Module and Pathway Test Report

Module FBSDK Downloads, July 2011
Pathway(s): Calculate crown fire behavior (IFT-crown)
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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

Crown Fire Behavior Test Case

This test case compared the Crown Fire Behavior module in IFTDSS to the desktop version of BehavePlus 5.0.5 using three stands. The three stands were set up using inputs within the ranges of commonly observed conditions expected to produce low, moderate, and high crown fire behaviors to allow the comparison of a variety of results. A total of 22 output parameters were compared.

Inputs and Results File Name

- Crown fire behavior test case results (included in the IFTDSS online help under **IFTDSS Compared with Other Systems > Module Test Cases**)
- Crown 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 Crown Fire Behavior Module" as Implemented in BehavePlus

Summary of Findings

The Crown 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 outputs from IFTDSS and desktop BehavePlus matched with negligible rounding/truncating differences.

Methods

Crown Fire Behavior Test Case

Three stands were set up (Table 1) to compare the Crown Fire Behavior module in IFTDSS to the desktop version of BehavePlus 5.0.5. The three stands were set up using inputs within the ranges of commonly observed conditions expected to produce low, moderate, and high crown fire behaviors to allow the comparison of a variety of results. For each stand, 22 output parameters were analyzed for a total of 66 comparisons across the three stands.

Table 1. Input data used for the Crown Fire Behavior module test case.

Input Parameter	Unit	Fire Behavior		
		Low	Moderate	High
Canopy Height	feet (ft)	60	40	20
Canopy Base Height	ft	45	30	15
Canopy Bulk Density	lb/ft^3	0.01	0.02	0.04
1-hr Fuel Moisture	percent	15	7	3
10-hr Fuel Moisture	percent	18	10	5
100-hr Fuel Moisture	percent	25	12	8
Live Woody Fuel Moisture	percent	140	100	75
Foliar Moisture	percent	150	125	100
20-ft Wind Speed	miles/hour	15	15	15
Heat Per Unit Area	Btu/ft^2	500	500	500
Flame Length	feet	10	10	10
Elapsed Time	hours	3	3	3

Results

Crown Fire Behavior Test Case

Results from the Crown Fire Behavior module implemented in IFTDSS and desktop BehavePlus for the three stands tested matched with negligible rounding/truncating differences (Table 2).

Table 2. Results from the Crown Fire Behavior module comparison.

Output Parameter	Unit	Low		Moderate		High	
		IFTDSS	Behave Plus	IFTDSS	Behave Plus	IFTDSS	Behave Plus
Critical Surface Intensity	Btu/ft/s	4,185.33	4,185.00	1,787.34	1,787.00	473.01	473.00
Critical Surface Flame Length	ft	20.85	20.9	14.1	14.1	7.65	7.6
Transition Ratio		0.2	0.2	0.47	0.47	1.79	1.79
Transition to Crown Fire		No	No	No	No	Yes	Yes
Crown Rate of Spread	chains/ hr	22.41	22.4	34.32	34.3	50.9	50.9
Critical Crown Rate of Spread	chains/ hr	55.85	55.9	27.93	27.9	13.96	14
Active Ratio		0.4	0.4	1.23	1.23	3.65	3.65
Active Crown Fire		No	No	Yes	Yes	Yes	Yes
Fire Type		Surface	Surface	Conditional Crowning	Conditional Crowning	Crowning	Crowning
Crown Spread Distance	chains	67.24	67.2	102.95	103	152.7	152.7
Crown Fire Area	acres	123.51	123.5	289.53	289.6	636.99	637.1
Crown Fire Perimeter	chains	142.36	142	217.96	218	323.29	323
Crown Fire Length-to-Width Ratio	chains/ chains	2.88	2.9	2.88	2.9	2.88	2.9
Crown Fireline Intensity	Btu/ft/s	698.55	699	1,321.17	1,321.00	1,959.66	1,960.00
Crown Flame Length	ft	15.75	15.7	24.08	24.1	31.32	31.3
Power of the Fire	ft-lb/s/ft^2	5.42	5	10.24	10	15.19	15
Power of the Wind	ft-lb/s/ft^2	10.67	11	10.35	10	9.91	10
Power Ratio		0.51	0.51	0.99	0.99	1.53	1.53
Wind-Driven Fire		Yes	Yes	Yes	Yes	No	No
Crown Load	tons/ acre	3.27	3.27	4.36	4.36	4.36	4.36
Canopy Heat/Unit Area	Btu/ft^2	1,200.00	1,200.00	1,600.00	1,600.00	1,600.00	1,600.00
Crown Fire Heat/Unit Area	Btu/ft^2	1,700.00	1,700.00	2,100.00	2,100.00	2,100.00	2,100.00