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NEWS IN THIS QUARTER

JEDI SkyLab: A Comprehensive Testbed for Data Assimilation Innovation

Clémentine Hardy-Gas

The Joint Effort for Data assimilation Integration, or JEDI, is a unified data assimilation software package for earth system prediction that is model-agnostic and generic to work with many types of observations, algorithms, and models. It is a combined effort developed at JCSDA with partners at NOAA, NASA, US Navy, and US Air Force, and additional collaboration from the UK Met Office, NCAR, academia, and the private sector. It offers a unified approach to algorithm development, model integration, observation processing, and software maintenance while preserving scientific diversity. SkyLab is a comprehensive testbed that allows new ideas, systems, and scenarios to be tested. It has immense flexibility for data assimilation science testing, and can also run operational-sized experiments, adding even more functionality. With an incredibly wide variety of options in everything from models to algorithms to platforms, SkyLab is an invaluable tool for data assimilation testing.

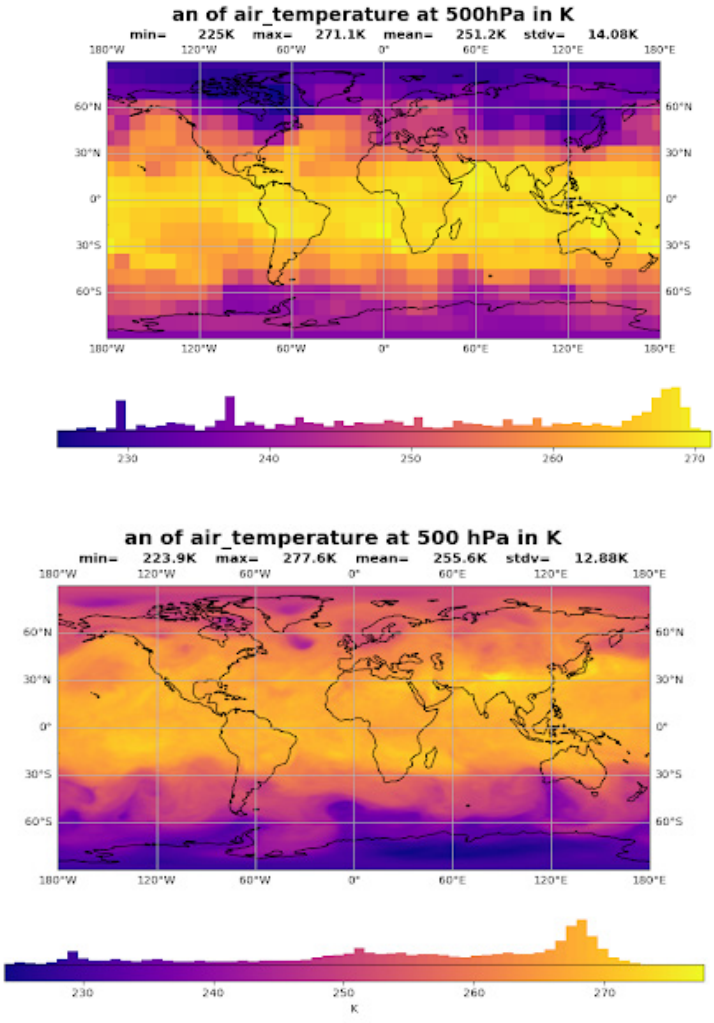
One large advantage of SkyLab for research purposes is that it can be run on a wide variety of platforms. SkyLab can run on a personal laptop, an HPC, or a cloud system (it can currently run on AWS, and is being tested for NOAA ParallelWorks). This reduces wait time for running experiments that don't actually need HPC computing power and also allows for early testing and bug-finding on a laptop, which can run at low resolution an experiment that will later be run at high resolution on an HPC.

SkyLab can also run with a wide variety of models, including MPAS, UFS, GEOS, MOM6, and the L95 and QG toy models. These models can be run at any resolution from coarse to very high. There are a number of algorithms to choose from as well, options for the representation of error covariances, over 30 different observing systems, and novelty applications developed by JCSDA or our partners.

SkyLab runs as a combination of several workflows. First there is an ingest suite for observations and model backgrounds, which fetches, converts, and stores them. Next in the cycle is the experiment, which can range from observation simulations to full cycling data assimilation systems. Then, all the results and diagnostics are pushed online for easy visualization of the experiment's results. A "suite", like the ingest suite, is a series of tasks needed to run one experiment.

There are several more advantages to SkyLab for users, as well. Changing any parameter of an experiment only requires changing a few words in a yaml configuration file, previous experiments are registered in the JEDI database (R2D2) and can easily be accessed, and the latest JEDI developments are constantly being added ready-to-use (for example, data from the new TEMPO instrument was running in SkyLab less than 24 hours after becoming publicly available). The updates to the latest JEDI version also make SkyLab an excellent tool for demonstrating JEDI capabilities to our partners.

Future plans for SkyLab include adding advanced capabilities for more models, new ensemble Kalman filter options, and continued onboarding of new instruments. You can find the latest release of skylab at skylab.jcsda.org.



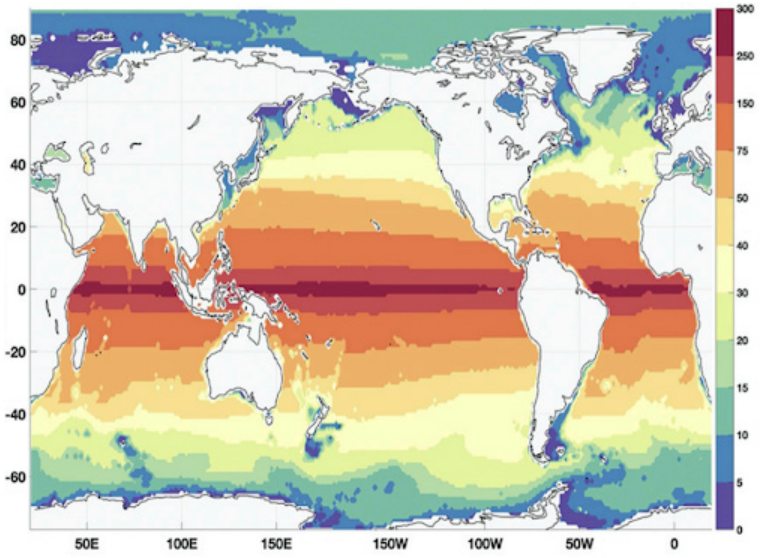
Air temperature: low resolution (top) and high resolution (bottom) versions of the same model run in Skylab

Generic Explicit Diffusion Operator Added to JEDI

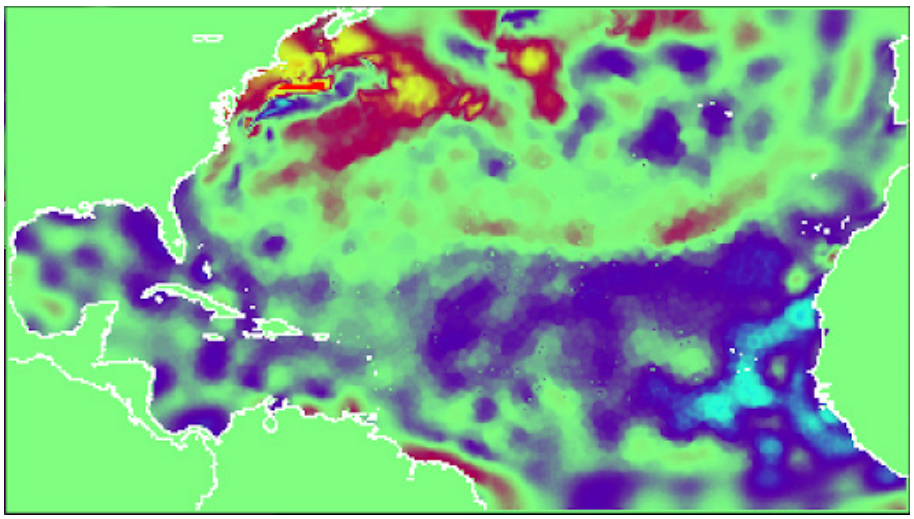
Travis Sluka

One of the key strengths of the JEDI system is the model agnostic components which can be used by many different model interfaces, allowing developments from one team to be used by every other. Use of these components has allowed the JCSDA team to make remarkable advancements with marine data assimilation in a short amount of time, using the generic JEDI components to jumpstart the work. Up until now it has mostly been the JCSDA Sea-ice Ocean Coupled Assimilation (SOCA) team using JEDI components developed by other teams, but that changes with this explicit diffusion operator.

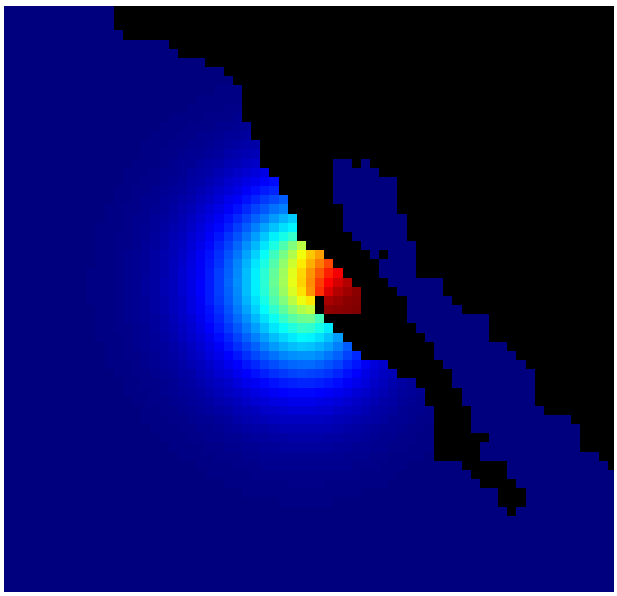
The JCSDA SOCA team has implemented a generic diffusion correlation operator, intended for short length scales, within System Agnostic Background Error Representation (SABER) repository that is usable by any model interface. Until recently another option called BUMP NICAS was used as the correlation operator for the ocean. However, BUMP NICAS was originally intended for large correlation lengths like those in the atmosphere. It does very well at these scales, but at smaller scales doesn't perform with sufficient computational efficiency. For ocean data assimilation, correlation lengths are much smaller than for most atmospheric variables; the largest lengths are just 250 km in a narrow band along the equator, but quickly shrink as you move to higher latitudes. Near the poles the correlation lengths drop to less than 10 km. At these small scales, the BUMP NICAS method is no-longer efficient and results in very long calibration times. But with the new explicit diffusion operator, combined with BUMP NICAS, JCSDA partners can represent a variety of spatial scales in a state-of-the-art DA system.



The typical correlation lengths in the ocean (km) as determined by the first surface mode deformation radius (Lacasce and Groeskamp, 2020)



The hexagonal patterns in BUMP NICAS that emerge when length scales get small



example of diffusion-based correlation flowing around land

EDITOR'S NOTE

Welcome to the Fall 2024 JCSDA Newsletter! Summer is drawing to a close, and the JCDSA has begun a new annual operating cycle, focused on continued advancement of the Joint Effort for Data assimilation Integration (JEDI) and accelerating its development to readiness for full operational implementation. Thus it's timely to feature an article in this edition authored by Clementine Gas on JEDI Skylab as a testbed for DA innovation, describing its motivation, design, features, ease of use, and applications to date. One application of JEDI that has already been operationally implemented is Sea-ice Ocean Coupled Assimilation (SOCA). Travis Sluka has contributed an article describing the SOCA team's development of a new generic diffusion operator in JEDI. I am confident that you will find the advancements described in these articles exciting.

There is only one new staff member, Liam Adams to introduce this month. I encourage you to read his biographical sketch here - even by the standard for diverse and interesting characters working with the JCSDA, he brings a unique perspective and background to us!

As these lines are being written abstracts are being submitted for the 13th Symposium on the JCSDA as part of the AMS Annual Meeting in January, 2025 in New Orleans, LA, and soon will be reviewed and organized into oral and poster sessions. The Symposium continues to be an excellent venue for interaction with and growth of the JCSDA community, and I hope you will be able to take an active part in this year.

Best Wishes - Jim Yoe, Editor

PEOPLE

Liam Adams

Liam joined the JCSDA in June 2024, coming from a position in NASA's Global Modelling and Assimilation Office (GMAO), where he worked on model linearization. Liam's background is in applied mathematics and software engineering, and he has previously worked on problems in motion capture technology and additive manufacturing. Prior to pursuing a more academically oriented career, Liam served for nearly a decade as a paratrooper in the British Army, and is likely one of very few paratroopers to have jumped from an aircraft with mathematics textbooks in their equipment. When not working, Liam enjoys many outdoor activities, including hiking, climbing, kayaking, and skiing.

SCIENCE CALENDAR

TITLE	DATE	LOCATION	WEBSITE
IROWG	September 12-17, 2024	Boulder, CO	
EUMETSAT Meteorological Satellite Conference	September 30-October 3, 2024	Wurzburg, Germany	https://www.eumetsat.int/eumetsat-meteorological-satellite-conference-2024
International Symposium on Data Assimilatio	October 21-24, 2024	Kobe, Japan	https://www.data-assimilation.riken.jp/
AMS 105th Annual Meeting and JCSDA Symposium	January 12-16, 2025	New Orleans, LA	https://annual.ametsoc.org/index.cfm/2025/
JEDI Space Weather Data Assimilation Workshop	August 28-29, 2024	Boulder, CO	https://irowg.org/irowg-10/

CAREER OPPORTUNITIES

Opportunities in support of JCSDA may be found at www.jcsda.org/news as they become available.