

# ABoVE: Model-ready Monthly Regrided Environmental Data at 0.5-Degree Resolution

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## Summary

This dataset provides model-ready monthly regrided environmental and biochemical variables for the Arctic-Boreal Vulnerability Experiment (ABoVE) domain. It is a standardized and harmonized collection of seven distinct ABoVE products, designed for seamless integration into Earth System Models. The synthesis encompasses twelve key climatic and biogeochemical variables: precipitation, burned area, soil CO<sub>2</sub> flux, gross primary production (GPP), ecosystem respiration (Reco), methane (CH<sub>4</sub>) flux, air temperature, surface temperature, snow depth, soil respiration, and active layer thickness. An elevation derivatives reference dataset has been included to describe relief and depositional characteristics at the sub-pixel level. To resolve inconsistencies in the original spatial and temporal scales of these disparate products, all data have been harmonized to a uniform 0.5-degree x 0.5-degree spatial resolution in a WGS 84 projection and aggregated to a monthly temporal resolution. Temporal coverage spans various ranges between 1980 and 2020 depending on the specific variable. Geographically, the dataset covers the core ABoVE domain (Alaska and western Canada) at a minimum, with several constituent products extending to cover the broader pan-Arctic and Boreal regions. The data are provided in NetCDF and GeoTIFF formats.

This dataset holds 14 NetCDFs and one cloud-optimized GeoTIFF.

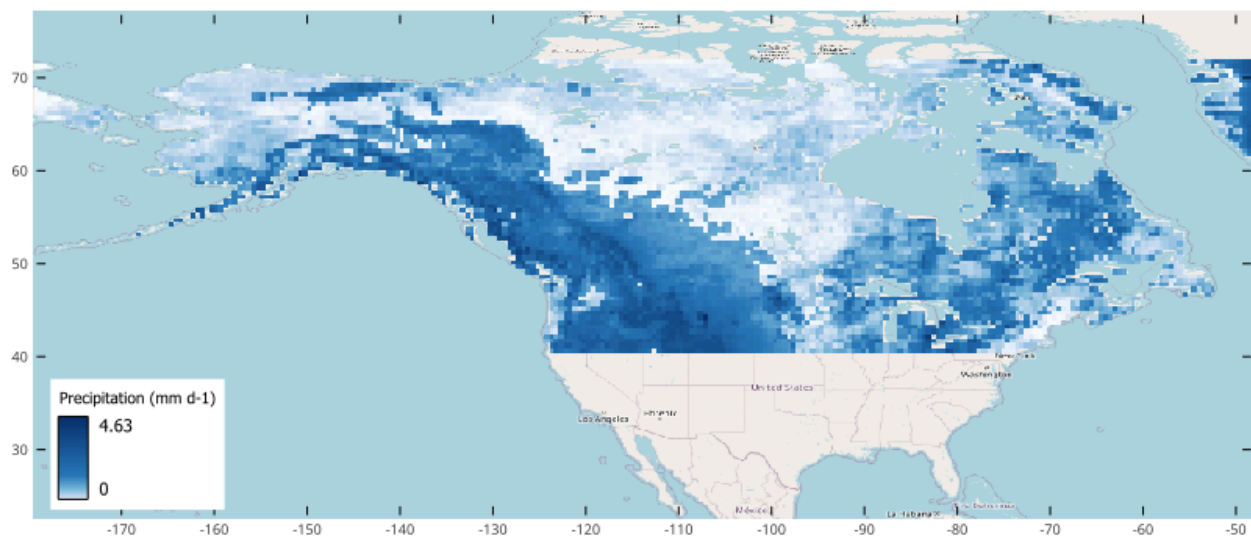


Figure 1. Mean daily precipitation for October 2001 for the ABoVE domain. Spatial resolution: 0.5 degree. Source: ABoVE\_mon\_regrid\_imerg\_precip\_2000-2020.nc

## Citation

LaNeve, C., J. Poe, E. Goodnough, E.E. Hoy, J.D. Watts, M.K. Farina, J.V. Fayne, C. Lober, S. Potter, J.B. Fisher, B.M. Rogers, K. Schaefer, R.K. Braghiere, E. Jafarov, and S. Natali. 2026. ABoVE: Model-ready Monthly Regrided Environmental Data at 0.5-Degree Resolution. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2524>

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## 1. Dataset Overview

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active layer thickness. An elevation derivatives reference dataset has been included to describe relief and depositional characteristics at the sub-pixel level. To resolve inconsistencies in the original spatial and temporal scales of these disparate products, all data have been harmonized to a uniform 0.5-degree x 0.5-degree spatial resolution in a WGS 84 projection and aggregated to a monthly temporal resolution. Temporal coverage spans various ranges between 1980 and 2020 depending on the specific variable. Geographically, the dataset covers the core ABoVE domain (Alaska and western Canada) at a minimum, with several constituent products extending to cover the broader pan-Arctic and Boreal regions.

**Project:** Arctic-Boreal Vulnerability Experiment ([ABoVE](#))

The Arctic-Boreal Vulnerability Experiment (ABoVE) was a field campaign conducted in Alaska and western Canada for nearly ten years, starting in 2015. Researchers participating in ABoVE linked field-based, process-level studies with geospatial data products derived from airborne and satellite sensors. The work provided a foundation for improving the analysis and modeling capabilities needed to understand and predict ecosystem responses to, and societal implications of, climate change in the Arctic and boreal regions.

#### Related Datasets:

Farina, M.K., and J.D. Watts. 2022. Gridded CO<sub>2</sub> and CH<sub>4</sub> Flux Estimates for pan-Arctic and Boreal Regions, 2003-2015. ORNL Distributed Active Archive Center. <https://doi.org/10.3334/ORNLDAAC/2121>

Liston, G.E., A.K. Reinking, and N.T. Boleman. 2023. Daily SnowModel Outputs Covering the ABoVE Core Domain, 3-km Resolution, 1980-2020. ORNL Distributed Active Archive Center. <https://doi.org/10.3334/ORNLDAAC/2105>

Lober, C., and J.V. Fayne. 2022. ABoVE: Bias-Corrected IMERG Monthly Precipitation for Alaska and Canada, 2000-2020. ORNL Distributed Active Archive Center. <https://doi.org/10.3334/ORNLDAAC/2097>

Potter, S., S. Veraverbeke, X.J. Walker, M.C. Mack, S.J. Goetz, J.L. Baltzer, C. Dieleman, N.H. F. French, E.S. Kane, M.R. Turetsky, E.B. Wiggins, and B.M. Rogers. 2022. ABoVE: Burned Area, Depth, and Combustion for Alaska and Canada, 2001-2019. ORNL Distributed Active Archive Center. <https://doi.org/10.3334/ORNLDAAC/2063>

Schaefer, K., L.K. Clayton, M.J. Battaglia, L.L. Bourgeau-Chavez, R.H. Chen, A.C. Chen, J. Chen, K. Bakian-Dogaheh, T.A. Douglas, S.E. Grelick, G. Iwahana, E. Jafarov, L. Liu, S. Ludwig, R.J. Michaelides, M. Moghaddam, S. Natali, S.K. Panda, A.D. Parsekian, A.V. Rocha, S.R. Schaefer, T.D. Sullivan, A. Tabatabaeenejad, K. Wang, C.J. Wilson, H.A. Zebker, T. Zhang, and Y. Zhao. 2021. ABoVE: Soil Moisture and Active Layer Thickness in Alaska and NWT, Canada, 2008-2020. ORNL Distributed Active Archive Center. <https://doi.org/10.3334/ORNLDAAC/1903>

Watts, J.D., S. Natali, and C. Minions. 2022. Soil Respiration Maps for the ABoVE Domain, 2016-2017. ORNL Distributed Active Archive Center. <https://doi.org/10.3334/ORNLDAAC/1935>

Watts, J.D., S. Natali, S. Potter, and B.M. Rogers. 2019. Gridded Winter Soil CO<sub>2</sub> Flux Estimates for pan-Arctic and Boreal Regions, 2003-2100. ORNL Distributed Active Archive Center. <https://doi.org/10.3334/ORNLDAAC/1683>

## 2. Data Characteristics

**Spatial Coverage:** Arctic and Boreal regions north of 40 degrees latitude

**Spatial Resolution:** 0.5 degree

**Temporal Coverage:** 1980 to 2020

**Temporal Resolution:** month

**Study Area:** Latitude and longitude are given in decimal degrees

| Site                      | Westernmost Longitude | Easternmost Longitude | Northernmost Latitude | Southernmost Latitude |
|---------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Arctic and Boreal regions | -180                  | 180                   | 85                    | 40                    |

**User Note:** The geographic extent of the data files extends globally but grid cells north and south of the Study Area are filled with nodata values.

#### Data File Information

This dataset holds 14 NetCDFs and one cloud-optimized GeoTIFF. The files in Table 1 hold harmonized monthly values regridded to a common 0.5-degree grid based on the WGS-84 datum. The nodata value is -9999.

Table 1. Regrided, monthly NetCDF files and descriptions.

| Filename                                        | Variable    | Units              | Description                                                    |
|-------------------------------------------------|-------------|--------------------|----------------------------------------------------------------|
| ABoVE_mon_alt_2008-2020.nc                      | alt         | cm                 | Measurements of active layer thickness at five point locations |
| ABoVE_mon_regrid_burned_area_2001-2019.nc       | burned_area | 1                  | Burned area fraction                                           |
| ABoVE_mon_regrid_imerg_precip_2000-2020.nc      | precip      | mm d <sup>-1</sup> | Precipitation amount (liquid water equivalent)                 |
| ABoVE_mon_regrid_snowmodel_airtemp_1980-2020.nc | tas         | K                  | Air temperature                                                |

| Filename                                            | Variable   | Units                                              | Description                                                                                 |
|-----------------------------------------------------|------------|----------------------------------------------------|---------------------------------------------------------------------------------------------|
| ABoVE_mon_regrid_snowmodel_snowdepth_1980-2020.nc   | snow_depth | m                                                  | Surface snow thickness                                                                      |
| ABoVE_mon_regrid_snowmodel_surftemp_1980-2020.nc    | tas        | degrees C                                          | Surface temperature                                                                         |
| ABoVE_mon_regrid_snowmodel_totalprecip_1980-2020.nc | precip     | m                                                  | Total Precipitation (rain+snow) (liquid water equivalent)                                   |
| ABoVE_mon_regrid_soil_resp_2016-2017.nc             | rs         | gCO <sub>2</sub> C m <sup>-2</sup> d <sup>-1</sup> | Soil respiration: carbon dioxide associated carbon flux expressed as grams carbon           |
| ABoVE_mon_regrid_tcfm_ch4_2003-2015.nc              | ch4        | mg m <sup>-2</sup> d <sup>-1</sup>                 | Methane emissions                                                                           |
| ABoVE_mon_regrid_tcfm_gpp_2003-2015.nc              | gpp        | g m <sup>-2</sup> d <sup>-1</sup>                  | Gross primary productivity of biomass                                                       |
| ABoVE_mon_regrid_tcfm_reco_2003-2015.nc             | reco       | g m <sup>-2</sup> d <sup>-1</sup>                  | Ecosystem respiration as carbon flux                                                        |
| ABoVE_mon_regrid_winter_soil_co2_2003-2017.nc       | rs         | gCO <sub>2</sub> C m <sup>-2</sup> d <sup>-1</sup> | Soil respiration in winter: carbon dioxide associated carbon flux expressed as grams carbon |

Table 2. Variables in *ABoVE\_mon\_regrid\_ElevationDerivatives\_0p5deg.nc* and *ABoVE\_mon\_regrid\_ElevationDerivatives\_0p5deg.tif*.

| Variables   | Units | Description                                                                                               |
|-------------|-------|-----------------------------------------------------------------------------------------------------------|
| mrvmf_mean  | 1     | MultiResolution Index of Valley Bottom Flatness (MRVBF) algorithm (Gallant and Dowling, 2003), mean value |
| mrvmf_min   | 1     | MRVBF, minimum value                                                                                      |
| mrvmf_max   | 1     | MRVBF, maximum value                                                                                      |
| elev_max    | m     | Elevation above mean sea level, maximum                                                                   |
| elev_min    | m     | Elevation above mean sea level, minimum                                                                   |
| elev_IQR    | m     | Elevation above mean sea level, interquartile range                                                       |
| elev_rms    | m     | Elevation above mean sea level, root mean squared                                                         |
| elev_mean   | m     | Elevation above mean sea level, mean                                                                      |
| elev_median | m     | Elevation above mean sea level, median                                                                    |

The GeoTIFF uses geographic coordinates (EPSG 4326) with spatial resolution of 0.5 degrees. There is one variable in each of 9 bands; variable names are included in the band descriptions. The data type is Float32, and the nodata value is -9999.

### 3. Application and Derivation

This dataset provides a standardized, model-ready synthesis of seven distinct datasets from the Arctic-Boreal Vulnerability Experiment (ABoVE) to facilitate integration into Earth system models. These datasets can also be applied as benchmarks for models through frameworks such as the International Land Model Benchmarking (ILAMB) project.

### 4. Quality Assessment

Refer to the quality information included with the source datasets.

### 5. Data Acquisition, Materials, and Methods

This dataset provides a standardized, model-ready synthesis of seven distinct datasets from the Arctic-Boreal Vulnerability Experiment (ABoVE). The collection encompasses twelve key environmental, climatic, and biogeochemical variables: precipitation, burned area, soil CO<sub>2</sub> flux, gross primary production (GPP), ecosystem respiration (Reco), methane (CH<sub>4</sub>) flux, air temperature, surface temperature, snow depth, soil respiration, and active layer thickness. Spatially, the geographic extent covers the core ABoVE domain at a minimum, with several constituent products extending to provide broader pan-Arctic coverage.

To facilitate integration into Earth system models, all data products have been regridded to a uniform half-degree (0.5° x 0.5°) spatial resolution using the WGS 84 projection, with reference elevation derivative data layers to describe sub-pixel spatial heterogeneity. The temporal resolution is monthly.

The spatial resampling used a nearest neighbor method.

The regridded burned area was derived by calculating burned area of the 500-m pixels in the source dataset using the burned fractions at native resolution then summing that burned area for all relevant 500-m pixels in the larger 0.5-degree grid cells.

The active layer thickness data was derived from Schaefer et al. (2021), and original measurements were taken over multi-kilometer transects with spacing every ~0.3 m (Clayton et al., 2021), resulting in a relatively small number of monthly averages over five locations.

### Elevation dataset information

The elevation and elevation derivatives dataset was created specifically as an optional input or reference to support interpretation and translation between scales of the diverse data layers used in this model. This dataset provides topographic derivatives on a 0.5-degree grid.

A key feature of this product is its application of the MultiResolution Index of Valley Bottom Flatness (MRVBF) algorithm (Gallant and Dowling, 2003) to effectively identify depositional areas. By averaging the outputs of several modified runs of the algorithm, this dataset offers a more comprehensive representation of landscape 'flatness' and elevation diversity than the original MRVBF approach. Within this index, low MRVBF values correspond to elevated topographical features (ridges), while high MRVBF values (greater than 5) indicate low-lying areas (valleys) with a higher likelihood of water and sediment deposition. The multi-layer file contains nine variables (Table 2). Derived from the Multi-Error-Removed Improved-Terrain (MERIT) DEM (Yamazaki et al 2017), the MRVBF statistics were initially calculated using the ABoVE projection before being averaged to the 0.5-degree resolution.

Table 3. Source data used to generate these model-ready files.

| Filename                                               | Variable                         | Source                  |
|--------------------------------------------------------|----------------------------------|-------------------------|
| ABoVE_mon_regrid_above_alt_2008-2020.nc                | Active layer thickness           | Schaefer et al. (2021)  |
| ABoVE_mon_regrid_burned_area_2001-2019.nc              | Burned area                      | Potter et al. (2022)    |
| ABoVE_mon_regrid_imerg_precip_2000-2020.nc             | Precipitation                    | Lober and Fayne (2022)  |
| ABoVE_mon_regrid_tcfm_ch4_2003-2015.nc                 | CH <sub>4</sub> emissions        | Farina and Watts (2022) |
| ABoVE_mon_regrid_tcfm_gpp_2003-2015.nc                 | Gross primary productivity (GPP) |                         |
| ABoVE_mon_regrid_tcfm_reco_2003-2015.nc                | Ecosystem respiration (Reco)     |                         |
| ABoVE_mon_regrid_snowmodel_airtemp_1980-2020.nc        | Air temperature                  | Liston et al. (2023)    |
| ABoVE_mon_regrid_snowmodel_snowdepth_1980-2020.nc      | Surface temperature              |                         |
| ABoVE_mon_regrid_snowmodel_surftemp_1980-2020.nc       | Snow Depth                       |                         |
| ABoVE_mon_regrid_snowmodel_totalprecip_1980-2020.nc    | Precipitation                    |                         |
| ABoVE_mon_regrid_soil_resp_2016-2017.nc                | Soil respiration                 | Watts et al. (2022)     |
| ABoVE_mon_regrid_winter_soil_co2_2003-2017.nc          | Soil CO <sub>2</sub> flux        | Watts et al. (2019)     |
| ABoVE_mon_regrid_ABoVE_ElevationDerivatives_0p5deg.nc  | Elevation and MRVBF              | Yamazaki et al. (2017)  |
| ABoVE_mon_regrid_ABoVE_ElevationDerivatives_0p5deg.tif |                                  |                         |

Table 4. Characteristics of the source datasets.

| Source                  | Variable                                                        | Spatial      |                 | Temporal   |           | Projection             |
|-------------------------|-----------------------------------------------------------------|--------------|-----------------|------------|-----------|------------------------|
|                         |                                                                 | Resolution   | Coverage        | Resolution | Coverage  |                        |
| Schaefer et al. (2021)  | Active layer thickness                                          | Point based  | Alaska & Canada | Daily      | 2008-2020 | -                      |
| Potter et al. (2022)    | Burned area                                                     | 500 m        | Alaska & Canada | Monthly    | 2001-2019 | Sinusoidal Custom      |
| Lober and Fayne (2022)  | Precipitation                                                   | 0.10 degrees | Alaska & Canada | Monthly    | 2000-2020 | WGS 84                 |
| Farina and Watts (2022) | CH <sub>4</sub> emissions, GPP, Reco                            | 1 km         | Pan Arctic      | Daily      | 2003-2015 | Behrmann Custom        |
| Liston et al. (2023)    | Air temperature, Surface temperature, Snow depth, Precipitation | 3 km         | ABoVE domain    | Daily      | 1980-2020 | Albers Custom          |
| Watts et al. (2022)     | Soil respiration                                                | 300 m        | ABoVE domain    | Monthly    | 2016-2018 | Cylindrical Equal Area |

|                        |                           |       |                 |         |                 |                 |
|------------------------|---------------------------|-------|-----------------|---------|-----------------|-----------------|
| Watts et al. (2019)    | Soil CO <sub>2</sub> flux | 25 km | Pan Arctic      | Monthly | 2003-2017       | Behrmann Custom |
| Yamazaki et al. (2017) | Elevation and MRBVF       | 90 m  | Alaska & Canada | -       | 2000, 2006-2011 | WGS 84          |

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