

Resolution Dependence of Convective Parameterizations in WRF

Joe Galewsky
Earth and Planetary Sciences
University of New Mexico
Albuquerque, NM



Motivating Question

- What is the smallest horizontal grid spacing at which the convective parameterization needs to be called?
 - Scale separation and parameterization
 - Grid spacing between 10 and 4 km is the 'dead zone'

A Better Question

- Does the convective parameterization become less 'important' at smaller grid spacings?
 - How do we define important?



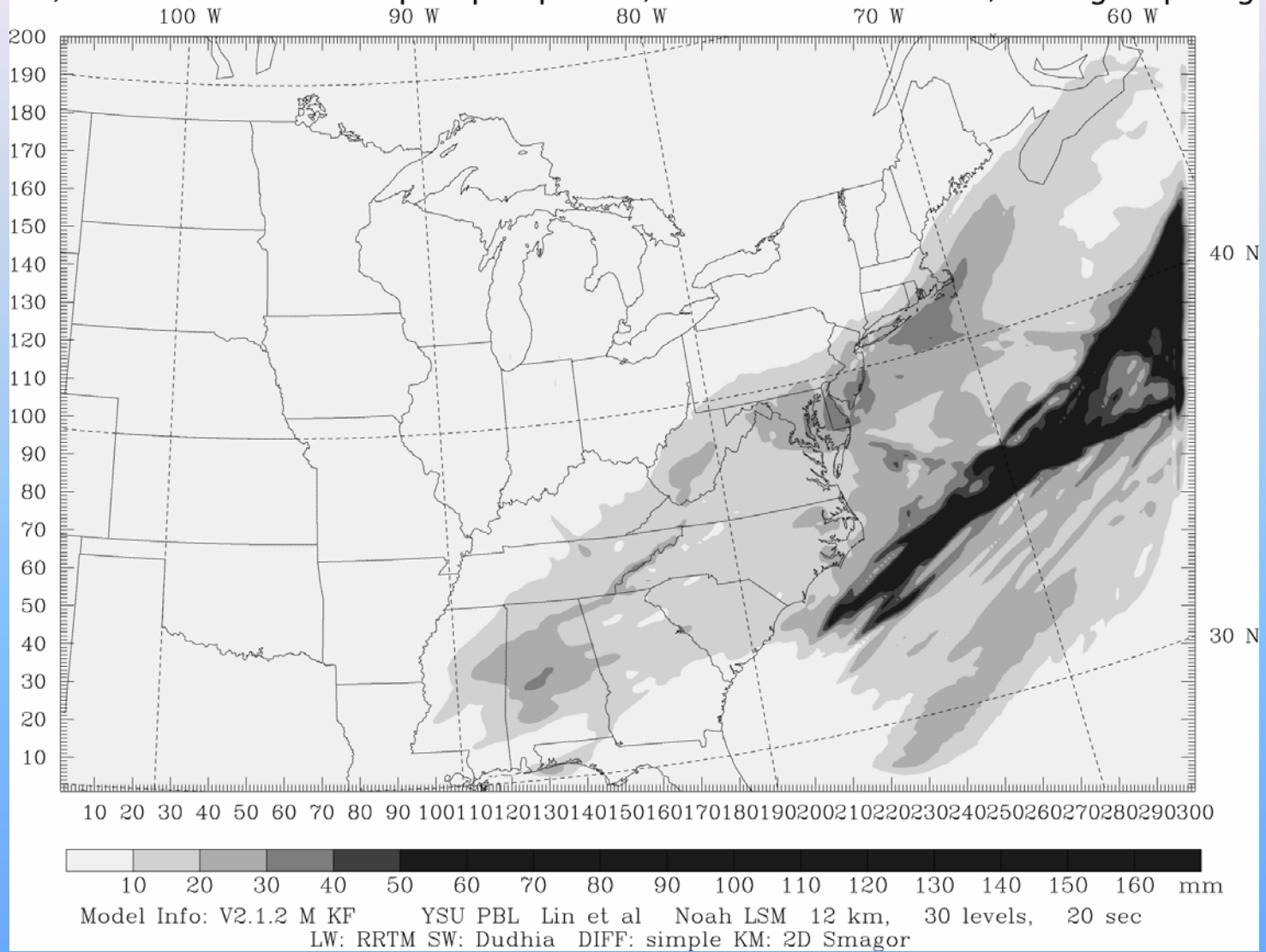
**DEAD
END**

Initial Approach

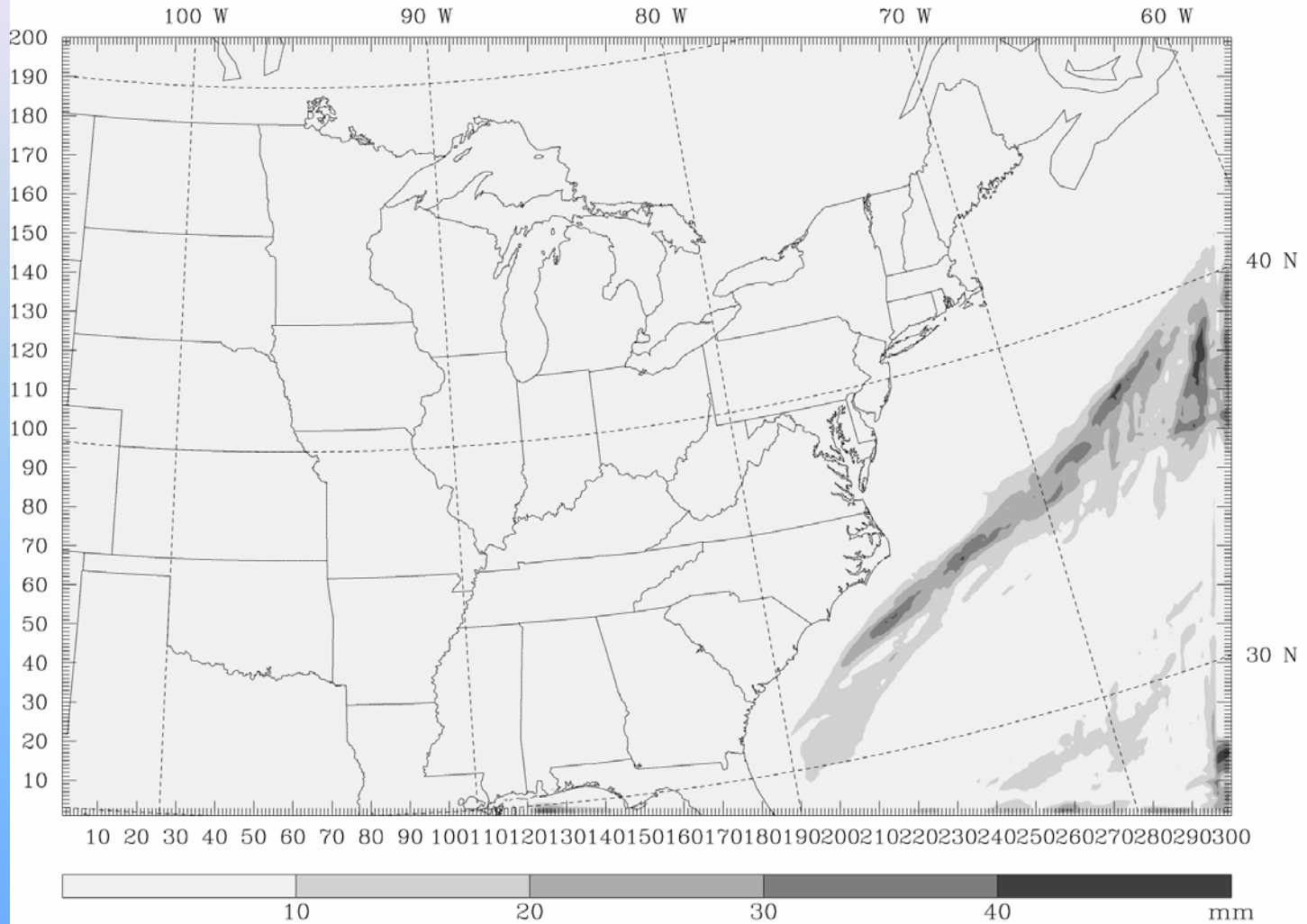
- Track how frequently the convective parameterization is called
 - Added new diagnostics to WRF, CONV_TOT field in the microphysics driver code
 - Because convective schemes (like KF) are triggered by vertical velocity, they are called more and more frequently as horizontal grid spacing decreases.
 - *No useful information here!*

Wintertime Case (Feb 2006 Blizzard)

a.) 48 hour accumulated explicit precipitation, valid 0000 UTC 13 Feb 06, 12 km grid spacing

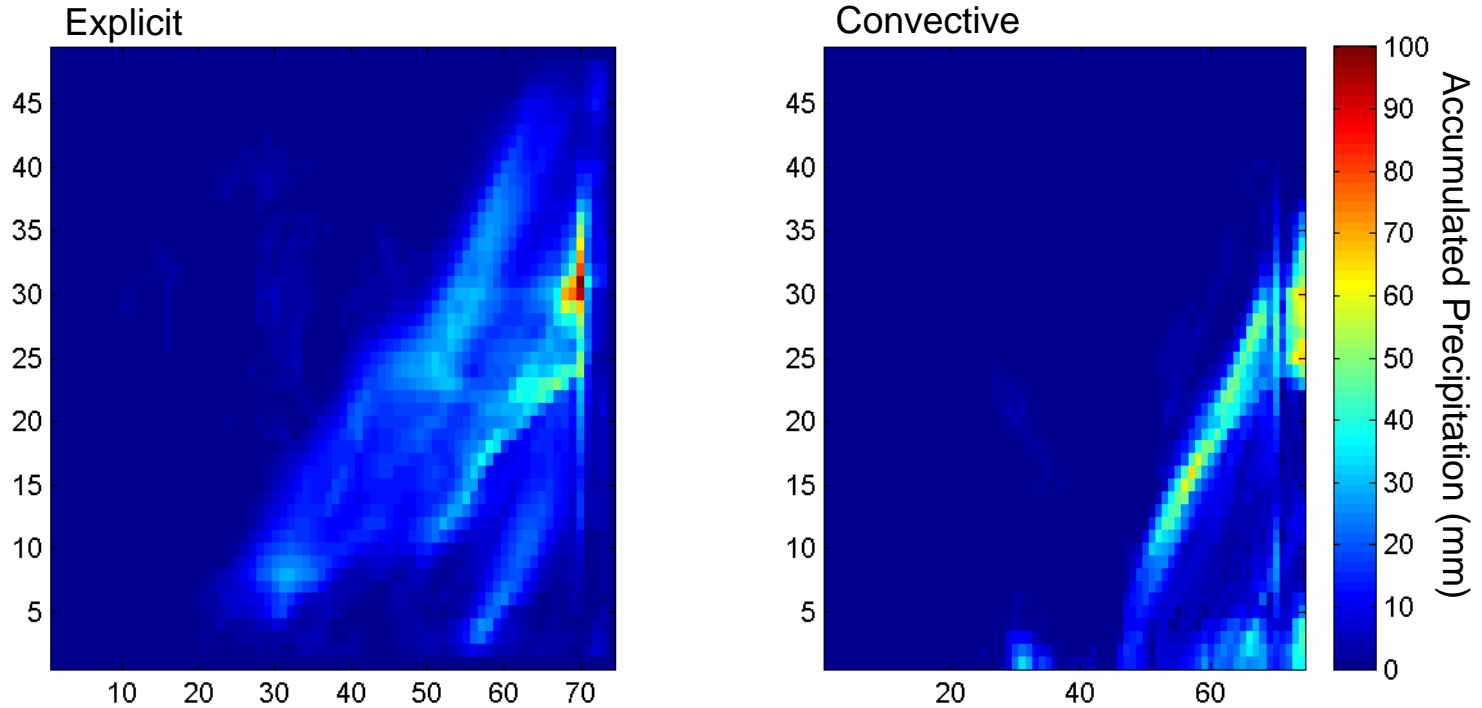


b.) 48 hour accumulated cumulus precipitation, valid 0000 UTC 13 Feb 06, 12 km grid spacing



Model Info: V2.1.2 M KF YSU PBL Lin et al Noah LSM 12 km, 30 levels, 20 sec
LW: RRTM SW: Dudhia DIFF: simple KM: 2D Smagor

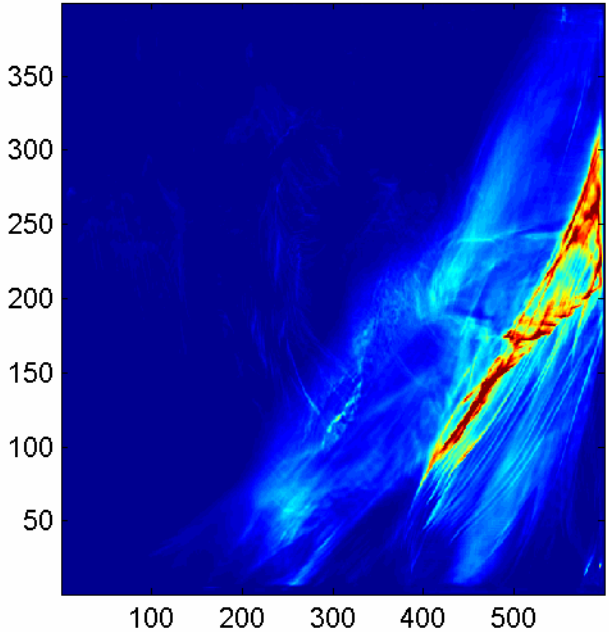
Wintertime Case (Feb 12-13, 2006) 48 km grid spacing



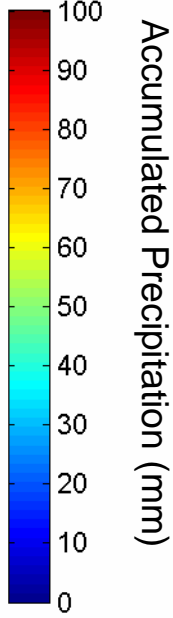
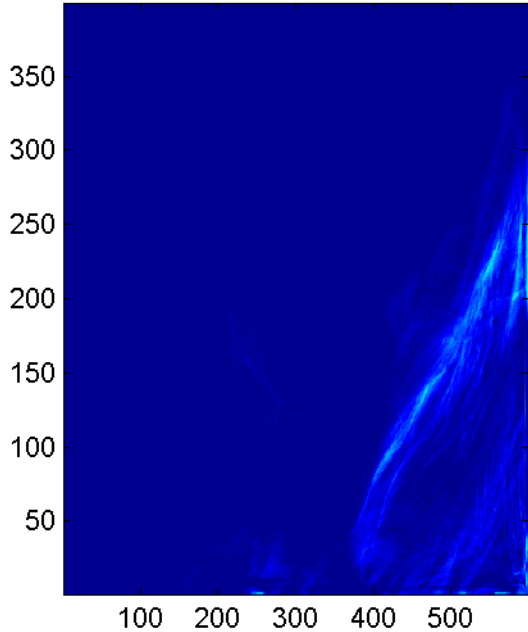
WRF ARW; Lin Microphysics, Kain-Fritsch Convection, 30 levels

Wintertime Case (Feb 12-13, 2006) 6 km grid spacing

Explicit

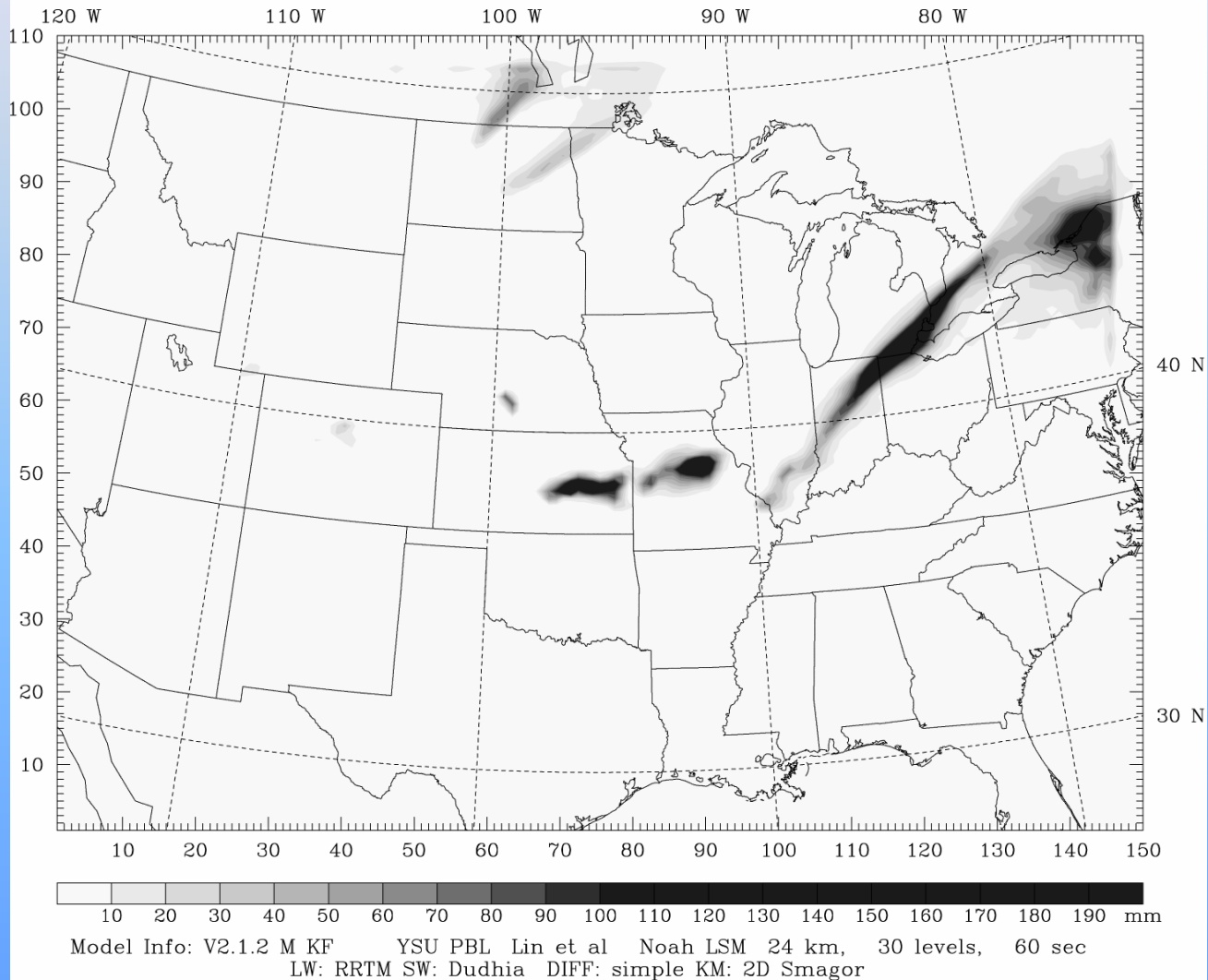


Convective



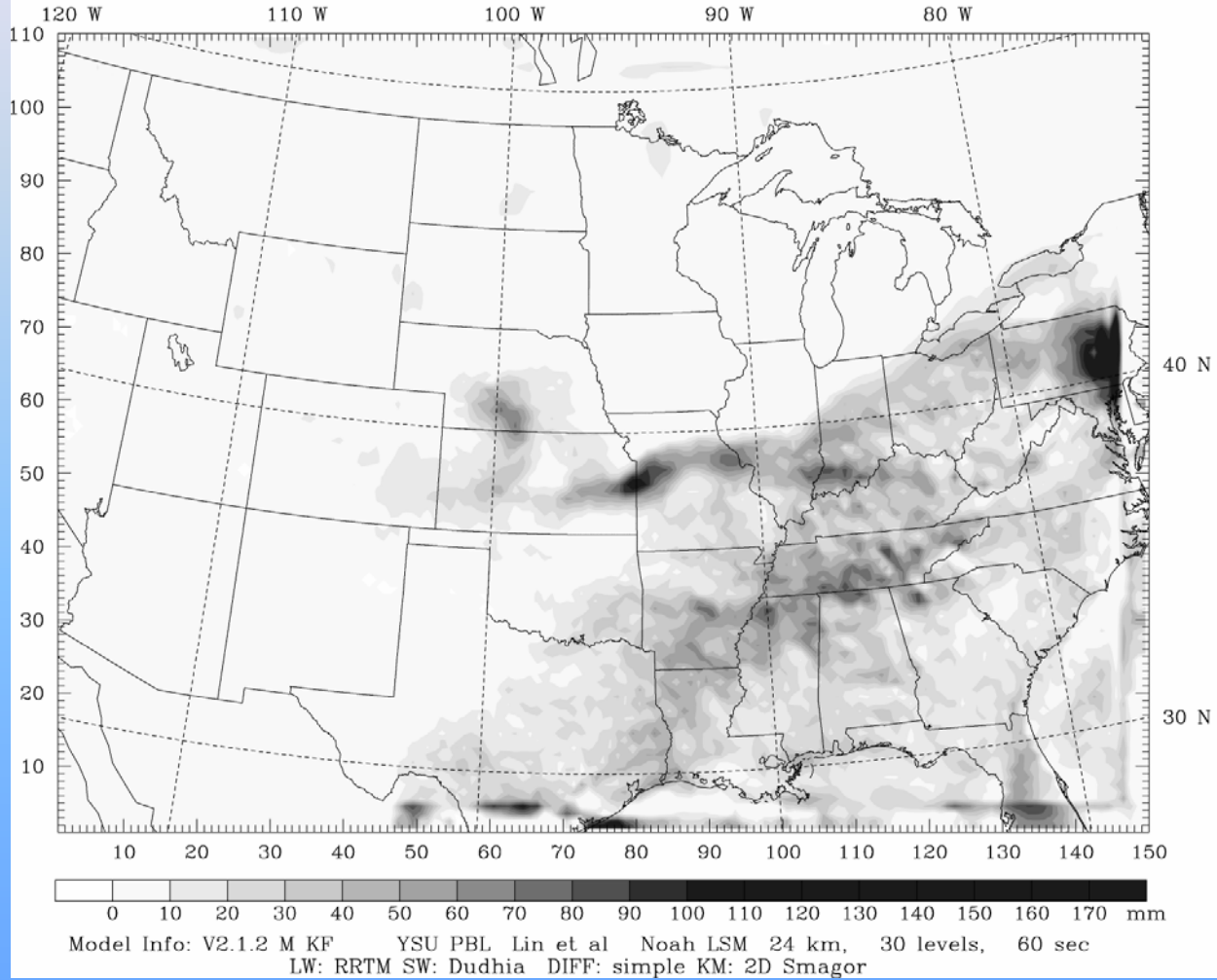
Accumulated Precipitation (mm)

a.) 48 hour accumulated explicit precipitation, valid 0000 UTC 14 Jun 03, 24 km grid spacing

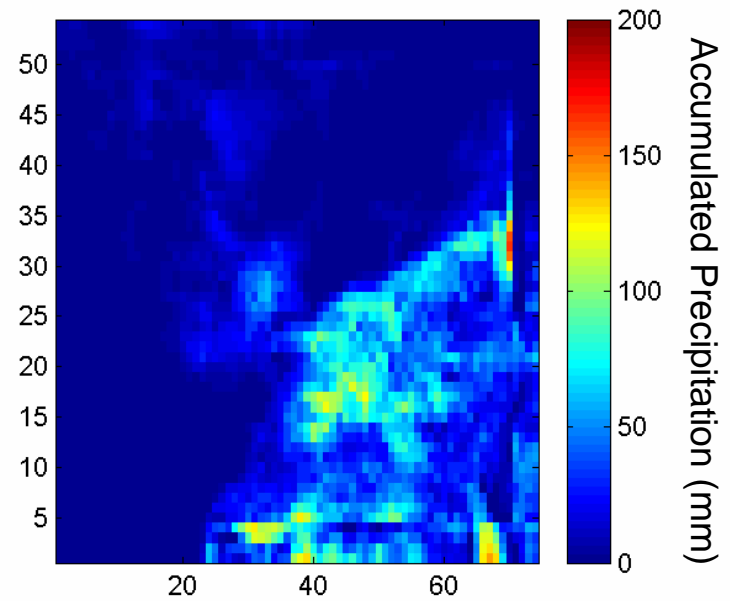
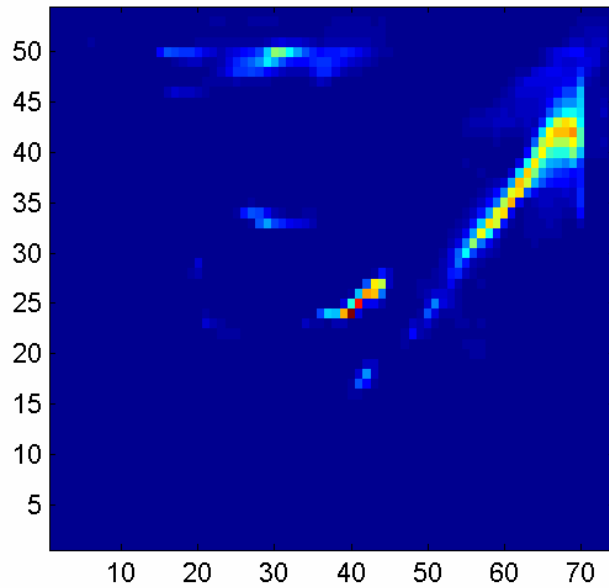


Summertime Case (June 2003)

b.) 48 hour accumulated cumulus precipitation, valid 0000 UTC 13 Feb 06, 24 km grid spacing

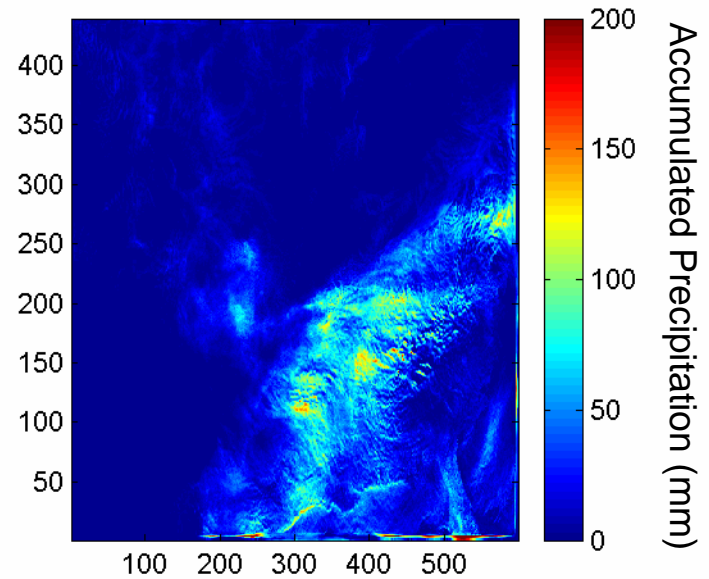
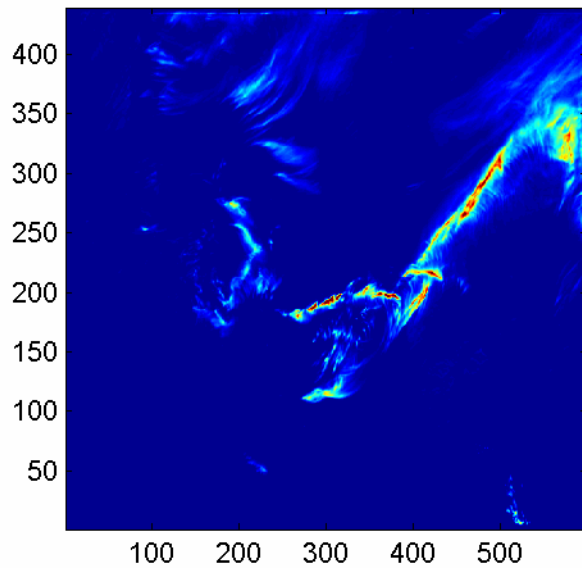


Summertime Case (June 12-13, 2003) 48 km grid spacing



WRF ARW; Lin Microphysics, Kain-Fritsch Convection, 30 levels

Summertime Case (June 12-13, 2003) 6 km grid spacing



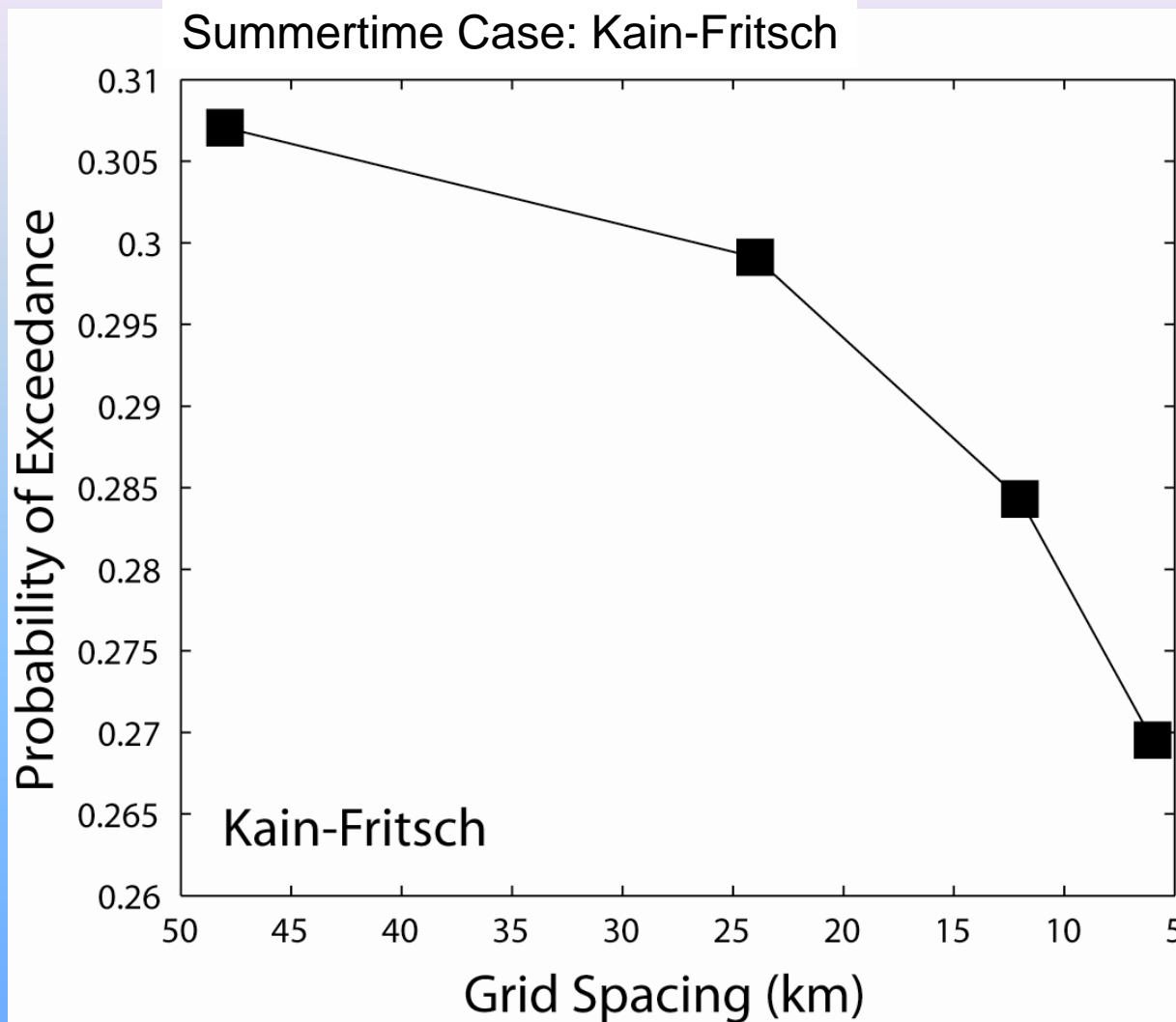
A better metric?

- Define two thresholds
 - P_{tot} : the total precipitation (explicit and cumulus) at a grid point.
 - P_{conv} : the ratio of convective to total precipitation at a grid point.

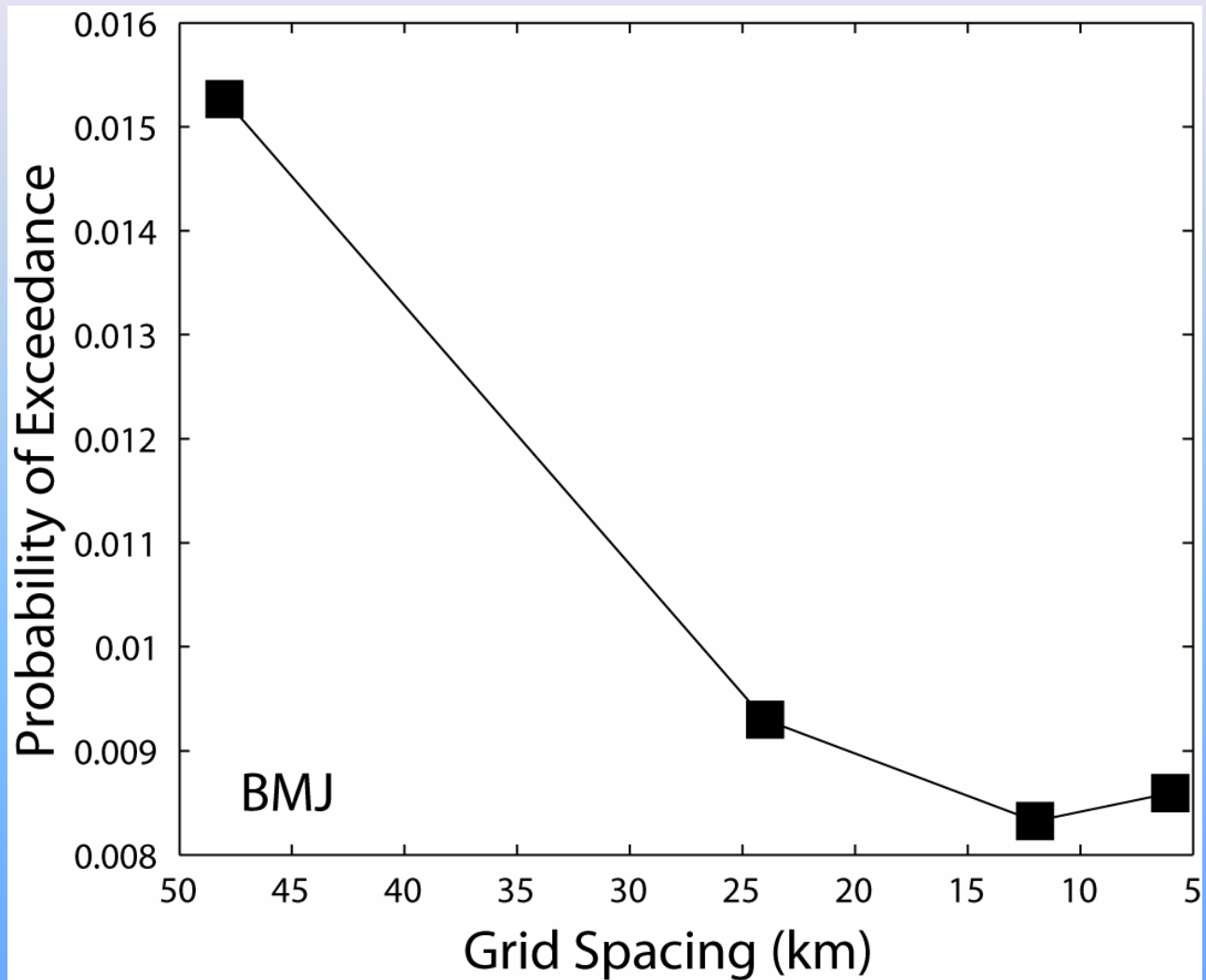
Of all the points where total precipitation exceeds P_{tot} , how many have a ratio of convective to total precipitation exceeding P_{conv} ?

$P_{\text{tot}}=20\text{mm}$

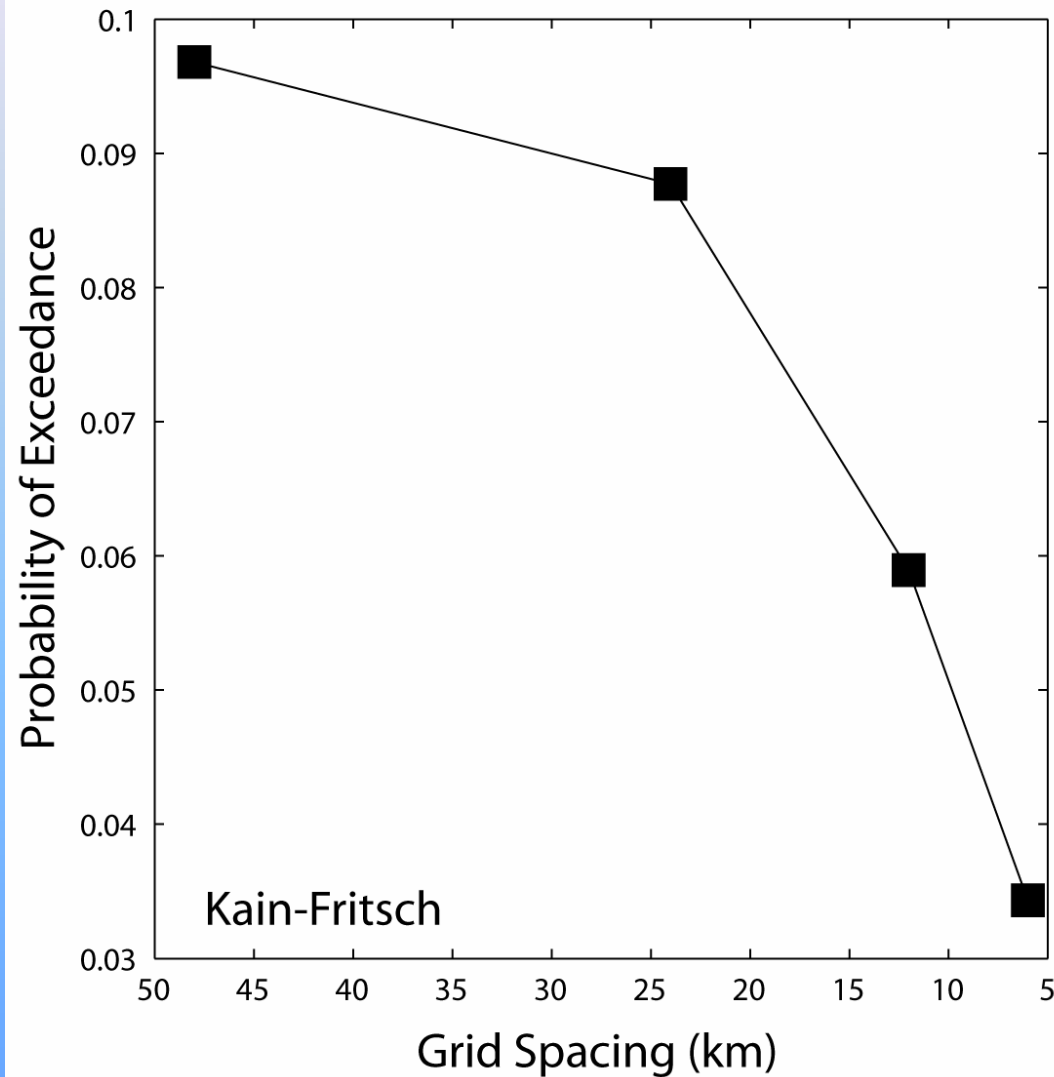
$P_{\text{conv}}=0.20$



Summertime Case: Betts-Miller



Wintertime Case



Kain-Fritsch

Future Work

- Extend to many more cases
- Add a forecast verification component
- Extend to WRF-NMM
- Dependence on microphysics?

Conclusions, etc.

- Probably still best to turn off convective scheme below ~12km.
- But, there do appear to be some inherent scaling properties associated with convective parameterization activity
- Strongly dependent on the scheme used.
- Clear seasonal dependence