[NICOLE] XUN CAI

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Github: https://github.com/nicolecx122/schism/tree/icm_Balg

Education

Ph.D. in Marine Science, 2022	Virginia Institute of Marine Science, William & Mary, VA Co-advisers: Y. Joseph Zhang and Jian Shen
M.S. in Marine Science, 2018	Virginia Institute of Marine Science, William & Mary, VA Co-advisers: Y. Joseph Zhang and Jian Shen
B.S. in Oceanography, 2015	Nanjing University, Nanjing, China

Appointments

Chesapeake Bay Program Office, EPA, MD	ORISE Postdoctoral Fellow	2022 – present
Chesapeake Bay Program Office, EPA, MD	ORISE Fellow	2021 – 2022
University of Oldenburg, Germany	International Visiting Fellow	2017
Virginia Institute of Marine Science, VA	Graduate Research Assistant	2015 – 2021

Peer-Reviewed Publications

[7]. **Cai, X.**, Shen, J., Zhang, Y., J., Qin, Q., and Linker, L., 2023. The Roles of Tidal Marshes in the Estuarine Biochemical Processes: A Numerical Modeling Study. Journal of Geophysical Research: Biogeosciences. doi: 10.1029/2022JG007066.

[6]. Xiong, J., Shen, J., Qin, Q., Tomlinsom, M., Zhang, Y., **Cai, X.**, Ye, F., Cui, L., and Mulholland, M., 2023. Biophysical Interactions Control the Progression of Harmful Algal Blooms in Chesapeake Bay: A Novel Lagrangian Particle Tracking Model with Mixotrophic Growth and Vertical Migration. Limnology and Oceanography Letters. doi: 10.1002/lol2.10308.

[5]. **Cai, X.**, Qin, Q., Shen, J. and Zhang, Y., J., 2022. Bifurcate Responses of Tidal Range to Sea-level Rise in Estuaries with Marsh Evolution. Limnology and Oceanography Letters. *7*(3), pp.210-217. doi: 10.1002/lol2.10256.

[4]. Tian, R., **Cai, X.**, Testa, J., Brady, D.C., Cerco, C. and Linker, L., 2022. Simulation of High-Frequency Dissolved Oxygen Dynamics in A Shallow Estuary, the Corsica River, Chesapeake Bay. Frontiers in Marine Science, *9*, p.2580. doi: 10.3389/fmars.2022.1058839.

[3]. Qin, Q., Shen, J., Tuckey, T.D., **Cai, X.** and Xiong, J., 2022. Using Forward and Backward Particle Tracking Approaches to Analyze Impacts of a Water Intake on Ichthyoplankton Mortality in the Appomattox River. Journal of Marine Science and Engineering, *10*(9), p.1299. doi: 10.3390/jmse10091299.

[2]. **Cai, X.**, Shen, J., Zhang, Y., J., Qin, Q., Wang, Z. and Wang H., 2021. Impacts of Sea Level Rise on Hypoxia and Phytoplankton Production in Chesapeake Bay: Model Prediction and Assessment. Journal of American Water Resources Association. doi: 10.1111/1752-1688.12921.

[1]. **Cai, X.**, Zhang, Y., J., Shen, J., Wang, H., Wang, Z., Qin, Q., and Ye, F., 2020. A Numerical Study of Hypoxia in Chesapeake Bay Using an Unstructured Grid Model: Validation and Sensitivity to Bathymetry Representation. Journal of American Water Resources Association, 1–24. doi: 10.1111/1752-1688.12887.

Manuscripts in Progress

Cai, X., Shen, J., Zhang, Y., J., Qin, Q., and Linker, L., Sea-level Rise Impacts on The Tidal Marshes and Estuarine Biogeochemical Processes. Under 2nd review. Journal of Geophysical Research: Biogeosciences.

Grants

Mar. 2023	**ECO-DAS XV Fellow**, Association for the Sciences of Limnology & Oceanography (ASLO) and National Science Foundation (NSF), Honolulu, HI – "Enhanced Sulfide Flux by Resuspension: An Underestimated Piece to Estuarine Hypoxia" ($3,337)
Apr. 2022	**W&M Open Access Financial Assistance**, for publication in L&O Letter – "Bifurcate Responses of Tidal Range to Sea-level Rise in Estuaries with Marsh Evolution" ($2,400)
Aug. 2020	**Commonwealth Coastal Research Fellowship**, VIMS, VA – for dissertation research focus which strategically advances VIMS' advisory service to the Commonwealth of Virginia in areas such as water quality research, and management and resilience approaches. ($31,245)
May. 2019	**CSDMS Integration Scholarship** at *Community Surface Dynamics Modeling System meeting 2019*, Boulder, CO – "Impact of Submerged Aquatic Vegetation on Water Quality in Cache Slough Complex, Sacramento-San Joaquin Delta: A Numerical Study"

Proposals and Collaborations (devoid of costs for the eligibility of the ORISE program)

"CHRP: An integrated study of Brown Shrimp responses to hypoxia and climate change in the northwestern Gulf of Mexico." proposal under 2nd review at NOAA in response to the grant NOAA-NOS-NCCOS-2023-2007528. PI: Dr. Jongsun Kim (University of Texas Rio Grande Valley), Co-PIs: Drs. Qubin Qin (VIMS), Carlos Cintra Buenrostro (University of Texas Rio Grande Valley), and MD Saydur Rahman (University of Texas Rio Grande

Valley), Collaborators/Advisory team: Drs. Jennifer Leo (NOAA), **Xun Cai** (ORISE fellow at EPA CBP), Fernando Martinez-Andrade (Texas Parks & Wildlife Department), and Joseph Zhang (VIMS).

"Developing cyanobacteria Harmful Algal Bloom model using a lower trophic level ecosystem model in the freshwater system of Rio Grande Valley." proposal submitted to the US Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC). PI: Dr. Jongsun Kim (University of Texas Rio Grande Valley), Co-PI: Myung Hwangbo (University of Texas Rio Grande Valley), Collaborators: Drs. **Xun Cai** (ORISE fellow at EPA CBP) and Qubin Qin (VIMS).

Teaching and Mentoring

May – Jul. 2023	Mentor of undergraduate summer intern Philip Ignatoff, William & Mary, VA – design of an 8-week research project "Revisit sediment diagenesis, bioturbation, and nutrient cycling" as a case study in Gadeken et al., in prep for *L&O Letters*
Apr. 2019	Teaching lecture at SCHISM Summit workshop, Sacramento, CA – "Introduction of SCHISM-ICM water quality model"

Research Experience

Aug. 2021 – present — Develop and apply phase 7 estuary models to support the Chesapeake Bay TMDL, funded by ORISE Research Participation Program at EPA

- Lead on the MTM developments in the James, York, Rappahannock, Potomac, and other rivers.
- Tian, R., Cai, X. et al., 2022, *Frontiers in Marine Science*

Dissertation Chapter 4
Aug. 2021 – Mar. 2022 — Study the impacts of sea-level rise in tidal marshes in the Chesapeake Bay, funded by CA Delta Stewardship Council

- Study the impacts of sea-level rise (SLR) on tidal marshes and estuarine biochemical processes.
- Cai, X. et al. 2022, *Limnology and Oceanography Letters*
- Cai, X. et al. In revision, *Journal of Geophysical Research: Biogeosciences*

Dissertation Chapter 3
Apr. 2020 – Jul. 2021 — Study the role of tidal marshes in the estuarine biogeochemical processes, funded by VIMS Commonwealth Coastal Research Fellowship

- Develop vegetation model: couple both marsh and SAV into water quality model with linkage to both water column and sediments.
- Cai, X. et al. 2023, *Journal of Geophysical Research: Biogeosciences*

Dissertation Chapter 2 — Study the impacts of sea-level rise on water quality in Chesapeake Bay, funded by VIMS Graduate Research Grants
Jul. 2019 – Mar. 2020

- Analyze the contributions of each physical and biochemical process to the changes on oxygen budget under SLR.
- Cai, X. et al. 2021, *Journal of American Water Resources Association.*

Dissertation Chapter 1 — Study the impacts of sea-level rise on water quality in Chesapeake Bay, funded by VIMS Graduate Research Grants
Aug. 2018 – Jun. 2019

- Develop SCHISM-ICM in Chesapeake Bay to simulate hypoxia, phytoplankton production and other biochemical processes.
- Cai, X. et al. 2020, *Journal of American Water Resources Association.*

Master Thesis — Study the impacts of SAV on water quality in San Francisco Bay delta, funded by CA Department of Water Resources
Feb. 2017 – July 2018

San Francisco Bay SAV Modeling Development:

- Develop SAV model: introduce SAV sub-model into water quality model with three components – leaf, stem and root as state variables, and calculate its relationship with the water column and sediments.
- Apply SCHISM-ICM to San Francisco Bay Delta, with SAV model imbedded, to simulate water quality and SAV biomass.

Awards

Mar. 2022	**Top Cited Article 2020-2021**, Journal of American Water Resources Association, Wiley – "A Numerical Study of Hypoxia in Chesapeake Bay Using an Unstructured Grid Model: Validation and Sensitivity to Bathymetry Representation."
Oct. 2021	**Juliette B. & Carroll W. Owens, Sr. Fellowship**, VIMS, VA – for academic performance and progress in the Ph.D. Degree Program
May. 2019	**Best Poster Award** at *Southeastern Virginia Postdoctoral Symposium*, Gloucester Point, VA – "Numerical Study of Impact of Submerged Aquatic Vegetation on Water Quality in Cache Slough Complex, Sacramento-San Joaquin Delta"

Invited Talks and First-author Conference Presentations

May 2023	Oral presentation at *International Society for Ecological Modelling Global Conference*, Toronto, Canada – "Impacts of sea-level rise on the tidal marshes and estuarine biochemical processes"
Mar. 2023	Invited talk at the first annual meeting of NSF project CHALK – "Development of biogeochemical modeling of tidal wetlands estuarine waters of the York River"

Jun. 2022	Oral presentation at *Chesapeake Bay Symposium,* Annapolis, MD – "Impacts of sea-level rise on the material exchange between tidal marshes and the estuary"
Jun. 2022	Oral presentation at *Chesapeake Bay Symposium,* Annapolis, MD – "Development of a Next-Generation Tributary Model in the tidal James River"
Jun. 2020	Oral presentation at *Chesapeake Bay Symposium,* virtual – "Impacts of Sea-level Rise on Hypoxia and Phytoplankton Production in Chesapeake Bay: Model Validation and Assessment"
Nov. 2019	Oral presentation at *Cerf*, Mobile, AL – "Numerical Simulation of Impacts from Sea-level Rise on Hypoxia in Chesapeake Bay Using an Unstructured Grid Model: Validation and Assessment"
Jun. 2016	Poster presentation at *Chesapeake Bay Symposium, 2016*, Williamsburg, VA – "Effect of pH on nutrients release and algal bloom in the Back River, Upper Chesapeake Bay"

Professional Skills

Numerical modeling	Semi-implicit Cross-scale Hydroscience Integrated System Model (SCHISM); Integrated Compartment Model (ICM) multi-dimensional water quality model; Sediment Flux Model; Tidal Marsh Model; Submerged Aquatic Vegetation Model; Benthic Algae Model; Benthic Feeder Model; Bioturbation Model; Sediment Transport Model; Wind Wave Model; Watershed and Airshed Coupling
Data analysis and machine learning	Harmonic Analysis, Regressions, Decision Tree, Classification and Regression Trees (CART), Random Forest, Neural Network, Empirical Mode Decomposition (EMD), Empirical Orthogonal Function (EOF)
Programing skills	Fortran, Matlab, Python, HTML, Perl, and C
Software	SMS, ArcGIS, CorelDRAW, STELLA
Operating system	Unix for high-performance computing (HPC)

Service and Outreach

2021 - present	Reviewer for Geology, Ocean Modeling, Marine Pollution Bulletin, Journal of American Water Resources Association, and USGS Colleague Review
2019 - 2022	VIMS Ombudsperson – Peer mentor and confidential resource for graduate students to promote conflict resolution for problems that arise in the university setting.
Aug. 2019	Oral presentation at *A Scientist Walks into A Bar – Grad Student Edition* – "To Save the Fish by Removing Seagrass?"