

Carlos A. Cruz

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HOME ADDRESS	7011 Devereux Circle Dr. Alexandria, VA 22315	<i>Phone:</i> (703) 405-4721 <i>E-mail:</i> carlos.a.cruz@gmail.com
EDUCATION	George Mason University , Fairfax, VA USA <i>Department of Atmospheric, Oceanic, and Earth Sciences</i> Ph.D., Climate Dynamics, December 2010 Dissertation Topic: “Global Circulation Variability Induced by Southern Ocean Winds” Advisor: Dr. Barry Klinger George Mason University , Fairfax, VA <i>Computational Sciences and Informatics</i> Completed coursework and thesis proposal toward a Ph.D. degree in Computational Materials Science. Proposal title: “Optimization of molecular clusters”, February, 2000 George Mason University , Fairfax, VA <i>Department of Physics</i> M.S., Applied Physics, May, 1996 B.S., Physics, May, 1988	
RESEARCH INTERESTS	Software engineering for scientific applications, climate dynamics, numerical modeling of physical systems, machine learning.	
SKILLS	<ul style="list-style-type: none">• High-Performance Computing (HPC)<ul style="list-style-type: none">• Expertise with large-scale climate and data assimilation workflows• Experience running and optimizing models on HPC clusters and cloud-based environments• Numerical Models<ul style="list-style-type: none">• NU-WRF, GEOS-5, ModelE, MOM4, HyCOM• Programming & Scripting<ul style="list-style-type: none">• Fortran, Python, C/C++, Bash• Focus on scientific computing, data processing, and workflow automation• Version Control & Collaboration<ul style="list-style-type: none">• Git, GitHub – branching workflows, CI/CD integration• Data Visualization<ul style="list-style-type: none">• Python Data Science Stack: Matplotlib, Cartopy, xarray, pandas, Plotly, and custom visualization package eViz• Automated figure generation, interactive dashboards, and publication-ready graphics• Matlab, GrADS• Documentation & Reporting<ul style="list-style-type: none">• LaTeX, Sphinx – reproducible documentation• MS Office – technical reports and presentations• Operating Systems<ul style="list-style-type: none">• Unix/Linux, macOS (Darwin), Windows	

PROFESSIONAL
EXPERIENCE

NASA/GSFC, Advanced Software and Technology Group, Greenbelt, MD

SSAI Chief Scientific Programmer Analyst, 5/12 - present

- Lead software engineer for the NASA Unified Weather Research and Forecasting (NU-WRF) system, optimizing performance and extensibility of regional Earth system simulations.
- Designed and developed *eViz*, a modular visualization toolkit for Earth system modeling data, enabling scientists to explore complex outputs interactively and efficiently.
- Contributed to the development of CREST, a reusable AI-first framework for building Earth System Models and Digital Twins; led integration into the TERRAHydro land surface model.
- Refactored and tested the NASA-GISS ModelE climate model to improve maintainability and long-term sustainability; implemented software engineering best practices for a modular codebase.
- Built *reg*, a Python-based regression testing framework, is deployed in both ModelE and NU-WRF development pipelines.
- Mentored junior developers and researchers; led technical onboarding, and provided project guidance across interdisciplinary teams. Helped to organize and train scientists and engineers in NASA's Training Boot Camps.

NASA/GSFC, Advanced Software and Technology Group, Greenbelt, MD

NGIT Physicist IV, 1/07 - 4/12

- Co-developed a high-performance giga-particle trajectory model in C++ with MPI parallelization, which enabled large-scale simulation of stratospheric processes.
- Collaborated on the Moving Objects Database (MOD) to automate the identification of meteorological phenomena from observational data.
- Ported legacy scientific codes to NASA computing platforms in support of the Earth science mission. Authored and maintained the GEOS-5 GCM User's Guide on NASA's Modeling Guru platform.
- Created Perl-based component analysis tools and Java-driven workflow scripts to support GEOS-5 modeling.
- Aligned GEOS-5 modules with ESMF (Earth System Modeling Framework) standards to ensure cross-component interoperability.

NASA/GSFC, Global Modeling and Assimilation Office, Greenbelt, MD

NGIT Senior member of technical staff, 3/00 - 12/06

- Integrated GEOS-5 AGCM with NOAA/NCEP/EMC's GSI atmospheric data assimilation system, enhancing predictive weather modeling capabilities.
- Led architecture and development efforts for Part III of the ESMF Data Assimilation project, focusing on efficient data structures and algorithm design.
- Developed a predictive analytics prototype tool to forecast climate-sensitive, vector-borne disease outbreaks.
- Established task objectives and conducted literature review.
- Automated modeling workflows through robust Unix scripting and system configuration.

US Bureau of the Census, Suitland, MD

SAIC Programmer, 8/98 - 3/00

- Designed and implemented a genetic algorithm-based module for solving a map coloring problem in census data processing.
- Enhanced and maintained C-based software in a UNIX environment, streamlining code updates and feature integration.
- Supported full lifecycle software development, including change request implementation and code-base refactoring.

CACI Federal, Inc, Arlington, VA

Systems Engineer, 3/96 - 1/97

- Developed and tested code for various modules of the Configuration Management Information System (CMIS) software.

- Created Graphical User Interface (GUI) for CMIS project using OBJECTVIEW.

Walter Reed Army Institute of Research, Bioengineering Section, Washington D.C.

Research assistant, 10/90 - 10/95

- Aided in developing experimental test models for the Film-less Dental Imaging (FDI) Project.
- Conducted statistical data analysis to support project objectives.
- Experiments involved the use of oscilloscopes, multimeters, and Geiger counters.
- Performed all kinds of mechanical duties involving machine shop instrumentation. Assisted in inventories, stocks, general laboratory management, and various administrative duties.
- Conducted polymer analysis using a 300 MHz NMR for the Micro-encapsulation Project.

MENTORING

Anna Boone, University of Oregon, 2024 NASA Summer Intern. Project: "sViz: a browser tool for creating visualizations using eViz"

Aarav Khanna, Cornell University, 2023 NASA Summer Intern. Project: "eViz: Enhanced visualization utilities for NU-WRF models"

Deon Kouatchou, Carnegie Mellon University, 2023 NASA Summer Intern. Project: "ASSERT - A Software Suite for Earth-Systems Regression Testing"

Deepthi Raghunandan, University of Maryland, 2021 NASA Summer Intern. Project: "eViz: Exploring Earth System Data Products and Diagnosing Earth System Models using a visualization environment"

Trisha Michael, South Dakota School of Mines and Technology, 2012 NASA Summer Intern. Project: "Preliminary Analysis of Tornado Producing Mesoscale Convective Systems using Event Tracker Program"

TEACHING

Adjunct Assistant Professor, Department of Computational and Data Sciences, George Mason University University, Fairfax, VA. 8/18-present:

- Modeling and Simulation I (CDS 230)
- Elements of High Performance Computing (CDS 351)
- Computing for Scientists (CDS 130) - Spring 2020 only

Lecturer, NASA Goddard Space Flight Center. Teaching duties:

- "ASTG Git/Github Training", Goddard Space Flight Center, Spring and Summer 2025
- "ASTG Fortran Training", Goddard Space Flight Center, Spring and Fall 2024
- "ASTG Git/Github Training", Goddard Space Flight Center, Spring and Fall 2024
- "ASTG Fortran Training", Goddard Space Flight Center, Spring and Fall 2023
- "ASTG Git/Github Training", Goddard Space Flight Center, Spring and Fall 2023
- "ASTG Fortran Training", Goddard Space Flight Center, Spring and Fall 2022
- "ASTG Git/Github Training", Goddard Space Flight Center, Spring and Fall 2022
- "ASTG Fortran Training", Goddard Space Flight Center, Fall 2021
- "GSFC Python Boot Camp", Goddard Space Flight Center, Summer 2020
- "GSFC Python Boot Camp", Goddard Space Flight Center, Summer 2019
- "NASA Langley Best Practices Workshop", SSAI Hampton, VA, Spring 2019
- "NASA Langley Fortran Training", SSAI Hampton, VA, Fall 2018
- "GSFC Python Boot Camp", Goddard Space Flight Center, Summer 2018
- "GSFC Python Boot Camp", Goddard Space Flight Center, Summer 2017
- "NASA Langley Python Training", SSAI Hampton, VA, Spring 2017
- "NASA Langley Python Training", SSAI Hampton, VA, Fall 2016
- "GSFC Python Boot Camp", Goddard Space Flight Center, Summer 2016

Teaching Assistant, Department of Computational and Data Sciences, George Mason University University, Fairfax, VA.

- Department of Physics, George Mason University University, Fairfax, VA. 1/97-5/98
- Department of Physics, George Mason University University, Fairfax, VA. 1/89-12/89

PUBLICATIONS

Xue, P., Huang, C., Zhong, Y., Notaro, M., Kayastha, M. B., Zhou, X., Zhao, C., Peters-Lidard, **C.**, **Cruz**, and Kemp, E.: Enhancing Winter Climate Simulations of the Great Lakes: Insights from a New Coupled Lake-Ice-Atmosphere (CLIAv1) Model on the Importance of Integrating 3D Hydrodynamics with a Regional Climate Model, *Geosci. Model Dev. Discuss.* [preprint], <https://doi.org/10.5194/gmd-2024-146>, 2025.

Larissa S. Nazarenko, Nick Tausnev, Gary L. Russell, David Rind, Ron L. Miller, Gavin A. Schmidt, Susanne E. Bauer, Maxwell Kelley, Reto Ruedy, Andrew S. Ackerman, Igor Aleinov, Michael Bauer, Rainer Bleck, Vittorio Canuto, Grégory Cesana, Ye Cheng, Thomas L. Clune, Ben I. Cook, **Carlos A. Cruz**, Anthony D. Del Genio, Gregory S. Elsaesser, Greg Faluvegi, Nancy Y. Kiang, Daehyun Kim, Andrew A. Lacis, Anthony Leboissetier, Allegra N. LeGrande, Ken K. Lo, John Marshall, Elaine E. Matthews, Sonali McDermid, Keren Mezuman, Lee T. Murray, Valdar Oinas, Clara Orbe, Carlos Pérez García-Pando, Jan P. Perlwitz, Michael J. Puma, Anastasia Romanou, Drew T. Shindell, Shan Sun, Kostas Tsigaridis, George Tselioudis, Ensheng Weng, Jingbo Wu, Mao-Sung Yao 2022: "Future Climate Change Under SSP Emission Scenarios With GISS-E2.1" *J. Adv. Model. Earth Syst.*, (2022), Vol 14, Issue 7

Michael Notaro, Yafang Zhong, Pengfei Xue, Christa Peters-Lidard, **Carlos Cruz**, Eric Kemp, David Kristovich, Mark Kulie, Junming Wang, Chenfu Huang, and Stephen J. Vavrus, 2021: Cold season performance of the NU-WRF regional climate model in the Great Lakes region. *Journal of Hydrometeorology*, 22, 2423-2454

Kim, D., M. Chin, **C. A. Cruz**, D. Tong, and H. Yu. 2021. "Spring Dust in Western North America and Its Interannual Variability—Understanding the Role of Local and Transported Dust." *Journal of Geophysical Research: Atmospheres*, 126 (22)

Miller, R.L., G.A. Schmidt, L. Nazarenko, S.E. Bauer, M. Kelley, R. Ruedy, G.L. Russell, I. Aleinov, M. Bauer, R. Bleck, V. Canuto, G. Cesana, Y. Cheng, T.L. Clune, B. Cook, **C.A. Cruz**, A.D. Del Genio, G.S. Elsaesser, G. Faluvegi, N.Y. Kiang, D. Kim, A.A. Lacis, A. Leboissetier, A.N. LeGrande, K.K. Lo, J.C. Marshall, S. McDermid, E.E. Matthews, K. Mezuman, L.T. Murray, V. Oinas, C. Orbe, C. Pérez García-Pando, J.P. Perlwitz, M.J. Puma, D. Rind, A. Romanou, D.T. Shindell, S. Sun, N. Tausnev, K. Tsigaridis, G. Tselioudis, E. Weng, J. Wu, and M. Yao, 2019: "CMIP6 Historical Simulations (1850-2014) with GISS-E2.1". *J. Adv. Model. Earth Syst.*, (2020), Vol 13, Issue 1

Kelley, M., G.A. Schmidt, L. Nazarenko, R.L. Miller, S.E. Bauer, R. Ruedy, G.L. Russell, I. Aleinov, M. Bauer, R. Bleck, V. Canuto, G. Cesana, Y. Cheng, T.L. Clune, B. Cook, **C.A. Cruz**, A.D. Del Genio, G.S. Elsaesser, G. Faluvegi, N.Y. Kiang, D. Kim, A.A. Lacis, A. Leboissetier, A.N. LeGrande, K.K. Lo, J.C. Marshall, S. McDermid, E.E. Matthews, K. Mezuman, L.T. Murray, V. Oinas, C. Orbe, C. Pérez García-Pando, J.P. Perlwitz, M.J. Puma, D. Rind, A. Romanou, D.T. Shindell, S. Sun, N. Tausnev, K. Tsigaridis, G. Tselioudis, E. Weng, J. Wu, and M. Yao, 2019: "GISS-E2.1: Configurations and climatology". *J. Adv. Model. Earth Syst.*, (2020), Vol 12, Issue 8

T. Clune, **C. Cruz**. "pFLogger: The parallel Fortran logging framework for HPC applications" Conference Paper: Proceedings of 2017 International Workshop on Software Engineering for High-Performance Computing in Computational and Data-Enabled Science and Engineering.

Z. Liu, B. Wang, T. Wang, Y. Tian, C. Xu, Y. Wang, W. Yu, **C. Cruz**, S. Zhou, T. Clune, S. Klasky "Profiling and Improving I/O Performance of a Large-Scale Climate Scientific Application"

Conference Paper: Computer Communications and Networks (ICCCN), June 2013

S. Zhou, **C. Cruz**, D. Duffy, R. Tucker, M. Purcell "Accelerating climate and weather simulations through hybrid computing" *Concurrency Computat: Pract. Exper.* 2012; 24(1): 54-62

B.A. Klinger, **C.A. Cruz**. "Decadal Response of Global Circulation to Southern Ocean Zonal Wind Stress Perturbation" *J. Phys. Ocean.* 39(8) pp 1888-1904, (2009)

S. Zhou, V. Balaji, **C. Cruz**, A. da Silva, C. Hill, E. Kluzek, S. Smithline, A. Trayanov, W. Yang. "Cross-organization interoperability experiments of weather and climate models with the Earth System Modeling Framework" *Concurrency Computat: Pract. Exper.* 2007; 19:583-592

J. Joiner, E. Brin, R. Treadon, J. Derber ; P. Van Delst, A. da Silva, J. Le Marshall, P. Poli, R. Atlas, D. Bungato, **C. Cruz**. "Effects of data selection and error specification on the assimilation of AIRS data" *Q. J. R. Meteorol. Soc.* 133; 181-196 (2007)

B.A. Klinger, **C.A. Cruz**, P. Schopf. "Targeted Shapiro Filter in an Ocean Model" *Ocean Modeling* 13 (2006) 148-155

C. Hill, C. DeLuca, V. Balaji, A. da Silva, W. Sawyer, **C.A. Cruz** et al. "Implementing Applications with the Earth System Modeling Framework" *Lecture Notes in Computer Science* (2006) Vol 32, pp 563-572

TECHNICAL REPORTS

S. Freeman, **C. Cruz**, R. Burns · K.S. Kuo · T. Clune · J. Kouatchou, "Tool for Automated Retrieval of Generic Event Tracks (TARGET)", NASA Tech Brief GSC-16665-1, July 2013

C.A. Cruz, B.A. Klinger. "Atlantic and Indo-Pacific Responses to a Southern Ocean Zonal Wind Stress Perturbation" Submitted to *J. Phys. Ocean* September 2012

Cruz C., Kelly M., Clausen M., Zhou S., and Higgins G., "Coupled Ocean-Atmosphere Shallow Water Model", TASC Internal Report, 2001

C.A. Cruz, E. Blaisten-Barojas "Structure and energetics of Silica clusters" GMU Technical Report, Spring 1998

C.A. Cruz, A. Haque, S. Landsberg, T. Zedan. "A crystal structure database of the elements and select diatomic compounds" GMU Technical Report, Fall 1997

POSTERS

C. Cruz, 2018: "NU-WRF Development and Support at NASA GSFC". 2018 WRF Workshop, Boulder, CO.

C. Cruz, T. Clune, L. Lait, S. Freeman, R. Burns, U. Ranawake 2009: "A giga-particle atmospheric trajectory model". 2009 AGU Fall Meeting, San Francisco, CA.

Cruz C., and Klinger, B. A., 2009: "Time-dependent Response of SST and Overturning to a Southern Ocean Wind Perturbation". First U.S. AMOC Annual Meeting 2009, Annapolis, MD.

C.A. Cruz, A. da Silva, W. Yang, A. Trayanov, 2005: "Data Assimilation Systems Using the Earth System Modeling Framework" 21st International Conference on Interactive Information Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology, Jan 9-13, 2005. San Diego CA

CONFERENCE PROCEEDINGS

D. Kim, M. Chin, S. Gasso, S. Park, **C. Cruz** "Remote sensing and modeling dust storms from the Copper River Valley, a major dust source in Alaska" 2024 AGU Fall Meeting, Washington DC.

C. Cruz, V. Valenti, D. Raghunandan "A Toolkit for Simplifying Earth System Models Data Visualization and Workflows" 2024 AGU Fall Meeting, Washington DC.

J. Yoo, J. Santanello, P. L. Parker, M. Navari, P. Oddo, **C. A. Cruz**, J. Bolten, K. M. Whitney "Revolutionizing Earth System Modeling with Generative AI: An Open-Source Framework for Accelerated Discovery" 2024 AGU Fall Meeting, Washington DC.

M. Saeedimoghaddam, C. Pelissier, G. S. Nearing, B. Smith, D. Raghunandan, **C. A. Cruz**, A. Saranathan, G. Liu, V. Valenti "TERRAHydro: An AI-based Framework for Land Surface Digital Twins" 2024 AGU Fall Meeting, Washington DC.

M. Saeedimoghaddam, C. Pelissier, G. S. Nearing, B. Smith, D. Raghunandan, **C. A. Cruz**, A. Saranathan, G. Liu, V. Valenti "Multi Target Learning Advances State-of-the-Art Accuracy in Land Surface Modeling" 2024 AGU Fall Meeting, Washington DC.

D. Raghunandan, C. Pelissier, B. Smith, **C. A. Cruz**, M. Saeedimoghaddam, G. S. Nearing, "Advancing Progress on Earth System Digital Twins through an Integrated AI-Enabled Framework" 2024 AGU Fall Meeting, Washington DC.

Jan Mandel; and M. Halem, C. Da, A. Kochanski, A. Farguell, M. Weldegaber, **C. A. Cruz**, Z. Yang, and J. Sorkin "Integrating WRF-SFIRE-CHEM in NASA Unified WRF (NUWRF)" 2024 AMS Fall Meeting, Baltimore MD.

C. Cruz, D. Raghunandan, V. Valenti "EViz - Empowering Earth System Model Data Visualization" 2024 AMS Fall Meeting, Baltimore MD.

Z. Tao, H. Bian, D. Kim, **C. A. Cruz**, and M. Chin "Improving Aerosol Representation in NUWRF in Support of the Emerging GEO LEO Satellite Observation of Air Quality" 2023 AMS Fall Meeting, Denver CO.

D. Raghunandan, **C. Cruz**, V. Valenti, J. Kouatchou, K. Emma Knowland, M. Damon, C. Pelissier "Diagnosing NASA Earth Science Models (ESM) using a live visualization environment: A novel approach" 2021 AGU Fall Meeting, New Orleans, LA.

V. Valenti, **C. Cruz**, D. Raghunandan, J. Kouatchou, K. Emma Knowland, M. Damon, C. Pelissier "Improving Data Exploration of Earth Systems Model Data with iViz: A Powerful Easy-to-use Interactive Visualization Toolkit" 2021 AGU Fall Meeting, New Orleans, LA.

K.S. Kuo, Y. Hang, T. Clune, S. Freeman, **C. Cruz**, J. Kouatchou, R. Burns "Automated Tracking of Tornado-Producing Mesoscale Convective Systems in the United States" 2011 AGU Fall Meeting, San Francisco, CA.

Cruz C. and B. A. Klinger, 2008: "Sensitivity of Meridional Overturning Response to Switched-on Southern Ocean Wind". AGU/ASLO Ocean Sciences 2008, Orlando, FL.

C. Cruz, E. Blaisten-Barojas, "Silica Clusters: Structures and Energetics" ACS Middle Atlantic Regional Meeting, American Chemical Society, May 2000

C. Cruz, E. Blaisten-Barojas, "Minimum Energy Structure of Silica Clusters", Virginia Academy of Science, Norfolk, Va., May 1999

AWARDS

- Computational Sciences and Informatics Fellowship: 1997-98 academic year.
- TASC Special Achievement Award: February, 2001.
- Robert H. Goddard Exceptional Achievement Team Award for Science: August 2010 (part of

team)

- Northrop Grumman TAP award: December, 2011

SOCIETIES

- Member of the American Geophysical Union.
- Member of the American Meteorological Society.
- Sigma Xi: The Scientific Research Society

SPECIAL QUALIFICATIONS

- Numerical Methods – applied to climate, weather, and geophysical modeling
- Scientific & Parallel Programming – Fortran, C/C++, Python, MPI, HPC optimization
- Geophysical Modeling – coupled atmosphere–ocean systems, data assimilation workflows
- Languages – Fluent in Spanish
- Clearance/Status – U.S. Citizen

VOLUNTEERISM

- STEM Education – Tutor for Alexandria City Public Schools (2016–2017) and Fairfax County Adult Education (2014)
- Science Outreach – Frequent judge for Alexandria & Fairfax County science fairs and regional science & engineering fairs
- Professional Service – Judge for Sigma Xi Research Showcase and other scientific review panels