



NEXUS 2.0

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Workshop agenda

- Introduction to NEXUS
- Models and concepts
- Demonstration

NEXUS 2.0 niche

- Non-spatial crown fire hazard assessment
- Shrub-canopy fire simulations
 - based on concepts similar to crown fire modeling (in development)
- Emphasizes graphical output, sensitivity analysis, crown fire behavior learning tool
- Necessary overlap, significant differences: BehavePlus, FARSITE/FlamMap, FMA Plus



NEXUS 2.0 features

- Stand-alone executable format
- Interactive outputs
 - Basic table and chart
 - Crown Fire Hazard Assessment Chart
 - Fire Characteristics Chart
- Ability to save/share work
- Custom and dynamic fuel models
- Export data and graphics
- Batch processing

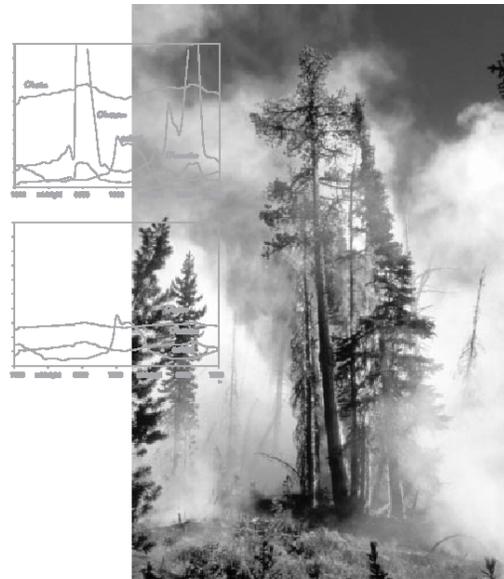
NEXUS 2.0 documentation

USDA United States Department of Agriculture
Forest Service
Rocky Mountain Research Station
Research Paper RMRS-RP-29
September 2001



Assessing Crown Fire Potential by Linking Models of Surface and Crown Fire Behavior

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Search | Print
help
guide

NEXUS 2.0 Help

Welcome to the online help document for NEXUS 2.0. The help file consists of four sections:

- [Reference Guide](#) -- contains information about the **structure and organization** of NEXUS 2.0, plus detailed information about each of the inputs and outputs.
- [User Guide](#) -- contains information about the **operation** of NEXUS 2.0, including instructions on how to build, save and interpret a crown fire hazard assessment simulation
- [Tutorials](#) -- contains step-by-step **tutorials and workshops** for teaching yourself to operate NEXUS 2.0.
- [About NEXUS](#) -- contains **nuts and bolts** information regarding NEXUS 2.0: funding, version, references, authorship, contact, etc.

Using NEXUS 2.0 help

A good way to learn NEXUS 2.0 and the modelling it relies upon is to begin with the [Reference Guide](#) and work down through each section. Use the Contents tab in the navigation pane at left to quickly go to the section and topic you need, or use the Index and Search tabs to look up a specific piece of information. The Index tab contains a list of keywords we have linked to one or more topics. Use the Search tab to search the text of the entire help file (not just keywords or topic titles) for the words you are looking for; a list of topics meeting your search criteria is displayed -- the topics at the top are usually the most relevant.

Use the "back" and "forward" buttons at the top of the help file to scroll back and forth between topics you have visited, just as you would in a web browser.

Finally, before using NEXUS 2.0, each user should read the license agreement and [warranty](#). Be sure to check for updates online at the NEXUS home page at www.fire.org/nexus.

Models and concepts

- Surface and crown fire models
- Transition models
- Crown fraction burned
- Crown fire hazard indices
- Hysteresis
- Interpretation and sensitivity

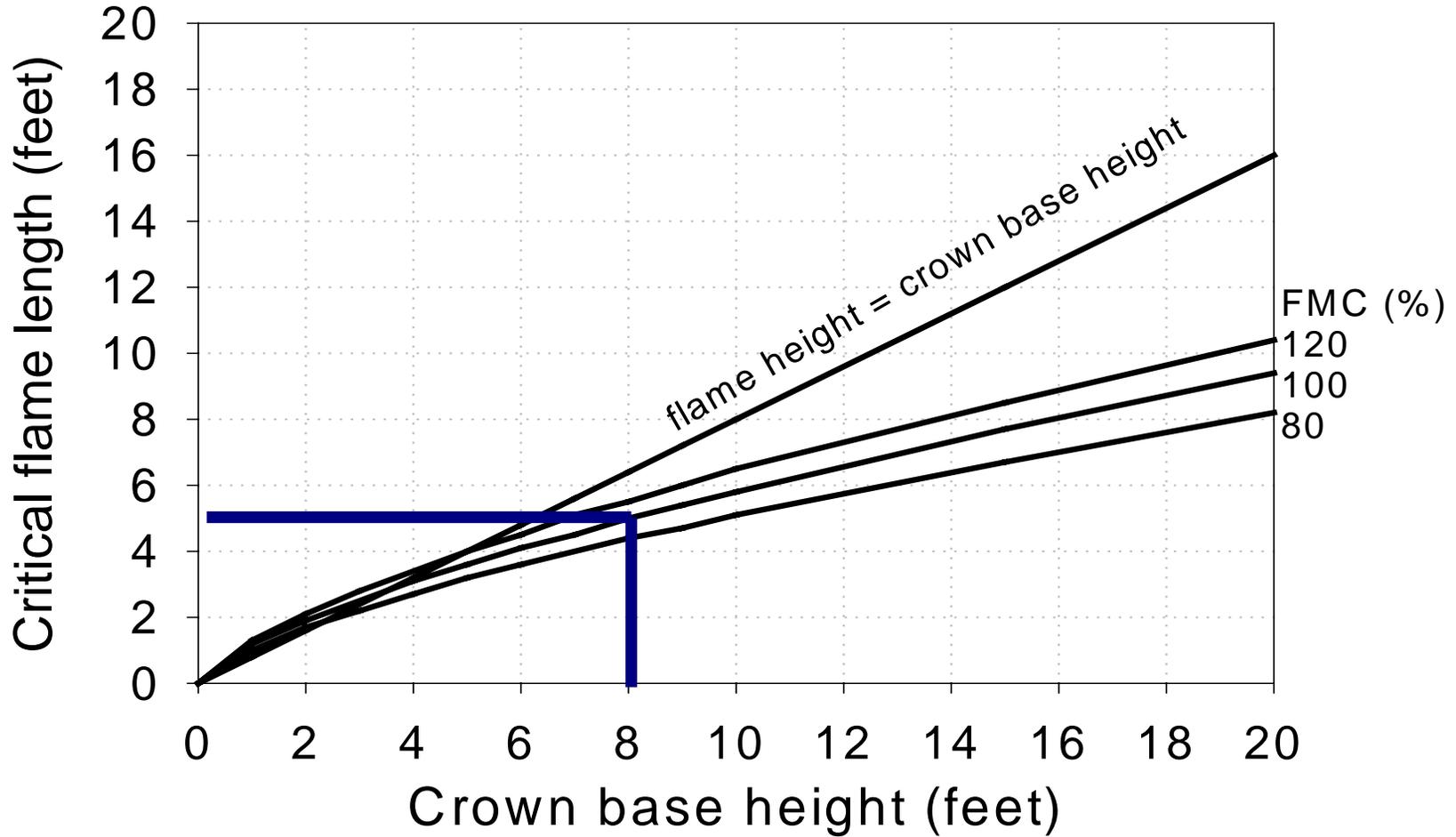
Surface fire model

- Rothermel's (1972) spread model
 - Fuel model (load, particle size, bulk density, extinction moisture)
 - Fuel moisture
 - Slope steepness
 - Wind speed and direction

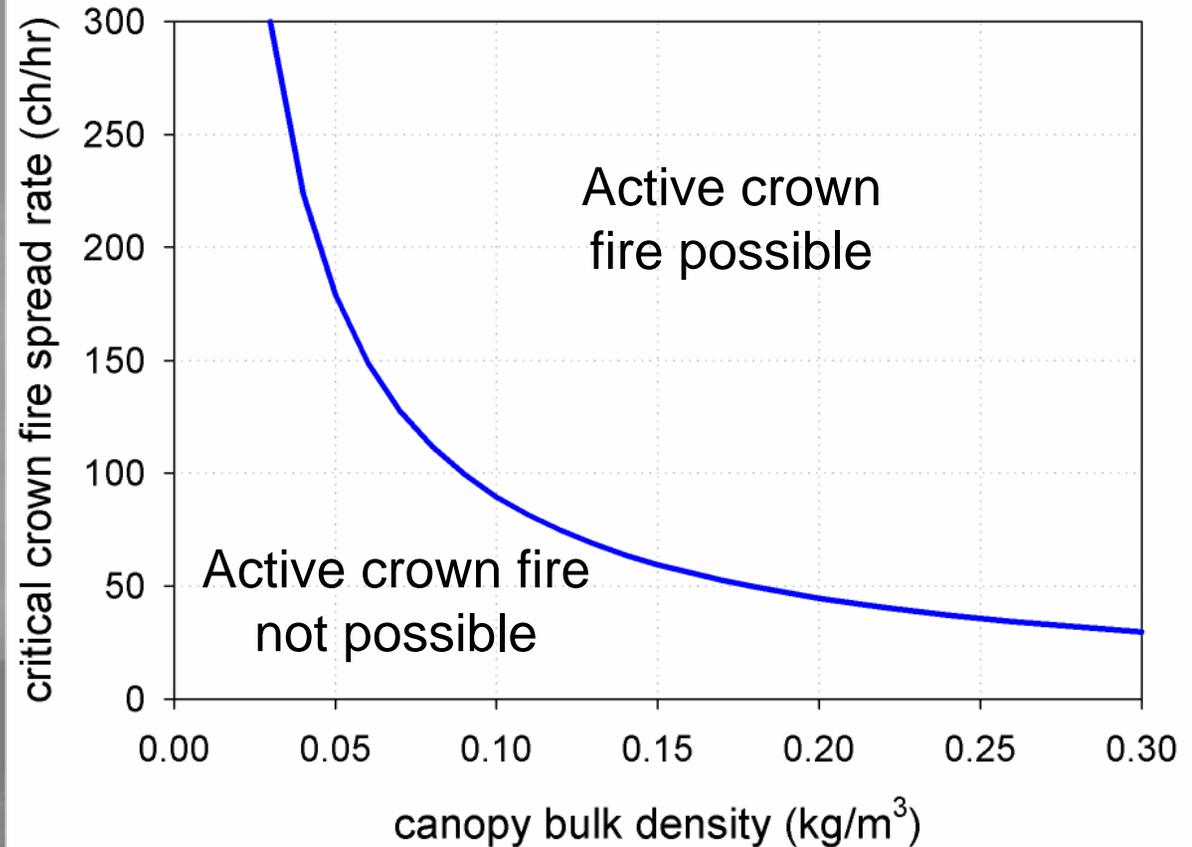
Crown fire model

- Rothermel's (1991) correlation of observed and predicted wildfires
- Primarily a function of windspeed, not a function of canopy characteristics
- $3.34 \times ROS_{10}(0.4)$
 - $ROS_{10}(0.4)$ = spread rate with surface fire model using fuel model 10 and wind adjustment factor of 0.4

Critical Flame Length for crown fire initiation



Transition models: sustained



Crown fire potential

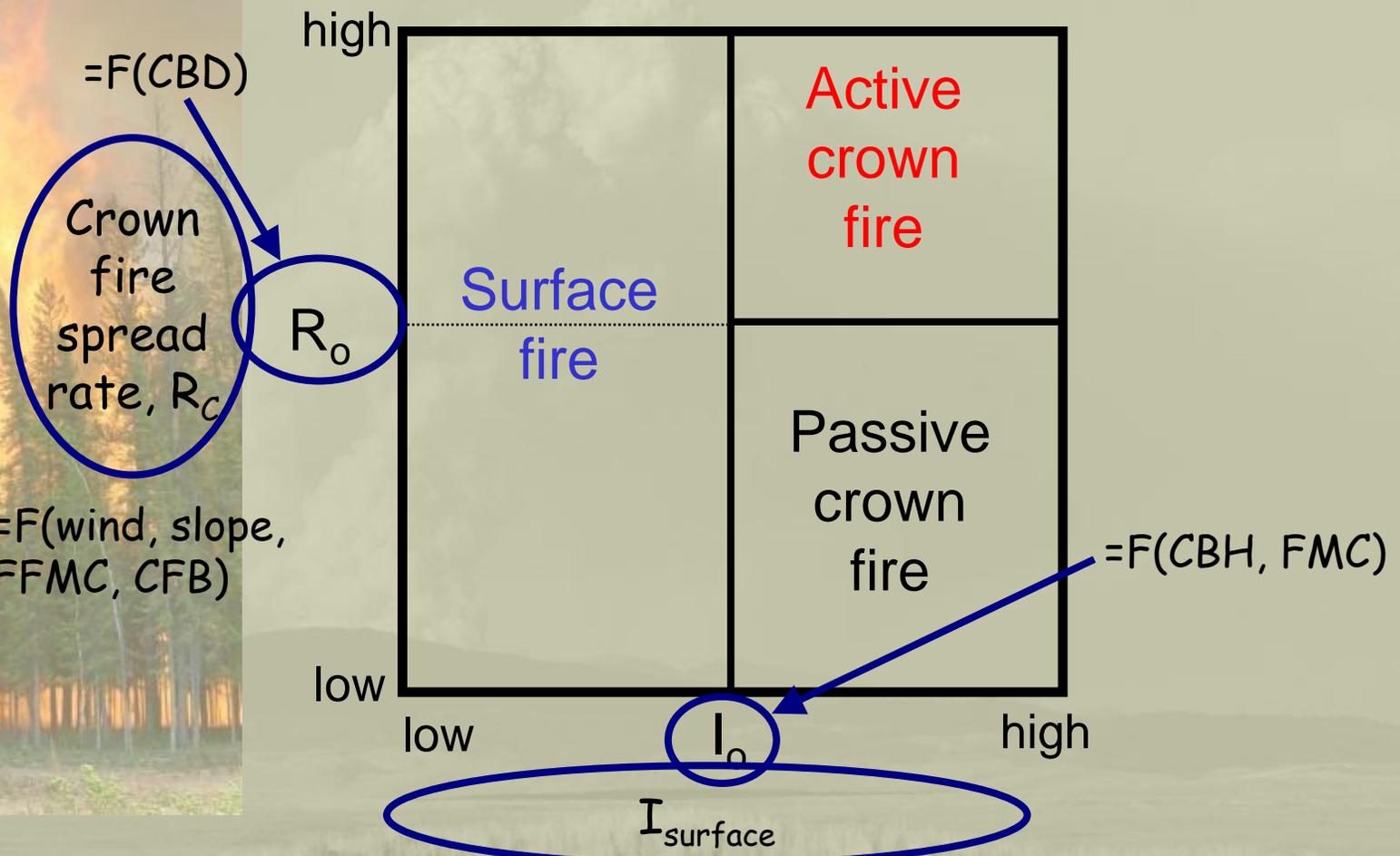
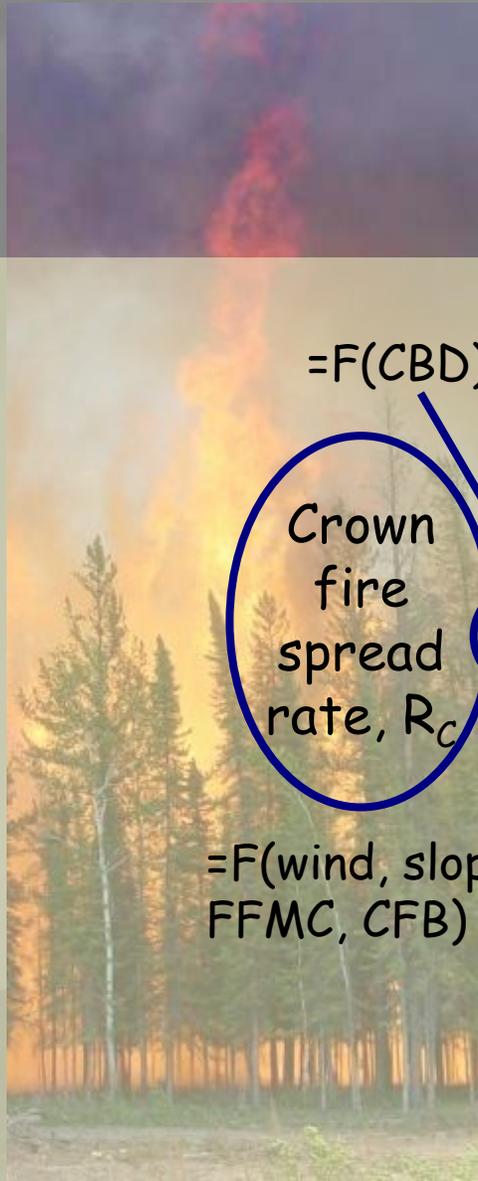
Torching Index

- 20-ft windspeed at which predicted surface fire spread rate (or FL or intensity) equals the critical needed for initiation

Crowning Index

- 20-ft windspeed at which predicted crown fire spread rate equals the minimum needed for sustained crown fire spread

Crown fire classification



$=F(\text{surface fuels, weather, topography, spread direction})$

Putting it together

- Black Mountain II fire (2003)
- Documented by AMSET (Fites-Kauffman and others (in prep))
- Observed surface and canopy fuel characteristics and fire behavior in adjacent dense and open stands

Black Mtn II

- Open site (PP/DF)



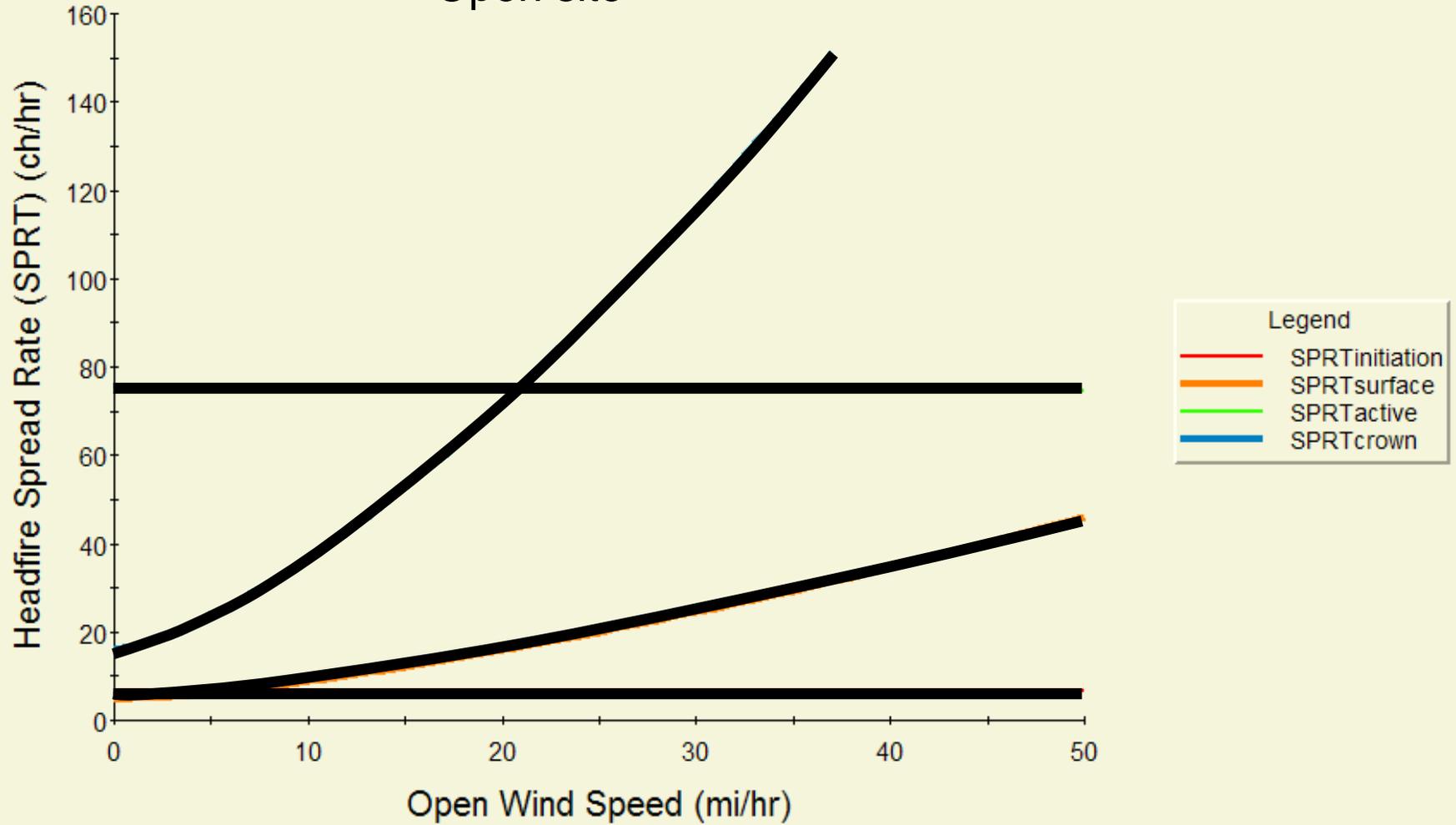
- Dense site (DF)



Photos and data provided by AMSET
NEXUS 2.0

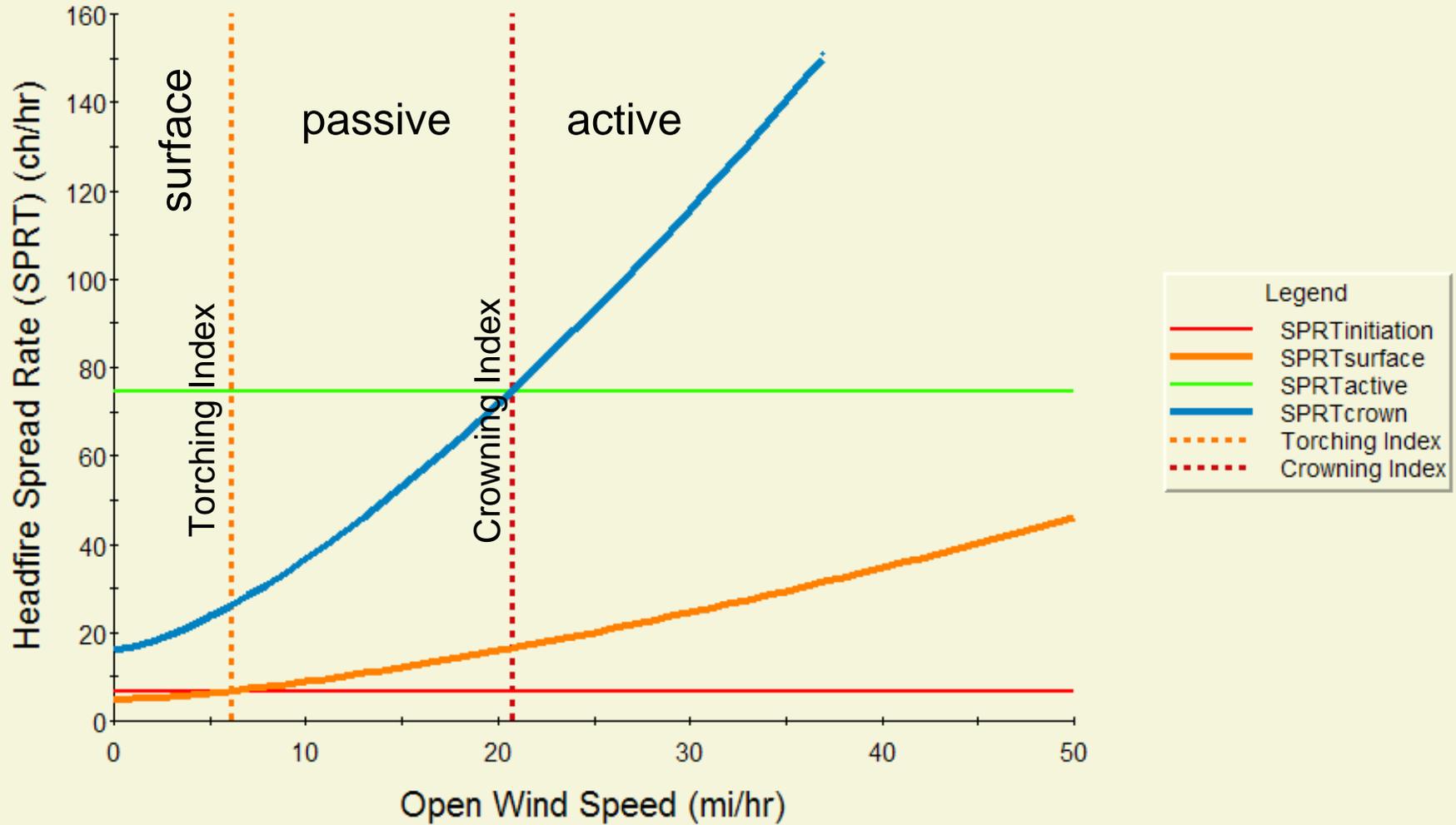
Crown Fire Hazard Assessment Chart

Open site



Crown Fire Hazard Assessment Chart

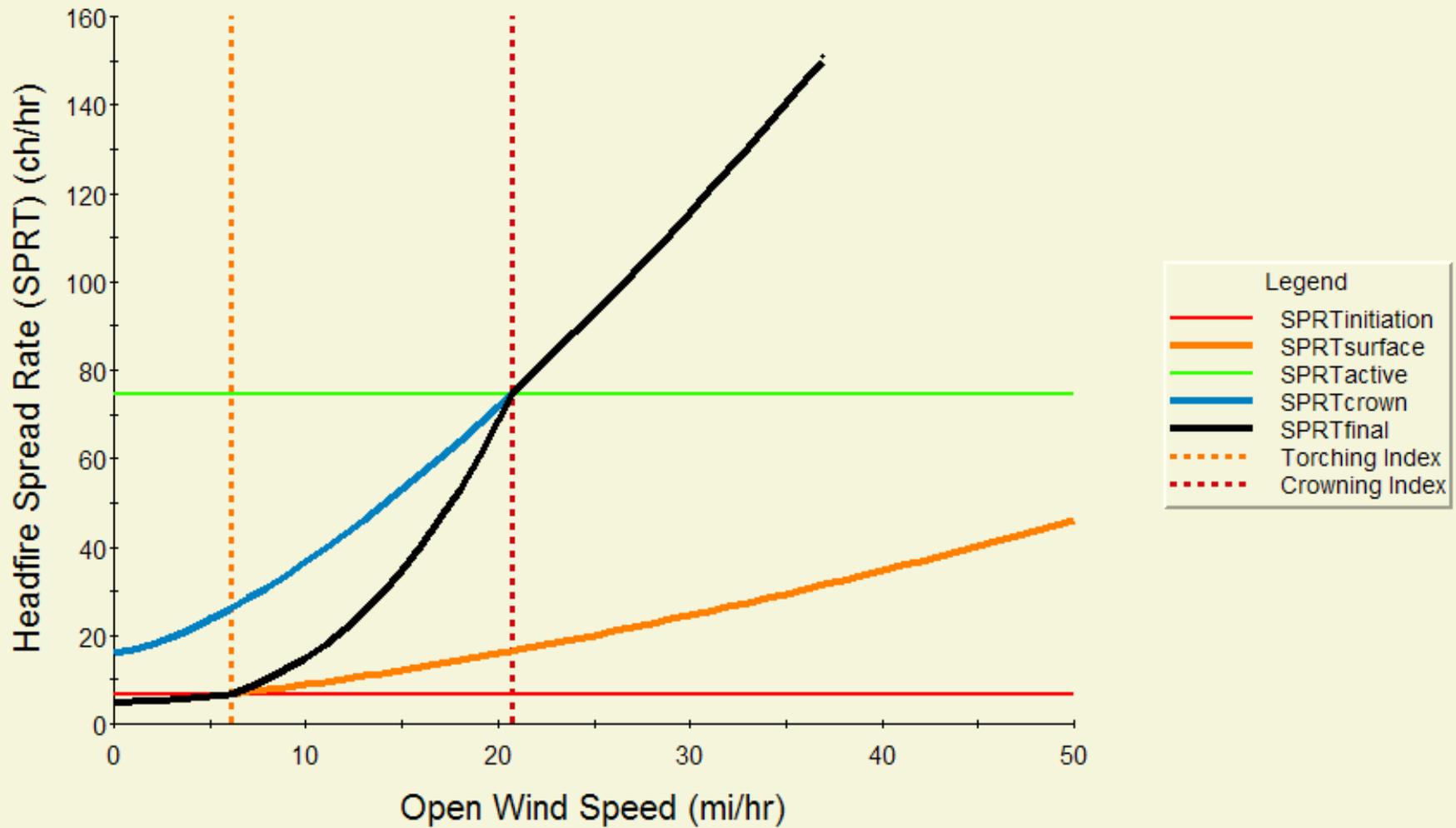
Open site



Final spread rate

- $R_{\text{final}} = R_{\text{surface}} + \text{CFB}(R_{\text{active}} - R_{\text{surface}})$
- where CFB (crown fraction burned)
 - transition function
 - scaled 0-1
 - CFB = 0 if surface fire
 - CFB = 1 if active crown fire

Crown Fire Hazard Assessment Chart

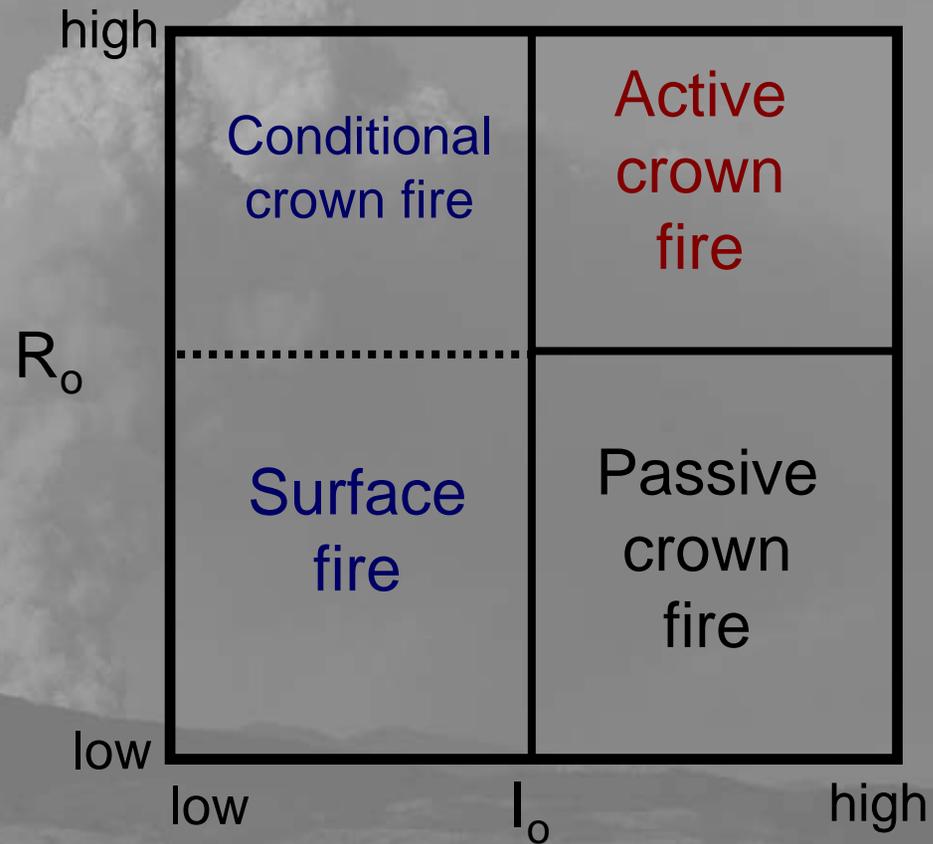


Hysteresis

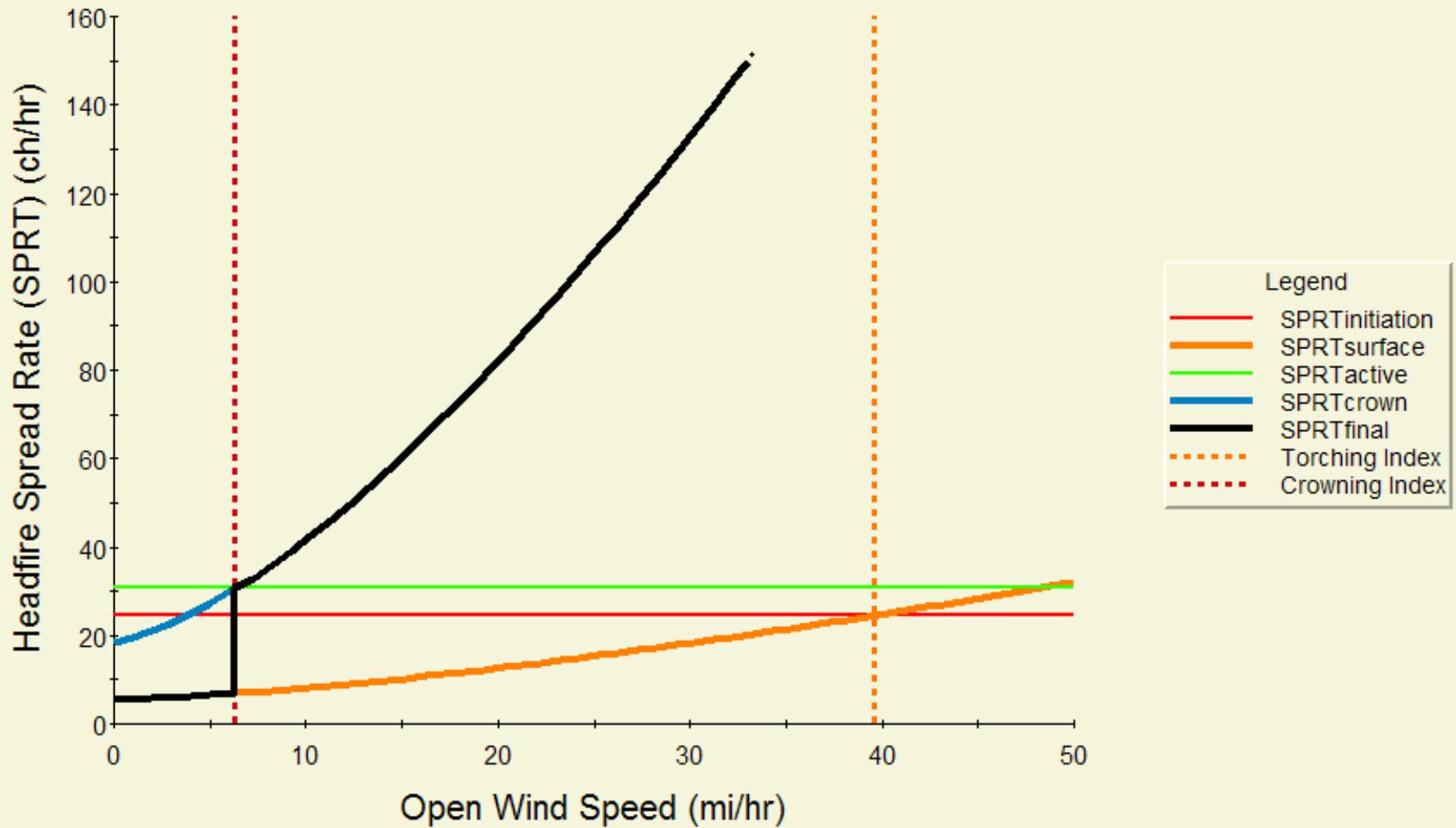
- The failure of a property that has been changed by an external agent to return to its original value when the cause of the change is removed.
- In crown fire, it is the persistence of active crowning after the fire environment has changed such that crown fire could not initiate.



Hysteresis



Crown Fire Hazard Assessment Chart





NEXUS 2.0

Hysteresis

- Conditions for cessation not necessarily the same as for initiation; that has been an assumption.
- Stands not prone to initiation are not necessarily safe from active crown fire.
- Transition to active crown fire can occur as an abrupt change with no period of passive crowning to act as a warning.
- Hysteresis allows a fire to take advantage of fire environment variability by initiating crown fire when conditions are favorable, yet continue active spread through the lulls.
- Hysteresis is not proven to exist; we should consider its possibility until further investigations can be carried out.

Output Interpretation

- Interpreting NEXUS output requires looking at both TI and CI
- Very high TI and CI indicates very low hazard
- Conditional crown fires can be either surface fires or active crown fires
- Small changes in TI or CI can be significant changes in crown fire potential

Questions?