**This document describes the associated (and provided) files used to run WRF simulations for Stanford et al. (2020) and the modifications to the WRF source code needed to create the stochastic mixing scheme. Results within Stanford et al. (2020) can thus be reproduced following the instructions in this document and utilizing the corresponding files. Further questions can be directed to McKenna Stanford via email:** [**mckenna.stanford@utah.edu**](mailto:mckenna.stanford@utah.edu) **or** [**mws2175@columbia.edu**](mailto:mws2175@columbia.edu)**.**

* WRF Version: Advanced Research WRF (WRF-ARW) v3.9.1 (available at <https://www2.mmm.ucar.edu/wrf/users/download/get_source.html>).
* Domain setup: 412 km x 122 km x 20 km
* Input soundings (text files with vertical profiles of thermodynamic and kinematic variables) for the 11 May and 20 May squall line cases are included as input\_sounding\_May11 and input\_sounding\_May20. These input soundings initialize the model domain with horizontally homogeneous conditions and is the standard method in which idealized WRF simulations are performed.
* All relevant model setup parameters are given in the attached file namelist.input. All variables in this file are described in detail at <https://esrl.noaa.gov/gsd/wrfportal/namelist_input_options.html>. The attached file is for the horizontal grid spacing (Δh) = 1 km simulations, but the appropriate namelist.input parameters would be changed for Δh.
* The following files from WRF-ARW v3.9.1 source code were modified to produce the stochastic mixing scheme:
  1. module\_diffusion\_em.F
  2. module\_first\_rk\_step\_part2.F
* The unmodified form of these files can be found through the following two paths emanating from the WRF-ARW v3.9.1 raw download:
  1. WRFV3/dyn\_em/module\_diffusion\_em.F
  2. WRFV3/dyn\_em/module\_first\_rk\_step\_part2.F
* The modified files module\_diffusion\_em.F and module\_first\_rk\_step\_part2.F are included in this dataset. Lines within these files that are modified for stochastic mixing are appended with the comment !MS. Performing the Unix command diff with the attached, modified files and the original files from the WRF-ARW v3.9.1 raw download will yield the changes necessary to produce the stochastic mixing scheme.
* Table 1 describes each of the simulations included in Stanford et al. (2020). The *multiplicative factor (F)* column shows the factor to be multiplied by the variable xkmh inside module\_diffusion\_em.F within the smag\_km subroutine in order to produce the desired simulation. Simulations from Stanford et al. (2020) with the appendage “\_FULL\_DEPTH” applied *F* to xkmh at every model level while simulations with the appendage “\_ABOVE\_4KM” applied *F* to xkmh only at model levels in which the height exceeded 4 km. For “ABOVE\_4KM” simulations, xkmh below 4 km used the diagnostic value.

Table 1. Description of simulations from Stanford et al. (2020).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Simulation Name** | **Multiplicative**  **Factor (*F*) in module\_diffusion\_em.F** | **Horizontal Grid Spacings Employed** | **# of simulations per horizontal grid spacing** | **Application Depth for *F*** |
| NO\_MIXING\_FULL\_DEPTH | 0 | 1 km | 1 | Every model level |
| NO\_MIXING\_ABOVE\_4KM | 0 | 1 km | 1 | Model levels above 4 km |
| QUARTERX\_FULL\_DEPTH | 0.25 | 1 km | 1 | Every model level |
| QUARTERX\_ABOVE\_4KM | 0.25 | 1 km | 1 | Model levels above 4 km |
| HALFX\_FULL\_DEPTH | 0.5 | 1 km | 1 | Every model level |
| HALFX\_ABOVE\_4KM | 0.5 | 1 km | 1 | Model levels above 4 km |
| 2X\_FULL\_DEPTH | 2 | 1 km | 1 | Every model level |
| 2X\_ABOVE\_4KM | 2 | 1 km | 1 | Model levels above 4 km |
| 4X\_FULL\_DEPTH | 4 | 1 km | 1 | Every model level |
| 4X\_ABOVE\_4KM | 4 | 1 km | 1 | Model levels above 4 km |
| STOCH\_FULL\_DEPTH | 2\*\*(rand\_pert(i,k,j)) | 0.5, 1, and 2 km | 5 | Every model level |
| STOCH\_ABOVE\_4KM | 2\*\*(rand\_pert(i,k,j)) | 0.5, 1, and 2 km | 5 | Model levels above 4 km |

* The 5 stochastic simulations within the STOCH\_FULL\_DEPTH and STOCH\_ABOVE\_4KM ensembles are different only by the random number seed (iseed\_rand\_pert) within namelist.input. To run various stochastic realizations, this parameter must be changed to a different integer.
* All simulations with modified mixing (either with stochastic or perturbed fixed-parameter setups) were initialized for the first 2 hrs with unmodified mixing (i.e. no *F* applied to xkmh within the first 2 hrs). Modified mixing was then turned on at 2 hrs using WRF restart files.
* All Δh = 0.5, 1, and 2 km simulations used a 3-second dynamic time step and the large eddy simulation (LES, Δh = 0.125 km) used a 0.75-second time step.