



PHYSICAL SCIENCES LABORATORY

PSL*advance*



— FALL 2024 —

Welcome to the first edition of PSL*advance*.

This quarterly newsletter from the NOAA Physical Sciences Laboratory (PSL) answers the question “*water* we up to?” as we perform innovative, groundbreaking research into the prediction of too much or too little water and related extremes. Also included are updates on additional projects aimed at supporting NOAA’s scientific mission and overall commitment to societal well-being.

PROJECT PIPELINE

Modernizing Probable Maximum Precipitation Estimations



In 2023, NOAA and PSL charged The National Academies of Sciences, Engineering, and Medicine to recommend the best approach to modernizing Probable Maximum Precipitation (PMP) estimations. Current approaches were developed decades ago and do not account for observed changes in climate.

PMP estimates are used by engineers to ensure high-hazard infrastructure is designed to withstand the most extreme precipitation events to ensure the safety of the surrounding communities.

In June, the National Academies' committee of precipitation and engineering experts released their comprehensive PMP report. PSL, which is leading a NOAA team on this Bipartisan Infrastructure Law project, is now reviewing the recommendations

and developing the long-term research approach that will improve the accuracy of these vital scientific estimates.

[Learn more](#)

Improving Fire Weather Observations in Complex Terrain



PSL scientists Christopher Cox and Janet Intrieri prepare for testing of the new fire weather drone in August 2024 on Table Mountain outside Boulder, Colorado, as PSL engineer Jackson Osborn completes drone assembly. Photo by NOAA/PSL

PSL is helping to strengthen wildfire weather prediction efforts in complex terrain by building new weather observation units throughout the western U.S in partnership with NOAA's Global Systems Laboratory, Global Monitoring Laboratory, and Air Resources Laboratory. Complex terrain has notoriously unpredictable weather, which makes fire weather prediction more difficult. These units—four fixed facilities, two mobile stations, and a meteorological drone (shown above)—are part of an initiative funded by the 2022 Bipartisan Infrastructure Law.

The data gathered from the fixed and mobile units will help NOAA better understand the weather dynamics in areas that are known to have a high risk of wildfires and can be greatly affected by

constant changes in wind and other factors due to the challenging terrain. This can lead to improvements in wildfire forecasting and understanding, and through NOAA Research's data assimilation and model development work, improved numerical weather prediction models run by the National Weather Service.

[Learn more](#)

New England research project to boost off-shore wind power generation



PSL engineers Jackson Osborn, Thomas Ayers, PSL/CIRES scientist Bianca Adler, and PSL Safety Officer William Otto assemble a 915-MHz radar wind profiler at the Block Island site. Photo by Laura Bianco, PSL/University of Colorado Boulder

NOAA, the Department of Energy, and Woods Hole Oceanographic Institution, in collaboration with other academic and non-profit entities, have launched a research field project—the 3rd Wind

Forecast Improvement Project (WFIP3)—on and off the southern New England coast to help improve off-shore wind forecasts. Improved offshore wind forecasts will help stabilize wind power generation as off-shore wind power fluctuates.

PSL deployed various meteorological instruments on the shores of Nantucket (MA) and Block Island (RI) in late 2023 and has been collecting data and servicing the instruments throughout 2024. The Department of Energy and Woods Hole have deployed instruments on the shores of Narragansett (RI) and Cape Cod and Martha's Vineyard (MA). At sea, the Department of Energy and Woods Hole deployed a barge with similar meteorological instruments this past summer. NOAA, including PSL, will be sailing a NOAA Research vessel in December to continue instrumentation readings in the rougher winter environment.

The project will use all of these on and off-shore instruments to gather data on wind and weather patterns until October 2025. This data will help refine NOAA's weather prediction models, supporting efficient renewable energy use, grid reliability, and savings for consumers and utilities. The improved models will also benefit mariners, aviators, and search and rescue teams.

[Read More](#)

PSL Aiding in Hurricane Measurements; Modeling

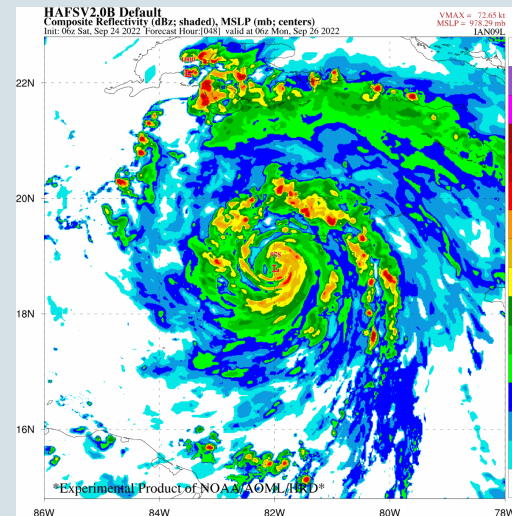
The 2024 hurricane season has already made a significant impact on the nation. PSL has been lending its instrumentation expertise to the hurricane monitoring efforts, as well as contributing to the next generation of the hurricane forecast model.



Flight through Tropical Storm Idalia on NOAA WP-3D Orion N43RF Miss Piggy on August 28, 2023. Photo by NOAA/Nick Underwood

PSL radars on the Hurricane Hunters

PSL's [W-band cloud radar](#) is being used by NOAA Atlantic Oceanographic and Meteorological Laboratory (AOML)'s



Hurricane Ian as modeled by the experimental HAFSV2.0 model prior to operationalization.

Hurricane Research Division to fly on the NOAA P-3 N43 aircraft, nicknamed “Miss Piggy”, throughout the 2024 hurricane season as part of the annual Hurricane Field Prediction/Advancing the Prediction of Hurricanes Experiment (APHEX) field campaign.

This radar is designed to capture detailed vertical profiles of light rain, clouds without rain, sea spray, and fog beneath the aircraft. It can measure the size of raindrops, the amount of water in clouds, and the vertical movement of air within clouds. The data collected helps APHEX better understand and predict hurricane paths, strength, structure, and related dangers and improve hurricane models. The W-band cloud radar is also collecting data over many stretches of the ocean in the marine boundary layer and lower to middle atmosphere, which is of research interest across PSL.

Also flying on “Miss Piggy” this season is the [Wide Swath Radar Altimeter](#) (WSRA) instrument developed and supported by PSL in partnership with ProSensing. WSRA is a unique instrument that produces detailed maps of ocean wave height, wave speed and direction, rainfall rate, and sea surface roughness. This information is used in research activities and for real-time forecast guidance by the National Hurricane Center.

PSL contributes to HAFS improvements

[Lisa Bengtsson](#) of the Modeling and Data Assimilation Division, as well as [Maria Gehne](#) and [Juliana Dias](#) of the Atmosphere-Ocean Processes and Predictability Division, contributed improvements to the Hurricane Analysis and Forecast System (HAFS) v2.0 that became operational by the National Weather Service in mid-July 2024.

The work improves the way HAFS simulates tropical storms by refining the physics of convection models—the models that help forecast storm development and intensity. Her work focuses on making the system more accurate in capturing tropical weather patterns and how clouds and storms grow on different scales.

Read more about what is behind these improvements in [*A Prognostic-Stochastic and Scale-Adaptive Cumulus Convection Closure for Improved Tropical Variability and Convective Gray-Zone Representation in NOAA’s Unified Forecast System \(UFS\)*](#).



UFS Replay Project Launched

A team of researchers in PSL's Modeling and Data Assimilation division have recently developed a new dataset to help improve the next generation of NOAA's medium range forecast system (Global Ensemble Forecast System version 13 - GEFSv13 / Global Forecast System GFSv17).

The new dataset is a replay dataset generated by nudging the current NOAA Unified Forecast System-based coupled model application GEFSv13 to ERA and ORAS5 data. ERA5 and ORAS5 are existing European Centre for Medium-Range Weather Forecasts fifth generation reanalysis datasets for real-world atmospheric and oceanic/ice conditions respectively.

Data replay is a technique used to enhance the accuracy and reliability of weather forecasts by running simulations of historical weather data through modern models to help improve the functionality and accuracy of the models over time. Nudging aligns real-world observations with model simulation outputs.

The resulting dataset provides initial conditions for retrospective forecasts (forecasts of past weather conditions run through modern models) to identify and correct model biases. The new dataset can also be used to train new Machine Learning emulators.

Improvements to the NOAA GEFSv13 system through initiatives such as PSL's UFS Replay project will better enable NOAA's predictions of global atmospheric behavior out to approximately one month.

[Learn more](#)

PEOPLE @ PSL

Awards



Capotondi wins AGU's Harald Sverdrup Lecture Award

Antonietta Capotondi of PSL's Atmosphere-Ocean Processes and Predictability Division for being awarded the 2024 Harald Sverdrup Lecture Award by the American Geophysical Union (AGU)!

Dr. Capotondi is the lead author of "A global overview of marine heatwaves in a changing climate.", recently published in *Communications Earth & Environment*.

As stated by AGU, the Harald Sverdrup Lecture recognizes outstanding contributions to, as well as unselfish promotion of cooperation in, atmospheric and oceanographic research. This lecture was named in honor of the life and work of the geophysicist, Harald Sverdrup. A lecturer is selected annually.



Fairall wins NOAA Distinguished Career Award

Chris Fairall of PSL's Boundary Layer Observations and Processes Division won the 2023 NOAA Distinguished Career Award "for outstanding contributions to NOAA's understanding of atmosphere-ocean interactions, and effective communication of this information to the nation."

Dr. Fairall, a research physicist, has spent decades studying how the ocean and atmosphere interact within Earth's climate system, from El Niño to hurricanes. He has pioneered air-sea observing systems on NOAA ships and aircraft, advancing technologies for directly measuring air-sea exchanges, including breakthroughs such as the direct measurement of carbon dioxide. Dr. Fairall has taken part in nearly 50 research missions, from the Tropics to the Arctic icecap.

The Distinguished Career Award "honors contributions on a sustained basis and a body of work, rather than a single defined accomplishment. In addition, this award recognizes significant accomplishments across all NOAA program areas and functions that have resulted in long-term benefits to the bureau's mission and

strategic goals.”



Grell wins PROUD Award - Excellence in Action

Evelyn Grell of PSL’s Modeling and Data Assimilation Division was recently awarded the PROUD Award for Excellence in Action by the Developmental Testbed Center (DTC).

Evelyn was lauded for her "outstanding grasp of weather phenomena across various scales and a deep knowledge of NOAA's numerical weather prediction models", insightful observations and analyses, as well as her "exemplary work ethic and collaborative spirit."

The DTC is a "distributed facility where the numerical weather prediction community can test and evaluate new models and techniques for use in research and operations."

[Read the award announcement from DTC](#)



Wilczak wins NOAA Bronze Medal

[Jim Wilczak](#) of PSL’s Boundary Layer Observations and Processes Division was awarded the NOAA Bronze Medal in Scientific or Engineering Achievement as part of the team that developed and implemented Air Quality Model v6 to significantly advance operational air quality predictions for the Nation.

Dr. Wilczak, a research meteorologist, focuses on the turbulent atmospheric boundary layer, including the relationship of the boundary layer to renewable energy and to air quality. He leads the PSL Renewable Energy team, as he has worked over the past decade to advance our knowledge of how weather and climate impacts wind and solar energy generation.

Dr. Wilczak is the lead author with his renewable energy team on [“A multi-decadal analysis of U.S. and Canadian wind and solar energy droughts”](#) recently published in the Journal of Renewable and Sustainable Energy.

The highest honor awarded by the Under Secretary of Commerce for Oceans and Atmosphere, the Bronze Medal recognizes

federal employees for superior performance and is awarded to individuals, groups (or teams), and organizations.

Lab Updates



Webb Retiring As PSL Director

PSL Director [Dr. Robert “Robin” Webb](#) has announced he will retire in January 2025 after more than 30 years at NOAA.

Dr. Webb began his career in NOAA’s Paleoclimatology Program at the National Geophysical Data Center and later worked at the Climate Diagnostics Center, which eventually became part of PSL. Robin was appointed PSL Director in 2014. He has played key roles in many national and international climate projects, including most recently the Forecast Informed Reservoir Operations project, the Precipitation Prediction Grand Challenge, Coast Inundation at Climate Timescales, and the Climate, Ecosystems, and Fisheries Initiative. Known for turning scientific research into practical guidance for policymakers, Dr. Webb has also mentored many early career scientists and received numerous awards for his innovative work and commitment to environmental stewardship.

Under his leadership, PSL has focused on improving weather-to-climate predictions by identifying early warning signals in atmospheric and ocean patterns that trigger extreme events like floods, droughts, and heat waves. The lab has advanced research in observations, process understanding, and predictive modeling of weather, water, and climate variations.

“PSL is well-positioned to continue advancing predictions of water availability and extremes for NOAA,” Dr. Webb said to staff. “I am confident the next director will make PSL even better.”

NOAA and PSL thank Robin for his years of service and wish him a happy retirement. A new PSL director will be named later with an acting director in the interim.



NOAA Research's Steve Thur visits with PSL

Assistant Administrator for NOAA Research [Steve Thur](#) visited PSL in October to meet with each lab Division and various support staff groups. PSL was honored to host Dr. Thur and share insights into our ongoing work to support NOAA Research's mission to tackle [key societal challenges](#) as NOAA advances our understanding of today to improve outcomes for the future.



Juliana Dias



Jennifer Bednar



Philip Pegion

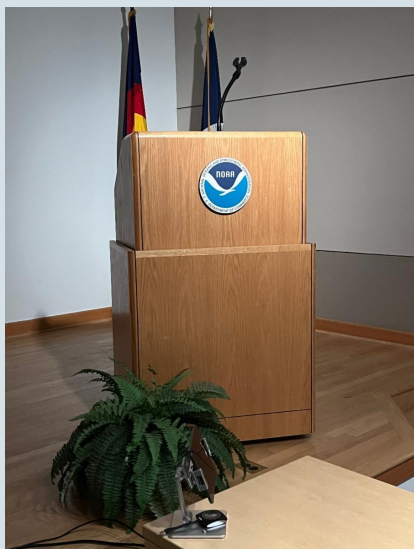
Division Chief Changes

PSL recently underwent some [lab Division](#) leadership changes, as three incumbent Division Chiefs go off into a well-deserved retirement. These new Division Chiefs assumed their positions on October 1:

- Atmosphere-Ocean Processes and Predictability Division: [Juliana Dias](#)
- Data, Instrumentation, and Field Campaigns Division: **Jennifer Bednar**
- Modeling and Data Assimilation Division: [Philip Pegion](#)

PSL thanks the outgoing Division Chiefs - [Michael Alexander](#), [Allen White](#), and [Jeffery Whitaker](#), respectively - for their decades of dedicated service!

Seminars and Publications



PSL Seminars

PSL live streams science seminars every other week for most of the year. Presenters include both internal NOAA and external researchers.

Next seminar:

December 3, 2024 • 2pm MST (UTC-7) • [Tropical predictability and connections to the TEPEX field campaign](#) • Presented by Aneesh Subramanian, University of Colorado Boulder

Visit the [PSL Seminars](#) page for more info and to sign up for seminar email reminders.

Please note: due to privacy concerns, the seminars are not recorded.

Publication Spotlights

For a full list of PSL publications from this and past years, visit the [PSL Publications](#) database.

Bold names indicate PSL authors.

February 2024

de Boer, G., B. J. Butterworth, et al. (February 2024): Evaluation and Intercomparison of Small Uncrewed Aircraft Systems Used for Atmospheric Research. *J. Atmos. Oceanic Technol.*, 41, 127–145, <https://doi.org/10.1175/JTECH-D-23-0067.1>.

March 2024

Deser, C., A. S. Phillips, **M. A. Alexander, D. J. Amaya, A. Capotondi, M. G. Jacox** and **J. D. Scott**: Future changes in the Intensity and Duration of Marine Heat and Cold Waves: Insights from Coupled Model Initial-Condition Large Ensembles. *J. Climate*, 37, 1877–1902, <https://doi.org/10.1175/JCLI-D-23-0278.1>.

Frolov, S., K. Garrett, I. Jankov, D. Kleist, J. Q. Stewart and **J. T. Hoeve** (March 2024 ONLINE): Integration of emerging data-driven models into the NOAA research to operation pipeline for numerical weather prediction. *Bull. Amer. Meteor. Soc.*, <https://doi.org/10.1175/BAMS-D-24-0062.1>.



Sledd, A., M. D. Shupe, A. Solomon, C. J. Cox, D. Perovich and R. Lei (March 2024): Snow thermal conductivity and conductive flux in the Central Arctic: estimates from observations and implications for models. *Elementa Sci. Anthrop.* (12), <https://doi.org/10.1525/elementa.2023.00086>.

May 2024

Schmitt, J.F., K.-C. Tseng, M. Hughes (Abel) and N.C. Johnson (May 2024): Illuminating snow droughts: The future of Western United States snowpack in the SPEAR large ensemble. *JGR: Atmospheres*, 129, e2023JD039754, <https://doi.org/10.1029/2023JD039754>.

- Note: **Julian Schmitt** was a PSL intern in 2022 and this paper is a result of his work during that time. NOAA and PSL are dedicated to mentoring the next generation of environmental science researchers.

July 2024

Abel, M. R., M. Behl, A. Kladzyk Constantino and A. Kellerman: Mentors as career investors to empower women's leadership in geosciences. *Nat Rev Earth Environ*, 5 (553-555), <https://doi.org/10.1038/s43017-024-00581-7>.

August 2024

English, J. M., D. D. Turner, D. C. Dowell, T. I. Alcott, W. R. Mininger, R. Cifelli and J. L. Bytheway: Probabilistic Forecasts of Atmospheric River Events Using the HRRR Ensemble. *J. Operational Meteor.*, 12, 40-53, <https://doi.org/10.15191/nwajom.2024.1204>.

Fong, A. A., . . . , M. D. Shupe, et al. (August 2024): Overview of the MOSAiC expedition: Ecosystem. *Elementa Sci. Anthrop.*, 12, 00135, <https://doi.org/10.1525/elementa.2023.00135>.

September 2024

Wilczak, J. M., Akish E., Capotondi A., Compo, G.P., Hoell, A.; A multi-decadal analysis of U.S. and Canadian wind and solar energy droughts. *J. Renewable Sustainable Energy* 1 September 2024; 16 (5): 056502. <https://doi.org/10.1063/5.0219648>

October 2024

Bengtsson, L., and J. Han, 2024: Updates to NOAA's Unified Forecast System's Cumulus Convection Parameterization Scheme between GFSv16 and GFSv17. *Wea. Forecasting*, 39, 1559–1570, <https://doi.org/10.1175/WAF-D-23-0232.1>

November 2024

Capotondi A, RR Rodrigues, A Sen Gupta, JA Benthuisen, C Deser, TL Frölicher, NS Lovenduski, DJ Amaya, N LeGris, T Xu et al (2024). A global overview of marine heatwaves in a changing climate. *Communications Earth & Environment*. <https://doi.org/10.1038/s43247-024-01806-9>



ABOUT PSL

The Physical Sciences Laboratory (PSL) is one of ten NOAA Research Laboratories and one of four labs co-located in the David Skaggs Research Center in Boulder, Colorado. PSL conducts research to advance the prediction of water availability and extremes.

psl.noaa.gov

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