

SITE-SPECIFIC SEASONAL BASELINES FOR FIRE RISK IN ONTARIO

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Quantifying the spatiotemporal seasonal effects of forest fire regime characteristics is important for fire management planning. Of particular interest is the determination of when and where fires may occur; investigating whether fire risk has changed over time, and specifically determining regional seasonality effects. Records of forty-four years of data on fire occurrence in the province of Ontario's Intensive Fire Management Zone are used to develop additive spline smoothing-based models of forest fire ignition processes. The study data sets are recorded on an irregular grid that partitions the area into an irregular lattice whose elements are relatively homogeneous with respect to forest ecosystems, climate, and levels of fire suppression activities. Our methods provide simultaneously estimated predictions of site-specific seasonality components and an overall interannual trend component, as well as confidence intervals for these effects. The model is found to fit the data well. Spatial similarities in the seasonality trends are observed, and a visualization technique that explores spatial patterns in temporal trends, based on the singular value decomposition of the data matrix is applied.

La quantification des effets saisonniers spatiotemporels des caractéristiques d'un régime de feux de forêt est importante pour la planification de la gestion des feux. La détermination du moment et de l'endroit où un feu peut survenir; les recherches à savoir si les risques d'incendie ont changé à travers les années et la détermination des effets régionaux des cycles saisonniers sont d'un intérêt particulier. On utilise l'équivalent de 44 ans de données sur les feux qui se sont produits dans la zone intensive de feux de la province de l'Ontario dans le but de développer des modèles de processus de déclenchement de feux de forêt basés sur le lissage par spline. Les jeux de données à l'étude se trouvent dans un tableau irrégulier qui segmente l'aire en un treillis irrégulier dont les éléments sont relativement fidèles aux écosystèmes, au climat et au niveau d'activité de suppression d'incendie des forêts. Nos méthodes nous fournissent des prédictions des composantes saisonnières propres à l'endroit estimées simultanément ainsi que des composantes des tendances générales interannuelles; elles nous fournissent aussi des intervalles de confiance pour ces effets. Le modèle correspond bien aux données. Des similarités spatiales dans les tendances saisonnières sont observées et on applique une technique de visualisation qui explore les modèles spatiaux selon les tendances temporelles basées sur la décomposition en valeurs singulières de la matrice de données.

1. Introduction

Improvements in fire management resource allocation decisions, budgeting, and forecasting depend on proper identification of spatiotemporal characteristics of forest fire seasonality. Such seasonal effects are influenced by several factors, but climate and vegetation are clearly very important factors. Current and recently observed weather conditions directly affect the flammability of a forested area. Moreover, climate indirectly affects a local fire regime by influencing the type of vegetation that covers a region. Regional vegetation is also influenced by land use activities such as forest harvesting and regeneration. The composition of vegetation in a region influences fire management because both living and dead forest vegetation are

potential fuels that play an important role in determining the behavior of any fires that ignite and burn in the area.

Locally, weather is a highly variable process on both spatial and temporal scales. However, it also follows an interannual pattern that induces a seasonality component on the numbers and sizes of fires in a region. For example, the climate in the late fall through to early spring in Ontario is not conducive to the ignition and spread of wildland fire and fire ignition processes "switch off" during this period. Conversely, from early spring to mid-fall of each year, Ontario experiences what is referred to as its *fire season* during which fire is present and active throughout its forested landscape. During this



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