

Andrew Tedstone

a.j.tedstone@bristol.ac.uk • atedstone.github.io

Research interests Ice sheet and glacier mass balance, albedo, hydrology and dynamics, in connection to responses to climate change.

Employment *Department of Geosciences, Université de Fribourg*, Switzerland.
Aug 2019–. Senior Researcher.
Firn hydrology and mapping the runoff limit of the Greenland Ice Sheet.
School of Geographical Sciences, University of Bristol, UK.
Jan 2016–. Research Associate.
Remote sensing of albedo; modelling the effects of albedo upon surface mass balance.

Education *School of GeoSciences, University of Edinburgh*, UK.
2011–2015. Ph.D. Hydrological controls on Greenland Ice Sheet motion.
Funded by the Natural Environment Research Council (NERC), UK.
Scott Polar Research Institute, University of Cambridge, UK.
2010–2011. M.Phil. Polar Studies (with Distinction).
Thesis: Sediment plumes as indicators of Greenland Ice Sheet runoff.
Funded by the Fitzwilliam Graduate Scholarship for M.Phil. research.
Fitzwilliam College, University of Cambridge, UK.
2007–2010. B.A. (now M.A.) Hons. Geography (1st Class).
Dissertation: The subglacial drainage system of Hagafellsjökull-Eystri, Iceland.

First Author Publications *Tedstone, A.*, J. Cook, C. Williamson, S. Hofer, J. McCutcheon, T. Irvine-Fynn, T. Gribbin & M. Tranter (in review). Algal growth and weathering crust structure drive variability in Greenland Ice Sheet ice albedo. **The Cryosphere Discussions**. DOI: 10.5194/tc-2019-131.

Tedstone, A., J. Bamber, J. Cook, C. Williamson, X. Fettweis, A. Hodson & M. Tranter (2017). Dark ice dynamics of the south-west Greenland Ice Sheet. **The Cryosphere**. DOI: 10.5194/tc-11-2491-2017.

Tedstone, A., P. Nienow, A. Dehecq, N. Gourmelen, D. Goldberg & E. Hanna. Decadal slowdown of a land-terminating sector of the Greenland Ice Sheet despite warming (2015). **Nature**, 526, 692–695. DOI: 10.1038/nature15722.

Tedstone, A., P. Nienow, N. Gourmelen & A. Sole (2014). Greenland Ice Sheet motion insensitive to spatial variations in subglacial hydraulic structure. **Geophys. Res. Lett.**, 41(24), 8910–8917. DOI: 10.1002/2014GL062386.

Tedstone, A., P. Nienow, A. Sole, D. Mair, T. Cowton, I. Bartholomew & M. A. King (2013). Greenland Ice Sheet motion insensitive to exceptional meltwater forcing. **Proc. Nat. Acad. Sci.**, 110 (49), 19719–19724. DOI: 10.1073/pnas.1315843110.

Tedstone, A. & N. Arnold (2012). Automated remote sensing of sediment plumes for identification of runoff from the Greenland Ice Sheet. **Journal of Glaciology**, 58 (210), 699-712. DOI: 10.3189/2012JoG11J204.

Co-author Publications Cook, J., *A. Tedstone* and 22 co-authors (in review). Glacier algae accelerate melt rates on the western Greenland Ice Sheet. **The Cryosphere Discussions**. DOI: 10.5194/tc-2019-58.

- Hofer, S., **A. Tedstone**, X. Fettweis & J. Bamber (2019). Cloud microphysics and circulation anomalies control differences in future Greenland melt. **Nature Climate Change**. DOI: 10.1038/s41558-019-0507-8.
- Dukhovskoy, D., I. Yashayaev, A. Proshutinsky, J. Bamber, I. Bashmachnikov, E. Chassignet, C. Lee & **A. Tedstone** (2019). Role of Greenland Freshwater Anomaly in the Recent Freshening of the Subpolar North Atlantic. **Journal of Geophysical Research: Oceans**. DOI: 10.1029/2018JC014686.
- Lamarche-Gagnon, G., J. Wadham, B. Sherwood Lollar, S. Arndt, P. Fietzek, A. Beaton, **A. Tedstone**, J. Telling, E. Bagshaw, J. Hawkings, T. Kohler, J. Zarsky, M. Mowlem, A. Anesio and M. Stibal (2019). Greenland melt drives continuous export of methane from its bed. **Nature**. DOI: 10.1038/s41586-018-0800-0.
- Hawkings, J., J. Hatton, K. Hendry, G. De Souza, J. Wadham, R. Ivanovic, T. Kohler, M. Stibal, A. Beaton, G. Lamarche-Gagnon, **A. Tedstone**, M. Hain, E. Bagshaw, J. Pike and M. Tranter (2018). The global silicon cycle impacted by past ice sheets. **Nature Communications**. DOI: 10.1038/s41467-018-05689-1.
- Bamber, J., **A. Tedstone**, A. Proshutinsky, D. Dukhovskoy, E. Enderlin, I. Howat, M. King, B. Noel and M. van den Broeke (2018). Land ice budget of the Arctic and North Atlantic Oceans. Part I: Data, methods and results. **Journal of Geophysical Research: Oceans**. DOI: 10.1002/2017JC013605.
- Williamson, C., A. Anesio, J. Cook, **A. Tedstone**, E. Sypianska, A. Holland, D. Fagan, M. Tranter, X. Fettweis and M. Yallop (2018). Ice algal bloom development on the surface of the Greenland Ice Sheet. **FEMS Microbiology Ecology**. DOI: 10.1093/femsec/fiy025.
- Cook, J., A. Hodson, A. Gardner, M. Flanner, **A. Tedstone**, C. Williamson, T. Irvine-Fynn, J. Nilsson, R. Bryant & M. Tranter (2017). Quantifying bioalbedo: A new physically-based model and critique of empirical methods for characterizing biological influence on ice and snow albedo. **The Cryosphere**. DOI: 10.5194/tc-11-2611-2017.
- Hofer, S., **A. Tedstone**, X. Fettweis & J. Bamber (2017). Decreasing cloud cover drives the recent mass loss on the Greenland ice sheet. **Science Advances**. DOI: 10.1126/sciadv.17005844.
- Kohler, T., J. Žárský, J. Yde, G. Lamarche-Gagnon, J. Hawkings, **A. Tedstone**, J. Wadham, J. Box, A. Beaton & M. Stibal (2017). Carbon dating reveals a seasonal progression in the source of particulate organic carbon exported from the Greenland Ice Sheet. **Geophysical Research Letters**. DOI: 10.1002/2017GL073219.
- Musilova, M., M. Tranter, J. Wadham, J. Telling, **A. Tedstone** & A.M. Anesio (2017). Microbially driven export of labile organic carbon from the Greenland ice sheet. **Nature Geoscience**. DOI: 10.1038/ngeo2920.
- Linhoff, B., M. Charette, P. Nienow, J. Wadham, **A. Tedstone** & T. Cowton (2017). Utility of ^{222}Rn as a passive tracer of subglacial distributed system drainage. **Earth and Planetary Science Letters**. DOI: 10.1016/j.epsl.2016.12.039.
- Hawkings, J., J. Wadham, L. Benning, K. Hendry, M. Tranter, **A. Tedstone**, P. Nienow & R. Raiswell (2017). Ice sheets as a missing source of silica to the polar oceans. **Nature Communications**. DOI:10.1038/ncomms14198.
- Wadham, J., J. Hawkings, J. Telling, D. Chandler, J. Alcock, E. O'Donnell, P. Kaur, E. Bagshaw, M. Tranter, **A. Tedstone** & P. Nienow (2016). Sources, cycling and export of nitrogen on the Greenland Ice Sheet. **Biogeosciences**. DOI: 10.5194/bg-13-6339-2016.

de Fleurian, B., M. Morlighem, H. Seroussi, E. Rignot, M. R. van den Broeke, P. K. Munneke, J. Mouginot, P. C. J. P. Smeets & A. *Tedstone* (2016). A modeling study of the effect of runoff variability on the effective pressure beneath Russell Glacier, West Greenland. **Journal of Geophysical Research: Earth Surface**. DOI: 10.1002/2016JF003842.

Hawkings, J., J. Wadham, M. Tranter, J. Telling, E. Bagshaw, A. Beaton, S-L. Simmons, D. Chandler, A. *Tedstone* and P. Nienow (2016). The Greenland Ice Sheet as a hotspot of phosphorus weathering and export in the Arctic. **Global Biogeochemical Cycles**. DOI: 10.1002/2015GB005237.

Hawkings, J., J. Wadham, M. Tranter, E. Lawson, A. Sole, T. Cowton, A. *Tedstone*, I. Bartholomew, P. Nienow and D. Chandler (2015). The effect of a warming climate on nutrient and solute export from the Greenland Ice Sheet. **Geochemical Perspectives Letters**, 1, 94-104. DOI: 10.7185/geochemlet.1510.

Hawkings, J., J. Wadham, M. Tranter, R. Raiswell, L. Benning, P. Statham, A. *Tedstone*, P. Nienow, K. Lee & J. Telling (2014). Ice sheets as a significant source of highly reactive nanoparticulate iron to the oceans. **Nat. Comm.**, 5, 3929. DOI: 10.1038.ncomms4929.

Sole, A., P. Nienow, I. Bartholomew, D. Mair, T. Cowton, A. *Tedstone*, & M. King (2013). Winter motion mediates dynamic response of the Greenland Ice Sheet to warmer summers. **Geophys. Res. Lett.**, 40, 3940–3944. DOI: 10.1002/grl.50764.

Skills

Scientific Programming: Python (advanced), FORTRAN, bash, MATLAB (intermediate). Git version-control. Super-computer deployments. My GeoRaster Python package is available on conda-forge and PyPI.

Geospatial data analysis: Remotely sensed data (MODIS, Landsat, Sentinel-2, UAV missions, MISR, feature tracking), GDAL, QGIS, ESA SNAP, Kinematic GPS processing (TEQC/TRACK), AgiSoft PhotoScan, automated processing chains, lab-based sensor calibrations, climate simulations using the Modèle Atmosphérique Régionale (MAR).

IT: Unix, Windows, Office, \LaTeX , vector and raster image editing, VirtualBox, Vagrant.

Languages: English (native), French (DELTA A2/B1).

Funding

Marie Skłodowska-Curie Actions Individual Global Fellowship, ‘IceMelt3D’. €231,191.36. Score: 97.8%, funding threshold: 92.6%. February 2019. *I did not pursue this Action owing to uncertainty in funding continuity following the UK’s exit from the EU.*

Scottish Alliance for Geoscience, Environment and Society (SAGES). Postdoctoral and Early Career Researcher Exchange program, to Université de Savoie, Annecy, France. £2,375. 2014.

SAGES Theme 3 Research Support. £200. 2014.

SAGES Theme 1 Research Enabling Funding for Conference Support. £220. 2013.

University of Edinburgh Club of Toronto (EDUCT) Geography Fund. £360. 2013.

University of Edinburgh Mackay Greenland Fund. £600. 2013.

University of Edinburgh Moss Scholarship. £5,000. 2012.

Natural Environment Research Council PhD studentship. £68,000. 2011.

Undergraduate dissertation research – £1,200 from various funding sources. 2009.

- Impact** *Media Outreach:* Creation of short films for social media networks. Film segments featured in Research Council films. Filmed with BBC News on the Greenland Ice Sheet during July 2017. Contributor to 'Ice Alive' short film, 2018 and to Dark Snow Project video updates, 2017.
- Equal Access:* Developed and delivered lectures and practical workshops for students with no family university background as part of the Lothians Education Access Programme.
- Public Outreach:* Public outreach exhibition at Dynamic Earth, Edinburgh, 2011; presentation to Swindon University of the Third Age (U3A), July 2019; presentation to Swansea U3A, 2017.
- Geography Ambassador* with the Royal Geographical Society, 2010-2011.
- Teaching** *Student supervision:* S. Hofer (*M.Res.*, then *Ph.D.*, 2016–); T. Gribbin (*BSc* dissertation 2018); F. Baldacchino (*MSc* dissertation 2018); R. Pappas (undergraduate from Montana State University, USA - term project in remote sensing).
- Python for Environmental Sciences* 3-day practical course (October 2016) for new PhD students at the University of Bristol. Created and led data analysis tutorials.
- Fundamentals of Glaciology.* Developed and delivered lectures on subglacial hydrology and dynamics for 2nd year undergraduates at the University of Bristol, 2017 and 2018.
- Field:* Total of 7 weeks. U.Bristol Study and Field Skills (Arolla, Switzerland), 2019. U.Edin. Iceland Undergraduate Elective, 2013, 2014 and 2015 — 10-day intensive field course including co-leadership of the 2014 Elective; supervision of student projects, equipment and food logistics. Cairngorms, Scotland, short courses 2011, 2013, 2014, 2015 — glacial geomorphology.
- Tutoring and Demonstrating:* Geomorphology, 2012–15; Environment Sensitivity and Change, 2011–2012; Plotting in Python, 2012; Quantitative Methods in Geography, 2011.
- Feedback Award* nominee, Edinburgh University Student Association, 2013.
- Service** *Lead Convenor* of EGU General Assembly 2019 session CR5.2/CL2.12 'Ice sheet and glacier surface mass balance and atmospheric interaction'.
- Reviewer* for Nature Scientific Reports, Journal of Glaciology, Annals of Glaciology, The Cryosphere, Journal of Geophysical Research: Earth Surface, Geoscientific Model Development, Geografiska Annaler.
- Convenor* of the Edinburgh GeoSciences Hutton Club seminar series for 2013–14.
- Vice-President* of the Edinburgh GeoSciences GradSchool (2012–2013)
Co-organiser for the School's annual 3-day conference for 120 delegates.
- Research Group Website* design and development of the Edinburgh Cryosphere website, 2012–2015.
- Vice-President* of Cambridge University Geographical Society (2009–2010).
- Fieldwork Experience** *Upernavik, north-west Greenland* July 2018. Surface sampling and reflectance measurements, unmanned aerial surface imaging.
- Himachal Pradesh, Indian Himalayas* September 2017. Bio-climatic characterisation of Chotta Shigri, as part of a Bristol collaboration with Jawaharlal Nehru University.

South-west Greenland ablation zone July 2017. Surface reflectance measurements using ASD FieldSpec Spectro-radiometer and unmanned aerial system with multispectral camera.

Svalbard March 2017. Unmanned aerial system tests; pingo hydrochemistry sampling for A. Hodson. Undertook UNIS Rifle and Snowmobile training.

South-west Greenland ablation zone August 2016. Albedo measurements of the ice sheet surface. Led organisation of field logistics for the 15-person, 6-week campaign consisting of three work packages spread across five institutions. Coordination of several tonnes of outbound freight and multiple helicopter flights.

Leverett Glacier, south-west Greenland May 2015: hydrological gauging for the University of Bristol.

Leverett Glacier, south-west Greenland May–August 2012 & May 2013: Dye dilution river discharge gauging, ablation measurements and SF_6 gas tracer sampling at a remote ice-marginal field camp. Deployment of differential GPS units, meteorological sensors and time lapse cameras along a 115 km transect.

Hagafellsjökull-Eystri, Iceland July–August 2009 (2 weeks). Hydrological measurements (stage, salt dilution gauging and hydrochemistry).

Recent Presentations

European Space Agency Living Planet Symposium, May 2019, Milan. *Poster: Fusion of multispectral UAV acquisitions with Sentinel-2 measurements to examine Greenland Ice Sheet albedo.*

European Geophysical Union General Assembly, April 2019, Vienna. *Poster: Modelling algal growth and its impact upon Greenland Ice Sheet melting.*

University of Edinburgh GeoSciences, March 2019. *Invited talk: Greenland Ice Sheet Melting and Darkening.*

International Glaciological Society British Branch Meeting, September 2019. *Talk: Assessing the impact of bio-albedo upon Greenland Ice Sheet melting.*

European Geophysical Union General Assembly, April 2018, Vienna. *Talks: (1) Assessing the impact of bio-albedo upon Greenland Ice Sheet melting; (2) Land Ice Contribution to the Fresh Water Budget of the Arctic and North Atlantic Oceans.*

Natural Environment Research Council, Swindon, November 2017. *Talk: How do we measure bio-albedo?*

Indo-UK workshop on Bio-climatic Feedbacks of Melting Himalayan Ice, JNU, New Delhi, September 2017. *Talk: Bio-albedo of Ice: Earth Observation and Modelling.*

Data Intensive Research in Environment: Challenges and Opportunities for the GW4 Alliance, University of Exeter, May 2017. *Talk: Challenges in projecting the sea level rise contribution of the Greenland Ice Sheet.*

AGU Fall Meeting, San Francisco, December 2016. *Talk: Physical controls on dark ice presence in south-west Greenland.*

Awards

SAGES Best Postgraduate Research Paper Prize, 2015 (for **Nature** study).

Best 3rd year presentation, Edinburgh GeoSciences GradSchool Conference, 2014.

Best Feedback Award nominee, Edinburgh University Student Teaching Awards, 2013.

Highly Commended in British Hydrological Society Student Dissertation Awards, 2010.

1912 Senior Scholar, and Cockle Prize recipient, Fitzwilliam College, 2010–2011.

Ongoing Learning *Short courses:* Lecturing for Research Staff; Programming with OpenMP; Beginning Fortran; Publishing Research Software; Statistics refresher; How to peer-review research manuscripts for journals; Science communication; Presentation Skills; MATLAB.

Summer Schools: Karthaus Course on Glaciers and Ice sheets in the Climate System, September 2014 (Institute for Marine and Atmospheric Research, Utrecht)

Other Experience *Web Developer*, NERC E³ Doctoral Training Partnership. July–September 2015.

Scout Leader at Avon District Explorer Scouts (2016–), 1st Histon Scout Group, Cambridge (2010–2011) and 1st Purton & Lydiard Scout Group, Wiltshire (2004–, including web and advertising).

Activities Instructor at Bonaly Scout Activity Centre, Edinburgh (2013–2015)

Technical Director for student theatre productions in Cambridge (2007–2010)

Sales Assistant, Millets (outdoor equipment retailer) (2006–2010)

Advising customers; covering supervisory duties; occasional store management.