



# Introduction to NASA Snow and Ice Data Products and Applications

Part 2: Access, Analysis, and Visualization of NASA Snow and Ice Data Products

ARSET Hosts: Amita Mehta (612, GESTAR II) & Sean McCartney (610, SSAI)  
Mikala Beig, Saber Brasher, Diane Fritz, Andy Barrett  
(National Snow and Ice data Center – NSIDC)

July 31, 2025



# Part 1 Review

- Snow and ice play a crucial role in Earth's water cycles:
  - Snowmelt serves an important source of water in many regions.
  - Interannual variations in snowpack has substantial impact on regional water availability, and can lead to floods or droughts.
- When snow accumulates at high latitudes or high elevations, water is stored from days and months, hundreds to tens of thousands of years (glaciers).
- **Measurements of snow:**
  - Snow Covered Area (SCA), Snow thickness, Snow Water Equivalent (SWE)
- **Snow properties:**
  - Snow albedo, Snow grain size, Snow impurities



# Part 1 Review

- **Remote Sensing of Snow:**
  - Passive microwave, visible and near-infrared spectral measurements are used
- **Satellite and Sensors:**
  - DMSP: SSMI, SSMIS, NASA/JAXA AMSR-E, AMSR-2
  - NASA EOS:MODIS
  - NOAA-8 to -19: AVHRR, SNPP & NOAA-20 & 21 VIIRS
- **Remote Sensing Products:**
  - Snow Cover, Snow Albedo, and Snow Water Equivalent



# Training Outline

## Part 1

Overview of NASA  
Snow and Ice Data  
Products

July 24, 2025

## Part 2

Access, Analysis,  
and Visualization of  
NASA Snow and Ice  
Data Products

July 31, 2025

## Part 3

Monitoring Mountain  
Snowpack and  
Prediction of Water  
Availability in the  
Western US for Water  
Resources and  
Disaster Applications

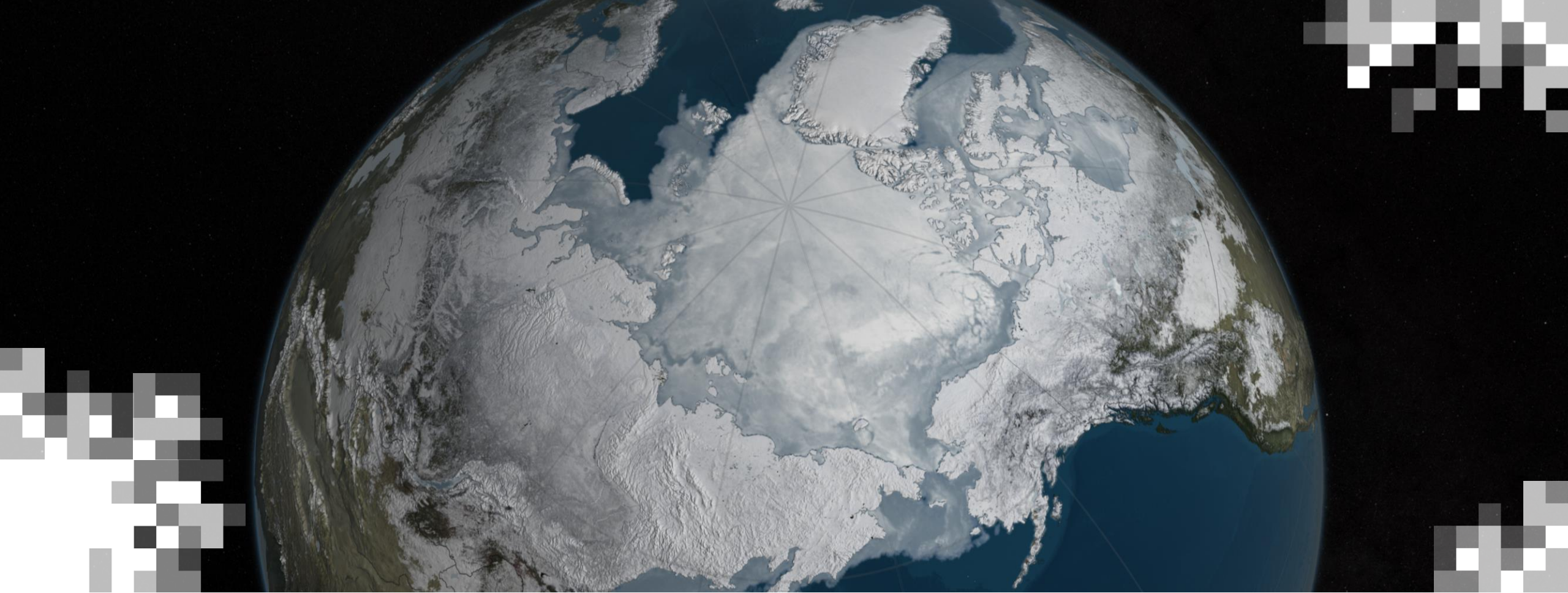
August 7, 2025

## Homework

Opens August 7 – Due August 21 – Posted on Training Webpage

A certificate of completion will be awarded to those who attend all live sessions and complete the homework assignment(s) before the given due date.





## **Part 2: Access, Analysis, and Visualization of NASA Snow and Ice Data Products**

## Part 2 Objectives

By the end of Part 2, participants will be able to:

- Search and access NASA snow and ice data products.
- Recognize ways to analyze and visualize snow and ice data products.
- Compare coincident snow data across in-situ, airborne, and satellite platforms from NASA's SnowEx, Airborne Snow Observatory (ASO), and MODerate resolution Imaging Spectroradiometer (MODIS) data sets.



# How to Ask Questions

- Please put your questions in the Questions box and we will address them at the end of the webinar.
- Feel free to enter your questions as we go. We will try to get to all of the questions during the Q&A session after the webinar.
- The remainder of the questions will be answered in the Q&A document, which will be posted to the training website about a week after the training.



# Guest Speakers

**Mikala Beig**  
Associate Scientist



**Saber Brasher**  
Associate Scientist



**Diane Fritz**  
Associate Scientist

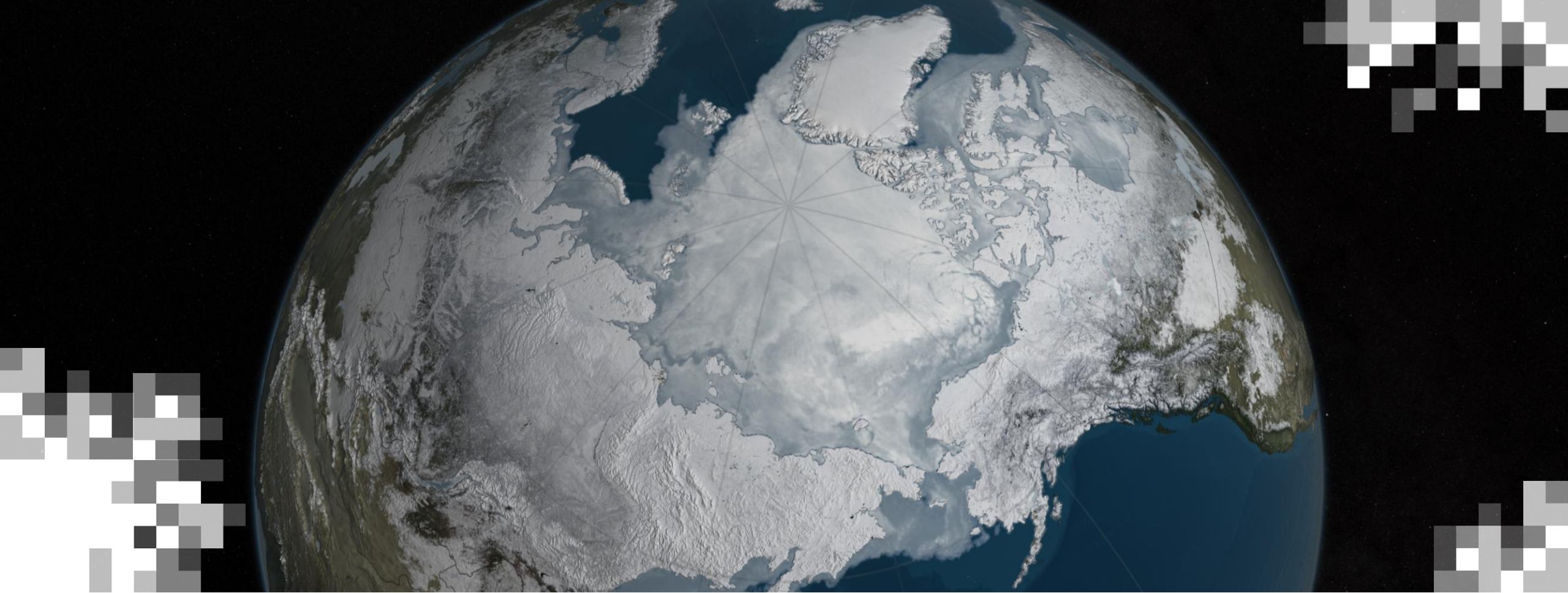


**Andrew Barrett**  
Senior Associate Scientist



## NASA National Snow and Ice Data Center (NSIDC)





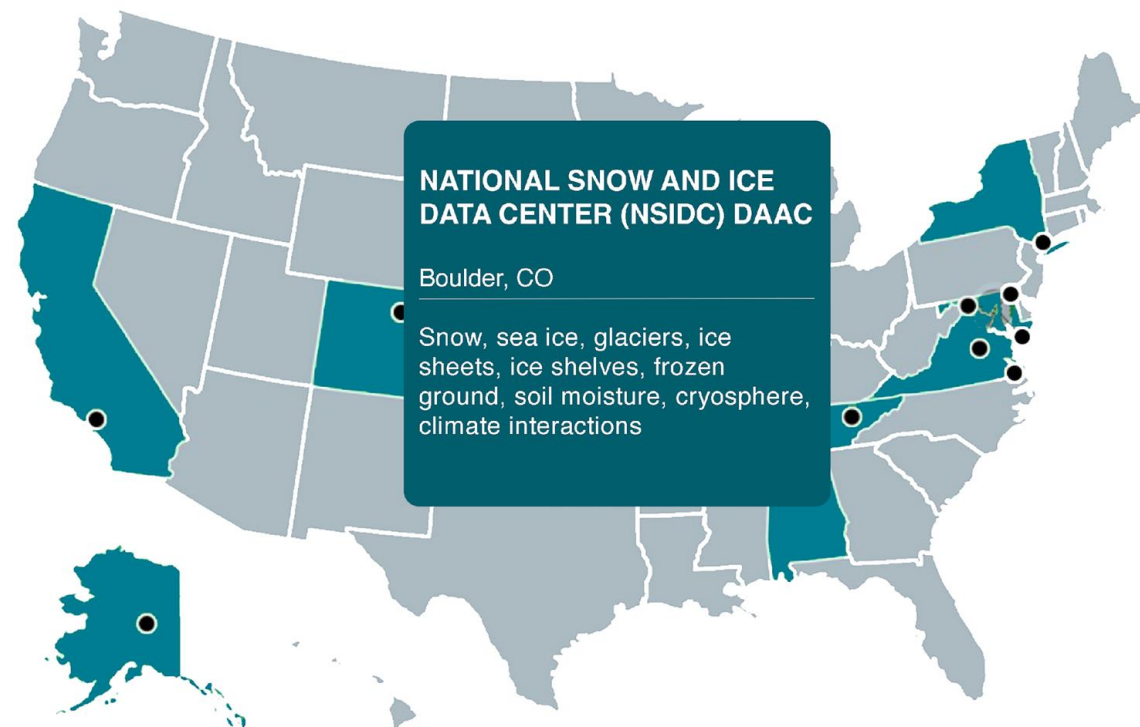
## **Search and Access NASA Snow and Ice Data**

Mikala Beig & Saber Brasher

National Snow and Ice Data Center

# NASA National Snow and Ice Data Center (NSIDC)

- NSIDC data management programs focus on preserving, documenting, and providing access to over 1400 data sets related to the snow and ice-covered regions of the world.
- They include data from Earth-observing satellite missions, airborne surveys, field observations, weather stations, historical records, and data rescue projects.
- NSIDC is one of 11 NASA Distributed Active Archive Centers (DAACs).
- NSIDC data is available for **free** to anyone!
  - Helpful to have some prior experience working with commonly used scientific data formats (e.g., GeoTIFF, NetCDF, or HDF)
  - Most data sets have **user guides** to help



# Searching for NSIDC Data

- [Explore Data Page](#): Search bar can search for keywords within NSIDC data sets
  - Browse data collections, which group data together by various NASA missions and other projects
  - Collections can be filtered by collection method, geographic area, and geophysical measurement (for example, sea ice, ice sheets, glaciers, snow, soil moisture, or frozen ground)
- Get started with NSIDC Data [FAQ](#)



National Snow and Ice Data Center  
a part of CIRES at the University of Colorado Boulder

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DATA ▾

OUR RESEARCH

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## Explore Data

Search data...



**BY DATA COLLECTIONS**

BY GEOPHYSICAL MEASUREMENTS

ALL DATA SETS

Filter by:

COLLECTION METHOD ▾

GEOGRAPHIC AREA ▾

GEOPHYSICAL MEASUREMENT ▾



# Data Set Specific Landing Pages: SnowEx17



The screenshot shows the landing page for the SnowEx17 Ground Penetrating Radar, Version 2 data set. At the top, there is a navigation bar with the NASA EarthData logo and the National Snow and Ice Data Center (NSIDC) logo. The main header features the title "SnowEx17 Ground Penetrating Radar, Version 2" and the data set ID "SNEX17\_GPR". Below the header, there are four circular icons for "USER GUIDE", "CITATION", "SUBSCRIBE", and "SERVICE". A note indicates that this is the most recent version of the data, with a link to the "Version Summary". The "Overview" section provides a brief description of the data set, including the location (Grand Mesa, Colorado) and the collection period (February 2017). A sidebar on the right contains a menu with options for "Overview", "Data Access & Tools", "Documentation", and "Help Articles". At the bottom right, there is a "Support" button.

## User Guide:

Comprehensive product documentation on file structure, variable info, data acquisition, etc.

## Citation

## Subscribe:

Sign up to receive email updates of the data set

## [SnowEx17 Ground Penetrating Radar, Version 2](#)



# Data Set Specific Landing Pages: NSIDC



## Data Access Tool →

[Search & Discover](#) [Get Data](#)

Filter files before downloading based on date, spatial area, or file name. Choose from various download options, such as Python script. Export bounding boxes as a GeoJSON.

### Related Help Resources

[How to filter and order from a data set web page](#)  
[How to use Earthdata Download](#)

Type: Web Application Last updated: April 2025 [View Metadata](#)

## NASA Earthdata Search →

[Visualize](#) [Search & Discover](#) [Get Data](#)

Search and order data from all NASA DAACs using spatial and temporal filters in a map interface. Reformatting, reprojecting, and subsetting options are available for some data sets.

### Related Help Resources

[How to search, order, and customize data with NASA Earthdata Search](#)

Type: Web Application

Overview

**Data Access & Tools**

Documentation

Help Articles

## Access:

Tools and services for accessing the data

## Documentation:

Known issues, ATBDs, Data dictionaries, User guides

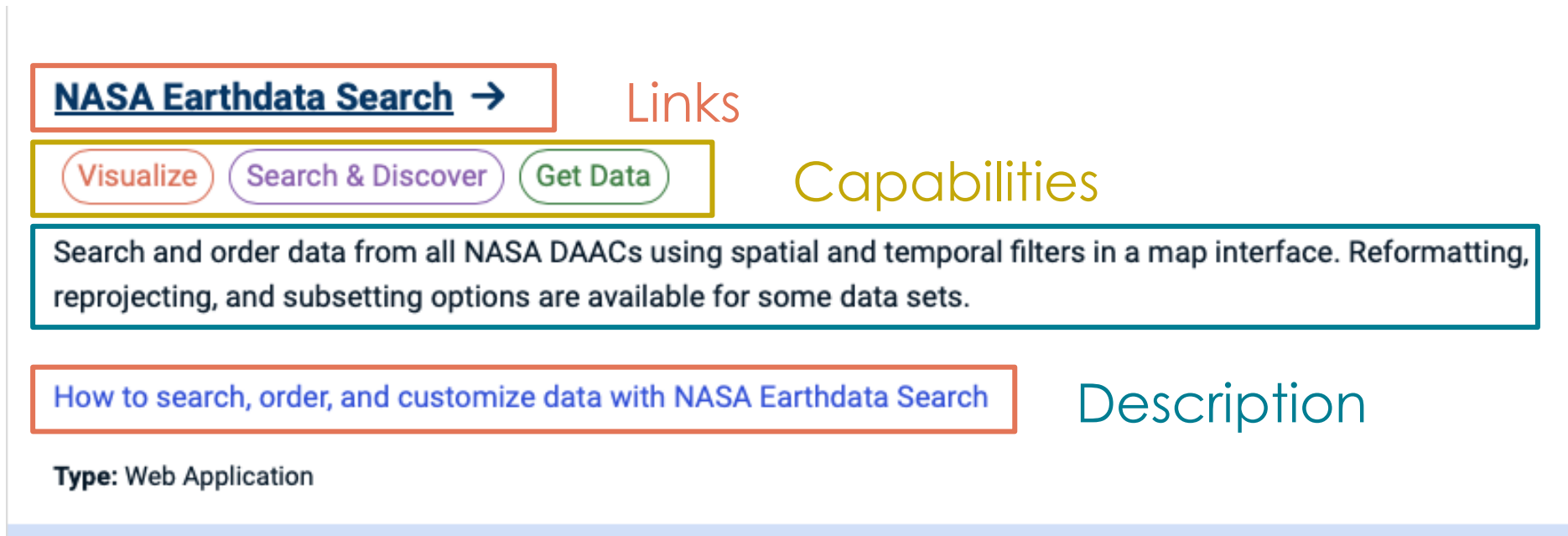
## Help articles:

Useful information for the data product



# Accessing NSIDC DAAC Data

Each “card” contains a link(s) (access!); the capabilities of the data access method (what it can do!); and a description of the services provided, such as below:



The image shows a screenshot of a data access card for NASA Earthdata Search. The card is divided into three main sections: Links, Capabilities, and Description. The Links section contains a blue link labeled "NASA Earthdata Search" with a right-pointing arrow. The Capabilities section contains three buttons: "Visualize" (orange), "Search & Discover" (purple), and "Get Data" (green). The Description section contains a blue link labeled "How to search, order, and customize data with NASA Earthdata Search" and a "Type: Web Application" label below it.

**Links**

[NASA Earthdata Search →](#)

**Capabilities**

Visualize Search & Discover Get Data

Search and order data from all NASA DAACs using spatial and temporal filters in a map interface. Reformatting, reprojecting, and subsetting options are available for some data sets.

**Description**

[How to search, order, and customize data with NASA Earthdata Search](#)

**Type:** Web Application



# NSIDC Data Access Tool



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## Data Access Tool

Use the selectors below to search and filter by time range and/or geographic area

• For tips on how to use this tool, read our [help article](#).

### Selected Data Set Information

Note: To select a different data set, close this window (or tab) and navigate to the data set landing page you want.

Data Set: SnowEx17 Ground Penetrating Radar, Version 2

Data Set ID: SNE17\_GPR

Data Set Summary: This data set contains the results of a ground penetrating radar survey conducted at Grand Mesa, Colorado. Data include the two-way travel time, calculated snow depth, and calculated snow water equivalent. Data were collected between 08 February 2017 and 25 February 2017 as part of the 2017 SnowEx campaign. The unprocessed, raw data are also archived at NSIDC (DOI: 10.5067/ZPOLBRHVWGSV).

**Temporal and spatial filters**

Filter by date: From 02/07/2017 To 02/25/2017

Filter spatially by bounding box: W -108.8 S 38.96 E -107.1 N 39.11

Filter spatially by drawing a bounding box or polygon:

Draw, import, export polygons

3 files selected (~210 MB)

**Text filter with "wildcards"**

File Name	Size (MB)	Start Time	End Time
SnowEx17_GPR_Version2_Week3.csv	66.4	2017-02-21 00:00:00	2017-02-25 23:59:59
SnowEx17_GPR_Version2_Week2.csv	85.5	2017-02-14 00:00:00	2017-02-17 23:59:59
SnowEx17_GPR_Version2_Week1.csv	57.3	2017-02-08 00:00:00	2017-02-10 23:59:59

1 2 3

Multiple data ordering options: Download Script, Download Files, Order via Earthdata Search

## NSIDC Data Access Tool:

- Intuitive and simple way to quickly filter and access data from the NSIDC website
- Provides multiple ways to place your order - 1) Python script, 2) Earthdata Download tool, 3) pre-configured Earthdata Search order

### Data Access Tool →

Search & Discover Get Data

Filter files before downloading based on date, spatial area, or file name. Choose from various download options, such as Python script. Export bounding boxes as a GeoJSON.

[How to filter and order from a data set web page](#)

Type: Web Application Last updated: July 2020 [View Metadata](#)



# NASA Earthdata Search

## NASA Earthdata Search:

- Discover, visualize, and access petabytes of Earth observing data from all NASA DAACs
- Filter data by mission, keyword, spatial and temporal range, filename, etc.
- Provides customization services (e.g., subsetting) for select data sets

The screenshot displays the NASA Earthdata Search interface. At the top, the search bar contains 'ASO\_3M\_SD' and the search results are for 'ASO L4 Lidar Snow Depth 3m UTM Grid V001'. The interface shows 5 matching granules with their respective start and end dates. A map on the right shows the search area in Colorado, with a green box highlighting the search results. The interface also includes a 'Filter Granules' section with options for Granule Search, Temporal, and Data Access.

## [NASA Earthdata Search](#) →

[Visualize](#) [Search & Discover](#) [Get Data](#)

Search and order data from all NASA DAACs using spatial and temporal filters in a map interface. Reformatting, reprojecting, and subsetting options are available for some data sets.

[How to search, order, and customize data with NASA Earthdata Search](#)

**Type:** Web Application



# Application for Extracting and Exploring Analysis Ready Samples (AppEARS)

## AppEARS:

- Access data from a variety of federal data archives
- Subset data spatially, temporally, and by variable
- Transform data from its original format into an analysis ready format (e.g., GeoTIFF)




AppEARS Extract Explore Help Sign In


Extract Menu  
Area  
Point


## Welcome to AppEARS!

Application for Extracting and Exploring Analysis Ready Samples (AppEARS)


The Application for Extracting and Exploring Analysis Ready Samples (AppEARS) offers a simple and efficient way to access and transform geospatial data from a variety of federal data archives. AppEARS enables users to subset **geospatial datasets** using spatial, temporal, and band/layer parameters. Two types of sample requests are available: **point samples** for geographic coordinates and **area samples** for spatial areas via vector polygons. Sample requests submitted to AppEARS provide users not only with data values, but also associated quality data values. Interactive visualizations with summary statistics are provided for each sample within the application, which allow users to preview and interact with their samples before downloading their data. Get started with a sample request using the Extract option above, or visit the [Help page](#) to learn more.


 National Aeronautics and Space Administration


 Land Processes Distributed Active Archive Center

 National Snow and Ice Data Center Distributed Active Archive Center

 Socioeconomic Data and Applications Center

 ORNL DAAC Distributed Active Archive Center for Biogeochemical Dynamics Oak Ridge National Laboratory Distributed Active Archive Center

 USGS science for a changing world United States Geological Survey

 National Park Service



# Data Discovery and Access

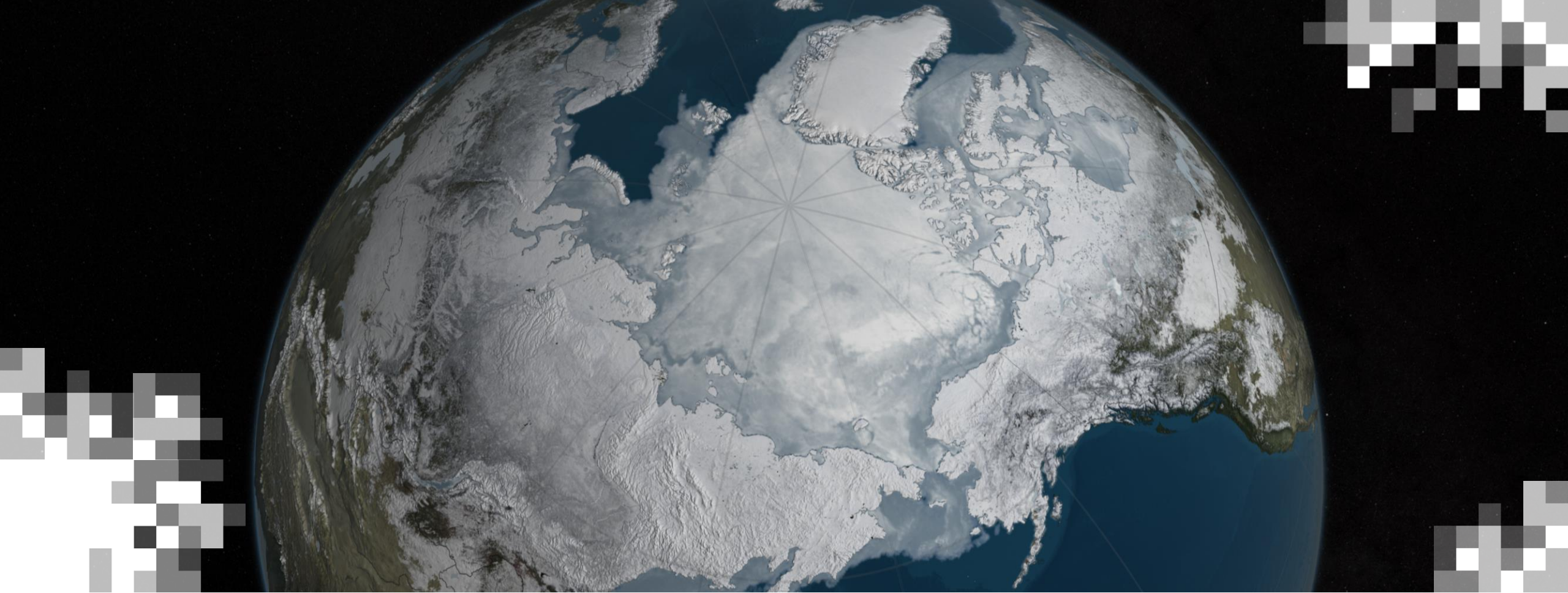
[NASA Earthdata Search Demo](#) :

Search for data from the NASA/JPL Airborne Snow Observatory (ASO) aircraft survey campaigns using a spatial filter.

For help email: [nsidc@nsidc.org](mailto:nsidc@nsidc.org)

To register for an Earthdata Login profile visit: <https://urs.earthdata.nasa.gov/>





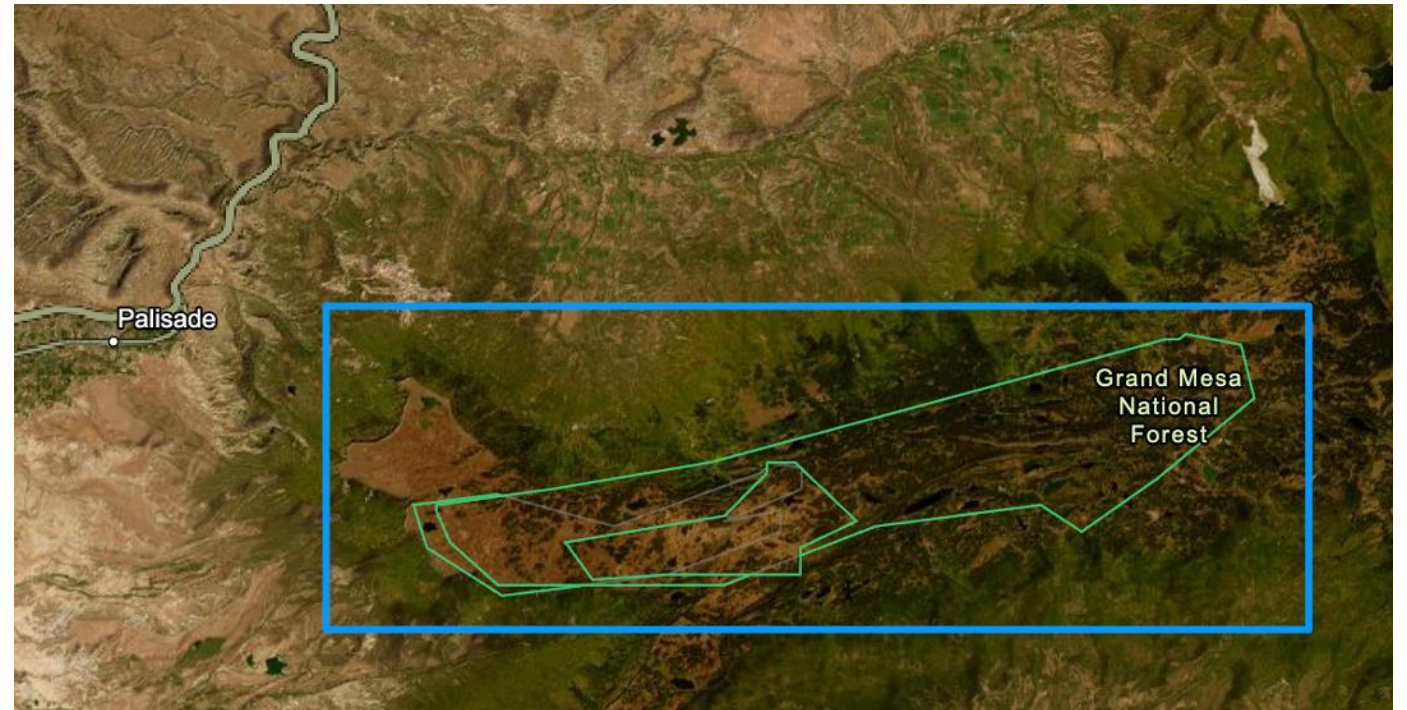
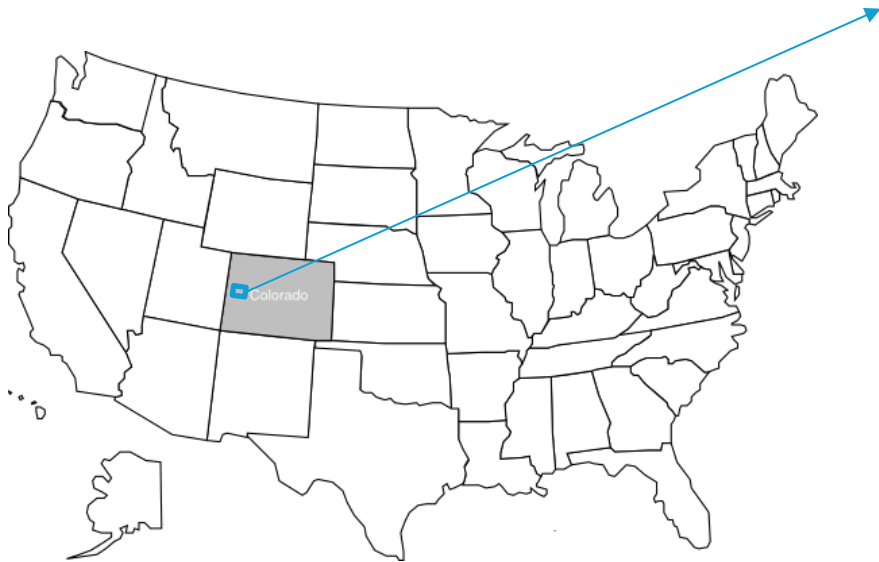
## **Download, Analyze, and Visualize Snow Data**

Diane Fritz & Andy Barrett

National Snow and Ice Data Center

# Goal – Go Through an Example Exploring Snow Data

- We've learned about NSIDC data and how to find it, so let's USE it!
- Example: Grand Mesa in Colorado
- Concepts can be applied to other basins across the globe



Grand Mesa study area showing SnowEx GPR data boundaries in NASA's Earthdata Search



# Platform: Visualizing and Analyzing Data with QGIS

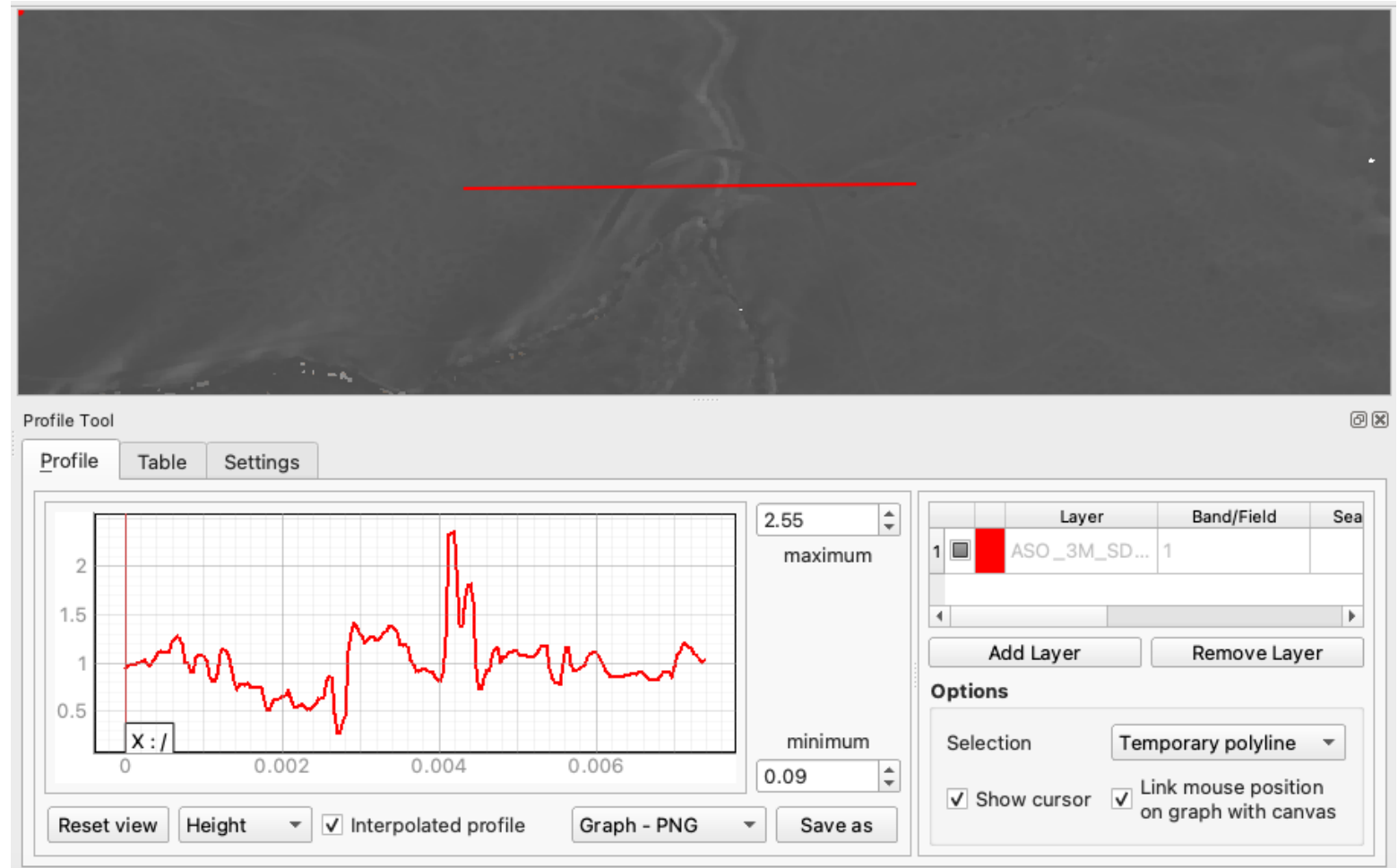
- QGIS is a free and opensource platform for working with spatial data
- [QGIS.org](https://qgis.org)
- Volunteer supported
- Highly customizable



# Working with QGIS

## Spatial data interface customizable with Plugins!

- We'll be using the Profile tool plugin to examine raster data values like snow depth.



ASO Ground Penetrating Radar (GPR) data displaying snow depth from NSIDC



# Snow Data We'll Use from NSIDC

These are just a few of many datasets we host!

- SnowEx GPR

- Short name: SNEX17\_GPR
- Parameters:
  - Snow "Thickness"
  - Snow Water Equivalent (SWE)
  - Two-way travel time
  - Location information



- ASO Gridded LiDAR

- Short name: ASO\_3M\_SD
- Snow Depth in meters
- 3-meter resolution



- MODIS NDSI

- Short name: MOD10A1
- Parameters:
  - NDSI scaled to 1–100
  - Data flags (clouds)

$$\text{NDSI} = (\text{Rvis} - \text{Rswir}) / (\text{Rvis} + \text{Rswir})$$



# Determining a Study Area and Time

- We'll start with our highest resolution data: SnowEx GPR
- Data access tool showing the extent of the SnowEx GPR data for Grand Mesa
- Create polygon for searching other data sets
- Note time of data campaign for temporal constraints

Filter by date: From  To  ↻

Filter spatially by bounding box: W  S  E  N  ↻

Filter spatially by drawing a bounding box or polygon: Export polygon

Note: Blue-green overlay shows the dataset coverage, unless it is global.

39.26N, 107.84W



NSIDC Data Access UI v4.0.1

3 files selected (~210 MB)  ↻

File Name	Size (MB)	Start Time	End Time
SnowEx17_GPR_Version2_Week3.csv	66.4	2017-02-21 00:00:00	2017-02-25 23:59:59
SnowEx17_GPR_Version2_Week2.csv	85.5	2017-02-14 00:00:00	2017-02-17 23:59:59
SnowEx17_GPR_Version2_Week1.csv	57.3	2017-02-08 00:00:00	2017-02-10 23:59:59

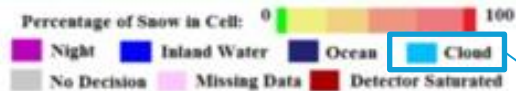
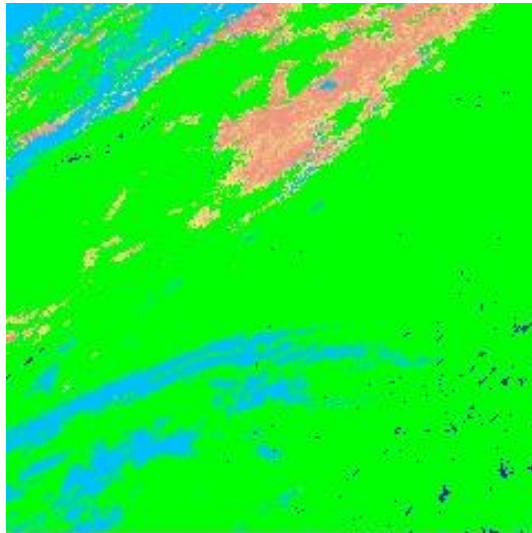
3 files selected (~210 MB)

[Download Script](#) [Download Files](#) [Order via Earthdata Search](#)



# Using Browse Images to Assess Data

- Be sure to select files with useful data



Example browse of MOD10A1 data in NASA's Earthdata Search

This light blue color represents clouds



# 3 Options: Turning MODIS Data into a GeoTIFF

HDF files are complicated in QGIS.

- GDAL command line

- gdal\_translate
- gdal\_warp



- AppEEARS (NASA tool)



- We'll use this in the demo!

- **Coming Soon:** NASA Earthdata Search transformations upon ordering



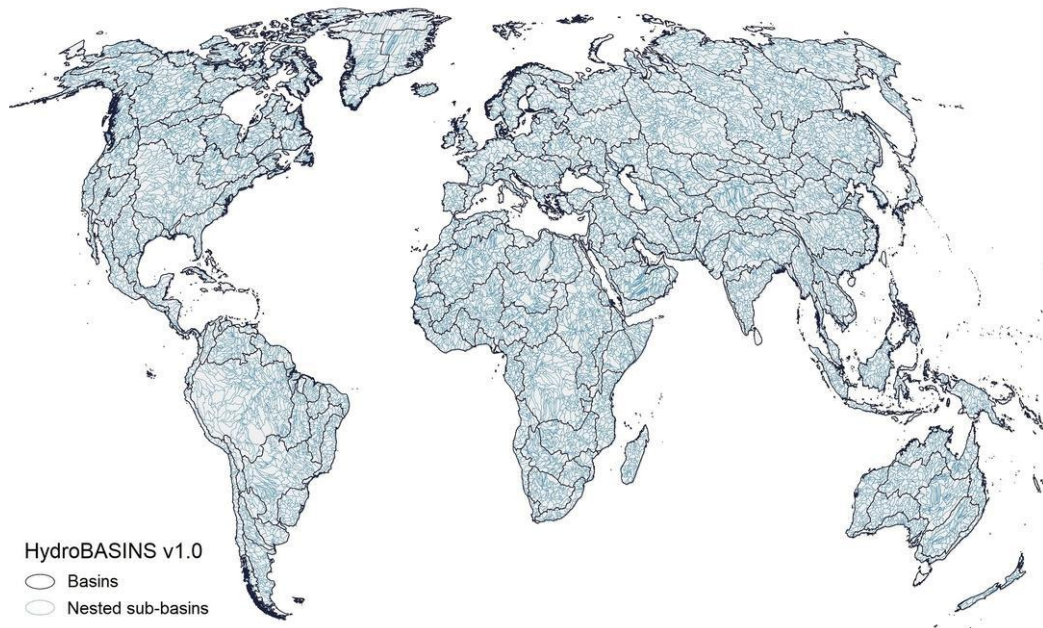
Drag and Drop



# Watershed Boundaries – Limiting Snow Data to Your Region of Interest

## Data external to NSIDC

- [Hydrobasins](#) (Global)
  - Nested scaled watersheds by continent
- [National Hydrography Dataset](#) (U.S.)
  - Smaller watershed boundaries available

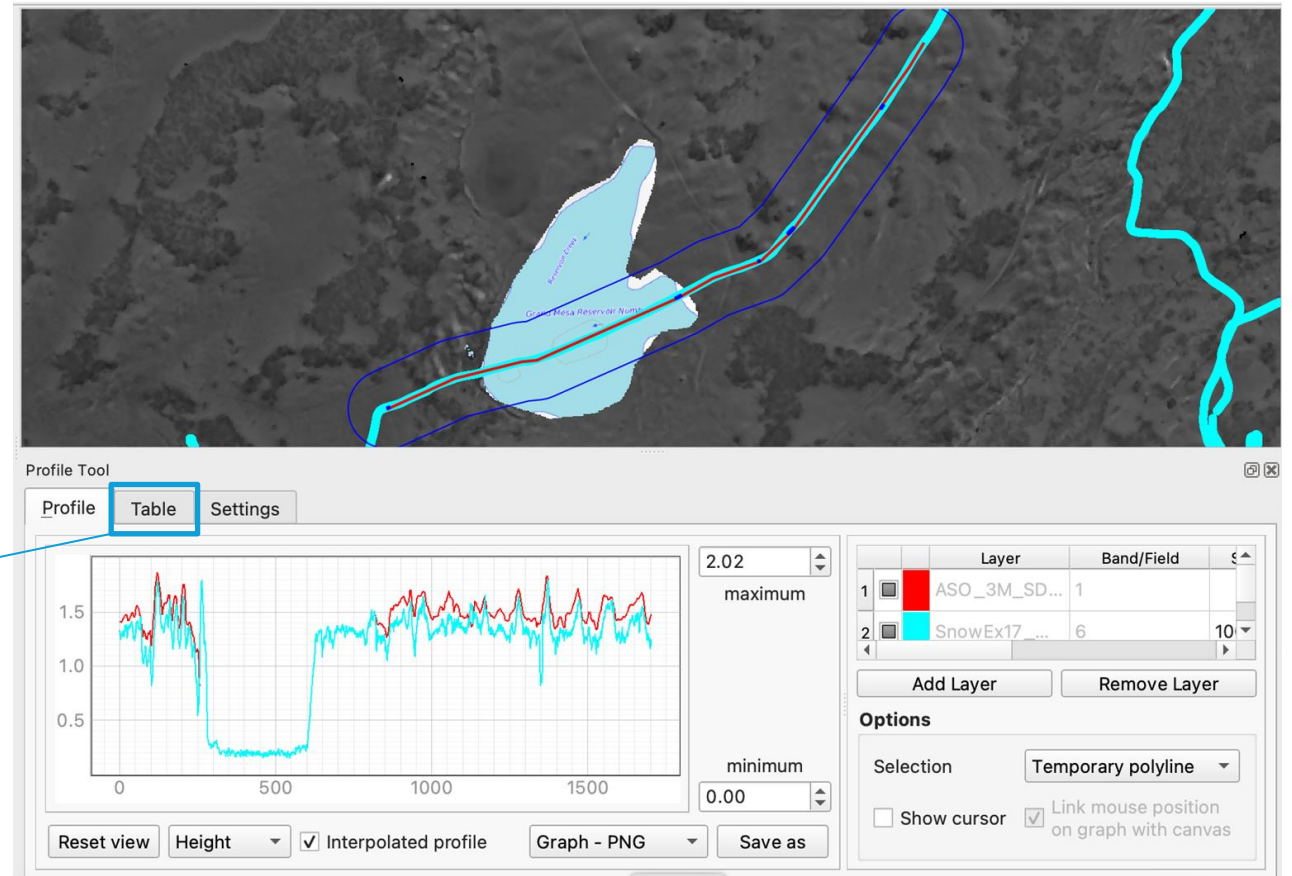


WBD data on Colorado's Continental Divide



# Comparing Snow Depth Data Along a Transect

- Compare data sources for verification of watershed basin calculations
- Transect can be straight or follow data collection path
- ASO: snow depth in meters
- SnowEx: thickness

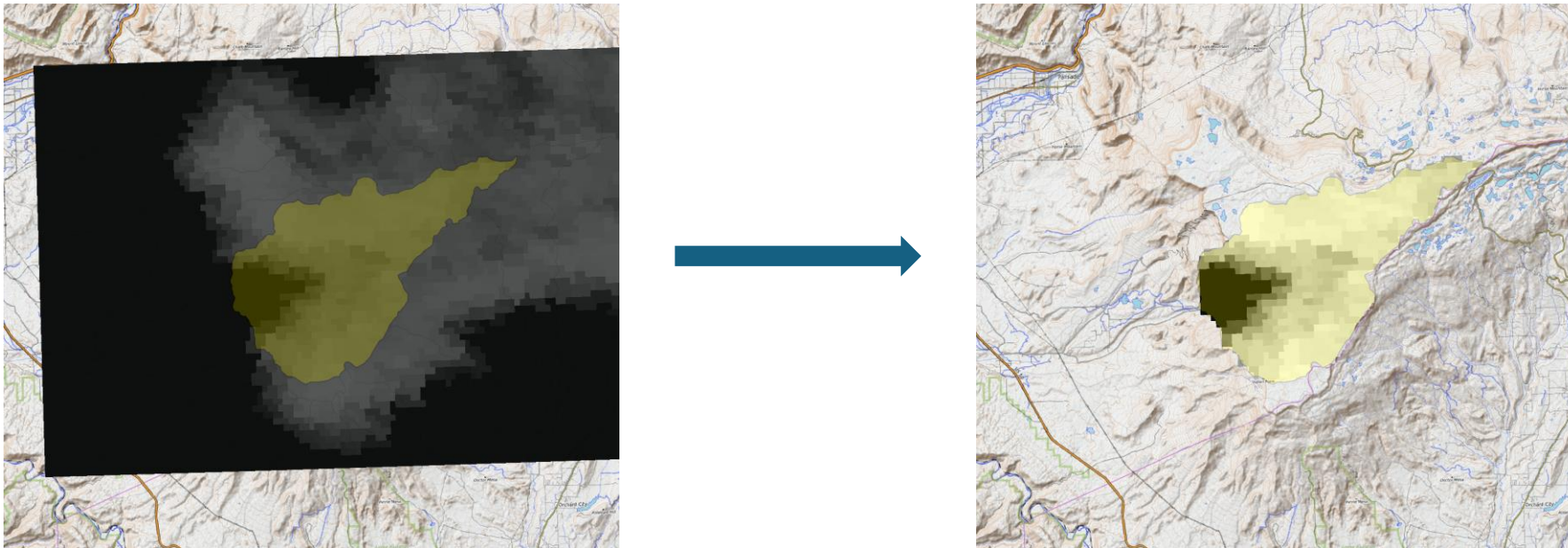


Values can be extracted from the Table option and used as inputs for model calculations



# Gathering NDSI Data (or Any Raster Data) for a Selected Basin

- Constrain MODIS NDSI data to a watershed boundary
- This could be done over multiple MODIS cloudless-captures to create a time series
- Method can be applied to any raster data with full coverage for your watershed of interest



Selected watershed from WBD used to limit MODIS NDSI data to area contributing to a specified outflow. Note that this catchment is in a mesa area and has a shape that contrasts with many catchments (outflow is to the west).





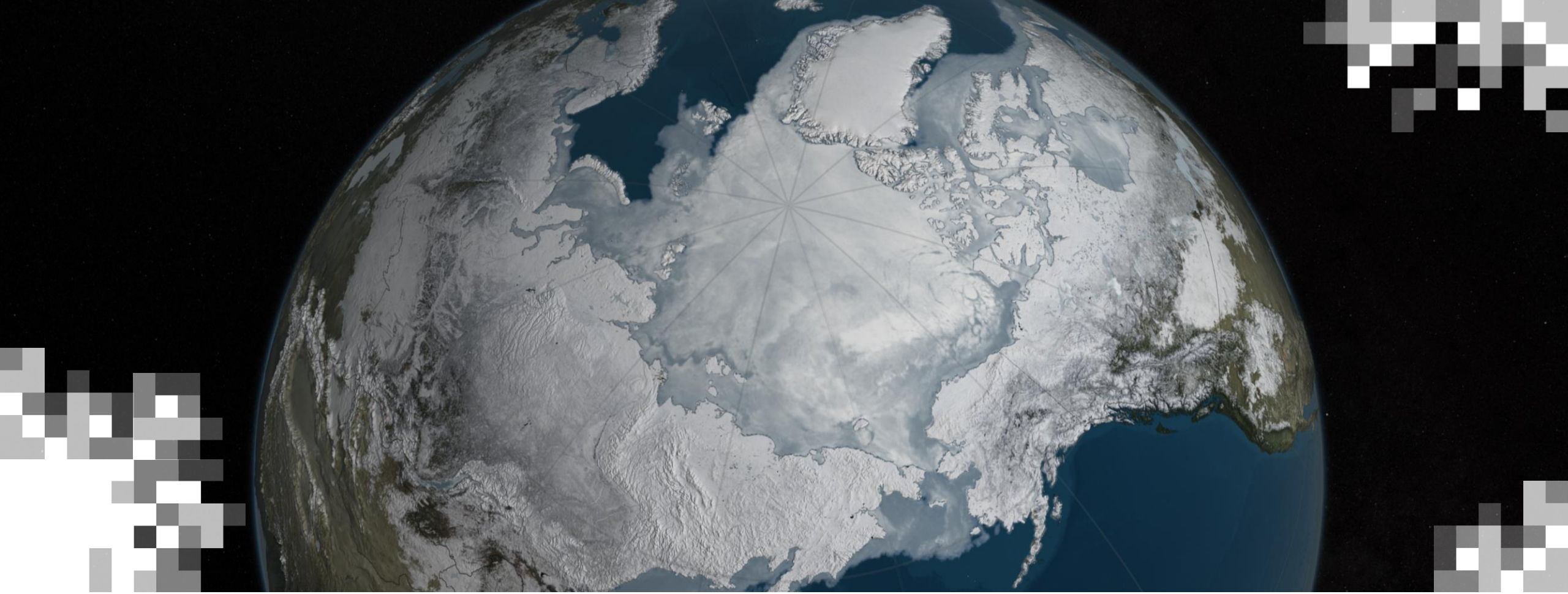
**Demonstration**

# Demo: Working with Snow Data in QGIS

We'll go through the following steps for exploring NSIDC's snow data in QGIS:

- Find coincident data using spatial and temporal filtering, starting with SnowEx GPR data
- Use AppEEARS to obtain MODIS data as a GeoTiff
- Load SnowEx GPR .csv into QGIS as a point vector layer
- Load ASO gridded LiDAR and MODIS rasters into QGIS
- Use QGIS Profile tool plugin to compare SnowEx and ASO snow depth data along a transect
- Clip MODIS GeoTiff with a watershed boundary and calculate mean value of NDSI





## Part 2: Summary

# Summary

- Overview of NSIDC:
  - Free access to over 1,400 data sets
  - Easy search and browse specific data set landing pages, user guides, and FAQ
  - Demonstration of data discovery and access tool: [NASA Earthdata Search](#)
  - Data sub-setting and extraction tool: [AppEARS](#)
- Download, analyze, and visualize snow data:
  - Demonstration using example in Grand Mesa in Colorado
  - Explore, Spatial/temporal selection of SnowEx, ASO, and MODIS NDSI data
  - Analyze and visualize data using QGIS



# Looking Ahead to Part 3

## Joint ARSET-Western Waters Action Office (WWAO) session:

- Impact of snow data in the Western US.
- Monitor and visualize snow cover, snow albedo, snow darkening, and snow cover duration in the Western US.
- Forecasting snow-fed river flow with case studies in the Western US.



# Homework and Certificates

- **Homework:**
  - One homework assignment
  - Opens on 08/07/2025
  - Access from the [training webpage](#)
  - Answers must be submitted via Google Forms
  - **Due by 08/21/2025**
- **Certificate of Completion:**
  - Attend all three live webinars (attendance is recorded automatically)
  - Complete the homework assignment by the deadline
  - You will receive a certificate via email approximately two months after completion of the course



# Acknowledgements

## Instructors:

Mikala Beig	Associate Scientist, NSIDC- DAAC
Saber Brasher	Associate Scientist, NSIDC-DAAC
Diane Fritz	Associate Scientist, NSIDC-0DAAC
Andrew Barrette	Senior Associate Scientist, NSIDC



# Contact Information

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- [ARSET Website](#)
- [ARSET YouTube](#)

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1. Send an email with no subject line to [arset-join@lists.nasa.gov](mailto:arset-join@lists.nasa.gov).
2. Follow the instructions sent in response.

Visit our Sister Programs:



# Resources

- [qgis.org](http://qgis.org) – Free and open-source tool for mapping and analyzing data
- [NSIDC datasets](#) – Repository of cryospheric data and more
  - [MODIS](#)
  - [Airborne Snow Observatory](#)
  - [SnowEx](#)
- [NASA's Earthdata Search](#)
- [AppEEARS](#)
- [GDAL documentation](#) – Specifics on how to use `gdal_translate` and `gdal_warp`
- [Hydrosheds](#) – Seamless hydrographic data for global and regional applications
- [The National Hydrography Dataset \(NHD\)](#) – Includes the watershed boundary dataset (WBD)
- [QGIS for Hydrological Applications](#) – Recipes for catchment hydrology and water management by Hans van der Kwast and Kurt Menke
- [Python tutorial](#) – a similar exploration of this data with efficiency for repetitive analysis





**Thank You!**

