SUMER Antarctic Ice-Shelf Buttressing, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Durand, G., F. Gillet-Chaulet, O. Gagliardini, and J. J. Fürst. 2016. *SUMER Antarctic Ice-shelf Buttressing, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/FWHORAYVZCE7. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0664

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

This data set, part of the French National Research Agency's project on Survey and Modelling of East Antarctica (SUMER), consists of high-resolution data about ice-shelf buttressing for the whole of Antarctica. Buttressing is inferred from known ice geometry and ice motion with the Elmer/Ice ice flow model. Input sources are Bedmap2, MEaSUREs surface ice velocities, and the MEaSUREs grounding-line positions. The data set consists of eight files, which comprise eight two-dimensional fields for the floating ice shelves of Antarctica.

1.1 Format

Data are in binary NetCDF (.nc) format.

1.2 File and Directory Structure

Data are available from NSIDC via HTTPS. Each file contains four variables, x, y, grid-mapping, and one variable specific to the file. The x, y, grid-mapping variables define the polar stereographic projection of the data, which is true scale at 71° S. Table 1 provides the file names, the file-specific variable, and descriptions. For all files, -9999 signifies no data. For more information on buttressing, refer to Section 1.7.1 Parameter Description below.

Table 1. File Names and Descriptions

File Name	Variable	Description
bmax_nsidc_sumer_buttressing_v1.0.nc	bmax	Maximum buttressing as derived by data assimilation with the Elmer/Ice ice flow model. The maximum is attained in the second principal stress direction, i.e., the direction of maximal extensive stress. [No units]
bmin_nsidc_sumer_buttressing_v1.0.nc	bmin	Minimum buttressing as derived from data assimilation with the Elmer/Ice ice flow model. The minimum is attained in the first principal stress direction, i.e., the direction of minimal extensive stress. [No units]
bflow_nsidc_sumer_buttressing_v1.0.nc	bflow	Buttressing calculated in flow direction on the basis of data assimilation with the Elmer/Ice ice flow model. [No units]

File Name	Variable	Description
ev21_nsidc_sumer_buttressing_v1.0.nc	ev21	X-component of the normalised second principal stress vector. The stress tensor was inferred from data assimilation with the Elmer/Ice ice flow model. [No units]
ev22_nsidc_sumer_buttressing_v1.0.nc	ev22	Y-component of the normalised second principal stress vector. The stress tensor was inferred from data assimilation with the Elmer/Ice ice flow model. [No units]
velx_nsidc_sumer_buttressing_v1.0.nc	velx	X-component of the ice velocities inferred from data assimilation with the Elmer/Ice ice flow model. The model was run in shallow-shelf approximation mode, a vertically integrated form of the force balance equations. [m/a]
vely_nsidc_sumer_buttressing_v1.0.nc	vely	Y-component of the ice velocities inferred from data assimilation with the Elmer/Ice ice flow model. The model was run in shallow-shelf approximation mode, a vertically integrated form of the force balance equations. [m/a]
visc_nsidc_sumer_buttressing_v1.0.nc	visc	Ice viscosity parameter B as inferred from the assimilation of velocity and ice thickness observations. The underlying constitutive equation is non-linear with an exponent of n=3. The viscosity parameter is related to the rate factor or fluidity parameter A via $A=1/(B^n)$. [10^6Pa $a^{(1/3)}$]

1.3 File Size

The .nc files are 231 MB each.

1.4 Volume

The volume of the data set is 1.8 GB.

1.5 Spatial Coverage

Southernmost Latitude: 90°S
Northernmost Latitude: 60°S
Westernmost Longitude: 180°W
Easternmost Longitude: 180°E

1.5.1 Spatial Resolution

Spatial resolution is 1 km.

1.6 Temporal Coverage

Temporal coverage for this data set is 1 September 1996 to 1 September 2009.

1.7 Parameter or Variable

The parameters for this data set include ice velocity and buttressing.

1.7.1 Parameter Description

In glaciology, buttressing is a normal force exerted by the ice shelf on the upstream grounded ice in a certain horizontal direction (Schoof, 2006; Gudmundsson et al., 2012; Gudmundsson, 2013). The normal force is inferred from the stress tensor choosing a certain horizontal direction n. This force is compared to the vertically integrated hydrostatic pressure, a normal force, that the ocean water would exert if the ice shelf was removed up to this position. The ratio of these two forces determines the buttressing potential of the ice shelf.

1.7.2 Sample Data Record

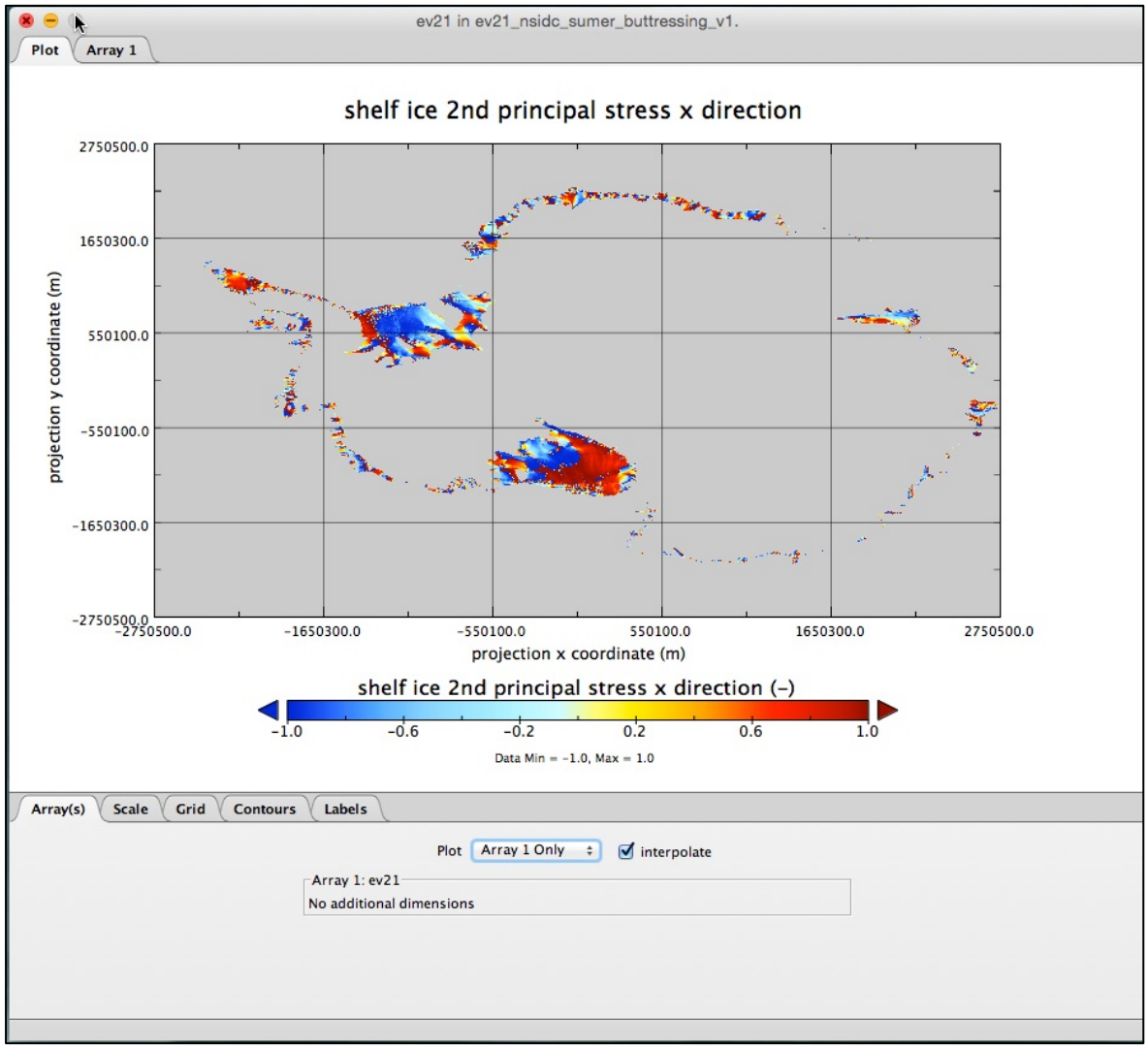

Figure 1. Sample Plot of X-Component of Normalized 2nd Principal Stress Vector

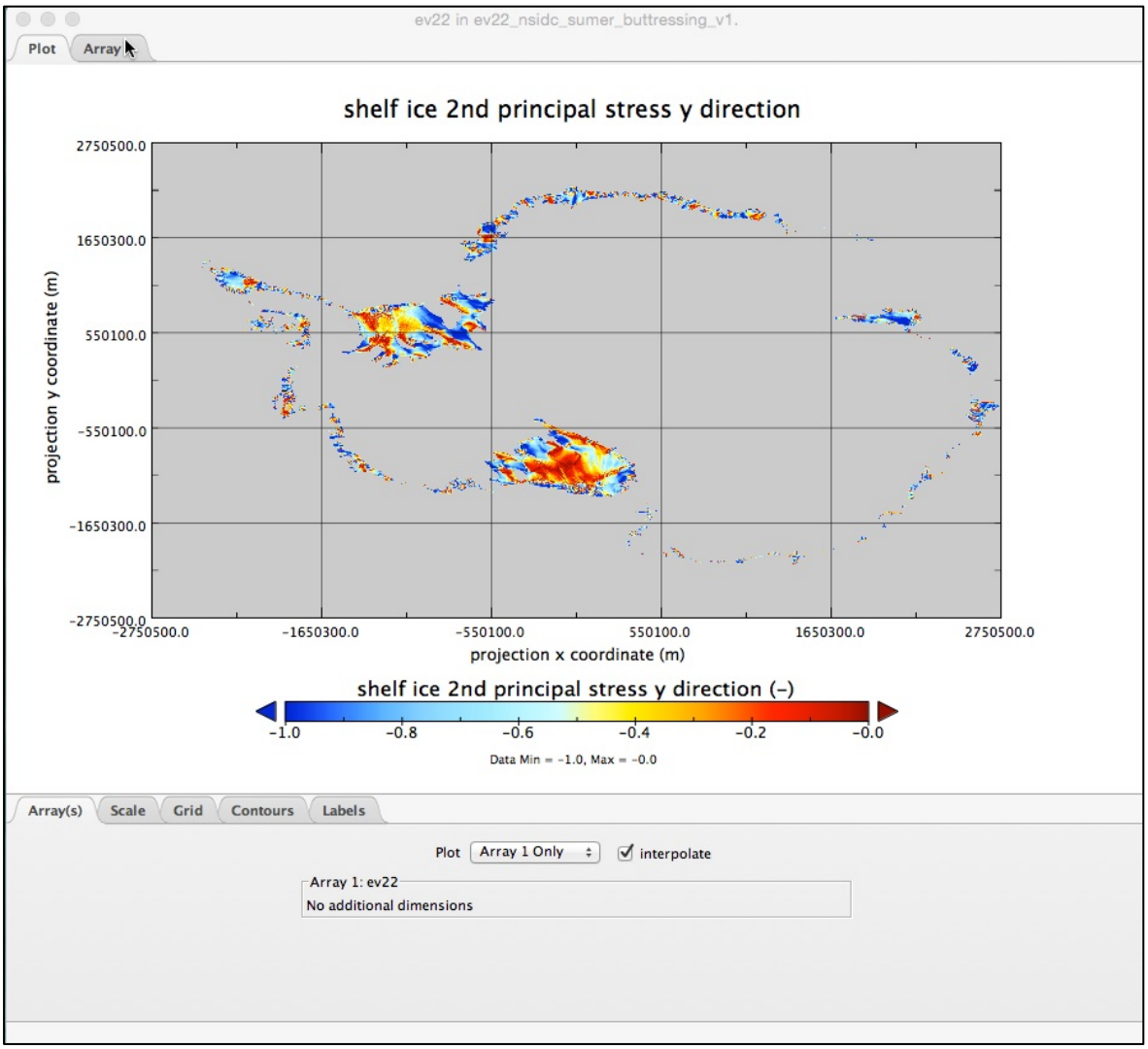

Figure 2. Sample Plot of Y-Component of Normalized 2nd Principal Stress Vector

2 SOFTWARE AND TOOLS

2.1 Software and Tools

See NetCDF Software Tools for a list of resources for accessing NetCDF files.

3 DATA ACQUISITION AND PROCESSING

3.1 Data Sources

Input data sources are Bedmap2, the MEaSUREs surface velocities and the MEaSUREs grounding-line positions. The ice geometry is exclusively informed from the Bedmap2 product: Bedmap2 - Ice thickness and subglacial topographic model of Antarctica. The MEaSUREs

grounding-line positions were used to locate additional pinning-points which provide basal resistance. See MEaSUREs InSAR-Based Antarctica Ice Velocity Map and MEaSUREs Antarctic Grounding Line from Differential Satellite Radar Interferometry.

3.2 Processing Steps

The quantification of ice-shelf buttressing relies on the stress regime within the ice body (Gudmundsson, 2013). As the stress tensor is not an observed quantity on large scales, the Elmer/Ice ice flow model provided data assimilation.

Data Assimilation

The stress tensor is inferred from assimilating geometry and velocity observations for the whole of Antarctica with the Elmer/Ice ice flow model (Fürst et al., 2015). Primary input to the assimilation is the Bedmap2 surface and bottom elevations (Fretwell et al., 2013) and MEaSUREs surface velocities from satellite interferometry (Rignot et al., 2011). The assimilation relies on standard inverse methods (Morlighem et al., 2010; Gillet-Chaulet et al., 2012; Arthern et al., 2015) and simultaneously infers a viscosity parameter B and a basal friction parameter b2. For details on the method and on the performance of the inversion on continental scales, please see Fürst et al., 2016 and Fürst et al., 2015.

4 REFERENCES AND RELATED PUBLICATIONS

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6 DOCUMENT INFORMATION

6.1 Publication Date

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6.2 Date Last Updated

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