

Dataset for “Reduced ice loss from Greenland under stratospheric aerosol injection”

(submitted to *Journal of Geophysical Research: Earth Surface*)

— README —

John C. Moore^{1,2,3}, Ralf Greve^{4,5}, Chao Yue¹, Thomas Zwinger⁶, Fabien Gillet-Chaulet⁷, Liyun Zhao^{1,8}

¹ College of Global Change and Earth System Science, Beijing Normal University, Beijing, China

² Arctic Centre, University of Lapland, Rovaniemi, Finland

³ CAS Center for Excellence in Tibetan Plateau Earth Sciences, Beijing, China

⁴ Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan

⁵ Arctic Research Center, Hokkaido University, Sapporo, Japan

⁶ CSC–IT Center for Science, Espoo, Finland

⁷ Univ. Grenoble Alpes, CNRS, INRAE, IRD, Grenoble INP, IGE, Grenoble, France

⁸ Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), China

14 model experiments (each run with the ice-sheet models SICOPOLIS and Elmer/Ice; for details see the manuscript)

- HIST: Historical simulation 1990–2015.
- CTRL: Unforced projection control experiment 2015–2090.
- <GCM>-<Scenario>-Rmed: Future climate experiments 2015–2090, where <GCM> = {BNU-ESM, HadGEM2-ES, MIROC-ESM, MIROC-ESM-CHEM} and <Scenario> = {RCP85, RCP45, G4}.

Variables

The variable names follow closely the ISMIP6 convention (e.g., Table A1 of <https://tinyurl.com/ismip6-wiki-gris>). However, years are used instead of seconds as the time unit ($1 \text{ a} = 3.1556925445 \times 10^7 \text{ s}$). Time itself is counted in days since 1990-01-01 00:00:00, using a 365-day calendar (no leap years, i.e., all years are 365 days long).

2D variables for SICOPOLIS are provided on the native 5-km grid (EPSG:3413), while for Elmer/Ice, they were resampled from the unstructured finite-element mesh to this grid.

2D state variables (in Output_{SICOPOLIS, ElmerIce}_2D.zip)

lithk	– Ice thickness (m)
orog	– Surface elevation (m)
base	– Ice base elevation (m)
topg	– Bedrock elevation (m)
xvelsurf	– Surface velocity in x-direction (m a^{-1}) *
yvelsurf	– Surface velocity in y-direction (m a^{-1}) *
zvelsurf	– Surface velocity in z-direction (m a^{-1}) *
velsurf	– Surface velocity in horizontal direction (m a^{-1}) *
xvelbase	– Basal velocity in x-direction (m a^{-1}) *
yvelbase	– Basal velocity in y-direction (m a^{-1}) *
zvelbase	– Basal velocity in z-direction (m a^{-1}) *
velbase	– Basal velocity in horizontal direction (m a^{-1}) *
xvelmean	– Mean velocity in x-direction (m a^{-1})
yvelmean	– Mean velocity in y-direction (m a^{-1})
velmean	– Mean velocity in horizontal direction (m a^{-1})
litemptop	– Surface temperature (K) *
litempbot	– Basal temperature (K) *
strbasemag	– Basal drag (Pa)
sftgif	– Land ice area fraction (–)
sftgrf	– Grounded ice area fraction (–) †
sftflf	– Floating ice area fraction (–) †

These variables are provided as yearly snapshots for the years 2016–2090 [historical: 1991–2015]. Time variable: ‘time’.

2D flux variables (in Output_{SICOPOLIS, ElmerIce}_2D.zip)

acabf	– Surface mass balance flux ($\text{kg m}^{-2} \text{a}^{-1}$)
libmassbgr	– Basal mass balance flux beneath grounded ice ($\text{kg m}^{-2} \text{a}^{-1}$)
libmassbffl	– Basal mass balance flux beneath floating ice ($\text{kg m}^{-2} \text{a}^{-1}$) †
lifmassbf	– Mass loss due to calving and ice front melting ($\text{kg m}^{-2} \text{a}^{-1}$)
ligroundf	– Mass flux through the grounding line ($\text{kg m}^{-2} \text{a}^{-1}$) †
dlithkdt	– Ice thickness imbalance (m a^{-1})
hfgeoubed	– Geothermal heat flux (W m^{-2}) *

These variables are provided as yearly averages over the intervals bounded by the years 2015–2090 [historical: 1990–2015]. Time variables: ‘time’, ‘time_bnds’.

Scalar state variables (in Output_{SICOPOLIS, ElmerIce}_Scalar.zip)

lim	– Total ice mass (kg)
limnsw	– Mass above floatation (kg)
iareagr	– Grounded ice area (m ²)
iareafl	– Floating ice area (m ²) †

These variables are provided as yearly snapshots for the years 2016–2090 [historical: 1991–2015]. Time variable: 'time'.

Scalar flux variables (in Output_{SICOPOLIS, ElmerIce}_Scalar.zip)

tendacabf	– Total surface mass balance flux (kg a ⁻¹)
tendlibmassbf	– Total basal mass balance flux (kg a ⁻¹)
tendlibmassbffl	– Total basal mass balance flux beneath floating ice (kg a ⁻¹) †
tendlifmassbf	– Total mass loss due to calving and ice front melting (kg a ⁻¹)
tendligroundf	– Total mass flux through the grounding line (kg a ⁻¹) †

These variables are provided as yearly averages over the intervals bounded by the years 2015–2090 [historical: 1990–2015]. Time variables: 'time', 'time_bnds'.

* Only for the SICOPOLIS results which include a vertical velocity profile and temperature.

† Only for the Elmer/Ice results which include floating ice.

Scripts related to the ISIMIP-method downscaling, SEMIC code, as well as configuration and input files for SICOPOLIS and Elmer/Ice are available in Repo_ISIMIP_downscale.zip, Repo_SEMIC.zip, Repo_SICOPOLIS.zip and Repo_ElmerIce.zip. See the separate README files in these folders for details.