Dr. Tilaye A. Tadesse

CONTACT INFORMATION

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EDUCATION

PhD, **Solar Physics**, *Max-Planck Institute for Solar System Research* Lindau, Germany, March 2011 with the Technical University of Braunschweig,

PhD Thesis *"Nonlinear force-free reconstruction of the coronal magnetic field with advanced numerical meth-ods"*

MSc, **Physics**, *Addis Ababa University*, Addis Ababa, Ethiopia, July 2005,

BSc, **Physics**, *Addis Ababa University*, Addis Ababa, Ethiopia, July 1995,

EXPERIENCE

7/15/2019–Present **Research Engineer and Space weather Scientist**, **Space Radiation Analysis Group**, NASA-Johnson Space Center with KBR, Houston, TX.

- o Developed a software tool for space weather prediction which is currently running at NASA Community Coordinated Modeling Center and Moon-To-Mars servers in real-time and being used by console operators at NASA-JSC control room to mitigate space environment: -

    - • MagPy: SDO/HMI vector magnetograms are utilized to calculate free energy indicators for every active region (AR) on the solar surface. Utilizing these free energy proxies, one can analyze the relationship between historically derived event rates and predict the probabilities of >M-class flares, >X-class flares, CMEs, Fast CMEs, and SPEs happening in the next 24 hours using Poisson statistics. (https://ccmc.gsfc.nasa.gov/models/MagPy~v2/)
    - • Trained MagPy on NASA Space Radiation Analysis Group cluster for better forecast
    - • Lead at a team to integrate MagPy to other space weather forecasting tools that use it as an input.

- o I am presently contributing to a project at the SRAG/NASA Johnson Space Center, where we are developing a machine learning-based space weather prediction tool that leverages magnetogram data from both ground-based and spaceborne instruments and involves computationally intensive modeling of the solar magnetic field throughout the solar volume.

- o As a member of the SRAG and ISEP, regularly analyzed remote sensing data from

the SDO as input, and also model the output from various models, including MagPy, provided real-time space weather awareness for missions and communicated the results to mission operators at SRAG.

o Investigate solar eruption source regions to gain insights into space weather mechanisms.

o Apply advanced principles of space weather to analyze the existing threats to missions, encompassing the origins of space weather and its implications for space missions.

o Mitigate impacts of space environment on International Space Station (ISS) and Artemis and the development and use of the appropriate predictive mathematical models for future Moon & Mars missions and beyond

o Utilizing cloud computing platforms for running models and transferring data and help CCMC and M2M to better run MagPy.

04/01/2015–7/15/2019, **Research associate**, Florida Institute of technology, FL, University of Toledo, OH, and   University of West Georgia, GA
- Used NLFF code to investigate SEP propagation in realistic 3D interplanetary and coronal magnetic fields
- Developed graphic users interface using IDL and Python to analysis solar data and plot magnetic field skeleton.

07/01/2018 – 07/15/2019, **Full Time Faculty** at Department of Physics and Astronomy, **University of Toledo/UT**, Toledo, OH, USA
- Teaching Astro/Physics several courses and labs

06/01/2018 – 07/28/2018, **Adjunct Faculty** at Department of Physical Science, Georgia State University/GSU, Perimeter College, Georgia, USA
- Teaching Calculus Based General Physics II and its Lab

08/01/2017 – 07/28/2018, **Full Time Faculty** at Department of Physics, **University of West Georgia/UWG**, USA
- Teaching Astro/Physics several courses and labs

08/01/2015 – 07/01/2017, **Adjunct Faculty** at Department of Physics, Astronomy & Geosciences, **Towson University**, MD, USA
- Teaching Astro/Physics several courses and labs

03/01/2013–04/01/2015, **NASA Postdoctoral Program (NPP) Fellow**, NASA-Goddard Space Flight Center, Greenbelt, MD.
- Developed Software tools (Cartesian and Spherical Nonlinear Force-Free Solar Coronal Magnetic Field Extrapolation tools) and installed to NASA Community Coordinated Modeling Center(CCMC) for public use on run-on-request. **https://ccmc.gsfc.nasa.gov/models/NLFF~NLFF-Cartesian-1.0**
  - NLFF is a Non-Linear Force Free coronal magnetic field model. It takes photospheric vector magnetograms as input. The code solves the non-linear force free field equations using an optimization procedure that minimizes a volume integral constructed from the force free equation, the solenoidal condition and a surface integral that forces the solution to stay close to the input magnetogram data.
- The Code is written in C to iteratively calculate 3D magnetic field from solar

boundary data obtained from SDO (Solar Dynamics Observatory) satellite.
- ○ Developed graphic users interface using IDL and Python to analysis solar data and plot magnetic field skeleton.

03/01/2012–03/01/2013 **NASA-grant Post-Doctoral Researcher**, DREXEL UNIVERSITY, Philadelphia, PA. Analyze SDO and NSO (National Solar Observatory) solar data
- ○ Team member of Data Format Translation Tools developers.
- ○ Compared SDO and NSO data using Python, R, and IDL.

03/01/2011–03/01/2012 **Solar Data Analyst**, MAX-PLANCK-INSTITUTE for SOLAR SYSTEM Research, Germany.
- ○ Develop Solar data analysis system.
- ○

04/25/2008–03/01/2011 **PhD Fellowship in Solar Physics**, MAX-PLANCK-INSTITUTE for SOLAR SYSTEM Research, Germany.
- ○ Developed cutting-edge numerical/ optimization method to extrapolate the magnetic field.
- ○ Developed algorithm to calculate 3D solar magnetic field from surface 2D field data.

11/14/2005-02/25/2008 **Full-Time Physics Lecturer**, Department of Physics, **Addis Ababa University**, Ethiopia,
- o Taught several physics courses.

09/25/2005 -11/14/2005 Full-**Time Physics Lecturer** at Department of Physics, **Jimma University**, Ethiopia,
- o Taught several physics courses.

10/15/1995 -09/15/1997 Full-**Time Physics Teacher**, **Bule Hora High School**, Oromia Gujji Zone, Ethiopia,
- o Taught physics and mathematics courses.

10/15/1997 -08/15/2003 Full-**Time Physics Teacher**, **Bore High School**, Oromia Gujji Zone, Ethiopia,
- o Taught physics and mathematics courses.

PhD THESIS

"Nonlinear force-free reconstruction of the coronal magnetic field with advanced numerical methods", ISBN 978-3-942171-45-8, Uni-edition GmbH, Germany, 2011 (http://www2.mps.mpg.de/solar-system-school/alumni/tadesse.pdf)

SKILLS

C, Python, R, IDL, FORTRAN, LaTex, Linux and Shall scripting, Cloud Computing, Managing projects
Data Analysis: Data Analysis with Python; Image processing ; machine learning using Python and R; parallel and distributed computing; Python data visualization including matplotlib, bokeh, plot.ly, seaborn; R data visualization

AWARDS AND GRANTS

o **The NASA Silver Group Achievement Award**: - "For outstanding achievement in space weather modeling and forecasting to ensure the health and welfare of current and future NASA explorers.", **December 2022**

o **NASA-Research Opportunities in Space and Earth Sciences** - 2014 (ROSES-2014) for the Living with a Star Science Program (LWS) "An investigation of solar energetic particles from poorly connected solar events by propagation through 3-D interplanetary and coronal magnetic elds" (Co-Investigator), **Jan 2015-Jan 2018**

o **NASA-Post Doctorial Program Researcher**, "Nonlinear force-free modeling of the coronal magnetic eld in spherical geometry (Estimation of free magnetic energy of solar eruptive events for prediction of space weather)" (P-Investigator), **April 2013-March 2015**

PUBLICATIONS

o **Potential Field Source Surface and Non-linear Force-Free Field Extrapolation to Model Magnetic Field Structure for a Giant Solar Filament,** Abbi S. Demissie, Tadesse, T, at al, Solar Physics, Volume 300, article number 67, 2025

o **Review of Solar Energetic Particle Prediction Models**, Kathryn Whitman, Tadesse,T., at al, Advances in Space Research, Volume 72, Issue 12, 15 December 2023

o **The first gradual solar energetic particle event with an enhanced 3He abundance on Solar Orbite**r, R. Bucík, Tadesse, T., at al; Astronomy & Astrophysics, Volume 669, A(13), 2023

o **Effect of Size of the Computational Domain on Spherical Nonlinear Force-Free Modeling of Coronal Magnetic Field Using SDO/HMI Data**, Tadesse,T., *at al*, Solar Physics, Volume 290, Issue 4, pp.1159-1171, 2015

o **Global Solar Free Magnetic Energy and Electric Current Density Distribution of Carrington Rotation 2124**, Tadesse,T., at al, Solar Physics, Volume 290, Issue 4, pp.1159-1171, 2015

o **A Comparison Between Nonlinear Force-Free Field and Potential Field Models Using Full-Disk SDO/HMI Magnetogram**, Tadesse,T., *at al*, Solar Physics, Volume 289, pp.831-8450, 2014.

o **First use of synoptic vector magnetograms for global nonlinear, force-free coronal magnetic eld models**, Tadesse,T., *at al*; Astronomy & Astrophysics, Volume 562, A(105), 2014.

o **Modeling coronal magnetic field using spherical geometry: cases with several active regions**, Tadesse,T., *at al*; Astrophysics & Space Science Journal, Volume 347, pp 21-27, 2013.

o **Full-disk nonlinear force-free field extrapolation of SDO/HMI and SOLIS/VSM magnetograms,** Tadesse,T., *at al*; Astronomy & Astrophysics Journal, Volume 550, A14, 2013.

o **Solar full-disk nonlinear force-free eld extrapolation of SDO/HMI and SOLIS/VSM magnetograms**, Tadesse,T., *at al*; Astronomy & Astrophysics, Volume 550, A(14), 2013.

o **How to optimize nonlinear force-free coronal magnetic eld extrapolations from SDO/HMI vector magnetograms?,** Wiegelmann, T., Tadesse,T., *at al*; Solar Physics, Volume 281, pp.37-51, 2012

o **Magnetic Field Structure and Evolution for Flaring AR 11117 and its Surrounding**, Tilaye Tadesse, at al; Solar Physics, Volume 281, pp.54-65, 2012.

o **Magnetic Connectivity between Active Regions 10987, 10988, and 10989 by Means of Nonlinear Force-Free Field Extrapolation**, Tadesse,T., at al; Solar Physics, Volume 277, pp.119-130, 2012.

o **Nonlinear force-free eld extrapolation in spherical geometry: improved boundary data treatment applied to a SOLIS/VSM vector magnetogram**, Tadesse,T., *at al*; Astronomy & Astrophysics, Volume 527, A(30), 2011.

o **Nonlinear force-free coronal magnetic eld modeling and preprocessing of vector**

magnetograms in spherical geometry, Tadesse,T., *at al*; Astronomy & Astrophysics, Volume 508, pp.421-432, 2009.

- o **A Critical Assessment of Nonlinear Force-Free Field Modeling of the Solar Corona for Active Region 10953**, Derosa, M. L*, at al*; The Astrophysical Journal, Volume 696, Issue 2, pp. 1780-1791, 2009

ORAL PRESENTATIONS & POSTERS

- o March 21, 2024 (Oral), NASA-Johnson Space Center, Space Radiation Group/SRAG, Houston, TX, **MagPy-LOS development Updates**, by Tilaye Tadesse
- o September 7, 2023 (Oral), Southwest Research Institute in San Antonio, TX, **MagPy Machine Learning real-time SEP forecasting tool**, by Tilaye Tadesse
- o December 17, 2021 (Oral), AGU-American Geophysical Union 2021 meeting, New Orleans, LA, **Improving and Converting MAG4 to Python Scripts (MagPy),** by Tilaye Tadesse
- o June 10, 2018 (Oral), NASA-Johanson Space Center, Space Radiation Group/SRAG, Houston, TX, **Space weather near the Sun**, by Tilaye Tadesse
- o April 9, 2018 (Oral), Case Western Reserve University, Department of Astronomy, Cleveland, OH, **Space Weather Data Analysis**, by Tilaye Tadesse, MacNiece, P.
- o December 22, 2017 (Poster), University of West Georgia, Carrollton, GA, **Role of Solar Magnetic field in initiating eruptions**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o May 20, 2016 (Oral), Loyola University of Maryland, Baltimore, MD, **Modeling solar magnetic field: Space weather forecasting needs**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o December 4, 2015 (Oral), Towson University, Department of Physics, Astron-omy and Geosciences, Towson, MD, **Modeling solar coronal magnetic field to understand space weather onsets**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o March 10, 2015 (Oral), NASA - Marshal Space Flight Center, Huntsville, AL, **Nonlinear force-free reconstruction of the coronal magnetic field in large scale using SDO/HMI data**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o December 14-19, 2014 (Poster), AGU-American Geophysical Union 2014 meeting, San Francisco, CA**, Effect of the computational domain size on nonlinear force-free models of coro-nal magnetic field using SDO/HMI data**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o November 3-6, 2014 (Oral), NASA 2014 Living With Star (LWS) meeting, Portland, OR**, First use of synoptic vector magnetograms for global NLFF coronal magnetic field models**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o October 21, 2014 (Oral), Department of Physics and Astronomy, Kansas Uni-versity, Lawrence, KS, **Modeling magnetic field in solar atmosphere for forecasting space weather**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o October 3, 2014 (Oral), Department of Physics and Space Sciences, Florida Institute of Technology, Melbourne, FL, **How to model magnetic eld in solar atmosphere for forecasting space weather**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.
- o September 19, 2014 (Oral), NASA-Goddard Space Flight Center (GSFC), Space

Weather Laboratory, Greenbelt, MD, **Estimation of free magnetic energy of solar eruptions for forecasting space weather**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.

o June 1-5, 2014 (Poster), 224th American Astronomical Society Meeting Workshops, Boston, MA, **First use of synoptic vector magnetograms for global nonlinear force free coronal magnetic field models**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.

o Feburary 18, 2014 (Oral), Seminar Series of the Physics Department at Morgan State University, Baltimore, MD, **Estimation of free magnetic energy of solar eruptive events for prediction of space weather**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.

o October 28, 2013 (Oral), NASA-Goddard Space Flight Center (GSFC), Space Weather Laboratory, **Estimation of free magnetic energy fof global Sun from Synoptic vector maps using NLFFF models**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.

o September 21, 2012 (Oral), NASA-Goddard Space Flight Center (GSFC), Space Weather Laboratory, **Nonlinear force-free reconstruction of the coronal magnetic field using SDO/HMI data with advanced numerical methods**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.

o July 25-29, 2011 (Poster), Stereo-4/SDO-2/SOHO-25 Workshop at Kiel, Kiel, Germany, **Magnetic Connectivity between Active Regions 10987, 10988, and 10989 using NLFFF modelling**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.

o May 9-13, 2011 (Poster), Fourth Solaire Network Meeting at Teistungen, Teistungen, Germany, **Magnetic Connectivity between Active Regions 10987, 10988, and 10989**, by Tilaye Tadesse, Wiegelmann, T., Inhester, B. and Pevtsov A.

o December 14, 2010 (Oral), Institute for Geophysical and Extraterrestrial physics, T. University of Braunschweig, Braunschweig, Germany, **Nonlinear force-free reconstruction of the coronal magnetic field with advanced numerical methods**, by Tilaye Tadesse

o July 18-25, 2010 (Oral), 38th COSPAR Scientific Assembly, Bremen, Germany, **Nonlinear force-free eld extrapolation in spherical geometry: improved boundary data treatment applied to a SOLIS/VSM vector magnetogram**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.

o July 7, 2010 (Oral), Solar System Seminar, Katlenburg-Lindau, Germany, **Nonlinear force-free eld extrapolation of a SOLIS/VSM vector magnetogram in spherical geometry**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.

o July 15, 2009 (Oral), **Solar System Seminar, Katlenburg-Lindau, Germany, Nonlinear force-free coronal magnetic eld modeling and preprocessing of vector magnetograms in spherical geometry**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.

o Jun. 23-25, 2009 (Oral), **NLFFF Consortium Meeting 6, St. Andrews University, Scotland, UK, NLFF coronal magnetic eld modeling and preprocessing of vector magnetograms in spherical geometry: a test on synthetic data**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.

o Jan. 14, 2009 (Oral), Solar System Seminar, Katlenburg-Lindau, Germany, **Nonlinear force-free reconstruction of solar corona magnetic elds in spherical geometry using an optimization method** by Tilaye Tadesse, Wiegelmann, T., and

Inhester, B.

- Oct. 22 - 23, 2008 (Oral), A Next Generation Coronal Active Region Model Workshop, Drexel University, Philadelphia, USA, **Nonlinear force-free extrapolation of solar corona magnetic elds in spherical geometry using an optimization method: a case for synthetic magnetogram**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.
- Jun. 30 - Jul. 2, 2008 (Oral), NLFFF Consortium Meeting 5, Katlenburg-Lindau, Germany, **NLFF coronal magnetic eld extrapolation in spherical coordinates for part of a sphere**, by Tilaye Tadesse, Wiegelmann, T., and Inhester, B.
- Sep. 27, 2007 (Oral), Max-Planck Institute for solar system research, Katlenburg-Lindau, Germany, **Comparison of different numerical algorithms for the determination of potential fields in the solar corona**, by Tilaye Tadesse, and Wiegelmann, T.