

UFS Land-DA Workflow

- Day 1: Quick Land DA Session Intro -

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Key Stakeholder Groups: NOAA EMC, PSL, GSL, NESDIS, NCAR, JCSDA

NOAA Earth Prediction Innovation Center (NOAA/EPIC)

<https://epic.noaa.gov/>

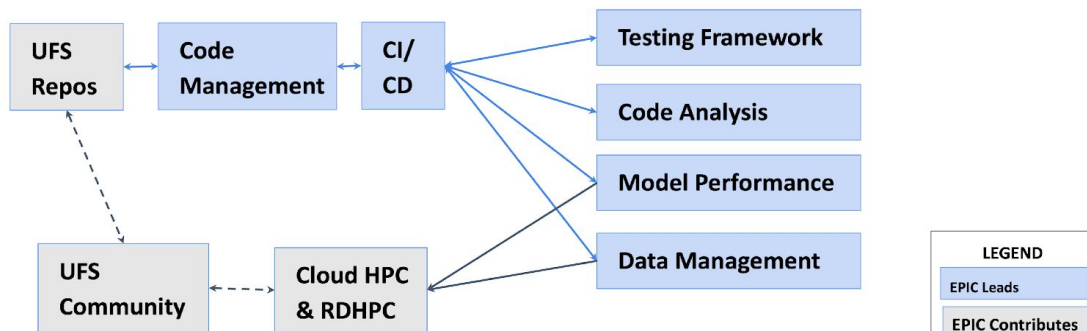


Outlines

- NOAA EPIC mission activities and Land DA motivation
- UFS (United Forecast System) Weather Model and Standalone JEDI-based NOAH-MP Land Data Assimilation Application
- Data Assimilation workflow component and structure
 - Model configuration and data assimilation workflow tasks
 - Consistency of workflow structure across UFS DA Applications: Land DA, SRW, etc.
 - File naming convention, environment variables and parameters, vertical workflow directory structure
 - Workflow management system and configuration tools: Rocoto, JEDI configuration Builder (JCB), Unified Workflow (UW) tools
- Analysis output and log files: CADRE DA sample configurations with choice of model and DA configuration options
 - Snow depth analysis: GHCN/IMS/GTS data sets, focus on 2025 January case for IMS data set with 3DVar with ERA5 forcing

EPIC's Keymission Activities

- NOAA created the Earth Prediction Innovation Center (EPIC) to improve operational weather forecast systems through scientific and technical innovation via model co-development with the Weather Enterprise — government, industry and academia.



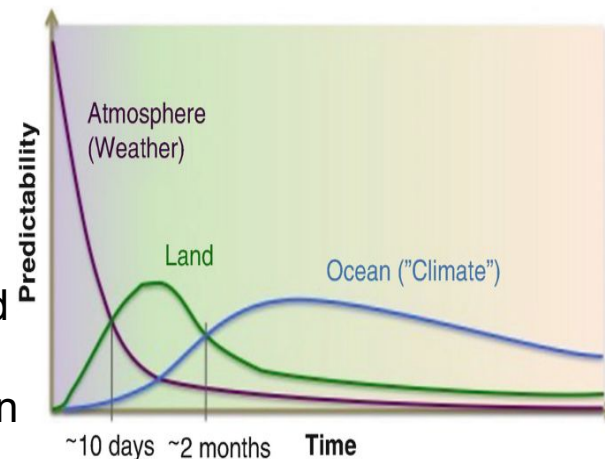
EPIC Infrastructure Focuses on:

- Develop/provide necessary Software Infrastructure;
- Manage, maintain, test, and evaluate the UFS WM and Apps source code;
- Develop and maintain the appropriate frameworks;
- Support the transition of the UFS WM to Cloud-based HPC

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Land Data Assimilation Motivation

- **Operational forecast models increasingly involve with coupled Earth modeling and data assimilation system**
- **Quantification and prediction of land surface state variability:**
 - Critical for initialization of weather and climate forecasts
 - Hydrological community applications include agricultural forecasting, drought and flood risk assessments, etc.
 - Land states can provide predictability in subseasonal-to-seasonal time scale: soil temperature and moisture, snow temperature, etc.
 - Strong influence of land surface flux and moisture partition on the atmospheric boundary layer
 - NWP model constraint: soil moisture, soil temperature, and snowpack



Courtesy of Ek and Dirmeyer

UFS Weather Model Coupling Options

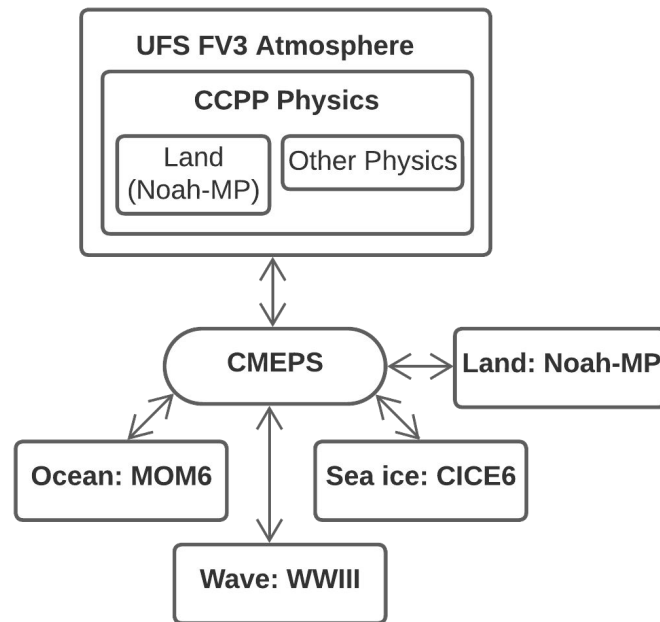
- **Current coupling options: 11 components for 14 coupling applications**
 - **Noah-MP coupling options: DATM (ERA5 and GWSP3 atmospheric forcings) and FV3-LND**

UFS Build Configurations	FV3: Atmosphere	<input checked="" type="checkbox"/> DATM: Aata Atmosphere	MOM6 or HYCOM: Ocean	DOCN: Data Ocean	CICE6: Sea Ice	<input checked="" type="checkbox"/> WW3: Wave	GOCART: Aerosol	AQM: Air Qaulity	Noah-MP or LM4: Land Component	<input checked="" type="checkbox"/> Fire Behavior
Global S2SWA	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global S2SW	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global S2S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global or regional ATM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global or regional ATMW	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global or regional ATMAERO	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global or regional ATMAQ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global ATMF	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Global or regional HAFS-ALL	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global or regional HAFS-MOM6W or HAFSW	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global NG-GODAS	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Global LND	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Global ATML	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Noah-MP Component Model: UFS Weather Model

- Supported Coupling Configurations

- **DATM+LND (incl. restart capability)**
 - Tested with GSWP3 and ERA5 input provided by CDEPS data components
- **FV3+LND side-by-side configuration (no feedback from land)**
 - FV3/CCPP/Noah-MP also runs
 - Aims to compare the results coming from component model and CCPP
- **FV3+LND fully coupled (incl. restart capability)**
 - Fully active atmosphere coupled two-way with land component
 - Supports also running land component in high resolution



The Joint Effort for Data assimilation Integration (JEDI)

- Collaborative development led by the Joint Center for Satellite Data Assimilation (JCSDA)
- JEDI provides a software infrastructure for data assimilation software infrastructure
- Key points:
 - Model agnostic, generic and portable from toy models to operational Earth system coupled models
 - Data assimilation on the model native grid
 - No restriction with one specific DA methodology or algorithm
 - Framework for generic observation handling capability and model-independent observation operators
 - Unified observation data process: Interface for Observation Data Access (IODA)
- FV3-JEDI: interfaces between the generic JEDI components and UFS
 - Noah-MP snow data assimilation: file-based pseudo model approach to read the state of a forecast from FV3 restart files

JEDI Core Components and Application Interfaces

- Oriented Prediction System (OOPS) – the operating system for JEDI. Provides wholly generic algorithms for running data assimilation and forecast models.
- Unified Forward Operator (UFO) – an ‘app-store’ of observation operators.
- Integrated Observation Data Access (IODA) – generic handling of observations.
- System Agnostic Background Error Representation (SABER) – gathering of all the state of the art B matrix methods in a generic fashion.

