Dynamic calculations of fire Disturbance Matrices for GCBM including fire severity

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Global Variables

Certain variables, like the fractionation of CO2:CH4:CO, are constant throughout ecozones, but vary by flaming vs smouldering. They are defined in a global variables table:

Duff Consumption

To be expanded later, but duff consumption can be calculated annually using the median hotspot Drought Code and de Groot's FFFC equations, as applied to median FFFL values. Could also be done per fire using fire-specific DC and mapped FFFC values as well. Need to compute this above for use below.

```
[[1]]
[1] 0.4
```

Constructing fire DMs from abstractions

First, a generic template for a fire DM is loaded, that can represent any ecozone. It comes in two parts: (1) a list of variables, some biophysical and not relating to fire severity (such as the portion of live branchwood that falls into the smaller size fraction); or (2) severity-specific variables (such as Crown Fraction Burn) for a severity class. The template is loaded, and replicated across the list of ecozones (or any spatial unit) desired. Other processes, such as the analysis of field data, can then be used to fill in ecozone-specific variables in severity classes.

An example of the variable definition template is as follows:

A plain language name for each variable is provided right in the data, as well.

A second template defines each flux in a Disturbance Matrix, with Source and Sink defined as precise character variables, and a plain language summary ("Process Synonym") included

Ecozone	Pool	Plain.Language.Name	Variable.Name	Value	SeverityClass	InterimValue
LA	Other	Portion of bark pool consumed in fire	Bark.Comb.Frac	0.01	Low	TRUE
TP	Other	Portion of bark pool consumed in fire	Bark.Comb.Frac	0.01	Low	TRUE
TSW	Other	Portion of bark pool consumed in fire	Bark.Comb.Frac	0.01	Low	TRUE
BSW	Other	Portion of bark pool consumed in fire	Bark.Comb.Frac	0.01	Low	TRUE
BP	Other	Portion of bark pool consumed in fire	Bark.Comb.Frac	0.01	Low	TRUE
P	Other	Portion of bark pool consumed in fire	Bark.Comb.Frac	0.01	Low	TRUE

Ecozone	FluxID	Source	Sink	ProcessSynonym	Pseudocode	Notes	SeverityClass	Value	InterimValue
LA	1	Softwood Merchantable	Softwood Merchantable	Survival rate of large conifers	1-mortality rate	Ellen provides	Low	0.8	TRUE
TP	1	Softwood Merchantable	Softwood Merchantable	Survival rate of large conifers	1-mortality rate	Ellen provides	Low	0.8	TRUE
TSW	1	Softwood Merchantable	Softwood Merchantable	Survival rate of large conifers	1-mortality rate	Ellen provides	Low	0.8	TRUE
BSW	1	Softwood Merchantable	Softwood Merchantable	Survival rate of large conifers	1-mortality rate	Ellen provides	Low	0.8	TRUE
BP	1	Softwood Merchantable	Softwood Merchantable	Survival rate of large conifers	1-mortality rate	Ellen provides	Low	0.8	TRUE
P	1	Softwood Merchantable	Softwood Merchantable	Survival rate of large conifers	1-mortality rate	Ellen provides	Low	0.8	TRUE

to tie this flux back to language used in the fire science literature. Pseudocode and notes are included in each flux, which is repeated for each fire severity class and ecozone. There are 3900 total fluxes, though many do not have sufficient information to describe differences between ecozones. Many of these are computed automatically, tying back into variables such as Crown Fraction Burned.

With both generic ecozone variables as well as severity-specific variables defined and the pseudocode for each flux included, actual DM values are computed as references to tables, subset by ecozone and severity class:

```
# SourceSink$Value[SourceSink$Ecozone == ecozone &
# SourceSink$FluxID == 1 & SourceSink$SeverityClass ==
# 'Low'] <- 1 - (VarDefs$Value[VarDefs$Variable.Name ==
# 'SW.CFB' & VarDefs$Ecozone == ecozone &
# VarDefs$SeverityClass == 'Low'])
```

Note that rather than defining softwood crown fraction burned as a variable called "SW.CFB.Boreal.Plains" for each ecozone, there is a row in the VarDefs table that represents SW.CFB in each ecozone and for each severity class, thus avoiding the creation of large lists of manually entered variable names and values in the R environment. Instead, these values can be programmatically entered via external analysis of plot data (not covered here).

And make a checksum table to ensure all the major pools sum of up 1:

In a final step, a classical tabular DM is show, with row and column names precisely matching those in the Sink and Source columns in the SourceSink table:

Table 1: Example moderate severity DM in Boreal Plains

	Softwood Merchantable	Softwood Stem Snag	Black Carbon	Softwood Foliage	Above Ground Very Fast soil C	CO2	CH4	CO
Softwood Merchantable	0.5	0.5	0	NA	NA	NA	NA	NA
Softwood Stem Snag	NA	NA	NA	NA	NA	NA	NA	NA
Black Carbon	NA	NA	NA	NA	NA	NA	NA	NA
Softwood Foliage	NA	NA	NA	0	0.45	0.45	0.005	0.045
Above Ground Very Fast soil C	NA	NA	NA	NA	NA	NA	NA	NA
CO2	NA	NA	NA	NA	NA	NA	NA	NA
CH4	NA	NA	NA	NA	NA	NA	NA	NA
CO	NA	NA	NA	NA	NA	NA	NA	NA