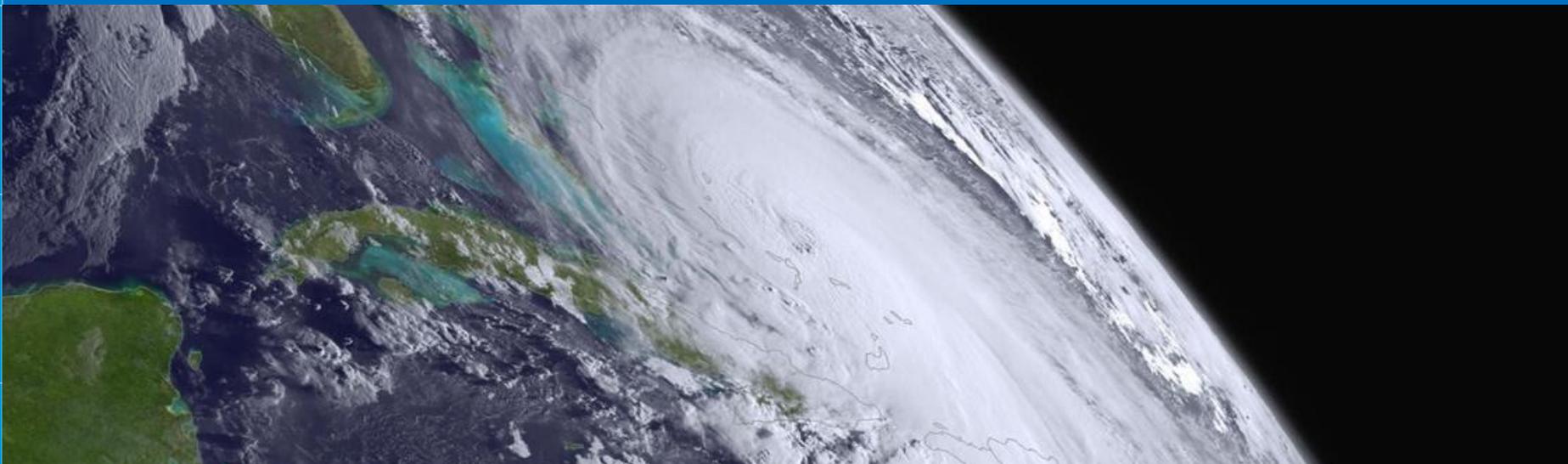




NOAA

The Earth Prediction Innovation Center (EPIC) and Unified Forecast System

Dorothy Koch, Ph.D. and DaNa L. Carlis, Ph.D., PMP
NESDIS Cloud Summit
November 21, 2019



NWS-OSTI and OAR-OWAQ Programs Contributing to the Unified Forecast System

- ◆ **NWS Office of Science and Technology Integration (OSTI) - Modeling**
 - Next Generation Global Prediction System (NGGPS)
 - Hurricane Forecast Improvement Program (HFIP)
 - Air Quality
 - Weeks 3-4
 - COASTAL Act

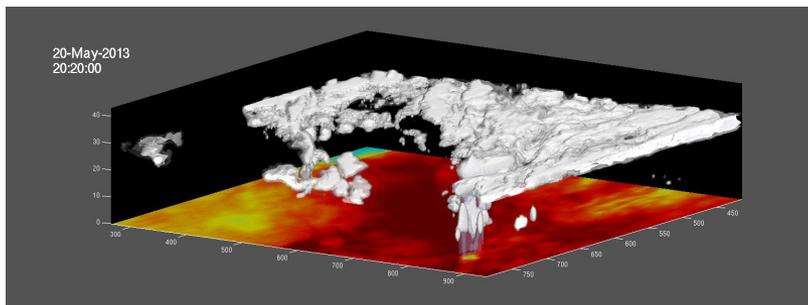
- ◆ **OAR - Office of Water and Air Quality (OWAQ)**
 - NGGPS/EPIC
 - JTTI
 - Weeks 3-4/ Subseasonal to seasonal

- ◆ **Disaster Supplemental FY18 and FY19**

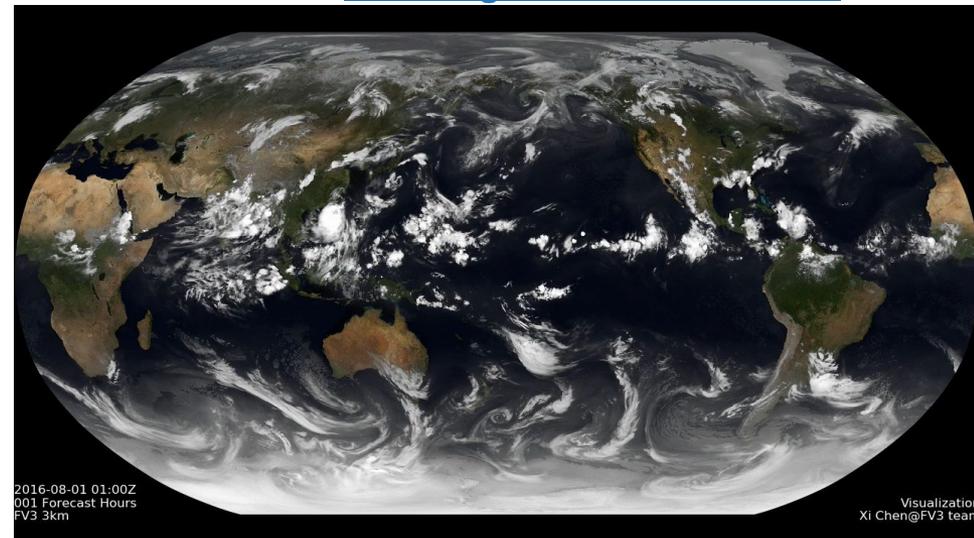
- ◆ **Coordination**
 - **Research to Operations: Provide model to Research community**
 - **Operation to Research: Forecast requirements drive development**
 - **LO Support according to Readiness-Level (RL)**

Next Generation Global Prediction System (NGGPS) (2014 - present)

- ◆ Identify and adopt an advanced non-hydrostatic dynamic core and evolve it to meet operational needs for the foreseeable future
- ◆ Evidence based decision making process to ensure scientific integrity and excellence
- ◆ Enhanced O2R2O process and a unified and efficient infrastructure for community engagement and rapid transition of advanced research into operations
- ◆ Seamless solutions for tropical weather and climate in a unified global-to-local-scale modeling framework



High-resolution nested grid simulations using HiRAM and Finite Volume 3 (FV3)





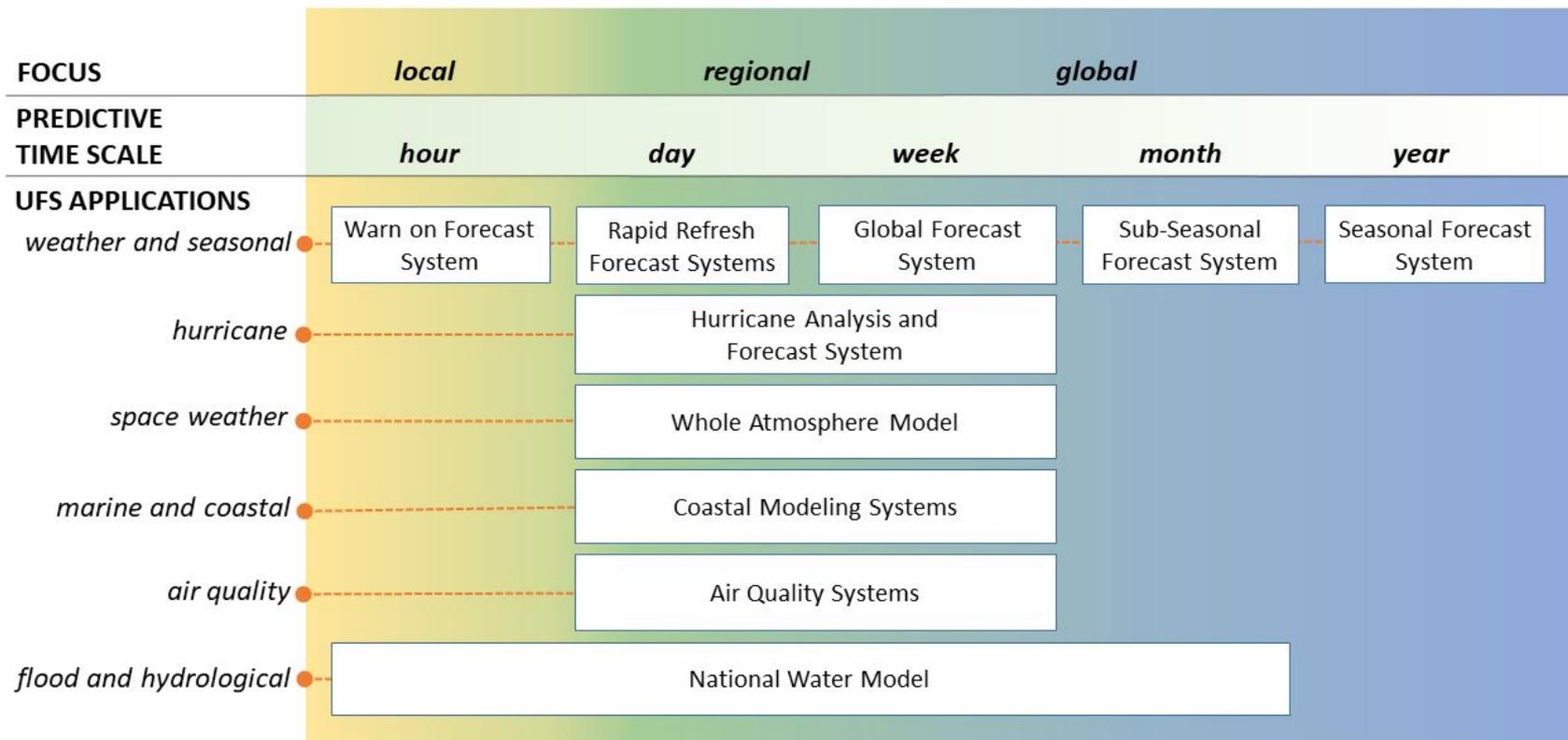
UFS
UNIFIED FORECAST SYSTEM

The Unified Forecast System (UFS)

- ◆ **A comprehensive, community-developed Earth modeling system, designed as both a research tool and as the basis for NOAA's operational numerical guidance systems**
- ◆ **Configurable into multiple applications that span local to global domains and predictive time scales from less than an hour to more than a year**
- ◆ **A *unified* system because the applications within it share science components and software infrastructure**
- ◆ **A paradigm shift that will enable NOAA to simplify the Production Suite, to accelerate use of leading research, and to produce more accurate forecasts for the U.S. and its partners**



UFS Applications Across Time Scales



NOAA Strategic Vision: Simplify the Modeling Suite

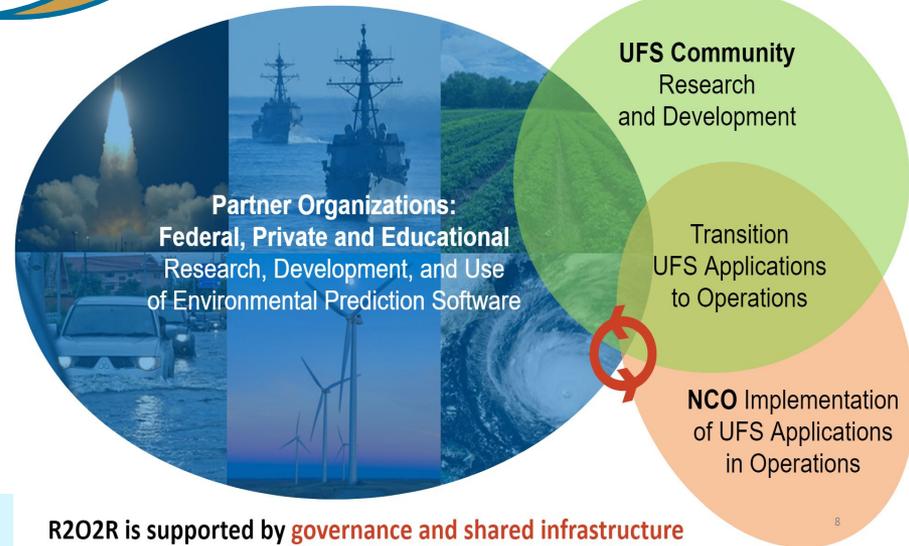
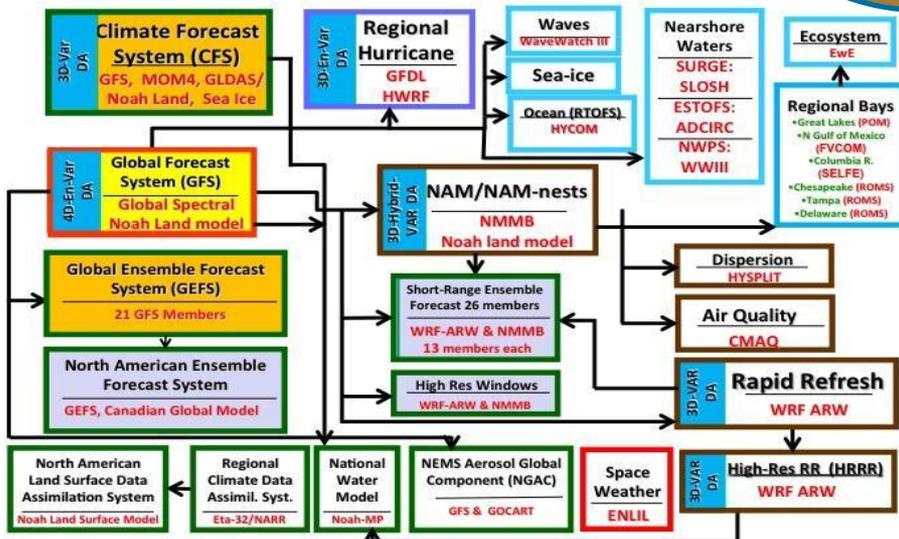
From a quilt of models and products created by implementing solutions rather than addressing requirements

Paradigm shift from an intricate web of operational modeling suite

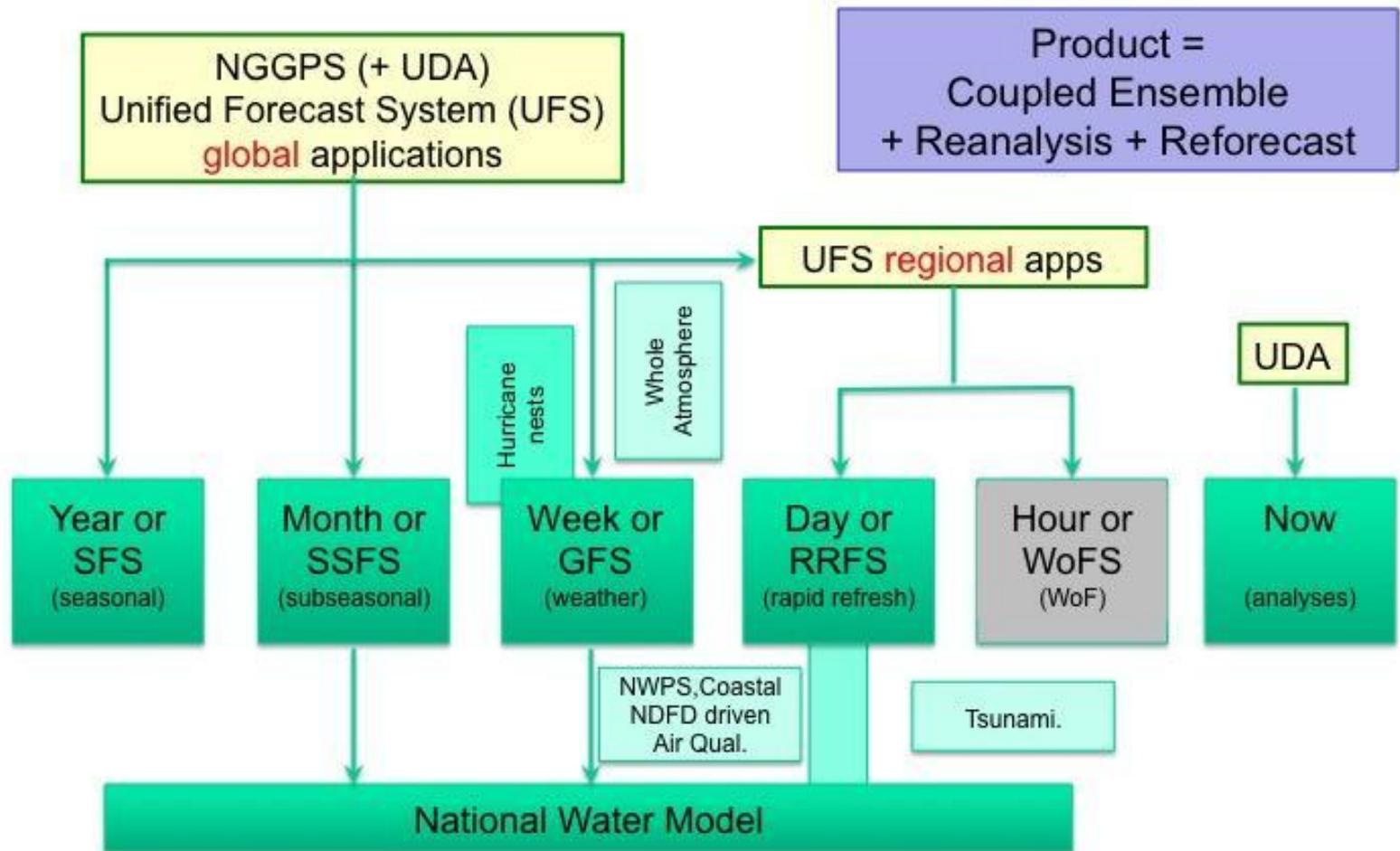
Streamlined unification of multiple operational models through a community modeling framework

UFS

Production Suite ca. August 2016



... to a product based system covering requirements in a more systematic and efficient way centered around FV3



UDA: Unified Data assimilation
 SFS: Seasonal Forecast System
 SSFS: Subseasonal Forecast System

GFS: Weather Forecast System
 RRFs: Rapid Refresh Forecast System
 WoFS; Warn on Forecast System



UFS
UNIFIED FORECAST SYSTEM

The Unified Forecast System (UFS)

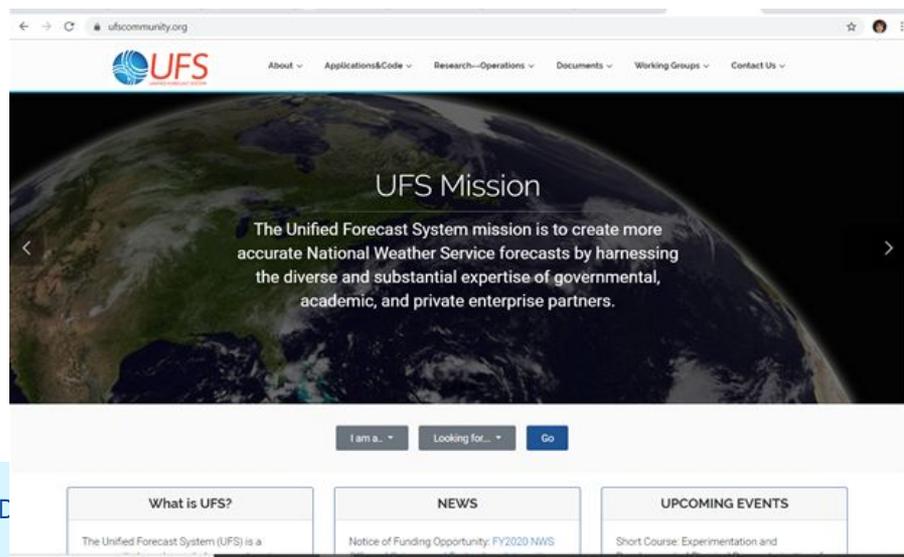
◆ The UFS is organized into

- **Application Teams:** focused on particular forecast model configurations (e.g. Convective Allowing Model, Medium-Extended Range Forecasting)
- **Cross-cutting Working Groups:** (e.g. physics, V&V, infrastructure) to keep the Applications Unified

◆ The UFS has organized itself around a Strategic Implementation Plan (SIP). They are currently updating the SIP

◆ OSTI and OWAQ will be inviting a proposal based from the updated SIP for funding in FY2020-2021. EPIC will use this project as its “host”

◆ UFScommunity.org:



The NOAA-NCAR MOA

Co-development of a Common Model Infrastructure

- Letter of Intent for collaboration between NCAR, NWS and OAR signed July 28, 2017
 - *“to develop a Memorandum of Agreement (MOA) that will describe how both organizations will work collaboratively toward the design and construction of a community unified modeling infrastructure. “*
 - *Identified benefits include*
 - *Synergies*
 - *Common repositories*
 - *Access to NOAA operational models*
- Unification for inter-component, intra-component coupling and common workflow development
- Unified testing to assure code is robust and performs as expected
- Unified model validation and expansion to application for fully coupled systems
- Github based repositories for all infrastructure
- Modeling support; leveraging, creating if necessary, or adapting support capabilities at NCAR and DTC



Unified Forecast System Cloud Pioneer efforts and challenges

- ◆ Disaster Supplemental project to run a Convective Allowing Model (CAM) in cloud (Chawla, EMC): Adds DA, V&V to FV3GFS already in-cloud
- ◆ Global Ensemble Forecast System (GEFS) port to cloud (Tallapragada, EMC): Adds ensemble capability
- ◆ Challenges:
 - Forecast systems are HPC intensive (cloud cost is poorly known)
 - Complex system: Multi-components (ocean, atmosphere, etc), Data assimilation, Ensembles, Validation/analysis, Postprocessing
 - Our community needs a variety of environments:
 - Operational (secure, reliable)
 - Developmental (short and frequent simulation)
 - **Extended test simulations; reanalysis/reforecast**



The Earth Prediction Innovation Center (EPIC)



Weather Research and Forecast Innovation Act: EARTH PREDICTION INNOVATION CENTER (EPIC) January 2019



Goal: To advance numerical guidance skill, reclaim and maintain international leadership in NWP, and improve the research to operations transition process.



EPIC will fulfill this goal by:

- 
- Leveraging the weather enterprise and existing resources within NOAA;
 - Enabling scientists and engineers to effectively collaborate;
 - Strengthening NOAA's ability to undertake research projects;
 - Creating a community global weather research modeling system
- 

What is the purpose of EPIC?

- The purpose of this effort is to develop and support the **establishment of the Earth Prediction Innovation Center (EPIC)**. EPIC will **create a community earth system model** that is **accessible** to the public and utilizes innovative strategies to **host and manage the modeling system**. EPIC will leverage existing NOAA resources to **accelerate advances to the Unified Forecast System**, a community-based, state of the science, **coupled Earth system model** designed to impact NOAA's operational forecast mission to protect life and property and improve economic growth.

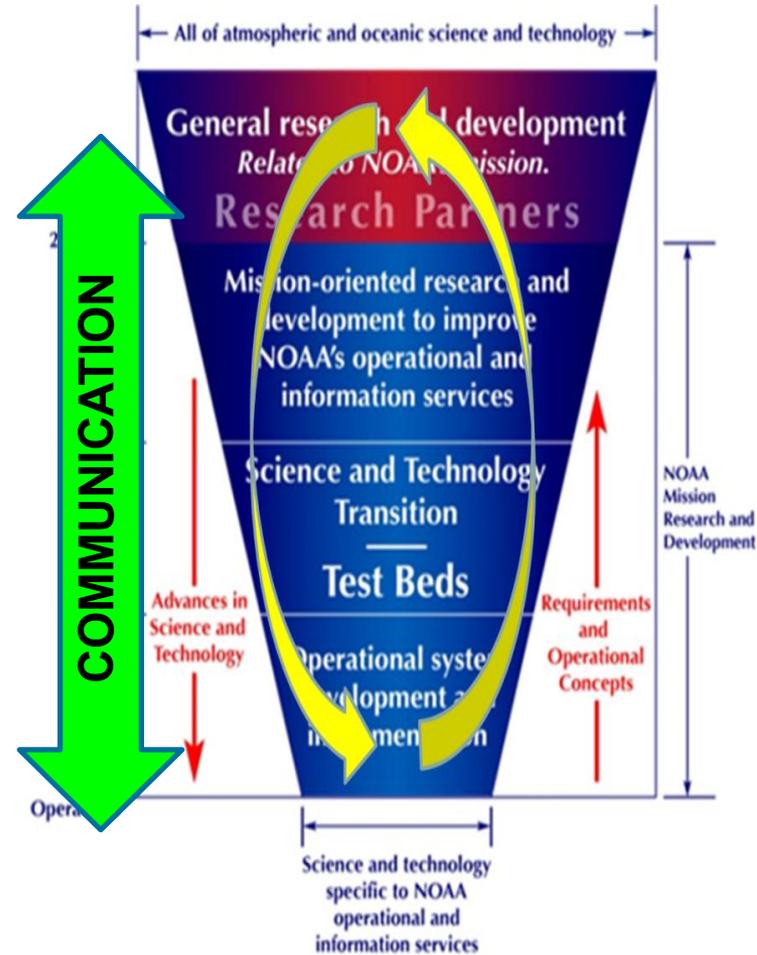


Core Investment Areas Identified by the EPIC RFI Analysis Team

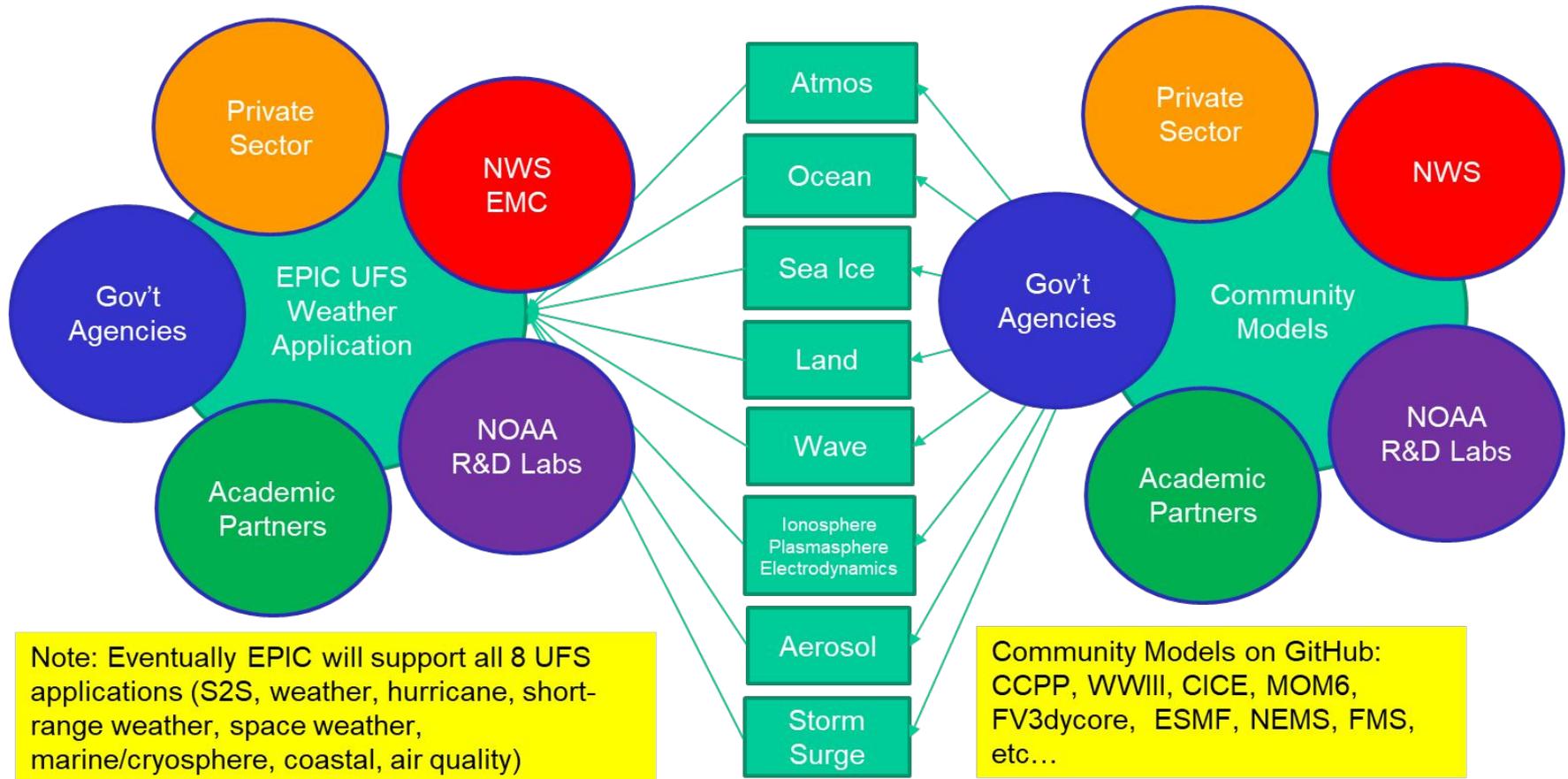
- Software engineering
- Software infrastructure
- User support services

Why EPIC will deliver *more* innovative operational outcomes?

1. Community modeling capability based on the UFS
2. Cloud-based development environment (hybrid HPC approach)
3. Connecting Scientists
4. Interagency Involvement
5. Connect mission, programs (\$\$) and people (outcomes)

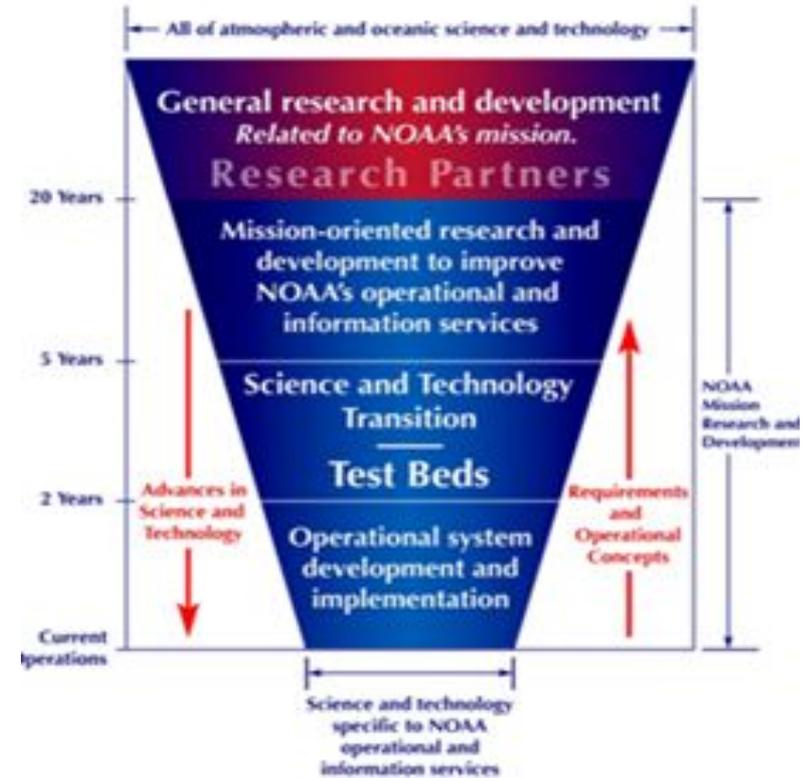


UFS Community Modeling Using Open Source Software



EPIC Initial Priorities

- Release of the UFS 1.0 through GitHub.
- User Support services
- Code documentation;
- Tutorials and workshops.
- Joint Effort for Data Assimilation and Integration (JEDI) integration into the
 - Unified Forecast System (UFS) and
 - NWS operations.
- Identify a leader of EPIC.
- Develop a governance plan.
- Establish an exchange program
- Release a draft Request for Proposals (RFP).
- Seek partnerships across the weather enterprise.
- Develop an EPIC Strategic and Implementation Plan.



GitHub

Questions?

