Journal of Glaciology authors' guide to the IGS LaTeX 2_ε class file

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ABSTRACT. The design for the *Journal of Glaciology* has been implemented as a LaTeX 2_ε class file and is derived from article.cls. We recommend that authors use this guide as a template. Import your text to below the `\maketitle` command and then cut-and-paste the title/author/affiliation/abstract details. While writing we suggest you use the two-column `[twocolumn]` option to check that mathematical equations fit the measure. Submitted papers must, however, be presented using the one-column `[review]` option. The *Journal of Glaciology* is printed in Optima. However, submissions using Computer Modern are fine. If you have any problems using the class file, please email Craig Baxter at the above address, attaching your tex, log, cls, sty, bib, bbl, bst and any additional sty files you are using. The abstract should be less than 200 words and one paragraph long.

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USING THE IGS CLASS FILE

Please ensure you have downloaded the latest version from http://igsoc.org/production/. The IGS LaTeX 2_ε journal guide has examples of most environments authors are likely to come across. The title page contains some new environments, e.g. affiliation and abstract. Papers should be divided into unnumbered sections with short section headings. SI units and internationally recognized systems of abbreviation should be used throughout. The TeX file should be named to reflect your paper number, i.e. 15J299.tex. Please remove any extraneous text (e.g. text from previous drafts, notes and comments that will not form part of the final printed text of the paper).

Additional packages supplied with igs.cls

The distribution package contains the following files; the first 10 are IGS-specific, the other 10 are standard LaTeX distribution files:

`igs2ejournalguide.tex` IGS LaTeX guide

`igs2ejournalguide.pdf` pdf file of this guide

`igs2ejournalguide[twocolumn].pdf` pdf file of this guide using the `[twocolumn]` option

`15J299Fig01.eps` Fig. 1 in this guide

`15J299Fig02.eps` Fig. 2 in this guide

`igs.cls` IGS class file

`igs.bst` IGS bibliography style file

`igsnatbib.sty` IGS style file for citations

`igsupmath.sty` IGS style file for upright Greek characters

`igsrefs.bib` sample BibTeX database

`amsbsy.sty` style file called in by igsupmath.sty

`amsfonts.sty` style file called in by amssymb.sty

`amsgen.sty` style file called in by igsupmath.sty

`amssymb.sty` accesses AMS fonts `msam` and `msbm`

`ednmath0.sty` style file required for [review] option

`edtable.sty` style file required for [review] option

`graphicx.sty` graphics style file

`lineno.sty` style file required for [review] option

`ltabptch.sty` style file required for [review] option

`vplref.sty` style file required for [review] option

Typesetting the title page

In the IGS design, shortened versions of the title and authors are used in the running head. The shortened version is specified in square braces immediately after the `\title` and `\author` commands (see below). The order in which the following elements appear may be crucial, i.e. `\maketitle` must be the last command before your paper commences. The *Journal of Glaciology* is printed on A4 paper which is slightly longer than US letter size. The default here is A4 paper but there is also a `[letterpaper]` option. Be aware that using `[letterpaper]` will fractionally lengthen your article. This guide was typeset using the following code:

```
% check that the math fits the two-column format:
% \documentclass[twocolumn]{igs}

% but use this version when submitting your article:
  \documentclass[review,oneside]{igs}

% other options are available
%   authors printing on US letter size are advised
%   to use the slightly shorter [letterpaper] option
% SINGLE COLUMN
%   \documentclass{igs}
% SINGLE COLUMN, FEWER LINES/PAGE
%   \documentclass[letterpaper]{igs}
% DOUBLE COLUMN, FEWER LINES/PAGE
%   \documentclass[twocolumn,letterpaper]{igs}

  \usepackage{igsnatbib}

% check if we are compiling under latex or pdflatex
```

```
  \ifx\pdftexversion\undefined
    \usepackage[dvips]{graphicx}
  \else
    \usepackage[pdftex]{graphicx}
    \usepackage{epstopdf}
    \epstopdfsetup{suffix=}
  \fi

% the default is for unnumbered section heads
% if you really must have numbered sections, remove
% the % from the beginning of the following command
% and insert the level of sections you wish to be
% numbered (up to 4):

% \setcounter{secnumdepth}{2}

\begin{document}

\title[IGS \LaTeXe\ guide]{Journal of Glaciology
  authors' guide to the IGS~\LaTeXe~class~file}

\author[Baxter and others]{Craig BAXTER,$^1$
  Rachel BROWN,$^2$\protect\thanks{Present address:
  Centre for Glaciology, Institute of Geography and
  Earth Sciences, University of Wales, Aberystwyth,
  UK.}\ \ Louise BUCKINGHAM,$^3$
  Magn\'us~M.~MAGN\'USSON$^1$}

\affiliation{%
$^1$International Glaciological Society, Scott
```

```
111   Polar Research Institute, Cambridge, UK\\
112 $^2$Climate Change Institute, University of Maine,
113   303 Bryand Global Sciences Center, Orono,
114   ME, USA\\
115 $^3$Institute of Geological and Nuclear Sciences
116   Ltd, Lower Hutt, New Zealand\\
117   Correspondence: Craig Baxter
118   $<$craig@igsoc.org$>$}
119
120 \abstract{The design for the \emph{Journal of...
121 The abstract should be less than 200 words and
122 one paragraph long.}
123
124 \maketitle
125
126 \section{Using the IGS class file}
127
```

Lists

The IGS class file provides for numbered (`enumerate`) and unnumbered (`itemize`) lists. Nested lists are not encouraged. The default numbering system is 1., 2., 3., etc.; please do not change this unless there is a good reason. The IGS design removes bullet points from unnumbered lists.

User-defined macros

If possible, please do not define any new macros.

Tables

Tables may be typeset in either one- or two-column format. To typeset two-column format, add asterisks (`\begin{table*}...\end{table*}`) as shown in Table 2. We may change the format in-house if necessary. Please avoid the use of colour or shading. Note that if you choose to refer to tables using labels, `\caption` must precede `\label`, as in standard LaTeX. Vertical rules are not house-style and will be removed. Note the use of the minipage environment in Table 1 which enables table footnotes to be output. If the table

Table 1. One-column table captions will extend beyond the rules in two-column format. Do not try to adjust! Table captions do not have full points at the end

Period*	Surface elevation change	Emergence velocity
1975–85	−0.50	0.43
1986–2002	−1.03	0.32
Difference	−0.53	−0.11

*Please do not use more than one '&' between columns, and note that if a table includes table footnotes, it must be inside a `minipage` environment.

```
\begin{table}% table1, one column
\caption{One-column table captions will extend beyond
  the rules in two-column format. Do not try to adjust!
  Table captions do not have full points at the end}
\label{period}
\begin{minipage}{86mm}% you only need this line if you
  % have a table footnote
\begin{tabular}{@{}lcc}\hline
Period\footnote{Please do not use more than one '\&'
  between columns, and note that if a table includes
  table footnotes, it must be inside a \texttt{minipage}
  environment.}%
  & Surface elevation change
  & Emergence velocity\\ \hline
1975--85   & $-0.50$ & 0.43\\
1986--2002 & $-1.03$ & 0.32\\
Difference & $-0.53$ & \llap{$-$}0.11
\end{tabular}
\end{minipage}% you only need this line if you have a
              % table footnote
\end{table}
```

is two-column, use {178mm} instead of {86mm} on line 6. The source code for Tables 1 and 2 is shown immediately below the tables.

Figures

Figures may be typeset in either one- or two-column format. One-column format allows up to 86 mm (e.g. Fig. 1); two-column format up to 178 mm (e.g. Fig. 2). Please do not provide original graphics files in which the figure is a great deal larger or smaller than what you envisage will be the final printed size. To typeset two-column format, add asterisks (`\begin{figure*}...\end{figure*}`) as shown in Fig. 2. We may change the format in-house if necessary. Please note that if you choose to refer to figures using labels, `\caption` must precede `\label`, as in standard LaTeX.

Please send one file for each figure (in other words do not use subfigures) and use a name that clearly identifies it (e.g. '15J299Fig03.eps').

In addition, figures should be eps, ai (illustrator), ps, tif, psd or pdf. Use strong black lines with a width of at least 0.75pt at final printed size (avoid tinting if possible) and SI units in labels. Lettering should ideally be Optima to match the final typeface; Arial or a similar sans serif font for a second choice. Aim to have the final-size lettering at 9pt, if possible. Figures should not be in boxes. The source code for Figs 1 and 2 is shown immediately below the figures.

Equations

We are including some complex equations as examples. Equations should be checked for width using the `[twocolumn]` option. Note the use of arrays in the following equation:

$$\alpha_{t_2} = \begin{cases} \alpha_{t_1} - a_1[\ln(T+1)]\mathrm{e}^{(a_2\sqrt{n})} & n_\mathrm{d} > 0 \quad \text{and} \quad T > 0 \\ \alpha_{t_1} - a_3\mathrm{e}^{(a_2\sqrt{n})} & n_\mathrm{d} > 0 \quad \text{and} \quad T < 0 \\ \alpha_{t_1} + a_4 P_\mathrm{s} & n_\mathrm{d} = 0 \end{cases} \tag{1}$$

Equation (1) above used the following code:

```
\begin{equation}
\label{arrayexample}
\alpha_{t_2}= \left\{%
  \begin{array}{ll}
    \alpha_{t_1} - a_1 [\ln (T+1)]
```

Table 2. Two-column table. Seasonal and annual SAT trends (°C decade^{-1}) in the Arctic

Area	1951–2005					1976–2005				
	Dec–Feb	Mar–May	Jun–Aug	Sep–Nov	Annual	Dec–Feb	Mar–May	Jun–Aug	Sep–Nov	Annual
Atlantic region	0.09	0.29	0.10	0.09	0.15	0.470	0.60	0.45	0.53	0.59
Siberian region	0.12	0.29	0.04	0.17	0.16	0.08	0.69	0.29	0.59	0.48
Pacific region	0.45	0.46	0.25	0.26	0.35	0.712	1.08	0.27	0.66	0.52
Canadian region	0.16	0.12	0.14	0.30	0.18	0.20	0.52	0.48	0.94	0.53
Baffin Bay region	−0.02	0.10	0.00	0.15	0.02	0.33	0.62	0.51	0.80	0.57
Arctic 1	0.16	0.21	0.12	0.20	0.18	0.36	200.65	0.42	0.74	0.54
Arctic 2	0.22	0.29	0.14	0.14	0.19	0.38	0.60	0.40	0.51	0.45
Arctic 3	0.28	0.31	0.14	0.13	0.21	0.42	40.53	0.41	0.42	0.43
NH (land + ocean)	0.13	0.13	0.10	0.10	0.12	0.27	0.24	0.25	0.25	0.25

```
\begin{table*}% table2, two column
\caption{Two-column table. Seasonal and annual SAT trends ($^\circ$C\,decade$^{-1}$) in the Arctic}
\label{seasonal}
% the following illustrates how to align columns on decimal points
% since all numbers are the same width in LaTeX, redefine a ? to take up the width of a number
% do not use if your table contains a genuine ?
\catcode`\?=\active \gdef?{\setbox0=\hbox{0}\hbox to\wd0{}}%
\setlength\tabcolsep{2.5pt}% column separation reduced from the default 6pt so the table fits the measure
\begin{tabular}{@{}l@{\hspace{20pt}}ccccc@{\hspace{20pt}}ccccc}\hline
Area                & \multicolumn{5}{c}{1951--2005} & \multicolumn{5}{c}{1976--2005}\\[5pt]
                    & Dec--Feb       & Mar--May    & Jun--Aug  & Sep--Nov         & Annual
                    & Dec--Feb       & Mar--May    & Jun--Aug  & Sep--Nov         & Annual\\ \hline
Atlantic region     & 0.09           & 0.29 & 0.10 & 0.09 & 0.15 & 0.470 & ??0.60 & 0.45 & 0.53 & 0.59\\
Siberian region     & 0.12           & 0.29 & 0.04 & 0.17 & 0.16 & 0.08? & ??0.69 & 0.29 & 0.59 & 0.48\\
Pacific region      & 0.45           & 0.46 & 0.25 & 0.26 & 0.35 & 0.712 & ??1.08 & 0.27 & 0.66 & 0.52\\
Canadian region     & 0.16           & 0.12 & 0.14 & 0.30 & 0.18 & 0.20? & ??0.52 & 0.48 & 0.94 & 0.53\\
Baffin Bay region   & \llap{$-$}0.02 & 0.10 & 0.00 & 0.15 & 0.02 & 0.33? & ??0.62 & 0.51 & 0.80 & 0.57\\
Arctic 1            & 0.16           & 0.21 & 0.12 & 0.20 & 0.18 & 0.36? & 200.65 & 0.42 & 0.74 & 0.54\\
Arctic 2            & 0.22           & 0.29 & 0.14 & 0.14 & 0.19 & 0.38? & ??0.60 & 0.40 & 0.51 & 0.45\\
Arctic 3            & 0.28           & 0.31 & 0.14 & 0.13 & 0.21 & 0.42? & ?40.53 & 0.41 & 0.42 & 0.43\\
NH ($\mathrm{land}
  + \mathrm{ocean}$) & 0.13           & 0.13 & 0.10 & 0.10 & 0.12 & 0.27? & ??0.24 & 0.25 & 0.25 & 0.25\\
```

```
       \mathrm{e}^{(a_2\sqrt{n})}
       & \mbox{$n_\mathrm{d} > 0\enskip$ and
       $\enskip T > 0$}\\
    \alpha_{t_1} - a_3 \mathrm{e}^{(a_2\sqrt{n})}
       & \mbox{$n_\mathrm{d} > 0\enskip$ and
       $\enskip T < 0$}\\
    \alpha_{t_1} + a_4 P_\mathrm{s}
       & \mbox{$n_\mathrm{d} = 0$}
  \end{array}
\right.
\end{equation}
```

Equations should be aligned on the equals signs where possible. Equations that extend beyond the one-column measure should be turned over before an operator. Note the `\skew4` command below which moves the bar over the R to the right. The value generally varies between `\skew1` and `\skew5`.

$$l_c = l_0 \left(\frac{\bar{R}_m}{R}\right)^2 \psi^{\frac{P}{P_0 \cos Z}} \times [\cos\beta\, \cos Z + \sin\beta\, \sin Z\, \cos(\psi_{\text{sun}} - \psi_{\text{slope}})] \tag{2}$$

Equation (2) above used the following code:

```
\begin{eqnarray}
\label{eqnarrayexample}
l_c &=& l_0 \left(\frac{\skew4\bar R_m}{R} \right)^2
  \psi^{\frac{P}{P_0\cos Z}}\nonumber\\
    &&  \mbox{}\times [\cos\beta\, \cos Z
    + \sin\beta\,\sin Z\,\cos(\psi_\mathrm{sun}
    - \psi_\mathrm{slope})]
\end{eqnarray}
```

Typesetting upright Greek characters

The `igsupmath` package provides macros for upright lower-case Greek (`\ualpha`–`\uxi`), and for bold lower-case Greek (`\ubalpha`–`\ubxi`). The bold upright symbol `\eta` has to be treated differently, in this case use `\uboldeta`.

To use the `igsupmath` package, you need to have the AMS `eurm/b` fonts installed.

The AMS packages are supplied from the AMS LaTeX distribution. If you already have the AMS LaTeX distribution installed, you can safely delete the `ams*.sty` files (it is worth checking if the supplied files are newer). If you do not have them already, the latest AMS Fonts/AMS LaTeX distributions can be found at http://ctan.org/.

For upright characters add a `u`, and for upright bold characters, `ub`, e.g.

α	`$\ualpha$`	$\boldsymbol{\alpha}$	`$\ubalpha$`
β	`$\ubeta$`	$\boldsymbol{\beta}$	`$\ubbeta$`
γ	`$\ugamma$`	$\boldsymbol{\gamma}$	`$\ubgamma$`
δ	`$\udelta$`	$\boldsymbol{\delta}$	`$\ubdelta$`

Authors who do not have this font are requested to key their articles using the commands above. The characters will be substituted automatically by the typesetter.

Typesetting the partial symbol

The `igsupmath` package also provides `\upartial` and `\ubpartial`.

Provided you have the AMS fonts, you can use the style file igsupmath.sty to typeset the partial symbol, e.g.

∂	`$\upartial$`	$\boldsymbol{\partial}$	`$\ubpartial$`

Marginal notes

The IGS class file redefines the LaTeX command `\marginpar`. If you wish to add a marginal note such as the one alongside this text, you would key `\marginpar{Editor! Help!}`. Marginal notes will be removed before printing.

Editor! Help!

References

All citations in text should include the author name(s) and the year of publication (e.g. 'Smith, 2014'; 'Smith and Jones, 2014'; 'Smith and others, 2015') and have an entry in the reference list.

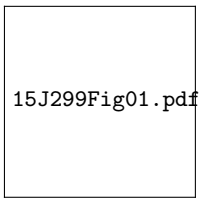

Fig. 1. One-column figures should be ≤86 mm. Good artwork can make or break a paper. Capitalize the first word of a label and use round not square brackets for units.

```
\begin{figure}%fig1, one column
\centering{\includegraphics{15J299Fig01.eps}}
\caption{One-column figures should be $\leq$86$\,$mm.
Good artwork can make or break a paper. Capitalize
the first word of a label and use round not square
brackets for units.}
\label{tracks}
\end{figure}
```

References should:

be short;

be complete and accurate;

be arranged in alphabetical order by first author's surname;

include too much rather than too little information;

include doi numbers where available (note that older bib databases often included doi's in the page field – in which case they may appear after a comma and without braces);

include works accepted but not published as 'in press';

not include personal communications, unpublished data or manuscript in preparation or submitted for publication, data published on the web (these should be included in the text).

Automatic references using BibTeX

To generate automatic references from a bib database, you must first specify the database (we are using `igsrefs.bib`) and then the IGS bibliography style by placing the following two commands where you would like the references to appear (normally at the end of your paper, before `\end{document}`):

```
\bibliography{igsrefs}
\bibliographystyle{igs}
```

Then run through the following steps:

1. Run your paper through LaTeX.
2. Run BibTeX on your paper.
3. Open the newly-created bbl file containing the cited references and copy the entire contents to just below the `bibliography`/`bibliographystyle` commands.
4. Then comment them out:

```
%\bibliography{igsrefs}
%\bibliographystyle{igs}
```

5. Run your paper through LaTeX *twice* more.

The IGS do not need your bib or bbl files. Note that BibTeX will lose the second initial in the entry 'Box JE', for example, if it has been typed as '{J.E.} Box' in the bib file. This is because any text in an entry enclosed in { } will be treated as a single unit, and will not be further parsed. Prof. Box's name will typeset correctly if entered as 'J. E. Box' in the bib file.

If you have cited 16 references from the bib database, e.g. (Rignot and Steffen, 2008), (Rignot and others, 2008), (Motyka and others, 2011), (Morlighem and others, 2010), (Morlighem and others, 2011), (Seroussi and others, 2011), (Yan and others, 2013), (Rogozhina and others, 2012), (Hanna and others, 2013), (Goelzer and others, 2013), (Lucas-Picher and others, 2012), (Edwards and others, 2014), (Gladstone and others, 2010), (Morlighem and others, 2013), (Goldberg and Sergienko, 2011) and (Paterson, 1994), the output will be just those 16 references and they will appear at the end of the article.

Citations using natbib commands

Note that the standard natbib style file has been modified to fall into line with IGS style. The modified style file is called igsnatbib.sty (included in this distribution), and works exactly the same as natbib.sty. The default IGS house style is (Yan and others, 2013). The following combinations are also available – refer to the natbib documentation if you require any further explanation:

(Yan and others, 2013)	`\citep{Yan13}`
(see Yan and others, 2013, p. 34)	`\citep[see][p.$\,$34]{Yan13}`
(e.g. Yan and others, 2013)	`\citep[e.g.][]{Yan13}`
(Yan and others, 2013, Section 2.3)	`\citep[Section~2.3]{Yan13}`
(Yan and others, 2013; Edwards and others, 2014)	`\citep{Yan13, Edwards14}`
Yan and others (2013); Edwards and others (2014)	`\cite{Yan13, Edwards14}`
Yan and others 2013	`\citealt{Yan13}`
Yan and others (2013)	`\cite{Yan13}`
Yan and others, 2013	`\citealp{Yan13}`
Yan and others	`\citeauthor{Yan13}`
(2013)	`\citeyearpar{Yan13}`
2013	`\citeyear{Yan13}`

Manual references

References should be complete and conform to the IGS reference style. Particular points to note are that author names should be Surname followed by Initials, and that doi numbers, if available, must be included in parentheses at the end of the reference. Authors not using the bibliography style file igs.bst can either produce a reference list in plain text or produce the same output at the end of the guide by typing the references along the following lines:

```
\begin{thebibliography}{16}
\providecommand{\natexlab}[1]{#1}
```

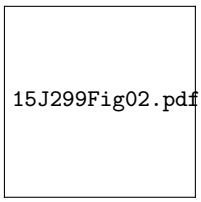

Fig. 2. Two-column figures should be ≤178 mm. SSA reconstructed components found by projecting the SSA filters found using the whole 2000 traces in Fig. 4, on trace number 1, ordered by magnitude of variance accounted for in the radar trace.

```
\begin{figure*}%fig2, two column
\centering{\includegraphics{15J299Fig02.eps}}
\caption{Two-column figures should be $\leq$178$\,$mm. SSA reconstructed components found by
  projecting the SSA filters found using the whole 2000 traces in Fig.~4, on trace number 1,
  ordered by magnitude of variance accounted for in the radar trace.}
\label{filters}
\end{figure*}
```

```
\expandafter\ifx\csname urlstyle\endcsname\relax
  \providecommand{\doi}[1]{doi: #1}\else
  \providecommand{\doi}{doi: \begingroup
  \urlstyle{rm}\Url}\fi

\bibitem[\protect\citename{Edwards and others, }2014]
  {Edwards14}
  Edwards TL, Fettweis X, Gagliardini O,
  Gillet-Chaulet F, Goelzer H, Gregory JM, Hoffman M,
  Huybrechts P, Payne AJ, Perego M, Price S,
  Quiquet A and Ritz C (2014) Effects of uncertainty
  in surface mass balance-elevation feedback on
  projections of the future sea level contribution
  of the {G}reenland ice sheet. \emph{The Cryosphere},
  \textbf{8}, 195--208 (\doi {10.5194/tc-8-195-2014})
```

```
281
282 \bibitem[\protect\citename{Gladstone and others, }2010]
283   {gladstone_grl_10}
284   Gladstone RM, Lee V, Vieli A and Payne AJ (2010)
285   Grounding line migration in an adaptive mesh ice
286   sheet model. \emph{J. Geophys. Res.-Earth},
287   \textbf{115}, F04014 (\doi {0.1029/2009JF001615})
288
289 \bibitem[\protect\citename{Goelzer and others, }2013]
290   {Goelzer13}
291   Goelzer H, Huybrechts P, F\"{u}rst JJ, Nick FM,
292   Andersen ML, Edwards TL, Fettweis X, Payne AJ and
293   Shannon S (2013) Sensitivity of {G}reenland ice
294   sheet projections to model formulations.
295   \emph{J.~Glaciol.}, \textbf{59}(216), 733--749
296   (\doi {10.3189/2013JoG12J182})
297
298 \bibitem[\protect\citename{Goldberg and Sergienko, }2011]
299   {Goldberg11}
300   Goldberg DN and Sergienko OV (2011) Data assimilation
301   using a hybrid ice flow model. \emph{The Cryosphere},
302   \textbf{5}, 315--327 (\doi {10.5194/tc-5-315-2011})
303
304 \bibitem[\protect\citename{Hanna and others, }2013]
305   {Hanna13}
306   Hanna E, Navarro FJ, Pattyn F, Domingues CM,
307   Fettweis X, Ivins ER, Nicholls RJ, Ritz C, Smith B,
308   Tulaczyk S, Whitehouse PL and Zwally HJ (2013)
309   Ice-sheet mass balance and climate change. \emph{Nature},
310   \textbf{498}, 51--59 (\doi {10.1038/nature12238})
```

```
311
312 \bibitem[\protect\citename{Lucas-Picher and others, }2012]
313   {Lucas12}
314   Lucas-Picher P, Wulff-Nielsen M, Christensen JH,
315   Adalgeirsd\'ottir G, Mottram RH and Simonsen SB (2012)
316   Very high resolution regional climate model simulations
317   over Greenland: identifying added value. \emph{J.~Geophys.
318   Res.}, \textbf{117}, D02108 (\doi {10.1029/2011JD016267})
319
320 \bibitem[\protect\citename{Morlighem and others, }2010]
321   {Morlighem10}
322   Morlighem M, Rignot E, Seroussi H, Larour E, Dhia HB
323   and Aubry D (2010) Spatial patterns of basal drag
324   inferred using control methods from a full-Stokes and
325   simpler models for Pine Island Glacier, West Antarctica.
326   \emph{Geophys. Res. Lett.}, \textbf{37}, L14502
327   (\doi {10.1029/2010GL043853})
328
329 \bibitem[\protect\citename{Morlighem and others, }2011]
330   {Morlighem11}
331   Morlighem M, Rignot E, Seroussi H, Larour E, Dhia HB
332   and Aubry D (2011) A mass conservation approach for
333   mapping glacier ice thickness. \emph{Geophys. Res. Lett.},
334   \textbf{38}, L19503 (\doi {10.1029/2011GL048659})
335
336 \bibitem[\protect\citename{Morlighem and others, }2013]
337   {Morlighem13}
338   Morlighem M, Seroussi H, Larour E and Rignot E (2013)
339   Inversion of basal friction in Antartica using exact
340   and incomplete adjoints of a higher-order model.
```

```
341   \emph{J.~Geophys. Res.}, \textbf{118}, 1746--1753
342   (\doi {10.1002/jgrf.20125})
343
344 \bibitem[\protect\citename{Motyka and others, }2011]
345   {Motyka11}
346   Motyka RJ, Truffer M, Fahnestock M, Mortensen J,
347   Rysgaard S and Howat I (2011) Submarine melting of
348   the 1985 Jakobshavn Isbrae floating tongue and the
349   triggering of the current retreat.
350   \emph{J.~Geophys. Res.}, \textbf{116}, F01007
351   (\doi {10.1029/2009JF001632})
352
353 \bibitem[\protect\citename{Paterson, }1994]
354   {paterson94}
355   Paterson WSB (1994) \emph{The physics of
356   glaciers}. Butterworth-Heinemann, Oxford,
357   3rd edition
358
359 \bibitem[\protect\citename{Rignot and Steffen, }2008]
360   {Rignot08}
361   Rignot E and Steffen K (2008) Channelized bottom
362   melting and stability of floating ice shelves.
363   \emph{Geophys. Res. Lett.}, \textbf{35}, L02503
364   (\doi {10.1029/2007GL031765})
365
366 \bibitem[\protect\citename{Rignot and others, }2008]
367   {Rignot08_2}
368   Rignot E, Box JE, Burgess E and Hanna E (2008)
369   Mass balance of the Greenland ice sheet from
370   1958 to 2007. \emph{Geophys. Res. Lett.},
```

```
  \textbf{35}, L02502 (\doi {10.1029/2008GL035417})

\bibitem[\protect\citename{Rogozhina and others, }2012]
  {Rogozhina12}
  Rogozhina I, Hagedoorn JM, Martinec Z, Fleming K,
  Soucek O, Greve R and Thomas M (2012) Effects of
  uncertainties in the geothermal heat flux
  distribution on the Greenland ice sheet: an
  assessment of existing heat flow models.
  \emph{J.~Geophys. Res.}, \textbf{117}, F02025
  (\doi {10.1029/2011JF002098})

\bibitem[\protect\citename{Seroussi and others, }2011]
  {Seroussi11}
  Seroussi H, Morlighem M, Rignot E, Larour E,
  Aubry D, Dhia HB and Kristensen SS (2011) Ice flux
  divergence anomalies on 79north glacier, Greenland.
  \emph{Geophys. Res. Lett.}, \textbf{38}, L09501
  (\doi {10.1029/2011GL047338})

\bibitem[\protect\citename{Yan and others, }2013]
  {Yan13}
  Yan Q, Zhang Z, Gao Y, Wang H and Johannessan OM
  (2013) Sensitivity of the modeled present-day
  Greenland ice sheet to climatic forcing and
  spin-up methods and its influence on future sea
  level projections. \emph{J. Geophys. Res. Earth
  Surf.}, \textbf{118}, 2174--2189
  (\doi {10.1002/jgrf.20156})
```

401 \end{thebibliography}

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406 REFERENCES

407 Edwards TL, Fettweis X, Gagliardini O, Gillet-Chaulet F, Goelzer H, Gregory JM, Hoffman M, Huybrechts P, Payne
408 AJ, Perego M, Price S, Quiquet A and Ritz C (2014) Effects of uncertainty in surface mass balance-elevation
409 feedback on projections of the future sea level contribution of the Greenland ice sheet. *The Cryosphere*, **8**, 195–208
410 (doi: 10.5194/tc-8-195-2014)

411 Gladstone RM, Lee V, Vieli A and Payne AJ (2010) Grounding line migration in an adaptive mesh ice sheet model.
412 *J. Geophys. Res.-Earth*, **115**, F04014 (doi: 0.1029/2009JF001615)

413 Goelzer H, Huybrechts P, Fürst JJ, Nick FM, Andersen ML, Edwards TL, Fettweis X, Payne AJ and Shannon S
414 (2013) Sensitivity of Greenland ice sheet projections to model formulations. *J. Glaciol.*, **59**(216), 733–749 (doi:
415 10.3189/2013JoG12J182)

416 Goldberg DN and Sergienko OV (2011) Data assimilation using a hybrid ice flow model. *The Cryosphere*, **5**, 315–327
417 (doi: 10.5194/tc-5-315-2011)

418 Hanna E, Navarro FJ, Pattyn F, Domingues CM, Fettweis X, Ivins ER, Nicholls RJ, Ritz C, Smith B, Tulaczyk
419 S, Whitehouse PL and Zwally HJ (2013) Ice-sheet mass balance and climate change. *Nature*, **498**, 51–59 (doi:
420 10.1038/nature12238)

421 Lucas-Picher P, Wulff-Nielsen M, Christensen JH, Adalgeirsdóttir G, Mottram RH and Simonsen SB (2012) Very
422 high resolution regional climate model simulations over Greenland: identifying added value. *J. Geophys. Res.*, **117**,
423 D02108 (doi: 10.1029/2011JD016267)

424 Morlighem M, Rignot E, Seroussi H, Larour E, Dhia HB and Aubry D (2010) Spatial patterns of basal drag inferred
425 using control methods from a full-Stokes and simpler models for Pine Island Glacier, West Antarctica. *Geophys.*
426 *Res. Lett.*, **37**, L14502 (doi: 10.1029/2010GL043853)

427 Morlighem M, Rignot E, Seroussi H, Larour E, Dhia HB and Aubry D (2011) A mass conservation approach for
428 mapping glacier ice thickness. *Geophys. Res. Lett.*, **38**, L19503 (doi: 10.1029/2011GL048659)

429 Morlighem M, Seroussi H, Larour E and Rignot E (2013) Inversion of basal friction in Antartica using exact and
430 incomplete adjoints of a higher-order model. *J. Geophys. Res.*, **118**, 1746–1753 (doi: 10.1002/jgrf.20125)

Motyka RJ, Truffer M, Fahnestock M, Mortensen J, Rysgaard S and Howat I (2011) Submarine melting of the 1985 Jakobshavn Isbrae floating tongue and the triggering of the current retreat. *J. Geophys. Res.*, **116**, F01007 (doi: 10.1029/2009JF001632)

Paterson WSB (1994) *The physics of glaciers*. Butterworth-Heinemann, Oxford, 3rd edition

Rignot E and Steffen K (2008) Channelized bottom melting and stability of floating ice shelves. *Geophys. Res. Lett.*, **35**, L02503 (doi: 10.1029/2007GL031765)

Rignot E, Box JE, Burgess E and Hanna E (2008) Mass balance of the Greenland ice sheet from 1958 to 2007. *Geophys. Res. Lett.*, **35**, L02502 (doi: 10.1029/2008GL035417)

Rogozhina I, Hagedoorn JM, Martinec Z, Fleming K, Soucek O, Greve R and Thomas M (2012) Effects of uncertainties in the geothermal heat flux distribution on the Greenland ice sheet: an assessment of existing heat flow models. *J. Geophys. Res.*, **117**, F02025 (doi: 10.1029/2011JF002098)

Seroussi H, Morlighem M, Rignot E, Larour E, Aubry D, Dhia HB and Kristensen SS (2011) Ice flux divergence anomalies on 79north glacier, Greenland. *Geophys. Res. Lett.*, **38**, L09501 (doi: 10.1029/2011GL047338)

Yan Q, Zhang Z, Gao Y, Wang H and Johannessan OM (2013) Sensitivity of the modeled present-day Greenland ice sheet to climatic forcing and spin-up methods and its influence on future sea level projections. *J. Geophys. Res. Earth Surf.*, **118**, 2174–2189 (doi: 10.1002/jgrf.20156)

APPENDIX

Start an appendix by typing `\appendix\section{Appendix}`. Appendices appear after the references. Equation numbers automatically start again with (A1).

$$2\eta\kappa\frac{\partial\bar{u}}{\partial t} + \rho_{\mathrm{r}} g\bar{u} + D\kappa^4\bar{u} = \bar{\sigma}_{zz}. \tag{A1}$$

HANDLING MORE THAN ONE APPENDIX

Use the following code to achieve heading APPENDIX A followed by APPENDIX B and APPENDIX C, with appropriate equation numbers:

```
\appendix
\section{Appendix A}

\setcounter{equation}{0}
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458 \renewcommand\theequation{B\arabic{equation}}
459 \section{Appendix B}
460
461 \setcounter{equation}{0}
462 \renewcommand\theequation{C\arabic{equation}}
463 \section{Appendix C}
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