Module and Pathway Test Report

Module: FBSDK Downloads, July 2011
Pathway(s): Calculate surface fire behavior (IFT-surface)
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Test Period: February 2012

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General Testing Procedures

All modules implemented in IFTDSS undergo two types of testing:

- **Scientific testing** to ensure that the outputs produced by the module are consistent with a range of expected values generated by the native desktop software application and/or provided by the scientific model developer(s). These tests include comparisons for a range of predefined scenarios developed to exercise different parts of the module.

- **Software testing** to ensure that the module is functioning from a usability perspective, accepting inputs, and producing outputs without generating software error reports. These automatic tests also ensure that as updates are made to the models or modeling framework, each individual module produces correct data values.

This document describes Sonoma Technology, Inc.'s test cases.

Scientific Testing

Surface Fire Behavior Test Case

This test case compared the Surface Fire Behavior module in IFTDSS to the desktop version of BehavePlus 5.0.5 using three stands, each simulated in three environmental scenarios expected to generate low, moderate, and high fire behavior. The fire behavior fuel models selected for the three stands are

- tall grass (FM3)
- moderate load, humid climate shrub (SH3)
- moderate load, humid climate timber-shrub (TU2)

A total of 17 output parameters were compared for each simulation.

Inputs and Results File Name

- Surface fire behavior test case results (included in the IFTDSS online help under **IFTDSS Compared with Other Systems > Module Test Cases**)

- Surface fire behavior test case summary (Appendix)

Passed/Fail: Passed

Issues: None identified

References

Documentation of BehavePlus operation and application:
http://www.firemodels.org/index.php/national-systems/behaveplus

Appendix: Scientific Test Case for the IFTDSS Calculate Surface Fire Behavior Module as Implemented in BehavePlus

Summary of Findings

The Surface Fire Behavior module as implemented in IFTDSS is a scientifically sound representation of the desktop version of BehavePlus 5.0.5. In this test case, the output values from IFTDSS and desktop BehavePlus matched in all simulations with negligible rounding/truncating differences.

Environmental Scenarios

Three environmental scenarios were tested that were expected to produce low, moderate, and high fire behavior (Table 1). Testing under different environmental scenarios allows the comparison of a variety of results between modules.

Table 1. The three environmental scenarios (low, moderate, high) used in the Surface Fire Behavior test cases.

Input Parameter	Fire Behavior		
	Low	Moderate	High
1-hour fuel moisture (%)	15	7	3
10-hr fuel moisture (%)	18	10	5
100-hr fuel moisture (%)	25	12	8
Live herbaceous fuel moisture (%)	110	75	50
Live woody fuel moisture (%)	140	100	75
Midflame wind speed (mi/hr)	5	15	25
Wind direction (degrees)	70	70	70

Methods

Surface Fire Behavior Test Case

Three stands were set up to compare the Surface Fire Behavior module in IFTDSS to the desktop version of BehavePlus 5.0.5. To test the effect of fuel models on surface fire behavior, three fire behavior fuel models were selected for the three stands: tall grass (FM3); moderate load, humid climate shrub (SH3); and moderate load, humid climate timber-shrub (TU2). A 25 percent slope, 45-degree aspect, and 3-hour elapsed time were applied to the stands because these are common values that a user may input, and each stand was simulated under the three environmental scenarios described in Table 1. The Surface Fire Behavior module implemented in IFTDSS differs from the desktop BehavePlus in that it

provides backing and flanking fire behavior output parameters, in addition to head fire behavior. Therefore, additional runs were carried out in BehavePlus using the backing and flanking directions calculated from the direction of maximum spread (head fire direction) as the input parameters for fire spread direction. In this test case, a total of 17 output parameters were analyzed for a total of 153 comparisons.

Results

Surface Fire Behavior Test Case

Results from the Surface Fire Behavior module implemented in IFTDSS and the BehavePlus desktop version for all simulations matched with negligible rounding/truncating differences (Table 2).

Table 2. Results from the Surface Fire Behavior module comparison (only the SH3 stand is shown; results from other stands were similarly well matched).

Output Parameter	Unit	SH3 (143): Moderate Load, Humid Climate Shrub					
		Low		Moderate		High	
		IFTDSS	Behave Plus	IFTDSS	Behave Plus	IFTDSS	Behave Plus
Head Fire Spread Rate	chains/hour	2.35	2.4	13.11	13.1	29.12	29.1
Backing Fire Spread Rate	chains/hour	0.12	0.1	0.14	0.1	0.19	0.2
Flanking Fire Spread Rate	chains/hour	0.23	0.2	0.29	0.3	0.39	0.4
Heat Per Unit Area	Btu/ft^2	391.62	392	464.19	464	566.11	566
Head Fire Fireline Intensity	Btu/ft/s	16.89	17	111.54	112	302.21	302
Backing Fire Fireline Intensity	Btu/ft/s	0.85	1	1.23	1	2.01	2
Flanking Fire Fireline Intensity	Btu/ft/s	1.62	2	2.43	2	4	4
Head Fire Flame Length	ft	1.65	1.7	3.94	3.9	6.23	6.2
Backing Fire Flame Length	ft	0.42	0.4	0.49	0.5	0.62	0.6
Flanking Fire Flame Length	ft	0.56	0.6	0.68	0.7	0.85	0.8
Reaction Intensity	$Btu/ft^2/min$	1,398.60	1,399.00	1,657.78	1,658.00	2,021.79	2,022.00
Head Fire Spread Direction	degrees	248	248	249	249	250	250

Table 2 (continued). Results from the Surface Fire Behavior module comparison (only the SH3 stand is shown; results from other stands were similarly well matched).

Output Parameter	Unit	SH3 (143): Moderate Load, Humid Climate Shrub					
		Low		Moderate		High	
		IFTDSS	Behave Plus	IFTDSS	Behave Plus	IFTDSS	Behave Plus
Head Fire Spread Distance	chains	7.06	7.1	39.32	39.3	87.35	87.4
Backing Fire Spread Distance	chains	0.36	0.4	0.43	0.4	0.58	0.6
Flanking Fire Spread Distance	chains	0.68	0.7	0.86	0.9	1.16	1.1
Residence Time	min	0.28	0.28	0.28	0.28	0.28	0.28
Effective Wind Speed (Head Fire)	miles/hour	5.36	5.4	15.28	15.3	20.68	20.7