Assessing the Impact of Burn Severity on Vegetation: A Time Series Analysis of the Meadow Valley & South Sugar Loaf Wildfire

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Abstract

Wildfires in the western United States have become more frequent and severe over the past two decades, significantly impacting ecosystems. Understanding the relationship between burn severity and post-fire recovery of vegetation and evapotranspiration (ET) is essential for effective landscape management. This study assessed the Meadow Valley and South Sugar Loaf wildfires using the Differenced Normalized Burn Ratio (dNBR) to classify burn severity and satellite-derived metrics such as the Normalized Difference Vegetation Index (NDVI) and ET from OpenET. Temporal trends were analyzed using the Mann-Kendall test, and the effects of burn severity and time were evaluated with Linear Mixed Effects (LME) models.

The Mann-Kendall test revealed significant upward post-fire trends in NDVI (Sen's Slope = 0.000028, $p < 0.05$) and ET (Sen's Slope = 0.05994, $p = 0.00057$) within the South Sugar Loaf fire, indicating recovery. However, trends outside the fire perimeters were insignificant. The LME model identified burn severity had a significant influence in the South Sugar Loaf fire, with high-severity areas showing slower NDVI ($p = 0.048$) and ET ($p = 2.01e-09$) recovery compared to low-severity areas. In contrast, the Meadow Valley fire exhibited no significant influence of burn severity on NDVI ($p = 0.25$) or ET ($p = 0.30248$) due to fire being low severity fire, with upwards trends in Mann-Kendall test, indicating recovery. The LME model found positive correlation in both fires for NDVI and ET, reinforcing regrowth with time. These findings underscore the role of burn severity and time in shaping post-fire recovery trajectories.