Dr Alek Petty

Polar climate scientist

Earth System Science Interdisciplinary Center, University of Maryland,
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Research summary

Research interests:
Polar sea ice variability; atmosphere-ice-ocean interactions; polar climate change projections; seasonal forecasting.

Research approach:
Remote sensing data production and analysis (laser altimetry/passive microwave/hyperspectral); geospatial & statistical analysis (Python tools); climate modeling (CMIP6/CESM/CICE); data assimilation (EnKF/DART); ML/AI prediction (GPR/MCMC/Random Forests/Neural Nets); Open- Science (Jupyter/GitHub/CryoCloud).

Recent focus:

- Analyzing sea ice data from NASA's ICESat-2 laser altimetry mission.
- Constraining future sea ice with observations and novel calibration methods.
- Defining mission requirements from a future surface topography mission using Observing System Simulation Experiments (OSSEs).
- Mission planning for the upcoming Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment (ARCSIX).

Professional experience

Research Scientist
2024 - present
Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, USA

Associate Research Scientist
2020 - 2024
Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, USA
NASA Goddard Space Flight Center, Greenbelt, MD, USA (2020-2023)

Assistant Research Scientist
2017 - 2020
NASA Goddard Space Flight Center, Greenbelt, MD, USA
Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, USA

Postdoctoral Associate
2015 - 2017
NASA Goddard Space Flight Center, Greenbelt, MD, USA
Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, USA

Research Associate
2014 - 2015
NOAA Center for Weather and Climate Prediction (NCWCP)
Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, USA

Education

University College London / Ph.D in Climate Science
September 2010 - January 2014, London, UK

Thesis Title: Sea ice and the ocean mixed layer over the Antarctic continental shelf
Supervisors: Daniel L. Feltham & Paul R. Holland

University of Bristol / MSci (1st Class honours)
October 2006 - July 2010, Bristol, UK
Thesis Title: Non-invasive detection of neural currents in the brain

Current Science Team & Working Group memberships

- Science Team member: NASA's Soil Moisture Active-Passive Mission (SMAP), 2024 onwards.
- Science Team member: NASA's Ice, Cloud and land Elevation Satellite (ICESat-2), 2023 onwards.
- Science Team member: NASA's Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment (ARCSIX), 2022 onwards.
- Science Team member: NASA Surface Topography & Vegetation (STV) Decadal Survey Incubation (DSI), 2022 onwards.
- Sea Ice Model Intercomparison Project (SIMIP) Scientific Steering Group (SSG) (invited role), 2024-2029.
- National Snow and Ice Data Center (NSIDC) User Working Group committee member (invited role), 2022-2026.

Publications

NB: starred (*) papers have not been fully peer reviewed

[53*] Cabaj, A., P. J. Kushner, **A. Petty** (2024), Investigating the impact of reanalysis snow input on an observationally calibrated snow-on-sea-ice reconstruction, EGUsphere (*preprint*), egusphere-2024-2562.

[52] Bushuk et al., inc. **A. A. Petty** (2024), Predicting September Arctic Sea Ice: A Multi-Model Seasonal Skill Comparison, Bull. Amer. Meteor. Soc., 105, E1170–E1203, doi: 10.1175/BAMS-D-23-0163.1.

[51] Studinger, M., B. Smith, N. Kurtz, **A. A. Petty**, T. Sutterley, R. Tilling (2024), Estimating differential penetration of green (532 nm) laser light over sea ice with NASA's Airborne Topographic Mapper: observations and models, The Cryosphere, 18, 2625–2652, doi: 10.5194/tc-18-2625-2024.

[50*] Meier, W., **A. A. Petty**, S. Hendricks et al., (2023), "Sea Ice", NOAA Arctic Report Card 2023, T. A. Moon, M. L. Druckenmiller, and R. L. Thoman, Eds, doi: 10.25923/f5t4-b865.

[49] Thoman, R., M. L. Druckenmiller, and T. Moon, Eds., (2023) The Arctic [in "State of the Climate in 2021"]. Bull. Amer. Meteor. Soc., 104 (9), S271–S321, doi: 10.1175/BAMS-D-23-0079.1

[48] Mchedlishvili, A., C. Lupkes, **A. A. Petty**, M. Tsamados, G. Spreen (2023), New estimates of the pan-Arctic sea ice-atmosphere neutral drag coefficients from ICESat-2 elevation data, The Cryosphere, 17, 4103-4131, doi: 10.5194/tc-17-4103-2023

[47] Massonnet, F. et al., inc. **A. A. Petty** (2023) SIPN South: six years of coordinated sea ice predictions in the Southern Ocean, accepted in Frontiers in Marine Science, 10, doi: /doi.org/10.3389/fmars.2023.1148899.

[46] Cicero, E., K. Poinar, R. Jones-Ivey, **A. A. Petty**, J. M. Sperhac, A. Patra, J. P. Briner (2023), Firn aquifer water discharges into crevasses across Southeast Greenland, Journal of Glaciology, 1-14. doi:10.1017/jog.2023.25.

[45] Cabaj, A., P. J. Kushner & **A. A. Petty** (2023). Automated calibration of a snow-on-sea-ice model. *Earth and Space Science*, 10, e2022EA002655, doi: 10.1029/2022EA002655.

[44] **Petty A. A.**, N. Keeney, A. Cabaj, P. Kushner, M. Bagnardi (2023), Winter Arctic sea ice thickness from ICESat-2: upgrades to freeboard and snow loading estimates and an assessment of the first three winters of data collection, The Cryosphere, 17, 127–156, doi: 10.5194/tc-17-127-2023.

[43*] Meier, W., **A. Petty**, S. Hendricks, Perovich, et al., (2022), "Sea Ice", NOAA Arctic Report Card 2022, T. A. Moon, M. L. Druckenmiller, and R. L. Thoman, Eds, doi: 10.25923/xyp2-vz45.

[42] Lim, W-I., H-S. Park, **A. A. Petty** & K-H, Seo, (2022), The role of summer snowstorms on seasonal Arctic sea ice loss, Journal of Geophysical Research: Oceans, 127, e2021JC018066, doi:10.1029/2021JC018066

[41] Smith, M, M., M. M. Holland, **A. A. Petty**, B. Light, D. A. Bailey, (2022) Effects of increasing the category resolution of the sea ice thickness distribution in a coupled climate model on Arctic and Antarctic sea ice, Journal of Geophysical Research: Oceans, 127, e2022JC019044. doi:10.1029/2022JC019044

[40] Thoman, R., M. L. Druckenmiller, and T. Moon, Eds., (2022) The Arctic [in "State of the Climate in 2021"]. Bull. Amer. Meteor. Soc., 103 (8), S257–S306, doi: 10.1175/BAMS-D-22-0082.1

[39*] W. Meier, D. Perovich, S. Farrell, C. Haas, S. Hendricks, A. A. Petty et al., (2021), "Sea Ice", NOAA Arctic Report Card 2021, R. L. Thoman, J. Richter-Menge, and M. L. Druckenmiller, Eds., doi:10.25923/y2wd-fn85.

[38] Glissenaar, I. A., J. C. Landy, A. A. Petty, N. T. Kurtz, and J. C. Stroeve (2021), Impacts of snow data and processing methods on the interpretation of long-term changes in Baffin Bay sea ice thickness, The Cryosphere, 15, 4909–4927, doi:10.5194/tc-15-4909-2021.

[37] Druckenmiller, M. L., T. Moon, and R. Thoman, Eds., 2021: The Arctic [in "State of the Climate in 2020"]. Bull. Amer. Meteor. Soc., 102 (8), S263–S315, doi: 10.1175/BAMS-D-21-0086.1

[36] Fons, S., N. Kurtz, M. Bagnardi, **A. A. Petty**, R. Tilling (2021), Assessing CryoSat-2 Antarctic snow freeboard retrievals using data from ICESat-2, Earth and Space Science, 8, e2021EA001728. doi:10.1029/2021EA001728

[35] Bagnardi, M. N. Kurtz, **A. A. Petty**, R. Kwok (2021), Sea surface height anomalies of the Arctic Ocean from ICESat-2: a first examination and comparisons with CryoSat-2, Geophysical Research Letters, 48, e2021GL093155, doi:10.1029/2021GL093155.

[34] MacGregor, J., L. N. Boisvert, B. Medley, **A. A. Petty**. et al. (2021), The scientific legacy of NASA's Operation IceBridge, Reviews of Geophysics, 59, e2020RG000712, doi:10.1029/2020RG000712.

[33] **Petty, A. A.**, M. Bagnardi, N. T. Kurtz, R. Tilling, S. Fons, T. Armitage, C. Horvat, R. Kwok (2021), Assessment of ICESat-2 sea ice surface classification with Sentinel-2 imagery: implications for freeboard and new estimates of lead and floe geometry Earth and Space Science, 8, e2020EA001491. doi:10.1029/2020EA001491.

[32] Kwok, R., **A. A. Petty**, M. Bagnardi, N. T. Kurtz, G. F. Cunningham, A. Ivanoff (2021), Refining the sea surface identification approach for determining freeboard in the ICESat-2 sea ice products, The Cryosphere, 15, 821–833, doi:10.5194/tc-15-821-2021

[31] Zhou, L., J. Stroeve, S. Xu, **A. A. Petty**, R. Tilling, M. Winstrup, P. Rostosky, I. Lawrence, G. E. Liston, A. Ridout, M. Tsamados, V. Nandan, (2021) Inter-comparison of snow depth over Arctic sea ice from reanalysis reconstructions and satellite retrieval, The Cryosphere, 15, 345–367, doi:10.5194/tc-15-345-2021.

[30*] Perovich, D., W. Meier, M. Tschudi, S. Hendricks, **A. A. Petty** et al., (2020), "Sea Ice", NOAA Arctic Report Card 2020, R. L. Thoman, J. Richter-Menge, and M. L. Druckenmiller, Eds., doi:10.25923/n170-9h57.

[29] Tilling, R., N. T. Kurtz, M. Bagnardi, A. A. Petty, R. Kwok (2020), Detection of Melt Ponds on Arctic Summer Sea Ice from ICESat-2. Geophysical Research Letters, 47, e2020GL090644. doi:10.1029/2020GL090644.

[28] Boisvert, L. N., M. A. Webster, **A. A. Petty**, T. Markus, R. I. Cullather, D. H. Bromwich (2020), Intercomparison of Precipitation Estimates Over the Southern Ocean from Atmospheric Reanalyses. Journal of Climate, 33 (24): 10627–10651, doi: 10.1175/JCLI-D-20-0044.1.

[27] Kwok, R., G. F. Cunningham, S. Kacimi, M. A. Webster, N. T. Kurtz, **A. A. Petty** (2020), Decay of the snow cover over Arctic sea ice from ICESat-2 acquisitions during summer melt in 2019. Geophysical Research Letters, 47, e2020GL088209. doi: 10.1029/2020GL088209.

[26] Horvat, C., E. Blanchard-Wrigglesworth, & **A. Petty** (2020), Observing waves in sea ice with ICESat-2. Geophysical Research Letters, 47, e2020GL087629. doi: 10.1029/2020GL087629.

[25] Notz, D., J. Dorr, D. A. Bailey, E. Blockley, M. Bushuk, J. B. Debernard, et al. (inc. **A. A. Petty**) (2020), Arctic Sea Ice in CMIP6. Geophysical Research Letters, 47, e2019GL086749. doi:10.1029/2019GL086749.

[24] Landy, J., **A. A. Petty,** M. C. Tsamados, J. Stroeve (2020), Sea ice roughness overlooked as a key source of uncertainty in Cryosat-2 ice freeboard retrievals J. Geophys. Res. Oceans, 125, e2019JC015820, doi:10.1029/2019JC015820.

[23] **Petty, A. A.**, N. T. Kurtz, R. Kwok, T. Markus, T. Neumann (2020), Sea ice thickness of the Arctic Ocean from ICESat-2, J. Geophys. Res. Oceans, 125, e2019JC015764. doi:10.1029/2019JC015764.

[22] Kwok, R., S. Kacimi, M. A. Webster, N. T. Kurtz, **A. A. Petty** (2020). Arctic snow depth and sea ice thickness from ICESat-2 and CryoSat-2 freeboards: A first examination. J. Geophys. Res. Oceans, 125, e2019JC016008. doi: 10.1029/2019JC016008.

[21] Armitage, T. W. K, G. E. Manucharyan and **A. A. Petty**, R. Kwok, A. F. Thompson, Critical role of sea ice and ocean eddies in the freshwater and energy balance of the Beaufort Gyre (2020), Nature Communications, 11. doi:10.1038/s41467-020-14449-z.

[20] Cabaj, A., P. Kushner, C. Fletcher, S. Howell, A. A. Petty, Encouraging agreement between CloudSat and reanalysis snowfall over the Arctic Ocean (2020), Geophys. Res. Lett., 47, doi:10.1029/2019GL08642.

[19] Kwok, R., T. Markus, N. T. Kurtz, **A. A. Petty**, T. A. Neumann, S. L. Farrell, et al (2019). Surface height and sea ice freeboard of the Arctic Ocean from ICESat–2: Characteristics and early results. J. Geophys. Res: Oceans, 124. doi:10.1029/2019JC015486.

[18] Frew, R., D. L. Feltham, P. R. Holland, A. A. Petty, (2019), Sea Ice - Ocean Feedbacks in the Antarctic Shelf Seas, J. Phys. Oceanogr., doi:10.1175/JPO-D-18-0229.1.

[17] **Petty, A. A.**, M. Webster, L. N. Boisvert, T. Markus (2018), The NASA Eulerian Snow on Sea Ice Model (NESOSIM) v1.0: Initial model development and analysis, Geosci. Model Dev., doi:10.5194/gmd-11-4577-2018.

[16] **Petty, A. A.**, M. M. Holland, D. A. Bailey, N. T. Kurtz, (2018), Warm Arctic, increased winter sea-ice growth?, Geophys. Res. Lett., 45, doi:10.1029/2018GL079223.

[15] Boisvert, L. N., M. A. Webster, **A. A. Petty**, T. Markus, D. H. Bromwich, R. I. Cullather (2018), Intercomparison of precipitation estimates over the Arctic Ocean and its peripheral seas from reanalyses, J. Climate, 31(20), 8441–8462, doi:10.1175/JCLI-D-18-0125.1.

[14*] **Petty, A. A.**, (2018) A possible link between winter Arctic sea ice decline and a collapse of the Beaufort High?, Geophys. Res. Lett., 45, doi: 10.1002/2018GL077704.

[13] Petty, A. A., J. C. Stroeve, P. R. Holland, L. N. Boisvert, A. C. Bliss, N. Kimura, W. N. Meier (2018), The Arctic sea ice cover of 2016: A year of record-low highs and higher-than-expected lows, The Cryosphere, 12, 433-452, doi:10.5194/tc-12-433-2018.

[12] Cole, S. T., J. M. Toole, R. Lele, M.-L. Timmermans, S. G. Gallagher, T. P. Stanton, W. J. Shaw, B. Hwang, T. Maksym, J. P. Wilkinson, M. Ortiz, H. Graber, L. Rainville, **A. A. Petty**, S. L. Farrell, J. A. Richter- Menge, and C. Haas (2017), Ice and ocean velocity in the Arctic marginal ice zone, Ice roughness and momentum transfer, Elem Sci Anth, 5: 55, doi:10.1525/elementa.241.

[11*] **Petty, A. A.**, T. Markus, N. Kurtz (2017), Improving our understanding of Antarctic sea ice with NASA's Operation IceBridge and the upcoming ICESat-2 mission, US CLIVAR Variations, 15, 3.

[10] **Petty, A. A.**, M. C. Tsamados, N T. Kurtz, Atmospheric form drag over Arctic sea ice using remotely sensed ice topography observations, J. Geophys. Res. Earth's Surf, 122, doi:10.1002/2017JF004209.

[9] Armitage, T. W. K., S. Bacon, A. L. Ridout, **A. A. Petty**, S. Wolbach, M. C. Tsamados (2017), Arctic Ocean geostrophic circulation 2003-2014, The Cryosphere, doi:10.5194/tc-2017-22.

[8] Graham, R. M., L. Cohen, **A. A. Petty**, L. N. Boisvert, M. A. Granskog, A. Rinke, S. R. Hudson, M. Nicolaus, Increasing frequency and duration of Arctic winter warming events, Geophys. Res. Lett. doi: 10.1002/2017GL073395

[7] **Petty, A. A.**, D. Schroder, J. C. Stroeve, T. Markus, J. Miller, N. T. Kurtz, D. L. Feltham, D. Flocco, Skillful spring forecasts of September Arctic sea-ice extent using passive microwave sea ice observations, Earth's Future, 5, doi:10.1002/2016EF000495.

[6] Boisvert, L. N., **A. A. Petty**, J. C. Stroeve (2016), The extreme winter 2015/2016 Arctic cyclone and its impact on the Barents-Kara seas, Mon. Wea. Rev, 144, 4279–4287, doi:10.1175/MWR-D-16-0234.1.

[5] **Petty, A. A.**, M. C. Tsamados, N. T. Kurtz, S. L. Farrell, T. Newman, J. Harbeck, D. L. Feltham, J. A. Richter-Menge (2016), Characterizing Arctic sea ice topography using high-resolution IceBridge data, The Cryosphere, 10(3), 1161–1179, doi:10.5194/tc-10-1161-2016.

[4] **Petty, A. A.**, J. K. Hutchings, J. A. Richter-Menge, M. A. Tschudi (2016), Sea ice circulation around the Beaufort Gyre: The changing role of wind forcing and the sea ice state, J. Geophys. Res. Oceans, 121(5), 3278–3296, doi:10.1002/2015JC010903.

[3] Tsamados, M. C., D. L. Feltham, **A.A. Petty**, D. Schroder, D. Flocco (2015), Processes controlling surface, bottom and lateral melt of Arctic sea ice in a state of the art sea ice model, Phil. Trans. Roy. Soc., Lond A, 373, doi:10.1098/rsta.2014.0167

[2] Petty, A. A., D. L. Feltham, and P. R. Holland (2014), Sea ice and the ocean mixed layer over the Antarctic shelf seas, The Cryosphere, 8(2), 761–783, doi:10.5194/tc-8-761-2014.

[1] **Petty, A. A.**, D. L. Feltham, and P. R. Holland (2013), Impact of atmospheric forcing on Antarctic continental shelf water masses, J. Phys. Oceanogr, 43(5), 920–940, doi:10.1175/JPO-D-12- 0172.1.

Other publications

[6] Kwok, R., **Petty, A.**, Wimert, J., Bagnardi, M., Cuningham, G., Hancock, D., Ivanoff, A., and Kurtz, N. (2022), Ice, Cloud, and Land Elevation Satellite-2 Project: Algorithm Theoretical Basis Document (ATBD) for Sea Ice Products, Release 006, https://icesat-2.gsfc. nasa.gov/science/data-products,, doi: 10.5067/9VT7NJWOTV3I.

[5] Kwok, R., **Petty, A.**, Wimert, J., Bagnardi, M., Cuningham, G., Hancock, D., Ivanoff, A., and Kurtz, N. (2022), Ice, Cloud, and Land Elevation Satellite-2 Project: Algorithm Theoretical Basis Document (ATBD) for Sea Ice Products, Release 005, https://icesat-2.gsfc. nasa.gov/science/data-products.

[4] Kwok, R., **Petty, A.**, Cuningham, G., Hancock, D., Ivanoff, A., Wimert, J., Bagnardi, M., and Kurtz, N. (2021) Ice, Cloud, and Land Elevation Satellite-2 Project: Algorithm Theoretical Basis Document (ATBD) for Sea Ice Products, Release 004, https://icesat-2.gsfc. nasa.gov/science/data-products.

[3] 2016 Sea Ice Prediction Network, (2016), Sea Ice Outlook post-season report, (co-author/action team member).

[2] 2015 Sea Ice Prediction Network, (2015),, Sea Ice Outlook post-season report, (co-author/action team member).

[1] Petty, A. A. (2013), Impact of Atmospheric Forcing on Antarctic Continental Shelf Water Masses, PhD Thesis, UCL, London, UK.

Code

Code/software I have led or significantly contributed to.

NASA Eulerian Snow On Sea Ice Model (NESOSIM)
- GitHub: https://github.com/akpetty/NESOSIM.
- Code archive: https://doi.org/10.5281/zenodo.444835.

ICESat-2 sea ice thickness analysis
- GitHub: https://github.com/akpetty/ICESat-2-sea-ice-thickness
- Jupyter Book: https://www.icesat-2-sea-ice-state.info

ICESat-2 sea ice hackweek tutorials (2020)
- GitHub: https://github.com/ICESAT-2HackWeek/2020_ICESat-2_Hackweek_Tutorials
- Code archive: https://zenodo.org/record/3966463

ICESat-2 sea ice hackweek tutorials (2019)
- GitHub: https://github.com/ICESAT-2HackWeek/ICESat2_hackweek_tutorials
- Code archive: https://zenodo.org/record/3360994

Datasets

Datasets I have produced or contributed significantly towards. In cases of multiple versions, only the latest version is shown.

Petty, A. A. (2024). NASA Eulerian Snow On Sea Ice Model Version 1.1 (NESOSIMv1.1) data: 1980 - 2024 (v1.1.7) [Data set]. Zenodo. doi:10.5281/zenodo.5164313.

Petty, A. A., N. Kurtz, R. Kwok, T. Markus, T. A. Neumann and N. Keeney. 2023. ICESat-2 L4 Monthly Gridded Sea Ice Thickness, Version 3. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: https://doi.org/10.5067/ZCSU8Y5U1BQW.

Kwok, R., **A. A. Petty**, G. Cunningham, T. Markus, D. Hancock, A. Ivanoff, J. Wimert, M. Bagnardi, N. Kurtz, and the ICESat-2 Science Team. (2023). ATLAS/ICESat-2 L3A Sea Ice Freeboard, Version 6 [Indicate subset used]. Boulder, Colorado USA. National Snow and Ice Data Center, doi:10.5067/ATLAS/ATL10.006.

Kwok, R., **A. A. Petty**, G. Cunningham, T. Markus, D. Hancock, A. Ivanoff, J. Wimert, M. Bagnardi, N. Kurtz, and the ICESat-2 Science Team. (2023). ATLAS/ICESat-2 L3A Sea Ice Height, Version 6 [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center, doi:10.5067/ATLAS/ATL07.006.

Petty, A. A., N. Kurtz, 2023. ICESat L4 Seasonal Gridded Sea Ice Thickness, Version 1. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi:10.5067/1S5M59IQ0OK3.

Petty, A. A., N. Kurtz, R. Kwok, T. Markus, T. A. Neumann and N. Keeney. 2022. ICESat-2 L4 Monthly Gridded Sea Ice Thickness, Version 2. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: 10.5067/OE8BDP5KU30Q.

Petty, A. A., N. T. Kurtz, R. Kwok, T. Markus, and T. A. Neumann. 2022. ICESat-2 L4 Along-Track Sea Ice Thickness, Version 1. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: 10.5067/JTI5YG3S6VAJ.

Petty, A. A., R. Kwok, M. Bagnardi, A. Ivanoff, N. Kurtz, J. Lee, J. Wimert, and D. Hancock (2021) ATLAS/ICESat-2 L3B Daily and Monthly Gridded Sea Ice Freeboard, Version 2. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi:10.5067/ATLAS/ATL20.002.

Petty, A. A., R. Kwok, M. Bagnardi, N. Kurtz, J. Wimert, J. Lee, and D. Hancock. 2021. ATLAS/ICESat-2 L3B Daily and Monthly Gridded Polar Sea Surface Height Anomaly, Version 1. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: 10.5067/ATLAS/ATL21.001.

Petty, A. A. (2021). NASA Eulerian Snow On Sea Ice Model Version 1.1 (NESOSIMv1.1) data: 1980 - 2022 (v1.1) [Data set]. Zenodo. doi:10.5281/zenodo.7051062.

Kwok, R., **A. A. Petty**, G. Cunningham, T. Markus, D. Hancock, A. Ivanoff, J. Wimert, M. Bagnardi, N. Kurtz, and the ICESat-2 Science Team. (2021). ATLAS/ICESat-2 L3A Sea Ice Freeboard, Version 5 [Data Set]. Boulder, Colorado USA. National Snow and Ice Data Center, doi:10.5067/ATLAS/ATL10.005.

Kwok, R., **A. A. Petty**, G. Cunningham, T. Markus, D. Hancock, A. Ivanoff, J. Wimert, M. Bagnardi, N. Kurtz, and the ICESat-2 Science Team. (2021). ATLAS/ICESat-2 L3A Sea Ice Height, Version 5 [Data Set]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center, doi:10.5067/ATLAS/ATL07.005.

Grant funding (current)

[*PI*] NASA A.22 Soil Moisture Active-Passive Mission Science Team NNH23ZDA001N-SMAP
Project period: 01/01/25–12/31/27
Title: Improved Arctic sea ice state estimation through fusion of ICESat-2 and SMAP data
Total budget: **$326,215** (my institute budget: $326,215)
PI: Alek Petty

[*PI*] NASA A.15 Cryospheric Sciences NNH23ZDA001N-CRYO
Project period: 01/01/25–12/31/27
Title: Improving sea ice surface melt predictions with state-of-the-art satellite data and model physics
Total budget: **$512,835** (my institute budget: $344,753)
PI: Alek Petty

[*PI*] NASA A.32 Studies with ICESat-2 NNH22ZDA001N-ICESAT2
Project period: 06/01/23–05/31/26
Title: Calibrating simulations of sea ice and polar climate change with satellite-derived estimates of sea ice freeboard and thickness
Total budget: **$619,824** (my institute budget: $468,529)
PI: Alek Petty

[*PI*] NASA A.45 Decadal Survey Incubation NNH21ZDA001N-DSI
Project period: 08/15/22–08/14/25
Title: New sea ice and ice sheet OSSE frameworks for determining ice topography science requirements from a future STV mission
Total budget: **$1,237,741** (my institute budget: $587,272)
PI: Alek Petty

[*PI*] NASA A.17 Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment
Project period: 09/01/22–08/31/25
Title: Summer Arctic sea ice characterization and cal/val flight planning for maximizing ARCSIX sea ice data collection
Total budget: **$143,680** (my budget: $143,680)
PI: Alek Petty

Grant funding (completed)

[*Unfunded Project Partner*] EU Horizon 2020 framework programme

Project period: 10/1/21–09/30/23
Polar Regions in the Earth System (PolarRES): Role of local-regional scale polar processes in the changing polar and global climate systems
PI: Priscilla Mooney

[*Unfunded Project Partner*] Canadian Space Agency's Class Grant and Contribution program, Earth System Science Data Analyses
Project period: 10/1/21–09/30/23
Title: Space-based observations for predicting weather and climate extremes in Canada's North
PI: Christopher Fletcher

[*Co-I*] NASA A.17 Cryospheric Science NNH20ZDA001N-CRYO
Project period: 10/1/20–09/30/23 (extended through 2024)
Title: Improving estimates of sea ice thickness variability and change over the last two decades
Total budget: **$499,178** (my institute budget: $91,291)
PI: Cecilia Bitz, Co-I: Alek Petty

[*Co-I*] NASA Unsolicited proposal (ICESat-2 summer sea ice campaign 2022)
Project period: 05/01/22–04/31/23
Title: Evaluating the influence of melt ponds on summer sea ice height and freeboard retrievals from ICESat-2
Total budget: **$123,000** (my budget: $12,000)
PI: Rachel Tilling, Co-I: Alek Petty

[*Co-I*] NASA A.36 Studies with ICESat-2 NNH19ZDA001N-ICESAT2
Project period: 05/01/20–04/31/22 (extended through 2024)
Title: Advancing understanding sea ice topography across scales and seasons
Total budget: **$600,000** (my institute budget: $80,240)
PI: Rachel Tilling, Co-Is: Alejandro Egido, Alek Petty

[*Co-I*] NASA A.16 Cryospheric Science NNH17ZDA001N-CRYO
Project period: 01/01/19–05/31/22
Title: A Coupled Antarctic Cryosphere System: Linking Ice Sheet Surface Mass Balance Processes and Ocean Surface Variability Across Coastal Antarctica
Total budget: **$425,000** (my budget: $49,969)
PI: Luke Trusel, Co-Is: Jan Lenaerts, Alek Petty

[*PI*] NASA Goddard Space Flight Center Summer Internship
Project period: July–August 2020
New estimates of winter Arctic sea ice growth from ICESat-2
Total budget: summer student stipend
PI: Alek Petty, Summer Student: Nicole Keeney

[*PI*] International Arctic Science Council cross-cutting funding
Project period: June 2018
Improving our understanding of extreme events in the Arctic using a cross-disciplinary approach - a discussion group at POLAR 2018
Total budget: **$6,000**,
PI: Alek Petty, Co-Is: Thomas Armitage, Manisha Ganeshan

[*PI*] NASA Goddard Space Flight Center Summer Internship
Project period: July–August 2018
Improving sea ice predictions using novel machine learning tools
Total budget: summer student stipend
PI: Alek Petty, Summer Student: Akira Sewnath

International Arctic Science Committee (IASC) Fellow for the Cryosphere Working Group, 2016–2019 (travel award to support attendance at international planning meetings).

UK National Environment Research Council postgraduate award. Awarded to University College London, 2010–2014.

Directed (internal) funding

Funds internally awarded from the NASA GSFC/ICESat-2 PSO

NASA's ICESat-2 Project Science Office
Project period: 01/01/18-06/30/23
Personal Budget: 0.4-0.8 FTE/year
Funding contact: Nathan Kurtz (NASA ICESat-2 directed funding)

PolarMERRA
Project period: 10/01/20-04/01/22
Personal Budget: 0.2 FTE/year
Funding contact: Thorsten Markus (NASA HQ Cryospheric Sciences directed funding)

NASA's Operation IceBridge Project Science Office
Project period: 10/1/15–09/30/2021
Personal Budget: 0.2-1.0 FTE/year
Funding contact: Joseph MacGregor (Operation IceBridge directed funding)

NASA-ESA Snow On Sea Ice (NESOSI)
Project period: 10/1/17–09/31/2019
Personal Budget: 0.3 FTE/year
Funding contact: Thorsten Markus (NASA HQ Cryospheric Sciences directed funding)

Presentations

Last five years only, the starred name highlights an invited talk, see alekpetty.com/presentations for complete listing.

Petty, A. A. C. Cardinale, M. Smith, Updates to IS-2 sea ice thickness estimates and model constraint efforts, ICESat-2 Science Team meeting , October 23rd, 2024 (oral, virtual).

Petty, A. A. C. Cardinale, Updates to the ICESat-2 winter Arctic sea ice thickness product and preliminary development and assessment of a new summer ice thickness product, Cryo2Ice 2024 symposium, HARPA, Reykjavik, Iceland, Sep 23-27, 2024 (poster).

Petty, A. A. C. Cardinale, M. Smith, Improving sea ice projections with the modern-era satellite altimetry record of freeboard and thickness, EGU General Assembly 2024, Apr 18th, 2024 (oral, virtual).

Petty, A. A. C. Cardinale, M. Smith, Comparing CMIP6 sea ice simulations with the modern-era satellite altimetry record of freeboard and thickness, CLIVAR Confronting Earth System Model Trends with Observations, Mar 15th, 2024 (oral, virtual).

Petty, A. A. C. Cardinale, M. Smith, Comparing CMIP6/CESM2 sea ice simulations with the modern-era satellite altimetry record of freeboard and thickness, CESM PCWG winter workshop, Feb 5th, 2024 (oral, virtual).

***Petty, A. A**. High-resolution sea ice profiling with NASA's ICESat-2: data product updates and new data assimilation activities, NASA GISS polar climate group seminar, May 4th, 2023 (oral, virtual).

***Petty, A. A**. High-resolution sea ice profiling with NASA's ICESat-2: towards seamless sea ice altimetry DA, 11th International Workshop on Sea Ice Modelling, Assimilation, Observations, Predictions and Verification, Oslo, Norway, 23rd March 2023 (oral, virtual).

***Petty, A. A.**, New insights into polar sea ice variability from NASA's ICESat-2, U Toronto Noble seminar series, 6th February 2023 (oral, virtual, invited).

***Petty, A. A.**, New insights into Arctic sea ice variability from NASA's ICESat-2 and the CICE sea ice model, University of Reading, Reading, United Kingdom,, 6th December 2022 (oral, invited).

Petty, A. A., M. Bagnardi (presenter), N. Kurtz, R. Tilling, S. Fons, N. Keeney, A. Cabaj, P. Kushner, Winter Arctic sea ice profiling from NASA's ICESat-2: 2018-2022, Living Planet Symposium, Bonn, Germany, May 2022 (oral).

Petty, A. A., J. Harbeck, M. Bagnardi, N. Kurtz, R. Tilling, R. Kwok, New insights into floe-scale sea ice characteristics from NASA's Operation IceBridge and ICESat-2, Ocean Sciences Meeting, 4th March 2022 (oral, virtual).

***Petty, A. A.**, New insights into the polar sea ice-ocean state from NASA's ICESat-2, University of Bremen, Institute of Environmental Physics seminar series, 23rd November 2021 (oral, virtual, invited).

***Petty, A. A.**, New insights into the polar sea ice-ocean state from NASA's ICESat-2, national Snow and Ice Data Center (NSIDC) seminar series, 17th November 2021 (oral, virtual, invited).

***Petty, A. A.**, New insights into the polar sea ice-ocean state from NASA's Operation IceBridge and ICESat-2, Los Alamos Polar Climate group, 20th October 2021 (oral, virtual, invited).

***Petty, A. A.**, M. Bagnardi, E. Buckley, ICESat-2 sea ice data products, University of Washington's ICESat-2 Hackweek 2020, 12th June 2020 (oral, virtual, invited).

Petty, A. A., N. Kurtz, R. Kwok, A. Cabaj, P. Kushner, Freeboard, snow depth and ice thickness in the early winter 2018/2019 from ICESat-2 and NESOSIM, NASA-ESA Snow on Sea Ice Meeting, 28th January 2020 (oral).

***Petty, A. A.**, N. Kurtz, T. Markus, R. Kwok, T. Neumann, A. Cabaj, P. Kushner, R. Tilling, M. Bagnardi, Sea ice thickness of the Arctic Ocean from ICESat-2, AGU Fall 2019, San Francisco, USA, 13th December 2019 (oral, invited).

Petty, A. A., J. Landy, M. Tsamados, J. MacGregor, N. Kurtz, Sea ice topography from NASA's Operation IceBridge and ICESat-2, AGU Fall 2019, San Francisco, USA, 13th December 2019 (poster).

Petty, A. A., N. Kurtz, T. Markus, R. Kwok, Sea ice thickness with ICESat-2, IGS International Symposium on Sea Ice at the Interface, Winnipeg, Canada, 20th August 2019 (oral).

Petty, A. A., Snow on sea ice in models, 2019 SIMIP workshop, Winnipeg, Canada, 18th August 2019 (oral).

***Petty, A. A.**, N. Kurtz, T. Markus, R. Kwok: New estimates of Arctic sea ice thickness from NASA's ICESat-2 mission, Alfred-Wegener-Institute Helmholtz-Center for Polar and Marine Research (AWI), Potsdam, Germany, 16th July 2019 (oral, invited).

Petty, A. A., N. Kurtz, T. Markus, R. Kwok: A reconciled time series of Arctic sea ice thickness, ESA Living Planet symposium, Milan, Italy, 13th May 2019 (oral).

Petty, A. A., N. Kurtz, J. MacGregor, L. Boisvert, R. Tilling, C. Haas: Leveraging recent and upcoming NASA-ESA Cal/Val efforts to improve and reconcile the sea ice thickness record, ESA Living Planet symposium, Milan, Italy, 14th May. 2019 (poster).

***Petty, A. A.**,: Constraining recent variability and future projections of Arctic sea ice with new and improved remote sensing data, McGill University, Montreal, 29th Apr. 2019 (oral, invited).

*__Petty, A. A.__,: Polar sea ice variability and impacts on global climate, University of Maryland, College Park, MD, 27th Mar. 2019 (oral, invited).

*__Petty, A. A.__, Polar sea ice and global climate, American University Environmental Sciences undergraduate guest lecture, American University, Washington DC, 18th Feb. 2019 (oral, invited).

*__Petty, A. A.__, NESOSIM development, recent additions, and preparations for ICESat-2, NASA-ESA Snow on Sea Ice meeting, College Park, MD, 31st January 2019 (oral, invited).

__Petty, A. A__., N. Kurtz, M. Holland, D. Bailey, M. Webster, L. N. Boisvert, T. Markus Current variability and future projections of winter Arctic sea ice thickness , American Geophysical Union fall meeting, 10th December 2018, Washington, DC, USA (poster).

*__Petty, A. A__., Deriving Sea Ice Thickness from ICESat-2: From Freeboard to Thickness via Snowfall , NASA GSFC SED Director's Seminar Series, 7th September 2018 (oral, invited).

*__Petty, A. A__., Improving our understanding of polar sea ice with NASA's ICESat, Operation IceBridge, and the upcoming launch of ICESat-2 , Reading University polar science seminar series, 17th July 2018 (oral, invited).

*__Petty, A. A__., The Arctic sea ice cover of 2016: A year of record low highs and higher-than-expected lows, NASA GSFC half-year science review to center directors, 2nd July 2018 (oral, invited).

Petty, A. A., M. Webster, L. N. Boisvert, T. Markus A New Snow on Sea Ice Budget Model and Snow Depth Dataset over the Polar Oceans, POLAR 2018, 23rd June 2018, Davos, Switzerland (oral).

Graham, R., __A. A. Petty__, et al, Increasing frequency and duration of Arctic winter warming events, POLAR 2018, 22nd June 2018, Davos, Switzerland (oral, on behalf of Rob Graham).

Petty, A. A., T. Armitage, G. Manucharyan, Energetics of the Beaufort Gyre and its link to freshwater dynamics, AGU Ocean Sciences, 14th February 2018, Portland, OR, USA (oral).

__Petty, A. A__., The NASA Eulerian Snow on Sea Ice Model, NASA-ESA Snow on Sea Ice Meeting, 23rd January 2018, NASA Goddard Space Flight Center, MD, USA (oral, invited).

Petty, A. A., Precipitation, accumulation and sea ice thickness over the Arctic Ocean, NASA Goddard Climate and Radiation Lab seminar series, 17th January 2018, NASA Goddard Space Flight Center, MD, USA (oral)

Supervising

Research Scientists

- Youngmin Choi (Assistant Research Scientist), University of Maryland, Primary Supervisor: **Dr. Alek Petty**. New sea ice and ice sheet OSSE frameworks for determining ice topography science requirements from a future STV mission (2022 onwards).
- Christopher Cardinale (Postdoctoral Research Scientist), University of Maryland, Primary Supervisor: **Dr. Alek Petty**. Calibrating simulations of polar sea ice change (2023 onwards).

Support Scientists

- Marco Bagnardi (Data Scientist), NASA Goddard Space Flight Center, Primary Supervisor: Nathan Kurtz, Co-Supervisor: **Dr. Alek Petty**, Assessing ICESat-2 sea ice data (2019-2022).
- Nicole Keeney (Faculty Assistant), University of Maryland, Primary Supervisor: **Dr. Alek Petty**, New estimates of winter Arctic sea ice growth from ICESat-2 (2021-2023)
- Jesse Wimert (Scientific Software Developer), NASA Goddard Space Flight Center, Primary Supervisor: Dr. Jeff Lee. Assessing ICESat-2 sea ice data (2020-2022).
- Jeremy Harbeck (Scientific Software Developer), NASA Goddard Space Flight Center, Primary Supervisor: Dr. Joseph MacGregor, Operation IceBridge sea ice analysis (2019-2021).
- Alvaro Ivanoff (Scientific Software Developer), NASA Goddard Space Flight Center, Primary Supervisor: Dr. Joseph Macgregor, Operation IceBridge sea ice analysis (2019-2020).

PhD Students

- Alex Cabaj, University of Toronto, Primary Supervisor: Prof. Paul Kushner, Constraining snow on Arctic sea ice (2019-2023).
- Rebecca Frew, University of Reading, Primary Supervisor: Daniel L. Feltham, Sea ice and climate feedbacks in the Southern Ocean (2015-2018).
- Steven Wolbach, University of Maryland, Primary Supervisor: James L. Carton, Beaufort Gyre ice-ocean dynamics (2016, did not finish).

Masters Students

- Ryan Klasky, University of Maryland, Primary Supervisor: **Dr. Alek Petty**. Antarctic sea ice forecasting (2016-2017).
- Colton Byers, United States Naval Academy, Primary Supervisor: Dr. Joseph P. Smith, Arctic sea ice mapping using low-cost aerial drones (2016).

Visiting Students

- Alex Cabaj (PhD student), University of Toronto, Primary supervisor: Prof. Paul Kushner, Constraining snow on Arctic sea ice (2019).

Internships

- Carlo Cordes, NASA Goddard Space Flight Center, Primary Supervisor: **Dr. Alek Petty**, Improved interpolation of ICESat-2 sea ice thickness using Gaussian Process Regression (spring 2023).
- Nicole Keeney, NASA Goddard Space Flight Center, Primary Supervisor: **Dr. Alek Petty**, New estimates of winter Arctic sea ice growth from ICESat-2 (summer 2020).
- Akira Sewnath, NASA Goddard Space Flight Center, Primary Supervisor: **Dr. Alek Petty**, Arctic sea ice forecasting using novel machine learning tools (summer 2018).

Academic service

Academic committees

- ESSIC Appointment, Evaluation and Promotion (AEP) committee chair, 2023, 2024.
- ESSIC Appointment, Evaluation and Promotion (AEP) committee member, 2018, 2019, 2020, 2021, 2022.
- Alexander Mchedlishvili, mid-PhD review, University of Bremen, April 2022.

- Alex Cabaj, mid-PhD review (member of the specialty exam committee, University of Toronto, November 2021.
- Steven Fons, PhD prospectus defense (member of the specialty exam committee, University of Maryland, March 2019.

Seminar Convening
- Co-organizer of the International Glaciology Society (IGS) Sea Ice Global Seminar series (virtual monthly seminars).

Session Convening
- 'Community tools and products for Cryosphere discovery and application' session at the AGU fall 2022 meeting, Chicago, USA (co- convener, virtual).
- 'Floe-scale sea ice processes: constraints from observations and models' poster and oral session at the Ocean Sciences Meeting 2022 (primary convener, virtual).
- 'Polar Atmospheric Processes and Their Interactions with Land, Ice, and Ocean' at the AGU Fall Meeting 2018 (co-convener).

Reviewer
- Nature Climate Change, Geophysical Research Letters, Journal of Geophysical Research, Science Advances, Journal of Climate, The Cryosphere, Journal of Glaciology, IEEE, Journal of Physical Oceanography.
- Snow, Water, Ice and Permafrost in the Arctic (SWIPA) follow-up assessment.
- Intergovernmental Panel on Climate Change (IPCC) AR6 report (volunteer reviewer for sea ice chapters 2 and 9)

Proposal reviewer (external)
- NOAA's Global Ocean Monitoring & Observing (GOMO) program
- NSF's Division of Polar Programs.
- NASA's Cryospheric Sciences program.
- NASA's ICESat-2 Project Science Office.
- DOE's Earth & Environmental Systems Modeling program

Review Panels
- NASA GSFC HBG peer award panel, 2020.
- NASA Future Investigators in NASA Earth and Space Science and Technology (FINESST), 2018; National Science Foundation, Division of Polar Programs, 2015.

Previous Science Team & Working Group memberships

- Member of the NASA ICESat-2 Project Science Office, 2019-2023.
- NASA representative on the CICE Consortium, 2021–2023.
- Member of the CLIVAR Ocean Uncertainty Quantification working group, 2020–2023.
- Member of the NASA Goddard Ocean Worlds Science Exploration and Analogs (OSEAN) science task group, 2019-2020.
- Member of the NASA Operation IceBridge Project Science Office, 2015–2021.
- US delegate to the International Arctic Science Committee (IASC), 2018–2020.
- Cryosphere Working Group Early Career Fellow, International Arctic Science Committee (IASC), 2016–2019.
- Sea Ice Outlook Action Team, Sea Ice Prediction Network, 2015–2017.
- Association for Polar Early Career Scientists (APECS) member, 2011–2019.

Awards

- NASA GSFC Robert H. Goddard Award, Science Team (Operation IceBridge), 2020.
- NASA GSFC Hydrospheric and Biospheric Sciences Laboratory (HOBI) Award for outstanding scientific achievement, 2019.
- American Geophysical Union Fall meeting Outstanding Student Paper Award (OSPA) in the Cryosphere section, 2011.

Workshop Organizing

- CICE Consortium user workshop, Santa Fe, June 2024 (co-organizer).
- University of Washington's NASA ICESat-2 (virtual) hackweek, University of Washington, Seattle, 10th-24th June 2020 (tutor, funded).
- University of Washington's NASA ICESat-2 hack week, University of Washington, Seattle, 17th-21st June 2019 (tutor, funded).
- Improving our understanding of extreme events in the Arctic using a cross-disciplinary approach, focus group discussion at POLAR 2018, Davos, Switzerland, 20th–23rd June 2018 (organizer, funded workshop).

Teaching experience

- Tutor and hackweek instructor at the 'University of Washington's ICESat-2 hack week' pro- viding support to the sea ice participants regarding data retrieval and analysis, University of Washington, June 2019 and June 2020.
- Guest lecture on 'Polar sea ice and global climate' for the Environmental Sciences, American University, Feb., 2019.
- Guest lecture on 'Polar sea ice and the global climate system' for the Department of Atmo- spheric and Oceanic Science, University of Maryland, Apr., 2018.
- Guest teacher on 'Polar Science at NASA' for K7 and K12 students, Sitka Alaska, Oct., 2017.
- MADE CLEAR climate change scientific expert - providing advice to K-12 teachers in Maryland/Delaware. Contributed to the new Climate Change Learning Progression draft, 2015-2017.
- Python for Cryospheric Sciences monthly meet-up organizer, NASA Goddard Space Flight Center.
- ASPIRE after school course, The Melting Planet, City & Islington College, London, UK on climate change and the polar regions (6 weekly lessons).
- UCL Earth Sciences GEOL 3039 course 'Physics of Oceans, Ice Sheets & Climate', teaching assistant, 2011–2013.
- UCL Earth Sciences GEOL 1006 course 'Foundations of Physical Geoscience', teaching assistant, 2011–2013 .
- UCL Earth Sciences undergraduate mathematics tutor, 2011–2013.

Workshop Attendance

- European Center for Medium-Range Weather Forecasting (ECMWF) NWP Training course: Predictability and ensemble forecast systems, ECMWF, Reading, UK (Nov 27 - Dec 1st 2023).
- NASA GSFC Mission Concept Development Workshop 2022 (January 2022, virtual).

Field experience

- NASA's Operation IceBridge Antarctic campaign, Nov. 2016.
  Role: Science advisor, outreach.
- Joint Ocean Ice Study (JOIS)/Beaufort Gyre Exploration Project (BGEP) Arctic research expedition, 20th Sep.–19th Oct. 2016.
  Role: On-ice lead scientist (ice cores, thickness transects), ship-based sea ice observations.
- NASA's Operation IceBridge spring Arctic campaign, Apr. 2016,
  Role: Science advisor, outreach.
- Joint Ocean Ice Study (JOIS)/Beaufort Gyre Exploration Project (BGEP) Arctic research expedition, 12th Sep.–14th Oct. 2014.
  Role: On-ice scientist (ice cores, thickness transects), ship-based sea ice observations.

Media & public outreach

Please see www.alekpetty.com/media for a list of media articles my work has been cited in and/or I have contributed quotes to.