EPIC Infrastructure update

Collaborative effort between - Community Collaborators slide attached

Special Acknowledgments: Dr. Mark Potts Dr. Stylianos Flampouris, Dr. Jong Kim, Kris Booker

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Agenda

- Partners/EPIC Progress
- We hear you, We want to hear more
- Community Infrastructure
  a. Repeatable to SRW, RRFS, LandDA, HAFS, and future applications
- CI/CD
  a. Complete for SRW
  b. Repeatable for LandDA, HAFS, and future applications
- Tutorials and training
- Closing
- Need for Testing
- Closing

Partners

Community Collaborators/Partners

Acknowledgement

- NOAA OAR: WPO, GSL, PSL, NSSL, CSL, AOML, GFDL
- NOAA Open Data Dissemination (NODD) Program
- NWS: EMC, OSTI
- DTC
- UCAR: CGD, JCSDA
- Academia: George Mason University, Oklahoma University, University of Michigan
- CSPs: AWS, Azure, and Google Cloud
- Cooperative Institutes: CIRES, CIMSS

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EPIC Progress

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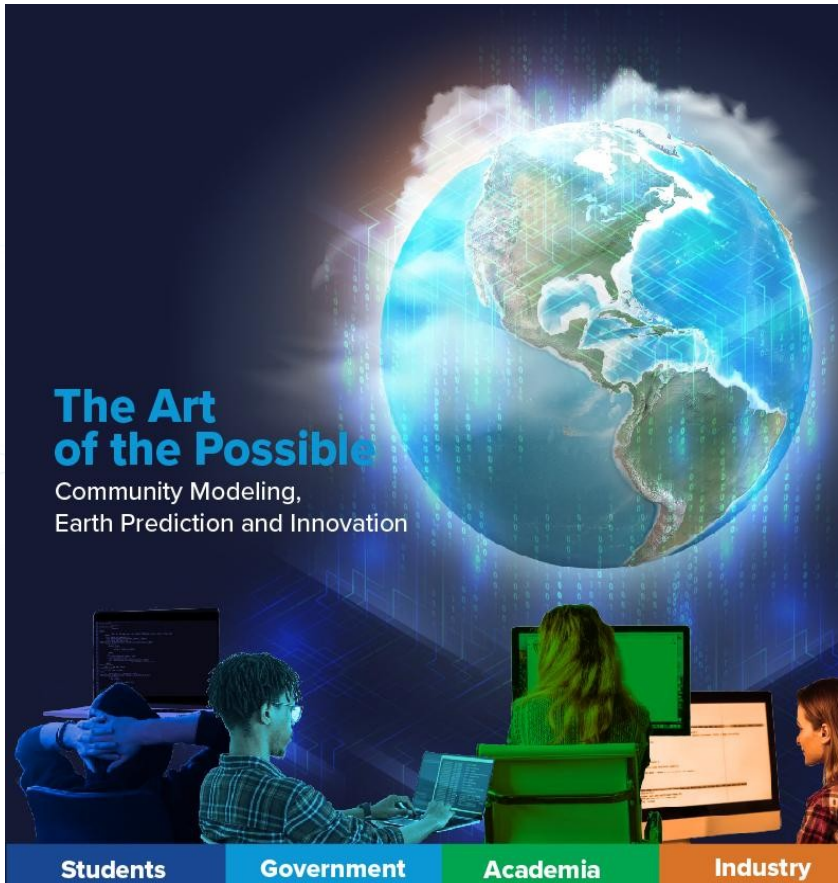
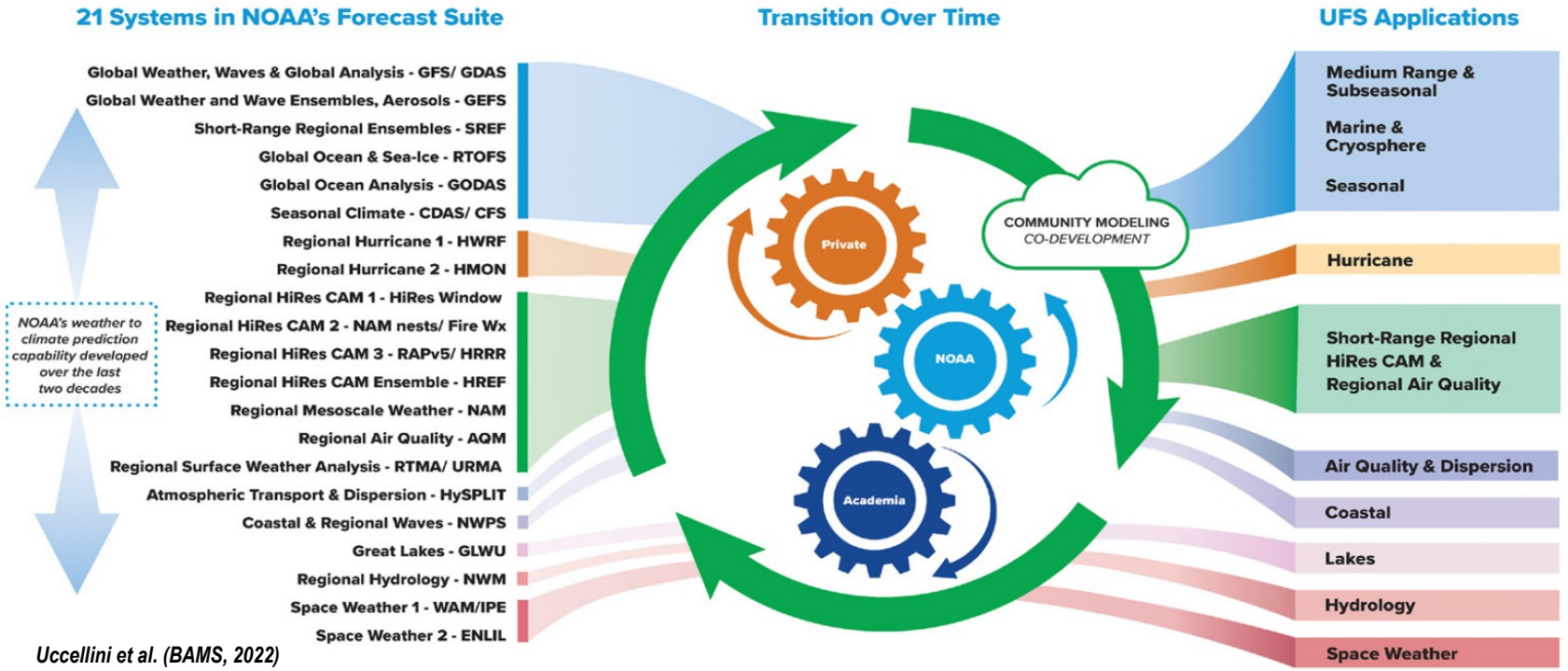
We hear you, we want to hear more!

- We need fewer users and more contributors.
- How do I replicate EPIC event infrastructure?
- How can we track contributors versus users across applications?
- How can we utilize repeatable processes (CI/CD) to test applications have passed all gates?
- Peer reviews need to be faster.
- More tutorials:
  - Contributing to UFS GitHub
  - GitHub Discussion and how to get user support
  - Azure AZ-HOP
- Don’t wait for a survey/meeting email: support.epic@noaa.gov



Simplifying NOAA's Operational Forecast Suite

Transitioning 21 of NOAA's Operational Forecast Systems into Eight Applications



Uccellini et al. (BAMS, 2022)

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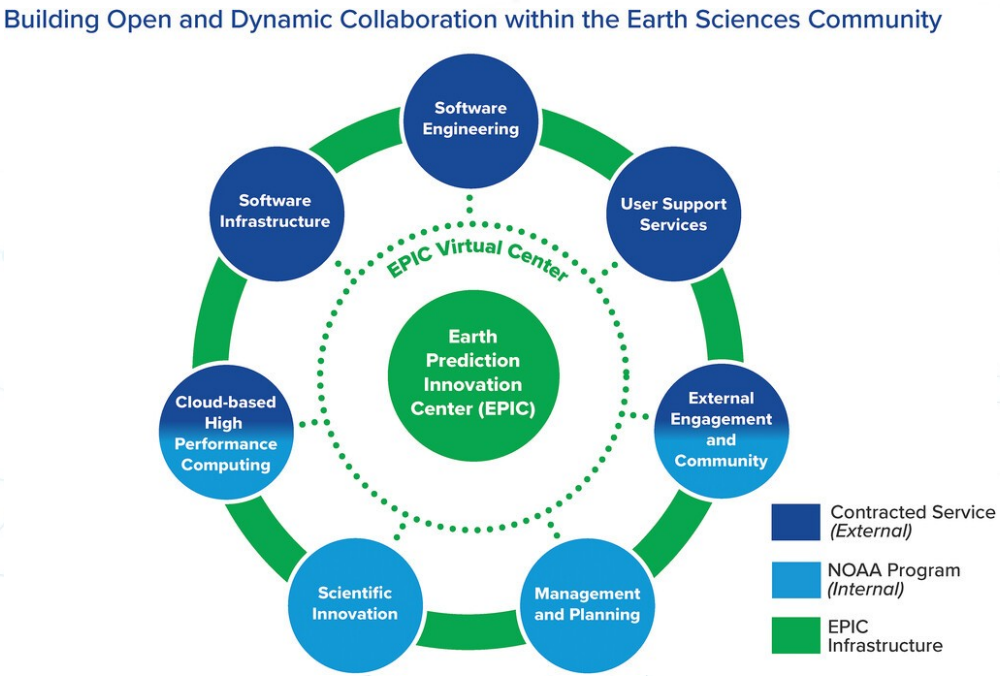
EPIC Architectural Plans



Continued Plans:

- CI/CD across more applications
- Transparent Gates
- Fail or Succeed Quickly
- Enhanced testing frameworks
- Advanced User Support
- Configuration Management
- Cloud configuration scripts
- Community Tools
- Unified Workflow
- Community Events

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Community Infrastructure

EPIC Cloud Architecture

Google Cloud

AWS RTX Sandbox	An AWS account that sits outside of the NOAA firewall to allow for non-CAC users.
AWS ACIO Sandbox	An AWS account that sits outside of the NOAA firewall to allow for non-CAC users. Login.gov access.
Azure RTX and ACIO Sandbox	An Azure account that sits outside of the NOAA firewall to allow for non-CAC users.
GCP ACIO Sandbox	A GCP account that sits outside of the NOAA firewall to allow for non-CAC users.
AWS ACIO Dev	An AWS account that sits inside the NOAA firewall containing our application code that is in active development under ACIO.
AWS ACIO Prod	An AWS account that sits inside the NOAA firewall containing our application code that is live in the production account under ACIO.
Parallel Works	A third-party HPC provider inside of the NOAA firewall that provides us virtual machines to test UFS applications on all 3 cloud service providers.

New Tutorial - Infrastructure as Code

- Common Infrastructure using Packer - able to deploy on any CSP
- https://github.com/NOAA-EPIC/packer-srwcluster
  - 12 lines of code to build out and run SRW
  - Tutorials - Earth Prediction Innovation Center (noaa.gov)

- Video 2: Creating a Head Node in AWS
  - Can be any of the CSP's

- Video 3: Running any application
  - Starting with SRW v2.1
  - Next: LandDA

HashiCorp Packer

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CI/CD Pipeline

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Pipeline Gates

- Average Build time
- Average time per gate
- Average build time per platform
- Code Coverage
- Forecast Skill

Checkout Source Code	Pull source code from GitHub and stage the data for analysis before deploying code.
Unit Testing	Run available unit tests for projects and ensure that the tests run as expected Collect code coverage metrics for the available baselines.
Lint (Flake 8)	Perform static code analysis that enforces style consistencies across program languages.
Dependency Check	Scan third-party libraries and modules for current vulnerabilities.
Build the Cloud Stack	Terraform/Cloudformation scripts will create a repeatable process for deployin applications.
Lint Cloud Stack	Examine the cloud stack template and return various suggestions.
Nag Cloud Stack	Pinpoint security vulnerabilities in cloud stack templates.
Scan Secrets	Scan for any improper use of security passwords or credentials.
Static Code Analysis	Scan code in all programming languages using SonarQube to determine curre vulnerabilities, maintenance issues, and defects. Note: SonarQube also has t ability to utilize architectural metrics such as cyclomatic complexity and maintainability metrics. Cyclomatic complexity as the example infers is a value tells the ability that a new engineer will be able to come in and maintain the ba If the number is high, then you have an application that is tough to upkeep, so tracking this number over time will make sure that your application is easy to maintain, which in turn reduces technical debt costs.
Package/Pull Artifacts/Deploy	This gate sequence will package up the artifacts and the application and deplo application as needed after completing all quality gate checks.
Run Regression Tests	Run a list of regression tests to test the overall end-to-end functionality.

CI/CD Pipeline

- Master Pipeline:

EPIC Dashboard - Selenium

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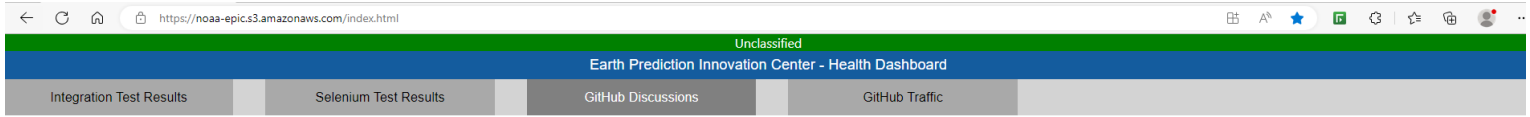
EPIC Dashboard - GitHub



Discussions

Includes: ufs-srweather-app, ufs-weather-model, UPP, land-DA_workflow, and NOAA-EPIC/land-offline_workflow

UFS Community Discussions

Repository	GitHub Id	Date Created	Initial Answ…	Github URL	Last Comment	Author
UPP	713	2023-05-24T13:36:22Z	Yes	https://github.com/NOAA-EMC/UPP/discussions/713/	2023-05-24T16:54:03Z	SiriusDanica666
UPP	712	2023-05-24T13:24:23Z	Yes	https://github.com/NOAA-EMC/UPP/discussions/712/	2023-05-24T16:47:23Z	SiriusDanica666
ufs-weather-model	1709	2023-04-13T13:07:35Z	Yes	https://github.com/ufs-community/ufs-weather-model/discussions/1709/	2023-04-13T13:45:37Z	ericaligo-NOAA
ufs-weather-model	1708	2023-04-12T20:28:22Z	Yes	https://github.com/ufs-community/ufs-weather-model/discussions/1708/	2023-04-12T21:12:51Z	benjamin-cash
ufs-weather-model	1671	2023-03-22T05:26:25Z	Yes	https://github.com/ufs-community/ufs-weather-model/discussions/1671/	2023-04-03T15:43:31Z	XiaSun-Atmos
ufs-weather-model	1666	2023-03-20T14:57:24Z	Yes	https://github.com/ufs-community/ufs-weather-model/discussions/1666/	2023-05-18T13:42:20Z	jiandewang
ufs-weather-model	1623	2023-02-23T20:50:54Z	Yes	https://github.com/ufs-community/ufs-weather-model/discussions/1623/	2023-02-27T16:55:31Z	mjhossen
ufs-weather-model	1611	2023-02-13T21:13:26Z	No	https://github.com/ufs-community/ufs-weather-model/discussions/1611/		ShawnCebulaNOAA
ufs-weather-model	1576	2023-01-20T19:36:54Z	Yes	https://github.com/ufs-community/ufs-weather-model/discussions/1576/	2023-01-27T02:19:41Z	aschuh
ufs-weather-model	1534	2022-12-12T23:31:56Z	Yes	https://github.com/ufs-community/ufs-weather-model/discussions/1534/	2022-12-13T16:36:47Z	rickgrubin

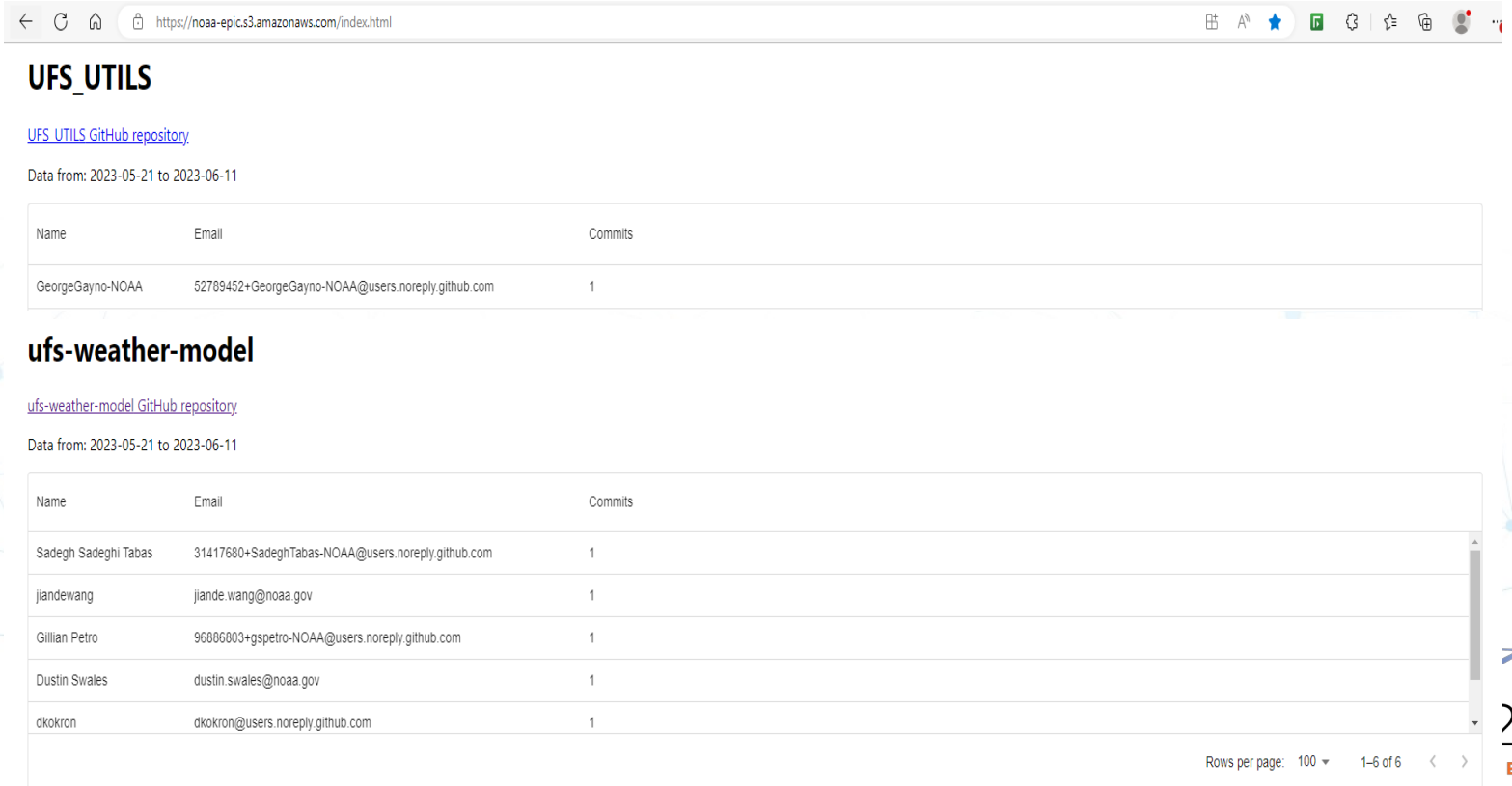
Rows per page: 100 1–32 of 32

Issues

Includes: ufs-srweather-app, ufs-weather-model, UPP, land-DA_workflow, and NOAA-EPIC/land-offline_workflow

Repository	GitHub Id	Date Created	Initial Answ…	Github URL	Last Comment	Author

EPIC Dashboard - GitHub Traffic



EPIC Dashboard - Pipeline

EPIC CI Build Status - ufs-srweather-app

Last updated: Sun Mar 12 22:42:01 PDT 2023

ufs-srweather-app/job/pipeline/view/change-requests						
timestamp	**PR-build**	**inProgress**	**duration (min)**	**result**	**WE2E-tests**	**S3-artifacts**
2023-03-10 15:29:36	ufs-srweather-app/job/pipeline/job/PR-667/1/	true				
2023-03-10 17:13:46	ufs-srweather-app/job/pipeline/job/PR-663/1/	false	309.8	FAILURE	cheyenne-intel gaea-intel jet-intel orion-intel	srw_build-cheyenne-gnu.log
2023-03-08 17:06:26	ufs-srweather-app/job/pipeline/job/PR-657/3/	false	518.3	FAILURE		srw_build-cheyenne-gnu.log
2023-03-08 17:00:05	ufs-srweather-app/job/pipeline/job/PR-657/2/	false	1	FAILURE		
2023-03-08 16:53:00	ufs-srweather-app/job/pipeline/job/PR-657/1/	false	0	FAILURE		
2023-03-10 15:08:26	ufs-srweather-app/job/pipeline/job/PR-656/1/	false	274.9	SUCCESS	cheyenne-gnu cheyenne-intel gaea-intel jet-intel orion-intel	srw_build-cheyenne-gnu.log
2023-03-08 19:16:35	ufs-srweather-app/job/pipeline/job/PR-650/1/	false	438.7	FAILURE	cheyenne-gnu cheyenne-intel gaea-intel jet-intel	srw_build-cheyenne-gnu.log
2023-03-09 01:43:47	ufs-srweather-app/job/pipeline/job/PR-637/2/	false	117	FAILURE	cheyenne-gnu cheyenne-intel gaea-intel jet-intel	srw_build-cheyenne-gnu.log
2023-03-08 16:29:15	ufs-srweather-app/job/pipeline/job/PR-637/1/	false	554.5	FAILURE		srw_build-cheyenne-gnu.log
2023-03-06 16:44:27	ufs-srweather-app/job/pipeline/job/PR-632/1/	false	167.3	FAILURE	cheyenne-gnu cheyenne-intel gaea-intel jet-intel	srw_build-cheyenne-gnu.log
2023-02-24 18:37:40	ufs-srweather-app/job/pipeline/job/PR-628/1/	false	218.5	SUCCESS	cheyenne-gnu cheyenne-intel gaea-intel jet-intel orion-intel	srw_build-cheyenne-gnu.log
2023-03-03 18:51:37	ufs-srweather-app/job/pipeline/job/PR-627/1/	false	432.1	FAILURE	cheyenne-gnu cheyenne-intel gaea-intel jet-intel	srw_build-cheyenne-gnu.log
2023-02-23 16:50:45	ufs-srweather-app/job/pipeline/job/PR-626/1/	false	140.6	ABORTED	cheyenne-gnu cheyenne-intel gaea-intel jet-intel	srw_build-cheyenne-gnu.log

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Implemented Process

UFS-SRW Application - Example

- ***Infrastructure*** – Update the CICD pipeline of the SRW to include the driver for forecast verification
- ***Scientific Hypothesis*** – Evaluate the impact on severe winter weather with the relevant UFS case to validate the hypothesis, i.e., Indianapolis case
- ***Objective Verification*** – Calculate skill score index based on weighted average of a combination of metrics (RMSE), variables (wind speed, dew point temperature, temperature, and pressure at the lowest level in the atmosphere), and lead time
- ***Output*** – Every source code update has a performance indicator; i.e., aiming for higher than 1.0.

Next Steps

- Expansion of the infrastructure to all the UFS repositories, already in the Land DA
- Well-established problems with focused research and development
- Significant increase to HPC resources dedicated to the testing, i.e., currently the SRW testing is not triggered due to the lack of resources
- Support for incremental change in development mindset, there are already great examples

Tutorials and Training

Community Engagement Activities

Community Portal and Resources	• Regular Updates, FAQs • Detailed descriptions of products and Services • Feedback Pages / Incorporating Feedback
Social Media Campaigns	• Twitter • Facebook • Instagram
Webinars and Workshops	• Host webinars and workshops for EPIC community • Topics related to EPIC, model dev and data analysis
Community Events	• Application Training • CodeFest • UIFCW
Publications and Newsletters	• Publish latest developments • Articles, impacts and contributions • Guides and technical documents for users
Outreach and Marketing	• Increase awareness of EPIC and community • Collaborate with external partners and stakeholders • Targeted messaging and communications strategies

Upcoming Events, Projects & Promotions

- Quarterly CodeFests & Application Trainings
  - Short-Range Weather CodeFest 2023: Unit Testing Framework for UFS - April 3-7, 2023
  - Short-Range Weather Application Training 2023: Running V2.1 Containers in AWS - April 7, 2023
  - EPIC CodeFest June 2023: Unit Testing Framework for the UFS - June 19-23, 2023
  - EPIC Application Training June 2023: Land Data Assimilation (DA) System - June 23, 2023
- Plan/Host UIFCW, Summer 2023
- Quarterly Video Tutorials
- UPP webpage on ECP (support transitioned from DTC to EPIC)
- Explore combining EPIC-UFS Communications Strategy
- Conferences (AGU & AMS)
- Launch an EPIC-UFS Newsletter
- Develop an enhanced metrics dashboard for the ECP
- Identify potential areas for improvement and engagement, discover new ways to incentivize external participation

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Need for testing and governance

Testing Framework

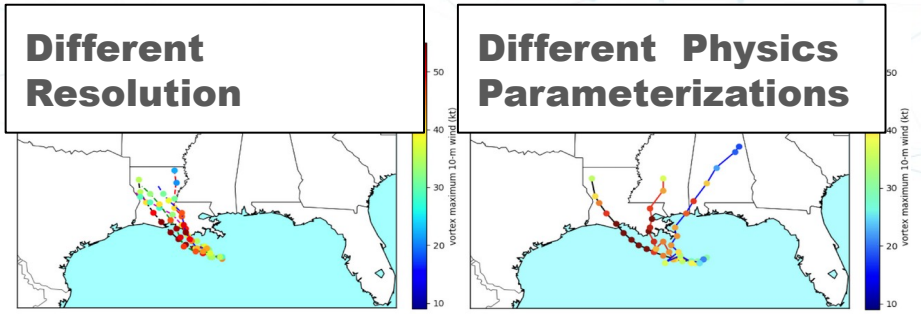
Objective: To quantify the impact of any code update, in terms of forecast accuracy and computational performance.

- Homogenize testing infrastructure
- Optimized testing (Reduction of cost)
- Simplification of Code Management
- User-friendly
- Multi-level testing

Increasing Complexity

```
    Start 1: ocn_unit_test
1/4 Test #1: ocn_unit_test ....................   Passed    0.75 sec
    Start 2: ocn_scm_test
2/4 Test #2: ocn_scm_test .....................   Passed   11.09 sec
    Start 3: datm_ocn_test
3/4 Test #3: datm_ocn_test ....................   Passed  248.82 sec
    Start 4: ufs_case_test
4/4 Test #4: ufs_case_test ....................   Passed  370.78 sec

100% tests passed, 0 tests failed out of 4
```



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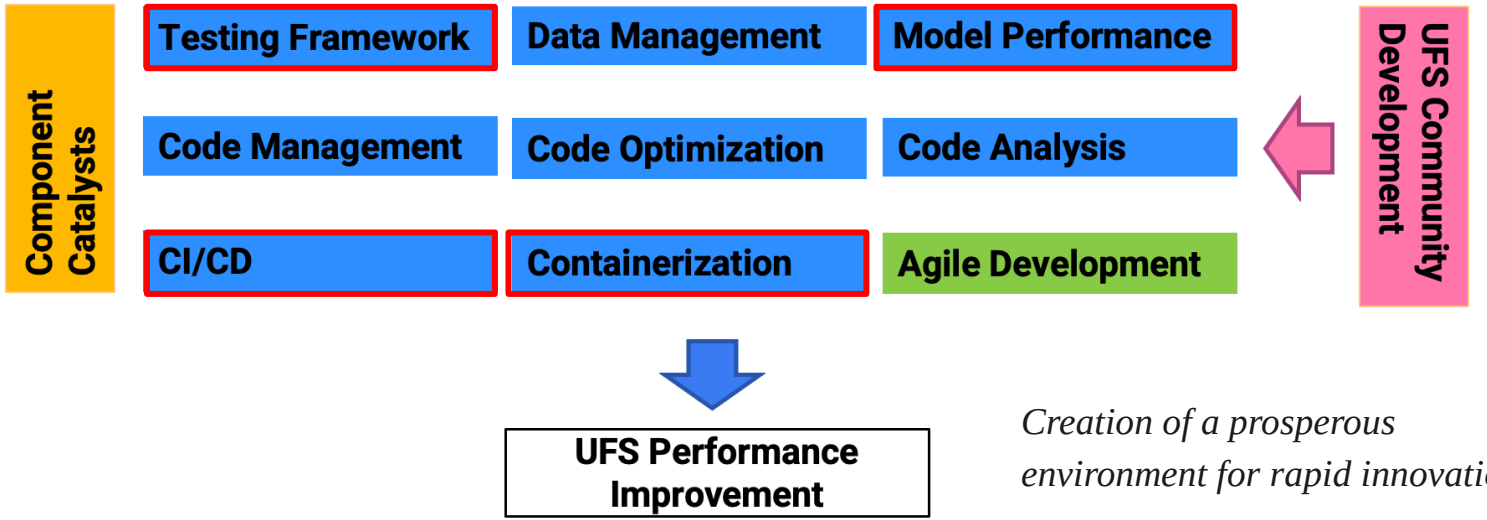
Infrastructure as an Innovation's Catalyst

Work in Progress by EPIC contract with the UFS Community



Creation of a prosperous environment for rapid innovation!

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Closing

- We value continuous feedback
- Our Advanced User Support Team is prepared to assist as needed with your technical questions.
- Await your transparent tools
  - Community Dashboard
  - Infrastructure as code
  - CI/CD Pipeline results are public for all applications
- More tutorials:
  - Contributing to UFS GitHub
  - GitHub Discussion and how to get user support
  - Azure AZ-HOP
- Don’t wait for a survey/meeting email: