

# Structure of the data files for the manuscript “EnviFlux (v1.0): a simplified surface flux inversion tool based on four-dimensional variational data assimilation (4D-Var)”

Ross Bannister, April 2026

- The EnviFlux user guide and code are available here: <https://zenodo.org/records/18803399>.
- Note a single file of associated Legendre polynomials file (included in the archive below)  
`cvt_ass_legendre_poly.dat`  
needs to be downloaded to run the code. Before compilation, edit the variable `ALPfilename[256]` in the file  
`source.h`  
(part of the source code found in the link above) to the path and name of this file.
- The tar archives contain data directories, most of which contain a script `*.bash` (the bash script to run the code).
- In the `*.bash` scripts, the `$BIN_DIR` and `$ENVIFLUX_DIR` variables need to be redefined to match the locations of the compiled code and head directory of the data, respectively, on the user's machine.
- Some dearchived files are symbolic links, so they need to be untared (dearchived) on a filing system that supports symbolic links (such as Unix-like systems).
- To untar (dearchive) the tar files use the example command:  
`tar xvf FIG03.tar`  
Doing this for all the `.tar` files in this Zenodo record will generate the directories listed below. Once dearchived the `.tar` files can be deleted.

## Data used to make figures in the manuscript

### Fig. 03 (background error vertical correlations)

`./RecoverBlobs/Sept2025_experiments/Covs`

### Fig. 04 (true state used in source/sink location experiments)

`./RecoverBlobs/Sept2025_experiments/Truth`

### Fig. 05a,b (analyses source detection experiments, perfect model, total column obs)

`./RecoverBlobs/Sept2025_experiments/Assim/TracerFac1.0_FluxFac0.01_wFac1.0_Bias0.0`

### Fig. 05c,d (analyses source detection experiments, surface obs)

`./RecoverBlobs/Sept2025_experiments/Assim/TracerFac1.0_FluxFac0.01_wFac1.0_Bias0.0_tob_z0`

### Fig. 06a (analyses source detection experiments, model error, total column obs)

`./RecoverBlobs/Sept2025_experiments/Assim/TracerFac1.0_FluxFac0.01_wFac0.9_Bias0.0`

**Fig. 06b (analyses source detection experiments, model error, total column obs)**

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.1\_Bias0.0

**Fig. 06c (analyses source detection experiments, model error, surface obs)**

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.9\_Bias0.0\_tob\_z0

**Fig. 06d (analyses source detection experiments, model error, surface obs)**

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.1\_Bias0.0\_tob\_z0

**Figs. 07a,b (flux values and positions for different wind factors, total column obs)**

w=0.6, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.6\_Bias0.0

w=0.7, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.7\_Bias0.0

w=0.8, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.8\_Bias0.0

w=0.9, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.9\_Bias0.0

w=0.95, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.95\_Bias0.0

w=1.0, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias0.0

w=1.05, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.05\_Bias0.0

w=1.1, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.1\_Bias0.0

w=1.2, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.2\_Bias0.0

w=1.3, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.3\_Bias0.0

w=1.4, total column obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.4\_Bias0.0

**Figs. 07c,d (flux values and positions for different wind factors, surface obs)**

w=0.6, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.6\_Bias0.0\_tob\_z0

w=0.7, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.7\_Bias0.0\_tob\_z0

w=0.8, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.8\_Bias0.0\_tob\_z0

w=0.9, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.9\_Bias0.0\_tob\_z0

w=0.95, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac0.95\_Bias0.0\_tob\_z0

w=1.0, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias0.0\_tob\_z0

w=1.05, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.05\_Bias0.0\_tob\_z0

w=1.1, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.1\_Bias0.0\_tob\_z0

w=1.2, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.2\_Bias0.0\_tob\_z0

w=1.3, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.3\_Bias0.0\_tob\_z0

w=1.4, surface obs

./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.4\_Bias0.0\_tob\_z0

**Fig. 08a (flux values for different observation biases, total column obs)**

bias=20000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+20000  
bias=15000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+15000  
bias=10000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+10000  
bias=8000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+8000  
bias=6000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+6000  
bias=4000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+4000  
bias=2000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+2000  
bias=0, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias0.0  
bias=-2000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-2000  
bias=-4000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-4000  
bias=-6000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-6000  
bias=-8000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-8000  
bias=-10000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-10000  
bias=-15000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-15000  
bias=-20000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-20000

**Fig. 08b (flux values for different observation biases, surface obs)**

bias=2.29, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+2.29\_z0  
bias=1.71, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+1.71\_z0  
bias=1.37, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+1.37\_z0  
bias=1.14, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+1.14\_z0  
bias=0.91, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+0.91\_z0  
bias=0.70, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+0.70\_z0  
bias=0.46, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+0.46\_z0  
bias=0.23, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias+0.23\_z0  
bias=0.0, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias0.0\_tob\_z0  
bias=-0.23, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-0.23\_z0  
bias=-0.46, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-0.46\_z0  
bias=-0.70, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-0.70\_z0  
bias=-0.91, surface obs  
./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-0.91\_z0

bias=-1.14, surface obs  
 ./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-1.14\_z0  
 bias=-1.37, surface obs  
 ./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-1.37\_z0  
 bias=-1.71, surface obs  
 ./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-1.71\_z0  
 bias=-2.29, surface obs  
 ./RecoverBlobs/Sept2025\_experiments/Assim/TracerFac1.0\_FluxFac0.01\_wFac1.0\_Bias-2.29\_z0

**Fig. 09a,b (truth for quasi-real-world experiments)**

./Bias/Sept2025\_experiments/Truth

**Fig. 09c,d (background for quasi-real-world experiments)**

./Bias/Sept2025\_experiments/Background

**Fig. 10a,b (analysis, quasi-real-world, total column obs)**

./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias0.00

**Fig. 10c,d (analysis, quasi-real-world, in-situ obs)**

./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias0.00\_z0

**Fig. 11a (analysis, quasi-real-world, total column obs, w=0.7)**

./Bias/Sept2025\_experiments/Assim/wFac0.7\_Bias0.0

**Fig. 11b (analysis, quasi-real-world, total column obs, w=1.3)**

./Bias/Sept2025\_experiments/Assim/wFac1.3\_Bias0.0

**Fig. 11c (analysis, quasi-real-world, in-situ obs, w=0.7)**

./Bias/Sept2025\_experiments/Assim/wFac0.7\_Bias0.0\_z0

**Fig. 11d (analysis, quasi-real-world, in-situ obs, w=1.3)**

./Bias/Sept2025\_experiments/Assim/wFac1.3\_Bias0.0\_z0

**Fig. 12 (flux values for different wind factors, total column observations)**

w=0.6, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac0.6\_Bias0.0  
 w=0.7, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac0.7\_Bias0.0  
 w=0.8, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac0.8\_Bias0.0  
 w=0.9, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac0.9\_Bias0.0  
 w=0.95, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac0.95\_Bias0.0  
 w=1.0, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias0.00  
 w=1.05, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac1.05\_Bias0.0  
 w=1.1, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac1.1\_Bias0.0  
 w=1.2, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac1.2\_Bias0.0  
 w=1.3, total column obs  
 ./Bias/Sept2025\_experiments/Assim/wFac1.3\_Bias0.0

w=1.4, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.4\_Bias0.0

**Fig. 12 (flux values for different wind factors, in-situ observations)**

w=0.6, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac0.6\_Bias0.0\_z0  
w=0.7, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac0.7\_Bias0.0\_z0  
w=0.8, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac0.8\_Bias0.0\_z0  
w=0.9, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac0.9\_Bias0.0\_z0  
w=0.95, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac0.95\_Bias0.0\_z0  
w=1.0, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias0.00\_z0  
w=1.05, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac1.05\_Bias0.0\_z0  
w=1.1, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac1.1\_Bias0.0\_z0  
w=1.2, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac1.2\_Bias0.0\_z0  
w=1.3, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac1.3\_Bias0.0\_z0  
w=1.4, in-situ obs  
./Bias/Sept2025\_experiments/Assim/wFac1.4\_Bias0.0\_z0

**Fig. 13a,b (flux values for different observation biases, total column obs)**

bias=25000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+25000  
bias=19000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+19000  
bias=13000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+13000  
bias=10000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+10000  
bias=8000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+8000  
bias=5000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+5000  
bias=2500, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+2500  
bias=0, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias0.00  
bias=-2500, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-2500  
bias=-5000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-5000  
bias=-8000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-8000  
bias=-10000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-10000  
bias=-13000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-13000  
bias=-19000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-19000  
bias=-25000, total column obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-25000

**Fig. 13c,d (flux values for different observation biases, in-situ obs)**

bias=2.29, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+2.29\_z0  
bias=1.71, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+1.71\_z0  
bias=1.37, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+1.37\_z0  
bias=1.14, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+1.14\_z0  
bias=0.91, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+0.91\_z0  
bias=0.70, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+0.70\_z0  
bias=0.46, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+0.46\_z0  
bias=0.23, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias+0.23\_z0  
bias=0.0, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias0.00\_z0  
bias=-0.23, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-0.23\_z0  
bias=-0.46, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-0.46\_z0  
bias=-0.70, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-0.70\_z0  
bias=-0.91, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-0.91\_z0  
bias=-1.14, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-1.14\_z0  
bias=-1.37, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-1.37\_z0  
bias=-1.71, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-1.71\_z0  
bias=-2.29, surface obs  
./Bias/Sept2025\_experiments/Assim/wFac1.0\_Bias-2.29\_z0

**Data for the a-priori (background states)**

**Background for Figs. 05, 06, 07, 08**

./RecoverBlobs/Sept2025\_experiments/Background

**Background for Figs. 09c,d, 10, 11, 12, 13**

./Bias/Sept2025\_experiments/Background

**Data for the driving winds**

**Wind directory for all experiments**

./data/ECMWF\_RedResWinds\_1995\_56levs

**Departure points files (for the semi-Lagrangian transport scheme, as an efficient alternative to winds)**

./Bias/OrigExperiments/InitInitConds  
./RecoverBlobs/Sept2025\_experiments/MakeDPfiles  
./RecoverBlobs/OrigExperiments

## Data for the observations

### Observations for Figs. 05a,b, 06a,b, 07a,b

./RecoverBlobs/Sept2025\_experiments/Observations/Unbiased\_TC

### Observations for Figs. 05c,d, 06c,d, 07c,d

./RecoverBlobs/Sept2025\_experiments/Observations/Unbiased\_tob\_z0

### Observations for Figs. 08a

bias=20000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+20000\_TC  
bias=15000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+15000\_TC  
bias=10000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+10000\_TC  
bias=8000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+8000\_TC  
bias=6000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+6000\_TC  
bias=4000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+4000\_TC  
bias=2000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+2000\_TC  
bias=0, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Unbiased\_TC  
bias=-2000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias-2000\_TC  
bias=-4000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias-4000\_TC  
bias=-6000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias-6000\_TC  
bias=-8000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias-8000\_TC  
bias=-10000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias-10000\_TC  
bias=-15000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias-15000\_TC  
bias=-20000, total column obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias-20000\_TC

### Observations for Figs. 08b

bias=2.29, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+2.29\_tob\_z0  
bias=1.71, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+1.71\_tob\_z0  
bias=1.37, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+1.37\_tob\_z0  
bias=1.14, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+1.14\_tob\_z0  
bias=0.91, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+0.91\_tob\_z0  
bias=0.70, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+0.70\_tob\_z0  
bias=0.46, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+0.46\_tob\_z0  
bias=0.23, surface obs  
./RecoverBlobs/Sept2025\_experiments/Observations/Bias+0.23\_tob\_z0  
bias=0.0, surface obs

```

./RecoverBlobs/Sept2025_experiments/Observations/Unbiased_tob_z0
bias=-0.23, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-0.23_tob_z0
bias=-0.46, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-0.46_tob_z0
bias=-0.70, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-0.70_tob_z0
bias=-0.91, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-0.91_tob_z0
bias=-1.14, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-1.14_tob_z0
bias=-1.37, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-1.37_tob_z0
bias=-1.71, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-1.71_tob_z0
bias=-2.29, surface obs
./RecoverBlobs/Sept2025_experiments/Observations/Bias-2.29_tob_z0

```

### **Observations for Figs. 10a,b, 11a,b, 12a,b**

```

./Bias/Sept2025_experiments/Observations/Bias_0.0_TotalCol

```

### **Observations for Figs. 10c,d, 11c,d, 12a,b**

```

./Bias/Sept2025_experiments/Observations/Bias_0.0_z0

```

### **Observations for Figs. 13a,b (total column obs)**

```

bias=25000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_+25000_TotalCol
bias=19000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_+19000_TotalCol
bias=13000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_+13000_TotalCol
bias=10000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_+10000_TotalCol
bias=8000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_+8000_TotalCol
bias=5000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_+5000_TotalCol
bias=2500, total column obs
./Bias/Sept2025_experiments/Observations/Bias_+2500_TotalCol
bias=0, total column obs
./Bias/Sept2025_experiments/Observations/Bias_0.0_TotalCol
bias=-2500, total column obs
./Bias/Sept2025_experiments/Observations/Bias_-2500_TotalCol
bias=-5000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_-5000_TotalCol
bias=-8000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_-8000_TotalCol
bias=-10000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_-10000_TotalCol
bias=-13000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_-13000_TotalCol
bias=-19000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_-19000_TotalCol
bias=-25000, total column obs
./Bias/Sept2025_experiments/Observations/Bias_-25000_TotalCol

```



### **Observations for Figs. 13c,d (in-situ obs)**

bias=2.29, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+2.29\_z0  
bias=1.71, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+1.71\_z0  
bias=1.37, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+1.37\_z0  
bias=1.14, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+1.14\_z0  
bias=0.91, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+0.91\_z0  
bias=0.70, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+0.70\_z0  
bias=0.46, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+0.46\_z0  
bias=0.23, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias+0.23\_z0  
bias=0.0, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias\_0.0\_z0  
bias=-0.23, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-0.23\_z0  
bias=-0.46, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-0.46\_z0  
bias=-0.70, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-0.70\_z0  
bias=-0.91, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-0.91\_z0  
bias=-1.14, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-1.14\_z0  
bias=-1.37, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-1.37\_z0  
bias=-1.71, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-1.71\_z0  
bias=-2.29, surface obs  
./Bias/Sept2025\_experiments/Observations/Bias-2.29\_z0

### **Control variable transform files**

#### **CVT for Figs. 05, 06, 07, 08 (for blob recovery experiments)**

./RecoverBlobs/Sept2025\_experiments/Covs

#### **CVT for Figs. 09c,d, 10, 11, 12a,b (for quasi-real-world experiments)**

./Bias/Sept2025\_experiments/Covs