Advances towards in-core Gain Form Ensemble Transform Kalman Filter (GETKF) Data Assimilation using JEDI and a coupled UFS model.

Session A43E: Community Modeling and Open Innovation to Advance Earth Prediction Systems II Oral

December 14, 2023

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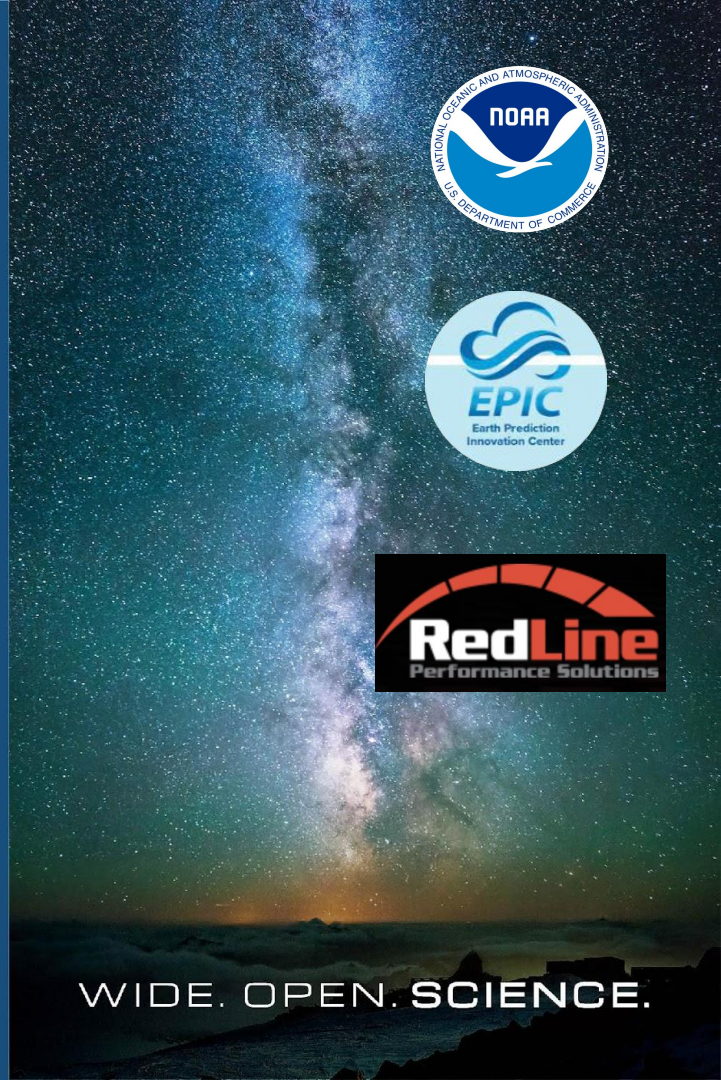


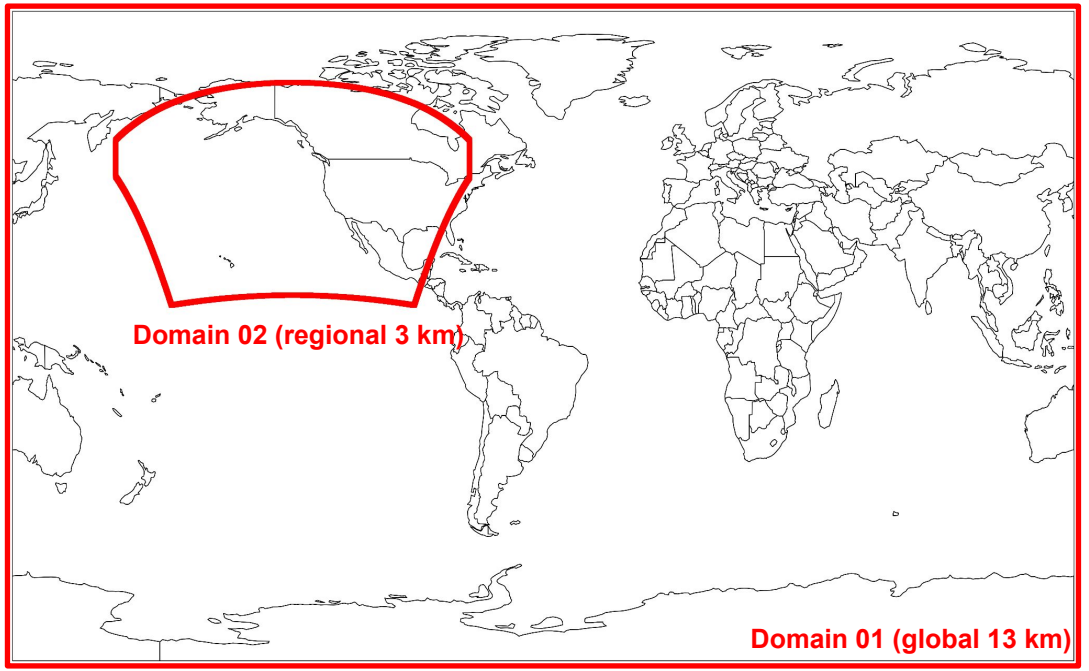
Overview

- Brief overview of Water in the West Project
- Current DA workflow
- Planned In-core workflow
- Progress to date
- Technical approach
- Future integration with UFS and JEDI

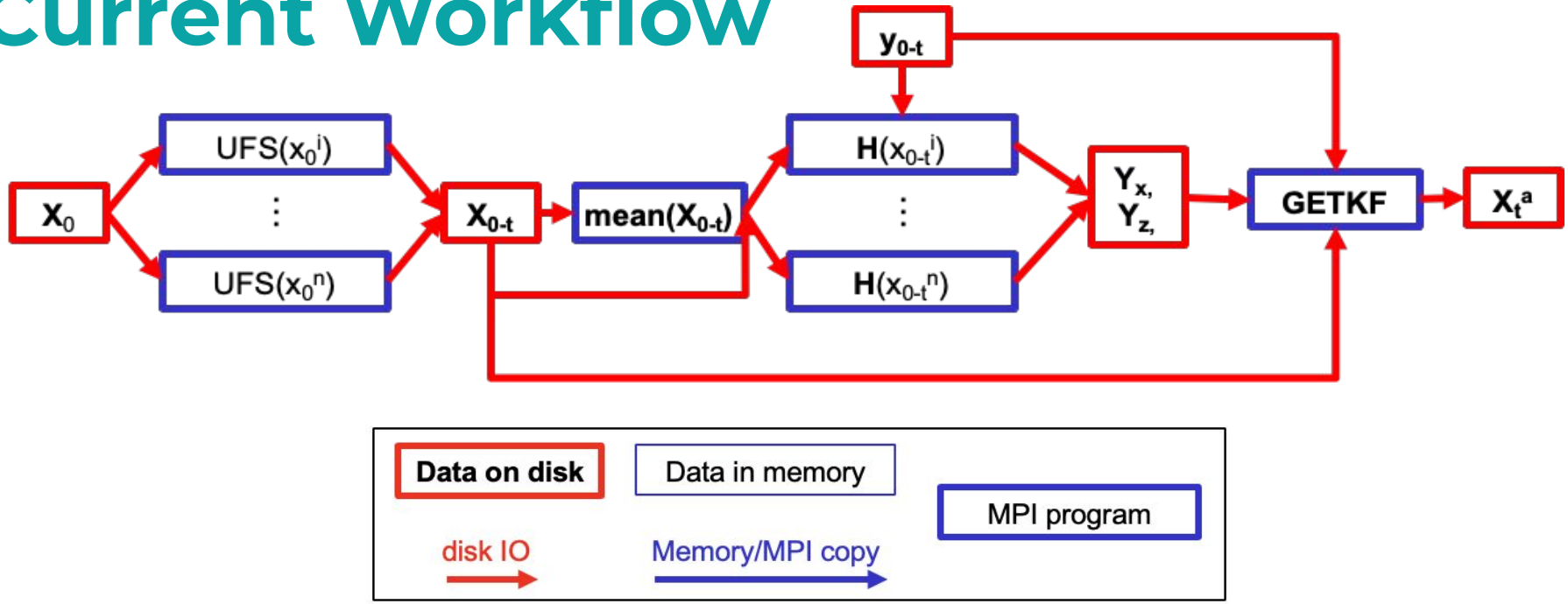
Water in the West Project

- 1.5 year project (started August 2023)
- Goal to better predict location and precipitation of atmospheric rivers in western North America
- Global grid with a high resolution nest over CONUS and eastern Pacific
- Initial use of primarily GSI for DA, but transition to in-core DA using JEDI (Joint Effort for Data assimilation Initiative)

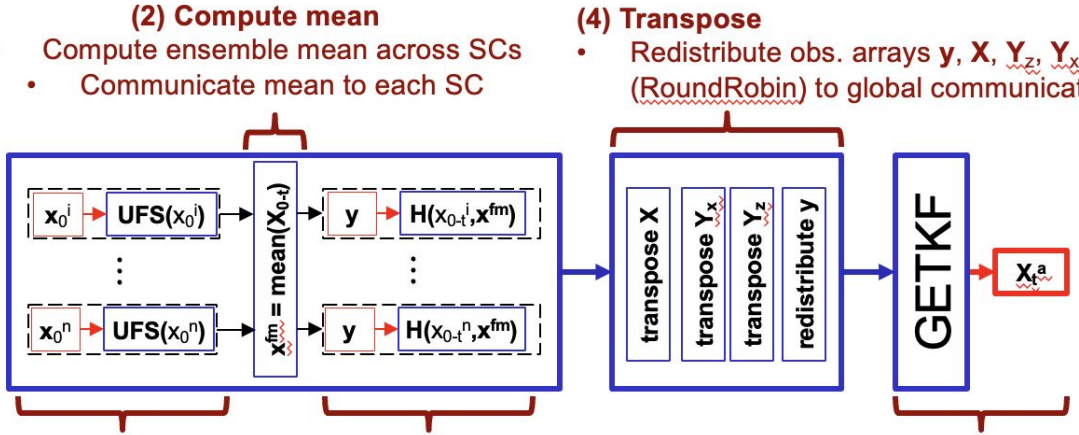
- The UFS framework allows for flexible integration of new physics and data assimilation
- Nested configuration allows for the representation of both large-scale features and terrain-driven processes
- Final configuration will be based on EMC's global workflow (with added nesting capabilities) and will run on multiple systems like Gaea C5 and cloud service providers



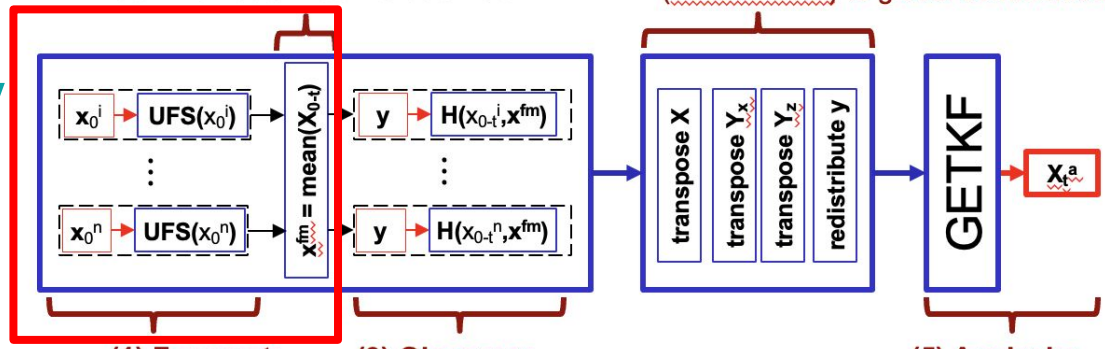
Current Workflow



Planned Workflow



Planned Workflow



(2) Compute mean
- Compute ensemble mean across SCs
- Communicate mean to each SC

(4) Transpose
- Redistribute obs. arrays **y**, **X**, Y_z, Y_x from SC (RoundRobin) to global communicator (Halo)

(1) Forecast:
- Split communicator
- Read I.C. on each SC
- Run batches of ensemble forecasts in parallel.
- Store trajectory of forecasts on each SC.

(3) Observer:
- Read obs (round robin) on all SC.
- Observe trajectories stored on each SC.

(5) Analysis:
- Perform analysis on global communicator
- Output ensemble of analysis

Technical Approach

- Built as a single application from ufs-bundle (https://github.com/jcsda/ufs-bundle.git)
- UFS is built as a component library for JEDI application called ufsjedi_Ensforecast.x
- MPI_COMM_WORLD is split into sub-communicators for each ensemble member
- Ensemble forecasts are run either in batches or in parallel and return a std::vector<State> variable to JEDI on the sub-communicator
- MPI collectives (means) are performed across ensembles for each tile (or subdivision of a tile)

Future integration with JEDI and UFS

- Requires spack-stack software environment (EPIC/EMC/JCSDA)
- A sample test case using C48 grids and 2 ensemble members will become part of the regression test suite for JCSDA's ufs-bundle
- There will be a smaller ensemble forecast test built into the oops repository
- As part of the Atmospheric Rivers project, an 80 member ensemble will be run at 13km resolution + a high resolution 3km grid
- Future work includes extending in-core DA to a coupled (ATM-OCN-ICE) forecast model

THANK YOU

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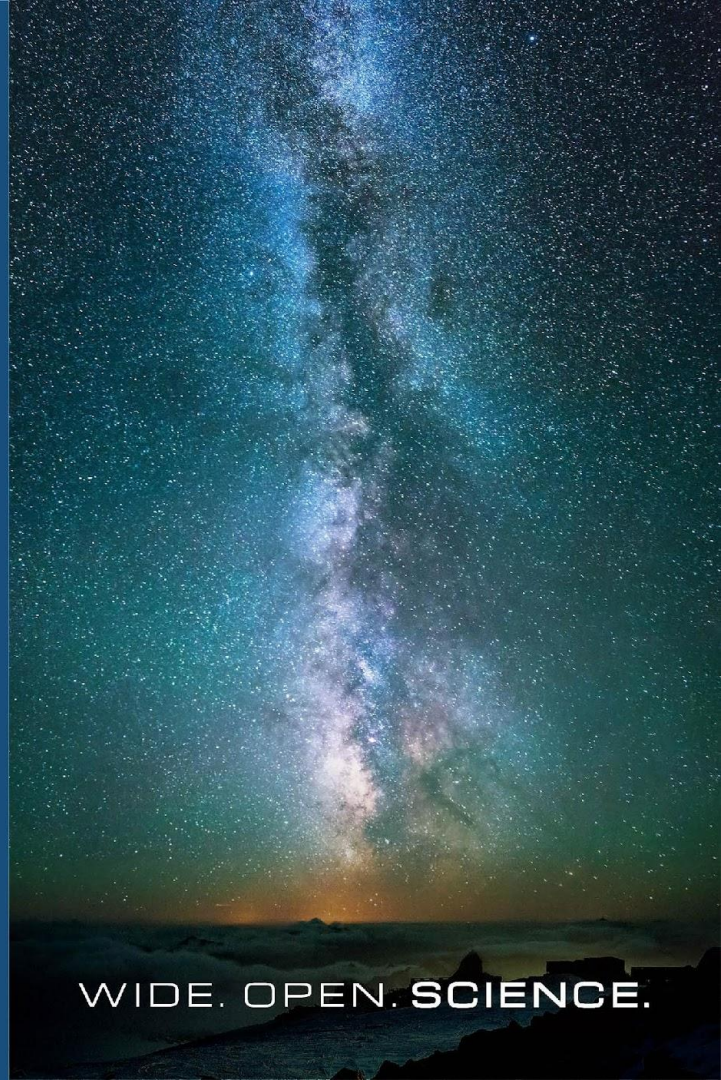

Questions?

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https://github.com/JCSDA/ufs-bundle.git
https://github.com/ufs-community/ufs-weather-model.git

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