

## Alejandro Soto

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*A planetary scientist and aerospace engineer involved in Solar System exploration.*

## Expertise

I have over a decade of experience developing and using atmospheric models to study the dynamics of terrestrial planets. I have used and help develop atmospheric models for Mars, Titan, and Pluto, including working with existing models such as NCAR's WRF, MarsWRF, TitanWRF, and GFDL's FMS. I also have experience in space instrument development and operations for planetary spaceflight missions, including the Mars Reconnaissance Orbiter and the Deep Impact mission.

## Professional Appointments

- Oct. 2019 - present, Southwest Research Institute, Senior Research Scientist
- Jan. 2015 – Sept. 2019, Southwest Research Institute, Research Scientist
- Jan. 2013 – Dec. 2014, Southwest Research Institute, Postdoctoral Scholar
- Aug. 2012 – Dec. 2012, California Institute of Technology, Postdoctoral Scholar
- Feb. 2012 – July 2012, Colorado School of Mines, Postdoctoral Scholar
- Apr. 2000 – July 2004, NASA Jet Propulsion Laboratory, System Engineer
- Sept. 1997 – Sept. 1998, Lockheed Martin Missiles & Space, Technical Staff

## Education

Ph.D., Planetary Science, **California Institute of Technology**, 2012.  
Dissertation: *Dynamical Paleoclimatology of Mars*. (Defended Nov. 2011).

M.S., Aeronautics & Astronautics, **Stanford University**, 2000.

B.A., Physics & Astronomy, with Honors, **Dartmouth College**, 1997.  
Senior Thesis: *A Kinematic Study of the Galactic Supernova Remnant 3C58*.

Vatican Observatory Summer School, Castel Gandolfo, Italy, 1997.

“Observations and Theoretical Understanding of Comets, Asteroids, and Meteorites”.

## Project Experience

- Co-Investigator on Project ESPRESSO, a SSERVI virtual institute. 2017 – present
- Payload Sys. Engineer, Phase A/B/C, Mars Reconnaissance Orbiter (MRO). 2001 – 2004.
- Instrument Sys. Engineer on the Terrestrial Planet Finder (TPF) program. 2003 – 2004.
- Science Sys. Engineer, Phase C/D, Deep Impact Mission. Launch: 2002 – 2004.
- Lead Instrument Engineer for JPL's MATMOS instrument. 2002 – 2004.
- Integration and Test Engineer, Phase C/D, Stanford's OPAL satellite. Launch: 1998 –1999.

## Flight Projects

**Deep Impact.** Dr. Soto was a science system engineer on the Deep Impact mission during Phase C & D. During that time, he helped develop the science operations sequences for the lunar flyby observations as well as the comet encounter observations. Dr. Soto also participated in the pre-launch science planning, balancing spacecraft resources with scientific objectives and requirements.

**Mars Reconnaissance Orbiter.** Dr. Soto was a payload systems engineer on the Mars Reconnaissance Orbiter (MRO) during Phase A through C. He participated in designing the interfaces, both physical and

operational, between the MRO spacecraft and the MCS, MARCI, and CTX instruments. As a member of the MRO engineering team, Dr. Soto was an advocate for the instruments.

**Stanford's OPAL spacecraft.** Dr. Soto was an integration and test engineer for Stanford's Orbiting Picosatellite Automated Launcher (OPAL) during Phase C & D. OPAL launched in January 2000.

## Instrument Projects

**Grain Velocimetry and Tomography Analysis System (GraVeTAS).** As a member of Project ESPRESSO, a Solar System Exploration Virtual Institute (SSERVI) team, Dr. Soto is investigating the dynamical processes associated with impact ejecta formation and how impact ejecta processes affect the small body surface environment, with a focus on the consequences for robotic and human operations. Dr. Soto and his team are developing the Grain Velocimetry and Tomography Analysis System (GraVeTAS), an instrument to simultaneously measure the size, shape, 3D velocity, and optical-NIR spectrum of ejecta particles with sizes from 0.25 micron to 3 millimeter in free flight traveling at speeds up to a kilometer per second launched from laboratory impact experiments.

**An Integrated Anemometer, Nephelometer, and Tomographer to Study Planetary Atmospheres.** Dr. Soto is involved in developing the system level requirements and in analyzing the performance of various prototypes of an optical instrument for in situ measurement of atmospheric properties. This instrument is intended for use on the surface of Venus, Mars, and Titan and in the atmospheres of the gas and ice giants.

## Refereed Papers

**Soto, A.** R. G. Fronk, K. Neal, B. Ehresmann, S. L. Bellinger, M. Shoffner, D. S. McGregor (2020). "A semiconductor-based neutron detection system for planetary exploration", *Nuclear Instrument and Methods in Physics Research, A*, in press, doi:10.1016/j.nima.2020.163852.

Rafkin, S. C. R. and **A. Soto** (2019). Air-Sea Interactions on Titan: Lake Evaporation, Atmospheric Circulation, and Cloud Formation. Submitted to *Icarus* and under review.

Steckloff, J. K., J. M. Soderblom, K. Farnsworth, V. Chevrier, J. Hanley, **A. Soto**, J. Groven, W. Grundy, L. Pearce (2019). The Evaporation-Induced Stratification of Titan's Lakes. Submitted to *Nature Astronomy* and under review.

Farnsworth, K. K., Chevrier, V. F., Steckloff, J. K., Laxton, D., Singh, S., **Soto, A.**, and Soderblom, J. M. (2019). Nitrogen Exsolution and Bubble Formation in Titan's Lakes. *Geophysical Research Letters*, doi:10.1029/2019gl084792.

McDonald, G. D., A. G. Hayes, R. C. Ewing, J. M. Lora, C. E. Newman, T. Tokano, A. Lucas, **A. Soto**, G. Chen, "Variations in Titan's dune orientations as a result of orbital forcing", *Icarus*, Volume 270, Pages 197-210, doi:10.1016/j.icarus.2015.11.036.

**Soto, A.**, M.A. Mischna, T. Schneider, C. Lee, M.I. Richardson (2015), "Martian atmospheric collapse: Idealized GCM studies", *Icarus*, Volume 250, Pages 553-569, doi:10.1016/j.icarus.2014.11.028.

Guo, X., M. I. Richardson, **A. Soto**, and A. Toigo (2010), "On the mystery of the perennial carbon dioxide cap at the south pole of Mars", *Journal of Geophysical Research*, 115, E04005, doi:10.1029/2009JE003382.

Fesen, R., G. Rudie, A. Hurford, and **A. Soto** (2008), "Optical Imaging and Spectroscopy of the Galactic Supernova Remnant 3C 58 (G130.7+3.1)." *The Astrophysical Journal Supplement Series*, 174:2, pages 379-395, doi:10.1086/522781.

Anderson, M.S., J.M. Andringa, R.W. Carlson, P. Conrad, W. Hartford, M. Shafer, **A. Soto**, A.I. Tsapin, J.P. Dybwad, W.Wadsworth, and K. Hand (2005), "Fourier Transform Infrared Spectroscopy for Mars Science." *Review of Scientific Instruments*, volume 76, doi:10.1063/1.1867012.

## Funding as Principal Investigator

“Investigating Clouds on Titan”, Grant No. 80NSSC18K0967, 05/22/2018 - 05/21/2021, role: Principal Investigator.

## Funding as Co-Investigator

“The Role of Moist Convection in Titan’s Hydrological Cycle and General Circulation”, Grant No. 80NSSC17K0722, PI: Juan Lora.

“Exploration Science Pathfinder Research for Enhancing SS Observations (ESPRESSO)”, a Solar System Exploration Research Virtual Institute (SSERVI) team, PI: Alex Parker.

“The biologic potential of the martian subsurface via brine production through atmosphere-regolith interactions”, Grant No. 80NSSC17K0742, PI: Edgard Rivera-Valentin.

“Environmental Consequences of Asteroidal Bombardment on Early Mars”, Grant No. NNX16AR87G, PI: Simone Marchi.

“The Hydrology, Climate, and Sedimentary Deposits of Meridiani Planum and Gale Crater”, Grant No. NNX15AH34G, PI: Jeffrey Andrews-Hanna.

“Climatic control of explosive volcanism on Mars”, Grant No. 80NSSC17K0059, PI: Jeffrey Andrews-Hanna.

## Service to the Science Community

- Reviewer for articles in Science, Icarus, Nature Geoscience, Geophysical Research Letters, and Journal of Atmospheric Science.
- Served on various NASA ROSES and NSF review panels in 2014, 2015, 2016, and 2018. Also provided external reviews to a variety of review panels from 2014 to the present.
- Member of the Division for Planetary Science (DPS) Prize Subcommittee, 2018-2019.
- Member of the American Astronomical Society Sustainability Committee, 2018-2021.
- Member of the Division for Planetary Science Professional Culture & Climate Subcommittee, 2018-
- Co-Chair for the Comparative Climatology of Terrestrial Planets III conference held in Houston, TX in August 2018.
- Member of the science organizing committee for the Mars Workshop on Amazonian and Present-Day Climate held in Denver, CO in June 2018.
- Member of MEPAG’s Ice and Climate Evolution Science Analysis Group (ICE-SAG).

## Memberships

- Division of Planetary Science (DPS) of the American Astronautical Society (AAS).
- American Institute of Aeronautics and Astronautics (AIAA).
- American Geophysical Union (AGU).
- American Meteorological Society (AMS).

## Science Communication and Outreach

- I volunteer as a [producer](#) for KGNU’s How on Earth science radio show, producing a number of shows on a [variety of science topics](#), including [planetary science](#).
- I was interviewed in Spanish and English as part of the MU69 observation campaigns in Mendoza, Argentina and Comodoro Rivadavia, Argentina, including an interview with [ADN Sur - Agencia de Noticias de Comodoro Rivadavia y Chubut](#) and an interview with [Texas Public Radio](#).
- Wrote an article for the Planetary Society about the [MU69 campaign](#).

- I participated in science outreach panels at the 2016 and 2017 Denver Comic Con, including a panel about the science of *The Martian* and a panel about pursuing a career in planetary science and exploration.
- In March 2019, I spoke at the San Antonio Astronomy on Tap event co-sponsored by the Witte Museum in San Antonio. As part of the “Mars Attacks!” event, I spoke about “Dust Storms on Mars”.