

# Dr. Lauren E. McKeown

JPL POSTDOCTORAL FELLOW

Jet Propulsion Laboratory, 4800 Oak Grove Dr, Pasadena, CA, 91109

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## Summary

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I am a Postdoctoral Research Fellow at NASA JPL with a specialisation in studying icy planetary surface processes on Mars and Europa through remote-sensing image analysis and laboratory analogue work. I am a Europa Clipper Project Science Affiliate and HiRISE Team Affiliate. I have a cross-disciplinary background, with a PhD in planetary science on the topic of Martian geomorphology and a first class honours degree in physics with astronomy and space science. I have worked as a tenured academic lecturer at Birkbeck, University of London and have research experience at NASA Ames, The Open University and The Natural History Museum. I have also worked in project management at The University of Cambridge. I am passionate about STEM outreach and creating a more equitable, diverse and inclusive culture in academia.

## Education

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### Ph.D. in Planetary Science

Dublin, Ireland

TRINITY COLLEGE DUBLIN

2014–2018

- Thesis: An Investigation of the Role of Sublimating CO<sub>2</sub> as a Geomorphic Agent on Mars. Supervisors: Dr. Mary Bourke, Prof. Jim McElwaine.
- PI on successful Europlanet Grant proposal. Designed, curated and orchestrated EU Horizon 2020 - funded experiments at The Open University Mars Simulation Chamber investigating the interaction between sublimating CO<sub>2</sub> ice and Mars regolith analog samples.
- PI on successful Irish Research Council Government of Ireland Postgraduate Scholarship proposal to investigate active Martian surface processes via remote sensing and laboratory analogue work
- Delivered Q1 journal publications and disseminated results internationally.

### B.Sc. Physics with Astronomy and Space Science

Dublin, Ireland

UNIVERSITY COLLEGE DUBLIN

2009–2013

- First Class Honours, GPA: 3.92
- Year 1: Won entrance scholarship based on entry level highest grades.
- Year 2: Won stage 2 scholarship for highest exam results on the course.
- Year 3: Study Abroad at San José State University
- Selected to participate in Intel Ideation Camp at NASA Ames
- Final Year Project: Space Mission Design (A). Collaborated with the University of Southampton to design a gamma ray detection space mission.

## Professional Experience

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### Europa Clipper Project Science Affiliate

Pasadena, CA

Oct 2022–present

### HiRISE Team Affiliate

Pasadena, CA

Apr 2022–present

### JPL Postdoctoral Fellow

Pasadena, CA

NASA JET PROPULSION LABORATORY

Jan 2022–present

- Investigating Martian 'spider' (araneiform) formation by CO<sub>2</sub> sublimation via analog laboratory experiments and remote sensing image analysis.
- Mapping and cataloging different classes of araneiforms.
- Characterizing the present-day surface and frost environment at araneiform sites.
- Conducting correlative analysis of environmental conditions at dendritic trough sites
- Leading planetary analog laboratory experiments to constrain remote-sensing image data analysis.
- Leading a cross-disciplinary investigation of the formation of a spider-like surface feature in Europa's Manannán crater.

### Associate Research Fellow

London, UK

BIRKBECK, UNIVERSITY OF LONDON

Jan 2022–present

- Honorary association with College.

### Tenured Lecturer in Planetary Surfaces

London, UK

BIRKBECK, UNIVERSITY OF LONDON

Aug 2021–Dec 2021

- Contributing to teaching and research in the field of planetary surfaces.
- Lecturing in Geology of the Solar System II.
- Lecturing in Remote Sensing and Planetary Surfaces
- Helping to develop new modules in the fields of planetary science and space exploration.
- Supervising H. Kreider M.Sc thesis at University College London in collaboration with Dr. Ramy El Maary at Khalifa University, Abu Dhabi.

## Honorary Lecturer

UNIVERSITY COLLEGE LONDON

London, UK

Aug 2021–Dec 2021

## Associate Lecturer

BIRKBECK, UNIVERSITY OF LONDON

London, UK

Jan 2021–Aug 2021

- Lecturing in Geology of the Solar System II.
- Received 100% feedback from students in student review.

## Postdoctoral Research Associate

THE OPEN UNIVERSITY

Milton Keynes, UK

March 2021–July 2021

- Preparation of laboratory experiments on collisions of mm and cm-sized icy grains under low temperature and vacuum conditions in order to understand how ensembles of icy interstellar grains aggregate around the snowline in proto-planetary disks during planetary formation.

## Postdoctoral Researcher

UTOPIA-ARGYRE PERIGLACIAL WORKING GROUP

Remote

Sept 2020–Jan 2021

- Mapping and statistical analysis of putatively periglacial surface features on Mars using high resolution remote-sensing images.

## Fact Checker

THE IRISH TIMES SPACE CAMP, SPONSORED BY CADBURY'S IRELAND

Dublin, Ireland

Jul 2020 - Sept 2020

- Fact checking scientific content relating to the Solar System and space exploration for a video series published online.
- Assisting with planetary science script writing for TV personalities and science communicators Mark the Science Guy and Dr. Norah Patten.

## Postdoctoral Research Associate

PLANETARY SURFACES GROUP, NATURAL HISTORY MUSEUM

London, UK

Aug 2019–Jul 2020

- Analysed multi-wavelength remote-sensing datasets of the Martian surface to identify 6 possible source locations of Martian meteorites.
- Mapped >10,000 craters using ArcMap 10.
- Used crater age-dating and model fits to date 118 ejecta blankets and underlying material.

## Founder and Art Teacher

BREWS & BRUSHSTROKES

Cambridge, UK

Aug 2019–Dec 2020

- Managing and teaching at public and corporate art events. Running online classes, communicating with students, applying a range of teaching and learning methodologies to both beginner and advanced-level students. Originally taught classes of up to 60 people, moved to online.

## Project Manager

TEXTILE TWO DIMENSIONAL, UNIVERSITY OF CAMBRIDGE

Cambridge, UK

Apr 2019–Jul 2019

- Agile project management at a startup spun out of the University of Cambridge and funded by the Royal Academy of Engineering. Managed medium-scale projects from start to completion. Communicated difficult scientific concepts to investors during pitching events.

## Postdoctoral Research Associate

UTOPIA-ARGYRE PERIGLACIAL WORKING GROUP

Remote

Oct 2018–Apr 2019

- Worked as part of an international consortium of researchers analysing remote-sensing images of potentially periglacial features on Mars.
- Applied relative stratigraphy and comparative planetology to investigate whether mid-high-latitude mounds are thermokarst features.
- Mapped high-centered and low-centered polygons and statistically analysed these data in Matlab to test ice-wedging formation hypothesis.

## NASA International Intern

NASA AMES

Mountain View, California

Jun-Aug 2015

- One of two Irish PhD students selected and funded to partake in the NASA International Internship Programme by the Irish Research Council.
- Analysed NASA astrobiology empirical datasets on metabolic control for long-haul spaceflight to Mars. Advisor: Dr. Yuri Griko.
- Investigated methods to monitor Enceladus' plume from Earth. Advisor: Dr. Chris McKay.

## Research Assistant

COOL STARS GROUP, DEPARTMENT OF PHYSICS, TRINITY COLLEGE DUBLIN

Dublin, Ireland

Sept 2013–Sept 2014

- Independently operated CARMA radio telescope array in California to acquire radio measurements of stellar atmospheric thermodynamics.

## First-Author Publications

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### The Formation of Araneiforms by Carbon Dioxide Venting and Vigorous Sublimation Dynamics Under Martian Atmospheric Pressure

Nature Scientific Reports

MC KEOWN, L.E., MCELWAINE, J.N., BOURKE, M.C., SYLVEST, M.E., PATEL, M.R.

2021

- [Online, open access](#)
- Press coverage: [National Geographic](#), [Universe Today](#), [CNN](#), [ITV News](#), [The Independent](#), [Esquire](#), [The Irish Independent](#), [The Irish Times](#) and 200+ news outlets worldwide

## Experiments on Sublimating Carbon Dioxide Ice and Implications for Contemporary Surface Processes on Mars

McKEOWN, L.E., BOURKE, M.C., McELWAIN, J.N.

- [Online, open access](#)
- Press coverage: [The Planetary Society](#), [International Business Times](#) and 50+ news outlets worldwide

*Nature Scientific Reports*

2017

## Morphometric Trends and Implications for the Formation of Araneiform Clusters

Mc KEOWN, L.E., DINIEGA, S. BOURKE, M.C., AND SCHWAMB, M.E.

*Earth and Planetary Science Letters*

*Under Review*

## Martian Araneiforms: A Review

Mc KEOWN, L.E., DINIEGA, S. PORTYANKINA, G., AYE, K.M., HANSEN, C.J., PIQUEUX, S., SCULLY, J.E.C., POSTON, M.

- Invited review paper

*JGR: Planets*

*In preparation*

## Lake Stars as an Analog for Europa's Manannán Crater Spider Feature

Mc KEOWN, L.E., LESAGE, E., SCULLY, J., LEONARD, E.J., PAPPALARDO, R.T., POTTER, M., TSAI, V.C., CHOUKROUN, M., AND DINIEGA, S.

*In Preparation*

## Empirically-tested Experiments of CO<sub>2</sub> Block Sublimation Theory Under Martian Pressure

Mc KEOWN, L.E., McELWAIN, J.N., BOURKE, M.C., SYLVEST, M.E., PATEL., M.R.

*In Preparation*

## Coauthor Publications

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### Modern Mars Geomorphological Activity, Driven by Wind, Frost and Gravity

DINIEGA, S., BRAMSON, A.M., BURATTI, B., BUHLER, P., BURR, D.M., CHOJNACKI, M., CONWAY, S.J., DUNDAS, C.M., HANSEN, C.J., McEWEN, A.S., Mc KEOWN, L.E., LAPÔTRE, M.G.A., LEVY, J., OWN, L.E., PIQUEUX, S., PORTYANKINA, G., SWANN, C., TITUS, T.N., WIDMER, J.N.

- [Online, open access](#), invited review paper

*Geomorphology*

2021

### Possible Ice-wedge Polygonisation in Utopia Planitia, Mars and its Poleward Gradient with Latitude

SOARE, R.J., PHILIPPE, M., CONWAY, S.J., WILLIAMS, J-P., Mc KEOWN, L.E., GODIN, E., HAWKSWELL, J.

- [Online, open access](#)

*Icarus*

2020

### Possible Pingo and Ice-Wedge/Thermokarst Complexes at the Mid Latitudes of Utopia Planitia, Mars

SOARE, R.J., CONWAY, S.J., WILLIAMS, J.P., GALLAGHER, C., McKEOWN, L.E.

- [Online, open access](#)

*Icarus*

2019

### The freeze-thaw cycling of water and landscape evolution on Mars; why not?

SOARE, R., COSTARD, F., WILLIAMS, J.-P., GALLAGHER, C., HEPBURN, A.J., STILLMAN, D., KOUTNIK, M., CONWAY, S.J., PHILIPPE, M., BUTCHER, F.E.G., Mc KEOWN, L.E., GODIN, E.

- Book chapter in 'Ice is Nice: a Volatile-Rich Journey from the Inner to the Outer Solar System'

*Elsevier*

*In Press*

### An Updated Global Catalogue of Rayed Craters on Mars: Potential Source Locations for Martian Meteorites

HARRIS, J.K., Mc KEOWN, L.E., PARENTI, C., GRINDROD, P.M., TORNABENE, L.L.

*Earth and Space Science*

*In Press*

### Late Amazonian Epoch glacial deposits on Mars: Using setting, structure and stratigraphy to understand ice evolution and climate history

KOUTNIK, M., BROUGH, S., BUTCHER, F., GALLAGHER, C., HEPBURN, A., HUBBARD, B., Mc KEOWN, L.E., PATHARE, A., SOARE, R.

- Book chapter in 'Ice is Nice: a Volatile-Rich Journey from the Inner to the Outer Solar System'

*Elsevier*

*In Press*

### Mars as a "Natural Laboratory" for Studying Surface Activity on a Range of Planetary Bodies

DINIEGA, S. ET AL (INCLUDING Mc KEOWN, L.E.)

- White paper

*Planetary Sciences Decadal Survey*

2020

## Invited Talks

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### Spiders on Mars, Europa and in the Laboratory: Insights for Icy Planetary Surface Processes through Analog Experiments

*Pennsylvania, USA*

McKEOWN, L.E.

*March, 2023*

- In person: Penn State University Department of Geosciences

### Experiments on CO<sub>2</sub> Sublimation on Granular Substrate Under Mars Conditions

*London, UK*

McKEOWN, L.E.

*March, 2020*

- Remote: UKI Europlanet Hub Science Meeting

### A Review of Martian CO<sub>2</sub> Sublimation Processes and Their Field and Laboratory Analogs

*Ushuaia, Argentina*

McKEOWN, L.E., DINIEGA, S., PORTYANKINA, G., AYE, K.-M., HANSEN, C.J.

*Jan 2020*

- In person: 7th International Conference on Mars Polar Science and Exploration

### PSI Pierazzo Award Talk: A Quantitative Comparison Between Theory And Experiment for CO<sub>2</sub> Sublimation on a Granular Surface under Terrestrial and Martian Conditions and Morphological Results

*Texas, USA*

Mc KEOWN, L.E., McELWAIN, J.N., BOURKE, M.C., SYLVEST, M.E., PATEL, M.R.

*March 2018*

- In Person: 49th Lunar and Planetary Science Conference

## Selected Conference Presentations

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### Spiders on Mars Simulated in the Laboratory

*London, UK*

McKEOWN, L.E.

*Sept, 2021*

- UCL/Birkbeck Centre for Planetary Sciences Summer Meeting

### An Updated Global Catalogue of Rayed Craters on Mars: Potential Sources for Martian Meteorites

*San Francisco, USA*

Mc KEOWN, GRINDROD, P.M., HARRIS, J.K., PARENTI, C.

*Dec, 2019*

- 100th American Geophysical Union Fall Meeting

### An Investigation of the Physical Constraints on Araneiform Morphometry

*Texas, USA*

Mc KEOWN, L.E., BOURKE, M.C., McELWAIN, J.N., SYLVEST, M.E., PATEL, M.R.

*March, 2019*

- 50th Lunar and Planetary Science Conference

### Carbon Dioxide Ice Sublimation: An Agent of Contemporary Martian Surface Feature Formation

*Texas, USA*

McKEOWN, L.E., BOURKE, M.C., McELWAIN, J.N.

*March, 2017*

- 49th Lunar and Planetary Science Conference

## Scientific Evaluation/Reviewing Activities

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NASA Panel review (2022), Planetary and Space Science (2021), JGR: Planets (2019, 2018), Icarus (2019), Geological Society London (2018, 2017)

## Organisation of International Conferences

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- 2022 **Conference Co-organiser**, Martian Enigmas: from the Late Noachian Epoch to the Present *Houston, Texas*
- Jul 2019 **Co-convenor**, Quaternary Mars session, 20th International Union for Quaternary Research Congress *Dublin, Ireland*
- Mar 2019 **Chair**, Processes on Modern Mars session, 50th Lunar and Planetary Science Conference *Houston, Texas*
- Sept 2016 **Chair**, Active Surface Processes session, 6th International Conference on Mars Polar Science and Exploration *Reykjavik, Iceland*

## Students Supervised

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- 2022 **NASA JPL SIRI Internship Program Supervision**, F. Alas *Pasadena, CA*
- 2022 **NASA JPL Summer Internship Program Supervision**, J. Dao *Pasadena, CA*
- 2022-present **Undergraduate Secondary Supervision**, S. Ryan Research Thesis, University College London *Dublin, Ireland*
- 2021-2022 **M.Sc. Secondary Supervision**, H. Kreider Research Thesis, University College London *London, UK*

## Teaching & Supervision

2021	<b>Associate Lecturer</b> , Geology of the Solar System II, Department of Earth and Planetary Sciences, Birkbeck	London, UK
2009–2021	<b>Mathematics Tutor</b> , Individual and small group teaching, in person and online	Dublin, Ireland
2016	<b>Teaching Assistant</b> , Changing Worlds, Geography Department, Trinity College Dublin	Dublin, Ireland
2016	<b>Teaching Advisor</b> , Junior Cycle Science Curriculum, Science Gallery, Trinity College Dublin	Dublin, Ireland
2013	<b>Laboratory Demonstrator</b> , Undergraduate Theoretical Physics, Physics Department, Trinity College Dublin	Dublin, Ireland

## Grants & Awards

2022	<b>CO-I: International Space Science Institute Award</b> , Ice Beyond Earth: Laboratory Investigations of Planetary Ices	Bern, Switzerland
2021	<b>CO-I: NASA ROSES Mars Data Analysis Research Grant</b> , To perform analog Martian icy surface processes experiments and remote sensing data analysis.	Pasadena, CA
2020	<b>International Mars Polar Science and Exploration Conference Travel Grant</b> , To present an invited talk at the 7th International Mars Polar Science and Exploration Conference.	Ushuaia, Argentina
2018	<b>Planetary Science Institute Pierazzo International Student Travel Award</b> , Awarded to one non-U.S. student annually.	Texas, USA
2017	<b>Mars Periglacial Research Grant</b> , To conduct a survey of putatively periglacial Martian surface features.	Quebec, CA
2017	<b>PI: Europlanet European Union Horizon 2020 Award</b> , To design and perform quantitative laboratory experiments at the Open University Mars Simulation Chamber.	Milton Keynes, UK
2015	<b>PI: Irish Research Council Government of Ireland Postgraduate Scholarship</b> , Funded 3 years of PhD including travel and research expenses.	Dublin, Ireland
2016	<b>European Geophysical Union Postgraduate Travel Award</b> , To present at the USRA 6th International Conference on Mars Polar Science and Exploration	Reykjavik, Iceland
2016	<b>International Association of Sedimentologists Award</b> , To present at the Martian Gullies workshop.	London, UK
2015	<b>Irish Research Council NASA International Student Internship</b> , One of two Irish postgraduate students selected. Travel, accommodation, stipend and visa to complete internship at NASA Ames Research Center.	California, USA
2014	<b>Trinity Award Postgraduate Scholarship</b> , One year of PhD funded.	Dublin, Ireland
2014	<b>Science Foundation Ireland Research Studentship</b> , Research on stellar atmospheres funded.	Dublin, Ireland
2010	<b>University College Dublin Undergraduate Scholarship</b> , Awarded to highest GPA. University fees funded.	Dublin, Ireland
2009	<b>University College Dublin Entrance Scholarship</b> , Awarded based on highest entry level high school grades. University fees funded.	Dublin, Ireland

## Professional Qualifications & Courses Taken

<b>Postgraduate Teaching and Learning Course</b>	Dublin, Ireland
TRINITY COLLEGE DUBLIN	2013
• Course which instructed upon how to teach undergraduates; teaching practices, communicating scientific topics, working with diverse students, relating to student needs, engaging interest and enthusiasm, diverse teaching and assessment methodologies, reflective practice	
<b>PRINCE2® Foundation Project Management Certification</b>	London, UK
THE KNOWLEDGE ACADEMY	2019

## Selected Media Engagements & Outreach

2022	<b>Feature in The Times</b> , Feature on my career in planetary science as an Irish woman and my dream of working for NASA since teenage years.	In Print and Online
2021	<b>Planetary Geomorphology Image of the Month for the month of June, 2021</b> , <b>Lauren Mc Keown science blog</b> , In collaboration with <b>Featherwax</b> post production, this blog aims to share my research and describe planetary surface processes that have no Earth analogues using artistic post-production movies and engaging with the general public via Twitter.	Online
2021	<b>Mars Reconnaissance Orbiter HiRISE Science Nugget</b> , Invited by the HiRISE science team to publish a science nugget on spider laboratory research on the HiRISE website and to share with NASA HQ	Arizona, USA
2021	<b>The World Radio Show</b> , <b>Radio Interview on Spiders from Mars in the Laboratory</b>	Boston, USA
2021	<b>Blackrock Castle Observatory</b> , Space Careers Video for Kids	Dublin, Ireland
2021	<b>Dublin's Q102 Radio Station</b> , Interview on Martian spiders in the laboratory	Dublin, Ireland
2020	<b>Panel Speaker: International Women's Day Museum Lates</b> , Natural History Museum	London, UK
2019	<b>Keynote Speaker: Lost Lectures, 50th Anniversary Moon Landing Talk</b> , Natural History Museum	London, UK
2018	<b>Cool Science and Curious Minds Podcast</b> , Ep 7, Mars Landing Sites	Dublin, Ireland
2017	<b>WeMartians Podcast</b> , Ep 21, LPSC, Interview, CO2 sublimation on Mars	Houston, Texas
2017	<b>Invited Speaker: FM104 Radio Regular Segment</b> , A Career in Planetary Science	Dublin, Ireland

## Skills and Interests

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<b>Teaching</b>	Lecturer in geology of the Solar System, undergraduate university teaching in geography and physics at Trinity College Dublin, developing course content, amending course structure to fit the state of the art, organising guest speakers in planetary science, designing module assessments to fit move to online, running module via Moodle, answering student queries, managing a diverse range of students from mature students on a certificate level course, to undergraduate students, writing exams, marking assignments and exams, online teaching, individual tutoring, PhD student co-supervision, international speaking engagements, science communication engagements with large audiences, working as part of a departmental team, discussing ways to improve module and courses with colleagues
<b>Planetary Science</b>	Remote-sensing studies of planetary surfaces, image and DTM analysis of active Martian surface processes in ArcGIS, Matlab, JMARS and Python statistical analysis applied to geophysical research, mapping, photogrammetry, 3D model development with Agisoft Metashape, Laboratory experiment design, scale extrapolation, sample handling, operating planetary simulation facility, hardware installation, LabView, numerical modelling and validation, field and laboratory analogue research
<b>Project Management</b>	PRINCE2®certified, agile project management, preparing reports, coordinating and chairing meetings
<b>Programming</b>	Matlab, Python, Bash, L <sup>A</sup> T <sub>E</sub> X
<b>Geospatial Information Systems</b>	ESRI ArcGIS, QGIS, JMARS
<b>Software &amp; Operating Systems</b>	Microsoft Excel, Word, Moodle, Powerpoint, Photoshop, OneNote, Windows, Linux, Mac
<b>Other</b>	Art, gym, yoga, creative writing, reading recreationally

## References

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### Dr. Mary Bourke

BOURKEM4@TCD.IE

*Relationship: Ph.D. supervisor*

Trinity College Dublin

### Dr. Chris McKay

CHRIS.MCKAY@NASA.GOV

*Relationship: Internship Mentor*

NASA Ames

### Dr. Yuri Griko

YURI.V.GRIKO@NASA.GOV

*Relationship: Internship Mentor*

NASA Ames