Improving seasonal forecasting of Alaska wildfires

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NOAA Climate Diagnostics and Prediction Workshop, 23-25 October 2018, Santa Barbara, CA

Main Results

- Fire managers need seasonal outlooks for the upcoming summer by March
- CFSv2 requires bias correction to produce reasonable forecasts of the Canadian Fire Weather Index
- Seasonal lightning can be estimated by regression from reanalysis but is challenging for CFSv2

Motivation

- Summer wildfires can burn large areas and most of Alaska area burned due to lightning-ignited fires
- Few seasons have large area burned (> 1 million acres)
- Seasonal predictions of wildfire risk need to be improved for fire managers to plan
- NMME seasonal prediction models can be used to assess fire danger
- CFS ensemble forecasts need to be analyzed

Data and Methods

- CFSv2 6-hr hindcast/prediction data employed 1982-2017
- Lightning observations
- Dynamically downscaled ERA-Interim reanalysis (Bieniek et al. 2016)

Components of the Canadian Fire Weather Index System (CFFWIS)

- Analysis conducted by predictive service area (PSA) and climate division
- Alaska fire managers use PSAs to predict wildfire danger
- Alaska fire danger is measured by the Canadian Forest Fire Weather Index System (CFFWIS)
- Compute CFFWIS using the CFS/reanalysis and assess predictability

- CFFWIS driven by daily afternoon temperature, wind speed, humidity and 24-hr precipitation
- Calibrated in the boreal forest so it was easily applied in Alaska
- Need to develop outlooks for May-August CFFWIS using forecasts in late winter
- Lightning is a key ignition source for large wildfires and outlooks of ignition risk are also critical

CFWVs2 bias corrections needed for wildfire danger thresholds

- CFSv2 March forecasts for May-August used to calculate CFWWIs
- Model is too wet and cool and results in much lower values of BUI than observed
- Temperature and precipitation were corrected by Quantile Mapping (QM)
- QM of the model increases BUI to expected range of values
- Improved forecast BUI magnitude for 2015 extreme season but missed late-season BUI peak in 2004

Observed lightning linked to reanalysis predictor variables

- Lighting observed at a ground station network 1986-present
- Homogenization of data needed through time due to changes in the network
- Most lightning strikes occur in Interior Alaska
- May-Aug Interior average convective precipitation from reanalysis is correlated with seasonal lightning totals
- Regressions are developed to diagnose weekly lightning with predictor variables from reanalysis
- Reanalysis normalized first to remove bias
- Regressions conducted on PSA-scale

Seasonal lightning prediction is challenging

- Normalized CFSv2 variables applied to PSA regressions for March, April and May to produce predictions of June-July lightning
- Low correlation between observed lightning and ensemble mean regression output
- Correlations between CFSv2 ensemble mean and reanalysis predictor variables by PSA and averaged over Interior Alaska show positive correlation between convective precipitation and 850-500hPa dT with lower values for dewpoint and temperature
- Lowest correlation for 500hPa heights
- Low model skill makes producing lightning outlooks difficult

Summary

- Bias corrections required for CFSv2 to reproduce CFWWIs observed magnitudes
- Quantile mapping of daily temperature and precipitation used for correction
- Weekly lightning prediction regressions produced for each PSA using reanalysis
- Low predictability with CFSv2 is a barrier for seasonal lightning and CFWWIs outlooks
- CFSv2 predictions of Jun-Jul 500hPa height have the lowest skill of all lightning predictions evaluated

Next Steps:
- CFSv2 hindcast evaluation by PSA to assess forecast skill
- Spatial evaluation of CFSv2 lighting predictor variables vs. reanalysis
- Fire managers want gridded outlooks: how can we provide those?

References


Acknowledgements

This work was supported by the Alaska Climate Adaptation Science Center through a Cooperative Agreement DE-AC02-05CH11231 from the USDOE, NOAA’s Climate Program Office’s Modeling, Analysis, Predictions, and Projections Program, NA19ARAR130142, and NSF EPSCoR grant OIA-1737448.