BFOLDS Technical Note
No. 1 • 2010

BFOLDS Version 1.1.0

Forest Landscape Ecology Program

This note summarizes the model algorithm changes incorporated in BFOLDS 1.1.0 (released 2010/06/14). These changes were made to accommodate user input received as direct requests and/or comments provided during user workshops.

Here we provide the pre-improvement model logic used in BFOLDS (V 1.0.0), outline the details of the changes, and show how they affect model function.

For further details about the changes, contact Marc Ouellette (marc.ouellette@ontario.ca).

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Initial model logic (BFOLDS 1.0.0)

Post-fire fuel availability assumed to have a 10-yr lag period

Once burned a pixel was assumed to have insufficient fuel build up to sustain another fire for a period of 10 years (Perera et al. 2008, p 32). This applied when fire intensity exceeded a forest cover mortality threshold and applied to both fire ignition and spread.

Ignitions not re-seeded when insufficient fuel available

If an ignition was seeded on a pixel that burned within 10 years, it was assumed that that ignition would not cause a fire, even if the fire weather were favourable. That ignition was then not re-seeded on the landscape on that day, implying sampling without replacement (Perera et al. 2008, p 31, 32).

Ignitions not re-seeded when duff moisture code too low to ignite

If an ignition was seeded when the duff moisture code (DMC) for a given pixel was below a threshold, that ignition would not cause a fire. That ignition was not re-seeded on the landscape on that day, implying sampling without replacement (Perera et al. 2008, p 31, 32).

Changes incorporated in BFOLDS 1.1.0

The changes incorporated in BFOLDS 1.1.0 are described below.

Lag period of post-fire fuel availability is a user assumption

The lag period in post-fire fuel availability has been changed to a user assumption; the user can now input a value between 1 and 60 years or accept the default value, which remains at 10 years. This has been renamed the *no-fuel period* in the BFOLDS graphic user interface (GUI).

Ignition seeding when insufficient fuel available is a user assumption

The user now has the option to re-seed failed ignitions resulting from the post-fire fuel availability lag period on a daily basis. If the user elects to re-seed, it implies sampling with replacement. (The default remains as no re-seeding of ignitions.)

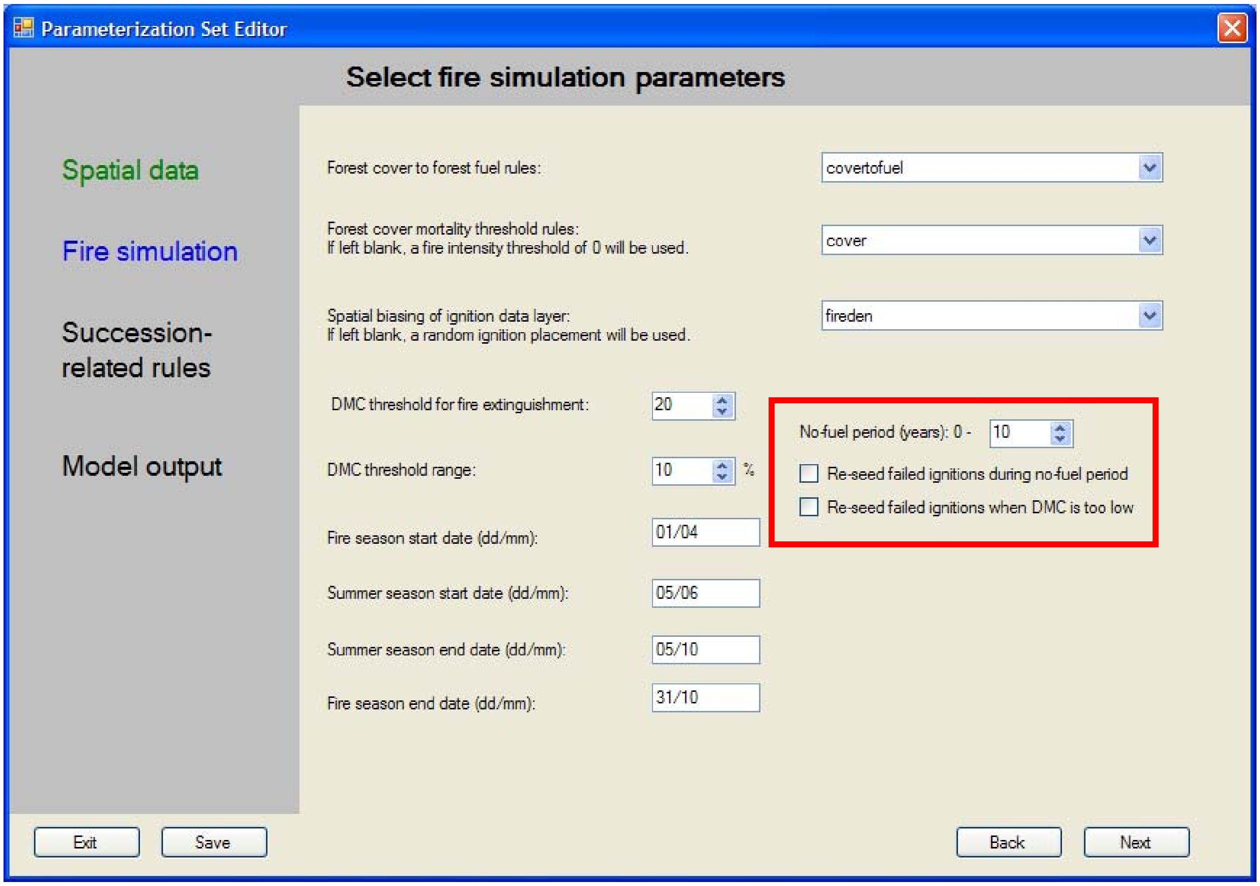
Ignition seeding when duff moisture code too low to ignite is a user assumption

The user now has the option to re-seed failed ignitions resulting from low DMC, on a daily basis. If the user selects to re-seed, it implies sampling with replacement. (The default remains as no re-seeding of ignitions.)

When creating a parameter set for use in model runs, the following features that relate to the new options described above can be accessed in the BFOLDS toolbox (Ouellette 2008):

- On the *Select fire simulation parameters* section, a text box is available to select the no-fuel period
- Check boxes are available to allow reseeding of failed ignitions

The locations of these features in the GUI are shown below (outlined in red).



Effect on model output/performance

Lag period of post-fire fuel availability

Changing the period of insufficient fuel availability for an area to reburn has a potentially significant effect on BFOLDS simulation results. Assuming shorter periods of insufficient post-fire fuel availability may produce more and larger fires given fewer fuel breaks (which would otherwise be created by recent burns). This has implications for the simulated fire regime. As well, the increased number and size of fires will increase simulation (computing) time. Conversely, longer periods of insufficient fuel availability are likely to produce fewer and smaller fires as the fires will encounter more fuel breaks (created by recent burns). Effects of the lag period assumption will be even more apparent if users opt for biased ignition seeding. (For details on ignition biasing, see Cui et al. 2009, p 11; Ouellette 2008, p 11.)

Ignition re-seeding during the period when insufficient fuel available

Choosing to re-seed ignitions during the period when insufficient fuel is available will increase the number of fires on a simulated landscape and potentially increase the annual area burned but may decrease individual fire sizes (depending whether fires merge). If ignition biasing is also applied, simulated fires are likely to merge more often than would be the case with random ignition placement. This will further influence the simulated fire regime.

Ignition re-seeding when duff moisture code too low to ignite

Choosing to re-seed ignitions when DMC is too low to ignite is likely to increase the number if ignitions in larger simulation areas but may not affect the results in small areas. This is because smaller areas are more likely to have similar fire weather, so new ignition seeds are less likely to encounter favourable fire weather.

Sample simulation results from BFOLDS 1.1.0

To show the effects of the user options on simulation outputs, below we illustrate the effect of ignition biasing on eight simulations with and without ignition reseeding. The lag in post-fire fuel availability was not included in the treatments since its effect is obvious.

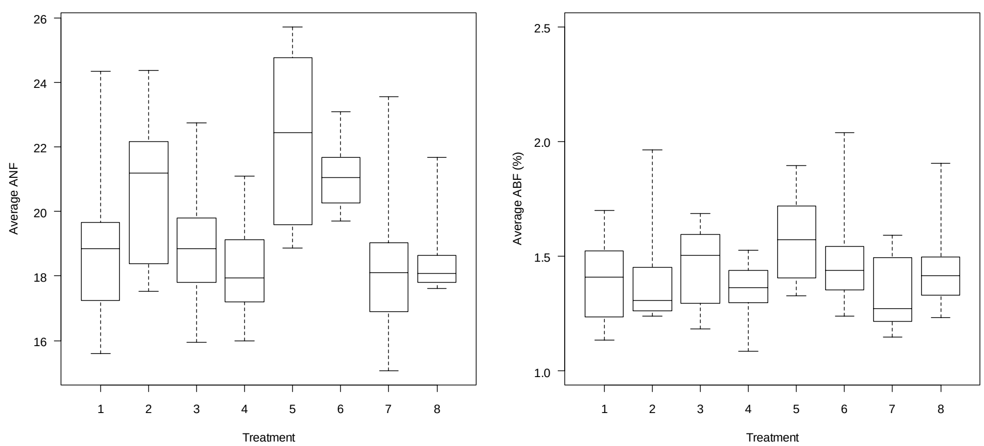
Simulation setup

Eight simulations with 10 replicates each and a simulation length of 150 years were run. Simulation inputs were identical, except for the differences among treatments as outlined below:

1. Biased ignition, Ignition re-seeding, DMC re-seeding
2. Biased ignition, Ignition re-seeding, no DMC re-seeding
3. Biased ignition, No Ignition re-seeding, DMC re-seeding
4. Biased ignition, No Ignition re-seeding, No DMC re-seeding
5. Random ignition, Ignition re-seeding, DMC re-seeding
6. Random ignition, Ignition re-seeding, No DMC re-seeding
7. Random ignition, No Ignition re-seeding, DMC re-seeding
8. Random ignition, No Ignition re-seeding, No DMC re-seeding

Treatments 4 (biased) and 8 (random) reflect BFOLDS 1.0.0 options. The other treatments reflect variations of the new features in BFOLDS 1.1.0.

The box plots below show the average annual number of fires (ANF) and the average annual burn fraction (ABF) per replicate for each treatment. (*The vertical position and height of the box show the middle half of the data. Within each box, the line indicates the median and the whiskers show the data range for that treatment.*)



For treatments 4 and 8 the average ANF is low because in the other treatments one or both types of failed ignitions were re-seeded.

The average ABF differed among treatments but less so because while there were more fires, fires also acted as fuel breaks and prevented other fires from increasing in size. Fires also fragmented the landscape and consumed the fuel, with the result that fires that occurred within the same10-year no burn window encountered fire scars that impeded their growth.

In closing, the new features incorporated in the revised version of BFOLDS shift assumptions about reburn time and ignition seeding from a model assumption (embedded in model logic) to a user assumption.

While we have provided example results, these are from simulations conducted with few replicates on a 2 million ha (i.e., relatively small) area. The study area, its size, and its fire regime will affect simulation behaviour resulting from these assumptions. To use BFOLDS effectively, model users need to test and understand these effects.

References

Cui, W., M.R. Ouellette, A.H. Perera and M. Gluck. 2009. Using BFOLDS to characterize fire regimes: a case study from a boreal forest landscape. Ontario Ministry of Natural Resources, Ontario Forest Research Institute, Sault Ste. Marie, ON. Forest Research Report No. 173. 40 p.

Ouellette, M. 2008. BFOLDS 1.0: A user's guide to the software package (Version 1.0.0). Ontario Ministry of Natural Resources, Ontario Forest Research Institute, Sault Ste. Marie, ON. Forest Research Information Paper No. 171. 68 p.

Perera, A.H., M.R. Ouellette, W. Cui, M. Drescher and D. Boychuk. 2008. BFOLDS 1.0: A spatial simulation model for exploring large scale fire regimes and succession in boreal forest landscapes. Ontario Ministry of Natural Resources, Ontario Forest Research Institute, Sault Ste. Marie, ON. Forest Research Report No. 152. 50 p.