



Past and future changes in Canadian boreal wildfire activity

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Climate change in Canadian boreal forests is usually associated with increased drought severity and fire activity. However, future fire activity could well be within the range of values experienced during the pre-industrial period. In this study, we contrast 21st century forecasts of fire occurrence (FireOcc, number of large forest fires per year) in the southern part of the Boreal Shield, Canada, with the historical range of the past 240 years statistically reconstructed from tree-ring width data. First, a historical relationship between drought indices and FireOcc is developed over the calibration period 1959-1998. Next, together with seven tree-ring based drought reconstructions covering the last 240 years and simulations from the CGCM3 and ECHAM4 global climate models, the calibration model is used to estimate past (prior to 1959) and future (post 1999). FireOcc. Last, time dependent changes in mean FireOcc and in the occurrence rate of extreme fire years are evaluated with the aid of advanced methods of statistical time series analysis. Results suggest that the increase in precipitation projected towards the end of the 21st century will be insufficient to compensate for increasing temperatures and will be insufficient to maintain potential evapotranspiration at current levels. Limited moisture availability would cause FireOcc to increase as well. But will future FireOcc exceed its historical range? The results obtained from our approach suggest high probabilities of seeing future FireOcc reach the upper limit of the historical range. Predictions, which are essentially weighed on northwestern Ontario and eastern boreal Manitoba, indicate that by 2061-2100, typical FireOcc could increase by more than 34% when compared with the past two centuries. The predicted increases in fire risk may lead to considerable increases in wildfire management costs,

offset the influences of elevated temperatures and atmospheric CO₂ concentrations on forest and tree productivity and affect the availability of harvestable trees. More frequent large wildfires may also become a major factor in our changing climate, owing to greater carbon losses that could feed the warming.