CLIMATE VARIABILITY & PREDICTABILITY

Research to better understand Earth's system and improve climate predictions

How can we better understand and anticipate the global and regional impacts of natural climate variability and long-term changes?

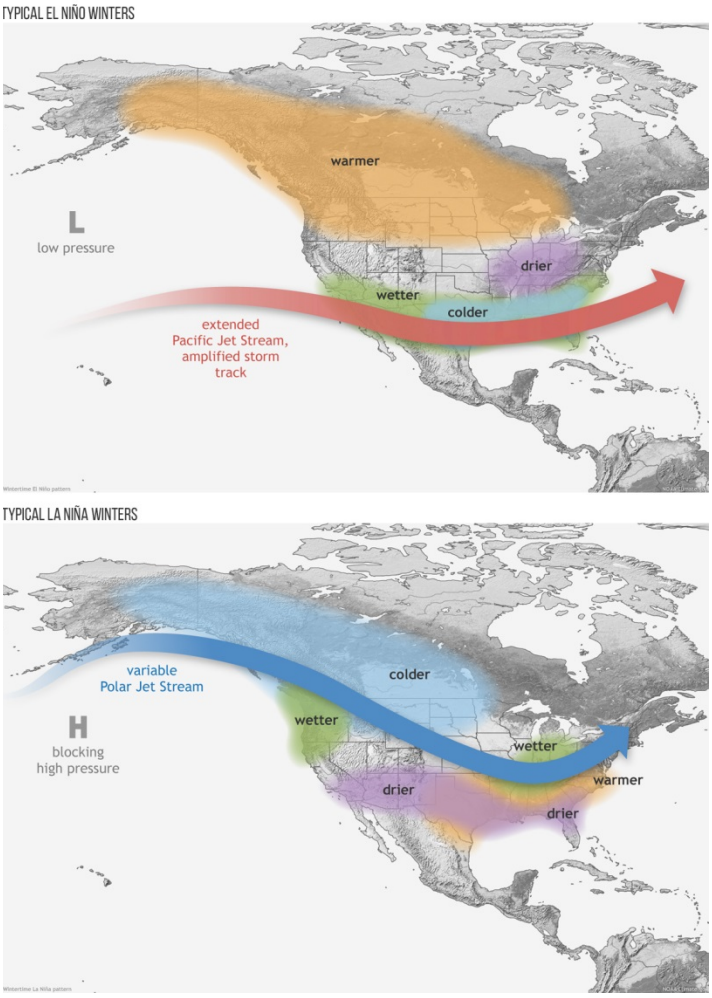
What foundational knowledge do we need to improve climate models and predictions, thereby improving our ability to assess risk and inform decision-making?

How can we close the predictability gap between weather models (0-2 weeks) and climate models (weeks to years) to inform sub-seasonal to seasonal predictions?

Answering these key questions is the main mission of the **Climate Variability and Predictability (CVP)** program, a vital part of the Climate Program Office, situated within NOAA's Office of Oceanic and Atmospheric Research. Natural climate variability patterns—El Niño / La Niña, the Madden-Julian Oscillation, the Arctic Oscillation, and others—produce extreme weather and water events that impact Americans' lives and livelihoods.

PUBLIC DEMAND

Public demand for improved predictions with longer lead times is increasing. Decision makers are increasingly asking for accurate forecasts and predictions at timescales longer than traditional weather forecasts, especially at the sub-seasonal to seasonal timescale (from weeks to several months) for use in planning, prioritizing, and budgeting. Although there have been recent improvements in seasonal predictions, there are processes and sources of predict-ability in the climate system which, if better understood, could help us improve sub-seasonal to seasonal predictive skill.



▲ Typical winter weather patterns observed during El Niño (top) and La Niña periods (bottom). Sustained research and modeling is needed to advance our ability to predict where and when extreme weather and water events are likely to occur.

WILL WE BE READY FOR AN ICE-FREE ARCTIC?

As sea ice retreats, opportunities for Arctic transportation, shipping, and resource exploration will expand. But the rapidity of these changes in the Arctic will introduce new challenges, such as increased storminess, migration of animals and diseases, and changes in weather patterns that move from the Arctic to the continental U.S. due to the meandering jet stream known as the "polar vortex."

Through a competitive process, CVP focuses the brightest scientific minds at research labs and universities around the country on scientific research that improves our under-standing, modeling, and prediction of changes in the Arctic. Oil companies, shipping companies, and fishing vessels require improved predictions of sea ice and Arctic weather to stay ahead of the competition and protect their employees and assets. **CVP-sponsored research enables more accurate predictions with longer lead times.**

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Learn more: **CPO.NOAA.gov/CVP**

BUILDING EARTH SYSTEM PREDICTION CAPABILITY TO KEEP OUR NATION SAFE & SUPPORT COMMERCE

CVP, as a partner in the National Earth System Prediction Capability, provides cutting-edge research advancements in support of the U.S. National Unified Operational Prediction Capability (NUOPC). NUOPC was formed in 2008 as an agreement between the Departments of Commerce and Defense (both the Navy and Air Force) to collaboratively accelerate transition of new technology and data to provide our nation's military with a superior global weather and climate prediction capability. The nation's security and economic wellbeing rely upon accurate, seamless global analysis and prediction of Earth's weather and climate on timescales ranging from days to decades. **Learn more:** espc.oar.noaa.gov

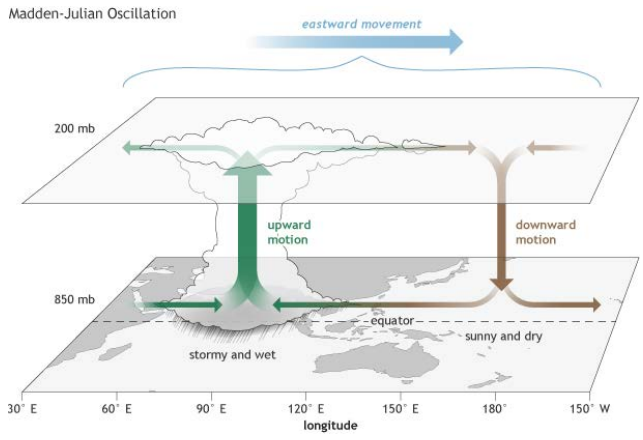
PARTNERING WITH THE NAVY TO PROTECT OUR NATION'S FLEET

The United States has the world's largest fleet of aircraft carriers. Repositioning this fleet in times of need can take several days to weeks. Foresight into marine weather—including both ocean and atmospheric predictions—is essential to get right so that our nation's military personnel and assets can be repositioned to stay out of danger, or to be ready to strike or respond as needed.

For these reasons, CVP partners with the Office of Naval Resources (ONR) to improve our ability to predict marine weather and climate systems. For example, CVP and ONR co-invest in research on the Madden-Julian Oscillation (MJO), which is a predictable and cyclic pulse of storm tracks moving from the Indian Ocean through the Pacific toward North America. Our shared goal is to improve the lead time and skill of predictions in the Pacific basin and across the United States.

ADVANCING UNDERSTANDING OF THE MJO

Since 2011, CVP has sponsored research projects focused on improving scientific understanding of the Madden-Julian Oscillation (MJO), a 30- to 90-day natural climate variability pattern that starts in the Indian Ocean and propagates around the world. Improvements in our understanding of the MJO—how it is initiated and how it travels around the globe—will increase our prediction skill within the 2-week to 3-month time window where there is currently a skill gap.



The MJO (above) influences the strength and direction of "atmospheric rivers,"—storm tracks across the Pacific that reach the U.S. West Coast. A strong atmospheric river (right) can carry about 7.5-15 times more water than the Mississippi River. About 30-50% of the West Coast's annual precipitation occurs in just a few atmospheric river events, sustaining water supply but causing floods.

Better forecasts within this time window are important for emergency responders, farmers and land managers, hydro-electric dam managers, shipping companies, and many other commercial sectors. Better understanding of the MJO would also increase the accuracy and lead time for predicting extreme weather over the United States, thus improving people's ability to prepare for dangerous conditions, such as very heavy precipitation caused by "atmospheric rivers." On average, about 30-50% of the west coast's annual precipitation occurs in just a few atmospheric river events, which sustain the region's water supply but can also produce damaging flood disasters.