Building and Running Land Data Assimilation (Land DA) v3.0 Container on Cloud

An Amazon Web Services (AWS) based Video Tutorial

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The UFS Land DA System

- Refer to **Land DA Introduction Guide** for more information on
  - EPIC's Key Mission activities
  - Platform Agnostic deployment through Singularity or Apptainer Container Images
  - UFS Land DA Motivation
  - UFS Weather Model (WM) Coupling options
  - Noah Multi-Physics (Noah-MP) Land Surface Model (LSM)
  - The Joint Effort for Data assimilation Integration (JEDI) DA framework
  - JEDI Core Components and Application Interfaces

The UFS Land DA System

Land Surface Model (LSM) + Data Assimilation (DA) System

- **LSM: Noah Multi-Physics (Noah-MP)**
  - Through ATMosphere-Land (ATML) coupling, it can
    - run **FV3ATM** within the UFS-Weather Model (WM) interactively with LSM **OR**
    - feed **ERA5** data to LSM using Data ATMosphere (**DATM**) forcing configurations

      (Register at ECMWF login page to access ERA5 data if you are a new user)

- **DA Framework: JEDI software uses**
  - Object-Oriented Prediction System (**OOPS**) for the following DA algorithms
    - Local Ensemble Transform Kalman Filter - Optimal Interpolation (**LETKF-OI**) **OR**
    - 3D Variational (**3D Var**) algorithm
  - Interface for Observation Data Access (**IODA**) for observation formatting and ingestion
  - Unified Forward Operator (**UFO**), H(x), for forecast & observations evaluation

The Land DA v3.0.0

- **Land DA v3.0.0** is the latest public release version. It expands coupling options, observation capabilities, and workflow automation among other enhancements from its previous release, v2.0.0
- **Supported Datasets**
  - *Snow data*
    - Global Historical Climatology Network, **GHCN**
    - Interactive Multi-sensor Snow and Ice Mapping System, **IMS**
    - Surface Snow water equivalent, **SFCSNO**
  - *Soil moisture datasets (see this EPIC news article for more details)*
    - Soil Moisture Active Passive, **SMAP**
    - Soil Moisture Operational Products System, **SMOPS**
- Please refer to the **Land DA v3.0.0 User's Guide** for additional details

Land DA Resources

Land DA Get-code Page	https://epic.noaa.gov/land-data-assimilation-system/
Land DA v3 Users Guide	https://land-da-workflow.readthedocs.io/en/release-public-v3.0.0/
Noah-MP LSM	https://github.com/NCAR/noahmp
JEDI DA System	https://github.com/JCSDA/jedi-bundle
Data Bucket	https://noaa-ufs-land-da-pds.s3.amazonaws.com/index.html#current_land_da_release_data/v3.0.0/
Land DA v3 container image	ubuntu22.04-intel-landda-release-public-v3.0.0.img *(a direct download link)*
Land DA Q&A Forum	https://github.com/ufs-community/land-DA_workflow/discussions/categories/q-a

Outline of Land DA Tutorial

Step 1: On a Linux-based utility host, spin up the **Land DA AWS parallel cluster**. See AWS_Create_UtilityHost_ParallelCluster_Instructions.pdf for a step-by-step guide.

New users are expected to create the utility host and the parallel cluster based on the build scripts provided at https://github.com/NOAA-EPIC/aws-landda-tutorial

Step 2: **Login to AWS**, select the region to “us-east-1” and connect to Land DA cluster

The cluster already contains the input data, container image, and all prerequisites

Step 3: **Set up the container** & Update **“config.yaml”** for input parameters

Step 4: **Launch the Rocoto workflow** and monitor workflow status

Step 5: **Explore the output directory**

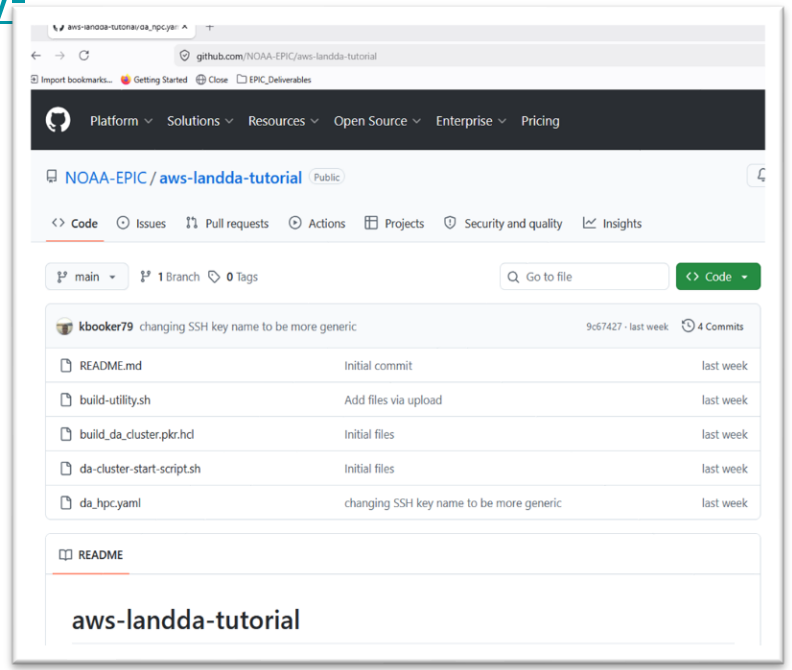
Step 6: **Transfer output plots** to your local computer

Create an S3 bucket (or use an existing one) to transfer files to your local machine

Setup a Utility Host & Create an AWS Cluster

- Set-up Linux based Utility Host (identical to login node on HPCs). Skip this step if a utility host already exists. Refer to this step-by-step guide for detailed instructions.
- Connect to the utility host and clone the Land DA Cluster build scripts from: https://github.com/NOAA-EPIC/aws-landda-tutorial
- Update these cluster build scripts to match your host settings
- Create a parallel cluster (identical to compute node on HPCs)

  AWS Setup (see "da_hpc.yaml" for additional info)
  - ❑ **Head node: c7i.2xlarge**
  - ❑ **Compute node: c7i.24xlarge**
  - ❑ **OS: ubuntu2204**
- This Land DA cluster will be fully provisioned with the necessary software, container image, & input data to begin your experiment



AWS Account Type

Organization (e.g. NOAA) /Institution provisioned

- Login through the **AWS SSO URL** shared by your cloud admin
- Governed by institutional policies, permissions, & security controls. You may need to coordinate with your **cloud admin** to build the cluster
- Once created, your cloud admin will share an "**instance-id**" to connect to the cluster

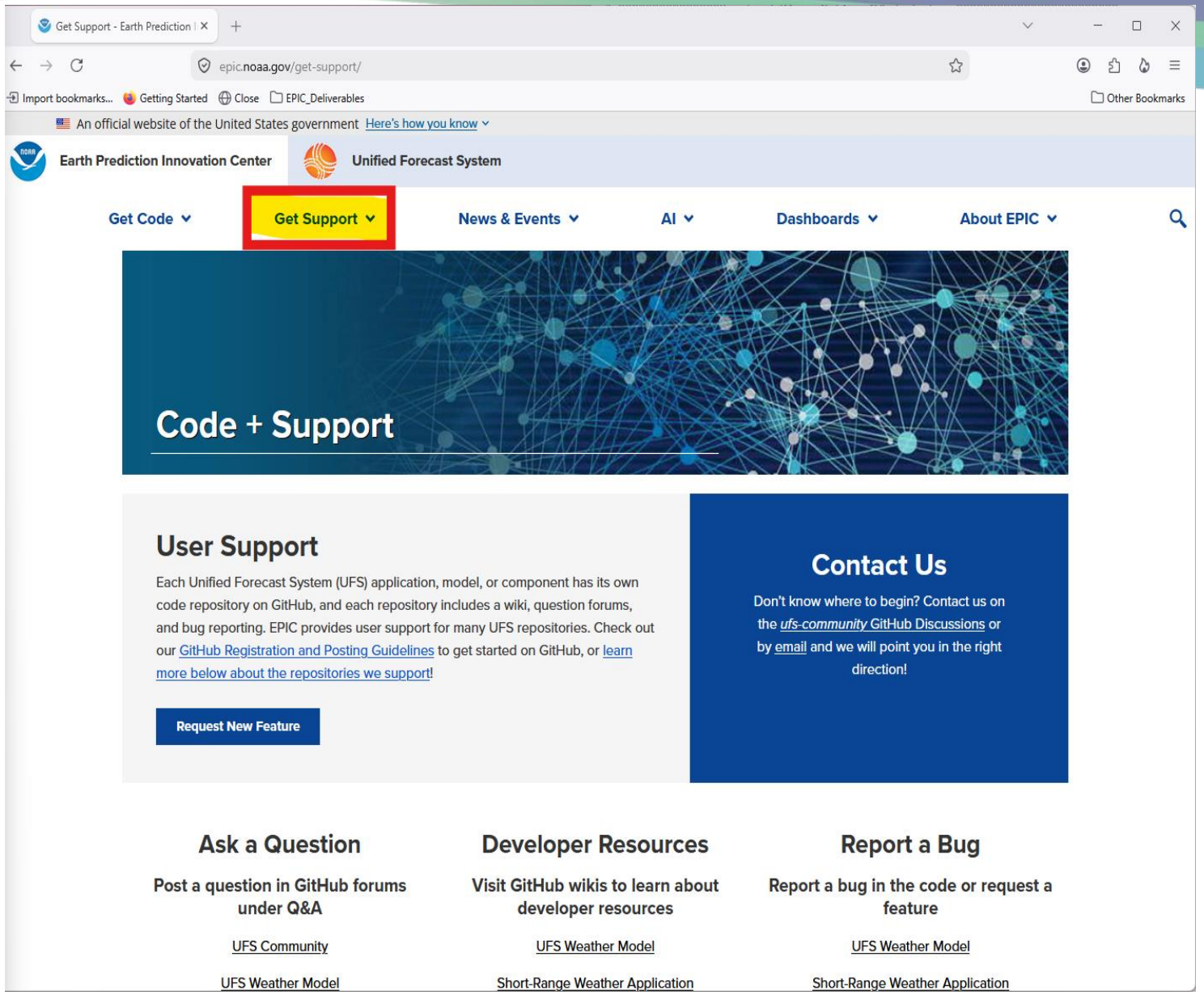
Personal AWS Accounts

- Requires a paid AWS account to run Land DA experiments
- login at https://console.aws.amazon.com/, or sign up if you already don't have an account
- Ideal for individual learning & experimentation; fully managed by the user
- User should follow the **set-up a Utility Host** & **create a Parallel Cluster** guide
- Once it is built, click on its "**instance-id**" to connect to the **cluster**

Land DA Forecast Experiment

- To create ***config.yaml***, *use the template config_samples/config.LND.era5.3dvar.ims.DA-fcst.warmstart.yaml*
- **Jan 19 – 20, 2025 (24 hr frequency, i.e., 2 cycles)**
- **LND** & **era5**: Noah-MP land component coupled through DATM component to feed era5 data
- **3dvar**: 3D-Var DA Algorithm
- **ims**: IMS snow cover
- **DA-fcst**: analysis (DA) result updates the restart files for the forecast run
- **warmstart**: uses saved variables from a recent forecast of the same model often via restart files

```
ACCOUNT: epic
APP: LND
ATMOS_FORC: era5
COLDSTART: 'NO'
COUPLER_CALENDAR: 2
DATE_CYCLE_FREQ_HR: 24
DATE_FIRST_CYCLE: 2025011900
DATE_LAST_CYCLE: 2025012000
DT_ATMOS: 900
DT_RUNSEQ: 3600
envir: lnd_era5_3dvar_ims
EXP_CASE_NAME: lnd_era5_3dvar_ims_00
FCSTHR: 24
JEDI_ALGORITHM: 3dvar
LND_CALC_SNET: .true.
LND_IC_TYPE: custom
LND_INITIAL_ALBEDO: 0.25
LND_LAYOUT_X: 1
LND_LAYOUT_Y: 2
LND_OUTPUT_FREQ_SEC: 21600
MED_COUPLING_MODE: ufs.nfrac.aoflux
net: landda
NPROCS_ANALYSIS: 6
NPZ: 127
OBS_GHCN_SNOW: 'NO'
OBS_IMS_SNOW: 'YES'
OBS_SFCSNO: 'YES'
RES: 96
RUN: landda
WE2E_TEST: 'NO'
~
```



Land DA Q&A Forum
https://github.com/ufs-community/land-DA_workflow/discussions/categories/q-a

EPIC User Support: support.epic@noaa.gov