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Research Article

Mapping the probability of large fire occurrence in northern Arizona, USA

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Abstract

In the southwestern U.S., wildland fire frequency and area burned have steadily increased in recent decades, a pattern attributable to multiple ignition sources. To examine contributing landscape factors and patterns related to the occurrence of large ($\geqslant$20 ha in extent) fires in the forested region of northern Arizona, we assembled a database of lightning- and human-caused fires for the period 1 April to 30 September, 1986–2000. At the landscape scale, we used a weights-of-evidence approach to model and map the probability of occurrence based on all fire types ($n = 203$), and lightning-caused fires alone ($n = 136$). In total, large fires burned 101,571 ha on our study area. Fires due to lightning were more frequent and extensive than those caused by humans, although human-caused fires burned large areas during the period of our analysis. For all fires, probability of occurrence was greatest in areas of high topographic roughness and lower road density. Ponderosa pine (*Pinus ponderosa*)-dominated forest vegetation and mean annual precipitation were less important predictors. Our modeling results indicate that seasonal large fire events are a consequence of non-random patterns of occurrence, and that patterns generated by these events may affect the regional fire regime more extensively than previously thought. Identifying the factors that influence large fires will improve our ability to target resource protection efforts and manage fire risk at the landscape scale.

Introduction

Recently, the American Southwest has experienced wildland fires of relatively unprecedented size and severity (e.g., the 2000 Cerro Grande fire in New Mexico and the 2002 Rodeo-Chediski fire in Arizona). Modern fire control efforts have contributed to levels of wildland fire frequency and intensity greater than those encountered during the early part of the 20th century (Agee 1998) and atypical in the paleoecological record (Grissino-Mayer and Swetnam 2000). Beginning in the late 1800s, the landscape was dramatically altered by the introduction of domestic livestock, large-scale timber harvesting, and aggressive fire suppression activities. Today's ponderosa pine-dominated (PIPO) forests are dense with many pole-size trees that help facilitate stand-replacing crown fires