

TOMOKO MATSUO'S CURRICULUM VITAE

Associate Professor

Smead Endowed Faculty Fellow

Ann and H.J. Smead Department of Aerospace Engineering Sciences

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BIOSKETCH

Dr. Matsuo's research interests include atmospheric sciences and space physics, statistical and machine learning, and remote sensing and modeling of Earth and space environments. As a Principal Investigator (PI), with funding (\$5.4M) from the NSF, NASA, European Space Agency (ESA), NOAA, Air Force Office of Scientific Research and Air Force Research Lab, including the NASA Science Mission Directorate Heliophysics Grand Challenges Research award of \$1.2M, she has developed original and independent research programs centered on data assimilation of remote sensing data of the Earth's upper atmosphere and near-Earth space. She has received an NSF CAREER award, for her work into the predictability of the atmosphere from the ground to near-Earth space, an Outstanding Junior Faculty award and an Outstanding Undergraduate Teaching & Mentoring award from the Smead Aerospace Engineering Sciences Department, and a Dean's Faculty Fellowship from the College of Engineering and Applied Science. She has authored and co-authored over 70 refereed publications. Because of her unique training in space physics, atmospheric sciences, and statistics and the interdisciplinary nature of data assimilation research, she collaborates widely across disciplinary boundaries with space physicists, atmospheric scientists, aerospace engineers, applied mathematicians, and statisticians. She has been actively recruited to give talks and lead sessions at national and international meetings, including 80 invited talks. Dr. Matsuo has served on high-level external and internal committees, including the NSF Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR) Science Steering committee (2012-2015), the NSF Geospace Section Committee of Visitors (2014), the NASA Heliophysics Advisory Committee (2017-2022), the NASA Geospace Dynamics Constellation Science and Technology Definition Team (2018-2019), the ESA Daedalus Mission Advisory Group (2018-2021), the NCAR Computational and Information Systems Laboratory's Science Requirements Advisory Panel for the High-performance Computing System procurement (2019-2020), the Advisory Board for the University of Colorado Boulder's Center for Research Data and Digital Scholarship (2017-2022), the University of Colorado Boulder Research and Innovation Office's ad hoc Committee for Research Computing Strategic Visioning (2021), the Department's Graduate Committee, as the Remote Sensing Earth and Space Science (RSESS) Focus Area Lead (2018-2020), the Department's Computing Committee as Chair (2019-present), and the Department's Inclusive Culture Committee (2020-2022). Since 2022, she is serving on the Steering Committee of National Academy of Sciences' Decadal Survey for Solar and Space Physics (Heliophysics) 2024-2033, the ESA-NASA Lower Thermosphere-Ionosphere Science (EN-LoTIS) Working Group, the International Association of Geomagnetism and Aeronomy (IAGA) Geospace Data Assimilation Working Group (GeoDAWG) as Chair, as well as on the Department's undergraduate committee for curriculum development. Dr. Matsuo has advised 20 graduate students, including 7 PhD students as a primary academic advisor, 1 PhD student as an academic co-advisor, 8 PhD students as a co-advisor in collaboration with their academic advisors, and 4 MS students as an advisor, on the topics of space physics, atmospheric sciences, and geophysical applications of data assimilation and spatial statistics. Dr. Matsuo has developed and taught two graduate-level courses on Data Assimilation and Inverse Methods for Earth and Geospace Observations (ASEN6055) and Remote Sensing Data Analysis (ASEN6337) and one large undergraduate-level course on Aerospace Computing and Engineering Applications (ASEN1320). She has developed education outreach activities based on ASEN6337 course work and offered three summer camps for first-generation precollegiate high-school students.

EDUCATIONAL BACKGROUND

Hokkaido University, Sapporo, Japan
Nagoya University, Nagoya, Japan
State University of New York, Stony Brook

Geophysics, B.Sc. 1995
Physics, M.Sc. 1998
Atmospheric Sciences, M.Sc. 2000, *Ph.D.* 2003

ACADEMIC EMPLOYMENTS

Ann and H.J. Smead Department of Aerospace Engineering Sciences (AES)	1/2017–Present
Affiliated Faculty with Department of Applied Mathematics (APPM)	1/2018–Present
<i>Assistant Professor (2017-2022) & Associate Professor (2022-)</i>	

Authored and co-authored 38 refereed publications. Won 9 new grant awards as PI from NSF, NASA, and NOAA, including the NSF CAREER award, and one new award as Co-PI from ESA, which amounts to the total of \$3M. Won 2 awards as Co-I from NASA and the Department of Education (DoEd). Gave 45 invited talks at national and international meetings and departmental seminars. Outcomes from my research group have been reported in 107 oral and poster contributed conference presentations. Developed and taught one new undergraduate core course on Aerospace Computing and Engineering Applications (ASEN1320), and two new graduate courses on Data Assimilation and Inverse Methods for Earth and Geospace Observations (ASEN6055) and Remote Sensing Data Analysis (ASEN6337). Taught one undergraduate elective course on Aerospace Software (ASEN4057), one graduate core course on Statistical Estimation for Dynamical Systems (ASEN5044), and Remote Sensing Seminar (ASEN5210). Mentored 56 students in total, including 7 PhD students as an advisor, 1 PhD student as a co-advisor, 4 MS students as an advisor (two with MS theses), 4 PhD students on PhD research and dissertation in collaboration with their academic advisors, 17 PhD students as a PhD thesis committee member, 2 MS students as a MS thesis committee member, 11 graduate students as a qualifying exam committee member, and 4 graduate and 6 undergraduate students on their internship projects. Developed and offered three summer STEM camps on remote sensing based on ASEN6337 course work for local first-generation precollegiate high-school students. Mentored one high-school student on her independent study for the Boulder Valley School District Science Fair. Led 27 sessions as a convener or co-convener at the CEDAR, Geospace Environmental Modeling (GEM) and American Geophysical Union (AGU) meetings. Served on external committees, including the National Academy of Sciences' Decadal Survey for Solar and Space Physics (Heliophysics) 2024-2033 Steering Committee, the ESA-NASA Lower Thermosphere-Ionosphere Science (EN-LoTIS) Working Group, the International Association of Geomagnetism and Aeronomy (IAGA) Geospace Data Assimilation Working Group (GeoDAWG) as Chair, the NASA Geospace Dynamics Constellation Science and Technology Definition Team, the NASA Heliophysics Advisory Committee, the AGU Basu United States Early Career Award committee, the ESA Daedalus Mission Advisory Group, the NCAR Computational and Information Systems Laboratory's Science Requirements Advisory Panel for the High-performance Computing System Procurement, International Space Science Institute (ISSI) Science Team for Data Assimilation in the Ionosphere and Thermosphere, and ISSI Science Team for Understanding Interhemispheric Asymmetry in MIT Coupling. Served on internal committees, including the University of Colorado Boulder Research and Innovation Office's ad hoc Committee for Research Computing Strategic Visioning, the Advisory Board for the University of Colorado Boulder's Center for Research Data and Digital Scholarship, the Department's Graduate Committee as Focus Area Lead, the Department's Computing Committee as Chair, the Department's Strategic Vision Committee, the Department's Inclusive Culture Committee, and the Department's Undergraduate Committee for Curriculum Development. Served as an associate editor for AGU Space Weather Special Collection for talks and posters presented the AGU Chapman Conference on Scientific Challenges Pertaining to Space Weather Forecasting Including Extremes, Pasadena, CA, 2019. Provided peer-reviews of 2 journal manuscripts, 1 book chapter, 8 proposals for NASA Heliophysics programs, and 4 proposals for NSF Geospace and Polar programs, and served on a peer-review proposal panel for NASA.

Cooperative Institute for Research in Environmental Sciences (CIRES)
Space Weather Prediction Center, NOAA
Research Associate & Scientist III (2013-2016) Scientist II (2007-2013)

8/2007–12/2016

Lead a multi-institutional collaborative project for developing an ensemble forecasting and data assimilation system capable of assimilating observations from the ground to geospace using the National Weather Service (NWS)'s operational ensemble forecasting and data assimilation systems. Won 7 externally funded grants as PI (\$2.4M) from the NSF, NASA, AFOSR and AFRL, including the NASA Science Mission Directorate (SMD) Heliophysics Grand Challenges Research award of \$1.2M. Gave 29 invited talks at national and international meetings and at research institutions and universities. Served on 5 peer-review proposal panels for the NSF. Lead sessions on data assimilation and related topics as a convener or co-convener at six national and three international meetings. Mentored 8 graduate students on their dissertation research related to data assimilation and spatial statistics. Supervised 2 CIRES research and associate scientists.

Institute for Mathematics Applied to Geosciences, NCAR
Visiting Scientist

6/2003–7/2007

Received post-doctoral training in statistics in NCAR's Geophysical Statistics Program under the guidance of Dr. Doug Nychka. Developed spatial statistical methods and applied them to large geophysical data sets. Applied an ensemble Kalman filter to the mesosphere lower thermosphere. Gave 5 invited talks at national and international meetings on the topic of data assimilation. Served on 2 peer-review proposal panels for NASA. Lead a session on data assimilation as a co-convener at the International Association of Geomagnetism and Aeronomy (IAGA) Scientific Assembly, Toulouse, France in 2005.

High Altitude Observatory, NCAR
Graduate Research Assistant

9/1999–7/2003

Conducted independent graduate research, under the supervision of Dr. Arthur Richmond and Prof. Marvin Geller, as an NCAR Advanced Study Program Graduate Fellow, on the effects of high-latitude ionospheric electric field variability on the estimation of global thermospheric Joule heating. Won 3 student paper awards from AGU and the NSF-CEDAR program. Gave one invited seminar at the NOAA Space Environment Center in 2002. Participated in the NATO Advanced Study Institute on Data Assimilation for the Earth System in Italy in 2002.

Space Environmental Center, NOAA
Visiting Research Scientist

6/1998–8/1999

Conducted a numerical simulation of the neutral density response to two geomagnetic storms using a coupled thermosphere ionosphere model and co-authored one refereed paper.

AWARDS AND HONORS

Smead Endowed Faculty Fellow	2022
CU Smead Aerospace Department Outstanding Undergraduate Teaching & Mentoring Award	2021
CU College of Engineering and Applied Science Dean's Faculty Fellowship	2021
CU Smead Aerospace Department Outstanding Junior Faculty Award	2019
NSF CAREER Award	2019
NSF CEDAR Student Poster Competition Award (1 st Place)	2003
NSF CEDAR Student Poster Competition Award (Honorable Mention)	2001
AGU Outstanding Student Paper Award	2001
NCAR High Altitude Observatory Newkirk Graduate Fellowship	2002–2003

RESEARCH GRANTS (\$5.4M AS PI)

<i>NASA SMD Heliophysics GOLD and ICON Guest Investigator - \$449,997</i>	10/2021–9/2025
Matsuo, T. (PI), Whole-Atmosphere Satellite Data Assimilation	
<i>NOAA NESDIS OPPA - \$218,406 (total) [\$203,062 (PI Matsuo portion)]</i>	10/2021–8/2022
Matsuo, T. (PI) and N. Maruyama (Co-I), Observing System Simulation Experiment (OSSE): Ionospheric Electron Density Profile	
<i>NASA Goddard Space Flight Center - \$82,023</i>	10/2021–9/2022
Matsuo, T. (PI), Geospace Data Assimilation Capabilities for CCMC	
<i>NOAA NESDIS OPPA - \$416,846 (total) [\$302,606 (PI Matsuo portion)]</i>	2/2021–8/2022
Matsuo, T. (PI), T. J. Fuller-Rowell, N. Maruyama, and N. Pedatella (Co-Is), Whole Atmosphere-Ionosphere Data Assimilation and Ensemble Forecasting System	
<i>ESA Earth Observation Program - \$44,143 (Co-PI Matsuo portion)</i>	6/2019–6/2020
Malaspina, T. (PI), T. Matsuo (Co-PI), Daedalus Science Study	
<i>NSF EarthCube Program - \$627,763</i>	9/2019–8/2022
Matsuo, T. (PI), EarthCube Data Capabilities: Collaborative Proposal: Assimilative Mapping of Geospace Observations	
<i>NASA FINNEST Program - \$135,000</i>	9/2019–8/2022
Matsuo, T. (PI), and Clayton Cantrall (Fellow), Airglow Radiance Data Assimilation for Characterizing Vertical Coupling of Atmospheric Layers	
<i>NSF CAREER Program - \$713,718 + \$16,000 (REU Participant Support)</i>	3/2019–2/2024
Matsuo, T. (PI), CAREER: Predictability of the Whole Atmosphere from Ground to Geospace	
<i>NSF Statistics Program - \$49,998</i>	9/2018–8/2021
Matsuo, T. (PI), Collaborative Research: Multi-scale Modeling of Non-Gaussian Random Fields on the Sphere	
<i>NASA SMD Heliophysics Living With Star Program – [\$40,484 (Co-I Matsuo portion)]</i>	10/2017–9/2021
Fang, T. (PI), T. J. Fuller-Rowell, N. Maruyama, T. Matsuo , M. Fedrizzi, D. Welling, and G. Toth (Co-Is), Quantifying the Variability of Equatorial Electrodynamics During Disturbed Geomagnetic Conditions Using First-principle Models	
<i>NSF CEDAR Program - \$250,000</i>	8/2017–7/2020
Matsuo, T. (PI), Collaborative Research: CEDAR: Assimilative Analysis of Low- and Mid-latitude Ionospheric Electrodynamics	
<i>NSF Polar Program - \$396,547 (total) [\$204,879 (PI Matsuo portion)]</i>	3/2015–2/2019
Matsuo, T. (PI), D. J. Knipp and A. D. Richmond (Co-Is), Assimilative Mapping of Interhemispheric Polar Ionospheric Electrodynamics	

– [\$24,091 (Co-I Matsuo portion)]

Yudin, V. (PI), **T. Matsuo**, T. J. Fuller-Rowell, and D. Kleist (Co-Is), Data Assimilation in the Vertically Extended Global Atmosphere Models of NEMS

AFOSR Space Science Program - \$80,000 (Institutional PI Matsuo portion)

8/2015–7/2018

Raeder, J. (PI, UNH PI), **T. Matsuo** (CU PI, Co-I), and J. L. Anderson (NCAR PI, Co-I), Ensemble Kalman filter for OpenGGCM

NSF EarthCube Program - \$100,000

9/2015–8/2018

Matsuo, T. (PI), EarthCube IA: Collaborative Proposal: Integrated GeoScience Observatory

NASA SMD Heliophysics Grand Challenges Research Program - \$1,162,686 (total)

4/2014–4/2018

– [\$831,882 (PI Matsuo portion)]

Matsuo, T. (PI), T. J. Fuller-Rowell, R. Akmaev, H. Wang, T.-W. Fang, K. Ide, D. Kleist and X. Yue (Co-Is), Predictability and Ensemble Modeling of the Space-Atmosphere Interaction Region

CU-Boulder Innovative Research Program - \$25,000

2015–2016

Matsuo, T. (PI) and D. Paul (Co-I), Modeling of Scale-dependent Stochastic Magnetosphere-Ionosphere Coupling Processes

AFOSR Science Program - \$159,894

2013–2016

Matsuo, T. (PI), Thermospheric Data Assimilation

AFRL - \$77,129

2012–2013

Matsuo, T. (PI) and D. J. Knipp (Co-I), Thermospheric Mass Density Specifications: Synthesis of Observations and Models

Air Force Small Business Technology Transfer Program

2012–2013

Crowley, G. (PI), T. J. Fuller-Rowell, **T. Matsuo**, M. Pilinski, S. Solomon, L. Qian, J. Thayer and M. Codrescu (Co-Is), Satellite Drag Physical Model Module for a Near Real-time Operation Testbed

NSF Space Weather Program - \$385,060

2010–2016

Matsuo, T. (PI), D. J. Knipp, A. D. Richmond and D. W. Nychka (Co-Is), Assimilative Mapping of Space-based and Extremely Localized Observations of Ionospheric Electrodynamics

NASA SMD Heliophysics LWS Program

2008–2013

Garcia, R. (PI), T. J. Fuller-Rowell, R. Akmaev, M. Codrescu, J. Fontenla, H.-L. Liu, D. Marsh, **T. Matsuo**, C. Randall, A. D. Richmond, S. Solomon and H. Wang (Co-Is), Integrated Modeling of the Atmosphere-Ionosphere System

AFOSR Multidisciplinary University Research Initiative (MURI) Program

2007–2012

Forbes, J. M. (PI), T. J. Fuller-Rowell (Co-PI), R. Akmaev, B. Argrow, G. Born, G. Crowley, D. Falconer, J. Fontenla, D. J. Knipp, **T. Matsuo**, D. Odstreil, J. Raeder and J. Thayer (Co-Is), Neutral Atmosphere Density Interdisciplinary Research

Air Force Small Business Innovation Research Program

2003–2006

Khattatov, B. (PI), M. Murphy and **T. Matsuo** (Co-Is), Long-term Ionospheric Forecasting System

Emery, B. A. (PI), A. D. Richmond, **T. Matsuo** and A. Maute (Co-Is), The Quantification and Validation of Variable Electrodynamic Forcing of the Thermosphere

PEER-REVIEWED PUBLICATIONS (71)

[71] Bossert, K., L. J. Paxton, **T. Matsuo**, L. Goncharenko, K. Kumari, and M. Conde (2022), Large Scale Travelling Atmospheric and Ionospheric Disturbances observed in GUVI, *Geophysical Research Letters*, in press, doi:10.1029/2022GL099901.

[70] Rajesh, P. K., C. H. Lin, J. T. Lin, C. Y. Lin, J. Y. Liu, **T. Matsuo**, C. Y. Huang, M. Y. Chou, J. Yue, H. Jin, J. M. Choi, S. P. Chen, M. Chou, and H. F. Tsai, Extreme poleward expanding super plasma bubbles triggered by Tonga volcano eruption during the recovery phase of a geomagnetic storm, *Geophysical Research Letters*, 49, e2022GL099798, <https://doi.org/10.1029/2022GL099798>.

[69] Dietrich*, N., **T. Matsuo**, and C.-H. Hsu (2022), Specifying Satellite Drag Through Coupled Thermosphere-Ionosphere Data Assimilation of Radio Occultation Electron Density Profiles, *Space Weather*, <https://doi.org/10.1029/2022SW003147>.

[68] Svaldi*, V., **T. Matsuo**, L. Kilcommons, and B. Gallardo-Lacourt (2022), High Latitude Ionospheric Electrodynamics During STEVE and non-STEVE Substorm Events, *J. Geophys. Res. Space Physics*, under review, <https://doi.org/10.1002/essoar.10510750.1>.

[67] Liu, J. Y., C. H. Lin, C. Y. Lin, I. T. Lee, Y.-Y. Sun, S. P. Chen, F. Y. Chang, P. K. Rajesh, C.-T. Hsu, **T. Matsuo**, C. H. Chen, and H. F. Tsai (2022), Retrospect and Prospect of Ionospheric Weather Observed by FORMOSAT-3/COSMIC and FORMOSAT-7/COSMIC-2, *Terrestrial, Atmospheric and Oceanic Sciences*, 22 (20), <https://doi.org/10.1007/s44195-022-00019-x>.

[66] Tang*, T., P. Alken, T. C. M. Lee, **T. Matsuo**, and D. Paul (2022), Modeling Vector Fields On An Annular Shell Using Needlets and Applications to Lithospheric Magnetic Fields, *Annals of Applied Statistics*, under review.

[65] Gilpin*, S., **T. Matsuo**, and S. E. Cohn (2022), Continuum Covariance Propagation for Understanding Variance Loss in Advective Systems, *SIAM / ASA Journal of Uncertainty Quantification*, 3(3), 886-914, <https://doi.org/10.1137/21M1442449>.

[64] Li*, J., **T. Matsuo**, and L. Kilcommons (2022), Assimilative Mapping of Auroral Electron Energy Flux using SSUSI Lyman-Birge-Hopfield (LBH) Emissions, *J. Geophys. Res. Space Physics*, 127, e2021JA029739, <https://doi.org/10.1029/2021JA029739>.

[63] Rajesh, P. K., C. H. Lin, J. T. Lin, C. Y. Lin, J. Yue, **T. Matsuo**, and S. P. Chen (2021), Day-to-day Variability of Ionosphere Electron Density During Solar Minimum Derived from FORMOSAT-7/COSMIC-2 Measurements, *Terrestrial, Atmospheric and Oceanic Sciences*, doi:10.3319/TAO.2021.08.01.01.

[62] Cantrall*, C., and **T. Matsuo** (2021), Deriving column-integrated thermospheric temperature with the N2 Lyman-Birge-Hopfield (2,0) band, *Atmospheric Measurements Technique*, 14, 6917–6928, <https://doi.org/10.5194/amt-14-6917-2021>.

* Papers by graduate students mentored and guided by Dr. Matsuo. ** Papers by posdocs mentored and guided by Dr. Matsuo

[61] **Matsuo, T.**, M. Fan, X. Shi, C. Miller, J. M. Ruohoniemi, D. Paul, and T. C. M. Lee (2021), Multiresolution Modeling of high-latitude ionospheric electric field variability and impact on Joule heating using SuperDARN data, *J. Geophys. Res. Space Physics*, 126, e2021JA029196, <https://doi.org/10.1029/2021JA029196>.

[60] Palmroth, M., Grandin, M., Sarris, T., Doornbos, E., Tourgaidis, S., Aikio, A., Buchert, S., Clilverd, M. A., Dandouras, I., Heelis, R., Hoffmann, A., Ivchenko, N., Kervalishvili, G., Knudsen, D. J., Kotova, A., Liu, H.-L., Malaspina, D. M., March, G., Marchaudon, A., Marghitu, O., **Matsuo, T.**, Miloch, W. J., Moretto-Jørgensen, T., Mpaloukidis, D., Olsen, N., Papadakis, K., Pfaff, R., Pirnaris, P., Siemes, C., Stolle, C., Suni, J., van den IJssel, J., Verronen, P. T., Visser, P., and Yamauchi, M. (2021): Lower thermosphere – ionosphere (LTI) quantities: Current status of measuring techniques and models, *Ann. Geophys.*, 39, 189-237, <https://doi.org/10.5194/angeo-39-189-2021>.

[59] **Matsuo, T.**, and C.-H. Hsu (2021), Inference of hidden states by coupled thermosphere-ionosphere data assimilation, In W. Wang and Y. Zhang (Eds.), In *Upper Atmosphere Dynamics and Energetics*, Geophysical Monograph Series: Space Physics and Aeronomy, 4 (18), 343-363, American Geophysical Union, <https://doi.org/10.1002/9781119815631.ch18>.

[58] Hsu **, C.-H., **T. Matsuo**, A. Maute, R. Stoneback, and C.-P. Lien (2021), Data-Driven Ensemble Modeling of Equatorial Ionospheric Electrodynamics: A Case Study During a Minor Storm Period Under Solar Minimum Conditions, *J. Geophys. Res. Space Physics*, 126, e2020JA028539, <https://doi.org/10.1029/2020JA028539>.

[57] Lin, J. T., C. H. Lin, P. K. Rajesh, J. Yue, C. Y. Lin, and **T. Matsuo** (2020), Local-Time and Vertical Characteristics of Quasi-6-Day Oscillation in the Ionosphere during the 2019 Antarctic Sudden Stratospheric Warming, *Geophysical Research Letters*, 47, e2020GL090345, <https://doi.org/10.1029/2020GL090345>.

[56] Rajesh, P. K., C. H. Lin, C. Y. Lin, C. H. Chen, J. Y. Liu, **T. Matsuo**, S. P. Chen, W. H. Yeh, and C. Y. Huang (2020), Extreme Positive Ionosphere Storm Triggered by a Minor Magnetic Storm in Deep Solar Minimum Revealed by FORMOSAT-7/COSMIC-2 and GNSS Observations, *J. Geophys. Res. Space Physics*, 125, e2020JA028261, <https://doi.org/10.1029/2020JA028261>.

[55] Lin, C. Y., C. H. Lin, J. Y. Liu, P. K. Rajesh, **T. Matsuo**, M. Y. Chou, H. F. Tsai, and W. H. Yeh (2020), The Early Results and Validation of FORMOSAT-7/COSMIC-2 Space Weather Products: Global Ionospheric Specification and Ne-Aided Abel Electron Density Profile, *J. Geophys. Res. Space Physics*, 125, e2020JA028028, <https://doi.org/10.1029/2020JA028028>.

[54] Mutschler*, S., P. Axelrad, and **T. Matsuo** (2020), A Partially Orthogonal EnKF Approach to Atmospheric Density Estimation using Orbital Debris, *Advances in Space Research*, 65, 8,1965-1980, <https://doi.org/10.1016/j.asr.2020.01.021>.

[53] **Matsuo, T.** (2020), Recent progress on inverse and data assimilation procedure for high-latitude ionospheric electrodynamics, In M. Dunlop and H. Luhr (Eds.) *Ionospheric Multi Satellite Analysis Tools: Approaches for Deriving Ionospheric Parameters*, ISSI Scientific Report Series, 17, Springer, Cham, https://doi.org/10.1007/978-3-030-26732-2_10.

[52] Shi*, Y., D. J. Knipp, **T. Matsuo**, L. Kilcommons, and B. J. Anderson (2020), Event studies of high-latitude field-aligned currents (FACs) with inverse and assimilative analysis of AMPERE magnetometer data, *J. Geophys. Res. Space Physics*, 125, e2019JA027266. <https://doi.org/10.1029/2019JA027266>.

- [51] Shi*, Y., D. J. Knipp, **T. Matsuo**, L. Kilcommons, and B. J. Anderson (2020), Modes of field-aligned currents (FACs) variability and their hemispheric asymmetry revealed by inverse and assimilative analysis of Iridium magnetometer data, *J. Geophys. Res. Space Physics*, 125, e2019JA027265, <https://doi.org/10.1029/2019JA027265>.
- [50] Shi*, Y., D. M. Oliveira, D. J. Knipp, E. Zesta, **T. Matsuo**, and B. J. Anderson (2019), Effects of Nearly Frontal and Highly Inclined Interplanetary Shocks on High-latitude Field-aligned Currents (FACs), *Space Weather*, 17, 1659-1673, <https://doi.org/10.1029/2019SW002367>.
- [49] Cantrall*, C., **T. Matsuo**, and S. Solomon (2019), Upper atmosphere radiance data assimilation: A feasibility study for GOLD far ultraviolet observations, *J. Geophys. Res. Space Physics*, 124, 8145-8164, <https://doi.org/10.1029/2019JA026910>.
- [48] Lin, J. T., C. H. Lin, C. Y. Lin, N. M. Pedatella, R. K. Rajesh, **T. Matsuo**, and J.-Y. Liu (2019), Revisiting the modulations of ionospheric solar and lunar migrating tides during the 2009 stratospheric sudden warming by using global ionosphere specification, *Space Weather*, 17, 767-777, <https://doi.org/10.1029/2019SW002184>.
- [47] Chen, C. H., C. H. Lin, and **T. Matsuo** (2019), Ionospheric responses to the 21 August 2017 solar eclipse by using data assimilation approach, *Progress in Earth and Planetary Science*, 6:13, <https://doi.org/10.1186/s40645-019-0263-4>.
- [46] Hsu*, C.-H., **T. Matsuo**, and J. Y. Liu (2018), Observation impact of the FORMOSAT-3/COSMIC and FORMOSAT-7/COSMIC-2 missions on the mid- and low-latitude ionospheric specification, *Earth and Space Science*, 5, 875-890, <https://doi.org/10.1029/2018EA000447>.
- [45] Fang, T.-W., T. J. Fuller-Rowell, V. Yudin, **T. Matsuo**, and R. Viereck (2018), Quantifying the sources of ionosphere day-to-day variability, *J. Geophys. Res. Space Physics*, 123, 9682-9696, <https://doi.org/10.1029/2018JA025525>.
- [44] Flynn*, S., D. J. Knipp, **T. Matsuo**, M. Mlynczak, and L. Hunt (2018), Understanding the global variability in thermospheric nitric oxide flux using empirical orthogonal functions (EOFs), *J. Geophys. Res. Space Physics*, 123, 4150-4170, <https://doi.org/10.1029/2018JA025353>.
- [43] Hsu*, C.-H., **T. Matsuo**, X. Yue, T.-W. Fang, T. Fuller-Rowell, K. Ide, and J.-Y. Liu, (2018). Assessment of the impact of FORMOSAT-7/COSMIC-2 GNSS RO observations on midlatitude and low-latitude ionosphere specification: Observing system simulation experiments using Ensemble Square Root Filter, *J. Geophys. Res. Space Physics*, 123, 2296-2314, <https://doi.org/10.1002/2017JA025109>.
- [42] Mlynczak, M. G., D. J. Knipp, L. A. Hunt, J. Gaebler, **T. Matsuo**, L. M. Kilcommons, and C. L. Young (2018), Space-based sentinels for measurement of infrared cooling in the thermosphere for space weather nowcasting and forecasting, *Space Weather*, 16, 363-375, <https://doi.org/10.1002/2017SW001757>.
- [41] Fan*, M., D. Paul, T. C. M. Lee, and **T. Matsuo** (2018), A multi-resolution model for non-Gaussian random fields on a sphere with application to ionospheric electrostatic potentials, *Annals of Applied Statistics*, 12, 1, 459-489, <https://doi.org/10.1214/17-AOAS1104>.
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derived from DE-2 measurements: Empirical Orthogonal Function (EOF) analysis, *Geophysical Research Letters*, 29, 1107, doi:10.1029/2001GL014077.

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INVITED TALKS (80)

[80] **Matsuo, T.**, A. Ratheesh Babu, N. Dietrich, C.-H. Hsu, J. L. Anderson, H. Kerhaw, B. Johnson (2022), Geospace Data Assimilation Capabilities for CCMC, *NASA Community Coordinated Modeling Center (CCMC) Workshop*, June 6-10, College Park, MD.

[79] **Matsuo, T.** (2022), Whole Atmosphere-Ionosphere Data Assimilation and Ensemble Forecasting System, *NOAA Office of Projects, Planning, and Analysis (OPPA) Brown Bag Seminar*, May 19, Virtual.

[78] **Matsuo, T.** (2022), Towards Building Numerical Space Weather Prediction Systems Infrastructure to Unify Observing and Modeling Capabilities, *Data science and analytics: Data fusion and assimilation panel, The National Academies of Sciences, Engineering and Medicine Space Weather Operations and Research Infrastructure Workshop Phase II*, April 11-14, Virtual.

[77] **Matsuo, T.** (2022), The Role of Auroral Imagery in Space Weather Applications of the Assimilative Mapping of Geospace Observations, Panel on Space Weather Applications of Auroral Imager, *18th Conference on Space Weather at 101th AMS Annual Meeting*, January 23-27, Houston, TX.

[76] **Matsuo, T.**, C.-T. Hsu, F. Shen, C. Cantrall, A. Kubaryk, T. J. Fuller-Rowell, N. Maruyama, N. Pedatella, and H. Shao (2021), Whole Atmosphere-Ionosphere Data Assimilation and Ensemble Forecasting System, SA33A-01, *AGU Fall Meeting*, December 13-17, New Orleans, LA.

[75] **Matsuo, T.** (2021), Assimilative Mapping of Geospace Observations (AMGeO): Data Science Tools for Collaborative Geospace Systems Science, *GeoDAWG (Geospace Data Assimilation Working Group) Seminar*, October 12, Virtual.

[74] **Matsuo, T.** (2021), NSF EarthCube: Assimilative Mapping of Geospace Observations Project, *GEM Decadal Survey Magnetosphere - Ionosphere Coupling Discussions Session*, July 25-30, Virtual.

[73] **Matsuo, T.** (2021), Opportunities and Challenges of Upper Atmosphere Satellite Data Assimilation: Assimilation of GOLD Disk Emission Data, *NOAA NSDIS Space Weather Observation Requirements Formulation Working Group Meeting*, July 14, Virtual.

[72] **Matsuo, T.**, J. Li, L. Kilcommons, and T. Nishimura (2021), Assimilative Mapping of Auroral Precipitation, *CEDAR Workshop Multi-scale IT System Science Dynamics Session*, June 20-25, Virtual.

[71] **Matsuo, T.** (2021), Data-Driven Ensemble Modeling of the Upper Atmosphere, *CEDAR Workshop Synergy Between First-Principles and Data-Informed Modeling*, June 20-25, Virtual.

[70] **Matsuo, T.** (2021), Assimilative Mapping of Geospace Observations (AMGeO): Building Community for Collaborative CEDAR Data Science, *CEDAR Workshop Plenary Science Highlight*, June 20-25, Virtual Meeting.

- [69] **Matsuo, T.** (2021), Towards Ingestion of COSMIC-2 Observations into NOAA's Whole Atmosphere-Ionosphere Data Assimilation System, *NOAA Office of Projects, Planning, and Analysis (OPPA) Staff Meeting*, May 25, Virtual.
- [68] **Matsuo, T.** (2021), Predictability of the Space-Atmosphere Interaction Region, *Ionosphere-Thermosphere-Mesosphere Session Facilitator's Scene Setting Talk for Heliophysics 2050 Workshop*, May 3-7, Virtual Meeting.
- [67] **Matsuo, T.** (2021), Towards Understanding the Global Implications of Regional Phenomenon by Combining ISR Data With Global Data Sets, *Workshop: A Strategic Vision for Incoherent Scatter Radar*, March 30-April 1, Virtual Meeting.
- [66] **Matsuo, T.** (2021), Data-Driven Modeling of Ionospheric Electrodynamics, *Engineering-Physics Space Plasma Seminar*, Dartmouth College, January 19, Hanover, NH.
- [65] **Matsuo, T.** (2021), Towards Unified Global and Local Perspectives on High-latitude Ionospheric Electrodynamics, *Mini-GEM 3D Ionospheric Electrodynamics and its Impact on the Magnetosphere-Ionosphere-Thermosphere Coupled System*, January 19, Virtual Meeting.
- [64] **Matsuo, T.**, and C.-H. Hsu (2020), Uncertainty Quantification in Data-Driven Ensemble Modeling of the Upper Atmosphere, *AGU Fall meeting*, Virtual Meeting.
- [63] **Matsuo, T.** (2020), Data-driven Modeling of High-latitude Electrodynamics, *1st Center for Geospace Storms DRIVE Science Center Workshop*, Virtual Meeting.
- [62] **Matsuo, T.**, C.-H. Hsu and N. Dietrich (2020), Inference of Neutral Mass Density From GPSRO by Coupled Thermosphere-Ionosphere Data Assimilation, *5th International Conference on GPS Radio Occultation*, Hsinchu, Taiwan.
- [61] **Matsuo, T.**, and C. Cantrall (2020), Opportunities and Challenges of Satellite Data Assimilation: Assimilation of GOLD Disk Emission, *CEDAR Workshop Grand Challenge: Coordinated Ground and Space-based Observations of the Ionosphere-Thermosphere System Session*, Virtual Meeting.
- [60] **Matsuo, T.**, and C.-H. Hsu (2020), Inference of Hidden States by Couped Thermosphere-Ionosphere Data Assimilation: Applications to Observability and Predictability of Neutral Mass Density, *JpGU-AGU Joint Meeting 2020*, Virtual Meeting.
- [59] **Matsuo, T.** (2020), Predictability and Observability of the Upper Atmosphere, *17th Conference on Space Weather at 100th AMS Annual Meeting*, Boston, MA.
- [58] **Matsuo, T.**, L. M. Kilcommon, J. M. Ruohoniemi, and B. J. Anderson (2019), Assimilative Mapping of Geospace Observations (AMGeo): Data Science Tools for Collaborative Geospace Systems Science, *AGU Fall meeting*, San Francisco, CA.
- [57] **Matsuo, T.**, C.-H. Hsu, and S. Shen (2019), Predictability and Observability of the Upper Atmosphere, *AGU Fall meeting*, San Francisco, CA.
- [56] **Matsuo, T.** (2019), Manage and Mine Geoscience Data for Your CEDAR Science Breakthroughs, *Student Workshop Plenary Tutorial, CEDAR Workshop*, Santa Fe, NM.

- [55] **Matsuo, T.** (2019), Data Assimilation Modeling, *CEDAR Workshop ITM Models: Past, Present, and Future Session*, Santa Fe, NM.
- [54] **Matsuo, T.** (2019), What it Takes to Fuse Observations in Geoscience?, *CEDAR Workshop The Challenge, Opportunity, and Art of Data Science For Geospace Session*, Santa Fe, NM.
- [53] **Matsuo, T.**, L. M. Kilcommons, D. L. Knipp, and Y. Shi (2019), High-latitude Electrodynamics Responses to Multiple CME Interaction Events on September 7-8 2017, *CEDAR-GEM Joint Workshop Strong-Extreme Events: September 2017 Session*, Santa Fe, NM.
- [52] **Matsuo, T.** (2019), Coupled Thermosphere-Ionosphere Data Assimilation, 4th Dynamic Earth SPP Colloquium, *Keynote Lecture*, Bad Aibling, Germany.
- [51] **Matsuo, T.** (2019), Numerical Space Weather Forecasting Facilitated by Ensemble Modeling and Data Assimilation, *Taiwan Geosciences Assembly*, Taipei, Taiwan.
- [50] **Matsuo, T.** (2019), Coupled Thermosphere-Ionosphere Data Assimilation: An Application to Predictability and Observability of Neutral Mass Density, *Taiwan Geosciences Assembly*, Taipei, Taiwan.
- [49] **Matsuo, T.** (2019), A Journey to the Edge of our Planet: How Data Assimilation and Computational Statistics Solve Problems in the Upper Atmosphere, *Plenary Keynote Speaker, Conference of Computational Interdisciplinary Science*, Georgia Institute of Technology, Atlanta, GA.
- [48] **Matsuo, T.**, C.-T. Hsu, and C. H. Chen (2018), Coupled Thermosphere-Ionosphere Data Assimilation, *AGU Fall meeting*, Washington, D.C.
- [47] **Matsuo, T.** (2018), A Journey to the Edge of our Planet: How Data Assimilation and Computational Statistics Solve Problems in the Upper Atmosphere, *Departmental Seminar*, Department of Mathematics and Statistical Sciences, University of Colorado, Denver, CO.
- [46] **Matsuo, T.** (2018), How to Assess Observation Impacts on Mass Density Specification and Forecasting, *CEDAR Workshop Space Weather Observation Network: Thermospheric Expansion Session*, Santa Fe, NM.
- [45] **Matsuo, T.** (2018), What Data Assimilative Modeling Advances Are Needs for Prediction and Specification?, *CEDAR Workshop Space Weather Observation Network: Ionospheric Disturbance Session*, Santa Fe, NM.
- [44] **Matsuo, T.** (2018), Recent Progress on Inverse and Data Assimilation Procedure for High-Latitude Ionospheric Electrodynamics, *Departmental Seminar*, Institute of Space Science, National Central University, Taiwan.
- [43] **Matsuo, T.** (2018), Predictability and Ensemble Modeling of the Space-Atmosphere Interaction Region, *Departmental Seminar*, Institute of Space Science, National Central University, Taiwan.
- [42] **Matsuo, T.** (2017), Between Earth and Space: Data Assimilation for High-dimensional Earth and Geospace systems, *Departmental Seminar*, Department of Applied Mathematics, University of Colorado, Boulder, CO.
- [41] **Matsuo, T.** (2017), Data Assimilation – How to Combine a Model and Observations Optimally, *National Academies Space Studies Board's Committee on Solar and Space Physics Meeting*, Irvine, CA.

- [40] **Matsuo, T.** (2017), Data Assimilation for High-dimensional Earth and Geospace systems, *International Meeting on High-Dimensional Data Driven Science*, Kyoto, Japan.
- [39] **Matsuo, T.** (2017), Data Assimilation – How to Combine a Model and Observations Optimally, *Student Workshop Plenary Tutorial, CEDAR Workshop*, Keystone, CO.
- [38] **Matsuo, T.** (2017), Space Weather Data Assimilation Requirements, Joint Effort for Data Assimilation Integration (JEDI) Goals and Requirements Planning Meeting, College Park, MD.
- [37] **Matsuo, T.** (2017), Numerical Space Weather Forecasting Facilitated by Ensemble Modeling and Data Assimilation, *14th Conference on Space Weather at 97th AMS Annual Meeting*, Seattle, WA.
- [36] **Matsuo, T.** (2017), History and recent progress of Assimilative Mapping Ionospheric Electrodynamics (AMIE), *Mini Keynote Speaker, CEDAR Workshop High-Latitude Ionospheric Electrodynamics and Their Impact on the Thermosphere Session*, Keystone, CO.
- [35] **Matsuo, T.**, T. J. Fuller-Rowell, T.-W. Fang, V. Yudin, C.-T. Hsu, D. Fuller-Rowel, K. Ide, D. Kleist, and X. Yue (2016), Between Earth and Space: Ensemble Modeling and Data Assimilation of the Space-Atmosphere Interaction Region, *Space Weather Workshop*, Broomfield, CO.
- [34] **Matsuo, T.** (2016), Between Earth and Space: Data Assimilation and Predictability of the Aerospace Environment, *Departmental Seminar*, Department of Aerospace Engineering Sciences, University of Colorado, Boulder, CO.
- [33] **Matsuo, T.**, C.-T. Hsu, and I.-T. Lee (2016), New Era of Upper Atmosphere Forecasting: Roles of RO Data in Coupled Thermosphere-Ionosphere Data Assimilation, *3rd International Conference on GPS Radio Occultation*, Taipei, Taiwan.
- [32] **Matsuo, T.** (2016), Between Earth and Space: Data Assimilation and Predictability of the Upper Atmosphere, *Colloquium*, High Altitude Observatory, NCAR, Boulder, CO.
- [31] **Matsuo, T.**, C.-T. Hsu, A. T. Chartier, I.-T. Lee, and J. L. Anderson (2014), Coupled Thermosphere-Ionosphere Data Assimilation, *International Radio Occultation Working Group Ionosphere-Atmosphere Coordination Workshop*, Boulder, CO.
- [30] **Matsuo, T.**, I.-T. Lee, and J. L. Anderson (2014), Ensemble Data Assimilation for Thermospheric Mass Density Specification and Forecasting, *Japan Geoscience Union Meeting*, Yokohama, Japan.
- [29] **Matsuo, T.** (2014), From Earth to Space: Data Assimilation as Engineering Solution for Ozone Monitoring, Satellite and Space Debris Tracking and Beyond, *Departmental Seminar*, Department of Aerospace Engineering Sciences, University of Colorado, Boulder, CO.
- [28] **Matsuo, T.** (2014), Assimilative Mapping of Ionospheric Electrodynamics, *Departmental Seminar*, Department of Statistics, University of California, Davis, CA.
- [27] **Matsuo, T.** (2013), The Role of Data Assimilation in Maximizing the Utility of Geospace Observations, *AGU Fall meeting*, San Francisco, CA.
- [26] **Matsuo, T.**, I.-T. Lee, J. L. Anderson (2013), Role of Ionosphere-Thermosphere Coupling in Upper Atmosphere Data Assimilation, *The XIIth IAGA Scientific Assembly*, Merida, Mexico.

- [25] **Matsuo, T.**, D. J. Knipp, A. D. Richmond, L. M. Kilcommons, B. J. Anderson, and E. D. P. Cousins (2013), Inverse Procedures for High-latitude Ionospheric Electrodynamics in a New Era of Global Space- and Ground-Based Instrumentation, *The XIth IAGA Scientific Assembly*, Merida, Mexico.
- [24] **Matsuo, T.** (2013), Assimilative Mapping of Apace-based and Extremely Localized Observations of Ionospheric Electrodynamics, *Departmental Seminar*, Institute of Space Science, National Central University, Taiwan.
- [23] **Matsuo, T.**, I.-T. Lee, J. L. Anderson (2013), Upper Atmosphere Data Assimilation with Ensemble Kalman Filter, *USNC-URSI National Radio Science Meeting*, Boulder, CO.
- [22] **Matsuo, T.**, I.-T. Lee, J. L. Anderson (2012), Upper atmosphere Data Assimilation With Ensemble Kalman Filter, *6th FORMOSAT-3/COSMIC Data Users' Workshop*, Boulder, CO.
- [21] **Matsuo, T.** (2012), Data Assimilation for Thermospheric Mass Density Specification, *Seminar*, The National Institute of Information and Communications Technology, Tokyo, Japan.
- [20] **Matsuo, T.** (2012), Upper Atmosphere Data Assimilation with Ensemble Kalman Filter, *5th Data Assimilation Workshop*, Institute of Statistical Mathematics, Tokyo, Japan.
- [19] **Matsuo, T.** (2012), Understanding Data Assimilation: Applications to Radio Occultation Observations, *Tutorial Lecture, GPS RO Summer School*, National Central University, Taiwan.
- [18] **Matsuo, T.**, I.-T. Lee, J. L. Anderson (2012), Upper atmosphere data Assimilation with ensemble Kalman filter, *Departmental Seminar*, Institute of Space Science, National Central University, Taiwan.
- [17] **Matsuo, T.** (2012), Data Assimilation for Thermospheric Mass Density Specification, *Seminar*, Los Alamos National Lab, Los Alamos, NM.
- [16] **Matsuo, T.**, J. L. Anderson, I.-T. Lee (2011), Ensemble Kalman Filtering for Assimilation of Mesosphere and Thermosphere Observations, *AGU Fall meeting*, San Francisco, CA.
- [15] **Matsuo, T.**, E. A. Araujo-Pradere, and J. L. Anderson (2010), Ensemble Kalman filtering for Assimilation of GPS-based Ionospheric Observations, *Asia-Pacific Radio Science Conference*, Toyama, Japan.
- [14] **Matsuo, T.**, E. A. Araujo-Pradere, and J. L. Anderson (2010), Ensemble Kalman filtering for assimilation of GPS-based ionospheric observations, *Beacon Satellite Symposium*, Barcelona, Spain.
- [13] **Matsuo, T.** (2008), Effects of High-latitude Ionospheric Electric Field Variability on the Estimation of Global Thermospheric Joule Heating, *Colloquium*, High Altitude Observatory, NCAR, Boulder, CO.
- [12] **Matsuo, T.** (2008), Multi-resolution Based Non-stationary Covariance Modeling and Ensemble Kalman Filtering for Assimilation of Mesosphere and Lower Thermosphere Observations, *Data Assimilation Workshop*, Institute of Statistical Mathematics, Tokyo, Japan.
- [11] **Matsuo, T.**, and J. L. Anderson (2008), Ensemble Kalman Filtering for Assimilation of Mesosphere and Lower thermosphere observations, *Japan Geoscience Union Meeting*, Chiba, Japan.
- [10] **Matsuo, T.**, J. L. Anderson, D. R. Marsh, and A. K. Smith (2008), Ensemble Kalman Filtering for

Assimilation of Mesosphere and Lower Thermosphere Observations, *European Geosciences Union General Assembly*, Vienna, Austria.

[9] **Matsuo, T.** (2008), Ensemble Kalman Filtering for Assimilation of Mesosphere and Lower Thermosphere Observations, *Departmental Seminar*, Utah State University, Logan, UT.

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- [25] Shi[†], Y., D. J. Knipp, and **T. Matsuo** (2018), Modes of FACs Variability and its Hemispheric Asymmetry Revealed by Inverse and Assimilative Analysis of Iridium Magnetometer Data, *GEM Workshop Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Session*, Santa Fe, NM.
- [24] Shi[†], Y., **T. Matsuo**, D. L. Knipp, L. M. Kilcommons, and B. J. Anderson (2018). Modes of high-latitude Field-aligned Currents Variability and its Hemispheric Asymmetry Revealed by Inverse and Assimilative Analysis of Iridium Magnetometer Data (Poster), *GEM Workshop*, Santa Fe, NM.
- [23] Lin[†], C.-Y., **T. Matsuo**, J.-Y. Liu, and C. H. Lin (2018), Data Assimilation of Ground-Based GPS and Radio Occultation Total Electron Content for Global Ionospheric Specification (Poster), *15th Annual Meeting Asia Oceania Geosciences Society*, Honolulu, HI.
- [22] **Matsuo, T.** and C. T. Hsu, T. W. Fang, and T. J. Fuller-Rowell (2018), Day-to-Day Variability and Predictability of the Ionosphere, *15th Conference on Space Weather at 98th AMS Annual Meeting*, Austin, TX.
- [21] Knipp, D. J., S. Flynn, **T. Matsuo**, M. G. Mlynczak, and L. A. Hunt (2018), Understanding and Forecasting Upper Atmosphere Nitric Oxide Through Data Mining Analysis of TIMED/SABER Data, *15th Conference on Space Weather at 98th AMS Annual Meeting*, Austin, TX.
- [20] Hsu[†], C.-T., **T. Matsuo**, X. Yue, T.-W. Fang, T. Fuller-Rowell, K. Ide, and J.-Y. Liu (2018), Assessment of the Impact of FORMOSAT-7/COSMIC-2 GNSS RO Observations on Mid- and Low-latitude Ionospheric Specification and Forecasting Using Observing System Simulation Experiments, *USNC-URSI National Radio Science Meeting*, Boulder, CO.

- [19] Lin[†], C.-Y., **T. Matsuo**, J.-Y. Liu, and C. H. Lin (2018), Data Assimilation of Ground-Based GPS and Radio Occultation Total Electron Content for Global Ionospheric Specification, *USNC-URSI National Radio Science Meeting*, Boulder, CO
- [18] Chen, C.-H., C. H. Lin, **T. Matsuo**, J.-Y. Liu (2018), The Ionospheric Forecast System by Assimilation GNSS Observations, *URSI National Radio Science Meeting*, Boulder, CO.
- [17] Lin, C. H., C.-H. Chen, P. K. Rajesh, and **T. Matsuo** (2018), Toward Ionosphere Forecast Using COSMIC-2, *USNC-URSI National Radio Science Meeting*, Boulder, CO.
- [16] Lin, C. H., C.-H. Chen, and **T. Matsuo** (2017), Ionosphere Data Assimilation Modeling of 2015 St. Patrick's Day Geomagnetic Storm (Poster), *14th Annual Meeting Asia Oceania Geosciences Society*, Singapore.
- [15] Lin, C. H., C.-H. Chen, and **T. Matsuo** (2017), Modeling the Ionospheric Electric Fields Using Coupled Thermosphere-ionosphere Data Assimilation, *14th Annual Meeting Asia Oceania Geosciences Society*, Singapore.
- [14] Rajesh, P. K., Lin, C. H., C.-H. Chen, and **T. Matsuo** (2017), Modeling Ionospheric Pre-reversal Enhancement and Plasma Bubble Growth Rate Using Data Assimilation, *AGU Fall Meeting*, New Orleans, LA.
- [13] Flynn[†], S., D. J. Knipp, **T. Matsuo**, M. Mlynczak, and L. Hunt (2017), Understanding and Forecasting Upper Atmosphere Nitric Oxide Through Data Mining Analysis of TIMED/SABER Data (Poster), *AGU Fall Meeting*, New Orleans, LA.
- [12] Kilcommons, L. M., and **T. Matsuo** (2017), Assimilative Mapping of Ionospheric Electrodynamics (AMIE) - AMIEPy, *CEDAR Workshop Geospace Science in the Digital Age: New Tools and Methods Session*, Keystone, CO.
- [11] Flynn[†], S., D. J. Knipp, **T. Matsuo**, M. Mlynczak, and L. Hunt (2017), Empirical Orthogonal Function (EOF) Analysis and Thermospheric Nitric Oxide Flux, *CEDAR Workshop: Next Generation Systems Science Session*, Keystone, CO.
- [10] Hsu[†], C.-T., **T. Matsuo**, X. Yue, T. Fang, T. Fuller-Rowell, and J.-Y. Liu (2017), Assessment of the Impact of FORMOSAT-7/COSMIC-2 GNSS RO Observations on Mid- and Low-latitude Ionosphere Specification and Forecasting Using Observing System Simulation Experiments (OSSEs) (Poster), *CEDAR Workshop*, Keystone, CO.
- [9] Flynn[†], S., D. J. Knipp, **T. Matsuo**, M. Mlynczak, and L. Hunt (2017), Understanding the Variability in Thermospheric Nitric Oxide Flux Using Empirical Orthogonal Functions (EOFs) (Poster), *CEDAR Workshop*, Keystone, CO.
- [8] Shi[†], Y., **T. Matsuo**, D. J. Knipp, L. M. Kilcommons, and B. J. Anderson (2017), Determining Optimal Setting for AMIENext Procedure Using Iridium Data (Poster), *CEDAR Workshop*, Keystone, CO.
- [7] **Matsuo, T.**, and S, Claudia (2017). Unified Global and Local Perspectives on High-latitude, Ionospheric Electrodynamics, *Forth Swarm Science Meeting*, Banff, Alberta, Canada.
- [6] Hsu[†], C.-T., **T. Matsuo**, X. Yue, T. Fang, T. Fuller-Rowell, and J.-Y. Liu (2017), Assessment of the Impact of FORMOSAT-7/COSMIC-2 GNSS RO Observations on Ionospheric Specification and Forecasting Using Observing System Simulation Experiments (Poster), *Space Weather Workshop*, Westminster, CO.

[5] Liu, J.-Y., C.-Y. Lin, **T. Matsuo**, C. H. Lin, H.-F. Tsai, and C.-Y. Chen (2017), Global Three-Dimensional Ionospheric Data Assimilation Model Using Ground-based GPS and Radio Occultation Total Electron Content, *European Geosciences Union General Assembly*, Vienna, Austria.

[4] Hsu[†], C.-T., **T. Matsuo**, X. Yue, T. Fang, T. Fuller-Rowell, and J.-Y. Liu (2017), Assessment of the Impact of FORMOSAT-7/COSMIC-2 GNSS RO Observations on Ionospheric Specification and Forecasting Using Observing System Simulation Experiments (Poster), *European Geosciences Union General Assembly*, Vienna, Austria.

[3] **Matsuo, T.** (2017), Ionosphere Specification and Forecasting Enabled by Coupled Thermosphere-Ionosphere Data Assimilation, *AFOSSR Space Sciences Program Review*, Arlington, VA.

[2] Lin, C. H., C.-H. Chen, and **T. Matsuo** (2017), Development of Ionospheric Data Assimilation Model using GNSS Observations (Poster), *14th Conference on Space Weather at 97th AMS Annual Meeting*, Seattle, WA.

[1] Hsu[†], C.-T., **T. Matsuo**, X. Yue, and J.-Y. Liu (2017), Assessment of the Impact of FORMOSAT-7/COSMIC-2 GNSS RO Observations on Mid- and Low-latitude Ionosphere Specification and Forecasting Using Observing System Simulation Experiments (OSSEs), *USNC-URSI National Radio Science Meeting*, Boulder, CO.

OTHER PRODUCTS

Cyberinfrastructure - Assimilative Mapping of Geospace Observations (AMGeO)

Developed and deployed a collaborative data science platform AMGeO (<https://amgeo.colorado.edu>) for the geospace science community for bringing together a diverse set of heterogeneous geospace observations as part of the NSF-funded EarthCube project. The platform is made of the Python open-source software and web application services that facilitate the data acquisition and pre-processing steps that are otherwise prohibitively labor-intensive and allow the latest data assimilative mapping tools available to the community.

TEACHING – COURSES TAUGHT

ASEN1320 *Aerospace Computing and Engineering Applications*

Fall 2020, Spring 2022

Developed and taught a new core undergraduate course on aerospace computing to provide students with little or no prior experience in programming with basics programming concepts and useful tools in C++ and MATLAB for solving problems of interests in engineering with an emphasis on aerospace engineering applications. Lead discussion with the Computer Science (CS) Department to have ASEN 1320 recognized as a prerequisite for CSCI 2270 (Data Structures) which is a pathway to a CS minor. Developed Cloud9 IDE for C++ using the AWS cloud service to enable remote teaching.

ASEN5044 *Statistical Estimation for Dynamical Systems*

Spring 2020

Taught a graduate core course on statistical estimation for dynamical systems, introducing theory and methods of statistical estimation for general linear and nonlinear dynamical systems, with emphasis on aerospace engineering applications. Major topics include: review of applied probability and statistics; optimal parameter and dynamical state estimation; theory and design of Kalman filters for linear systems; extended/unscented Kalman filters and general Bayesian filters for non-linear systems.

ASEN4057 Aerospace SoftwareSpring 2018, Spring 2019, Spring 2020

Lectured and led computing lab sessions for aerospace software course to provide an overview of prevalent software, hardware, and computing concepts utilized in aerospace academia and industry and to establish the background necessary to tackle programming projects on different computing platforms (e.g., Linux, Unix) with various software tools (e.g., Git, MPI, OpenMP) and programming languages (e.g., Shell, C, MATLAB).

ASEN6337 Remote Sensing Data AnalysisFall 2017, Fall 2019

Redeveloped and taught a graduate course on remote sensing data analysis that covers some of the most commonly used machine learning techniques in remote sensing data analysis, specifically for clustering, classification, feature extraction and dimensionality reduction, and inverse methods used to retrieve geophysical information from remote sensing data. Designed hands-on computational homework assignments, and group and individual projects to provide the opportunities to apply the classroom curricula to real remote sensing data.

ASEN6055 Data Assimilation & Inverse Methods for Earth & Geospace ObservationsSpring 2017, Fall 2018, Fall 2020

Developed and taught a new graduate course that covers a selection of topics in probability theory, spatial statistics, estimation theory, numeric optimization, and geophysical nonlinear dynamics that form the foundation of commonly used data assimilation and inverse methods in the Earth and space sciences. Designed hands-on computational homework and projects to provide the opportunities to apply the classroom curricula to realistic examples in the context of data assimilation.

ASEN5210 Remote Sensing SeminarFall 2019

Lead a remote sensing seminar series that covers subjects pertinent to remote sensing of the Earth and geospace, including oceanography, meteorology, vegetation monitoring, geology, and space science with emphases on techniques for extracting geophysical information from satellite data.

ASEN5335 Aerospace Environment2001

Lectured on thermosphere and ionosphere responses to magnetospheric forcing and developed an interactive web interface for satellite drag estimation as part of teaching practicum requirements.

Oceanography (lower-level undergraduate)1998

Led recitation sections and graded homework as Teaching Assistant at State University of New York, Stony Brook.

Dynamic Meteorology (upper-level undergraduate)1997

Led recitation sections and graded homework as Teaching Assistant at State University of New York, Stony Brook.

TEACHING – STUDENT INDIVIDUAL MENTORING

PhD students advised (7)

Ms. Kawther Rouabhi, PhD student (AES)	2022–present
Mr. Nicholas Bartel, PhD student (AES)	2021–present
Ms. Skyler Shaver, PhD student (AES), Post Preliminary	2021–present
Mr. Nicholas Dietrich, PhD student (AES), Post Preliminary	2019–present

Mr. Chuan-Ping Lien, PhD student (AES), Post Preliminary	2019–present
Ms. Shay Gilpin, PhD student (APPM), Post Comprehensive	2018–present
Dr. Clayton Cantrall, PhD student (AES), Graduated in May 2022	2017–2022

PhD student co-advised (1)

Dr. Yining Shi, PhD student (AES), Graduated in Dec 2019	2015–2019
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PhD student co-advised or mentored in collaboration with their academic advisors (8)

Dr. Tongyi Tang [‡] , PhD student (Statistics) at University of California Davis	2018–2021
Dr. Tae Yen (Amy) Kim [‡] , PhD student (Statistics) at University of California Davis	2017–2020
Dr. Chih-Ting Hsu [‡] , J-1 visiting student from National Central University, Taiwan	2014–2018
Dr. Minjie Fan [‡] , PhD student (Statistics) at University of California Davis	2013–2017
Dr. Ryan McGranaghan [‡] , PhD student (AES)	2013–2016
Dr. Chi-Yen Lin [‡] , J-1 visiting student from National Central University, Taiwan	2011–2015
Dr. Yang-Yi Sun [‡] , J-1 visiting student from National Central University, Taiwan	2011–2014
Dr. I-Te Lee [‡] , J-1 visiting student from National Central University, Taiwan	2009–2013

MS thesis students advised (2)

Mr. Jason Li, Master student (AES)	2018–2021
Ms. Sierra Flynn, Master student (ASE)	2017–2017

MS students advised (2)

Dr. Si Shen, Master student (CS)	2018–2019
Mr. Will Evonosky, Master student (ASE)	2017–2018

PhD dissertation committee (17)

Mr. Kenichi Sasaki, PhD student (AES)	2021–present
Ms. Fan Shen, PhD student (CS)	2021–present
Mr. Eduard Heijkoop, PhD student (AES)	2020–present
Mr. Chris Heney, PhD student (Atmospheric and Oceanic Sciences)	2017–present
Dr. Ramya Rajasekaran, PhD student (AES)	2020–2022
Dr. Shaylah Mutschler, PhD student (AES)	2018–2022
Dr. Vishal Ray, PhD student (AES)	2020–2021
Dr. Forest Gasdia, PhD student (AES)	2020–2021
Dr. Andre Lucas, PhD student (AES)	2019–2021
Dr. Brian Breitsch, PhD student (AES)	2018–2021
Dr. Caleb Miller, PhD student (APPM)	2017–2021
Dr. Paul Diaz, PhD student (AES)	2019–2020
Dr. Viliam Klein, PhD student (AES)	2018–2019
Dr. Gregor Robinson, PhD student (APPM)	2018–2019
Dr. Ryan Hardy, PhD student (AES)	2017–2019
Dr. Michael Croteau, PhD student (AES)	2017–2018
Dr. Matthew Tooth, PhD student (AES)	2017–2018

[‡] Students mentored by Dr. Matsuo on their PhD research and dissertation in collaboration with their academic advisors

MS thesis committee (2)

Ms. Yu-Shan Chan, National Cheng Kung University, Taiwan	2020–2020
Mr. Jonathon Nikkel, Master student (AES)	2018–2018

PhD preliminary exam committee[§] (11)

Ms. Kaylee Champion, PhD student (AES)	2022
Ms. Celeste Guiles, PhD student (AES)	2022
Mr. Danielle J. Carroll, PhD student (AES)	2022
Ms. Mozhgan A. Farahani, PhD student (CU Denver)	2021
Mr. Kevin Sacca, PhD student (AES)	2020
Ms. Alexandra Wold, PhD student (AES)	2020
Mr. Evan Tucker, PhD student (AES)	2020
Mr. Yang Wang, PhD student (AES)	2019
Mr. Ryotaro Sakamoto, PhD student (AES)	2018
Mr. Shota Takahashi, PhD student (AES)	2018
Mr. Alfred Cruz, PhD student (AES)	2017

Graduate student mentoring on independent study (6)

Mr. Lewis Redner, Master student (AES) as a Graduate Research Assistant over the summer	2020
Mr. Tsung-Yu Wu, PhD student from National Central University, Taiwan as a summer visitor	2018
Ms. Gayatri Iyer, Master student from University of Texas Dallas as a summer visitor	2018
Mr. David Gunderman, PhD student (APPM) as a summer intern	2017
Dr. Xueling Shi, PhD student (EE) from Virginia Tech as a summer visitor	2016
Dr. Zachary Thomas ^{***} , PhD student (Statistics) from Ohio State University as a summer intern	2014

Undergraduate student mentoring on independent study (7)

Mr. Brandon Dilorenzo, Undergraduate Research Assistant	2022–present
Mr. Kristian Mrazek ^{††} , REU student from Augustana College, IL	2020
Mr. Willem Mirkovich, Discovery Learning Apprenticeship (CS)	2019–2020
Ms. Sara Reitz, Discovery Learning Apprenticeship (AES)	2018–2019
Ms. Valerie Svaldi ^{‡‡} , Research Assistant from Colorado School of Mines	2018–present
Ms. Tanya Leung, Undergraduate Research Assistant (CS)	2018
Ms. Suzanne Smith ^{††} , REU student from Lycoming College, PA	2010

EDUCATION GRANTS

DoED Graduate Assistantships in Areas of National Need (GAANN) Program 10/2018–9/2022

Axelrad, P. (PI), A. Anderson, B. Argrow, A. Doostan, J. Evans, E. Frew, D. Klaus, **T. Matsuo**, J. Morton, S. Palo, H. Schaub, and D. Scheeres (Co-Is), Critical Aerospace Technologies

CU-Boulder Engineering Excellence Fund (EEF) Program 5/2020–4/2021

[§] Not including 3 PhD advisees and 3 PhD students for whom serving on the PhD dissertation committee

^{***} NCAR's Summer Internships in Parallel Computational Science (<https://www2.cisl.ucar.edu/sipares>) program participant.

^{††} CU LASP' REU Program in Solar and Space Physics (<http://lasp.colorado.edu/home/education/reu>)

^{‡‡} Started as CU LASP' REU Program in Solar and Space Physics participant from Red Rocks Community College, CO, 2018

Hense, D. (Primary Author), K. Graham, **T. Matsuo**, R. Hoenigman, R. Regueiro, and N. Stites (Supporting Authors), Online Mathworks Courses for Enhanced Student Support for MATLAB

EDUCATION OUTREACH ACTIVITIES

Boulder Valley School District (BVSD) Science Fair Mentor

11/2020-2/2021

Mentored a student at the Boulder High School (Ms Lauren Christiansen) on research involving citizen science auroral sighting data for the BVSD Corden Pharma Science Fair (<https://www.bvsd.org/parents-students/academics/bvsd-sponsored-events/science-fair>)

CU Science Discovery Mountain Research Experience

7/2019

Offered a one-day STEM summer camp program on remote sensing based on ASEN 6037 Remote Sensing Data Analysis coursework for high-school students as part of the CU Science Discovery Mountain Research Experience (<https://www.colorado.edu/sciencediscovery/programs/mountain-research-experience>).

CU ODECE Pre-Collegiate Bridge Program

6/2018

Developed an outreach program composed of hands-on activities that traverse the entire arc of remote sensing and in-situ data collection, analysis, and modeling based on ASEN 6037 Remote Sensing Data Analysis coursework, and offered a one-week STEM summer camp for first-generation precollegiate high-school students in collaboration with the CU Science Discovery and Office of Diversity, Equity and Community Engagement (ODECE) (<https://www.colorado.edu/odece/what-we-do/pre-college-outreach-engagement>).

CU Science Discovery High School STEM Academy

8/2017

Presented a lecture on aerospace environment and organized a NOAA Space Weather Prediction Center forecast office tour as part of the CU Science Discovery High School STEM Academy on Aerospace Engineering (<https://www.colorado.edu/sciencediscovery/programs/high-school-stem-academies-cu-boulder>).

Earth Explorers

2012, 2014

Participated in Earth Explorers' short-film projects (<https://scied.ucar.edu/events/earth-explorers>) on NOAA scientists by underrepresented middle-school students.

Expanding Your Horizons

2/2007, 2/2008, 2/2010, 2/2011, 2/2012, 2/2013, 2/2014

Presented hands-on experiment workshops (e.g., liquid nitrogen, electromagnetism experiments) to encourage 6th, 7th, and 8th-grade girls to study math, science, and technology at annual Expanding Your Horizons conferences at the CU Engineering Center (<https://eyh.techbridgegirls.org/conferences/Boulder>).

SERVICE ACTIVITIES

Session Conveners and Conference Program Committees (38)

AGU Fall Meeting, Machine Learning in Space Weather session, Chicago, IL, 2022; AGU Fall Meeting, Data-driven Modelling and New Measurements of the Magnetosphere-Ionosphere-Thermosphere (MIT) System, Chicago, IL, 2022; AGU Fall Meeting, Leveraging Multi-point and Multi-source Observations to Advance Frontier ITM Science, Chicago, IL, 2022; CEDAR Workshop, Understanding the Electromagnetic Energy Input to Earth's Atmosphere ground-challenge session, Austin, TX, 2022; GEM Workshop, Inter-hemispheric

Approach to Understanding Magnetosphere-Ionosphere Coupling session, Honolulu, HI, 2022; AGU Fall Meeting, Machine Learning in Space Weather session, New Orleans, LA, 2021; GEM Workshop, Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Coupling session, Virtual, 2021; CEDAR Workshop, Accelerating Your Science With Assimilative Mapping of Geospace Observations (AMGeO): Tutorial and Interactive Demos session, Virtual 2021; CEDAR Workshop, Reproducibility in Geospace Science: Best Practices for Data Stewardship session; CEDAR Workshop, Understanding the Electromagnetic Energy Input to Earth's Atmosphere ground-challenge session, Virtual, 2021; Mini-GEM Workshop, Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Coupling session, Virtual, 2021; AGU Fall Meeting, Machine Learning in Space Weather session, Virtual, 2020; CEDAR Workshop, Understanding the Electromagnetic Energy Input to Earth's Atmosphere ground-challenge session, Virtual, 2020; GEM Workshop, Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Coupling session, Virtual, 2020; AGU Fall Meeting, Machine Learning in Space Weather session, San Francisco, 2019; Mini-GEM Workshop, Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Coupling session, San Francisco, 2019; AGU Chapman Conference on Scientific Challenges Pertaining to Space Weather Forecasting Including Extremes, Pasadena, CA, 2019; GEM Workshop, Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Coupling session, Santa Fe, NM, 2019; AGU Fall Meeting, Ground-truth Data and Model Validation for Magnetosphere-Ionosphere Coupling Processes session, Washington DC, 2018; AGU Fall Meeting, Geospace Research From Polar Environments session, Washington DC, 2018; Mini-GEM Workshop, Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Coupling session, Washington DC, 2018; CEDAR Workshop, Next Generation CEDAR Science: Addressing Geospace System Science in the Age of Data Science session, Santa Fe, NM, 2018; GEM Workshop, Inter-hemispheric Approach to Understanding Magnetosphere-Ionosphere Coupling session, Santa Fe, NM, 2018; CEDAR-GEM Joint Workshop, Interhemispheric Processes, Hemispheric Symmetries and Asymmetries panel, Santa Fe, NM, 2018; AGU Fall Meeting, Frontier Solar-terrestrial Science Enabled by the Combination of Data-driven Techniques and Physics-based Understanding session, New Orleans, LA, 2017; CEDAR Workshop, Next Generation Systems Science: Embracing Data Fusion and Data Science Methods to Understand Geospace Complexities session, Keystone, CO, 2017; CEDAR Workshop, Geospace Science in the Digital Age: New Tools and Methods session, Keystone, CO, 2017; CEDAR Workshop, High-Latitude Ionospheric Electrodynamics and Their Impact on the Thermosphere session, Keystone, CO, 2017; CEDAR-GEM Joint Workshop, Making Sense of Geospace Observations session, Santa Fe, NM, 2016; International Union of Geodesy and Geophysics (IUGG) General Assembly, Data Assimilation in Geophysical Sciences session, Prague, Czech Republic, 2015; AGU Fall Meeting, Data Assimilation for Space Physics and Aeronomy session, San Francisco, CA, 2014; CEDAR Workshop, Data Assimilation and Inverse Problems for High-latitude Electrodynamics session, Seattle, WA, 2014; AGU Fall Meeting, Data Assimilation for Space Physics session, San Francisco, CA, 2013; CEDAR Workshop, System-theoretic Approach to CEDAR Science session, Boulder, CO, 2013; CEDAR-GEM Joint Workshop, Tutorial on Data Assimilation session, Santa Fe, NM, 2011; IUGG General Assembly, Data Assimilation and Ensemble Forecasting for Weather and Climate session, Melbourne, Australia, 2011; IUGG General Assembly, Data Assimilation and Space Weather session, Perugia, Italy, 2007; IAGA Scientific Assembly, Data Assimilation Techniques for the Ionosphere-Thermosphere Magnetosphere System session, Toulouse, France, 2005.

Panels and Committee (14)

National Academy of Sciences' Decadal Survey for Solar and Space Physics (Heliophysics) 2024-2033 Steering Committee, 8/2022-current; ESA-NASA Lower Thermosphere-Ionosphere Science (EN-LoTIS) Working Group, 4/2022-current; International Association of Geomagnetism and Aeronomy (IAGA) Geospace Data Assimilation Working Group (GeoDAWG) as Chair, 8/2022-current; NASA Heliophysics Advisory Committee, 9/2017-8/2022; AGU Basu United States Early Career Award committee, 5/2017-1/2022; International Space Science Institute (ISSI) Science Team for Data Assimilation in the Ionosphere and Thermosphere, 6/2021-present; ISSI Science Team for Understanding Interhemispheric Asymmetry in MIT Coupling, 6/2021-present; ESA Daedalus Mission Advisory Group, 1/2018-6/2021; NCAR Computational and Information Systems

Laboratory's Science Requirements Advisory Panel for the High-performance Computing System Procurement, 1/2019-7/2020; NASA Geospace Dynamics Constellation Science and Technology Definition Team, 5/2018-10/2019; International Space Science Institute (ISSI) Working Group for Ionospheric Multi-spacecraft Analysis Tools, Bern, Switzerland, 2015-2017; NSF Geospace Section Committee of Visitors, 2014; NSF-CEDAR Science Steering committee, 2012-2015; ISSI Science Team for 3D ionospheric modeling, 2005-2006.

University and Department Committees (9)

Smead Aerospace Engineering Sciences Department's Undergraduate Committee for Curriculum Development, 8/2022-present; Smead Aerospace Engineering Sciences Department's Inclusive Culture Committee, 10/2020-5/2022; Smead Aerospace Engineering Sciences Department's Computing Committee, 8/2019-5/2022; University of Colorado Boulder Research and Innovation Office's ad hoc Committee for Research Computing Strategic Visioning, 1/2021-5/2021; University of Colorado Boulder's Center for Research Data and Digital Scholarship Advisory Board, 1/2017-5/2022; Smead Aerospace Engineering Sciences Department's Strategic Vision Committee, 8/2019-5/2020; Smead Aerospace Engineering Sciences Department's Graduate Committee, 8/2018-5/2020; Smead Aerospace Engineering Sciences Department's RSESS Focus Area Lead, 8/2018-5/2020; University of Colorado Boulder's International Strategy Committee, 8/2017-12/2019.

Proposal Reviews

NASA Heliophysics Research and Analysis Program peer-review panels; NSF Antarctic Aeronomy and Astrophysics Program peer-review panels; NSF Coupling, Energetics, and Dynamics of Atmospheric Regions Program peer-review panels; NSF Geospace Environment Modeling Program peer-review panels; AFOSR, NASA, NSF, and DOE mail-in external reviewers.

Paper Reviews

Journal of Geophysical Research; Monthly Weather Review; Geophysical Research Letter; Radio Science; Space Weather; Tellus; Mathematical Geosciences; Annals of the Institute of Statistical Mathematics; AGU Monograph; Elsevier Limited; Space Science Reviews; Springer.