# Package 'cffdrs.core'

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**Type** Package

**Title** Canadian Forest Fire Danger Rating System

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**Description** This project provides a group of new functions to calculate the outputs of the two main components of the Canadian Forest Fire Danger Rating System (CFFDRS) Van Wagner and Pickett (1985) <https://cfs.nrcan.gc.ca/publications?id=19973>) at various time scales: the Fire Weather Index (FWI) System Wan Wagner (1985) <https://cfs.nrcan.gc.ca/publications?id=19927> and the Fire Behaviour Prediction (FBP) System Forestry Canada Fire Danger Group (1992) <http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/10068.pdf>.

**License** GPL-2

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`cffdrs.core-package` *Canadian Forest Fire Danger Rating System*

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## Description

The cffdrs.core package allows R users to calculate the outputs of the two main components of the Canadian Forest Fire Danger Rating System (CFFDRS; http://cwfis.cfs.nrcan.gc.ca/background/summary/fdr): the Fire Weather Index (FWI) System (http://cwfis.cfs.nrcan.gc.ca/background/summary/fwi) and the Fire Behaviour Prediction (FBP) System (http://cwfis.cfs.nrcan.gc.ca/background/summary/fbp) along with additional methods created and used Canadian fire modelling. These systems are widely used internationally to assess fire danger (FWI System) and quantify fire behavior (FBP System).

## Details

The FWI System (Van Wagner 1987) is based on the moisture content and the effect of wind of three classes of forest fuels on fire behavior. It consists of six components: three fuel moisture codes (Fire Fuel Moisture Code, Duff Moisture Code, Drought Code), and three fire behavior indexes representing rate of spread (Initial Spread Index), fuel consumption (Buildup Index), and fire intensity (Fire Weather Index). The FWI System outputs are determined from daily noon weather observations: temperature, relative humidity, wind speed, and 24-hour rainfall.

The FBP System (Forestry Canada Fire Danger Group 1992; Hirsch 1996) provides a set of primary and secondary measures of fire behavior. The primary outputs consist of estimates of fire spread rate, fuel consumption, fire intensity, and fire description (i.e., surface, intermittent, or crown fire). The secondary outputs, which are not used nearly as often, give estimates of fire area, perimeter, perimeter growth rate, and flank and back fire behavior based on a simple elliptical fire growth model. Unlike the FWI System, which is weather based, the FBP System also requires information on vegetation (hereafter, fuel types) and slope (if any) to calculate its outputs. Sixteen fuel types are included in the FBP System, covering mainly major vegetation types in Canada.

| | |
|---|---|
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| Type: | Package |
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| License: | GPL-2 |

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## References

1. Van Wagner, C.E. and T.L. Pickett. 1985. Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. Can. For. Serv., Ottawa, Ont. For. Tech. Rep. 33. 18 p.

2. Van Wagner, C.E. 1987. Development and structure of the Canadian forest fire weather index system. Forest Technology Report 35. (Canadian Forestry Service: Ottawa).

3. Lawson, B.D. and O.B. Armitage. 2008. Weather guide for the Canadian Forest Fire Danger Rating System. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, AB.

4. Hirsch K.G. 1996. Canadian Forest Fire Behavior Prediction (FBP) System: user's guide. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Spec. Rep. 7. 122p.

5. Forestry Canada Fire Danger Group. 1992. Development and structure of the Canadian Forest Fire Behavior Prediction System. Forestry Canada, Ottawa, Ontario Information Report ST-X-3. 63 p. http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/10068.pdf

6. Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p. http://publications.gc.ca/collections/collection_2010/nrcan/Fo123-2-10-2009-eng.pdf

7. Tymstra, C., Bryce, R.W., Wotton, B.M., Armitage, O.B. 2009. Development and structure of Prometheus: the Canadian wildland fire growth simulation Model. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, AB. Inf. Rep. NOR-X-417.

## See Also

fbp, fireSeason, fwi, gfmc, hffmc, sdmc, wDC

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# BackRateOfSpread *Back Fire Rate of Spread Calculator*

---

## Description

Calculate the Back Fire Spread Rate. All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992).

## Usage

```
BackRateOfSpread(FUELTYPE, FFMC, BUI, WSV, FMC, SFC, PC, PDF, CC, CBH)
```

### Arguments

| | |
|---|---|
| FUELTYPE | The Fire Behaviour Prediction FuelType |
| FFMC | Fine Fuel Moisture Code |
| BUI | Buildup Index |
| WSV | Wind Speed Vector |
| FMC | Foliar Moisture Content |
| SFC | Surface Fuel Consumption |
| PC | Percent Conifer |
| PDF | Percent Dead Balsam Fir |
| CC | Degree of Curing (just "C" in FCFDG 1992) |
| CBH | Crown Base Height |

### Value

BROS: Back Fire Rate of Spread

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

---

## BuildupEffect *Build Up Effect Calculator*

---

### Description

Computes the Buildup Effect on Fire Spread Rate. All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992).

### Usage

```
BuildupEffect(FUELTYPE, BUI)
```

### Arguments

| | |
|---|---|
| FUELTYPE | The Fire Behaviour Prediction FuelType |
| BUI | The Buildup Index value |

### Value

BE: Build up effect

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

`BuildupIndex` *Build Up Index Calculator*

## Description

Buildup Index Calculation. All code is based on a C code library that was written by Canadian Forest Service Employees, which was originally based on the Fortran code listed in the reference below. All equations in this code refer to that document. Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. 1985. Van Wagner, C.E.; Pickett, T.L. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ontario. Forestry Technical Report 33. 18 p.

## Usage

```
BuildupIndex(dmc, dc)
```

## Arguments

| | |
|---|---|
| `dmc` | Duff Moisture Code |
| `dc` | Drought Code |

## Value

A single Build Up Index value

## References

http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/19927.pdf Development and structure of the Canadian Forest Fire Weather Index System. 1987. Van Wagner, C.E. Canadian Forestry Service, Headquarters, Ottawa. Forestry Technical Report 35. 35 p.

`CriticalSurfaceIntensity` *Critical Surface Intensity Calculator*

## Description

Calculate Critical surface intensity (CSI).

## Usage

```
CriticalSurfaceIntensity(FMC, CBH)
```

## Arguments

| | |
|---|---|
| `FMC` | Foliar Moisture Content |
| `CBH` | Crown Base Height |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

CSI

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

---

## `CriticalSurfaceRateOfSpread` *Critical Surface Rate of Spread Calculator*

---

### Description

Calculate Critical Surface fire rate of spread (RSO). The value of each of these equations can be returned to the calling function without unecessary additional calculations.

### Usage

```
CriticalSurfaceRateOfSpread(CSI, SFC)
```

### Arguments

| | |
|---|---|
| `CSI` | Critical Surface Intensity |
| `SFC` | Surface Fuel Consumption |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

RSO

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

## CrownFractionBurned *Crown Fraction Burned Calculator*

### Description

Calculate Calculate Crown Fraction Burned.

### Usage

```
CrownFractionBurned(ROS, RSO)
```

### Arguments

| | |
|---|---|
| ROS | Rate of Spread |
| RSO | Critical Surface Rate of Spread |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

CFB

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

## CrownFuelConsumption *Crown Fuel Consumption calculation*

### Usage

```
CrownFuelConsumption(FUELTYPE, CFL, CFB, PC, PDF)
```

### Arguments

| | |
|---|---|
| FUELTYPE | The Fire Behaviour Prediction FuelType |
| CFL | Crown Fuel Load (kg/m^2) |
| CFB | Crown Fraction Burned (0-1) |

| | |
|---|---|
| PC | Percent Conifer (<br>\itemPDFPercent Dead Balsam Fir (<br>CFC Crown Fuel Consumption (kg/m^2)<br>Computes the Crown Fuel Consumption by Fuel Type. All variables names are laid out in the same manner as FCFDG (1992) or Wotton et. al (2009)<br>Forestry Canada Fire Danger Group (FCFDG) (1992). "Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.<br>Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p. |

---

`CrownRateOfSpreadC6` *C-6 Crown Fire Spread Calculator*

---

## Description

Calculate crown rate of spread (RSC).

## Usage

```
CrownRateOfSpreadC6(ISI)
```

## Arguments

| | |
|---|---|
| ISI | Initial Spread Index |

## Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

## Value

RSC

## References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

## DistanceAtTime *Distance at time t calculator*

### Description

Calculate the Head fire spread distance at time t. In the documentation this variable is just "D".

### Usage

```
DistanceAtTime(FUELTYPE, ROSeq, HR, CFB)
```

### Arguments

| | |
|---|---|
| FUELTYPE | The Fire Behaviour Prediction FuelType |
| ROSeq | The predicted equilibrium rate of spread (m/min) |
| HR | The elapsed time (min) |
| CFB | Crown Fraction Burned |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

DISTt - Head fire spread distance at time t

## DroughtCode *Drought Code Calculator*

### Usage

```
DroughtCode(dc_yda, temp, rh, prec, lat, mon, lat.adjust = TRUE)
```

### Arguments

| | |
|---|---|
| dc_yda | The Drought Code from previous iteration |
| temp | Temperature (centigrade) |
| rh | Relative Humidity (<br>\itemprecPrecipitation(mm)<br>\itemlatLatitude (decimal degrees)<br>\itemmonMonth (1-12)<br>\itemlat.adjustLatitude adjustment (TRUE, FALSE, default=TRUE)<br>A single drought code value<br>Drought Code Calculation. All code is based on a C code library that was written by Canadian Forest Service Employees, which was originally based on the |

Fortran code listed in the reference below. All equations in this code refer to that document. Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. 1985. Van Wagner, C.E.; Pickett, T.L. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ontario. Forestry Technical Report 33. 18 p. Additional reference on FWI system Development and structure of the Canadian Forest Fire Weather Index System. 1987. Van Wagner, C.E. Canadian Forestry Service, Headquarters, Ottawa. Forestry Technical Report 35. 35 p.

http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/19927.pdf Development and structure of the Canadian Forest Fire Weather Index System. 1987. Van Wagner, C.E. Canadian Forestry Service, Headquarters, Ottawa. Forestry Technical Report 35. 35 p.

---

`DuffMoistureCode` *Duff Moisture Code Calculator*

---

## Usage

```
DuffMoistureCode(dmc_yda, temp, rh, prec, lat, mon, lat.adjust = TRUE)
```

## Arguments

| | |
|---|---|
| `dmc_yda` | The Duff Moisture Code from previous iteration |
| `temp` | Temperature (centigrade) |
| `rh` | Relative Humidity ( |
| | \itemprecPrecipitation(mm) |
| | \itemlatLatitude (decimal degrees) |
| | \itemmonMonth (1-12) |
| | \itemlat.adjustLatitude adjustment (TRUE, FALSE, default=TRUE) |
| | A single duff moisture code value |
| | Duff Moisture Code Calculation. All code is based on a C code library that was written by Canadian Forest Service Employees, which was originally based on the Fortran code listed in the reference below. All equations in this code refer to that document. |
| | Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. 1985. Van Wagner, C.E.; Pickett, T.L. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ontario. Forestry Technical Report 33. 18 p. |
| | Additional reference on FWI system |
| | Development and structure of the Canadian Forest Fire Weather Index System. 1987. Van Wagner, C.E. Canadian Forestry Service, Headquarters, Ottawa. Forestry Technical Report 35. 35 p. |
| | http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/19927.pdf Development and structure of the Canadian Forest Fire Weather Index System. 1987. Van Wagner, C.E. Canadian Forestry Service, Headquarters, Ottawa. Forestry Technical Report 35. 35 p. |

`FineFuelMoistureCode` *Fine Fuel Moisture Code Calculation*

## Usage

```
FineFuelMoistureCode(ffmc_yda, temp, rh, ws, prec)
```

## Arguments

| | |
|---|---|
| `ffmc_yda` | The Fine Fuel Moisture Code from previous iteration |
| `temp` | Temperature (centigrade) |
| `rh` | Relative Humidity ( |
| | \itemwsWind speed (km/h) |
| | \itemprecPrecipitation (mm) |
| | A single fine fuel moisture code value |
| | Fine Fuel Moisture Code Calculation. All code is based on a C code library that was written by Canadian Forest Service Employees, which was originally based on the Fortran code listed in the reference below. All equations in this code refer to that document. |
| | Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. 1985. Van Wagner, C.E.; Pickett, T.L. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ontario. Forestry Technical Report 33. 18 p. |
| | Additional reference on FWI system Development and structure of the Canadian Forest Fire Weather Index System. 1987. Van Wagner, C.E. Canadian Forestry Service, Headquarters, Ottawa. Forestry Technical Report 35. 35 p. |

`FireBehaviourPrediction`
*Fire Behaviour Prediction System Calculation (hidden)*

## Description

Fire Behavior Prediction System calculations. This is the primary function for calculating FBP for a single timestep. Not all equations are calculated within this function, but have been broken down further.

## Usage

```
FireBehaviourPrediction(input = NULL, output = "Primary")
```

## Arguments

| | |
|---|---|
| `input` | Data frame of required and optional information needed to calculate FBP function. View the arguments section of the fbp manual (fbp.Rd) under "input" for the full listing of the required and optional inputs. |
| `output` | What fbp outputs to return to the user. Options are "Primary", "Secondary" and "All". _Default:_ "Primary" |

### Value

output: Either Primary, Secondary, or all FBP outputs in a data.frame

---

`FireIntensity` *Fire Intensity Calculator*

---

### Description

Calculate the Predicted Fire Intensity

### Usage

```
FireIntensity(FC, ROS)
```

### Arguments

| | |
|---|---|
| `FC` | Fuel Consumption (kg/m^2) |
| `ROS` | Rate of Spread (m/min) |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

FI: Fire Intensity (kW/m)

---

`FireWeatherIndex` *Fire Weather Index Calculation.*

---

### Description

All code is based on a C code library that was written by Canadian Forest Service Employees, which was originally based on the Fortran code listed in the reference below. All equations in this code refer to that document.

### Usage

```
FireWeatherIndex(isi, bui)
```

### Arguments

| | |
|---|---|
| `isi` | Initial Spread Index |
| `bui` | Buildup Index |

## Details

Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. 1985. Van Wagner, C.E.; Pickett, T.L. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ontario. Forestry Technical Report 33. 18 p.

Additional reference on FWI system

Development and structure of the Canadian Forest Fire Weather Index System. 1987. Van Wagner, C.E. Canadian Forestry Service, Headquarters, Ottawa. Forestry Technical Report 35. 35 p.

## Value

A single fwi value

---

`FlankRateOfSpread` *Flank Fire Rate of Spread Calculator*

---

## Description

Calculate the Flank Fire Spread Rate.

## Usage

```
FlankRateOfSpread(ROS, BROS, LB)
```

## Arguments

| | |
|---|---|
| `ROS` | Fire Rate of Spread (m/min) |
| `BROS` | Back Fire Rate of Spread (m/min) |
| `LB` | Length to breadth ratio |

## Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

## Value

FROS Flank Fire Spread Rate (m/min) value

## FoliarMoistureContent *Foliar Moisture Content Calculator*

### Description

Calculate Foliar Moisture Content on a specified day. All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Usage

```
FoliarMoistureContent(LAT, LONG, ELV, DJ, D0)
```

### Arguments

| | |
|---|---|
| LAT | Latitude (decimal degrees) |
| LONG | Longitude (decimal degrees) |
| ELV | Elevation (metres) |
| DJ | Day of year (offeren referred to as julian date) |
| D0 | Date of minimum foliar moisture content. _If D0, date of min FMC, is not known then D0 = NULL._ |

### Value

FMC: Foliar Moisture Content value

## InitialSpreadIndex *Initial Spread Index Calculator*

### Description

Computes the Initial Spread Index From the FWI System. Equations are from Van Wagner (1985) as listed below, except for the modification for fbp takene from FCFDG (1992).

### Usage

```
InitialSpreadIndex(ffmc, ws, fbpMod = FALSE)
```

### Arguments

| | |
|---|---|
| ffmc | Fine Fuel Moisture Code |
| ws | Wind Speed (km/h) |
| fbpMod | TRUE/FALSE if using the fbp modification at the extreme end |

### Details

Equations and FORTRAN program for the Canadian Forest Fire Weather Index System. 1985. Van Wagner, C.E.; Pickett, T.L. Canadian Forestry Service, Petawawa National Forestry Institute, Chalk River, Ontario. Forestry Technical Report 33. 18 p.

Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical ReportST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

ISI - Intial Spread Index

---

## `IntermediateSurfaceRateOfSpreadC6` *C-6 Conifer Plantation Intermediate Surface Fire Spread Rate Calculator*

---

### Description

Calculate intermediate surface fire rate of spread, before BUI effect is applied (RSI).

### Usage

```
IntermediateSurfaceRateOfSpreadC6(ISI, FMC)
```

### Arguments

| | |
|---|---|
| `ISI` | Initial Spread Index |
| `FMC` | Foliar Moisture Content |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

RSI

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

## LengthToBreadthRatio *Length-to-Breadth ratio*

### Description

Computes the Length to Breadth ratio of an elliptically shaped fire. Equations are from listed FCFDG (1992) except for errata 80 from Wotton et. al. (2009).

### Usage

```
LengthToBreadthRatio(FUELTYPE, WSV)
```

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p.

@param FUELTYPE The Fire Behaviour Prediction FuelType @param WSV The Wind Speed (km/h)

### Value

Length to Breadth ratio value

## LengthToBreadthRatioAtTime *Length-to-Breadth ratio at time t*

### Description

Computes the Length to Breadth ratio of an elliptically shaped fire at elapsed time since ignition. Equations are from listed FCFDG (1992) and Wotton et. al. (2009), and are marked as such.

### Usage

```
LengthToBreadthRatioAtTime(FUELTYPE, LB, HR, CFB)
```

### Arguments

| | |
|---|---|
| FUELTYPE | The Fire Behaviour Prediction FuelType |
| LB: | Length to Breadth ratio |
| HR: | Time since ignition (hours) |
| CFB: | Crown Fraction Burned |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p.

### Value

Length to Breadth ratio at time since ignition

---

`RateOfSpread` *Rate of Spread Calculation*

---

### Usage

```
RateOfSpread(FUELTYPE, ISI, BUI, FMC, SFC, PC, PDF, CC, CBH)
```

### Arguments

| | |
|---|---|
| `ISI` | Intiial Spread Index |
| `BUI` | Buildup Index |
| `FMC` | Foliar Moisture Content |
| `SFC` | Surface Fuel Consumption (kg/m^2) |
| `PC` | Percent Conifer ( |
| | \itemPDFPercent Dead Balsam Fir ( |
| | \itemCCConstant |
| | \itemCBHCrown to base height(m) |
| | \itemFUELTYPETheFire Behaviour Prediction FuelType |
| | ROS - Rate of Spread (m/min) value |
| | Computes the Rate of Spread prediction based on fuel type and FWI conditions. Equations are from listed FCFDG (1992) and Wotton et. al. (2009), and are marked as such. |
| | All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario. |
| | Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p. |

## RateOfSpreadAtTheta *Rate of spread at a point along the perimeter calculator*

### Description

Computes the Rate of Spread at any point along the perimeter of an elliptically shaped fire. Equations are from Wotton et. al. (2009).

### Usage

```
RateOfSpreadAtTheta(ROS, FROS, BROS, THETA)
```

### Arguments

| | |
|---|---|
| ROS | Rate of Spread (m/min) |
| FROS | Flank Fire Rate of Spread (m/min) |
| BROS | Back Fire Rate of Spread (m/min) |
| THETA | |
| FUELTYPE | The Fire Behaviour Prediction FuelType |

### Details

Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p.

### Value

ROSTHETA - Rate of spread at point theta(m/min)

## RateOfSpreadAtTime *Rate of spread at time t calculation*

### Description

Computes the Rate of Spread prediction based on fuel type and FWI conditions at elapsed time since ignition. Equations are from listed FCFDG (1992).

### Usage

```
RateOfSpreadAtTime(FUELTYPE, ROSeq, HR, CFB)
```

### Arguments

| | |
|---|---|
| FUELTYPE | The Fire Behaviour Prediction FuelType |
| ROSeq | Equilibrium Rate of Spread (m/min) |
| HR | Time since ignition (hours) |
| CFB | Crown Fraction Burned |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

ROSt - Rate of Spread at time since ignition value

---

## `RateOfSpreadC6` *C-6 Conifer Plantation Fire Spread Calculator*

---

### Description

Calculate rate of spread (ROS).

### Usage

```
RateOfSpreadC6(RSC, RSS, CFB)
```

### Arguments

| | |
|---|---|
| `RSC` | Crown Fire Spread Rate (m/min) |
| `RSS` | Surface Fire Spread Rate (m/min) |
| `CFB` | Crown Fraction Burned |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

ROS

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

`SlopeAdjust` *Slope Adjusted wind speed or slope direction of spread calculation*

## Usage

```
SlopeAdjust(
  FUELTYPE,
  FFMC,
  BUI,
  WS,
  WAZ,
  GS,
  SAZ,
  FMC,
  SFC,
  PC,
  PDF,
  CC,
  CBH,
  ISI,
  output = "RAZ"
)
```

## Arguments

| | |
|---|---|
| `FUELTYPE` | The Fire Behaviour Prediction FuelType |
| `BUI` | The Buildup Index value |
| `WS` | Windspeed (km/h) |
| `WAZ` | Wind Azimuth |
| `GS` | Ground Slope (<br>\itemSAZSlope Azimuth<br>\itemFMCFoliar Moisture Content<br>\itemSFCSurface Fuel Consumption (kg/m^2)<br>\itemPCPercent Conifer (<br>\itemPDFPercent Dead Balsam Fir (<br>\itemCCConstant<br>\itemCBHCrown Base Height (m)<br>\itemISIInitial Spread Index<br>\itemoutputType of variable to output (RAZ/WSV, default=RAZ)<br>RAZ or WSV - Rate of spread azimuth (degrees) or Wind Slope speed (km/hr)<br>Calculate the net effective windspeed (WSV), the net effective wind direction (RAZ) or the wind azimuth (WAZ).<br>All variables names are laid out in the same manner as FCFDG (1992) and Wotton (2009).<br>Forestry Canada Fire Danger Group (FCFDG) (1992). "Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario. |

Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p.

---

`SurfaceFuelConsumption` *Surface Fuel Consumption Calculator*

---

## Usage

```
SurfaceFuelConsumption(FUELTYPE, FFMC, BUI, PC, GFL)
```

## Arguments

| | |
|---|---|
| `FUELTYPE` | The Fire Behaviour Prediction FuelType |
| `FFMC` | Fine Fuel Moisture Code |
| `BUI` | Buildup Index |
| `PC` | Percent Conifer (<br>\itemGFLGrass Fuel Load (kg/m^2)<br>SFC Surface Fuel Consumption (kg/m^2)<br>Computes the Surface Fuel Consumption by Fuel Type. All variables names are laid out in the same manner as FCFDG (1992) or Wotton et. al (2009)<br>Forestry Canada Fire Danger Group (FCFDG) (1992). "Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.<br>Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p. |

---

`SurfaceRateOfSpreadC6` *C-6 Conifer Plantation Fire Spread Calculator*

---

## Description

Calculate surface fire rate of spread (RSS).

## Usage

```
SurfaceRateOfSpreadC6(FUELTYPE, RSI, BUI)
```

## Arguments

| | |
|---|---|
| `FUELTYPE` | The Fire Behaviour Prediction FuelType |
| `RSI` | Intermediate Surface Fire Rate of Spread |
| `BUI` | Buildup Index |

### Details

All variables names are laid out in the same manner as Forestry Canada Fire Danger Group (FCFDG) (1992). Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Value

RSS

### References

https://cfs.nrcan.gc.ca/publications/download-pdf/10068 Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

---

## TotalFuelConsumption *Total Fuel Consumption calculation*

---

### Description

Computes the Total (Surface + Crown) Fuel Consumption by Fuel Type. All variables names are laid out in the same manner as FCFDG (1992) or Wotton et. al (2009)

Forestry Canada Fire Danger Group (FCFDG) (1992). "Development and Structure of the Canadian Forest Fire Behavior Prediction System." Technical Report ST-X-3, Forestry Canada, Ottawa, Ontario.

### Usage

```
TotalFuelConsumption(CFC, SFC)
```

### Arguments

| | |
|---|---|
| CFC | Crown Fuel Consumption (kg/m^2) |
| SFC | Surface Fuel Consumption (kg/m^2) |

### Details

Wotton, B.M., Alexander, M.E., Taylor, S.W. 2009. Updates and revisions to the 1992 Canadian forest fire behavior prediction system. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10, 45p.

### Value

TFC Total (Surface + Crown) Fuel Consumption (kg/m^2)

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