Todd Anderson – Doctoral Candidate in Earth and Space Sciences, University of Washington

Contact Information

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Education

Sept. 2015-present: Coursework towards PhD in Earth and Space Sciences (ESS) at the University of Washington. Courses in the ESS Department have focused on space plasma physics including plasma waves, scientific computing, and classical electrodynamics using the Jackson text.
Seattle, WA, USA

Spring 2015: Completed graduate courses in Atomic Physics and Radiative Processes at the University of Utah.
Salt Lake City, UT, USA

June 2014: B. A. in Physics with Honors from Dartmouth College. Completed an undergraduate thesis entitled "Orbital dynamics model of a CubeSat swam under aerodynamic torque in LEO".
Hanover, NH, USA

Professional Development

Summer 2020: Participated in the inaugural **NASA-JPL Heliophysics Mission Design School (HMDS)**, as part of a 19-person cohort made up of early-career scientists. HMDS is a 10-week course for early-career scientists about the formulation and proposal of NASA Heliophysics missions, with an emphasis establishing science traceability; that is, demonstrating how agency goals lead to science objectives, which mission requirements. The school culminated in an intensive week working with the JPL Team X on mission and spacecraft design, and ended with a proposal to a NASA review board. Our mission, the **Sun**-**S**ailing **P**olar **O**rbiting **T**elescope (SunSPOT), will be presented at the 2020 AGU Fall Meeting (see "Presentations" section).

Research Experience

Aug. 2015-present: Research assistant in Atmospheric Electrodynamics group led by Dr. Robert Holzworth, Dept. Earth and Space Sciences (ESS), University of Washington.
Current projects: (1) Balloon campaign to study the fair-weather return current of the Global Electric Circuit. With Dr. Michael McCarthy (PI), Dr. Robert Holzworth and others, will launch a vector electric field instrument on three high-altitude balloons: a test flight in Summer 2019, and two to four

overlapping science flights in Summer 2020. The fair-weather return current will be compared with global thunderstorm activity, quantified by the World Wide Lightning Location Network (WWLLN) as well as the Geostationary Lightning Mapper onboard the GOES-16 satellite.

(2) Effects of solar activity on sferic propagation the Earth-ionosphere waveguide as seen in global lightning data. Solar flares and CMEs disrupt VLF sferic propagation between lightning strokes and detecting stations, by altering reflection properties of the Earth-ionosphere waveguide. Using WWLLN, I am investigating the spatial and temporal extent of attenuation regions caused by solar activity. I hope to evolve this work into a real-time lower ionosphere monitor. This work has resulted in a publication (Anderson, et al. 2020).

(3) Raytracing of whistler waves from WWLLN-detected lightning strokes into the plasmasphere. Lightning strokes, and other terrestrial radio sources, launch radio waves that propagate in the Earth-ionosphere waveguide; a portion of the VLF component of these waves escapes through the ionosphere and propagate as whistler-mode waves in the magnetosphere, interacting with particle populations there. Using optical raytracing techniques, combined with the WWLLN global lightning dataset, I am building a climatology of whistler wave energy in the plasmasphere.

(4) Current work also includes **hardware support for WWLLN**.

Previous work has included a study of the effects of hypersonic dust injection in the ionosphere. With Dr. Michael McCarthy (UW ESS), performed prelaunch diagnostics on the UW vector electric field instrument on the **Charged Aerosol Release Experiment II** (CARE II) sounding rocket. Operated cameras on NASA observation aircraft during launch window. The CARE II project was funded by the Naval Research Laboratory and US Department of Defense.

Oct. 2014-May 2015: Research assistant in the Applied Cognition Laboratory under Drs. David Strayer and Joel Cooper, Dept. Psychology, University of Utah. Studied the distracting effects of voice-based in-vehicle infotainment systems. This study funded by the American Automobile Association.

Mar. 2012-June 2014: Undergraduate researcher in group led by Dr. Kristina Lynch, Dept. Physics and Astronomy, Dartmouth College. Group is working towards simultaneous multipoint measurement of auroral plasma using a nanosatellite swarm; personal responsibilities include sounding balloon launch predictions and logistics, satellite swarm orbit modeling, sounding rocket payload design. Thesis in attitude and swarm cohesion control of the Ionospheric CubeSwarm Pathfinder (ICSP) mission using aerodynamic torque, using STK and MATLAB simulation and analysis tools. Participated in a TeamXc study of the ICSP mission at the Jet Propulsion Laboratory in March 2014. This group funded by the NASA Jet Propulsion Laboratory through a JPL-SURP grant.

2011 Summer: Research on synthesis of Cadmium-chalcogenide nanorods with Dr. Michael H. Bartl, Dept. Chemistry, University of Utah. CdS, CdSe and CdTe quantum dots and nanorods were synthesized and characterized using visible light spectroscopy and transmission electron microscopy. Charge transport in synthesized CdSe and CdTe rods was studied with Dr. Jordan Gerton, Dept. Physics, University of Utah; using atomic force microscopy. Project funded by the US Department of Energy.

2009 Summer: Research on rapid synthesis of TiO2/SiO2 thin film photonic crystals with Dr. Michael H. Bartl, Dept. Chemistry, University of Utah. Titania and silica layers were deposited on glass and silicon slides by dip-coating in solution and sintering; multilayer structures were characterized using visible light spectroscopy, and optical- and scanning electron microscopy. Project funded by the US Department of Energy.

Teaching Experience

Spring 2016-2019: Teaching Assistant for ESS 205: Access to Space, a course in which students from all disciplines develop and conduct experiments to study the interface of Earth's atmosphere and space. This involves a theoretical component of atmospheric and space science, as well as electronic payload fabrication, radio telemetry, and balloon methodology. The course culminates in the launch of one or two sounding balloons carrying student-build payloads.

Publications

1. Anderson, T. S., McCarthy, M. P., & Holzworth, R. H. (2020). Detection of VLF attenuation in the Earth-ionosphere waveguide caused by X-class solar flares using a global lightning location network. *Space Weather*, 18, e2019SW002408. https://doi.org/10.1029/2019SW002408

2. Holzworth, R. H., Brundell, J. B., McCarthy, M. P., Jacobson, A. R., Rodger, C. J., & **Anderson, T. S.** (in review). Lightning in the Arctic. Preprint: https://doi.org/10.1002/essoar.10504658.1

Presentations

December 2020: Poster at the 2020 AGU Fall Meeting, entitled "A Mission Concept for a Solar Observatory in a Highly-Inclined Heliocentric Orbit - Demystifying the Magnetic Nature and Activity of our Star" [presenting author: Georgios Chintzoglou].

December 2019: Talk at the 2019 AGU Fall Meeting, entitled "Quantifying the thunderstorm contribution to Earth's Global Electric Circuit" [see project (1) in Research Experience].

February 2019: Poster at the AGU Chapman Conference on Challenges Related to Space Weather Forecasting Including Extremes, entitled "Initial steps for a system to monitor space weather effects on the lower ionosphere using global lightning as a probe signal" [see project (2) in Research Experience].

December 2017: Poster at the 2017 AGU Fall Meeting, entitled "Sferic propagation perturbations caused by energetic particle events as seen in global lightning data" [see project (2) in Research Experience].

Outreach

June 2016: Volunteered at Leschi Elementary, teaching 4th-grade students about rocketry. Helped students build and launch water rockets.

February 2016: Volunteered at the Enumclaw STEM Expo, an event for K-12 students to learn about science, technology, engineering and mathematics research and activity in academic and private organizations. I set up a booth with three other students from the UW ESS department whose research involves plasma physics and rocket experimentation, and demonstrated how electric and magnetic fields evident in simple demonstrations (a plasma globe and a coil gun) are relevant to our research.

Computer Skills *Programming*: MATLAB, Julia, Python; some experience in C, Java and VHDL. *Software*: Autodesk EAGLE and FUSION360, LaTeX, Microsoft Office, SolidWorks, STK, Wolfram Mathematica.

Certifications Amateur Radio Technician license (KF7ZEG), expires Oct. 2022.
First Aid/CPR, expires Sept. 2021