Global wildland fire season severity in the 21st century[1]

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Forecasting Future Fire Seasons

Recent literature suggests a warming climate will lead to more acres burned annually and longer fire seasons. Fewer studies have looked at trends in fire intensity or severity, even though the question fire managers are really interested in is: will fire season severity change? How hard will it be to control or manage future fires? Flannigan et al. (2013) recently tackled this question using component indices of the Canadian Forest Fire Danger Rating System (CFFDRS).

Review: The CFFDRS Fire Weather Index (FWI) system models the moisture content of moss/duff fuel layers using inputs from automated weather stations.

- **FFMC (Fine Fuels Moisture Code): fine fuels, live moss**
- **DMC (Duff Moisture Code): loosely compacted dead moss**
- **DC (Drought Code): deep compacted organic matter**

Timelags for these fuels are 2/3 day for FFMC, 15 days for DMC, and 53 days for DC at 70°F, 45% RH

Build-up Index (BUI) is a combined index of all three fuel layers, indicating availability of fuel for consumption. Initial Spread Index (ISI) combines FFMC with wind to estimate spread rate. Combining BUI and ISI yields the FWI, theoretically indicating the potential intensity of fires. Since area burned increases exponentially with fire diameter, the authors used $FWI^{1.77}$ for a "Daily Severity Rating" (DSR) as an index of fire suppression difficulty. The sum of DSRs over a season then yields cumulative severity rating (CSR).

1. This document summarizes the following article: Flannigan, M., A.S. Cantin, W.J. de Groot, M. Wotton, A. Newbery, and L.M. Gowman (2013). *Global wildland fire season severity in the 21st century*. Forest Ecology and Management **294**: 54–61. Link to document: http://dx.doi.org/10.1016/j.foreco.2012.10.022.

Model Results

Using large-scale gridded weather data from NOAA, the authors reconstructed fire season weather from a base period of 1971–2000 and compared it to predicted weather grids for decades 28 and 78 years in the future. Since climate models differ, they compared three models: Canadian (least warming), French (intermediate), and British (most warming) models. All three models agreed in predicting strong increases in fire season severity (CSR) across most of the U.S., western Canada, Scandinavia, Europe, and eastern South America by mid-century, becoming more pronounced by the end of the century. The intermediate-warming model indicated CSR would double in the western U.S. and Alaska by the 2040s and triple on the North Slope. There was less model agreement for Australia, Africa, and the Middle East. Warmer temperatures were associated with more severe fire seasons, even with modest increases in precipitation.

The authors also modeled fire season length, using criteria for the start of fire season as 3 consecutive days > 48°F and the end as 3 consecutive days < 35°F. Model forecasts agreed on increased fire season length in North America of 3–20 days by the 2040s, and by > 20 days in large areas (continental U.S., Chile, much of Europe, and Scandinavia) by the 2090s. In Alaska, the models called for the North Slope, eastern Interior, and southcoastal Alaska fire seasons to increase by > 20 days/year.

SUMMARY

Warmer temperatures seem to be linked to more wildland fire by drying fuels (both evapotranspiration and desiccation of litter), increasing convective storm potential and longer seasons of burning. Fire season severity appears sensitive to rising global temperature. Increased CSR and fire season length are predicted for the Northern Hemisphere over the next few decades.

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