

Development of the NOAA Unified Forecast System and Its Application to Subseasonal and Seasonal Predictions

Phil Pegion¹, Fanglin Yang², Neil Barton², Bing Fu², Xiaqiong Zhou²

1. NOAA/OAR Physical Science Laboratory
2. NOAA/NWS Office of Modeling and Development

NOAA is collaborating with the broader U.S. weather and climate science community to develop the Unified Forecast System (UFS), a next-generation, fully coupled Earth system modeling framework. The UFS is designed to support both research and operational forecasting across temporal and spatial scales, ranging from hours to seasons and from regional to global domains. Its unified architecture enhances scientific collaboration, streamlines research-to-operations transitions, and improves forecast efficiency and effectiveness. The core components of the current UFS for coupled global applications include the FV3 atmospheric dycore, CCPP atmospheric physics, MOM6 ocean, CICE6 sea-ice, Noah-MP land surface, and WW3 ocean surface wave components. This presentation will describe how the UFS has been configured for the medium-range weather Global Forecast System (GFSv17), the subseasonal Global Ensemble Forecast System (GEFSv13), and the Seasonal Forecast System (SFSv1). A central objective of this development effort is the unification of atmospheric physics parameterizations and ocean and sea-ice components across applications and scales to improve physical consistency, reduce maintenance costs, and accelerate operational implementation. We describe the process of configuring and evaluating a common atmospheric physics package for different forecasting applications. Results from the latest GEFSv13 and SFSv1 systems will be presented to highlight key technical and scientific advances. Ongoing challenges in transitioning these systems into NOAA operations will also be discussed.