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Fire Regime Condition Class (FRCC) Interagency Handbook
Reference Conditions

Modeler: Steve Croy and Cecil Frost **Date:** 3/1/05 **BpS (PNVG) Code:** PFPF

Potential Natural Vegetation Group: Piedmont Floodplain Forest

Geographic Area: Floodplains of the larger rivers and streams that flow east across the Piedmont, beginning in New Jersey and Pennsylvania, south to Georgia and around the southern tip of the Appalachian Mountains to the eastern margins of the Mississippi River Valley. Covering a broad plain from the upper Coastal Plain to the toe of the Appalachian Mountains, the Piedmont extends up to 150 miles wide across in its southern reaches in Georgia, but tapers to a narrow band as it approaches the Hudson River near New York City. For purposes of this model the Piedmont ends there at the southern margin of the glaciated region. This model also includes floodplains of the major rivers extending from the Piedmont into the mountain valleys of the southern and central Ridge and Valley Province, the Blue Ridge, the Cumberlands, the Interior Low Plateau, and Interior Highlands including the Ouachita and Ozark Mountains. These rivers include those such as the Susquehanna, Potomac, James, Savannah, Tennessee, and Ouachita. The PFPF model encompasses the broad vegetated floodplains of these and similar large, low-gradient rivers, immediate tributaries, and smaller streams. It does not include the floodplain forests of the southeast and Gulf Coastal Plain nor the high gradient, narrow headwater streams of the Appalachian and Ouachita/Ozark mountains.

Related models: Compare SOFP (Southern Flood Plain) model for the Atlantic and Gulf coastal plain variant of this type. This coastal type is characterized by wider floodplains and vegetation adapted to greater inundation including baldcypress (*Taxodium distichum*) and gums such as tupelo (*Nyssa aquatica*), swamp black gum (*Nyssa biflora*) and Ogeechee plum (*Nyssa ogeche*) in the southern part of the range. Long hydroperiods are characteristic and permanent standing water may be found where these stands occur at sea level. Piedmont and mountain river floodplain forests are differentiated from adjacent mesophytic upland forests (see model MMHF, Mixed Mesic Hardwoods Forest) by the presence of plants indicative of alluvial or bottomland settings such a sycamore (*Platanus occidentalis*), eastern cottonwood (*Populus deltoids*), river birch (*Betula nigra*), and box elder (*Acer negundo*).

Description: This Piedmont bottomland type differs from the Coastal Plain model in several ways. First it is floristically different in that it lacks cypress and tupelo except in its lowest elevation where it transitions to the Coastal Plain. Permanent standing water is lacking except in old oxbow lakes. Hydroperiods are shorter and fluvial features such as river terraces, oxbows, alluvial flats, point bars, streamside levees and other fine-scale alluvial floodplain features are abundant. Synonyms for this BpS (PNVG) and its variations include eastern riverfront forest, bottomland hardwood forest, and alluvial forest.

In pre-European settlement forests, community diversity in these wetland systems was much more complex. Fire and beaver activity created a mosaic whose elements included canebrake, beaver ponds, and grass-sedge meadows in abandoned beaver clearings, as well as the swamps and bottomland hardwood forests that make up more than 95% of the cover that exists today.

Neglecting beaver communities, which will be covered in another model, at least three major groupings of bottomland forest can be defined: bottomland hardwoods, levee forests, and canebrakes. Nearly all the canopy species are deciduous. The most prominent evergreen is the

shade-intolerant loblolly pine (*Pinus taeda*), which manages to maintain itself by reproducing in larger (multi-tree) treefall gaps.

Bottomland Hardwoods. Most of the system is forest vegetation. The canopy is usually dominated by a mix of characteristic alluvial and bottomland species (depending on the region) such as sycamore (*Platanus occidentalis),* river birch *(Betula nigra),* box elder *(Acer negundo*), eastern cottonwood *(Populus deltoides),* sugarberry *(Celtis laevigata),* green ash *(Fraxinus pennsylvanica),* sweetgum *(Liquidambar styraciflua),* swamp chestnut oak *(Quercus michauxii)*, and willow oak *(Quercus phellos)*. Some more widespread species such as tulip tree (*Liriodendron tulipifera)* and red maple (*Acer rubrum)* are also abundant. The driest and most fire sheltered sites supported the wetland hickories including *Carya glabra*, and *Carya ovata* and other fire sensitive species such as beech (*Fagus grandifolia*). Successional areas are often dominated by loblolly pine (*Pinus taeda),* sweetgum *(Liquidambar styraciflua)*, or tulip tree (*Liriodendron tulipifera)*. Subcanopy species included American holly (*Ilex opaca*), deciduous holly (*Ilex decidua and Ilex ambigua*), red mulberry (*Morus rubra*), ironwood (*Carpinus caroliniana*) and hop hornbeam (*Ostrya virginiana*). Shrubs such as spicebush (*Lindera benzoin*), beautyberry (*Callicarpa americana*), yellowroot (*Xanthorhiza simplicissima),* grasses *(Elymus hystrix*, *Elymus canadensis,* and *Chasmanthium latifolium)*, and false nettle *(Boehmeria cylindrica)* may be present. Non-forested vegetation is generally limited to small patches or bands along the channel, and is quite variable in structure and composition. Partly submerged bars may be dominated by waterwillow (*Justicia americana)*. Frequently reworked gravel bars may be dominated by young black willow (*Salix nigra),* sycamore *(Platanus occidentalis)*, or river birch (*Betula nigra)*, or they may have sparse vegetation of a wide variety of annual and perennial herbs of weedy habits. The few extensive bedrock-scour areas in gorges have distinctive vegetation dominated by perennial herbs rooted in pockets and crevices.

Canebrakes. There are numerous accounts of canebrake in piedmont bottomlands, both as historical accounts and on deed descriptions (Frost 2005). Canebrake occurred in particular locations that had easy access for fire (i.e. bottomlands bordered by upland flats as opposed to steep slopes) and where the uplands experienced frequent fire as the result of a combination of lightning and Native American ignitions. Canebrake, once an abundant type in southeastern bottomlands from Virginia to the Mississippi River, has now been eliminated from all but perhaps 1 to 3% of its original acreage as a consequence of land clearing and fire suppression.

Levee Forests. Levee forests form on ridges of silt and sand deposited on stream margins during flood conditions. They receive more light and may be dominated by stream margin specialists such as sycamore (*Platanus occidentalis),* willows *(Salix nigra),* river birch (*Betula nigra*, box elder (*Acer negundo*) and Eastern cottonwood *(Populus deltoides)*. Streamside levees are typical habitat for river oats (*Chasmanthium latifolium*) and a diverse flora of other bottomland graminoids and forbs.

Fire Regime Description: Fire regime group III (conspicuous and most frequent in stands with canebrake). Fire return interval varied highly. Except in canebrake, most fires were very light surface fires, creeping in hardwood litter with some thin, patchy cover of bottomland grasses such as *Chasmanthium laxum* and river oats (*Uniola latifolia*). Flame lengths were mostly 6 to 12 inches. Even so, fire-scarred trees can be found in most bottomlands except in the wettest microsites. Stand replacement fires are unknown in this type. Except where Native American burning was involved, fires likely occurred primarily during drought conditions and then often only when fire spread into bottomlands from more pyrophytic uplands.

Trees may be partially girdled by fire in duff, followed by bark sloughing. While fire rarely killed the tree, this allowed entry of rot, which, in the moist environment, often resulted in hollow trees, providing nesting and denning habitat for many species of birds and animals. Surface fires occurred on a frequency ranging from about 3-8 years in canebrake and bottomland hardwood/canebrake, to 25 years or more in hardwood litter. Low areas having a long

hydroperiod, islands, and areas protected from fire by backswamps and oxbows were virtually fire free.

Fire effects were largely limited to top kill of shrubs and tree saplings less than 2 inches diameter, and formation of hollow trees. Large old hollow trees were sometimes ignited from within by a lightning strike or by a surface fire that entered through a basal opening. We stood within a very large, hollow baldcypress about 2 meters diameter that had been ignited by lightning (it occurred on a substrate of wet mud with no fuel whatsoever) that had burned out in the previous month, leaving only a hollow shell formed by the fire-resistant cambium and bark. The top was open to the sky and the chimney effect probably contributed to the complete consumption of wood and immediate death of the tree. This phenomena has also been observed in eastern cottonwoods and sycamores.

Other Disturbance Types. The distinctive dynamics of river flooding are presumably the primary reason for the distinctive vegetation of this system, though not all of the factors are well known. The large rivers have the largest watersheds in the region, but the gradients of most of these rivers limit floods to fairly short duration. Flooding is most common in the winter, but may occur in other seasons. The sorting of plant communities by depositional landforms of different height suggest that wetness or depth of flood waters may be of significance, though it has much less influence than in the Coastal Plain. Flood waters have significant energy, and scouring and reworking of sediment are an important factor in bar and bank communities. In addition to disturbance, floods bring nutrient input, deposit sediment, and disperse plant seeds.

While flooding rarely lead to canopy tree mortality except where beavers impounded a channel or along stream banks where a tree might be subject to undercutting in the process of channel migration, the most significant disturbance in bottomlands was wind. Winds have a major affect in bottomland forests because of wet soils, less dense soil, and trees that are shallow-rooted. Like all but a few Eastern forest types, canopy tree mortality was limited to tree by tree or small group replacement and windthrow was the primary cause of mortality in bottomlands. The frequency of these events equates with major hurricanes, occurring at approximately 20 year intervals. While tornado tracks can be found passing across uplands and bottomlands (see one such indicated on a map of Umstead State Park, Raleigh, North Carolina), leaving narrow swaths of felled trees, the majority of wind throw seems to have been the result of hurricanes and hurricane-spawned tornadoes. Following Hurricane Fran in 1996, even though the Piedmont is removed from the coast by 25 to over 100 miles, there was extensive wind throw of middle-aged and old growth trees in Piedmont bottomlands. Bottomland oaks, even though seemingly more sheltered, were much more heavily affected than hardwoods on adjacent uplands. Gaps as large as 1 hectare were seen intermixed in areas with extensive single tree windthrow.

Model Assumptions:

- Pixels represent the death of a single large canopy tree or a treefall gap of 1 to several trees.
- The closed path is dominant.
- The open path (C, D) represents the canebrake phenomenon. “Open” refers to the combination of small canopy openings as well as the open understory in the small percent of the landscape where canebrake was present, or on the bottomland margins where fires may have maintained a grass sedge layer under bottomland hardwoods. In both cases, and especially with canebrake, fire kept the understory free of shrubs and all but a few saplings.
- Replacement fire in the sense of crown fire (as defined by FRCC guidelines) did not occur in these forests. Mosaic fire was limited to canebrakes where only single trees or small clusters were killed.
- Wind disturbance selectively affected the largest trees.
- Flooding effects were largely limited to suppressing the herb layer and undercutting trees on the margins of migrating stream channels.

Disturbance Notes:
CLASS A:
Repl Fire___ could only affect a small percent (the fringe or otherwise fire-susceptible areas) so the probability of any pixel being affected in any year is very small, even though there may have been zones with frequent fire.
WindWethStress___Only a small annual probability because small stems in the bottomlands would be little affected by either wind or drought.
Optional1___This disturbance is used to represent prolonged flooding of sufficient duration to kill 1-4 years seedlings and some small saplings, thus setting succession back to the starting point.
Optional2__This disturbance represents openings and changes in species composition resulting from beaver activity.
Mosaic fire___Used to include the situation where a few scattered canopy trees were killed in the small percent of the landscape occupied by canebrake. It might take a mosaic fire to open the canopy enough to support canebrake. Mosaic fire in A is probably how canebrakes got started.

Class B:
Repl Fire (same comments as for A
WindWethStress___Same comments as for A for younger pixels, but for the older pixels there would be trees big enough to have broken limbs, broken trunks and wind throw as factors so WindWethStress begins to have an effect.
Optional1___Prolonged flooding could kill some small stems, selecting for the more flood tolerant species otherwise would not be expected to have much effect.

Classes C and D:
SurfFire___In stream bottom canebrakes the original fire freq was mostly 2-8 years (Frost 1995). There were all densities of tree canopy from completely open (treeless canebrake) to closed canopy but with frequent fire keeping the understory clear of all woody stems other than cane and an occasional surviving sapling to replace an old canopy tree (survival of a sapling to a safe size after it escaped into the canopy was a rare event but sufficiently frequent enough to maintain the canopy).
MosaicFire___Rare but happens occasionally in canebrakes under severe burning conditions. May have no effect other than locally reducing tree cover in canebrake.
ClsdPath___Canebrakes (without fire suppression) tend to be relatively stable because they occur in frequent fire parts of the landscape. Occasionally a patch would remain fire free long enough to go to B or E.

Class E:
WindWethStress___This should be the major disturbance in E. Class E represents old growth in naturally fire-sheltered areas such as bottomland forests protected from fire by oxbows and channels, and also stands in only marginally fire susceptible areas (subject to the occasional light surface fire in thin leaf litter in types such as *Nyssa biflora* that can carry fire only under unusual drought conditions (20 yrs or more) and may scar but very rarely kill trees). Wind that killed only 1 tree would not affect the community much, just promote tree by tree replacement. Wind that flattened a patch would reset the pixel to A.

Uncharacteristic vegetation
Much of what were once bottomland forests of the Piedmont and mountains are now converted to agriculture or inundated by reservoirs built for flood control and power generation. On wetter soils in the lower Piedmont near the Coastal Plain, pure stands of swamp black gum and red maple usually indicate areas where oaks or baldcypress were logged and failed to regenerate because of the shade cast by remnant subcanopy trees which rapidly captured the site. Swamp black gum is a prolific sprouter and can form closed canopy cover in a few years from sprouts. Repeatedly logged sites often become dominated by early successional species such as sweetgum, loblolly pine, water oak and red maple. Bottomlands, especially after logging, are often invaded by exotic species such as Chinese privet (*Ligustrum sinense)*, Japanese

honeysuckle (*Lonicera japonica*), garlic mustard (*Alliaria petiolata*), and many more moist soil, shade tolerant species. A rapidly expanding invader from China, Japanese stilt grass (*Microstegium vimineum)*, threatens to replace native grasses over large areas.

Vegetation Type and Structure

Class*	Percent of Landscape	Description
A: post replacement	15	Treefall gaps 0-20 years in age with saplings and small trees up to 30 cm dbh. Potential canopy species are typically mixed with subcanopy species and herbs, and an occasional stem of a short-lived early successional species such as willow (*Salix nigra*).
B: mid-seral closed	27	Old treefall gaps with closed canopy 20-80 years in age, ranging from 30-70 cm dbh. Shade tolerant species in the understory.
C: mid-seral open	6	Canebrake with varying amounts of canopy hardwood cover.
D: late- seral open	4	Canebrake with varying amounts of canopy hardwood cover.
E: late- seral closed	48	Closed hardwood canopy with trees ranging from 80 to >300 years in age.
Total	100	

Fire Frequency and Severity

Fire Severity	Fire Frequency (yrs)	Probability	Percent, All Fires	Description
Replacement Fire	976	0.001	6	Almost no replacement fire in bottomland forest except in canebrakes where replacement is still only tree by tree or small clusters. Mortality is from bole heating, not crown fire.
Non-Replacement Fire	62	.016	94	Low-intensity surface fires, flame lengths ranging from a few inches to 3 ft, consuming only surface fuels and litter.
All Fire Frequency*	59	.017	100	

*All Fire Probability = sum of replacement fire and non-replacement fire probabilities. All Fire Frequency = inverse of all fire probability (previous calculation).

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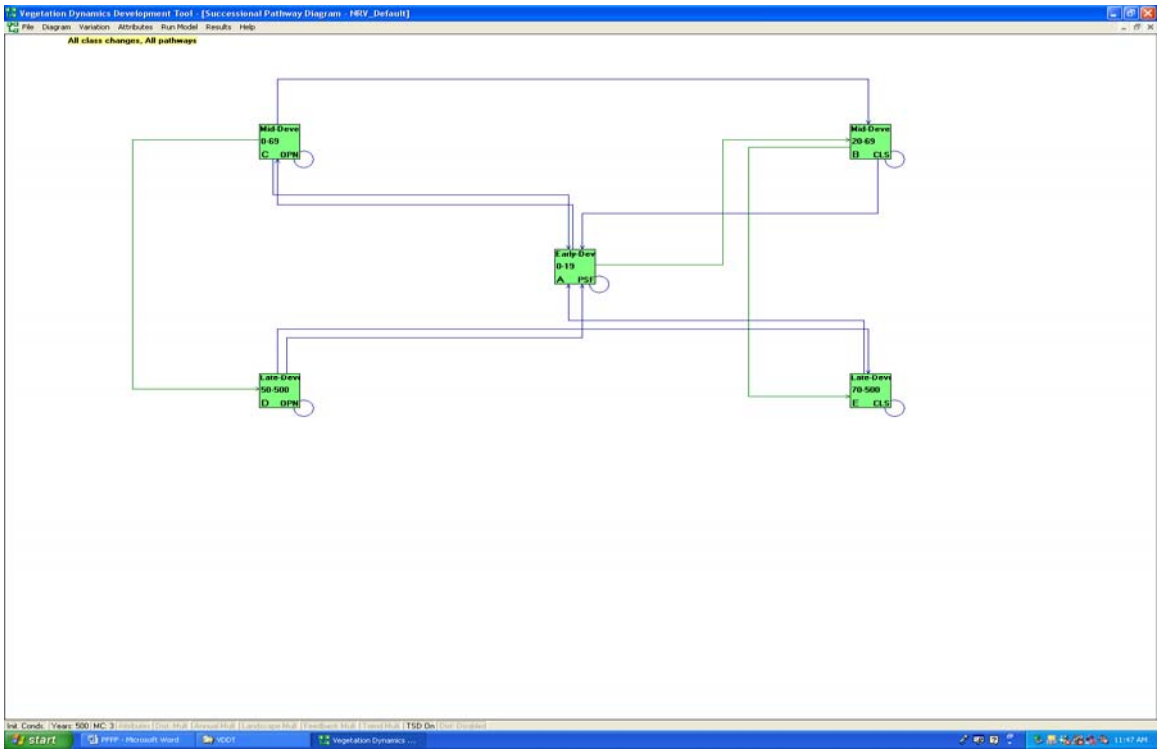
VDDT File Documentation
Include screen captures (print-screens) from any of the VDDT graphs that were used to develop reference conditions.


Vegetation Dynamics Development Tool - [Successional Pathway Diagram - NRV_Default]
All class changes, All pathways
Mid-Deve
0-69
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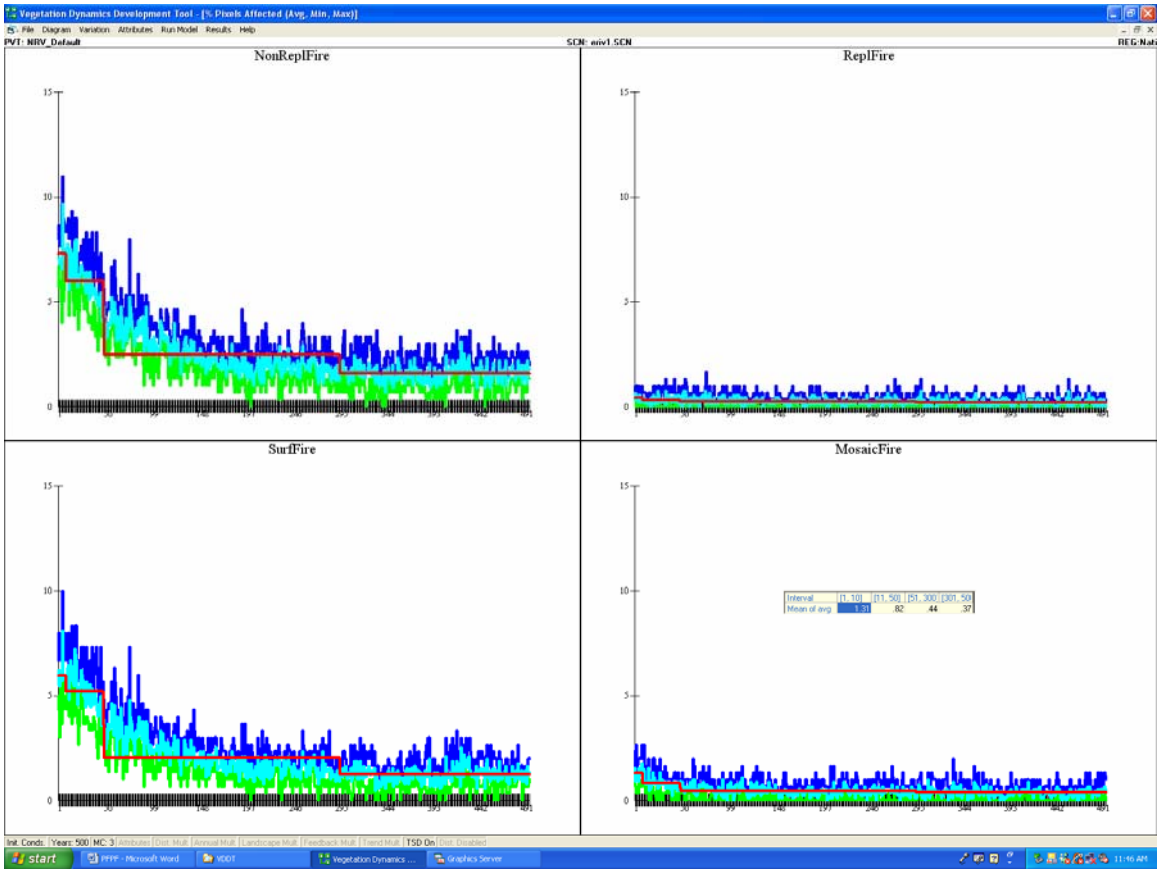
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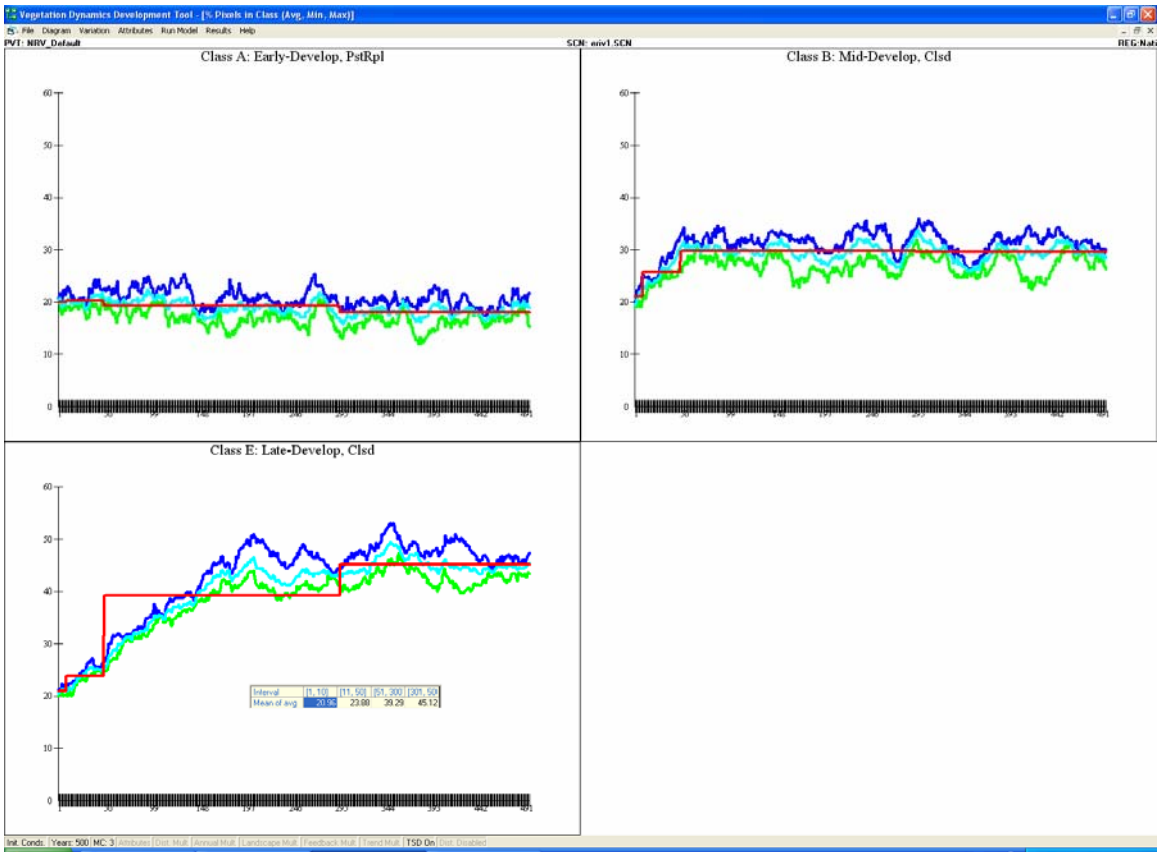
NonReplFire
ReplFire
SurfFire
MosaicFire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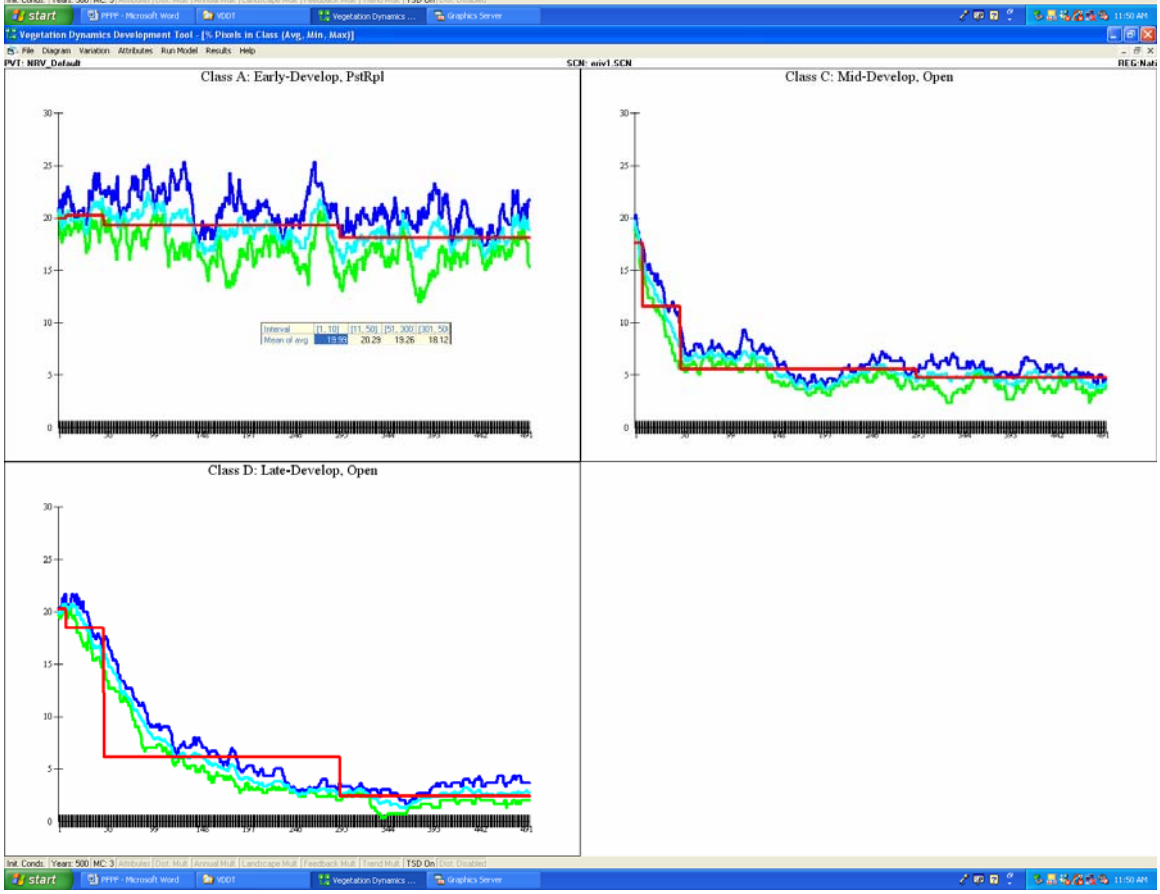
Class B: Mid-Develop, Clsd
Class E: Late-Develop, Clsd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Class C: Mid-Develop, Open
Class D: Late-Develop, Open