



# 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, the cryosphere, planetary habitability, 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*

◦Stephanie Olson	2018-	“3D ozone calculations for ancient Earth and exoplanets”
◦Tad Komacek	2018-	“The effects of clouds on the atmospheres of terrestrial exoplanets”
◦Jun Yang	2012-15	“M-star planet habitability”
◦Yi-Ping Ma	2011-13	“Mathematics of climate”

### *PhD Students*

◦Haynes Stephens	ex. 2023	“Exoplanet and habitability fun”
◦Jade Checlair	ex. 2021	“Statistical approach to exoplanet habitability”
◦Predrag Popović	ex. 2019	“Fractal behavior of sea ice melt ponds”

- Jonah Bloch-Johnson ex. 2018 “Climate feedback temperature dependence”
- Navah Farahat ex. 2018 “Climate and seafloor weathering”
- 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”

### *Undergraduates*

- Jeffrey Yang 2018 “Tidally locked runaway greenhouse”
- Andrea Salazar 2018- “Tidally locked snowball planets”
- Olivia Alcabes 2018- “Gaia 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**

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>

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 CO<sub>2</sub> 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 H<sub>2</sub>-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 CO<sub>2</sub>, *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.

Abbot, D.S., A. Voigt, and D. Koll (2011), The Jormungand Global Climate State and Implications for Neoproterozoic Glaciations, *Journal of Geophysical Research*, 116, D18103.

Cathles, L.M., D.S. Abbot, J.N. Bassis, D.R. MacAyeal (2011), Modeling surface-roughness/solar-ablation feedback: Application to small-scale surface channels and crevasses of the Greenland Ice Sheet, *Annals of Glaciology*, 52(59), 99–108.

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.

Pierrehumbert, R.T., D.S. Abbot, A. Voigt, and D. Koll (2011), Climate of the Neoproterozoic, *Annual Review of Earth and Planetary Sciences*, 39, 417-60.

MacAyeal, D.R., D.S. Abbot, and O.V. Sergienko (2011), Iceberg capsizing and 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 CO<sub>2</sub> concentrations? *Journal of Climate*, 22(21), 5719–5731.

Abbot, D.S., M. Huber, G. Bousquet, and C.C. Walker (2009), High-CO<sub>2</sub> 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.

Abbot, D.S. and E. Tziperman (2009), Controls on the Activation and Strength of a High Latitude Convective Cloud Feedback, *Journal of the Atmospheric Sciences*, 66(2), 519–529.

Abbot, D.S. (2008), A High-Latitude Convective Cloud Feedback, PhD Thesis, advised by Eli Tziperman, Harvard University, Cambridge, MA.

Abbot, D.S. and E. Tziperman (2008), Sea Ice, High Latitude Convection, and Equable Climates, *Geophysical Research Letters*, 35(3), L03702.

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Abbot, D.S. and K.A. Emanuel (2007), A Tropical and Subtropical Land-Sea-Atmosphere Drought Oscillation Mechanism, *Journal of the Atmospheric Sciences*, 64(12), 4458–4466.

Palmer, P. I., D.S. Abbot, et al. (2006), Quantifying the seasonal and interannual variability of North American isoprene emissions using satellite observations of formaldehyde column, *Journal of Geophysical Research*, 111(D12), D12315.

Shim, C., Y. Wang, Y. Choi, P. I. Palmer, D.S. Abbot, and K. Chance (2005), Constraining global isoprene emissions with GOME formaldehyde column measurements, *Journal of Geophysical Research*, 110(D24), D24301.

Abbot, D.S., P. I. Palmer, R. V. Martin, K. V. Chance, D. J. Jacob, and A. Guenther (2003), Seasonal and interannual variability of isoprene emissions as determined by formaldehyde column measurements from space, *Geophysical Research Letters*, 30(17), 1886.