Scot C. R. Rafkin, Ph.D., Director

Department of Space Studies, Southwest Research Institute, Boulder, Colorado, USA 80302

Dr. Rafkin researches planetary atmospheres with a specialization in numerical weather prediction, mesoscale modeling, atmospheric dynamics, and cloud microphysics. He has extensive experience developing weather and research modeling codes and has applied these to the study of mesoscale circulations, clouds, and aerosols for Earth and to other terrestrial planetary atmospheres including Mars, Titan, Venus, and Pluto. NASA has selected Dr. Rafkin and his team to provide environmental predictions for every Mars rover and lander since 2003. Dr. Rafkin also develops and leads proposals for space instrumentation and missions for remote and in situ atmospheric measurements. He is a science Co-Investigator on the MSL Rover Curiosity, the Mars 2020 Rover Perseverance, and the New Frontiers Dragonfly mission to Titan.

Education

B.S., Dept. of Atmospheric Science, UCLA, 1989. Senior Thesis, "Tornadoes in the Los Angeles Basin", Advisor: R. Wakimoto.

M.S., Dept. of Atmospheric Science, Colorado State University, 1992, "Cloud Electrification of Monsoon Convection", Advisor: S. A. Rutledge.

Ph.D., Dept. of Atmospheric Science, Colorado State University, 1996, "Development of a Cumulus Parameterization Suitable for Use in Mesoscale through GCM-scale Models", Advisor: W. Cotton.

Post-Doctoral Fellow, University Corporation for Atmospheric Research, 1996-1997, "Implementation of a Mesoscale Model to Improve Convective Forecasting in the NWSFO".

Professional Employment

2023-	Director, Southwest Institute, Boulder, CO
2014-2023	Program Director/Acting Asst. Director, Southwest Research Institute, Boulder, CO
2011-2014	Assistant Director, Southwest Research Institute, Boulder, CO
2007-2011	Section Manager, Southwest Research Institute, Boulder, CO
2005-2007	Principal Scientist, Southwest Research Institute, Boulder, CO
2003-2005	Senior Scientist, Southwest Research Institute, Boulder, CO
1997-2003	Assistant Professor, Department of Meteorology, San Jose State University, San Jose, CA
1996-1997	Postdoctoral Fellow, University Corporation for Atmospheric Research, Boulder, CO
1989-1996	Graduate Research and Teaching Assistant, Colorado State University, Fort Collins, CO
1988-1988	Summer Undergraduate Fellow, Atmospheric Trace Molecule Spectroscopy Experiment (ATMOS), Jet Propulsion Laboratory, Pasadena, CA
1985-1989	Undergraduate Assistant, Cloud Microphysics Wind Tunnel & Stratospheric-Tropospheric Radar Project, Dept. Atmospheric Science, UCLA, Los Angeles, CA

Auxiliary Academic and Professional Titles

2011-Present	Adjunct Faculty, University of Colorado, Boulder, Colorado
2013-Present	Visiting Research Scholar, University of Arizona
2014-Present	Adjunct Faculty, Universidad Complutense de Madrid, Spain
1998-2003	NASA Ames Research Center Associate
1998-1999	NASA-ASEE Faculty Fellow, NASA Ames Research Center

Experience, Service, and Awards

- Mars Science Laboratory Rover, Radiation Assessment Detector (MSL-RAD) Project Scientist
- Mars Science Laboratory Rover, Science Co-Investigator
- Mars 2020 Rover, Science Team Co-Investigator
- New Frontiers Dragonfly Mission to Titan, Science Co-Investigator and Meteorology Group Lead
- PI of E/PO Camera on TGE Mars Scout Proposal (Phase A)
- Deputy PI of Mars Balloon Discovery Proposal
- Group Achievement Award, Mars 2020 Entry, Descent, and Landing

- Group Achievement Award, Mars Phoenix Scout
- Group Achievement Award, MSL-RAD Instrument
- Group Achievement Award, MSL Rover Environmental Monitoring Station Instrument
- Group Achievement Award, Mars Phoenix Entry, Descent and Landing Group
- NASA Planetary Science Subcommittee Managers Operations Working Group
- Subpanel Chair for NASA programs: PATM, MFRP, MDAP, OPR
- Review Panel Member for NASA programs: MRO PS, MSL PS, OPR, PATM, MFRP, ASTID, MDAP, PIDDP
- Science Definition Team, Mars Telecommunication Orbiter and Titan Flagship Mission
- NASA MEPAG Mars Science Objectives, Climate Goal Co-Chair (Emeritus)
- NASA MEPAG Humans on Mas Science Objectives Science Analysis Group Member
- Kavli Prize Symposia Lecturer, Oslo, Norway, 2014
- National Collegiate Weather Forecasting Contest, "Best Overall Graduate Student Forecaster", 2003
- Honorable Mention, AMS Macelwane Award, "Tornadoes in the Los Angeles Basin", 1989

Former & Current Students

Timothy Michaels, M.S., San Jose State University, 2002
Eena Sta. Maria, M.S., San Jose State University, 2002
Jorge Pla-Garcia, Ph.D., University Complutense, Madrid Spain, 2018.
Cecilia Leung, Ph.D., University of Arizona, 2019.
Guillermo Adrian Chin Canche, Ph.D. Candidate, Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California.

Professional Societies

American Geophysical Union, American Meteorological Society, American Astronomical Society, European Geophysical Union, Japan Geoscience Union, International Union of Geophysics and Geodesy Commission on Planetary Science (Secretary/Treasurer)

Languages

English (native), Spanish (partial fluency).

Peer Reviewed Journal Publications (12,620 Citations, h-index: 54, i10-index: 110)

2023

Rodriguez-Manfredi, J.A.,...**Rafkin. S**.,…., 2023. The diverse meteorology of Jezero crater over the first 250 sols of Perseverance on Mars. Nature Geoscience, 16(1), pp.19-28.

Pla-García, J., Munguira, A., **Rafkin, S.**, et al., 2023. Nocturnal Turbulence at Jezero Crater as Determined From MEDA Measurements and Modeling. JGR Planets, 128., doi: 10.1029/2022JE007607

2022

Rafkin, S.C., Lora, J.M., Soto, A. and Battalio, J.M., 2022. The interaction of deep convection with the general circulation in Titan's atmosphere. Part 1: Cloud resolving simulations. Icarus, 373, p.114755.

Battalio, J.M., Lora, J.M., **Rafkin, S.** and Soto, A., 2022. The interaction of deep convection with the general circulation in Titan's atmosphere. Part 2: Impacts on the climate. Icarus, 373, p.114623.

Chatain, A., **Rafkin**, **S.C**., Soto, A., Hueso, R. and Spiga, A., 2022. Air–Sea Interactions on Titan: Effect of Radiative Transfer on the Lake Evaporation and Atmospheric Circulation. The Planetary Science Journal, *3*(10), p.232.

Diniega, S., Barba, N., Giersch, L., Jackson, B., Soto, A., **Rafkin, S**., Swann, C. and Sullivan, R., 2022. Optimally-sized Mission Concepts for Focused In-situ Studies of Planetary Surface-atmosphere Interactions. JGR Planets, 123, pp.468-488.

Mischna, M.A., Villar, G., Kass, D.M., Dutta, **S., Rafkin**, **S**., Tyler, D., Barnes, J., Cantor, B., Lewis, S.R., Hinson, D. and Pla-García, J., 2022. Pre-and Post-entry, Descent and Landing Assessment of the Martian Atmosphere for the Mars 2020 Rover. The Planetary Science Journal, 3(6), p.147.

2021

Diniega, S., Burr, D., Dundas, C.M., Jackson, B., Mischna, M., **Rafkin, S**., Smith, I., Sullivan, R., Titus, T., Vriend, N. and Walker, I., 2021. A Critical Gap: In situ Measurements of Planetary Surface-Atmosphere Interactions Beyond Earth. Bulletin of the American Astronomical Society, 53(4), p.044.

Guo, J., Zeitlin, C., Wimmer-Schweingruber, R.F., Hassler, D.M., Ehresmann, B., **Rafkin, S.**, Freiherr von Forstner, J.L., Khaksarighiri, S., Liu, W. and Wang, Y., 2021. Radiation environment for future human exploration on the surface of Mars: the current understanding based on MSL/RAD dose measurements. The Astronomy and Astrophysics Review, 29(1), pp.1-81.

Webster, C.R., Mahaffy, P.R., Pla-Garcia, J., **Rafkin, S.C.**, Moores, J.E., Atreya, S.K., Flesch, G.J., Malespin, C.A., Teinturier, S.M., Kalucha, H. and Smith, C.L., 2021. Day-night differences in Mars methane suggest nighttime containment at Gale crater.

2020

Rafkin, S.C. and Soto, A., 2020. Air-sea interactions on Titan: Lake evaporation, atmospheric circulation, and cloud formation. *Icarus*, *351*, p.113903.

Rafkin, S.C.R. and Banfield, D., 2020. On the problem of a variable Mars atmospheric composition in the determination of temperature and density from the adiabatic speed of sound. Planetary and Space Science, 193, p.105064.

2019

Pla-Garcia, J., **Rafkin, S. C. R.**, Karatekin, O. and Gloesener, E., 2019: Comparing MSL Curiosity rover TLS-SAM methane measurements with Mars Regional Atmospheric Modeling System (MRAMS) atmospheric transport experiments. *J. Geophys. Res*., 124(8), pp. 2141-2167.

Pla-García, J., **Rafkin, S.C.R.**, Martinez, G.M., Vicente-Retortillo, Á., Newman, C.E., Savijärvi, H., de la Torre, M., Rodriguez-Manfredi, J.A., Gómez, F., Molina, A. and Viúdez-Moreiras, D., 2020. Meteorological Predictions for Mars 2020 Perseverance Rover Landing Site at Jezero Crater. *Space Science Reviews*, *216*(8), pp.1-21.

2018

Rodriguez, S., Le Mouélic, S., Barnes, J.W., Kok, J.F., **Rafkin, S.C.R.**, Lorenz, R.D., Charnay, B., Radebaugh, J., Narteau, C., Cornet, T. and Bourgeois, O., 2018. Observational evidence for active dust storms on Titan at equinox. Nature Geoscience, 11(10), p.727.

Read, W.G., Tamppari, L.K., Livesey, N.J., Clancy, R.T., Forget, F., Hartogh, P., **Rafkin, S.C.** and Chattopadhyay, G., 2018. Retrieval of wind, temperature, water vapor and other trace constituents in the Martian Atmosphere. *Planetary and Space Science*, *161*, pp.26-40.

García, J.P. and **Rafkin, S.C.**, 2018. Resolviendo el misterio del metano marciano. *Astronomía*, (227), pp.24-31.

2017

Rafkin, S. C. R., Spiga, A., and Michaels, T. I., 2017: Mesoscale Meteorology, In *The Atmosphere and Climate of Mars*, 18, Cambridge University Press.

Guo, J., Slaba, T. C., Zeitlin, C., Wimmer-Schweingruber, R. F., Badavi, F. F., Böhm, E., Böttcher, S., Brinza, D. E., Ehresmann, B., Hassler, D., Matthiä, D., and **Rafkin**, **S.,** 2017: Dependence of the Martian radiation environment on atmospheric depth: Modeling and measurement. Journal of Geophysical Research: Planets, 122(2), pp.329-341.

Ehresmann, B., Zeitlin, C. J., Hassler, D. M., Matthiä, D., Guo, J., Wimmer-Schweingruber, R. F., Appel, J. K., Brinza, D. E., **Rafkin, S. C**., Böttcher, S. I. and Burmeister, S., 2017: The charged particle radiation environment on Mars measured by MSL/RAD from November 15, 2015 to January 15, 2016. Life Sciences in Space Research, 14, pp.3-11.

2016

Rafkin, S. C. R. et al., 2017: Mesoscale Meteorology, In *The Atmosphere and Climate of Mars*, Cambridge University Press.

Rafkin, S. C. R, et al., 2016: The Meteorology of Gale Crater as Determined from Rover Environmental Monitoring Station Observations and Numerical Modeling. Part II: Interpretation, *Icarus*, 280, 114-138.

Rafkin, S., Jemmett-Smith, B., Fenton, L., Lorenz, R., Takemi, T., Ito, J. and Tyler, D., 2016: Dust devil formation. Space Science Reviews, 203(1-4), pp.183-207.

Rafkin, S. C. R., 2016: Prólogo. Física de la Tierra, Norteamérica. Disponible en: <https://revistas.ucm.es/index.php/FITE/article/view/53885/49328>. Fecha de acceso: 24 ene. 2017.

Barth, E.L., Farrell, W.M. and **Rafkin, S. C.**, 2016: Electric field generation in Martian dust devils. Icarus, 268, pp.253-265.

Ehresmann, B., Hassler, D. M., Zeitlin, C., Guo, J., Köhler, J., Wimmer-Schweingruber, R. F., Appel, J. K., Brinza, D. E., **Rafkin, S. C**., Böttcher, S.I. and Burmeister, S., 2016: Charged particle spectra measured during the transit to Mars with the Mars Science Laboratory Radiation Assessment Detector (MSL/RAD). Life Sciences in Space Research, 10, pp.29-37.

Kite, E. S., Sneed, J., Mayer, D. P., Lewis, K. W., Michaels, T. I., Hore, A. and **Rafkin, S. C**., 2016: Evolution of major sedimentary mounds on Mars: Buildup via anticompensational stacking modulated by climate change. Journal of Geophysical Research: Planets, 121(11), pp.2282-2324.

Matthiä, D., Ehresmann, B., Lohf, H., Köhler, J., Zeitlin, C., Appel, J., Sato, T., Slaba, T., Martin, C., Berger, T. Boehm, E., Boettcher, S., Brinza, D. E., Burmeister, S., Guo, J., Hassler, D. M., Posner, A., **Rafkin**, **S. C. R.,** Reitz, G., Wilson, J. W., and Wimmer-Schweingruber, R. F., 2016. The Martian surface radiation environment–a comparison of models and MSL/RAD measurements. Journal of Space Weather and Space Climate, 6, p.A13.

Moore, C. A., Moores, J. E., Lemmon, M. T., **Rafkin, S. C.**, Francis, R., Pla-García, J., Haberle, R. M., Zorzano, M.-P., Martín-Torres, F. J., Burton, J. R. and MSL Team, 2016: A full martian year of line-of-sight extinction within Gale Crater, Mars as acquired by the MSL Navcam through sol 900. Icarus, 264, pp.102-108.

Moores, J.E., Schieber, J., Kling, A.M., Haberle, R.M., Moore, C.A., Anderson, M.S., Katz, I., Yavrouian, A., Malin, M.C., Olson, T. and **Rafkin, S.C**., 2016: Transient atmospheric effects of the landing of the Mars Science Laboratory rover: The emission and dissipation of dust and carbazic acid. Advances in Space Research, 58(6), pp.1066-1092.

Pla-Garcia, J., and **Rafkin, S. C. R.**, 2016: Meteorología mesoescalar en Marte. Física de la Tierra, Norteamérica, 28.

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Zeitlin, C., Hassler, D.M., Wimmer-Schweingruber, R.F., Ehresmann, B., Appel, J., Berger, T., Böhm, E., Böttcher, S., Brinza, D.E., Burmeister, S., Guo, J., Lohf, H., Martin C., Matthiäs, D., Posner , A., **Rafkin S.**, Reitz, G., Tyler, Y. D., Vincent, M., Weigle G., Iwata Y., Kitamura, H., and Murakami, T., 2016. Calibration and Characterization of the Radiation Assessment Detector (RAD) on Curiosity. Space Science Reviews, 201(1-4), pp.201-233.

2015

Rafkin, S. C. R. and E. L. Barth, 2015: Environmental Control of Deep Convective Clouds on Titan: The Combined Effect of CAPE and Wind Shear on Storm Dynamics, Morphology and Lifetime, *J. Geophys. Res.*, In press, DOI: 10.1002/2014JE004749.

Rafkin, S., 2015: The atmospheric characterization for exploration and science (ACES) instrument suite for Mars. In Aerospace Conference, 2015 IEEE (pp. 1-6). IEEE.

Beaty, D. W. and Niles, P. B. and Bass, D. S. and Bell, M. S. and Bleacher, J. E. and Cabrol, N. A. and Conrad, P. G. and Eppler, D. B. and Hamilton, V. E. and Hays, L. E. and Head, J. W. and Kahre, M. A. and Levy, J. S. and Lyons, T. W. and Macalady, J. L. and **Rafkin, S. C. R**. and Rice, J. W., 2015: Planning Ahead for Mars Sample Science in the Human Exploration Era. Meteoritics and Planetary Science, 50 (S1).

Charnay, B., Barth, E., **Rafkin, S.**, Narteau, C., Lebonnois, S., Rodriguez, S., Du Pont, S. C. and Lucas, A., 2015. Methane storms as a driver of Titan/'s dune orientation. Nature Geoscience, 8(5), pp.362-366.

Guo, J., Zeitlin, C., Wimmer-Schweingruber, R. F., Hassler, D. M., Ehresmann, B., Köhler, J., Böhm, E., Böttcher, S., Brinza, D., Burmeister, S. and Cucinotta, F., C. Martin, A. Posner, **S. Rafkin** and G. Reitz, 2015: MSL-RAD radiation environment measurements. Radiation protection dosimetry, 166(1-4), pp.290-294.

Guo, J., Zeitlin, C., Wimmer-Schweingruber, R. F., **Rafkin, S**., Hassler, D. M., Posner, A., Heber, B., Köhler, J., Ehresmann, B., Appel, J. K. and Böhm, E., 2015: Modeling the variations of dose rate measured by RAD during the first MSL Martian year: 2012–2014. The Astrophysical Journal, 810(1), p.24.

Guo, J., Zeitlin, C., Wimmer-Schweingruber, R.F., Hassler, D.M., Posner, A., Heber, B., Köhler, J., **Rafkin, S**., Ehresmann, B., Appel, J.K. and Böhm, E., 2015. Variations of dose rate observed by MSL/RAD in transit to Mars. Astronomy & Astrophysics, 577, p.A58.

Guo, J., Zeitlin, C., Wimmer-Schweingruber, R.F., Hassler, D.M., Ehresmann, B., Köhler, J., Böhm, E., Böttcher, S., Brinza, D., Burmeister, S. and Cucinotta, F., Martin C., Posner, A., **Rafkin, S.**, and Reitz, G., 2015: MSL-RAD radiation environment measurements. Radiation protection dosimetry, 166(1-4), pp.290-294.

Hamilton, V.E., **Rafkin, S**., Withers, P., Ruff, S., Yingst, R.A., Whitley, R., Center, J.S., Beaty, D.W., Diniega, S., Hays, L. and Zurek, R., 2015: Mars Science Goals, Objectives, Investigations, and Priorities: 2015 Version, NASA Mars Exploration Program Analysis Group.

Köhler, J., Ehresmann, B., Zeitlin, C., Wimmer-Schweingruber, R. F., Hassler, D. M., Reitz, G., Brinza, D. E., Appel, J., Böttcher, S., Böhm, E., Burmeister, S., Guo, J., Lohf, H., Martin, C., Posner, A., **Rafkin, S.**, 2015: Measurements of the neutron spectrum in transit to Mars on the Mars Science Laboratory, Life Sciences in Space Research, Volume 5, 6-12, doi:10.1016/j.lssr.2015.03.001.

Moores, J. E., Lemmon, M. T., Kahanpää, H., **Rafkin, S. C.**, Francis, R., Pla-Garcia, J., Bean, K., Haberle, R., Newman, C., Mischna, M. and Vasavada, A. R., 2015: Observational evidence of a suppressed planetary boundary layer in northern Gale Crater, Mars as seen by the Navcam instrument onboard the Mars Science Laboratory rover. Icarus, 249, pp.129-142.

Moores, J. E., Lemmon, M. T., **Rafkin, S. C.**, Francis, R., Pla-Garcia, J., De La Torre Juárez, M., et al., 2015: Atmospheric movies acquired at the Mars Science Laboratory landing site: Cloud morphology, frequency and significance to the Gale Crater water cycle and Phoenix mission results. *Advances in Space Research*, *55*(9), 2217-2238.

Wimmer-Schweingruber, R.F., Köhler, J., Hassler, D.M., Guo, J., Appel, J.K., Zeitlin, C., Böhm, E., Ehresmann, B., Lohf, H., Böttcher, S.I. and Burmeister, S., Cesar Martin, Alexander Kharytonov,David E. Brinza, Arik Posner, Günther Reitz, Daniel Matthiä, **Scot Rafkin**, Gerald Weigle, Francis Cucinotta2015. On determining the zenith angle dependence of the Martian radiation environment at Gale Crater altitudes. Geophysical Research Letters, 42(24).

2014

Rafkin, S. C. R. et al., 2014: Diurnal Variations of Energetic Particle Radiation at the Surface of Mars as Observed by the Mars Science Laboratory Radiation Assessment Detector, *J. Geophys. Res.*, 119, DOI: 10.1002/2013JE004525.

Chen, A., Cianciolo, A., Vasavada, A. R., Karlgaard, C., Barnes, J., Cantor, B., Kass, D., **Rafkin, S**. and Tyler, D., 2014: Reconstruction of Atmospheric Properties from Mars Science Laboratory Entry, Descent, and Landing. Journal of Spacecraft and Rockets, 51(4), pp.1062-1075.

Ehresmann, B., Zeitlin, C., Hassler, D. M., Wimmer-Schweingruber, R. F., Böhm, E., Böttcher, S., Brinza, D. E., Burmeister, S., Guo, J., Köhler, J., Martin, C., Posner, A., **Rafkin, S.**, Reitz, G., 2014: Charged particle spectra obtained with the Mars Science Laboratory Radiation Assessment Detector (MSL/RAD) on the surface of Mars. Journal of Geophysical Research: Planets, 119(3), pp.468-479.

Gómez-Elvira, J., Armiens, C., Carrasco, I., Genzer, M., Gómez, F., Haberle, R., Hamilton, V. E., Harri, A. M., Kahanpää, H., Kemppinen, O. and Lepinette, A., Soler, J. M., Martín-Torres, J., Martínez-Frías, J., Mischna, M., Mora, L., Navarro, S., Newman, C., de Pablo, M. A., Peinado, V., Polkko, J., **Rafkin, S. C. R.**, et al., 2014: Curiosity's rover environmental monitoring station: Overview of the first 100 sols. Journal of Geophysical Research: Planets, 119(7), pp.1680-1688.

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2013

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