

Andrés MUÑOZ-JARAMILLO

SouthWest Research Institute

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WORK EXPERIENCE

MAR 2017 to PRESENT	Senior Research Scientist, SouthWest Research Institute, Boulder, USA. Visiting Scholar, High Altitude Observatory & National Solar Observatory, Boulder, USA. Statistical analysis of surface magnetism and its use for reconstructing historical solar activity and solar cycle prediction.
JUN 2015 to MAR 2017	Senior Research Scientist, Georgia State University, Atlanta, USA. Visiting Scholar, University of California, Berkeley, & Stanford University, Stanford, USA. Application of computer vision algorithms to full disk solar magnetograms. Development and analysis of a homogeneous bipolar active region database.
SEP 2013 to MAY 2015	Research Associate, Montana State University, Bozeman, USA. Visiting Scholar, University of California, Berkeley, & Stanford University, Stanford, USA. Consolidation of 40 years of magnetic observations. Statistical analysis of sunspot groups and sunspot group demographics.
JUL 2011 to AUG 2013	LWS - Jack Eddy Postdoctoral fellow, Harvard-Smithsonian Center for Astrophysics, Cambridge, USA. Consolidation of a proxy for the evolution of the solar polar magnetic fields during the last century, and development of a 3D kinematic dynamo code.
SEP 2010 to JUL 2011	Visiting Postdoctoral Fellow, Harvard-Smithsonian Center for Astrophysics, Cambridge, USA. Study of the mechanisms that led to the extended minimum of solar cycle 23.
JAN 2005 to AUG 2010	Graduate Research Assistant, Montana State University, Bozeman, USA. Development of a 2.5 kinematic dynamo model of the solar magnetic cycle.

SCHOLARSHIPS AND AWARDS

2011 [Fred L. Scarf Award](#) granted by the Space Physics and Aeronomy section of the American Geophysical Union for outstanding dissertation research that contributes directly to solar-planetary science, USA.
2011 [Jack Eddy Postdoctoral Fellowship](#) of the NASA - Living With a Star program, USA.
2008 Studentship Award granted by the Solar Physics Division of the American Astronomical Society, USA.
1998 Undergraduate Scholarship of the Neme Foundation, Colombia.

ONGOING RESEARCH GRANTS

Title:	Geophysically Relevant Prediction of Solar Cycle 25.
Grant Number:	NNX16AB77G.
Role:	PI.
Total Budget:	\$445,076.
Percentage of Writing Effort:	60%.
Performance Period:	05/15/2016 to 05/14/2019.

ONGOING RESEARCH GRANTS (CONTINUED)

Title: Data Driven 3D Dynamo Simulations for Cycle Forecasts.
Grant Number: NNX14AO83G.
Role: Co-I.
Total Budget: \$1,178,526.
Percentage of Writing Effort: 60%.
Performance Period: 09/01/2014 to 08/31/2017.

EDUCATION

AUG 2010 | Doctor of Philosophy in PHYSICS
Montana State University, Bozeman, USA
Thesis: "Towards Better Constrained Models of the Solar Magnetic Cycle"

MAY 2007 | Master of Science in PHYSICS
Montana State University, Bozeman, USA

MAY 2005 | Undergraduate Degree in ELECTRONIC ENGINEERING
Universidad de los Andes, Bogotá, Colombia
Thesis: "Formulation and Validation of a Model for a SnO₂ Gas Sensor"

DEC. 2004 | Undergraduate Degree in PHYSICS
Universidad de los Andes, Bogotá, Colombia
Thesis: "Simulation on MCNP of an Angiographic Phantom Using a Dual Energy Technique"

TEACHING EXPERIENCE

JUL 2015 | *Solar Cycle & Dynamo (Including Extended Minima and Maxima), and the Large-Scale Field*
NASA's Living With a Star Summer School, Boulder, CO, USA

SEP 2015 | International School of Space Science, L'Aquila, Italy

OCT 2015 | Solar Physics Invited Lecture at the Universidad Nacional, Bogotá, Colombia

SUMMERS
2015, 2014
2013, & 2011 | *The Sun's Interior and the Solar Magnetic Cycle*
Lecture series for the Research Experience for Undergraduates program.
Montana State University, Bozeman, USA
Harvard-Smithsonian Center for Astrophysics, Cambridge, USA

SPRING
2013 | *The Solar System*
PHYS/ASTR 1050 Introductory level astronomy course.
University of Utah, Salt Lake City, USA

SEP 2012 | *The Solar Cycle: Observations, Characteristics, Understanding, and Theory*
ISWI & MAGDAS School on Space Science, Bandung, WJ, Indonesia

SPRING
& FALL 2002
2003, & 2004 | Teaching Assistant, College Physics I, II and III
Universidad de los Andes, Bogotá, Colombia

MENTORING EXPERIENCE

JAN 2016 to
PRESENT | Sushant S. Mahajan,
PhD Co-Mentor with Piet Martens at Georgia State University, Atlanta, USA.
Measurement of the solar meridional flow during the last 40 years using feature tracking.

NOV 2015 to
PRESENT | Tim Whitbread,
PhD Co-Mentor with Anthony Yeates at Durham University, Durham, UK.
Application of genetic algorithms to dynamo models for efficient phase space exploration.

MENTORING EXPERIENCE(CONTINUED)

OCT 2015 to PRESENT	Juan P. Vargas-Acosta , Independent Studies mentor at the Universidad Nacional, Bogotá, Colombia. REU mentor at Montana State University, Bozeman, USA. Automatic detection, and characterization, of bipolar magnetic regions. Cycle 24.
JUN 2015 to PRESENT	Zachary A. Werginz , Independent Studies mentor at St. Norbert College, De Pere, USA. REU mentor at Montana State University, Bozeman, USA. Automatic detection, and characterization, of bipolar magnetic regions. Cycles 21 & 22.
JUN 2014 to AUG 2014	Michael D. DeLuca , REU mentor at Montana State University, Bozeman, USA. Automatic detection, and characterization, of bipolar magnetic regions. Cycle 23.
JUN 2013 to AUG 2013	Ryan R. Senkpeil, REU mentor at the Harvard-Smithsonian Center for Astrophysics, Cambridge, USA. Characterization of the statistical properties of sunspot group sizes.

SYNERGISTIC ACTIVITIES & PROFESSIONAL SERVICES

- Steering committee of NASA's Living With a Star's Jack Eddy Fellowship, 2017-present.
- Review panelist for NASA's Heliophysics Supporting Research program, Washington, DC, 2015.
- External reviewer for the NASA-LWS' Targeted Research & Technology program and NASA's Solar and the Heliospheric Supporting Research program. 2012, 2014, 2015.
- Referee for *Nature Geoscience*, the *Astrophysical Journal*, *Astronomy & Astrophysics*, the *Geophysical Research Letters*, *Space Science Reviews*, *Advances in Space Research*, *Solar Physics*, the *Journal of Space Weather and Space Climate*, and the *Journal of Atmospheric and Solar-terrestrial Physics*.
- Member of the LOC of the 4th Space Climate Symposium, Goa, India, 2011.
- Development, in collaboration with NASA artist Tom Bridgman, of movies for education and outreach of the solar magnetic cycle <http://svs.gsfc.nasa.gov/search/Series/SolarDynamo.html>. 2008.
- Member of the LOC of the NASA-CAWSES International Workshop on "Solar Variability, Earth's Climate and the Space Environment", hosted by Montana State University in Bozeman, USA, 2008.

ARTICLES IN PREPARATION

1. *The Proximity of the Butterfly Wings to the Equator and Its Impact on Solar Cycle Amplitude: Evidence of a Highly Diffusive Dynamo in Conflict With the Flux-Transport Paradigm.* **A. Muñoz-Jaramillo**, A. G. Tlatov, L. A. Balma-ceda, & P. C. H. Martens.
2. *Main Factors Determining the Amplitude of the Poloidal and Toroidal Phases of the Solar Cycle: A More Detailed Analysis of Solar Cycle Memory and Hemispheric Cross-Talk.* **A. Muñoz-Jaramillo**, M. Dasi-Espuig, & W. D. Pesnell.
3. *Detailed reconstruction of solar activity during the Maunder minimum.* **A. Muñoz-Jaramillo**, J. M. Vaquero, R. Egeland, P. G. Judge, J. C. Hall, & P. C. H. Martens.

LIST OF PUBLICATIONS

1. *Parameter optimization for surface flux transport models.* T. Whitbread, A. R. Yeates, **A. Muñoz-Jaramillo**, & G. J. D. Petrie, **Submitted** (2017).
2. *The best of both worlds: Using automatic detection and limited human supervision to create a homogenous magnetic catalog spanning four solar cycles.* **A. Muñoz-Jaramillo**, Z. A. Werginz, J. P. Vargas-Acosta, M. D. DeLuca, J. C. Windmueller, J. Zhang, D. W. Longcope, D. A. Lamb, C. E. DeForest, S. Vargas-Dominguez, J. W. Harvey, & P. C. H. Martens, **2016 IEEE International Conference on Big Data**, 3194 (2016).

3. *The Minimum of solar cycle 23: As deep as it could be?* A. Muñoz-Jaramillo, R. R. Senkpeil, D. W. Longcope, A. G. Tlatov, A. A. Pevtsov, L. A. Balmaceda, E. E. DeLuca, & P. C. H. Martens, **ApJ**, 804, 68 (2015).
4. *Small-scale and global dynamos, and the area and flux Distributions of active regions, sunspot groups, and sunspots: A multi-database study.* A. Muñoz-Jaramillo, R. R. Senkpeil, J. C. Windmueller, E. C. Amouzou, D. W. Longcope, A. G. Tlatov, Y. A. Nagovitsyn, A. A. Pevtsov, G. A. Chapman, A. M. Cookson, A. R. Yeates, F. T. Watson, L. A. Balmaceda, E. E. DeLuca, & P. C. H. Martens, **ApJ**, 800, 48 (2015).
5. *Polar network index as a magnetic proxy for the solar cycle studies.* M. Priyal, D. Banerjee, B. B. Karak, A. Muñoz-Jaramillo, B. Ravindra, A. R. Choudhuri, & J. Singh, **ApJL**, 793, L4 (2014).
6. *Kinematic active region formation in a three-dimensional solar dynamo model.* A. R. Yeates, & A. Muñoz-Jaramillo, **MNRAS**, 436, 3366 (2013).
7. *Helioseismic perspective of the solar dynamo.* A. Muñoz-Jaramillo, P. C. H. Martens, & D. Nandy, **ASP Conference Series**, 478 (2013).
8. *Using the dipolar and quadrupolar moments to improve solar cycle predictions based on the polar magnetic fields.* A. Muñoz-Jaramillo, L. A. Balmaceda, & E. E. DeLuca, **PRL** 111, 041106 (2013).
9. *Solar cycle propagation, memory, and prediction: insights from a century of magnetic proxies.* A. Muñoz-Jaramillo, M. Dasi-Espuig, L. A. Balmaceda, & E. E. DeLuca, **ApJL** 767, L25 (2013).
10. *Calibrating 100 years of polar faculae measurements: implications for the evolution of the heliospheric magnetic field.* A. Muñoz-Jaramillo, N. R. Sheeley Jr., J. Zhang, & E. E. DeLuca, **ApJ** 753, 146 (2012).
11. *All quiet on the solar front: origin and heliospheric consequences of the unusual minimum of solar cycle 23.* D. Nandy, A. Muñoz-Jaramillo, & P. C. H. Martens, **Sun & Geosph.** 7(1), 16 (2012).
12. *“El misterio de un Sol inmaculado” (The mystery of a spotless Sun).* A. Muñoz-Jaramillo, Invited letter for **Investigación y Ciencia**, Spanish edition of the Scientific American 420, 8 (2011).
13. *The unusual minimum of sunspot cycle 23 caused by meridional plasma flow variations.* D. Nandy, A. Muñoz-Jaramillo, & P. C. H. Martens, **Nature** 471, 80 (2011).
14. *Magnetic quenching of turbulent diffusivity: reconciling mixing-length theory estimates with kinematic dynamo models of the solar cycle.* A. Muñoz-Jaramillo, D. Nandy, & P. C. H. Martens, **ApJL** 727, L23 (2011).
15. *A double-ring algorithm for modeling solar active regions: unifying kinematic dynamo models and surface flux-transport simulations.* A. Muñoz-Jaramillo, D. Nandy, P. C. H. Martens, & A. R. Yeates, **ApJL** 720, L20 (2010).
16. *Helioseismic data assimilation in solar dynamo models.* A. Muñoz-Jaramillo, D. Nandy, & P. C. H. Martens, **ApJ** 698, 461 (2009).

INVITED PRESENTATIONS

1. *Theoretical and Observational Constrains on the Poloidal Signature of Active Regions and Their Origin Within the Convection Zone.*
 - Dynamo Focus Meeting at the National Solar Observatory, Boulder, CO, USA, March 2017.
2. *Advances on Our Understanding of Solar Cycle Propagation and Predictability.*
 - 2016 SDO Workshop, Burlington, VT, USA, October 2016.
3. *Advances on Our Understanding of Solar Cycle Propagation and Predictability.*
 - 2016 SDO Workshop, Burlington, VT, USA, October 2016.
4. *Demographics of the LWS heliophysics summer school(in Haiku form).*
 - 10th Anniversary Celebration of the LWS Heliophysics Summer School, Boulder, CO, USA, August 2016.

5. *Contextualizing Solar Cycle 24: Report on the Development of a Homogenous Database of Bipolar Active Regions Spanning Four Cycles.*
 - 2015 AGU Fall Meeting, San Francisco, CA, USA, December 2015.
6. *Modeling Active Region Emergence in 3D Flux-Transport Solar Dynamios.*
 - NASA LWS Workshop on Solar Dynamo Frontiers, Boulder, CO, USA, June 2015.
7. *One Model Doesn't Fit All: Recent Results of a Detailed Analysis of Sunspot Demographics.*
 - Sunspot Formation Workshop, Stockholm, Sweeden, March 2015.
8. *Insider's Perspectives of the Jack Eddy LWS Fellowship.*
 - Living with a Star: Past Accomplishments and Future Promise, Princeton, NJ, USA, September 2013.
9. *Helioseismic Perspective of the Solar Dynamo.*
 - "Fifty Years of Seismology of the Sun and Stars", NSO Workshop in Tucson, AZ, USA, May 2013.
10. *Implications of Changes to the SSN for Solar Dynamo Studies & Climate Change.*
 - Meeting of American Geophysical union in San Francisco, CA, USA, December 2013.
 - 3rd SSN Workshop in Tucson, AZ, USA, January 2013.
11. *Solar Surface Observations and their Role in Solar-cycle Predictions.*
 - Invited review for the 26th NSO Workshop in Sunspot, NM, USA, April 2012.
12. *Bridging the Gap: Recent Improvements of Kinematic Models of the Solar Magnetic Cycle.*
 - Fred L. Scarf Award presentation at the AGU Fall Meeting 2011 in San Francisco, CA, USA, December 2011.
13. *Forecasting the Solar Cycle: Lessons Learned from the Unusual Minimum of Solar Cycle 23.*
 - Invited panelist for the session "Solar Cycle Forecasting and Comparative Solar Minima - Maxima Studies" of the ILWS Science Workshop in Beijing, China, August 2011.
14. *Why was the Sun so quiet?*
 - Invited review for the ILWS Science Workshop in Beijing, China, August 2011.
15. *Origins and Manifestations of the Solar Cycle: What we know and what we don't.*
 - Invited discussion leader for the session "Bridging the Great Divide: Linking the Solar Dynamo to the Dynamic Heliosphere". SHINE Workshop in Snowmass, CO, USA, July 2011.
16. *Solar Internal Dynamics and the Unusual Minimum of Sunspot Cycle 23.*
 - Invited presentation at the AGU Meeting of the Americas, Foz do Iguazu, Brazil, September 2010.
17. *The unusual minimum of cycle 23: observations and interpretation.*
 - Keynote presentation at the Meeting of the Solar Physics Division in Boulder, CO, USA, June 2009.

RESEARCH SEMINARS

1. *The Rails Inside the Sun and the Butterflies that Ride Them.*
 - Georgia State University, GA, USA, February 2017.
 - High Altitude Observatory in Boulder, CO, USA, March 2016.
 - Seminar of the Solar & Astrophysics Laboratory, Lockheed Martin, Palo Alto, CA, USA, January 2016.
 - Stanford Solar Group Meeting, Palo Alto, CA, USA, January 2016.

2. *Using Sunspot Demographics to Probe the Small-Scale vs. Global Components of the Dynamo.*

- Seminar of the Solar & Astrophysics Laboratory, Lockheed Martin, Palo Alto, CA, USA, February 2015.
- Stanford Solar Group Meeting, Palo Alto, CA, USA, February 2015.
- Heliophysics Science Seminar at NASA/AMES, Mountain View, CA, USA, February 2015.

3. *The Statistics of Magnetic Structures: The Future of Cycle Prediction and the Key to the Livingston-Penn Effect.*

- Brown bag seminar at the National Solar Observatory, Tucson, AZ, USA, September 2014.

4. *Building the next-generation of model-based solar cycle predictions.*

- Space Physics Seminar at the University of Oulu, Oulu, Finland. April 2014.
- Astronomy Seminar at the Universidad Nacional de Colombia, Bogotá, Colombia. March 2014.
- High Energy Seminar at the Universidad de los Andes, Bogotá, Colombia. March 2014.
- Astronomy Seminar at the Universidad de Antioquia, Medellín, Colombia. March 2014.
- Seminar at the Southwest Research Institute, Boulder, CO, USA, February 2014.
- Seminar at the High Altitude Observatory, Boulder, CO, USA, February 2014.
- Seminar of the Solar & Astrophysics Laboratory, Lockheed Martin, Palo Alto, CA, USA, January 2014.
- Space Science Seminar, University of California - Berkeley, Berkeley, CA, USA, January 2014.
- Heliophysics Science Seminar at NASA/GSFC, Washington, DC, USA, January 2014.
- Solar Theory Seminar at the Naval Research Laboratory, Washington DC, USA, January 2014.
- SPA&CS Seminar at George Mason University, Fairfax, VA, USA, January 2014.
- Stanford Solar Group Meeting, Palo Alto, CA, USA, October 2013.
- Physics Seminar at Montana State University, Bozeman, MT, USA, August 2013.

5. *Improvements and applications of the kinematic models of the solar magnetic cycle.*

- Heliophysics Science Seminar at NASA/Goddard Space Flight Center, Washington, DC, USA, September 2011.
- School of Physics, Astronomy and Computational Sciences Seminar at George Mason University, Fairfax, VA, USA, September 2011.
- Solar Theory Seminar at the Naval Research Laboratory, Washington, DC, USA, September 2011.
- Astronomy and Astrophysics Seminar at the Université de Montréal, Montréal, Canada, March 2011.
- Invited colloquium speaker at the Udaipur Solar Observatory, Udaipur, India, January 2011.
- Seminar of the Solar, Stellar and Planetary Sciences Division at the Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA, October 2010.
- High Energy Seminar at the Universidad de los Andes in Bogotá Colombia, September 2010.
- High Altitude Observatory in Boulder, CO, USA, May 2010.
- Physics Seminar at the Indian Institute of Science Education and Research, Kolkata, India, April 2010

6. *Solar Cycle Propagation, Memory, and Prediction: Insights from a Century of Magnetic Proxies.*

- Numerical Analysis Seminar at Durham University, Durham, UK, June 2013.
- HEAP seminar at the University of Utah, Salt Lake City, UT, USA, February 2013.
- Brown bag seminar at the National Solar Observatory, Tucson, AZ, USA, January 2013.

EDUCATIONAL PRESENTATIONS

1. *Less is More: Ruminations on Data Mining and Analysis.*
 - Computer Science Seminar at Georgia State University, Atlanta, GA, USA, February 2016.
2. *Solar Cycle & Dynamo (Including Extended Minima and Maxima), and the Large-Scale Field.*
 - Solar Physics Invited Lecture at the Universidad Nacional, Bogotá, Colombia, October 2015.
 - International School of Space Science, L'Aquila, Italy, September 2015.
 - Invited lecture for NASA's Living With a Star Summer School, Boulder, CO, USA, July 2015.
3. *The Solar Cycle.*
 - REU Seminar at Montana State University, Bozeman, MT, USA, June 2015.
 - REU Seminar at Montana State University, Bozeman, MT, USA, June 2014.
 - Seminar of the Salt Lake Astronomical Society in Salt Lake City, UT, USA, March 2013.
4. *From the Sun to the Earth: Much more than Light and Heat.*
 - Undergraduate Seminar at the University of Utah, Salt Lake City, UT, USA, September 2012.
 - Invited colloquium speaker at the Universidad de los Andes in Bogotá, Colombia, September 2010.
5. *The Solar Cycle: Observations, Characteristics, Understanding, and Theory.*
 - Invited lecture for the ISWI & MAGDAS School on Space Science, Bandung, WJ, Indonesia, September 2012.
6. *The Sun's Interior and the Solar Magnetic Cycle.*
 - Invited lecture for SAO's Research Experience for Undergraduates Program, Cambridge, MA, USA, June 2011.

CONTRIBUTED ORAL PRESENTATIONS

1. *A New Generation of Long-Term Variability Datasets with Better Estimates of Uncertainty*
 - Boulder Solar Day, Boulder, CO, USA, April 2017.
2. *The Rails Inside the Sun and the Butterflies that Ride Them*
 - Space Climate Symposium 6, Levi, Finland, April 2016.
3. *The Minimum of Solar Cycle 23: As Deep as It Could Be?*
 - 2015 Triennial Earth-Sun Summit, Indianapolis, IN, USA, April 2015.
4. *Automatic vs. Human Detection of Bipolar Magnetic Regions: Using the Best of Both Worlds.*
 - Meeting of American Geophysical union in San Francisco, CA, USA, December 2014.
5. *How the Statistical Analysis of Magnetic Structures Will Help Us Usher a New Generation of Solar Cycle Predictions.*
 - 2014 Living With a Star Science Meeting in Portland, OR, USA, November 2014.
6. *From the Tachocline Into the Heliosphere: Coupling a 3D kinematic dynamo to the CCMC.*
 - Meeting of the Solar Physics Division in Boston, MA, USA, June 2014.
7. *From the Tachocline Into the Heliosphere.*
 - Meeting of American Geophysical union in San Francisco, CA, USA, December 2013.
8. *What Makes Each Cycle Unique?.*
 - Meeting of American Geophysical union in San Francisco, CA, USA, December 2013.

9. *Solar Cycle Propagation, Memory, and Prediction: Insights from a Century of Magnetic Proxies.*
 - Meeting of the Solar Physics Division in Bozeman, MT, USA, July 2013.
10. *Calibrating 100 Years of Polar Faculae Measurements: Implications for the Evolution of the Heliospheric Magnetic Field.*
 - Meeting of the Solar Physics Division in Anchorage, AK, USA, June 2012.
11. *Polar Faculae: A Proxy for the Evolution of the Solar Polar Field during the Last 100 Years.*
 - CfA Postdoc Science Symposium in Cambridge, MA, USA, November 2011.
 - Hinode-5 Meeting in Cambridge, MA, USA, October 2011.
12. *Understanding the Origin of the Extended Minimum of Sunspot Cycle 23.*
 - IAU Symposium 286 in Mendoza, Argentina, October 2011.
13. *The Double-Ring Algorithm: Reconciling Surface Flux Transport Simulations and Kinematic Dynamo Models.*
 - Meeting of the Solar Physics Division in Las Cruces, NM, USA, June 2011.
14. *The unusual minimum of solar cycle 23 explained.*
 - Hinode-4 Meeting in Palermo, Italy, 2010
15. *Are changes in the solar meridional circulation responsible for the characteristics of minimum 23-24?.*
 - SORCE Meeting in Keystone, CO, USA, May 2010.
16. *Towards Better Constrained Kinematic Dynamo Models: The Velocity Fields and Turbulent Diffusivity Profiles.*
 - Meeting of the Solar Physics Division in Boulder, CO, USA, May 2010.