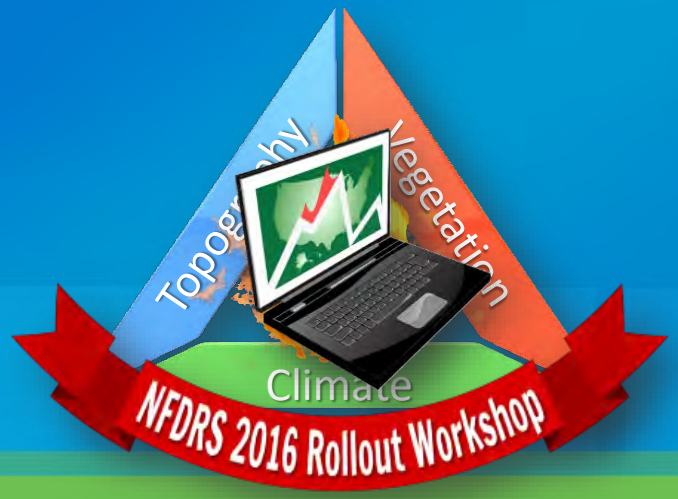
NFDRS2016: New Dead Fuel Moisture Model

Lesson #4 (Part 2)



NFDRS 2016 Rollout Workshop

Presentation Options

Slides

Video

New Dead Fuel Moisture Model

Nelson Model Modifications

New dead fuel moisture model

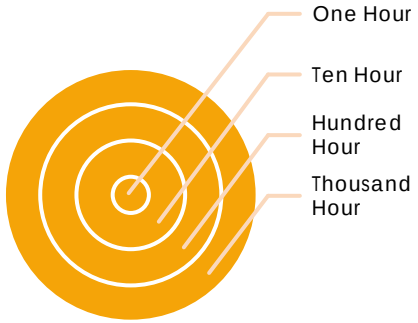
New Dead Fuel Moisture Model

- The previous version of NFDRS required direct user input of State-of-the-Weather (SOW) and changing R to O in WIMS to calculate fine dead fuel moisture before any indices are produced.
- It also required a separate model for calculating 1/10 hr and 100/1000hr dead fuel moistures.
- The old 1hr – 1000hr fuel moistures models will be replaced by the scalable Nelson Dead Fuel Moisture Model

New Fine Dead Fuel Moisture Model **Nelson**

- Nelson Model:
  - More accurately models diurnal and seasonal dead fuel moisture using hourly fire weather observations
  - Requires no daily human intervention (I.E. No state-of-the-weather)
  - Has been running in a prototype mode in operational WIMS since December, 2011 and has been part of fire behavior prediction tools (FARSITE, FlamMap) for over a decade

Nelson Dead Fuel Moisture Model



- Calculated HOURLY
- Nelson has 4 weather inputs:
  - Temperature
  - Relative Humidity
  - Solar Radiation
  - Precipitation

- We define an instance of the Nelson model of the four timelag dead fuel classes used in NFDRS:

Time Lag	Stick Radius	
	in	cm
1-hour	0.08	0.20
10-hour	0.25	0.64
100-hour	0.80	2.00
1000-hour	1.50	3.81

Nelson Model Specifics

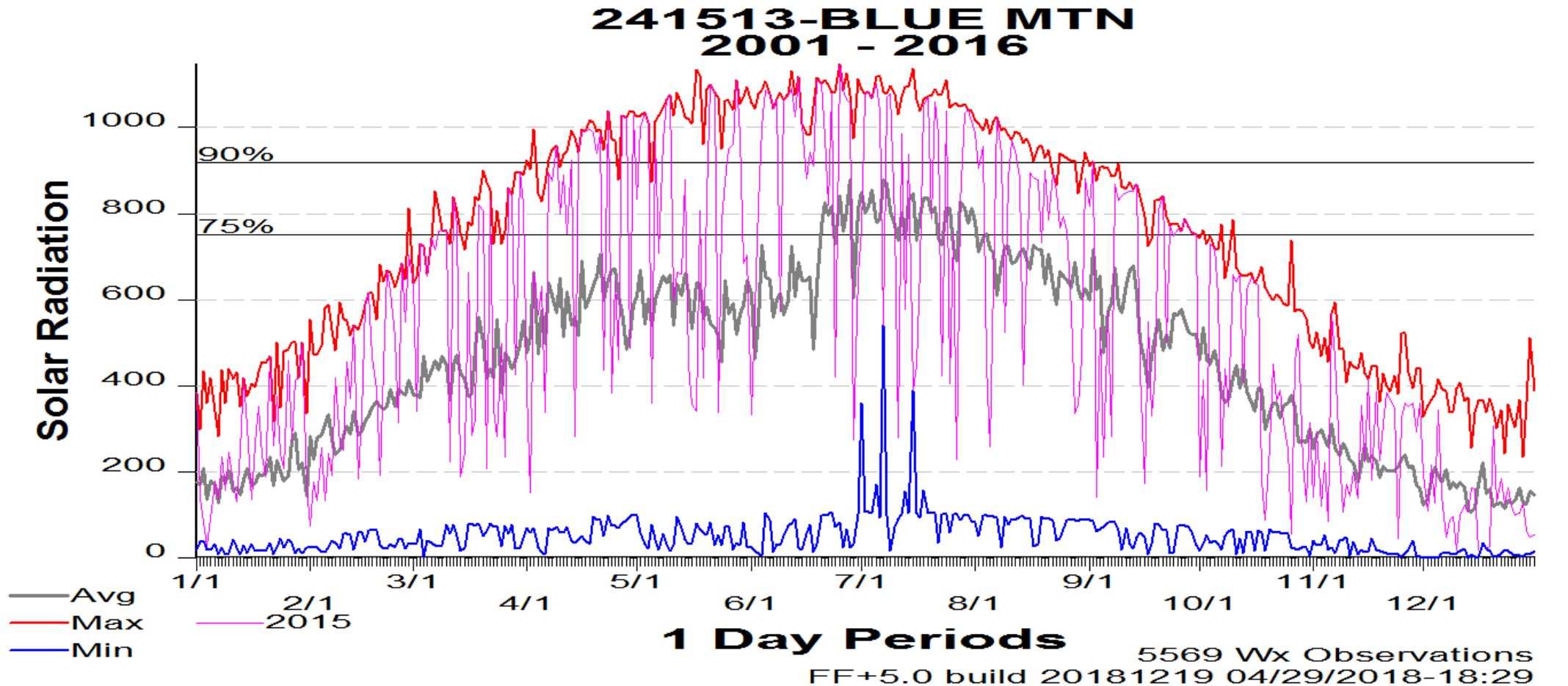
- Accounts for diffusive and capillary water transport between the fuel and the atmosphere
- Derives surface temperature from an energy balance
  - Net input of heat gains and losses
- Accounts for dew formation on fuel surface
- Scalable to any size dead fuel

Fuel Energy Balance

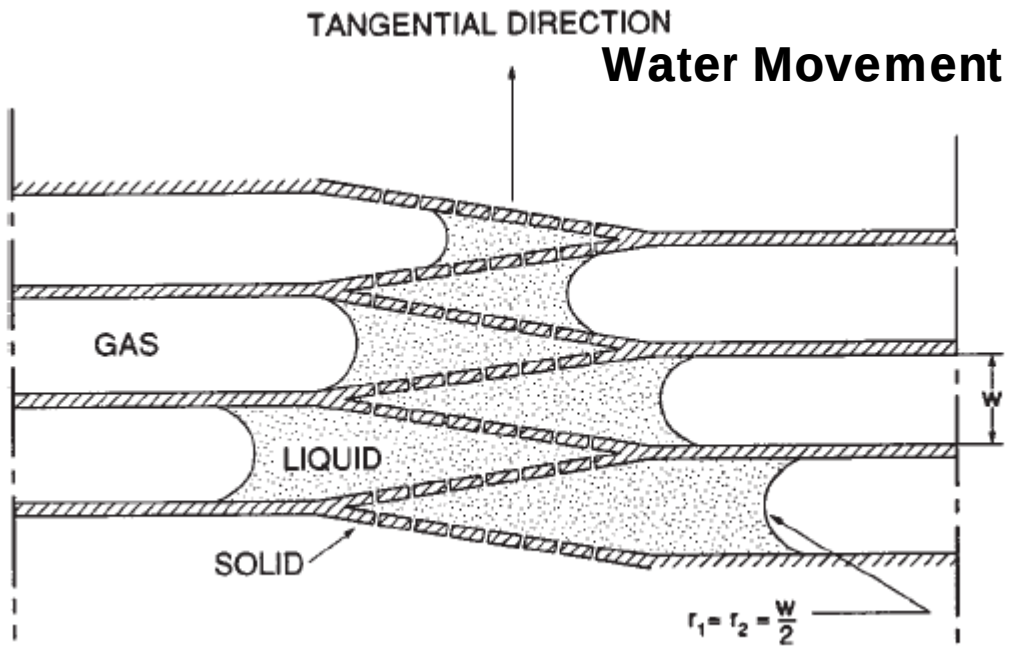
Heat Loss = Heat Gain

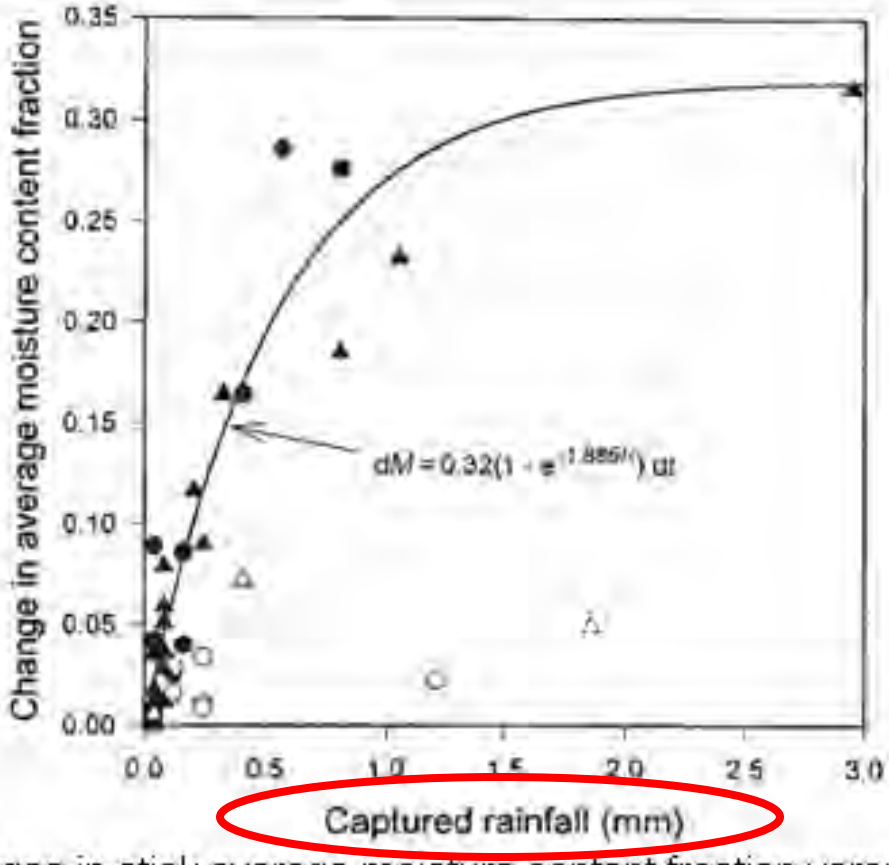
- **Conduction + Longwave Radiation + Evaporation**

  = Solar Heating + Convective Heating

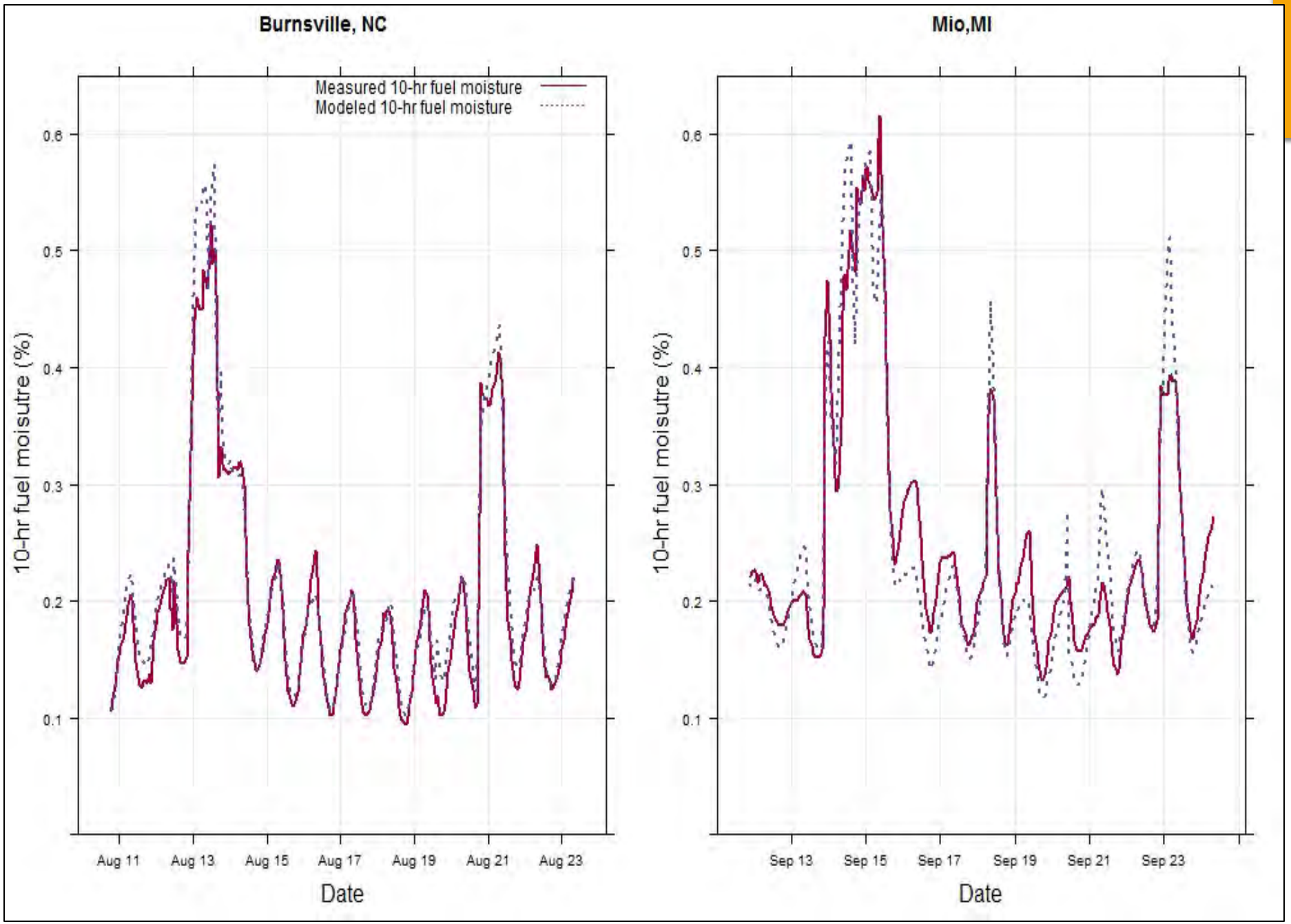

241513-BLUE MTN
2001 - 2016
Solar Radiation
1000
800
600
400
200
0
90%
75%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2015
1 Day Periods
5569 Wx Observations
FF+5.0 build 20181219 04/29/2018-18:29

Capillary water transport in Nelson

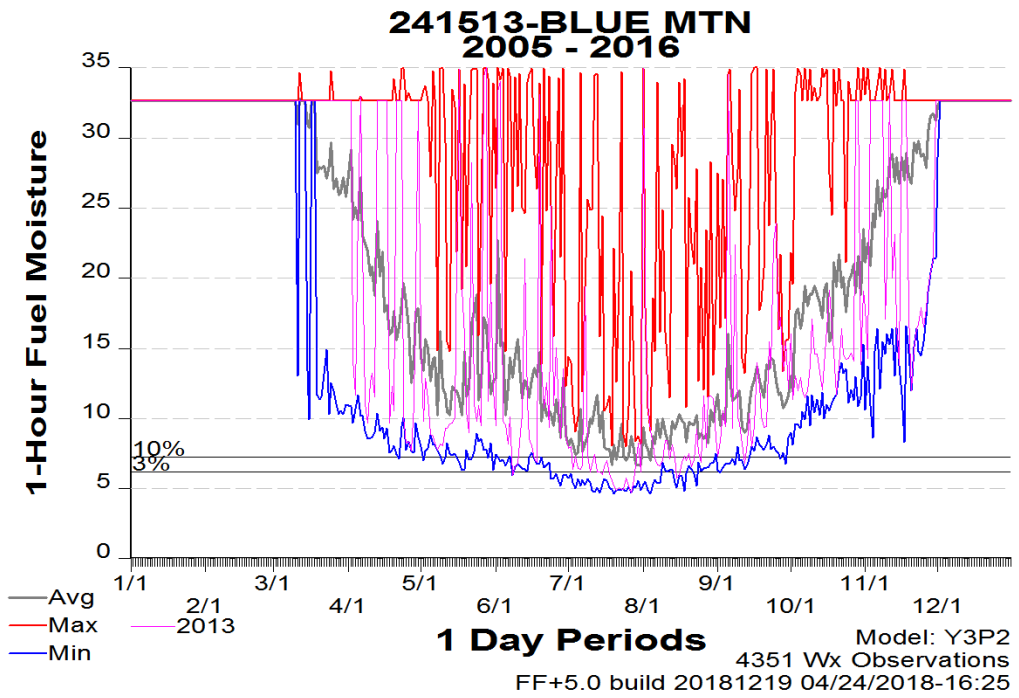


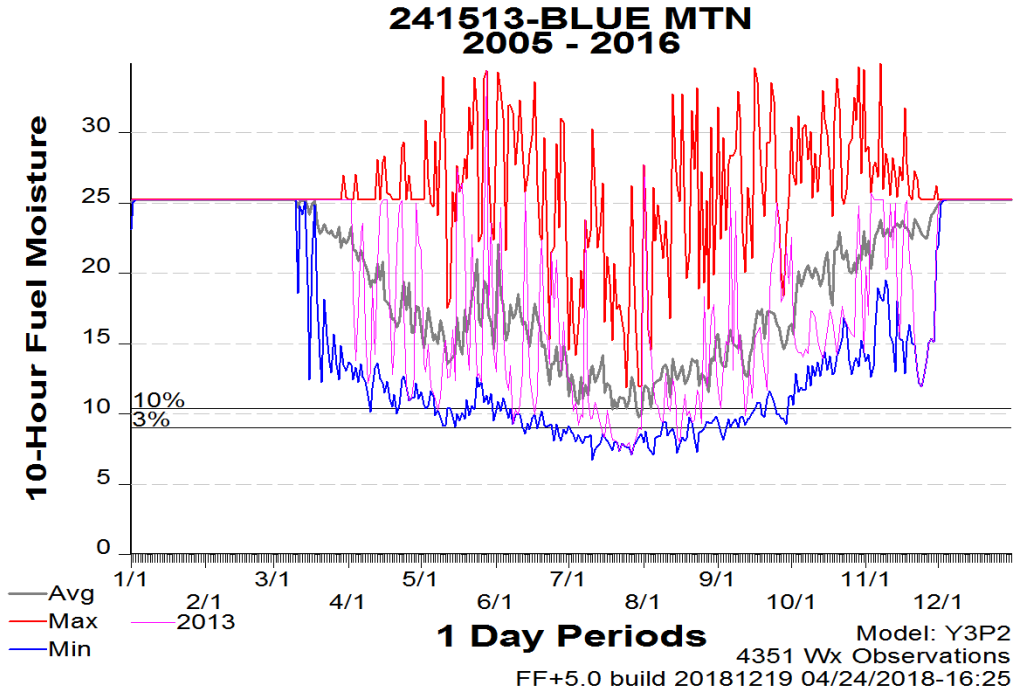


Changes in stick average moisture content fraction versus hourly captured rainfall (dt = 1 h) during field experiments in Burnsville, N.C. (circles), and Mio, Mich. (triangles). Solid symbols initial moisture fraction smaller than 0.4; open symbols, initial fraction greater than 0.4 (from Nelson, 2000).

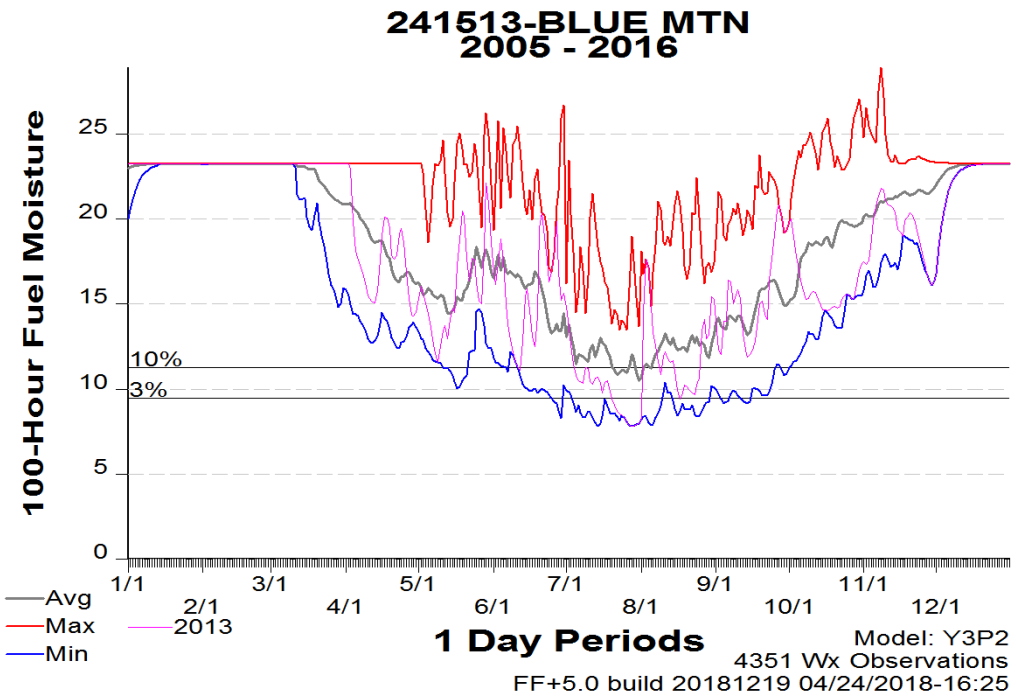

Burnsville, NC
Measured 10-hr fuel moisture
Modeled 10-hr fuel moisture
10-hr fuel moisutre (%)
0.6
0.5
0.4
0.3
0.2
0.1
Aug 11
Aug 13
Aug 15
Aug 17
Aug 19
Aug 21
Aug 23
Date
Mio,MI
10-hr fuel moisutre (%)
0.6
0.5
0.4
0.3
0.2
0.1
Sep 13
Sep 15
Sep 17
Sep 19
Sep 21
Sep 23
Date

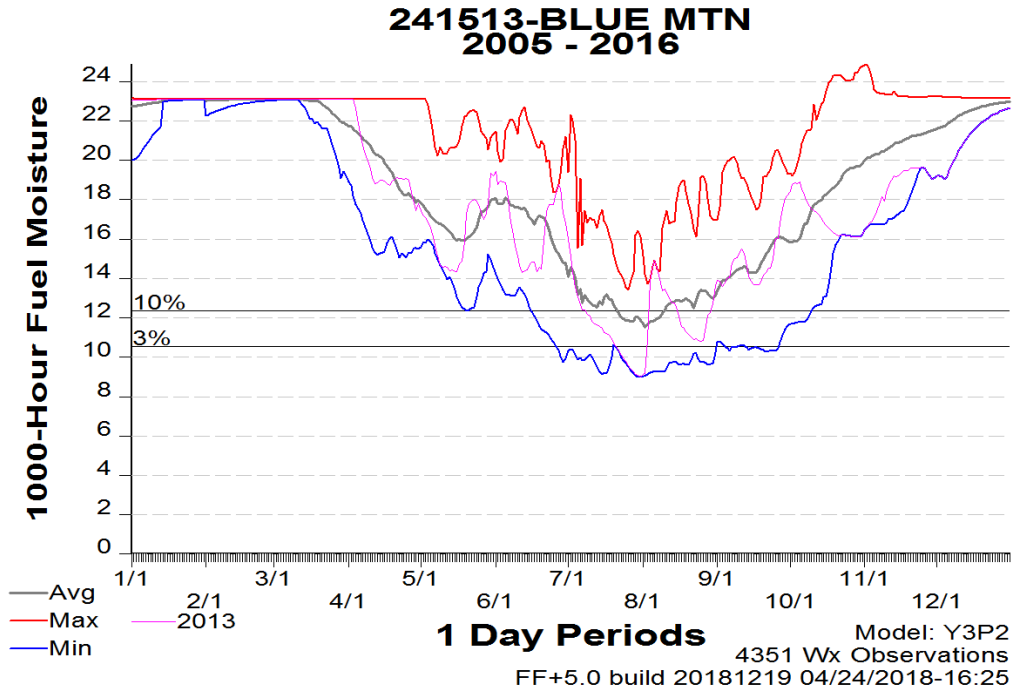
Example Nelson 1hr and 10 hr fuel moistures





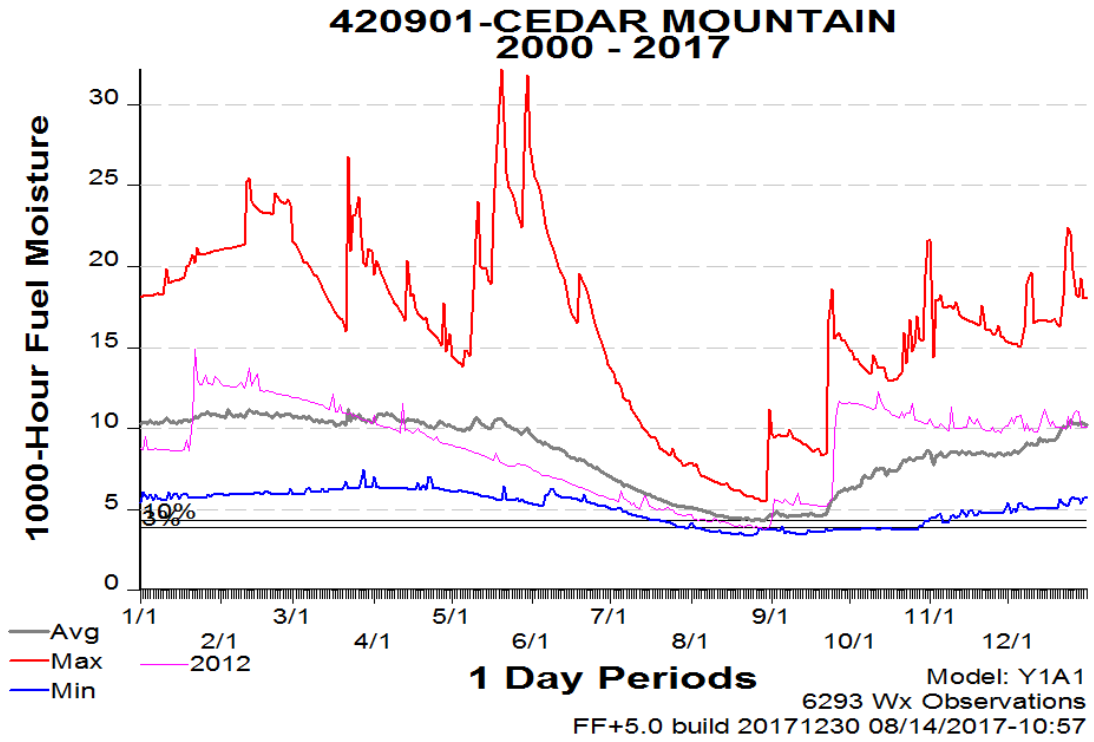
Example Nelson 100hr and 1000hr fuel moistures

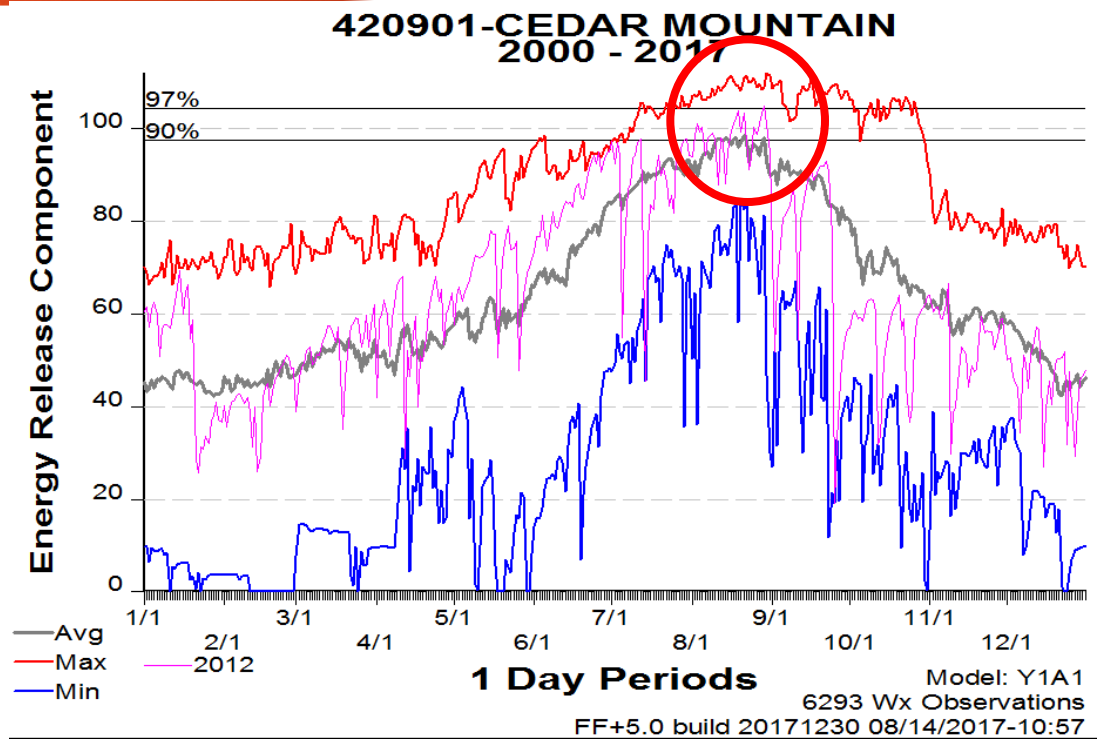




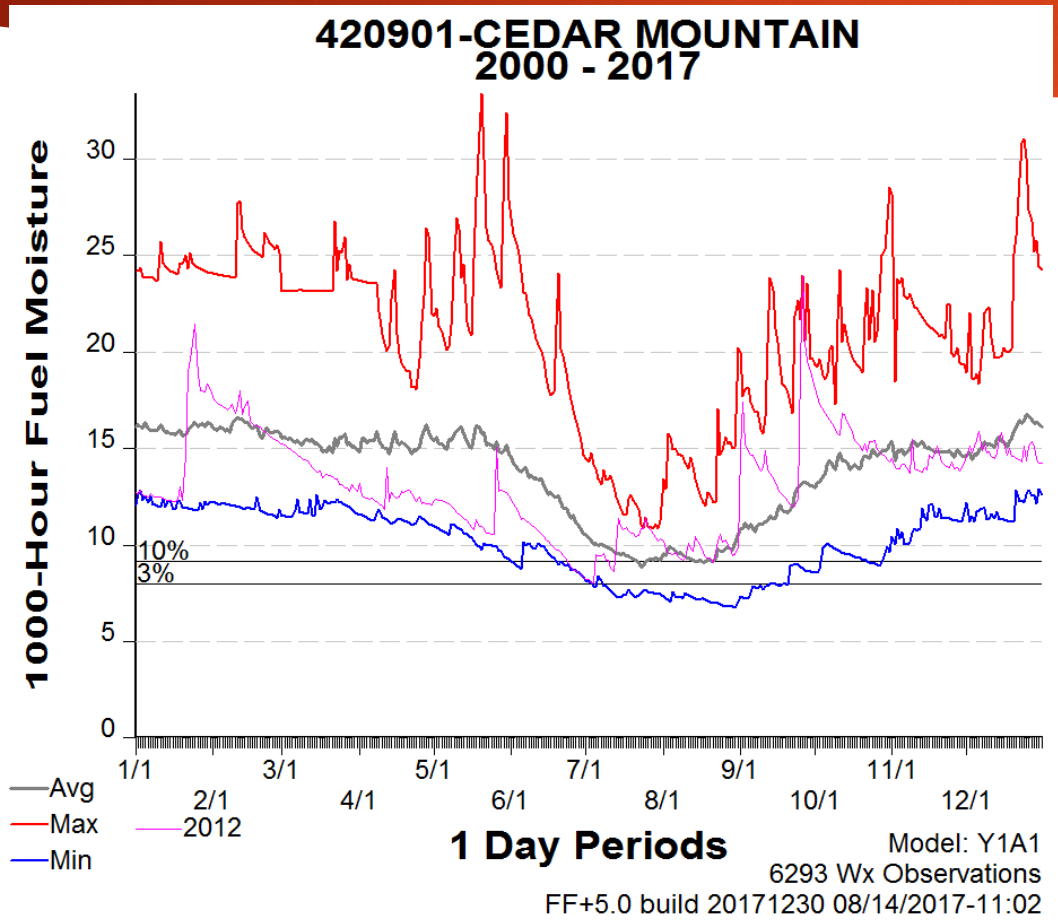
Recent Nelson 1000-hr Model Modifications

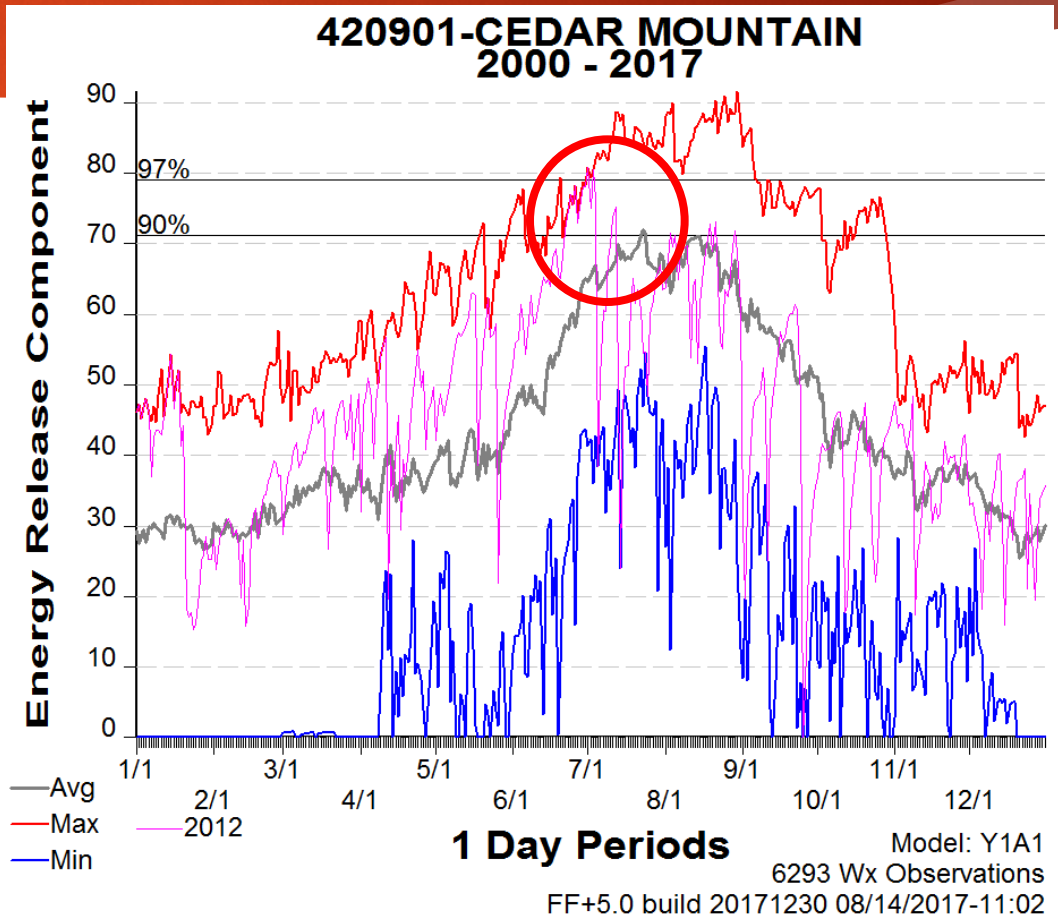
Uncorrected Nelson 1000hr and subsequent ERC



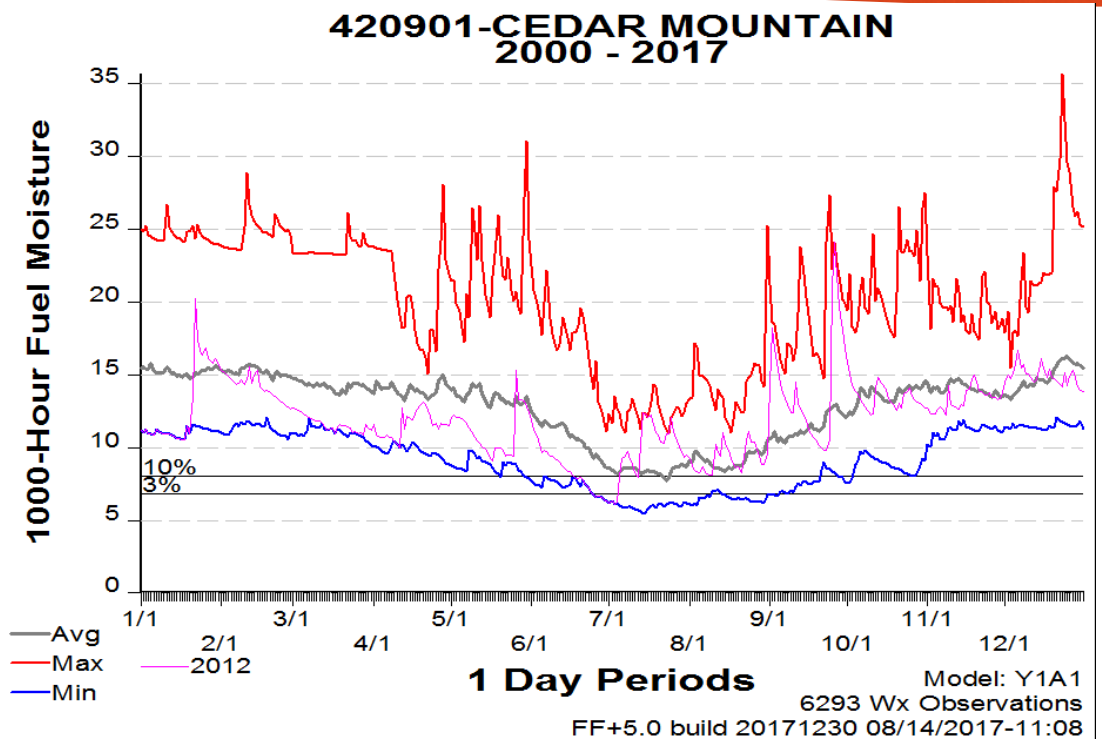


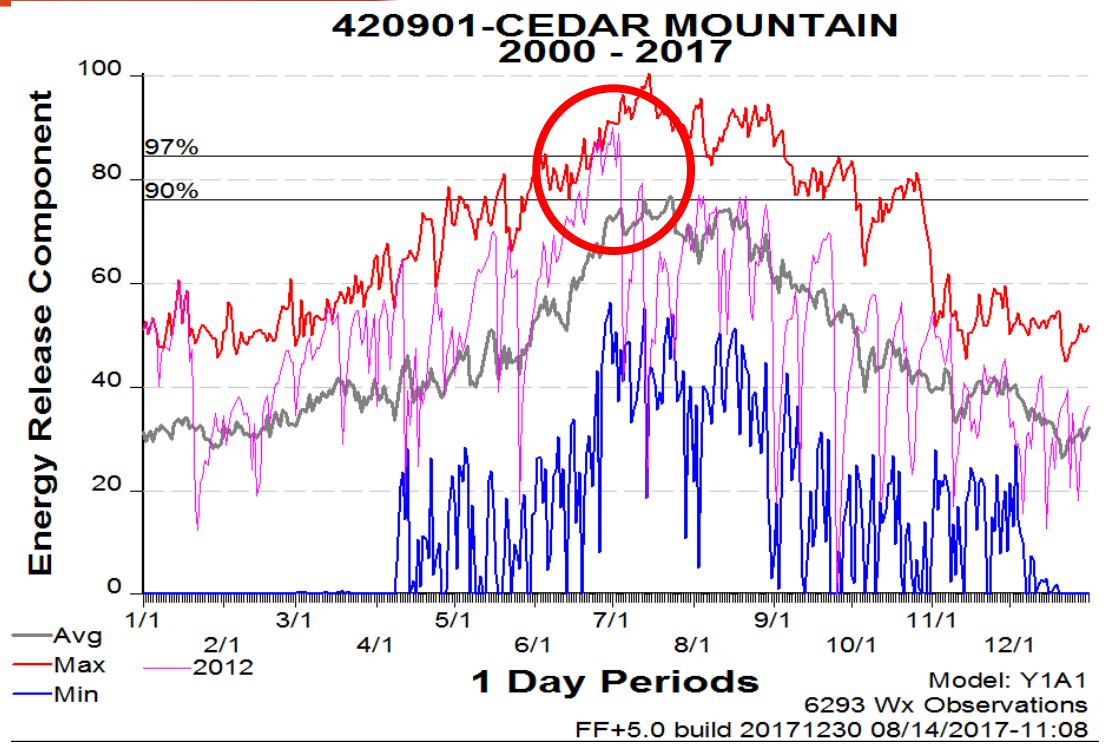
New Minimum Adsorption Rate



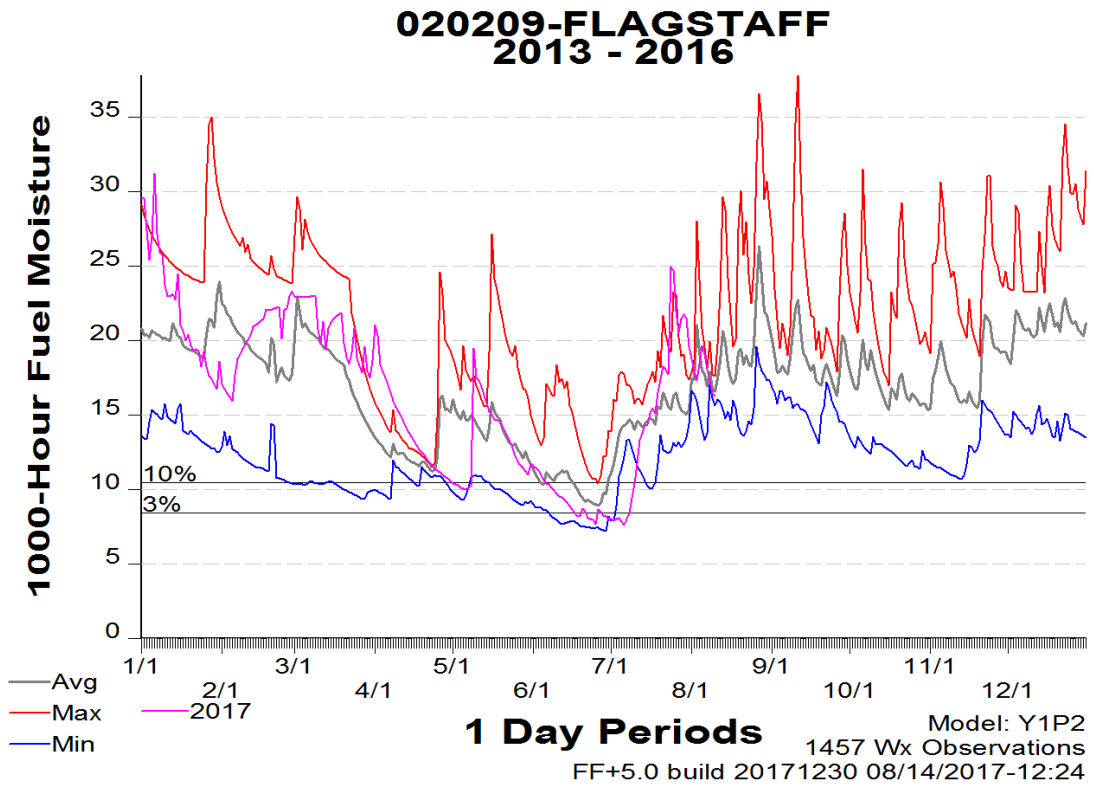


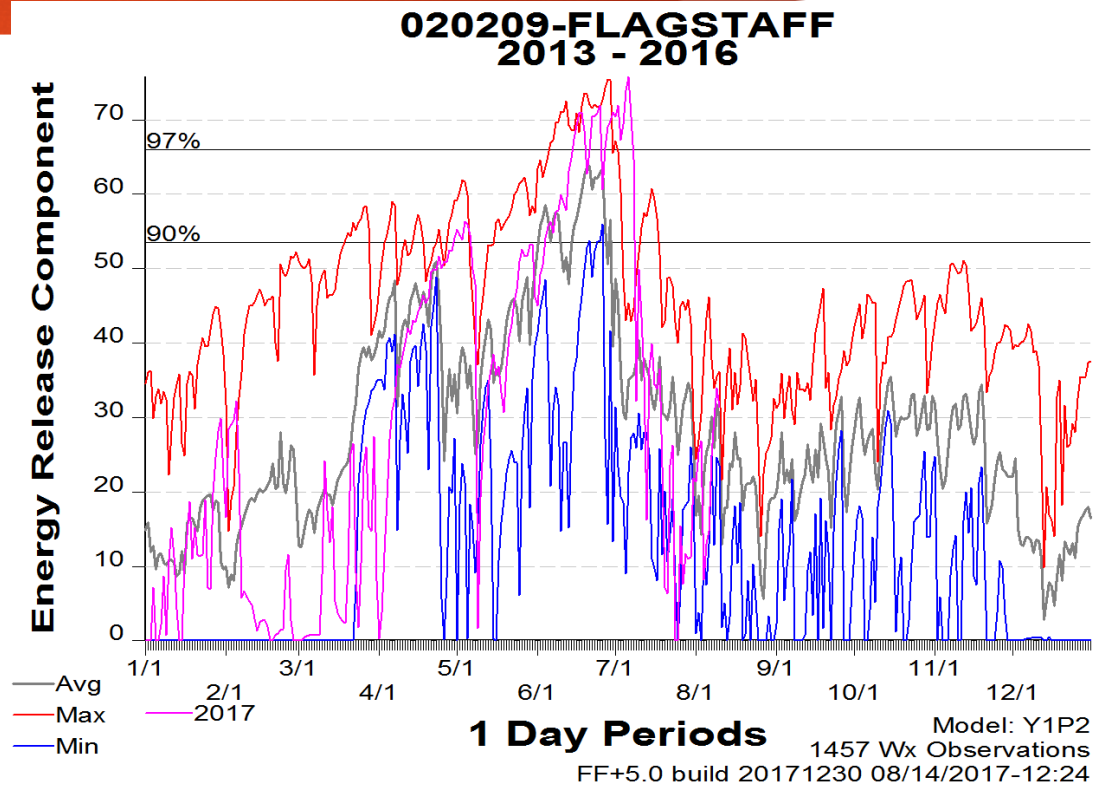
New minimum Adsorption Rate and Realigned fuel stick diameters



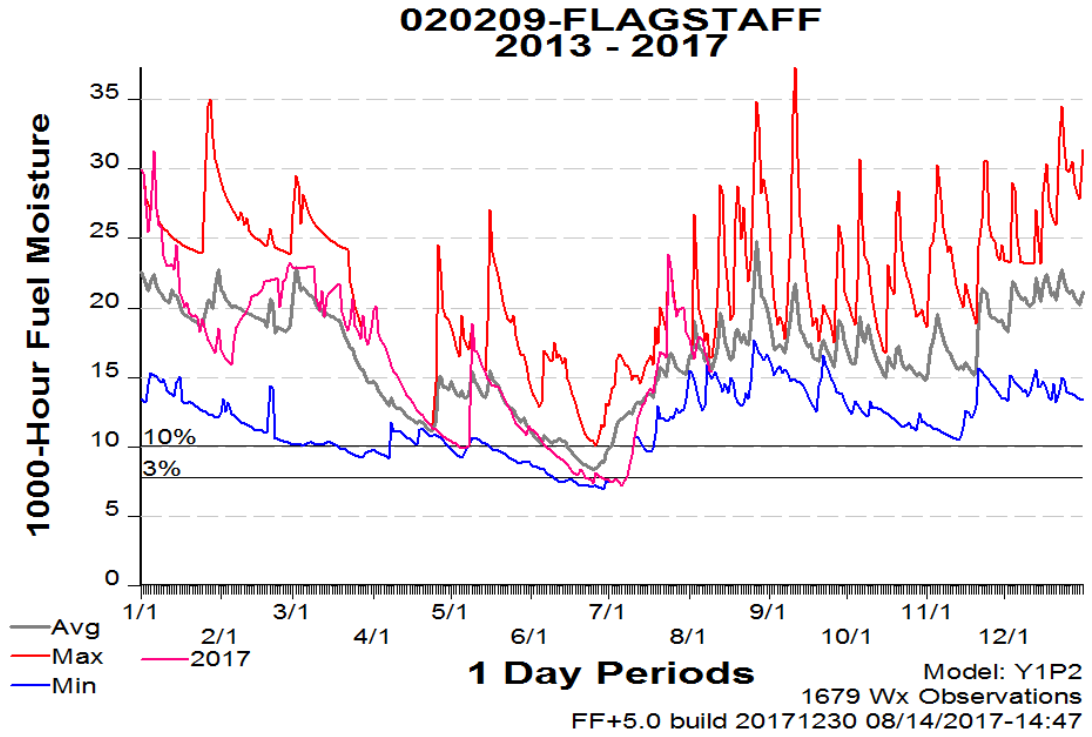


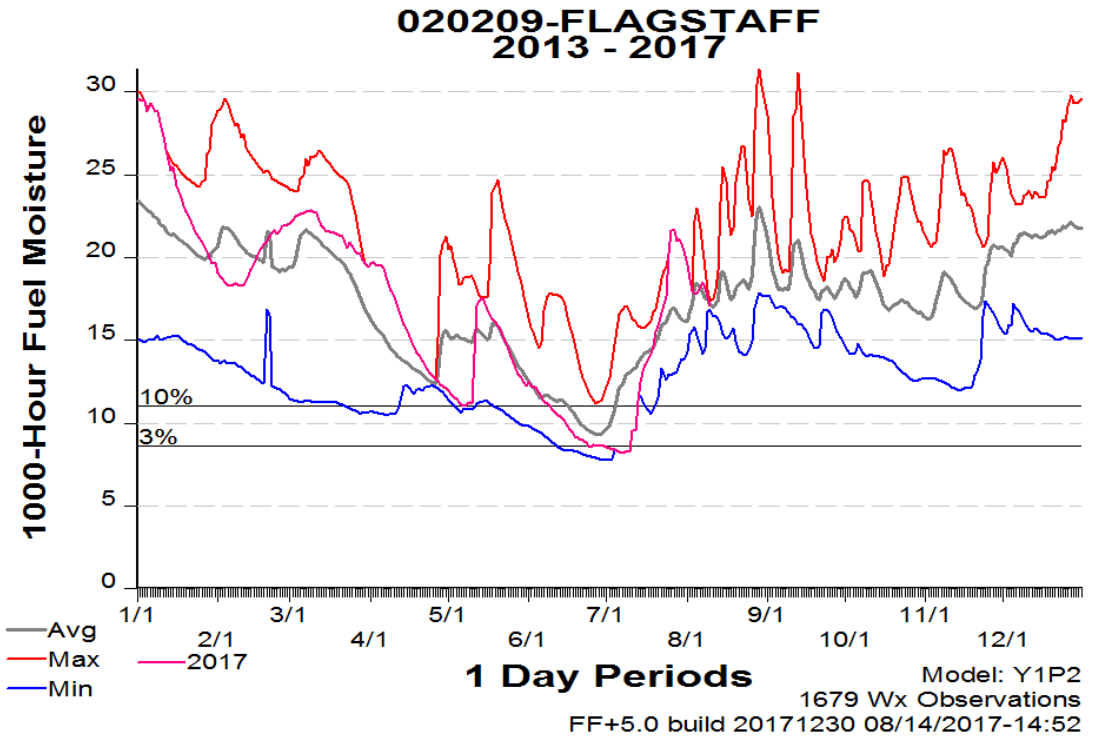
Flagstaff example: New Model with 2017

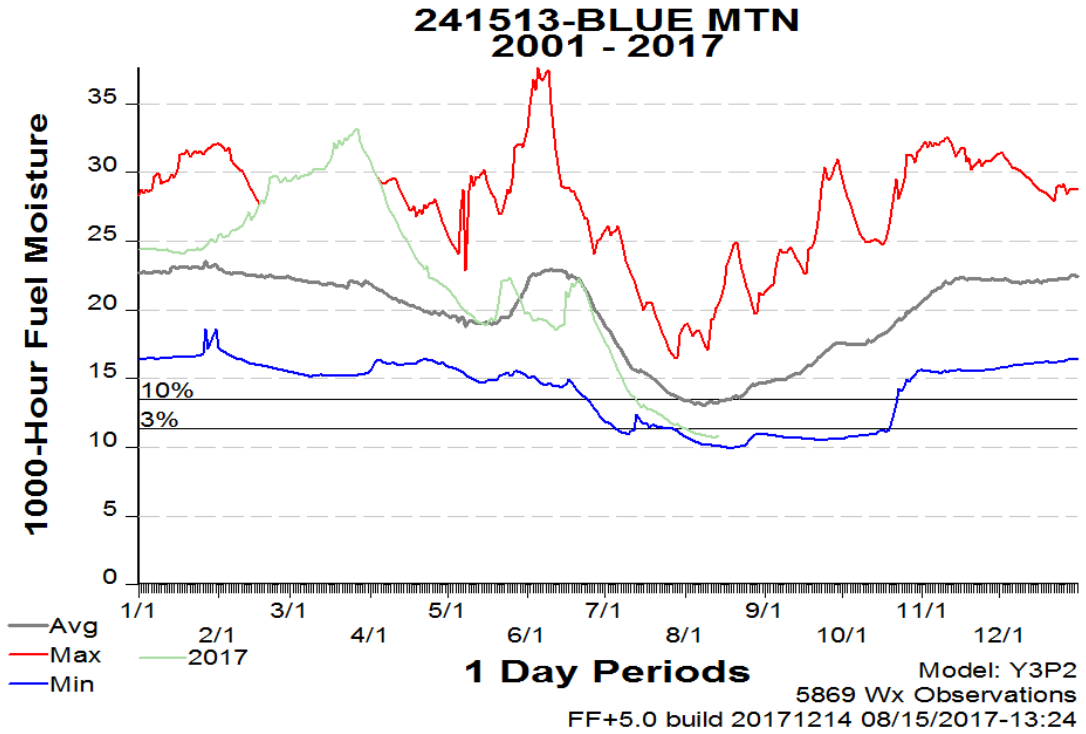


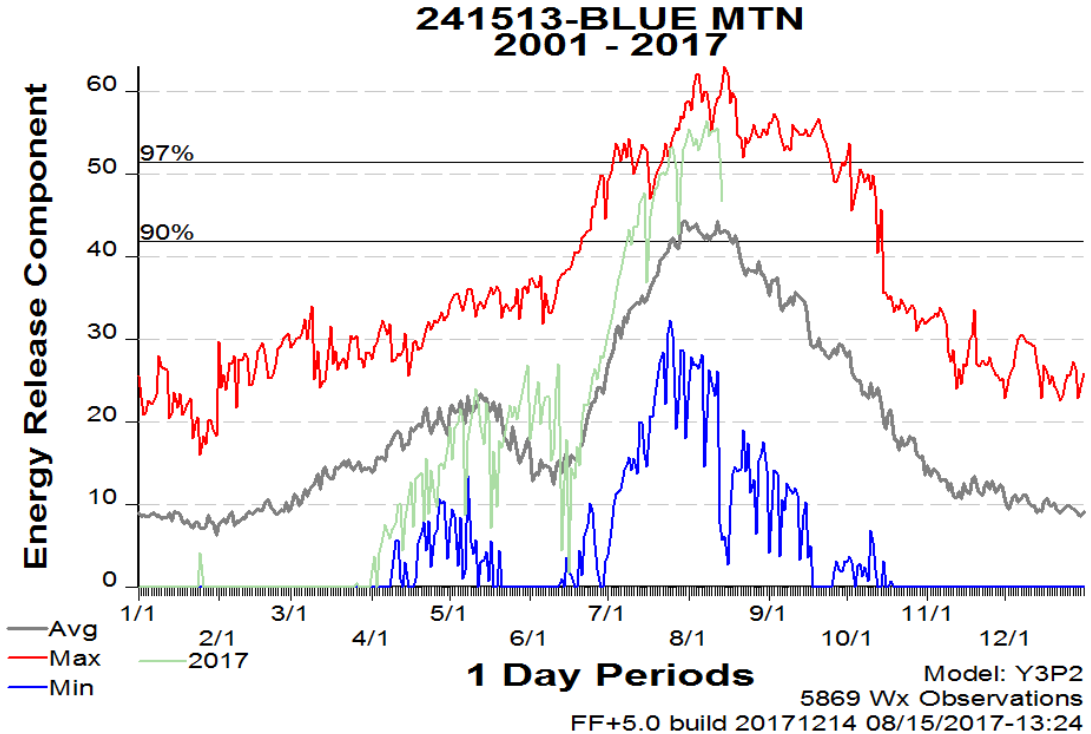


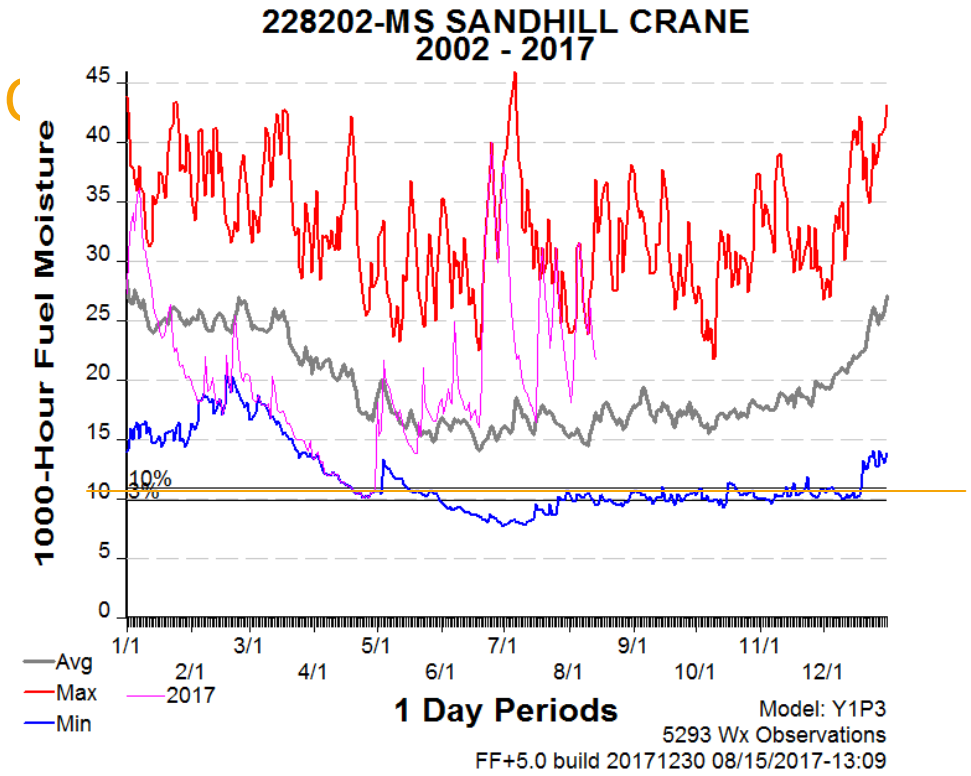
Determining stick moisture from nodes

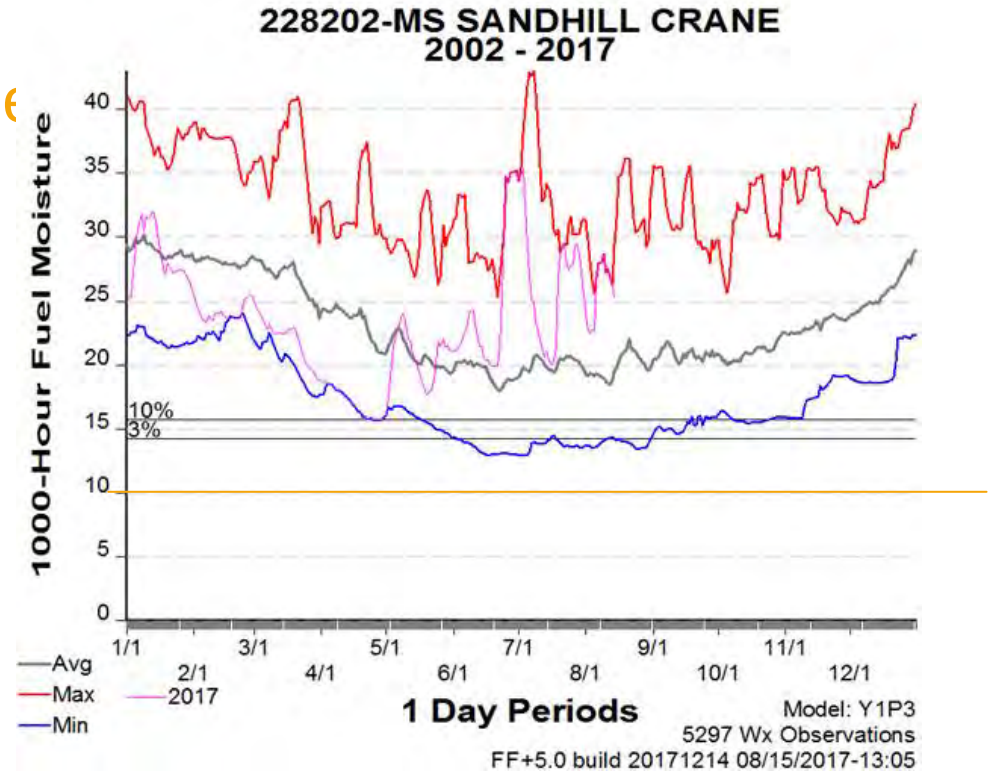


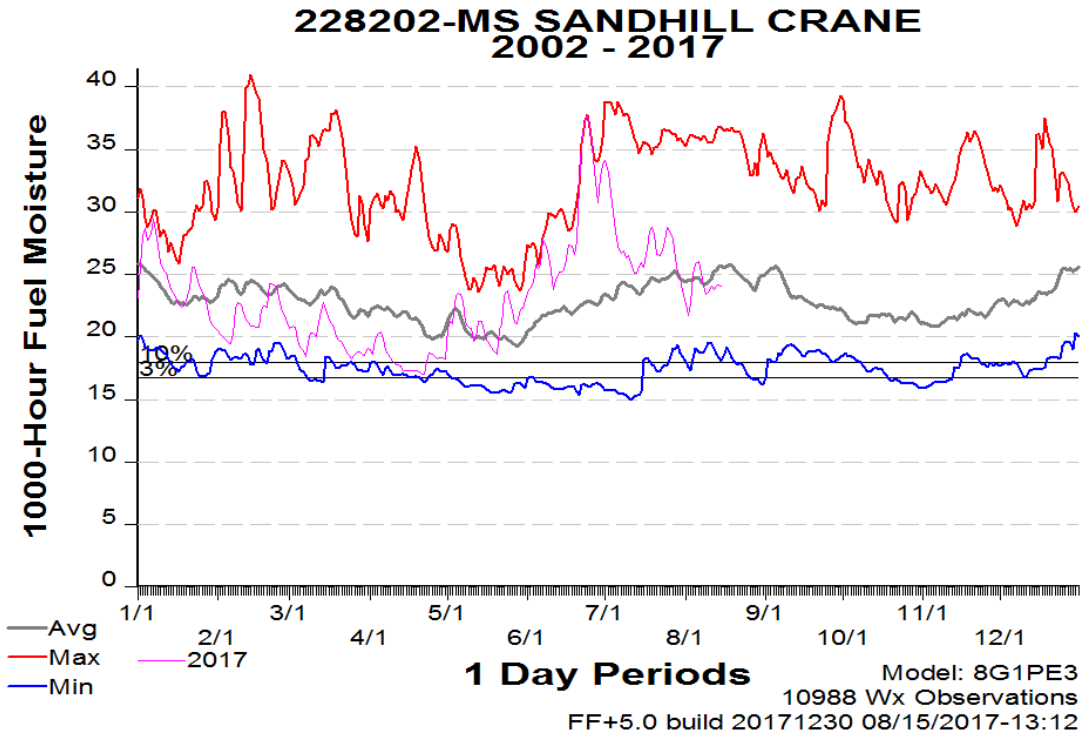


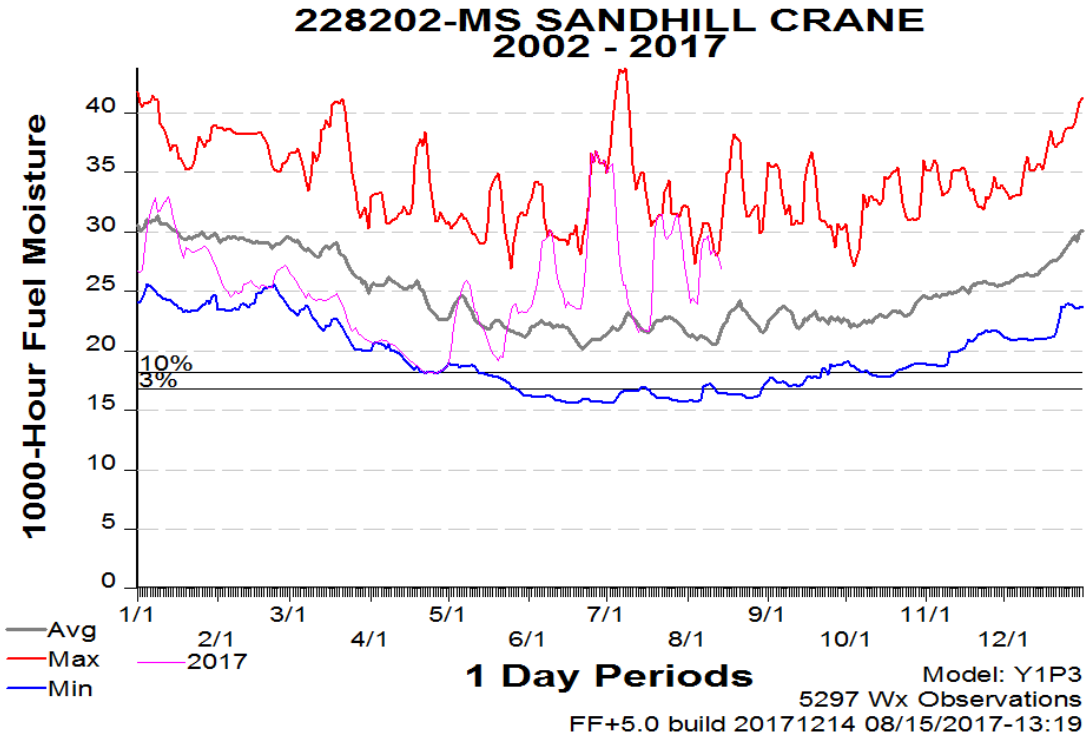

241513-BLUE MTN
2001 - 2017
1000-Hour Fuel Moisture
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y3P2
5869 Wx Observations
FF+5.0 build 20171214 08/15/2017-13:24

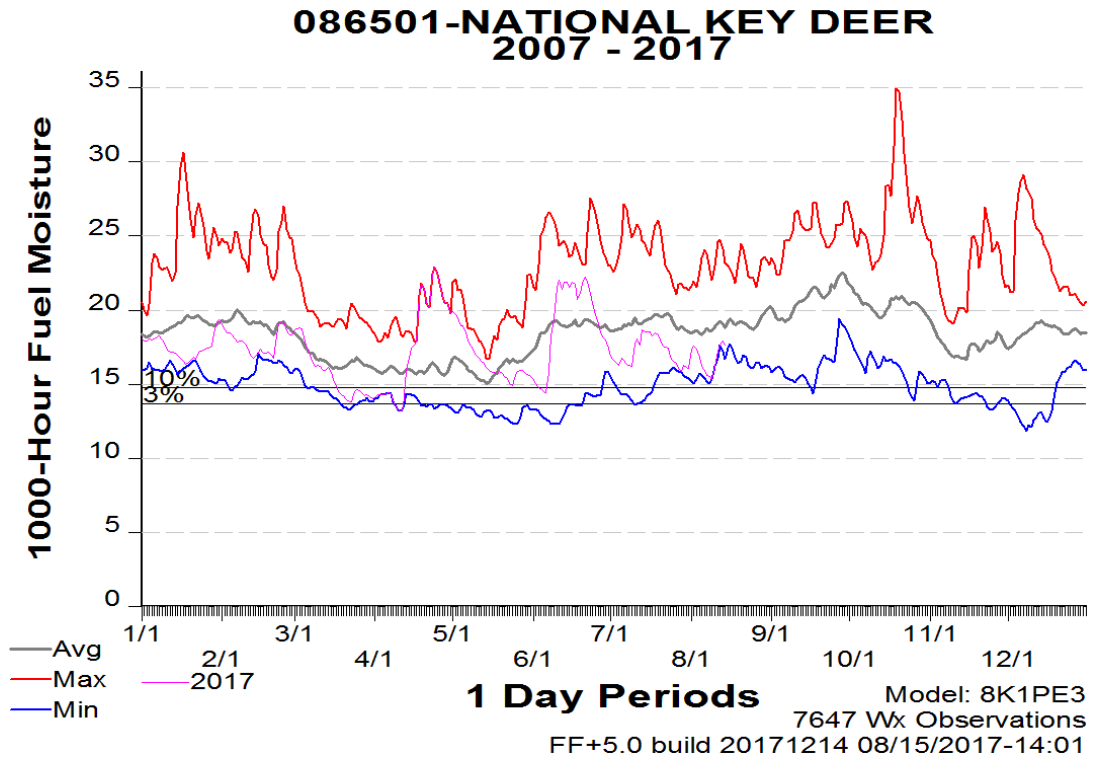

241513-BLUE MTN
2001 - 2017
Energy Release Component
60
50
40
30
20
10
0
97%
90%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y3P2
5869 Wx Observations
FF+5.0 build 20171214 08/15/2017-13:24

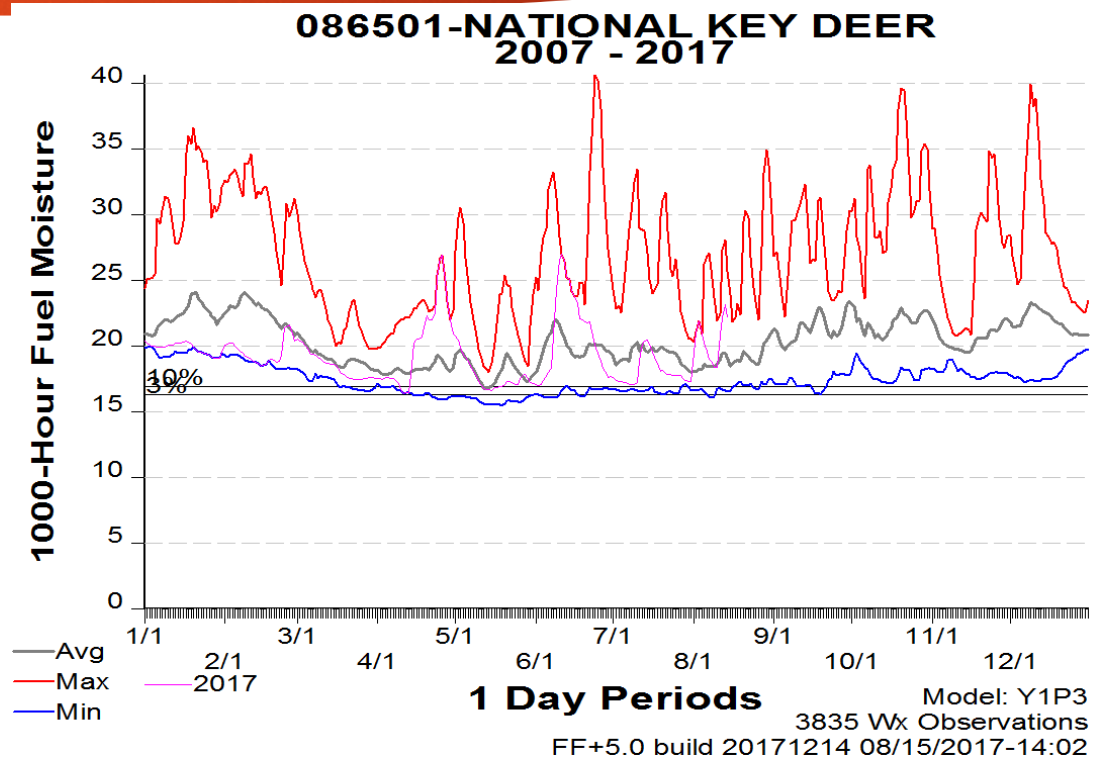

228202-MS SANDHILL CRANE
2002 - 2017
1000-Hour Fuel Moisture
45
40
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y1P3
5293 Wx Observations
FF+5.0 build 20171230 08/15/2017-13:09

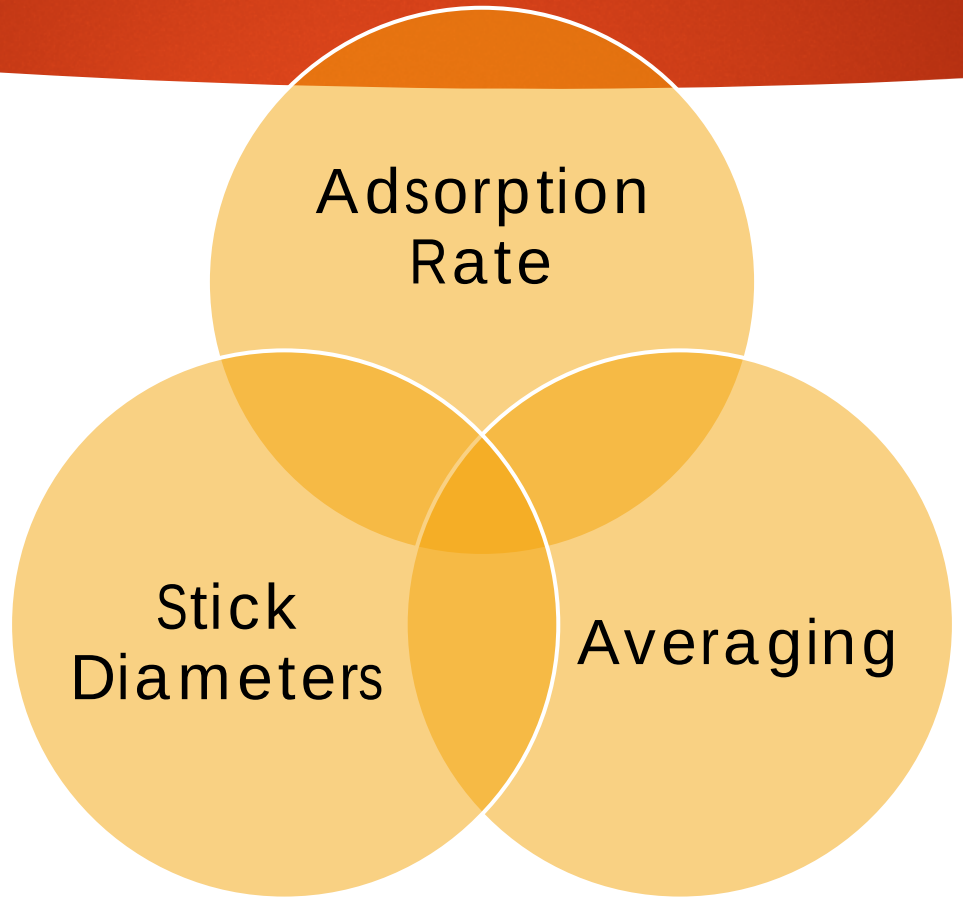

228202-MS SANDHILL CRANE
2002 - 2017
1000-Hour Fuel Moisture
40
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y1P3
5297 Wx Observations
FF+5.0 build 20171214 08/15/2017-13:05


228202-MS SANDHILL CRANE
2002 - 2017
1000-Hour Fuel Moisture
40
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: 8G1PE3
10988 Wx Observations
FF+5.0 build 20171230 08/15/2017-13:12

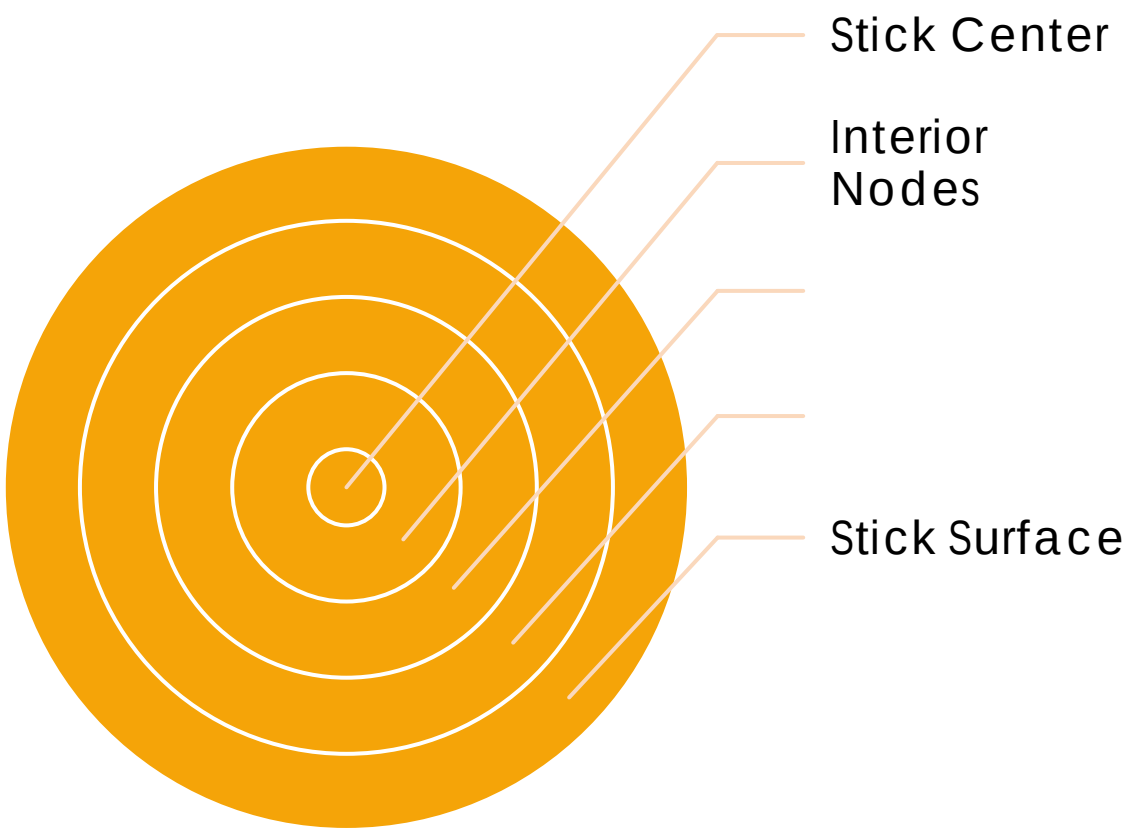

228202-MS SANDHILL CRANE
2002 - 2017
1000-Hour Fuel Moisture
40
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y1P3
5297 Wx Observations
FF+5.0 build 20171214 08/15/2017-13:19

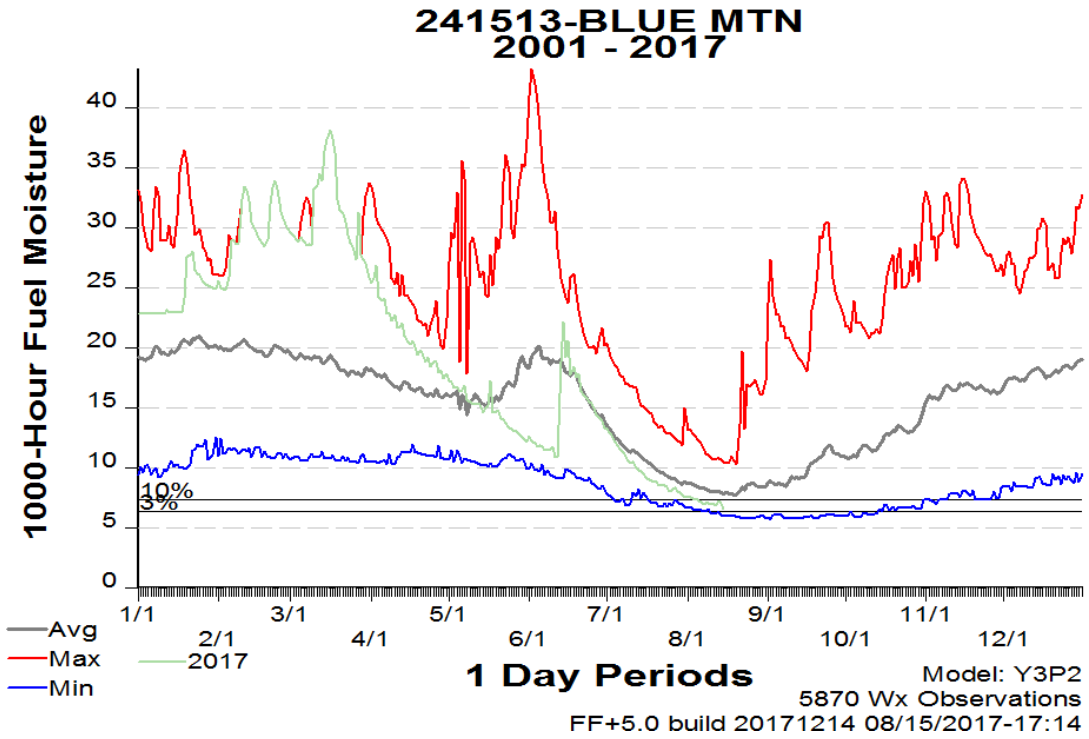

086501-NATIONAL KEY DEER
2007 - 2017
1000-Hour Fuel Moisture
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: 8K1PE3
7647 Wx Observations
FF+5.0 build 20171214 08/15/2017-14:01

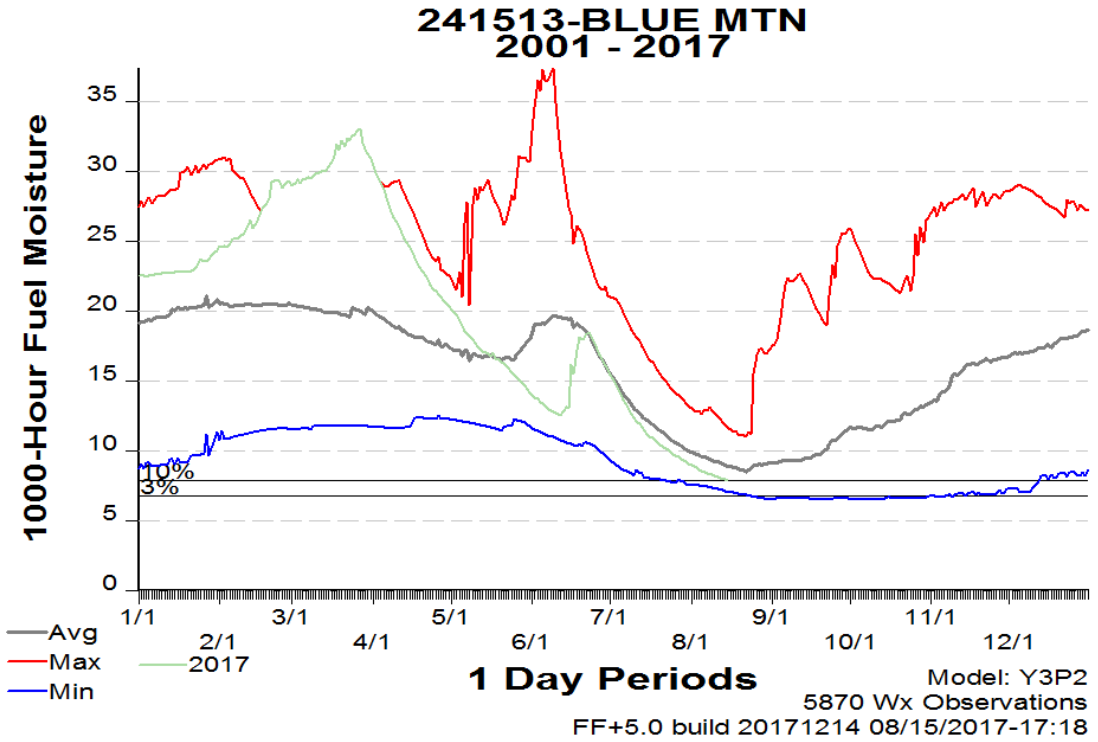

086501-NATIONAL KEY DEER
2007 - 2017
1000-Hour Fuel Moisture
40
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y1P3
3835 Wx Observations
FF+5.0 build 20171214 08/15/2017-14:02


Adsorption Rate
Stick Diameters
Averaging

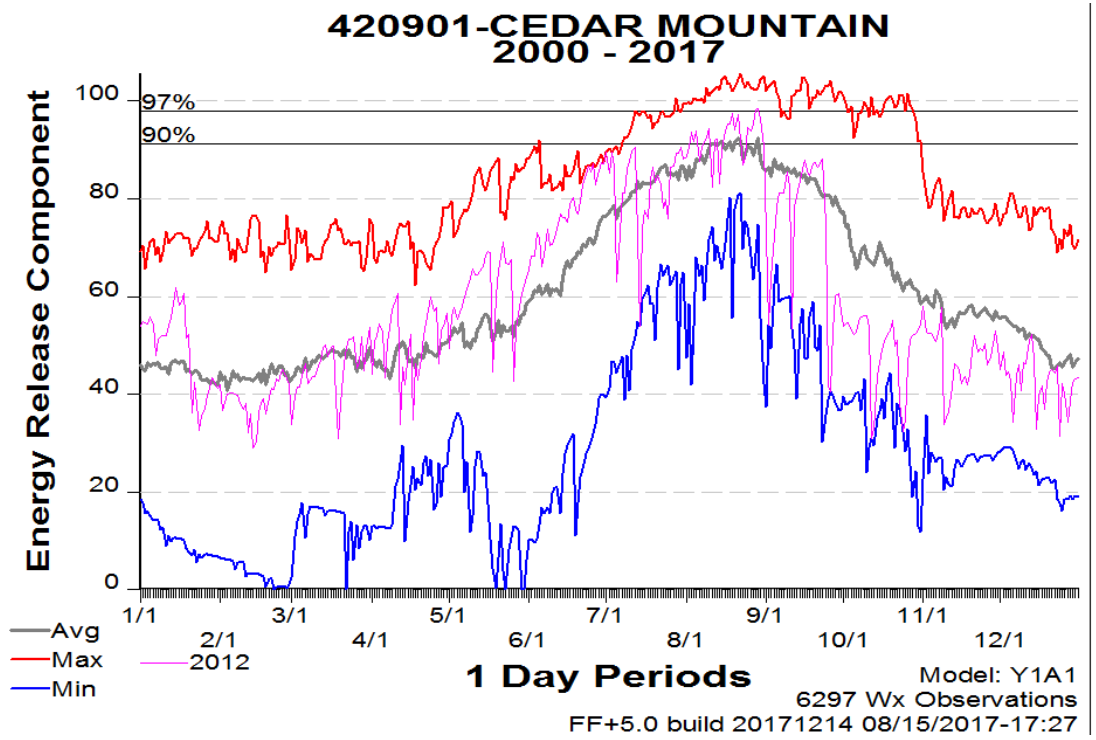
Nelson Model

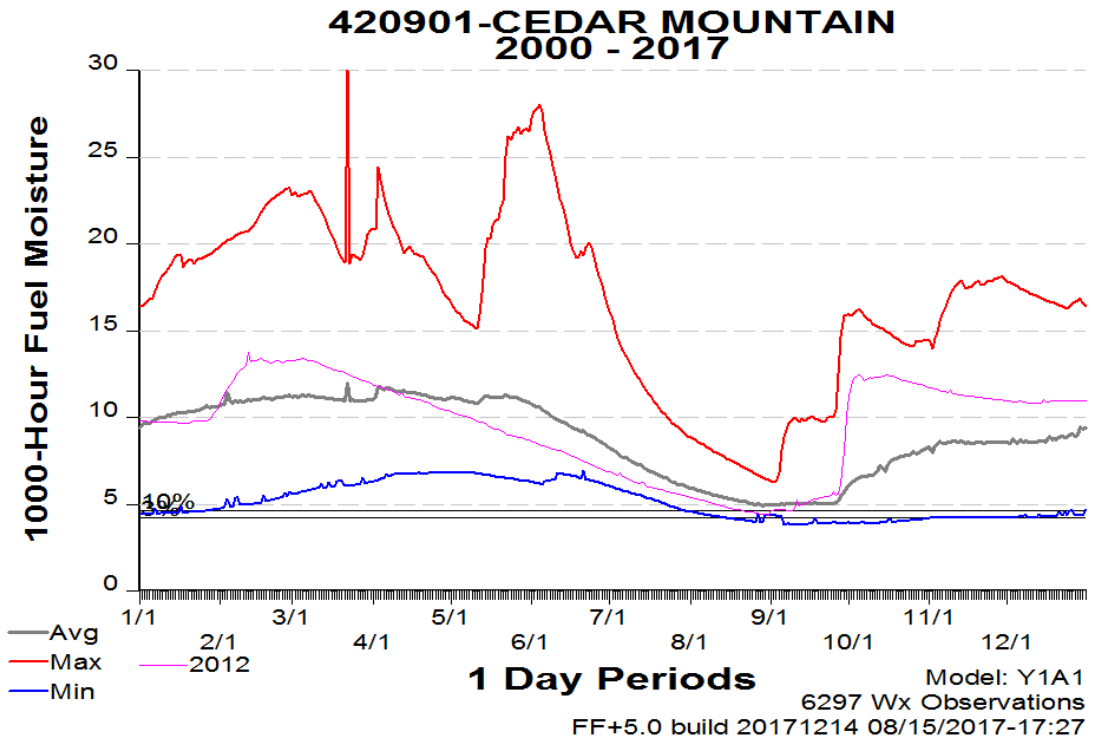



241513-BLUE MTN
2001 - 2017
1000-Hour Fuel Moisture
40
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y3P2
5870 Wx Observations
FF+5.0 build 20171214 08/15/2017-17:14

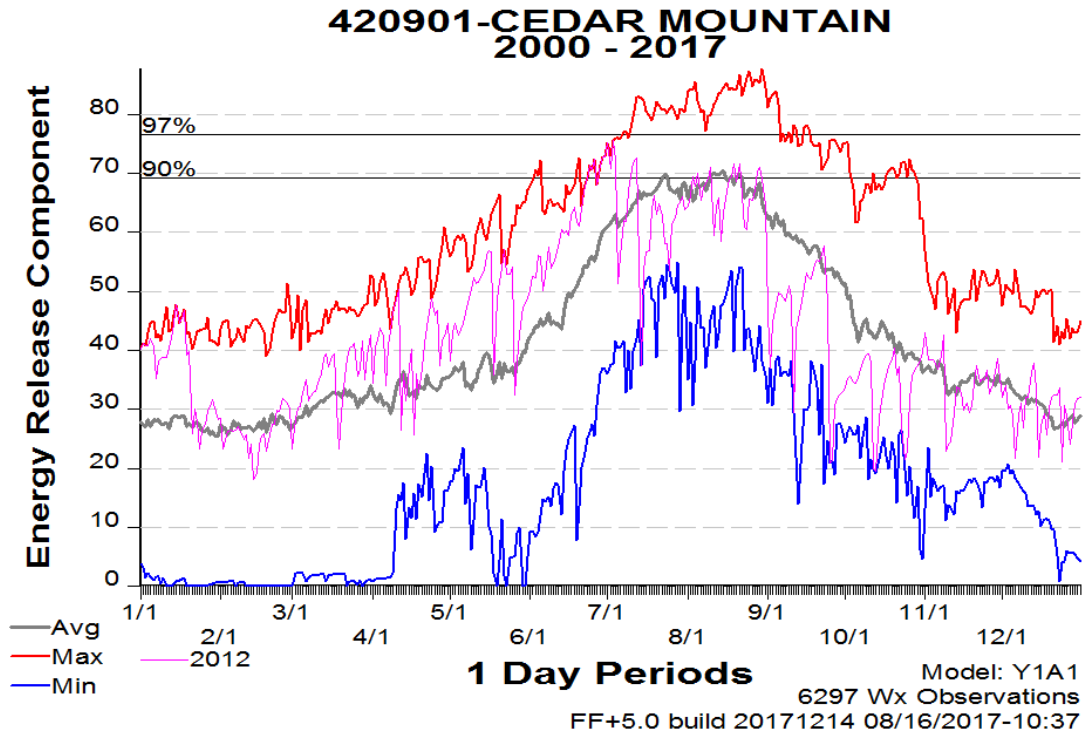

241513-BLUE MTN
2001 - 2017
1000-Hour Fuel Moisture
35
30
25
20
15
10
5
0
10%
3%
1/1
2/1
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Avg
Max
Min
2017
1 Day Periods
Model: Y3P2
5870 Wx Observations
FF+5.0 build 20171214 08/15/2017-17:18

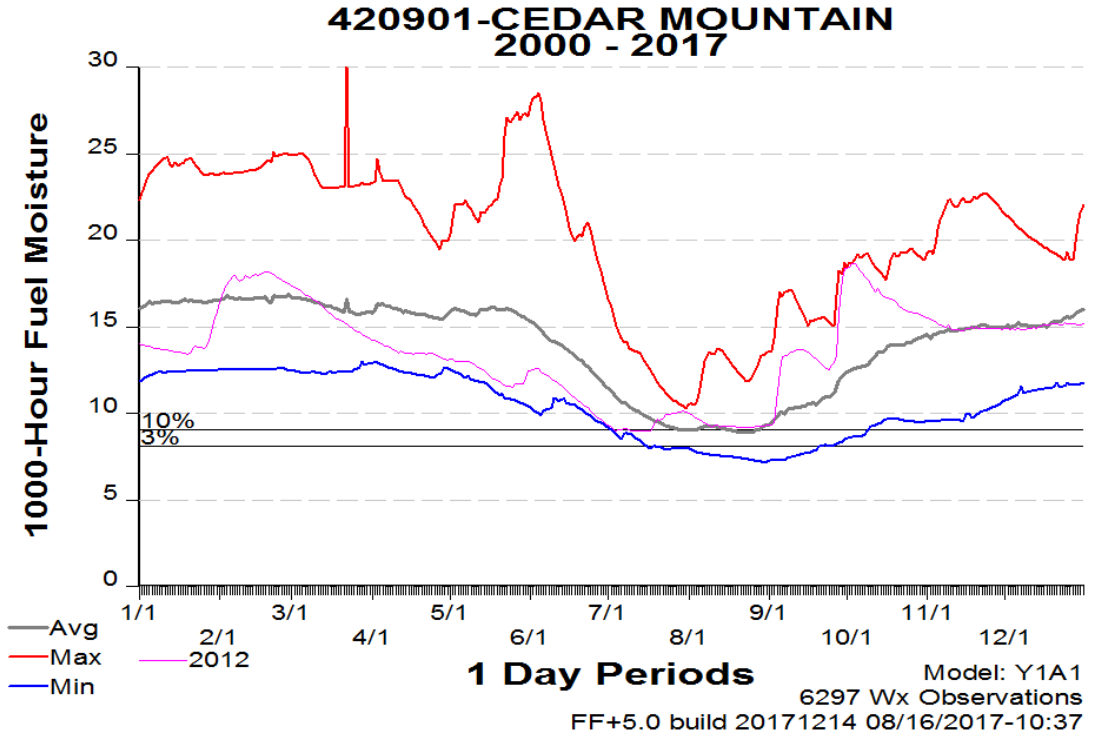
New model with Radial Median



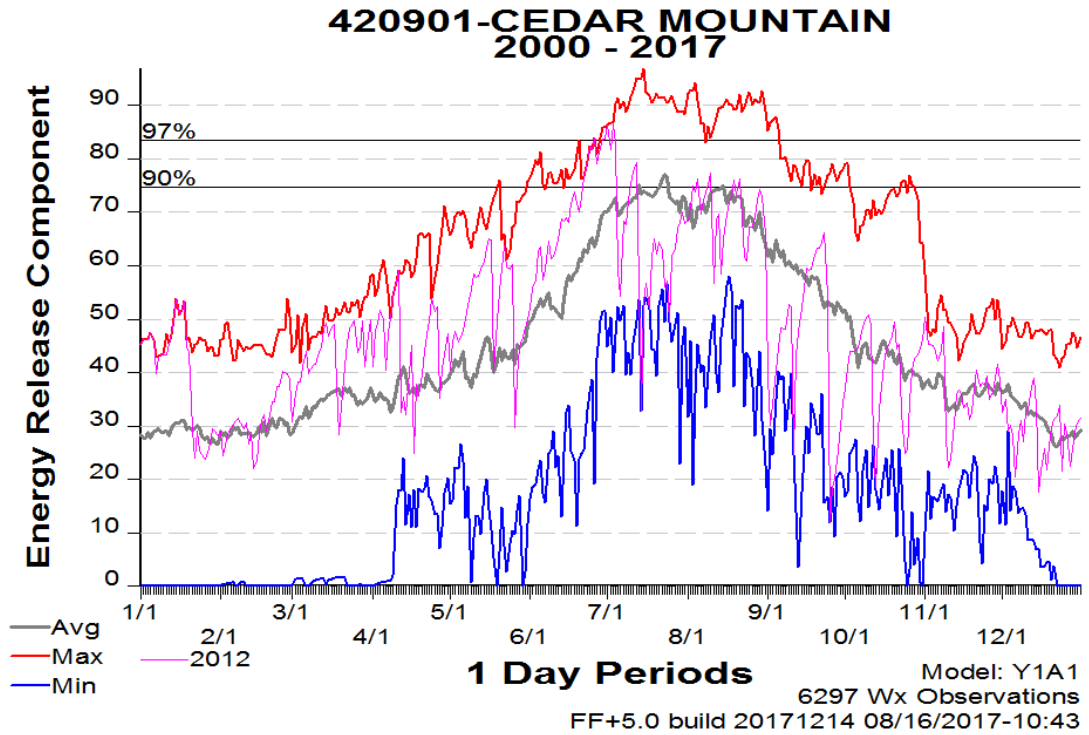


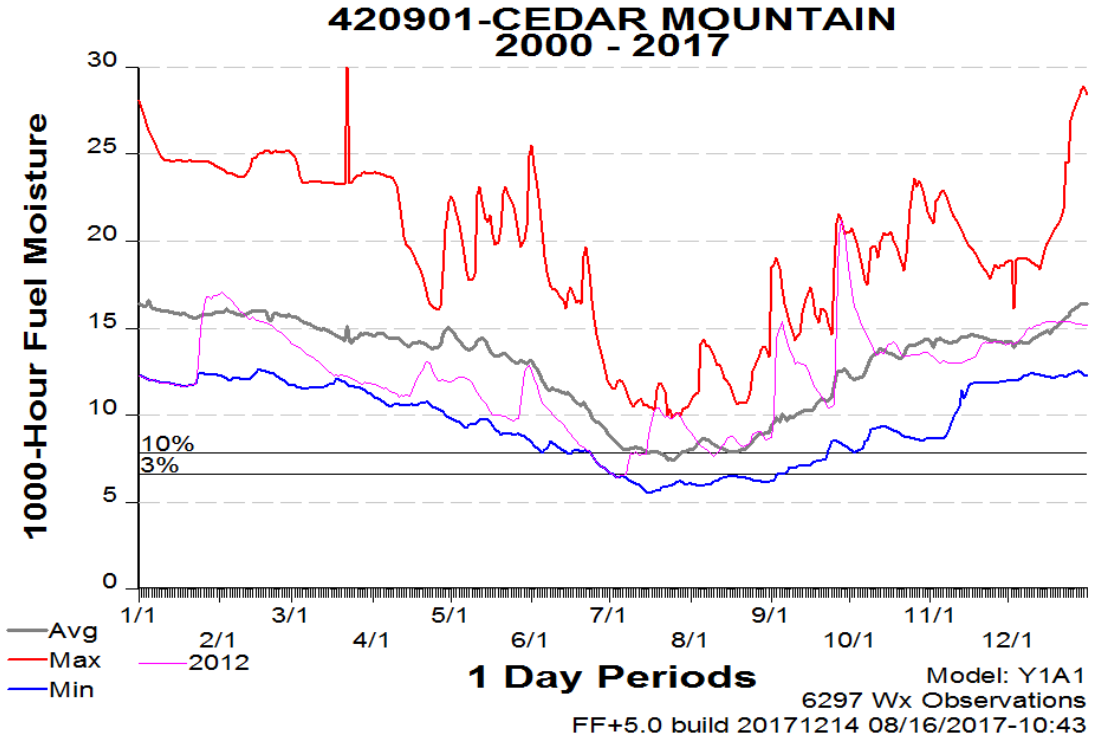
New model with Radial Median and Adsorption Correction



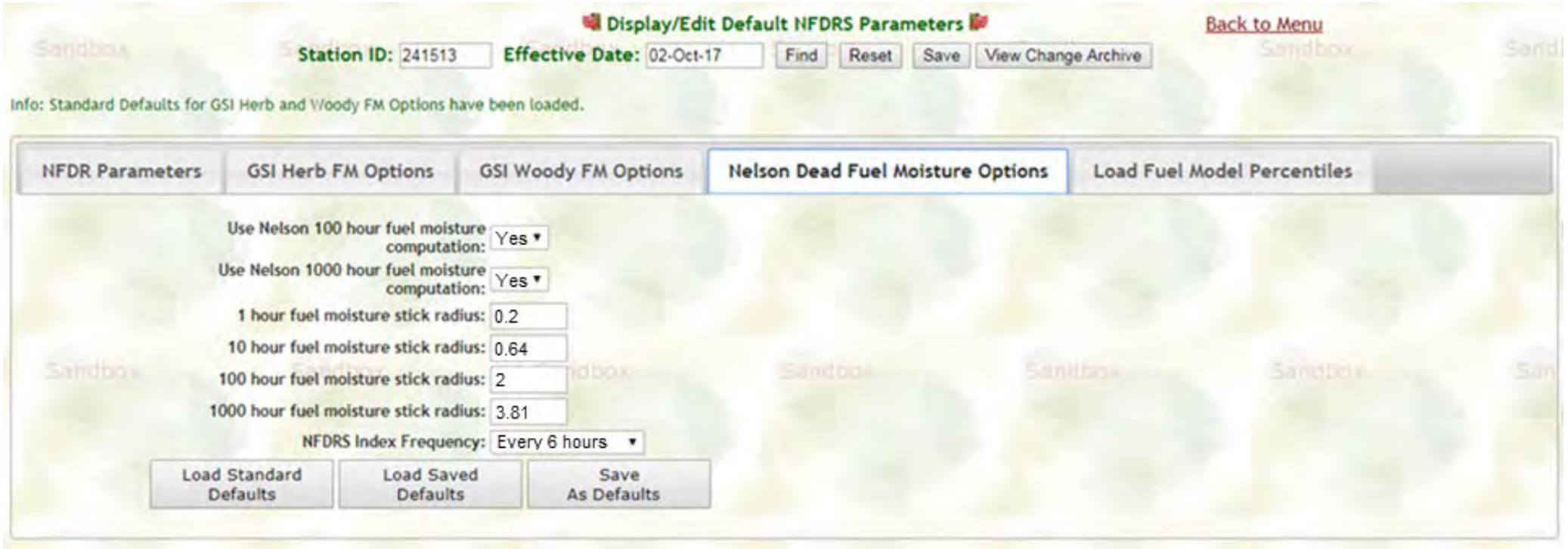


New model with Radial Median, Adsorption Correction and modified stick radii





- Change the Minimum Adsorption Rate
- Change the stick diameters
- Change the radial averaging method


Display/Edit Default NFDRS Parameters
Back to Menu
Station ID: 241513
Effective Date: 02-Oct-17
Find
Reset
Save
View Change Archive
Info: Standard Defaults for GSI Herb and Woody FM Options have been loaded.
NFDR Parameters
GSI Herb FM Options
GSI Woody FM Options
Nelson Dead Fuel Moisture Options
Load Fuel Model Percentiles
Use Nelson 100 hour fuel moisture computation: Yes
Use Nelson 1000 hour fuel moisture computation: Yes
1 hour fuel moisture stick radius: 0.2
10 hour fuel moisture stick radius: 0.64
100 hour fuel moisture stick radius: 2
1000 hour fuel moisture stick radius: 3.81
NFDRS Index Frequency: Every 6 hours
Load Standard Defaults
Load Saved Defaults
Save As Defaults

New Fine Dead Fuel Moisture Model **Nelson**

- NFDRS78 requires daily State-of-the-Weather (SOW) input and R to O in WIMS to calculate fine dead fuel moisture before indices are produced.
- The old 1hr – 1000hr fuel moistures models will be replaced by the scalable Nelson Dead Fuel Moisture Model
- Nelson Model:
  - Diurnal and seasonal dead fuel moisture using hourly fire weather observations
  - Requires no daily human intervention (I.E. No state-of-the-weather)
  - Has been running in WIMS since Dec 2011 and has been part of fire behavior prediction tools (FARSITE, FlamMap) for over a decade

Nelson Dead Fuel Moisture Model

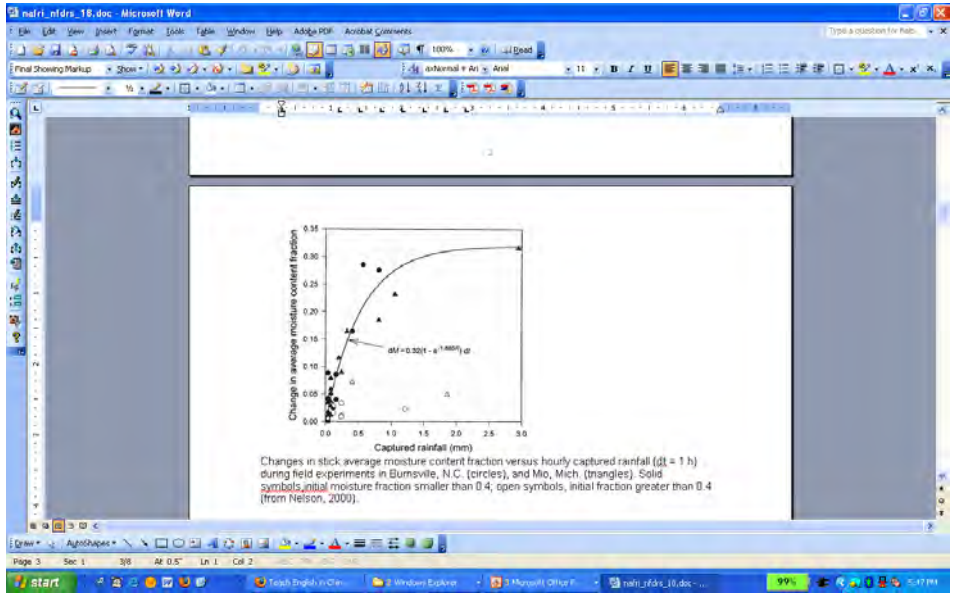
- Calculated HOURLY
- Nelson has 4 weather inputs:
  - Temperature
  - Relative Humidity
  - Solar Radiation
  - Precipitation

Time Lag	Stick Radius	
	in	cm
1-hour	0.08	0.20
10-hour	0.25	0.64
100-hour	0.80	2.00
1000-hour	1.50	3.81

- We define an instance of the Nelson model of the four timelag dead fuel classes used in NFDRS:

Good qualities of Nelson's model

Direct Precipitation Control



Full Energy Balance

Heat Loss = Heat Gain

- **Conduction + Longwave Radiation + Evaporation**

= Solar Heating + Convective Heating

- Accounts for dew formation on fuel surface
- Removes need for SOW

Nelson Jr, R.M., 2000. Prediction of diurnal change in 10-h fuel stick moisture content. Canadian Journal of Forest Research 30, 1071-1087.

Questions?