



SCAR Sub-Group

ISMASS

SG

PS

Person
Responsible:

Frank Pattyn

SCAR Delegates Report 2020

Ice Sheet Mass Balance and Sea Level (ISMASS) 2018-2020 Report

Summary

Report Author(s)

Frank Pattyn (fpattyn@ulb.ac.be) - BELGIUM,
Catherine Ritz (catherine.ritz@univ-grenoble-alpes.fr) - FRANCE,
Guðfinna Aðalgeirsdóttir (gua@hi.is) – ICELAND,
Edward Hanna (ehanna@lincoln.ac.uk) – UK
Heiko Goelzer (h.goelzer@uu.nl) – THE NETHERLANDS (Proposed to take the lead of ISMASS, to be discussed at the coming SC)

Summary of activities from 2018-20

ISMASS organized a one-day workshop on 15 June 2018 as a side meeting of the SCAR Open Conference in Davos, entitled “Update on mass balance of Greenland and Antarctica (linkages between data and models)”. A review article came out of this workshop: *Hanna, E., F. Pattyn, F. Navarro, V. Favier, H. Goelzer, M.R. van den Broeke, M. Vizcaino, P.L. Whitehouse, C. Ritz, K. Bulthuis, B. Smith (2020) Mass balance of the ice sheets and glaciers - progress since AR5 and challenges. Earth Science Reviews. 201, doi: 10.1016/j.earscirev.2019.102976.*

ISMASS is dedicated to both Arctic and Antarctic science and is supported by SCAR, CliC, and IASC. The following information does not directly concern Antarctica but Greenland. However, the tools are common for both ice sheets. ISMASS promoted an intercomparison project (SMBMIP, also in the framework of ISMIP6) which is being led by Dr. Xavier Fettweis (University of Liege, Belgium; Xavier.Fettweis@uliege.be and ISMASS member) and has recently evaluated regional climate model (RCM), positive degree day (PDD) and global climate model (GCM) estimates of surface mass balance (SMB) for the Greenland Ice Sheet, with the goal of forcing ice sheet models with reconciled information from SMB models. The first results were presented at AGU in December 2018, and an updated analysis/synthesis was published as a journal paper in The Cryosphere Discussions: <https://www.the-cryosphere-discuss.net/tc-2019-321/>

Pattyn, F., C. Ritz, E. Hanna, X. Asay-Davis, R. DeConto, G. Durand, L. Favier, X. Fettweis, H. Goelzer, N.R. Golledge, P. Kuipers Munneke, J.T.M. Lenaerts, S. Nowicki, A.J. Payne, A. Robinson, H. Seroussi, L.D. Trusel, M. van den Broeke (2018) The Greenland and Antarctic ice sheets under 1.5°C global warming. Nature Climate Change 8, 1053-1061.

ISMASS: 2018-2020 Report, cont.

This article is a review paper on the contribution of Greenland and Antarctic ice sheets to future sea level under a 1.5°C warmer climate (in line with the Paris Agreement). The study concludes it is important to limit global warming by 2100 to 1.5°C to maximise the chance of avoiding so-called tipping points that would dramatically accelerate mass loss. It is the direct outcome of the workshop organised by ISMASS in Brussels from 11-13 January 2017.

Frank Pattyn and Guðfinna Aðalgeirsdóttir (both representing ISMASS) co-hosted a CliC-sponsored (with SCAR and IASC) session CR1.1 on Ice sheet mass balance and sea-level: ISMASS/ISMIP6” at the EGU General Assembly 2020 *Sharing Geoscience Online* during 4-8 May 2020. The session explored improvements in understanding and quantification of past, present and future ice sheet and sea-level changes. While the focus is on present and future (multi-centennial) Greenland and Antarctic ice sheets, paleo-studies are encouraged if they shed light on above topics. Due to COVID-19, the session was an online chat session and 194 people attended.

Summary Budget 2019 to 2022

	2019	2020	2021	2022
	Spent	Allocated	Request	Request
(US\$)	0	4500	2500	2500

Progress to date

Sub-group Outcomes Summary

(Summarize the above and in each case provide your sub-group name in left hand column to assist Science Group COs in compiling their reports)

Sub-group	Activity/Outcome/Benefit/Achievement
Model Intercomparison experiments	ISMASS interacts with initiatives like ISMIP6 and MISOMIP and has organized further model intercomparisons, such as SMBMIP

Sub-group Cash Flow

(From previous Delegates meeting to date)

Sub-group	Allocation	Amount spent		
		2018	2019	2020

Future plans

Planned activities in 2020 to 2022

Sub-group	Planned activity
Ice sheets changes: “climate” versus “weather” Led by E. Hanna	Focus on signal-to-noise ratio of recent (last 2-3 decades) ice-sheet changes, perhaps linking this topic with thresholds, extreme events (e.g. the near-record Greenland Ice Sheet melt of summer 2019) and relevant climate feedbacks. Workshop planned in summer/autumn 2021 in Lincoln, UK / review paper.
Involvement in future SRP INSTANT (Led by F. Pattyn, C. Ritz, H. Goelzer, F. Colleoni)	ISMASS has a strong expertise in ice sheet modelling and conversely ISMASS plans to investigate the link between past and future ice sheet changes on long and on short timescales. Exchanges with INSTANT will be beneficial for both parties. The type of organisation of these exchanges is still to be defined.
North-South feedbacks (Led by T. Aðalgeirsdóttir)	This activity reflects the two poles of ISMASS (co-supported by SCAR/CliC and IASC) and which is also exemplified by a session at the Hobart OSC in 2020.
Model intercomparisons and ISMIP6	ISMASS has a strong expertise in model intercomparisons. ISMIP6 is designed to deliver projections of the ice sheet contribution to sea level rise. ISMIP6 brings together a consortium of international ice sheet models and coupled ice sheet – climate models. This effort will thoroughly explore the sea level contribution from the Greenland and Antarctic Ice Sheet in our changing climate and assess the impact of large ice sheets on the climate system.

Planned use of funds for 2020 to 2022

Year (YYYY)	Purpose/Activity	Amount (in USD)	Contact Name	Contact Email
2021	Lincoln Workshop	5000	E. Hanna	ehanna@lincoln.ac.uk
2022	ISMASS Workshop	4500	F. Pattyn	fpattyn@ulb.ac.be
Total				

Any additional detail on funds usage and desired results/outcomes

SCAR funds are generally used to organize workshops and attend SCAR meetings. In the present situation we have a poor visibility on meeting organisation in the next years. The rules we plan to follow are:

- organize (if possible) one workshop in a place where most people can join by train but open it to online participation
- Stick to major events such as EGU to organize specific sessions/ Splinter meetings.

ISMASS uses the budget primarily to enable ECRs to attend meetings and workshops. Due to the COVID-19 situation, it is unclear how this will evolve in the (near) future. The remainder is spent to comply with publication costs and workshop organizations (see planned activities).

We plan a workshop in Lincoln (UK) in 2021. Funds are meant to cover room costs, catering and inviting ECRs. An ISMASS workshop is planned with the next SCAR OSC in 2022.

Percentage of the budget to be used for support of early-career researchers

The policy of ISMASS is to spend approximately 50% of the funds on fellowships allowing ECR to attend ISMASS sessions/workshops

- 2020: 50%
- 2021: 50%
- 2022: 50%

Percentage of the budget to be used for support of scientists from countries with developing Antarctic programmes

- 2020:
- 2021:
- 2022:

Membership

Leadership

First Name	Last Name	Affiliation	Country	Email	Date Started	Date Term is to End
Catherine	Ritz	Université Grenoble Alpes	France	catherine.ritz@univ-grenoble-alpes.fr	2012	2020
Frank	Pattyn	Université Libre de Bruxelles	Belgium	fpattyn@ulb.ac.be	2012	2020
Edward	Hanna	University of Lincoln	UK	ehanna@lincoln.ac.uk	2012	2020
Gudfinna	Aðalgeirsdóttir	University Iceland	Iceland	gua@hi.is	2018	2020
Heiko	Goelzer	University Utrecht	The Netherlands	h.goelzer@uu.nl	2020	--

*Please identify early-career researchers with * in first column*

Other members

First Name	Last Name	Affiliation	Country	Email
Dan	Dixon	University of Maine	USA	Daniel.Dixon@umit.maine.edu
Xavier	Fettweis	Université de Liège	Belgium	Xavier.Fettweis@ulg.ac.be
David	Holland	New York University	USA	david.holland@nyu.edu
Andrew	Shepherd	University of Leeds	UK	A.Shepherd@leeds.ac.uk
Pippa	Whitehouse	Durham University	UK	pippa.whitehouse@durham.ac.uk
Florence	Colleoni	OGS Trieste	Italy	fcolleoni@inogs.it
Ellyn	Enderlin	Univ. of Maine (APECS rep.)	USA	ellyn.enderlin@gmail.com

*Please identify early-career researchers with * in first column*

Additional information (optional)

Please add any more detail here that you wish, on your subgroup activities, papers published, etc.

Notable Papers

(Five to ten most notable papers – see the example below, which includes a brief statement (shaded) indicating the link to the group)

ISMASS publications

Hanna, E., F. Pattyn, F. Navarro, V. Favier, H. Goelzer, M.R. van den Broeke, M. Vizcaino, P.L. Whitehouse, C. Ritz, K. Bulthuis, B. Smith (2020) Mass balance of the ice sheets and glaciers - progress since AR5 and challenges. *Earth Science Reviews*. 201, doi: 10.1016/j.earscirev.2019.102976.

This article is the outcome of the ISMASS workshop held in Davos in June 2018. Title: “Update on mass balance of Greenland and Antarctica (linkages between data and models)”. Recent research shows increasing decadal ice mass losses from the Greenland and Antarctic Ice Sheets and more generally from glaciers worldwide in the light of continued global warming. Here, in an update of our previous ISMASS paper (Hanna et al., 2013), we review recent observational estimates of ice sheet and glacier mass balance, and their related uncertainties, first briefly considering relevant monitoring methods. Focusing on the response to climate change during 1992-2018, and especially the post-IPCC AR5 period, we discuss recent changes in the relative contributions of ice sheets and glaciers to sea-level change. We assess recent advances in understanding of the relative importance of surface mass balance and ice dynamics in overall ice-sheet mass change. We also consider recent improvements in ice-sheet modelling, highlighting data-model linkages and the use of updated observational datasets in ice-sheet models. Finally, by identifying key deficiencies in the observations and models that hamper current understanding and limit reliability of future ice-sheet projections, we make recommendations to the research community for reducing these knowledge gaps. Our synthesis aims to provide a critical and timely review of the current state of the science in advance of the next Intergovernmental Panel on Climate Change Assessment Report that is due in 2021.

Pattyn, F., C. Ritz, E. Hanna, X. Asay-Davis, R. DeConto, G. Durand, L. Favier, X. Fettweis, H. Goelzer, N.R. Golledge, P. Kuipers Munneke, J.T.M. Lenaerts, S. Nowicki, A.J. Payne, A. Robinson, H. Seroussi, L.D. Trusel, M. van den Broeke (2018) The Greenland and Antarctic ice sheets under 1.5°C global warming. *Nature Climate Change* 8, 1053-1061.

This article is a review paper on the contribution of Greenland and Antarctic ice sheets to future sea level under a 1.5°C warmer climate (in line with the Paris Agreement). The study concludes it is important to limit global warming by 2100 to 1.5°C to maximise the chance of avoiding so-called tipping points that would dramatically accelerate mass loss. It is the direct outcome of the workshop organised by ISMASS in Brussels from 11-13 January 2017.

Pattyn, F. and M. Morlighem (2020) The uncertain future of the Antarctic ice sheet. *Science* 367 (6484): 1331-1335; DOI: 10.1126/science.aaz5487

This review paper that is part of three papers published in *Science* in March 2020 for the 200th anniversary of the first sighting of Antarctica.

Selection of core ISMIP6 papers:

ISMIP6 description paper: Nowicki, S. M., A. Payne, E. Larour, et al. 2016. "Ice Sheet Model Intercomparison Project (ISMIP6) contribution to CMIP6." *Geoscientific Model Development* 9 (12): 4521-4545 [10.5194/gmd-9-4521-2016]

Analysis of initMIP-Greenland: Goelzer, H., Nowicki, S., Edwards, T., Beckley, M., Abe-Ouchi, A., Aschwanden, A., Calov, R., Gagliardini, O., Gillet-Chaulet, F., Golledge, N. R., Gregory, J., Greve, R., Humbert, A., Huybrechts, P., Kennedy, J. H., Larour, E., Lipscomb, W. H., Le clec'h, S., Lee, V., Morlighem, M., Pattyn, F., Payne, A. J., Rodehacke, C., Rückamp, M., Saito, F., Schlegel, Seroussi, H., Shepherd, A., Sun, S., van de Wal, R., and Ziemann, F. A.: Design and results of the ice sheet model initialisation experiments initMIP-Greenland: an ISMIP6 intercomparison, *The Cryosphere*, 12, 1433-1460, doi:10.5194/tc-12-1433-2018, 2018.

Analysis of initMIP-Antarctica: Seroussi, H., Nowicki, S., Simon, E., Abe-Ouchi, A., Albrecht, T., Brondex, J., Cornford, S., Dumas, C., Gillet-Chaulet, F., Goelzer, H., Golledge, N. R., Gregory, J. M., Greve, R., Hoffman, M. J., Humbert, A., Huybrechts, P., Kleiner, T., Larour, E., Leguy, G., Lipscomb, W. H., Lowry, D., Mengel, M., Morlighem, M., Pattyn, F., Payne, A. J., Pollard, D., Price, S. F., Quiquet, A., Reerink, T. J., Reese, R., Rodehacke, C. B., Schlegel, N.-J., Shepherd, A., Sun, S., Sutter, J., Van Breedam, J., van de Wal, R. S. W., Winkelmann, R., and Zhang, T.: initMIP-Antarctica: an ice sheet model initialization experiment of ISMIP6, *The Cryosphere*, 13, 1441-1471, <https://doi.org/10.5194/tc-13-1441-2019>, 2019.

Ocean forcing for the Antarctic Ice Sheet: Nicolas C. Jourdain, Xylar Asay-Davis, Tore Hattermann, Fiammetta Straneo, Helene Seroussi, Christopher M. Little, and Sophie Nowicki, A protocol for calculating basal melt rates in the ISMIP6 Antarctic ice sheet projections, *The Cryosphere Discuss.*, <https://doi.org/10.5194/tc-2019-277>

Revised Protocol for Standalone simulation: Nowicki, S., Payne, A. J., Goelzer, H., Seroussi, H., Lipscomb, W. H., Abe-Ouchi, A., Agosta, C., Alexander, P., Asay-Davis, X. S., Barthel, A., Bracegirdle, T. J., Cullather, R., Felikson, D., Fettweis, X., Gregory, J., Hatterman, T., Jourdain, N. C., Kuipers Munneke, P., Larour, E., Little, C. M., Morlighem, M., Nias, I., Shepherd, A., Simon, E., Slater, D., Smith, R., Straneo, F., Trusel, L. D., van den Broeke, M. R., and van de Wal, R.: Experimental protocol for sealevel projections from ISMIP6 standalone ice sheet models, *The Cryosphere Discuss.*, <https://doi.org/10.5194/tc-2019-322>, in review, 2020.

Greenland CMIP5 driven multi-model projections: Goelzer, H., Nowicki, S., Payne, A., Larour, E., Seroussi, H., Lipscomb, W. H., Gregory, J., Abe-Ouchi, A., Shepherd, A., Simon, E., Agosta, C., Alexander, P., Aschwanden, A., Barthel, A., Calov, R., Chambers, C., Choi, Y., Cuzzone, J., Dumas, C., Edwards, T., Felikson, D., Fettweis, X., Golledge, N. R., Greve, R., Humbert, A., Huybrechts, P., Le clec'h, S., Lee, V., Leguy, G., Little, C., Lowry, D. P., Morlighem, M., Nias, I., Quiquet, A., Rückamp, M., Schlegel, N.-J., Slater, D., Smith, R., Straneo, F., Tarasov, L., van de Wal, R., and van den Broeke, M.: The future sea-level contribution of the Greenland ice sheet: a multi-model ensemble study of ISMIP6, *The Cryosphere Discuss.*, <https://doi.org/10.5194/tc-2019-319>, in review, 2020.

Antarctica CMIP5 driven multi-model projections: Seroussi, H., Nowicki, S., Payne, A. J., Goelzer, H., Lipscomb, W. H., Abe Ouchi, A., Agosta, C., Albrecht, T., Asay-Davis, X., Barthel, A., Calov, R., Cullather, R., Dumas, C., Gladstone, R., Golledge, N., Gregory, J. M., Greve, R., Hatterman, T., Hoffman, M. J., Humbert, A., Huybrechts, P., Jourdain, N. C., Kleiner, T., Larour, E., Leguy, G. R., Lowry, D. P., Little, C. M.,

Morlighem, M., Pattyn, F., Pelle, T., Price, S. F., Quiquet, A., Reese, R., Schlegel, N.-J., Shepherd, A., Simon, E., Smith, R. S., Straneo, F., Sun, S., Trusel, L. D., Van Breedam, J., van de Wal, R. S. W., Winkelmann, R., Zhao, C., Zhang, T., and Zwinger, T.: ISMIP6 Antarctica: a multi-model ensemble of the Antarctic ice sheet evolution over the 21st century, *The Cryosphere Discuss.*, <https://doi.org/10.5194/tc-2019-324>, in review, 2020.

Direct support from outside organisations received for your activities

(Numbered list with values indicated if direct cash support. Please restrict in-kind support to substantive in-kind support only)

We receive additional support from WCRP-CLiC. ISMASS was allocated 4000 CHF to support a 2020 workshop. In 2019, 3000 CHF was allocated by CliC; some of this was used to support the participation of E. Hanna as an invited presenter on behalf of ISMASS at the CLiC SSG and AGU FM in San Francisco in December 2019.

Major collaborations your Science Group has with other SCAR groups and with organisations/groups beyond SCAR

(Numbered list of substantive collaborations)

Within SCAR

1. SERCE (F. Pattyn is also SC member)
2. AntClim21
3. PAIS (Florence Colleoni is now member of ISMASS SC and is also in PAIS SC)
4. INSTANT. (Florence Colleoni is co-lead and F. Pattyn and C. Ritz are members)

Outside SCAR

1. IASC Cryosphere Working Group (T; Aðalgeirsdóttir is also the Chair)
2. WCRP-CLiC (E. Hanna is also CLiC activity leader, H. Goelzer is one of the scientific steering committee members of ISMIP6)
3. WCRP Grand Challenge on Regional Sea Level and its impacts (H. Goelzer is member)

Outreach, communication and capacity-building activities

Brief highlights of any activities undertaken since the SCAR Delegates meeting in 2018.

ISMASS produced two review papers in the last few years, highlighting the current state of Mass

SCAR fellowship reviewers

Please list one or more people (name and email address) from your group who would be willing to serve as reviewers for the next few years, along with 1-3 keywords on their principal expertise.

First Name	Last Name	Email	Principal Expertise
Edward	Hanna	ehanna@lincoln.ac.uk	Surface mass balance, Greenland ice sheet, climate science