

Supplementary Information

Title

MSDT v1.0: An Open-source Multi-method Snow Drought Toolbox

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Multi-method Snow Drought Tool (MSDT)

MSDT
Multi-method Snow Drought Tool

Analysis
Visualization
Download

1. Method

Time Scale
☐ Yearly
☒ Monthly
☐ Daily

Descriptor
SWEI

Metric	Snow Drought Threshold	Intensity range	Class value	Description
SWEI	< user SWEI threshold	-inf,-2.0	-5	Exceptional_Drought
		-2.0,-1.6	-4	Extreme_Drought
		-1.6,-1.3	-3	Severe_Drought
		-1.3,-0.8	-2	Moderate_Drought

2. Data Input

SWE Folder
Select

SWE Field
Auto Detect

Precipitation
Select

Extent Mask
Select

3. Parameters

Baseline
Select

Winter Period
7
-
6

Drought Threshold
-0.5
SWEI value. Drought is identified below this value.

SWEI Distribution
Empirical (Gringorten)
Probability model used before normal-score transform.

SWEI Scale
3
Accumulation window in months (1-12).

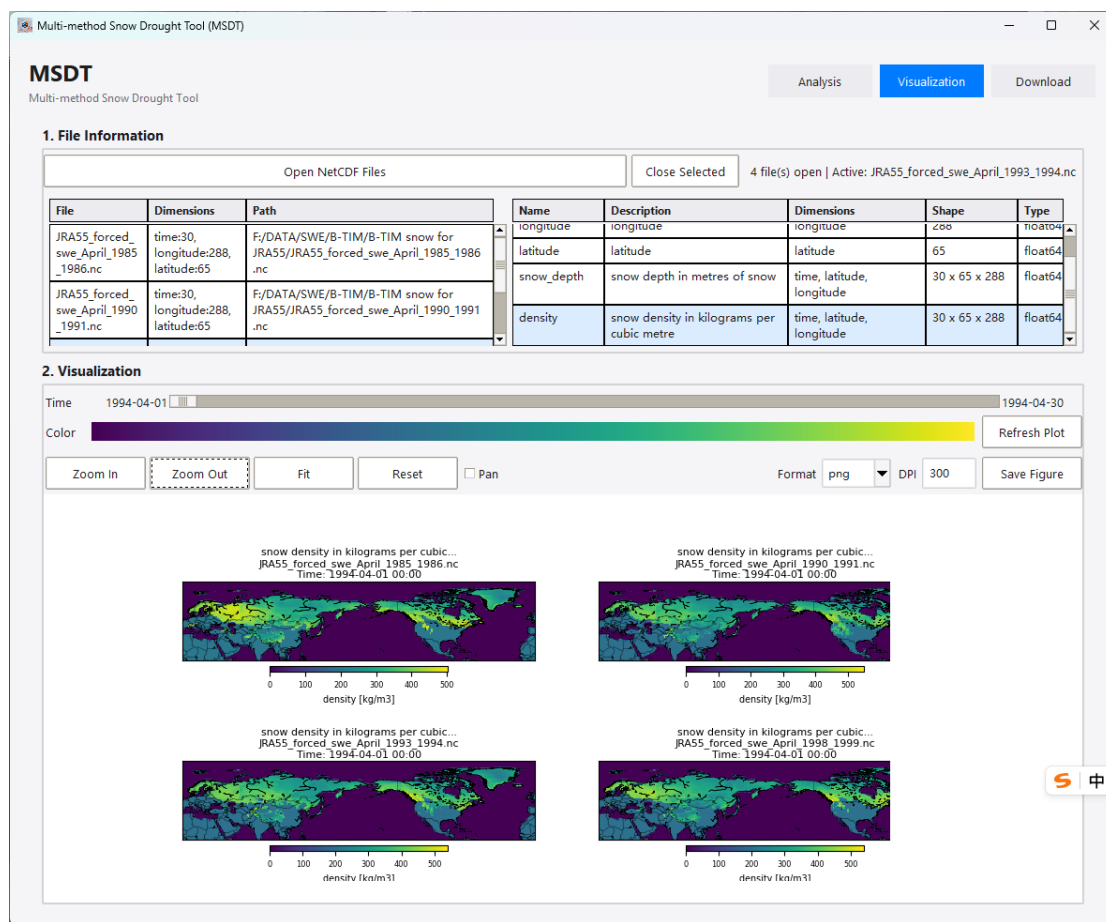
4. Output

Output File
Select

Run Analysis

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Figure S1. Graphical user interface of MSDT for snow drought identification.



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Figure S2. Graphical user interface of MSDT for snow data visualization.

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ERA5-Land
GlobSnow V3.0
SWE Products

1. API Configuration

CDS API URL
<https://cds.climate.copernicus.eu/api>

CDS API Key

Save Credentials

2. Dataset Selection

☐ Monthly
☒ Daily

3. Variable Selection

Temperature:
☐ 2m dewpoint temperature
☐ 2m temperature
☐ Skin temperature
☐ Soil temperature level 1

Snow:
☐ Snow depth water equivalent

4. Time Range

Start Year
1950
End Year
2026

5. Format Settings

Data Format
☒ NetCDF
☐ GRIB

Download Format
☒ Unarchived (not zipped if single file)
☐ Zip

6. Geospatial Parameters

Area [N,W,S,E]
90,-180,-90,180

Grid [lat,lon]
0.25,0.25

Browse
Start

Figure S3. Graphical user interface of MSDT for data download.

Table S1. SWE-related data products listed in the MSDT data-catalog panel.

Category	Product	Time	Resolution	Data source	Access link
In-situ	NRCS SNOTEL / Snow Course	long records to present	Point stations	USDA NRCS	https://www.nrcs.usda.gov/resources/data-and-reports/snow-and-water-interactive-map
	NOAA GHCN Daily	historical to present	Point stations	NOAA NCEI	https://www.ncei.noaa.gov/products/land-based-station/global-historical-climatology-network-daily
Reanalysis	ERA5-Land	1950-present	0.1 deg; hourly/monthly/daily derivatives	ECMWF / Copernicus CDS	https://cds.climate.copernicus.eu/datasets/reanalysis-era5-land
	MERRA-2 Land Diagnostics	1980-present	0.5 x 0.625 deg; hourly/time-averaged	NASA GMAO / GES DISC	https://disc.gsfc.nasa.gov/datasets/M2T1NXLND_5.12.4/summary
	GLDAS Noah	2000-present for v2.1	0.25 deg; 3-hourly/monthly	NASA GES DISC	https://disc.gsfc.nasa.gov/datasets/GLDAS_NOAH025_3H_2.1/summary
	SNODAS	30 September 2003-present	1 km; daily; CONUS	NOAA NOHRSC / NSIDC	https://nsidc.org/data/g02158/versions/1
Remote sensing	GlobSnow SWE v3.0	1979-2022 archive	25 km EASE-Grid; daily/monthly	Finnish Meteorological Institute / ESA heritage	https://www.globsnow.info/swe/archive_v3.0/
	ESA Snow CCI SWE	1979 onwards; product dependent	Passive-microwave grid products; product dependent	ESA Climate Change Initiative	https://climate.esa.int/en/projects/snow/
	AMSR-E / AMSR2 SWE	AMSR-E 2002-2011; AMSR2 2012-present	25 km EASE-Grid; daily	NASA NSIDC	https://nsidc.org/data/ae_dysno/versions/3