

UFS Land-DA Workflow

- Day 3: JEDI-bundle & Pre/post-processing -

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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/>



Outline

- JEDI-bundle synced with GDAS App
- Pre-processing: Snow observation data / ERA5 DATM forcing data
- Diagnostic plots in Analysis Task
- Built-in tile-to-tile converter
- Post-processing
- GitHub Repository: Issue / Pull Request (PR) / Projects
- Next steps (future plan)

JEDI-bundle Synced with GDAS App

- The JEDI bundle synced with GDAS (NOAA/EMC) is provided in the 'sync_gdas' branch under the NOAA-EPIC fork of the JCSDA/jedi-bundle repository:

NOAA-EPIC / jedi-bundle

<> Code Pull requests Actions Projects Wiki Security Insights Settings

jedi-bundle Public
forked from JCSDA/jedi-bundle

sync_gdas 2 Branches 0 Tags

This branch is 10 commits ahead of JCSDA/jedi-bundle:develop.

chan-hoo Merge branch 'sync_gdas' of https://github.com/NOAA-EPIC/jedi-bundle 9ae5d · 2 months ago 33 Commits

File	Commit Message	Time
modulefiles	Merge branch 'sync_gdas' of https://github.com/NOAA-EPIC/jedi-bundle	2 months ago
.gitignore	add job card for orion	2 months ago
CMakeLists.txt	fix module for hercules	2 months ago
LICENSE	Release 1.0.0: replace branches with tags in CMakeLists.txt	3 years ago
README.md	Update develop (public) from develop (internal)	2 years ago
fv3-interface.cmake	update module files	2 months ago

NOAA-EMC / GDASApp

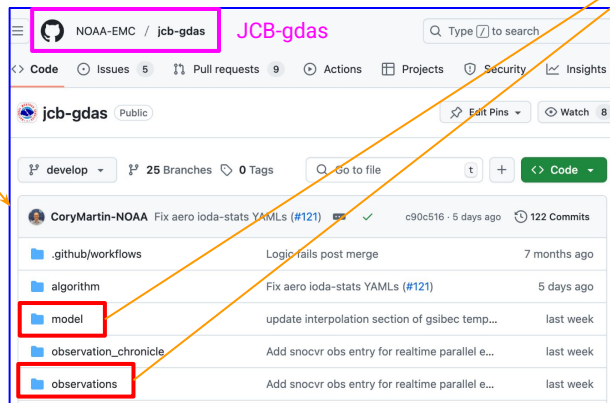
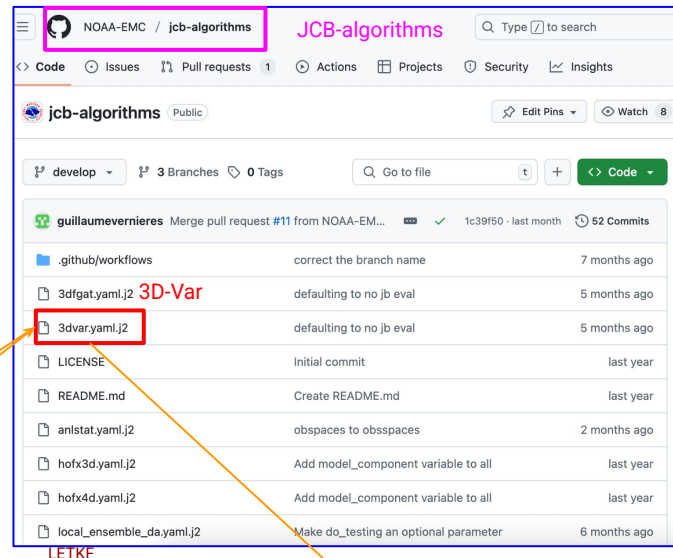
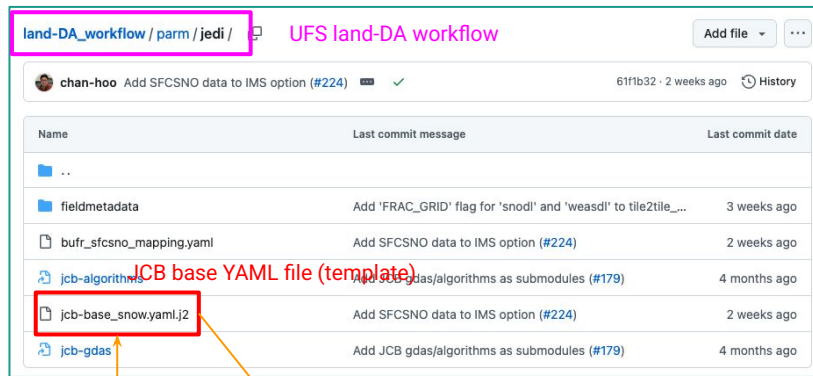
<> Code Issues 123 Pull requests 9 Discuss

Files GDASApp / src /

Directory	Git URL	Tag
ecbuild_bundle(PROJECT crtm	GIT "https://github.com/JCSDA/crtm.git"	TAG bb7adb
ecbuild_bundle(PROJECT gsw	GIT "https://github.com/JCSDA-internal/GSW-Fortran.git"	TAG 697cbe
ecbuild_bundle(PROJECT bufr-query	GIT "https://github.com/NOAA-EMC/bufr-query"	TAG 97367fc
ecbuild_bundle(PROJECT oops	GIT "https://github.com/JCSDA/oops.git"	TAG 215f2de
ecbuild_bundle(PROJECT vader	GIT "https://github.com/JCSDA/vader.git"	TAG 27bb498
ecbuild_bundle(PROJECT saber	GIT "https://github.com/JCSDA/saber.git"	TAG 379cc26
option(ENABLE_IODA_DATA "Obtain ioda test data from ioda-data repository (vs tarball)" ON		
ecbuild_bundle(PROJECT ioda	GIT "https://github.com/JCSDA/ioda.git"	TAG 28269a0
option(ENABLE_UFO_DATA "Obtain ufo test data from ufo-data repository (vs tarball)" ON		
ecbuild_bundle(PROJECT ufo	GIT "https://github.com/JCSDA/ufo.git"	TAG 5ec987f
include(fv3-interface.cmake)		
ecbuild_bundle(PROJECT fv3	GIT "https://github.com/JCSDA/GFDL_atmos_cubed_sphere.git"	TAG ab25dc0
ecbuild_bundle(PROJECT fempis	GIT "https://github.com/JCSDA/fempis.git"	TAG 4f12677
ecbuild_bundle(PROJECT fv3-jedi-lm	GIT "https://github.com/JCSDA/fv3-jedi-linear-model.git"	TAG 5994c38
option(ENABLE_FV3_JEDI_DATA "Obtain fv3-jedi test data from fv3-jedi-data repository (vs tarball)" ON		
ecbuild_bundle(PROJECT fv3-jedi	GIT "https://github.com/JCSDA/fv3-jedi.git"	TAG 9ca9320
#ecbuild_bundle(PROJECT soca	GIT "https://github.com/JCSDA-internal/soca.git"	TAG bdd7828
ecbuild_bundle(PROJECT iodaconv	GIT "https://github.com/JCSDA-internal/ioda-converter.git"	TAG cdab772

JEDI Configuration by JCB

- The JEDI input configuration YAML is created by JCB in the 'jcb' workflow task.



jedi_3dvar_snow.yaml

JEDI input YAML file

If you want to tune the configuration in JCB-gdas, you can fork the 'NOAA-EPIC/jcb-gdas' repository and change it in a new branch.

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

Pre-processing: IODA Converters for Snow Observation Data

- IODA (Interface for Observation Data Access) converters: convert the snow observation raw data into the format of UFO and OOPS in JEDI.
 - UFO (**U**nified **F**orward **O**perator): Computes the simulated observations $H(x)$ and performs the quality control (QC) and filtering of the observation data.
 - OOPS (**O**bject-**O**riented **P**rediction **S**ystem): provides data assimilation algorithms.
- IODA converter scripts used in the 'prep_data' task of the UFS land-DA workflow:
 - **GHCN** data: 'land-DA_workflow/ush/[ghcn_snod2ioda.py](#)'
 - Input: {year}.csv, ghcnd-stations.txt
 - Output: ghcn_snwd_ioda_{date}.nc (JEDI format)
 - **IMS** data: 'land-DA_workflow/ush/[imsfv3_scf2ioda.py](#)'
 - Input: ims_{date}.asc (ASCII file) obtained from the archive of GFS/GDAS.
 - Intermediate converter '**calfIMS.exe**': Convert the raw ASCII file to NetCDF file.
 - Output: obs_{date}.ims_snow.tm00.nc (JEDI format)

Pre-processing: ERA5 (DATM Forcing Data)

- The ERA5 forcing data can be downloaded from the Climate Data Store (CDS):



<https://cds.climate.copernicus.eu/datasets>

Climate Data Store

Datasets

Applications

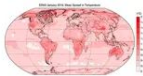
User guide

Live

Background

ERA5 hourly data on single levels from 1940 to present

Updated today



ERA5 is the fifth generation ECMWF reanalysis for the global climate and weather for the past 8 decades. Data is available from 1940 onwards. ERA5 replaces the ERA-Interim reanalysis. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset...

Reanalysis Copernicus C3S Global Past Atmosphere (surface) Atmosphere (upper air)

ERA5 hourly data on single levels from 1940 to present

Overview

Download

Documentation

Complete all required fields before submitting the request.

[Clear all fields](#)

Product type [Select all](#) [Clear all](#)

☒ Reanalysis

☐ Ensemble mean

☐ Ensemble members

☐ Ensemble spread

References

[Citation and attribution](#)

DOI: [10.24381/cds.adbb2d47](https://doi.org/10.24381/cds.adbb2d47)

Licence

[Licence to use Copernicus Products](#)

Variables:

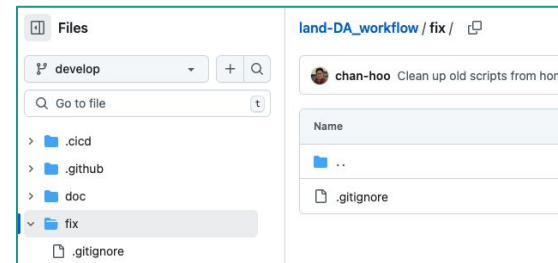
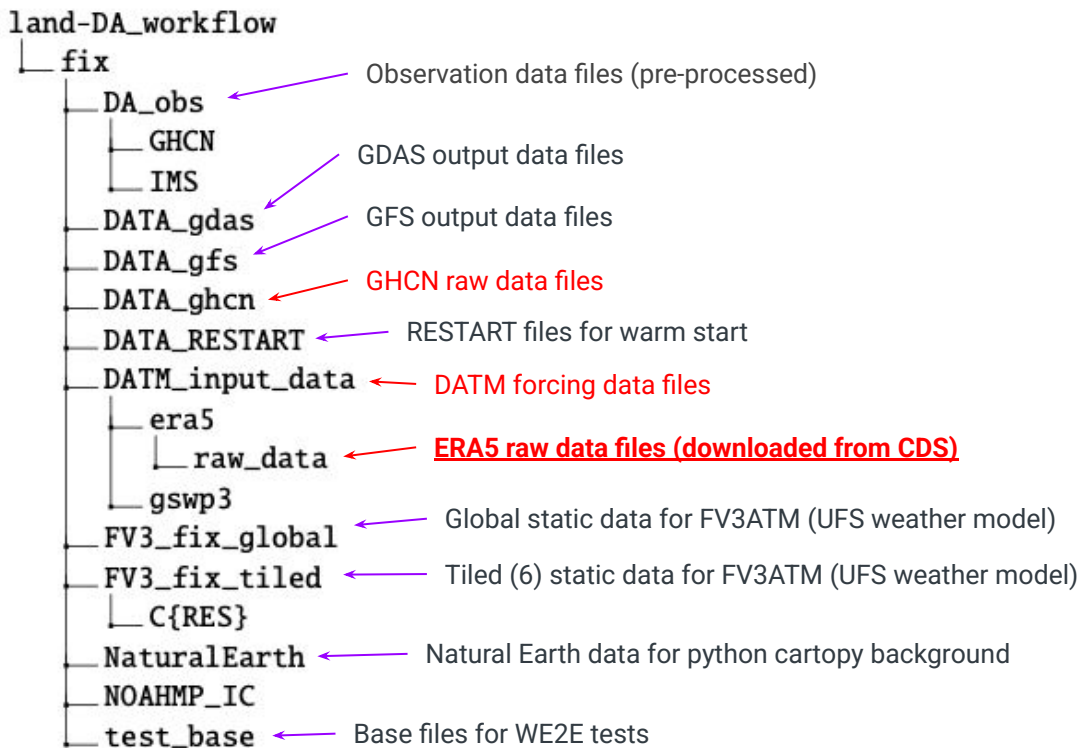
1. 10m u-component of wind
2. 10m v-component of wind
3. 2m dewpoint temperature
4. 2m temperature
5. Surface pressure
6. Mean surface downward long-wave radiation flux
7. Mean surface downward short-wave radiation flux
8. Mean total precipitation rate

The downloaded NetCDF data files should be moved to the 'fix' directory

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

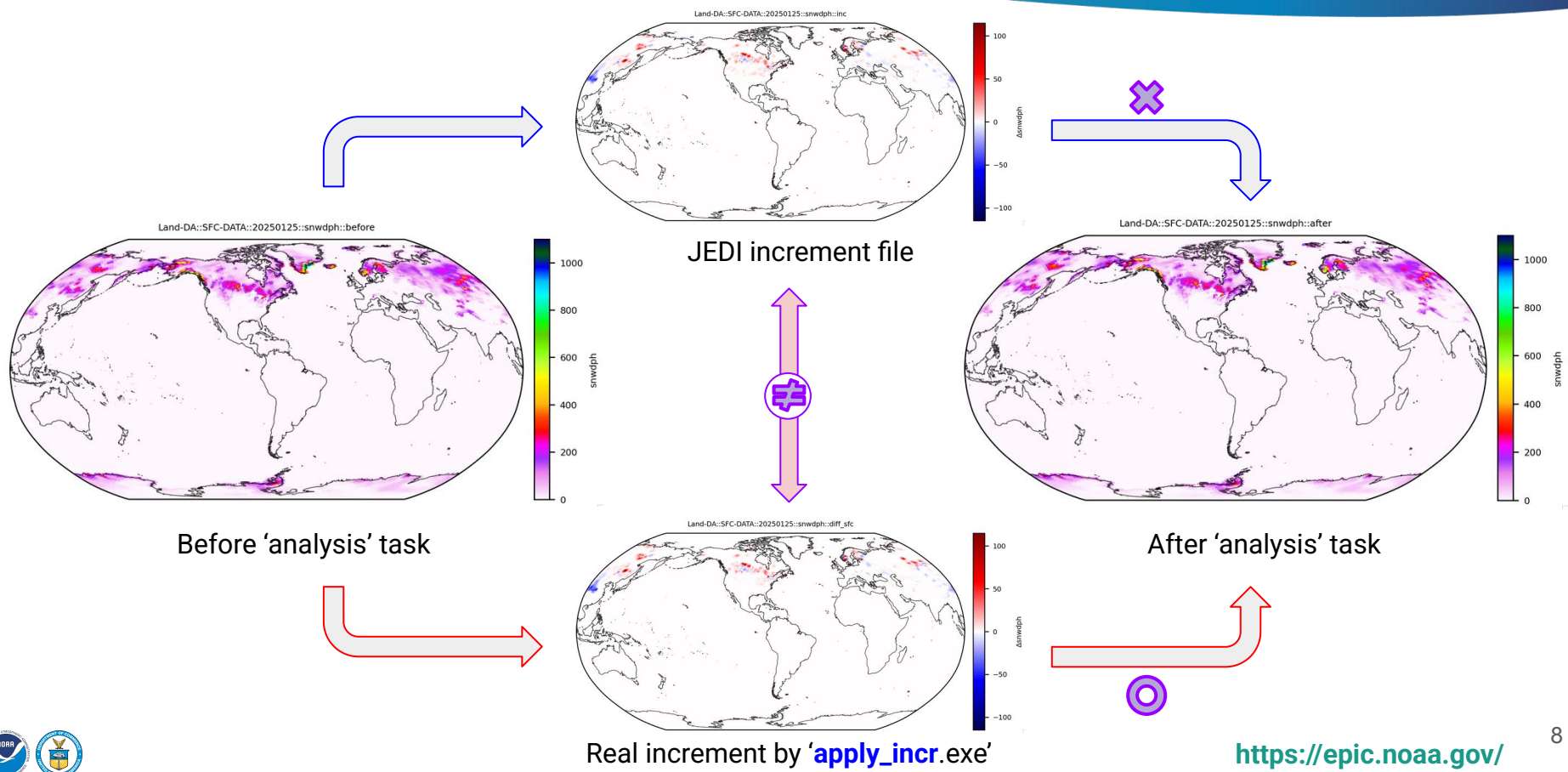
Static Data (FIX) Directory

- The input static data (fix) files are soft-linked into the 'fix' directory by the build script.



Initially empty in GitHub repository

Diagnostic Plots in Analysis Task



Tile-to-tile Converter

- Acts like a mediator between JEDI and the land model (Noah-MP) of the ufs weather model.
- The built-in tool 'tile2tile_converter' runs in two workflow tasks:
 - In 'pre_anal': Creates the 'sfc_data' files from the restart files for the 'analysis' task.
 - In 'post_anal': Creates the restart files for warm-start from the 'sfc_data' and restart files for the 'forecast' task.
- Two key variable names do not match between JEDI (sfc_data files) and the land model (restart files):

Variable name in 'tile2tile_converter'	Description	Noah-MP (restart)	JEDI (sfc_data)
swe	Snow water equivalent	weasd	sheleg / weasdl
snow_depth	Snow depth over land	snwdph	snwdph / snodl

- Source code: land-DA_workflow/sorc/tile2tile_converter.fd

Post-processing: 'plot_stats'

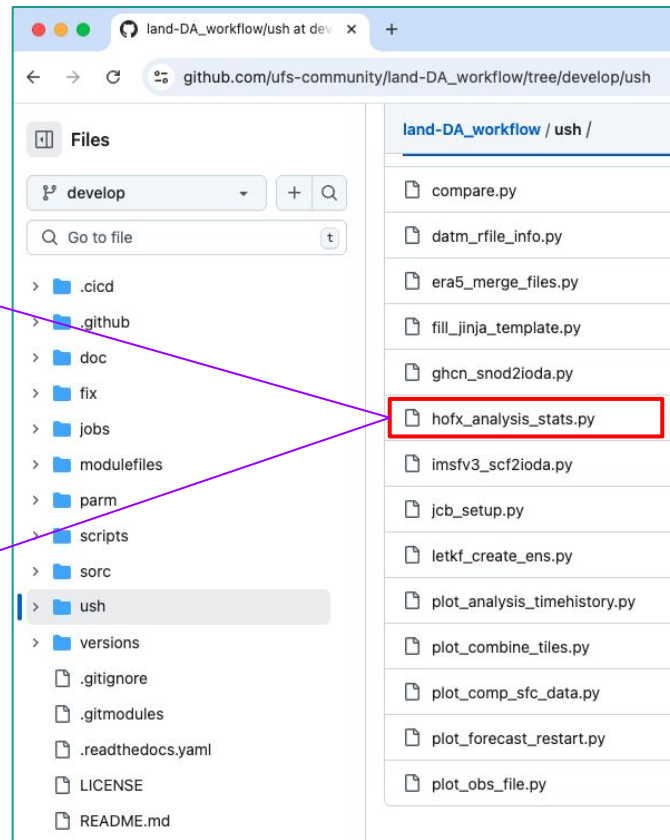
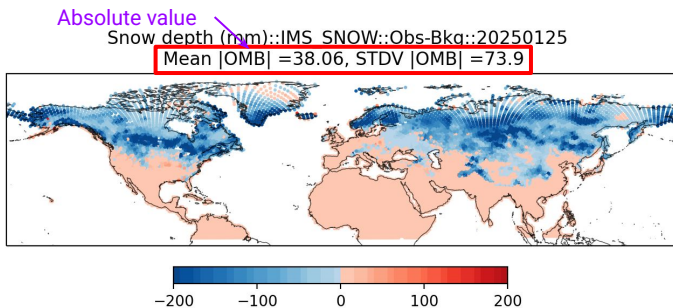
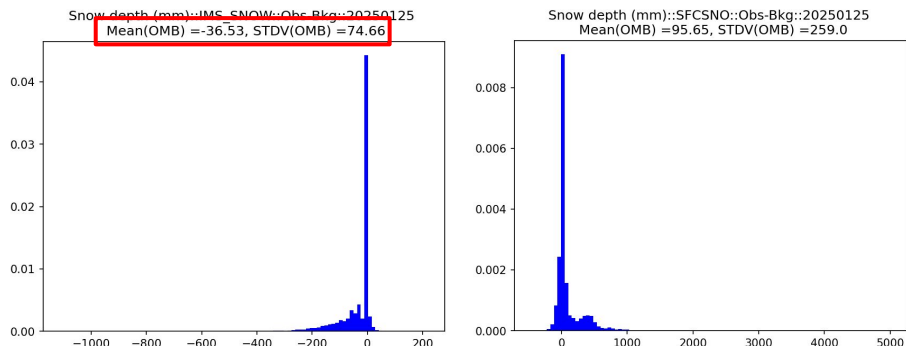
- Result file of JEDI: 'diag.{obs_type}_{cycle_date}.nc'

Group name	Description	LETKF	3D-Var
EffectiveError0	UFO's computed effective ObsError value	<input type="radio"/>	<input type="radio"/>
EffectiveQC0	UFO's final QC value given by 'QCflags.h'	<input type="radio"/>	<input type="radio"/>
MetaData	Ancillary data such as stationElevation, longitude, and latitude	<input type="radio"/>	<input type="radio"/>
ObsBias0	Bias correction of observation data	<input type="radio"/>	<input type="radio"/>
ObsError	Observation errors from upstream data sources	<input type="radio"/>	<input type="radio"/>
ObsValue	Directly measured observation values	<input type="radio"/>	<input type="radio"/>
hofx0	End product of the forward operator; $H(x)$		<input type="radio"/>
hofx0_1	$H(x)$ of Ensemble member 1	<input type="radio"/>	
hofx0_2	$H(x)$ of Ensemble member 2	<input type="radio"/>	
hofx_y_mean_xb0	Mean of $H(x)$	<input type="radio"/>	
ombg	Observation - $H(\text{Background})$	<input type="radio"/>	<input type="radio"/>

Post-processing: Histogram and Scatter Plots

- Task 'plot_stats': plots of 'ombg' from JEDI output (histogram / scatter plot)

CADRE 1: IMS + SFCSNO



Post-processing: Time-history Plot

- Task 'plot_stats': Time-history plots of ombg over cycles

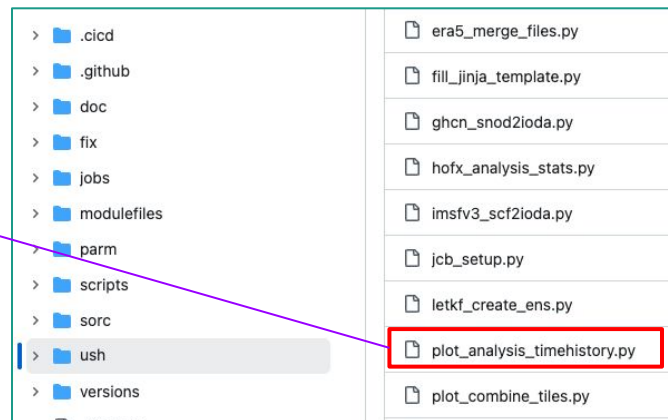
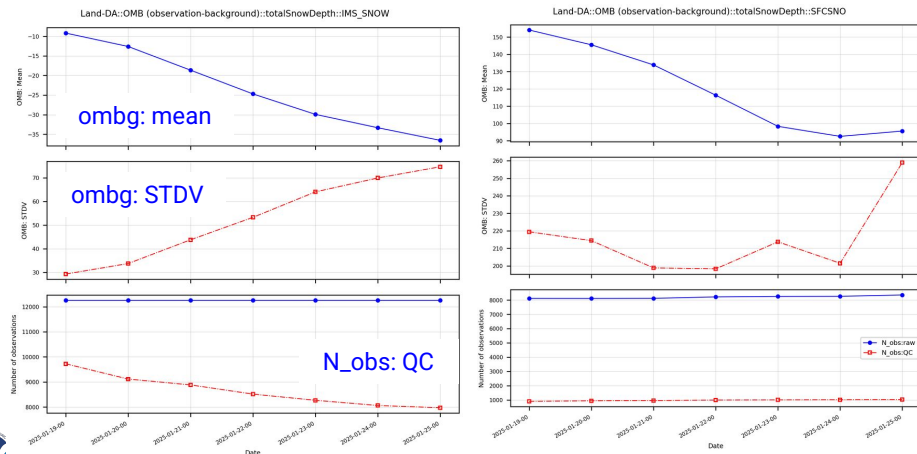
com_dir/landda.{date}/hofx/{time_history_data}.txt

```
epic 1084787 May 1 20:57 diag.ghcn_snow_2025012500.nc
epic 277 May 1 21:04 hofx_omb_timehis_abs_ghcn_snow.txt
epic 301 May 1 21:04 hofx_omb_timehis_ghcn_snow.txt
```

log_dir/analysis_{date}.log

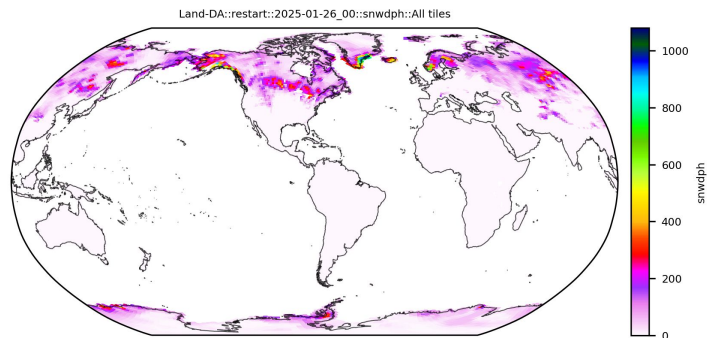
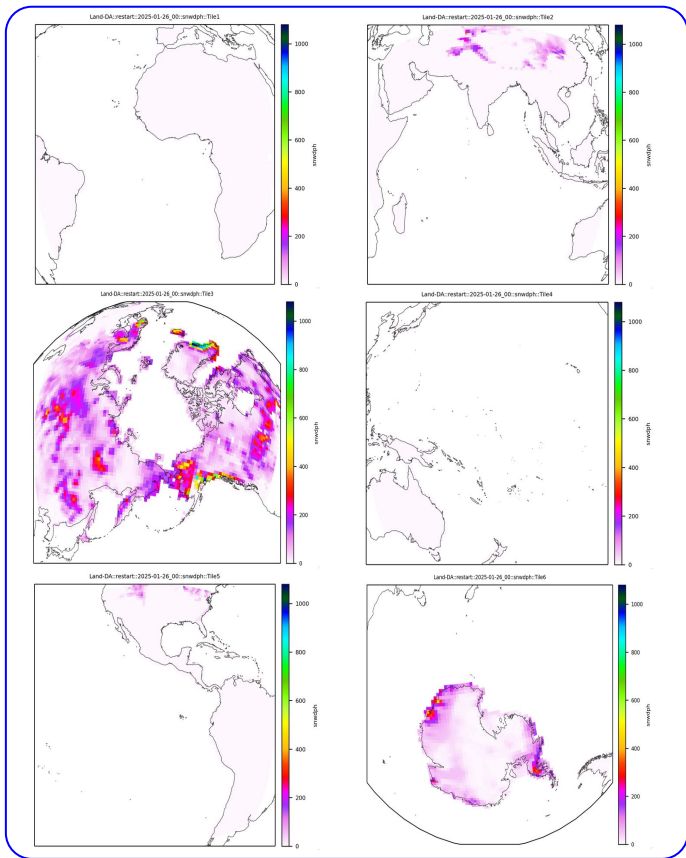
```
QC ims_snow snowCoverFraction: 12254 rejected as processed but not assimilated.
QC ims_snow snowCoverFraction: 0 passed out of 12254 observations.
QC ims_snow totalSnowDepth: 3 missing values.
QC ims_snow totalSnowDepth: 3272 out of bounds.
QC ims_snow totalSnowDepth: 319 black-listed.
QC ims_snow totalSnowDepth: 43 rejected by first-guess check.
QC ims_snow totalSnowDepth: 8617 passed out of 12254 observations.
```

CADRE 1: IMS + SFC Sno

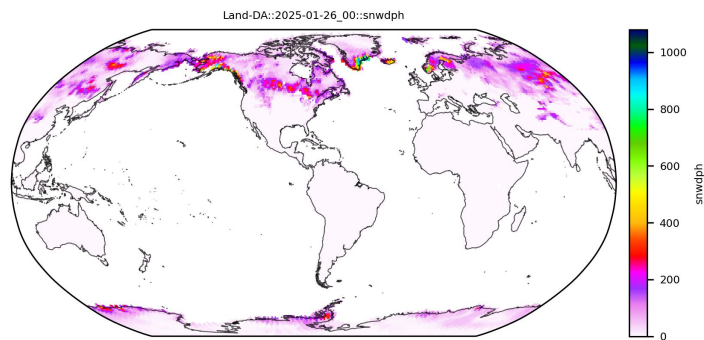


Post-processing: Plots of Restart Files

- Task 'plot_stats': three types of 'snow depth' plots for restart files (result of UFS weather model)



All tiles on the globe



Interpolated onto the coarse grid (400x200)

Git Issues to GitHub Repository

- You can open any issues on the land-DA workflow to the GitHub repository:

The screenshot shows the GitHub interface for the repository `ufs-community / land-DA_workflow`. The `Issues` tab is selected and highlighted with a red box. A red arrow points to the `New issue` button. The search bar contains `is:issue state:closed`. The list of issues is filtered to show only closed issues. The issues are:

Issue Title	Category	Number	Status	Author	Created
Need sample configuration scripts for CADRE training	enhancement	#226	Closed	chan-hoo	3 days ago
IMS data alone is not good enough	enhancement	#223	Closed	chan-hoo	5 days ago
Variable names <code>snodl</code> and <code>weasdl</code> do not work for the <code>tile2tile_converter</code>	enhancement	#220	Closed	chan-hoo	2 weeks ago
Need tool to create ERA5 forcing input files with CDS raw data	enhancement	#218	Closed	chan-hoo	3 weeks ago
CCPP suite for APP=ATML needs to be updated	enhancement	#215	Closed	chan-hoo	last month

Github repository of UFS land-DA workflow: https://github.com/ufs-community/land-DA_workflow

Pull Request (PR) to GitHub Repository

- Every update/development is integrated into the repo through a pull request (PR).
- PRs are reviewed by the code managers and should be approved by at least one.
- All PR commit history can be checked in the GitHub repository.

ufs-community / land-DA_workflow

Code Issues 1 Pull requests 1 Discussions Actions Projects 1 Wiki Security Insights Settings

Filters is:pr is:closed Labels 19 Milestones 0 New pull request

Clear current search query, filters, and sorts

	Author	Label	Projects	Milestones	Reviews	Assignee	Sort
<input type="checkbox"/> 1 Open ✓ 115 Closed							
<input type="checkbox"/> Add sample configuration for CADRE training ✓ #227 by chan-hoo was merged 3 days ago • Approved 3 of 17 tasks					1		1
<input type="checkbox"/> Change location of py env for JCB to work dir on gaea-c6 ✓ enhancement #225 by chan-hoo was merged 4 days ago • Approved 3 of 17 tasks							1
<input type="checkbox"/> Add SFCSNO data to IMS option ✓ #224 by chan-hoo was merged 5 days ago • Approved 3 of 17 tasks					1		1

Project Management in GitHub Repository

- The GitHub issues and PRs are managed in the GitHub projects.

The screenshot shows the GitHub interface for the 'ufs-community / land-DA_workflow' repository. The 'Projects' tab is selected and highlighted with a red box. Below the navigation bar, the 'Projects' section shows a search filter 'is:open' and a 'New project' button. A list of projects is displayed, with 'land-DA_workflow_management' highlighted by a red arrow. Below the projects list, a table of issues is shown, including their status, assignee, and labels.

Issue Number	Issue Description	Assignee	Status	Linked Issue	Label
1	Executable 'apply_incr' does not work correctly in certain case #172	chan-hoo	On Hold		bug
2	Build-related files and directories should be located inside src to meet NCO standards #48	chan-hoo	Done	#49	NCO EE2 compliance
3	template files should be relocated #50	chan-hoo	Done	#49	NCO EE2 compliance
4	Module and configuration files need to be re-organized #51	chan-hoo	Done	#93	enhancement
5	Versions of modules should be controlled in centralized location #52	chan-hoo	Done	#63	NCO EE2 compliance

Next Steps

- Continue to enhance the [coupling options](#) of Noah-MP (land) and FV3ATM (atmosphere) in the sync with UFS Weather Model.
- Continuous alignment of the [GFSv17](#) JEDI land-DA operational features though the JCB analysis configuration: analysis control variables and observation database management.
- Extend analysis experiment capability including [high-resolution](#) model configuration and re-analysis capability: a complete set of pre- and post-processing utilities.
- Continue to enhance DA workflow structure and framework reproducible for [additional applications](#).

Q / A

Community feedbacks: https://github.com/ufs-community/land-DA_workflow

or

Emails: jong.kim@noaa.gov / chan-hoo.jeon@noaa.gov