

# Package ‘firebehaviorR’

July 18, 2018

**Title** Prediction of wildland fire behavior  
**Version** 0.0.0.9000  
**Description** Functions for estimating wildland fire behavior using common models in the US.  
**Depends** R (>= 3.4.1)  
**License** GPL-2  
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**LazyData** true  
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## R topics documented:

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|         |   |
|---------|---|
| canFuel | <i>Canopy Fuel Stratum Characteristics Calculator</i> |
|---------|---|

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### Description

Canopy parameters estimated by Cruz, Alexander & Wakimoto (2003).

### Usage

canFuel(ba, ht, tph, type)

### Arguments

|      |  |
|------|--|
| ba   | a vector or data frame with stand basal area (m <sup>2</sup> /ha).   |
| ht   | a vector or data frame with average stand height (m).  |
| tph  | a vector or data frame with stand density (trees/ha).  |
| type | a vector or data frame with forest cover type, either: df for Douglas-fir ( <i>Pseudotsuga menziesii</i> ); pp for ponderosa pine ( <i>Pinus ponderosa</i> ); lp for lodgepole pine ( <i>Pinus contorta</i> ); mc for mixed conifer. |

### Value

a data frame with canopy base height (m), canopy fuel load (kg/m<sup>2</sup>), and canopy bulk density (kg/m<sup>3</sup>).

### Author(s)

Justin P Ziegler

### References

Cruz M.G., Alexander M.E., Wakimoto R.H. 2003. Assessing canopy fuel stratum characteristics in crown fire prone fuel types of western North America. *International Journal of Wildland Fire*. 12(1):39-50.

### See Also

This function outputs values for [nexus](#) and [cfis](#) parameter inputs.

### Examples

```
library(firebehaviorR)
```

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cfis

*Canopy Fire Initiation & Spread model*

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### Description

Prediction of crown fire probability, crown fire rate of spread and separation distance (Alexander and Cruz 2006). Separation distance is distance ahead of main fire front required for a spot fire to form, separate of a main fire.

### Usage

```
cfis(fsg, u10, effm, sfc, cbd, id)
```

**Arguments**

|      |   |
|------|---|
| fsg  | a vector or data frame of fuel stratum gap (m)  |
| u10  | a vector or data frame with open (at a height 10 m above the canopy) wind speed [m/min]   |
| effm | a vector or data frame with effective fine fuel moisture (%)  |
| sfc  | a vector or data frame of surface fuel consumed (kg/m <sup>2</sup> )  |
| cbd  | a vector or data frame of canopy bulk density (kg/m <sup>3</sup> )  |
| id   | a vector or data frame of spot ignition delay, the time during which a given firebrand generates, is transported aloft, and ignites a receptive fuelbed (min) |

**Value**

a data frame with probability of crown fire occurrences (%), type of fire, crown fire rate of spread (m/min), and critical spotting distance (m)

**Author(s)**

Justin P Ziegler, <justin.ziegler@colostate.edu>

**References**

Alexander M.E. & Cruz M.G. 2006. Evaluating a model for predicting active crown fire rate of spread using wildfire observations. *Canadian Journal of Forest Research*. **36**:2015-3028.

**Examples**

```
library(firebehaviorR)
```

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fuelModels

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*Surface fuel models.*


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**Description**

Fuel models developed by Anderson (1982), Scott (1999), and Scott & Burgan (2005) for prediction of surface fire behavior.

**Usage**

```
data(fuelModels)
```

**Format**

A data frame with 69 observations of 8 variables:

**Fuel\_Model\_Type** 'S'tatic or 'D'ynamic fuel load transfer

**Load\_litter** load of litter fuel (0.1kg/m<sup>2</sup>)

**Load\_1h** load of 1-hr fuel (0.1kg/m<sup>2</sup>)

**Load\_10h** load of 10-hr fuel (0.1kg/m<sup>2</sup>)

**Load\_100h** load of 100-hr fuel (0.1kg/m2)  
**Load\_Live\_Herb** load of herbaceous fuel (0.1kg/m2)  
**Load\_Live\_Woody** load of woody fuel(0.1kg/m2)  
**SA.V\_litter** load of litter fuel (0.1kg/m2)  
**SA.V\_1h** load of 1-hr fuel (0.1kg/m2)  
**SA.V\_10h** load of 10-hr fuel (0.1kg/m2)  
**SA.V\_100h** load of 100-hr fuel (0.1kg/m2)  
**SA.V\_Live\_Herb** load of herbaceous fuel (0.1kg/m2)  
**SA.V\_Live\_Woody** load of woody fuel(0.1kg/m2)  
**Fuel\_Bed\_Depth** load of woody fuel(0.1kg/m2)  
**Mx\_dead** Dead fuel moisture of extinction (%)  
**Heat** Heat content (kJ/kg)  
**Description** Fuel model name  
**Source** Scientific source ...

## References

Anderson, H.E. 1982. Aids to determining fuel models for estimating fire behavior. *Gen. Tech. Rep. INT-GTR-122*. Ogden, UT: US Department of Agriculture, Forest Service, Intermountain Forest and Range Experimental Station.  
 Scott, J.H. 1999. NEXUS: A system for assessing crown fire hazard. *Fire Management Notes* 59(2):20–24.  
 Scott, J.H., & Burgan, R. E. 2005. A new set of standard fire behavior fuel models for use with Rothermel's surface fire spread model. *Gen. Tech. Rep. RMRS-GTR-153*. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

## See Also

[nexus](#)

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fuelMoisture

*Modified Scott & Burgan (2005) moisture scenarios.*

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## Description

Moisture scenarios are a set of fuel moistures of surface fuels, on a dry-weight basis, for each of the surfacefuel classes. Originally developed by Scott & Burgan (2005), this dataset includes fuel moistures of litter.

## Usage

```
data(fuelMoisture)
```

**Format**

A data frame with 16 observations of 7 variables:

**FM\_litter** moisture of litter, (%)

**FM\_1hr** moisture of 1-hr fuel, (%)

**FM\_10hr** moisture of 10-hr fuel, (%)

**FM\_100hr** moisture of 100-hr fuel, (%)

**FM\_Live\_Herb** moisture of herbaceous fuel, (%)

**FM\_Live\_Woody** moisture of woody fuel, (%)

**Description** Scenario description ...

**Source**

Scott, J., & Burgan, R. E. 2005. A new set of standard fire behavior fuel models for use with Rothermel's surface fire spread model. *Gen. Tech. Rep. RMRS-GTR-153*. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station.

**See Also**

[nexus](#)

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hello

*Hello, World!*

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**Description**

Prints 'Hello, world!'.

**Usage**

```
hello()
```

**Examples**

```
hello()
```

nexus

*Nexus Fire Behavior Modeling System***Description**

Potential fire behavior predicted with the approach used in Nexus (Scott & Reinhardt 2001).

**Usage**

```
nexus(surfFuel, moisture, crownFuel, enviro, rosmult = 1,
      cfbform = "FARSITE")
```

**Arguments**

|           |   |
|-----------|---|
| surfFuel  | a vector or data frame of surface fuel attributes consisting of: the fuel model type with either 'S'tatic or D'ynamic fuel load transferring; fuel loads [Mg/ha] for litter, 1-hr, 10-hr, 100-hr, herbaceous, and woody fuels; surface area-to-volumes [m <sup>2</sup> /m <sup>3</sup> ] for litter, 1-hr, 10-hr, 100-hr, herbaceous, and woody fuels; fuel bed depth [cm]; moisture of extinction ["%"]; and heat content [kJ/kg], respectively (16 values or columns) |
| moisture  | a vector or data frame of fuel moistures on a dry-weight basis ["%"] for litter, 1-hr 10-hr, 100-hr, herbaceous, and woody fuel classes, respectively (6 values or columns)   |
| crownFuel | a vector or data frame consisting of canopy fuel attributes consisting of: canopy bulk density [kg/m <sup>3</sup> ]; foliar moisture content (%); canopy base height [m]; and canopy fuel load [kg/m <sup>2</sup> ], respectively (4 values or columns)   |
| enviro    | a vector or data.frame of environmental variables including: topographic slope (%); open windspeed [m/min]; wind direction, from uphill [deg.]; and wind adjustment factor [0-1], respectively  |
| rosmult   | a numeric value for the rate of spread multiplier, defaults to 1  |
| cfbform   | a character string specifying how crown fraction burned is calculated. Options are "linear", "exponential", or "FARSITE" (default)  |

**Details**

This is an R build of the Nexus fire behavior modeling system (Scott & Reinhardt 2001) which links sub-models of surface fire rate of spread (Rothermel 1972), criteria for crown fire initiation (Van Wagner 1977), and Rothermel's (1991) crown fire rate of spread for potential rate of spread Rothermel's (1972) surface and (1991a) crown fire models, and Van Wagner's (1977) models of transition to crown fire. `rosmult` multiplies the rate of spread for active or passive crown fires and is recommended a value of 1.7 when a user desires a maximum crown fire rate of spread (Rothermel 1991).

**Value**

a list with 6 data frames

|              |   |
|--------------|---|
| FireBehavior | a data frame which summarizes fire behavior including: fire type, crown fraction burned (%), rate of spread [m./min], heat per unit area [kW/m <sup>2</sup> ], Fireline Intensity [kW/m], Flame Length [m], Direction of max spread [deg], Scorch |
|--------------|---|

height [m], Torching Index [m/min], Crowning Index [m/min], Surfacing Index [m/min], Effective Midflame Wind [m/min], Flame Residence Time [min]

#### Intermediates\_Surface

a data frame with some intermediate variables of surface fire behavior including: Potential ROS [m/min], No wind, no slope ROS [m/min], Slope factor [0-1], Wind factor [0-1], Characteristic dead fuel moisture (%), Characteristic live fuel moisture (%), Characteristic SAV [m<sup>2</sup>/m<sup>3</sup>], Bulk density [kg/m<sup>3</sup>], Packing ratio [-], Relative packing ratio [-], Reaction intensity [kW/m<sup>2</sup>], Heat source [kW/m<sup>2</sup>], Heat sink [kJ/m<sup>3</sup>]

#### Intermediates\_Crown

a data frame with some intermediate variables of crown fire behavior including: Potential ROS [m/min], No wind, no slope ROS [m/min], Slope factor [0-1], Wind factor [0-1], Characteristic dead fuel moisture (%), Characteristic live fuel moisture (%), Characteristic SAV [m<sup>2</sup>/m<sup>3</sup>], Bulk density [kg/m<sup>3</sup>], Packing ratio [-], Relative packing ratio [-], Reaction intensity [kW/m<sup>2</sup>], Heat source [kW/m<sup>2</sup>], Heat sink [kJ/m<sup>3</sup>]

#### Crit\_Initiation

a data frame of critical values for crown fire initiation including: Fireline Intensity [kW/m], Flame length [m], Surface ROS [m/min], Canopy base height [m]

#### Crit\_Active

a data frame of critical values for active crown fire including: Canopy bulk density [kg/m<sup>3</sup>], "ROS, crown (R'active) [m/min]

#### Crit\_Cessation

a data frame of critical values for cessation of crown fire including: Canopy base height [m], O'cessation [m/min]

### Author(s)

Justin P Ziegler, <justin.ziegler@colostate.edu>

### References

Scott, J.H., Reinhardt, E.D., 2001. Assessing crown fire potential by linking models of surface and crown fire behavior. USDA For. Serv. Rocky Mt. Res. Station. Res. Pap. RMRS-RP-29.

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