Modernizing Simulation Services and Accelerating R2O2R at the Community Coordinated Modeling Center (CCMC): Next-Generation Continuous Runs Framework

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NASA Community Coordinated Modeling Center

NOAA Space Weather Prediction Center

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Highlights

Where we are today

Working together

Architecture for Collaborative Evaluation (ACE) environment

Proving Ground as a prototype

Acronyms:

NASA Community Coordinated Modeling Center (CCMC)

NOAA Space Weather Prediction Center (SWPC)

Research to Operations to Research (R2O2R)

The Community Coordinated Modeling Center (CCMC) at NASA: **Mission & Services**

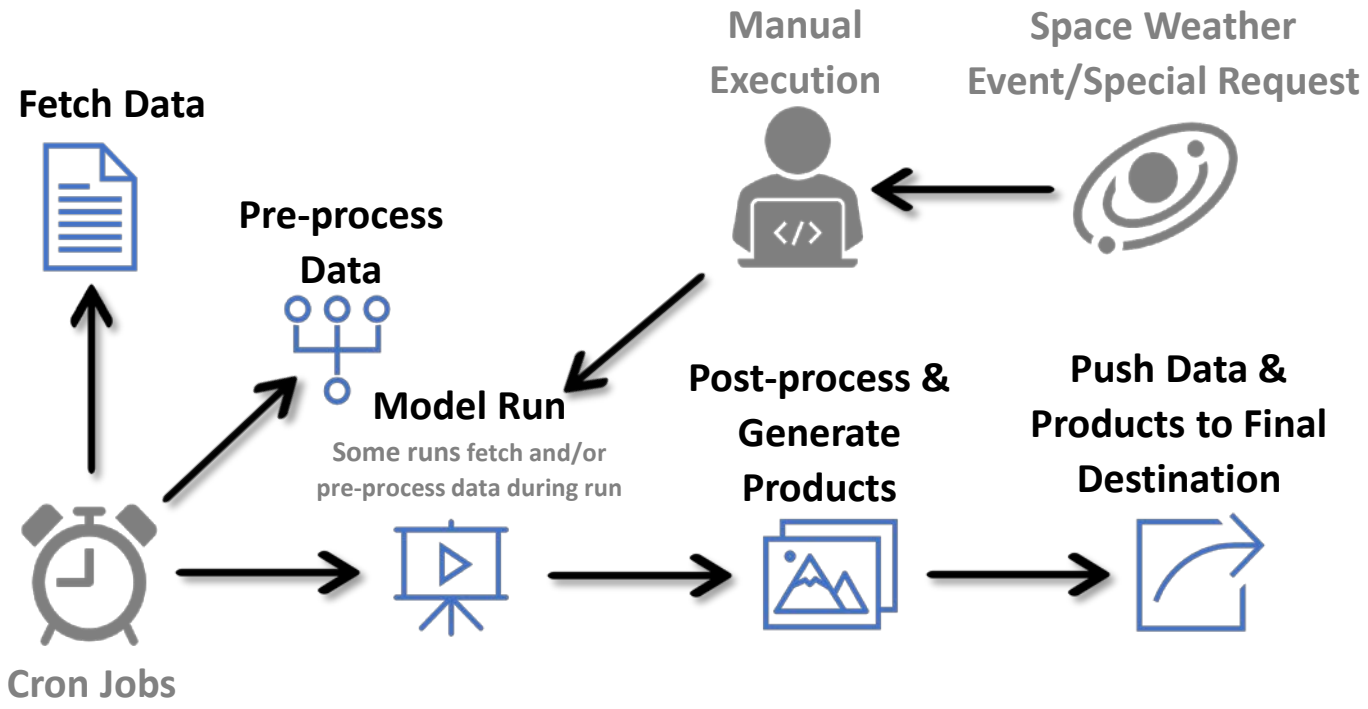
CCMC SUPPORTS:

- ❖ The scientific community.
- ❖ Space science education.
- ❖ CCMC's operational partners.

- Multi-agency partnership whose mission is **to promote the research and development of state-of-the-art space science and space weather models.**
- **Key player in space weather in the United States.**
- **Services:**
  - Simulation services: **Specific to R2O2R – Continuous Runs System.**
  - Visualization and analysis of simulation results.
  - Validation of space weather forecasting methods.
  - Space weather educational activities.

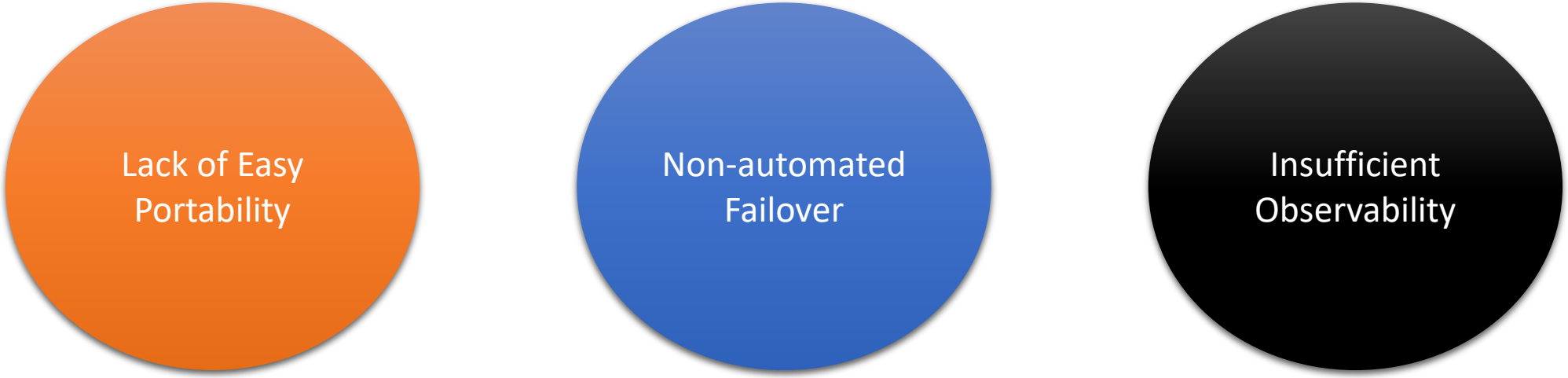
Website: https://ccmc.gsfc.nasa.gov

The Current Continuous Runs System: **Overview**



Executes over 20 space weather research models continuously in near-real time in order to **test for operational readiness.**

The Current Continuous Runs System: **Challenges and areas for improvement**



These issues affect CCMC operations and slow down R2O2R.

NASA CCMC & NOAA SWPC Collaboration

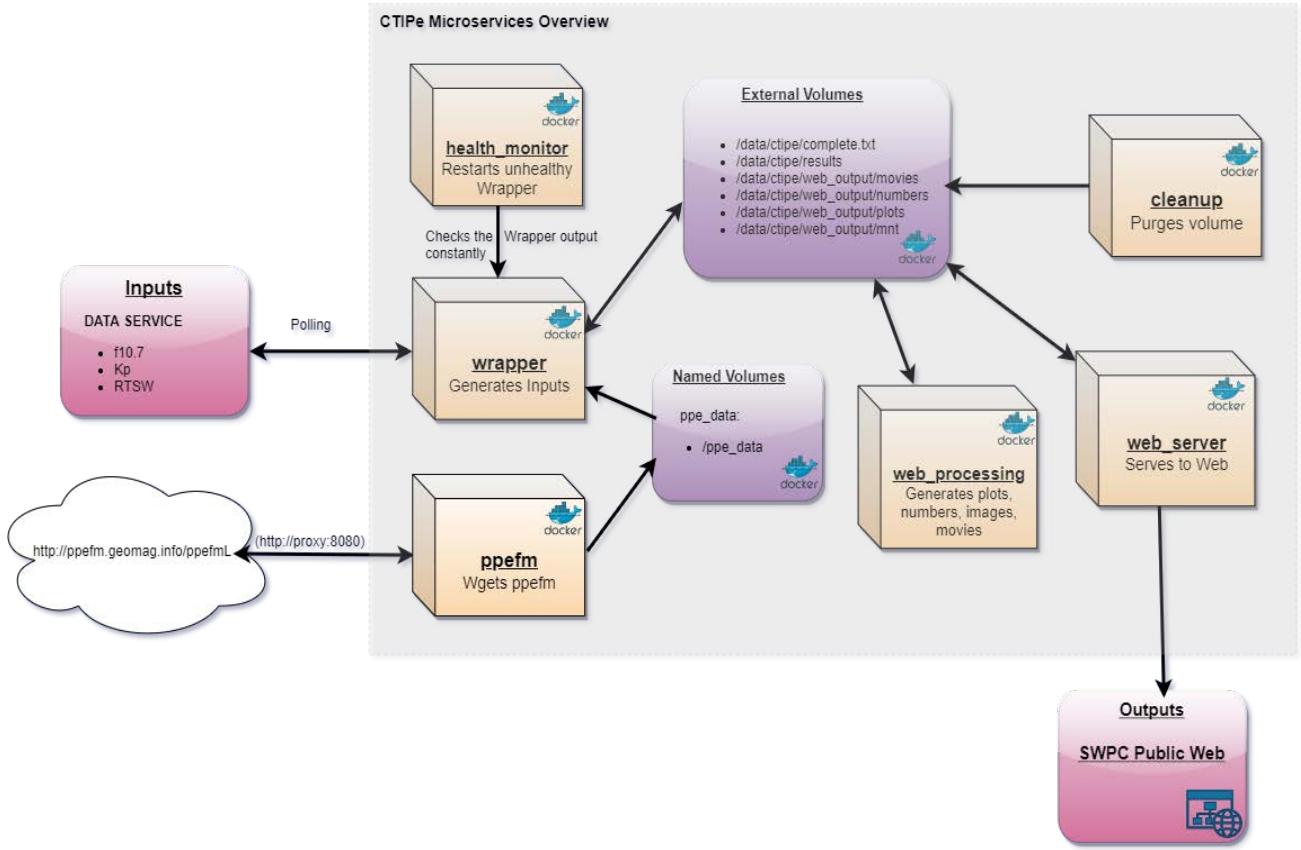
- **NOAA Space Weather Prediction Center (SWPC)** and **NASA CCMC** developed the **Space Weather R2O2R Framework** to improve and accelerate R2O2R.

- Framework developed in response to executive orders to prepare the nation for space weather events.

- Developed the CCMC-SWPC **shared** proving ground environment.
  - To enhance operational-grade models and software.
  - To demonstrate that research-grade models and software are **ready to be transitioned into operational settings**.
  - Initially set up to mirror SWPC operational environment as closely as possible.

CCMC-SWPC Proving Ground: **What we did**

- Proving ground was set up in the **AWS cloud**.
- Utilized AWS cloud services: Elastic Compute Cloud (EC2), Virtual Private Cloud (VPC), and Simple Storage Service (S3).
- A **SWPC** containerized (with Docker) version of the Coupled Thermosphere Ionosphere Plasmasphere Electrodynamics (**CTIPe**) model was installed and tested.
- Continuous assessment and improvement of the software system was iteratively performed.
- Model was finally transitioned from AWS to CCMC production server.



Containerized model and supporting software running as Docker Compose micro-services in the AWS cloud.
***Image courtesy of SWPC team**

CCMC-SWPC Proving Ground: **What we achieved**

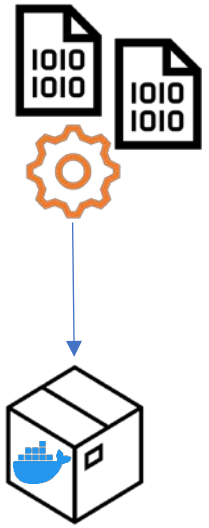
- An R2O2R environment in the AWS cloud was successfully implemented.
- **Effectively transitioned a containerized CTIPe model from operations to research through the R2O2R environment.**
- Using AWS cloud services promoted secure and **convenient collaboration** between operations and research teams.
- Using Docker containers, as well as version control with GitLab, **enabled rapid portability between operational and research systems.**
- Areas for improvement were identified and will be used to enhance this and future proving grounds.
- Following **best practices and standards was vital** in ensuring a successful and repeatable outcome.

Next Generation Continuous Runs Framework: **The vision**

- Will solve portability, redundancy, and observability issues.
- Will use the **CCMC-SWPC proving ground as a prototype**.
- Proving ground will be a stepping-stone to **develop cutting-edge build and run-time solutions** that enhance CCMC operations and ultimately R2O2R.

Next Generation Continuous Runs Framework: **Putting it all together**

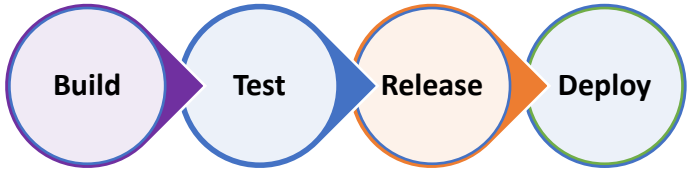
Containerize models and software

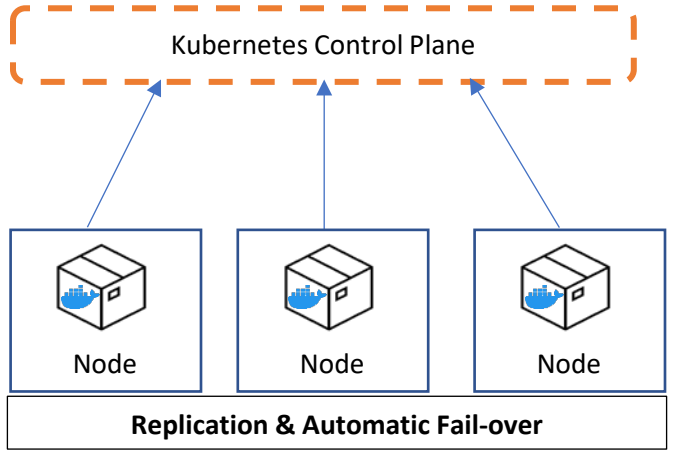


Robust real-time monitoring

Follow best practices

Implement CI/CD pipeline





Kubernetes container orchestration

CCMC & Services | NASA CCMC & NOAA SWPC | Proving Ground | Next Generation Continuous Runs

Questions?