2D squall line demonstration (Part 1)
ATM 419/563 Spring 2023- Fovell

*** Preliminaries**

• Create a directory called SQUALL in your lab space, and copy into it
$LAB/SQUALL/SETUP.TAR, and unpack as usual. This file contains:
namelist.input, input_sounding, make_all_links.sh, reflec.gs, control_file, uthetap.gs, wthetap.gs, wdiabatic.gs, freezeH2O.dat, qr_acr_qg.dat, qr_acr_qs.dat

$ sh make_all_links.sh

*** A 6-h simulation using the Purdue Lin scheme (mp_physics = 2)**

• The namelist.input file is configured to make a 6 h simulation using microphysics
• scheme #2, the Purdue Lin scheme, and hourly output. **No editing at this time.**

$ srun -p snow ideal.exe
$ srun -p snow wrf.exe
• Look for SUCCESS COMPLETE WRF

• Now use w2g to create a GrADS output file. Use **control_file** [not control_file.ensemble]

$ w2g control_file mp02

> launch GrADS and open **mp02.ctl**.
----
* execute the script **reflec.gs**. This sets to <u>final time</u> (set t 7), and makes a color
* shaded plot of model estimated 10cm radar reflectivity field, and then <u>PAUSES</u>
* Only part of the domain is shown.

reflec.gs

* after you **hit return**, it superimposes the domain-relative horizontal wind field with black contours. Note the principal horizontal airflow features.
* The script **uthetap.gs** plots horizontal wind (shaded) and perturbation potential
* temperature for the final time
* Perturbation potential temperature is defined at the initial time at the left corner

uthetap.gs

* The script **wthetap.gs** plots vertical velocity (shaded) and perturbation theta
* Note the most positively buoyant air is rising the fastest, and there is a cold pool

```
wthetap.gs
```

* The script **wdiabatic.gs** plots diabatic heating (K/h) on vertical velocity
* Diabatic heating due to microphysics is field *h_diabatic* in wrfout file
* Note the diabatic heating field is concentrated at relatively small scales

```
wdiabatic.gs
```

* The Purdue Lin scheme predicts cloud droplets, rain, ice crystals, snow and graupel,
* called QCLOUD, QRAIN, QICE, QSNOW, and QGRAUP in the model

• Pause between each sequence so you can see what's been added

• *Note variation in contour intervals*

```
clear
set black 0 0
set cint 0.25
d 1000*qcloud          # converting kg/kg to g/kg
```

* Continue **without** clearing the screen…

```
set black 0 0
set cint 0.5
d 1000*qrain

set black 0 0
set cint 0.05
d 1000*qice

set black 0 0
set cint 0.05
d 1000*qsnow

set black 0 0
set cint 0.3
d 1000*qgraup
```

• Let's sum up the hydrometeor fields. "set clab off" turns off contour labeling

```
clear
set clab off
set cint 0.1
d 1000*(qcloud+qice+qrain+qsnow+qgraup)
```

• Look at domain total hydrometeors by species, First compute mean air density
• (as a function of height for the leftmost column and at the initial time)

```
clear
set x 1
set t 1
set z 1 80
den = (p*100)/(287.*(tc+273.15))
set t 1 7
set xaxis 0 6 1
```

• These are plotted from larger to smaller quantities
• The “tloop” command speeds these calculations up considerably

```
d tloop(sum(sum(den*qgraup,x=1,x=201),z=1,z=80))
d tloop(sum(sum(den*qrain,x=1,x=201),z=1,z=80))
d tloop(sum(sum(den*qcloud,x=1,x=201),z=1,z=80))
d tloop(sum(sum(den*qsnow,x=1,x=201),z=1,z=80))
d tloop(sum(sum(den*qice,x=1,x=201),z=1,z=80))
```

(end of Part 1)