Selected Publications:

Seasonal to Decadal Variability, Predictability & Change (2020-2024)

(year in **bold** indicates GFDL lead authors; Version 1.7.2025)

1. Seasonal predictability and predictions

(a) Exploring predictability of seasonal climate and extremes

2024: A hybrid approach for skillful multiseasonal prediction of winter North Pacific blocking. *npj Climate and Atmospheric Science*, 7, 227, DOI:10.1038/s41612-024-00767-2

2024: Seasonal predictions of summer compound humid heat extremes in the southeastern United States driven by sea surface temperatures. *npj Climate and Atmospheric Science*, 7, 180, DOI:10.1038/s41612-024-00723-0.

2024: Skillful seasonal prediction of wind energy resources in the contiguous United States. *Communications Earth and Environment*, 5, 313, DOI:10.1038/s43247-024-01457-w.

2024: Predictability and prediction skill of summertime East/Japan Sea surface temperature events. *npj Climate and Atmospheric Science*, 7, 210, DOI:10.1038/s41612-024-00754-7.

2024: Dynamically downscaled seasonal ocean forecasts for North American east coast ecosystems. Ocean Sci.,20,1631-1656. https://os.copernicus.org/articles/20/1631/2024/

2023: Seasonal prediction of North American wintertime cold extremes in the GFDL SPEAR forecast system. *Climate Dynamics*, DOI:10.1007/s00382-022-06655-w.

2023: Recent advances in seasonal and multi-annual tropical cyclone forecasting. *Tropical Cyclone Research and Review*, 12, DOI: 10.1016/j.tcrr.2023.09.003.

2023: Improvements in September Arctic sea ice predictions via assimilation of summer CryoSat-2 sea ice thickness observations. *Geophysical Research Letters*, 50(24), DOI:10.1029/2023GL105672

2022: Mechanisms of regional Arctic sea ice predictability in two dynamical seasonal forecast systems. *Journal of Climate*, 35, 4207–4231. DOI:10.1175/JCLI-D-21-0544.1

2022: Skillful seasonal prediction of North American summertime heat extremes. *Journal of Climate*, 35(13), DOI:10.1175/JCLI-D-21-0364.14331-4345.

2022: On the seasonal prediction and predictability of winter surface Temperature Swing Index over North America. *Frontiers in Climate*, 4:972119, DOI:10.3389/fclim.2022.972119

2022: Prospects for seasonal prediction of summertime trans-Arctic sea ice path. *Journal of Climate*, 35(13), DOI:10.1175/JCLI-D-21-0634

2022: Impacts of midlatitude western North Pacific sea surface temperature anomaly on the subseasonal to seasonal tropical cyclone activity: case study of the 2018 boreal summer. *SOLA*, 18, DOI: 10.2151/sola.2022-015.

2021: Are multiseasonal forecasts of atmospheric rivers possible? *Geophysical Research Letters*, 48(17), DOI:10.1029/2021GL094000.

2021: Seasonal prediction and predictability of regional Antarctic sea ice. *Journal of Climate*, 34(15), DOI:10.1175/JCLI-D-20-0965.

2021: Seasonal predictability of baroclinic wave activity. *npj Climate and Atmospheric Science*, 4, 50, DOI:10.1038/s41612-021-00209-3

2021: Assimilation of Satellite-Retrieved Sea Ice Concentration and Prospects for September Predictions of Arctic Sea Ice. *Journal of Climate*, 34(6), DOI:10.1175/JCLI-D-20-0469

2021: Dynamical seasonal predictions of tropical cyclone activity: Roles of sea surface temperature errors and atmosphere-land initialization. *Journal of Climate*, 34, DOI: 10.1175/JCLI-D-20-0215.1

2021: A Seasonal Probabilistic Outlook for Tornadoes (SPOTter) in the Contiguous United States based on the leading patterns of large-scale atmospheric anomalies. *Monthly Weather Review*, 149 (4), 901-919. https://doi.org/10.1175/MWR-D-20-0223.1

2020: Effect of anthropogenic forcing and natural variability on the occurrence of the 2018 heatwave in Northeast Asia. *Bulletin of the American Meteorological Society*, 101(1), DOI: 10.1175/BAMS-D-19-0156.1.

(b) Real-time experimental seasonal prediction contributions

GFDL conducts real-time experimental seasonal prediction each month using SPEAR, and contributes those forecasts to multiple partners, one of which is the North American Multimodel Ensemble (NMME). A paper describing the NMME is here. Forecasts of seasonal hurricane activity are also supplied to the National Centers for Environmental

Prediction for use in the official NOAA seasonal hurricane outlook. Some additional information at https://www.cpc.ncep.noaa.gov/products/outlooks/hurricane.shtml?exception=true&iap=false&utm_source=chatgpt.com (see section 2, “Science Behind the Outlook”).

Each month, GFDL contributes forecaster input into NOAA CPC’s El Niño/Southern Oscillation (ENSO) seasonal outlook and diagnostic discussion. GFDL also regularly provides additional perspectives and analysis related to ENSO and its impacts to the broader public through the Climate.gov ENSO Blog.

Real-time seasonal prediction tools:

2020: SPEAR – the next generation GFDL modeling system for seasonal to multidecadal prediction and projection. *Journal of Advances in Modeling Earth Systems*, 12(3), DOI:10.1029/2019MS001895

2020: GFDL's SPEAR seasonal prediction system: initialization and ocean tendency adjustment (OTA) for coupled model predictions. *Journal of Advances in Modeling Earth Systems*, 12(12), DOI:10.1029/2020MS002149

2. Decadal variability and predictability

(a) Exploring decadal variability and predictability

2024: Exploring multiyear-to-decadal North Atlantic sea level predictability and prediction using machine learning. *npj Climate and Atmospheric Science*, 7, 255, DOI:10.1038/s41612-024-00802-2

2024: Causes and multiyear predictability of the rapid acceleration of U.S. Southeast Sea level rise after 2010. *npj Climate and Atmospheric Science*, 7, 113, DOI:10.1038/s41612-024-00670-w

2024: A predicted pause in the rapid warming of the Northwest Atlantic Shelf in the coming decade. *Geophysical Research Letters*, 51(17), DOI:10.1029/2024GL110946.

2024: Antarctic sea ice multidecadal variability triggered by Southern Annular Mode and deep convection. *Communications Earth and Environment*, 5, 633, DOI:10.1038/s43247-024-01783-z.

2024: Role of anthropogenic forcing in Antarctic sea ice variability simulated in climate models. *Nature Communications*, 15, 10511, DOI: 10.1038/s41467-024-54485-7.

2024: Predictability of tropical Pacific decadal variability is dominated by oceanic Rossby waves. *npj Climate and Atmospheric Science*, 7, 292. https://doi.org/10.1038/s41612-024-00851-7

2023: Skillful multiyear to decadal predictions of sea level in the North Atlantic Ocean and U.S. East Coast. *Communications Earth and Environment*, 4, 420, DOI:10.1038/s43247-023-01093-w.

2023: Skillful decadal prediction skill over the Southern Ocean based on GFDL SPEAR Model-Analogs. *Environmental Research Communications*, 5(2), DOI:10.1088/2515-7620/acb90e

2023: Multidecadal variability and predictability of Antarctic sea ice in the GFDL SPEAR_LO model. *The Cryosphere*, 17(12), DOI:10.5194/tc-17-5219-20235219-5240.

2023: The role of upper-ocean variations of the Kuroshio-Oyashio Extension in seasonal-to-decadal air-sea heat flux variability. *npj Climate and Atmospheric Science*, 6, 123. https://doi.org/10.1038/s41612-023-00453-9

2022: Seasonal-to-decadal variability and prediction of the Kuroshio Extension in the GFDL coupled ensemble reanalysis and forecasting system. *Journal of Climate*, 35(11), DOI:10.1175/JCLI-D-21-0471.13515-3535

2022: The relative role of the subsurface Southern Ocean in driving negative Antarctic Sea ice extent anomalies in 2016–2021. *Communications Earth and Environment*, 3, 302, DOI:10.1038/s43247-022-00624-1

2022: Roles of meridional overturning in subpolar Southern Ocean SST trends: Insights from ensemble simulations. *Journal of Climate*, 35(5), DOI:10.1175/JCLI-D-21-0466.11577-1596

2021: The dependence of internal multidecadal variability in the Southern Ocean on the ocean background mean state. *Journal of Climate*, 34(3), DOI:10.1175/JCLI-D-20-0049.11061-1080

2020: Natural variability of Southern Ocean convection as a driver of observed climate trends. *Nature Climate Change*, 9(1), DOI:10.1038/s41558-018-0350-3

2020: Multidecadal modulations of key metrics of global climate change. *Global and Planetary Change*, 188(103149), DOI:10.1016/j.gloplacha.2020.103149

(b) Real-time experimental decadal predictions

GFDL participates in a real-time experimental decadal prediction activity coordinated through the World Meteorological Organization. Each year GFDL conducts decadal predictions using SPEAR, in which the model is initialized with observations and run for the next 10 years using projected changes in radiative forcing. Output is made publicly available at: https://hadleyserver.metoffice.gov.uk/wmolc/

GFDL participated in an activity to prepare for rapid decadal predictions in the event of a major volcanic eruption. This activity is described in: 'Decadal prediction centers prepare for a major volcanic eruption'. *Bulletin of the American Meteorological Society*. DOI:10.1175/BAMS-D-23-0111.1.

2021: On the development of GFDL's decadal prediction system: Initialization approaches and retrospective forecast assessment. *Journal of Advances in Modeling Earth Systems*, 13(11), DOI:10.1029/2021MS002529

3. Multidecadal projections and extremes

(a) Heat and Precipitation

2024: Contributions of tropical cyclones and atmospheric rivers to extreme precipitation trends over the northeast US. *Earth's Future*, 12(4), DOI:10.1029/2023EF004370

2024: Changes in United States summer temperatures revealed by explainable neural networks. *Earth's Future*, 12(2), DOI:10.1029/2023EF003981

2024: Illuminating snow droughts: The future of western United States snowpack in the SPEAR Large Ensemble. Journal of Geophysical Research: Atmospheres, 129, e2023JD039754, DOI:10.1029/2023JD039754

2024: The driving of North American climate extremes by North Pacific stationary-transient wave interference. *Nature Communications*, 15, 7318, DOI:10.1038/s41467-024-51601-5

2024: A rapid response process for evaluating causes of extreme temperature events in the United States: The 2023 Texas/Louisiana heat wave as a prototype. *Environmental Research: Climate*, 3(4), DOI:10.1088/2752-5295/ad8028

2023: Increases in extreme precipitation over the Northeast United States using high-resolution climate model simulations. *npj Climate and Atmospheric Science*, 18, DOI:10.1038/s41612-023-00347-w

2023: Using large ensembles to examine historical and projected changes in record-breaking summertime temperatures over the contiguous United States. *Earth's Future*, 11(12), DOI:10.1029/2023EF003954.

2022: Increasing frequency of anomalous precipitation events in Japan detected by a deep learning autoencoder. *Earth's Future*, 10(4), DOI:10.1029/2021EF002481

2022: When will humanity notice its influence on atmospheric rivers? *JGR Atmospheres*, 127(9), DOI:10.1029/2021JD036044.

2021: Natural variability vs forced signal in the 2015–2019 Central American drought. *Climatic Change*, 168, 16, DOI:10.1007/s10584-021-03228-4

2021: The Alaskan summer 2019 extreme heat event: The role of anthropogenic forcing, and projections of the increasing risk of occurrence. *Earth's Future*, 9(8), DOI:10.1029/2021EF002163

2021: Summertime east Antarctic cooling induced by decadal changes in Madden-Julian Oscillation.*Science Advances,* 7, DOI: 10.1126/sciadv.abf9903.

2020: Increasing risk of another Cape Town "Day Zero" drought in the 21st century. *Proceedings of the National Academy of Sciences*, 117(47), DOI:10.1073/pnas.200914411729495-29503.

(b) Tropical Storms

2024: Robust future projections of global spatial distribution of major tropical cyclones and sea level pressure gradients. *Communications Earth and Environment*, 5, DOI:10.1038/s43247-024-01644-9.

2024: Effect of regional anthropogenic aerosols on tropical cyclone frequency of occurrence. Geophys.*Geophysical Research Letters*, 51, DOI: 10.1029/2024GL110443.

2024: Projected increase in the frequency of extremely active Atlantic hurricane seasons. *Science Advances*, 10, DOI:10.1126/sciadv.adq7856.

2024: Anthropogenic effects on tropical cyclones near western Europe.*npj Climate and Atmospheric Science*, 7, DOI:10.1038/s41612-024-00721-2.

2023: Anthropogenic forcing changes coastal tropical cyclone frequency. *npj Climate and Atmospheric Science*, 7, DOI:10.1038/s41612-023-00516-x.

2023: An update on the influence of natural climate variability and anthropogenic climate change on tropical cyclones.*Tropical Cyclone Research and Review*, 12, DOI: 10.1016/j.tcrr.2023.10.001.

2022: Substantial global influence of anthropogenic aerosols on tropical cyclones over the past 40 years, *Science Advances*, 8, DOI:10.1126/sciadv.abn9493.

2022: Patterns and frequency of projected future tropical cyclone genesis are governed by dynamic effects.*Communications Earth and Environment*, 3, DOI:10.1038/s43247-022-00410-z.

2022: A potential explanation for the global increase in tropical cyclone rapid intensification. *Nature Communications*, 13, DOI: 10.1038/s41467-022-34321-6.

2020: Detected climatic change in global distribution of tropical cyclones. *Proceedings of the National Academy of Sciences*, 117(20), DOI:10.1073/pnas.1922500117.

2020: Dynamic genesis potential index for diagnosing present-day and future global tropical cyclone genesis. *Environmental Research Letters*, 15, DOI: 10.1088/1748-9326/abbb01.

2020: Tropical cyclone motion in a changing climate. *Science Advances,* 6, DOI: 10.1126/sciadv.aaz7610.

(c) Climate Reversibility and Impact of radiative forcing on variability

2024: Mitigation-driven global heat imbalance in the late 21st century. *Communications Earth and Environment*, 5, 651, DOI:10.1038/s43247-024-01849-y.

2022: A weakened AMOC may prolong greenhouse gas–induced Mediterranean drying even with significant and rapid climate change mitigation. *Proceedings of the National Academy of Sciences*, 119(35), DOI:10.1073/pnas.2116655119.

2022: Stronger decadal variability of the Kuroshio Extension under simulated future climate change. *npj Climate and Atmospheric Science*, 5, 63, DOI:10.1038/s41612-022-00285

2022: Future changes in boreal winter ENSO teleconnections in a large ensemble of high-resolution climate simulations. *Frontiers in Climate*, 4:941055, DOI:10.3389/fclim.2022.941055-z

2020: Simulated changes of the Southern Ocean air-sea heat flux feedback in a warmer climate. *Climate Dynamics*, DOI:10.1007/s00382-020-05460-7

(d) Climate change detection using ML

2024: Exploring a data-driven approach to identify regions of change associated with future climate scenarios. *JGR Machine Learning and Computation*, 1(4), DOI:10.1029/2024JH000327

2022: Increasing frequency of anomalous precipitation events in Japan detected by a deep learning autoencoder. *Earth's Future*, 10, DOI:10.1029/2021EF002481.

4. ENSO and Tropical Pacific dynamics, variability, and change

2024: Estimating uncertainty in simulated ENSO statistics. *Journal of Advances in Modeling Earth Systems*, 16(9), DOI:10.1029/2023MS004147

2024: Predictability of tropical Pacific decadal variability is dominated by oceanic Rossby waves. *npj Climate and Atmospheric Science*, 7, 292. https://doi.org/10.1038/s41612-024-00851-7

2024: Improving equatorial upper ocean vertical mixing in the NOAA/GFDL OM4 model. *Earth and Space Science*, 11 (10), e2023EA003485. https://doi.org/10.1029/2023EA003485

2024: Tropical Pacific Observing System (TPOS) Equatorial Pacific Experiment (TEPEX) Science Plan. https://cpo.noaa.gov/wp-content/uploads/2024/07/TEPEX_SciencePlan_W4.pdf

2022: On the future zonal contrasts of equatorial Pacific climate: Perspectives from observations, simulations, and theories. *npj Climate and Atmospheric Science*, 5, 82. https://doi.org/10.1038/s41612-022-00301-2

2022: Projections of faster onset and slower decay of El Niño in the 21st century. *Nature Communications*, 13, 1915, DOI:10.1038/s41467-022-29519-7

2021: ENSO dynamics in the E3SM-1-0, CESM2, and GFDL-CM4 climate models. *Journal of Climate*, 34 (23), 9365-9384. https://doi.org/10.1175/JCLI-D-21-0355.1

2021: Evaluating climate models with the CLIVAR 2020 ENSO metrics package. *Bulletin of the American Meteorological Society*, 102 (2), E193-E217. https://doi.org/10.1175/BAMS-D-19-0337.1

2021: Understanding diverse model projections of future extreme El Niño. *Journal of Climate*, 34 (2), 449-464. https://doi.org/10.1175/JCLI-D-19-0969.1

2020: ENSO diversity. Chapter 4 of: *El Niño Southern Oscillation in a Changing Climate*, American Geophysical Union, Washington, DC, pp. 65-86. https://doi.org/10.1002/9781119548164.ch4

2020: ENSO low-frequency modulations and mean state interactions. Chapter 8 of: *El Niño Southern Oscillation in a Changing Climate*, American Geophysical Union, Washington, DC, pp. 173-198. https://doi.org/10.1002/9781119548164.ch8

2020: El Niño / Southern Oscillation response to low-latitude volcanic eruptions depends on ocean pre-conditions and eruption timing. *Nature Communications Earth and Environment*, 1, 12. https://doi.org/10.1038/s43247-020-0013-y

5. Tool building

2024: Exploring multiyear-to-decadal North Atlantic sea level predictability and prediction using machine learning. *npj Climate and Atmospheric Science*, 7, 255, DOI:10.1038/s41612-024-00802-2

2023: Skillful decadal prediction skill over the Southern Ocean based on GFDL SPEAR Model-Analogs. *Environmental Research Communications*, 5(2), DOI:10.1088/2515-7620/acb90e

2021: On the development of GFDL's decadal prediction system: Initialization approaches and retrospective forecast assessment. *Journal of Advances in Modeling Earth Systems*, 13(11), DOI:10.1029/2021MS002529

2020: SPEAR – the next generation GFDL modeling system for seasonal to multidecadal prediction and projection. *Journal of Advances in Modeling Earth Systems*, 12(3), DOI:10.1029/2019MS001895

2020: GFDL's SPEAR seasonal prediction system: initialization and ocean tendency adjustment (OTA) for coupled model predictions. *Journal of Advances in Modeling Earth Systems*, 12(12), DOI:10.1029/2020MS002149.