

# Steps to Reproduce Data and Figures

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1. Download the latest version of RAMS from the GitHub repository here:  
<https://github.com/RAMSmmodel/RAMS/releases/tag/v6.3.04>.
2. Compile RAMS on your machine or supercomputer following the instructions in docs/README-FIRST-RAMS.pdf within the RAMS directory.
3. Download ERA5 data on pressure levels containing temperature, geopotential, specific humidity, u, and v, covering the global domain, from 00 UTC 1 January 2010 to 00 UTC 4 January 2010. Rename this file as era5\_jan2010\_air.grib.
4. Download ERA5 data on single levels containing soil temperature, soil moisture, snow depth, and snow mass covering the global domain. Rename this file as era5\_jan2010\_ground\_dprep.grib.
5. Do `cat era5_jan2010_air.grib era5_jan2010_ground_dprep.grib > era5_jan2010_merged.grib` to concatenate the pressure-level and single-level data together (necessary for the data prep to make varfiles for RAMS).
6. Download the folder containing the information to remake the data and plots.
7. Make folders for the CONTROL, NLH, and VARTEMP simulations.
8. Run `RAMSIN.les_control_hires` with `RUNTYPE` set to `MKSFC`. Make sure that the `sst` filepath is set to use the 1-degree Reynolds-averaged sea surface temperatures. Set the output filepath for these surface files to the CONTROL folder.
9. Copy the land surface files from CONTROL to NLH, and VARTEMP. \*It's okay that we're copying land surface data for now! We'll modify it later for each simulation in python.\*
10. Run the degribber (in `bin.dp.grib1` in the RAMS install) on the `era5_jan2010_merged.grib` file to produce data prep (dp-p files) which will be used by RAMS to make varfiles.
11. Run `RAMSIN.les_control_hires` with `RUNTYPE` set to `MKVFILE`.
12. Run "sim\_setup\_hires\_mod.py." Text prompts will guide you through the steps to modify the land surface files and varfiles from CONTROL to make the NLH and VARTEMP simulations.

13. Now you're all ready to run the simulations! Make sure to switch RUNTYPE in all of the RAMSINs to INITIAL, as leaving it on MKSFC or MKVFILE will undo the modifications we just went through, and make you do them all over again!
14. Run the post-processing script available from this github page: <https://doi.org/10.5281/zenodo.10889733> on the output for the CONTROL and NLH simulations. This interpolates data from the native sigma-z coordinate system of RAMS to a cartesian coordinate system, and calculates many derived variables. We did not use this for the VARTEMP simulation, since we were only focused on surface variables which were provided in the RAMS analysis files. \*\*Required: Python version 3.10 or newer, numpy, scipy, matplotlib, pandas, astropy, xarray, xesmf, cartopy, metpy, jupyter lab.\*\*
15. Download python plotting scripts (and a few other files necessary for making the plots) from here: <https://doi.org/10.5281/zenodo.10889772>
16. Download ERA5 data on single levels covering the global domain again, but this time download variables for mean sea level pressure, surface air pressure, 2 m air temperature, 2 m dewpoint, 10 m zonal wind speed, and 10 m meridional wind speed. Save this file as "era5\_jan2010\_ground.grib" (Similarly named to our above reanalysis file, but keep in mind that this has different variables than that one).
17. Run PaperPlots.ipynb.
18. (Optional) Run les\_combplots\_paper\_carto.py. This will output comparison plan view plots between NLH and CONTROL for a user-selected time span.
19. Done!