

Robert G. Nystrom

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Research Interests:

My research focuses on improving the predictability of tropical cyclones and better understanding their dynamics through the use of ensemble data assimilation and ensemble forecasts. I am particularly interested in the use of aircraft and all-sky satellite observations to improve tropical cyclone prediction and the air-sea interactions within tropical cyclones.

Education:

The Pennsylvania State University

PhD Candidate, Department of Meteorology and Atmospheric Science and The Center for Advanced Data Assimilation and Predictability Techniques (ADAPT), 2015-Present
(Expected Graduation: August 2020)

Advisor: Dr. Fuqing Zhang, Distinguished Professor of Meteorology and Professor of Statistics
& Dr. Steven Greybush, Associate Professor of Meteorology

University of Illinois at Urbana-Champaign

B.S. in Atmospheric Sciences with Highest Distinction, 2015

Peer-Reviewed Publications:

1. **Nystrom, R. G.** and F. Zhang, 2019: Practical Uncertainties and Underlying Dynamics in the Limited Predictability of the Record-Breaking Intensification of Hurricane Patricia (2015). *Mon. Wea. Rev.*, **147**, 3535–3556, <https://doi.org/10.1175/MWR-D-18-0450.1>.
2. **Nystrom, R. G.**, F. Zhang, E. B. Munsell, S. A. Braun, J. A. Sippel, Y. Weng, and K. A. Emanuel, 2018: Predictability and dynamics of Hurricane Joaquin (2015) explored through convection-permitting ensemble sensitivity experiments. *J. Atmos. Sci.*, **75**, 401–424, <https://doi.org/10.1175/JAS-D-17-0137.1>.
3. Zhang F., M. Minamide, **R. G. Nystrom**, X. Chen, S.-J. Lin, and L. M. Harris, 2019: Improving Harvey forecasts with next-generation weather satellites. *Bull. Amer. Meteor. Soc.*, **100**, 1217–1222, <https://doi.org/10.1175/BAMS-D-18-0149.1>.
4. Tao, D., K. A. Emanuel, F. Zhang, R. Rotunno, M. M. Bell, and **R. G. Nystrom**, 2019: Evaluation of the assumptions in the steady-state tropical cyclone self-stratified outflow using three-dimensional convection-allowing simulations. *J. Atmos. Sci.*, **76**, 2995–3009, <https://doi.org/10.1175/JAS-D-19-0033.1>.

Publications Submitted or in Preparation:

1. **Nystrom, R. G.**, X. Chen, F. Zhang, and C. A. Davis, 2019: Nonlinear Impacts of Surface Exchange Coefficient Uncertainty on Tropical Cyclone Air-Sea Interactions and Intensification. *Geophys. Res. Lett.*, in review.

2. **Nystrom, R. G.**, R. Rotunno, C. A. Davis, and F. Zhang, 2019: Consistent impacts of surface enthalpy and drag coefficient uncertainty between an analytical model and simulated tropical cyclone maximum intensity and storm structure, *In prep.*
3. **Nystrom, R. G.** and F. Zhang, 2019: The impact of air-sea momentum and enthalpy fluxes and their uncertainties in the development, structure and intensification of Hurricane Patricia (2015), *In prep.*

Funded Proposals:

- **Nystrom, R. G.** (PI), 2017-2020: Improving the Predictability and Understanding of Tropical Cyclones: Ensemble Assimilation of All-Sky Satellite Observations. *NASA Earth and Space Science Graduate Fellowship Program Grant 17-EARTH17F-184.*

Honors:

- Alumni Association Dissertation Award/Distinguished Doctoral Scholar Medal nominee, The Pennsylvania State University, 2019–2020
- Al and Betty Blackadar Graduate Scholarship for superior academic record and promise of outstanding academic success, The Pennsylvania State University Department of Meteorology and Atmospheric Science, 2019
- AMS Student Travel Grant 23rd Symposium on Boundary Layers and Turbulence/21st Conference on Air-Sea Interaction, 2018
- NASA Earth and Space Science Fellowship (NESSF) Program Recipient, 2017-Present
- Hans Neuberger Award for excellent teaching of meteorology, The Pennsylvania State University Department of Meteorology and Atmospheric Science, 2017
- National Science Foundation Graduate Research Fellowship Honorable Mention, 2015
- Ogura Outstanding Senior in Atmospheric Sciences, University of Illinois at Urbana-Champaign Department of Atmospheric Sciences, 2015
- Ogura Undergraduate Research Award, University of Illinois at Urbana-Champaign Department of Atmospheric Sciences, 2015
- NOAA Ernest F. Hollings Scholar, 2013-2015

Teaching Experience:

- Invited Lecturer: The International Multiscale Convection Summer School: *Tropical Cyclone Data Assimilation: challenges, current practices, and future frontiers*, Peking University Department of Atmospheric and Oceanic Sciences (Beijing, China), May 2019
- Guest Lecturer: METEO 527 Data Assimilation (Penn State University), Spring 2019
- Instructor: METEO 005 Severe and Unusual Weather (Penn State University), Summer 2018
- Teaching Assistant: METEO 436 Radiation and Climate (Penn State University), Fall 2016

Outreach:

- Weather Where I Am, Spring & Summer 2017
 - Led interactive community events at local libraries introducing parents and their children to weather observations and weather forecasting.
- Rock 'N Weather Camp at Discovery Space Science Center, July 2016

- Led interactive discussions and activities on the basics of meteorology and hurricanes during weeklong weather camp for kids under the age of 10 years old.

Professional Experiences:

Conferences and Workshops:

- Organizer: *Special Symposium: Honoring Professor Fuqing Zhang's contributions to the Tropical Meteorology Community*, 34th American Meteorology Society Conference on Hurricanes and Tropical Meteorology (New Orleans, LA), May 2020
- Session Chair: *Tropical Cyclone Research and Forecasting III: Climate and Theory*, 2020 American Meteorology Society Annual Meeting (Boston, MA), January 2020
- Session Chair: *Tropical Cyclones: Observations, Data Assimilation, and Forecasting III*, 2019 American Meteorology Society Annual Meeting (Phoenix, AZ), January 2018
- Session Chair: *Field Experiments: Observations and Assimilation Results-Part I*, 2019 American Meteorology Society Annual Meeting (Phoenix, AZ), January 2018

Committees and Professional Affiliations:

- American Meteorological Society (AMS), American Geophysical Union (AGU)
- AMS Banner I. Miller award committee, 2019
- AMS committee on Tropical Meteorology and Tropical Cyclones, 2018-Present
- Next Generation Global Prediction System (NGGPS) Ensemble Working Group, 2017

Reviewer of Articles for the Following Professional Journals:

Journal of the Atmospheric Sciences, Journal of Applied Meteorology and Climatology, Geophysical Research Letters, Atmosphere

Selected Conference Presentations and Invited Talks:

- "The Importance of Air-Sea Momentum and Enthalpy Fluxes and their Physical Uncertainties in the Development, Structure and intensification of Hurricane Patricia (2015)", Talk, 2019 18th AMS Conference on Mesoscale Processes, July 2019
- "Predictability, Uncertainties and Underlying Dynamics in the Limited Predictability of the Record-Breaking Intensification of Hurricane Patricia", **Invited Talk**, 31st International Workshop of the Severe Weather International Consortium, Peking University Department of Atmospheric and Oceanic Sciences, June 2019
- "The Predictability and Dynamics of Major Hurricanes: explored through ensemble data assimilation", **Invited Talk**, Nanjing University School of Atmospheric Science, May 2019
- "Practical Uncertainties and Underlying Dynamics in the Limited Predictability of the Record-Breaking Intensification of Hurricane Patricia (2015)", Talk, 2019 AMS Annual Meeting, January 2019
- "Predictability and Dynamics of the Record-Breaking Intensification of Hurricane Patricia (2015)", Poster, 2019 AMS Annual Meeting, January 2019
- "An Energetics Perspective of Hurricane Patricia (2015) as a Heat Engine through Isentropic Analysis", Poster, 2019 AMS Annual Meeting, January 2019.
- "Predictability and Dynamics of the Record-Breaking Intensification of Hurricane Patricia (2015)", Talk, 2018 AGU Fall Meeting, December 2018

- “Historic rapid intensification of Hurricane Patricia (2015): Cloud-resolving analysis and prediction through ensemble assimilation of dropsonde, radar, and satellite observations”, Talk, The 8th EnKF Data Assimilation Workshop, May 2018
- “Historic rapid intensification of Hurricane Patricia (2015): Cloud-resolving analysis and prediction through ensemble assimilation of dropsonde, radar, and satellite observations”, Talk, 33rd Conference on Hurricanes and Tropical Meteorology, April 2018
- Predictability and Dynamics of Hurricane Joaquin (2015), Explored through Convection-Permitting Ensemble Sensitivity Experiments, Talk, 33rd AMS Conference on Hurricanes and Tropical Meteorology, April 2018
- “Dynamics and Predictability of Hurricane Joaquin (2015): An Ensemble Sensitivity Prospective”, Talk, 8th Northeast Tropical Meteorology Workshop, June 2017.
- “Improving the Vortex Initialization of Hurricane Karl (2010) Through the Assimilation of Tropical Cyclone Vitals Quadrant Wind Radii Estimates”, Talk, The 7th EnKF Data Assimilation Workshop, May 2016
- “A Statistical Take on the Hurricane’s Structure and its Spatial Extent”, Poster, 2015 American Meteorological Society Student Conference, January 2015.
- “Intraseasonal Variability of Tropical Cyclogenesis over the East Atlantic”, Poster, University of Illinois School of Earth, Society, and the Environment Research Review, February 2015
- “A Statistical Take on the Hurricane’s Structure and its Spatial Extent”, Talk, NOAA Hurricane Research Division Monthly Science Meeting, July 2014.
- “A Statistical Take on the Hurricane’s Structure and its Spatial Extent”, Talk, NOAA Science and Education Symposium, July 2014
- “Impacts of ENSO on the Formation of Cape Verde Storms”, Poster, University of Illinois School of Earth, Society, and the Environment Research Review, February 2014
- “Impacts of ENSO on the Formation of Cape Verde Storms”, Poster, American Meteorological Society Student Conference, February 2014
- “Using Stable Isotopes to Characterize Differential Water Uptake in Perennial Biofuel and Traditional Crops”, Poster, 2013 AGU Fall Meeting, December 2013.

Other Relevant Experiences:

- NCAR ASP Colloquium, July 2019
Quantifying and Communicating Uncertainty in High-Impact Weather Prediction
 - Participated in collaborative colloquium which explored interdisciplinary atmospheric science, data science and social science research focused on high-impact weather prediction.
 - Completed a collaborative project investigating interdisciplinary research ideas on the April 2017 high impact flash-flooding events in Missouri, Illinois and Indiana.
- NCAR Visiting Scholar, Summer 2019
Mentors: Drs. Richard Rotunno and Christopher Davis
 - Examined the impacts of uncertainty in the surface exchange coefficients of enthalpy and momentum on tropical cyclone intensification using idealized CM1 simulations.
- NOAA Hurricane Research Division Hollings Visiting Scholar, Summer 2014
Advisor: Dr. Altug Aksoy

- Examined storm-relative correlation structures in idealized HWRF environments to provide improvements to the Hurricane Ensemble Data Assimilation System.
- Contributed in Hurricane Field Program P-3 flights into Hurricane Arthur (2014) where I assisted in processing and quality control of dropsonde observations.
- Led weeklong map discussion to guide planning for the Hurricane Field Program.
- University of Illinois Department of Atmospheric Sciences Undergraduate Research, 2013-2015
Advisor: Dr. Zhuo Wang
 - Examined the intraseasonal variability of tropical cyclogenesis over the east Atlantic Ocean with specific emphasis on the role of ENSO and the MJO.
- University of Illinois Department of Plant Biology Undergraduate Research in Environmental Plant Physiology, 2012-2015
Advisors: Dr. Carl Bernacchi, Dr. Mir Zaman Hussain, and Jesse Miller
 - Processed and collected regular meteorological field observations to assist the labs research objectives.