How the Unified Forecast System Benefits Academia

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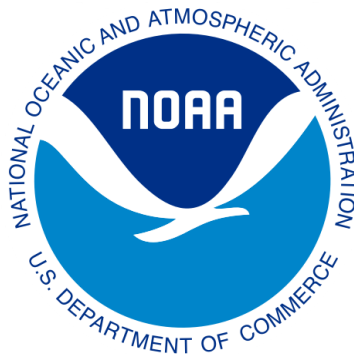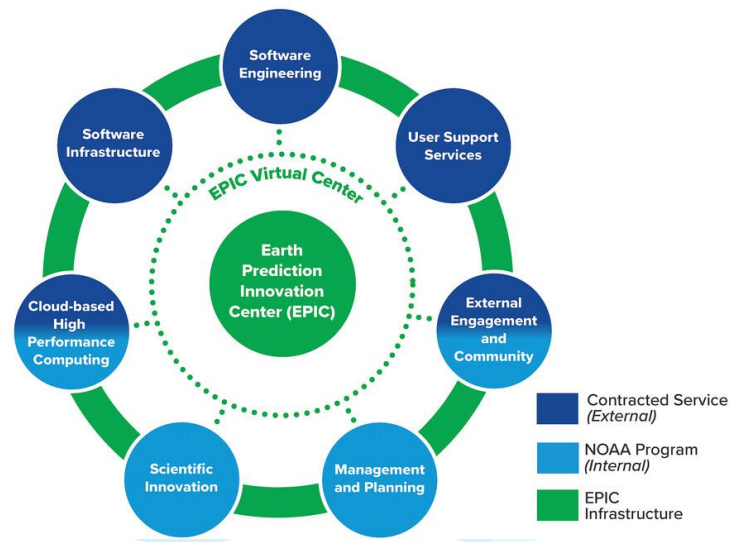# What is the Unified Forecast System (UFS)?

The Unified Forecast System (UFS) is a community-based Earth modeling system with public and private code repositories located in GitHub.

Fig. 3. Bulletin of the American Meteorological Society 103, 10; 10.1175/BAMS-D-21-0061.1

      Additional information can be found at the following link: Unified Forecast System. Dr. Neil Jacobs, Chief Science Advisor for the Unified Forecast System (UFS), speaks about the vision depicting the Earth Prediction Innovation Center (EPIC) acting as an innovative framework for the UFS in this informational session: EPIC Program Details - Earth Prediction Innovation Center.

      The community-based model originated from the realm of possibility when community-friendly, open innovation became idealized. This innovative technique would benefit all areas of the Weather Enterprise equally and inclusively: industry, private sector, and academia. The efforts of the UFS and EPIC teams will effectively increase the efficiency of the National Oceanic and Atmospheric Administration's (NOAA) operational forecast model prediction, including weather, water, and climate science (Jacobs, 2021).

Unified Forecast System in the Scientific & Technological Realm

  Aside from providing community access to NOAA's public infrastructure and source code, the UFS heavily assists the journey from Research to Operations (R2O) and Operations to Research (O2R). The following Bulletin of the American Meteorological Society (BAMS) paper highlights the pioneering framework to accelerate and incentivize the R2O and O2R pathways through a multitude of programming languages and outreach methods.

[NOAA's Great Lakes Wave Prediction System: A Successful Framework for Accelerating the Transition of Innovations to Operations](#) (Alves et al., 2023)

  The UFS creates the opportunity for researchers, professionals, and academia to extract valuable and credible tools from public code repositories. Making changes and improvements to personal code transforms research proposals into innovative, operational results. The UFS incorporates a Readiness Level (RL) process, shown in the image below. The GitHub code repository assists with finalizing research to prepare for funding. Funded research submissions then make their way through each RL to operations, in the process known as R2O. Team members working at each stage of the RL process not only support innovative research, but they also identify research in need of refinement.

Fig. 2. Bulletin of the American Meteorological Society 102, 10; 10.1175/BAMS-D-21-0030.1
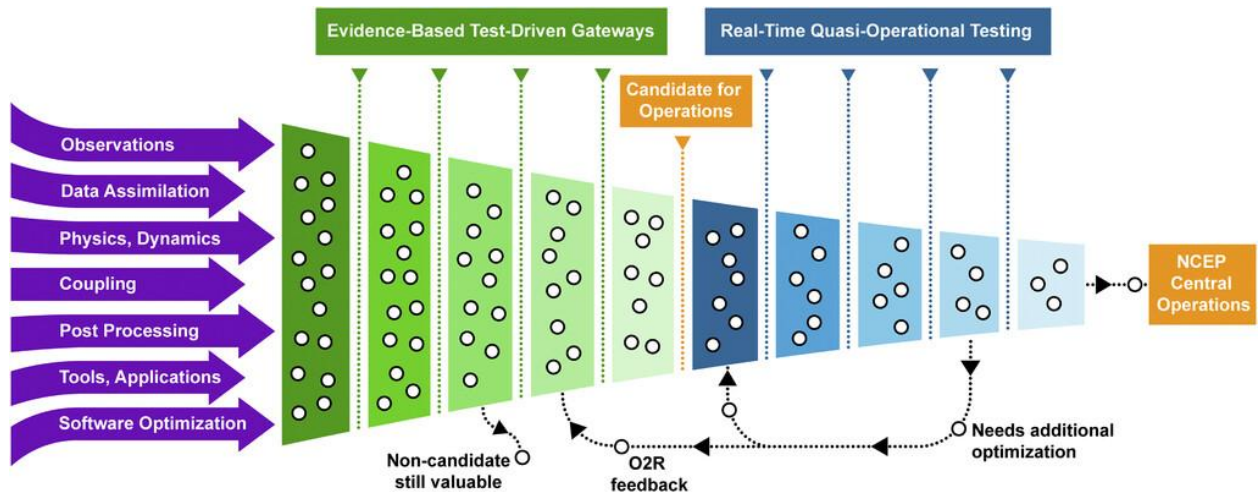
The UFS' many partnerships with cloud server providers, including Amazon Web Services (AWS) sandbox, Google Cloud Platform (GCP), Azure, and Oracle Cloud Infrastructure (OCI), allow users to run experimental code in the Cloud Environment. These partnerships, along with GitHub collaboration, influence R2O and O2R efficiency. The public GitHub code repository containing NOAA applications' infrastructure and source code can be located at the link below.

[Unified Forecast System (UFS) · GitHub](#)

Many opportunities regarding UFS training and tutorials are offered for the community through Hackathons, CodeFests, the Unifying Innovations in Forecasting Capabilities Workshop (UIFCW, annual workshop), application training, and cloud/on-prem workshops.

What Makes the UFS Unique

Access to the UFS code repositories is not limited to individuals associated with NOAA, but is granted for anyone in the community to access application code. The UFS involves and works closely with professional software engineers and physical scientists to provide an innovative pathway to program transparency and unity. This environment undergoes constant conforming and configuration to current and common programming languages. This community model encourages increased collaborative and innovative efforts and results. The BAMS paper below captures the inspiration for the UFS community model network from Dr. Neil Jacobs, Chief Science Advisor for the UFS.

[Open Innovation and the Case for Community Model Development](#) (Jacobs, 2021)

Another BAMS paper discussing the implications of EPIC for the future of NOAA: [EPIC as a Catalyst for NOAA's Future Earth Prediction System](#) (Uccellini et al. 2022)

UFS and Academia

Coaching undergraduate and graduate students for programming and Numerical Weather Prediction (NWP)/modeling in their academic programs allows them to gain skills and experience for the workforce. The UFS provides all the necessary resources to incorporate community code into personal research projects. The implementation of a learning curve allows students to experience an unveiling of the future of R2O/O2R and NWP/modeling. Making the UFS more accessible to academia will lessen exclusivity within the Weather Enterprise.

The UFS and EPIC teams are constantly developing and designing user-friendly tutorials and training materials to spread the knowledge of UFS applications. If, in the future, atmospheric science/climate science and computer science-based courses want to implement the UFS into their academic plans and curriculums, these training modules, user-friendly tutorials, and community coding sessions/collaborations have the potential to serve as a pathway towards official lesson plans and course materials. Most UFS application code has already been, or is in the process of, reconfiguration to current and common programming languages.

As of present, there are no programming or NWP/modeling requirements written into many accreditation and certification standards for the academic meteorological realm. These include the Meteorology Series GS-1340, American Meteorological Society (AMS) certifications, National Weather Association (NWA) certifications, and World Meteorological Organization (WMO) certifications.

Students who utilize the benefits and advantages of the UFS package will be gaining access to platforms and technologies that are operated by mid-career professionals. The increasing need for software programmers and modelers is another reason for students to adapt and learn new programming languages/software codes, as they will be a step ahead when entering a competitive workforce. Introducing students to resources that will shape and assist their workforce confidence will discard intimidation caused by coding and programming stereotypes. Students will not only be able to access community code on GitHub repositories, but they will receive the chance to contribute their own innovative ideas to this community repository.

UFS Engaging with the Community

Throughout the past few years, NOAA, UFS, EPIC, and NOAA's Weather Program Office (WPO) have been working towards the UFS having an increasingly larger presence in the scientific, academic, and industry communities.

To achieve this, these organizations have implemented the annual Unifying Innovations in Forecasting Capabilities Workshop (UIFCW). This workshop will be held this summer from July 24th to July 28th, 2023 at UCAR Center Green in Boulder, Colorado and everywhere online. Participants have the opportunity to attend in-person, hybrid, or completely virtually, with the in-person registration deadline being July 10th, 2023. The UIFCW invites professional and student speakers from all sectors of the Weather Enterprise to present important and innovative research and projects. All speaker sessions will include progressive and pioneering stances on how the UFS is the future of operational forecasting and Earth system modeling.

More information on the UIFCW can be obtained from the following link: Unifying Innovations in Forecasting Capabilities Workshop 2023. Please note that in-person registration is now closed but virtual attendance is open until the start of the workshop on July 24th. If interested in registering, please navigate to the link here.

References

Alves, J., Tolman, H., Roland, A., Abdolali, A., Ardhuin, F., Mann, G., Chawla, A., Smith, J. (2023). NOAA's Great Lakes Wave Prediction System: A Successful Framework for Accelerating the Transition of Innovations to Operations. *Bull. Amer. Meteor. Soc.,* 104, E837-E850. https://doi.org/10.1175/BAMS-D-22-0094.1.

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