

J. MICHAEL BATTALIO

Department of Earth and Planetary Sciences ◊ Yale University
210 Whitney Ave. ◊ New Haven, CT 06511
(601) 415-9805 ◊ joseph.battalio@yale.edu
<http://battalio.com>

Education	Ph.D. Atmospheric Sciences Texas A&M University · College Station, TX Dissertation: <i>Wave Energetics of the Atmosphere of Mars</i>	May 2017
	M.S. Geoscience Mississippi State University · Starkville, MS	May 2012
	B.S. Physics & B.S. Geoscience (Professional Meteorology) minors in Mathematics, Communication, and Music Mississippi State University · Starkville, MS	May 2010
Experience	Postdoctoral Associate Yale University · New Haven, CT	2019–present
	Postdoctoral Fellow Harvard-Smithsonian Center for Astrophysics · Cambridge, MA	2017–2019
	Graduate Research and Teaching Assistant Texas A&M University · College Station, TX <i>Kenneth P. Pipes Endowed Fellow</i>	2012–2017 2014–2016
	Lecturer and Laboratory Manager Teacher Academy in the Natural Sciences · Starkville, MS	2010–2012
	Graduate Research and Teaching Assistant Mississippi State University · Starkville, MS <i>American Meteorological Society 21st Century Fellow</i>	2010–2012 2010–2011
Funded Grants & Fellowships	Principal Investigator “ <i>Annular Modes of Variability in the Martian Atmosphere.</i> ” funded by NASA Mars Data Analysis Program PI: J. Michael Battalio, Yale University Funded 2021–2024. (Amount to Yale: \$259,573)	
	Co-Investigator (PI of Yale subcontract) “ <i>Development and Evolution of Martian Regional-Scale Dust Storms in Space and Time.</i> ” funded by NASA Mars Data Analysis Program PI: David Kass, NASA Jet Propulsion Laboratory Funded 2021–2024. (Amount to Yale: \$116,500)	
	Co-Investigator (PI of Yale subcontract) “ <i>Improved Climatology of Lower and Middle Atmospheric Gravity Wave Activity at Mars.</i> ” funded by NASA Mars Data Analysis Program PI: Nicholas Heavens, Space Science Institute Funded 2019–2022. (Amount to Yale: \$160,075)	
	Research Fellow “ <i>21st Century Graduate Fellowship.</i> ” funded by the American Meteorological Society Funded 2010–2011. (Amount: \$24,000)	

Publications Peer-Reviewed Articles (Accepted/Published)

- 17 **Battalio, J. Michael**. “*Transient eddy energetics on Mars in three reanalysis datasets.*” (accepted in Journal of the Atmospheric Sciences).
- 16 Rafkin, Scot, Juan M. Lora, Alejandro Soto, and **Battalio, J. Michael**. “*The interaction of deep convection with the general circulation in Titan’s atmosphere. Part 1: Cloud Resolving Simulations.*” (accepted in Icarus).
- 15 **Battalio, J. Michael** and Juan M. Lora. “*Global impacts from high-latitude storms on Titan.*” Geophysical Research Letters 48, 18 (2021): e2021GL094244. doi: 10.1029/2021GL094244.
- 14 **Battalio, J. Michael**, Juan M. Lora, Scot Rafkin, and Alejandro Soto. “*The interaction of deep convection with the general circulation in Titan’s atmosphere. Part 2: Impacts on the climate.*” Icarus (2021): 114623. doi: 10.1016/j.icarus.2021.114623.
- 13 **Battalio, J. Michael** and Juan M. Lora. “*Annular modes of variability in the atmospheres of Mars and Titan.*” (2021) Nature Astronomy. doi: 10.1038/s41550-021-01447-4.
- 12 **Battalio, J. Michael** and Huiqun Wang. “*The Mars Dust Activity Database (MDAD): A comprehensive statistical study of dust storm sequences.*” Icarus 354 (2021): 114059. doi: 10.1016/j.icarus.2020.114059.
- 11 Smith, Christina L., Mark Lemmon, John Moores, Scott Guzewich, Timothy H. McConnochie, Claire E. Newman, Alain S. J. Khayat, **J. Michael Battalio**, Casey A. Moore, and Douglas Ellison. “*The Line-of-Sight Extinction record at Gale Crater as observed by MSL’s Mastcam and Navcam through ~2500 sols.*” Journal of Geophysical Research: Planets 125 (2020): 2020JE006465. doi: 10.1029/2020JE006465.
- 10 Shirley, James H., Richard J. McKim, **J. Michael Battalio**, and David M. Kass. “*Orbit-Spin Coupling and the Triggering of the Martian Planet-Encircling Dust Storm of 2018.*” Journal of Geophysical Research: Planets (2020): e2019JE006077. doi: 10.1029/2019JE006077.
- 9 **Battalio, J. Michael** and Huiqun Wang. “*Eddy Evolution during Large Dust Storms.*” Icarus 338 (2020): 113507. doi: 10.1016/j.icarus.2019.113507.
- 8 Cooper, Brittney, John Moores, **J. Michael Battalio**, Scott Guzewich, Rachel Modestino, and Michael Tabascio. “*Aphelion Cloud Belt Phase Function Investigations with Mars Color Imager (MARCI).*” Planetary and Space Science 184 (2020): 104840. doi: 10.1016/j.pss.2020.104840.
- 7 Moore, Casey, John Moores, Claire Newman, Mark Lemmon, Scott Guzewich, **J. Michael Battalio**. “*Vertical and Horizontal Heterogeneity of Atmospheric Dust Loading in Northern Gale Crater, Mars.*” Icarus 329 (2019): 197–206. doi: 10.1016/j.icarus.2019.03.041.
- 6 **Battalio, J. Michael** and Huiqun Wang. “*The Aonia-Solis-Valles Dust Storm Track in the Southern Hemisphere of Mars.*” Icarus 321 (2019): 367–378. doi: 10.1016/j.icarus.2018.10.026.
- 5 **Battalio, J. Michael**, Istvan Szunyogh, and Mark Lemmon. “*Wave Energetics of the Southern Hemisphere of Mars.*” Icarus 309 (2018): 220–240. doi: 10.1016/j.icarus.2018.03.015.
- 4 Guzewich, Scott, Claire E. Newman, Michael Smith, John E. Moores, Christina L. Smith, Casey Moore, Mark I. Richardson, David Kass, Armin Kleinböhl, Michael Mischna, F. J. Martin-Torres, M-P. Zorzano-Mier, and **J. Michael Battalio**. “*The Vertical Dust Profile over Gale Crater, Mars.*” Journal of Geophysical Research: Planets 122 (2017): doi:10.1002/2017JE005420.

- 3 Newman, Claire, Javier Gomez-Elvira, Mark Richardson, Mercedes Marin, Sara Navarro, Josefina Torres, **J. Michael Battalio**, Scott Guzewich, Robert Sullivan, Manuel de la Torre, Ashwin Vasavada, and Nathan Bridges. “Winds Measured by the Rover Environmental Monitoring Station (REMS) during the Mars Science Laboratory (MSL) Rover’s Bagnold Dunes Campaign and Comparison with Numerical Modeling using MarsWRF.” *Icarus* 291 (2017): 203–231. doi:10.1016/j.icarus.2016.12.016.
- 2 **Battalio, J. Michael** and Jamie Dyer. “The Minimum Length Scale for Evaluating QG Omega Using High Resolution Numerical Model Data.” *Monthly Weather Review* 145 (2017): 1659–1678. doi:10.1175/MWR-D-16-0241.1.
- 1 **Battalio, J. Michael**, Istvan Szunyogh, and Mark Lemmon. “Energetics of the Martian Atmosphere Using the Mars Analysis Correction Data Assimilation (MACDA) Dataset.” *Icarus* 276 (2016): 1–20. doi:10.1016/j.icarus.2016.04.028.
Corrigendum: *Icarus* 302 (2018): 565–567. doi: 10.1016/j.icarus.2017.10.001.

Peer-Reviewed Articles (submitted)

1. Heavens, Nicholas G., Alexey Pankine, **J. Michael Battalio**, and Corwin Wright. “The horizontal wavelength spectrum of gravity wave activity in Mars’s lower atmosphere: the perspective from MGS-*TES* nadir observations.” (in review at *The Planetary Science Journal*).
2. Heavens, Nicholas G., Alexey Pankine, **J. Michael Battalio**, Corwin Wright, David M. Kass, Armin Kleinböhl, Sylvain Piqueux, and John T. Schofield. “Mars Climate Sounder observations of gravity wave activity throughout Mars’s lower atmosphere.” (in revision at *The Planetary Science Journal*).

Peer-reviewed articles as “Science Team” member

1. Mahaffy P. R., et al., and the MSL Science Team*. “The imprint of atmospheric evolution in the D/H of Hesperian clay minerals on Mars.” *Science* (2015) doi:10.1126/science.1260291 [***Battalio** identified as a member of the “MSL Science Team” in Supplementary Material]
2. Webster, C. R., et al., and the MSL Science Team*. “Mars methane detection and variability at Gale crater.” *Science* (2014) doi:10.1126/science.1261713 [***Battalio** identified as a member of the “MSL Science Team” in Supplementary Material]

Published Datasets

1. **Battalio, J. Michael**, and Helen Wang, 2019: *The Mars Dust Activity Database (MDAD)*. *Harvard Dataverse*, doi: 10.7910/DVN/F8R2JX.
2. Wang, Helen, **J. Michael Battalio**, and Zachery Huber, 2018: *Mars MRO MARCI Daily Global Weather Maps v1*. *NASA Planetary Data System*.

Awards

Titan Through Time 5 Travel Grant	July 2021
NASA Group Achievement Award <i>MSL Extended Mission-1 Science and Operations Team</i>	June 2017
AAS Division of Planetary Science Travel Grant	September 2016
Outstanding Graduate Seminar Speaker Award	Fall 2015
NASA Group Achievement Award <i>MSL Prime Mission Science and Operations Team</i>	June 2015
Outstanding Graduate Seminar Speaker Award	Spring 2014
Texas A&M College of Geoscience Top Off Scholarship	2013
Ernestine P. Scoggins Memorial Scholarship <i>Texas A&M Department of Atmospheric Sciences</i>	2013
National Science Foundation S-STEM Fellow	2010

Mississippi State University Society of Scholars	2010
Guillermo Salazar Rodriguez Undergraduate Scholarship	2009
<i>American Meteorological Society</i>	

Invited

Presentations

1. *“Impact of Climate Modes and Transient Waves on Mars’s Dust Storms”* NASA JPL Mars Forum, virtual, 10/15/2021.
2. *“Annular Modes in Mars’s and Titan’s Atmospheres”* Planetary Lunch (PLUNCH) Seminar, UC Santa Cruz Other Worlds Laboratory, virtual, 10/11/2021.
3. *“Annular Modes in Mars’s and Titan’s Atmospheres”* NASA Goddard Institute for Space Studies planetary journal club, virtual, 9/7/2021.
4. *“A Mars dust storm climatology using the Mars Dust Activity Database (MDAD)”* Planetary Science Seminar, California Institute of Technology, virtual, 11/3/2020.
5. *“Regional Atmospheric Dynamics and the Mars Dust Activity Database”* Department of Geology and Geophysics, Yale University, New Haven, CT, 11/14/2019.
6. *“Observations of Martian Dust Storms from Global to Micro-scale”* Department of Geology and Geophysics, Postdoc Luncheon, New Haven, CT, 11/13/2019.
7. *“The Solstitial Pause, Dust, and Baroclinic Instability in the Martian Atmosphere”* Department of Atmospheric Sciences, Texas A&M University, College Station, Texas, 1/26/2016.
8. *“Effects of the Martian Global Dust Storm on the Energetics of the Martian Atmosphere”* Department of Atmospheric Sciences, Texas A&M University, College Station, Texas, 1/24/2015.

Contributed Extended Abstracts

Presentations

1. **J. M. Battalio**, J. Lora. *“Titan’s Annular Modes of Climate Variability Compared to Earth and Mars.”* Titan Through Time 5, Boulder, CO, August 2021.
2. Lora, J. M., **J. M. Battalio**. *“Global Influences of Polar Storms in Simulations of Titan’s Climate.”* Titan Through Time 5, Boulder, CO, August 2021.
3. Kahanpää, Henrik, Mark Lemmon, D. Reiss, J. Raack, E. Mason, **J. Michael Battalio**. *“Martian Dust Devils Observed Simultaneously by Imaging and By Meteorological Measurements.”* 49th Lunar and Planetary Science Conference, Woodlands, TX, March 2018.
4. Lemmon, Mark, C. E. Newman, N. Renno, E. Mason, **J. Michael Battalio** and others. *“Dust Devil Activity at the Curiosity Mars Rover Field Site.”* Lunar and Planetary Science Conference XLVIII, Woodlands, TX, March 2017.
5. **Battalio, J. Michael**, I. Szunyogh, M. T. Lemmon. *“Eddy Energetics of the Southern Hemisphere of Mars from the Mars Analysis Correction Data Assimilation (MACDA).”* Sixth International Workshop on the Mars Atmosphere: Modeling and Observations, Granada, Spain, January 2017.

Oral Presentations

1. *“Connecting regional dust storms to atmospheric traveling waves using the Mars Dust Activity Database (MDAD).”* **J. M. Battalio**. 53rd DPS Meeting, virtual, October 2021.
2. *“Comparison of Baroclinic Waves and Annular Modes Across Reanalysis Datasets.”* **J. M. Battalio**. Mars Climate Sounder Team Meeting, virtual, August 2021.
3. *“Contrasting Convective Systems in the Extratropics of Earth and Titan.”* **J. M. Battalio**. 19th Southeast Severe Storms Symposium, virtual, March 2021.
4. *“Barotropic and Baroclinic Annular Modes of Variability in the Atmospheres of Mars and Titan.”* **J. M. Battalio**, J. Lora. American Geophysical Union 2020 Meeting, virtual, December 2020.
5. *“Comparison of Gravity Wave Activity between THEMIS Band-10 and MCS Nadir Observations.”* **J. M. Battalio**, N. Heavens, A. Pankine, J. Cowart. 52nd DPS Meeting, virtual, October 2020.
6. *“Atmospheric Circulation and Dust Activity on Mars.”* **J. M. Battalio**, H. Wang. American Geophysical Union 2018 Meeting, Washington DC, November 2018.

7. “*Development Histories of Martian Dust Storms.*” **J. M. Battalio**, H. Wang. Harvard-CfA Postdoc Symposium, Cambridge, MA, October 2017.
8. “*The Energetics of Transient Eddies in the Martian Northern Hemisphere.*” **J. M. Battalio**, I. Szunyogh, M. T. Lemmon. The Dynamical Martian Atmosphere, 48th DPS Meeting, Pasadena, CA, October 2016.
9. “*Reduced Baroclinicity During Martian Global Dust Storms.*” **J. M. Battalio**, I. Szunyogh, M. T. Lemmon. Mars’s Atmosphere and Surface, 47th DPS Meeting, National Harbor, MD, November 2015.
10. “*Energetics of the Northern Hemisphere of Mars.*” **J. M. Battalio**, I. Szunyogh. Atmospheric Sciences Graduate Council Seminar, Texas A&M University, March 2014.
11. “*Application of QG Theory to Assess Model Initialization.*” **J. M. Battalio**, J. L. Dyer, 10th Southeast Severe Storm Symposium, Starkville, MS, March 2012.

Poster Presentations

1. “*Major and Minor Dust Storm Sequences on Mars.*” **J. M. Battalio**, H. Wang. American Geophysical Union 2019 Meeting, San Francisco, CA, December 2019.
2. “*An Important Dust Storm Track in the Southern Hemisphere of Mars.*” **J. M. Battalio**, H. Wang. 50th DPS Meeting, Pasadena, Knoxville, TN, October 2018.
3. “*The Minimum Horizontal Length Scale When Evaluating Quasi-Geostrophic Omega.*” **J. M. Battalio**, J. L. Dyer. 28th Conference on Weather Analysis and Forecasting / 24th Conference on Numerical Weather Prediction, American Meteorological Society Meeting, Seattle, WA, January 2017.
4. “*Extinction Measurements of Dust Aerosol from Mars Science Laboratory Solar Images.*” M. T. Lemmon, **J. M. Battalio**, and others. Current Processes in the Atmosphere of Mars I, American Geophysical Union 2016 Meeting, San Francisco, CA, December 2016.
5. “*Using Recent Inter-Annual Variability in Mars Atmospheric Dynamics to Consider Past Climates.*” **J. M. Battalio**. Astrobiology Graduate Conference, Boulder, CO, July 2016.
6. “*Necessity of Convection Parameterization in Simulating an MCS at High Resolution.*” **J. M. Battalio**, K. Pitts, M. Herrera. 30th Conference on Hydrology, Precipitation Processes and Observations for Atmospheric, Land Surface, and Hydrological Modeling, American Meteorological Society Meeting, New Orleans, LA, January 2016.
7. “*An Investigation of the Local Energetics of the Martian Atmosphere.*” **J. M. Battalio**, I. Szunyogh, M. T. Lemmon. Current Processes in the Atmosphere of Mars I, American Geophysical Union 2014 Meeting, San Francisco, CA, December 2014.
8. “*Quantitative Analysis and 3D Visualization of NWP Data Using Quasi-Geostrophic Equations.*” **J. M. Battalio**, J. L. Dyer. 28th Conference on Interactive Information Processing Systems American Meteorological Society Annual Meeting, New Orleans, LA, January 2012.
9. “*Visualization of Vorticity and Divergence in Three Dimensions.*” **J. M. Battalio**, J. L. Dyer. 36th Annual Meeting National Weather Association Conference, Birmingham, AL, October 2011.

Co-authored Presentations

1. “*Global influences of polar storms in simulations of Titan’s climate.*” J. M. Lora, **J. M. Battalio**. Titan Through Time 5, Boulder, CO, August 2021.
2. “*Re-examining the horizontal wavelength spectrum of gravity wave activity in Mars’s lower atmosphere.*” N. Heavens, A. Pankine, **J. M. Battalio**, American Geophysical Union 2020 Meeting, virtual, December 2020.
3. “*A Multiannual Record of Gravity Wave Activity in Mars’s Lower Atmosphere of On-Planet Observations by the Mars Climate Sounder.*” N. Heavens, D. Kass, A. Kleinböhl, J. Schofield, **J. M. Battalio**, A. Pankine. UK Planetary Atmospheres Meeting, London, UK, February 2020.
4. “*Major Dust Storms and Changes in Atmospheric Circulation on Mars.*” H. Wang, **J. M. Battalio**. 42nd COSPAR Scientific Assembly, Pasadena, CA, July 2018.
5. “*The Vertical Profile of Dust over Gale Crater, Mars.*” S. D. Guzewich, C. E. Newman, M. D. Smith, J. E. Moores, C. L. Smith, C. Moore, M. I. Richardson, D. Kass,

- A. Kleinböhl M. Mischna, F. J. Martin-Torres, M-P. Zorzano Mier, **J. M. Battalio**. American Geophysical Union 2017 Meeting, New Orleans, LA, December 2017.
6. “*Meteorological properties of Martian Dust Devils as observed by MSL.*” H. Kahanpää, M. T. Lemmon, E. Mason, **J. M. Battalio**. European Planetary Science Congress 2017, Riga, Latvia, September, 2017.
 7. “*The Mars Science Laboratory Dust Storm Campaign.*” S. D. Guzewich, C. E. Newman, M. De la Torre, M. Lemmon, E. Mason, **J. M. Battalio** and others. Sixth International Workshop on the Mars Atmosphere: Modeling and Observations, Granada, Spain, January 2017.
 8. “*A Comparison of Martian Transient Wave Energetics in High and Low Optical Depth Environments.*” **J. M. Battalio**, I. Szunyogh, M. T. Lemmon. Current Processes in the Atmosphere of Mars I, American Geophysical Union 2016 Meeting, San Francisco, CA, December 2016.

**White
Papers**

1. Guzewich, Scott, et al., [including **Battalio**]. “*Measuring Mars Atmospheric Winds from Orbit.*” 2020, submitted to the National Academy of Sciences Planetary Science and Astrobiology Decadal Survey 2023–2032.
2. Montabone, Luca, Nicholas Heavens, et al., [including **Battalio**]. “*Observing Mars from Areostationary Orbit: Benefits and Applications.*” 2020, submitted to the National Academy of Sciences Planetary Science and Astrobiology Decadal Survey 2023–2032.
3. Newman, Claire, Tanguy Bertrand, **J. Michael Battalio** et al.,. “*Toward More Realistic Simulation and Prediction of Dust Storms on Mars.*” 2020, submitted to the National Academy of Sciences Planetary Science and Astrobiology Decadal Survey 2023–2032.
4. Newman, Claire, Michael A. Mischna, Alejandro Soto, **J. Michael Battalio** et al.,. “*An Urgently Needed Repository for Planetary Atmospheric Model Output.*” 2020, submitted to the National Academy of Sciences Planetary Science and Astrobiology Decadal Survey 2023–2032.

Teaching

Texas A&M University courses

ATMO 202 *Atmospheric Science Lab* F2012, S2013, F2013
Course Director/Instructor (7 sections, 151 students total)

ATMO 321 *Computer Applications in the Atmospheric Sciences* F2014
Teaching Assistant (1 section, 23 students total)

Teaching Academy in the Natural Sciences

Introductory Physics Su2010, Su2011, Su2012
Lecturer (~80 students total)

Mississippi State University courses

GR 6842 *Forecasting Severe Local Storms* S2012
Co-Instructor (1 section, ~20 students, 5 lectures)

GR 4303/6303 *Principles of GIS* S2011, F2011
Teaching Assistant (2 sections, ~45 students total)

GR 1123 *Introduction to World Geography* F2010, S2011, F2011, S2021
Teaching Assistant (4 sections, ~400 students total)

GR 4933/6933 *Dynamic Meteorology II* S2011, S2021
Substitute Lecturer (2 sections, 4 lectures total)

GR 4823/6823 *Dynamic Meteorology I* F2010, F2011
Substitute Lecturer (2 sections, 2 lectures total)

PH 1011 *Physical Science Lab* S2010
Course Director/Instructor, Department of Physics (1 section, 18 students)

Mentoring

Graduate
Ashley Arroyo, Nicholas Lombardo
Yale University (principally advised by J. M. Lora)

Undergraduate
Colin Baccioco, Juliana Surprenant, Mary Yap, Sofia Menemenlis
Yale University (principally advised by J. M. Lora)
Lindsay Hogan
Yale University (principally advised by R. Smith)
Carlee Loeser and Barrett Goudeau
Texas A&M University (principally advised by I. Szunyogh)

Service & Outreach

Reviewer: *Geophysical Research Letters, Icarus, The Planetary Science Journal, Journal of Geophysical Research-Planets, Geoscience Data Journal, Planetary and Space Science, International Journal of Biometeorology*

Panel Reviewer (6 Panels total)
Mars Data Analysis Program; Solar System Workings; Future Investigators in NASA Earth and Space Science and Technology

External Reviewer (8 Panels total)
Mars Data Analysis Program; Solar System Workings; Planetary Data Archiving, Restoration, and Tools

Seminar Co-chair September 2020–present
Atmosphere, Ocean, and Climate Dynamics Seminar Series Yale University

Session Chair Mars: From the Surface to the Atmosphere October 2021
53rd Annual Meeting of the AAS Division of Planetary Science

Session Chair Mars Surface/Atmosphere Interactions October 2020
52nd Annual Meeting of the AAS Division of Planetary Science

Judge AGU Outstanding Student Presentation Awards December 2019

Seminar Organizing Committee Member December 2017–September 2019
Harvard-Smithsonian Center for Astrophysics

Contributor NASA Mars Rover Curiosity: Mission Updates March–October 2017
<https://mars.jpl.nasa.gov/msl/mission/mars-rover-curiosity-mission-updates/>

Organizer Department of Atmospheric Science March for Science Spring 2017
Texas A&M University

Session Chair Mars Atmosphere General Circulation and Dynamics January 2017
6th Workshop on the Mars Atmosphere: Modelling and Observations

Atmospheric Sciences Graduate Council President June 2015–June 2017
Department of Atmospheric Sciences Texas A&M University
Invited Speaker Committee Chair, Recruitment & Graduate Electives Committees
Graduate Program Committee Student Representative

Atmospheric Sciences Graduate Council Vice-President June 2013–May 2015
Department of Atmospheric Sciences Texas A&M University
IT Committee Chair, Graduate Electives Committee Chair
Texas A&M Graduate Student Council

Judge Texas A&M University Student Research Week 2013–2017

Member:
American Meteorological Society 2007–present
American Geophysical Union 2012–present
American Astronomical Society (Division of Planetary Science) 2014–present

Updated: October 1, 2021