JEDI-SABER Experiment

DARC/NCEO data assimilation training course 2025

In this practical, we explore how observation information is spread by the background error covariance matrix in data assimilation systems. Specifically, we investigate

- *How does an observation of a single variable at one grid point influence other points for the same variable?*
- *How does it influence other model variables (through dynamical constraints such as geostrophic balance)?*

We use the System Agnostic Background Error Representation (SABER) repository within the Joint Effort for Data assimilation Integration (JEDI) framework. We use a static background error covariance matrix similar to that used in the Met Office system. Step-by-step instructions for running the experiments are given below.

Experiment 1: Geostrophic balance

We examine how a pressure observation at a single grid point can influence the pressure field as well as the eastward and northward wind fields.

Step 1: Set up the experiment by running the following commands (after logging into RACC)

> *cp /storage/research/nceo/DA-training-course/docs/setup_saber_exps.sh .*

> *bash setup_saber_exps.sh*

> *cd saber_exps*

Step 2: Run the saber experiment

> *bash run_saber.sh*

This generates a NetCDF file named "output.nc".

Alternatively, we can submit the job to a compute node for faster execution:

> *sbatch run_saber.sh*

Step 3: Load the Anaconda environment for Python

> *module load anaconda/2023.09-0/met-env*

Step 4: Plot the result

Replace <variable> with

- dimensionless_exner_function_levels_minus_one
- eastward_wind
- northward_wind

to see how information of an observation of pressure spreads in the pressure, eastward wind or northward wind fields.

This generates a PNG file named "figure_ <variable>.png", which can be viewed by

display figure_ <variable>.png

Questions to discuss:

- *How do the wind fields respond to an observation in the pressure field? And why?*
- *If the observation location is changed (e.g., moved closer to the equator), how do you expect the wind response to change?*

Hint: To change the latitude of the observation, open the file "dirac_spectralb_gauss_vader_1.yaml" and modify line 141. Avoid setting both latitude and longitude to 0 simultaneously, as this will cause an error. Instead, use a value close to zero for latitude, such as 0.01.

Then repeat Steps 2 and 4.

Experiment 2: Non-divergent wind

We now investigate how an observation in the eastward wind component influences the northward wind field. This helps us understand the dynamic relationships in a non-divergent flow.

Question to discuss:

How are the eastward and northward wind components related in a non-divergent wind field?

Hint: To run the experiment, open the file "dirac_spectralb_gauss_vader_1.yaml" and change the variable on line 145 to "eastward_wind".

Then repeat Steps 2 and 4.