# SHUANG XU

Department of Physics
Utah State University
4415 Old Main Hill Office SER-220A
Logan, UT 84322-4415, USA
Homepage: https://cas.hamptonu.edu/profile/shuang-xu/
Google scholar: https://scholar.google.com/citations?user=HSyizXkAAAAJ
+1 (303) 960-4561 | xushuang9999@gmail.com / shuang.xu@usu.edu

## EDUCATION

**Utah State University (USU)** — Logan, UT, USA
- Postdoctoral Research Fellow — Nov. 2023–

**Hampton University (HU)** — Hampton, VA, USA
- Ph.D. in Atmospheric Science — Aug. 2019–Oct. 2023

**University of Science and Technology of China (USTC)** — Hefei, Anhui, China
- M.S. in Geophysics — Sep. 2016–Jun. 2019

**Sun Yat-sen University (SYSU)** — Guangzhou, Guangdong, China
- B.S. in Geographic Information System — Sep. 2012–Jun. 2016

## AREAS OF EXPERTISE

Atmospheric gravity waves, Stratospheric dynamics, Mesosphere and Lower Thermosphere (MLT) region dynamics, Satellite data applications

## PUBLICATIONS

1. **Xu, S.**, S.L. Vadas, J. Yue, (2023), *Quiet-Time Thermospheric Gravity Waves Observed by GOCE and CHAMP.* (Journal of Geophysical Research: Space Physics, minor revision.)
2. **Xu, S.**, J. Carstens, J.A. France, C.E. Randall, J. Yue, V.L. Harvey, J. Gong, J. Lumpe, L. Hoffmann, J. M. Russell III (2023), *Seasonal distribution of gravity waves near the stratopause in 2019-2022*. (Earth and Space Science, minor revision)
3. Harvey, V. L., C. E. Randall, L. P. Goncharenko, E. Becker, J. M. Forbes, J. Carstens, **S. Xu**, J. A. France, S.-R. Zhang, & S. M. Bailey, (2023), *CIPS observations of gravity wave activity at the edge of the polar vortices and coupling to the ionosphere*. **Journal of Geophysical Research: Atmosphere, doi: 10.1029/2023JD038827**
4. **Xu, S.**, S.L. Vadas, J. Yue (2021), *Thermospheric Traveling Atmospheric Disturbances in Austral Winter from GOCE and CHAMP,* **Journal of Geophysical Research: Space Physics, doi: 10.1029/2021JA029335**
5. Yue, J., S. Perwitasari, **S. Xu**, Y. Hozumi, T. Nakamura, T. Sakanoi, A. Saito, S.D. Miller, W. Straka, P. Rong (2019), *Preliminary Dual-Satellite Observations of Atmospheric Gravity Waves in Airglow,* **Atmosphere 10(11): 650, doi:10.3390/atmos10110650**
6. Vadas, S.L., **S. Xu**, J. Yue, K. Bossert, E. Becker, & G. Baumgarten. (2019). *Characteristics of the Quiet-time Hotspot Gravity Waves Observed by GOCE over the Southern Andes on 5 July 2010*, **Journal of Geophysical Research: Space Physics. doi:10.1029/2019ja026693**
7. **Xu, S.**, J. Yue, X. Xue, S.L. Vadas, S. Miller, I. Azeem, W. Straka, L. Hoffmann and S. Zhang (2019),

*Dynamical coupling between Hurricane Matthew and the Middle to Upper Atmosphere via gravity waves.* **Journal of Geophysical Research: Space Physics, 124. doi:10.1029/2018JA026453**

8. Huang, A., G. Lu, J. Yue, W. Lyons, F. Lucena, F. Lyu, S. Cummer, W. Zhang, L. Xu, X. Xue, **S. Xu** (2018), *Observations of red sprites above Hurricane Matthew*, **Geophysical Research Letters, 45, 13158-13165, doi:10.1029/2018GL079576**
9. Miller, S.D., W. Straka III, J. Yue, C. Seaman, **S. Xu**, C. Elvidge, L. Hoffmann, and I. Azeem (2018), *The Dark Side of Hurricane Matthew—Unique Perspectives from the Day/Night Band*, **Bulletin of the American Meteorological Society, 2561-2574, doi:10.1175/BAMS-D-17-0097.1**

## CONFERENCES

1. Poster presentation in 2023 CEDAR Workshop Jun. 25–30, 2023, San Diego, CA
2. Poster presentation in AGU 2022 Fall Meeting Dec. 12–16, AGU Fall 2022, A15I-1344, Chicago, IL
3. Talk presentations in 2022 AIM Science Team Meeting Jul. 19–21, 2022, Blacksburg, VA
4. Poster and oral presentations in 2022 CEDAR Workshop Jun. 19–24, 2022, Austin, TX
5. Oral presentation in Hampton University School of Science 26th Annual Research Symposium Apr. 7–8, 2022 (Virtual)
6. Poster presentation in the SPARC 2022 Gravity Wave Symposium Mar. 28–Apr. 1, SPARC 2022 (Virtual)
7. Poster presentation in AGU 2021 Fall Meeting Dec. 13–17, AGU Fall 2021, SA45A-2185 (Virtual)
8. Poster presentation in 2021 CEDAR Workshop Jun. 20–25, 2021 (Virtual)
9. Poster presentation in AGU 2020 Fall Meeting Dec. 1–17, AGU Fall 2020, SA008-0012 (Virtual)
10. Oral presentation in the 5th Young Scientist Forum of Earth Science Oct. 26–29, 2018 Nanjing, China
11. Volunteer and poster presentation in the 10th Workshop on Long-term Changes and Trends in the Atmosphere May 14–18, 2018 Hefei, China

## RELEVANT COURSES

Atmospheric Physics
Atmospheric Radiative Transfer
Atmospheric measurements
Geophysical Fluid Dynamics
Atmospheric Chemistry
Math Methods of Physics
Principles of Planetary Science
Winter 2020 WRF Tutorial (NCAR, Boulder, CO)

## COMPUTER SKILLS

- IDL, cartography, MATLAB, basic Linux, basic Python, basic Fortran

## SYNERGISTIC ACTIVITY

- Reviewer, Journal of Geophysical Research: Space Physics
- Reviewer, Journal of Geophysical Research: Atmosphere
- Teaching assistant, Fall Semester 2021 (HU undergraduate course: APS 101 – Introduction to Weather and Climate, lecturer: Dr. Robert Loughman)
- One member of the watch-keeping team of USTC Sodium Lidar nighttime observations (part of Chinese Meridian Project) during 2017-2019, which is used to observe metal layers in MLT region.

## SELECTED RESEARCH EXPERIENCE

**Ray-tracing model of gravity waves** Feb.–Jun. 2016

Dr. Xianghui Xue, School of Earth and Space Sciences, USTC Hefei, Anhui, China

- Developed a *Preliminary Ray-tracing model of gravity waves in upper atmosphere.*

**Dynamical Coupling between Hurricane Matthew and the Middle to Upper Atmosphere via Gravity Waves** Sep. 2017–Jan. 2019

Dr. Jia Yue, Center for Atmospheric Sciences, HU Hampton, VA, USA

Dr. Xianghui Xue, School of Earth and Space Sciences, USTC Hefei, Anhui, China

- Publications: see 5, 7, 8, 9 in Publications.
- Key points: 1) Gravity waves generated by Hurricane Matthew were seen from the tropopause to the ionosphere with horizontal wavelengths of ~200–300 km in Oct. 2016. 2) Both small- and large-scale gravity wave patterns seen in VIIRS Day-night Band and GPS TEC observations correlated with Hurricane Matthew's most intense period. 3) Hurricane induced concentric TID could not directly propagate to over ~470 km altitude using dispersion relationship with viscosity considered.
- My key contributions: 1) In paper 5, I cooperated with a Japanese team and applied dual-satellite observations by combining the VIIRS DNB and IMAP datasets. 2) In paper 7, I utilized remote sensing data from multiple platforms to do synergetic studies of gravity waves generated from Hurricane Matthew, which includes AIRS 4.3 μm & 15 μm BT, VIIRS DNB data, and GPS TEC data. I also carried out the studies of gravity waves by investigating their characteristics and atmospheric background conditions. 3) In papers 8 and 9, I projected a photo of gravity waves and red sprites taken by a citizen scientist to map for analyzing their characteristics.

**Thermospheric Gravity Waves Observed by GOCE and CHAMP satellites** Sep. 2019–Present

Dr. Sharon L. Vadas, Northwest Research Associates, Boulder, Colorado, USA.

Dr. Jia Yue, NASA Goddard Space Flight Center Greenbelt, MD, USA

- Publications: see 1 (under review), 4, 6 in Publications.
- Key points: 1) GOCE thermospheric traveling atmospheric disturbances in austral winter are mainly induced by orographic waves during geomagnetic quiet time. 2) Medium and large scale traveling atmospheric disturbances in CHAMP create a bipolar distribution in austral winter quiet time. 3) Traveling atmospheric disturbances during geomagnetic activities are likely caused by aurora generated gravity waves. 4) The strongest GW events occur most often in the summer polar region during geomagnetic quiet times. 5) GWs in the winter hemisphere at midlatitudes during quiet times and 12–24 LST (local solar time) are possible due to the polar vortex. 6) CHAMP observes a clockwise (counterclockwise) rotation of GW azimuth in the northern (southern) hemisphere over LST.
- My key contributions: Satellites like GOCE and CHAMP equipped with precise accelerometers are powerful tools for studying thermospheric gravity waves. However, due to limitation in methodology, the along-track wind measurements cannot be directly derived by accelerometer measurements. 1) In Paper 1 (under review), I applied Wavelet Analysis to extract density and cross-track wind perturbations observed in GOCE & CHAMP density data. Then I applied dissipative dispersion and polarization relations for thermospheric gravity waves to restore the intrinsic parameters of waves, such as horizontal wavelengths, intrinsic period, propagation directions, etc. We found a semi-annual and annual variations in thermospheric Gravity waves, strongly suggest the predominantly higher-order generation of these Gravity waves shaped by intricate interactions between primary gravity waves and seasonally varying background wind fields. We also found a clear diurnal dependence of gravity wave propagation azimuth opposite to the background wind direction. 2) In paper 4, I applied a climatology study based on traveling atmospheric disturbances that are extracted and filtered from GOCE &

CHAMP density observations in the thermosphere. By extrapolating gravity wave activities in the Austral Winter hemisphere along Kp index, I conclude that the Southern Andes quiet-time hotspot is mainly generated by lower atmosphere instead of geomagnetic disturbances. I also found a quiet-time thermosphere hotspot over Antarctica, which is roughly in agreement with the results in the HIAMCM simulation. 3) In paper 6, I carried out a preliminary case study by extracting/filtering characteristics of gravity waves from GOCE density observations.

**Stratopause gravity waves climatology derived from CIPS RAA data** Jan. 2021–Jun, 2023

Dr. Cora E. Randall LASP, University of Colorado Boulder, Boulder, Colorado, USA

Dr. Justin Carstens Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA,

- Publications: see 2, 3 (under preparation) in Publications.
- Key points: 1) The Rayleigh Albedo Anomaly (RAA) observations obtained by Cloud Imaging and Particle Size (CIPS) instrument occupy a unique spatial and temporal niche in providing information about the vertical propagation of gravity waves from the lower atmosphere into the mesosphere. 2) In order to facilitate quantitative analyses using CIPS RAA data and to reduce the random noise in the CIPS scenes, we have developed a variance data product that uses a Fast Fourier Transform (FFT) window filter. The RAA variances provide a quantitative measure of wave-driven fluctuations that can be used in automated analyses targeting gravity waves.
- My key contributions: 1) In papers 2 and 3, I played a key role in the development of algorithms for generating the RAA variance dataset and in the curation of RAA datasets, (Level 2B, 2C, and 3A). The RAA variance dataset is valuable because it quantifies stratopause gravity waves. In paper 2, I conducted a seasonal analysis to explore how gravity waves affect the stratopause, focusing on variations in different months. I compared these findings with climatological results from CIPS and AIRS, and delved into the factors that might explain any differences observed in the intercomparison between these datasets.

## SELECTED AWARDS AND HONORS

- SYSU Scholarship (Third grade, top 20%) Academic year 2013–2014
- USTC Academic Scholarship for graduate student (Second grade) 2018
- Hampton University School of Science 26th Annual Research Symposium, the first place of graduate student presentation award Apr. 7–8, 2022, Virtual
- CEDAR Student Poster MLT 1st Place Jun. 25–30, 2023, San Diego, CA