EPSCoR Updates: Update on the Path to Constructing a Seasonal Outlook for Wildland Fire in Alaska

Uma Bhatt, Peter Bieniek, Cece Borries-Strigle, Jonathan Chriest


Alaska Fire Science Consortium Webinar, Tuesday April 9, 2020,
Presenters in Fairbanks Alaska via GoToMeeting

- Lightning - connect observations to lightning
- Summer Weather Outlook
EPSCoR Project Team

**Climate Variability**
- Uma Bhatt (co-lead)
- Peter Bienick

**Ecology**
- Todd Brinkman (co-lead)
- Krista Heeringa

**Economics and Ecosystem Services**
- Matt Berman
- Jen Schmidt
- Joseph Little
- UAA Terrestrial Faculty Hire

**Fire Management Expertise**
- Teresa Hollingsworth
- Robert Ziel
- Randi Jandt
- Alison York

**Remote Sensing and Fuel Mapping**
- Santosh Panda
- Martin Stuefer
- Chris Waigl (postdoc)
- UAF Remote Sensing Faculty Hire
Lightning ignites Alaska’s largest wildfires

- Lightning-ignited fires are responsible for ~90% of seasonal area burned totals
- Understanding if lightning activity has changed over time is difficult to assess since the sensor network has undergone multiple upgrades
- Better forecasting of lightning from hourly to seasonal to decadal scales would be beneficial for different planning horizons
Most lightning occurs in June-July

1986-2015 monthly lightning climatology

- For analysis: strikes counted on a 20km grid
- Multiplicity parameter summed to estimate strokes in pre-2012 data
- Most lightning activity occurs in June-July
- Correlated with model reanalysis estimates of convective precipitation

Bieniek et al (2020 submitted to JAMC)
Historical lightning activity has modestly increased

- Model estimates of seasonal lightning counts produced from meteorological predictor variables at Predictive Service Area scale
- June-July lightning increased by 17% over 1979-2015 based on reanalysis (ERA) estimate.
- Long-term projections of lightning from two GCMs (GFDL & CCSM) anticipate a 103-125% increase in lightning over 2005-2100 in the RCP8.5 scenario

Bieniek et al (2020 submitted to JAMC)
Recent Years PSA Scale Lightning Climatology

May  

June  

July  

August

- PSAs with the most lightning in June are further south and west
- PSAs with the most lightning in July are further north and east
- Interesting case: Seward Peninsula has seen more lightning in August than July in recent years
Hourly Distribution Of Lightning

Interior PSAs

Hourly Lightning Distributions of Interior PSAs

- Tanana Valley East
- Upper Yukon
- Tanana Valley West
- Tanana Zone-South
- Tanana Zone-North
- Kuskokwim Valley
- Middle Yukon
- Lower Yukon

Percent of Total Strikes vs Hour (AKDT)

Coastal PSAs

Hourly Lightning Distributions of Coastal PSAs

- Copper River Basin
- Matanuska Valley & Anchorage
- Kenai Peninsula
- North Slope
- Bristol Bay & AK Pen
- Koyukuk & Upper Kobuk
- YK Delta
- Seward Peninsula

Percent of Total Strikes vs Hour (AKDT)
Changes By Month

- Trend toward lightning later in the day, later in the summer
  - Not true everywhere
  - Most defined in the Eastern Interior
- Lower Yukon & YK Delta have relatively higher amounts of lightning overnight, particularly in August.
Terrain Is A Factor

Tanana Valley West

- Most lightning occurs near the valley floor.
- Higher density of lightning higher in elevation.
Part 2: Weather and lightning thresholds

### Summer Lightning-Weather Correlations - Fairbanks FMZ 2012-2019

<table>
<thead>
<tr>
<th>Weather Variable</th>
<th>Correlation to # of Lightning Strokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2m Dew Point</td>
<td>0.77</td>
</tr>
<tr>
<td>Convective Precip</td>
<td>0.68</td>
</tr>
<tr>
<td>Cloud Base Height</td>
<td>-0.28</td>
</tr>
</tbody>
</table>

- Determine thresholds below or above which lightning is unlikely.
- Boil down to model output variables for seasonal application.
- Quantify rules of thumb to improve daily and seasonal lightning forecasts.
- Questions?
  - Jonathan Chriest, jachriest@alaska.edu
March 2020 Seasonal Outlook

Cece Borries-Strigle
cjborries@alaska.edu

- Forecast seasonal fire activity (BUI) from March seasonal model forecasts
  - CFSv2 (NCEP, NOAA)
  - SEAS5 (ECMWF)
- Address model biases for temperature and precipitation
- Evaluate forecast (ROC scores)
  - Split BUI values into three groups/terciles
  - Evaluate each tercile separately
  - Evaluate each fire season separately
  - Slight skill for upper terciles, none for middle or lower terciles
Delta Method of Correction

Model temps too low

Calculate model anomalies

Add model anomalies to observed climatology
2020 Seasonal Forecast - PSA AK01W

Model Skill | Season | Tercile | Wind | Duff | Drought | Diurnal |
---|---|---|---|---|---|---|
CFSv2 | 0.440 | M | 0.495 | M | 0.395 | U | 0.409 | M | 0.356 | M |
SEAS5 | 0.376 | M | 0.393 | M | 0.422 | M | 0.342 | M | 0.325 | M |

No score > 0.5, no skill
2020 Seasonal Forecast - PSA AK02

<table>
<thead>
<tr>
<th>Model</th>
<th>Season</th>
<th>Tercile</th>
<th>Wind</th>
<th>Duff</th>
<th>Drought</th>
<th>Diurnal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFSv2</td>
<td>0.288</td>
<td>M</td>
<td>0.375</td>
<td>0.457</td>
<td>0.228</td>
<td>0.379</td>
</tr>
<tr>
<td>SEAS5</td>
<td>0.536</td>
<td>U</td>
<td>0.415</td>
<td>0.464</td>
<td>0.241</td>
<td>0.341</td>
</tr>
</tbody>
</table>

Entire season BUI avg. > 0.5, slight skill in SEAS5
2020 Seasonal Forecast - PSA AK14

**Model Skill**

<table>
<thead>
<tr>
<th>Model</th>
<th>Season</th>
<th>Tercile</th>
<th>Wind</th>
<th>Duff</th>
<th>Drought</th>
<th>Diurnal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFSv2</td>
<td>0.418</td>
<td>M</td>
<td>0.298</td>
<td>M</td>
<td>0.251</td>
<td>M</td>
</tr>
<tr>
<td>SEAS5</td>
<td>0.384</td>
<td>M</td>
<td>0.378</td>
<td>M</td>
<td>0.395</td>
<td>M</td>
</tr>
</tbody>
</table>

No score > 0.5, no skill
Seasonal Forecast Next Steps:

● Include one more seasonal forecast model in analysis
  ○ Increase in skill with multi-model ensemble

● Further analysis on forecast skill
  ○ Correct model variance
Take Home Messages and Next Steps

- Lightning likelihood has links to meteorology in observations, need to check with forecasts
- Skilled forecasts for high latitudes are a *challenge*
- Identify the predictability in observations for AK summer weather (Plug for upcoming postdoc position)
- Ultimate goal is to produce a seasonal outlook that includes information on climate, lightning risk and fuel conditions.

**Acknowledgements:** This work was supported by NOAA's Climate Program Office's Modeling, Analysis, Predictions, and Projections Program grant NA16OAR4310142. This material is also based upon work supported by the National Science Foundation under award #OIA-1753748 and by the State of Alaska.