WFDSS Modeling Tips

Introduction

There is no intention to limit creativity--there are many ways to use models correctly. However, if you are unsure of how much you can push the system without breaking it, use the guidelines provided here. There is no shame in asking another fire behavior person (LTAN, FBAN) to look over your run and provide input! Ask someone you know, or call Analysis & Decision Content Support at 208-387-5253.

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Modeling….In General

- Understand the **question**
- This is a surface fire spread model; attempting to replicate **plume-dominated** fire spread violates the assumptions and limitations.
- Talk to locals or **observe** fire behavior to help you calibrate the model.
- Yes, **calibrate**.
- If spread is inconsistent, consider not using models at all and arrive at decisions using "**persistence**," especially if you find the models continually over-predicting for small amounts of growth. Remember, each pixel is 30-240m and if the fire isn't growing a lot it may not even grow one pixel wide in a burn period.
- Consider using Basic or ST to figure out what weather or fuel **triggers** are going to show active/passive crown fire before jumping right into NT modeling.
- Use Scott and Burgan's "Standard Fire Behavior Fuel Models" guide, Table 7 to remind you which fuel models are **dynamic**--the live fuel moisture values will impact how these fuels behave.
- The models assume no **suppression**.
- There is no modeled **interaction** among adjacent fires.

Figure 1. The Question: What movie should we watch tonight?

LCP Extent & the Goldilocks Rule, Not too big, not too small!

There used to be a pop-up if you drew a really large, fine (30m) LCP...but not anymore. These are recommendations--each situation is unique:

- Use **60m if LCP is 10-20 miles** in extent.
- Use **90m-120m (or more) for 20-30 mile** extent.
- Use **270m if >30-mile extent**; start at 270m for the initial run, see how it goes, then consider 120m….or 90m (minimum).
- If >30m LCP edge, consider modeling flanks in separate runs.

Figure 2. Goldilocks is happily napping on her perfectly-sized LCP.

We've seen LCPs at 30m for 115-mile extents on 14-day FSPro runs….this kind of setup is never going to finish. Think about the purpose of the run and what you are going to do with the results and how fast you need them.

Ensure you have enough room for the fire to spread without hitting the landscape edge...AND without going too big on the LCP (use STFB or a coarse NTFB to get some rough estimates on LCP size).

High resolution LCPs need to do a lot of pre-calculating for EVERY pixel. How can you reduce pixels? Extent. Resolution. Modify burned area to FM99.

"A journey of a thousand failed runs begins with an LCP having too many cells." - Anonymous

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Use Spotting like Table Salt

Spotting should be the last knob you turn. Calibrate to surface spread without spotting; add a dash of spotting a little at a time to spice things up.

Spot % is just a number and has no real-world meaning. Yes, it's hard to come to terms with. It cannot replicate Haines Index. Over-use of spotting can void all your hard-earned calibration!

Better to ***modify a fuel model to get an increase*** in surface spread. Fuel models are fire-behavior-based, not vegetation-based...if the forest is burning like sawgrass, use sawgrass (OK, that's extreme, but you get the idea).

Models will run faster and when fire activity changes, the model is likely to stay 'tuned up' and need fewer calibrations as weather inputs, not spotting, do the driving.

Figure 3. If this picture represented Scott & Reinhardt CFM at .15 on a 30m LCP it would be habenero powder.

Table 1. If crown fire is modeled at a cell (passive or active)

NTFB = more embers	FSPro = fewer embers
16 embers *lofted* from each vertex (LCP resolution mesh) according to…oh, just read documentation in FlamMap Help> Reference Stuff.	16 embers *generated* from some vertices (LCP resolution mesh), and only one ember chosen to be lofted from that vertex & travel random distance (0-max)
A portion of *embers* randomly selected by the user-set probability.	A portion of *nodes* randomly selected to launch embers based on user-set probability.
Embers are tracked until they land; if land on burnable fuel, they ignite 100% of the time.	Embers are tracked until they land; if land on burnable fuel, they ignite 100% of the time.
Start low (0.02); this is lower than you would set percentages with FSPro	Same process at STFB (can use ST for calibration), which is MTT. Can usually set higher than NTFB.

PIG and Spots

The spotting inputs are just numbers for the computer and, unfortunately, are not tied to field calculations we are familiar with, like Probability of Ignition (PIG).

To complicate things, values are different between Short-Term/FSPRO and NTFB (Table 1).

In NTFB, spotting is maxed at 15%. A rough crosswalk for NTFB spotting vs. PIG follows (inputs increase exponentially):

1% input = 5% PIG

5% input = 40% PIG

10% input = 80% PIG

15% input = 100% PIG

Figure 4. Pigs are real. Percent spotting inputs in models are not.

Polygons do Not burn Inward

Keeping this in mind can help you simplify your run and it will process FASTER.

NTFB only burns outward from a polygon ignition, even if there is more than one poly.

There is little need to apply a mask to the burned area **if you are using a polygon ignition(s),** unless you want to eliminate initializing calculations for those cells.

IF you use the perimeter to make the interior unburnable, **CHECK that the ignition isn't in the black** before launching. To be clear, it's OK to have ignitions in the black, but not if you were expecting them to ignite.
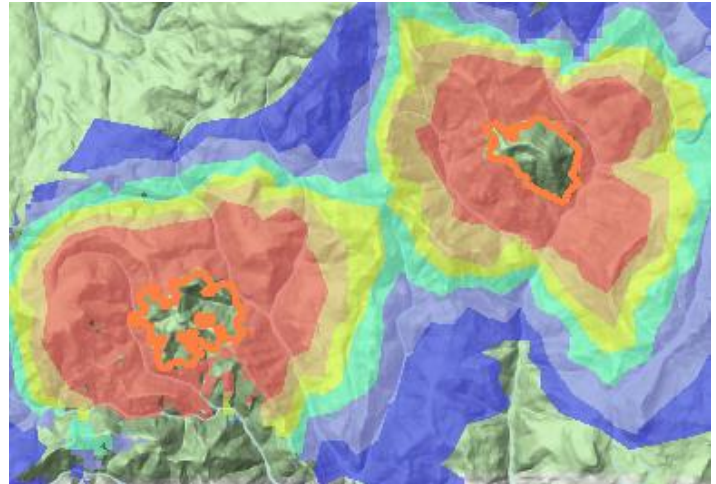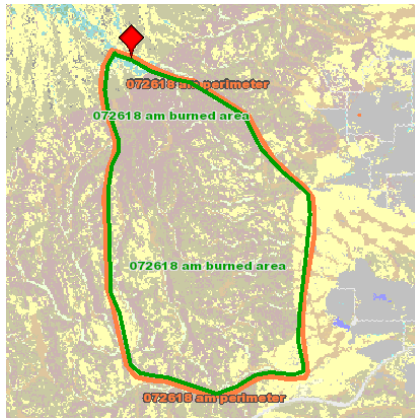

Figure 5. These fires burned ONLY outward with no masking of the LCP to make burned area FM99 and no barrier file to prevent the burned area from burning. This works well to make runs FAST!

There's no need to use a "barrier" to represent burned area, and then adding a polygon ignition "around" the barrier. This can SLOW your run or inhibit your ignition file.

Figure 6. The barrier here doesn't do anything since the poly ignition won't burn inward...no harm, just not necessary. IF you use the same file for the green and orange line, any overlap is going to be a problem, though.

Use Care When Masking with an Ignition Shapefile

This is usually an issue when you use the fire perimeter as the LCP Mask to create Fuel Model 99 for the burned area, and then use that same perimeter as the ignition. Landscape edits are applied to the *__square pixels__* and *__ignitions are polygon lines__* on top of that grid. If the same shapefile is used as an ignition and mask only about 20% of the perimeter will ignite (those portions of the ignition line that cross over unburned landscape corners between squares).
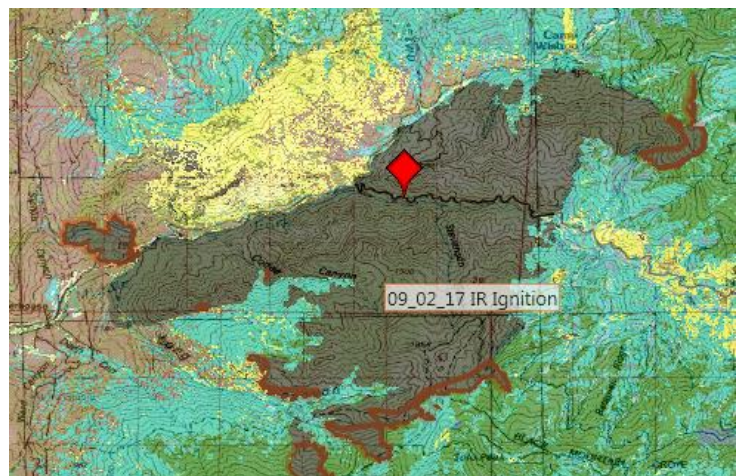

Figure 7. The entire ignition is in the black. We've all done it! We get in a hurry and forget to check that this isn't going to do much at all....

Add to your workflow to CHECK THE SETUP before you launch. You may not know the run failed for several hours and you'll have to wing-it for your briefing...

Ignitions—Finding Your Zen

1. Avoid drawing ignitions that criss-cross over your barrier--zoom in and take care when hand-drawing barriers and ignitions so they don't cross.
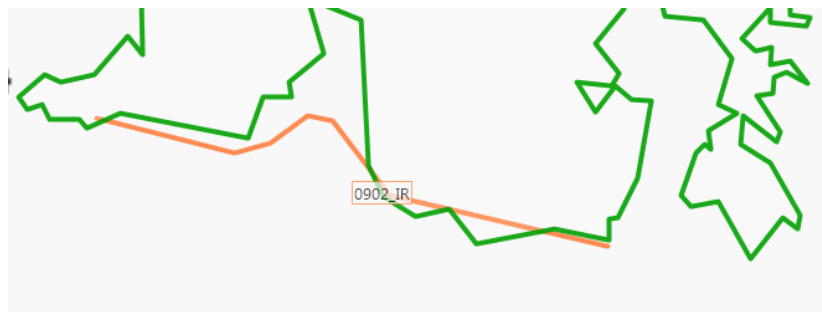

Figure 8. Criss-Cross makes math hard!

2. Can complex ignitions be simplified? Fig A. will burn all those small polys outward, constantly merging and untangling in between where it's probably already burned. One way to remedy this is to make that interior FM99 and let the ignitions poke out around the edges of the black. Fig B. shows a simple line using the ignition in Blue, another potential solution.
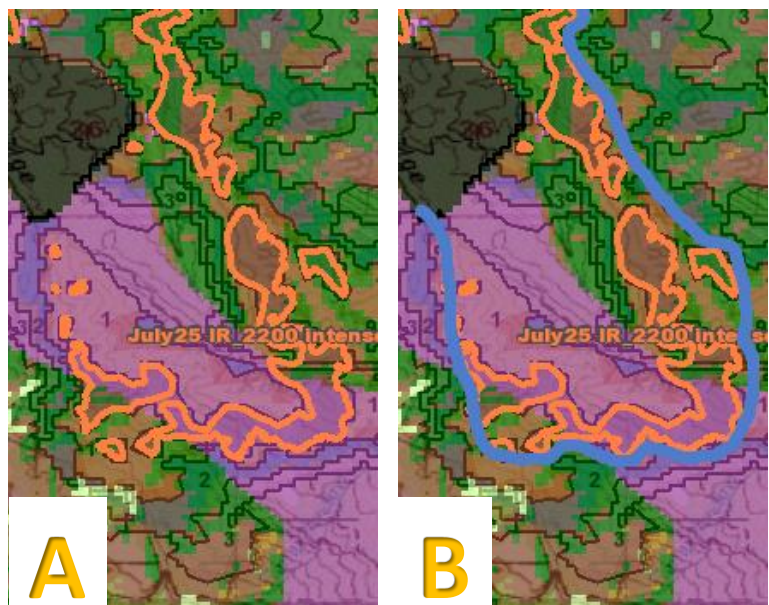
3. Are you igniting FM99? This happens when using the same shape for LCP edits and the ignition. Remember, Vector vs. Raster data.
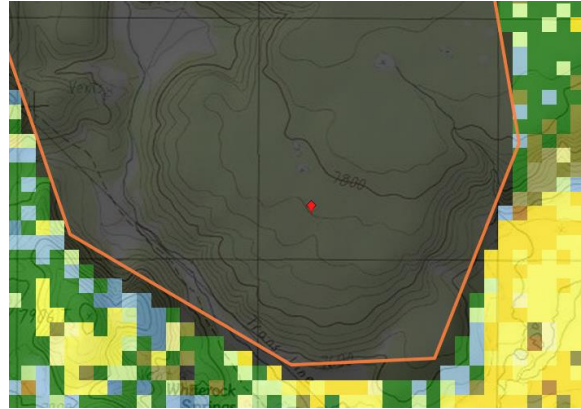

Figure 10. Remember, the shapefile "cuts out" the burned cells using pinking shears, not razor blades.

4. Draw a single polygon poking out of the black where there's heat. Four short lines would burn out into unburned, but ALSO "in" toward the black…the poly shown here won't. Using little dashed line ignitions around the burned area requires NT to calculate spread between the ignition and the burned area. This takes the model time to resolve without providing valuable output. Instead, overlap polygon ignitions slightly onto "burned area" to avoid creating unburned gaps between ignition and the unburned area.

Figure 11. The "daisy" or "fidget spinner" method...one poly to represent inconsistent heat around the fire perimeter.

5. Sometimes IR shapefiles have several fires lumped into one shape. **If** you're only running one of those fires, don't make all of them into ignitions. We're not sure if this "confuses" NT, but these runs seem to take longer. And don't cut an ignition in half with your LCP...this violates the SOP of avoiding ignitions too close to the edge of the LCP anyway.
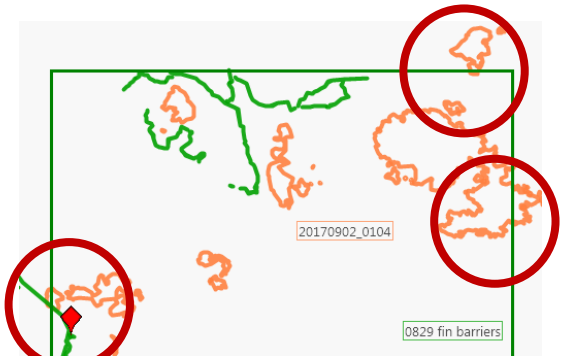

Figure 12. Regardless of other settings, this is going to take a long time to run because of these ignition placements.

Take a minute to pull up your LCP and overlay the ignition, barriers, and current fire perimeter.

Use LCP Critique--are your edits there?

Figure 13. In this example, the line ignition will burn outward in both directions.
The LCP wasn't changed to reflect burned pixels...will the results be useful?

A one-minute check can be worth HOURS of your time :)

Near Term Fire Behavior

NTFB is the most computationally intensive model in WFDSS.

- It conditions dead fuel moistures every hour inside and outside of the burn period for every cell on the landscape. E.v.e.r.y. C.e.l.l.
- It models spread every hour of the burn period by drawing vertices and lines for the fire front and all spots. NTFB creates points and lines for every hour of spread. When these bump into rock, the landscape edge, barriers, spots, or other fire they force the application to do some very complex math to merge the tangles into one fire.

Figure 14. Tangles are a drag!

- When fires grow together or hit unburnable or landscape edge, all tangles and overlaps must be calculated for each hour (computationally intensive).
- We cannot see the spotting output and may not realize the run is creating literally, MILLIONS of spot fires with certain fuel types/inputs.
- WFDSS has much more machine power than a single desktop running FARSITE, but models with intense inputs can still take hours, or days, to run.

There are ways to set up analyses to help them run faster!

LCP Resolution: Implications in NT

High Resolution slows NTFB because:

Figure 15. Sometimes low resolution works just fine!

- More vertices are created that each generate more embers.
- Every cell must be conditioned for every hour of every burn period.
- NTFB default resolution is at 30m, which is fine for a basic polygon ignition <10,000 acres but typically too fine for larger more complex runs, especially with high spotting.
- Unless picking up scattered rock is important on a landscape, a slightly larger resolution (60m) usually has negligible impacts on the final output.
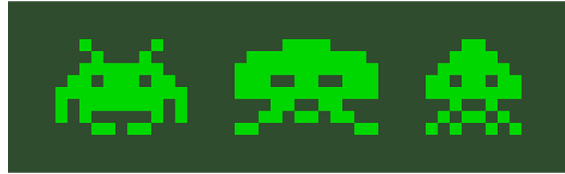
Remember: 60m is four times coarser than 30m, not double...your analyses will run at least four times faster.

Stick to 3 days when you can

NTFB lets you model out 5 days. Sometimes you need to do that and it makes sense. Consider, if you are on a full suppression fire, whether or not it really makes sense to model out that far. If you are going to brief the product every single day with an updated NT, it might be better to just run 3 days....remember, the 5th day is built on lots of compounding assumptions (and no VLAT availability).

Figure 16. ....said no LTAN ever.

It's totally acceptable to run 5 days--especially if you are delivering a product on a small fire where they are looking for an initial product to make a go/no-go decision, or you are tapped and can only provide products every few days. Grass could go with even fewer days--three max...especially if it's a suppression fire.
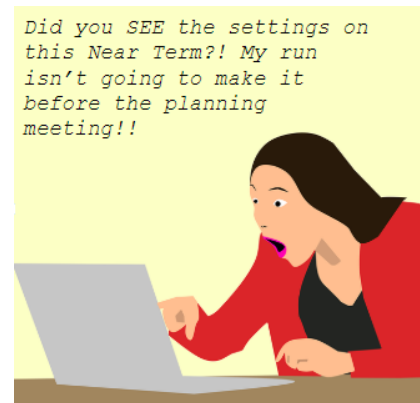
The load on the system improves for everyone if people who CAN live with 3-day runs STICK to 3-day runs.

Check the Weather

It's soooo easy to just click the RAWS and hit save. Sometimes we don't stop to look at what we've just told the model to do.

Click on the Weather Summary>Hourly Records and **at least SCAN the data**. Does it look reasonable? Are winds opposite of what you anticipated?

Is anything missing? If so, is something wrong with the station? Check Mesowest, KCFast, or the NWS.

FSPro

FSPro: Weather

Weather uses constant for the entire day.

If you only see red it's because all the days were set to use weather instead of climatology; **one rule of thumb: use max ⅓ days as weather and the rest left to chance (climatology).**

To model a weather scenario (e.g. cold front), FSPro is not likely the best choice. It uses climatology, not weather. Yes, you can add a few days of "weather", but this just locks in one ERC, Wind speed, and Wind direction for the burn period. In this case, it's better to use Near Term or Short Term.

Figure 17. This is a 7-day run with 7-days of weather--DON'T DO THIS unless you have a specific need...maybe?

FSPro: Things to Remember

- There is no fuel moisture conditioning by slope or aspect.
- Foliar moisture is set at 100% and uneditable.
- No gridded winds.
- If you don't see any pink on your results, you aren't modeling the rare event. The number of iterations depends on the question. Do you want "most likely" event? A few hundred may do. Do you want "rare event"? 1000 is the minimum in most cases; 3000 is good; 5000 only if you can afford to do the time and are sure you will use the result. 5000 is not to be trifled with!
- If you are seeking the rare event, it's a really good idea not to approve outputs where the pink goes well off the map. It's just not good form.
- Check this out--Mark Finney talks FSPro: https://www.youtube.com/watch?v=Pr_v2HBm3_Q
- You can run a very long simulation (30 days), but is it necessary? You will likely have new information in a week that would prompt a new run. Think about fuel moistures over 30 days--is the run valid?
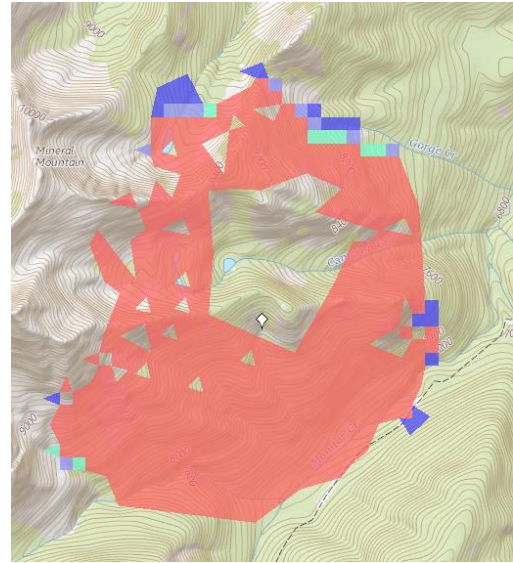

Figure 18. If it helps, make yourself a checklist to run through before setting up your analyses and hitting "go".

Getting Help

- **WFDSS Self-Help**: https://wfdss.usgs.gov/wfdss_help/index.htm The Help content is up to date and provides detailed information about all aspects of WFDSS.
- **Local expertise** may exist on your unit or surrounding units, consider checking locally for assistance when needed.
- **The WFDSS Helpdesk** can be reached at: IIA-Helpdesk@fs.fed.us or 1-866-244-7677 (call here for password resets).
- **Geographic Area Editors (GA Editor)** have been identified for each region and can often provide assistance with decisions, aid in analysis, or at a minimum assist the unit in finding resources who can assist. The GA Editor role is a regionally designated individual who has editor privileges and oversight of incidents throughout a region. This user role can grant privileges requested by various users throughout a region. For steps on how to do this refer to the WFDSS Help section Finding Your Geographic Area Editor, https://wfdss.usgs.gov/wfdss_help/WFDSSHelp_Find_GA_Editor.html.
- **Click Feedback**: Click "Feedback" in the upper right corner of WFDSS and we will respond (see next topic).
- **Analysis and Decision Support Hotline**: The Wildland Fire Management Research Development and Application unit https://www.wfmrda.nwcg.gov or 1-208-473-8107 helps with all aspects of WFDSS technical issues, decision support and analytics.

Feedback

This button is in WFDSS at the top right of almost every page. We want you to send in feedback if you need help, you've got something to share, or you have a complaint. There are a lot of folks on that email chain, so you should take care to keep your comments professional, but don't hesitate to send it.

Sending Feedback makes things a bit easier for us because we get a message with all the details--the browser you're using, a link to your analysis, and any problematic shapes that you are dealing with are attached. Also, while we only have one designated person on the "bat phone", we have lots of folks who can watch feedback and respond.

We appreciate any inputs to this document. Thanks to all of those who contributed.

Last update: 6/27/19