

The Unified Forecast System:

Improving Weather and
Climate Forecasting

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ufsccommunity.org

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Weather forecasts impact nearly every aspect of American life – supporting operations in vital economic areas from transportation and energy generation to construction and agriculture. The effective management of weather-related risks enables Americans to feed their families, provides shelter and safety, and comfort and peace of mind. It protects our way of life.

America, the beautiful, is also the land of wide ranging weather conditions including extreme cold and heat waves, lightning, floods, tornadoes, poor air quality, wildfires, hurricanes, and paralyzing freezes. Fortunately, our weather warning system links ever-improving forecasts with the American people. Improved forecast accuracy is the key to alerting communities to what is ahead and enabling local decision makers and emergency managers to act.

But significant weather events aren't the only time forecasts have proven to be useful. Shipping, transportation on land, in the air, through water, agriculture, public health, and of course recreation are all contingent on accurate and timely forecasts and messaging.

While we can't do anything directly about changing the weather, we can continue to learn and understand how to predict it better. That's where the Unified Forecast System comes into focus.

Modern weather forecasting is based on numerical prediction - a method for forecasters to predict the future state of the Earth system using computer-encoded mathematical equations. Data from numerical models are also increasingly being used by artificial intelligence algorithms to generate forecasts distributed to the public through the media, weather apps, and emergency managers by way of decision support systems.

Unfortunately, U.S. global numerical weather and climate prediction capability, according to many measures, has fallen behind that of other developed nations. One reason for this deficit is that the current set of modeling systems used to produce official forecasts is overly complex. The National Oceanic and Atmospheric Administration (NOAA) responded by initiating the Unified Forecast System (UFS) to engage innovation for improving forecasts.

What is the Unified Forecast System (UFS)?

The UFS is a community-based, coupled, comprehensive Earth modeling system. It is designed to be the source system for operational numerical prediction applications that produce forecast guidance used by NOAA. The UFS takes a holistic, application-based approach aimed at simplifying the current suite of models and forecast systems into a single seamless suite. UFS applications span local to global domains and predictive time scales from sub-hourly (the likelihood of rain each hour tomorrow) to seasonal predictions (it will likely be a very rainy fall).

The UFS Community

The UFS community is composed of researchers, developers, and users from NOAA, educational institutions, other federal agencies, and the private sector. All of whom work with the modeling system, and are committed to scientific integrity, evidence-based decision-making and incorporation of innovations originating from a diverse community. The UFS supports research and development in the community and accelerates the transition of research successes to operations.

The UFS community embraces:

- Creating world-class environmental predictions on weather to climate scales.
- Using the world's best predictions to better protect lives, secure property, and increase community and national resilience.

- Serving the industry needs through targeted, applied, and accurate forecasts and messaging that make data and the science behind the data easy for others to use.
- Fostering American leadership and innovation in the Earth sciences by publicly sharing the UFS code and removing barriers to entry, development and contribution.
- Nurturing and engaging the best research, then sorting the results to produce the broad benefits for the social good.
- Open source software principles, with code available, for example, on GitHub.

Public benefits of UFS

Although we live in man-made structures and use a wide range of technologies in our everyday lives, our safety and security are impacted by weather, climate, and environmental forces. Fortunately, there is a pathway towards building more resilient communities, one that would require the enhancement of our capacity to create world-class weather and climate prediction.

Congress has recognized the importance of community-based modeling and created the Earth Prediction Innovation Center (EPIC) for “leveraging the weather enterprise to provide expertise on removing barriers to improving numerical weather prediction.” EPIC will be working with the UFS community on supporting and improving the UFS code.

The UFS provides the means for NOAA to better meet its mission to protect lives and property by embracing a fresh and powerful approach to furthering both scientific study and practical applications. This is made possible by the community-based approach that involves engaging experts across government, higher education, and private enterprise, and in so doing fosters American leadership and innovation in the Earth Sciences.

Benefits

Citizens:

- Better support for everyday decision making about outdoor activities.
- The ability for homeowners to better protect their key investment - their home and property by taking meaningful preparation actions prior to hazardous weather.
- Farmers benefit from more accurate and longer range forecasts
- Safer travel
- Enhanced public security
- World class science and technology

Industry:

- Utilization of commercially-produced weather and climate guidance.
- Improved information as the UFS community works on model development
- Private weather and climate enterprises will benefit as the models improve

UFS into the Future

These three principles – scientific and evidence-based decision making; community-based end-to-end research, development, and evaluation to enable continuous integration and delivery; and an agile, community-governed code development framework – will revolutionize research and operations in weather and climate forecasting.

The UFS will more effectively use the vast intellectual resources in the U.S. weather enterprise and stimulate innovation in the academic and private sectors.

This community-based Earth modeling system will reduce cost by shortening the time and overhead of transitioning research innovations into operational prediction. It will also simplify and unify the suite of software infrastructure and applications that are used by the National Weather Service to provide forecasts, watches and warnings that are critically important for saving lives and property.

The UFS, continuously improved by collaborative research and development across the Earth system modeling community, will provide world-class predictions of weather and climate that support the protection of life and property and the advancement of prosperity.

The success of the UFS will be measured by improvements in forecast skill and reliability, increasing quality and resolution of weather and climate forecast products, and the reduction of the harmful impacts of severe weather and climate variability and change.

Want to learn more?

Visit ufscommunity.org to learn about user success stories, challenges and to access the code.

For more information about EPIC, visit epic.noaa.gov.

For questions, send email to secretariat@ufscommunity.org.

