

Dr. Joshua Laughner
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Education:

University of California, Berkeley; Berkeley, CA, USA Aug 2018
Ph.D., Chemistry
Concentrations: atmospheric chemistry, physical chemistry
Dissertation: Space-based constraints on NO_x emissions and lifetime using high-resolution NO₂ retrievals

The Pennsylvania State University; University Park, PA, USA May 2013
The Schreyer Honors College With Highest Distinction
B.S. Chemistry with Honors
Thesis: Synthesis and Transport Studies of a Delivery Mechanism for Oxidative In-Situ Remediation of Groundwater

B.M. Music Composition with Honors
Thesis: Virtual Evolving and Self-Producing Rapid Audio (V.E.S.P.R.A.)

Selected Research Experience:

Jet Propulsion Laboratory, NASA Oct 2021–present
Algorithm development for remote sensing of greenhouse gases and air pollutants.

Wennberg Group, Caltech Oct 2018–Oct 2021
Retrieval development for TCCON.

Cohen Research Lab, UC Berkeley Oct 2013–Oct 2018
NO₂ remote sensing retrieval development and space-based NO_x emissions and lifetime constraints. Developer on the BEHR retrieval (<http://behr.cchem.berkeley.edu/>).

Mallouk Research Group, Penn State June 2012–May 2013
Development of oxidative groundwater remediation using peroxide microcapsules

Merck Pharmaceuticals (Internship), Danville, PA, USA June 2011–Aug 2011
Process optimization of crystal size for product yield and purity at the Danville, PA site

Curriculum development research w/ Dr. Katherine Masters, Penn State Jan 2011–Dec 2012
Design of new curriculum for honors organic chemistry lab course

Cherokee Pharmaceuticals (Internship), Danville, PA, USA June 2010–Aug 2010
Study of the effect of antisolvent addition on product yield and purity

Awards and service positions:

- Total Carbon Column Observing Network (TCCON) Deputy Algorithm Co-Chair, Apr 2020–present.
- Ancillary data subgroup lead, Keck Institute for Space Studies Virtual Workshop, “COVID-19: Identifying Unique Opportunities for Earth System Science,” Apr 2020–present.
- NASA ROSES review panel
- Reviewer for Atmos. Meas. Tech., Atmos. Chem. Phys., and Geophys. Res. Lett.

- NASA Earth and Space Science Fellowship, 2014–2017.
- Teas Scholarship, Penn State Department of Chemistry, 2012.
- 3M Fellowship, Penn State, 2012.

Publications:

- J. L. Laughner**, A. Andrews, S. Roche, M. Kiel, G. Toon, D. Wunch, B. Baier, S. Biraud, H. Chen, R. Kivi, T. Laemmle, P.-Y. Quéhé, C. Rousogonous, and P. O. Wennberg (2022). “A new algorithm to generate a priori trace gas profiles for the GGG2020 retrieval algorithm”. *in prep. (manuscript available on request)*
- J. L. Laughner**, G. C. Toon, D. Wunch, S. Roche, J. Mendonca, M. Kiel, C. M. Roehl, C. Petri, and P. O. Wennberg (2022). “The Total Carbon Column Observing Network’s GGG2020 Data Version”. *Earth Sys. Sci. Data* (in prep)
- Q. Zhu, **J. L. Laughner**, and R. C. Cohen (2022b). “Estimate of OH Trends over One Decade in North American Cities”. *PNAS* (in press)
- Q. Zhu, **J. L. Laughner**, and R. C. Cohen (2022a). “Combining Machine Learning and Satellite Observations to Predict Spatial and Temporal Variation of near Surface OH in North American Cities”. *Environ. Sci. Technol.* DOI: 10.1021/acs.est.1c05636
- J. L. Laughner**, J. L. Neu, D. Schimel, P. O. Wennberg, K. Barsanti, K. W. Bowman, A. Chatterjee, B. E. Croes, H. L. Fitzmaurice, D. K. Henze, J. Kim, E. A. Kort, Z. Liu, K. Miyazaki, A. J. Turner, S. Anenberg, J. Avise, H. Cao, D. Crisp, J. de Gouw, A. Eldering, J. C. Fyfe, D. L. Goldberg, K. R. Gurney, S. Hasheminassab, F. Hopkins, C. E. Ivey, D. B. A. Jones, J. Liu, N. S. Lovenduski, R. V. Martin, G. A. McKinley, L. Ott, B. Poulter, M. Ru, S. P. Sander, N. Swart, Y. L. Yung, and Z.-C. Zeng (2021). “Societal shifts due to COVID-19 reveal large-scale complexities and feedbacks between atmospheric chemistry and climate change”. *PNAS* 118.46. DOI: 10.1073/pnas.2109481118
- S. Roche, K. Strong, D. Wunch, J. Mendonca, C. Sweeney, B. Baier, S. C. Biraud, **J. L. Laughner**, G. C. Toon, and B. J. Connor (2021). “Retrieval of atmospheric CO₂ vertical profiles from ground-based near-infrared spectra”. *Atmos. Meas. Tech.* 14.4, pp. 3087–3118. DOI: 10.5194/amt-14-3087-2021
- A. Müller, H. Tanimoto, T. Sugita, T. Machida, S. Nakaoka, P. K. Patra, **J. Laughner**, and D. Crisp (2021). “New approach to evaluate satellite-derived XCO₂ over oceans by integrating ship and aircraft observations”. *Atmos. Chem. Phys.* 21.10, pp. 8255–8271. DOI: 10.5194/acp-21-8255-2021
- T. E. Taylor, A. Eldering, A. Merrelli, M. Kiel, P. Somkuti, Ce. Cheng, R. Rosenberg, B. Fisher, D. Crisp, R. Basilio, M. Bennett, D. Cervantes, A. Chang, L. Dang, C. Frankenberg, V. R. Haemmerle, G. R. Keller, T. Kurosu, **J. L. Laughner**, R. Lee, Y. Marchetti, R. R. Nelson, C. W. O’Dell, G. Osterman, R. Pavlick, C. Roehl, R. Schneider, G. Spiers, C. To, C. Wells, P. O. Wennberg, A. Yelamanchili, and S. Yu (2020). “OCO-3 early mission operations and initial (vEarly) XCO₂ and SIF retrievals”. *Rem. Sens. Environ.* 251, p. 112032. ISSN: 0034-4257. DOI: <https://doi.org/10.1016/j.rse.2020.112032>
- J. Lapierre, **J. Laughner**, J. Geddes, W. Koshack, R. Cohen, and S. Pusede (2020). “Observing regional variability in lightning NO₂ production rates”. *J. Geophys. Res. Atmos.* 125, e2019JD031362. DOI: 10.1029/2019JD031362
- J. L. Laughner** and R. C. Cohen (2019). “Direct observation of changing NO_x lifetime in North American cities”. *Science* 366, pp. 723–727. DOI: 10.1126/science.aax6832
- Q. Zhu, **J. L. Laughner**, and R. C. Cohen (2019). “Lightning NO₂ simulation over the contiguous US and its effects on satellite NO₂ retrievals”. *Atmos. Chem. Phys.* 19.20, pp. 13067–13078. DOI: 10.5194/acp-19-13067-2019
- R. F. Silvern, D. J. Jacob, L. J. Mickley, M. P. Sulprizio, K. R. Travis, E. A. Marais, R. C. Cohen, **J. L. Laughner**, S. Choi, J. Joiner, and L. N. Lamsal (2019). “Using satellite observations of tropospheric NO₂ columns to infer long-term trends in US NO_x emissions: the importance of accounting for the free tropospheric NO₂ background”. *Atmos. Chem. Phys.* 19.13, pp. 8863–8878. DOI: 10.5194/acp-19-8863-

- J. L. Laughner**, Q. Zhu, and R. Cohen (2019). “Evaluation of version 3.0B of the BEHR OMI NO₂ product”. *Atmos. Meas. Tech.* 12, pp. 129–146. DOI: 10.5194/amt-12-129-2019
- J. L. Laughner**, Q. Zhu, and R. C. Cohen (2018). “The Berkeley High Resolution Tropospheric NO₂ Product”. *Earth System Science Data* 10, pp. 2069–2095. DOI: 10.5194/essd-10-2069-2018
- R. F. Silvern, D. J. Jacob, K. R. Travis, T. Sherwen, M. J. Evans, R. C. Cohen, **J. L. Laughner**, S. R. Hall, K. Ullmann, J. D. Crouse, P. O. Wennberg, J. Peischl, and I. B. Pollack (2018). “Observed NO/NO₂ Ratios in the Upper Troposphere Imply Errors in NO-NO₂-O₃ Cycling Kinetics or an Unaccounted NO_x Reservoir”. *Geophys. Res. Lett.* 45, pp. 4466–4474. DOI: 10.1029/2018GL077728
- J. L. Laughner** and R. C. Cohen (2017). “Quantification of the effect of modeled lightning NO₂ on UV-visible air mass factors”. *Atmos. Meas. Tech.* 10, pp. 4403–4419. DOI: 10.5194/amt-10-4403-2017
- B. A. Nault, **J. L. Laughner**, P. J. Wooldridge, J. D. Crouse, J. Dibb, G. Diskin, J. Peischl, J. R. Podolske, I. B. Pollack, T. B. Ryerson, E. Scheuer, P. O. Wennberg, and R. C. Cohen (2017). “Lightning NO_x Emissions: Reconciling Measured and Modeled Estimates With Updated NO_x Chemistry”. *Geophys. Res. Lett.* 44, pp. 9479–9488. DOI: 10.1002/2017GL074436
- J. L. Laughner**, A. Zare, and R. C. Cohen (2016). “Effects of daily meteorology on the interpretation of space-based remote sensing of NO₂”. *Atmos. Chem. Phys.* 16.23, pp. 15247–15264. DOI: 10.5194/acp-16-15247-2016
- K. R. Travis, D. J. Jacob, J. A. Fisher, P. S. Kim, E. A. Marais, L. Zhu, K. Yu, C. C. Miller, R. M. Yantosca, M. P. Sulprizio, A. M. Thompson, P. O. Wennberg, J. D. Crouse, J. M. St. Clair, R. C. Cohen, **J. L. Laughner**, J. E. Dibb, S. R. Hall, K. Ullmann, G. M. Wolfe, I. B. Pollack, J. Peischl, J. A. Neuman, and X. Zhou (2016). “Why do models overestimate surface ozone in the Southeast United States?” *Atmos. Chem. Phys.* 16.21, pp. 13561–13577. DOI: 10.5194/acp-16-13561-2016
- S. E. Pusede, K. C. Duffey, A. A. Shusterman, A. Saleh, **J. L. Laughner**, P. J. Wooldridge, Q. Zhang, C. L. Parworth, H. Kim, S. L. Capps, L. C. Valin, C. D. Cappa, A. Fried, J. Walega, J. B. Nowak, A. J. Weinheimer, R. M. Hoff, T. A. Berkoff, A. J. Beyersdorf, J. Olson, J. H. Crawford, and R. C. Cohen (2016). “On the effectiveness of nitrogen oxide reductions as a control over ammonium nitrate aerosol”. *Atmos. Chem. Phys.* 16.4, pp. 2575–2596. DOI: 10.5194/acp-16-2575-2016

Selected presentations:

- Laughner, J.L.** (1 Mar 2021) *NO_x lifetime and background concentrations during the COVID-19 pandemic: a first look from TROPOMI (invited)*. Virtual talk for the National Center for Atmospheric Research: Atmospheric Chemistry Observations and Modeling group seminar series.
- Laughner, J.L.**, Croes, B., Gentemann, G., Crichton, D., Chatila, I. (8 Dec 2020) *The COVID-19 Atmospheric Ancillary Data Portal (invited)*. Virtual talk at the AGU 2020 Fall Meeting (1–17 Dec 2020).
- Laughner, J.L.** and 32 others. (16 Dec 2020) *The GGG2020 TCCON Data Product*. Virtual talk at the AGU 2020 Fall Meeting (1–17 Dec 2020).
- Laughner, J.L.** and 11 others. (5 June 2020) *GGG2020 prior profile design*. Virtual talk at the 16th IWGGMS meeting (2–5 June 2020).
- Laughner, J.L.**, Kiel, M., Andrews, A., Wunch, D., Toon, G., Wennberg, P.O. (13 May 2020) *GGG2020 prior profile design: the “ginput” package*. Virtual talk at the TCCON network meeting (13–14 May 2020).
- Laughner, J.L.**, and 11 others. (13 Dec 2019) *Testing the separation of diurnal and seasonal variation in XCO₂ measured by OCO-3 with TCCON data*. Talk at AGU Fall Meeting in San Francisco, CA, (9–13 Dec 2019).
- Laughner, J.L.** and Cohen, R.C. (28 Aug 2019) *Direct observation of changing NO_x lifetime in North*

American cities. Talk at Aura science team meeting at in Pasadena, CA (27–29 Aug 2019).

Laughner, J.L. and Cohen, R.C. *Direct observation of changing NO_x lifetime in North American cities*. Poster at Gordon Research Conference for Atmospheric Chemistry in Newry, ME (28 Jul to 2 Aug 2019).

Laughner, J.L. (26 Jul 2019) *Direct observation of changing NO_x lifetime in North American cities*. Talk at ACCESS XV meeting at Brookhaven National Lab, 24–26 Jul 2019.

Laughner, J.L., and Kiel, M. (20 May 2019) *Updates to GGGNext priors: CO_2 , N_2O , CH_4 , HF , CO* . Talk at the Joint NDACC-IRWG and TCCON meeting, Wanaka, New Zealand, 20–24 May 2019.

Laughner, J.L. (20 May 2019) *Bias correction sensitivity to available TCCON data*. Talk at the Joint NDACC-IRWG and TCCON meeting, Wanaka, New Zealand, 20–24 May 2019.

Laughner, J.L. and Cohen, R.C. (11 Dec 2018) *Direct space-based observations of decadal changes in NO_x emissions and lifetime: implications for oxidative capacity*. Talk at AGU Fall Meeting in Washington, D.C. (10–14 Dec 2018).

Laughner, J.L. (19 Sept 2018) *Direct observation of NO_x lifetime from space: challenges and applications*. Invited talk in Berkeley Atmospheric Science Center seminar series, Berkeley, CA.

Laughner, J.L. and Cohen, R.C. (15 Dec 2017) *The Next-generation Berkeley High Resolution NO_2 (BEHR NO_2) Retrieval: Design and Preliminary Emissions Constraints.*, Poster at American Geophysical Union Fall Meeting, New Orleans, LA, 11–15 Dec 2017.

Laughner, J.L. and Canfield-Dafilou, E. (22 June 2017) *Illustrating trends in nitrogen oxides across the United States using sonification*, Talk at International Conference for Auditory Display, University Park, PA, 20–23 June 2017.

Laughner, J.L., Zare, A., and Cohen, R.C. (3 Feb 2017) *Effects of daily, high resolution a priori profiles on satellite-derived NO_x emissions and lifetime*, Poster at Berkeley Atmospheric Science Symposium, Berkeley, CA, 2–3 Feb 2017.

Laughner, J.L., Zare, A., and Cohen, R.C. (16 Dec 2016) *Effects of daily, high resolution a priori profiles on satellite-derived NO_x emissions and lifetime*, Poster at American Geophysical Union Fall Meeting, San Francisco, CA, 12–16 Dec 2016.

Laughner, J.L., Zare, A., and Cohen, R.C. (30 Aug 2016) *Effects of daily meteorology on satellite a priori and implications for constraint of NO_x chemistry from space*, Talk at Aura Science Team Meeting, Rotterdam, Netherlands, 30 Aug–1 Sept 2016.

Laughner, J.L., Zare, A., and Cohen, R.C. (14 Dec 2015) *The impact of day-to-day variability in input assumptions on regional satellite retrievals of NO_2* .

Laughner, J.L. and Cohen, R.C. (7 May 2015) *Aerosol effects on NO_2 retrievals: an assessment using DISCOVER observations*, Talk at DISCOVER-AQ Science Team Meeting, Boulder, CO, 3–8 May 2015.

Laughner, J.L. and Mallouk, T. (Aug. 2012) *Synthesis of PLGA Microcapsules for Groundwater Remediation*, Presentation of research at conclusion of 3M Summer Fellowship.

Laughner, J.L. and Mallouk, T. (Apr. 2012) *Oxidation of Groundwater Contaminants with Hydrogen Peroxide Containing Microcapsules*, Penn State Undergraduate Research Exposition.

Teaching Experience:

NASA Global Learning and Observation to Benefit the Environment (GLOBE) Dec 2014–Feb 2018

Visit high school classes to discuss my research and help students with their own research projects.

Bay Area Scientists in Schools (BASIS)

Jan 2014–Mar 2018

Science lessons with elementary students in Oakland and Berkeley, CA, USA

- Graduate Student Instructor, Chem 15, UC Berkeley Aug 2015–Dec 2015
Analytical chemistry: instructor for 25-student lab section; office hours on lab and lecture material
- Graduate Student Instructor, Chem 4A, UC Berkeley Aug 2013–Dec 2013
Aug 2014–Dec 2014
General chemistry: instructor for 20-student lab section; office hours on lab and lecture material
- Tutor for undergraduate resource room, Penn State Sept 2010–May 2013
Individual to small group tutoring on general and organic chemistry
- Mentor for high school student lab experience during summer leadership camp Aug 2012
Led high-school students in water filtration lab, discussion of relevance
- Undergraduate Instrument Room TA, Penn State Aug 2011–Dec 2011
Instructed student use of NMR, IR, GC, and data interpretation

Skills:

- *Programming:* fluent in Python, Matlab, Julia, Bash, Git, Mercurial; conversant with Fortran, C, C++, C#, Rust, Supercollider.
- *Atmospheric remote sensing:* development of UV-visible & IR retrieval algorithms; application of NO₂ remote sensing for emissions and lifetime constraints.
- *Atmospheric chemical transport modeling:* experienced with GEOS-Chem and WRF-Chem.
- *Radiative transfer modeling:* conversant with SCIATRAN.
- *Typesetting and visualization:* fluent with Latex, GIMP (GNU Image Manipulation Program), Inkscape (open source vector image editor), and Blender (open source 3D modeling program).

Selected programming examples:

- COVID Atmospheric Ancillary Data Agglomerator (CAADA): <https://github.com/joshua-laughner/CAADA>
- BEHR Retrieval: <https://github.com/CohenBerkeleyLab/BEHR-core> and dependencies
- Modification of WRF-Chem to automatically scale anthropogenic emissions to the run year: https://github.com/CohenBerkeleyLab/WRF-Chem-R2SMH/commits/conv_emiss_racm2-r2smh, esp. commits b7a4f62 & 64225f2
- Code to automate configuration, compilation, input preparation, and execution of WRF-Chem: <https://github.com/CohenBerkeleyLab/AutoWRFChem-Base>
- Matlab-Python data type interface: <https://github.com/firsttempora/MatlabPythonInterface>