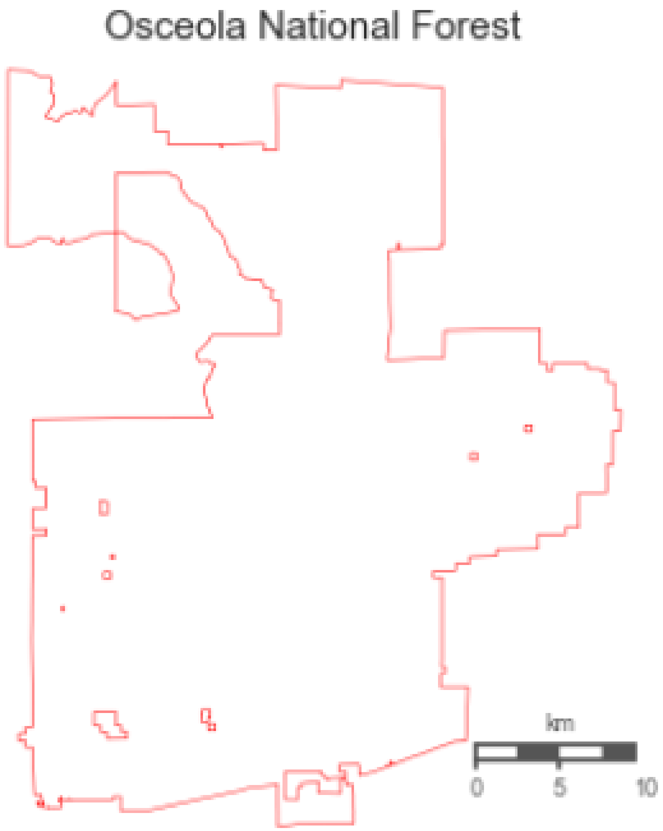
The analysis extent (Osceola National Forest). Roughly 162,000 ha, about 56% of which is actively simulated At 150 x 150 meter resolution (2.25 ha / pixel). The main questions we want to answer are:

1) How does extreme fire weather affect burn severity, C efflux from wildfire, and above ground C in the OSNF
2) How does management affect that relationship? Thinning, burning, thinning and burning.

Basically, we're saying extreme fire weather events are going to be more common in the future. Can certain management approaches mitigate the C detriment to the environment, and if so what do those approaches look like?



The following slides are a very rough cut flow of the ideas and processing that went into getting to where we are currently: a pre management implementation view of contemporary and extreme fire weather on the landscape's C and burn severity dynamics. This is a perfect time to show you what's going on, and ask for your sniff test (get criticism).

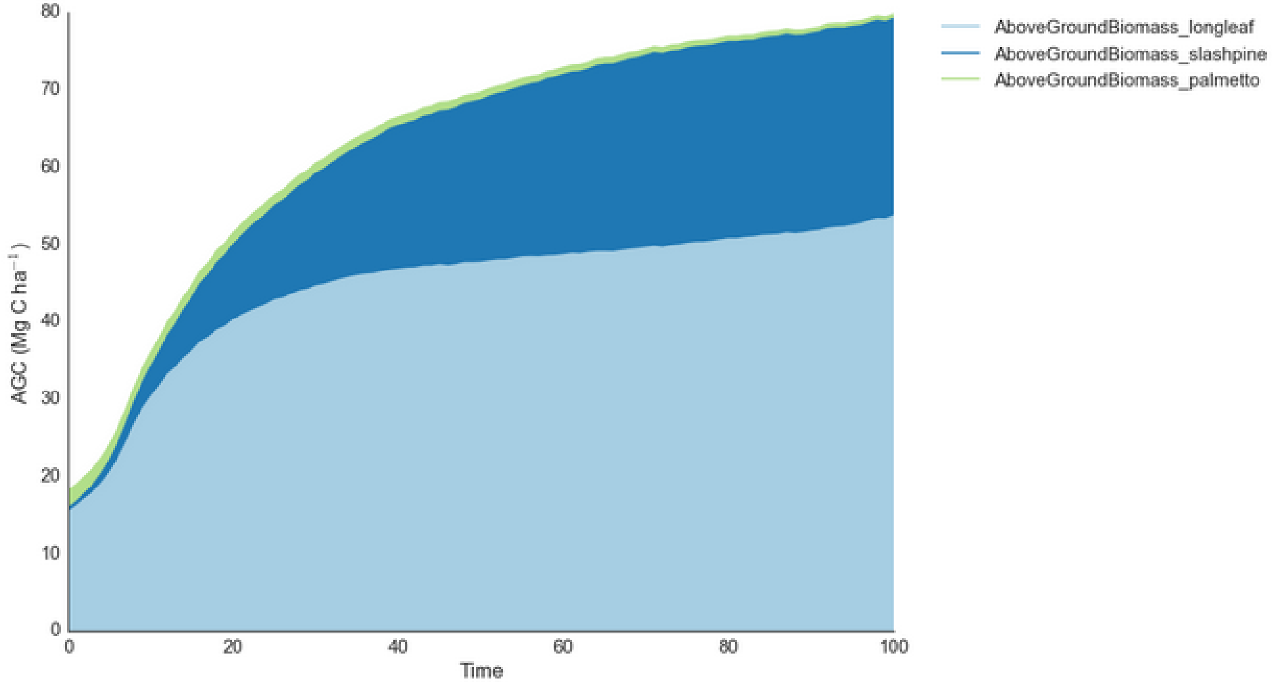
Burnable Areas

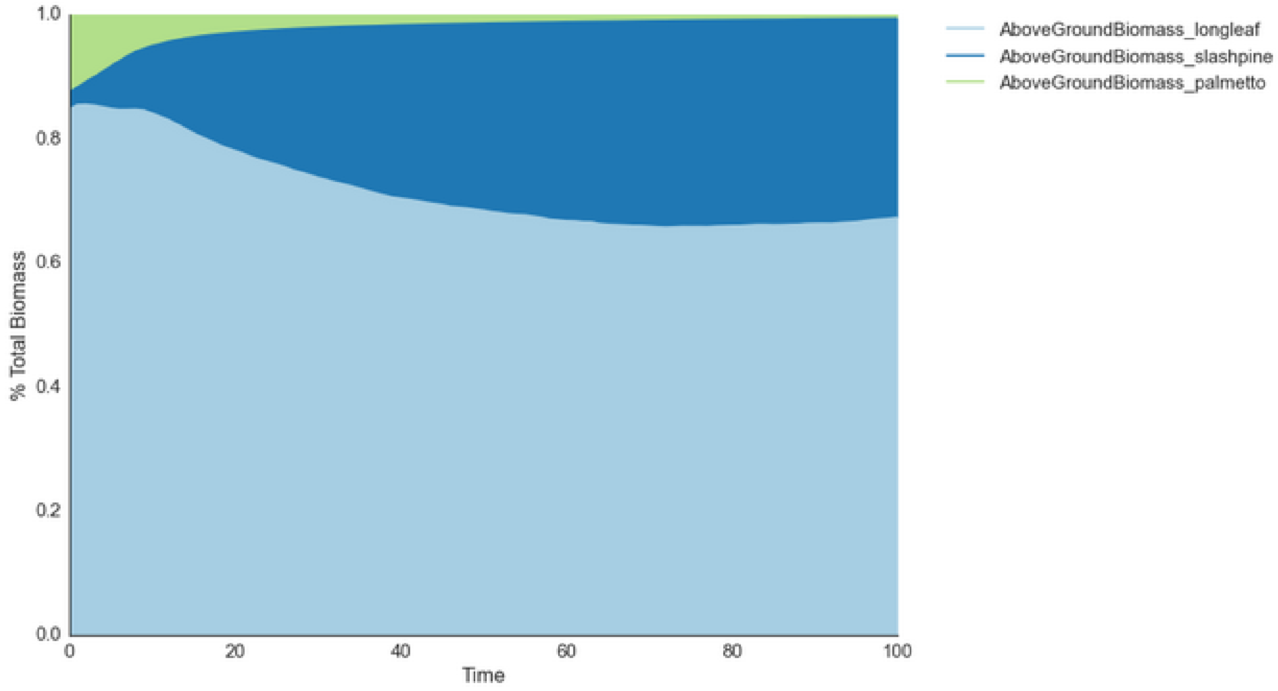
Wetland Areas

Ecoregions

The model we're using (LANDIS-II) uses an extension based on the CENTURY soil model to handle C and N cycling
Above and below ground. We needed to split the region into edaphically and climatically similar chunks. Based on
Our time spent out there, we decided to go with swampy areas, and areas that were pine dominated. The OSNF GIS
Shop had some layers for wetlands, and what they referred to as 'burnable'. These match closely with GSSURGO, and I
Used them to separate the area into swamp ecoregions (green) and pine ecoregions (black).

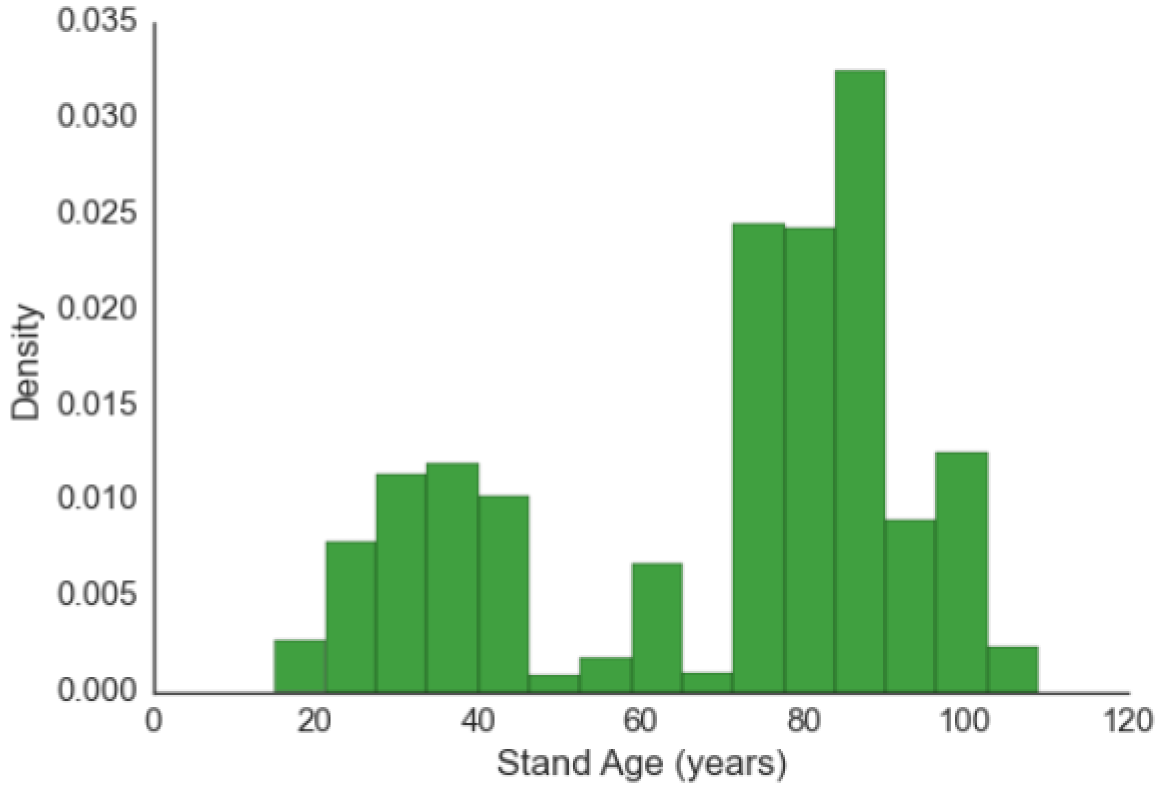
We're using DAYMET weather to drive growth and succession of veg across the analysis extent, and are running 100 year
Simulations.

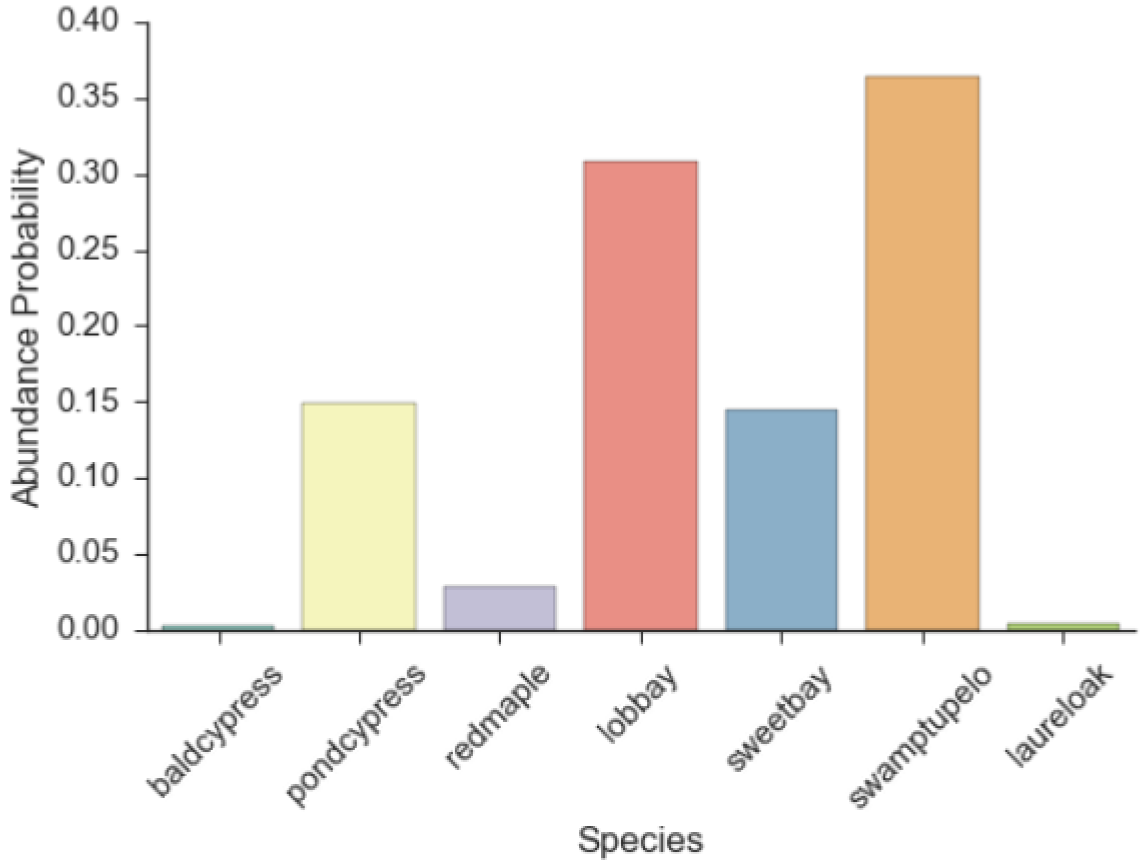




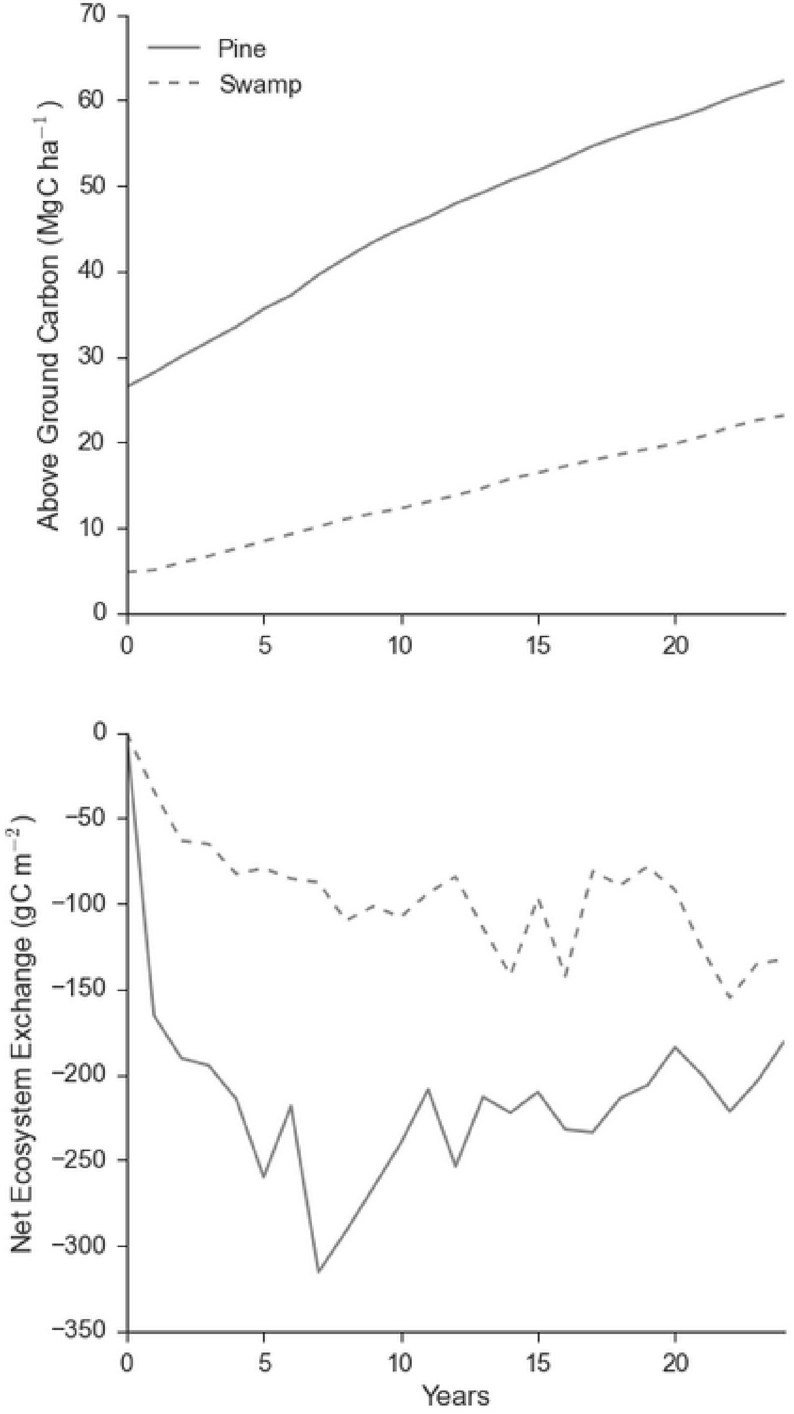
We gathered species composition information from FIA Plots and information the OSNF provided, and developed a list of species and functional group parameters from the published lit, Silvics manuals, best guesses, etc. We then ran a series of simple runs with different compositions of dominant species at different age distributions to make sure nothing looked too bogus. Here is an example of our Pine dominated single cell test, with combinations of longleaf, slashpine, and palmetto. AGC (Above Ground Carbon, top), and % of total biomass (bottom), over the 100 year simulation period.

Note that this is in the absence of disturbance (no fire), and the only loss of biomass is due to age or shade based mortality, and shifts in cohort distributions.



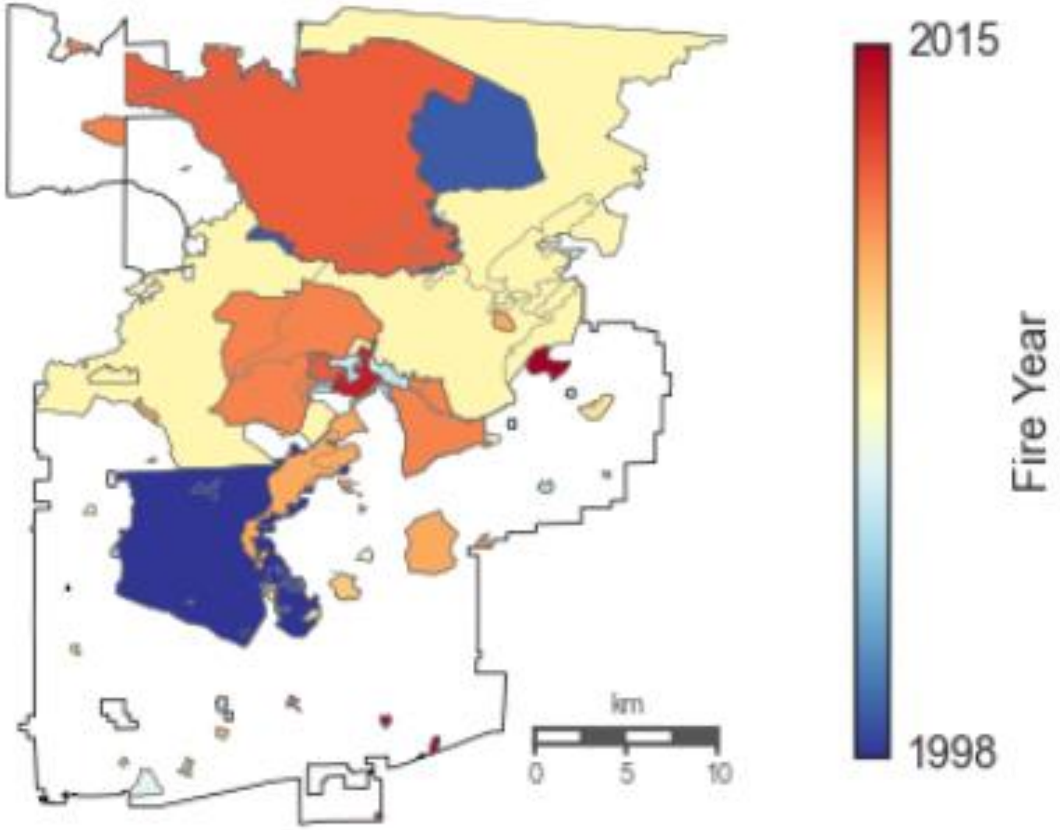


Because LANDIS-II needs an 'initial communities' map to initialize biomass across the landscape, we needed to actually create a raster where each grid cell lists the species present, and the various age cohorts present for each species. This is a royal pain in the ass and represents one of the largest sources of uncertainty in the model parameterization process. We used OSNF and FIA data to generate age distributions by species, were prescriptive where we had the information, and used informed draws from distributions where we didn't.

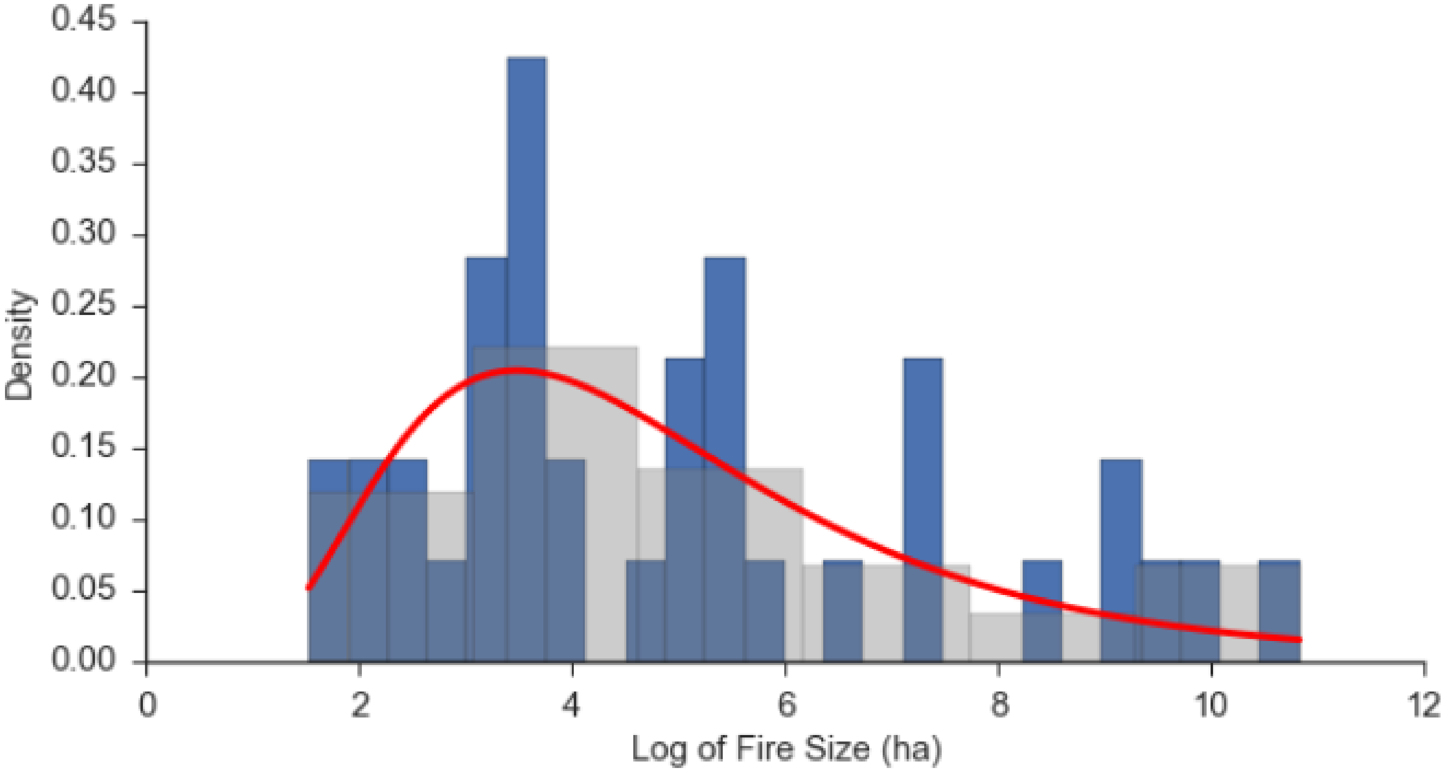


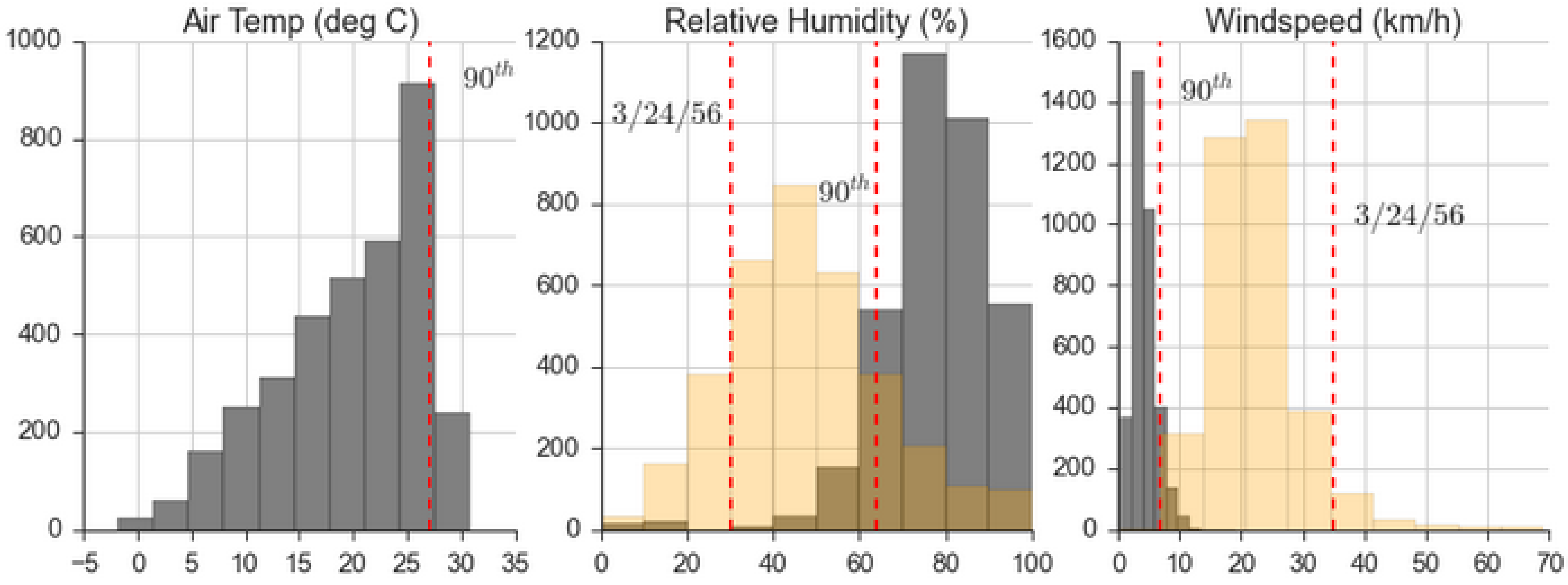
The next step in testing the parameterization was to run the entire landscape for a few years. We then asked ‘what is the average above ground carbon, and net carbon exchange, of each of the two ecoregions?’ Overall, the pine dominated ecosystems showed larger growth rates relative to the swamps, and contained about 2x the above ground C.

The NEE (bottom) of the two ecoregions stabilized / converged after the ~30 years of simulation in this test.



We parameterized fire size and frequency using a log normal distribution of fire size (bottom), generated from ~17 years of fire history data recorded for the OSNF (left).





A part of the research question we're after has to do with how the system responds to extreme fire weather events, And similar to the previous work we've done, we ultimately will look at the role management plays in mitigating those detrimental impacts. So we needed to define what 'extreme' looked like for fire weather. I grabbed data from the closest RAWS station and looked at the upper 90th percentile for TA, rH, and WSV (red lines, above). I was getting some pretty crazy hot fires under these conditions, so I also looked at old stenograph depictions of fire weather during historic fire events (e.g., 3/24/1956, Impassible Bay fire), and convinced myself that this was a conservative representation of extreme weather (next two slides).

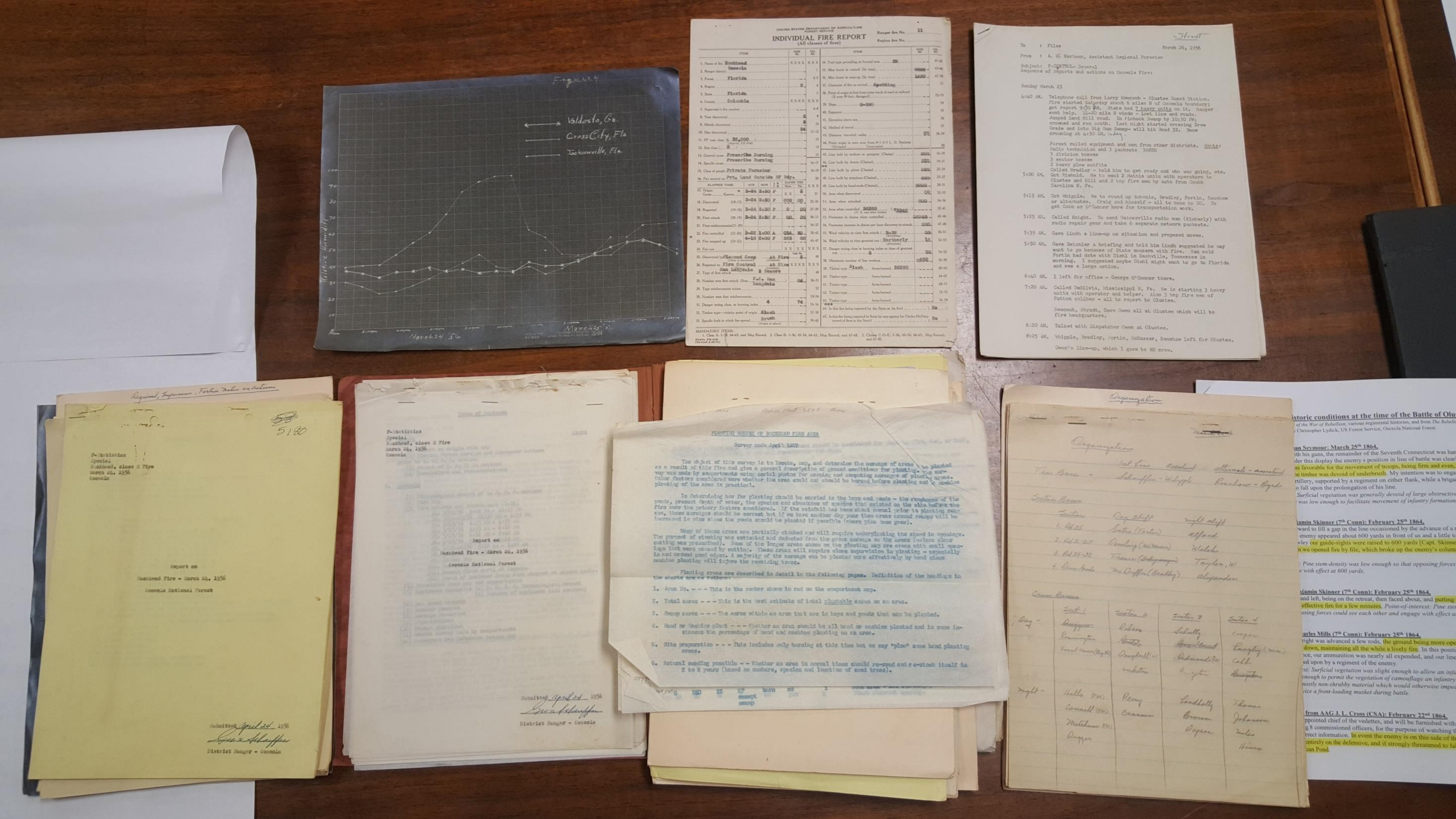
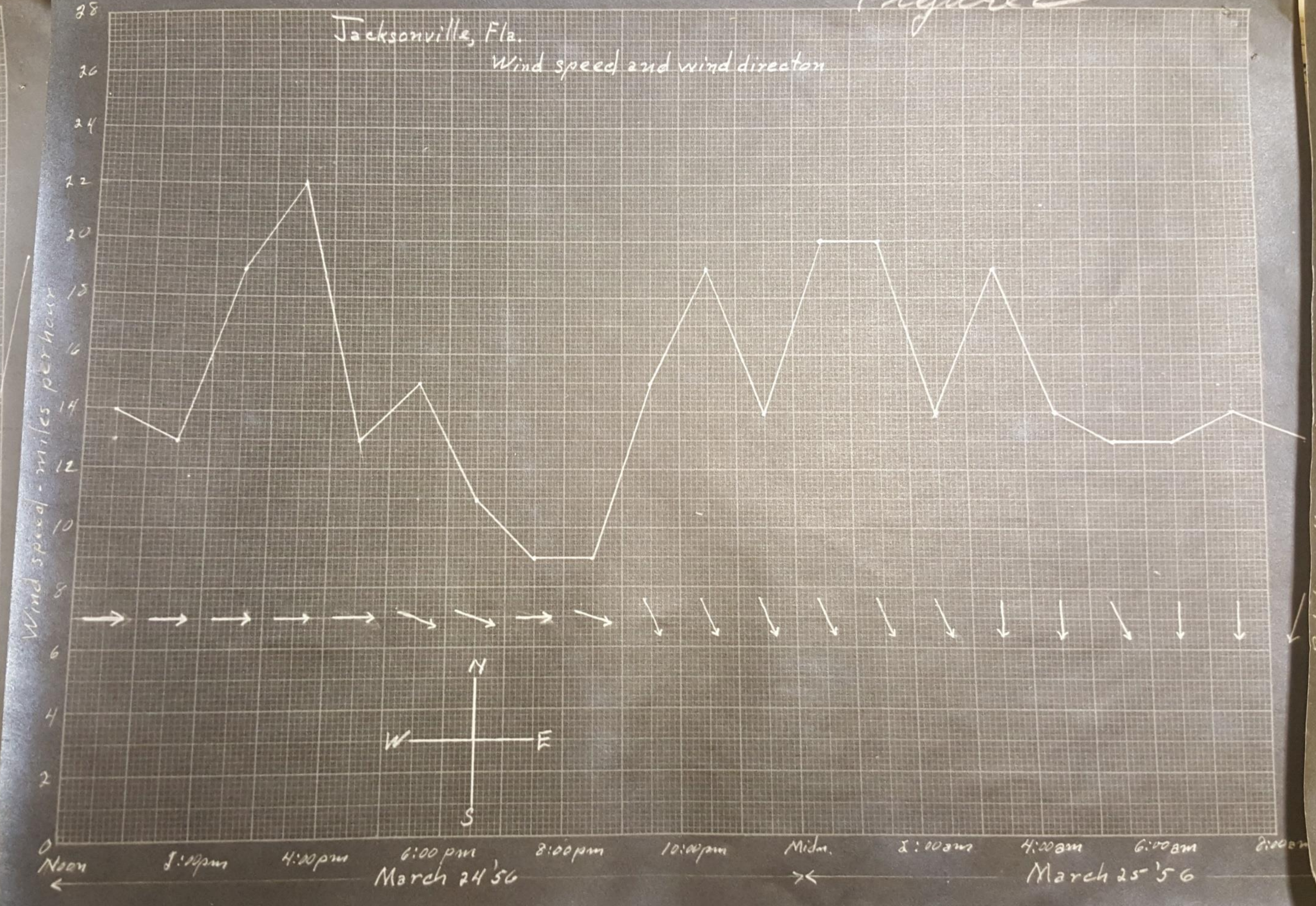


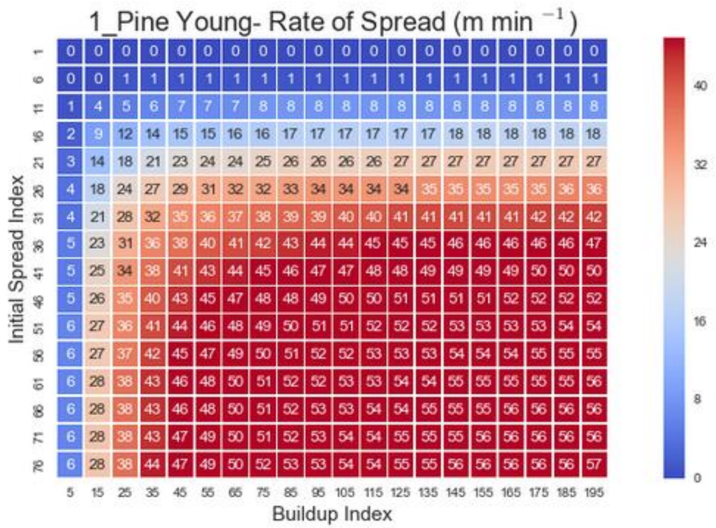
Figure 4
Valdosta, Ga.
Cross City, Fla
Jacksonville, Fla.
Relative Humidity
March 24 56
March 25
UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
INDIVIDUAL FIRE REPORT
(All classes of fires)
To : Files
March 26, 1956
From : A. W. Hartman, Assistant Regional Forester
Subject: F-CONTROL- General
Sequence of reports and actions on Osceola Fire:
Sunday March 25
Regional, Supervisor, Forlan Notes on Action
F-Statistics
Special
Buckhead, class E Fire
March 24, 1956
Osceola
Report on
Buckhead Fire - March 24, 1956
Osceola National Forest
Submitted April 24 1956
District Ranger - Osceola
PLANTING SURVEY OF BUCKHEAD FIRE AREA
Survey made April 1957
Organization
Historic conditions at the time of the Battle of Olu

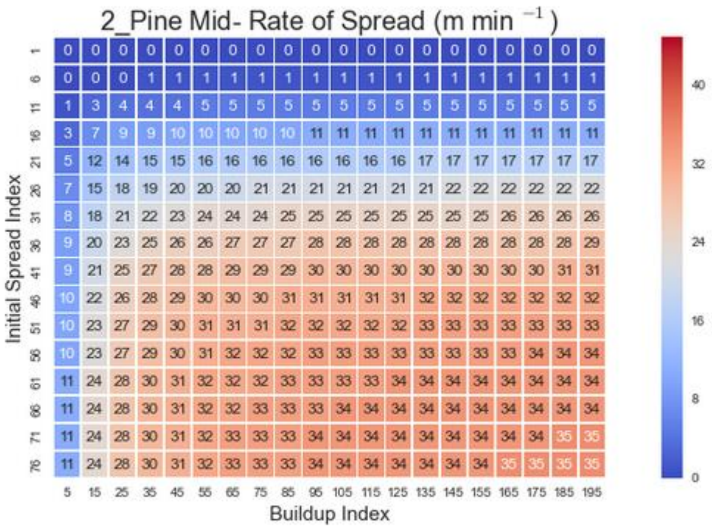
Figure 2

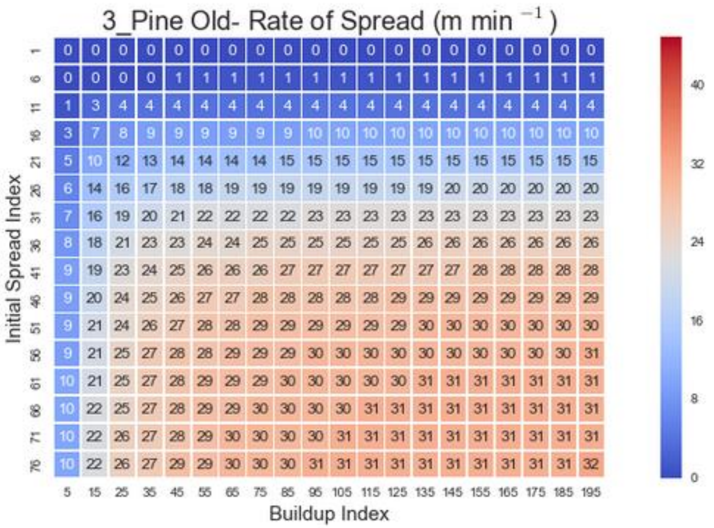


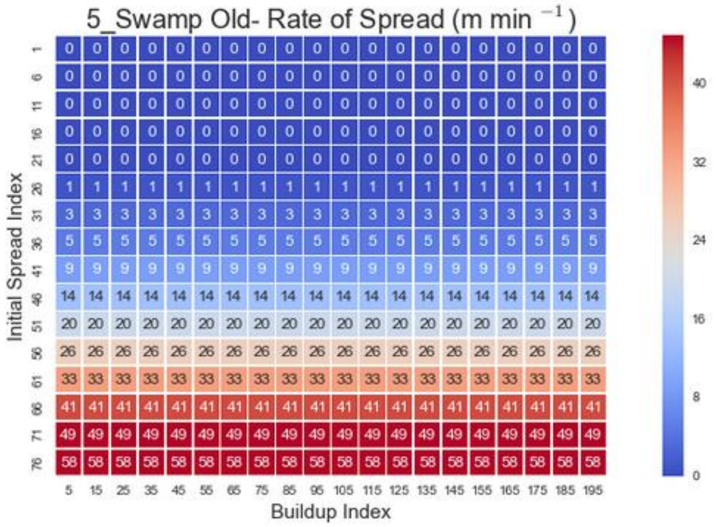
Jacksonville, Fla.
Wind speed and wind directon
Wind speed - miles per hour
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
N
W
E
S
Noon
2:00pm
4:00pm
6:00 pm
8:00pm
10:00pm
Midn.
2:00am
4:00am
6:00am
8:00am
March 24 '56
March 25 '56

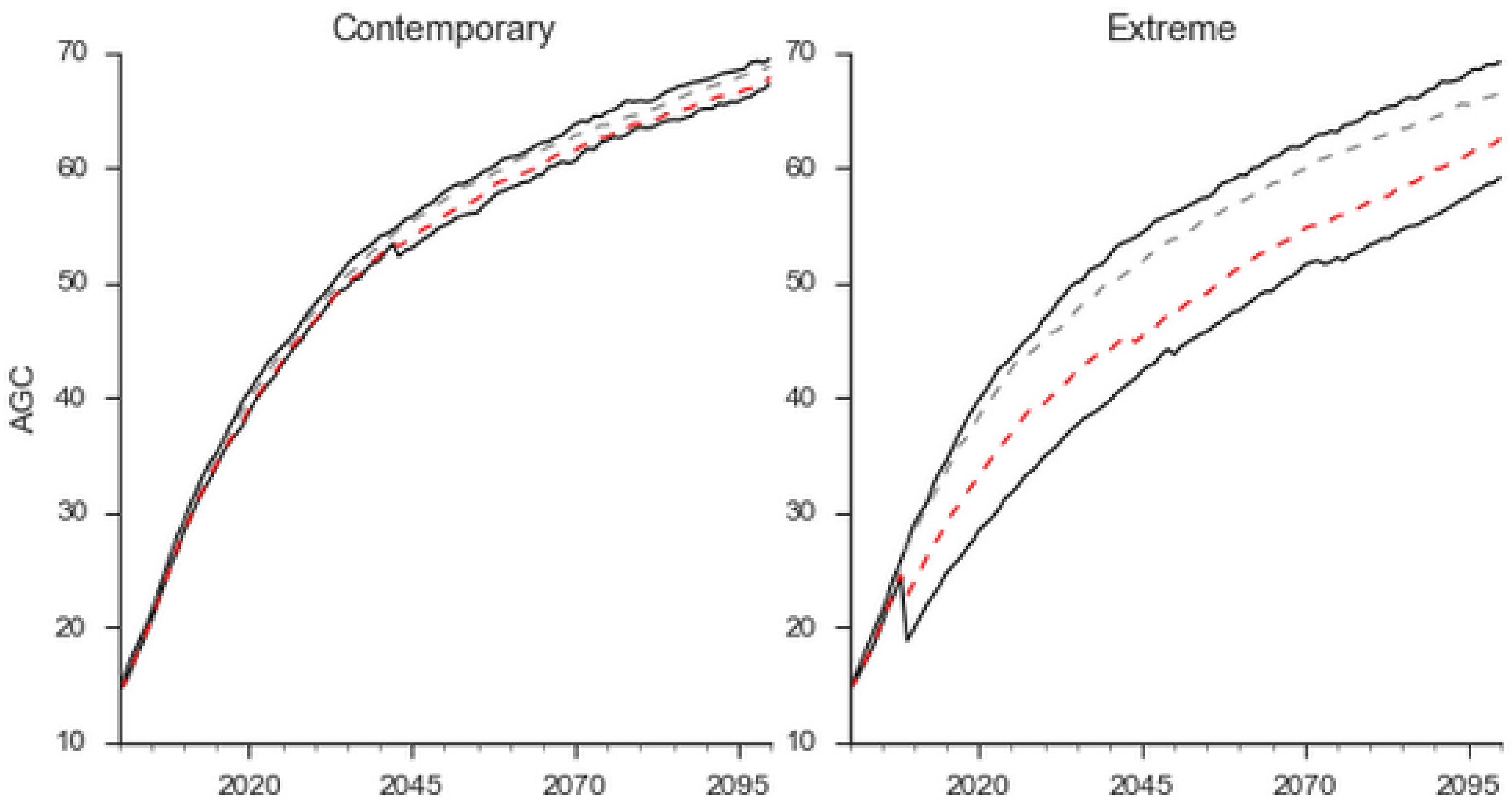
The final piece of getting wildfire behavior parameterized was the fuels. LANDIS-II currently handles this using a version of the Canadian Fire Behavior and Prediction System, where initial spread index and build up index result in fire rate of spread surfaces. I rebuilt all that code and made my own figures to convince myself it looked reasonable. Keep in mind, the age of the stand is associated with physical properties like canopy base height, etc, so the fuel type for a given grid cell changes with succession (time) or disturbance (treatment, wildfire, etc). For the swamps, since there's basically no information out there aside from 'when its really hot and dry, the swamps rip' heuristic understanding from the OSNF folks, I tried to build a quick bifurcation from basically no ROS to insane ROS, irrespective of buildup index. This way, under the hottest and driest conditions, initial spread index should allow fire to spread over and into swamps no problem.



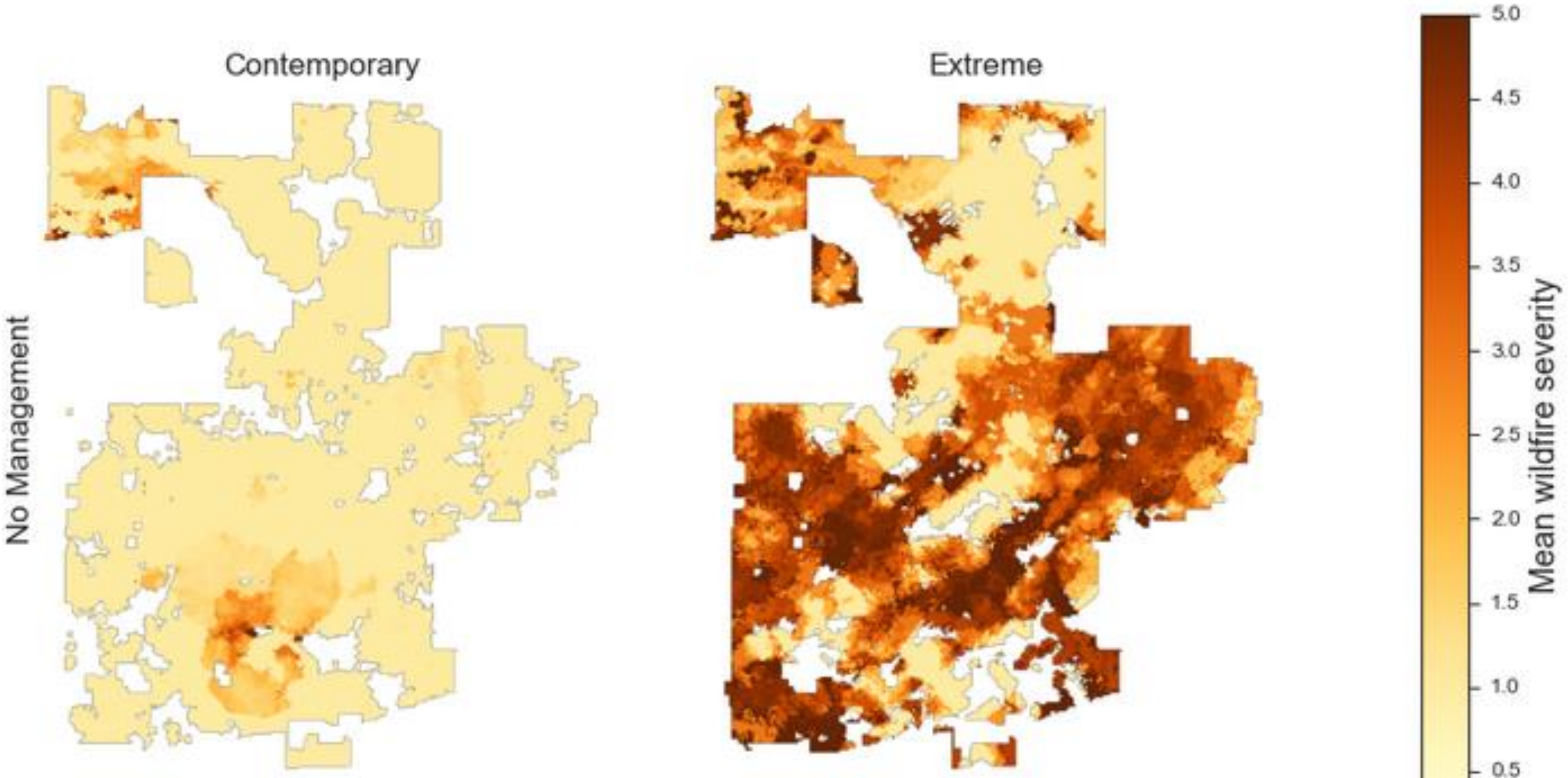




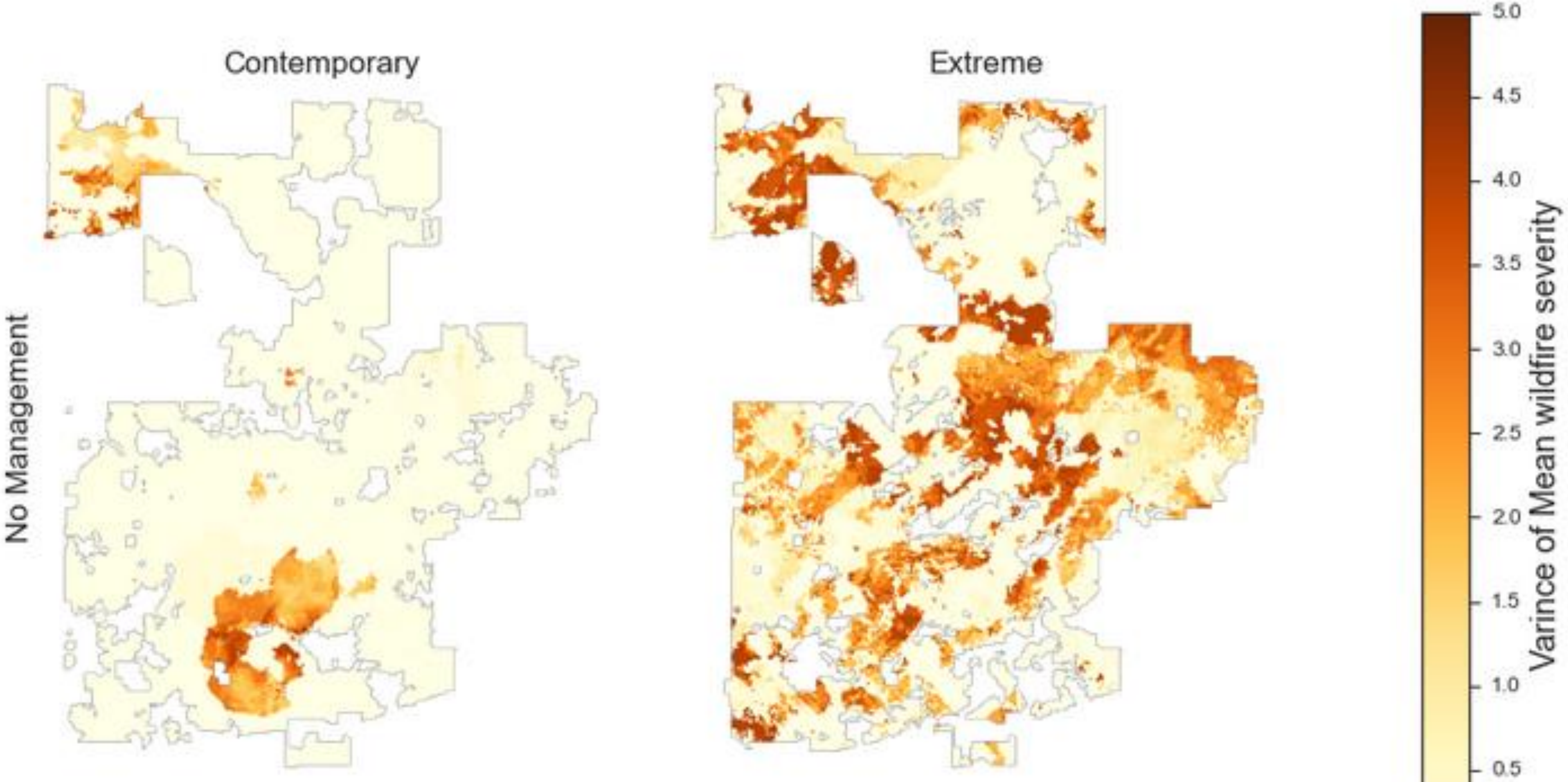




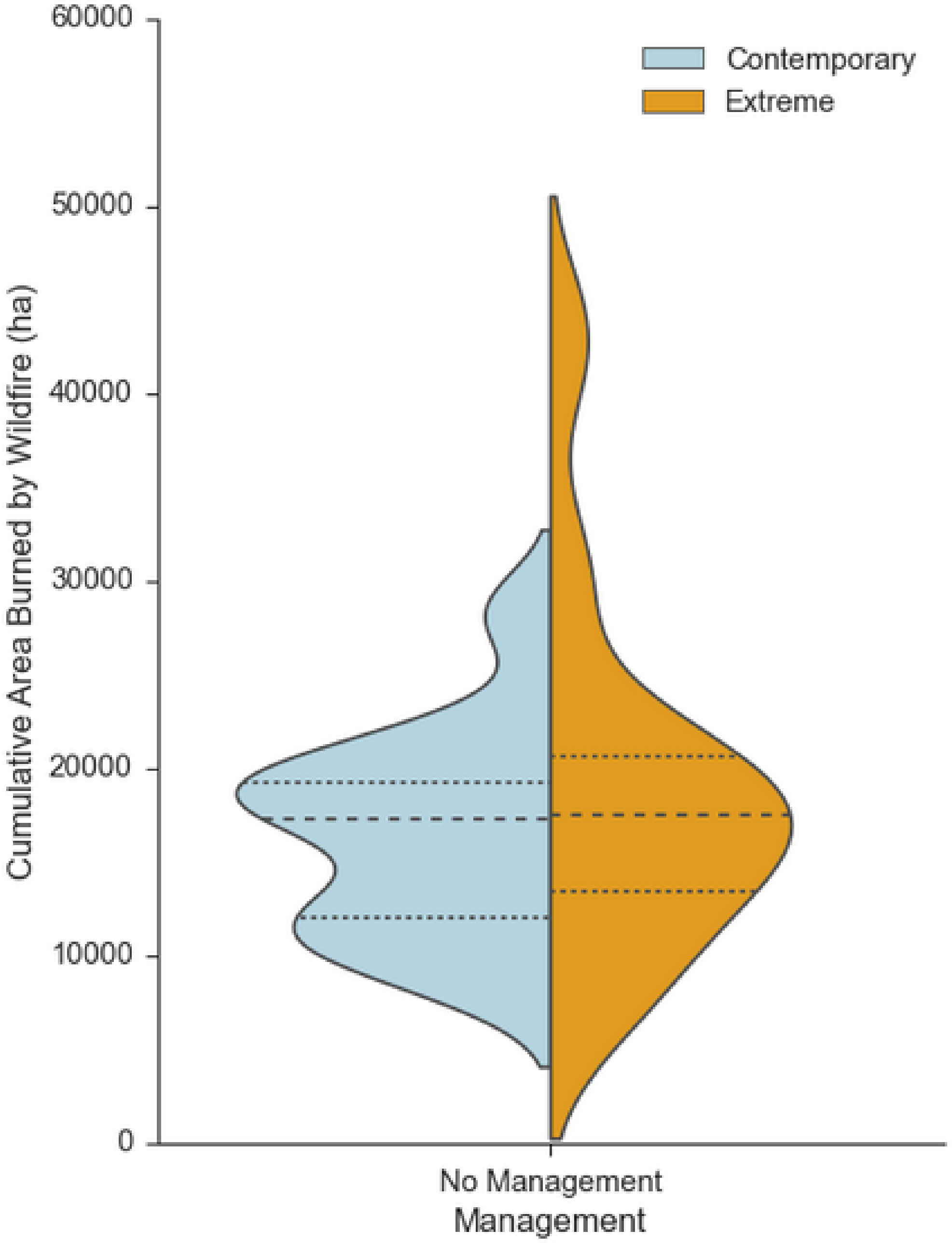
Initial runs showing the maximum, minimum, mean (gray dash), and lowest 95th percentile (dashed red) for above ground carbon across the entire OSCF (here in Mg C per hectare), look promising. This figure was created taking the 12 replicate simulations that we have finished and for every time step, plotting the maximum AGC (minimum, mean, etc.) in any of those 12 reps. This way you can get a better sense of the possible range of outcomes instead of a mean and confidence interval for example. The left plot is the simulation run with draws from unadulterated RAWS fire weather. The right plot uses the 'extreme' 90th percentile RAWS weather for the entire simulation. We're not using projected weather or anything, so ignore the X axis, its just running for 100 years.



Another useful output to compare the two simulations is mean wildfire burn severity. In LANDIS this ranges from 0 (no fire) to 5 (more than 90% of the canopy was killed). These rasters represent means of 12 replicates and 100 years a piece. Note, that here we exclude 0's from the analysis – meaning these figures only answer the question **'When a grid cell burns, what is the mean severity with which it burns?'**



Same as before, but here we're looking at the variance of each grid cell's mean wildfire severity. This is heavily affected by low numbers of replicates, and once we have all 30 finished the story will be a bit cleaner – but generally speaking, more variable, high severity is what we have seen under extreme fire weather in the past.



Violin plot of cumulative area burned in each replicate. These are kernel density estimates derived from the 12 replicates of each fireweather. These will flesh out as well once we get all 30 replicates finshed. Take home however, again, is slightly higher mean (3 quartiles are shown in the dotted lines in the middle) but much larger variance in cumulative area burned. These sums are over 100 year periods. Once we have a couple treatment options built up, we'll include those distributions as well to really tell the story.