Fire Modeling in Alaska during an extended dry fire season, 2009
Thoughts from a Long Term Analyst

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Background

The 2009 fire season in Alaska was characterized by numerous fires in the coastal and interior areas, very dry conditions, and an extended period without rain beyond the normal fire season. This afforded the opportunity to model fire behavior using the recently developed/updated landscape fuels maps with FSPro within the Wildland Fire Decision Support System (WFDSS) under more extreme conditions. Following includes some observations, questions, and recommendations developed during my detail at the Alaska Interagency Coordination Center (AICC) from July 24 through August 6. I focused on probabilistic fire behavior modeling using FSPro. Several other fire behavior specialists had the opportunity to work in Alaska in 2009 and they should be contacted as well: Brian Sorbel, NPS; Tonja Opperman, NPS; Rick Stratton, Systems for Environmental Management; Bret Fay, BLM; Jim Hutton, NPS; Brenda Wilmore, USDA FS; Marsha Henderson, Alaska Division of Forestry; Frank Cole, Alaska Division of Forestry; and John Barborinas, BIA.

Summary

Probabilistic fire behavior modeling shows some promise for Alaska; however, much calibration is necessary, more so than in the lower 48 states, at least during extended dry periods.

Fuel models and characteristics appear to be reasonable for many vegetation types; however, some adjustments may be necessary, particularly during extended dry periods.

Weather stations provide significant support for fire behavior modeling; however, it can be difficult to find a representative station, depending on fire location. This may be more problematic in interior than coastal areas.

Energy Release Component (index used in FSPro) shows a faster decline than Drought Code or Build Up Index in August, potentially requiring some additional adjustments within FSPro.

Specifics

<u>Calibration of FSPro</u>.

One method of determining reliability of FSPro outputs is to calibrate the model by simulating one fire in a time period for which you have an actual starting and ending fire perimeter (See calibration documents on Zitziana fire by Rick Stratton). By using the actual weather that occurred as forecasted weather in the model and setting the number of fires to 1, the model should depict fire growth similar to that which actually occurred. I attempted calibration runs for the Wood River, Jagged Edge and Minto Fires. FSPro greatly under predicted fire movement for all three fires, a potential result of too little wind, too high of fuel moistures, and or conservative fuel models. By using the maximum winds between 1000 and 2000 for each day from the Nenana ASOS station, the recommended canopy characteristic adjustments in fuel model 164 and the recommended fuel model changes in fires from 2000 – 2008 (see recommendations from Stephen and Sorbel),, the model produced a reasonable calibration. One interesting note was that there was a vast difference between fire spread for a seven day run when the only difference between the two runs was a wind of 16 mph versus 15 mph on one day. Likely 16 mph is the crowning index (i.e. wind speed at which active crown fire occurs). Unfortunately the Nenana weather station is unavailable for use in FSPro.

Calibration of Minto fire required the change of the 102 grass fuel model to 103. After considering the rapid rate of backing fire spread, the high moisture of extinction, the depth of the dry duff, and the characteristics of the fuels, I decided that the humid grass models may better predict fire spread. The calibration using 103 slightly over predicted fire spread, but was more reasonable than with fuel model 102.

Calibration of the Jagged Edge fire was accomplished also by changing the grass fuel models to fuel model 103, increasing burn period, and decreasing live fuel moistures for every ERC bin. There was still some slight under prediction and perhaps 104 or 106 may function better; however, these were not tried. Another difficult issue with the fires near Circle is that the Crazy Mountains have a topographic effect on the winds, channeling many winds so that they are predominantly west winds. The Bluff, Jagged, and Paddle fire all experienced large runs to the east with a strong west wind.

<u>Observations regarding inputs to fire behavior models</u>

Fire Danger Indices

Alaska generally uses the Canadian Fire Danger Rating System (CFDRS) while FSPro requires the National Fire Danger Rating System (NFDRS), particularly ERC. Comparing ERC to Drought Code (DC) or Build Up Index (BUI) for several weather stations shows that ERC tracks parallel to DC or BUI during May, June and early July. In late July through August ERC declines at a faster rate than the Canadian indices. Since the time series in FSPro develops potential seasons that trend from existing conditions toward average, assessments completed in late July and August may use higher fuel moistures, shorter burn periods, and less spotting than actually exist, particularly for long assessments. There are several ways to ameliorate this issue: modify the fuel moistures, burn periods, and spotting probabilities for each ERC bin and add ERC bins to include the 50th and possibly the 40th percentile ERC or set the assessment date to earlier in the year to avoid the declining ERC trend. This would only be appropriate in an extended fire season.

Modifications to ERC bins

Modifications to the live fuel moisture, burn periods, and spotting probability were necessary and were done as follows:

Herb FM	Woody FM	Burn Period	Spot Prob
30.0	50.0	720	0.30
32.0	55.0	720	0.30
34.0	60.0	600	0.25
36.0	65.0	600	0.25
38.0	70.0	540	0.20
40.0	75.0	540	0.20

These values were chosen based on calibration work completed by Rick Stratton and discussions regarding live fuel moistures. Live fuel moistures fluctuate predominantly through the season based on the phonological stage as well as soil moisture conditions. Because it was late season and soils were very dry, the fuels in the highest ERC bin were considered cured. The moisture values do not greatly increase as ERCs lower because it is unlikely that live fuels at this time of year would experience a significant change in fuel moisture over a short period of time. Burn periods and spotting probability were increased to reflect actual and apparently actual conditions. These adjustments appeared to better reflect fire growth during this time period, but may not be appropriate during a normal fire season.

Fuel models

The fuel model map used in FSPro is one generated from LANDFIRE existing vegetation type map and the AWFCG fuel model crosswalk. In the interior, there is a significant amount of the area modeled as 161. This should be reviewed as this may not reflect actual fuels and may result in under estimating fire behavior. Previous guidance for modification of fuels in fire since 2000 (not reflected in LANDFIRE) was modified to reflect the fact that many fires were burning through portions of the 2004 fires. Thus fires from 2007 – 2008 were modeled as 181, 2005 – 2006 fires as 161, and 2000 – 2004 fires as 142. After a drive to Circle and review of previous as well as viewing fire perimeters on GoogleEarth, it is clear that a blanket fuel model change in previous fires does not capture the different intensities and post fire vegetation response. Some areas that burned in 2004 were fields of fireweed with moss on the surface while others were grass and shrub.

Robert Ziel (state of Michigan) had recommended the use of fuel model 145 in place of 164, particularly during dry years. The difference in fire behavior is substantial; however, this change may better reflect fire behavior during the extended season. I did not have sufficient time to try this modification.

While reviewing the vegetation types, fuel characteristics including duff, moisture of extinction, and fire behavior, I pondered the use of the humid fuel models. I did change many of the grasses that were close to surface water to grass model 103 and considered other models as well.

Future work related to fire behavior prediction

The 2009 Alaska fire season afforded an outstanding opportunity to test the use of fire behavior models, particularly FSPro in Alaska. During my detail I developed several questions that lead to future work in fire behavior science in Alaska. Following are items for consideration for graduate students and or fire behavior specialists in Alaska.

Fire Danger Indices and Fire Growth Indicators

There may be several issues related to the use of ERC in FSPro. Because Alaska generally uses the CFDRS and there are trend differences between the indices in each system, work should be done to determine the effect of using ERC in FSPro. Specifically:

- How many stations are managed for NFDRS and what are the implications of using NFDRS indices from a station that isn't managed for NFDRS?
- Which indices are most effective in correlating with fire behavior and are most appropriate for use in fire behavior prediction?
- Will there be better calibration in FSPro using CFDRS rather than ERC?
- What is the impact to FSPro outputs resulting from the faster decline of ERC versus a CFDRS index?

If it can be demonstrated that there are significant differences between CFDRS and NFDRS based outputs and that CFDRS based outputs more accurately reflect fire behavior in Alaska, then there is a need to petition WFDSS developers to incorporate a method to accommodate CFDRS based calculations.

Review Rod Norum's work on large fire growth thresholds and determine if those thresholds are the same that have occurred recently or need modification. Make these thresholds readily known, determine frequency of occurrence in the recent past compared to the more distant past, and during fire season note when they are forecasted. In light of climate change, a comparison between recent and more distant past may help frame people's personal reference which for those with many years of fire experience includes cooler, moister periods.

Review past seasons to determine indicators of season outlooks. It was discovered that some fire danger indices in 2009 followed a very similar trend to 2004. Are there patterns that emerge that might help inform season outlooks.

Develop season ending event criteria and season ending event probability curves for various portions of Alaska.

Fuels

Fuel models should be reviewed and validated, particularly when the new LANDFIRE data becomes available. I recommend using some of the 2004 and 2009 fires, including fires with large and small growth to determine the ability of the LANDFIRE data to model actual fire spread. By doing this in the winter season, the landscape can be adjusted to better reflect actual conditions. Additionally, I recommend conducting a LANDFIRE assessment/calibration workshop to review the landscape and the rules that drive the fuel model assignment. This workshop can look at where the initial data is not performing well, using a group of Alaska fuel experts review and modify the rules for fuel model assignment, create a new fuel layer, and the test the new layer in fire behavior models. Although one is not scheduled, it is the intent of LANDFIRE to conduct such a workshop in January or February 2010 (Kris Lee, RMRS Missoula Fire Science Lab is the contact)

Additional work on fuels includes review of the humid models and consider their use for some of the grasses and deciduous forest fuel types. Research how soil moisture affects not just fuel moisture, but fuel model. The Okefenokee NWR has a similar fuel structure with a deep duff layer. Fuel availability is dependent on the water table so fuels are depicted with two different fuel models depending on the water table. Alaska may experience a similar phenomenon where the duff moisture is not simply reflected in the live and dead fuel moistures, but is such that the fire behavior is best modeled using different fuel models based on the moisture conditions. Also consider having a fuel moisture sampling grid. And maintain a log of disturbances and management actions that is used to update the fuels information for the landscape files.

Information Presentation and Management

AICC has established a great schedule of briefings, including a weather briefing. Consider including a little predicted fire behavior summary with the weather briefing. This would include where and in what conditions to expect the most active fire behavior and perhaps where there may be values at greatest threat from fire for the day or near future. This would be somewhat generic, meant to cue the fire behavior analyst or long term analyst on each fire to pay particular attention to those areas to develop specific forecasts for each fire.

Consider displaying some fire behavior output maps that may be of benefit when determining priorities for resources. The conference room at AICC is a potential location.

Maintain a fire progression data base that can be used to calibrate and adjust mapped fuel characteristics, determine large fire growth events, determine fire effects, and be used in future research. The Citrix database may be sufficient as long as the data is appropriately archived.

Maintain a fire behavior log documenting observed fire behavior, fuel conditions and weather parameters.