Alaska Seasonal Strategic Analysis Tool

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Chris Moore, AFS, Tanana Zone
Kato Howard, AFS, Fuels
Heidi Strader, AICC Predictive Services
Sharon Alden, AICC Predictive Services
Robert Ziel, Alaska Fire Science Consortium
Executive Summary

The Seasonal Strategic Analysis Tool is designed to help managers evaluate incident duration when making long term decisions. In the late 1980s Dan Burrows plotted a worse case fire season in Alaska tracking BUI (Buildup Index) and DMC (Drought Moisture Code) throughout the fire season and highlighting thresholds and important events during each phase. This tool is an updated version of the Burrows graph. With the use of the Alaska Fire and Fuels database (https://akff.mesowest.org/) this general graph has been updated and customized for each Predictive Service Area (PSA), but still uses the four phases of the fire season as a framework.

Along with updated graphs, each PSA was analyzed for historical dates when the BUI fell below 80 and did not recover for the rest of the season. These dates were then broken out into percentiles. These values, in conjunction with the graphs, can give fire managers the opportunity to compare the current fire season BUI values to historic averages, and examine the current phase of fire season in relation to historic MODIS fire detection counts to aid in decision making.

Available long term weather data, the number of RAWS stations, and correlations made to BUI are stronger in the Interior Boreal Forest of Alaska than on the west coast in the tundra fuel types. As more data becomes available, analyses will continue to track fire season trends and update findings as necessary.
Introduction

There have been many efforts to define and characterize Alaska's fire season. Fire season in Alaska is normally very episodic: periods of dryness followed by periods of rain, coupled with great yearly fluctuations make it challenging to summarize. A typical fire season in Alaska has fuels drying to burnable levels during the end of May and the beginning of June. Lightning starts to become prevalent by the end of May and into early June, often bringing the historic peak of fire season. By the middle to end of July southwest flow begins and the Interior of Alaska begins to receive regular rains which typically end fire season. Not every year follows this trend. During some seasons, regular rain keeps fuels below burnable levels, and during others southwest flow ends early or does not materialize and August is dry enough for existing fires to once again become active. This tool is another step towards quantifying Alaska's fire season, building on information that has been previously summarized and using newer tools to help improve the analysis.
Alaska’s Fire Season Categorized

Alaska’s fire season is characterized as having four distinct phases. Using the Canadian Forest Fire Danger Rating System (CFFDRS) as a way to track season changes, the Alaska fire season can be broken down into: Wind Driven, Duff Driven, Cumulative Drought, and Diurnal Effect. These four phases are highlighted by the characteristic which defines the fire behavior and spread.

**Wind Driven Season** - April 1 to June 10. Highlighted by pre green-up conditions. Mainly a problem in grass and tundra fuel types during high wind events with low temperatures and low humidity. Usually ends after green-up as upper duff layers begin to dry and carry fire. The lower duff layers have not had a chance to dry, resulting in mainly surface fire.

**Duff Driven Season** - June 11 to July 9. Usually affects the upper levels of duff. Fire is normally not burning more than 4-5” in depth, but more than surface fuels are becoming involved. Resistance to control increases as the season continues and the duff continues to dry.

July 10th is historically the Conversion Date. Based on the Alaska Fire Management Plan, managers discuss converting lands in a Modified suppression option to a Limited suppression option. This conversion is based on weather trends and whether or not normal weather patterns are setting up to increase the amount of precipitation received in the Interior. If weather patterns are “normal”, this typically signifies the end of large fire growth. Not uncommon (2004, 2005, 2009, 2010, 2013) is that after significant rain events, August dries and fires that were dormant begin to spread. If this occurs, then the next phase of the fire season becomes significant.

**Cumulative Drought Season** - July 11 to August 15. Fire season normally ends with precipitation events at the end of July or beginning of August. If fire season does not end by significant rains, the deeper layers of duff continue to dry and become more involved in burning. Fire becomes increasingly difficult to suppress as resistance to extinguishment increases. Significant rain is needed to stop fire spread. Fires can easily become active again after moderate precipitation. Lightning usually subsides in the beginning of August but existing fires can continue to burn under cumulative drying.

**Diurnal Effect Season** - August 16 to September 30. As the summer winds down, Alaska sees rapid loss in daylight coupled with lowering solar angle. This reduces solar heating and greatly diminishes the burn period, but high levels of drought can enable fire spread even though the burn period is greatly reduced. Cooler nights require more heating for fuels to carry fire. Even with very dry deeper fuels, the increase in darkness and cooler nights begins to slow fire spread as the burn period decreases. Despite the loss of burn period, this is also the time when hunter fires can become prevalent or fires that have been dormant for long periods can become active.
Predictive Service Areas (PSA)
Predicted Service Areas are geographic areas that are delineated based on similarities of fuels, weather, and topography. Alaska is divided into 18 different Predictive Service Areas. This paper does not address PSAs that do not currently have a significant fire season or enough weather stations to perform adequate analysis. PSAs that were not analyzed were North Slope (AK00), Southeast Alaska (AK15,16,17), and Kodiak Island (AK18). Lower Kuskokwim (AK07) was combined with Kuskokwim Valley (AK09) due to AK07 only having one RAWS station, Innoko Flats (NKOA2), with a weather record of more than 20 years.

Correlating FWI Values and Strategic Analysis of the Alaska Fire Season
Together, FFMC and BUI represent the total fuel available for combustion. A strong correlation has been noted between MODIS detections (representing significant fire growth), and fuel moisture conditions using Fine Fuel Moisture Code above 88 and Build Up Index above 80 as shown in the graph below and published here: https://www.frames.gov/documents/catalog/ziel_et_al_2015_modeling-fire-growth-potential.pdf

At least 80% of MODIS detections in Alaska have occurred under these conditions, which can be correlated to active fire spread. These same thresholds were used to calculate the end of historical fire seasons. The main criterion is BUI. Most typical fire seasons were considered at an end when the BUI fell below 80 and remained below 80. For seasons that did not reach a BUI of 80, a secondary threshold of 70 was used to capture a fire season that may not have been as active, but still had fire growth. For seasons that did not reach a BUI of 70, no season
ending date was recorded. An additional criterion is the FFMC, which is used to describe an end to a particularly dry season, when the BUI does not fall below 80 even after September 1st. Though the FFMC is not a long term indicator of drought, when used in conjunction with the BUI at this time of year, it helps simulate the Diurnal Effect. A dry late summer and early fall with a higher BUI does not necessarily denote conditions that support fire spread. The diminishing daylight and dropping temperatures will limit fire growth in spite of very dry lower fuels. Therefore, targeting the time frame where the FFMC stays below 88 recognizes the shorter, cooler days will limit fire spread.

Historical season ending percentiles were calculated for each PSA based on available weather station data from the Alaska Fire and Fuels database. Season end dates were analyzed for each weather station for each year available in a PSA. These dates were then entered into the Term module in RERAP 7.03. As data for more years become available, the term files will be updated.

Applicability and Use
The graphs in Appendix A provide historical ranges for BUI, Average BUI, and MODIS detections by week, framed in reference to the four phases of the Alaska fire season and two historically significant fire seasons for the PSA. Tracking seasonal progression will help place the current fire season in a well referenced historical context.
Appendix A: Information by PSA
Probability of BUI falling below 80 and remaining below 80.

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<tr>
<td>50%</td>
<td>8/5</td>
<td>Cumulative Drought-Resistance to Extinguishment</td>
</tr>
<tr>
<td>75%</td>
<td>9/4</td>
<td>Diurnal-Short burn window, good RH recovery</td>
</tr>
<tr>
<td>90%</td>
<td>10/2</td>
<td></td>
</tr>
</tbody>
</table>

Stations analyzed:  
Alcan Hwy MI-1244 (ALHA2) 1994-2017  
Dry Creek (DRY) 1994-2017  
Northway (PAOR) 1994-2017  
T Lake (TEEA2) 1995-2017  
Jatahmund Lake (TETA2) 1994-2017  
Tok (TKFA2) 1994-2017  
Tok River Valley (TKRA2) 1999-2019
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<tr>
<td>90%</td>
<td>9/30</td>
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Stations analyzed:
- Angel Creek (AGLA2) 1999-2017
- Chatanika (CHTA2) 1994-2017
- Caribou Peak (CPKA2) 1998-2017
- Fairbanks (FRBA2) 1997-2017
- Good Pasture (GDPA2) 1997-2017
- George Creek (CECA2) 1999-2017
- Fort Greely (PABI) 1994-2017
- Fairbanks Airport (PAFA) 1994-2017
- Nenana (PANN) 1994-2017
- Salcha (SLRA2) 1999-2017
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<tr>
<td>50%</td>
<td>8/17</td>
<td>Cumulative Drought-Resistance to Extinguishment</td>
</tr>
<tr>
<td>75%</td>
<td>9/8</td>
<td>Diurnal-Short burn window, good RH recovery</td>
</tr>
<tr>
<td>90%</td>
<td>9/26</td>
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</table>

Stations analyzed:

- Helmut Mountain (AWRA2) 1994-2017
- Ben Creek (BENA2) 1994-2017
- Birch Creek (BIRA2) 1999-2017
- Chalkyitsik (CIKA2) 1998-2017
- Chicken (CKNA2) 1999-2017
- Eagle (EGYA2) 1994-2017
- Graphite Lake (GRFA2) 1995-2017
- Hodzana (HOZA2) 1994-2017
- Little Black (LBKA2) 2000-2017
- Lost Creek (LSTA2) 2000-2017
- Preacher Creek (PCKA2) 1994-2017
- Salmon Trout (SMTA2) 1994-2017
- Vunzik Lake (VNKA2) 1995-2017
- Beaver (WBQA2) 1994-2017
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<td>Cumulative Drought- Resistance to Extinguishment</td>
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<td>75%</td>
<td>8/29</td>
<td>Diurnal- Short burn window, good RH recovery</td>
</tr>
<tr>
<td>90%</td>
<td>9/19</td>
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Stations analyzed:  
- Kanuti (KANA2) 1994-2017  
- Norutak Lake (NRUA2) 1995-2017  
- Bettles (PABT) 1994-2017  
- Seven Mile (SMIA2) 1994-2017
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</thead>
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| 25%        | 7/4       | Duff Driven-
             |                        | Resistance to control |
| 50%        | 7/26      | Cumulative Drought-
             |                        | Resistance to Extinguishment |
| 75%        | 8/19      |                        |
| 90%        | 9/8       | Diurnal-
             |                        | Short burn window, good RH recovery |

Stations analyzed:
- Livengood (LIVA2) 1999-2017
- Lake Minchumina (LMHA2) 1994-2017
- McKinley River (MKLA2) 1994-2017
- Poorman (PMNA2) 1994-2017
- Tanana (PATA) 1994-2017
- Round Lake (RNDA2) 1994-2017
- Wonder Lake (WONA2) 2000-2017
- Wein Lake (WNLA2) 1994-2017
### Probability of BUI falling below 80 and remaining below 80

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<tr>
<td>50%</td>
<td>7/24</td>
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<tr>
<td>75%</td>
<td>8/6</td>
<td>Cumulative Drought-Resistance to Extinguishment</td>
</tr>
<tr>
<td>90%</td>
<td>8/17</td>
<td></td>
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</tbody>
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Stations analyzed:  
Kavat Creek (KAVA2) 1997-2017  
Kelly (KELA2) 1994-2017  
Noatak (KTZA2) 1995-2017  
Ambler (PAFM) 1994-2017  
Kotzebue (PAOT) 1994-2017  
Kiana (SRKA2) 1994-2017  
Selawik (SWKA2) 1994-2017
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<td>50%</td>
<td>7/22</td>
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<td>75%</td>
<td>8/5</td>
<td>Cumulative Drought - Resistance to Extinguishment</td>
</tr>
<tr>
<td>90%</td>
<td>8/16</td>
<td></td>
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Stations analyzed:
- Cottonwood (COTA2) 1994-2017
- Hogatza River (HOGA2) 1994-2017
- Kaiyuh (KAIA2) 1998-2017
- Koyukuk (KOYA2) 1994-2017
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<tr>
<td>75%</td>
<td>8/11</td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>8/25</td>
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Stations analyzed: Haycock (HAYA2) 1994-2017
Hoodoo Hill (HDOA2) 1994-2017
Nome (PAOM) 1994-2017
Quartz Creek (QRZA2) 1994-2017
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</tr>
<tr>
<td>90%</td>
<td>8/21</td>
<td></td>
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Stations analyzed: Innoko Flats (NKO2A) 1994-2017

This station was included in analysis for AK09 and probabilities are combined for both PSA’s.
Weather station data is marginal in western PSA’s (AK06, AK08, AK10). BUI is currently being used until more data is compiled for better analysis.

Stations analyzed:
- Bethel (PABE) 1994-2017
- Reindeer River (RDRA2) 1996-2017
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<td></td>
</tr>
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<td>90%</td>
<td>8/21</td>
<td></td>
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Stations analyzed:
- Farewell (FWLA2) 1999-2017
- Flat (MCWA2) 1999-2017
- McGrath (PAMC) 1994-2017
- Aniak (PANI) 1994-2017
- Stoney River 1994-2017
- Stoney 1999-2017
- Telida (TLDA2) 1994-2017
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<td>7/19</td>
<td></td>
</tr>
<tr>
<td>75%</td>
<td>8/3</td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>8/15</td>
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Stations analyzed:
- Port Alsworth (ALSA2) 1996-2017
- Kilbuck (KILA2) 1994-2017
- Dillingham (PADL) 1997-2017
- Iliamna (PAIL) 1994-2017
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<td>90%</td>
<td>8/11</td>
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Stations analyzed: Bentalit (BLSA2) 1999-2017
Talkeetna (PATK) 1994-2017
Willow (WOWA2) 2000-2017

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Stations analyzed:  
- Chisana (CSNA2) 1996-2017  
- Strelna (CXCA2) 1994-2017  
- Chistochina (CZOA2) 1994-2017  
- Klawasi (KLAA2) 1999-2017  
- Kenny Lake (KNY) 1994-2017  
- May Creek (MCKA2) 1995-2017  
- Gulkana (PAGK) 1994-2017  
- Paxson (PXKA2) 1997-2017  
- Renee (RENA2) 2000-2017  
- Slana (SSZ) 1994-2017  
- Tazlina Lodge (TZL) 1994-2017  
- Tazlina Village (TZV) 1994-2017
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Stations analyzed:
- Big Lake (BGQA2) 1994-2017
- Campbell Creek (CBKA2) 2008-2017
- Eagle Creek (ERVA2) 2009-2017
- Grazelka Range (GRZA2) 2005-2017
- Palmer (PAAQ) 1995-2017
- Anchorage (PANC) 1994-2017
- Pt. Mac (PMZA2) 2008-2017
- Rabbit Creek (RBTA2) 1994-2017
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Stations analyzed:  
- Broadview (BDVA2) 1995-2017  
- Granite (GRAA2) 2000-2017  
- Homer (HMEA2) 1994-2017  
- Kenai NWR (KNAA2) 1995-2017  
- Kenai Lake (KNLA2) 1998-2017  
- Ninilchik (NCKA2) 1994-2017  
- Kenai (PAEN) 1994-2017  
- Homer Airport (PAHO) 1994-2017  
- Skilak Guard Station (SGSA2) 2000-2017  
- Swanson River (SWNA2) 1995-2017  
- Soldotna (SXQ) 1994-2014  
- Soldotna (SDFA2) 2013-2017