Research Digest

Issue no. 10 (January - March 2024)

VIMS | William & Mary

Virginia Institute of Marine Science

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Message from the Associate Dean of Research and Advisory Services

This Digest is intended to provide stakeholders, colleagues, and interested persons a sense of the depth and breadth of the research happening at VIMS. While we attempt to be as comprehensive as possible, it likely does not contain every article published in the issue's timespan due to differences in timelines and release dates across various publishers and databases that curate peer reviewed research.

If you are interested in reading the full text of any article that you do not have appropriate library/institution access for, please contact the VIMS author or corresponding author of the paper. Contact information for current VIMS scientists can be found on our website: www.vims.edu/about/directory/search/.

Mark W. Luckenbach, Associate Dean

Office of Research & Advisory Services
Virginia Institute of Marine Science
William & Mary

Topics In This Issue

(click topic heading below to jump to desired section)

Navigating this document

Click on one of the headings listed above to jump to the desired section. Alternatively, search the document using keywords or an author's name. To search for words or names, simultaneously press the 'ctrl' and 'F' keys, type the desired word or name in the search field, then press 'enter' or 'return'. If the search term is in the document, it will be highlighted.

VIMS authors in this issue

(Listed alphabetically by last name. An asterisk (*) indicates VIMS student.)

Title	Direct observations of microbial community succession on sinking marine particles
Author(s)	Stephens B.M., Durkin C.A., Sharpe G., Nguyen T.T.H., Albers J., Estapa M.L., **Steinberg D.K.**, Levine N.M., Gifford S.M., Carlson C.A., Boyd P.W., Santoro A.E.
Journal	The ISME Journal 18(1): wrad010 (2024)
Link	https://doi.org/10.1093/ismejo/wrad010
Summary	Microbial community dynamics on sinking particles control the amount of carbon that reaches the deep ocean. We observed community succession with corresponding changes in microbial metabolic potential on larger sinking particles in the N. Atlantic Ocean that transport the majority of carbon to the deep sea.

Title	Resetting thermal limits: 10-year-old white sturgeon display pronounced but reversible thermal plasticity
Author(s)	Weber T.A., **Dichiera A.M.**, Brauner C.J.
Journal	Journal of Thermal Biology 119: 103807 (2024)
Link	https://doi.org/10.1016/j.jtherbio.2024.103807
Summary	10-year-old white sturgeon greatly increase thermal tolerance with warm acclimation, but this increased thermal tolerance is lost after reacclimation to control temperatures. However, fish exposed to warm temperatures have 45% smaller livers even after one-month recovery, indicating warm acclimation may have lasting effects on energy usage and metabolism.

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Title	Different effects between cold front and tropical cyclone on short-term morphodynamics in the Changjiang Delta
Author(s)	Wu X., He Q., **Shen J.**, Peng Z., Guo L., Xie W., Lin J.
Journal	Journal of Marine Systems 243: 103961 (2024)
Link	https://doi.org/10.1016/j.jmarsys.2023.103961
Summary	Extreme weather, such as typhoons and cold fronts, can cause significant short-term sediment transport in the Changjiang Delta. Typhoons increase sediment flux and transport sediment toward Hangzhou Bay, while cold fronts enhance seaward flushing. Bed-level changes are substantial but recover quickly. The study improves understanding of storm-driven hydromorphodynamics.

Title	Production and abundance of macro-aggregate bed clasts from moderately consolidated cohesive beds and their implications for sediment management
Author(s)	Perkey D.W.*, Smith S.J., Fall K.A., Tarpley D.R.N., **Friedrichs C.T.**
Journal	Journal of Sedimentary Research 94(1): 37-50 (2024)
Link	https://doi.org/10.2110/jsr.2023.040
Summary	Using flume experiments, we show moderately consolidated, cohesive sediments commonly produce large muddy aggregates that account for over 20% of eroded mass. Clay content strongly influences aggregate size and abundance. Understanding this phenomenon is essential for predicting sediment transport and informing sediment management, particularly in estuarine and coastal environments.

Title	Differences in internal sedimentologic and biotic structure between natural, managed, and constructed coastal foredunes
Author(s)	**Davis E.H.***, **Hein C.J.**, Cohn N., White A.E., Zinnert J.C.
Journal	Geomorphology 451:109083 (2024)
Link	https://doi.org/10.1016/j.geomorph.2024.109083
Summary	Using sediment cores, ground-penetrating radar, and morphology data, we found that the internal dune structure varies significantly between natural, managed, and constructed (i.e., man-made) coastal sand dunes. These differences reflect the divergent physical processes governing dune evolution for natural, managed, and constructed foredunes.

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Title	Relating geotechnical sediment properties and low frequency CHIRP sonar measurements
Author(s)	Jaber R., Stark N., Sarlo R., McNinch J.E., **Massey G.**
Journal	Remote Sensing 16(2): 241 (2024)
Link	https://doi.org/10.3390/rs16020241
Summary	Co-located shallow water sediment geotechnical and geoacoustic measurements show that acoustic impedance values deduced from CHIRP sonar data fall within a range of +25% of acoustic impedance estimated from porosity and bulk density even for very soft sediments (s_u < 3 kPa) and loose sands (~20% relative density).

Title	Sediment characterization based on portable free fall penetrometer measurements using a deep neural network
Author(s)	Rahman Md.R., Hunstein E., Rodriguez-Marek A., Stark N., **Massey G.**, **Friedrichs C.T.**, Dorgan, K.M., Cox, C.
Book	Geo-Congress 2024: Geotechnical Data Analysis and Computation 352: 354-363 (2024)
Link	https://doi.org/10.1061/9780784485347.036
Summary	Using flume experiments, we show moderately consolidated, cohesive sediments commonly produce large muddy aggregates that account for over 20% of eroded mass. Clay content strongly influences aggregate size and abundance. Understanding this phenomenon is essential for predicting sediment transport and informing sediment management, particularly in estuarine and coastal environments.

Title	Vertical accretion trends project doughnut-like fragmentation of saltmarshes
Author(s)	**Hein C.J.**, **Connell J.E.**, FitzGerald D.M., Georgiou I.Y., Hughes Z.J., **King K***.
Journal	Communications Earth & Environment 5(1): art no. 74
Link	https://doi.org/10.1038/s43247-024-01219-8
Summary	Saltmarshes keep pace with sea-level rise through organic-matter production and incorporation of inorganic sediment. This paper demonstrates how these processes are acting differentially in marshes in the southeast US: Marsh interiors are nearing drowning, but those near the exposed edges of marsh platforms are growing faster than sea-level rise.

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Title	Reproductive biology, elemental composition and diel vertical migration of the cosmopolitan warm-temperate pelagic tunicate *Soestia zonaria*
Author(s)	Lüskow F., Bahl A.A., Décima M., **Steinberg D.K.**, Pakhomov E.A.
Journal	Journal of Plankton Research 46(1): 72–85 (2024)
Link	https://doi.org/10.1093/plankt/fbad053
Summary	Reproductive biology, stoichiometry, and vertical distribution of the pelagic salp species *Soestia zonaria* was investigated in the Southern Ocean and NE Atlantic Ocean.

Title	Rapid greening in mangroves
Author(s)	**Chen, Y.**, **Kirwan, M.L.**
Journal	Nature Ecology & Evolution 8: 186–187 (2024)
Link	https://doi.org/10.1038/s41559-023-02247-x
Summary	Two decades of global satellite observations reveal increased productivity of mangrove forests relative to adjacent evergreen forests, which highlights important differences in the response of coastal and terrestrial ecosystems to sea level rise.

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Modeling

(*VIMS authors in **bold**, asterisk indicates VIMS student*)

Title	A multi-glimpse deep learning architecture to estimate socioeconomic census metrics in the context of extreme scope variance
Author(s)	Runfola D., Stefanidis A., **Lv Z**., O'Brien J., Baier H.
Journal	International Journal of Geographical Information Science 38(4): pg. 726-750 (2024)
Link	https://doi.org/10.1080/13658816.2024.2305636
Summary	This study explores the use of Convolutional Neural Networks (CNNs) to estimate census variables across diverse Mexican municipalities, spanning various geographic scales. By leveraging deep learning techniques, particularly a multi-glimpse recurrent attention model, the research achieves promising results, with nearly half of the tested socioeconomic variables (22 out of 52) attaining R^2 values above 0.75. These findings highlight the potential of satellite imagery for estimating socioeconomic indicators, both in historical contexts and in regions where traditional data collection is challenging.

Title	Evaluating the skill of correlative species distribution models trained with mechanistic model output
Author(s)	**Horemans, D.M.L**., **Friedrichs, M.A.M**., **St-Laurent, P**., Hood, R.R., Brown, C.W.
Journal	Ecological Modelling 491: 110692 (2024)
Link	https://doi.org/10.1016/j.ecolmodel.2024.110692
Summary	Species distribution models (SDMs) are typically trained with observations but often applied using model-derived environmental fields in forecasts, which impacts their prediction accuracy. We demonstrate that incorporating mechanistic model output during SDM training can improve SDM predictive skill by addressing errors in these environmental fields.

Title	On the sensitivity of coastal hypoxia to its external physical forcings
Author(s)	**St-Laurent P.**, **Friedrichs M.A.M.**
Journal	Journal of Advances in Modeling Earth Systems 16(1): e2023MS003845 (2024)
Link	https://doi.org/10.1029/2023MS003845
Summary	The study evaluates the possibility of modeling Chesapeake Bay hypoxia using global ocean models. The results indicate that hypoxia is primarily dictated by local drivers (terrestrial loadings and temperature) and that biases/inaccuracies in the oceanic conditions have limited impact on the realism of hypoxia.

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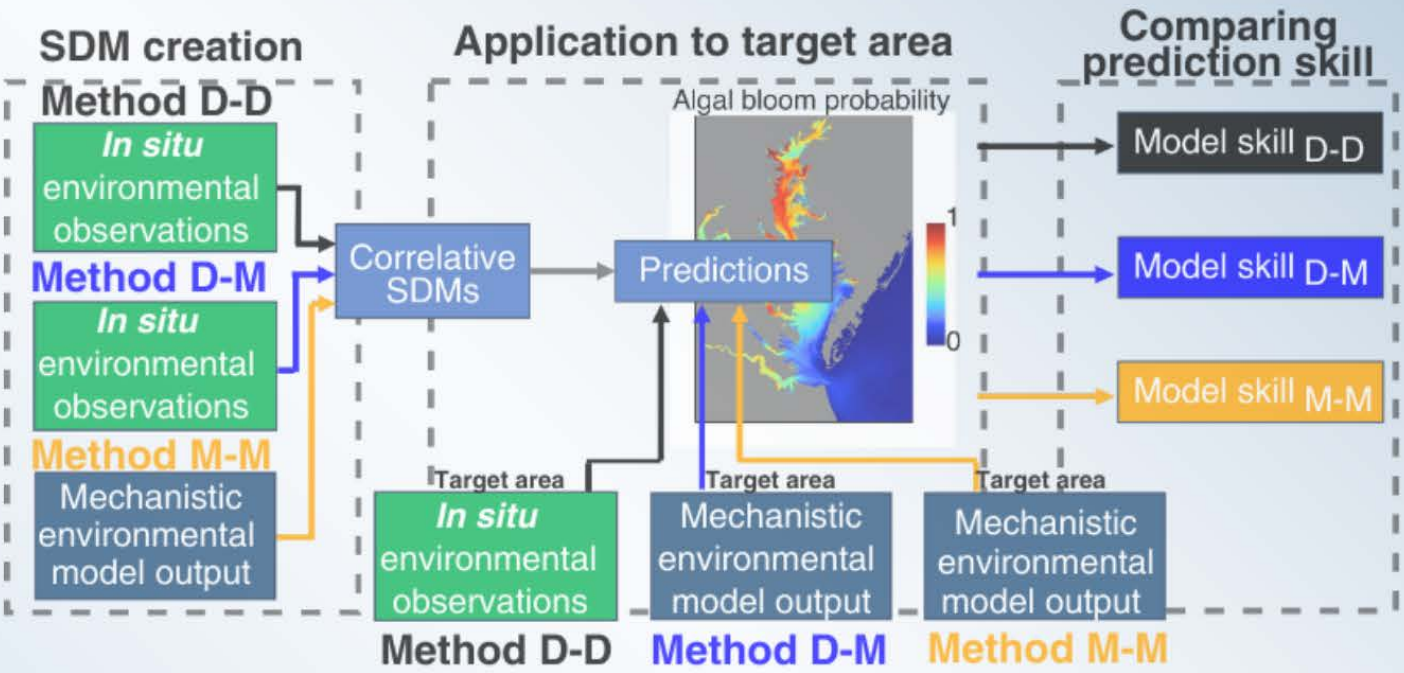
Featured Articles

Horemans et al. 2024 (see page 8)

Caption: Schematic overview of approach used to assess model prediction skills of correlative SDMs (Species Distribution Models).

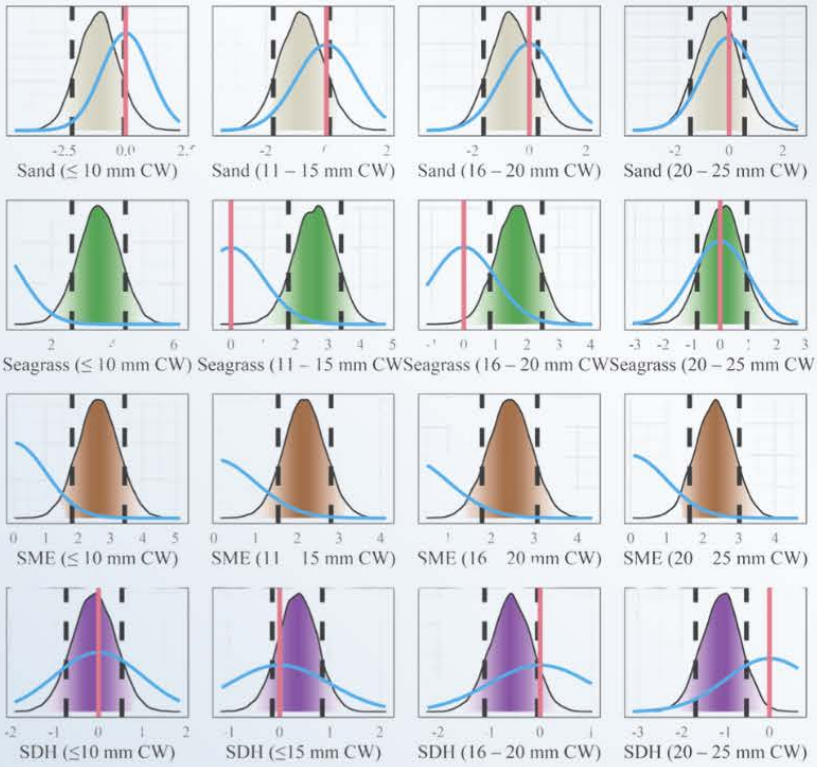
Figure credit: Dante Horemans



Hyman et al. 2024 (see page 10)

Caption: Dashed black lines denote 80% Bayesian confidence intervals, red lines denote 0, and blue lines depict prior distributions.

Figure credit: A. Challen Hyman



Title	Ontogenetic patterns in juvenile blue crab density: Effects of habitat and turbidity in a Chesapeake Bay tributary
Author(s)	**Hyman, A.C.***, **Chiu, G.S.**, **Seebo, M.S.**, **Smith, A.**, **Saluta, G.G.**, **Lipcius, R.N.**
Journal	Marine Ecology Progress Series 729: 135 - 150 (2024)
Link	https://doi.org/10.3354/meps14490
Summary	A unified Bayesian modeling approach simultaneously accounts for specific blue crab abundance across multiple size classes, habitat types, and turbidity levels. Although the study is not longitudinal, the model's conditional autoregressive dependency structure suggests changes in blue crabs' preference for surroundings as they grow through size classes.

Title	Planning hydrological restoration of coastal wetlands: Key model considerations and solutions
Author(s)	Twomey A.J., **Nunez K.**, Carr J.A., Crooks S., Friess D.A., Glamore W., Orr M., Reef R., Rogers K., Waltham N.J., Lovelock C.E.
Journal	Science of the Total Environment 915: 169881 (2024)
Link	https://doi.org/10.1016/j.scitotenv.2024.169881
Summary	The article synthesizes current knowledge on selecting appropriate modeling approaches for the hydrological restoration of coastal wetlands, emphasizing the balance between complexity, cost, and uncertainty. It highlights practical solutions to enhance model accuracy and decision-making, ensuring alignment with project goals for effective restoration planning.

Title	Mapping the tidal marshes of coastal Virginia: A hierarchical transfer learning approach
Author(s)	**Lv Z.**, **Nunez K.**, Brewer E., Runfola D.
Journal	GIScience and Remote Sensing 61(1): art no. 2287291 (2024)
Link	https://doi.org/10.1080/15481603.2023.2287291
Summary	The article presents a deep learning segmentation model utilizing Sentinel-2 and NAIP imagery to classify high and low tidal marshes in coastal Virginia. Achieving 88% accuracy at a 0.6 m resolution, this approach demonstrates the effectiveness of combining multispectral satellite imagery and deep learning for marsh type classification.

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Title	Hydrodynamic responses of estuarine bays along the Texas-Louisiana coast during Hurricane Harvey
Author(s)	Huang W., **Ye F.**, **Zhang Y. J.**, Du J., Park K, **Yu H.**, **Wang Z.**
Journal	Ocean Modelling 187: 102302 (2024)
Link	https://doi.org/10.1016/j.ocemod.2023.102302
Summary	The study analyzes how Hurricane Harvey impacted hydrodynamics and salinity in Galveston Bay, Sabine Lake, Calcasieu Lake, and Vermilion Bay. Using a coupled hydrodynamic model, it finds that storm surge and river discharge caused large salt fluxes, with wind-driven currents playing a crucial role in redistributing water and salinity.

Title	Delayed coastal inundations caused by ocean dynamics post-Hurricane Matthew
Author(s)	Park K., Di Lorenzo E., **Zhang Y.J.**, **Wang H.**, Ezer T., **Ye F.**
Journal	npj Climate & Atmospheric Science 7: art no. 5 (2024)
Link	https://doi.org/10.1038/s41612-023-00549-2
Summary	Post Hurricane Abnormal Water Level (PHAWL) poses a persistent inundation threat to coastal communities, yet unresolved knowledge gaps exist regarding its spatiotemporal impacts and causal mechanisms. Using a high-resolution coastal model with a set of observations, we find that the PHAWLs are up to 50 cm higher than the normal water levels for several weeks and cause delayed inundations around residential areas of the U.S. Southeast Coast (USSC).

Title	Sudden arrival of marine litter on the northeastern coast of Brazil: Physical forcings and associated transport
Author(s)	Cintra M.M., Silva-Cavalcanti J.S., B. Araújo M.C., **Mazzini P.L.F**., Rollnic M., Mendes D.
Journal	Regional Studies in Marine Science 71: 103382 (2024)
Link	https://doi.org/10.1016/j.rsma.2024.103382
Summary	This study used numerical simulations to investigate an event of a sudden arrival of more than 50 tons of marine litter on the northeastern Brazilian coast. Virtual particles were released and had their trajectories investigated, as well as their relationship with major physical forcings, including tides, winds and the North Brazil Under Current (NBUC).

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Title	Compound marine cold spells and hypoxic events in a nearshore upwelling system
Author(s)	Walter, R.K., Dalsin, M., **Mazzini, P.L.F.**, **Pianca, C.**
Journal	Estuarine, Coastal and Shelf Science 300: 108706 (2024).
Link	https://doi.org/10.1016/j.ecss.2024.108706
Summary	We investigated compound marine cold spells (MCSs)-hypoxic events at a nearshore site in central California using nearshore water temperature data and short-term nearshore dissolved oxygen data. From 1988 to 2020, we identified 55 MCS events, with 50 events (~90.9%) initiated during anomalously strong upwelling and identified 20 of the 55 MCS events (~34.6%) as potential compound MCS-hypoxic events, with an average duration of 11.7 days.

Title	Impacts of marine heatwaves on subsurface temperatures and dissolved oxygen in the Chesapeake Bay
Author(s)	**Shunk N.P.***, **Mazzini P.L.F.**, Walter R.K.
Journal	Journal of Geophysical Research: Oceans 129(3): e2023JC020338 (2024)
Link	https://doi.org/10.1029/2023JC020338
Summary	This study uses a suite of in-situ data (1986-2021) to characterize subsurface temperature and dissolved oxygen anomalies during surface marine heatwaves. Seasonal stratification and mixing controlled the vertical heat transport/diffusion of anomalous surface heating. Marine heatwaves were associated with an expansion of the hypoxic zone below the surface mixed layer.

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Title	*Phaeocystis*: A global enigma
Author(s)	**Smith, Jr. W.O.**, Trimborn S.
Journal	Annual Review of Marine Science 16: pg. 417-441 (2024)
Link	https://doi.org/10.1146/annurev-marine-022223-025031
Summary	The phytoplankton genus *Phaeocystis* has a major impact throughout the ocean and is distributed globally. In many systems it has a negative impact on local food webs. This paper reviews its distribution, impacts, and future consequences of its increased growth in marine systems.

Title	Temporal and spatial variability of constitutive mixotroph abundance and proportion
Author(s)	**da Costa M.D.***, Gast R. J., **Millette N.C.**
Journal	FEMS Microbiology Ecology 100(3): fiae015 (2024)
Link	https://doi.org/10.1093/femsec/fiae015
Summary	This study advanced our understanding of how in situ mixotroph abundance and proportion are influenced by not only environmental factors, but by the taxa present.

Title	Omnivorous summer feeding by juvenile Antarctic krill in coastal waters
Author(s)	**Conroy J.A.***, **Steinberg D.K.**, Nardelli S.C., Schofield O.
Journal	Limnology and Oceanography 69(4): 874-887 (2024)
Link	https://doi.org/10.1002/lno.12533
Summary	Juvenile Antarctic krill fed mostly on heterotrophic prey (as opposed to phytoplankton) during summer, and this food web complexity should be considered more broadly throughout the changing Southern Ocean.

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Title	Twenty years later: PBDEs in fish from U.S. sites with historically extreme contamination
Author(s)	**La Guardia M.J.**, **Mainor T.M.**, **Luellen D.R.**, **Harvey E.**, **Hale R.C.**
Journal	Chemosphere 351: 141126 (2024)
Link	https://doi.org/10.1016/j.chemosphere.2024.141126
Summary	This study re-examined a U.S. riverine system found in 1999 to have the highest PBDE fish tissue burdens in the world. Results indicate PBDE levels still exceed maxima observed in European and Asian and 1000's of times higher than the quality standard set by European Parliament.

Title	Comparative accumulation and effects of microplastics and microplastic-associated PCB-153 in the white hard clam (*Meretrix lyrata*) and giant river prawn (*Macrobrachium rosenbergii*) following chronic exposure
Author(s)	Trinh B., Le L.T., Tran L.M., Rosen G., **Hale R.C.**
Journal	Environmental Technology & Innovation 34:103581 (2024)
Link	https://doi.org/10.1016/j.eti.2024.103581
Summary	We investigated and compared the accumulation and effects of polyethylene microbeads (PEMBs), waterborne polychlorinated biphenyl 153 (PCB-153), or PEMB-associated PCB-153 (PEMB-PCB) in the two indigenous aquatic organisms in Viet Nam. MPs were observed in the digestive systems after 0.5-day and during 28-day exposure. Although the effect of MPs and MP-associated PCB-153 on mean survival rate was not statistically significant, it was towards the end of the 28-day exposure. Also, while MP-associated PCB-153 did not significantly affect weight gain of the prawns, it did in clams.

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Title	Retreating coastal forest supports saltmarsh invertebrates
Author(s)	**Goetz E.M.***, **Johnson D.S.**
Journal	Ecosphere 15(1): e4743
Link	https://doi.org/10.1002/ecs2.4743
Summary	Salt marshes migrate into coastal forests to keep up with rising seas. Saltmarsh invertebrates such as small crustaceans like amphipods (also known as marsh hoppers) move into the forest before the forest completely turns to marsh.

Title	A grazing crab drives saltmarsh carbon storage and recovery
Author(s)	**Wittyngham S.S.***, **Johnson D.S.**, **Chen Y.**, **Kirwan M.L.**
Journal	Ecology 105(9): e4385 (2024)
Link	https://doi.org/10.1002/ecy.4385
Summary	At high densities, purple marsh crabs can turn parts of the marsh into mudflats by eating the grass. These are called consumer fronts. These crab fronts move upland. As they do, they can reduce carbon stored in saltmarsh soils up to 70%. Eventually, the grass regrows, but it can take decades to centuries for the carbon stocks to return to pre-crab levels. Carbon stored in salt marshes is critical to combat climate change.

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