Jonathan L. Vigh *curriculum vitae*

Mar 2018

PERSONAL DETAILS

Project Scientist I
National Center for Atmospheric Research (NCAR)

Joint Numerical Testbed Program (JNTP)
NCAR Research Applications Laboratory (RAL)
P.O. Box 3000
Boulder, CO 80307-3000

Office Phone: (303) 497-8205
Office Fax: (303) 497-2729

Email: jvigh@ucar.edu
Web: http://www.ral.ucar.edu/staff/jvigh/

Citizenship: United States of America
Birth date: 12 August 1977
Birth place: Tappahannock, Virginia
Home town: Lexington, Kentucky
Ethnicity: Caucasian / Native American
Tribal membership: Seneca Nation of Indians

Orcid ID: 0000-0001-6399-563X
ResearcherID: B-7604-2008

EDUCATION

April 2010 **Ph.D.** **Department of Atmospheric Science, Colorado State University** **3.87 GPA**
Dissertation: "Formation of the Hurricane Eye"
Advisor: Wayne H. Schubert, Ph.D.

July 2004 **M.S.** **Department of Atmospheric Science, Colorado State University** **3.82 GPA**
Thesis: "Forecasting of Atlantic Tropical Cyclones Using a Kilo-Member Ensemble"
Advisor: Wayne H. Schubert, Ph.D.

May 2000 **B.S.** **Department of Meteorology, Pennsylvania State University** **4.00 GPA**
Major in Meteorology, graduated with highest honors (*Summa cum laud*)

PROFESSIONAL EXPERIENCE

Jan 2012 – Present **Project Scientist I**, Joint Numerical Testbed Program (JNTP), Research Applications Laboratory, NCAR, Boulder, CO

Current role, responsibilities, and supervisor:

- Supervisor: Paul Kucera (NCAR/RAL/JNTP)
- Work on a variety of projects in RAL, including in JNTP and the Climate Science & Applications Program (CSAP).
- Develop proposals to build up new hurricane projects at RAL.
- Lead Developer for the Climate Risk Management engine (CRMe).

Current Projects:

Development Testbed Center Data Assimilation Task (Feb 2018 – present)

- Role: Support scientist
- Goal: Conduct a verification of multiple model experiments to evaluate the impact of radial winds from NEXRAD radars on the High-Resolution Rapid Refresh (HRRR) model.
- Effort to date: 1.0 month

International Finance Corporation (IFC) (Jan 2016 – present)

- Role: Support scientist (Project leader: Caspar Ammann)
- Funding entity: International Finance Corporation
- Goal: Provide and provision hazard-specific climate input data for sectoral screening tools that will be used to screen potential IFC investment projects against the risk posed by changing climate.
- Effort to date: 9.0 months
- Outcomes to date: I played an integral role in working with three different consulting teams to define climate variables and indicators for use in climate risk screening tools. I developed codes to implement many of the indicators myself and integrated team member's contributions into the Climate Risk Management engine (CRMe). New indicators include extreme value analysis indicators for precipitation, fire weather indicators, climate change indicators. I also developed tropical cyclone wind risk indicators using TCRM. I developed a novel method for delivering the climate risk data directly into Excel spreadsheets tailored for each consulting team. Finally, I developed documentation and provided a high level of support to the consulting teams, assisting them in correct interpretation and use of the climate risk data.

Climate Change Knowledge Portal (CCKP) (Jan 2015 – present)

- Role: Support scientist, developer (Project leader: Caspar Ammann)
- Funding entity: World Bank
- Goal: Provide curated climate data for the World Bank Climate Change Knowledge Portal. Data include five 20-year time slices for 20 different CMIP5 models for 4 different representative climate pathways. Phase II expanded this by adding additional application-oriented indices and indicators for prototype dashboards that provide a succinct overview of the impacts of climate change for a given sector.
- Effort to date: 1.8 months
- Outcomes to date: Worked as part of a team to provide high quality GIS-enabled climate data on a rapid delivery schedule to populate the new CCKP web page.

Be Secure Project for Water Security in the Philippines (Oct 2014 – present)

- Role: Support scientist for training and research collaboration with the Philippines Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA)
- Funding Entity: U.S. Agency for International Development (USAID)
- Goal: Build capacity to improve water security in the Philippines, assess tropical cyclone hazard in the Philippines, improve PAGASA's typhoon

modeling capabilities, conduct collaborative research for publication in peer-reviewed journals.
- Effort to date: 2.3 months
- Outcomes to date: I was the main facilitator for a 2-day workshop to train PAGASA forecasters in the techniques of tropical cyclone forecasting (Nov 2014). I am assisting in an effort to evaluate and improve PAGASA's typhoon model. I am undertaking an assessment of tropical cyclone hazard baselines under simplified future scenarios of climate change using the Australia Geoscience Tropical Cyclone Risk Model (TCRM).

Tropical Cyclone Guidance Project (Feb 2010 – present)
- Role: Lead developer
- Goals: (1) provide a global repository of tropical cyclone forecast aids for track, intensity, and structure information, (2) provide real-time plots of these data for active tropical cyclones, (3) visualize structure and intensity parameters from observations taken by reconnaissance aircraft, (4) provide retrospective plots of these data for past tropical cyclones, (5) provide real-time data sources needed to foster and support researchers in developing new prediction techniques, (6) support research into advanced visualization.
- Project web site: http://www.ral.ucar.edu/hurricanes/
- Effort since 2012: 3.0 months

Past projects:

Advanced Climate and Regional Model Validation for Societal Applications (EaSM2) (May 2014 – Nov 2017)
- Role: Support scientist, lead developer of CRMe (Project leader: Caspar Ammann)
- Funding entity: National Science Foundation
- Goal: Develop advanced tools for validation of climate and regional models for societal applications including multi-disciplinary application-oriented and process-oriented metrics.
- Effort to date: 3.7 months
- Outcomes to date: Development continues on the CRMe, a highly extensible NCL-based platform for processing a wide variety of climate data for the purpose of evaluation and application-oriented uses (for more on CRMe's capabilities, see the description under the National Predictions & Projections Platform in the 'past projects' section below). I also developed an innovative and intuitive web-based viewer interface to allow users to quickly drill down into the O(~100,000) plots and datasets that have been produced by CRMe.
- Future plans: Add more interactive capabilities to the viewer including "on-the-fly" calculations to enable a wide variety of users to access these climate data in ways that are relevant and useful.

An Improved Historical Database for Tropical Cyclone Wind Risk Modeling (Sep 2013 – Jan 2016)
- Role: Principal Investigator
- Funding entity: Risk Prediction Initiative (RPI2.0), Bermuda Institute of Ocean Sciences (BIOS)
- Goal: Develop a new historical database of tropical cyclone wind and size parameters that is suited for wind risk modeling.

- Effort to date: 11.3 months
- Budget: $79,964
- Project website: http://verif.rap.ucar.edu/tcdata/
- Technical Description: This project is developing a new historical observations-based hurricane database for the purpose of supporting parametric wind risk modeling. Novel innovations of the new database include higher temporal and spatial resolution than existing databases, the use of objective methods to provide time-dependent error bounds on the estimated wind parameters, and the incorporation of alternative metrics for intensity and size. The aim is to provide the highest quality database possible for the parametric wind modeling applications used by (re)insurance industry to simulate wind risk from tropical cyclones.
- Outcomes: Built several source datasets, including the Enhanced Vortex Data Message (VDM+) Dataset and the Extended Flight Level (FLIGHT+) Dataset. The new historical database, which is called the Tropical Cyclone Observations-Based Structure Database (TC-OBS) was delivered Jan 2016 and will be publicly released in Nov 2016.

National Climate Predictions & Projections Platform (NCPP) (Apr 2013 – Aug 2015)

- Role: Support scientist, lead developer for the NCPP evaluation engine (Project leader: Caspar Ammann)
- Funding entity: NOAA
- Goal: Created an evaluation engine to compute various metrics and indices across a large set of downscaled regional climate data sets.
- Effort to date: 7.5 months
- Technical description: Designed a highly efficient and integrated workflow using an NCAR Command Language (NCL) code set to accomplish the following: (a) restructure each downscaled data set over the monthly, seasonal, and annual timescales; (b) compute base statistics for a variety of metrics and indices; (c) compute climatological period statistics; (d) and finally, generate a unique evaluation plot for each metric or index combination for the designated period time frame, along with an associated self-contained NetCDF data file and XML metadata file. Metrics computed include the mean, median, standard deviation, 5th, 10th, 25th, 75th, 90th, and 95th percentiles. Various groups of indices are also computed including ETCCDI climate extremes indices, BioClim indices, and additional health-related indices. Comparison datasets are also generated to allow users to compare the various downscaled regional climate model data to several observational standards, which include the Maurer BCCA dataset and the Daymet 2.1 dataset. The processing can be accomplished on a local workstation or spread across many nodes of Yellowstone's visualization and data processing cluster. Altogether, 159,000 plots and datasets were created. The output datasets comply with CF conventions and support other applications such as open-climate GIS. Development has continued on the evaluation engine, now called the Climate Risk Management engine (CRMe). CRMe continues to be used in a variety of projects in CSAP as its capabilities increase.

USDA Agriculture Project (Sep 2013 – Feb 2015)

- Role: Support scientist, programmer (Project leader: Caspar Ammann)
- Funding entity: U.S. Department of Agriculture

- Goal: Implement computation of return periods, ensemble, and extreme value analysis techniques to examine the effects of changing climate on agriculture and food security.
- Effort to date: 1.4 months

Development of an HWRF Diagnostics Module to Evaluate Intensity and Structure Using Synthetic Flight Paths Through Tropical Cyclones (Aug 2012 – Sep 2014)

- Role: Principal Investigator
- Funding entity: Development Testbed Center Visitor Program
- Effort: 3.1 months
- Budget: $35,929
- Technical description and outcomes: Developed a module to implement synthetic profiles in the Hurricane WRF (HWRF) model to diagnose wind structure in simulated HWRF storms. The module conducts a direct comparison between radial legs of flight level wind speed observed in the actual storm and the synthetically-computed radial legs of wind speed from the HWRF model. Results have been analyzed for Hurricane Sandy (2012). The results show that the synthetic profiles technique hold great potential for advanced verification and applications for "guidance-on-guidance" for intensity and structure change.

Large-scale Diagnostics of the Basin-scale HWRF Model (Jan – Aug 2012)

- Role: Support scientist for the Development Testbed Center (DTC) Hurricane Task (Task lead: Ligia Bernardet (CIRES/NOAA)
- Effort: 8.0 months
- Technical description and outcomes: Worked to conduct large scale diagnostics of the basin-scale HWRF model (bHWRF) in a tera-scale computing environment. Developed a custom workflow to compare a season of bHWRF simulations to corresponding 0-hr forecast fields of the NCEP Global Forecast System (GFS) model; accumulated the spatial bias and error structures; analyzed biases to try to understand if they could be tied to systematic model errors; made recommendations on ways to improve the bHWRF model.

Feb 2010 – Jan 2012 **Postdoctoral Fellow**, Advanced Study Program
National Center for Atmospheric Research, Boulder, CO

Research Foci:

- Structure and intensity changes during hurricane eye formation
- Radius of maximum wind in tropical cyclones – controls and lifecycle
- An improved dataset for intensity and structure prediction

Aug 2000 – Jan 2010 **Graduate Research Assistant**, Schubert Research Group
Department of Atmospheric Science, Colorado State University, Fort Collins, CO

Ph.D. Research Focus: **Hurricane eye formation** (see attached abstract)

Conducted original research on the structure and intensity changes which occur before, during, and after eye formation. Synthesized a new data set from Vortex Data Messages taken by aircraft reconnaissance, developed a new algorithm to filter these noisy data, and computed useful upper and lower bounds to determine the ranges and trends about the time of eye formation for intensity, radius of

maximum wind, and other dynamic and thermodynamic parameters. Developed computer codes to implement a theoretical investigation of the conditions whereby a storm can rapidly develop a warm core. Conducted a review of eye formation in geophysical vortices.

M.S. Research Focus: **Tropical cyclone ensemble track prediction**

Used a multigrid barotropic track prediction model (MUDBAR) to develop and test a kilo-member ensemble method for track forecasting of Atlantic tropical cyclones. Implemented a real-time ensemble prediction system in a simulated operational environment. Conducted a sensitivity study of the influence of various model parameters on forecast performance. Developed an automated web page for viewing forecasts of the ensemble and other operational tropical cyclone forecast models.

Fall 2003 **Graduate Teaching Assistant**

Department of Atmospheric Science, Colorado State University, Fort Collins, CO

Course: An Introduction to Atmospheric Modeling (AT604)

Role: Developed extensive solution sets to assigned homework including programming tasks, graded course assignments, provided useful feedback and suggestions to students.

Summer 2000 **Protégé, Significant Opportunities in Atmospheric Research and Science (SOARS)**

Research Applications and Programs Division, NCAR, Boulder, CO

Science research mentor: Kevin Petty, Ph.D.

Research focus: Applied a fuzzy logic/adaptive weighting statistical prediction scheme to the hurricane intensity for the Northeast Pacific Basin. Results were compared with standard linear regression method.

Summer 1999 **Protégé, Significant Opportunities in Atmospheric Research and Science (SOARS)**

Climate and Global Dynamics Division, NCAR, Boulder, CO

Science research mentor: Joel Norris, Ph.D.

Research focus: Compared predicted clouds in the Climate Community Model (CCM3) to remote sensing observations (ERBE, ISCCP, GPCP). Developed graphical visualization tools for qualitative comparison to diagnose errors in cloud parameterization.

1999-2000 **Undergraduate Teaching Assistant**

Department of Meteorology, Pennsylvania State University, State College, PA

Course: Introduction to Meteorology (for non-science major undergraduates)

Role: Taught a lab section (2 semesters), with an emphasis on physical and conceptual understanding of basic meteorological phenomenon. Gave weekly lectures, coursework, grading.

1997 – 1998 **High School Teacher**

Chuuk Seventh-day Adventist School, Chuuk State, Federated States of Micronesia

Courses: Physics, Pre-algebra, Algebra I & II, Geometry, Earth Science, Geography.

Role: Taught high school courses, assigned coursework, created tests, graded. Took part in various leadership activities and was instrumental in helping the high school achieve accreditation.

1996 – 1997 **Physics Tutor**

Southern Adventist University, Collegedale, TN

Role: Tutored college students in topics in General Physics, helping them develop a physical and intuitive understanding of physics.

TRAINING ACTIVITIES

Nov 18-19, 2014 Served as main facilitator for a 2-day workshop to train 31 tropical cyclone forecasters at PAGASA headquarters in Quezon City, Metro Manila, Philippines. Presented and adapted material used by the WMO Region IV tropical cyclone training workshops, with adaptations to make the material relevant to the Western Pacific basin. Covered topics of TC genesis, track and intensity forecasting, lifecycle and structure change, rainfall forecasting, use of microwave imagery to analyze TC structure, and verification.

NUMERICAL WEATHER PREDICTION AND VERIFICATION EXPERIENCE

Relevant Coursework Beyond Core Required Graduate Classes in Atmospheric Science

- *Numerical Weather Prediction*
  - Atmospheric Modeling (Dr. David Randall, AT 604)
  - Numerical Weather Prediction (Dr. Wayne Schubert, AT 703)
  - Mesoscale Modeling (Dr. Roger Pielke Sr., AT 730)
- *Mesoscale Dynamics,Microphysics, and Boundary Layer*
  - Atmospheric Boundary Layer (Dr. David Randall, AT 623)
  - Cloud Microphysics (Dr. William Cotton, AT 724)
  - Mesoscale Dynamics (Dr. Richard Johnson, AT 735)
- *Tropical Cyclones and Related Phenomenon*
  - Meteorological Analysis and Forecasting (Dr. William Gray, AT 655)
  - Atmospheric Waves and Vortices (Dr. Michael Montgomery, AT 707)
  - Geophysical Vortices (Dr. Wayne Schubert, AT 710)
- *Statistics and Diagnostics*
  - Objective Analysis (Dr. David Thompson, AT 655)
  - Measurement Systems and Theory (AT 650)
- *Climate and General Circulation*
  - General Circulation (Dr. David Randall, AT 605)
  - Advanced General Circulation (Dr. David Randall, AT 745)
  - Global Carbon Cycle (Dr. Scott Denning, AT 760)
  - Climate Dynamics (Dr. Hank Dijkstra, AT 765)
- *Computer Programming*
  - Informal FORTRAN course on parallel programming practices, MPI, etc.

Modeling and Verification Workshops and Tutorials Attended

Jan 31 – Feb 2, 2018	Model Evaluation Toolkit (MET, v6.1) Tutorial	Boulder, CO
Nov 8-10, 2011	HFIP Annual Review Meeting and HFIP Regional GSI-Hybrid Data Assimilation Workshop	Miami, FL
Feb 22, 2011	EMC/MMM/DTC Joint Hurricane Science Workshop	Boulder, CO
Feb 22-26, 2010	EMC/MMM/DTC Joint Hurricane Science Workshop and Joint WRF Tutorial for Hurricanes	Boulder, CO
Feb 7-10, 2006	WRF/NMM Tutorial	Boulder, CO
Oct 26-27, 2004	Hurricane WRF Workshop	Camp Springs, MD
Jun 22, 1999	4th Annual CSM Workshop	Breckinridge, CO

CAREER DEVELOPMENT ACTIVITIES

Nov 1-2, 2011	NSF Communicating Science Workshop: "Becoming the Messenger"	Boulder, CO
May 24, 2010	EOD Training Workshop: "WE JUST DISAGREE: Personal Tools to Understand & Resolve Conflicts"	Boulder, CO
Apr 29, 2010	AAAS/NSF Workshop: "Communicating Science: Tools for Scientists and Engineers"	Boulder, CO
Apr 14, 2010	EOD workshop: "Organize Your Desk, E-mail and Time"	Boulder, CO

COMPUTING SKILLS

Operating Systems Linux/UNIX, Microsoft Windows 7/8/10

Programming Languages NCAR Command Language (NCL)
UNIX shell scripting
FORTRAN 90/95/2003

Version Control Subversion, Git

Data Analysis and Visualization NCL, Microsoft Excel

Document Preparation LaTeX, Microsoft Word

Other Activities System administration of personal Linux work station/server (5 years)

WEB DEVELOPMENT

Software Tools Microsoft Expression Web 4, Adobe Photoshop CS3

Web Languages HTML5, CSS3, PHP, Javascript, AJAX, jQuery

2010 – present **Tropical Cyclone Guidance Project**
http://www.ral.ucar.edu/hurricanes/
A high-profile NCAR web site to visualize operational tropical cyclone forecast aids and structure-based data. The site also includes an open, global repository of model guidance to encourage the development of new forecast aids for underserved tropical cyclone basins worldwide. RAL web developer Lara Ziady developed the overall site style and navigation template with my input. The site has received over four million hits since its initial release in August 2011.

2014 – present **Tropical Cyclone Data Project**
http://verif.ral.ucar.edu/tcdata/
A web site for the provision of three research-quality tropical cyclone datasets and a new historical database. The web site features detailed data provenance for the datasets and provides an Export Control-compliant registration system.

2015 - present **Climate Risk Management engine (CRMe) Viewer**
http://verif.ral.ucar.edu/jntweb/crme/dashboard/current_stable_version/
This web site provides a natural and intuitive touch-enabled interface to allow users to access a wide variety of CRMe datasets and output. Under the hood,

AJAX and jQuery run client-side, allowing the user to seamlessly traverse the complex CRMe data directory structure. (NOTE: The CRMe Viewer works best with the Google Chrome and Mozilla Firefox browsers; may not work with the Safari or Internet Edge web browsers.)

PROFESSIONAL AND ACADEMIC SERVICE

World Meteorological Organization, Tropical Cyclone Programme

- 9th International Workshop on Tropical Cyclones (IWTC-IX), Honolulu, Hawaii, U.S., 2018 (upcoming)
  - **Rapporteur**, Working Group for Topic X.3: Intensity Change: Internal Influences
- 8th International Workshop on Tropical Cyclones (IWTC-VIII) and Tropical Cyclone Landfall Processes (IWTCLP-III), Jeju Island, South Korea, 2014
  - **Member**, Working Group for Topic 4.1: Structure Change Processes
  - **Member**, Working Group for Topic 4.3: Structure Change Forecasting
  - **Participant**, contributed a draft recommendation to expand aircraft reconnaissance in the Western Pacific (this became one of the official IWTC recommendations); participated in break-out discussions
- 7th International Workshop on Tropical Cyclones (IWTC-VII), La Réunion, France, 2010
  - **Member**, Working Group for Topic 1.2: Structure and Intensity Change: Inner Core Impacts
  - **Participant**, contributed draft recommendations and participated in break-out discussions

Mesoscale & Microscale Meteorology Division, NCAR

- **Co-coordinator**, Dynamics Happy Hour (informal seminar series), 2010—2012
- **Coordinator**, Joint CSU/NOAA/NCAR Hurricane Workshop, 2011

University Corporation for Atmospheric Research

- **Member**, SOARS Steering Committee, 2004—2007

Research Applications Laboratory, NCAR

- **Initiator and chief developer of the *Tropical Cyclone Guidance Project***, 2010 – present
  - Project aim: to provide a global, open source repository for the collection and dissemination of real-time model products and aircraft-derived wind structure data
  - Phase I includes plots of track and intensity forecast aids for the North Atlantic, Northeast Pacific, and Central Pacific basins and real-time collections of Vortex Data Messages (released 14 August 2011).
  - Phase II expanded the repository to cover all global basins.
  - Phase III will add real-time visualizations of structure parameters.
  - Phase IV will feature an archive of retrospective plots for historical storms.

Computational Information Systems Laboratory, NCAR

- **Contributor**, NCAR Command Language (NCL) Development Team, 2005 – present
  - Provide occasional NCL user support
  - Occasionally develop new visualization examples and discover bugs

Colorado State University

- **Guest Lecturer**, yearly lectures on hurricane impacts for Marine Ecotourism course: 2006—2008
- **Presenter** on hurricanes to 5th graders for the Discovery Science Institute, 2008

American Meteorological Society

- **Referee**, Monthly Weather Review (2003, 2011-2013, 2016)
- **Referee**, Journal of Atmospheric Science (2010, 2012, 2014)

- **Referee,** Journal of Applied Meteorology and Climatology (2015)
- **Referee**, Bulletin of the American Meteorological Society (2016)
- **Max Eaton Student Prize Selection Committee,** 30th Conf. on Hurricanes and Tropical Meteorology (April 2012)

Royal Society of Meteorology
- **Referee**, Quarterly Journal of the Royal Meteorological Society (2013)
- **Referee**, International Journal of Climatology (2017)

Springer Vienna
- **Referee**, Meteorology and Atmospheric Physics (2016)

National Science Foundation
- **Proposal Referee** (2012)

HONORS AND AWARDS

Colorado State University
- **Shrake/Culler Graduate Engineering Fellowship,** C*ollege of Engineering, 2004*

Significant Opportunities in Atmospheric Research and Science (SOARS) Program
- **Protégé**, 1999 and 2000
- **SOARS Graduate Fellowship support**, 2000—2002

American Meteorological Society
- **Guillermo Salazar-Rodriguez Undergraduate Scholarship**, 1999
- **Graduate Fellowship**, 2000

Pennsylvania State University
- **Distinguished Dean's List**, 1998—2000
- **Matthew J. Wilson Honors Scholarship**, *College of Earth and Mineral Sciences*, 1999
- **Chi Epsilon Pi (Meteorology) Honor Society**, 1999
- **John D. Dutton Award for Excellence in Atmospheric Dynamics**, Department of Meteorology, 2000

Southern Adventist University
- **President's Scholarship**, 1995
- **Distinguished Dean's List**, 1996—1997

MENTORING AND ADVISING

University of the South Pacific
- **Masters thesis committee**, Alick Haruhiru (advisor: Elisabeth Holland), 2013-2015
    - Served on Alick's Masters thesis committee and co-hosted him during his 9-month visit to NCAR, along with James Done and Cindy Bruyere (NCAR/MMM). During his visit, I spent considerable time mentoring him on his project, which was to examine statistical downscaling of GCMs to understand past and future changes in tropical cyclone frequency and intensity in the South Pacific. During his stay, I taught him how to program in NCAR Command Language.

Graduate Student Visitor Program, Advanced Study Program, NCAR, Boulder, CO
- **Research host and collaborator**, Daria Schönemann (advisor Dr. Thomas Frisius), 2011

- I served as the local research host for a graduate student visitor from Hamburg, Germany on a project to examine the fundamental controls on the radius of maximum wind in tropical cyclones. I organized this collaboration after a successful proposal to ASP's Graduate Visitor Program. Daria was here from August through December conducting runs with an axisymmetric hurricane model (HURMOD). Other NCAR collaborators include Dr. Richard Rotunno, Dr. George Bryan, and Dr. Brian Tang.

Significant Opportunities in Atmospheric Research and Science (SOARS) Program, NCAR, Boulder, CO

- **Science Research Co-Mentor**, Jonathan Martinez, 2014
  - Jointly mentored Mr. Martinez, a recent graduate from Florida State University, on a project to examine the relationship between intensity, intensification, and radial wind structure. Using the Extended Flight Level Dataset (FLIGHT+), Mr. Martinez computed composites of the radial wind structure for over 190 tropical cyclones (1999-2013) for various bins in an intensity-intensification rate phase diagram.
- **Science Research Co-mentor**, Diamilet Perez-Betancourt, 2010
  - Jointly mentored Diamilet, an undergraduate student from the University of Puerto Rico, on a project to examine environmental influence for cases of failed eye formation. Diamilet used my structure and intensity data set, the SHIPS development data set, and GPS dropsondes from the NOAA Gulfstream IV to examine the spatial and temporal variations of environmental vertical wind shear for storms which developed an eye structure, storms which failed to develop eyes, and storms which developed transient eyes.

REFEREED PUBLICATIONS IN PREPARATION

REFEREED PUBLICATIONS

The number of citations to each paper is given according to Web of Science as of Mar 20, 2018.

10. Stevenson, S. N., K. L. Corbosiero, M. DeMaria, and **J. L. Vigh**, 2018: A 10-year survey of tropical cyclone inner-core lightning bursts and their relationship to intensity change. Wea. Forecasting, 33, 23-36, doi:10.1175/WAF-D-17-0096.1. [no citation information available]

9. Martinez, J., M. M. Bell, **J. L. Vigh**, R. F. Rogers, 2017: Examination of Tropical Cyclone Structure and Intensification with the FLIGHT+ Dataset from 1999 to 2012. *Mon. Wea. Rev.*, **145**, 4401-4421, doi:10.1175/MWR-D-17-0011.1. [no citation information available]

8. Guentchev, G. S., R. B. Rood, C. Ammann, J. B. Barsugli, K. Ebi, V. Berrocal, M. S. O'Neill, C. J. Gronlund, **J. Vigh**, B. Koziol, L. Cinquini, 2015: Evaluating the appropriateness of downscaled climate information for projecting risks of *Salmonella*. *Int. J. Environ. Res. Public Health*, **13(3)**, 267, doi:10.3390/ijerph13030267. [2 citations]

7. Stern, D. P., **J. Vigh**, D. Nolan, and F. Zhang, 2015: Revisiting the relationship between eyewall contraction and intensification. *J. Atmos. Sci.*, **72**, 1283—1306, doi:10.1175/JAS-D-14-0261.1. [28 citations]

   Correspondence arising (not peer-reviewed):

   - Stern, D. P., **J. L. Vigh**, D. S. Nolan, and F. Zhang, 2017: Reply to "Comments on `Revisiting the relationship between eyewall contraction and intensification'". J. Atmos. Sci., 74, 4275-4286, doi:10.1175/JAS-D-17-0120.1. [no citation information available]

6. Frisius, T., D. Schönemann, and **J. L. Vigh**, 2013: The impact of gradient wind imbalance on tropical cyclones in an unbalanced slab boundary layer model. *J. Atmos. Sci.,* **70**, 1874-1890, doi:10.1175/jas-d-12-0160.1. [5 citations]

5. Musgrave, K. D., R. K. Taft, **J. L. Vigh**, B. D. McNoldy, and W. H. Schubert, 2012: Time evolution of the intensity and size of tropical cyclones. *J. Adv. Model. Earth Syst.*, **4**, M08001, 15 pp, doi:10.1029/2011MS000104. [16 citations]

4. **Vigh, J. L.**, J. A. Knaff, and W. H. Schubert, 2012: A climatology of hurricane eye formation. *Mon. Wea. Rev.*, **140**, 1405-1426, doi:10.1175/MWR-D-11-00108.1 (with supplement). [19 citations]

3. **Vigh, J. L.** and W. H. Schubert, 2009: Rapid development of the tropical cyclone warm core. *J. Atmos. Sci.*, 66, 3335-3350, doi:10.1175/2009JAS3092.1. [93 citations]

2. Schubert, W. H., C. M. Rozoff, **J. L. Vigh**, B. D. McNoldy, and J. P. Kossin, 2007: On the distribution of subsidence in the hurricane eye. *Quart. J. Roy. Meteor. Soc.*, **133**, 595-605, doi:10.1002/qj.49. [39 citations]

1. **Vigh, J.**, S. R. Fulton, M. DeMaria, and W. H. Schubert, 2003: Evaluation of a multigrid barotropic tropical cyclone track model. *Mon. Wea. Rev.*, **131**, 1629-1636, doi:10.1175//2551.1. [1 citation]

Current citation metrics as of Mar 2018:

Web of Science / ResearcherID:
- *h*-index: 5
- Total citations: 203
- Average citations per article: 22.56
- Most cited article: Rapid Development of the Tropical Cyclone Warm Core – 93 citations

Google Scholar (includes citations from conference papers and other "gray" literature)**:**
- *h*-index: 7
- *i10*-index: 6
- Total citations: 343
- Most cited article: Rapid Development of the Tropical Cyclone Warm Core – 130 citations

ResearchGate:
- *h*-index: 6
- Total citations: 239
- ResearchGate Score: 21.46

DATASETS and PRODUCTS

4. **Vigh, J. L.**, E. Gilleland, C. L. Williams, D. R. Chavas, N. M. Dorst, 2018: TC-OBS: The Tropical Cyclone Observations-Based Structure Database (version 0.42, an alpha-level release). Tropical Cyclone Data Project, National Center for Atmospheric Research, Research Applications Laboratory, Boulder, Colorado. [Available online at: http://dx.doi.org/10.5065/D6BC3X95.]

3. **Vigh, J. L.**, N. M. Dorst, C. L. Williams, E. W. Uhlhorn, B. W. Klotz, J. Martinez, H. E. Willoughby, F. D. Marks, Jr., D. R. Chavas, 2016: FLIGHT+: The Extended Flight Level Dataset for Tropical Cyclones (Version 1.1). Tropical Cyclone Data Project, National Center for Atmospheric Research,

Research Applications Laboratory, Boulder, Colorado. [Available online at: http://dx.doi.org/10.5065/D6WS8R93.]

2. Chavas, D. R. and **J. L. Vigh**, 2015: QSCAT-R: The QuikSCAT Tropical Cyclone Radial Structure Dataset (Version 1.0). Tropical Cyclone Data Project, National Center for Atmospheric Research, Research Applications Laboratory, Boulder, Colorado. [Available online at: http://dx.doi.org/10.5065/D65B00J3.]

1. **Vigh, J. L.**, 2015: VDM+: The Enhanced Vortex Data Message Dataset (Version 1.100). Tropical Cyclone Data Project, National Center for Atmospheric Research, Research Applications Laboratory, Boulder, Colorado. [Available online at: http://dx.doi.org/10.5065/D61Z42GH.]

NON-REFEREED PUBLICATIONS

19. Emanuel, K., P. Caroff, S. Delgado, C. Guard, M. Guishard, C. Hennon, J. Knaff, K. R. Knapp, J. Kossin, C. Schreck, C. Velden, and **J. Vigh**, 2018: On the desirability and feasibility of a global reanalysis of tropical cyclones. Bull. Amer. Meteor. Soc., 99, 427-429, doi:10.1175/BAMS-D-17-0226.1.

18. **Vigh, J. L.**, C. A. Ammann, J. A. Lee, 2016: An Efficient Workflow Environment to Support the Collaborative Development of Actionable Climate Information Using the NCAR Climate Risk Management Engine (CRMe). Poster, *AGU Fall Meeting*, San Francisco, California, Amer. Geophys. Union, Poster A13I-0400, doi:10.13140/RG.2.2.28381.82400.

17. **Vigh, J. L.**, E. Gilleland, C. L. Williams, D. R. Chavas, N. M. Dorst, J. Done, G. Holland, and B. G. Brown, 2016: A New Historical Database of Tropical Cyclone Position, Intensity, and Size Parameters Optimized for Wind Risk Modeling. Extended Abstract, 32nd Conf. on Hurricanes and Tropical Meteorology, San Juan, Puerto Rico, Amer. Meteor. Soc., Paper 12C.2, http://dx.doi.org/10.13140/RG.2.1.3720.5361.

16. **Vigh, J. L.**, 2015: VDM+: The Enhanced Vortex Data Message Dataset: Intensity, Structure, and Environmental Parameters from Atlantic Tropical Cyclones. NCAR Technical Note NCAR/TN-517+STR, 72 pp, doi:10.5065/D6PR7T26.

15. Chavas, D.R., and **J. L. Vigh**, 2014: QSCAT-R: The QuikSCAT Tropical Cyclone Radial Structure Dataset. NCAR Technical Note NCAR/TN-513+STR, 25 pp, doi:10.5065/D6J67DZ4.

14. **Vigh, J. L.**, 2014: Development of an HWRF diagnostics module to diagnose intensity and structure using synthetic flight paths through tropical cyclones. Final report to the Development Testbed Center Visitor Program, 44 pp., Boulder, CO, doi:10.13140/2.1.1587.9683.

13. **Vigh, J. L.**, C. Kieu, V. Tallapragada, L. R. Bernardet, and E. W. Uhlhorn, 2014: Use of Synthetic Profiles to Diagnose Simulated Tropical Cyclones in Regional Hurricane Models. Extended Abstract, *31st Conf. on Hurricanes and Tropical Meteorology*, San Diego, CA, Amer. Meteor. Soc., Paper 16D.6.

12. **Vigh. J. L.**, and C. M. Rozoff, 2012: Impact of inner-core tropical cyclone structure on the potential for rapid intensification. Extended Abstract, *30th Conf. on Hurricanes and Tropical Meteorology*, Ponte Vedra Beach, FL, Amer. Meteor. Soc., Paper 8B.2.

11. Stern, D., **J. L. Vigh**, D. S. Nolan, and F. Zhang, 2012: Revisiting the relationships between eyewall contraction and intensification. *Poster, 30th Conf. on Hurricanes and Tropical Meteorology*, Ponte Vedra Beach, FL, Amer. Meteor. Soc., P2.47.

10. Frisius, T., D. Schönemann, and **J. L. Vigh**, 2012: The impact of gradient wind imbalance on potential intensity of tropical cyclones. *Poster, 30th Conf. on Hurricanes and Tropical Meteorology*, Ponte Vedra Beach, FL, Amer. Meteor. Soc., P2.51.

9. Holland, G. J. and **J. L. Vigh**, 2011: Targeting as a mode of science communication: principles, issues, and a practical example. Poster, *AGU Fall Meeting*, Abstract ED33B-0786. doi:10.13140/RG.2.2.10195.58403.

8. **Vigh, J. L.**, 2010b: Structure and intensity changes during hurricane eye formation. Extended Abstract, *29th Conf. on Hurricanes and Tropical Meteorology*, Tucson, AZ, Amer. Meteor. Soc., Paper 8B.1.

7. **Vigh, J. L.**, 2010a: Formation of the hurricane eye. *Ph.D. dissertation*, Colorado State University, 538 pp., Fort Collins, Colorado, 80523.

6. **Vigh, J. L.** and W. H. Schubert, 2008: The role of inertial stability in the rapid development of the tropical cyclone warm core. Extended Abstract, *28th Conf. on Hurricanes and Tropical Meteorology*, Orlando, FL, Amer. Meteor. Soc., Paper 17C.1.

5. **Vigh, J.**, 2006: Formation of the hurricane eye. Extended Abstract, *27th Conf. on Hurricanes and Tropical Meteorology*, Monterey, CA, Amer. Meteor. Soc., Paper 1B.6,

4. **Vigh, J.**, 2006: Hurricane eye formation remains unexplained. Bull. Amer. Meteor. Soc., 87, 1314–1315.

3. **Vigh, J.**, 2004: Forecasting of Atlantic tropical cyclones using a kilo-member ensemble. *M.S. thesis*, 180 pp., Dept. of Atmospheric Science, Colorado State University, Fort Collins, Colorado, 80523..

2. **Vigh, J.**, 2004: Evaluation of a kilo-member ensemble for track forecasting. Preprints, *26th Conf. on Hurricanes and Tropical Meteorology*, Miami, FL, Amer. Meteor. Soc., Paper 5C.7, 160–161,.

1. **Vigh, J.**, 2002: Track forecasting of 2001 Atlantic tropical cyclones using a kilo-member ensemble. Preprints, *25th Conf. on Hurricanes and Tropical Meteorology*, San Diego, CA, Amer. Meteor. Soc., Paper 4D.1, 212–213.

ORAL PRESENTATIONS

Oral presentation, Front Range Tropical Cyclone Workshop
- Boulder, Colorado 08 March 2018
- Title: A Preliminary Exploration of the Upper Bound of Tropical Cyclone Intensification

Oral presentation, Workshop on Global Tropical Cyclone Reanalysis
- Asheville, North Carolina 22 May 2017
- Title: Use of Objective Methods for Tropical Cyclone State Estimation

Oral presentation, Front Range Tropical Cyclone Workshop
- Fort Collins, Colorado 24 October 2016
- Title: The Tropical Cyclone Observations-Based Structure Database

Oral presentation, 32nd Conf. on Hurricanes and Tropical Meteorology
- San Juan, Puerto Rico 20 April 2016

- Title: A New Historical Database of Tropical Cyclone Position, Intensity, and Size Parameters Optimized for Wind Risk Modeling

Oral presentation, Risk Prediction Initiative Research Update Workshop
- Hamilton, Bermuda 26 September 2014
- Title: An Improved Historical Database for Tropical Cyclone Wind Risk Modeling

Oral presentation, 31st Conf. on Hurricanes and Tropical Meteorology
- San Diego, CA 04 April 2014
- Title: Use of Synthetic Profiles to Diagnose Simulated Tropical Cyclones in Regional Hurricane Models

Class Lecture, Department of Atmospheric Sciences, National Taiwan University
- Taipei, Taiwan 20 February 2014
- Title: Atmospheric Adjustment Mechanisms and the Rapid Development of the Tropical Cyclone Warm Core

Seminar, Department of Atmospheric Sciences, National Taiwan University
- Taipei, Taiwan 20 February 2014
- Title: Tropical Cyclone Eye Formation: Observations of Structure and Intensity Change

Oral presentation, Joint CSU/NOAA/NCAR Hurricane Workshop on Tropical Cyclones, Boulder, CO
- Boulder, CO 08 January 2014
- Title: Steps Toward an Improved Database for Tropical Cyclone Wind Risk Modeling

Oral presentation, American Geophysical Union 2013 Fall Meeting
- San Francisco, CA 09 December 2013
- Title: A Computationally Efficient Platform To Examine the Efficacy of Regional Downscaling Methods

Oral presentation, Risk Prediction Initiative Research Update Workshop
- Hamilton, Bermuda 12 October 2013
- Title: Development of an Improved Database of Tropical Cyclone Size Parameters

Oral presentation, 16th Cyclone Workshop
- Sainte-Adèle, Quebec, Canada 23 Sep 2013
- Title: Evaluation of the Simulated Structure of Hurricane Sandy Using Synthetic Flight Paths

Oral presentation, Joint CSU/NOAA/NCAR Hurricane Workshop on Tropical Cyclones, Fort Collins, CO
- Fort Collins, CO 16 May 2013
- Title: Progress Toward the Extended Flight Level Dataset

Oral presentation, Joint CSU/NOAA/NCAR Workshop on Tropical Cyclones
- Boulder, CO 16 August 2012
- Title: Diagnosing Spatial Bias Structure of the Basin Scale HWRF Model

Oral presentation, 30th Conf. on Hurricanes and Tropical Meteorology
- Ponte Vedra Beach, FL 16 April 2012
- Title: Impact of inner-core tropical cyclone structure on the potential for rapid intensification

Oral presentation, Joint CSU/NOAA/NCAR Workshop on Tropical Cyclones
- Fort Collins, CO 16 November 2011
- Title: How often does eye formation coincide with rapid intensification?

Seminar, Meteorologisches Institut, Universität Hamburg

- Hamburg, Germany 22 June 2011
- Title: A climatology of hurricane eye formation

Oral presentation, Joint CSU/NOAA/NCAR Workshop on Tropical Cyclones

- Boulder, CO 01 April 2011
- Title: A climatology of hurricane eye formation

Oral presentation, Joint CSU/NOAA/NCAR Workshop on Tropical Cyclones

- Fort Collins, CO 07 October 2010
- Title: Intensification and contraction: do they always go together?

Oral presentation, 29th Conf. on Hurricanes and Tropical Meteorology

- Tucson, AZ 12 May 2010
- Title: Structure and intensity changes during hurricane eye formation

Oral presentation, Joint CSU/NOAA/NCAR Workshop on Tropical Cyclones

- Fort Collins, CO 26 August 2009
- Title: Eye Formation and Warm Rings

Oral presentation, Joint CSU/NOAA/NCAR Workshop on Tropical Cyclones

- Boulder, CO 25 February 2009
- Title: Towards a Comprehensive Structure and Intensity Dataset

Oral presentation, Joint CSU/NOAA/NCAR Workshop on Tropical Cyclones

- Fort Collins, CO 26 August 2008
- Title: An extended flight level dataset

Oral presentation, 28th Conf. on Hurricanes and Tropical Meteorology

- Orlando, FL 02 May 2008
- Title: Rapid development of the tropical cyclone warm core

Oral presentation, 27th Conf. on Hurricanes and Tropical Meteorology

- Monterey, CA 24 April 2006
- Title: Formation of the Hurricane Eye

Oral presentation, 26th Conf. on Hurricanes and Tropical Meteorology

- Miami, FL 05 May 2004
- Title: Evaluation of a Kilo Member Ensemble for Track Forecasting

Oral presentation, 25th Conf. on Hurricanes and Tropical Meteorology

- San Diego, CA 30 April 2002
- Track Forecasting of 2001 Atlantic Tropical Cyclones Using a Kilo-member Ensemble

Oral Presentation, SOARS Colloquium

- Boulder, CO August 2000
- Science Mentor: Kevin Petty
- A Fuzzy Logic System for Predicting Hurricane Intensity in the Eastern North Pacific

Oral Presentation, Native Society of Native American Studies Annual Meeting
- Houston, TX February 2000
- Co-panel member (lead: Thomas Windham)
- Title: Bridging Two Worlds: Native American Students in Science Benefit from Traditional Knowledge, Values, and Practice

Oral Presentation, SOARS Colloquium
- Boulder, CO August 1999
- Science Mentor: Joel R. Norris
- Title: Diagnosing Sources of Error in the Cloud Parameterizations of the NCAR Climate Community Model

CURRENT FUNDING

Development Toward a Real-Time Tropical Cyclone Risk Calculator
- Role: Principal Investigator
- Funding entity: RAL Opportunities Fund (internal)
- Amount: $29,241
- Date of award: 05 May 2017
- Performance period: 1 June 2017 – 31 May 2018

PAST FUNDING

Development of an HWRF diagnostics module to evaluate intensity and structure using synthetic flight paths through tropical cyclones
- Role: Principal Investigator
- Funding entity: Development Testbed Center Visitor Program
- Amount: $35,929
- Date of award: 17 July 2012
- Performance period: 1 Aug 2012 – 31 Jul 2013

An Improved Historical Database for Tropical Cyclone Wind Risk Modeling
- Role: Principal Investigator
- Funding entity: Risk Prediction Initiative (RPI2.0), Bermuda Institute of Ocean Sciences (BIOS)
- Amount: $79,964
- Date of award: 15 July 2013
- Performance period: 1 Oct 2013 – 31 Dec 2015

PROFESSIONAL AFFILIATIONS

2000 – present **American Meteorological Society, Full Member as of 2011**

2001 – present **American Geophysical Union**

2003 – 2004 **American Indian Science and Engineering Society**

EXTERNAL LEADERSHIP ACTIVITIES

2018 – present	Elders Board, **Denver South Seventh-day Adventist Church**
2014 – 2016	Lead, Community Council of Elders, **Boulder Seventh-day Adventist Church**
2001 – 2009	President, Treasurer, Secretary, **Adventist Christian Fellowship at Colorado State University** (CSU student organization)
2003 – 2009	Founder and owner of the **Fort Collins Trail Runners** Yahoo Group (1000+ members)
1998 – 2000	Participant and forecaster, **Campus Weather Service**, Pennsylvania State University

HOBBIES, INTERESTS, AND EXTRACURICULAR ACTIVITIES

Meteorology	Tropical cyclones, downslope wind storms, extratropical storms, National Weather Service storm spotter, storm chasing, mountain meteorology, lake effect snowstorms, severe local storms.
Mountaineering	Climbed all 54 14,000-foot peaks in Colorado and 26 of the 50 U.S. State highpoints.
Trail Running	Pikes Peak Marathon (5 time finisher), Wellsville Ridgewalk (1st place overall in 2007, 2nd place in 2008), Blue Sky Half Marathon (1st place overall in 2008).
Other sports	Running, hiking, backpacking (West Coast Trail, British Columbia).
Other activities	Parenting, home improvement, church (teaching, ordained Elder), financial planning and investing, web page design, nature photography.
Travel	All 50 U.S. States and 37 other countries

ABSTRACT OF DISSERTATION

This dissertation consists of three distinct studies which investigate aspects of eye formation. The first study reviews eye phenomenon in a variety of vortices ranging from simple vortices to the menagerie of geophysical vortices, emphasizing similarities and differences to the eyes formed in hurricanes. The hurricane eye is found to be a paradoxical structure imposed by conservation of angular momentum and the boundaries of the vortex. A comprehensive definition for hurricane eye formation is proposed and various eye formation mechanisms are summarized.

The next study presents a simple theoretical argument to isolate the conditions under which a tropical cyclone can rapidly develop a warm-core thermal structure and subsequently approach a steady state. The theoretical argument is based on the balanced vortex model and, in particular, on the associated transverse circulation equation and the geopotential tendency equation. The transverse circulation and the temperature tendency in a tropical vortex depend not only on the diabatic forcing, but also on the spatial distributions of the static stability, the baroclinity, and the inertial stability. The vortex response to diabatic heating depends critically on whether the heating occurs in the low inertial stability region outside the radius of maximum wind or in the high inertial stability region inside the radius of maximum wind. This result suggests that rapid intensification is favored for storms which have at least some of the eyewall convection inside the radius of maximum wind. The development of an eye

partially removes diabatic heating from the high inertial stability region of the storm center, yet rapid intensification may continue if the eyewall heating continues to become more efficient. As the warm core matures and static stability increases over the inner core, conditions there become less favorable for deep upright convection and the storm tends to approach a steady state.

The final study characterizes the kinematic and thermodynamic changes that occur before, during, and after the initial eye formations of a broad set of Atlantic tropical cyclones. To obtain the requisite structure and intensity parameters, a new data set has been synthesized from the Vortex Data Messages transmitted by routine aircraft reconnaissance from 1989-2008. Intensity ranges are determined for the times when the eye/eyewall structure first appears in aircraft radar and infrared satellite imagery. The mean intensity at which an eye is first observed in both aircraft or satellite imagery is found to be 58 kt, somewhat lower than reported in previous studies. Changes about the time of eye formation are examined for intensity, the radius of maximum winds, the minimum Rossby radius of deformation, eye temperature and dew point temperature depression. Storms are found to intensify most rapidly near the time of eye formation, especially when a persistent eye is observed in infrared satellite imagery. Many storms which are forming eyes are found to undergo a substantial and rapid contraction in the radius of maximum winds during the 24-h period before the eye is observed; once the eye is present, this contraction slows or ceases. Strong warming at lower levels (850 or 700 hPa) of the eye is not observed to correlate well with the time in which the eye is first observed. Finally, observations suggest that the dynamical heating efficiency of the resulting eyewall increases even as the physical scale of the efficient heating region decreases. This allows the storm to continue intensifying even though the total inner core diabatic heating may decrease. The answer to why some storms fail to form eyes may shed light on whether eye formation is a stochastic process involving constructive and destructive mesoscale interactions -- or whether it is a manifold attractor of the system sometimes stymied by an unfavorable environment.