SUMMARY REPORT

Assessment of Indicators for Coastal Zone Fire Risk

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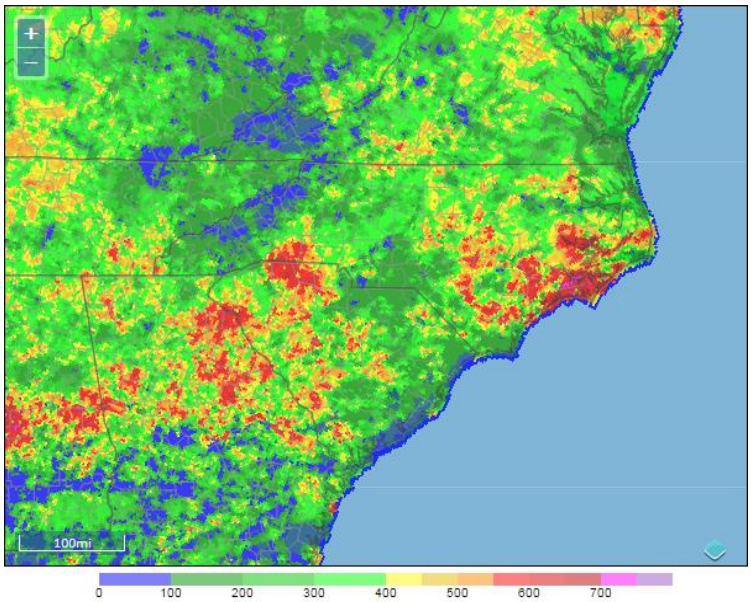
The organic soils in eastern North Carolina have a complex composition and are often found in regions with subtle but meaningful terrain differences. These soils can burn and smolder easily, even several feet underground. Because of this, existing measures of near-surface dryness and fire risk such as drought indices and National Fire Danger Rating System parameters have traditionally been viewed as poor indicators of fire and smoldering risk in organic soils. A further investigation of organic fire risk indicators was conducted as part of this NIDIS-funded project.

One commonly used fire risk parameter is the Keetch-Byram Drought Index (KBDI), which estimates dryness in the uppermost eight inches of the soil. KBDI has historically been available only at RAWS-standard weather stations, so much of eastern North Carolina did not have direct coverage. Using daily radar-derived precipitation estimates from the National Weather Service and daily maximum temperature and annual average precipitation data from the PRISM dataset, a gridded KBDI dataset was created at 4 km resolution for the period beginning in March 2007.



Gridded KBDI data for July 31, 2011

A comparison with the RAWS KBDI observations showed that the gridded data generally underestimates values, with annual maximum values 136.65 points lower in the gridded dataset, on average. This difference is likely due to the underestimation of maximum temperatures in the PRISM dataset and/or a warm bias in RAWS temperature observations.

Several gridded indices, including KBDI, daily precipitation, and the Standardized Precipitation Index (SPI) over one- to four-month periods, were then compared with fuel and soil moisture data from an experimental Estimated Smoldering Potential (ESP) dataset. This ESP data was collected intermittently from 2012 to 2014 from three coastal stations in the Pocosin Lakes National Wildlife

Refuge in Hyde County, in the Alligator River National Wildlife Refuge in Dare County, and near Green Swamp in Brunswick County. The results showed that all three indices were only weakly correlated with the ESP data. Separate comparisons using RAWS Energy Release Component (ERC) data using both fuel models G and O also showed only weak relationships with the soil moisture observations from the ERC dataset, as seen by the results in the table below.

	Alligator River (n = 349)	**Allen Road** (n = 278)	**Green Swamp** (n = 51)
Soil moisture vs. 1-month SPI	0.253	-0.075	0.833
Soil moisture vs. 2-month SPI	0.483	-0.235	0.725
Soil moisture vs. 3-month SPI	0.479	-0.316	0.648
Soil moisture vs. 4-month SPI	0.391	-0.352	0.711
Soil moisture vs. gridded daily precipitation	0.017	0.125	0.091
Soil moisture vs. gridded KBDI	0.372	-0.331	-0.563
Soil moisture vs. ERC (fuel model O)	-0.116	-0.057	-0.254
Soil moisture vs. ERC (fuel model G)	0.147	0.011	-0.217

Correlation coefficients (r) for analyses with soil moisture data from ESP arrays and other gridded and point-based datasets.

The weak correlations are likely because these indices cannot capture the terrain, drainage, and composition of organic soils. To that extent, few to no existing indices can model this combination of environmental and non-meteorological characteristics. Because of this, no single index based on current widely available data is likely to be a consistent indicator of organic fire risk. A combination of monitoring recent NFDRS parameters to assess surface fuel burning, local soil sampling, and groundwater levels is recommended until further improvements are made.

Additional research may suggest better options. A study in progress by Jim Reardon (Rocky Mountain Research Station) and Gary Curcio (Montgomery Community College Prescribed Fire Training Center) is examining remotely sensed soil moisture data as an indicator of smoldering in organic soils. The deployment of soil moisture probes across eastern North Carolina could also establish a reliable sensor network and provide a longer period of record than the ESP stations. Along with providing a finer-scale monitoring network in this part of the state, this would allow for a more robust comparison with existing datasets to search for good indicators of organic fire risk.

The gridded KBDI dataset should become a valuable monitoring tool, especially for assessing response and mop-up with lightning-caused fires, in non-organic regions since it provides local estimates between weather stations. Additional evaluation of temperature datasets may suggest a more accurate option than the daily PRISM data. If a daily relative humidity dataset was also found, gridded 100-hour and 1000-hour fuel moisture and ERC datasets could also be created.