ARCLIM: Bioclimatic atlas of the terrestrial Arctic

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BACKGROUND

- The Arctic is warming rapidly, 3-4 times faster than globally. In addition to the long-term trend in temperatures, extreme weather events are becoming increasingly frequent causing disturbances to the Arctic terrestrial ecosystems.

- Changes in bioclimate have been linked to observed changes in Arctic vegetation productivity (i.e. greening and browning, Fig. 1).

- However, many existing climate datasets concentrate on seasonal precipitation and temperature at relatively coarse spatial and temporal resolutions, thus neglecting many ecologically significant aspects of the Arctic climate.

- For instance, growing season length (Fig. 2), snow cover duration (Fig. 3), or heatwave magnitude index (Fig. 2) are known to be important variables for Arctic ecology that may not be represented by the more widely used climate datasets.

Fig 1. Examples of greening (top) and browning (bottom) of the Arctic.

METHODS

- ARCLIM variables are based on ERA5-Land reanalysis (Fig. 4, Muñoz-Sabater et al., 2021). ARCLIM consists of 14 climate and event-type indicators that are particularly relevant for investigating the changes in the Arctic ecosystems.

- The ARCLIM dataset covers the northern high-latitudes (45–90°N) from 1950 to 2021, hence providing a 72-year long time series of seasonal climate and extreme event indicators in the Arctic.
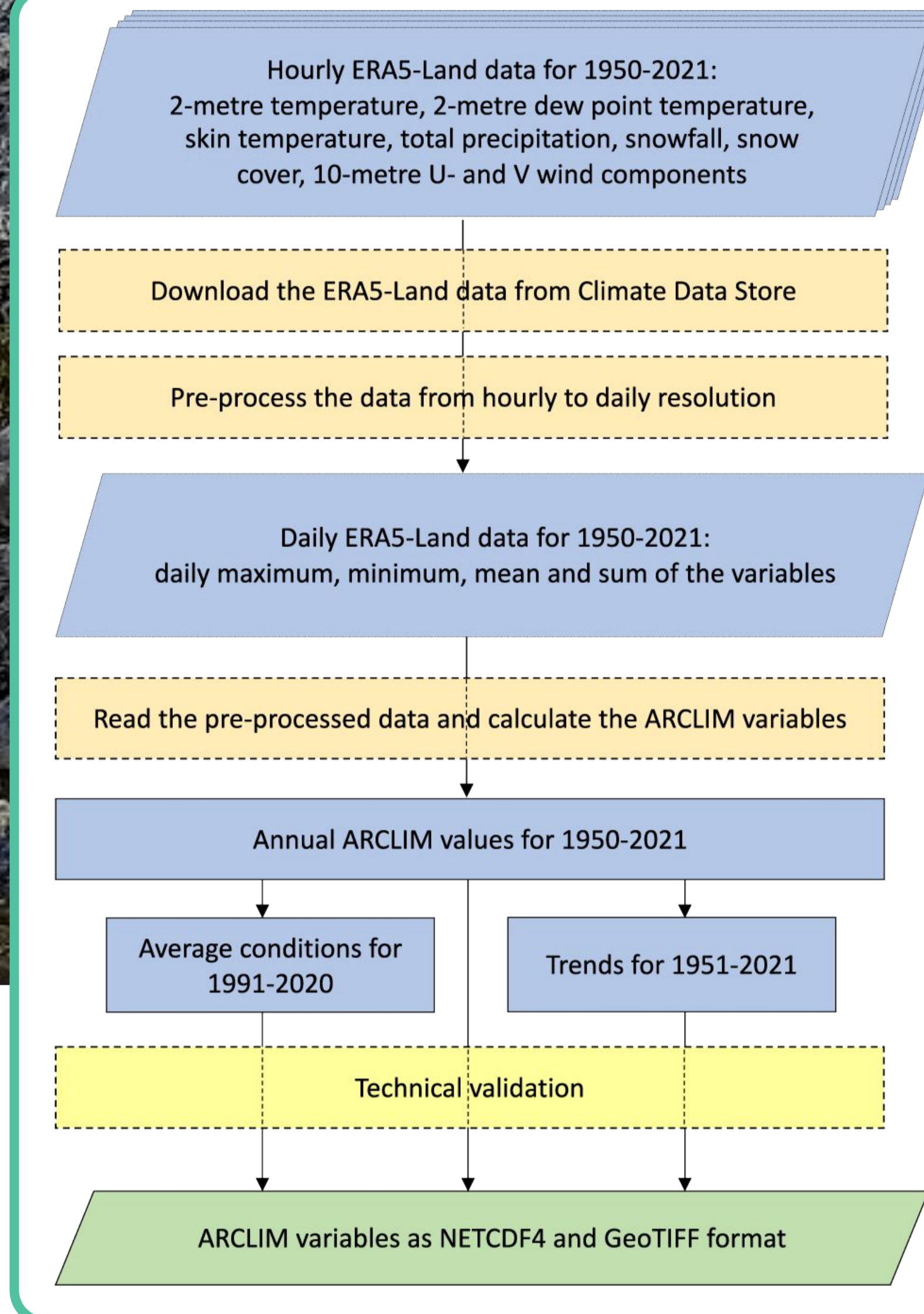

Fig 4. The production of the ARCLIM dataset step by step.

EXAMPLES OF THE DATASET
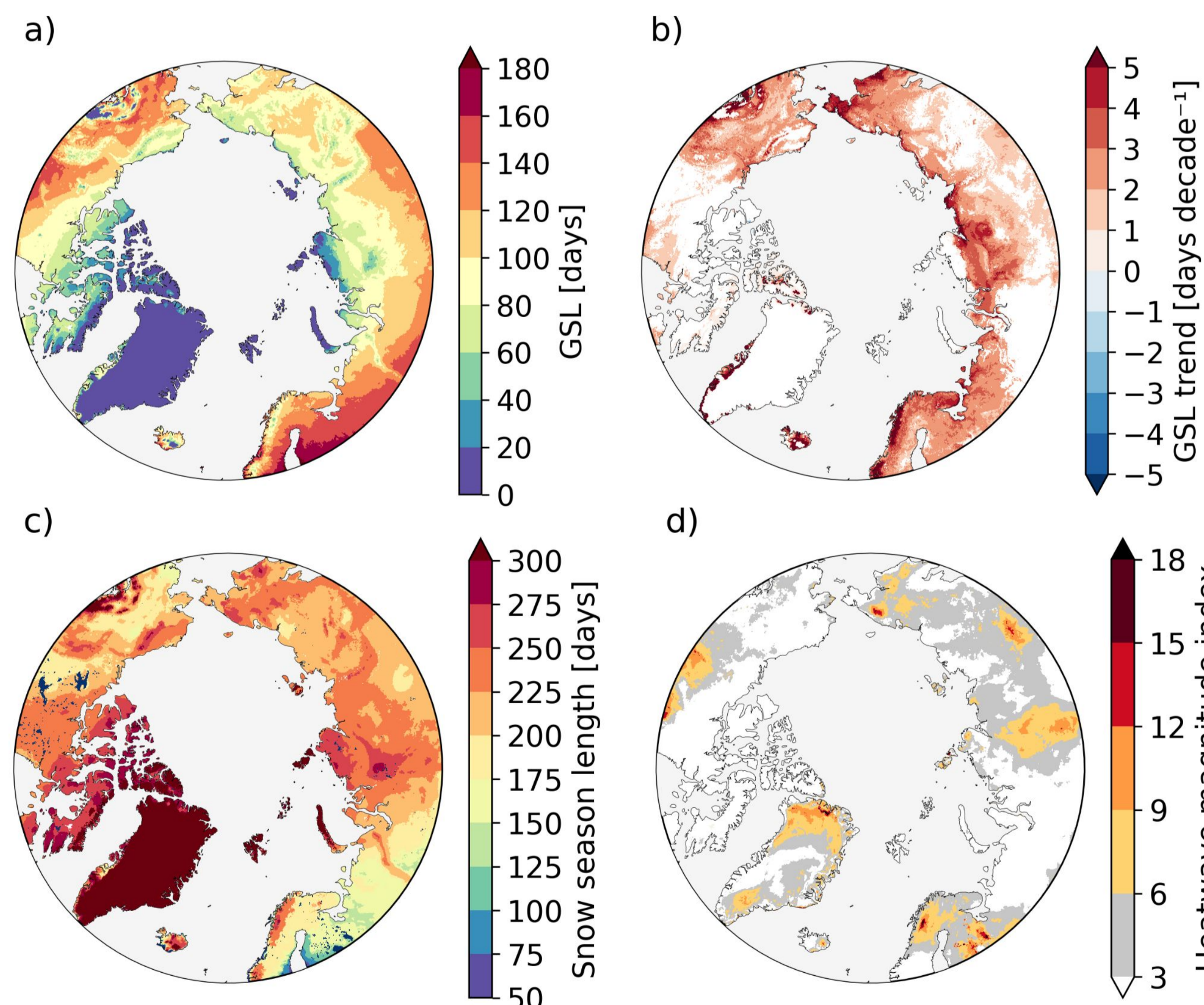
Fig 2. (left) Examples of ARCLIM dataset.
a) average growing season length over 1991-2020, b) linear trend of growing season length over 1951-2021, c) snow season length in 2021, and d) heatwave magnitude index in 2021

Fig 3. (right) Time series of snow season lengths in three Arctic regions in winters 1951-2021. The maps show the linear trends.
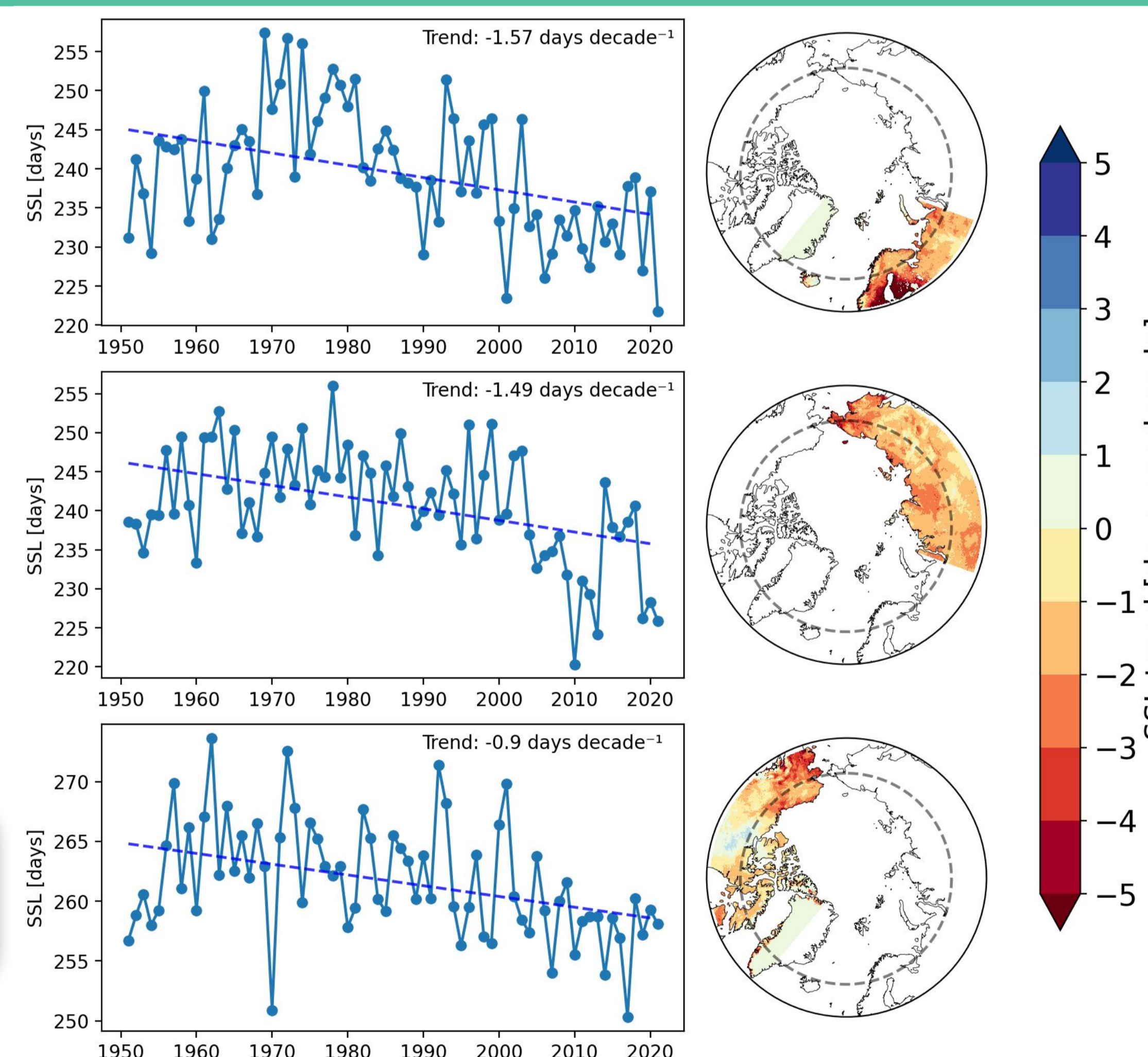
Temporal coverage: 1950-2021

Spatial coverage: 45°-90°N

Horizontal resolution: 0.1°

Table 1. Summary list of the ARCLIM variables.

Full name	Abbreviation	Unit
Thermal growing season length	GSL	days
Thermal growing degree day sum	GDD	°C days
Frost during the growing season	FGS	°C days
Freezing degree days	FDD	°C days
Number of rain-on-snow events	ROS	year−1
Number of winter warming events	WWE	year−1
Intensity of winter warming events	WWI	°C days
Heatwave magnitude index	HWMI	
Vapor pressure deficit magnitude index	VPDI	
Summer warmth index	SWI	°C
Snow season length	SSL	days
Onset of snow season	SSO	Day of year
End of snow season	SSE	Day of year
Number of high wind speed events	HWE	year−1
Annual mean temperature	TAVG	K
Annual precipitation	PRA	m
Annual snowfall	SFA	m
Annual 10-m wind speed	WSA	ms−1

ACCESS TO THE DATASET

Peer-reviewed data descriptor article is available from Scientific Data journal (Rantanen et al. 2023). The ARCLIM dataset is available in NETCDF4 and GeoTIFF format from Figshare repository: https://doi.org/10.6084/m9.figshare.c.6216368.v1.

Annual values 1950-2021

Mean conditions 1991-2020

Trends 1951-2021

Access the data here

References
Muñoz-Sabater, J. *et al.* (2021): ERA5-Land: a state-of-the-art global reanalysis dataset for land applications. *Earth Syst. Sci. Data* 13, 4349–4383.
Rantanen, M., Kämäräinen, M., Niittynen, P. *et al.* Bioclimatic atlas of the terrestrial Arctic. *Sci Data* 10, 40 (2023). https://doi.org/10.1038/s41597-023-01959-w