March 2022 Thunderstorm cumulus ensemble exploration

ATM 419/563 Spring 2023 - Fovell

• **SETUP**

• Move to $LAB/TSTORM

• Launch GrADS

• open cu_ensemble.ctl

• We have 21 ensemble members – look at a subset of them

• **contours.gs**: total cumulus RAINC red, total microphysics RAINNC black

• Both contour intervals 3 mm; hit return after microphysics precip plots

• Only part of domain is shown. Accumulations through last time shown.

• KF (member 1): one of several Kain-Fritsch [KF] schemes in WRF

• These are "mass flux" schemes with CAPE triggers

• A lot of the cumulus precip associated with orographic lifting

• A lot of the microphysics precip associated with eastward propagating line

set e 1

contours.gs *[plots microphysics precip ; hit return to plot cumulus precip]*

• Help differentiate cumulus from microphysics precip a little more

c

set cint 3

d rainc

c

set cint 3

d rainnc

• BMJ - a lot less cumulus precipitation than KF scheme

• A very different kind of cumulus scheme

set e 2

contours.gs

• Tiedtke - related to KF but produces even less cumulus precip

set e 5

contours.gs

• New Tiedtke – looks more like some of the other schemes now

set e 9

contours.gs

• KSAS - allowed very little *microphysics* precip
• One of several Simplified Arakawa Schubert [SAS] schemes in WRF
• Based on idea CAPE is destroyed as it is created
set e 8
contours.gs

• NSAS - another SAS scheme - also allowed little microphysics precip
• [The Grell schemes (members 3,4,10) are also related to the SAS schemes]
set e 13
contours.gs

• Look at KF again
set e 1
contours.gs

• MS-KF - a modified KF, produces very little cumulus rain over ADK, but more
• microphysics precip
set e 7
contours.gs

• compare cumulus precip for MS-KF and KF
c
set cint 3
d rainc(e=7)

• pause and look at magnitudes of cumulus precip
set cint 3
d rainc(e=1)

• now compare microphysics precip for MS-KF and KF - more for MS-KF in ADK
c
set cint 3
d rainnc(e=7)
set cint 3
d rainnc(e=1)

• now total precip for MS-KF and KF - TOTAL precip more similar – divided it differently
c
set cint 5
d rainc(e=7)+rainnc(e=7)
• pause and look
set cint 5
d rainc(e=1)+rainnc(e=1)

• Members 15 and 16 are KF versions with differing trigger functions
• Member 15 (trigger=2) produces less cumulus rain in ADK than standard version
c
d rainc(e=15)-rainc(e=1)

• Member 16 (trigger=3) more cumulus rain in Pennsylvania than standard version
c
d rainc(e=16)-rainc(e=1)

• Compare run w/ cumulus and NO MP to run with MP and NO cumulus
c
set e 18 [no MP]
set cint 5
d rainc

• look before proceeding
c
set e 17 [no CUMULUS]
set cint 5
d rainnc

• Two-domain run with no cumulus in outer domain. Viewing precip in D1.
c
set e 20
set cint 5
d rainnc

• Two-domain run with KF cumulus in outer domain. Viewing precip in D1.
c
set e 21
set cint 5
d rainnc

• Execute plot_precip.gs script
plot_precip.gs

>> Plots time series of area integrated cumulus, microphysics, and total precip
>> Tiedtke, MS-KF: very little cumulus precip. No MP member: huge cumulus precip.
>> 2nd plot: "TRUTH" = member 21 (KF in D1, off in D2)
>> 3rd plot, total precip. "TRUTH" in the middle, no MP very large total precip