

Identification of Mesoscale Convective Precipitation in GPM Data

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October 16-20, 2017



Reviews of Geophysics

REVIEW ARTICLE

The variable nature of convection in the tropics and subtropics: A legacy of 16 years of the Tropical Rainfall Measuring Mission satellite

Robert A. Houze Jr.¹, Kristen L. Rasmussen², Manuel D. Zuluaga³, and Stella R. Brodzik¹

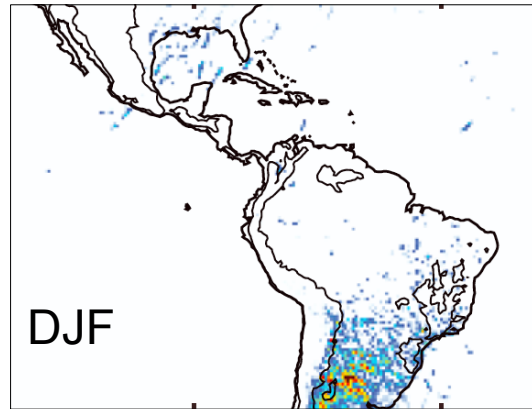
August 2015

The TRMM study identified
categories of convective and
stratiform echoes based on their
3D structure

Object	Echo Characteristic	Height	Area
Isolated Shallow Echoes	> min detectable	< 4 km	2 pixels
Deep Convective Cores	> 40 dBZ (<u>strong</u>)	> 10 km	N/A
	> 30 dBZ (<u>moderate</u>)	> 8 km	N/A
Wide Convective Cores	> 40 dBZ (<u>strong</u>)		> 1000 km ² at some altitude
	> 30 dBZ (<u>moderate</u>)		> 800 km ² at some altitude
Broad Stratiform Regions	Contiguous stratiform		> 50,000 km ² (<u>strong</u>)
			> 30,000 km ² (<u>moderate</u>)
			30-50,000 km ² (<u>filtered</u>)

An Example of the TRMM Results

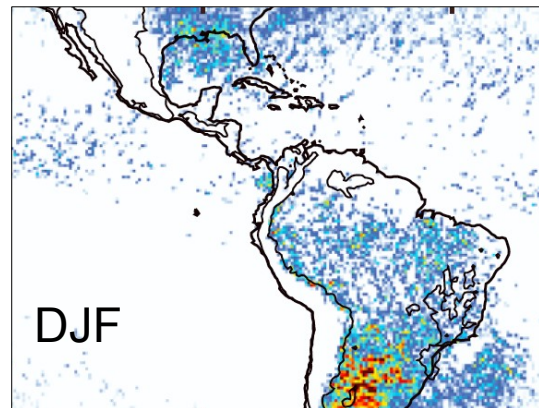
Deep Convective Cores
(strong)



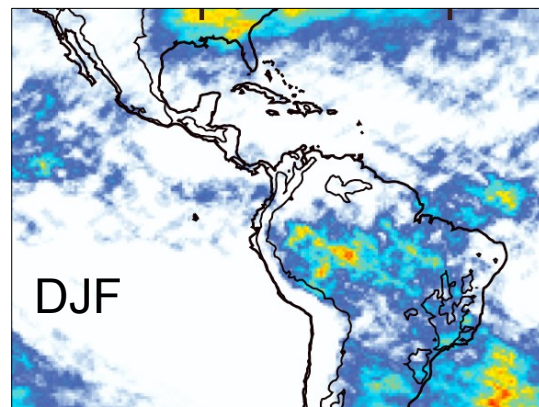
Frequencies of occurrence

See Houze et al. 2015 for
full low-latitude patterns of
these features

Wide Convective Cores
(strong)



Broad Stratiform
(strong)



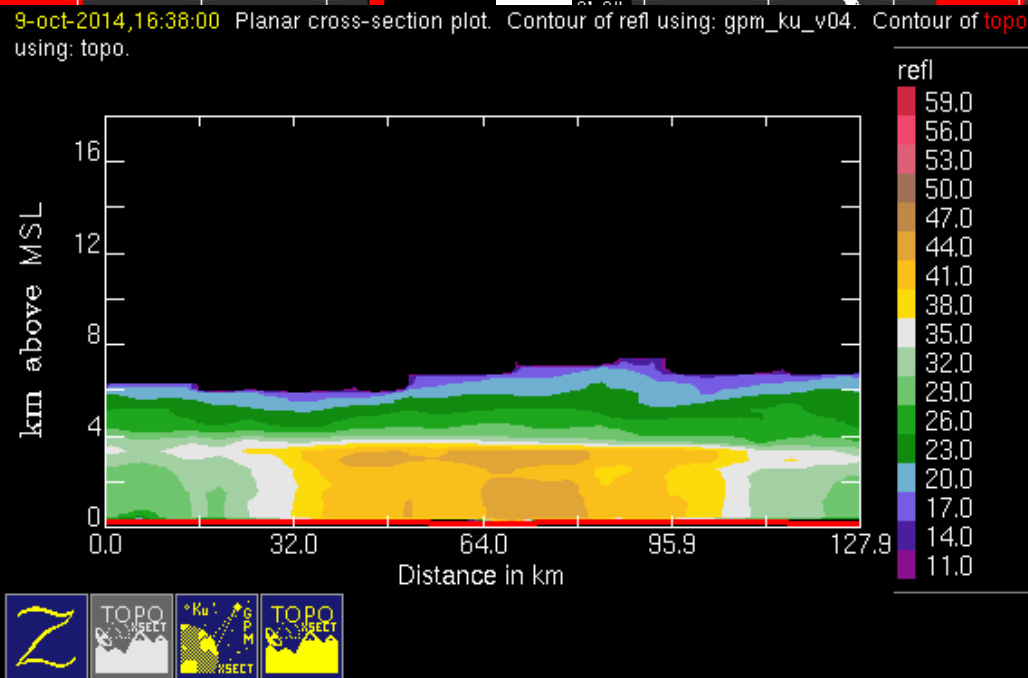
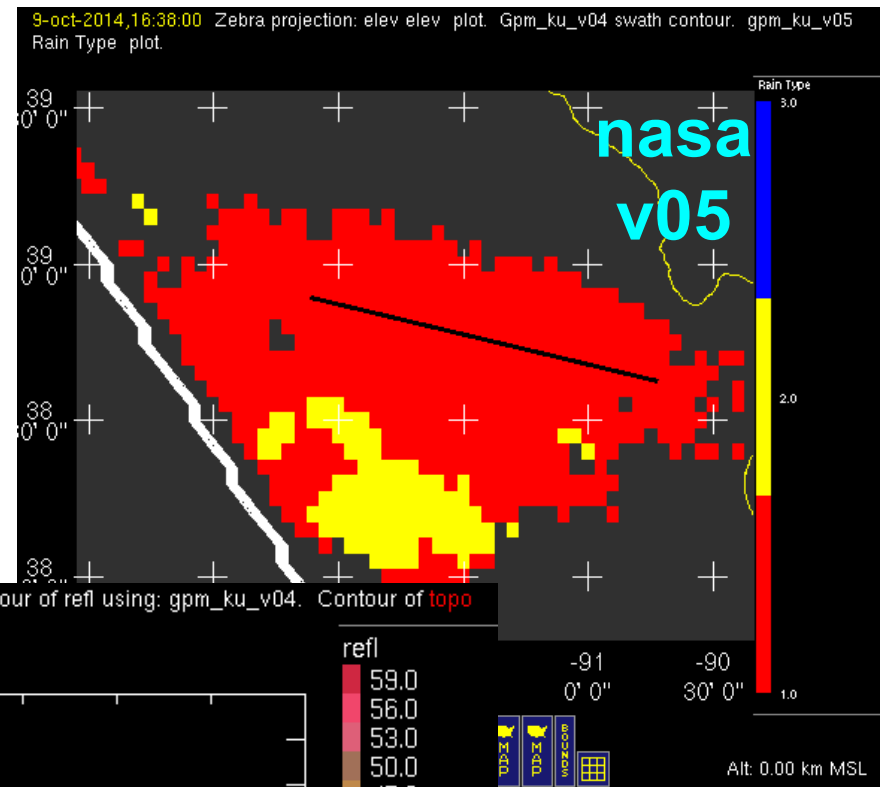
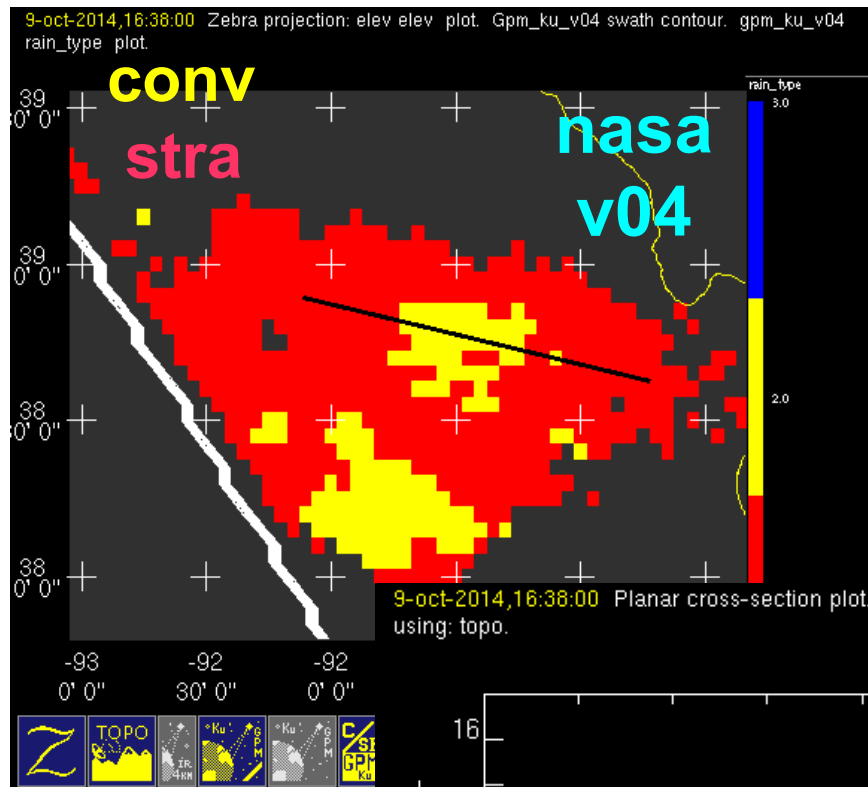
GPM Goal:

Extend this work to higher latitudes

Problem:

- V4 classified a lot of Ku stratiform echo as convective
- V5 corrected much of this problem

Example of successful correction



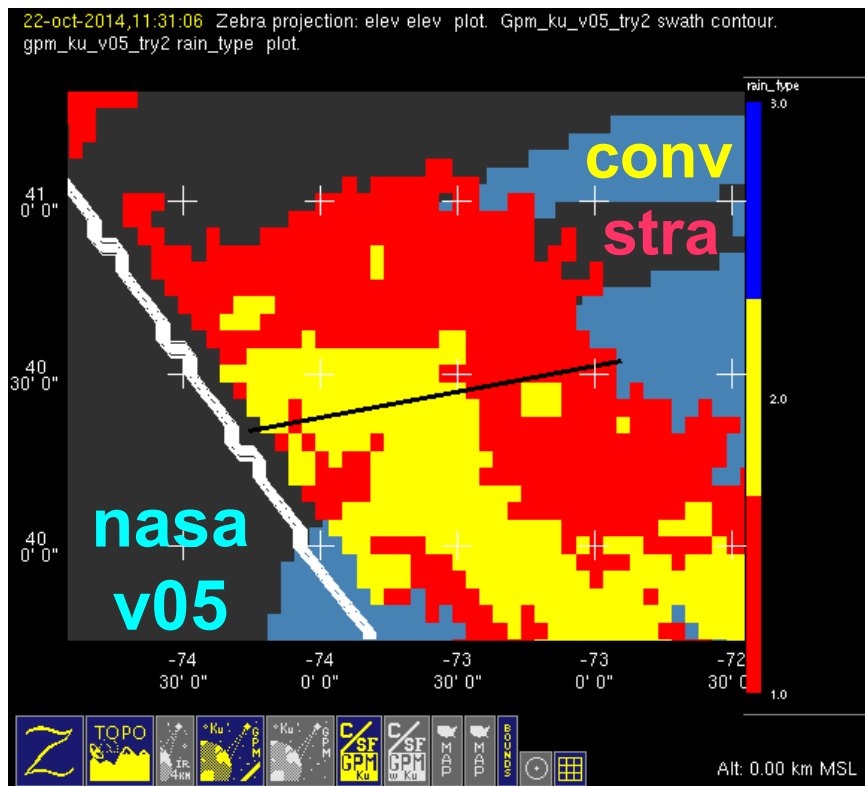
October
Missouri

(20141009/1637)

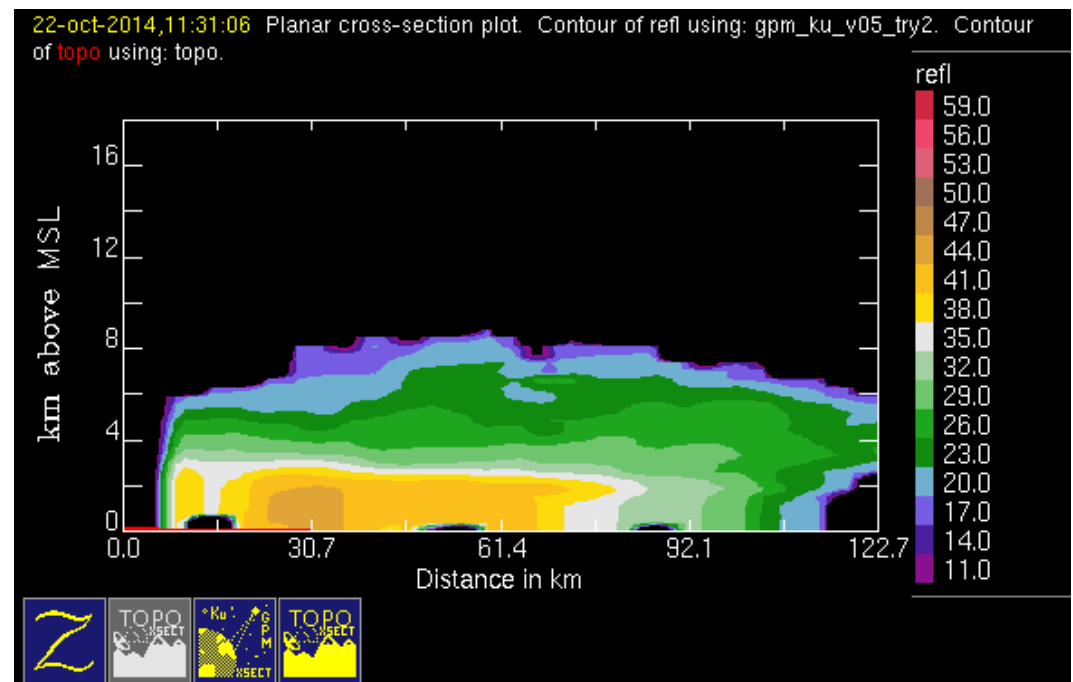
HUGE
improvement

But problems remain

Problem case: East Coast Front

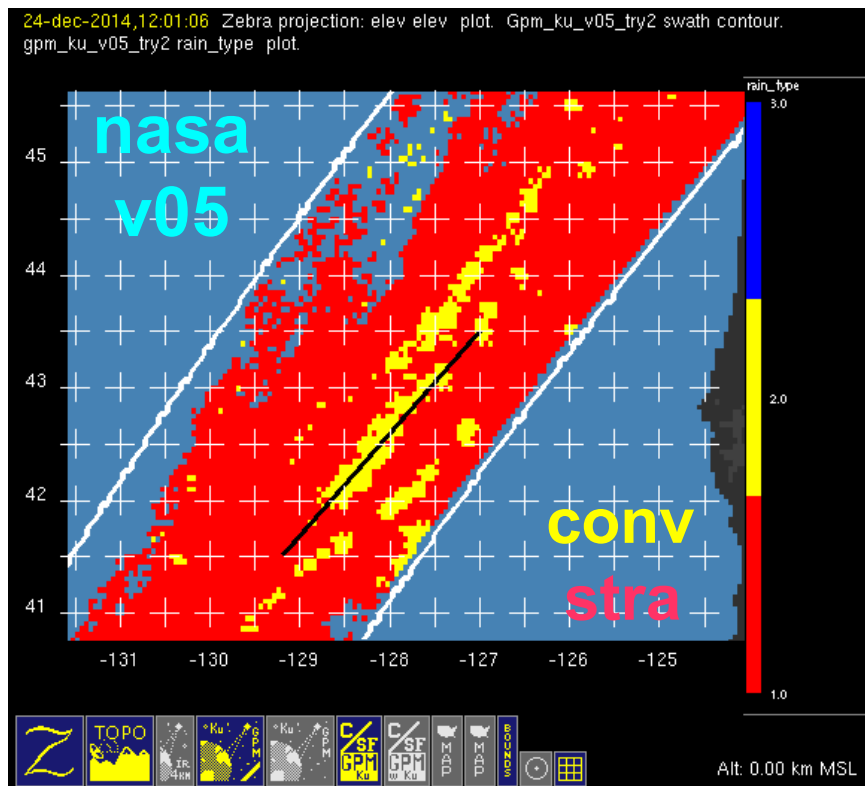


October
NE U.S.

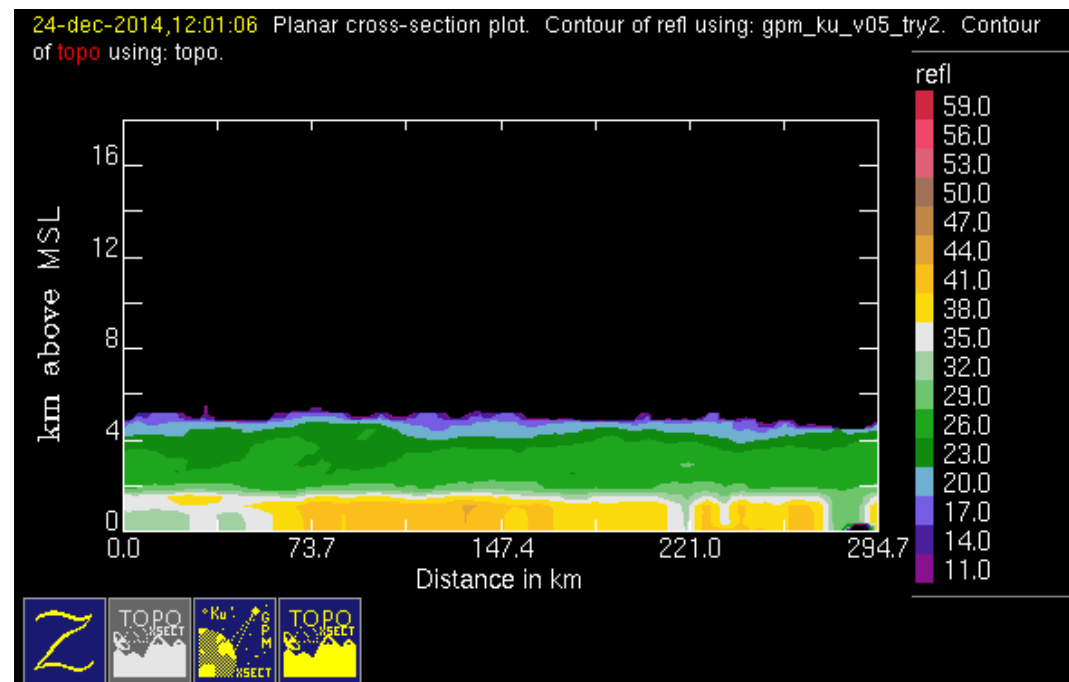


(20141022/1132)

Problem case: West Coast Front

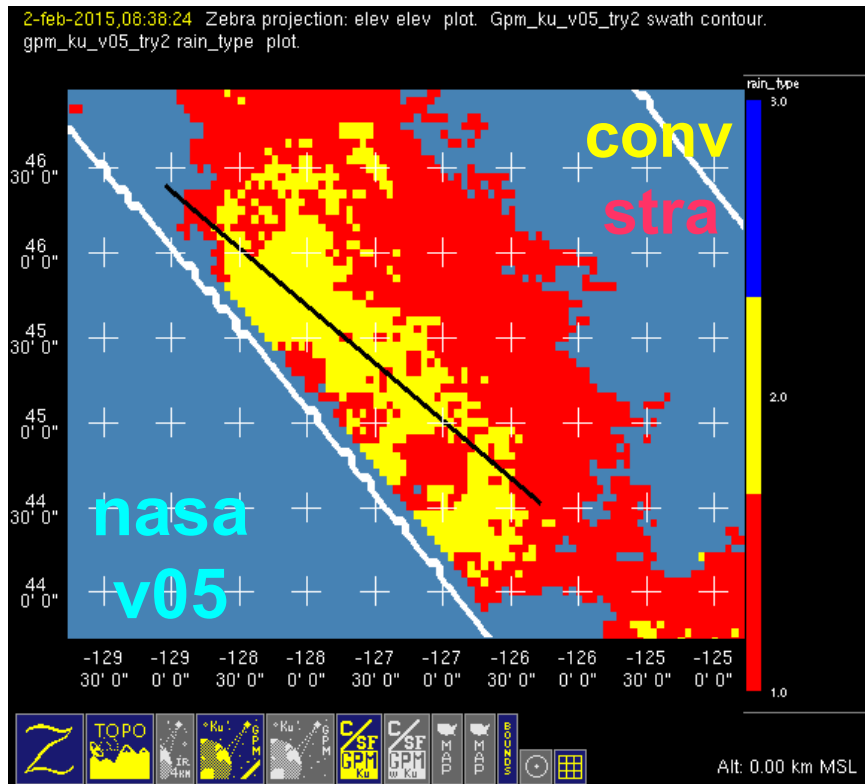


December
NW coast of U.S.

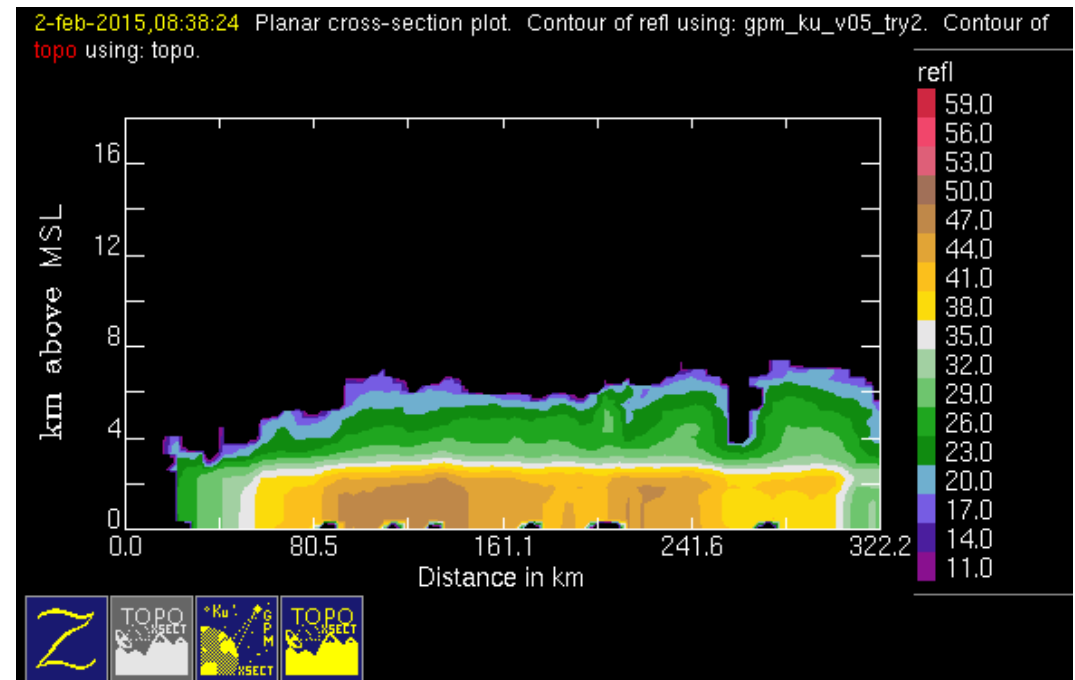


(20141224/1202)

Problem case: North Pacific



February
North Pacific



(20150202/0839)

Solving this remaining problem is
critical to all applications that depend on
convective/stratiform classification

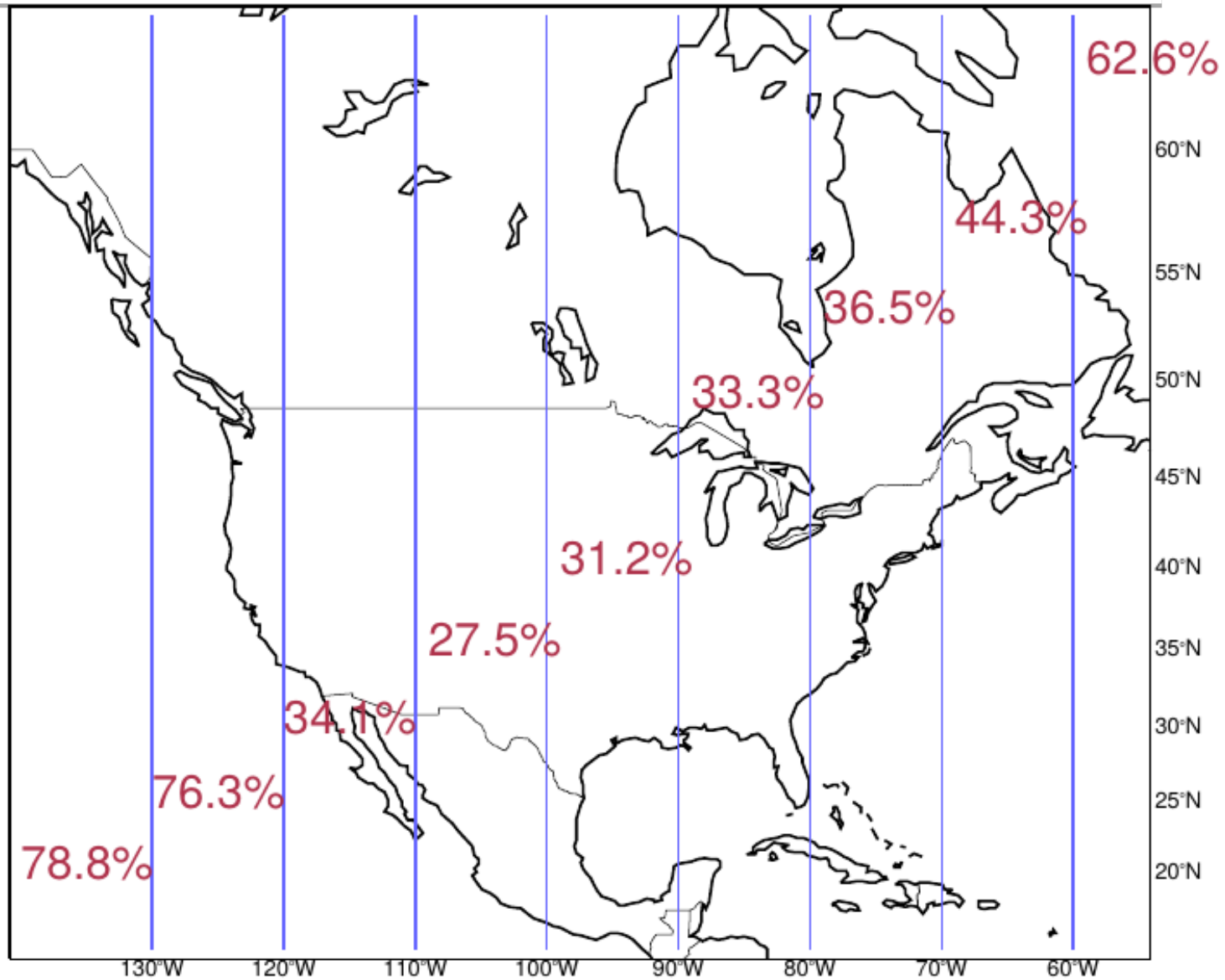
(latent heating, PSD, ...)

Complicating factors in identifying stratiform echo in GPM data:

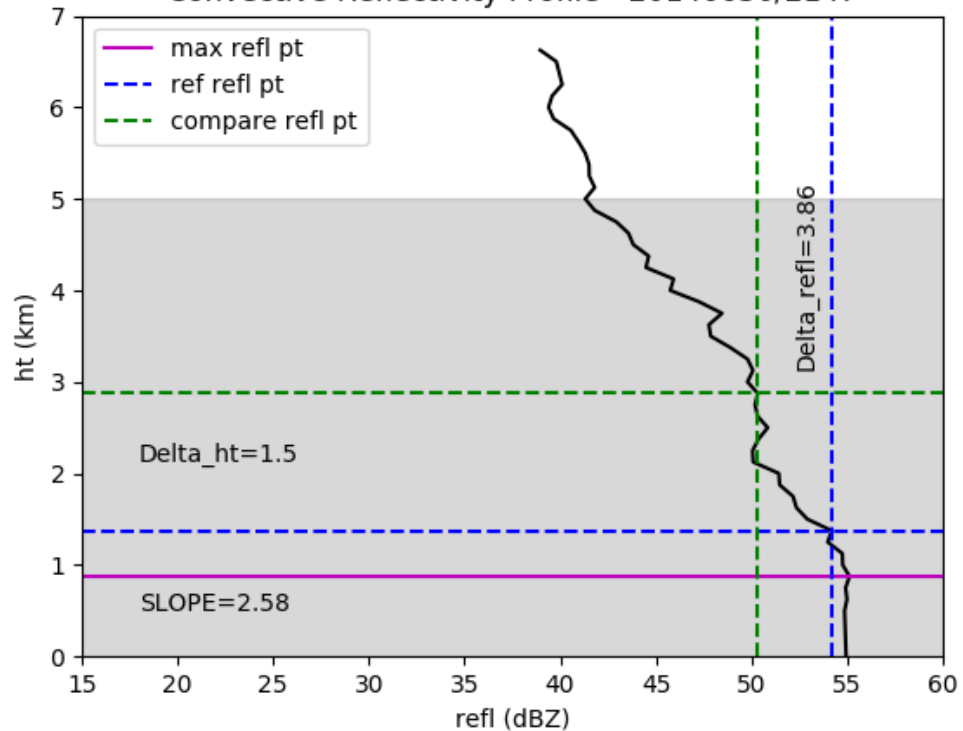
- Melting level height varies
- Bright band is often >40 dBZ
- Melting level is not always a sharp peak in dBZ
- Key indicator of SF is a strong drop off in reflectivity above melting level

UW add-on to V5 C/S algorithm

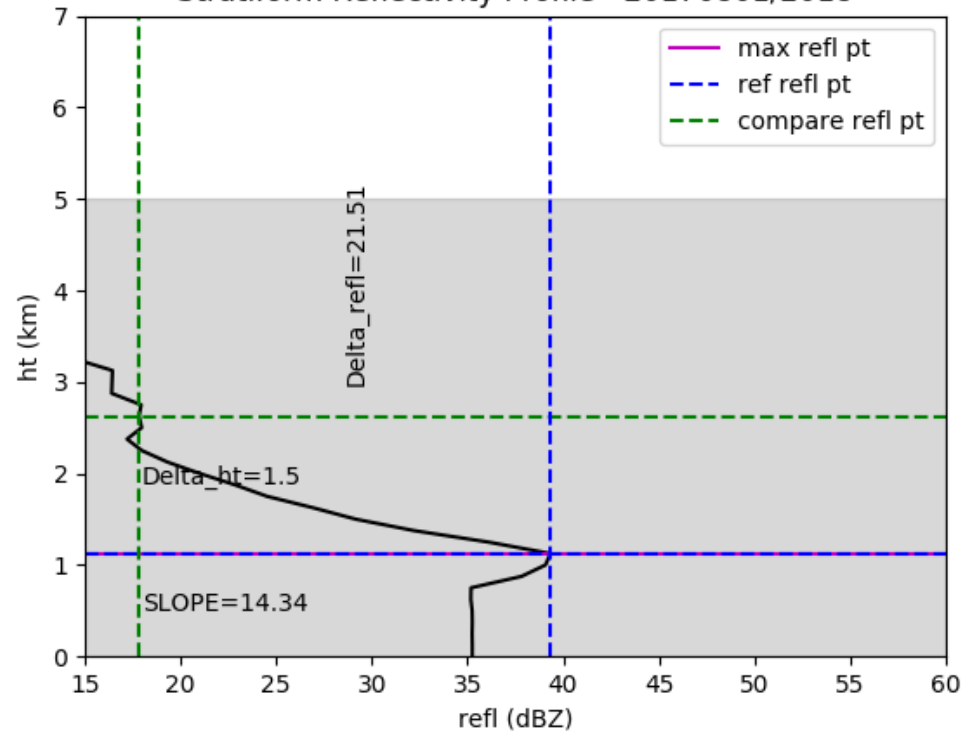
Test Area



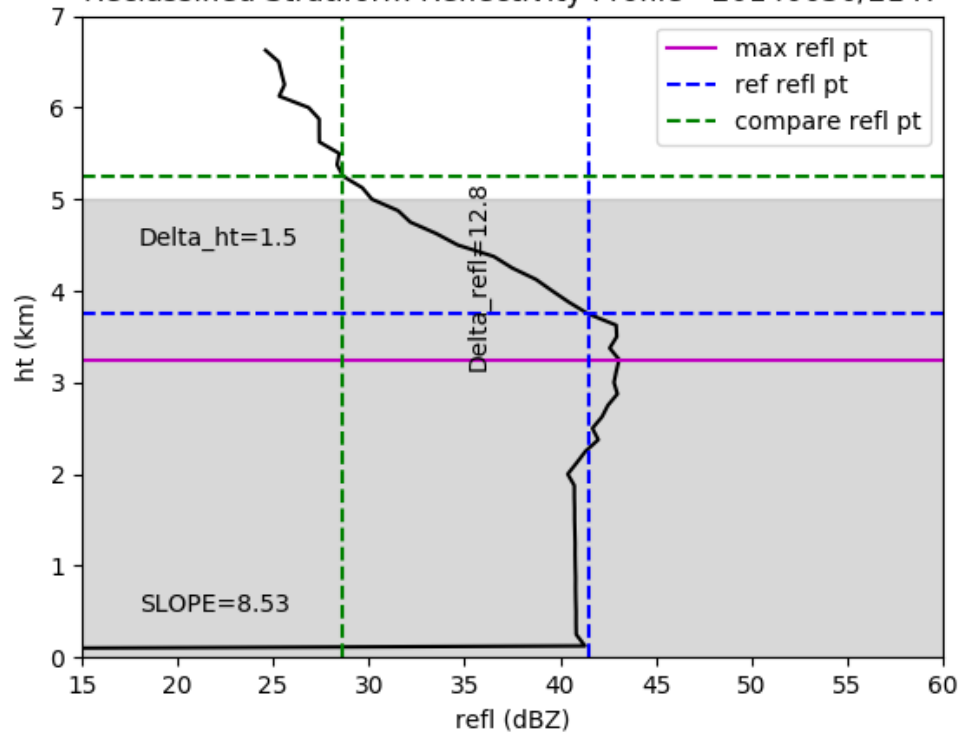
Convective Reflectivity Profile - 20140630/2147



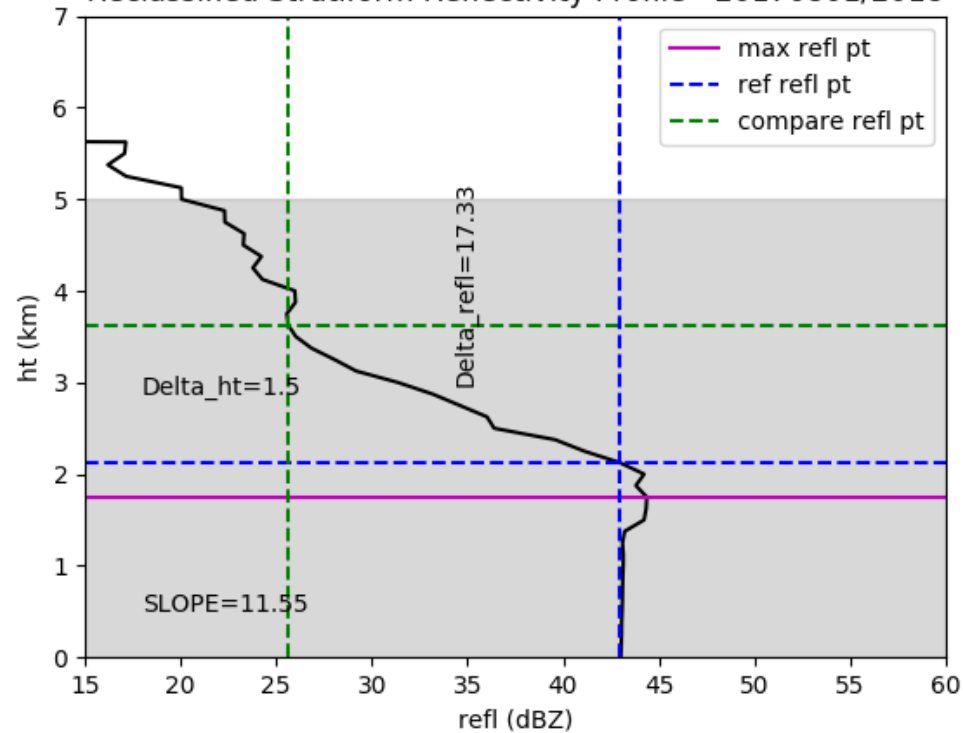
Stratiform Reflectivity Profile - 20170801/2018



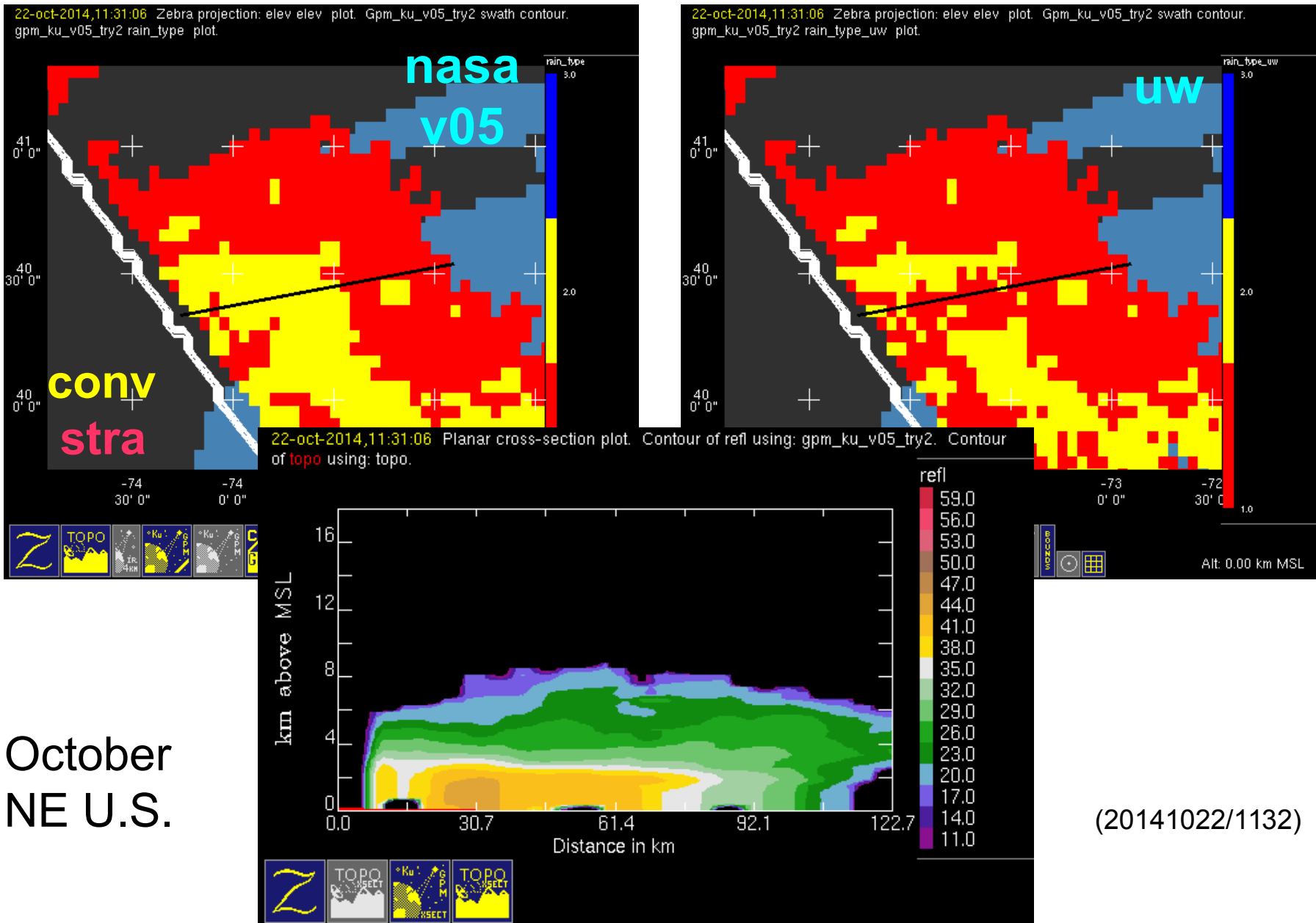
Reclassified Stratiform Reflectivity Profile - 20140630/2147



Reclassified Stratiform Reflectivity Profile - 20170801/2018



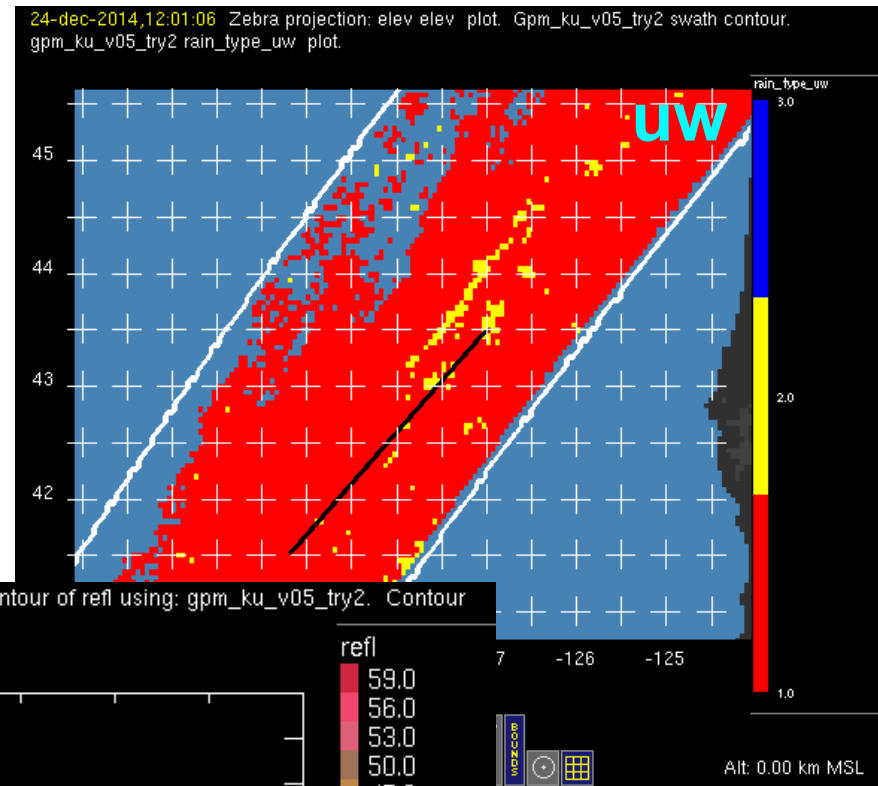
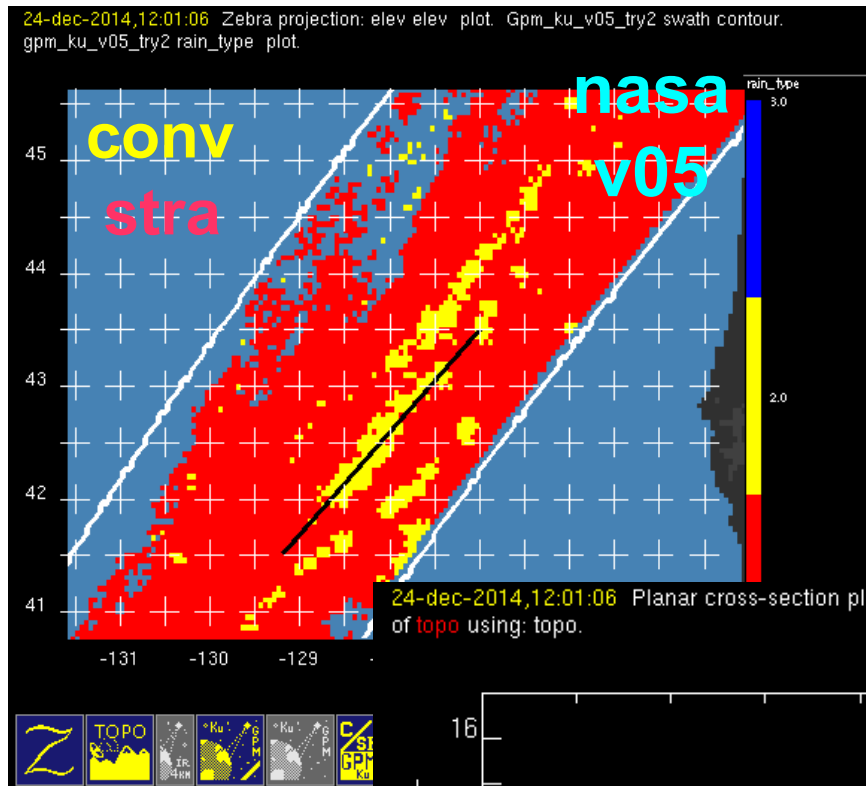
Problem case: East Coast Front



October NE U.S.

(20141022/1132)

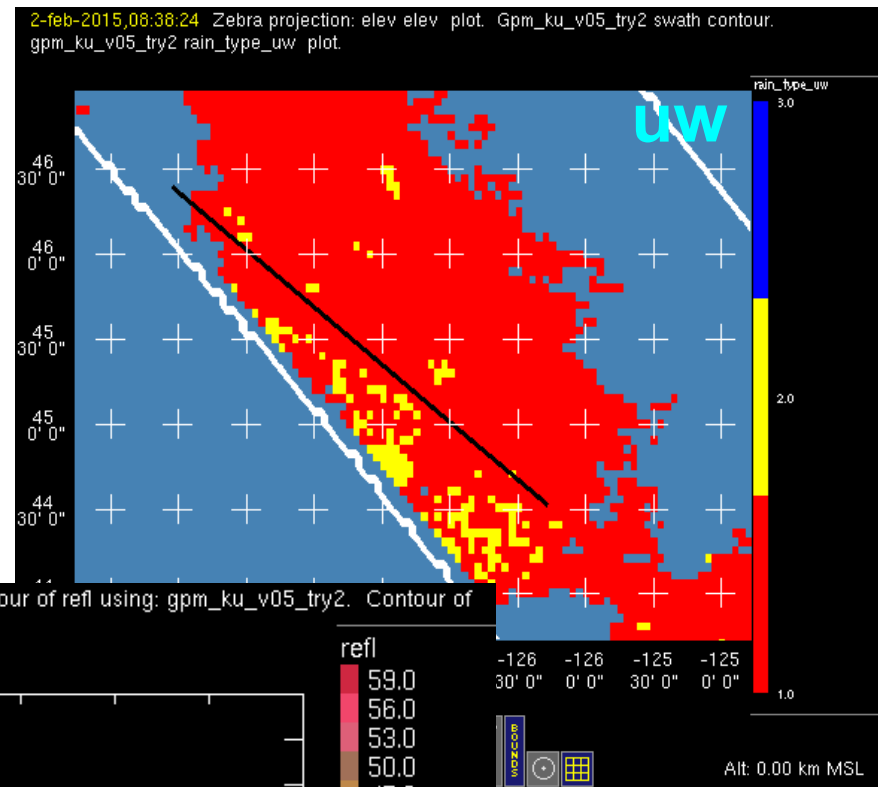
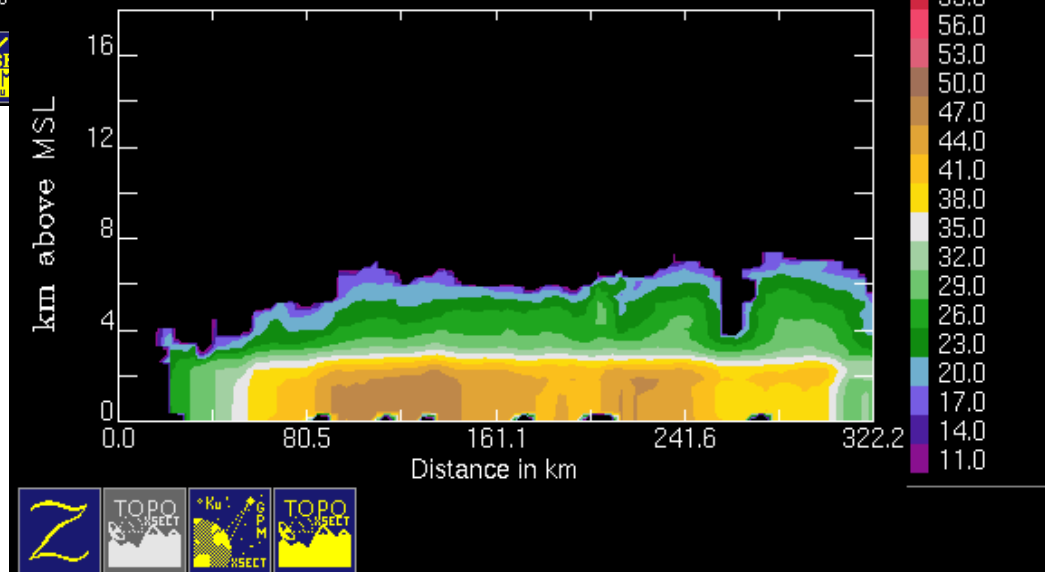
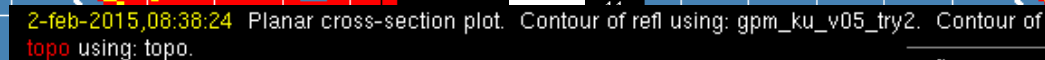
Problem case: West Coast Front



December
NW U.S.

(20141224/1202)

February North Pacific



(20150202/0839)

Object	Echo Characteristic	Height	Area
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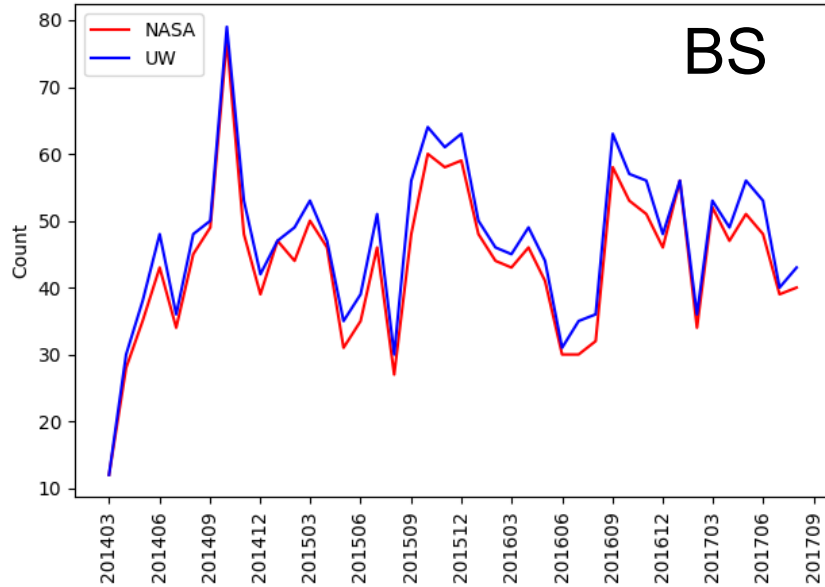
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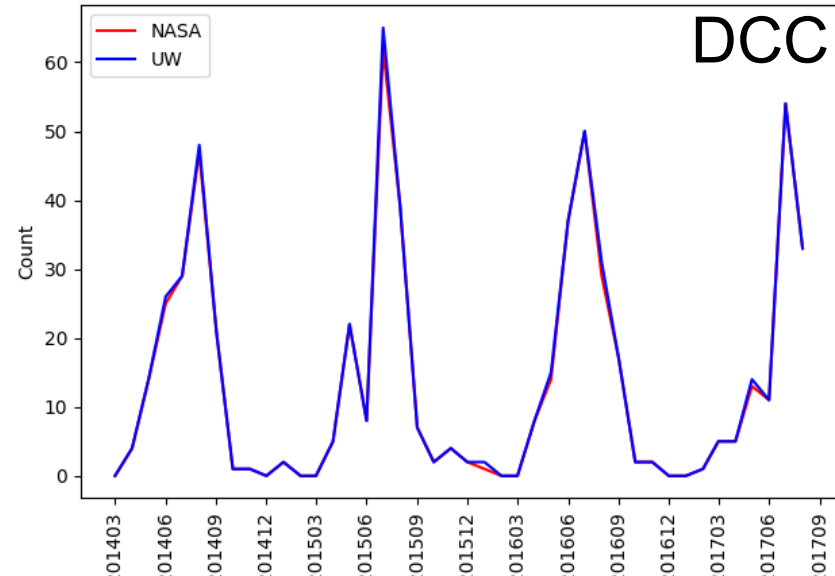
Broad Stratiform Regions	Contiguous stratiform		> 50,000 km ² (<u>strong</u>)
			> 30,000 km ² (<u>moderate</u>)
			30-50,000 km ² (<u>filtered</u>)

Comparison of v05 Counts NASA/UW (strong thresholds)

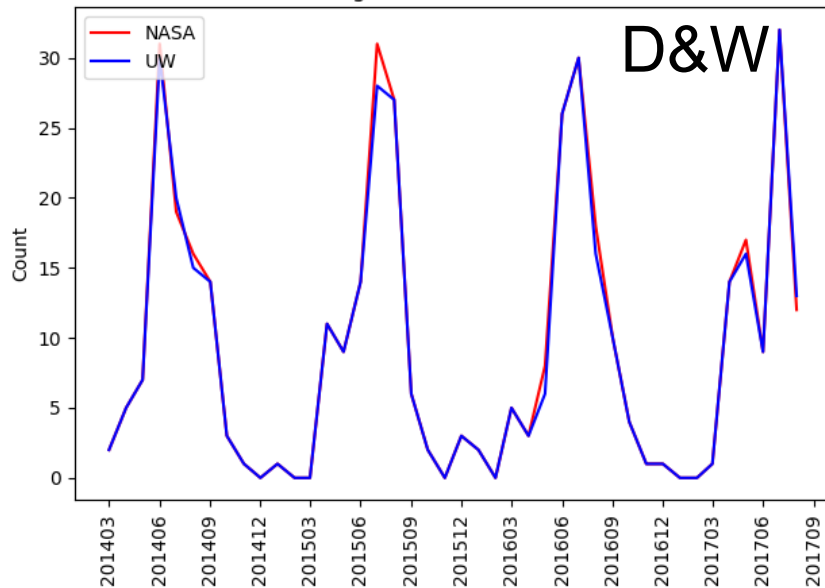
NAM BS (High Thresholds)- NASA/UW - v05



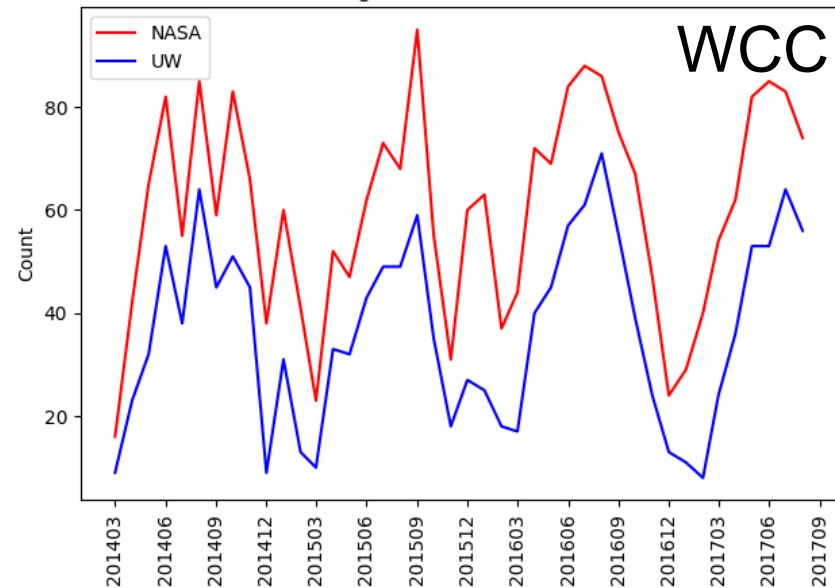
NAM DCC (High Thresholds)- NASA/UW - v05



NAM DWC (High Thresholds)- NASA/UW - v05



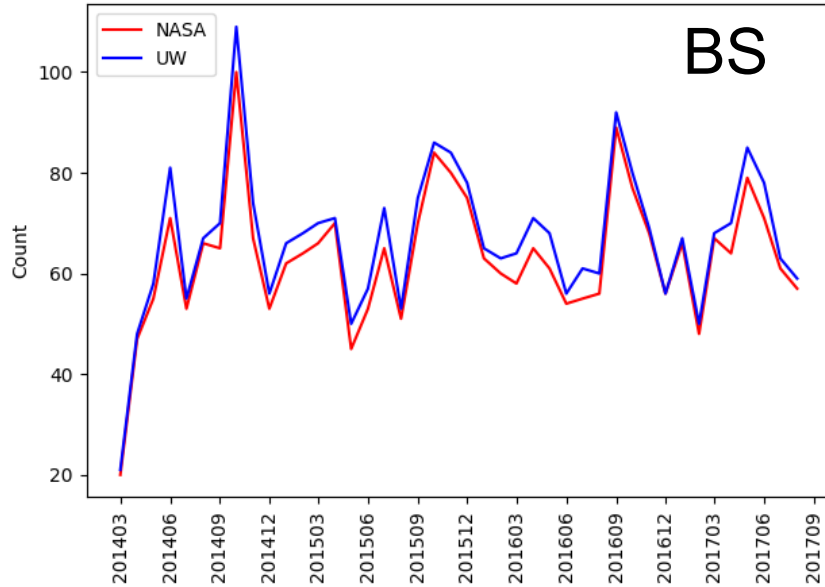
NAM WCC (High Thresholds)- NASA/UW - v05



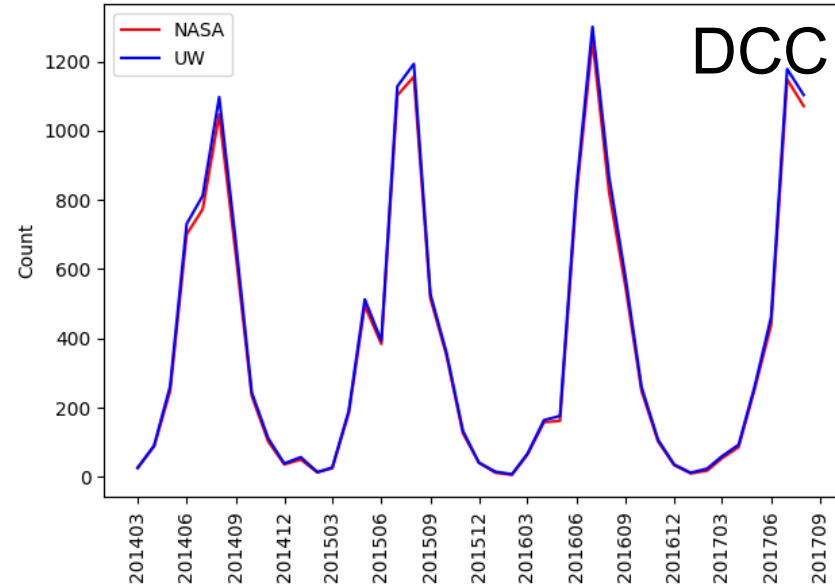
Comparison of v05 Counts

NASA/UW (moderate thresholds)

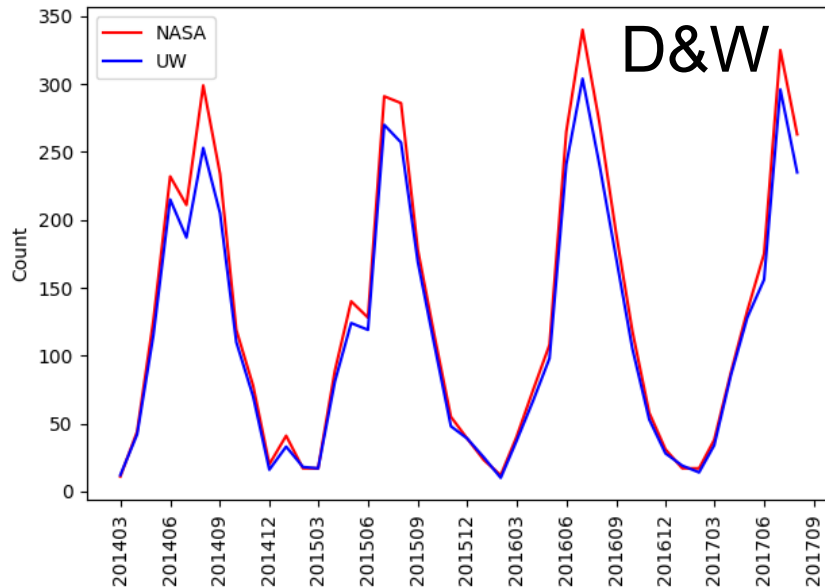
NAM BS (Moderate Thresholds)- NASA/UW - v05



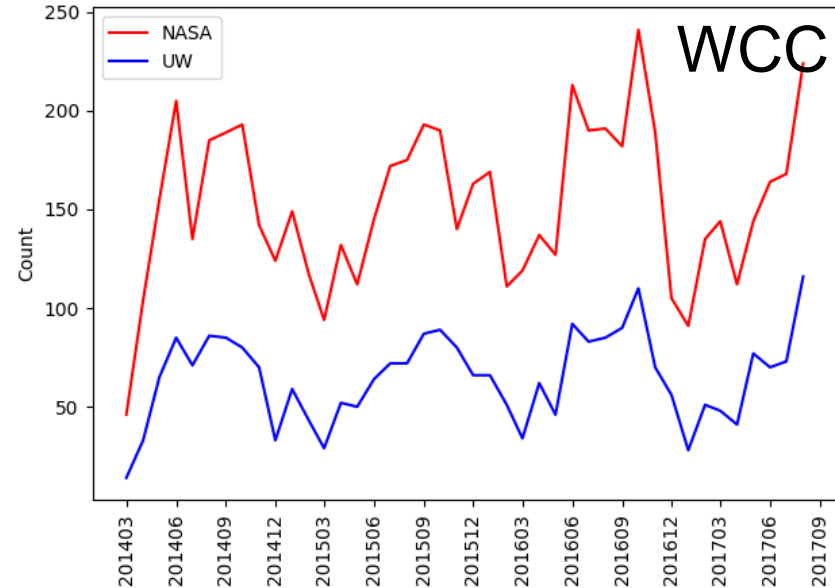
NAM DCC (Moderate Thresholds)- NASA/UW - v05



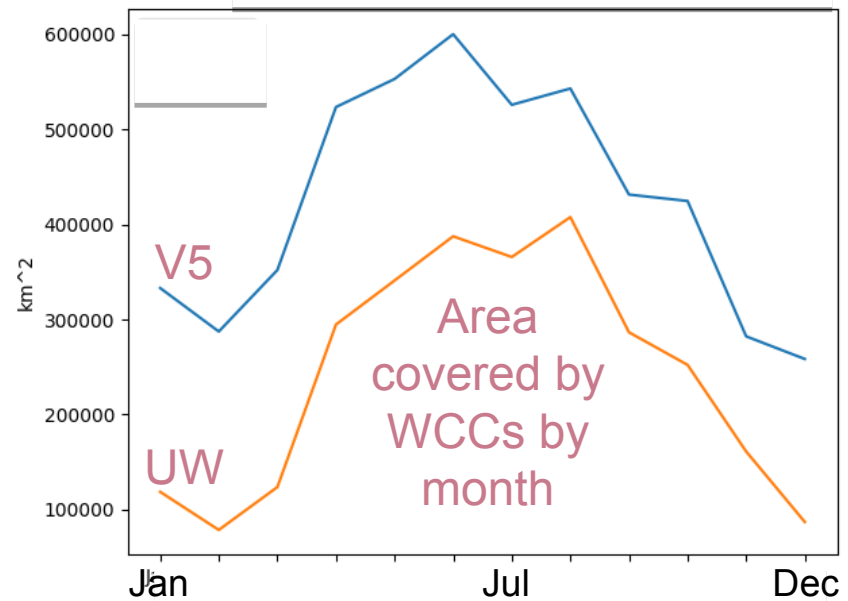
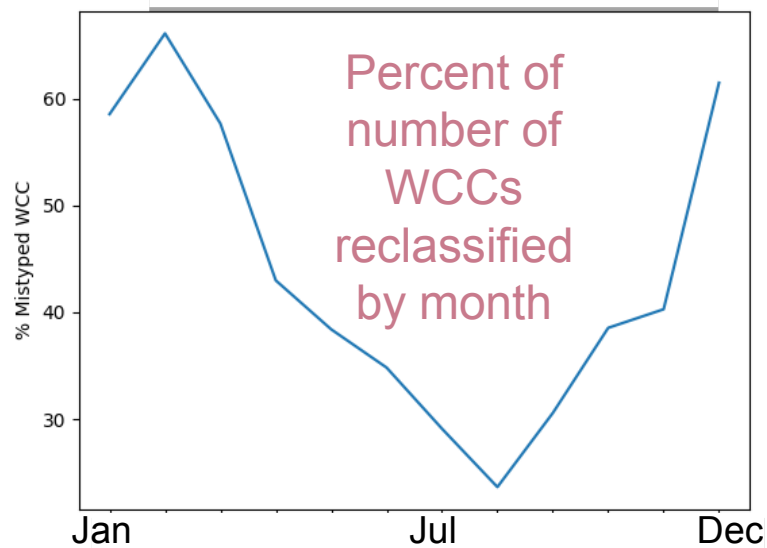
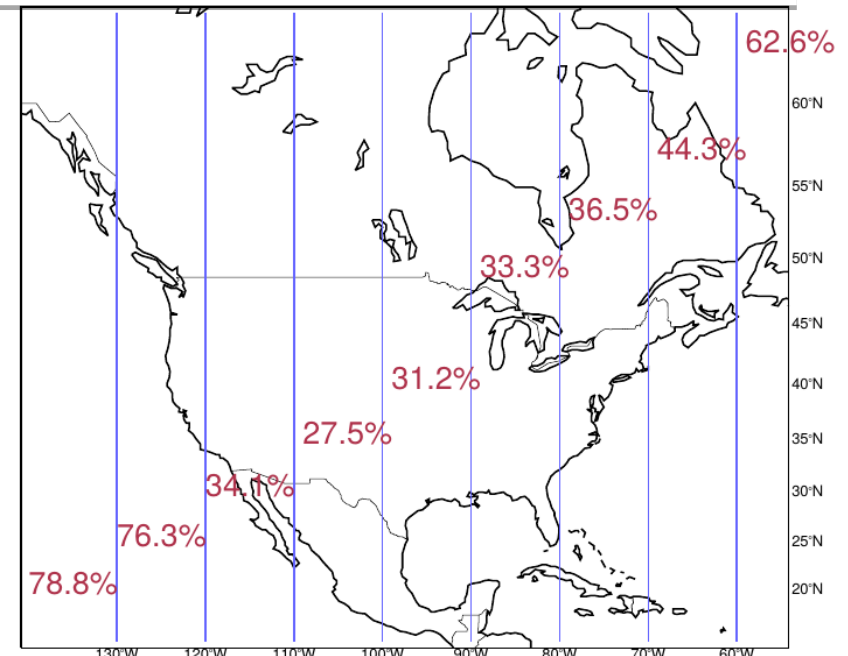
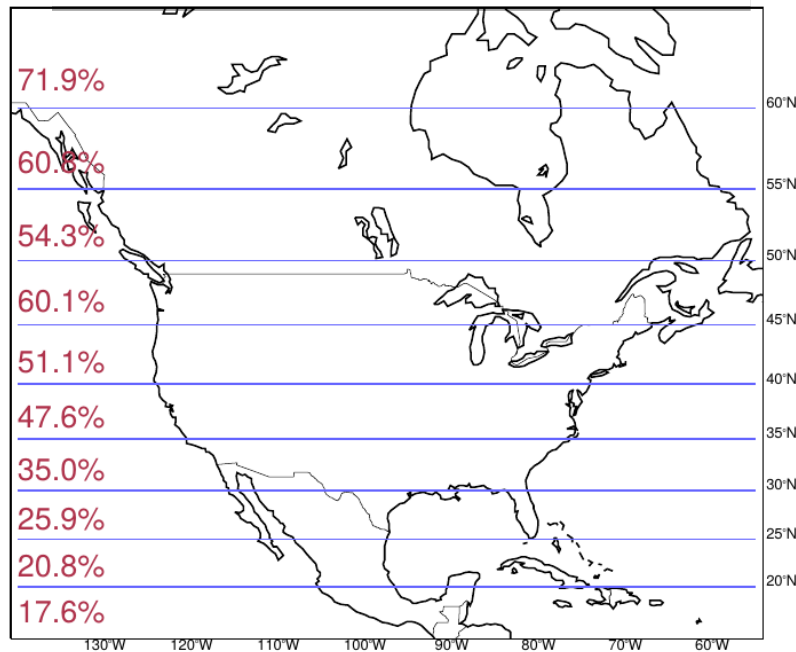
NAM DWC (Moderate Thresholds)- NASA/UW - v05



NAM WCC (Moderate Thresholds)- NASA/UW - v05

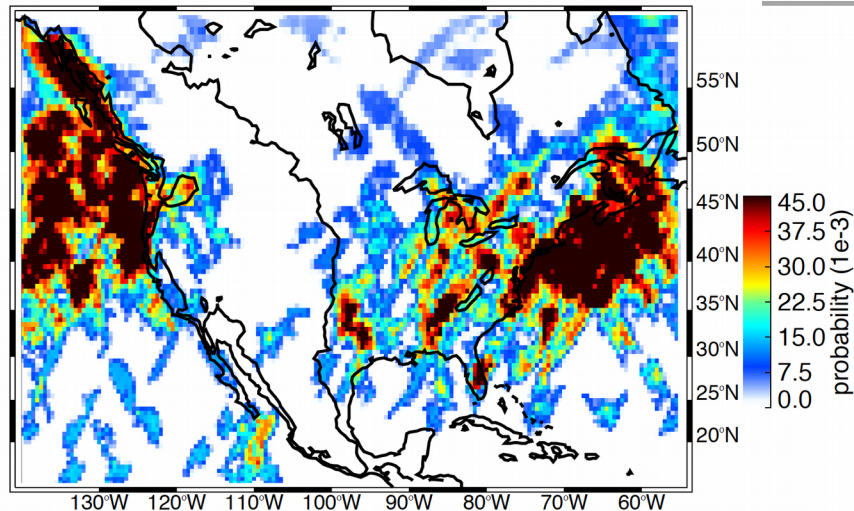


Percentage of WCCs reclassified by UW add-on (strong threshold cases)

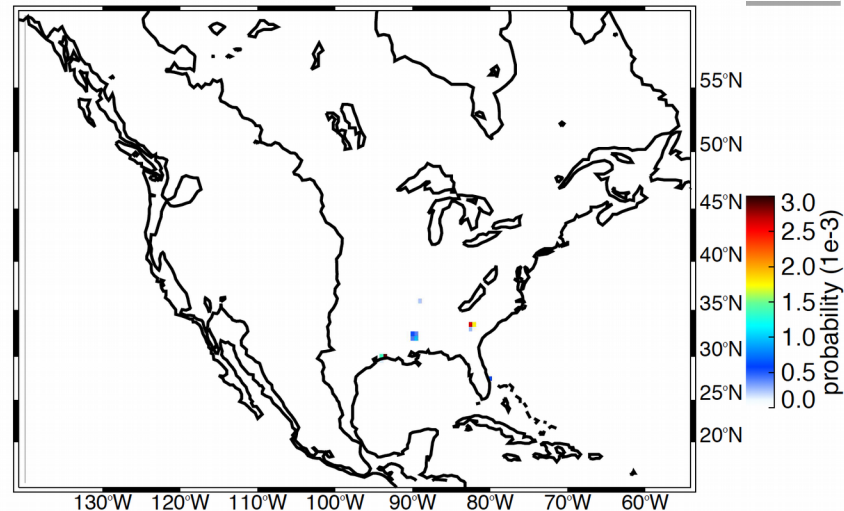


PROBABILITY MAPS (BASED ON GPM-Ku v05, 2014-2017)

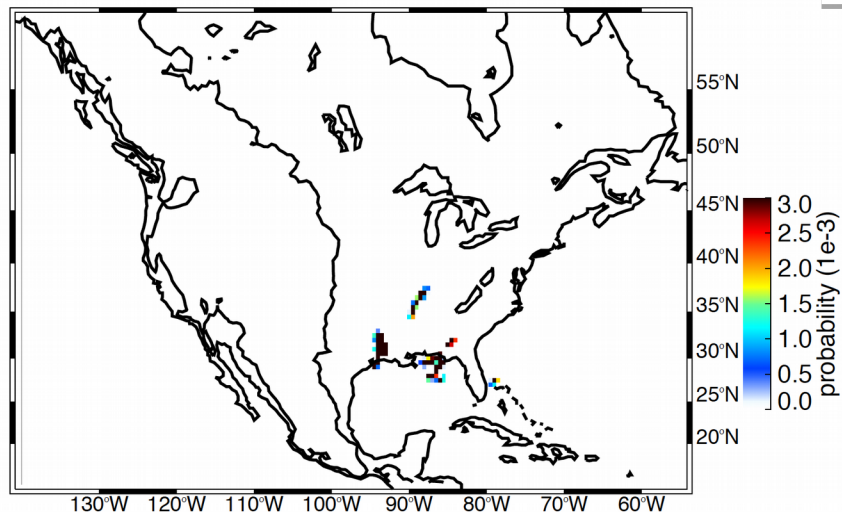
(a) DJF broad stratiform regions strong thresholds



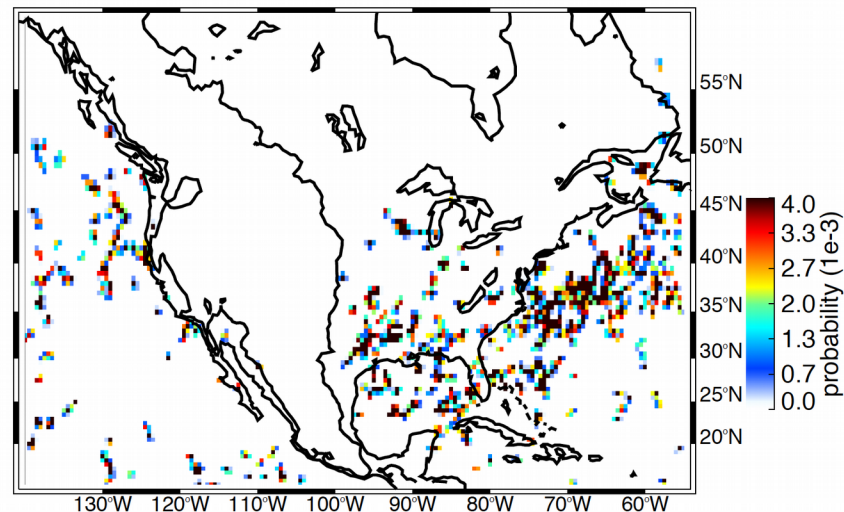
(b) DJF deep convective cores strong thresholds



(c) DJF deep/wide convective cores strong thresholds

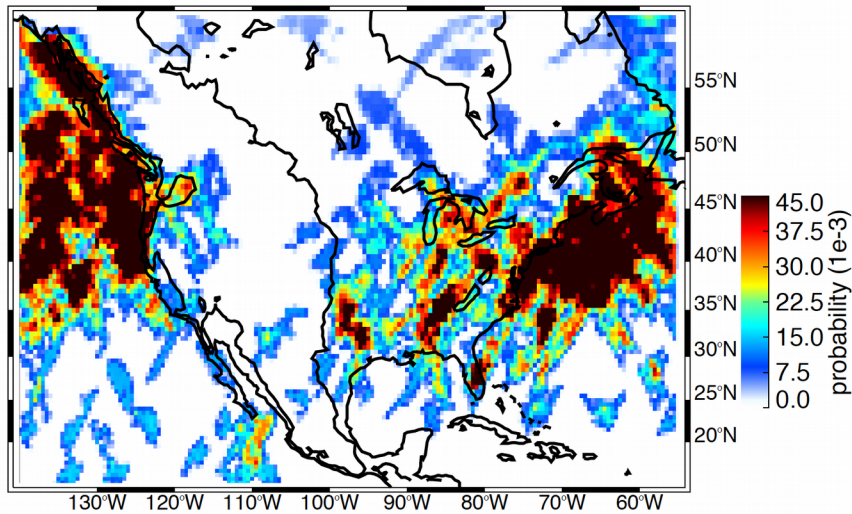


(d) DJF wide convective cores strong thresholds

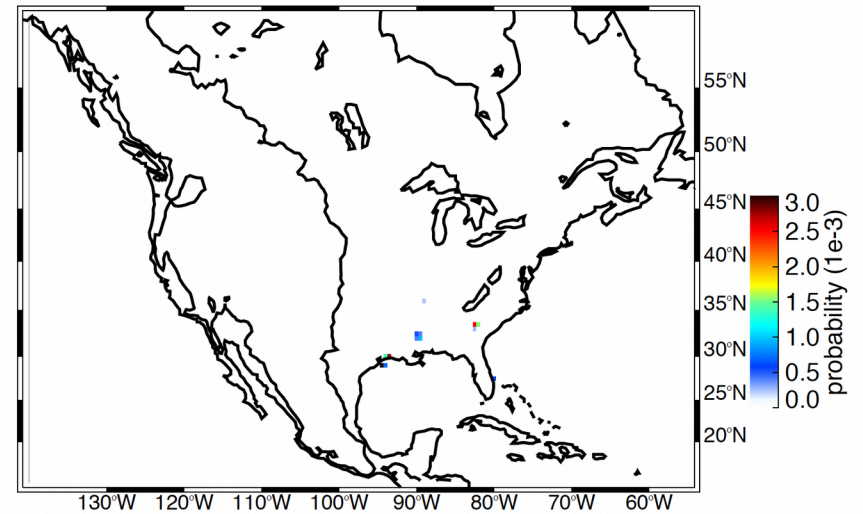


PROBABILITY MAPS (BASED ON GPM-Ku v05uw2, 2014-2017)

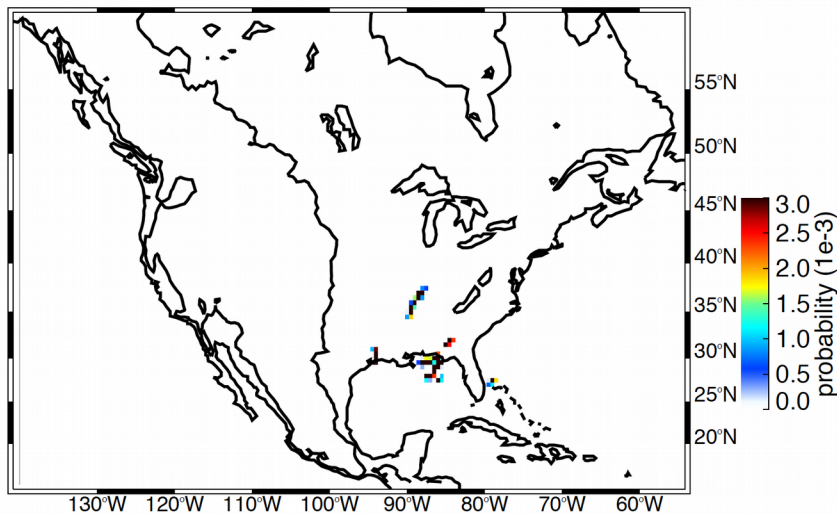
(a) DJF broad stratiform regions strong thresholds (uw2)



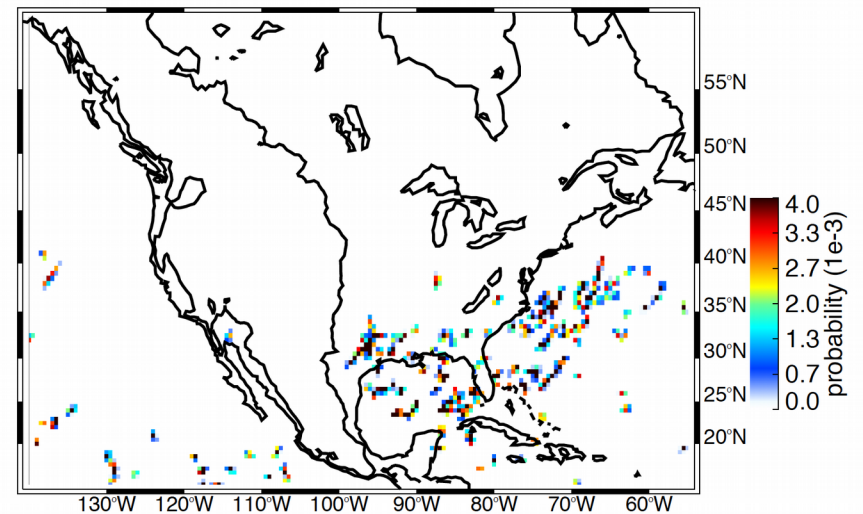
(b) DJF deep convective cores strong thresholds (uw2)



(c) DJF deep/wide convective cores strong thresholds (uw2)

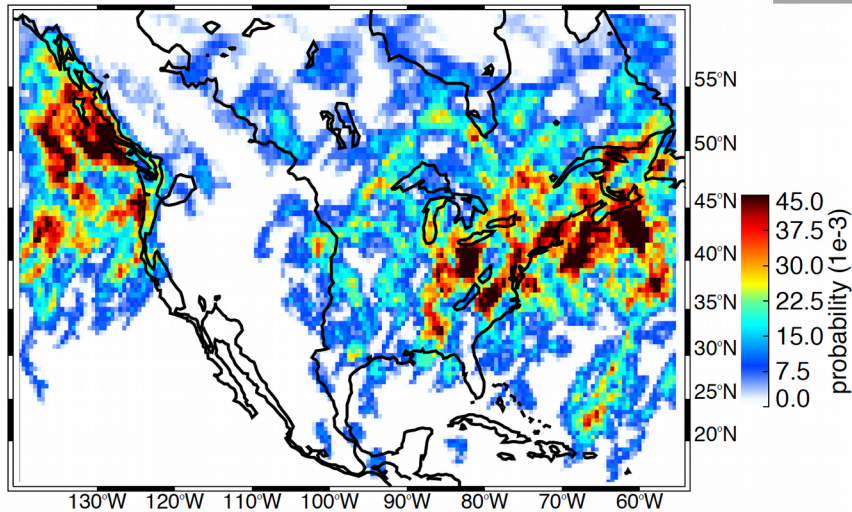


(d) DJF wide convective cores strong thresholds (uw2)

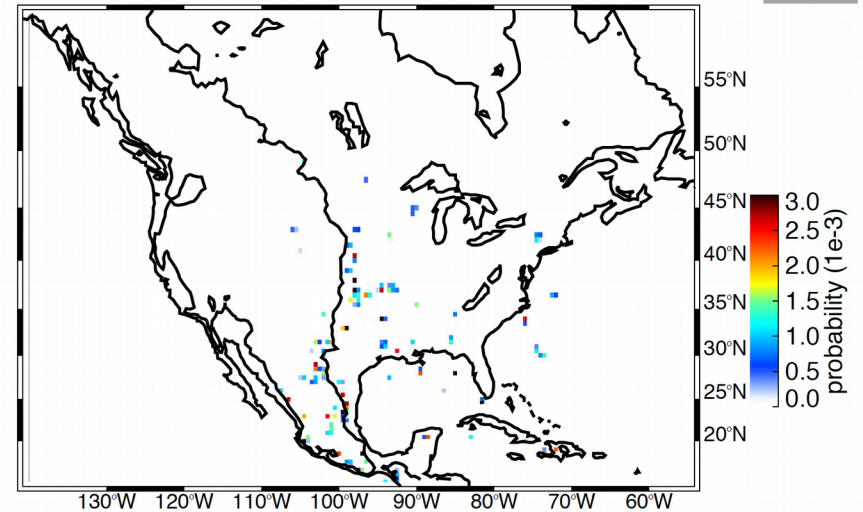


PROBABILITY MAPS (BASED ON GPM-Ku v05, 2014-2017)

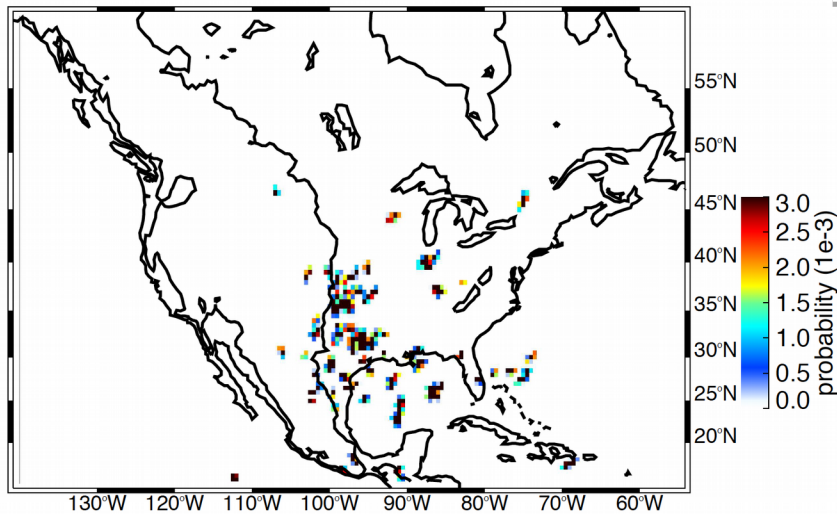
(a) MAM broad stratiform regions strong thresholds



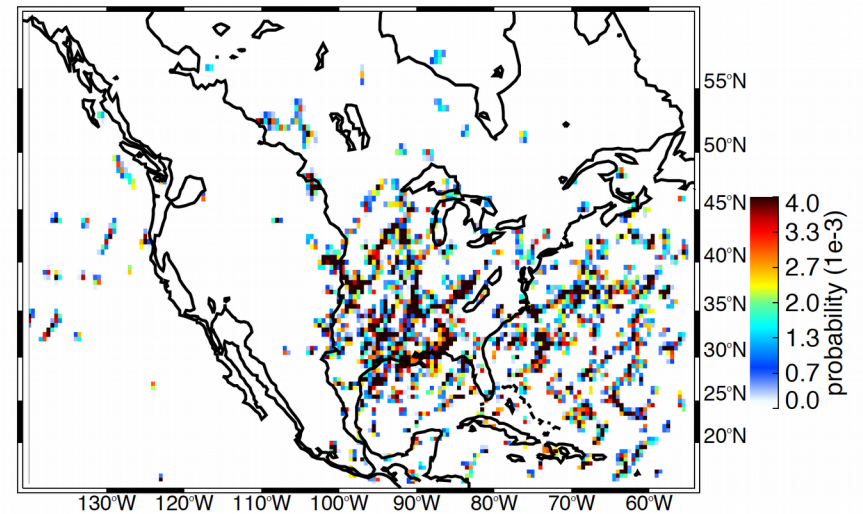
(b) MAM deep convective cores strong thresholds



(c) MAM deep/wide convective cores strong thresholds

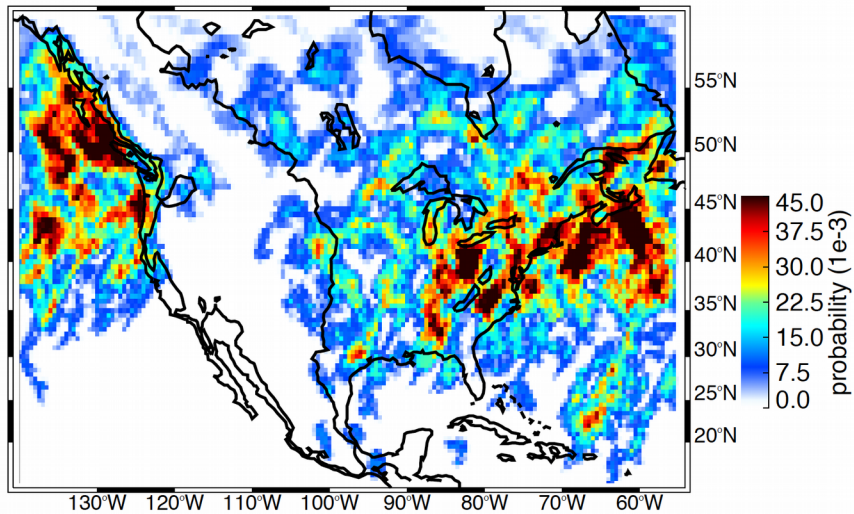


(d) MAM wide convective cores strong thresholds

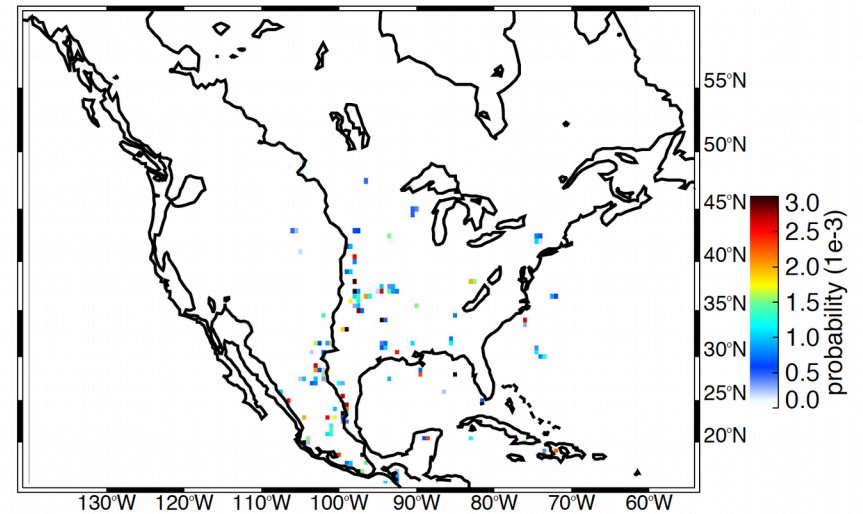


PROBABILITY MAPS (BASED ON GPM-Ku v05uw2, 2014-2017)

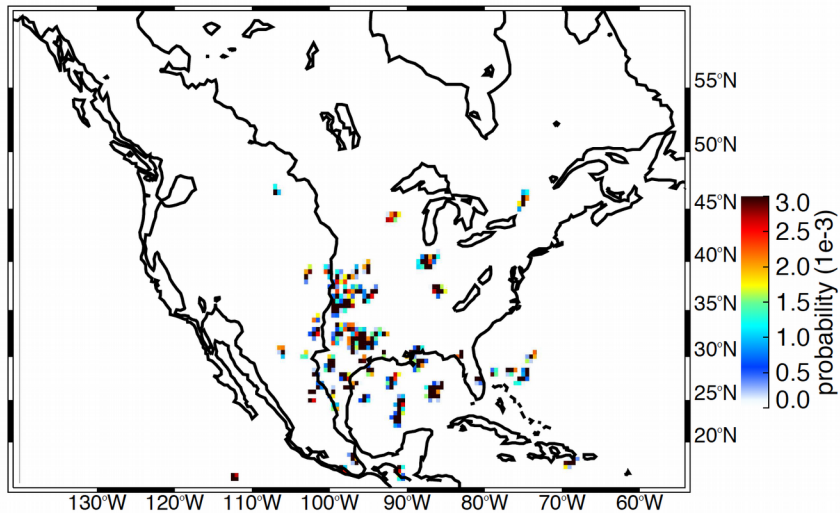
(a) MAM broad stratiform regions strong thresholds (uw2)



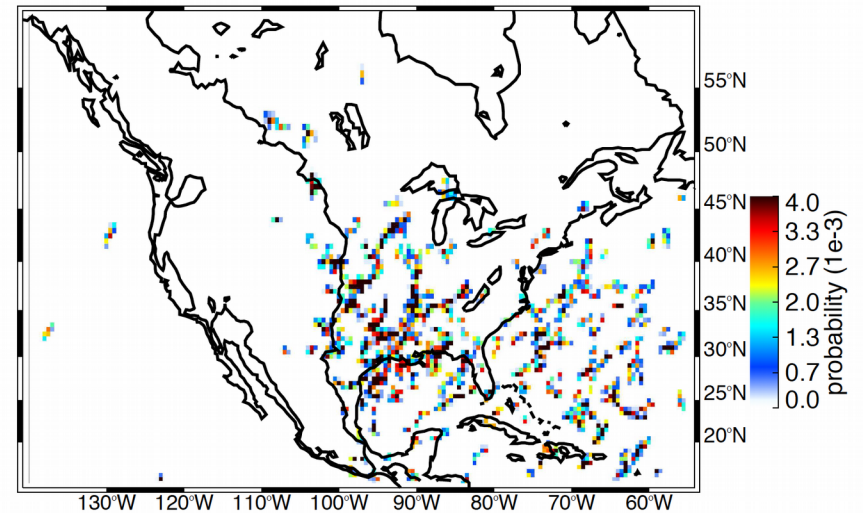
(b) MAM deep convective cores strong thresholds (uw2)



(c) MAM deep/wide convective cores strong thresholds (uw2)



(d) MAM wide convective cores strong thresholds (uw2)



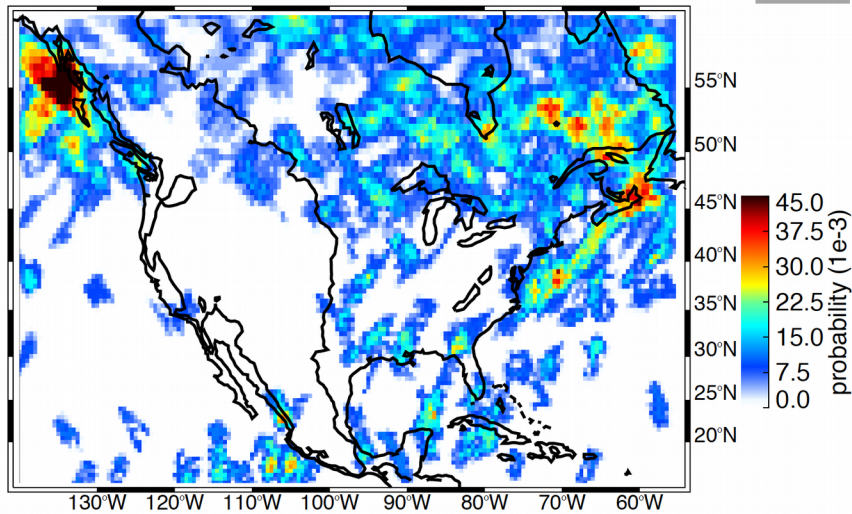
Conclusions

- V5 performs better than V4 but still indicates a lot of stratiform as convective 
overestimation of convective latent heating
- An algorithm based on the dropoff of reflectivity above the maximum dBZ eliminates most of the problem
- Over the North America sector, the problem is greatest in winter and spring, at higher latitudes, & over the ocean

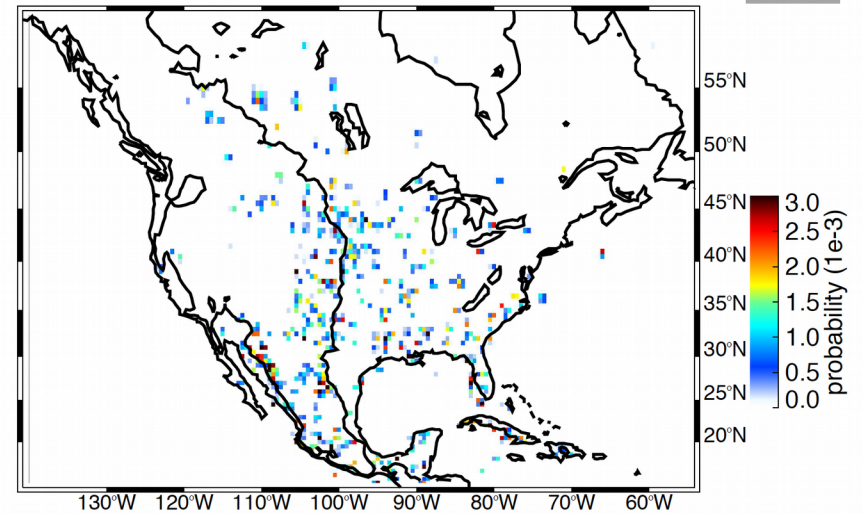
Extra Slides

PROBABILITY MAPS (BASED ON GPM-Ku v05, 2014-2017)

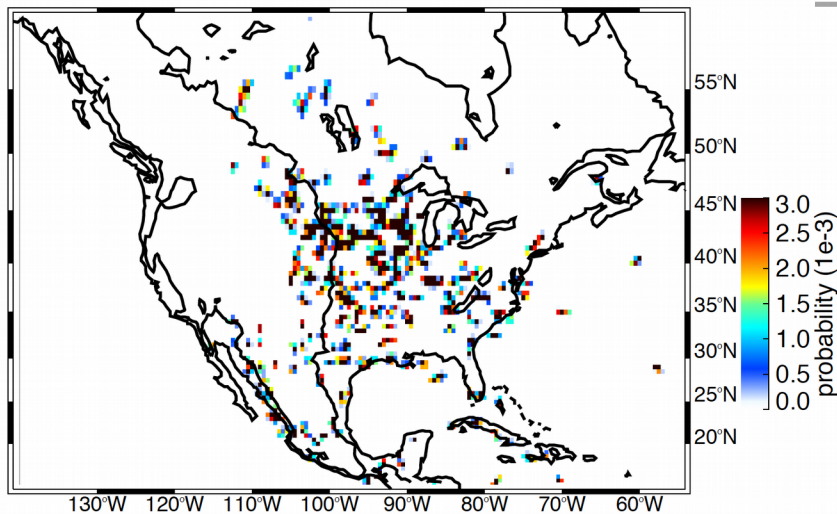
(a) JJA broad stratiform regions strong thresholds



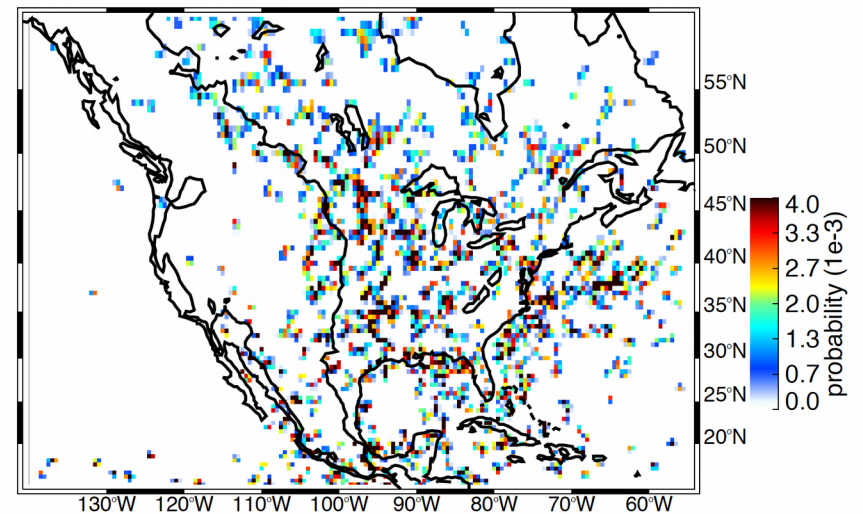
(b) JJA deep convective cores strong thresholds



(c) JJA deep/wide convective cores strong thresholds

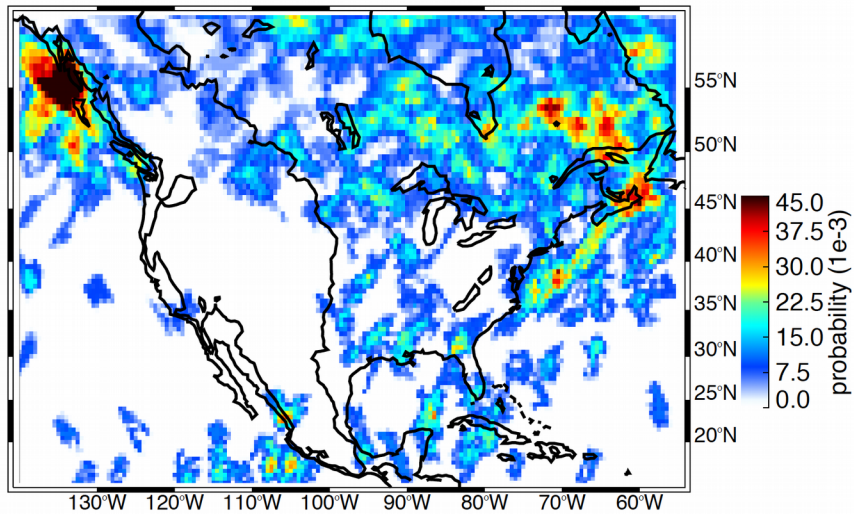


(d) JJA wide convective cores strong thresholds

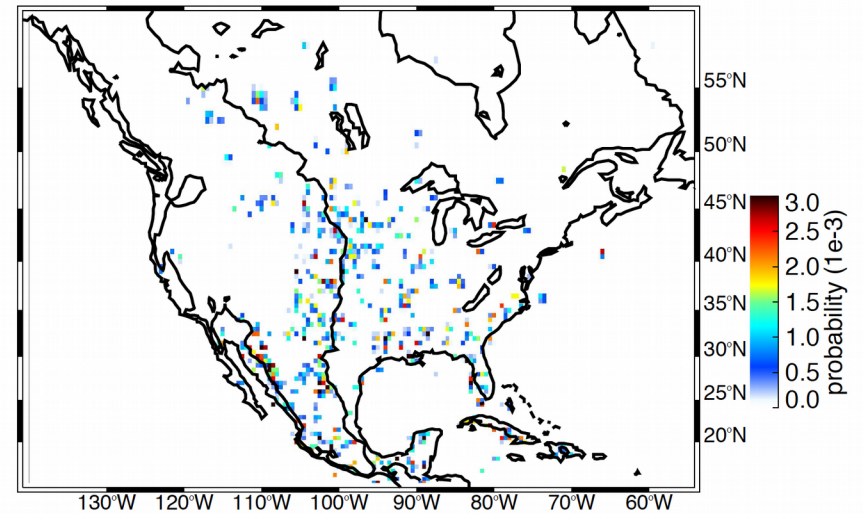


PROBABILITY MAPS (BASED ON GPM-Ku v05uw2, 2014-2017)

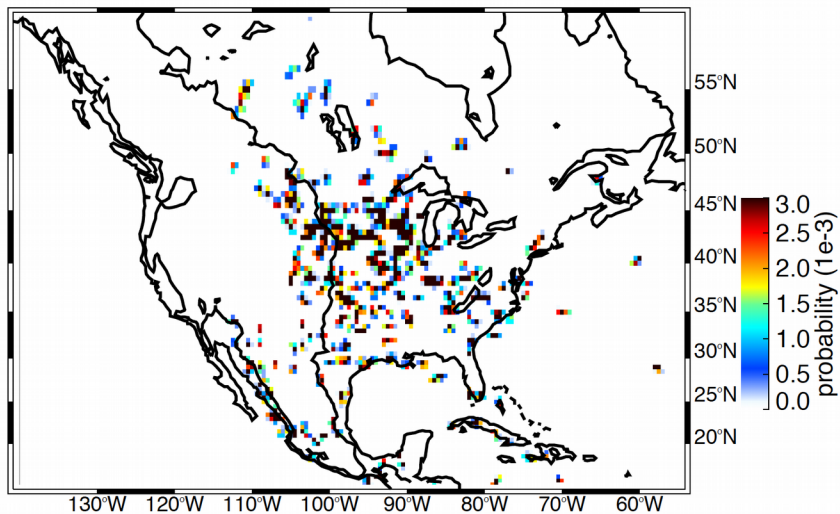
(a) JJA broad stratiform regions strong thresholds (uw2)



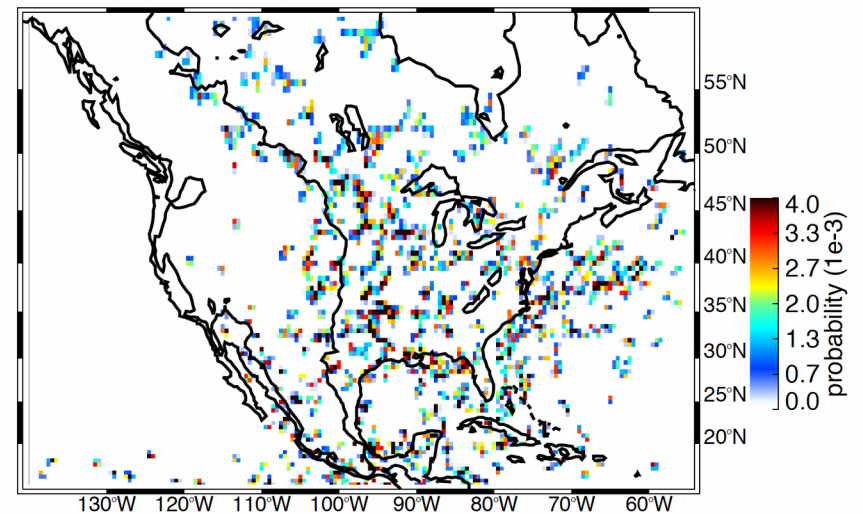
(b) JJA deep convective cores strong thresholds (uw2)



(c) JJA deep/wide convective cores strong thresholds (uw2)

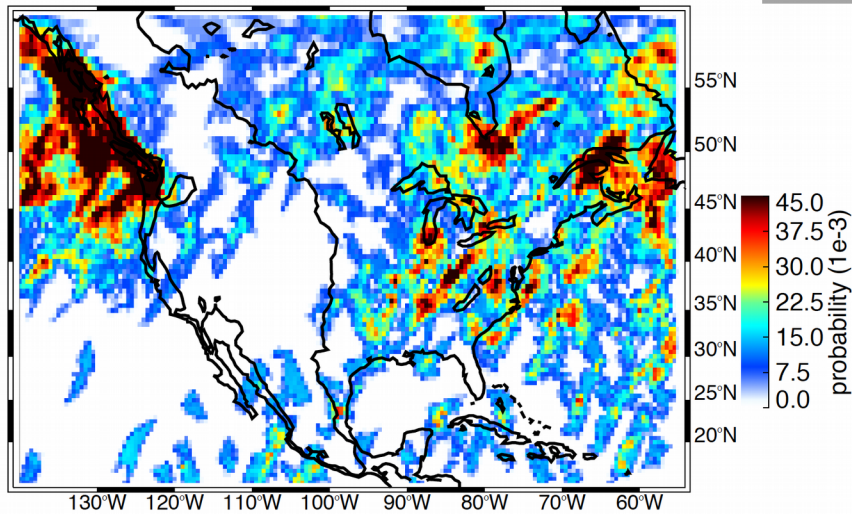


(d) JJA wide convective cores strong thresholds (uw2)

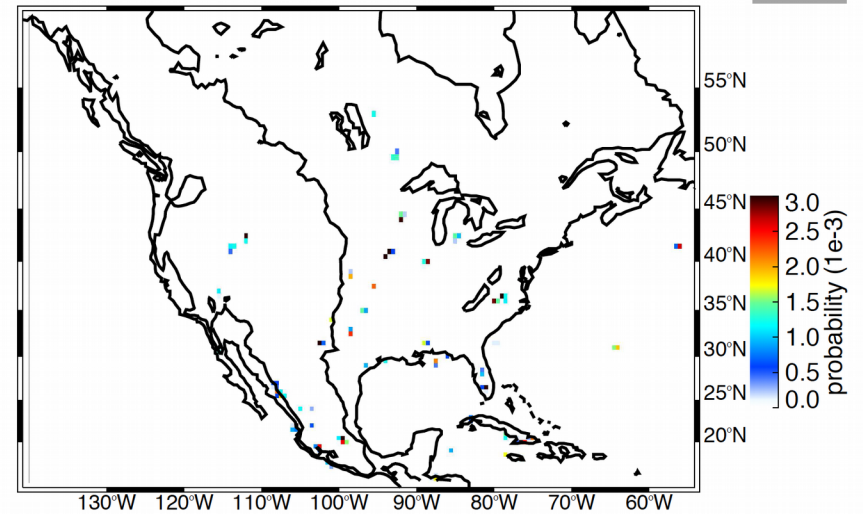


PROBABILITY MAPS (BASED ON GPM-Ku v05, 2014-2016)

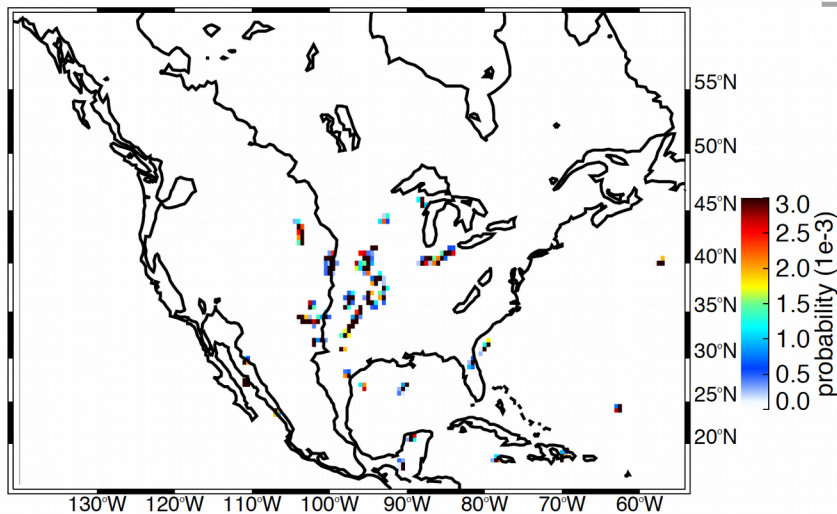
(a) SON broad stratiform regions strong thresholds



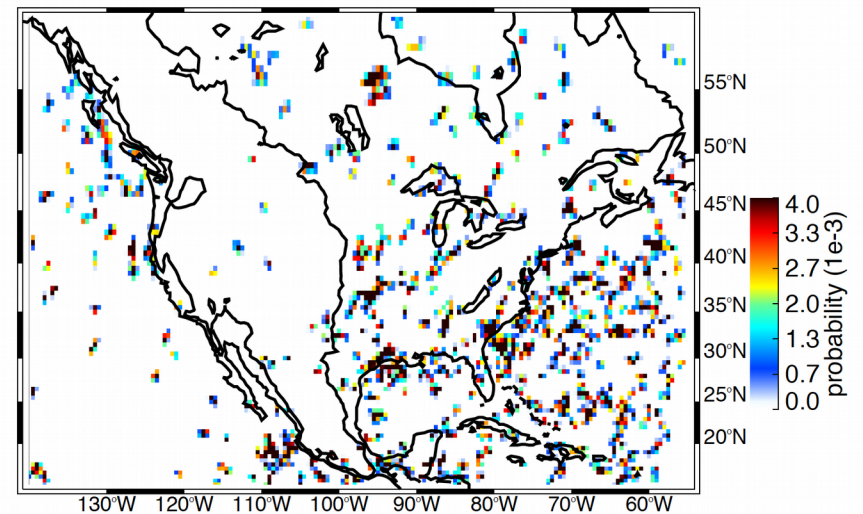
(b) SON deep convective cores strong thresholds



(c) SON deep/wide convective cores strong thresholds

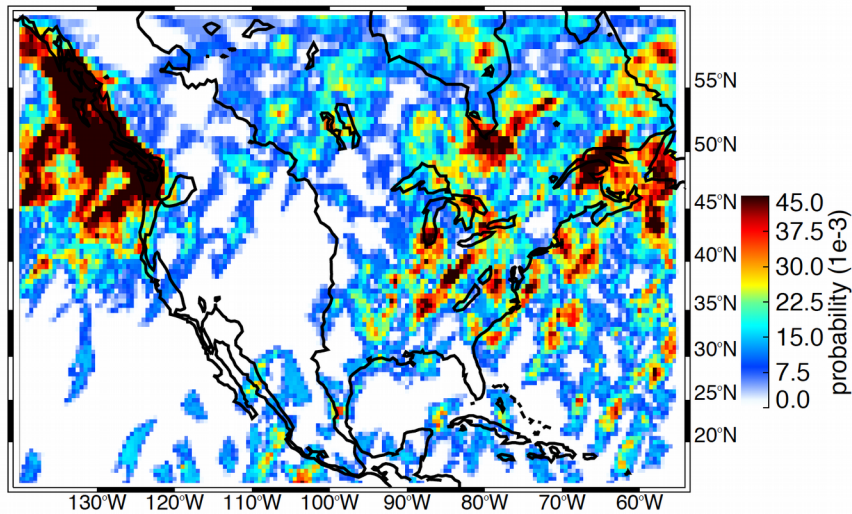


(d) SON wide convective cores strong thresholds

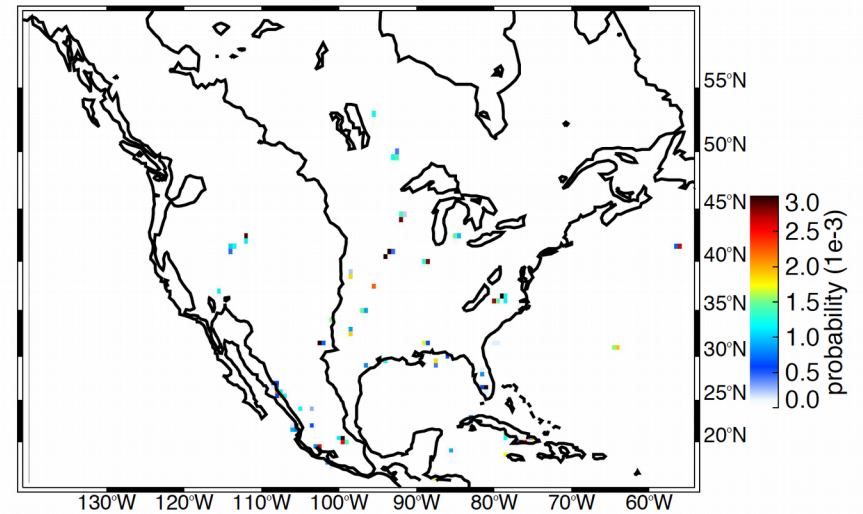


PROBABILITY MAPS (BASED ON GPM-Ku v05uw2, 2014-2016)

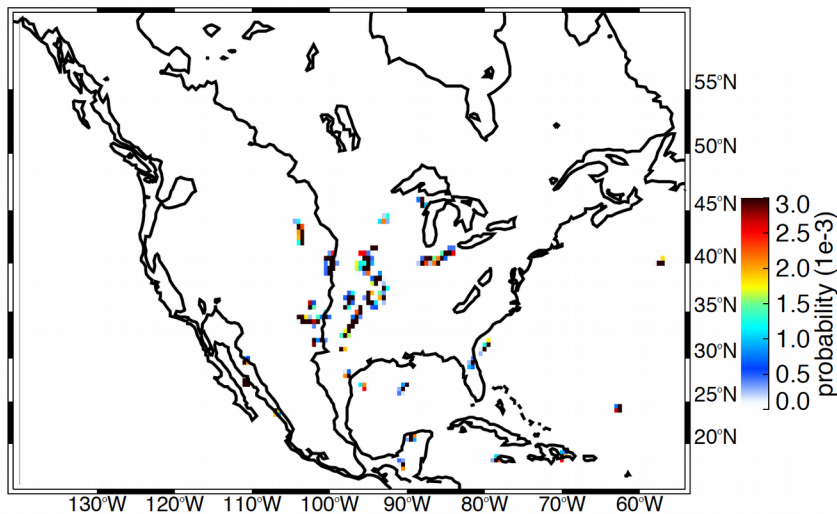
(a) SON broad stratiform regions strong thresholds (uw2)



(b) SON deep convective cores strong thresholds (uw2)



(c) SON deep/wide convective cores strong thresholds (uw2)



(d) SON wide convective cores strong thresholds (uw2)

