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HISTORY OF EMPLOYMENT

Scientist VI (New Scientific Track), NSF National Center for Atmospheric Research, Boulder, CO	2025 – present
Scientist III, NSF National Center for Atmospheric Research, Boulder, CO	2025
Scientist II, NSF National Center for Atmospheric Research, Boulder, CO	2021 – 2025
Scientist I, NSF National Center for Atmospheric Research, Boulder, CO	2016 – 2020
Postdoctoral Researcher, Nansen Environmental and Remote Sensing Center, Bergen, Norway	2015 – 2016
Graduate Researcher, Massachusetts Institute of Technology, Cambridge, MA	2014
Visiting Researcher, Deltares / Delft University of Technology, Delft, Netherlands	2012 – 2013

DEGREES

Ph.D., Earth Sciences and Engineering, King Abdullah University of Science and Technology (KAUST), Saudi Arabia	2015
M.S., Earth Sciences and Engineering, King Abdullah University of Science and Technology (KAUST), Saudi Arabia	2011
B.S., Geological Engineering (minor: Remote Sensing and GIS), Middle East Technical University (METU), Turkey	2009

NARRATIVE OF RESEARCH EXPERIENCE

My research addresses the Bayesian inference problem at the heart of data assimilation (DA): how best to merge observations with complex Earth-system models to improve their fidelity to reality. Early in my career, at KAUST, I worked on variational DA, optimizing the four-dimensional variational (4D-Var) technique through reduced surrogate adjoint models to lower its computational cost for groundwater and reservoir flow problems. As ensemble-based methods gained traction, I shifted my focus to sequential approaches built around the ensemble Kalman filter (EnKF), developing joint and dual state-parameter estimation frameworks and a one-step-ahead smoothing technique that uses future observations to refine current and past estimates. These schemes proved to be model-agnostic, and I validated them across subsurface hydrology, reservoir engineering, ocean biogeochemistry, meteorology, and even epidemiological modeling, where they measurably improved COVID-19 forecasts.

A second major thread of my work has targeted core limitations of ensemble DA: sampling error, non-Gaussianity, and model bias. I developed a spatially and temporally adaptive covariance inflation method, now widely adopted across research institutions, that has proven essential to robust filtering in applications ranging from atmospheric reanalysis to flood forecasting. Building on this, I introduced an adaptive hybrid ensemble-variational algorithm that blends ensemble-based covariances with climatological background statistics, reducing long-term biases while cutting computational overhead, and, more recently, a randomized dormant ensemble Kalman filter that partitions ensembles into active and dormant subsets to improve streamflow and sea-ice forecasts under limited ensemble sizes.

These methodological advances converge in Hydro-DART, a hydrologic DA system I have led for the past several years that couples NCAR's WRF-Hydro model with DART. Central to this system is a novel Along-The-Stream (ATS) localization strategy I designed for unstructured river networks, validated during Hurricanes Florence and Ian, which has extended flood-forecasting lead times by up to 18 hours and been adopted by 40+ researchers worldwide, including the USGS. In parallel, I have led development of a coupled ocean-atmosphere-ecosystem prediction system for the Red Sea with KAUST and the Scripps Institution of Oceanography, engineering interfaces between DART, WRF, MITgcm, and the N-BLING biogeochemistry model to enable ultra-high-resolution (1/100°) ocean state estimation and to advance understanding of weakly and strongly coupled DA.

As one of the lead developers of the Data Assimilation Research Testbed (DART), a data assimilation software framework used internationally across academia and operational centers, I have also taken on growing scientific leadership within CISL's Data Assimilation Research Section, mentoring junior scientists and students, helping secure funded partnerships with USGS, KAUST, Baron Weather, and Scripps, and co-founding the West Asia and North Africa (WANA) Affinity Group at NSF NCAR. I have authored or co-authored more than 45 peer-reviewed journal articles and book chapters, and in 2023 was named one of BizWest Magazine's "40 Under 40" young professionals shaping the future of Boulder County.

KEY PUBLICATIONS

- El Gharamti, M., et al., 2025: The Data Assimilation Research Testbed: A Robust, Scalable Software Facility with Groundbreaking Capabilities for Model-Data Integration. *Bull. Amer. Meteor. Soc.*, 106, E2328–E2345.
 - Sanikommu, S., ... El Gharamti, M., et al., 2025: Evaluating a Hybrid Ensemble Data Assimilative Coupled Physical-Biogeochemical Ecosystem Model of the Red Sea. *J. Adv. Model. Earth Syst.*, 17, e2025MS005086.
 - El Gharamti, M., Rafieeinassab, A., and McCreight, J., 2024: Leveraging a Novel Hybrid Ensemble and Optimal Interpolation Approach for Enhanced Streamflow and Flood Prediction. *Hydrol. Earth Syst. Sci.*, 28, 3133–3159.
 - Hoteit, I., ... El Gharamti, M., et al., 2021: Towards an End-to-End Analysis and Prediction System for Weather, Climate, and Marine Applications of the Red Sea. *Bull. Amer. Meteor. Soc.*, 102, 1–61.
 - El Gharamti, M., 2021: Hybrid Ensemble-Variational Filter: A Spatially and Temporally Varying Adaptive Algorithm to Estimate Relative Weighting. *Mon. Wea. Rev.*, 149, 1–42.
 - El Gharamti, M., et al., 2021: Ensemble Streamflow Data Assimilation Using WRF-Hydro and DART: Novel Localization and Inflation Techniques Applied to Hurricane Florence Flooding. *Hydrol. Earth Syst. Sci.*, 25, 5315–5336.
 - El Gharamti, M., 2018: Enhanced Adaptive Inflation Algorithm for Ensemble Filters. *Mon. Wea. Rev.*, 146, 623–640.
- Full list of 45 peer-reviewed journal articles available upon request.

HONORS

- NSF NCAR/CISL Special Recognition Award, for delivering DAREs science while short-staffed, 2026
- NSF NCAR/CISL Special Recognition Award, for excellence in outreach and community engagement, 2025
- NSF NCAR Special Recognition Award, for contributions to the Earth System Predictability and Prediction Working Group, 2025
- Named one of BizWest Magazine's (Boulder County) "40 Under 40" young professionals shaping the future of Boulder, 2023
- NSF NCAR Explorer Series Special Recognition Award, 2023
- NSF NCAR/CISL Special Recognition Award, for exceptional teamwork in rescuing the DART-CAM6 Reanalysis, 2020
- KAUST Provost Academic Excellence Award, 2013; Highest-Ranking Graduate Student Award, KAUST, 2011
- METU Highest-Ranked Undergraduate Student in the entire history (60+ years) of the Geological Engineering Department, 2005 – 2009

PROFESSIONAL SOCIETY MEMBERSHIPS

American Geophysical Union (AGU) • American Meteorological Society (AMS) • European Geophysical Union (EGU) • Society for Industrial and Applied Mathematics (SIAM)