YANGCHENG LUO

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EDUCATION

California Institute of Technology (Division of Geological and Planetary Sciences) Pasadena, California, USA
Ph.D. candidate in Planetary Science — August 2018 – Present

California Institute of Technology (Division of Geological and Planetary Sciences) Pasadena, California, USA
M.S. in Environmental Science and Engineering — August 2018 – June 2020

Peking University (School of Physics) Beijing, China
B.S. in Atmospheric Science — September 2014 – July 2018

PUBLICATIONS

First-authored or corresponding-authored:

1. **Luo, Y.**, & Callies, J. (*in preparation*). Submesoscale Vertical Exchange Between the Mixed Layer and the Thermocline.
2. **Luo, Y.**, Hu, Y., Yang, J., & Yung, Y. L. (*in preparation*). Three-Dimensional Ozone Distributions on TRAPPIST-1e Simulated with a Climate-Chemistry Model.
3. **Luo, Y.**, Hu, Y., Yang, J., & Yung, Y. L. (*submitted to Nature Astronomy*). Beyond Stability and Convergence: Coupled Atmospheric Chemistry and Dynamics of an Exoplanet Reveal a New Class of Oscillatory Behavior.
4. **Luo, Y.**, Mischna, M. A., Lin, J. C., Fasoli, B., Cai, X., & Yung, Y. L. (2021). Mars Methane Sources in Northwestern Gale Crater Inferred from Back-Trajectory Modeling. *Earth and Space Science*, *8*, e2021EA001915. https://doi.org/10.1029/2021EA001915

Co-authored:

5. Li, J., Mischna, M. A., **Luo, Y.**, Adams, D., & Yung, Y. L. (*in preparation*). Localizing Methane Sources in Gale Crater Using a Multi-Detector Strategy.
6. Zhang, A., Yang, J., **Luo, Y.**, & Fan, S. (*submitted*). 2060: Civilization, Energy, and Progression of Humanity on the Kardashev Scale.
7. Adams, D., Luo, Y., & Yung, Y. L. (*under review*). Hydrocarbon Chemistry in the Atmosphere of a Warmer Exo-Titan.
8. Klusman, R. W., **Luo, Y.**, Chen, P., Yung, Y. L., & Tallapragada, S. (2022). Seasonality in Mars Atmospheric Methane Driven by Seepage, Barometric Pumping and Absorption. *Icarus*, *383*, 115079. https://doi.org/10.1016/j.icarus.2022.115079
9. Zhang, X., Berkinsky, D., Markus, C. R., Chitturi, S. R., Grieman, F., Okumura, M., **Luo, Y.**, Yung, Y. L., & Sander, S., P. (2021). Reaction of Methane and UV-Activated Perchlorate: Relevance to Heterogeneous Loss of Methane in the Atmosphere of Mars. *Icarus*, 114832. https://doi.org/10.1016/j.icarus.2021.114832
10. Adams, D., **Luo, Y.**, Wong, M. L., Dunn, P., Christensen, M., Dong, C., Hu, R., & Yung, Y. L. (2021). Nitrogen Fixation at Early Mars. *Astrobiology*, *21*(8), 968-980. https://doi.org/10.1089/ast.2020.2273
11. Li, Z., **Luo, Y.**, Arnold, N., & Tziperman, E. (2019). Reductions in strong upwelling-favorable wind events in the Pliocene. *Paleoceanography and Paleoclimatology*, *34*, 1931-1944. https://doi.org/10.1029/2019PA003760

RESEARCH EXPERIENCES

University of Chicago (Rossbypalooza Summer School)

Chicago, IL, USA

Limit Cycles in Magma-Mediated Clouds Featuring 55 Cancri e July 2022
Advisor: Prof. Edwin Kite
Collaborator: Kaitlyn Loftus

- Used delayed differential equations to model oscillations in cloud albedo and surface temperature of 55 Cancri e

California Institute of Technology (Division of Geological and Planetary Sciences)
Pasadena, CA, USA

Detectability of Spectral Features in Atmospheres of Exo-Titans May 2022 – July 2022
Advisor: Prof. Yuk L. Yung
Collaborator: Danica Adams

- Compute the transmission spectrum of hydrocarbon species in exo-Titan atmospheres

Retrieving NO2 Column Concentration Using a Double-Limb Method April 2022 – present
Advisor: Prof. Yuk L. Yung, Dr. Stanley Sander, & Dr. Zhao-Cheng Zeng
Mentee: Xuyang Zhou

- Retrieve the column abundance of NO_2 in Los Angeles based on the data from the FTUVS instrument using a double-limb method for calibrating the SAGE satellite measurements

Modeling the Transport of Methane in the Martian Atmosphere with Chemical Removal
March 2022 – present
Advisor: Prof. Yuk L. Yung
Mentee: Guixin Xing

- Update the Mars-STILT model to incorporate chemical reaction in the transport process of methane in the Martian atmosphere

Modeling Oscillations in the Abundances of Atmospheric Species in Exoplanetary Atmospheres September 2021 – July 2022
Advisors: Prof. Yuk L. Yung, Prof. Yongyun Hu, Prof. Jun Yang

- Use a three-dimensional climate-photochemistry-radiation model to simulate changes in atmospheric abundances of ozone and nitrogen oxides that are observable

Designing a Future Sensor Deployment Strategy to Localized Methane Sources Within Gale Crater, Mars June 2021 – present
Advisor: Prof. Yuk L. Yung
Collaborators: Dr. Jiazheng Li, Dr. Michael Mischna, Danica Adams

- Optimized a sensor deployment strategy to better constrain the location of methane sources within Gale crater based on an inverse Lagrangian method

Three-Dimensional Ozone Distributions on TRAPPIST-1e Simulated with a Climate-Chemistry Model June 2021 – present
Advisors: Prof. Yongyun Hu, Prof. Jun Yang, Prof. Yuk L. Yung

- Use WACCM, a three-dimensional climate-photochemistry model to simulate ozone layers on TRAPPIST-1e
- Compute the transmission spectrum of the ozone layer and assess its detectability
- Compute the surface UV flux and assess the surface UV habitability

Reaction of Methane and UV-Activated Perchlorate: Relevance to Heterogeneous Loss of Methane in the Atmosphere of Mars January 2021 – January 2022
Advisor: Prof. Yuk L. Yung
Collaborators: Dr. Xu Zhang, Dr. Stanley Sander

- Estimated the lifetime of methane in the Martian atmosphere against the removal by surface perchlorates according to experimental data

Modeling the Stability of Polygonal Patterns of Vortices at the Poles of Jupiter
October 2020 – February 2021

Advisors: Prof. Andrew P. Ingersoll, Prof. Jörn Callies, Prof. Cheng Li

- Used a QGPV model to simulate the drift of vortices in a polar-β plane
- Explored the dependence of the stability of the polygonal patterns of vortices on large-scale environmental parameters

Seasonality in Methane Concentration on Mars Driven by Barometric Pumping
May 2020 – August 2021

Advisors: Prof. Yuk L. Yung, Prof. Ronald W. Klusman

- Calculated subsurface temperature and pressure profiles on Mars
- Used PHREEQC to compute the brine compositions in the subsurface of Mars

Detecting Nightside Hemispherical Vortices on Tidally Locked Terrestrial Exoplanets
September 2020 – November 2021

Advisor: Prof. Yuk L. Yung
Collaborator: Dr. Lixiang Gu

- Used a radiative transfer model to assess the detectability of ozone enrichment in nightside hemispherical vortices on tidally locked Earth-like exoplanets

New Horizons Disk-Integrated Photometry of Pluto January 2020 – February 2021

Advisor: Prof. Yuk L. Yung
Collaborators: Dr. Siteng Fan, Daniel Bi

- Plotted scattered light intensity as a function of the phase angle in four wavelength bands
- Backed out surface and aerosol properties by curve-fitting

Submesoscale Vertical Exchange Between the Mixed Layer and the Thermocline
November 2018 – present

Advisor: Prof. Jörn Callies

- Simulated vertical motions at the base of the mixed layer in an idealized configuration
- Investigated the dependence of the vertical exchange rate on dimensionless parameters

Mapping the Location of Surface Methane Sources on Mars from Inverse Modeling
August 2018 – November 2021

Advisor: Prof. Yuk L. Yung
Collaborators: Dr. Michael Mischna, Prof. John C. Lin, Benjamin Fasoli

- Developed a coupled MarsWRF/STILT model for back-trajectory analysis based on simulated winds
- Traced back methane spikes detected at Gale crater to their surface origins

Nitrogen Fixation on a Warm and Wet Early Mars August 2018 – August 2021

Advisor: Prof. Yuk L. Yung
Collaborator: Danica Adams

- Developed a generic code to compute convective available potential energy (CAPE) for planetary atmospheres
- Computed CAPE on early Mars and estimated NO_x production rate from lightning

Harvard University (Department of Earth and Planetary Sciences) Cambridge, MA, USA

Reductions in Strong Upwelling-Favorable Wind Events in the Pliocene

July 2017 – October 2019

Advisor: Prof. Eli Tziperman

Collaborator: Dr. Nathan Arnold, Zhiyuan Li

- Used a fine-resolution GCM to simulate upwelling-inducing coastal winds in the Pliocene
- Analyzed the causality between strong storm activities and extreme upwelling events

Peking University (Department of Atmospheric and Oceanic Sciences) Beijing, China

Three-Dimensional Ozone Distributions on Tidally Locked Earth-Like Planets Simulated with a Climate-Chemistry Model June 2016 – June 2021

Advisors: Prof. Yongyun Hu, Prof. Jun Yang

- Used a climate-photochemistry model to simulate ozone layers on tidally locked Earth-like planets around M dwarf stars
- Computed transmission spectra of the ozone layers and assessed their detectability
- Computed surface UV fluxes and assessed the surface UV habitability

TEACHING EXPERIENCES

California Institute of Technology Pasadena, CA, USA

- Teaching assistant in Ge/ESE 150 *Planetary Atmospheres* in the 2021 – 2022 academic year
- Guest lecturer in Ge 159 *Astrobiology* in the 2021 – 2022 academic year
  - Theme of the lecture: *Methane on Mars*
- Teaching assistant in ESE 131 *Ocean Dynamics* in the 2020 – 2021 academic year
- Teaching assistant in ESE 131 *Ocean Dynamics* in the 2019 – 2020 academic year

CONFERENCES

1. **Luo, Y.**, Hu, Y., Yang, J., Yung, Y. L. (2021). The Ozone Layer on TRAPPIST-1e and Its Detection (poster contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, New Orleans, LA, USA.
2. Chen, H., **Luo, Y.**, & Horton, D. E. (2021). Caveats for the Water-Loss Limits at the Inner Edge of the Habitable Zone (poster contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, New Orleans, LA, USA.
3. Klusman, R. W., **Luo, Y.**, Chen, P., Yung, Y. L., & Tallapragada, S. (2021). Seasonality in Mars Atmospheric Methane Driven by Microseepage, Barometric Pumping, Adsorption, and Proximity of the Source to Curiosity (oral contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, New Orleans, LA, USA.
4. Li, J., **Luo, Y.**, Mischna, M., Adams, D., & Yung, Y. L. (2021). Localizing Methane Sources in Gale Crater Using a Multi-Detector Strategy (oral contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, New Orleans, LA, USA.
5. **Luo, Y.**, Hu, Y., & Yang, J. (2021). Ozone Layers on Tidally Locked Terrestrial Exoplanets and Biosignature Detection (poster contribution). *National Planetary Science Conference*, Suzhou, Jiangsu, China.
6. **Luo, Y.**, Mischna, M. A., Yung, Y. L., Lin, J. C., & Fasoli, B. (2021). Localizing Methane Emission Sites on Mars from Inverse Modeling of Tracer Transport (oral contribution). *43rd Committee on Space Research* (*COSPAR*) *Scientific Assembly*, online.
7. **Luo, Y.**, Klusman, R. W., Chen, P., & Yung, Y. L. (2020). Modeling Subsurface Origins and Transport of Methane on Mars (oral contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, online.

8. Mischna, M. A., **Luo, Y.**, Yung, Y. L., Lin, J. C., & Fasoli, B. (2020). Localizing Methane Emission Sites on Mars from Inverse Modeling (oral contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, online.
9. Adams, D. J., **Luo, Y.**, Wong, M. L., Dunn, P., Dong, C., Hu, R., & Yung, Y. L. (2020). Nitrogen Fixation at Early Mars (poster contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, online.
10. **Luo, Y.**, Hu., Y., Yang, J., & Yung, Y. L. (2020). The Ozone Layer Over Tidally-Locked Terrestrial Exoplanets and Biosignature Detection (oral contribution). *52nd Meeting of the American Astronomical Society Division for Planetary Sciences* (*AAS-DPS*), online.
11. Gu, L., **Luo, Y.**, Fan, S., Hu, Y., Jiang, J., & Yung, Y. L., (2020). Detectability of Ozone on Tidally-locked Earth-like Exoplanets (poster contribution). *52nd Meeting of the American Astronomical Society Division for Planetary Sciences* (*AAS-DPS*), online.
12. Bi., D. W., Natraj, V., Zeng, Z., **Luo, Y.**, & Yung, Y. L. (2020). Retrieval of Pluto's Spectral Surface Albedo from New Horizons Measurements (oral contribution). *52nd Meeting of the American Astronomical Society Division for Planetary Sciences* (*AAS-DPS*), online.
13. **Luo, Y.**, Hu, Y., Yang, J., & Yung, Y. L. (2020). The Ozone Layer Over Tidally-Locked Terrestrial Exoplanets and Biosignature Detection (oral contribution). *Jet Propulsion Laboratory Exoplanetary Science Initiative Symposium* (*JPL-ESIS*), Pasadena, CA, USA.
14. **Luo, Y.**, Mischna, M., Yung, Y., Kleinböhl, A., & Chen, P. (2019). Localizing Putative Methane Sources on Mars from Back-Trajectory Modeling Techniques (poster contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, San Francisco, CA, USA.
15. Adams, D. J., **Luo, Y.**, Wong, M. L., Dong, C., Hu, R., & Yung, Y. L. (2019). Nitrogen Fixation at Early Mars (poster contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, San Francisco, CA, USA.
16. **Luo, Y.** & Callies, J. (2019). Submesoscale Exchange Between the Mixed Layer and the Thermocline (oral contribution). *California Geophysical Fluid Dynamics* (*CalGFD*) *Meeting*, Pasadena, CA, USA.
17. **Luo, Y.**, Mischna, M., Yung, Y., Kleinböhl, A., & Chen, P. (2019). Localizing Putative Methane Sources on Mars from Spacecraft Observations and Back-Trajectory Modeling Techniques (poster contribution). *9th International Conference on Mars*, Pasadena, CA, USA.
18. **Luo, Y.**, Hu, Y., & Yang, J. (2019). Three-Dimensional Ozone Distributions on Tidally Locked Earth-Like Planets Simulated with a Climate-Chemistry Model (poster contribution). *Sagan Exoplanet Summer Workshop*, Pasadena, CA, USA.
19. **Luo, Y.**, Mischna, M., Yung, Y. L., Lin, J., & Fasoli, B. (2019). Localizing Potential Methane Sources on Mars from Back-Trajectory Modeling (poster contribution). *Astrobiology Science Conference* (*AbSciCon*), Bellevue, WA, USA.
20. Adams, D. J., **Luo, Y.**, Yung, Y. L., Wong, M. L., & Hu, R. (2019). Nitrogen Fixation on Early Mars (oral contribution). *Astrobiology Science Conference* (*AbSciCon*), Bellevue, WA, USA.
21. Mischna, M., Fan, S., **Luo, Y.**, Yung, Y. L., Kleinböhl, A., Chen, P., & Ehlmann, B. L. (2018). Localizing Putative Methane Sources on Mars from Spacecraft Observations and Back-Trajectory Modeling Techniques (poster contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, DC, USA.
22. **Luo, Y.**, Hu, Y., & Yang, J. (2018). The Ozone Layer Over Tidally Locked Earth-Like Planets Around M Dwarfs (poster contribution). *American Geophysical Union* (*AGU*) *Fall Meeting*, DC, USA.
23. Wong, M., Adams, D. J., **Luo, Y.**, & Yung, Y. L. (2018). Nitrogen Fixation on a Warm and Wet Early Mars (poster contribution). *50th Meeting of the American Astronomical Society Division for Planetary Sciences* (*AAS-DPS*), Knoxville, TN, USA.

SEMINARS

1. Locating Methane Sources on Mars Using Back-Trajectory Analysis. *DIX Planetary Science Seminar* at California Institute of Technology, April 2022, Pasadena, CA, USA.
2. Methane on Mars: Enigmas and Solutions. *Climate Dynamics Group 2022 Weekly Seminar*, February 2022, online.
3. The Ozone Layer Over Tidally Locked Exoplanets around M Dwarfs. *Yuk Lunch Seminar* at California Institute of Technology. August 2018, Pasadena, CA, USA.

ADVISING

1. June 2020 – November 2021: Advised a high school student to analyze data from the *Curiosity* rover and visualize results for a paper about methane on Mars.
2. March 2022 – present: Advising an undergraduate student to update an atmospheric transport/diffusion model for methane on Mars.
3. 2018: Advised an undergraduate student on data analysis for a paleoclimate project.

ACADEMIC ACTIVITIES

1. Participant in the *Rossbypalooza Summer School* at the University of Chicago. Title of Hackathon project: *Limit Cycles in Magma-Mediated Clouds Featuring 55 Cancri e*. July 2022.
2. Co-host of the *Mars Meeting* in the Yuk L. Yung research group. Fall 2019 – Summer 2020.
3. Host of the *Yuk Lunch Seminar* at California Institute of Technology. Fall 2019 – Winter 2022.

PROFESSIONAL SKILLS

Programming Languages: C, NCL, Fortran, MATLAB, Python, R, Linux, LaTeX

SELECTED AWARDS AND HONORS

- Chinese-American Engineers and Scientists Association of Southern California (CESASC) Jonathan H. Jiang Prize for Fundamental Science (Physics) 2022
- CESASC Scholarship Award 2020
- Outstanding Graduate of the City of Beijing 2018
- Outstanding Graduate of Peking University 2018
- Wei-Ming Young Physicists Award 2017
- Merit Student of Peking University 2017
- Jinhui Scholarship 2017
- Merit Student of Peking University 2016
- Canon Scholarship 2016
- Second Prize of Excellent Freshman Scholarship of Peking University 2014

EXTRACURRICULAR ACTIVITIES

2022:	Member of the Caltech Sovereignty Club, lead discussions in geopolitics.
2013:	Participant in the Asian Youth Development Program in Okinawa.
2012 – 2013:	Student leader of the Wind Orchestra of the High School Affiliated to Minzu University of China. Principal trombonist.