

Nathaniel E. Putzig

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Geophysicist, studying the geology and climate of Mars with orbital radar and thermal data since 2001. 14 years prior experience with active-source seismic data in academia and industry. Expertise in processing, modeling, and interpretation of remote-sensing data. Skilled in software development, training course design and instruction, and personnel and project management.

Education

PhD Geophysics, University of Colorado, Boulder, Colorado, 2006
GPA: 3.9/4.0. SEG Scholarship. Advisors: Michael Mellon, Bruce Jakosky
Dissertation: *Thermal inertia and surface heterogeneity on Mars*

Industry Training, 1989 – 1999. **23 weeks in geoscience and computer systems**

MA Geophysics, Rice University, Houston, Texas, 1988
GPA: 3.8/4.0. Presidential Fellowship. Advisor: Alan Levander
Thesis: *Modeling wide-angle seismic data from the central California margin*

BS Geophysical Engineering, Colorado School of Mines, Golden, Colorado, 1986
GPA: 3.7/4.0. Minor in geology; six weeks geophysical field course

Valedictorian, Berne–Knox–Westerlo High School, Berne, New York, 1982

NASA Mission Science Teams

SHARAD, the Shallow Radar on Mars Reconnaissance Orbiter (MRO), 2006 – present
US/Deputy Team Leader, appointed in 2015 to succeed Roger Phillips
Co-Investigator, appointed in 2013
Liaison to Phoenix and Mars Science Laboratory landing site analysis teams

InSight Landing Site Analysis Team, **Co-Investigator**, 2014 – present

MARSIS, Mars Advanced Radar for Subsurface and Ionosphere Sounding, 2006 – present

THEMIS, the Thermal Emission Imaging System on Mars Odyssey, 2002 – present

TES, the Thermal Emission Spectrometer on Mars Global Surveyor, 2001 – 2006

Beagle II, MER *Spirit* and *Opportunity* Landing Sites Analysis Team, 2002 – 2006

Experience

Planetary Science Institute (PSI), Lakewood, CO, 2016 – present
Senior Scientist. Analyzing near-surface ices and the regolith of Mars using orbital radar, thermal observations, and other data

Manager of PSI's new Colorado office (opened in July 2016).

Project Manager, **CO-SHARPS**, the Colorado SHARAD Processing System

Project Manager, **MARSTHERM** Thermophysical Analysis Tools for Mars Research

Research Advisor to one post-doc, one research scientist, one research associate, and one

PGGURP student

Experience (continued)

Univ. of Colorado, Laboratory for Atmospheric and Space Physics, Boulder, 2015 – present
Adjoint Associate Professor. Advising graduate students and supporting their research through NASA PG&G and MFRP grants since 2010

Southwest Research Institute, Department of Space Studies, Boulder, CO, 2007 – 2016
Principal Scientist. Same as PSI research and project management activities
Research Advisor to one post-doc, four grad students, and three PGGURP students

Washington University, Earth and Planetary Sciences, St. Louis, Missouri, 2006 – 2007
Postdoctoral Research Associate. Analysis of subsurface radar from SHARAD and MARSIS. Advisor: Roger Phillips

Univ. of Colorado, Laboratory for Atmospheric and Space Physics, Boulder, 2001 – 2006
Graduate Research Assistant. Global derivation, mapping, and analysis of thermal inertia with TES and THEMIS. Advisor: Michael Mellon

Geomancer, Houston, Texas, 1996 – 2000

Geophysical Consultant. Founded [consultancy](#) offering exploration and systems services to the oil and gas industry. Carried out 2D and 3D seismic processing and interpretation, mapping prospects in Texas, Oklahoma, Louisiana, Mississippi, Alabama, the Gulf of Mexico, and Paradox Basin. Provided network and systems administration services. Developed training courses and provided on-site instruction for seismic interpretation and Unix. Primary clients: PetroCorp; JN Oil & Gas; Broughton Operating

CogniSeis Development, Inc., Houston, Texas, 1995 – 1996

Manager, Customer Support. Oversaw 28-person department providing technical support, system staging, software installation, and applications training for several hundred clients encompassing six geoscience application suites. Corrected deficiencies in staffing levels and product knowledge with strategic hiring and cross-training of existing staff.

Photon Systems Inc., Houston, Texas, 1993 – 1995

Manager, Geoscience Support. Supervised four professionals and provided support and training of seismic and well interpretation software for 100 clients. Provided technical assistance in client evaluations critical to dozens of workstation and software sales. Developed training courses and provided training to 45 clients in twelve one-week courses. Performed 50 custom site installations and wrote an extensive body of code for format conversion, third-party product integration, and software problem tracking.

Shell Oil Company, Houston, Texas, 1988 – 1993

Exploration Geophysicist. Provided acquisition design and processing of seismic data for exploration prospects in Yemen, West Texas, and Michigan Basins. Expertise with mixed-source datasets and with refraction statics modeling to address near-surface noise. Cash award for leading seven-person team in developing a cost-saving, superior processing method for a Yemen dataset. Performed user training and coordinated user feedback for internal and vendor refraction statics software.

Experience (continued)

Rice University, Department of Geology and Geophysics, Houston, Texas, 1986 – 1988
Graduate Research Assistant. Participated in design and acquisition of a deep crustal, wide-angle reflection–refraction survey across the North American–Pacific plate boundary in central California. Led refraction-data interpretation. Advisor: Alan Levander

Grants and Awards

NASA Planetary Geology and Geophysics Program

Early Career Fellow, selected in conjunction with 2013 grant, 2014

PI, *Material Properties of Dune Fields in the Southern Highlands of Mars*, 2013

PI, *Thermophysical behavior of the north polar erg on Mars*, 2007

NASA Mars Data Analysis Program

PI, *Adv. 3-D Subsurface Imaging & Analysis of Planum Boreum w/SHARAD*, 2015

Co-I, *Understanding Layered Ejecta (“Lobate”) Craters on Mars*, 2014

PI: Stuart Robbins, Southwest Research Institute

PI, *3-D Subsurface Imaging and Analysis of Planum Australe with SHARAD*, 2012

Co-I, *Mars sediment production: roles of chemical & mechanical weathering*, 2010

PI: Victoria Hamilton, Southwest Research Institute

PI, *3-D Subsurface Imaging and Analysis of Planum Boreum with SHARAD*, 2009

Co-I, *Linking Visible & Radar Stratigraphy in the Martian Polar Deposits*, 2008

PI: Kathryn Fishbaugh/Patrick Russell, Smithsonian Institution

NASA Mars Fundamental Research Program

PI, *Thermal Effects of Physical Heterogeneity on Mars*, 2010

Jet Propulsion Laboratory Critical Data Products Program (landing-site analysis)

PI, *Surface Properties from Radar and Thermophysical Data for InSight*, 2013

Southwest Research Institute Internal Research Program

Co-I, *Modeling of Exotic Ice Glaciers on Pluto and Mars*, 2016

PI: Isaac Smith, Southwest Research Institute

NASA Group Achievement Awards

MRO Comet Siding Spring Observing Team, 2015

MRO SHARAD Science Team, for polar/ice studies, 2011

US SHARAD Team, for radar sounder processing and analysis tools, 2009

Memberships and Certifications

American Geophysical Union

Division of Planetary Scientists of the American Astronomical Society

Society of Exploration Geophysicists

Geological Society of America

Registered *Engineer in Training*, State of Colorado, April 1986

Certified *White Water Raft Guide*, Arkansas River, Colorado, June 1997

Publications

- Aslam, S., with **Putzig, N.**, and 23 colleagues, 2016. Dual-telescope multi-channel thermal-infrared radiometer for outer planet fly-by missions. *Acta Astronautica* 128, 628-639, doi: [10.1016/j.actaastro.2016.08.009](https://doi.org/10.1016/j.actaastro.2016.08.009).
- Barratt, E. M. (*advisee*) (2013), *Thermophysical Analysis of Gale Crater Using Observations from TES, THEMIS and the Mars Science Laboratory Curiosity Rover*. Master of Science thesis, University of Colorado, Boulder, Colorado, 57 p.
- Bierson, C. J., Phillips, R. J., Smith, I. B., Wood, S. E., **Putzig, N. E.**, Nunes, D., Byrne, S., 2016. Stratigraphy and Evolution of the Buried CO₂ Deposit in the Martian South Polar Cap. *Geophys. Res. Lett.* 43, doi:[10.1002/2016GL068457](https://doi.org/10.1002/2016GL068457).
- Boisson, J., with **Putzig, N. E.**, and 9 colleagues, 2009. Sounding the Subsurface of Athabasca Valles Using MARSIS Radar Data: Exploring the Volcanic and Fluvial Hypotheses for the Origin of the Rafted-Plate Terrain. *J. Geoph. Res.* 114, E8, E08003, doi:[10.1029/2008JE003299](https://doi.org/10.1029/2008JE003299).
- Bramson, A. M., with **Putzig, N. E.**, and 5 colleagues, 2015. Widespread Excess Ice in Arcadia Planitia, Mars. *Geophys. Res. Lett.* 42, doi:[10.1002/2015GL064844](https://doi.org/10.1002/2015GL064844).
- Campbell, B. A., **Putzig, N. E.**, Foss II, F. J., Phillips, R. J., 2014. SHARAD Signal Attenuation and Delay Offsets Due to the Martian Ionosphere. *IEEE Geosci. Rem. Sens. Lett.* 11, 632-635.
- Campbell, B. A., **Putzig, N. E.**, and 4 colleagues, 2013. Roughness and Near-Surface Density of Mars from SHARAD Radar Echoes. *J. Geophys. Res.* 118, No. 3, 436-450.
- Campbell, B., Carter, L., Phillips, R., Plaut, J., **Putzig, N.**, Safaeinili, A., Seu, R., Biccari, D., Egan, A., Orosei, R., 2008. SHARAD Radar Sounding of the Vastitas Borealis Formation in Amazonis Planitia. *J. Geoph. Res.* 113, E12010, doi:[10.1029/2008JE003177](https://doi.org/10.1029/2008JE003177).
- Carter, L. M., Campbell, B. A., Holt, J. W., Phillips, R. J., **Putzig, N. E.**, Mattei, S., Seu, R., Okubo, C. H., Egan, A. F., 2009. Dielectric properties of lava flows west of Ascræus Mons, Mars. *Geophys. Res. Lett.* 36, L23204, doi:[10.1029/2009GL041234](https://doi.org/10.1029/2009GL041234).
- Carter, L. M., with **Putzig, N. E.**, and 10 colleagues, 2009. Shallow Radar (SHARAD) Sounding Observations of the Medusae Fossae Formation, Mars. *Icarus* 199, 295-302.
- Foss II, F. J., **Putzig, N. E.**, Campbell, B. A., Phillips, R. J., 2017. 3-D Imaging of Mars' Polar Ice Caps Using Orbital Radar Data. *The Leading Edge* 36(1), 43-57, doi:[10.1190/tle36010043.1](https://doi.org/10.1190/tle36010043.1).
- Golombek, M., with **Putzig, N. E.**, and 33 colleagues, 2016. Selection of the InSight Landing Site. *Space Sci. Rev.*, doi:[10.1007/s11214-016-0321-9](https://doi.org/10.1007/s11214-016-0321-9).
- Golombek, M. P., with **Putzig, N. E.**, and 6 colleagues, 2008. Martian Surface Properties from Joint Analysis of Orbital, Earth-based, and Surface Observations. Ch. 21 in in Bell, J. F. et al., eds., 2008, *The Martian Surface: Composition, Mineralogy, and Physical Properties*. Cambridge University Press, ISBN: 9780521866989.
- Hanna, R. D., Hamilton, V. E., **Putzig, N. E.**, 2016. The Complex Relationship Between Olivine Abundance and Thermal Inertia on Mars. *J. Geophys. Res.*, doi:[10.1002/2015-JE004924](https://doi.org/10.1002/2015-JE004924).
- Holt, J. W., with **Putzig, N. E.**, and 8 colleagues, 2010. The Construction of Chasma Boreale on Mars. *Nature* 465, 446-449.
- Hynek, B. M., **Putzig, N. E.**, 2005. Ground Truth For Remotely-Sensed Thermal Infrared Data of Mars. *Geol. Soc. Amer.*, Paper No. 233-8.

Publications (continued)

- Jakosky, B. M., with **Putzig, N. E.**, and 6 colleagues, 2005. Thermophysical Properties of the MER and Beagle II Landing Site Regions on Mars. *J. Geophys. Res.*, **111**, E08008.
- Martínez-Alonso, S., Jakosky, B. M., Mellon, M. T., **Putzig, N. E.**, 2005. A volcanic interpretation of Gusev Crater surface materials from thermophysical, spectral, and morphological evidence, *J. Geophys. Res.* **110**, E01003, doi:10.1029/2004JE002327, 20 pp.
- Mellon, M. T., with **Putzig, N.**, and 6 colleagues, 2008. A Pre-Landing Assessment of the Ice-Table Depth and Ground-Ice Characteristics in Martian Permafrost at the Phoenix Landing Site. *J. Geophys. Res.* **113**, E00A25, doi:10.1029/2007JE003067.
- Mellon, M. T., Fergason, R. L., **Putzig, N. E.**, 2008. The Thermal Inertia of the Surface of Mars. Ch. 18 in Bell, J. F. et al., eds., 2008, *The Martian Surface: Composition, Mineralogy, and Physical Properties*. Cambridge University Press, ISBN: 9780521866989.
- Murphy, N. W., with **Putzig, N. E.**, and 4 colleagues 2007. Thermophysical properties of the Isidis basin, Mars. *J. Geophys. Res.* **112**, E05004, doi:10.1029/2005JE002586.
- Phillips, R. J., with **Putzig, N. E.**, and 16 colleagues, 2011. Massive CO₂ Ice Deposits Sequestered in the South Polar Layered Deposits of Mars. *Science* **332**, 838-841.
- Phillips, R. J., with **Putzig, N. E.**, and 25 colleagues, 2008. Mars North Polar Deposits: Stratigraphy, Age, and Geodynamical Response. *Science* **320**, 1182-1185.
- Plaut, J. J., with **Putzig, N. E.**, and 6 colleagues, 2009. Radar evidence for ice in lobate debris aprons in the mid-northern latitudes of Mars. *Geoph. Res. Lett.* **36**, L2203.
- Putzig, N. E.**, 2006. *Thermal inertia and surface heterogeneity on Mars*. Ph. D. dissertation, University of Colorado, Boulder, Colorado, 195 pp.
- Putzig, N. E.**, 1988. *Modeling wide-angle seismic data from the central California margin*. Master of Arts thesis, Rice University, Houston, Texas, 145 pp.
- Putzig, N. E.**, Morgan, G. A., Campbell, B. A., Grima, C., Smith, I. B., Phillips, R. J., Golombek, M., 2016. Radar-derived Properties of the InSight Landing Site in Western Elysium Planitia on Mars. *Spac. Sci. Rev.*, doi:10.1007/s11214-016-0322-8.
- Putzig, N. E.**, Phillips, R. J., Campbell, B. A., Mellon, M. T., Holt, J. W., Brothers, T. C., 2014. SHARAD soundings and surface roughness at past, present, and proposed landing sites on Mars: Reflections at Phoenix may be attributable to deep ground ice. *J. Geoph. Res.* **119**, doi:10.1002/2014JE004646.
- Putzig, N. E.**, Mellon, M. T., Herkenhoff, K. E., Phillips, R. J., Davis, B. J., Ewer, K. J., Bowers, L. M., 2014. Thermal behavior and ice-table depth within the north polar erg of Mars. *Icarus* **230**, 64-76.
- Putzig, N. E.**, Phillips, R. J., Campbell, B. A., Foss II, F. J., 2010. Imaging the Subsurface Structure of Planum Boreum with the Mars Reconnaissance Orbiter Shallow Radar. Proc. 13th Int. Conf. Ground Penetrating Radar, Lecce, Italy, doi:10.1109/ICGPR.2010.5550144.
- Putzig, N. E.**, Phillips, R. J., Campbell, B. A., Holt, J. W., Plaut, J. J., Carter, L. M., Egan, A. F., Bernardini, F., Safaeinili, A., Seu, R., 2009. Subsurface structure of Planum Boreum from Mars Reconnaissance Orbiter Shallow Radar soundings. *Icarus* **204**, 443-457.
- Putzig, N. E.**, Mellon, M. T., 2007. Apparent thermal inertia and the surface heterogeneity of Mars. *Icarus* **191**, 68-94.
- Putzig, N. E.**, Mellon, M. T., 2007. Thermal behavior of horizontally mixed surfaces on Mars. *Icarus* **191**, 52-67.

Publications (continued)

- Putzig, N. E.**, Mellon, M. T., Kretke, K. A., Arvidson, R. E., 2005. Global thermal inertia and surface properties of Mars from the MGS mapping mission. *Icarus* 173, 325-341.
- Putzig, N. E.**, King, K. M., Dwan, F. S., 1992. Yemen 1992 Reprocessing at Pecten, Shell Oil Company confidential paper, Houston, Texas.
- Seu, R., with **Putzig, N. E.**, and 50 colleagues, 2007. Accumulation and Erosion of Mars' South Polar Deposits. *Science* 317, 317, 1715-1718, doi:10.1126/science.1144120.
- Smith, I. B., **Putzig, N. E.**, Phillips, R. J., Holt, J. W., 2016. An ice age recorded in the polar deposits of Mars. *Science* 352, 1075-1078, doi:10.1126/science.aad6968.

Invited Lectures

- Putzig, N. E.**, 2017. Exploring the Interior and Climate History of Mars with MRO's Shallow Radar Sounder. Heiland Lecture, invited presentation. Colorado School of Mines, Golden, Colorado, January 19.
- Foss II, F. J., **Putzig, N. E.**, Campbell, B. A., Phillips, R. J., 2017. 3-D imaging of Mars' polar ice caps using orbital radar data. Invited joint presentation by Foss and Putzig, Denver Geophysical Society luncheon, Denver, Colorado, January 12.
- Putzig, N. E.**, Foss II, F. J., Campbell, B. A., 2016. Three-dimensional radar imaging of structures within the north polar cap of Mars. Invited Keynote presentation, 22nd Annual 3D Seismic Symposium of The Rocky Mountain Association of Geologists and The Denver Geophysical Society, Denver, Colorado, March 3.
- Putzig, N. E.**, Foss II, F. J., 2015. SeisWare on Mars. Presented SHARAD 3D volume of Planum Boreum in the SeisWare booth at the 2015 Society of Exploration Geophysicists Annual Meeting in New Orleans, Louisiana, October 19-21.
- Putzig, N. E.**, Seu, R., Phillips, R. J., and the SHARAD Team, 2015. SHARAD: Bringing a third dimension to Mars exploration. Presented at the Jet Propulsion Laboratory seminar on Mars Reconnaissance Orbiter Project: 10 Years of Exploration at Mars, October 15.
- Putzig, N. E.**, 2015. Subsurface Imaging with SHARAD and Implications for the Recent Climate History of Mars. University of Colorado, LASP Seminar, January 15.
- Putzig, N. E.**, 2013. 3-D imaging of the polar caps of Mars with SHARAD. Seminar on the Exploration of Mars with the MARSIS and SHARAD Italian Radars, DIET, Sapienza Università di Roma, May 7.
- Putzig, N. E.**, 2013. 3-D radar imaging of the Martian polar caps. Keynote address for Mars & Beyond Session, Crossroads Conference, Univ. of Indiana Dept. of Geology, April 4.
- Putzig, N. E.**, 2013. CAT scans of Mars: Three-dimensional imaging of the polar layered deposits with SHARAD. University of Arizona Lunar and Planetary Laboratory Colloquium, January 29.
- Putzig, N. E.**, 2012. SeisWare on Mars: Structure, stratigraphy, and depositional history of the Martian north polar cap from 2-D and 3-D orbital radar sounder data. Presented in the SeisWare booth at the 2012 Society of Exploration Geophysicists Annual Meeting in Las Vegas, Nevada.
- Putzig, N. E.**, 2010. Subsurface Radar Mapping of Mars. University of Colorado Astrobiology Seminar, November 17.
- Putzig, N. E.**, 2007. Mars in 3D: Layering from thermal and radar investigations. Southwest Research Institute Colloquium, Boulder, Colorado, March 8.

Invited Lectures (continued)

- Putzig, N. E.**, 2006. Thermal inertia and surface heterogeneity on Mars. PhD dissertation defense, University of Colorado, Boulder, Colorado, August 29. [Defense Leaflet and Abstract](#).
- Putzig, N. E.**, 1988. Modeling wide-angle seismic data from the central California margin. Masters thesis defense, Rice University, Houston, Texas, April 15.

Selected Abstracts

- Barratt, E. M., **Putzig, N. E.**, 2013. Thermophysical Analysis of Gale Crater Using TES and THEMIS Observations. EPSC [Abstract 613](#).
- Bowers, L. M., **Putzig, N. E.**, 2011. Dune Morphology and its Effects on the Thermal Behavior of Olympia Undae. LPSC XLII, [Abstract 2819](#).
- Courville, S. W., **Putzig, N. E.**, Hoover, R., Fenton, L. K., 2016. Thermophysical Variation within Dune Fields in the Southern Hemisphere of Mars. AGU Fall Meeting, [Abstract P21A-2073](#).
- O'Shea, P. M., **Putzig, N. E.**, Van Kooten, S. J., Fenton, L. K., 2015. The Effects of Dune Slopes and Material Heterogeneity on the Thermal Behavior of Dune Fields in Mars' Southern Hemisphere. AGU Fall Meeting, [Abstract P43A-2092](#).
- Putzig, N. E.**, Foss II, F. J., Campbell, B. A., Phillips R. J., Smith, I. B., 2016. Structures Within the South Polar Cap of Mars from Three-dimensional Radar Imaging. AGU Fall Meeting, [Abstract P54B-07](#).
- Putzig, N. E.**, Foss II, F. J., Campbell, B. A., Smith, I. B., Phillips R. J., 2016. Structures Within Martian Polar Caps Revealed in SHARAD 3-D Radar Volumes. Sixth Mars Polar Science Conference, [Abstract 6101](#).
- Putzig, N. E.**, Phillips, R. J., Campbell, B. A., Plaut, J. J., Holt, J. W., Bernardini, F., Egan, A. F., Smith, I. B., 2016. Custom SHARAD processing via the CO-SHARPS Processing Boutique. LPSC XLVII, [Abstract 3010](#).
- Putzig, N. E.**, Phillips, R. J., Smith, I. B., Thomason, C. J., Mellon, M. T., Campbell, B. A., Wood, S. E., 2015. Low Radar Reflectivity in Planum Australe Points to Past Episodes of Martian Atmospheric Collapse. LPSC XLVI, [Abstract 2586](#).
- Putzig, N. E.**, Barratt, E. M., Mellon, M. T., Michaels, T. I., 2013. MARSTHERM: A Web-based System Providing Thermophysical Analysis Tools for Mars Research. [Abstract P43C-2023](#). Poster presented at the AGU Fall Meeting in San Francisco, CA, December 12.
- Putzig, N. E.**, Levander, A. R., 1988. Interpretation of continuous-offset seismic data in the central California margin, AAPG Bulletin 72 (3), 392 ([abstract](#)). Invited paper presented at Pacific sections AAPG, SEG, SEPM, SPWLA annual meeting in Santa Barbara, CA, Apr18.
- Van Kooten, S. J., **Putzig, N. E.**, O'Shea, P. M., Fenton, L. K., 2016. Investigating the Poleward Trend of Southern Dune Field Stabilization on Mars Using Thermophysical Observations. LPSC XLVII, [Abstract 2528](#).