



# PSL*advance*



— SUMMER 2025 —

## The Latest News

### Weather Whiplash: From Drought to Flood - PSL Analysis



'Weather whiplash' is the abrupt transition from one extreme environmental condition to another that amplifies the effects of the individual extreme events.

Weather whiplash of extraordinary proportions affected central Texas in early July 2025 when an exceptional and prolonged drought that led to reduced agricultural yields, livestock losses, and low water availability was abruptly followed by a 1 in 1000-year precipitation event. The result was catastrophic flooding, significant loss of life, destroyed infrastructure, and an altered natural landscape.

A joint PSL and NIDIS team documented this extraordinary transition from drought to flood and analyzed the meteorological and hydrological events to help provide improved understanding of such weather whiplash extremes and advance early warning and planning guidance.

[Read the analysis](#)

## AI Innovations: Project EAGLE Q&A



A team from NOAA Research, the National Weather Service, and the Earth Prediction Innovation Center (EPIC) recently unveiled a new, experimental environment to rapidly test and demonstrate artificial intelligence (AI) weather models in near-real time: **Project EAGLE** (Experimental AI Global and Limited-area Ensemble forecast system).

PSL has been heavily involved in the development of training datasets for AI models and is uniquely positioned to be part of Project EAGLE. PSL's Sergey Frolov, Chief Scientist on the project, provided some insights into this new initiative that is a notable advance in NOAA's AI weather prediction innovation capabilities.

[Learn more about EAGLE](#)

## Probable Maximum Precipitation Project Progressing



Probable maximum precipitation (PMP) estimates are used by engineers to design large, critical facilities like dams and nuclear power plants. These estimates help them gauge the “worst-case scenario” precipitation for the area, ensuring the facility can withstand such an event, reducing the risk of a catastrophe.

**The NOAA-wide effort led by PSL to modernize PMP estimates has made great strides over the past several months.** This includes:

- development of Extreme Precipitation Event Case Study webpages which will host analyses of many past events relevant for updating PMP;
- authorship of several research papers documenting the representation of extreme precipitation in key NOAA datasets; and
- development and evaluation of new experimental high-resolution, rapidly updating NOAA models that will also be leveraged for producing extended reforecast datasets.

More information on this important progress, other successes, and the project timeline for the remainder of the year can be found on the PSL PMP project page.

[See the updates](#)

**In brief: What is a ‘thirstwave’?**



A new term for prolonged periods of atmospheric thirst has been coined: **thirstwaves**.

Meetpal Kukal, a research hydrologist at the University of Idaho, and Mike Hobbins, a CIRES researcher at PSL, describe the new term and examine past United States thirstwaves in a new paper published in *Earth's Future*.

[Learn about thirstwaves](#)

## PSL and the Madden-Julian Oscillation



PSL does extensive research into the Madden-Julian Oscillation (MJO), a mode of sub-seasonal atmospheric variability over the Indian Ocean that influences the location and strength of tropical precipitation. The MJO can impact extreme weather throughout the globe, including in the United States. PSL has a recently redesigned MJO page dedicated to the latest info and research into this phenomenon.

[Visit the PSL MJO page](#)

Most recently, a new study by PSL's Lisa Bengtsson in collaboration with other PSL researchers published in the *Geophysical Research Letters* has made a **key discovery** related to the impact of a forecast model's starting state on the accuracy of Madden-Julian Oscillation prediction.

[Learn about the discovery](#)

## PSL's atmospheric river observatories: serving up data rain or shine



Did you know PSL operates nine (9) atmospheric river observatories at sites distributed along the coast from Washington to Southern California? These unmanned weather stations send round-the-clock observations back to the laboratory, which analyzes and displays the data publicly on its Atmospheric River Portal.

The National Weather Service utilizes this data portal to produce forecasts and weather warnings. State and local agencies also use the portal for creating water management strategies and emergency response planning.

[Learn more about the AROs \(NOAA Research\)](#)

Interested in seeing all of PSL's observation sites? Check out the [PSL Observation Network interactive tool](#).

## Awards

### Jacox, Alexander, Amaya honored with NOAA Research Outstanding Scientific Paper of the Year Award



*From left to right: Michael Jacox, Dillon Amaya, Juliana Dias (PSL Atmosphere-Ocean Processes and Predictability Division Chief), and Roger Pulwarty (PSL Senior Scientist and Acting PSL Director). Not pictured: Michael Alexander. Credit: Chelsea Thompson/NOAA/CSL*

Michael Jacox (NOAA Fisheries/PSL), Michael Alexander (PSL, retired), and Dillon Amaya (PSL) recently won the **NOAA Research Outstanding Scientific Paper of the Year award** for their paper 'Global seasonal forecasts of marine heatwaves'.

Their groundbreaking work used "climate forecast systems to develop global predictions of MHWs [marine heatwaves] and evaluate their skill over the past three decades...

highlight[ing] the feasibility of predicting MHWs and provid[ing] a foundation for a much-needed operational MHW forecast system.”

Read the paper

## PSL mentors high school student; wins NASA science award

### Seasonal Precipitation Swings and Area Burned by Wildfire in Colorado

#### The Motivations:

- Precipitation from May-September decreasing post several decades- correlated with wildfires (Gleason, 2015).
- Effects of precipitation decrease thought to be worsened by hydroclimatic swings between dry and wet spells (De, 2021).
- However, impacts of wet springs followed by dry summers in Colorado - not formally understood



Fig. 1: The five climate divisions of Colorado numbered, with counties outlined in black, colored by elevation (height)

#### The Data:

- Precipitation Dataset: National Centers for Environmental Information (NCEI), monthly area-averaged precipitation over each division
- Wildfire Dataset: Monitoring Trends in Burn Severity (MTBS)- summed area and severity of all suitable burns in climate divisions

#### The Goal:

- By comparing seasonal precipitation and wildfires, we hoped to reveal if there is a relationship between seasonal precipitation swings and wildfires - how strong this relationship could be

#### References - Acknowledgements:

Fig. 1. - <https://www.cclm.gov/arcgis/rest/services/Colorado/MapServer/0>  
 Fig. 2. - <https://www.ncep.noaa.gov/metadata/mtbs/>  
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#### Methodology:

- Seasonal precipitation for spring and summer defined as summed average monthly precipitation for spring months (March, April, May) and summer months (June, July, August) in millimeters
- Swings were found by subtracting the spring precipitation from the summer

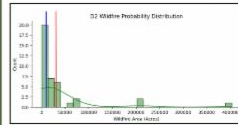


Fig. 7: Probability distribution of the area burned by wildfires in Division 2, with the lower tercile highlighted in blue and the upper tercile highlighted in red

#### The Results: Precipitation

- Principal analysis revealed little relationship between years with high spring precipitation and lower summer precipitation and wildfire in any division
- Relationship in some divisions between low spring and low summer precipitation and wildfires

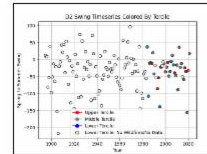


Fig. 2: Time series of the difference between spring and summer precipitation in Colorado Division 2, precipitation with area burned by wildfires after the 1st of July, December

- Total monthly wildfires (excluding controlled burns) were summed from July through December and divided into terciles
- 13 years with least (most) area burned - lower (upper) tercile

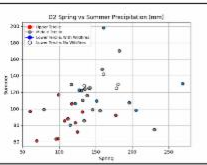


Fig. 9: Scatter diagram of summer and spring Colorado Division 2 precipitation with July, December area burned by wildfires after 1994

#### The Results: Atmospheric Conditions

- Strong wildfire years often coincided with cool sea surface temperature anomalies in the eastern equatorial Pacific and high atmospheric pressure, which corresponds with La Nina events

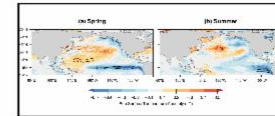


Fig. 5: Area sea surface temperature departures from average in the equatorial and mid-Pacific summer when the area of precipitation in both spring and summer fell in the lower tercile. The black line indicates average departures from average that are statistically different from zero at the 95% level of proof

#### The Conclusions:

- Little to no relationship between seasonal swings and wildfire
- Relationship between low precipitation in both seasons and wildfires
- Low precipitation coincides with high atmospheric pressure, which coincides with La Nina events

#### Applications:

- Relationship found between La Nina events, low precipitation in Colorado, and increased area burned by wildfire may be used to anticipate heavy wildfire seasons and form mitigation strategies ahead of time

PSL’s Andrew Hoell, Rochelle Worsnop, Melissa Breeden, and Ryan Harp mentored a Broomfield (Colorado) High School student earlier this year who won the **NASA Earth System Science Project Award** and placed second place at the Boulder Valley School District Science Fair. The presentation was on conditions related to area burned by wildfire in Colorado and qualified to present at the Colorado Science Fair.

## Publications

## Publication Report - 1st Half of 2025

See a list of peer-reviewed products from lead and contributing PSL authors from January through June 2025.

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



[View the report \(PDF\)](#)



## 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.

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