# Journal Supporting Information

**Article Title:** *Repeat short-interval fires put carbon storage at risk in Interior Alaska**via cumulative combustion of soil carbon*

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## S1. Allometric equations

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| Table S1. Allometric equations used to calculate aboveground biomass, reported by species. Y represents aboveground dry biomass in grams. DBH stands for diameter at breast height (measured and reported in centimeters), MSE stands for mean square error, SE stands for standard error. | | | | | | | |
| Species | Source | Equation | | R2 | Published DBH range | Our DBH range | Error |
| *Populus tremuloides* | Bond-Lamberty et al. 2002 | Log10Y = 2.614 + 0.852\*(log10DBH) | | 0.99 | 0.3-23.7 | 0.1–6.5 | MSE 0.016 |
| *Populus balsamifera* | Byrd 2013 | Y = 0.261e0.0591\*DBH | | 0.86 | AV 2.77 | 1.3–2.3 |  |
| *Betula neoalaskana* | Bond-Lamberty et al. 2002 | Log10Y = 2.462 + 1.095\*(log10DBH) | | 0.66 | 0.3-0.7 | 0.1–23.5 | MSE 0.012 |
| *Picea Mariana* | Bond-Lamberty et al. 2002 | Log10Y = 3.011 + 1.202\*(log10DBH) + -.01(AGE) + 0.972(Log10DBH\*AGE) | | 0.97 | 0.5-17 | 0.1-20 | MSE 0.021 |
| *Salix* | Bond-Lamberty et al. 2002 | Log10Y = 2.481 + 1.19(log10DBH) | | 0.54 | 0.3-1 | 0.1–8.1 | MSE 0.043 |
| *Alnus* | Binkley et al. 1984 | Leaves | LogeY = 1.82 + 2.38(LogeDBH) | 0.88 | 2-7 | 0.2–4.5 | SE 0.276 |
| Stem | LogeY = 4.5 + 2.3(LogeDBH) | 0.88 | 2-7 | 0.2-4.5 | SE 0.127 |

## S2. Tree ring core results

We took tree-ring cores at each plot to estimate the age of mature (unburned) stands and to provide additional estimates of the age of reburned stands. Not all reburned stands contained individuals large enough to take a tree core (marked “No sample” in the table below).

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| **Table S2.** Results of tree-ring cores taken at each plot. Age is represented in years – we report the oldest date obtained from dating tree cores, as well as the median date. We present both next to the confirmed age of the stand based on fire history obtained from aerial photographs and remote sensing. | | | | | | |
| Site | Burn History | Plot | n | Max Age | Median Age | Confirmed age |
| *Upland* | Mature | 10\_0 | 11 | 78 | 86 |  |
| 11\_0 | 10 | 78 | 87 |
| 44\_0 | 11 | 79 | 83 |
| 58\_0 | 19 | 75 | 87 |
| 1 fire | 42\_1 | 1 | 16 | 16 | 16 |
| 12\_1 | 7 | 7 | 11 | 14 |
| 41\_1 | 3 | 15 | 27 |
| 48\_1 | 4 | 9 | 10 |
| 50\_1 |  | No sample |  |
| 52\_1 | 2 | 11 | 11 |
| 64\_1 |  | No sample |  |
| 65\_1 |  | No sample |  |
| 2 fires | 40\_2 | 3 | 16 | 18 | 16 |
| 32\_2 | 6 | 13 | 16 |
| 39\_2 | 6 | 11.5 | 14 | 14 |
| 16\_2 | 4 | 10 | 12 |
| 47\_2 |  | No sample |  |
| 56\_2 | 4 | 7.5 | 10 |
| 57\_2 | 6 | 9 | 14 |
| 8\_2 | 6 | 9 | 13 |
| 3 fires | 14\_3 | 3 | 7 | 11 | 14 |
| 15\_3 | 2 | 11 | 14 |
| 37\_3 | 4 | 8 | 15 |
| 54\_3 | 4 | 9 | 10 |
| 55\_3 | 1 | 52 | 52 |
| 7\_3 | 4 | 67 | 9 |
| *Lowland* | Unburned | 1\_0 | 4 | 81 | 93 |  |
| 31\_0 | 3 | 61 | 106 |
| 6\_0 | 7 | 80 | 84 |
| 9\_0 | 6 | 83 | 88 |
| 1 fire | 18\_1 | 1 | 15 | 15 | 15 |
| 33\_1 | 1 | 15 | 15 |
| 28\_1 | 1 | 15 | 15 |
| 29\_1 | 2 | 8 | 10 |
| 20\_1 | 1 | 13 | 13 | 13 |
| 36\_1 | 1 | 13 | 13 |
| 5\_1 | 1 | 15 | 15 |
| Two fires | 19\_2 | 1 | 66 | 66 | 15 |
| 26\_2 | 2 | 9 | 9 |
| 27\_2 | 1 | 66 | 66 |
| 3\_2 | 4 | 10 | 12 |
| 34\_2 | 1 | 62 | 62 |
| 4\_2 |  | No sample |  |
| Three fires | 17\_3 | 1 | 62 | 62 | 15 |
| 2\_3 | 3 | 8 | 9 |
| 22\_3 | 1 | 62 | 62 |
| 23\_3 | 4 | 9 | 11 |
| 24\_3 | 3 | 12 | 15 |
| 25\_3 | 3 | 12 | 13 |
| 35\_3 | 2 | 12.5 | 14 |

## S3. Bayesian Models

**Model Specification**

**Bayesian Model Implementation**

The Bayesian hierarchical model is completed by specifying prior distributions for model parameters. Those include …. We used Markov Monte Carlo (MCMC) to sample from the joint posterior distribution for all model parameters ()

We assigned normal priors for all regression coefficients within the X and X models. Specifically …

We used a Metropolis-within-Gibbs Markov chain Monte Carlo (MCMC) algorithm to sample from the joint posterior distribution for all model parameters () using the package “R2Jags” (Su and Yajima 2021, version 07.1). For each model, we ran 3 chains across 2,500 iterations following a burn-in of 100 samples. We assessed convergence visually using traceplots (included below in Figure S ##).

Ecologists disagree whether measurement error (Holdaway et al. 2014) or allometric error (Chen et al. 2015) contribute to greater uncertainty in estimates of stand-level aboveground carbon. To minimize uncertainty from both sources, we relied on locally-estimated species-specific allometric equations where available (Vorster et al. 2020) and incorporated uncertainty associated with allometric equations explicitly within the model by adding a measurement error term. We incorporated uncertainty into soil carbon estimates by calculating the total uncertainty in each plot by calculating the standard deviation of the estimated Mg of carbon across cores (by plot) and summing across a plot (Fourqurean et al. 2015). The total uncertainty per plot was included as the error term variable in the soil carbon models.

**Figure S#. Traceplots from model of biomass as a function of fire modified by site.**

Inferences

* Display posteriors such that it could be used as priors in future study
  + Table with means, medians, variances/sd, quantiles of parameters
  + Including whether they have skewed / multimodal densities

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| **Table S1. Posterior Median values (and 95 percent credible intervals) for site-specific effect coefficients and plot- and site-level variances for the Upland and Lowland site.** | | | | | | | | | |
| Model | Parameter | Median | 95 |  |  |  |  |  |  |
| Biomass | Intercept |  |  |  |  |  |  |  |  |
| Coefficient |  |  |  |  |  |  |  |  |
| Soil C | Intercept |  |  |  |  |  |  |  |  |
| Coefficient |  |  |  |  |  |  |  |  |
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Appropriate inferences from 1 + model

* Look at chapter 9 for specifics
* Go beyond AIC weights