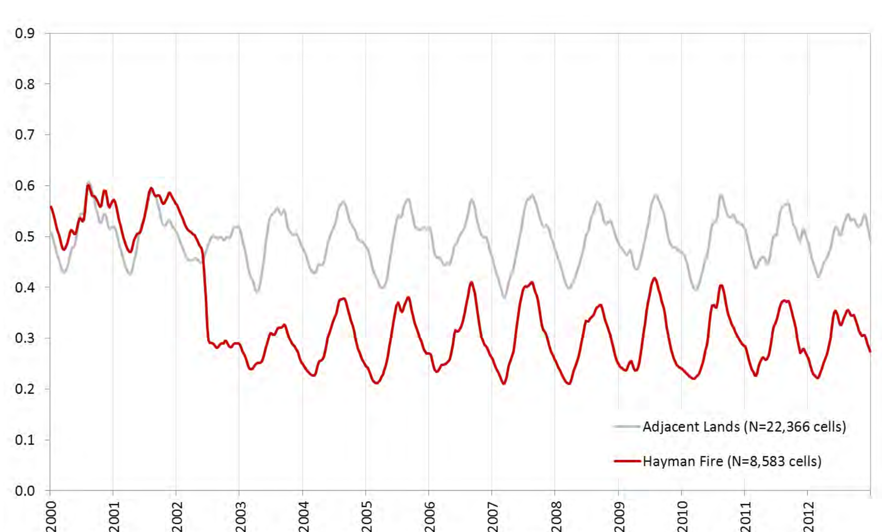


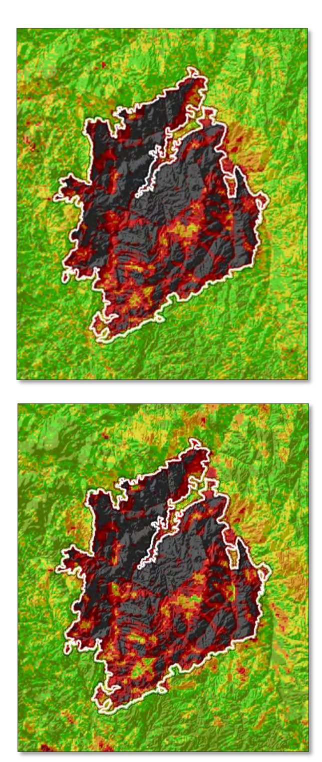


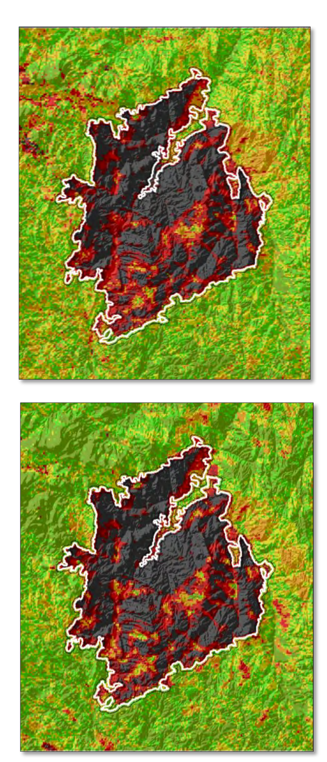


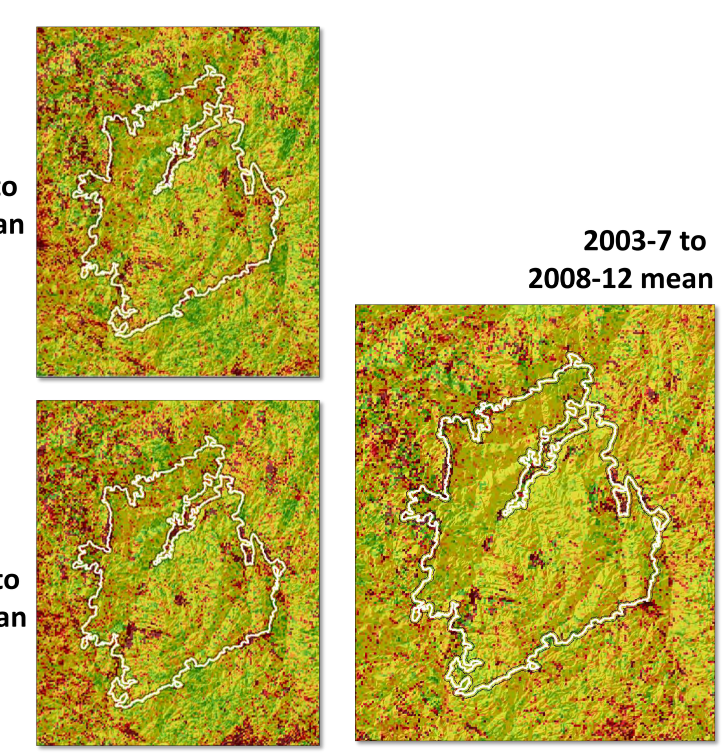
The **Rodeo-Chediski Fire** burned from mid June to early July, scorching 468,638 acres. Fire severity was high in areas that historically experienced frequent low severity fire. Soon after the fire, winter wheat and native grass seed was aerially applied over 38% of the burn. Since 2003, both the biomass and evergreen component have partially recovered over most of the fire with a decrease in grassiness. Areas on the northern edge show fire-induced drops that do not appear to be recovering (areas in black at right). Non-green areas outside the 2002 perimeter at right reflect recent drought and other fires.

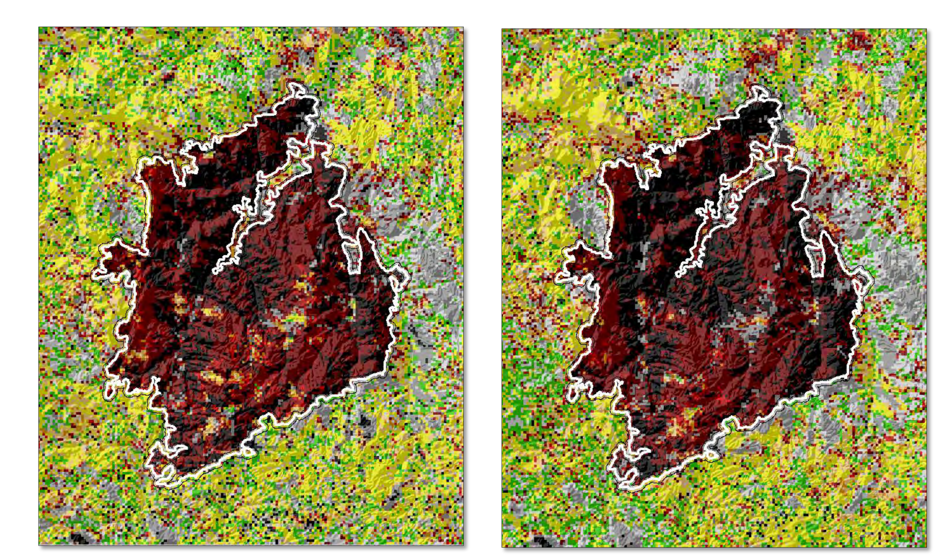
2002 Hayman Fire, Colorado











The **Hayman Fire** burned from June 8 to July 18 and scorched 138,000 acres. Extreme burning conditions and high fuel loads contributed to a 60,000 acre single-day fire run that killed most trees in the fire's path. Aerial grass seeding after the fire was wide-spread, particularly in the north near the Cheeseman Reservoir. Since the burn, vast areas have seen little or no observable recovery of biomass or the evergreen component. Yellow areas outside the 2002 perimeter reflect recent drought and non-fire tree mortality relative to 2000-01.