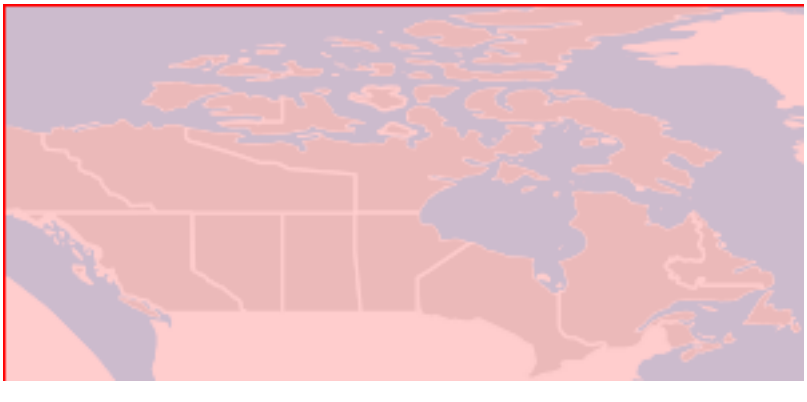
Canadian Forest Fire Weather Index (FWI) System - Daily Maps

Description

The Canadian Forest Fire Weather Index (FWI) System consists of six components that account for the effects of fuel moisture and weather conditions on fire behavior. The first three components are fuel moisture codes, which are numeric ratings of the moisture content of the forest floor and other dead organic matter. Their values rise as the moisture content decreases. There is one fuel moisture code for each of three layers of fuel: litter and other fine fuels; loosely compacted organic layers of moderate depth; and deep, compact organic layers. The remaining three components are fire behavior indices, which represent the rate of fire spread, the fuel available for combustion, and the frontal fire intensity; these three values rise as the fire danger increases. • The Fine Fuel Moisture Code (FFMC) is a numeric rating of the moisture content of litter and other cured fine fuels. This code is an indicator of the relative ease of ignition and the flammability of fine fuel; • The Duff Moisture Code (DMC) is a numeric rating of the average moisture content of loosely compacted organic layers of moderate depth. This code gives an indication of fuel consumption in moderate duff layers and medium-size woody material; • The Drought Code (DC) is a numeric rating of the average moisture content of deep, compact organic layers. This code is a useful indicator of seasonal drought effects on forest fuels and the amount of smoldering in deep duff layers and large logs; • The Initial Spread Index (ISI) is a numeric rating of the expected rate of fire spread. It is based on wind speed and FFMC. Like the rest of the FWI system components, ISI does not take fuel type into account. Actual spread rates vary between fuel types at the same ISI; • The Buildup Index (BUI) is a numeric rating of the total amount of fuel available for combustion. It is based on the DMC and the DC. The BUI is generally less than twice the DMC value, and moisture in the DMC layer is expected to help prevent burning in material deeper down in the available fuel; • The Fire Weather Index (FWI) is a numeric rating of fire intensity. It is based on the ISI and the BUI, and is used as a general index of fire danger throughout the forested areas of Canada; • The Daily Severity Rating (DSR), an additional component of the FWI system, is a numeric rating of the difficulty of controlling fires. It is based on the Fire Weather Index but it more accurately reflects the expected effort required for fire suppression. Maps updated daily, year-round.

Geographic Extent	SW:-141.003 41.676, NE:-52.617 83.114



Time Period	From:2000 - To:2020

Resources

Resource Name	Resource Type	Language	Format
Fire Weather Maps	Web Service	English, French	PNG

Preview Image

Data Classification

GC Core Subject Thesaurus	Forest fires, Risk management
Topic category	Environment

Metadata Contact

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Resource Name	Resource Type	Language	Format
Canadian Forest Fire Weather Index (FWI) System - Web Service (WMS)	Web Service	English, French	WMS
FWI - Current Conditions	Dataset	English, French	TIFF
Canadian Forest Fire Weather Index (FWI) System - full metadata	Supporting Document	English, French	XML

Additional Information

Dataset Identification

Date	2020 (Publication)
Date Type	Publication
Date	2020-01-01 (Creation)
Date Type	Creation
Status	On going
Maintenance and Update Frequency	Daily
Use Limitation	Open Government Licence - Canada (http://open.canada.ca/en/open-government-licence-canada)
Access Constraints	License
Use Constraints	Other restrictions
Use Constraints	License End User
Other constraints	Please note, an End-User Agreement is required for accessing these data. Please refer to this agreement for information regarding restrictions of use: https://cwfis.cfs.nrcan.gc.ca/downloads/EUA/End_User_Agreement_gen_EN.html.php When the Data is displayed, in print, electronically, or otherwise, the source (i.e., Natural Resources Canada) must be acknowledged along with the following citation: Canadian Forest Service. 2020. Canadian Wildland Fire Information System (CWFIS), Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta. http://cwfis.cfs.nrcan.gc.ca.
Spatial representation type	Grid
Metadata language	English
Supplemental Information	Canadian Forest Fire Weather Index (FWI) System Data Sources and Methods for Daily Maps:

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Role	Distributor

Inputs to the FWI System include elevation and current daily weather data from a variety of sources. Geographic Information Systems (GIS) software is used to interpolate the weather data between stations to produce gridded weather maps. The FWI System components are then calculated on a cell-by-cell basis according to the equations in Van Wagner and Pickett (1985) to produce the FWI maps.

Elevation:

The elevation grid is derived from the US Geological Survey's (USGS) 1- x 1- km hydrologically corrected version of GTOPO30, a 30-arcsecond global digital elevation model assembled by the USGS. The Canadian portion of the data for GTOPO30 were obtained from two sources: Digital Chart of the World and Digital Terrain Elevation Data, both produced by the US National Imagery and Mapping Agency (formerly the Defense Mapping Agency).

Weather Data:

The CWFIS currently uses weather data from about 2500 stations in Canada and the United States. About 900 of these stations are operated by Environment and Climate Change Canada (ECCC) or other federal departments under contract to ECCC. About 600 stations are operated by the National Weather Service (NWS) of the United States, and the remainder of the stations are operated by the provincial and territorial governments.

The online data mart managed by ECCC provides a source for many observations from stations operated by federal agencies. Observations from stations belonging to Alberta Agriculture and Forestry’s drought monitoring program also can be downloaded here, and observations from United States locations are usually obtained from Unidata (a university data-sharing program) nodes. Data from provincial and territorial wildland fire management programs are obtained through various methods.

Forecast Weather Data:

Forecasted weather used in the Canadian Wildland Fire Information System is provided by the Canadian Meteorological Centre, a branch of Environment and Climate Change Canada. These data take the form

of spot forecasts for 750 Canadian weather stations or sample points. Weather elements are generated from the regional Global Environmental Multiscale (GEM) model and model output statistics (MOS) for three-hour intervals out to 48 hours. Noon weather is then interpolated from these data and fire danger conditions are calculated. Note that the spot forecasts are straight model outputs or statistically post-processed data and do not include input from regional forecast offices.

Extended forecasts are based upon the North American Ensemble Forecast System (NAEFS), in which Canadian and American models contribute repeated forecasts with different initial conditions or physics packages. Median values of the 40-member ensemble are used to predict temperature, humidity, wind speed, and 24-hour precipitation at more than 250 weather stations for the next 14 days. These values are used to generate the extended forecast maps and the predicted fire weather conditions. Accuracy is limited because of the range of these forecasts. These forecasts are best used to judge the trend of long-term indices such as the duff moisture code (DMC), the drought code (DC), and the build-up index (BUI).

FWI Calculation Start-up:

To determine spring start-up dates and starting fuel moisture code values, the procedures described in Lawson and Armitage (2008) are used. There are two methods, depending on snow cover.

Method 1:
For stations that report significant snow cover during the winter, start-up occurs when the station has been snow-free for three consecutive days. Significant snow cover is defined as a mean snow depth of more than 10 cm, with snow cover present at least 75% of the days in January and February. Start-up values are as follows:
• Fine Fuel Moisture Code (FFMC) is set to 85
• Duff Moisture Code (DMC) is set to 6
• Drought Code (DC) is set to 15*

Method 2:
For stations that do not report significant snow cover during the winter, start-up occurs when the noon daily temperature is 12°C or higher for three consecutive days. The following values are used for start-up:

• FFMC is set to 85
• DMC is set to 2 times the number of days since precipitation
• DC is set to 5 times the number of days since precipitation*

*Where overwinter precipitation data are available, the DC is set according to an alternative method, also found in Lawson and Armitage (2008), which takes into account the fact that saturation of the deep fuel layers might not occur over the winter. In areas with low overwinter precipitation, the starting value for the DC can be significantly higher than the default.

Daily Weather Processing:

Weather observations are received in raw format and must be decoded before being saved in the weather database. The FWI System requires observed temperature, relative humidity, wind speed at noon local standard time, and 24-hour precipitation. Various other observations, such as snow depth on the ground, wind direction, dew point, and atmospheric pressure are also saved in the database to be used for interpolation. These parameters are used in calculations for spring start-up and fall shutdown, as well as adjustment of temperature and humidity for elevation differences.

The FWI System requires an unbroken record of daily weather. If a station fails to report or reports missing data, the missing values are estimated from nearby stations by means of inverse distance weighted (IDW) interpolation. For temperature and relative humidity, the IDW interpolated value is corrected for elevation.

Lastly, daily FWI system output values are calculated for each station and saved in the database.

Daily Weather Grids:

Daily raster maps (grids) of temperature, relative humidity, wind speed, and precipitation are created by interpolating values between weather stations using IDW interpolation. Values are assigned to each grid cell by calculating a weighted mean of the values of the nearest 12 stations. For each cell, the station values are weighted by the inverse of the square of the distance to the cell.
The weather grids are then used as inputs to the Fire Weather Index (FWI)

and Fire Behavior Prediction (FBP) grid calculations.

Elevation Correction:

Temperature and relative humidity grid values are adjusted for elevation using the elevation grid (see above). For temperature, the adjustment is based on the United States Standard Lapse Rate of -6.5°C/km; that is, for every kilometer gain in elevation, the temperature is assumed to drop by 6.5°C. For relative humidity, the mixing ratio (ratio of water vapor to dry air by weight) is assumed to be constant with elevation. The mixing ratio is calculated for each station and interpolated to each grid cell location. The relative humidity is then calculated on a cell-by-cell basis using the elevation-adjusted temperature grid.

Daily Grid Production:

The grids for the fuel moisture codes (FFMC, DMC, and DC) are built using both interpolation and calculation. Because the fuel moisture code calculations require the previous day's values as inputs, values for areas where new stations are starting up are interpolated rather than calculated. In areas where the previous day's values are available, the fuel moisture codes are calculated on a cell-by-cell basis using the previous day's grids, together with the current day's weather grids, as inputs. In the output maps, the non-calculating areas are assigned a null value, as are areas above the arctic treeline.

The FWI System fire behavior indices (not to be confused with the Fire Behavior Prediction System outputs) are calculated from the fuel moisture codes. These calculations are generated on a cell-by-cell basis to produce the ISI, BUI, and FWI grids. Lastly, the Daily Severity Rating (DSR) grid is calculated from the FWI grid.

References:

• Lawson, B.D.; Armitage, O.B. 2008. Weather Guide for the Canadian Forest Fire Danger Rating System. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, AB. 84 p.

• Van Wagner, C.E.; Pickett, T.L. 1985. Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. Canadian

Forest Service, Ottawa, ON. Forestry Technical Report 33.

• Turner, J.A.; Lawson, B.D. 1978. Weather in the Canadian Forest Fire Danger Rating System. A user guide to national standards and practices. Environment Canada, Pacific Forest Research Centre, Victoria, BC. BC-X-177.

Examples of Fire Behavior in Jack Pine Stands can be viewed here: http://cwfis.cfs.nrcan.gc.ca/background/examples/fwi ;

More information about the Canadian Forest Fire Weather Index (FWI) System is available in the Background Information: https://cwfis.cfs.nrcan.gc.ca/background/summary/fwi

Distribution Information

Distribution format

Name	WMS
Version	PNG, PNG8, JPEG, GIF, TIFF, TIFF8, GeoTIFF, GeoTIFF8, SVG, PDF, GeoRSS, KML, KMZ, OpenLayers

Distribution format

Name	TIFF
Version	TIFF

Metadata Record

File Identifier	3b5c5376-2cc1-4593-b1fa-22b42e62ceea
Hierarchy Level	Dataset
Date Stamp	2020-05-25T21:17:17
Metadata language	English (Other language:French)
Character set	UTF8
Metadata standard name	North American Profile of ISO 19115:2003 - Geographic information - Metadata
Metadata standard version	CAN/CGSB-171.100-2009

Reference System Information

Unique resource identifier	EPSG:3978
Codespace	http://www.epsg-registry.org