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Alper Altuntas

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Objective

With a background in scientific computing, formal verification, and climate modeling, I have a strong passion to apply best practices and to devise novel approaches for maintainable, efficient, and reliable systems.

Experience

National Center for Atmospheric Research **Boulder, CO**
Software Engineer II *May 2017-Jan 2022*
Software Engineer III *Jan 2022 -Present*

- Leading the software efforts to develop the ocean component of the Community Earth System Model (CESM), a state-of-the-art climate model used by researchers in the United States and internationally.
- Planning and resources management efforts as the lead software engineer of several multi-year projects.
- Devising novel formal methods techniques to improve software reliability and maintainability.
- Providing advanced technical consulting at internal and external meetings.
- Developing HPC applications of general interest available to the climate modeling community.
- Serving as the software liaison for the CESM Ocean Modeling Working Group.

North Carolina State University **Raleigh, NC**
Research Assistant *May 2011-Dec. 2016*

- Developed an adaptive reanalysis technique for hurricane storm surge models, resulting in a tenfold or greater increase in computational efficiency of sensitivity analyses.

Education

North Carolina State University **Raleigh, NC**
Ph.D. in Civil Engineering / Computing & Systems *Dec. 2016*

North Carolina State University **Raleigh, NC**
M.S. in Civil Engineering / Computing & Systems *Dec. 2012*

Istanbul Technical University **Istanbul, Turkey**
B.S. in Civil Engineering *June 2010*

Publications

Journals

- Small, Justin, Jaison Kurian, Ping Chang, Gaopeng Xu, Hiroyuki Tsujino, Stephen Yeager, Gokhan Danabasoglu, Who Kim, **Alper Altuntas**, Frederic Castruccio. "Eastern Boundary Upwelling Systems in ocean-sea-ice simulations forced by CORE and JRA55-DO: mean state and variability at the surface". Journal of Climate, 2024.
- Baugh, John, and **Alper Altuntas**. "Formal methods and finite element analysis of hurricane storm surge: A case study in software verification." *Science of Computer Programming* 158 (2018): 100-121.
- **Altuntas, Alper**, and John Baugh. "Adaptive subdomain modeling: A multi-analysis technique for ocean circulation models." *Ocean Modelling* 115 (2017): 86-104.
- Baugh, John, **Alper Altuntas**, Tristan Dyer, and Jason Simon. "An exact reanalysis technique for storm surge and tides in a geographic region of interest." *Coastal Engineering* 97 (2015): 60-77.

Conference Proceedings

- Vanover, Jackson, **Alper Altuntas**, Cindy Rubio-González. "Toward Automated Precision Tuning of Weather and Climate Models: A Case Study" In Proceedings of Correctness 2024: Eighth International Workshop on Software Correctness for HPC Applications. (Accepted)
- **Altuntas, Alper**, John Baugh, and Jesse Nusbaumer. "Verifying ParamGen: A Case Study in Scientific Software Abstraction and Modeling" In Proceedings of the 2023 Improving Scientific Software Conference, pages 1-9, 2023. (No. NCAR/TN-576+PROC)
- Dyer, Tristan, **Alper Altuntas**, and John Baugh. "Bounded Verification of Sparse Matrix Computations." In Proceedings of 2019 IEEE/ACM 3rd International Workshop on Software Correctness for HPC Applications (Correctness), pp. 36-43. IEEE, 2019.
- **Altuntas, Alper**, and John Baugh. "Hybrid Theorem Proving as a Lightweight Method for Verifying Numerical Software." In Proceedings of 2018 IEEE/ACM 2nd International Workshop on Software Correctness for HPC Applications (Correctness), pp. 1-8. IEEE, 2018.
- **Altuntas, Alper**, and John Baugh. "Verifying Concurrency in an Adaptive Ocean Circulation Model." In Proceedings of the First International Workshop on Software Correctness for HPC Applications, pp. 1-7. ACM, 2017
- Baugh, John, and **Alper Altuntas**. "Modeling a Discrete Wet-Dry Algorithm for Hurricane Storm Surge in Alloy."In International Conference on Abstract State Machines, Alloy, B, TLA, VDM, and Z, pp. 256-261. Springer International Publishing, 2016.

Technical Report

- **Altuntas, Alper**, Allison Baker, Ilene Carpenter, Brian Dobbins, Michael Duda, Dorit Hammerling, Thomas Hauser, Karsten Peters-von Gehlen (2024). Report on the 2023 Workshop on Correctness and Reproducibility for Climate and Weather Software (No. NCAR/TN-582+PROC). doi:10.5065/0534-mc88

Selected Posters

- **Altuntas, Alper**, Isla Simpson, Scott Bachman, Samuel Levis, Brian Dobbins, and Gokhan Danabasoglu . "visualCaseGen: Streamlining CESM Simpler Modeling Efforts and Beyond." Climate & Global Dynamics Laboratory (CGD) Advisory Panel Meeting. Boulder, Colorado. May 16, 2024.
- **Altuntas, Alper** and John Baugh. "An Adaptive Reanalysis Technique and a Modern Software Architecture for Ocean Circulation Models." Computing & Systems (C&S) Research Symposium, North Carolina State University, Raleigh NC. April 22, 2016.

Selected Talks

- "visualCaseGen: A GUI for CESM Simpler Models Framework." *Presented at the following events:*
  - 2021 UFS Workflows Meeting, Online. June 30, 2021
  - 26th Annual CESM Workshop. Boulder, CO. June 16. 2021
  - Climate & Global Dynamics (CGD) Research Reports. Boulder, CO. April 22, 2021.
- "Coupling MOM6 in CESM: Software Challenges and Advances." 25th Annual CESM Workshop. Boulder, CO. June 17, 2020.
- "Using MOM6 in CESM." 2020 MOM6 Webinar Series. Boulder, CO. April 27, 2020.
- "Formal Methods and Modeling HPC Software." NCAR Climate & Global Dynamics (CGD) Research Reports. Boulder, CO. November 29, 2018.
- "Adaptive Subdomain Modeling in ADCIRC++." 20th Annual ADCIRC Model Workshop, Vicksburg, MS. May 6, 2016.
- "Developments in Subdomain Modeling." 19th Annual ADCIRC Model Workshop, College Park, MD. March 31, 2015.

Research Community Engagement

A list of selected contributions and active involvements within the research community:

- **Co-organizer:**
  - Workshop on Correctness and Reproducibility for Climate and Weather Software. *National Center for Atmospheric Research.* (2023) https://ncar.github.io/correctness-workshop/
- **Committee Member**:
  - International Workshop on Software Correctness for HPC Applications (Correctness). *Held in conjunction with the International Conference for High Performance Computing, Networking, Storage and Analysis*. (2019-Present)
- **Reviewer:**
  - Future Generation Computer Systems (FGCS)
  - The Journal of Open Source Software (JOSS)
  - Journal of Advances in Modeling Earth Systems (JAMES)
- **Panelist:**
  - NSF Grant Review Panel. 2024
  - "Facilitating the Adoption of Correctness Tools in HPC Applications." *2nd International Workshop on Software Correctness for HPC Applications (Correctness)*. Dallas, TX. November 12, 2018.

Projects

Served as an investigator and/or participated in the preparation of the following project proposals.

- "Addressing Correctness and Reproducibility for Large Climate and Weather Simulation Codes," Scientific Research Award. UCAR President's Strategic Initiative Fund (2023). Lead PIs: Baker, Altuntas.
- "Collaborative Research: Mixing and the Meridional Overturning Circulation in the Modern and Glacial Ocean," NSF-GEO-OCE/Ocean Sciences, June 15, 2021 to May 31, 2024. $83,201.00, PI: Danabasoglu, Co-PIs: Altuntas, Bachman

- "Development and Application of a Data-Driven Methodology for Validation of Risk Informed Safety Margin Characterization Models," US Department of Energy, Oct 1, 2016 to Sep 30, 2019, $3,520,000, PI: Dinh, Co-PIs: Gupta, Bolotnov, Baugh, Avramova (completed).
- "Downscaling Storm Surge Models for Engineering Applications" (extension), Department of Homeland Security, July 1, 2014 to June 30, 2015, $10,000, PI: Baugh (completed).
- "Prediction of Damage Caused by Typhoon and Wave Surge in the Coastal Area of Shizuoka Prefecture by Numerical Simulation," University Network of Shizuoka Prefecture, Jul 1, 2013 to Feb 1, 2014, ¥1,990,000, PI: Miyazaki, Co-PIs: Yuze, Baugh (completed).

Software Projects

Collaborative, multi-agency software projects for which I am a lead or substantial contributor:

- Modular Ocean Model v.6 (MOM6) — https://github.com/mom-ocean/MOM6
- Community Earth System Model (CESM) — https://github.com/ESCOMP/CESM
- visualCaseGen — https://github.com/ESMCI/visualCaseGen
- CESM-MOM6 Interface — https://github.com/ESCOMP/MOM_interface
- Parallel Ocean Program — https://github.com/ESCOMP/POP2-CESM

Tutorials and Teaching

- *"CESM Summer Tutorials: Ocean Component"* – Participated in the preparation and holding of practical sessions. (2017-present)
- *"MOM6 Webinar Series: Using MOM6 in CESM"* – Designed and led a tutorial on using MOM6 within the CESM framework. (2020)
- *"Mentorship: UC Davis"* – As part of a collaborative project for improving the performance of MOM6, I have mentored graduate students from UC Davis and instructed them on how to work on HPC environments, run and evaluate MOM6 and climate modeling applications. (2020-2021)

Awards

- Better Scientific Software (BSSw) Fellow. 2025
- UCAR President's Strategic Initiative Fund (PSIF). 2023

Computational Skills

- **Programming Languages:** Python, C++, Fortran, Julia
- **Parallel Computing:** MPI, OpenMP, OpenACC, C++14 multithreading, Dask
- **Formal Methods:** Alloy, Z3, KeYmaera, LTSA (FSP)
- **Development Tools:** Intel VTune, Arm Forge
- **Platforms:** Linux (HPC), Mac, Windows