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AFSC Research Brief
2018-4

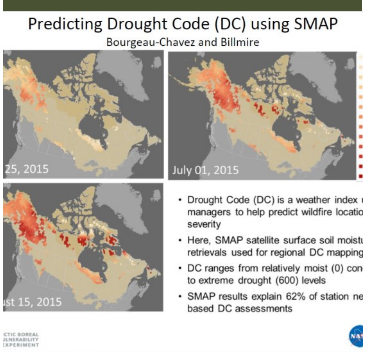
NASA Making Contributions to Alaska Fire Science & Management

Randi Jandt, *Nov. 23, 2018*

NASA ABoVE website: **https://above.nasa.gov/**

Top: Hank Margolis slide showing just how many space sensors NASA has!

Below: Excerpt from Bourgeau-Chavez presentation[5] on SMAP soil moisture *vs.* the Drought Code.



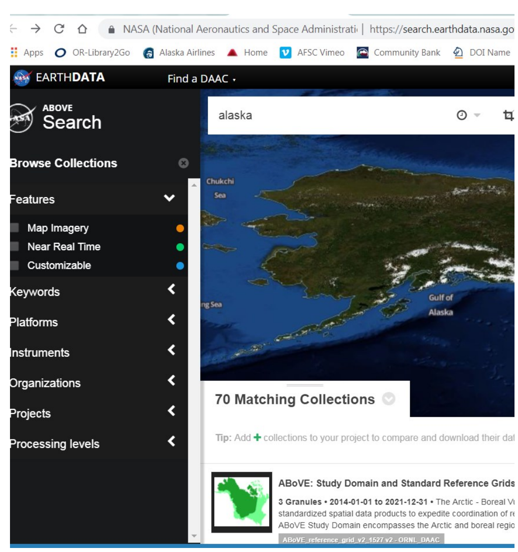
See all Posters/Abstracts from the 2018 ABoVE Science team meeting: <HERE>

The Arctic-Boreal Vulnerability Experiment (ABoVE) field campaign funded by NASA's Terrestrial Ecology Program began in 2015. Its science objectives are to 1) *improve understanding of Arctic and boreal ecosystem response to environmental change*, and 2) *provide data for informed decision-making to guide societal responses*. Disturbance from wildfire is one of ABoVE's six science themes. The research campaign (expected to continue until at least 2023) has already conducted many field studies related to wildfire as well as testing new air– and space-borne sensors for fire detection/monitoring/ effects and deriving information on fuels, permafrost, and snow/ice cover.

Fire Severity & Fire Effects Studies

Although there are way too many projects to cover in one brief, here are a few highlights from the last couple years. Christopher Potter studied thaw depth, soil moisture and soil temperature in burned/unburned interior spruce forests (near Tanana) after the 2015 fires in Alaska[1]. His team found deep consumption of forest floor moss led to substantially warmer (14-18° F) and wetter soils at 4-12" depth. And the new ice-free profile in severely burned forest areas was 20" deeper than in unburned forest soils!

Another study focused a large field effort on Northwest Canada after the record-breaking 2014 fire season. Investigators measured 213 field plots for burn severity, consumption and fire effects over a large area roughly encircling Great Slave Lake, and the results have now been published [2,3]. In a nutshell, their findings confirm results from earlier studies in Alaska, namely that 90% of biomass consumed was not in the trees but in the "soil organic layer" or duff and that older black spruce stands tended to contribute more total emissions but younger stands had proportionally more of their (lesser) stores of accumulated biomass consumed[2]. The latter result implies that more frequent burning will reduce the long-term C storage in boreal forests. Interestingly, the researches noted that not masking out small to medium waterbodies in coarse-scale burn area estimates (>500 km pixels)—used for consumption and C emissions estimations—leads to overestimation of burn area by up to 25%. This caveat holds for Alaska and Canada agency fire perimeter database estimates of burn



Find archived ABoVE data at NASA Data Centers in the Earthdata portal.

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area as well! Even with Walker et al.'s more conservative estimates, the amount of carbon released by the NWT fires of 2014[2] (94 ± 8 Tg) equates to *over ten times* the amount sequestered annually by boreal forest ecosystems of Alaska (8.3 Tg C year)[4].

A continued area of interest is the utility of satellite-derived subsurface duff moisture data (*aka* SMAP) for verifying fire weather and risk indices. Laura Bourgeau-Chavez and her team presented a great poster on that at the 4th ABoVE Science Team meeting[5].

Gerald Frost is studying the little-known fire history of the Yukon-Kuskokwim Delta, and finding differences from other boreal and tundra ecosystems[6].

Big Datasets Now Available

NASA takes the archiving and public utility of datasets from the ABoVE campaign very seriously. Every investigator is required to post their data to the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC). So far they've published [64 ABoVE datasets](), including airborne, field, and modeling products at the ORNL DACC. Now, instead of project-scale data on permafrost, snow cover, post-fire dNBR we can access this data on a regional, state, or North America boreal scale. Fire-specific data sets appear in the figure on the right (as of 2018) but there are many other datasets which may be useful to management. How about the extent of surface water over the last 20 years, or the last day of spring snow in Alaska from 2000-2016? Thaw depths at burned *vs.* unburned sites? Date of burning (using satellite MODIS detections) of fires across Alaska from 2001-2015? This kind of "Big Data" has not been available to us in the past and will surely be useful for further scientific query and trend analysis.

turbance (7 datasets)

entries

Filter:

Fire Disturbance ABoVE dataset	Published	User Guide	Download
ABoVE: Landsat-derived Burn Scar dNBR across Alaska and Canada, 1985-2015	2018-07-13		
ABoVE: AVHRR-Derived Forest Fire Burned Area-Hot Spots, Alaska and Canada, 1989-2000	2018-02-14		
ABoVE: Wildfire Date of Burning within Fire Scars across Alaska and Canada, 2001-2015	2018-01-30		
ABoVE: Burn Severity, Fire Progression, and Field Data, NWT, Canada, 2015-2016	2017-09-27		
ABoVE: Cumulative Annual Burned Area, Circumpolar High Northern Latitudes, 2001-2015	2017-09-20		
ABoVE: Ignitions, burned area and emissions of fires in AK, YT, and NWT, 2001-2015	2017-06-21		
ABoVE: Burn Severity, Fire Progression, Landcover and Field Data, NWT, Canada, 2014	2016-05-11		

to 7 of 7 entries

Listing of NASA ABoVE fire-related datasets as of Nov, 2018. See the latest list at: https://daac.ornl.gov/

More to Come!

The ABoVE research campaign is expected to continue until at least 2023, so we are just seeing the "tip of the iceberg" with respect to published studies and datasets. Personal relationships between field managers and eminent scientists and ecologists may be equally important to research results, and new management tools from remotely sensed indices (for soil moisture or snow-off date data, for example) are already coming online.

CITATIONS

[1]Potter, C and C Hugny. (2018) POSTER: Wildfire Effects on Permafrost and Soil Moisture in Spruce Forests of Interior Alaska. 4th ABoVE Science Team Meeting, Jan. 23-26, Seattle, WA. https://above.nasa.gov/meeting_jan2018/above_mtg2018_stm4_poster_agenda.html

[2]Walker, XJ, BM Rogers, JL Baltzer, SG Cumming, NJ Day, S Goetz, JF Johnstone, EA Schuur, MR Turetsky, and MC Mack. 2018. Cross-scale controls on carbon emissions from boreal forest mega-fires. Global Change Biology 24(9): 4251-4265 . doi: 10.1111/gcb.14287 *(Mack TE 2014)*

[3]Walker, XJ, JL Baltzer, SG Cumming, NJ Day, JF Johnstone, BM Rogers, K Solvik, MR Turetsky, and MC Mack. 2018. Soil organic layer combustion in boreal black spruce and jack pine stands of the NWT, Canada. Intl. J. of Wildland Fire 27 (2): 125-134.

[4]McGuire, D, H Genet, A Lyu, N Pastick, S Stackpoole, R Birdsey and Z Zhu. 2018. Assessing historical and projected carbon balance of Alaska: A synthesis of results and policy/management implications. Ecological Applications 28(6): 1396-1412 . https://doi.org/10.1002/eap.176

[5]Bourgeau-Chavez,L, M Battaglia, W Buller, M Billmire, K McDonald, C Hanes, L Jenkins, J Kimball, R Jandt and J Buckley. (2018) POSTER: Retrieving Soil Moisture from Satellite Microwave Sensors for Fire Danger Assessment in Boreal and Arctic Regions. 4th ABoVE Science Team Meeting, Jan. 23-26, Seattle, WA. https://above.nasa.gov/meeting_jan2018/above_mtg2018_stm4_poster_agenda.html

[6]Frost, G, L Saperstein, R Loehman, K Sowl, M Macander, P Nelson and D Paradis. (2018) POSTER: Ecosystem Dynamics and Succession after Tundra Fire, Yukon-Kuskokwim Delta. 4th ABoVE Science Team Meeting, Jan. 23-26, Seattle, WA. https://above.nasa.gov/meeting_jan2018/above_mtg2018_stm4_poster_agenda.html

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