Global wildland fire season severity in the 21st century

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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 FWI1.77 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).

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.

1. This document summarizes the following article:
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: