## Supporting Data for

***Projections and Physical Drivers of Extreme Precipitation in Greenland & Baffin Bay***

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## Overview

This dataset includes the data needed to reproduce the results and figures of the manuscript “Projections and Physical Drivers of Extreme Precipitation in Greenland & Baffin Bay”, submitted to *Journal of Geophysical Research: Atmospheres*. Two types of files are included:

1. CSV files of summaries for nine subregions: 6 Greenland watersheds and 3 Canadian islands.
   1. Greenland Subregions: Central West (‘CW’), Northeast (‘NE’), North (‘NO’), Northwest (‘NW”), Southeast (‘SE’), and Southwest (‘SW’)
   2. Canadian Subregions: Baffin Island (‘baffin’), Devon Island (‘devon’), and Ellesmere Island (‘ellesmere’)
2. NetCDF files with gridded fields of atmospheric parameters.
   1. The projectionfor all netCDF files is the 25-km EASE2 grid with a central latitude of 90°N and a central longitude of 0° (i.e., EPSG 6391).
   2. All data are provided on a 720 by 720 grid, which encompasses the entire Northern Hemisphere. However, precipitation data is set to NaN beyond the study region of (55°N-90°N, 130°W-25°E).

Input datasets for these derived products include the fifth-generation atmospheric reanalysis from the ECMWF (ERA5; Hersbach et al., 2020) and a simulation of the second-generation Community Earth System Model (CESM2.2; Danabasoglu et al., 2020) run on a variable-resolution “ARCTIC” grid (Herrington et al., 2022). Note that the native grid for these datasets is different from the grid used for derived data products. A single spatial grid is used here to facilitate the combination / overlay of the data contained within the dataset. Cyclone detection is performed using version 13.2 of the CEOS/NSIDC Extratropical Cyclone Tracking algorithm (Crawford et al., 2021). Atmospheric rivers are detected using the algorithm from TempestExtremes v2.1 (Ullrich et al., 2021).

## CSV files

**{subregion}\_distribution\_5mm.csv**

Daily precipitation distribution for each subregion in the domain in 5 mm accumulation bins (used in Figure 3).

Columns:

bin – upper value of accumulation bin [mm]

hist – number of occurrences of that accumulation in VR-CESM HIST (1980-1999)

fut – number of occurrences of that accumulation in VR-CESM FUT (2080-2099)

era – number of occurrences of that accumulation in ERA5 (1980-1999)

*Note: 1 occurrence = 1 day in 1 grid cell*

**subregion\_mean\_ex\_thres.csv**

Average extreme daily precipitation thresholds for each dataset for each subregion (vertical lines in Figure 3).

Columns:

subregion – name of subregion

hist – extreme daily precipitation threshold for VR-CESM HIST [mm]

fut – extreme daily precipitation threshold for VR-CESM FUT [mm]

era – extreme daily precipitation threshold for ERA5 [mm]

**regional\_monthly\_total\_ex\_precip.csv**

Average monthly accumulations from extreme precipitation days in each subregion (Figure 4).

Columns:

subregion – name of subregion

month – month (1-12)

hist – subregion mean monthly accumulation from extreme days in VR-CESM HIST [mm]

fut – subregion mean monthly accumulation from extreme days in VR-CESM FUT [mm]

era – subregion mean monthly accumulation from extreme days in ERA5 [mm]

## NetCDF Files

**historical\_era5\_annual\_values.nc**

Values of ERA5 used in Figure 1.

Variables:

ann\_precip: mean annual precipitation [mm]

ex\_thres: extreme daily precipitation threshold [mm]

ex\_precip: mean annual accumulation from extreme precipitation days [mm]

**historical\_vrcesm\_annual\_values.nc**

Values of VR-CESM HIST used in Figures 1 and 2.

Variables:

ann\_precip: mean annual precipitation [mm]

ex\_thres: extreme daily precipitation threshold [mm]

ex\_precip: mean annual accumulation from extreme precipitation days [mm]

**historical\_CESM2.2\_annual\_values.nc**

Values of CESM2.2 used in Figure 2.

Variables:

ann\_precip: mean annual precipitation [mm]

ex\_thres: extreme daily precipitation threshold [mm]

**annual\_cyclone\_track\_density.nc**

Average annual cyclone track densities.

Variables:

hist\_trkdens: average annual track density in VR-CESM HIST [Tracks per 40,000 km2]

fut\_trkdens: average annual track density in VR-CESM FUT [Tracks per 40,000 km2]

era\_trkdens: average annual track density in ERA5 [Tracks per 40,000 km2]

**seasonal\_cyclone\_track\_density\_JFM.nc & seasonal\_cyclone\_track\_density\_JAS.nc**

Average seasonal cyclone track densities for JFM (winter) and JAS (summer), respectively.

Variables:

hist\_trkdens: average seasonal track density in VR-CESM HIST [Tracks per 40,000 km2]

fut\_trkdens: average seasonal track density in VR-CESM FUT [Tracks per 40,000 km2]

era\_trkdens: average seasonal track density in ERA5 [Tracks per 40,000 km2]

**annual\_ar\_days.nc**

Average annual number of days each grid cell is impacted by an AR.

Variables:

hist\_ar\_days: average annual number of AR days in VR-CESM HIST [days/year]

fut\_ar\_days: average annual number of AR days in VR-CESM FUT [days/year]

era\_ar\_days: average annual number of AR days in ERA5 [days/year]

**seasonal\_ar\_days\_JFM.nc & seasonal\_ar\_days\_JAS.nc**

Average seasonal number of days each grid cell is impacted by an AR for JFM (winter) and JAS (summer), respectively.

Variables:

hist\_ar\_days: average seasonal number of AR days in VR-CESM HIST [days/year]

fut\_ar\_days: average seasonal number of AR days in VR-CESM FUT [days/year]

era\_ar\_days: average seasonal number of AR days in ERA5 [days/year]

**annual\_ex\_day\_associations.nc**

Percent of all annual extreme precipitation days in each grid cell occurring with a cyclone and/or an AR present in the same grid cell.

Variables:

hist\_ex\_cap: percent of all extreme precipitation days in VR-CESM HIST occurring with a cyclone present (i.e., cyclone-associated precipitation (CAP)) [%]

hist\_ex\_ar\_cap: percent of all extreme precipitation days in VR-CESM HIST occurring with both a cyclone and an AR present [%]

hist\_ex\_ar: percent of all extreme precipitation days in VR-CESM HIST occurring with an AR present [%]

fut\_ex\_cap: percent of all extreme precipitation days in VR-CESM FUT occurring with a cyclone present (i.e., cyclone-associated precipitation (CAP)) [%]

fut\_ex\_ar\_cap: percent of all extreme precipitation days in VR-CESM FUT occurring with both a cyclone and an AR present [%]

fut\_ex\_ar: percent of all extreme precipitation days in VR-CESM FUT occurring with an AR present [%]

**seasonal\_ ex\_day\_associations\_JFM.nc & seasonal\_ ex\_day\_associations\_JAS.nc**

Percent of all extreme precipitation days in winter (JFM) and summer (JAS) in each grid cell occurring with a cyclone and/or an AR present in the same grid cell, respectively.

Variables:

hist\_ex\_cap: percent of all seasonal extreme precipitation days in VR-CESM HIST occurring with a cyclone present (i.e., cyclone-associated precipitation (CAP)) [%]

hist\_ex\_ar\_cap: percent of all seasonal extreme precipitation days in VR-CESM HIST occurring with both a cyclone and an AR present [%]

hist\_ex\_ar: percent of all seasonal extreme precipitation days in VR-CESM HIST occurring with an AR present [%]

fut\_ex\_cap: percent of all seasonal extreme precipitation days in VR-CESM FUT occurring with a cyclone present (i.e., cyclone-associated precipitation (CAP)) [%]

fut\_ex\_ar\_cap: percent of all seasonal extreme precipitation days in VR-CESM FUT occurring with both a cyclone and an AR present [%]

fut\_ex\_ar: percent of all seasonal extreme precipitation days in VR-CESM FUT occurring with an AR present [%]

## References

Crawford, A. D., Schreiber, E. A. P., Sommer, N., Serreze, M. C., Stroeve, J. C., & Barber, D. G. (2021). Sensitivity of Northern Hemisphere Cyclone Detection and Tracking Results to Fine Spatial and Temporal Resolution Using ERA5. *Monthly Weather Review*, *149*(8), 2581–2598.<https://doi.org/10.1175/MWR-D-20-0417.1>

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Ullrich, P. A., Zarzycki, C. M., McClenny, E. E., Pinheiro, M. C., Stansfield, A. M., & Reed, K. A. (2021). TempestExtremes v2.1: a community framework for feature detection, tracking, and analysis in large datasets. Geoscientific Model Development, 14(8), 5023–5048. <https://doi.org/10.5194/gmd-14-5023-2021>