



THE UNIVERSITY OF CHICAGO

DORIAN SCHUYLER ABBOT
THE UNIVERSITY OF CHICAGO
GEOPHYSICAL SCIENCES
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Research Focus

I use low-order mathematical models and complex numerical models to understand climate, paleoclimate, planetary habitability, planetary dynamics, and exoplanets.

Positions

2015-Present	Associate Prof	Geophysical Sciences	U. of Chicago
2011-2015	Assistant Prof	Geophysical Sciences	U. of Chicago

Education

2009-2011	Postdoc	Geophysical Sciences	U. of Chicago
2008-2009	Postdoc	Earth and Planet. Sci.	Harvard
2008	PhD	Applied Mathematics	Harvard
2004	S.M.	Applied Mathematics	Harvard
2004	A.B.	Physics	Harvard

Science Family

Advisor

◦Eli Tziperman

Postdocs

◦Mark Hammond	2020-2021	“Hot Jupiter weather”
◦Stephanie Olson	2018-2020	“Exoplanet oceanography”
◦Tad Komacek	2018-2020	“Clouds on terrestrial exoplanets”
◦Jun Yang	2012-15	“M-star planet habitability”
◦Yi-Ping Ma	2011-13	“Mathematics of climate”

PhD Students

◦Xuan Ji	ex. 2025	“Binary Star Habitability”
◦Huazhou Yang	ex. 2024	“Cloud microphysics on terrestrial exoplanets”
◦Jade Checlair	ex. 2021	“Statistical approach to exoplanet habitability”
◦Navah Farahat	2020	“Numerical models for a better understanding of

		off-axis hydrothermal systems”
○Predrag Popović	2020	“Idealized models of Arctic sea ice melt ponds”
○Jonah Bloch-Johnson	2018	“Climate feedback temperature dependence”
○David Plotkin	2018	“Rare events in weather and climate”
○Daniel Koll	2016	“Dry atmospheric circulations on rocky exoplanets”

MS Students

○Nathan Baskin	2016	“The effect of forced orbital evolution on planetary habitability”
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Undergraduates

○Runxin Ni	2020	“Pacific typhoons in WRF”
○James Butler	2020	“Sudden stratospheric warming”
○Yixiao Zhang	2020	“Applying Roms equilibration to ExoCAM”
○Hang Luo	2019	“Warm Jupiters”
○Jeffrey Yang	2018	“Tidally locked runaway greenhouse”
○Andrea Salazar	2018-20	“Tidally locked snowball planets”
○Olivia Alcabes	2018-20	“Gaia hypothesis investigation”
○Francisco Spaulding-Astudillo	2017-18	“Global glaciation and thick ice flow”
○R.J. Graham	2016-18	“Snowball Earth stratospheric circulation”
○Sean Mills	2011-12	“Weak temperature gradient approximation for tidally locked planets”

Courses Taught

Global Warming (Undergraduate Core Program)

Radiative Transfer (Undergraduate+Graduate)

The Atmosphere (Undergraduate)

Fundamentals of Geophysical Fluid Dynamics (Graduate)

What makes a planet habitable? (Undergraduate+Graduate)

Mathematical Methods for Earth Science (Graduate)

Topics in Atmospheric Science (Graduate)

Publications

<https://scholar.google.com/citations?user=UqDnxT0AAAAJ&hl=en>

Checlair, J.H., Villanueva, G.L., Hayworth, B.P., Olson, S.L., Komacek, T.D., Robinson, T.D., Popovic, P., Yang, H. and Abbot, D.S. (2021). Probing the capability of future direct imaging missions to spectrally constrain the frequency of Earth-like planets. *The Astrophysical Journal*, 161:150.

Finkel, J., D.S. Abbot, J. Weare (2020), Path properties of atmospheric transitions: illustration with a low-order sudden stratospheric warming model, *Journal of the Atmospheric Sciences*, 77(7), 2327-2347.

Salazar, A.M., S.L. Olson, T.D. Komacek, H. Stephens, D.S. Abbot (2020), The Effect of Substellar Continent Size on Ocean Dynamics of Proxima Centauri b, *The Astrophysical Journal Letters*, 896 (1), L16.

Komacek, T.D., D.R. Chavas, and D.S. Abbot (2020), Hurricane genesis is favorable on terrestrial exoplanets orbiting late-type M dwarf stars, *Astrophysical Journal*, 898:115.

Olson, S.L., M. Jansen, and D.S. Abbot (2020), Oceanographic Constraints on Exoplanet Life, *Astrophysical Journal*, 895:19.

Popović, P., M. Silber, and D.S. Abbot (2020), Critical percolation threshold restricts late-summer Arctic sea ice melt pond coverage, *Journal of Geophysical Research*, 125, e2019JC016029.

Popović, P., J. Finkel, M. Silber, and D.S. Abbot (2020), Snow topography on undeformed Arctic sea ice captured by an idealized “snow dune” model, *Journal of Geophysical Research*, 125, e2019JC016034.

Bloch-Johnson, J., M.A.A. Rugenstein, D.S. Abbot (2020), Spatial radiative feedbacks from interannual variability using multiple regression, *Journal of Climate*, 33(10), 4121-4140.

Komacek, T.D., T.J. Fauchez, E.T. Wolf, and D.S. Abbot (2020), Clouds will likely prevent the detection of water vapor in JWST transmission spectra of terrestrial exoplanets, *Astrophysical Journal Letters*, 888:L20.

Alcabes, O.D.N., S. Olson, and D.S. Abbot (2020), Typical Climate Perturbations Unlikely to Disrupt Gaia Hypothesis, *Monthly Notices of the Royal Astronomical Society*, 492(2), 2572–2577.

Graham, R.J., T.A. Shaw, and D.S. Abbot (2019), The Snowball Stratosphere, *Journal of Geophysical Research*, 124, 11,819–11,836.

Checlair, J.H., S.L. Olson, and D.S. Abbot (2019), No snowball on habitable tidally locked planets with a dynamic ocean, *Astrophysical Journal Letters*, 884:L46.

Checlair, J.H., A.M. Salazar, A. Paradise, K. Menou, and D.S. Abbot (2019), No snowball cycles at the outer edge of the Habitable Zone for habitable tidally locked planets, *Astrophysical Journal Letters*, 887:L3.

Komacek T.D., M.F. Jansen, E.T. Wolf, and D.S. Abbot (2019), Scaling Relations for Terrestrial Exoplanet Atmospheres from Baroclinic Criticality, *Astrophysical Journal*, 883:1.

Webber, R.J., D.A. Plotkin, M.E. O'Neill, D.S. Abbot, and J. Weare (2019), Practical rare event sampling for extreme mesoscale weather, *Chaos*, 29 (5), 053109.

Koll, D.D., M. Malik, M. Mansfield, E. M. R. Kempton, E. Kite, D. Abbot, and J. L. Bean (2019), Identifying Candidate Atmospheres on Rocky M Dwarf Planets via Eclipse Photometry, *Astrophysical Journal*, 886(2), 140.

Yang, H., T.D. Komacek, and D.S. Abbot (2019), Effects of Radius and Gravity on the Inner Edge of the Habitable Zone, *Astrophysical Journal Letters*, 876 (2), L27.

Plotkin, D.A., R.J. Webber, M.E. O'Neill, J. Weare, and D.S. Abbot (2019), Maximizing simulated tropical cyclone intensity with action minimization, *Journal of Advances in Modeling Earth Systems*, 11 (4), 863-891.

Yang, J., J. Leconte, E.T. Wolf, T. Merlis, D.D.B. Koll, F. Forget, and D.S. Abbot (2019), Simulations of Water Vapor and Clouds on Rapidly Rotating and Tidally Locked Planets: A 3D Model Intercomparison, *Astrophysical Journal*, 875 (1), 46.

Komacek, T.D. and D.S. Abbot (2019), The Atmospheric Circulation and Climate of Terrestrial Planets Orbiting Sun-like and M Dwarf Stars over a Broad Range of Planetary Parameters, *Astrophysical Journal*, 871:245.

Yang, J., D.S. Abbot, D.D.B. Koll, Y. Hu, and A.P. Showman (2019), Ocean Dynamics and the Inner Edge of the Habitable Zone for Tidally Locked Terrestrial Planets, *Astrophysical Journal*, 871:29.

Abbot, D.S., J. Bloch-Johnson, J. Checlair, N.X. Farahat, R.J. Graham, D. Plotkin, P. Popović, and F. Spaulding-Astudillo (2018), Decrease in hysteresis of planetary climate for planets with long solar days, *Astrophysical Journal*, 854:3.

Popović, P., B.B. Cael, Mary Silber, and D.S. Abbot (2018), Simple rules govern the patterns of Arctic sea ice melt ponds, *Physical Review Letters*, 120, 148701.

Bean, J.L., D.S. Abbot and E. M.-R. Kempton (2017), A Statistical Comparative Planetology Approach to the Hunt for Habitable Exoplanets and Life Beyond the Solar System, *Astrophysical Journal*, 841:L24.

Checlair, J., K. Menou, and D.S. Abbot (2017), No snowball on habitable tidally locked planets, *Astrophysical Journal*, 845:132.

Farahat, N.X., D. Archer, and D.S. Abbot (2017), Validation of the BASALT model for simulating off-axis hydrothermal circulation in oceanic crust, *Journal of Geophysical Research*, 122, 5871-5889.

Popović, P. and D.S. Abbot (2017), A simple model for the evolution of melt pond coverage on permeable Arctic sea ice, *The Cryosphere*, 11, 1149-1172.

Yang, J., M.F. Jansen, F.A. MacDonald, and D.S. Abbot (2017), Persistence of A Surface Freshwater Ocean After A Snowball Earth, *Geology*, 45(7), 615–618.

Hoffman, P.F., D.S. Abbot, Y. Ashkenazy, D.I. Benn, J.J. Brocks, P.A. Cohen, G.M. Cox, J.R. Creveling, Y. Donnadieu, D.H. Erwin, I.J. Fairchild, D. Ferreira, J.C. Goodman, G.P. Halverson, M.F. Jansen, G. Le Hir, G.D. Love, F.A. Macdonald, A.C. Maloof, C.A. Partin, G. Ramstein, B.E.J. Rose, C.V. Rose, P.M. Sadler, E. Tziperman, A. Voigt, and S.G. Warren (2017), Climate dynamics of Snowball Earth and Cryogenian geology-geobiology, *Science Advances*, 3:e1600983.

Komacek, T.D. and D.S. Abbot (2016), Effect of surface-mantle water exchange parameterizations on exoplanet ocean depths, *Astrophysical Journal*, 832, 54.

Abbot, D.S. (2016), Analytical investigation of the decrease in the size of the habitable zone due to limited CO₂ outgassing rate, *Astrophysical Journal*, 827, 117.

Yang, J., J. Leconte, E.T. Wolf, C. Goldblatt, N. Feldl, T. Merlis, Y. Wang, D.D.B. Koll, F. Ding, F. Forget, and D.S. Abbot (2016), Differences in water vapor radiative transfer among 1D models can significantly affect the inner edge of the habitable zone, *Astrophysical Journal*, 826, 222.

Koll, D.D.B., and D.S. Abbot (2016), Temperature Structure and Atmospheric Circulation Strength of Tidally Locked Rocky Exoplanets, *Astrophysical Journal*, 825, 99.

Hill, K., D.S. Abbot, and M. Silber (2016), Analysis of an Arctic sea ice loss model in the limit of a discontinuous albedo, *SIAM Journal on Applied Dynamical Systems*, 15(2), 1163-1192.

Abbot, D.S. (2015), A proposal for climate stability on H₂-greenhouse planets, *Astrophysical Journal Letters*, 815, L3.

Bloch-Johnson, J., R.T. Pierrehumbert, and D.S. Abbot (2015), Feedback Temperature Dependence Determines the Risk of High Warming, *Geophysical Research Letters*, 43(12), 4973–4980.

Koll, D.D.B. and D.S. Abbot (2015), Deciphering Thermal Phase Curves of Dry, Tidally Locked Terrestrial Planets, *Astrophysical Journal*, 802, 21.

Yang, J., Y. Liu, Y. Hu, and D.S. Abbot (2014), Water Trapping on Tidally Locked Terrestrial Planets Requires Special Conditions, *Astrophysical Journal Letters*, 796, L22.

Plotkin, D.A., J. Weare, and D.S. Abbot (2014), Distinguishing meanders of the Kuroshio using machine learning, *Journal of Geophysical Research*, 119, 6593–6604.

Arnold, N.P., M. Branson, M.A. Burt, D.S. Abbot, Z. Kuang, D.A. Randall, E. Tziperman (2014), The effects of explicit atmospheric convection at high CO₂, *Proceedings of the National Academy of Sciences*, 111(30), 10943–10948.

Yang, J., G. Boue, D.C. Fabrycky, and D.S. Abbot (2014), Strong Dependence of the Inner Edge of the Habitable Zone on Planetary Rotation Rate, *Astrophysical Journal Letters*, 787, L2.

Abbot, D.S. (2014), Resolved Snowball Earth Clouds, *Journal of Climate*, 27(12), 4391–4402.

Yang, J. and D.S. Abbot (2014), A Low-order Model of Water Vapor, Clouds, and Thermal Emission of Tidally Locked Terrestrial Planets, *Astrophysical Journal*, 784, 155.

Cowan, N.B. and D.S. Abbot (2014), Water cycling between ocean and mantle: super-Earths need not be waterworlds, *Astrophysical Journal*, 781, 27.

Cathles, L.M., D.S. Abbot, and D.R. MacAyeal (2014), Intra-surface radiative transfer limits the geographic extent of snow penitentes on horizontal snow fields, *Journal of Glaciology*, 60, 147–154.

Rodehacke, C.B., A. Voigt, F. Ziemer, and D.S. Abbot (2013), An open ocean region in Neoproterozoic glaciations would have to be narrow to allow equatorial ice sheets, *Geophysical Research Letters*, 40, 5503–5507.

Mills, S.M. and D.S. Abbot (2013), Utility of the Weak Temperature Gradient Approximation for Earth-like Tidally Locked Exoplanets, *Astrophysical Journal Letters*, 774, L17.

Koll, D.D.B. and D.S. Abbot (2013), Why Tropical Sea Surface Temperature is Insensitive to Ocean Heat Transport Changes, *Journal of Climate*, 26, 6742–6749.

Yang, J., N.B. Cowan, and D.S. Abbot (2013), Stabilizing Cloud Feedback Dramatically Expands the Habitable Zone of Tidally Locked Planets, *Astrophysical Journal Letters*, 771, L45.

Abbot, D.S., A. Voigt, D. Li, G. Le Hir, R.T. Pierrehumbert, M. Branson, D. Pollard, and D.D.B. Koll (2013), Robust elements of Snowball Earth atmospheric circulation and oases for life, *Journal of Geophysical Research*, 118, 6017-6027.

Voigt, A. and D.S. Abbot (2012), Sea-ice dynamics strongly promote Snowball Earth initiation and destabilize tropical sea-ice margins, *Climate of the Past*, 8, 2079-2092.

Farrell, B.F. and D.S. Abbot (2012), A Mechanism for Dust-Induced Destabilization of Glacial Climates, *Climate of the Past*, 8, 2061-2067.

Abbot, D.S., A. Voigt, M. Branson, R.T. Pierrehumbert, D. Pollard, G. Le Hir, D.D.B. Koll (2012), Clouds and Snowball Earth Deglaciation, *Geophysical Research Letters*, 39, L20711.

Cowan, N.B., A. Voigt, and D.S. Abbot (2012), Thermal phases of exoplanets: Disentangling eccentricity, obliquity, and climate, *Astrophysical Journal*, 757, 80.

Abbot, D.S., N.B. Cowan, and F.J. Ciesla (2012), Indication of insensitivity of planetary weathering behavior and habitable zone to surface land fraction, *Astrophysical Journal*, 756, 178.

Leibowicz, B.D., D.S. Abbot, K.A. Emanuel, and E. Tziperman (2012), Correlation between present-day model simulation of Arctic cloud radiative forcing and sea ice consistent with positive winter convective cloud feedback, *Journal of Advances in Modeling Earth Systems*, 4, M07002.

Cowan, N.B., D.S. Abbot, and A. Voigt (2012), A false positive for ocean glint on exoplanets: the latitude-albedo effect, *Astrophysical Journal Letters*, 752, L3.

Tziperman, E., D.S. Abbot, Y. Ashkenazy, H. Gildor, D. Pollard, C.G. Schoof, and D.P. Schrag (2012), Continental constriction and oceanic ice-cover thickness in a Snowball-Earth scenario, *Journal of Geophysical Research*, *Journal of Geophysical Research*, 117, C05016.

Burton, J.C., J.M. Amundson, D.S. Abbot, A. Boghosian, L. Mac. Cathles, S. Correa-Legisos, K.N. Darnell, N. Guttenberg, D.M. Holland, and D.R. MacAyeal (2012), Laboratory investigations of iceberg-capsize dynamics, energy dissipation and tsunamigenesis, *Journal of Geophysical Research*, 117, F01007.

Abbot, D.S., M. Silber, and R.T. Pierrehumbert (2011), Bifurcations Leading to Summer Arctic Sea Ice Loss, *Journal of Geophysical Research*, 116, D19120.

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Guttenberg, N., D.S. Abbot, J.M. Amundson, J.C. Burton, L.M. Cathles, D.R. MacAyeal, and W.W. Zhang (2011), A computational investigation of iceberg capsizes as a driver of explosive ice-shelf disintegration, *Annals of Glaciology*, 52(59), 51–59.

Abbot, D.S. and E.R. Switzer (2011), The Steppenwolf: A proposal for a habitable planet in interstellar space, *Astrophysical Journal*, 735:L27.

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MacAyeal, D.R., D.S. Abbot, and O.V. Sergienko (2011), Iceberg capsize tsunamigenesis, *Annals of Glaciology*, 52(58), 51–56.

Voigt, A., D.S. Abbot, R.T. Pierrehumbert, and J. Marotzke (2011), Initiation of a Marinoan Snowball Earth in a state-of-the-art atmosphere-ocean general circulation model, *Climate of the Past*, 7, 249-263.

Abbot, D.S., I. Eisenman, and R.T. Pierrehumbert (2010), The Importance of Ice Resolution for Snowball Climate and Deglaciation, *Journal of Climate*, 23(22), 6100-6109.

Abbot, D.S. and I. Halevy (2010), Dust Aerosol Important for Snowball Earth Deglaciation, *Journal of Climate*, 23(15), 4121-4132.

Abbot, D.S., and R.T. Pierrehumbert (2010), Mudball: Surface dust and Snowball Earth deglaciation, *Journal of Geophysical Research*, 115, D03104.

Abbot, D.S., C.C. Walker, and E. Tziperman (2009), Can a convective cloud feedback help to eliminate winter sea ice at high CO₂ concentrations? *Journal of Climate*, 22(21), 5719–5731.

Abbot, D.S., M. Huber, G. Bousquet, and C.C. Walker (2009), High-CO₂ Cloud Radiative Forcing Feedback over both Land and Ocean in a Global Climate Model, *Geophysical Research Letters*, 36, L05702.

Crouch, R.C. and D.S. Abbot (2009), Is Green Education Blue or Red? State-level Environmental Education Program Development through the Lens of Red- and Blue-State Politics, *Journal of Environmental Education*, 40(3), 52–62.

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