

Monica G. Bobra

Principal Data Scientist
State of California, Office of Data and Innovation
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Summary

I have fifteen years of experience working as a research scientist. I develop novel machine learning algorithms and apply them to complex data to glean insights and inform public decision-making. I develop open data and open source scientific software for data-intensive research. I provide expertise on data science workflows by publishing papers, giving talks, organizing conferences, developing new communities, mentoring students, and serving on committees and boards. See <https://mbobra.github.io> for more information.

Positions

Principal Data Scientist, State of California, Office of Data and Innovation (May 2023 – present)

- Leading new initiatives with partner departments, such as the California Natural Resources Agency and the California Environmental Protection Agency, as well as academic and federal organizations to develop and implement novel machine learning models that improve safety, sustainability, and decision-making
- Leading a community of data scientists across the state to co-develop best practices in ethical data science, and briefing legislators on interpretability and explainability in data science
- Supporting, together with other departments, the Governor's Executive Order on Generative AI

Research Scientist, Stanford University (April 2010 – July 2021)

- Published several studies and presented talks on solar flare prediction using novel machine learning algorithms and petabyte-scale image data returned by the NASA Solar Dynamics Observatory that pioneered a new field of research, won \$1.8M in NASA and NSF grants, and garnered media attention
- Organized conferences to foster interdisciplinary collaboration, such as Machine Learning in Heliophysics (2019), Python in Astronomy (2020), and COSPAR Data Science Workshops (2021)
- Led the development of open source software as Vice-Chair of the Board for SunPy, a founding member of the Python in Heliophysics community, and an editor for the Journal of Open Source Software
- Led a culture of open scholarship at Stanford Data Science as a founding member of the Center for Open and REproducible Science
- Wrote science policy to inform the direction of data science at a federal level as a member of the National Academy of Sciences Heliophysics Mid-Decadal Committee (2020)

Astrophysicist, Harvard-Smithsonian Center for Astrophysics (October 2005 – August 2007)

- Worked on two NASA satellites and developed a solar magnetic field model that accurately reproduces observations from these satellites

Education

University of New Hampshire, Master of Science in Physics (January 2010)
Boston University, Bachelor of Arts in Astronomy (May 2004)

Refereed Publications

Bibliometrics: 3000+ total citations, h-index of 22

Manolis Georgoulis, Stephanie L. Yardley, Jordan A. Guerra, Sophie A. Murray, Azim Ahmadzadeh, Anastasios Anastasiadis, Berkay Aydin, Graham Barnes, Alessandro Bemporad, Federico Benvenuto, Monica G. Bobra, Cristina Campi, Enrico Camporeale, A. Gordon Emslie, David Falconer, Li Feng, Weiqun Gan, Lucie Green, Sabrina Guastavino, Mike Hapgood, Irina Kitiashvili, Ioannis Kontogiannis, Marianna B. Korsos, K. D. Leka, Paolo Massa, Anna Maria Massone, Alexander Nindos, Athanasios Papaioannou, Sung-Hong Parka, Spiros Patsourakos, Michele Piana, Nour E. Raouafia, Viacheslav M. Sadykova, Shin Toriumi, Angelos Vourlidas, Haimin Wang, Jason T. L. Wang, Kathryn Whitman, Yihua Yan, Andrei N. Zhukov. “Prediction of Solar Eruptive Events Impacting Space Weather Conditions.” 2024, *Advances in Space Research*.

Zeyu Sun, Monica G. Bobra, Xiantong Wang, Yu Wang, Hu Sun, Tamas Gombosi, Yang Chen, and Alfred Hero. “Predicting Solar Flares using CNN and LSTM on Two Solar Cycles of Active Region Data.” 2022, *Astrophysical Journal*, 931, 163.

Spiridon Kasapis, Lulu Zhao, Yang Chen, Xiantong Wang, Monica G. Bobra, Tamas Gombosi. “Interpretable Machine Learning to Forecast SEP Events for Solar Cycle 23.” 2022, *Space Weather*, 20, e2021SW002842.

Monica G. Bobra, Paul J. Wright, Xudong Sun, and Michael J. Turmon. “SMARPs and SHARPs: Two Solar Cycles of Active Region Data.” 2021, *Astrophysical Journal Supplement Series*, 256, 26.

Will T. Barnes, Mark C. M. Cheung, Monica G. Bobra, et al. “aiapy: A Python Package for Analyzing Solar EUV Image Data from AIA.” 2020, *Journal of Open Source Software*, 5(55), 2801.

Monica G. Bobra, Stuart J. Mumford, Russell J. Hewett, et al. “A Survey of Computational Tools in Solar Physics.” 2020, *Solar Physics*, 295, 57.

Brett M. Morris, Monica G. Bobra, Eric Agol, Yu Jin Lee, Suzanne L. Hawley. “The Stellar Variability Noise Floor for Transiting Exoplanet Photometry with PLATO.” 2020, *Monthly Notices of the Royal Astronomical Society*, 493, 4.

The SunPy Community, Will T. Barnes, Monica G. Bobra, et al. “SunPy: A Python package for Solar Physics.” 2020, *Journal of Open Source Software*, 5(46), 1832.

The SunPy Community, Will T. Barnes, Monica G. Bobra, et al. “The SunPy Project: Open Source Development and Status of the Version 1.0 Core Package.” 2020, *Astrophysical Journal*, 890, 1.

Kolja Glogowski, Monica G. Bobra, Nitin Choudhary, Arthur B. Amezcua, and Stuart J. Mumford. “drms: A Python package for accessing HMI and AIA data.” 2019, *Journal of Open Source Software*, 4(40), 1614.

Richard Galvez, David F. Fouhey, Meng Jin, Alexandre Szenicer, Andrés Muñoz-Jaramillo, Mark C. M. Cheung, Paul J. Wright, Monica G. Bobra, Yang Liu, James Mason, and Rajat Thomas. “A Machine Learning Dataset Prepared From the NASA Solar Dynamics Observatory Mission.” 2019, *Astrophysical Journal Supplement Series*, 242, 1.

Brett M. Morris, Jason L. Curtis, Stephanie T. Douglas, Suzanne L. Hawley, Marcel A. Agüeros, Monica G. Bobra, and Eric Agol. “Are Starspots and Plages Co-Located on Active G and K Stars?” 2018, *Astrophysical Journal*, 156, 203.

Eric Jonas, Monica G. Bobra, Vaishaal Shankar, J. Todd Hoeksema, and Benjamin Recht. “Flare Prediction Using Photospheric and Coronal Image Data.” 2018, *Solar Physics*, 293, 48.

Monica G. Bobra and Stathis Ilonidis. “Predicting Coronal Mass Ejections Using Machine Learning Methods.” 2016, *Astrophysical Journal*, 821, 127.

Keiji Hayashi, J. Todd Hoeksema, Yang Liu, Monica G. Bobra, Xudong Sun, Aimee A. Norton. “The Helioseismic and Magnetic Imager (HMI) Vector Magnetic Field Pipeline: Magnetohydrodynamics Simulation Module for the Global Solar Corona.” 2015, *Solar Physics*, 290, 5.

Xudong Sun, Monica G. Bobra, J. Todd Hoeksema, Yang Liu, Yan Li, Chenglong Shen, Sébastien Couvidat, Aimee A. Norton, and George H. Fisher. “Why Is the Great Solar Active Region 12192 Flare-rich but CME-poor?” 2015, *Astrophysical Journal Letters*, 804, L28.

Monica G. Bobra and Sébastien Couvidat. “Solar Flare Prediction Using SDO/HMI Vector Magnetic Field Data with a Machine-Learning Algorithm.” 2015, *Astrophysical Journal*, 798, 2.

J. Todd Hoeksema, Yang Liu, Keiji Hayashi, Xudong Sun, Jesper Schou, Sébastien Couvidat, Aimee A. Norton, Monica G. Bobra, Rebecca Centeno, K. D. Leka, Graham Barnes, and Michael Turmon. “The Helioseismic and Magnetic Imager (HMI) Vector Magnetic Field Pipeline: Overview and Performance.” 2014, *Solar Physics*, 289, 9.

Monica G. Bobra, Xudong Sun, J. Todd Hoeksema, Michael Turmon, Yang Liu, Keiji Hayashi, Graham Barnes, K. D. Leka. “The Helioseismic and Magnetic Imager (HMI) Vector Magnetic Field Pipeline: SHARPs - Space-Weather HMI Active Region Patches.” 2014, *Solar Physics*, 289, 9.

Yang Liu, J. Todd Hoeksema, Monica G. Bobra, Keiji Hayashi, Peter W. Schuck, Xudong Sun. “Magnetic Helicity in Emerging Solar Active Regions.” 2014, *Astrophysical Journal*, 785, 1.

Monica G. Bobra, Edward E. DeLuca, and Adriaan A. van Ballegooijen. “Modeling Magnetic Fields in Solar Active Regions.” 2008, *Astrophysical Journal*, 672, 1209.

Fabio Reale, Susanna Parenti, Kathy K. Reeves, Mark Weber, Monica G. Bobra, Marco Barbera, Ryouhei Kano, Noriyuki Narukage, Masumi Shimojo, Taro Sakao, Giovanni Peres,

and Leon Golub. “Fine Thermal Structure of a Coronal Active Region from Hinode XRT.” 2007, *Science*, 318, 1571.

Monica G. Bobra, Steven M. Petrinec, Stephen A. Fuselier, Scott E. Claflin, and Harlan E. Spence. “On the Solar Wind Control of Cusp Aurora During Northward IMF.” 2004, *Geophysical Research Letters*, 31, L04, 805.

White Papers, Technical Briefs, and Science Policy Publications

Monica Bobra, Dan Wang, Hung Bui, Esa Eslami, Kimberly Hicks, Eric Zúñiga and Arman Madani. 2024. Forecasting community water system outages. DOI: <https://doi.org/10.5281/zenodo.10951573>

National Academies of Sciences, Engineering, and Medicine. 2020. Progress Toward Implementation of the 2013 Decadal Survey for Solar and Space Physics: A Midterm Assessment. Washington, DC: *The National Academies Press*. DOI: <https://doi.org/10.17226/25668>. Committee members: Robyn Millan, Thomas N. Woods, Timothy S. Bastian, Monica G. Bobra, Anthea J. Coster, Edward E. DeLuca, Scott L. England, Stephen A. Fuselier, Ramon E. Lopez, Janet G. Luhmann, Katariina Nykyri, Jens Oberheide, Merav Opher, Carolus J. Schrijver, Joshua Semeter, Jeffrey P. Thayer, Alan M. Title.

Enrico Camporeale, Hazel Bain, Monica Bobra, Jacob Bortnik, Mark Cheung, Veronique Delouille, Farzad Kamalabadi, Michael Kirk, Giovanni Lapenta, Stefan Lotz, Sophie Murray, Bala Poduval, Pete Riley, Simon Wing. “ML-Helio: An Emerging Community at the Intersection Between Heliophysics and Machine Learning.” 2020, *Journal of Geophysical Research: Space Physics*, 125, 2.

Monica G. Bobra, Will T. Barnes, Mark C. M. Cheung, Laura A. Hayes, Jack Ireland, Miho Janvier, Michael S. F. Kirk, James P. Mason, Stuart J. Mumford, Paul J. Wright, “Science Platforms for Heliophysics Data Analysis.” 2020, *Heliophysics 2050 Workshop White Papers*, DOI: 10.5281/zenodo.4025217.

Ryan McGranaghan, Barbara Thompson, Enrico Camporeale, Jacob Bortnik, Monica Bobra, Giovanni Lapenta, Simon Wing, Bala Poduval, Stefan Lotz, Sophie Murray, Michael S. F. Kirk, Hazel Bain, Pete Riley, Mark C. M. Cheung, Benoit Tremblay, Véronique Delouille, “Heliophysics Discovery Tools for the 21st Century: Data Science and Machine Learning structures and recommendations for 2020-2050.” 2020, *Heliophysics 2050 Workshop White Papers*, DOI: 10.5281/zenodo.4025352.

Books

Monica G. Bobra and James P. Mason, “Machine Learning, Statistics, and Data Mining in Heliophysics.” 2021. DOI: 10.5281/zenodo.4521380. See helioml.org.

Selected Talks

Monica Bobra. “An Ethical Approach to Data Science at the State of California.” California Natural Resources Agency / Department of Water Resources 2024 Environmental Sciences Workshop, California Natural Resources Agency Headquarters, Sacramento, CA, November 2024. [Invited]

Monica G. Bobra and Dan Wang. “Forecasting Community Water System Outages.” Science Understanding through Data Science, Caltech, Pasadena, CA, August 2024.

Monica G. Bobra, “A Review of Solar Flare Prediction Using a Modern Scientific Workflow.” Indian Institute of Astrophysics Golden Jubilee Conference Series: Advances in Observations and Modelling of Solar Magnetism and Variability, Virtual Conference, March 2021. [Invited]

Monica G. Bobra, “Machine Learning in Heliophysics.” The National Academy of Sciences Space Weather Operations and Research Infrastructure Workshop, Virtual Workshop, September 2020. [Invited]

Monica G. Bobra, “Forecasting Solar Flares.” Scientific Computing with Python (SciPy), Virtual Conference, July 2020.

Monica G. Bobra, “SunPy: Status of the Project and v1.0 Core Package.” Scientific Computing with Python (SciPy), Virtual Conference, July 2020.

Monica G. Bobra, “An Overview of Solar Flare Prediction Using Machine Learning Techniques.” Machine Learning in Heliophysics, Royal Tropical Institute, Amsterdam, Netherlands, September 2019.

Monica G. Bobra, “Predicting Solar Flares Using Machine Learning Methods.” PyAstro, Flatiron Institute, New York, NY, May 2018. [Invited]

Monica G. Bobra, “Predicting Solar Activity Using Machine Learning Methods.” AGU Fall Meeting, New Orleans, LA, December 2017. [Invited]

Monica G. Bobra, “Machine Learning in Solar and Space Physics.” National Academy of Science Space Studies Board Fall Meeting, Irvine, CA, November 2017. [Invited]

Monica G. Bobra, “Solar Flare Prediction.” Lorentz Center Workshop: Space-Weather – A Multi-Disciplinary Approach, University of Leiden, Leiden, Netherlands, September 2017.

Monica G. Bobra, “Machine Learning in Practice: Solar Flare Prediction.” NASA Frontier Development Laboratory’s Artificial Intelligence Deep-Dive Workshop, NVIDIA Corporation, Santa Clara, CA, June 2017. [Invited]

Monica G. Bobra, “Machine Learning and Understanding Our Sun.” National Academy of Science Symposium on America’s Future in Civil Space, Washington, D.C., May 2017. [Invited]

Monica G. Bobra, “Solar Flare Prediction.” CCMC-LWS Working Meeting: Assessing Space Weather Understanding and Applications, Cape Canaveral, FL, April 2017.

Monica G. Bobra, “Solar and CME Prediction: 3 Ways.” Flare Prediction Workshop, International Space Science Institute, Bern, Switzerland, October 2016.

Monica G. Bobra, “Studying Solar Flares with the Solar Dynamics Observatory.” Southwest Research Institute, San Antonio, TX, April 2016. [Invited]

Monica G. Bobra, “Solar Flare Prediction with Machine Learning Algorithms.” UC Berkeley Algorithms Machines People (AMP) Laboratory, Berkeley, CA, March 2016. [Invited]

Monica G. Bobra, “Space-Weather HMI Active Region Patches (SHARPs).” Forecasts and Warnings of Extreme Solar Storms Workshop, Lund University, Lund, Sweden, May 2015. [Invited]

Monica G. Bobra, “Solar Flare Prediction Using SDO/HMI Vector Magnetograms with Machine Learning Algorithms.” Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, CA, March 2015. [Invited]

Community Service

- SunPy Leadership (Vice-Chair of the Board, 2017 – 2024, Member of the Steering Committee, 2024 – present)
- Data Science Editor, Journal of Open Source Software (2019 – present)
- Founding Member, Python in Heliophysics (2018 – present)
- Referee for *Astrophysical Journal*, *Astrophysical Journal Letters*, *Solar Physics*, *Space Weather*, *Monthly Notices of the Royal Astronomical Society*, and *Astronomy & Astrophysics* (2010 – present)
- Contributing Editor, *Sky & Telescope Magazine* (2020 – 2023)
- Member, Artificial Intelligence Data Analysis (AIDA) Project [funded by the European Union’s Horizon 2020 Research and Innovation program] Advisory Board (2019 – 2021)
- Founding Member, Stanford Data Science Institute Center for Open and Reproducible Science (2020 – 2021)
- Founding Member, Machine Learning in Heliophysics (2020 – 2021)
- Member, NASA Solar Dynamics Observatory Science Team (2010 – 2021)
- Member, National Academy of Sciences Committee for the Review of Progress toward Implementing the Decadal Survey, Solar and Space Physics: A Science for a Technological Society (2018 – 2020)
- Chair, American Astronomical Society Solar Physics Division Popular Writing Award Committee (2014 – 2019)
- Member, NASA Hinode Science Team (2005 – 2010)

Conferences and Workshops

- Science Organizing Committee member, SciPy 2022
- Science Organizing Committee member, Cloud Computing for Space Research Workshop at Committee on Space Research (COSPAR) 2021
- Co-Chair of Science Organizing Committee, Python in Astronomy 2020
- Science Organizing Committee member, Machine Learning in Heliophysics 2019
- Science Organizing Committee member, Python in Astronomy 2019

- Science Organizing Committee member, Space Sciences at Stanford 2019
- Science Organizing Committee member, Solar Dynamics Observatory Science Meeting SunPy Workshop 2018
- Science Organizing Committee member, Solar Dynamics Observatory Science Meeting Machine Learning Workshop 2018
- Science Organizing Committee member, American Astronomical Society Solar Physics Division Meeting SunPy Workshop 2017
- Science Organizing Committee member, NASA Frontier Development Laboratory Deep-Dive AI Workshop 2017

Popular Media

- Monica Bobra, “The Shrinking Transistor.” *Physics Magazine*, 2022.
- Monica Bobra, “The Cutting Edge: To Boldly Go.” *Sky & Telescope*, 2021.
- Monica Bobra, “Crossing the Edge of Our Solar System.” *Sky & Telescope*, 2020.
- Monica Bobra, “Amateur Filmmaker Captured Solar Eclipse — in 1900.” *Sky & Telescope*, 2019.
- Monica Bobra, “Here’s Why the Government Should Fund ‘Gee Whiz’ Science.” *Scientific American*, 2018.
- Monica Bobra, “Is The Sun Changing?” *Sky & Telescope*, 2018.
- Toshiyuki Oono, “Cosmic Front.” *Nippon Hoso Kyokai* (Japanese Broadcasting Corporation), 2017.
- Monica Bobra, “Big Blast from the Sun.” *Scientific American*, 2017.
- Monica Bobra, “Citizens Do Eclipse Science.” *Sky & Telescope*, 2017.
- Monica Bobra, “Mercury Takes a Stroll across the Sun.” *Scientific American*, 2016.
- Susanna Kohler, “Predicting Major Solar Eruptions.” *AAS Nova*, 2016.
- Monica Bobra, “How Astronomers Count Sunspots.” *Sky & Telescope*, 2016.
- Monica Bobra, “Superflares.” *Sky & Telescope*, 2015.
- Monica Bobra, “Forecasting the Sun’s Fury: How Artificial Intelligence Can Predict Solar Flares.” *Scientific American*, 2015.
- James Urton, “Stanford Pair Helping Predict Solar Storms.” *San Jose Mercury News*, 2015.
- Leslie Willoughby, “Artificial intelligence helps Stanford physicists predict dangerous solar flares.” *Stanford News*, 2015.
- Monica Bobra, “New Scrutiny of the Sun’s Secrets.” *Sky & Telescope*, 2011.
- Monica Bobra, “Hinode Reveals the Sun.” *Sky & Telescope*, 2007.

Academic Mentorship

Mentored graduate students, undergraduate students, and early-career scientists through the NASA Frontier Development Laboratory, Stanford Physics Summer Undergraduate Research Program, and Google Summer of Code (for contributions to SunPy). [Please email for a list of names.]

Awarded Grants

Tamas Gombosi (PI), Spiro Antiochos, Graham Barnes, Monica Bobra, Yang Chen, David Fouhey, Alfred Hero, Todd Hoeksema, Enrico Landi, KD Leka, Yang Liu, Tuija Pulkkinen, Philip Scherrer, Peter Schuck, Igor Sokolov, Shasha Zhou, “Solar Storms and Terrestrial Impacts Center (SOLSTICE).” 2019. NASA 18-DRIVE18-0006. Award amount: \$1,302,162.00.

Monica Bobra (PI), Eric Jonas, Todd Hoeksema, Philip Scherrer, “Prediction of solar eruptions with machine-learning algorithms combining physical models and observations.” 2019. NSF Solar Terrestrial Program, Award Number 1922713. Award amount: \$494,705.00

Junwei Zhao (PI), Marc DeRosa, Monica Bobra, Todd Hoeksema, Shea Hess Webber, Philip Scherrer, “Reliably Inferring the Sun's Far-Side Magnetic Field Based on the Time-Distance Helioseismic Imaging Method.” 2018. NASA N7-HSWO2R17-0003. Award amount: \$248,482.00

Awards

Robert H. Goddard Exceptional Achievement for Science Award (2024)
NASA Group Achievement Award, SunPy Development Team (2024)
American Astronomical Society Solar Physics Division Popular Media Award (2021)
NASA Group Achievement Award, Solar Dynamics Observatory Team (2017)
Robert H. Goddard Exceptional Achievement for Science Award (2016)
NASA Space Grant Fellowship (2008-2009)
NASA Group Achievement Award, Hinode Team (2007)