

Dr. Andrew M. Annex

SENIOR SCIENCE SYSTEMS ENGINEER

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Education

Johns Hopkins University

PH.D. EARTH AND PLANETARY SCIENCES

- Dissertation title: The Regional Sedimentary Record of Arabia Terra, Mars.
- Advisor: Dr. Kevin Lewis

Baltimore, MD

2016 – 2022

Johns Hopkins University

M.A. EARTH AND PLANETARY SCIENCES

The University of Virginia

B.S. ENVIRONMENTAL SCIENCES

- Course work in GIS, Linear Algebra, Statistics and Computer Science.

Baltimore, MD

2016 – 2018

Charlottesville, VA

2010 – 2014

Experience

Senior Science Systems Engineer

SETI INSTITUTE

- NASA VIPER VIS Instrument Scientist

Remote

January 2024 – present

Postdoctoral Scholar Research Associate

CALIFORNIA INSTITUTE OF TECHNOLOGY

- Mars 2020 Rover Science Team Collaborator, Mastcam-Z Postdoctoral Collaborator
- Tactical Science Operations Payload Uplink Lead for geology and multispectral targeting of Mastcam-Z during rover planning.
- Directed and communicated observation requirements, science intent, and pointing designs to science and engineering leads.
- Participated in science discussion and campaign implementation meetings and Sedimentology and Stratigraphy working groups.
- Contributed to open-source software for OGC Tiles and dynamic raster tile servers to improve accessibility of planetary science data.
- Applied machine learning to image segmentation of Mastcam-Z & NavCam images to support tactical science planning.
- Consulted for Python programming and open-source best practices for grant proposals and interviews of undergraduate research intern candidates.

Pasadena, CA

February 2022 – January 2024

Attitude Control lead, Planetary Science Summer School

JET PROPULSION LABORATORY

- Designed spacecraft attitude control and determination requirements necessary for remote sensing instruments to achieve science objections for mission concept study.
- Communicated requirements with JPL Team-X and other team members to select components and finalize design.

Remote

May – July 2020

AI Researcher

FRONTIER DEVELOPMENT LAB

- Applied machine learning to flood prediction and monitoring for the USGS resulting in multiple presentations at NASA, Google campus, and NeurIPS 2020 workshops.

Mountain View, CA

June – August 2019

Graduate Research Assistant

JOHNS HOPKINS UNIVERSITY

- Using stereo imaging and machine learning lead investigation into climate history of Mars through correlation of regional stratigraphy of Arabia Terra.
- Developed a novel crater statistics method to constrain depositional hiatus lengths from partially exhumed craters.
- Created end-to-end scalable and reproducible scientific pipeline with Pangeo stack (Dask & Xarray).
- Applied innovative statistical geologic modeling to visualize 3D structural geology of deposits utilizing HPC resources.
- Built reproducible HiRISE stereo photogrammetry pipeline that also support other lab members, saving days of time required for manual approach.
- Pioneered application of Deep Learning (U-Net CNN) to automate time-intensive geologic mapping of layered deposits on Mars.

Baltimore, MD

September 2016 – February 2022

Data Scientist

COMMONWEALTH COMPUTER RESEARCH INC.

- Designed new features for GeoMesa (FOSS Geodatabase) including geospatial BlobStore.
- Implemented new geospatial analytics and OGC web service integrations between GeoMesa and Geoserver backend.
- Worked with customers onsite with deployment and integration of GeoMesa and web-map visualization tools.
- Developed cloud based analytical and visualization framework for satellite imagery processing and orthorectification on Hadoop/Accumulo.

Charlottesville, VA

June 2014 – August 2016

Intern, CIRS instrument science team, Cassini-Huygens mission.

NASA GSFC

- Designed data coverage reports for CIRS instrument science team for end-of-mission observation planning.
- Developed Python based ETL and analysis pipeline to generate reproducible reports from legacy database system.
- Collaborated with engineers and science team on report designs resulting in 1 peer-reviewed publication.

Greenbelt, MD

May – August 2013

Undergraduate Research Assistant

UNIVERSITY OF VIRGINIA

- Implemented ETL pipeline for Cassini ISS NAC imagery to investigate photometric properties of the moons of Saturn resulting

Charlottesville, VA

May 2011 – May 2014

A current publication list is also available from my Orcid (ID: 0000-0002-0253-2313).

REFEREED PUBLICATIONS

- 2024 **Elevation anomalies of the volcanic floor unit and their relationships to the multiple lakes of Jezero crater, Mars.**, A. Annex, B. Ehlmann, *GRL*, doi: 10.1029/2023GL108069
- 2024 **Constraining the duration and ages of stratigraphic unconformities on Mars using exhumed craters**, A. Annex, K. Lewis, *in revisions JGR: Planets*
- 2024 **Sedimentology and Stratigraphy of the Shenandoah Formation, Western Fan, Jezero Crater, Mars**, K. M. Stack, L. R. W. Ives, S. Gupta, M. P. Lamb, M. Tebolt, G. Caravaca, J. P. Grotzinger, P. Russell, D. L. Shuster, A. J. Williams, H. Amundsen, S. Alwmark, **A. M. Annex**, R. Barnes, J. Bell, O. Beyssac, T. Bosak, L. S. Crumpler, E. Dehouck, S. J. Gwizd, K. Hickman-Lewis, B. H. N. Horgan, J. Hurowitz, H. Kalucha, O. Kanine, C. Lesh, J. Maki, N. Mangold, N. Randazzo, C. Seeger, R. M. E. Williams, A. Brown, E. Cardarelli, H. Dypvik, D. Flannery, J. Frydenvang, S.-E. Hamran, J. I. Núñez, D. Paige, J. I. Simon, M. Tice, C. Tate, R. C. Wiens, *JGR: Planets*, doi: 10.1029/2023JE008187
- 2023 **Mineralogy, morphology, and emplacement history of the Maaz formation on the Jezero crater floor from orbital and rover observations**, B. Horgan, A. Udry, M. Rice, S. Alwmark, H. E. F. Amundsen, J. F. Bell, III, L. Crumpler, B. Garczynski, J. Johnson, K. Kinch, L. Mandon, M. Merusi, C. Million, J. I. Núñez, P. Russell, J. I. Simon, M. St. Clair, K. M. Stack, A. Vaughan, B. Wogsland, **A. Annex**, A. Bechtold, T. Berger, O. Beyssac, A. Brown, E. Cloutis, B. A. Cohen, S. Fagents, L. Kah, K. Farley, D. Flannery, S. Gupta, S. E. Hamran, Y. Liu, G. Paar, C. Quantin-Nataf, N. Randazzo, E. Ravanis, S. Sholes, D. Shuster, V. Sun, C. Tate, N. Tosca, M. Wadhwa, R. C. Wiens, *JGR: Planets*, doi: 10.1029/2022JE007612
- 2023 **Bedding scale correlation on Mars in western Arabia Terra**, A. Annex, A. Koepfel, K. Lewis, C. Edwards, *JGR: Planets*, doi: 10.1029/2023JE007776
- 2023 **The Complex Exhumation History of Jezero Crater Floor Unit and its implication for Mars Sample return**, C. Quantin-Nataf, S. Alwmark, F. J. Calef, J. Lasue, K. Kinch, K. M. Stack, V. Sun, N. R. Williams, E. Dehouck, L. Mandon, N. Mangold, O. Beyssac, E. Clave, S. H. G. Walter, J. I. Simon, **A. Annex**, B. Horgan, J. W. Rice, D. Shuster, B. Cohen, L. Kah, S. Sholes, B. P. Weiss, *JGR: Planets*, doi: 10.1029/2022JE007628
- 2023 **Spectral variability of rocks and soils on the Jezero crater floor: A summary of multispectral observations from Perseverance's Mastcam-Z instrument**, M. Rice, J. Johnson, C. Million, M. St. Clair, B. Horgan, A. F. Vaughan, J. I. Núñez, B. Garczynski, S. Curtis, K. Kinch, M. Merusi, A. Hayes, J. F. Bell, III, L. Duflot, K. Lapo, A. A. Evans, A. Eng, E. Cloutis, A. J. Brown, **A. Annex**, *JGR: Planets*, doi: 10.1029/2022je007548
- 2023 **Three-dimensional data preparation and immersive mission-spanning visualization and analysis of Mars 2020 Mastcam-Z stereo image sequences**, G. Paar, T. Orter, C. Tate, R. G. Deen., P. Abercrombie, M. Vona, J. Proton, A. Bechtold, F. Calef, R. Barnes, C. Koeberl, K. Herkenhoff, E. M. Hausrath, C. Traxler, P. Caballo, **A. Annex**, S. Gupta, J. F. Bell, III, J. Maki, *Earth and Space Science*, doi: 10.1029/2022EA002532
- 2022 **A fragile record of fleeting water on Mars**, A. Koepfel, C. Edwards, **A. Annex**, K. Lewis, G. Carrillo, *Geology*, doi: 10.1130/G49285.1
- 2021 **Tiger: Concept Study for a New Frontiers Enceladus Habitability Mission**, E. Spiers, J. Weber, C. Venigalla, **A. Annex**, C. Chen, P. Gray, C. Lee, K. McIntyre, J. Berdis, S. Carberry Mogan, P. Pereira, S. Kumar, W. O'Neill, E. Czajka, P. Johnson, A. Pascuzzo, S. Tallapragada, D. Phillips, K. Mitchell, A. Nash, J. Scully, L. Lowes, *AAS PSJ*, doi: 10.3847/PSJ/ac19b7
- 2021 **Neptune Odyssey: A Flagship Concept for the Exploration of the Neptune-Triton System**, A. Rymer, K. Runyon, B. Clyde, S. Ensor, C. T. Aplan, J. Bruzzi, J. Vertisi, K. Hansen, K. Soderlund, K. Sayanagi, A. Stern, L. C. Quick, T. Becker, M. Hedman, I. Cohen, F. Crary, J. Fortney, A. Masters, A. Simon, A. Patthoff, C. Scott, C. Campo, C. Krupriaz, C. Hansen, C. Corey, C. Paty, C. Gantz, D. Rodriguez, D. Gallagher, D. Hurley, D. Crowley, E. Abel, E. Provornikova, E. Turtle, G. Clark, G. B. Hospodarsky, H. Todd Smith, H. Wakeford, I. de Pater, J. Wilkes, J. Hunt1, J. Roberts, J. Rehm, J. Nunez, J. Arrieta, K. Mandt, K. Murray, K. B. Stevenson, L. Wolfarth, L. Fletcher, L. Spilker, M. Hofstadter, M. T. Ozimek, E. S. Martin, M. Parisi, M. Norkus, N. Izenberg, R. McNutt, R. Stough, R. Nikoukar, R. Vervack, P. Schenk, S. Kijewski, T. Spilker, T. Stallard, W. Cheng, J. Feldman, G. Allen, D. Prabhu, S. Dutta, S. Moran, **A. Annex**, *AAS PSJ*, doi: 10.3847/PSJ/abf654
- 2020 **SpiceyPy: a Pythonic Wrapper for the SPICE Toolkit**, A. Annex, B. Pearson, B. Seignovert, B. Carcich, H. Eichhorn, J. Mapel, J. Forstner, J. McAuliffe, J. Rio, K. Berry, K. Aye, M. Stefko, M. Val-Borro, S. Kulumani, S. Murakami, *JOSS*, doi: 10.21105/joss.02050
- 2019 **Regional Correlations in the layered deposits of Arabia Terra, Mars**, A. M. Annex, K. W. Lewis, *JGR: Planets*, doi: 10.1029/2019JE006188

2019 **Cassini Composite Infrared Spectrometer (CIRS) Observations of Titan 2004-2017**, C. A. Nixon, T. M. Ansty, N. A. Lombardo, G. L. Bjoraker, R. K. Achterberg, **A. M. Annex**, M. Rice, P. N. Romani, D. E. Jennings, R. E. Samuelson, C. M. Anderson, A. Coustenis, B. Blezard, S. Vinatier, E. Lellouch, R. Courtin, N. A. Teanby, V. Cottini, F. M. Flasar, *ApJS*, doi: 10.3847/1538-4365/ab3799

2018 **Snakes on a Spaceship - An Overview of Python in Heliophysics**, A. G. Burrell, A. Halford, J. Klenzing, R. A. Stoneback, S. K. Morley, **A. M. Annex**, K. M. Laundal, A. C. Kellerman, D. Stansby, J. Ma, *ApJ*, doi: 10.3847/1538-4357/ab3eb4

CONFERENCE PROCEEDINGS

2019 **Machine Learning for Generalizable Prediction of Flood Susceptibility**, C. Sidrane, D. J Fitzpatrick, **A. Annex**, D. O'Donoghue, Y. Gal, P. Biliński, *NeurIPS Climate Change Workshop*

2015 **GeoMesa: a distributed architecture for spatio-temporal fusion**, J. N. Hughes, **A. M. Annex**, C. N. Eichelberger, A. Fox, A. Hulbert, M. Ronquest, *SPIE*, doi: 10.1117/12.2177233

WHITEPAPERS

2020 **Opportunities and Challenges for Structural Geology and Tectonics in the Planetary Sciences**, C. Klimczak, C. B. Beddingfield, P. Byrne, H. C. J. Cheng, K. T. Crane, **A. Annex**, *2023-2032 Planetary Science and Astrobiology Decadal Survey*

2020 **Neptune and Triton: A Flagship for Everyone**, A. Rymer, K. Runyon, J. Vertisi, K. Hansen, K. Soderlund, K. Sayanagi, A. Stern, L. Quick, T. Becker, M. Hedman, I. Cohen, F. Crary, J. Fortney, A. Masters, A. Patthoff, A. Simon, **A. Annex**, C. Hansen, C. Paty, C. Cochrane, D. Hurley, E. A. Provornikova, E. Z. Turtle, E. S. Martin, H. Smith, H. Wakeford, I. de Pater, J. Roberts, J. I. Nunez, J. Arrieta, K. E. Mandt, K. B. Stevenson, L. Fletcher, L. Spilker, M. Hofstadter, N. Izenberg, P. Marzia, P. Schenk, R. McNutt, R. Nikoukar, R. Vervack, S. Moran, T. Spilker, T. Stallard, A. Azari, G. B. Hospodarsky, *2023-2032 Planetary Science and Astrobiology Decadal Survey*, doi: 10.3847/25c2cfcb.0b72af56

2020 **Comparative Planetology of Kuiper Belt Dwarf Planets Enabled by the Near-Term Interstellar Probe**, K. Runyon, C. J. Ahrens, C. B. Beddingfield, J. T. S. Cahill, R. Cartwright, I. Cohen, B. Holler, T. Stryk, P. Kollmann, E. Kite, J. T. Keane, J. F. Cooper, C. Harman, M. Bannister, K. Singer, A. Stern, A. M. Rymer, N. Izenberg, **A. Annex**, *2023-2032 Planetary Science and Astrobiology Decadal Survey*, doi: 10.3847/25c2cfcb.4873908b

ABSTRACTS

2024 **Version 2.0 of Mastcam Stereo Analysis and Mosaics (MSAM)**, **A. Annex**, R. G. Deen, A. Tinio, B. L. Ehlmann, J. Dickson, J. P. Grotzinger, *Lunar and Planetary Science Conference*

2024 **Streamlining Mastcam-Z Multispectral Analysis with Pixel Disparity**, **A. Annex**, R. G. Deen, J. F. Bell III, B. L. Ehlmann, *Lunar and Planetary Science Conference*

2024 **Past Variations Of Water Level Of Jezero Paleolake**, N. Mangold, G. Caravaca, S. Gupta, R.M.E. Williams, O. Gasnault, S. Le Mouélic, E. Dehouck, G. Dromart, **A. Annex**, J. Hurowitz, L.R.W. Ives, L. C. Kah, N. Randazzo, J. I. Simon, K. Stack, M. M. Tice, J. F. Bell III, A. Cousin, S. Maurice, R.C. Wiens, *Lunar and Planetary Science Conference*

2024 **Overview Of The Mars 2020 Mission Perseverance Rover Third Science Campaign: Exploring Jezero Crater'S Upper Fan**, M. Nachon, K. L. Siebach, S. Sholes, V. Z. Sun, T. Del Sesto, B. P. Weiss, K. M. Stack, K. A. Farley, F. Calef, N. Mangold, J. Hurowitz, G. Caravaca, P. Russell, C. Quantin-Nataf, J. I. Núñez, S. Alwmark, **A. Annex**, R. William, A. Broz, A. Czaja, M. Tice, Y. Liu, S. Gupta, E. Dehouck, *Lunar and Planetary Science Conference*

2024 **Going With the Flow: Sedimentary Evolution of the Jezero Western Fan, Mars**, S. Gupta, K. Stack Morgan, N. Mangold, L. R. W. Ives, S. Gwizd, G. Caravaca, R. M. E. Williams, N. Randazzo, A. J. Williams, P. Russell, B. H. N. Horgan, K. L. Siebach, M. M. Tice, J. Hurowitz, R. Barnes, C. Tate, J. I. Núñez, S. Scholes, L. C. Kah, M. E. Minitti, G. Dromart, J. F. Bell III, J. Maki, G. Paar, **A. Annex**, B. P. Weiss, O. Beyssac, J. Frydenvang, M. Nachon, R. Kronyak, V. Sun, A. J. Jones, D. L. Shuster, J. I. Simon, M. P. Lamb, J. P. Grotzinger, S. Le Mouélic, O. Gasnault, R. C. Wiens, S. Maurice, K. A. Farley, *Lunar and Planetary Science Conference*

2024 **Reconstructing the Sedimentology and Depositional Setting of the Margin Unit, Jezero Crater**, A. J. Jones, S. Gupta, R. Barnes, B. Horgan, G. Paar, K. Stack, B. Garczynski, R. Williams, J. Bell, J. Maki, S. Alwmark, E. Ravanis, F. Calef, L. Crumpler, K. Williford, A. Vaughan, J. Simon, S. Gwizd, C. Tate, **A. Annex**, A. Klidas, K. Farley, N. Randazzo, N. Schmitz, L. Kah, A. Brown, G. Caravaca, N. R. Williams, *Lunar and Planetary Science Conference*

2023 **Applications Of The Machine Learning Segment Anything Model To In-situ Imagery For Planetary Science**, **A. M. Annex**, B. S. Kathir, B. L. Ehlmann, M. S. Rice, *AGU Fall Meeting*

2023 **Recent Geology, Geomorphology, Multispectral, and Atmospheric Imaging Results from the Mastcam-Z Investigation on the NASA Mars 2020 Perseverance Rover in Jezero Crater**, J. F. Bell III, J. Maki, S. Holm-Alwmark, **A. Annex**, R. Barnes, E. Cardarelli, S. A. Fagents, B. Garczynski, S. Gupta, M. Hedman, K. E. Herkenhoff, B. H. N. Horgan, E. Jensen, J. Roy Johnson, M. T. Lemmon, J. I. Núñez, G. Paar, K. Paris, E. M. Ravanis, J. Rice, M. S. Rice, N. Schmitz, D. L. Shuster, R. J. Sullivan Jr., C. Tate, A. F. Vaughan, M. J. Wolf, *AGU Fall Meeting*

- 2023 **The formation of the fluvio-deltaic deposits of the western fan of Jezero crater, Mars, during lake-level fall**, N. Mangold, G. Caravaca, S. Gupta, R. M. E. Williams, G. Dromart, O. Gasnault, E. Dehouck, S. L. Mouelic, **A. Annex**, J. F. Bell III, S. Maurice, R. C. Wiens, *AGU Fall Meeting*
- 2023 **Segment Anything and Applications in Planetary Science**, **A. M. Annex**, B. L. Ehlmann, *6th Planetary Data Workshop*
- 2023 **Update to Filling in the Gaps in Maps: Embracing Open GIS Standards in Planetary Science**, **A. M. Annex**, T. M. Hare, J. R. Laura, N. Manaud, J-C. Malapert, B. Seignovert, *6th Planetary Data Workshop*
- 2023 **The Status of SpicyPy in 2023**, **A. M. Annex**, *6th Planetary Data Workshop*
- 2023 **Fill History of Jezero: Volcanic Floor Units and Their Relationships to the Many Lakes of Jezero Crater**, **A. M. Annex**, B. L. Ehlmann, *Lunar and Planetary Science Conference*, *bib: 2023LPICo2806.1651A*
- 2023 **Filling in the Gaps in Maps: Embracing Open GIS Standards in Planetary Science**, **A. M. Annex**, T. M. Hare, J. R. Laura, N. Manaud, J-C. Malapert, B. Seignovert, *Lunar and Planetary Science Conference*, *bib: 2023LPICo2806.1668A*
- 2023 **Lithofacies, Flow Directions, and Preliminary Depositional Interpretations of Ledge-Forming Sandstones at Alagnak, Jezero Crater, Mars**, L. R. W. Ives, K. M. Stack, R. Barnes, S. Gupta, G. Caravaca, P. Russell, **A. M. Annex**, *Lunar and Planetary Science Conference*, *bib: 2023LPICo2806.2953G*
- 2023 **Fine-Scale Sedimentary Architecture of the Upper Part of the Jezero Western Delta Front**, S. Gupta, J. F. Bell III, G. Caravaca, N. Mangold, K. Stack, O. A. Kanine, C. Tate, M. M. Tice, A. J. Williams, P. Russell, J. I. Núñez, G. Dromart, R. M. E. Williams, S. Le Mouelic, R. Barnes, **A. Annex**, G. Paar, S. Holm-Alwmark, M. S. Rice, J. Rice, B. H. N. Horgan, J. P. Grotzinger, J. Maki, K. Hickman-Lewis, L. C. Kah, D. L. Shuster, J. I. Simon, M. E. Minitti, K. Siebach, O. Gasnault, R. C. Wiens, S. Maurice, K. A. Farley, *Lunar and Planetary Science Conference*, *bib: 2023LPICo2806.2953G*
- 2023 **Stratigraphy Relationships of the Delta and Crater Floor in Jezero Crater from RIMFAX GPR Observations**, P. S. Russell, D. A. Paige, S. E. Hamran, H. Amundsen, **A. Annex**, T. Berger, L. Carter, T. M. Casademont, H. Dypvik, S. Eide, R. Kakaria, M. T. Mellon, D. Nunes, J. I. Núñez, E. Shoemaker, J. I. Simon, *Lunar and Planetary Science Conference*, *bib: 2023LPICo2806.2975R*
- 2023 **Constructing Geological Cross-Sections to Constrain the Three-Dimensional Stratigraphic Architecture of the Jezero Delta Front**, R. Barnes, S. Gupta, G. Paar, K. M. Stack, B. Horgan, L. Crumpler, M. Tebolt, G. Caravaca, S. Alwmark, T. Ortner, C. Traxler, A. Bechtold, H. Kalucha, A. Broz, C. Tate, **A. Annex**, J. F. Bell III, J. Maki, O. Kanine, J. Núñez, S. F. Sholes, L. Kah, N. Schmitz, R. Williams, *Lunar and Planetary Science Conference*, *bib: 2023LPICo2806.2716B*
- 2023 **The Metaverse is here – so let’s use it to Explore Mars**, C. D. Tate, **A. M. Annex**, M. Wolff, A. H. Hayes, N. Randazzo, K. E. Powell, *Lunar and Planetary Science Conference*, *bib: 2023LPICo2806.2888T*
- 2022 **Fine-Scale Sedimentary Architecture of the Upper Part of the Jezero Western Delta Front**, S. Gupta, J. F. Bell III, G. Caravaca, O. A. Kanine, N. Mangold, K. M. Stack, C. Tate, M. M. Tice, A. J. Williams, P. Russell, J. I. Núñez, G. Dromart, R. M. E. Williams, S. Le Mouelic, R. Barnes, **A. Annex**, G. Paar, S. Holm-Alwmark, M. S. Rice, J. Rice, B. H. N. Horgan, J. P. Grotzinger, J. Maki, K. Hickman-Lewis, L. C. Kah, D. L. Shuster, J. I. Simon, M. E. Minitti, K. Siebach, O. Gasnault, R. C. Wiens, S. Maurice, K. A. Farley, *AGU Fall Meeting*, *bib: 2022AGUFM.P56A..05G*
- 2022 **The Three-Dimensional Stratigraphic Architecture of the Jezero Delta Front**, R. Barnes, S. Gupta, G. Paar, A. Bechtold, T. Ortner, C. Traxler, K. M. Stack, J. Bell, G. Caravaca, O. Kanine, C. Tate, M. Tebolt, **A. Annex**, B. Horgan, J. Núñez, S. F. Sholes, L. Kah, N. Schmitz, L. Crumpler, R. Williams, *AGU Fall Meeting*, *bib: 2022AGUFM.P52C1562B*
- 2022 **Sedimentary Facies and Stratigraphy of the Enchanted Lake Outcrop Explored by the Perseverance Rover, Jezero Crater, Mars**, M. Tebolt, K. M. Stack, S. Gupta, R. Barnes, G. Caravaca, **A. Annex**, L. Kah, J. Núñez, *AGU Fall Meeting*, *bib: 2022AGUFM.P52C1564T*
- 2022 **Depositional Conditions for the Rockytop Interval of the Lower Jezero Delta Complex, Mars**, R. Williams, M. E. Minitti, L. Kah, R. Bhartia, C. Lee, M. Kennedy, A. Pascuzzo, S. Gupta, R. Barnes, **A. Annex**, B. Garczynski, A. Brown, J. Núñez, *AGU Fall Meeting*, *bib: 2022AGUFM.P52C1569W*
- 2022 **Emplacement History of Lava Flows of the Mááz Formation on the Jezero Crater Floor: Geochronological Significance and Relationship with the Delta**, B. Horgan, A. Udry, M. S. Rice, S. Holm-Alwmark, J. F. Bell III, L. S. Crumpler, B. Garczynski, J. R. Johnson, K. M. Kinch, M. Merusi, C. Million, J. Núñez, J. Simon, M. St Clair, K. Stack, A. F. Vaughan, B. Wogsland, **A. Annex**, K. Benzerara, A. Brown, E. Cloutis, B. Ehlmann, S. Fagents, L. Kah, K. Farley, D. Flannery, L. Mandon, G. Paar, C. Quantin-Nataf, E. M. Ravanis, S. Sholes, D. L. Shuster, N. Tosca, M. Wadhwa, R. Wiens, *AGU Fall Meeting*, *bib: 2022AGUFM.P56A..07H*
- 2022 **Stratigraphic Unconformity Durations from Partially Exhumed Craters on Mars.**, **A. M. Annex**, K. W. Lewis, A. H. D. Koepfel, C. S. Edwards, *Lunar and Planetary Science Conference*, *bib: 2022LPICo2678.2240A*
- 2021 **ASAP-Stereo, Ames Stereo Automated Pipeline**, **A. M. Annex**, K. W. Lewis, *Planetary Data Workshop and PSIDA meeting*, *bib: 2021LPICo2549.7003A*

- 2021 **The Planetary Software Organization and Open Source Software Governance**, J. Mapel, **A. M. Annex**, K. M. Aye, R. A. Beyer, J. Laura, V. Silva, *Planetary Data Workshop and PSIDA meeting*, *bib: 2021LPICo2549.7029M*
- 2021 **The PlanetaryPy Project**, K. M. Aye, R. A. Beyer, **A. M. Annex**, C. Million, *Planetary Data Workshop and PSIDA meeting*, *bib: 2021LPICo2549.7026A*
- 2021 **TIGER: JPL PSSS Architecture and Feasibility Study for a New Frontiers 5 Mission Concept to Enceladus.**, E. Spiers, J. Weber, C. Venigalla, **A. Annex**, J. Berdis, C. Chen, C. Lee, A. Pascuzzo, E. Czajka, P. Pereira, P. Gray, S. Kumar, K. McIntyre, D. Phillips, S. Tallapragada, S. Carberry Mogan, P. Johnson, W. O'Neill, L. Lowes, K. Mitchell, A. Nash, J. Scully, *Lunar and Planetary Science Conference*, *bib: 2021LPI....52.1598A*
- 2020 **Integrating the sedimentary stratigraphy of Arabia Terra, Mars: depositional history of Sera and Jiji craters**, **A. M. Annex**, K. W. Lewis, A. H. D. Koepfel, C. S. Edwards, *American Geophysical Union Fall Meeting*, *bib: 2020AGUFMP073...04A*
- 2020 **The Martian Dust Bowl: Thermal Inertia in Sediment-Filled Craters Reveals a Noachian Dry Spell**, A. H. D. Koepfel, C. S. Edwards, G. Carrillo, **A. M. Annex**, K. W. Lewis, *American Geophysical Union Fall Meeting*, *bib: 2020AGUFMP073...05K*
- 2020 **Arabia Terra Layered Deposit Stratigraphy from Correlation and Geologic Modeling**, **A. M. Annex**, K. W. Lewis, A. H. D. Koepfel, C. S. Edwards, *Lunar and Planetary Science Conference*, *bib: 2020LPI....51.2116A*
- 2020 **Reinterpreting Thermal Inertia for Mapping Martian Geology**, A. H. D. Koepfel, C. S. Edwards, G. Carrillo, **A. M. Annex**, K. W. Lewis, *Lunar and Planetary Science Conference*, *bib: 2020LPICo2357.7056K*
- 2020 **Compositional and Thermophysical Stratigraphy in Mars Mound Deposits**, A. H. D. Koepfel, C. S. Edwards, **A. M. Annex**, K. W. Lewis, *Lunar and Planetary Science Conference*, *bib: 2020LPI....51.2173K*
- 2019 **Compositional and Thermophysical Indicators of Aqueous Activity in Arabia Terra Crater Deposits**, A. H. D. Koepfel, **A. M. Annex**, C. Pan, C. S. Edwards, K. W. Lewis, *9th Mars Conference*, *bib: 2019LPICo2089.6319K*
- 2019 **SpiceyPy, a Complete Pythonic Interface for Spice**, **A. M. Annex**, *4th Planetary Data Workshop*, *bib: 2019LPICo2151.7043A*
- 2019 **Scarp Associated with Martian Layered Deposits in Arabia Terra**, **A. M. Annex**, K. W. Lewis, C. S. Edwards, *Lunar and Planetary Science Conference*, *bib: 2019LPI....50.1973A*
- 2018 **Stratal thicknesses in the Layered Deposits of Arabia Terra using High-Resolution Stereo Topography**, **A. M. Annex**, K. W. Lewis, C. S. Edwards, *American Geophysical Union Fall Meeting*, *bib: 2018AGUFM.P31I3825A*
- 2018 **Automated stratigraphic mapping using Convolution Neural Networks**, **A. M. Annex**, K. W. Lewis, *NASA Goddard Workshop on AI*
- 2018 **Cassini ISS Photometry of Enceladus Surface and Major Terrains**, A. J. Verbiscer, P. Helfenstein, **A. M. Annex**, *Cassini Science Symposium*
- 2017 **Stratigraphic Mapping of Intra Crater Layered Deposits in Arabia Terra from High-Resolution Imaging and Stereo Topography**, **A. M. Annex**, K. W. Lewis, C. S. Edwards, *American Geophysical Union Fall Meeting*, *bib: 2017AGUFM.P24C..04A*
- 2017 **SpiceyPy, A Python Wrapper for Spice**, **A. M. Annex**, *3rd Planetary Data Workshop*, *bib: 2017LPICo1986.7081A*
- 2014 **Spectrophotometric Properties of Thermally Anomalous Terrain on Mimas**, A. J. Verbiscer, P. Helfenstein, C. J. A. Howett, **A. M. Annex**, P. Schenk, *DPS*, *bib: 2014DPS....4650208V*
- 2013 **Photometric Properties of Thermally Anomalous Terrain on Icy Saturnian Satellites**, **A. M. Annex**, A. J. Verbiscer, C. J. A. Howett, P. Schenk, *DPS*, *bib: 2013DPS....4541702A*
- 2012 **Photometric Properties of Enceladus' South Polar Terrain**, **A. M. Annex**, A. J. Verbiscer, P. Helfenstein, *DPS*, *bib: 2012DPS....4411210A*

Presentations

CONFERENCE TALKS

AGU Fall Meeting

AGU

Applications Of The Machine Learning Segment Anything Model To In-situ Imagery For Planetary Science

San Francisco, CA

December 2023

6th Planetary Data Workshop

LPI

Segment Anything and Applications in Planetary Science

Flagstaff, AZ

June 2023

6th Planetary Data Workshop

LPI

Update to Filling in the Gaps in Maps: Embracing Open GIS Standards in Planetary Science

Flagstaff, AZ

June 2023

6th Planetary Data Workshop

LPI

The Status of SpicyPy in 2023

Lunar and Planetary Science Conference (2023)

LPI

Fill History of Jezero: Volcanic Floor Units and Their Relationships to the Many Lakes of Jezero Crater

Lunar and Planetary Science Conference (2022)

LPI

Stratigraphic Unconformity Durations from Partially Exhumed Craters on Mars.

Planetary Data Workshop and PSIDA meeting

LPI

ASAP-Stereo, Ames Stereo Automated Pipeline

American Geophysical Union Fall Meeting (2020)

AMERICAN GEOPHYSICAL UNION

Integrating the sedimentary stratigraphy of Arabia Terra, Mars: depositional history of Sera and Jiji craters

Lunar and Planetary Science Conference (2020), canceled

LPI

Stratigraphic Mapping of Intra-Crater Layered Deposits in Arabia Terra from High-Resolution Imaging and Stereo Topography

4th Planetary Data Workshop

LPI

SpicyPy, a Complete Pythonic Interface for Spice

NASA Goddard Workshop on AI

NASA

Automated stratigraphic mapping using Convolutional Neural Networks

American Geophysical Union Fall Meeting (2017)

AMERICAN GEOPHYSICAL UNION

Stratigraphic Mapping of Intra-Crater Layered Deposits in Arabia Terra from High-Resolution Imaging and Stereo Topography

3rd Planetary Data Workshop.

LPI

SpicyPy, a Python Wrapper for SPICE

BROWN BAG MEETINGS

OpenPlanetary Lunch Talk series

OPENPLANETARY, [HTTPS://YOUTU.BE/TNCPTfYvO2k](https://youtu.be/TNCPTfYvO2k)

ASAP Stereo project

OpenPlanetary Lunch Talk series

OPENPLANETARY, [HTTPS://YOUTU.BE/BQNxOTM6AUs](https://youtu.be/BQNxOTM6AUs)

SpicyPy, A Pythonic wrapper for SPICE

POSTERS

Lunar and Planetary Science Conference (2019)

LPI

Scarp Associated with Martian Layered Deposits in Arabia Terra

American Geophysical Union Fall Meeting

AMERICAN GEOPHYSICAL UNION

Stratal thicknesses in the Layered Deposits of Arabia Terra using High-Resolution Stereo Topography

Flagstaff, AZ

June 2023

Houston, TX

March 2023

Houston, TX

March 2022

Remote

June 2021

Remote

December 2020

Houston, TX

March 2020

Flagstaff, AZ

19 June 2019

Greenbelt, MD

November 2018

New Orleans, LA

December 2017

Flagstaff, AZ

12 June 2017

Remote

25 August 2020

Remote

14 April 2020

Houston, TX

March 2019

Washington, DC

December 2018

Media Appearances

Featured in: "Open Source Software at NASA" at FOSDEM 2023

[HTTPS://FOSDEM.ORG/2023/SCHEDULE/EVENT/NASA/](https://fosdem.org/2023/schedule/event/nasa/)

SpicyPy was highlighted by Steve Crawford in his Keynote at FOSDEM 2023 (21 minute mark).

Featured in: Talk Python to Me Podcast, Episode 393

[HTTPS://TALKPYTHON.FM/EPISODES/SHOW/393/SPACE-SCIENCE-WITH-PYTHON](https://talkpython.fm/episodes/show/393/space-science-with-python)

SpicyPy was discussed and featured during the interview of Thomas Albin about his YouTube Channel called "Space Science with Python".

We Martians Podcast, Episode 74

[HTTPS://WEMARTIANS.COM/EPISODE074/](https://wemartians.com/episode074/)

Interviewed for my LPSC 2020 abstract on layered deposits in Arabia Terra.

Keynote Highlight

5 February 2023

Podcast

8 December 2022

Podcast

31 March 2020

Software and Computing

SKILLS

Programming Languages (ranked by proficiency)	Python, Scala, Java, Bash, C/C++, R, IDL, SQL
Scientific Toolkits	GDAL/OGR, QGIS, SPICE, ISIS3, Ames Stereo Pipeline, ArcGIS
Packages	Rasterio, Shapely, GeoPandas, Numpy, Scipy, Leaflet, Geotools, JTS, Keras, Scikit-learn
Cloud and Scientific Computing	Github workflows, GCP, AWS, SLURM, GeoMesa, TiTiler, Geoserver, Accumulo, Hadoop
Other	MS Office, Git, GitHub, Docker, Flask, JIRA, Confluence, Linux, macOS, Windows

OPEN SOURCE CONTRIBUTIONS

A more complete record of my contributions is available on my [GitHub profile](#).

SpiceyPy

AUTHOR

2014 – present

[AndrewAnnex/SpiceyPy](#)

A complete open source Python interface for NASA JPL's SPICE toolkit, with over 200 stars on GitHub, solving issue of only proprietary interpreted language support (IDL and MATLAB). Utilized by multiple operating space missions, cited in peer-reviewed research, and public education and outreach including AMNH planetarium show.

ASAP-Stereo

AUTHOR

2020 – present

[AndrewAnnex/asap_stereo](#)

Workflow CLI and wrapper for NASA Ames Stereo Pipeline using Python and Jupyter notebooks. Makes DEM production more automated and richly logged for traceability and reproducibility through Jupyter notebooks.

Professional Service

NASA Review Panel.

PANELIST

2023

Reviewed grant proposals as part of a NASA review panel

Lunar and Planetary Science Conference (2022)

SESSION CHAIR

March 2022

In-person session chair for 'Sedimentary Rocks on Mars: Deposition, Diagenesis, and Stratigraphy'

NASA Review Panel.

PANELIST

2022

Participated as a panelist in a NASA review panel

NASA Review Panel

EXECUTIVE SECRETARY

September 2020

Coordinated votes and captured key decision points from panel discussions.

Honors and Awards

NASA Group Achievement Award

MARS 2020 MASTCAM-Z

2022

For exceptional achievements in scientific and engineering support by the Mastcam-Z science/operations team towards the success of the Mars 2020 Perseverance rover mission.

NASA Group Achievement Award

MARS 2020 SCIENCE TEAM

2022

For exceptional achievement in the scientific exploration of Jezero crater throughout the early Perseverance rover surface mission.

GRO Travel Award

JHU GRADUATE REPRESENTATIVE ORGANIZATION

March 2019

Spirit of the Hill Award

BROWN RESIDENTIAL COLLEGE, UNIVERSITY OF VIRGINIA

May 2013

Dean's List

THE UNIVERSITY OF VIRGINIA

May 2013

Teaching

TEACHING EXPERIENCE

AS.270.114 Guided Tour: the Planets

TEACHING ASSISTANT

Graded examinations prior to March 2020 COVID-19.

AS.270.308 Population Ecology

TEACHING ASSISTANT

Graded and proctored examinations.

Johns Hopkins University

Spring 2020

Johns Hopkins University

Spring 2018

Memberships

- Planetary Software Technical Steering Committee
- PlanetaryPy Technical Committee
- Integrated Software for Imagers and Spectrometers Technical Committee
- American Geophysical Union
- Locationtech
- OpenPlanetary Board of Advisors
- Python in Heliophysics Community (PyHC)