TRMM V 7 and V 6 rain retrievals in intense convective systems

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Objective

Examine how changes from Version 6 to Version 7 affect TRMM retrievals in *intense convective systems*

- *focus here on 2A12, 2A25, 2B31*

Algorithm changes lead to a net increase or decrease in global mean precip, zonal means, etc., *but*…

The increase or decrease is far from uniform across different regimes and precipitation modes

Approach

•Examine V6 and V7 values in Intense Convective Systems for 2A12, 2A25, 2B31

•Take the 100 strongest cases over land and 100 strongest cases over ocean (ranked by lowest 37 GHz PCT; < 135 K for land, < 154 K for ocean)

•Include *all pixels from the V 6 precipitation feature*, not just the intense convection

•Use V6 Precipitation Features as starting point. Pixels with:

20+ dBZ 2A25 (V6) Near Surface Z ***or***

≤ 250 K 85 GHz PCT from 1B11 (V6)

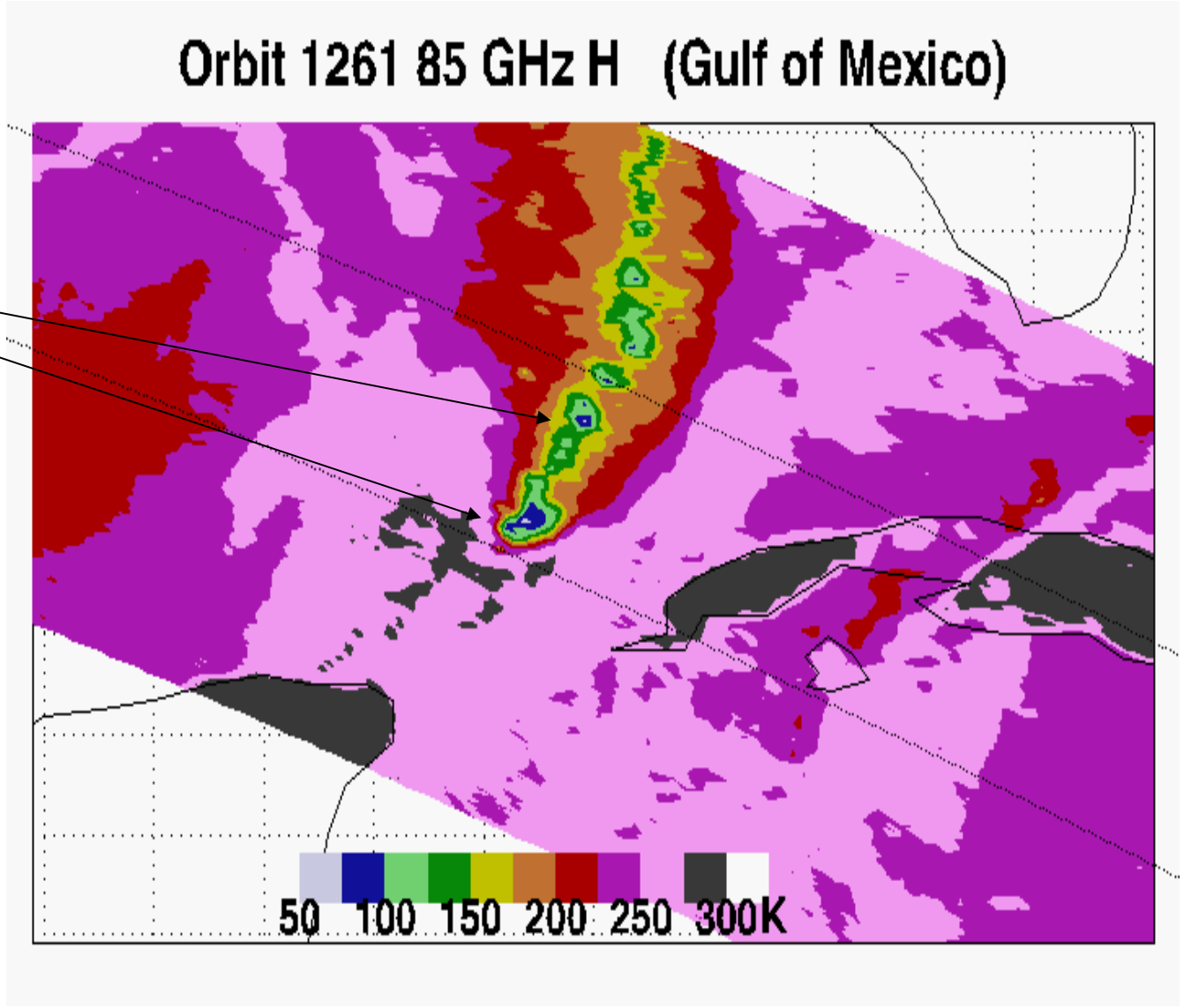
•Consider *subset of pixels with strong convection*:

30+ dBZ 2A25 (V7) **at 8 km** altitude ***or***

≤ 220 K 37 GHz PCT from 1B11 (V7)

Example - 85 H

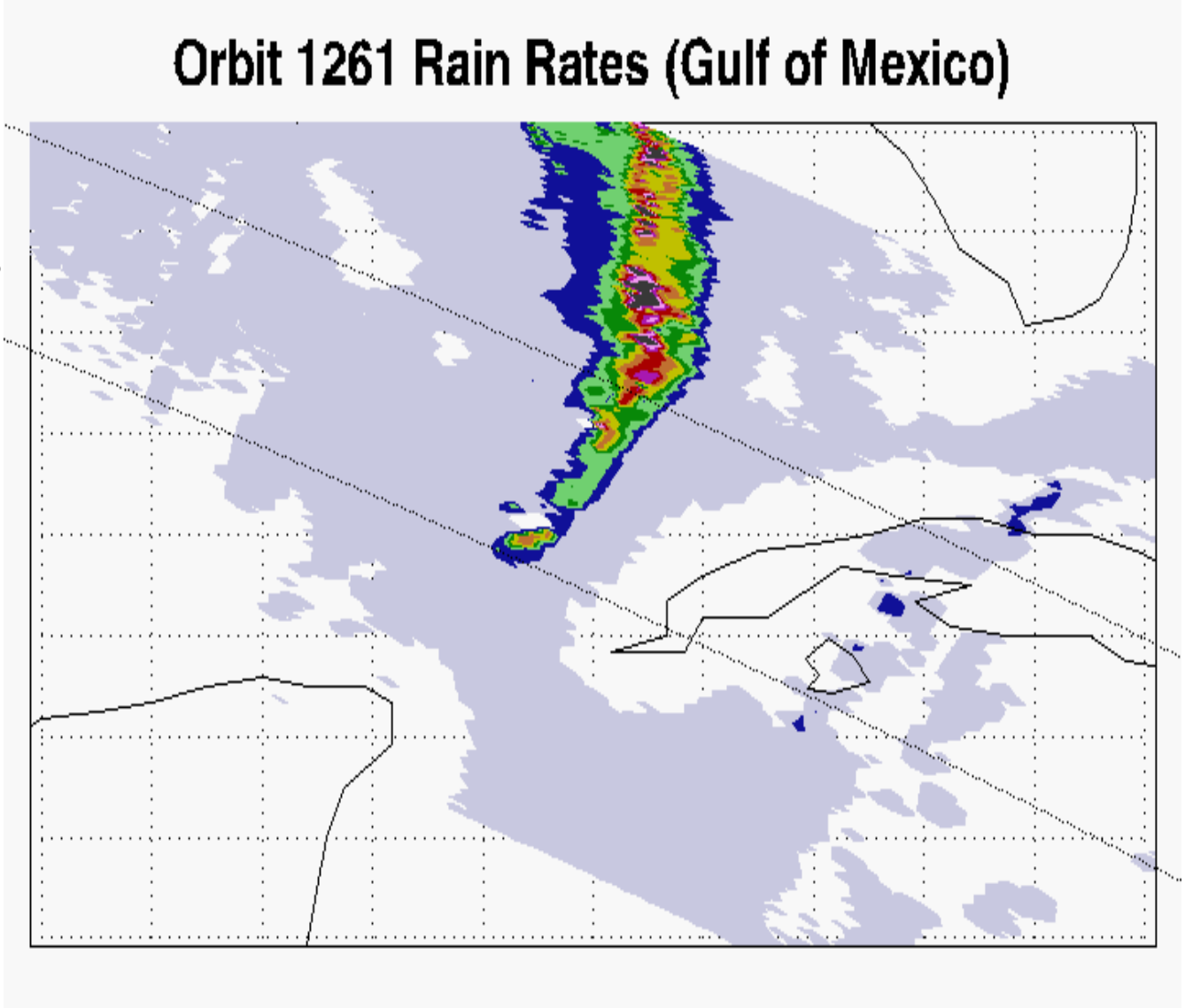
A few pixels under 70 K



Example - 2A12 V 7 (ocean)

Colors:

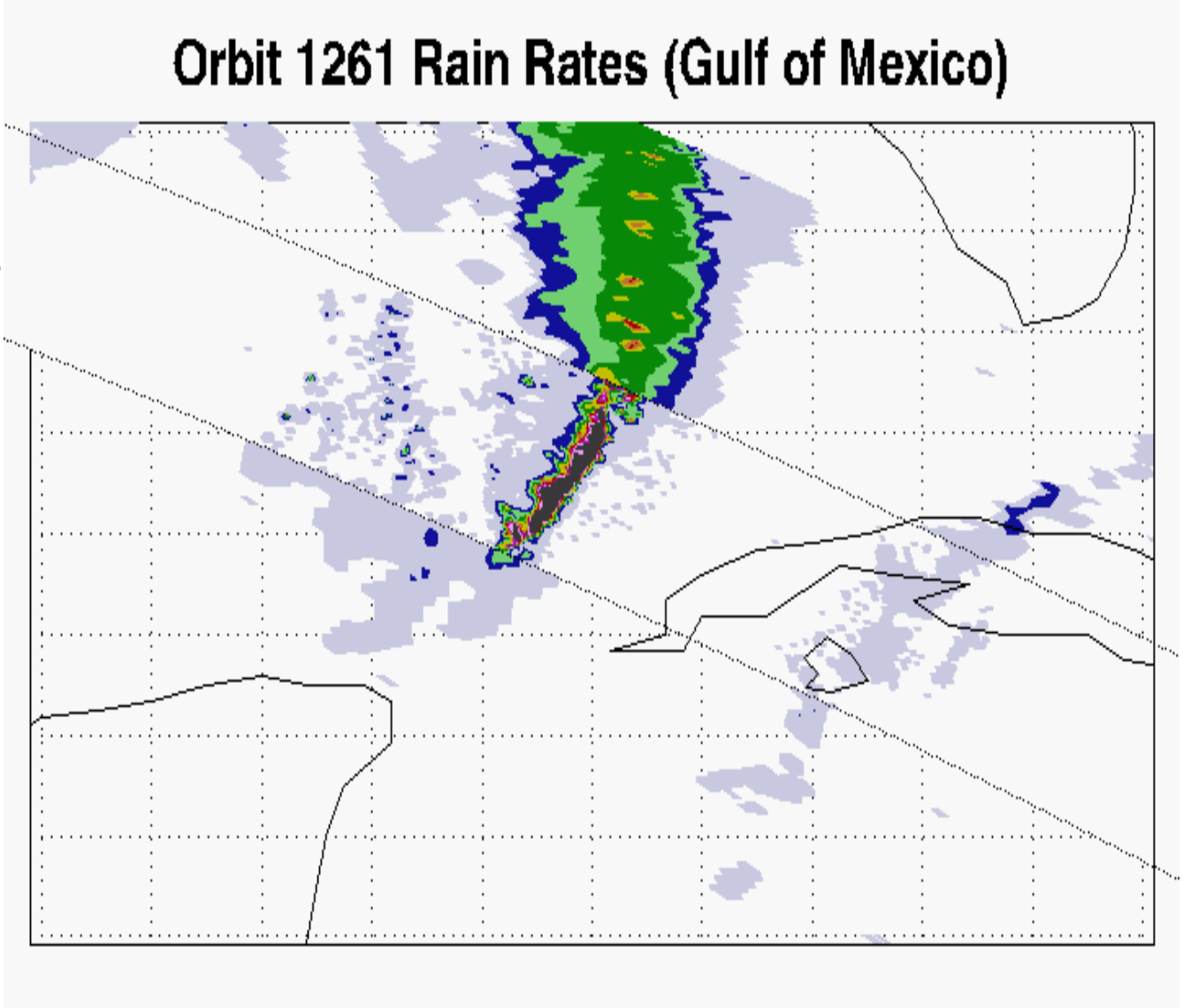
5 mm / h increments



Example - 2A25 V 7

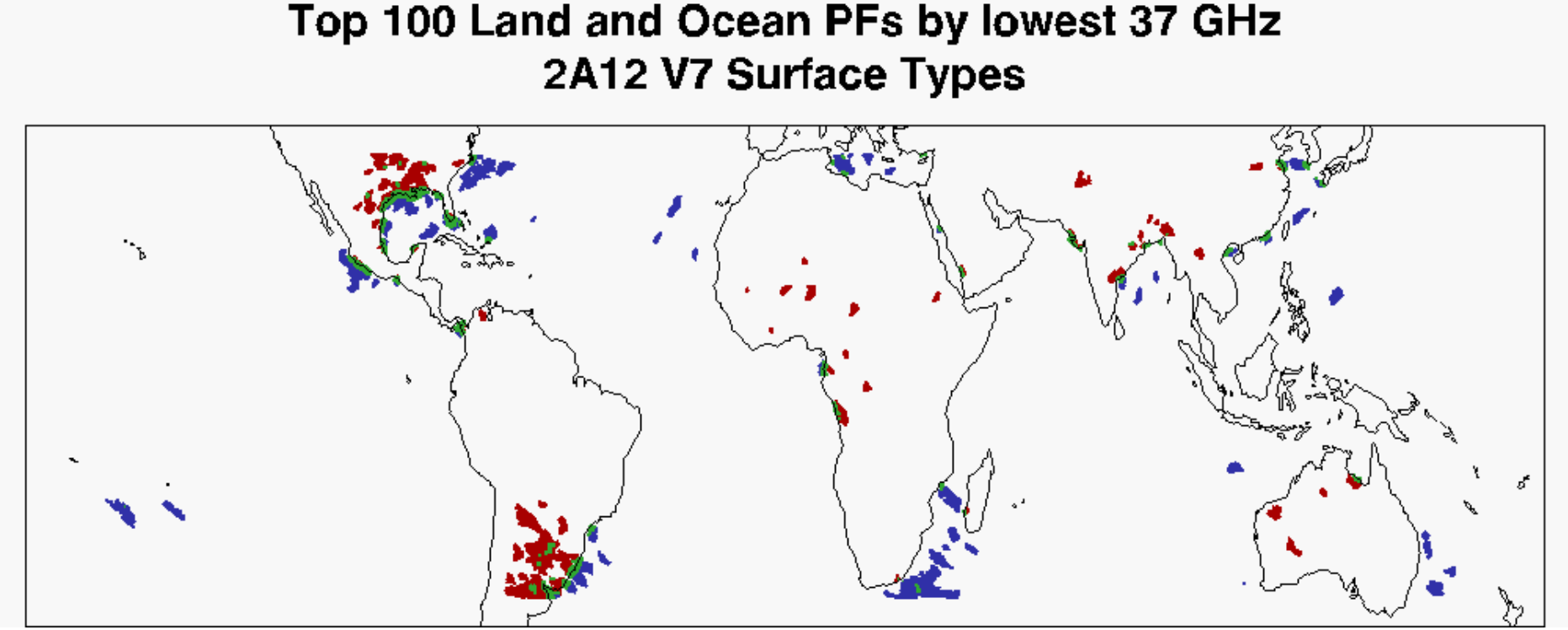
Colors:

5 mm / h increments



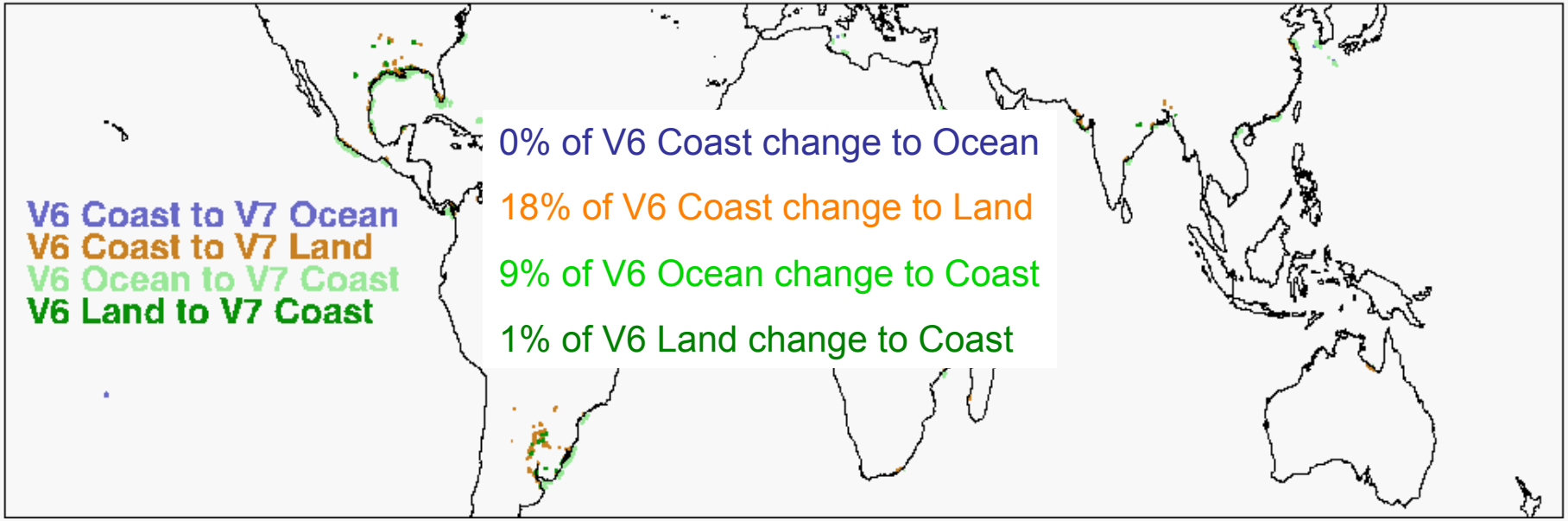
Sample used - Surface Types

All pixels had 2A25 20+ dBZ or 85 GHz PCT ≤ 250 K *in V6*

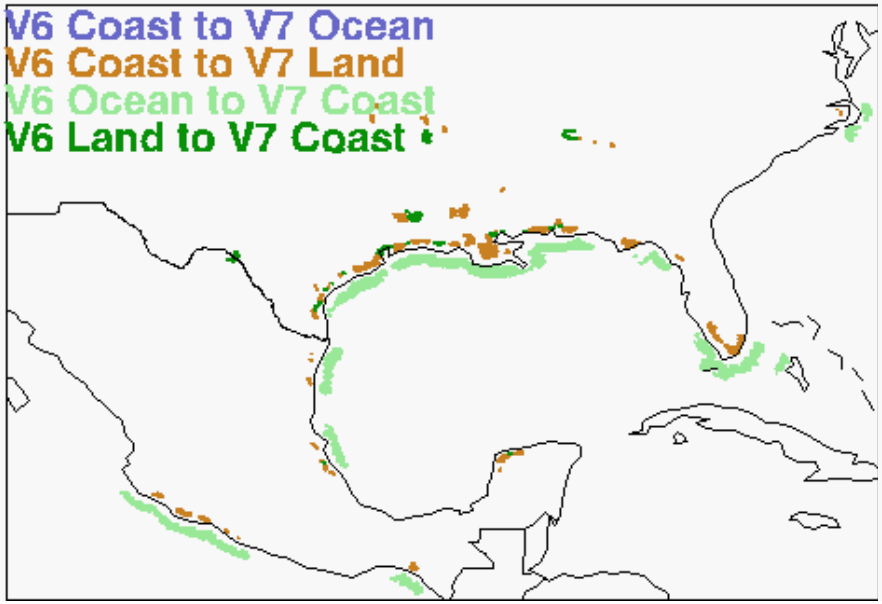


Subsequent plots characterize pixels based on their 2A12 V 7 Surface Type

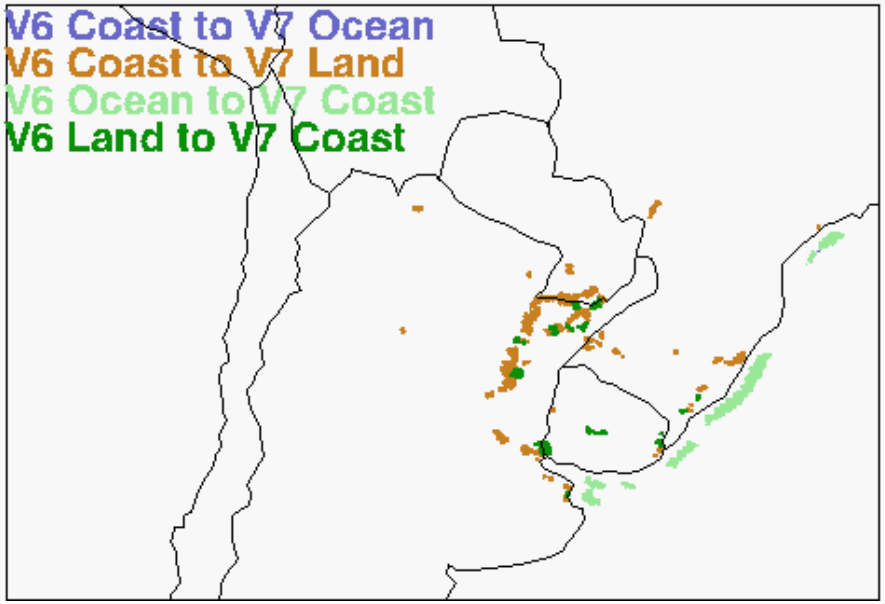
Changes of 2A12 Surface type



Changes of 2A12 Surface type



Changes of 2A12 Surface type

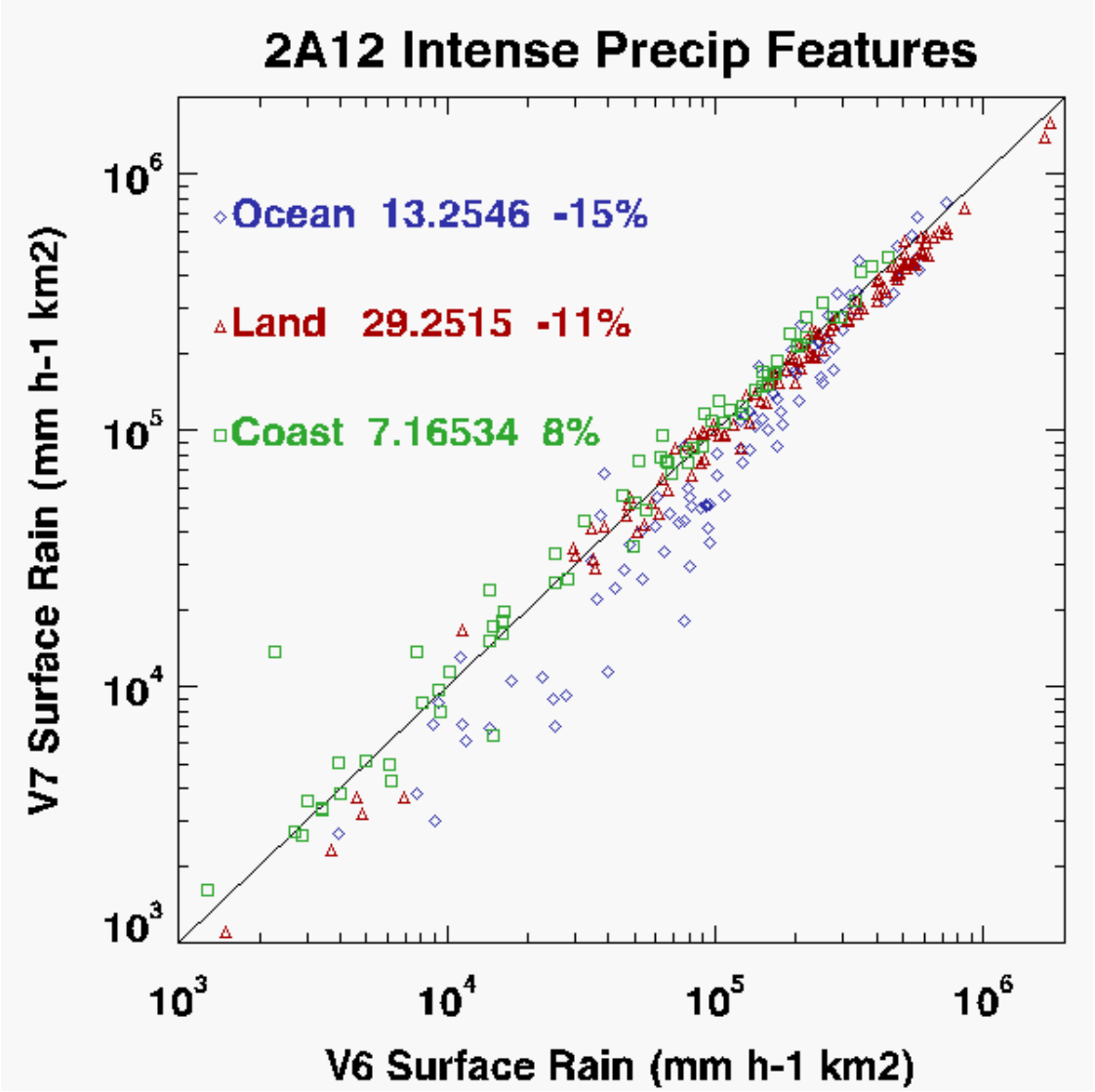


2A12 V6 versus V7

Rain totaled for pixels with a given 2A12 ***V 7*** Surface Type

Total V 7 rain (*10^{12} kg h^{-1}) from all systems printed in legend, with % change from V 6 to V 7

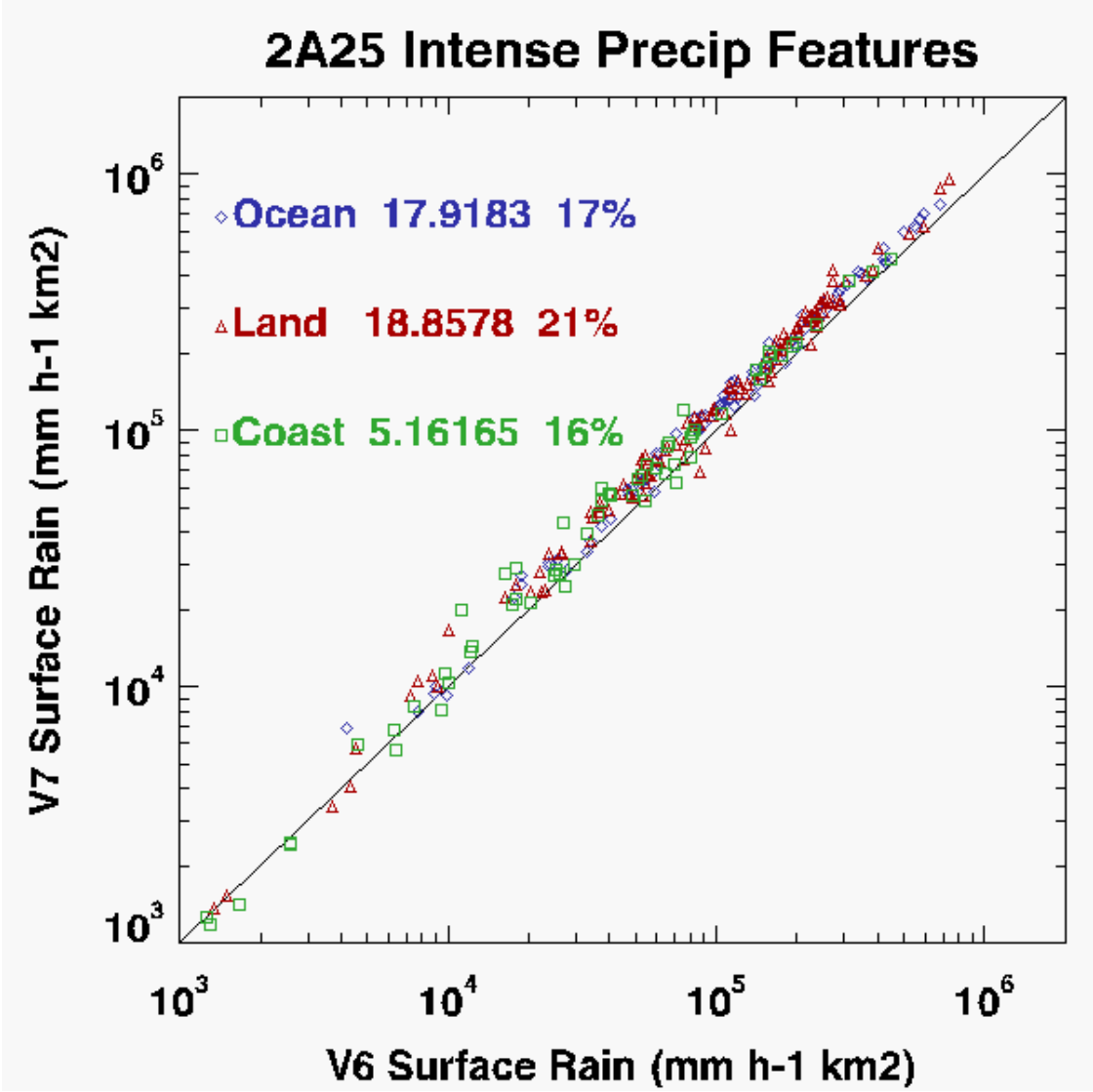
Total for these 200 cases is a *net 10% reduction* from V 6 to V 7



2A25 V6 versus V7

Almost every individual precipitation feature here has an increase in 2A25 rain estimate from V 6 to V 7

Total for these 200 cases is a *net 18% increase* from V 6 to V 7

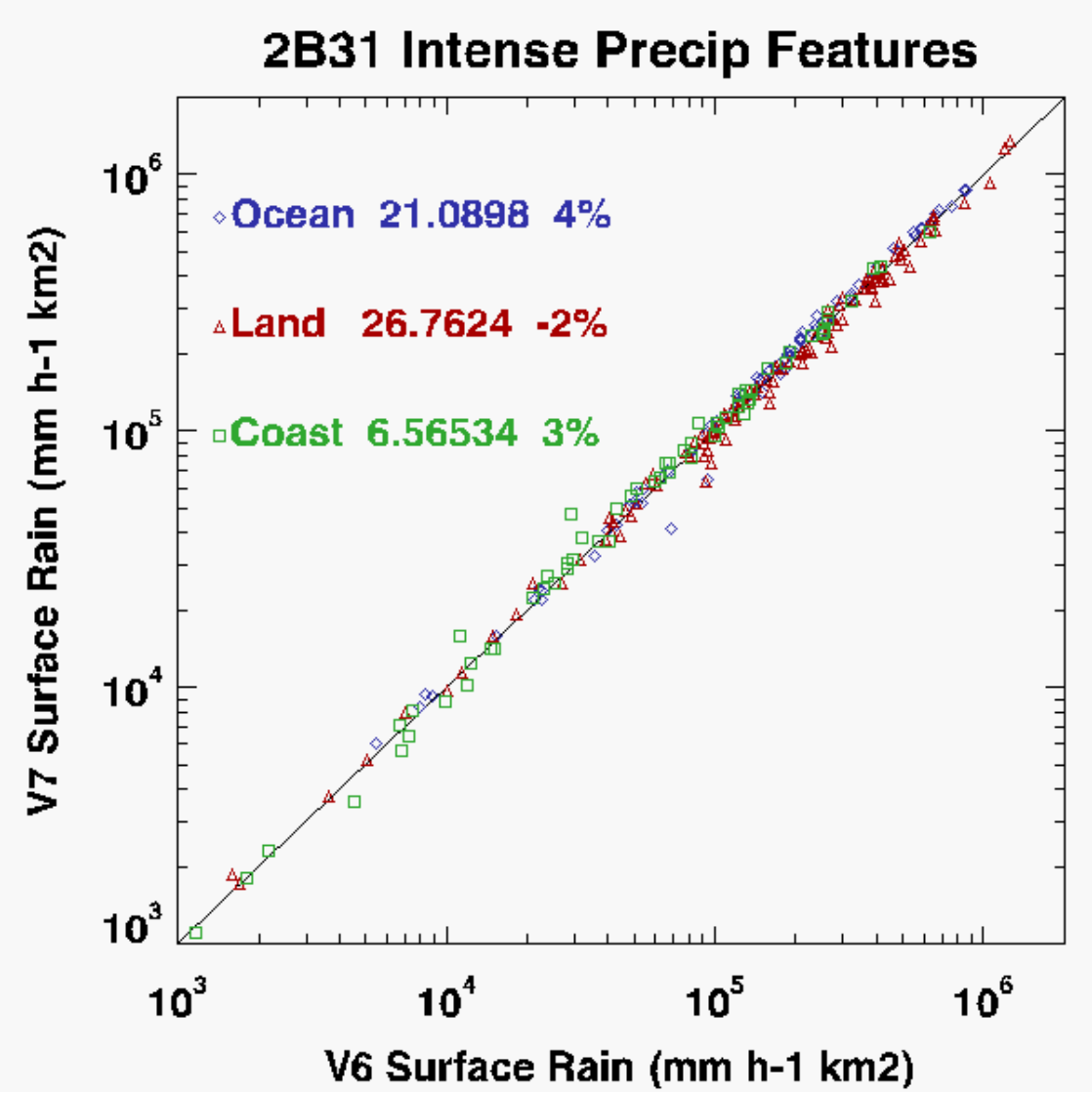


2B31 V6 versus V7

Not much net change in 2B31 rain estimate from V 6 to V 7

Changes of land surface classification might be bigger than algorithm changes

Total for these 200 cases is a *net 1% increase* from V 6 to V 7



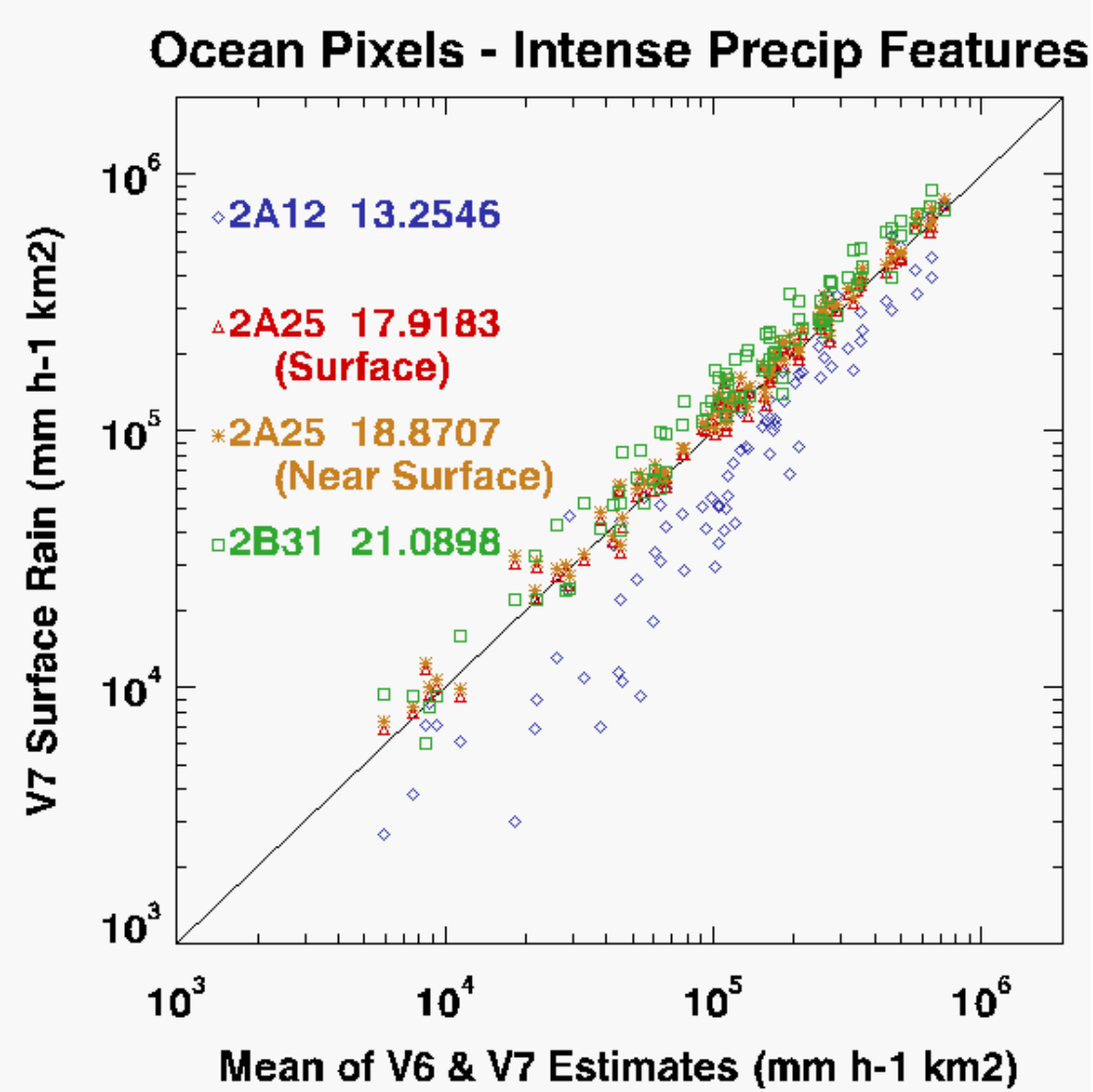
Ocean Pixels V6 versus V7

2B31 almost always gives the most rain of the V 7 algorithms

2A12 almost always gives the least

2A25 is near the mean of all the V 6 and V 7 estimates

Consensus of V 6 and V 7 for all three algorithms is 17.2 e12 kg h^{-1}



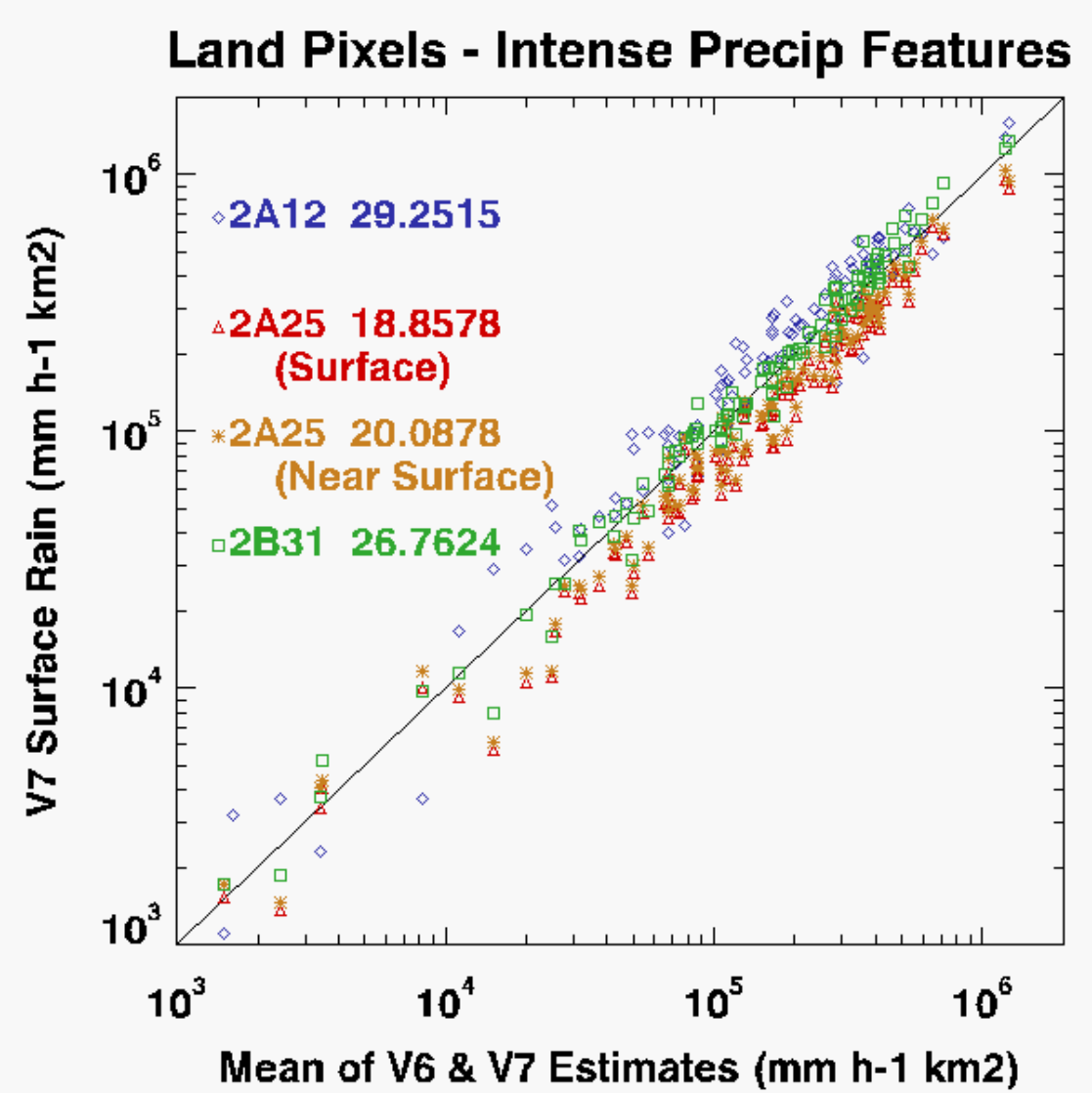
Land Pixels V6 versus V7

2A12 almost always gives the most rain of the V 7 algorithms

2A25 almost always gives the least

2B31 is near the mean of all the V 6 and V 7 estimates

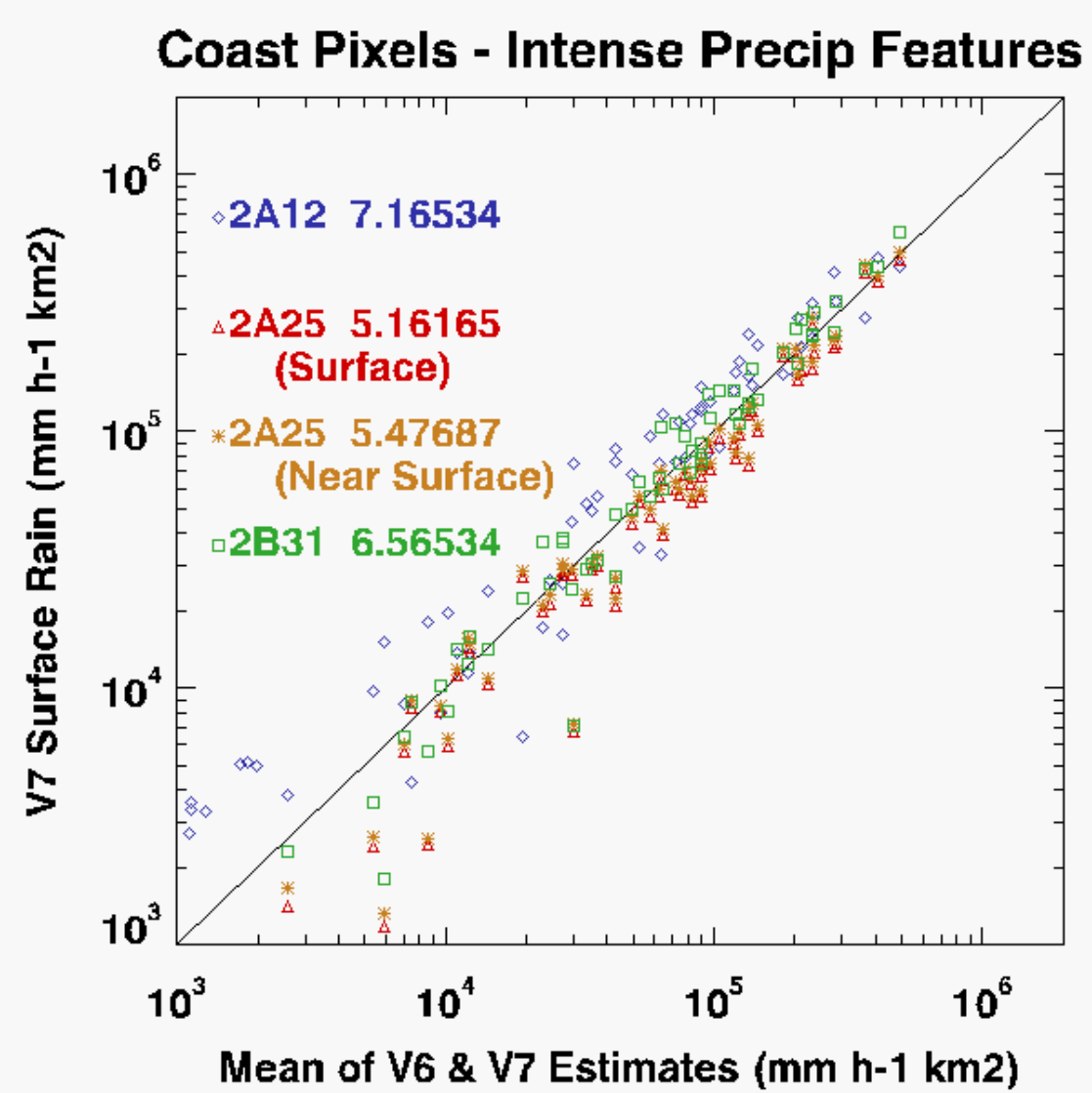
Consensus of V 6 and V 7 for all three algorithms is 25.1 e12 kg h^{-1}



Coast Pixels V6 versus V7

Similar to Land comparisons

Consensus of V 6 and V 7 for all three algorithms is 6.0 e12 kg h^{-1}

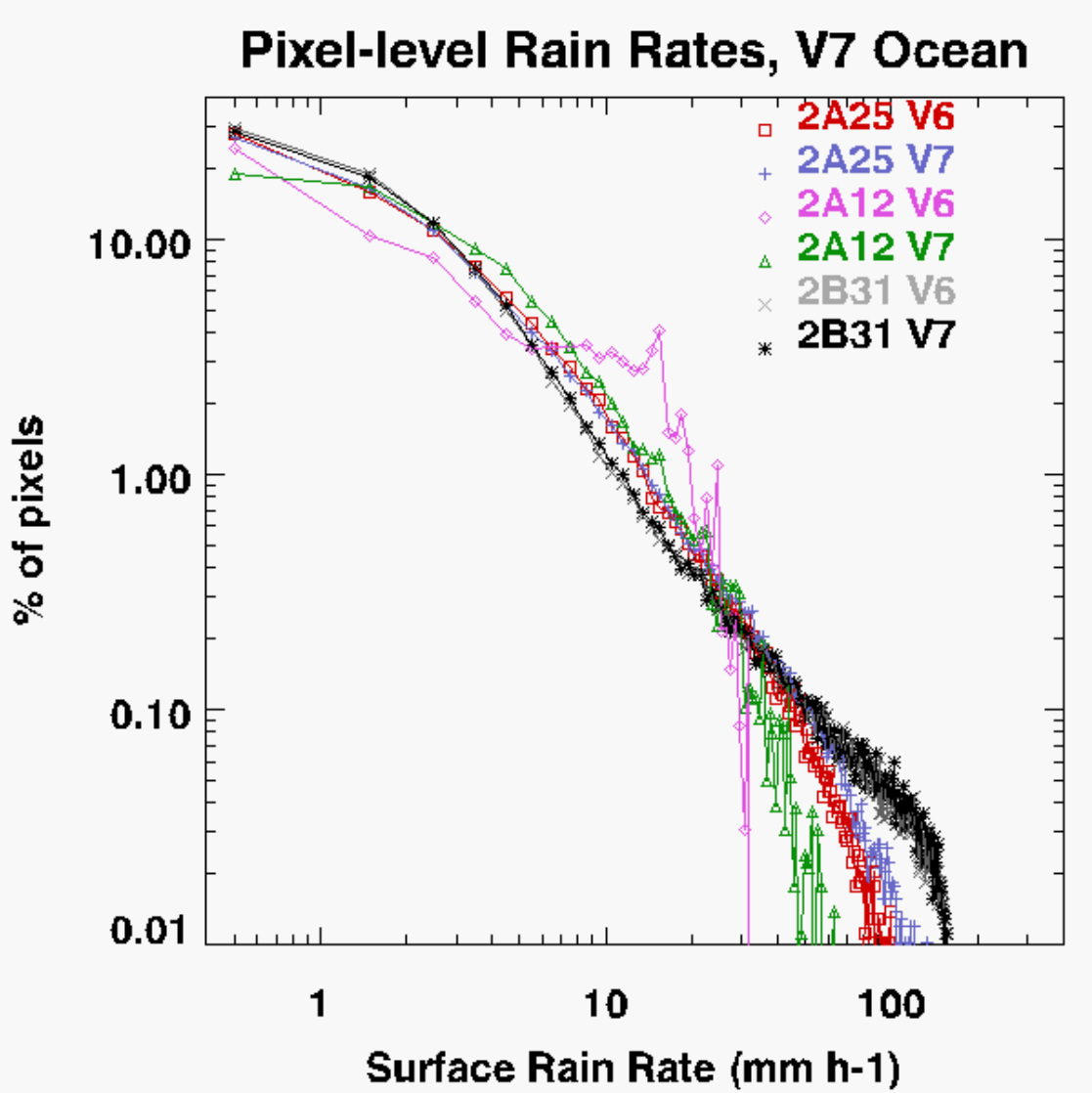


Ocean Rain Rate Histogram

2A12 and 2A25 V 7 both extend to higher rain rate extremes than they did in V 6, but not much change overall for 2A25

2A12 V 7 greatly decreases the occurrence of rain rates between 8-20 mm h^{-1}, looks more realistic than before

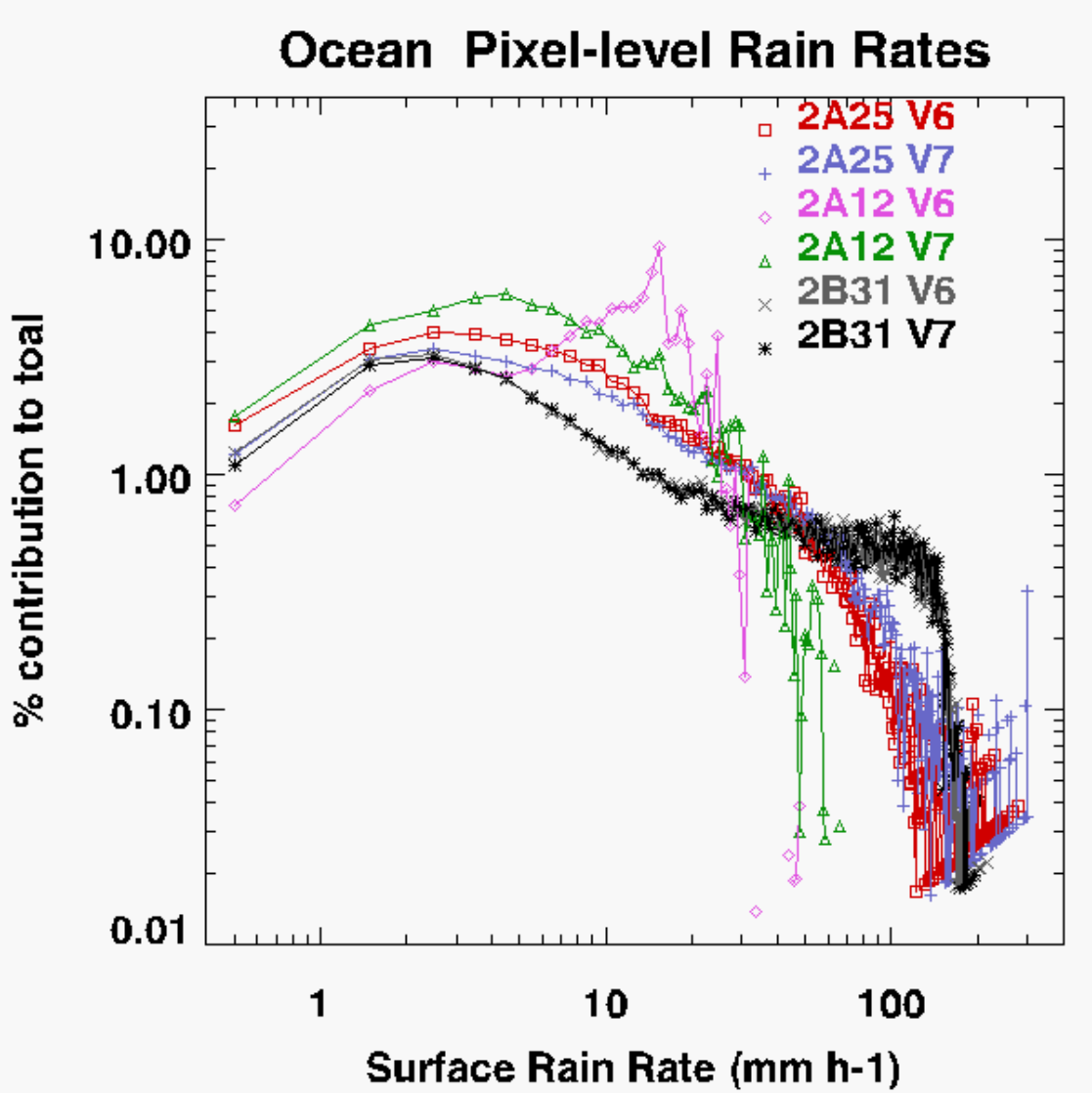
2A12 V7 increases the occurrence of rain rates < 8 mm h^{-1}



Contributions to total Ocean Rain

2A12 now has same basic shape as other algorithms (unlike V 6)

2A12 V 7 gets a lot of rain from low - moderate rates, but not getting enough from high rain rates (> 30 mm h-1)

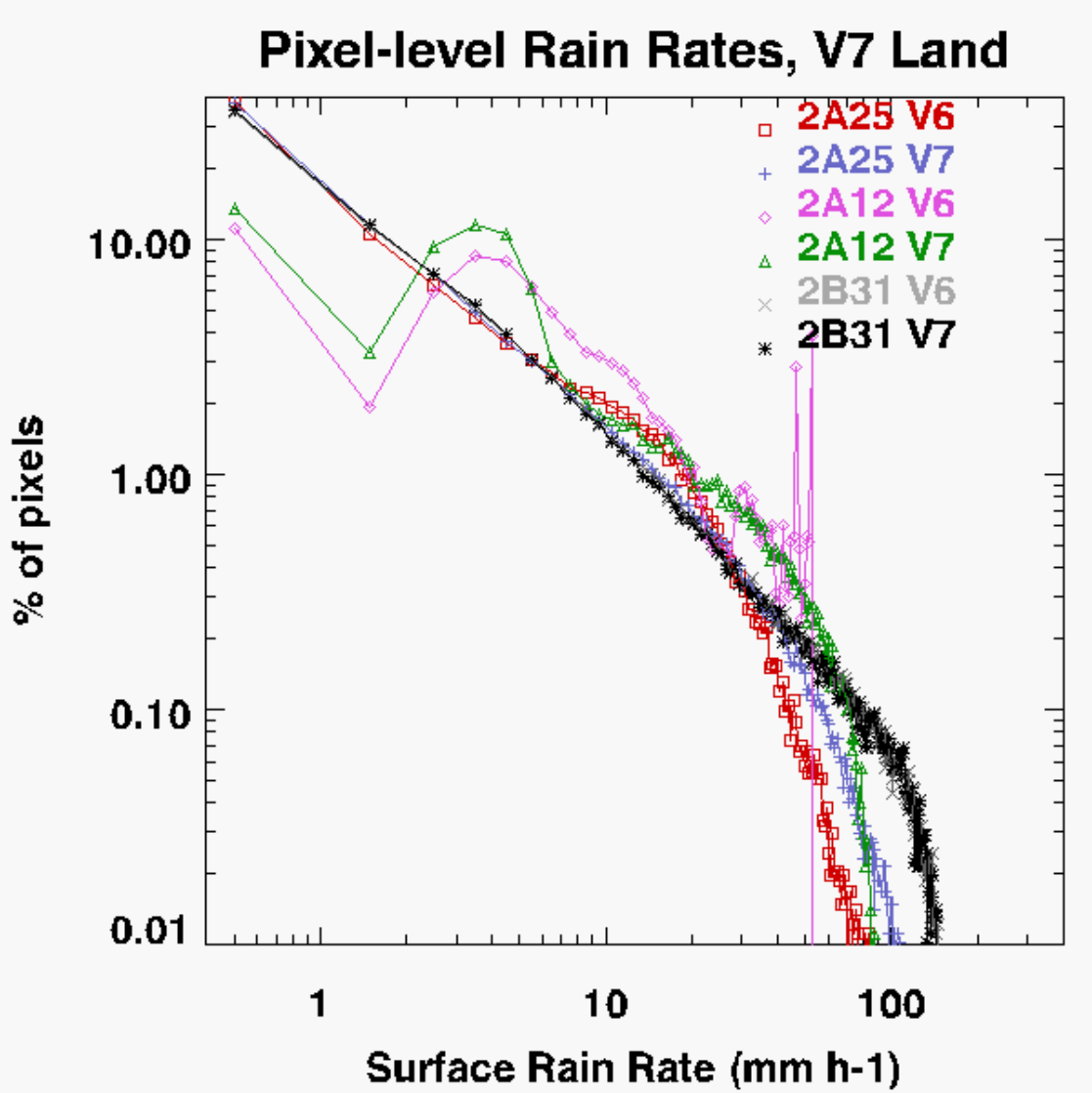


Land Rain Rate Histogram

2A12 and 2A25 V 7 both extend to higher rain rate extremes than they did in V 6

2A12 and 2A25 V 7 both decrease the occurrence of rain rates around 10 mm h^{-1}

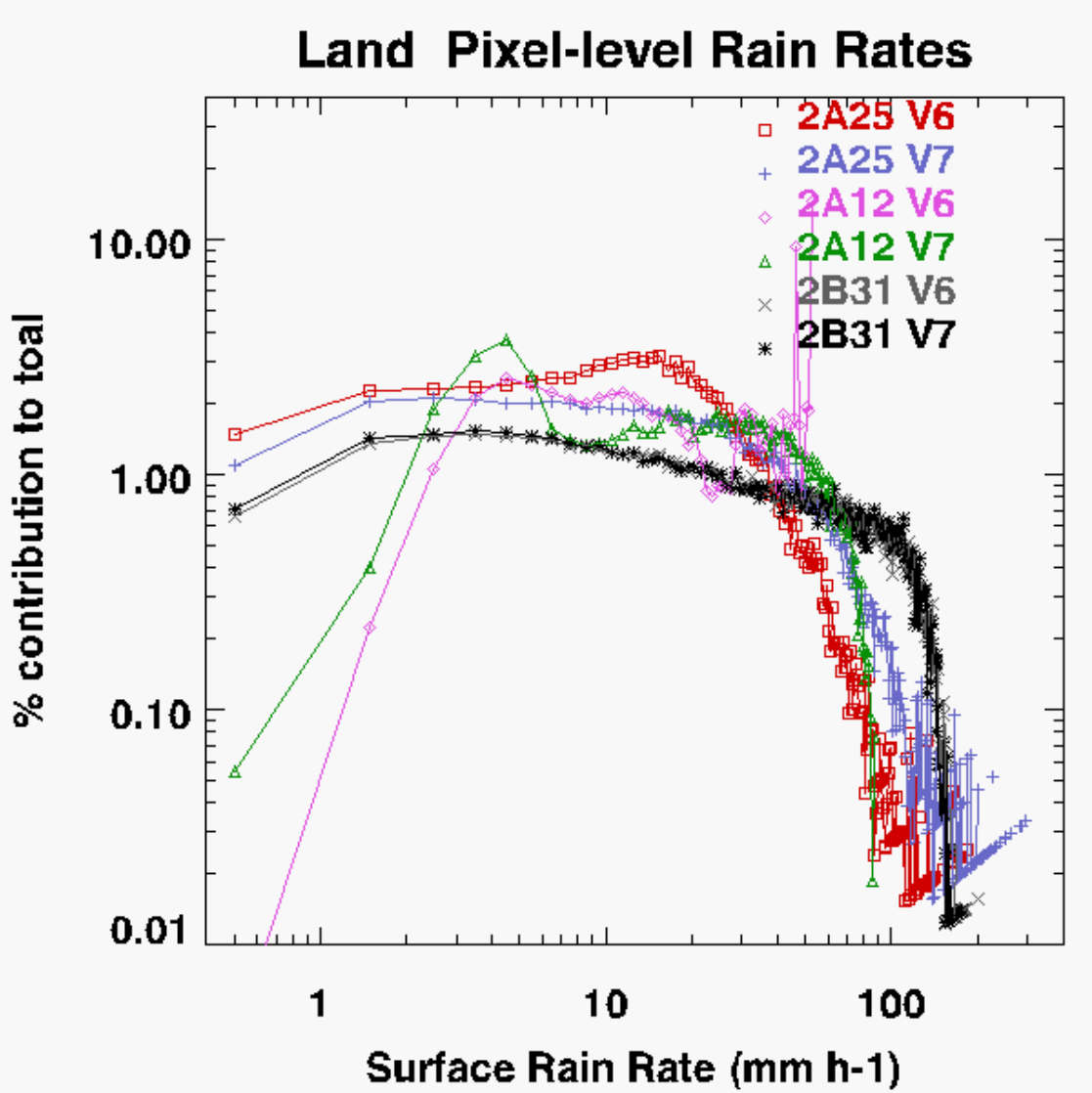
2A12 V7 increases the occurrence of rain rates < 5 mm h^{-1}



Contributions to total Land Rain

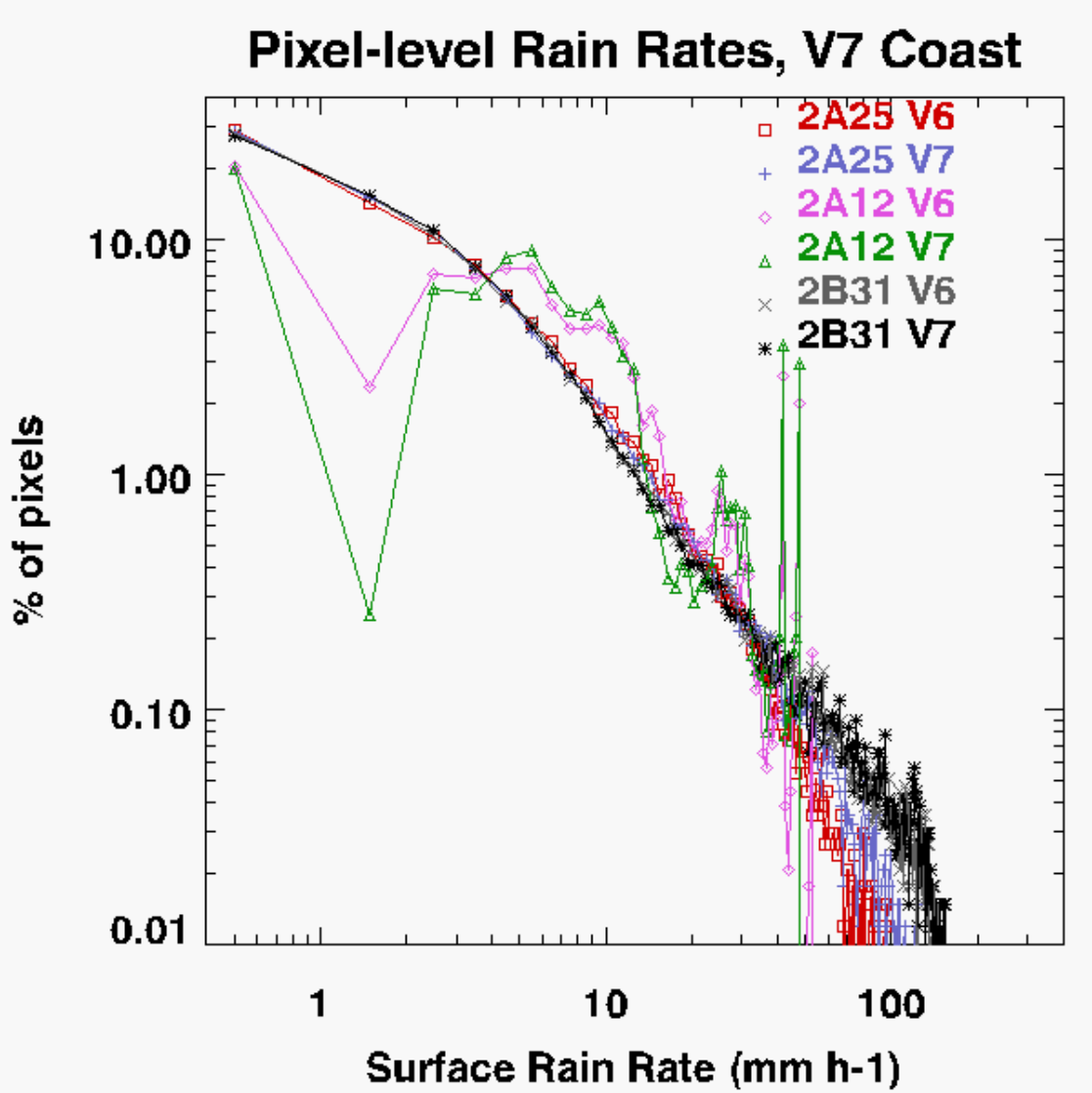
2A12 V 7 peak contribution from 4 - 5 mm h^{-1} …odd shape for the distribution

Distributions are more flat than from the ocean pixels… less relative contribution from weak / moderate rain rates



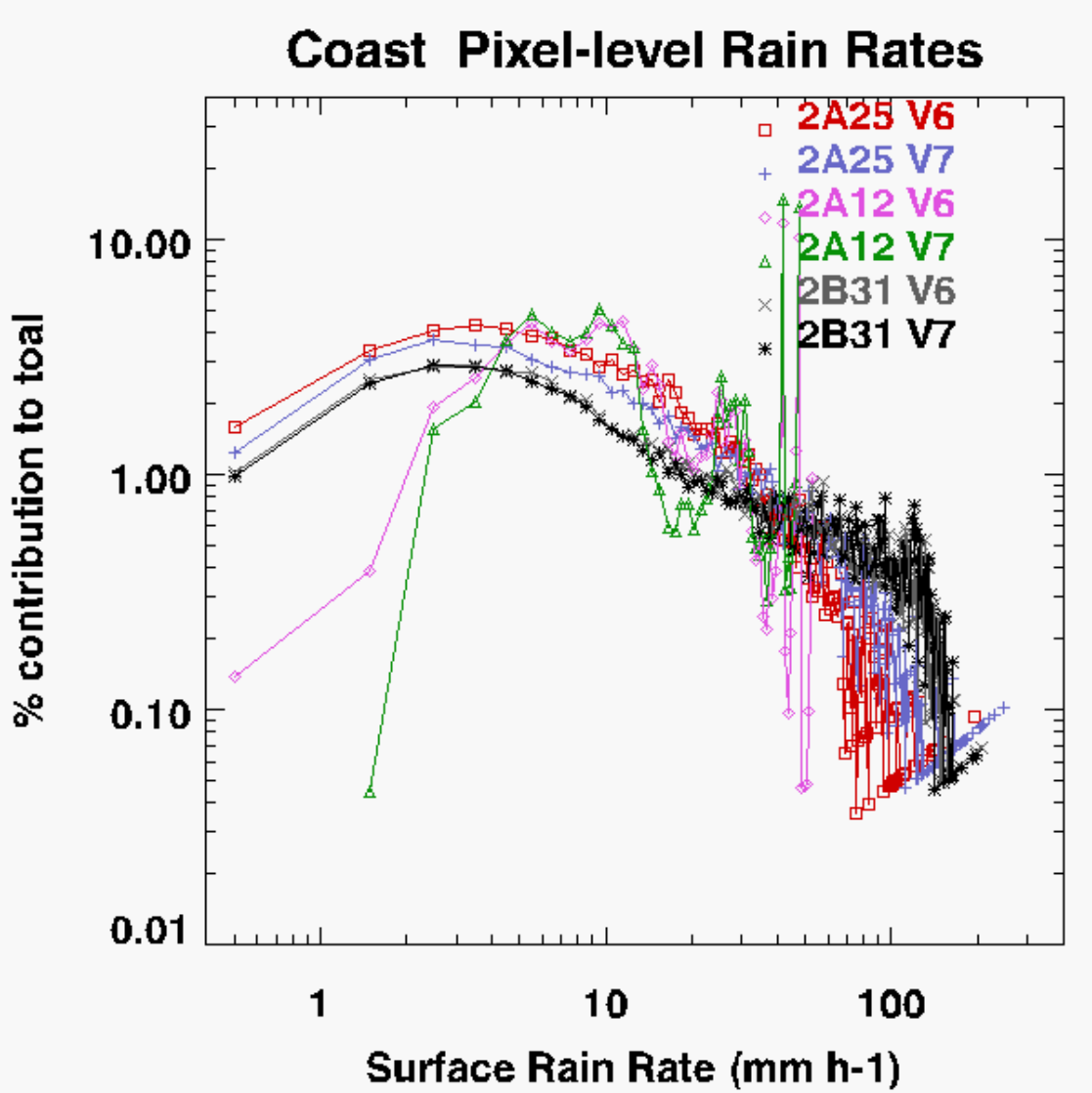
Coast Rain Rate Histogram

Doesn't look like there were many changes



Contributions to total Coast Rain

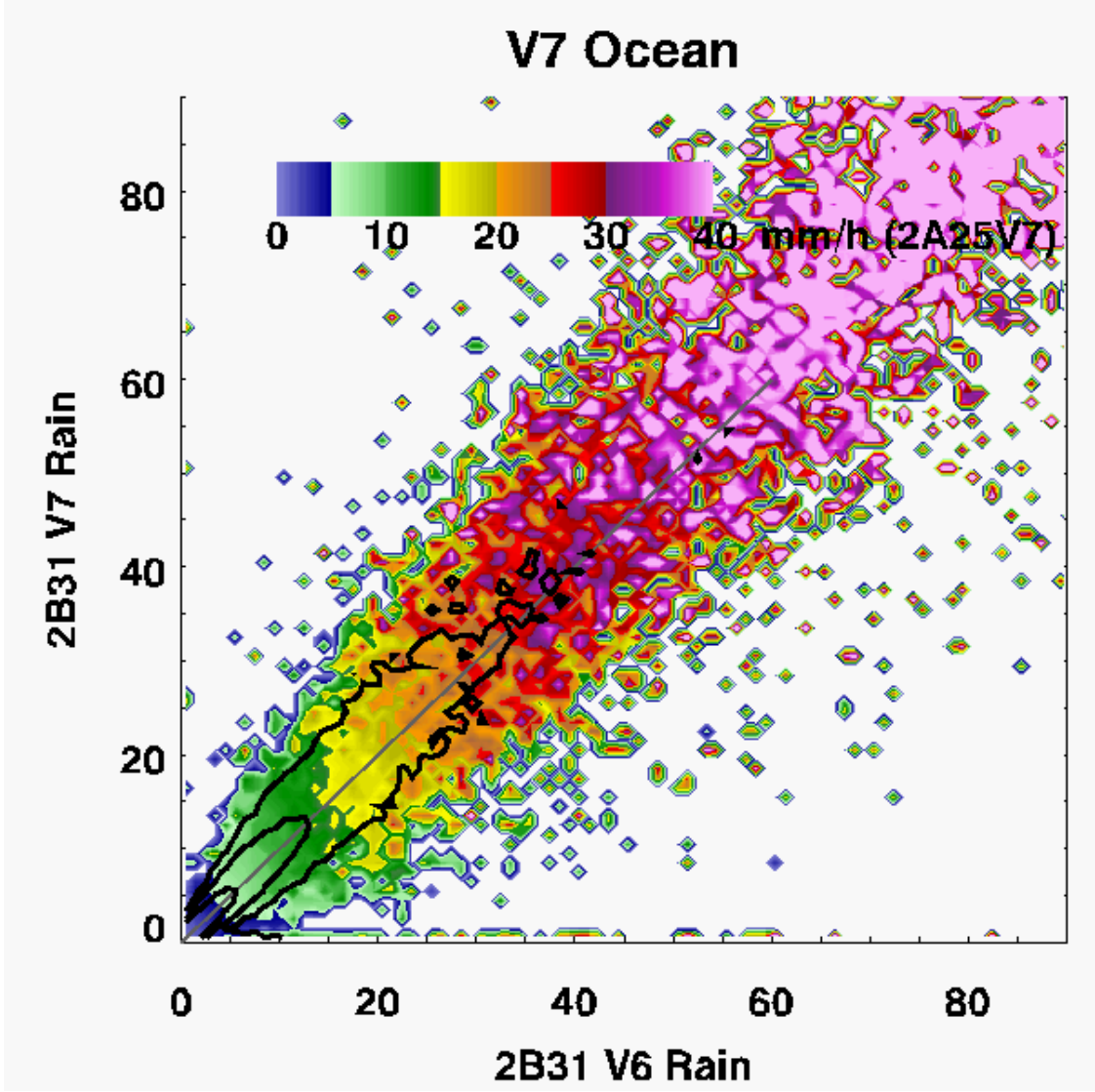
Not sure what to say about these, so let's hurry to the next slide…



2B31 V 6, 7 compared to 2A25 V 7

Color coding is the 2A25 V 7 mean surface rain rate for pixels with the given combination of 2B31 V6 and V7 surface rain rate

No big systematic changes in 2B31



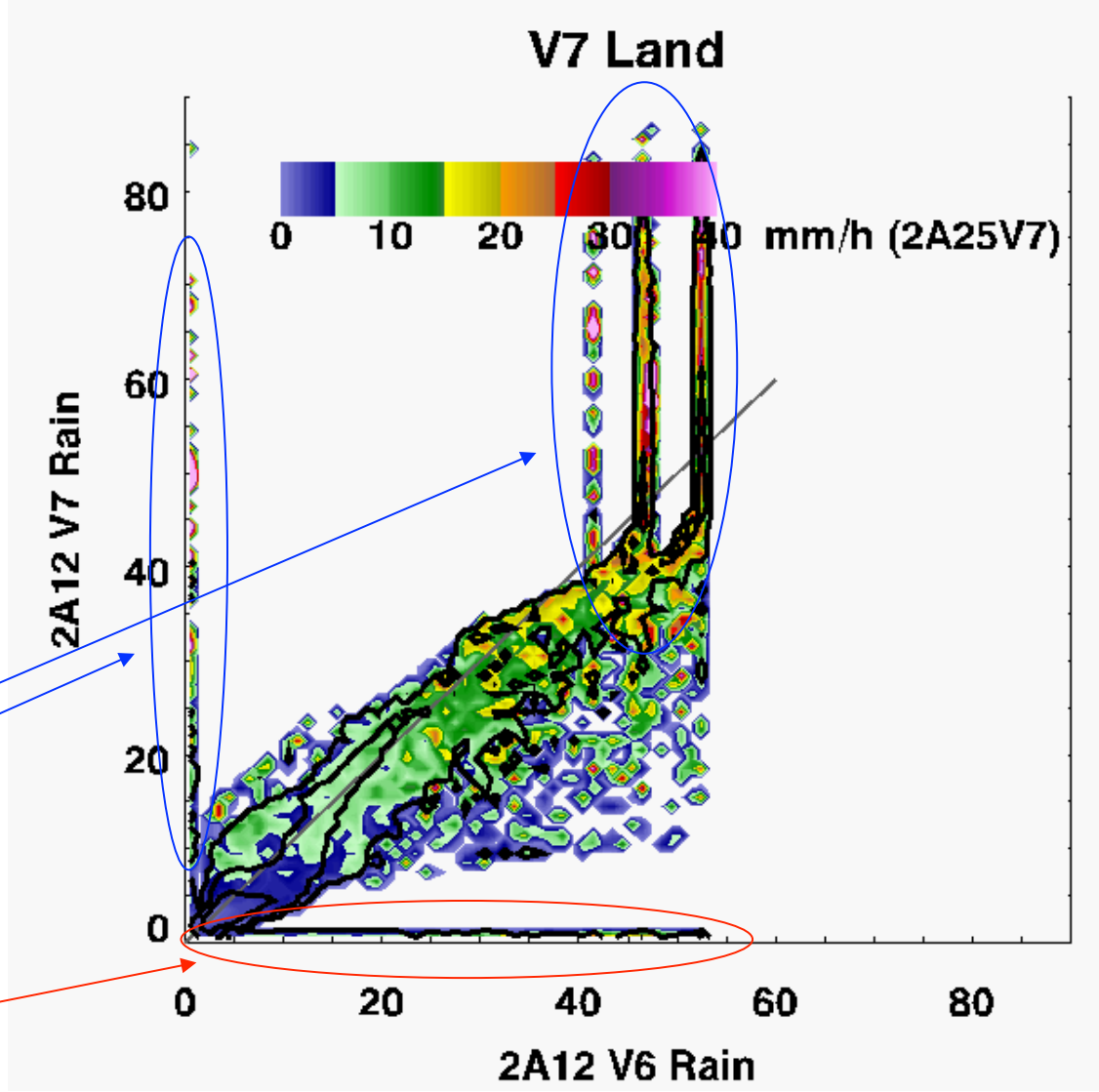
2A12 V 6, 7 *Land* compared to 2A25 V 7

2A12 V 7 Land often has lower rain rate than 2A12 V 6 Land,

2A25 V 7 Land in better agreement with 2A25 V 7

Many spurious values from V 6 corrected in V 7

Some new spurious zero values in V 7, but not as often as V 6

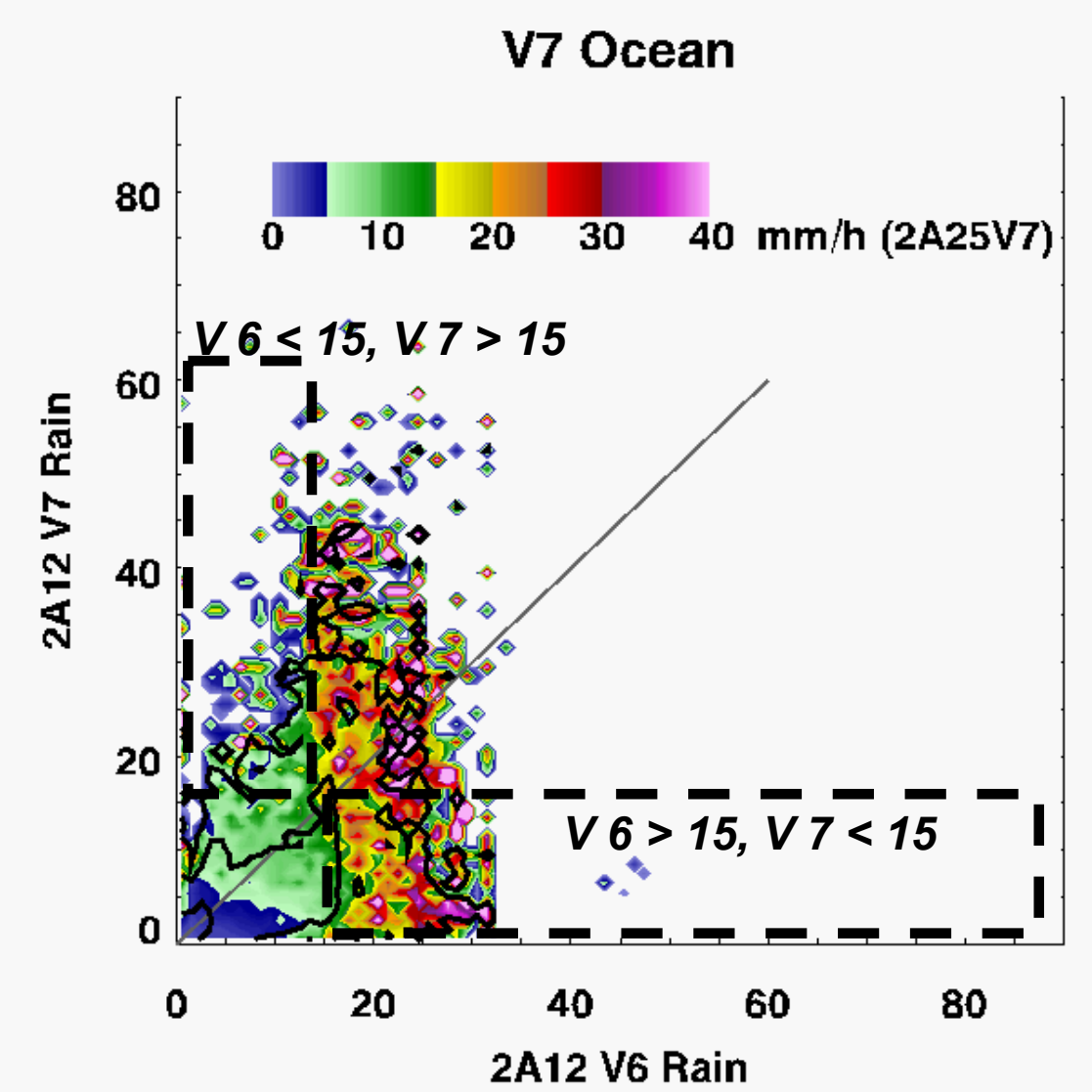


2A12 V 6, 7 *Ocean* compared to 2A25 V 7

2A12 V 6 Ocean looks like it does a better job identifying high rain rates than 2A12 V 7 Ocean

2A25 V 7 Ocean does better with the low - moderate rain rates, which occur more often

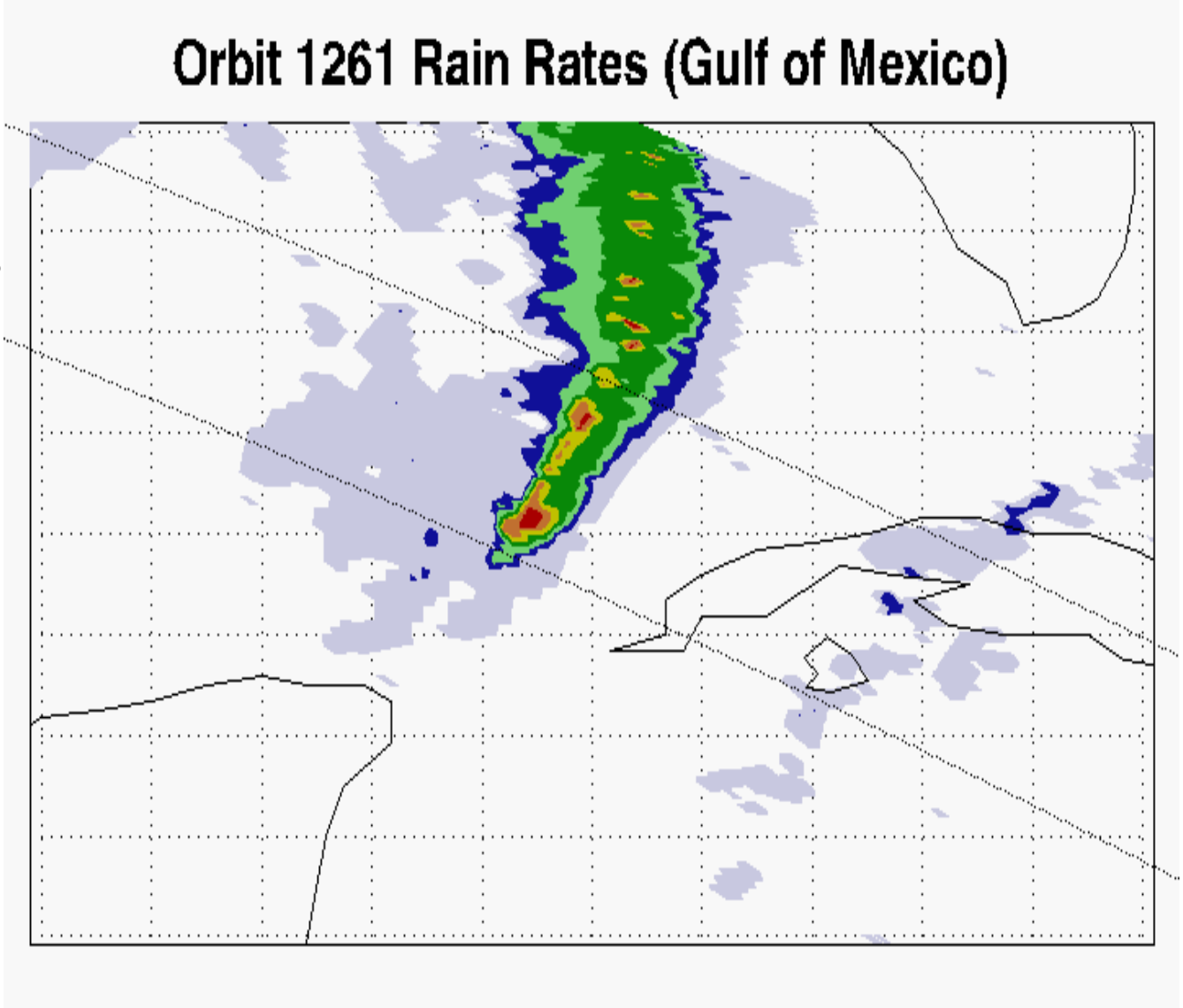
Many spurious values from V 6 corrected in V 7



Example - 2A12 V 6 (ocean)

Colors:

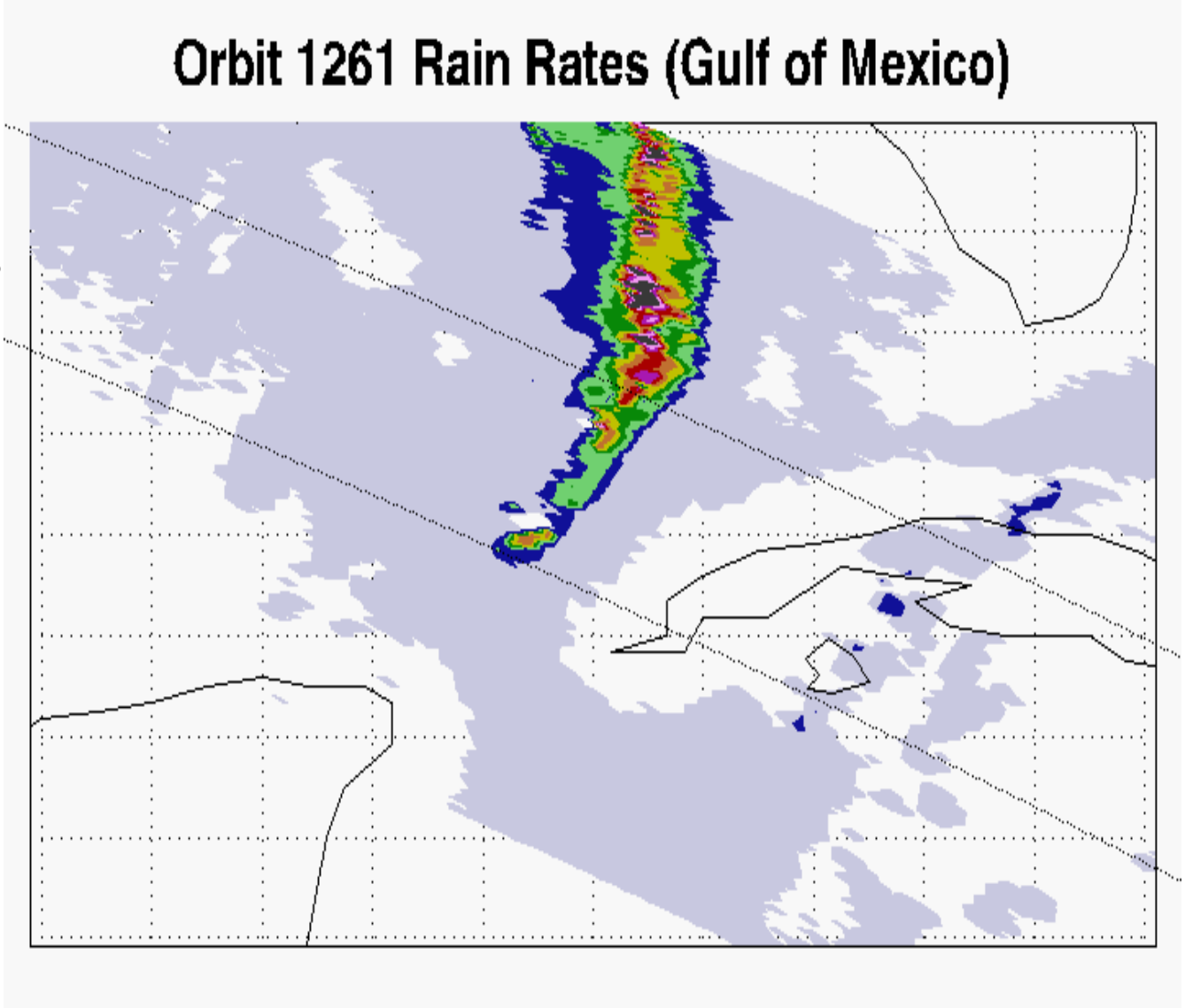
5 mm / h increments



Example - 2A12 V 7 (ocean)

Colors:

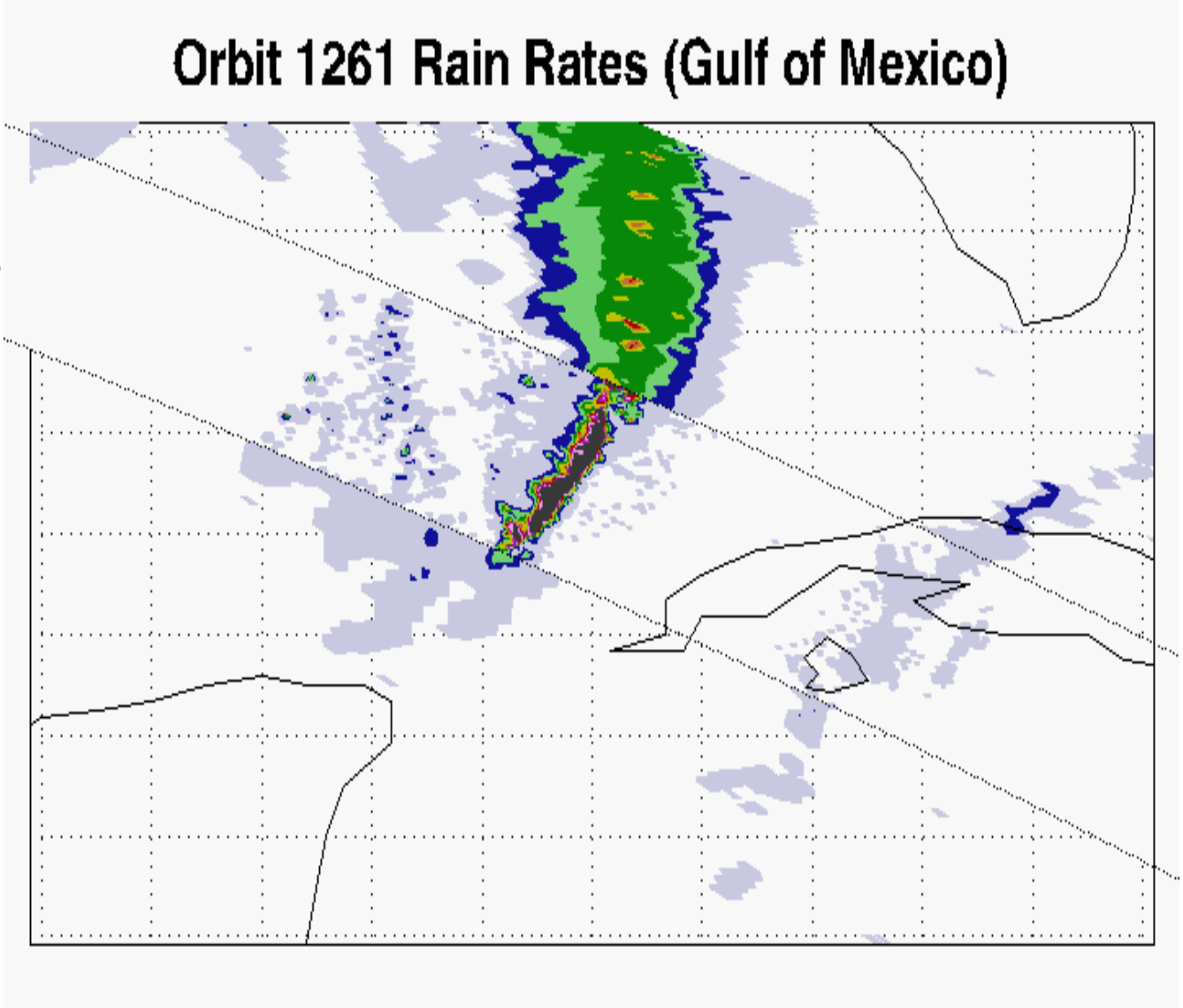
5 mm / h increments



Example - 2A25 V 7

Colors:

5 mm / h increments

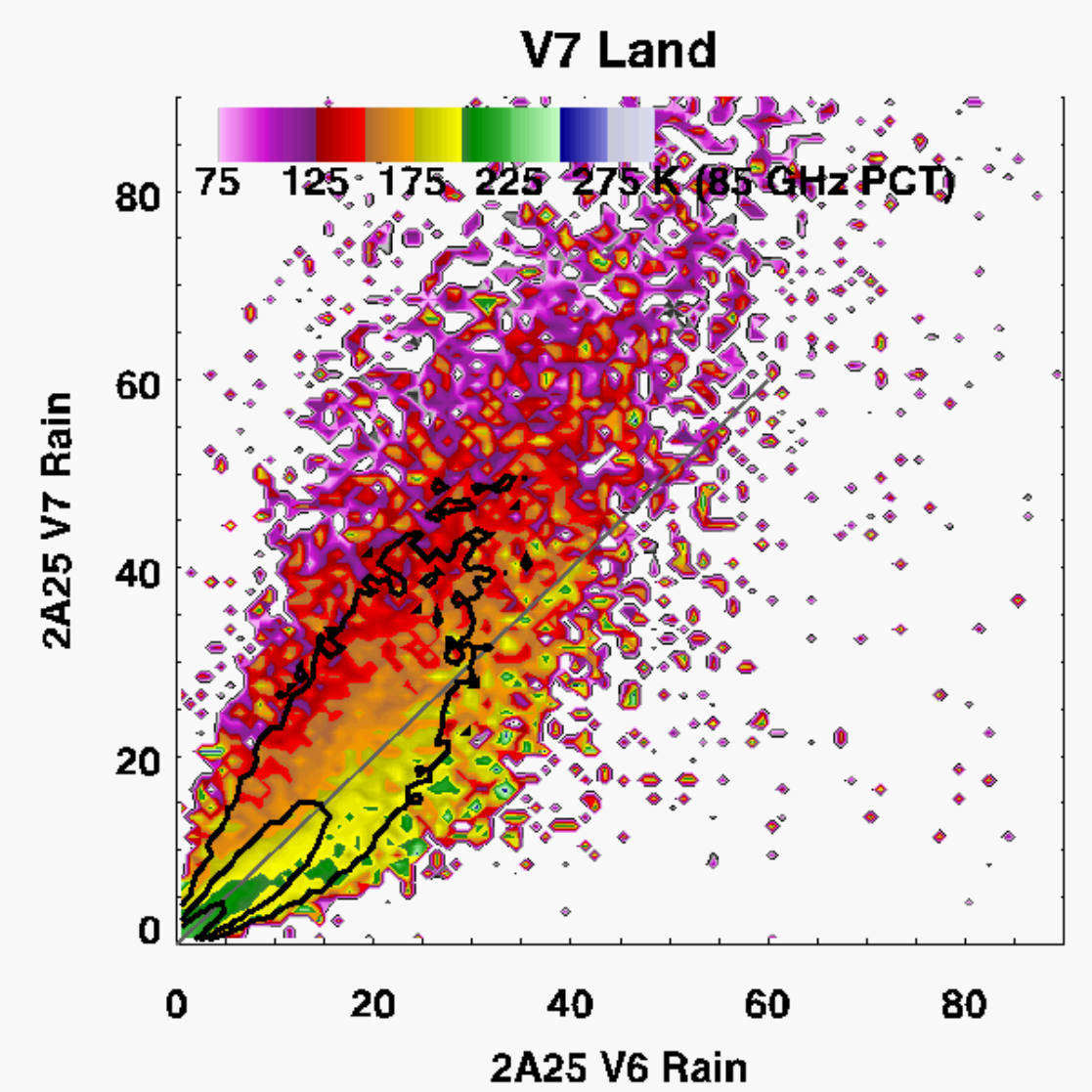


2A25 V 6, 7 *Land* compared to 85 GHz PCT

Color coding is mean 85 GHz PCT for the given combination of 2A25 V6 and V7 surface rain

Where V 7 > V 6, the mean 85 GHz is < 200 K

Seems suggestive of V 7 handling deep profiles better (better attenuation correction???)

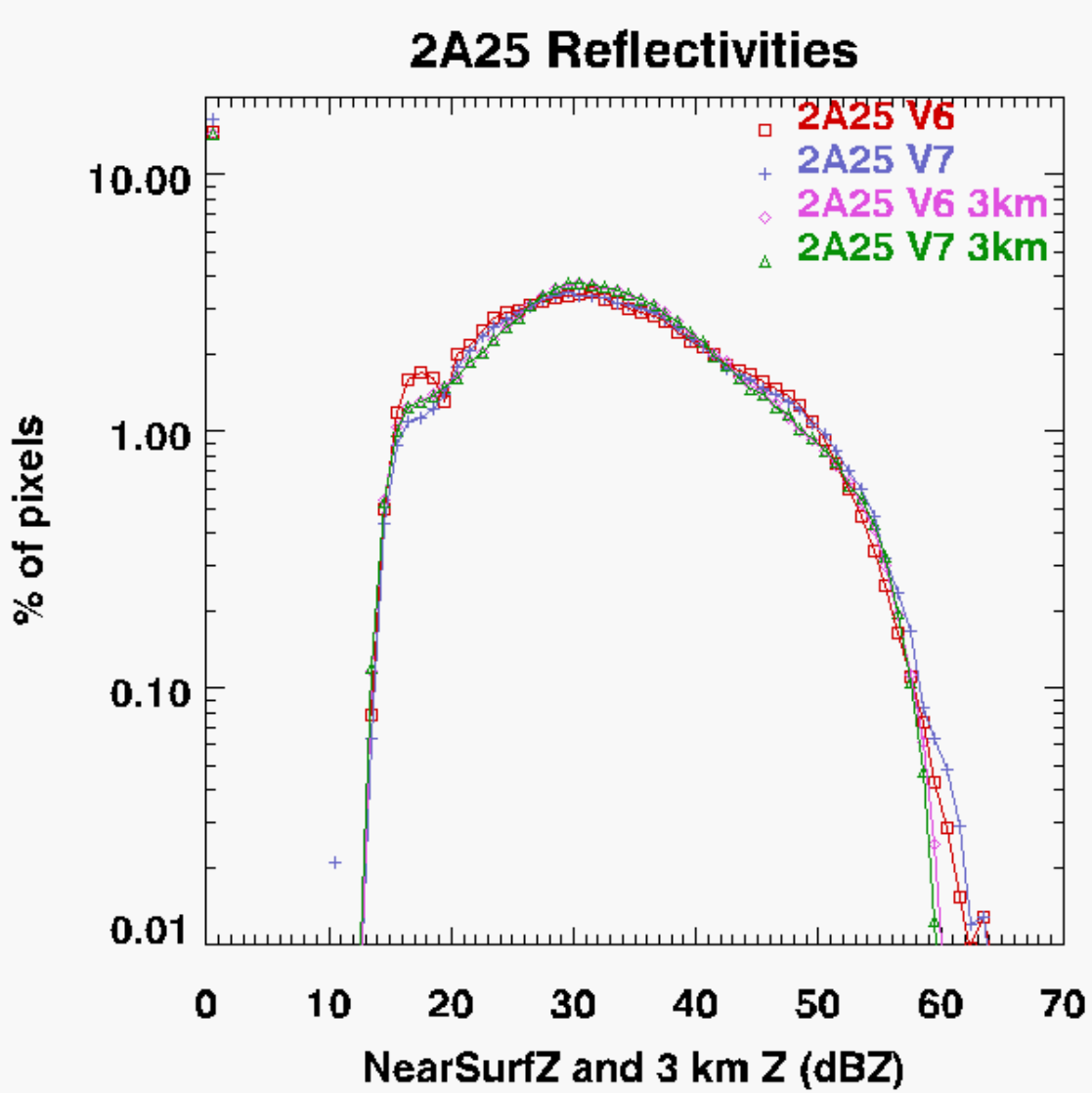


2A25 V 6, 7 *Ocean* compared to 85 GHz PCT

Maybe just a better handling of the surface bin in 2A25 V 7

Subtle changes in Near Surface Reflectivity

No noticeable change in 3 km reflectivity



Conclusions - Ocean Pixels

For pixels in Intense Convective Systems (including their accompanying stratiform regions):

Ocean pixels in 2A12 V 7, compared to mean of all 2A12, 2A25, 2B31, Version 6 and Version 7 estimates :

2A12 Version 7 has 23% less total rain *(15% less than 2A12 V 6)*

2B31 Version 7 has 22% more total rain *(4% more than 2B31 V 6)*

2A25 Version 7 is near consensus *(18% more than 2A25 V 6)*

2A12 V 7 looks improved at low rain rates (< 10 mm h^{-1}), worse at high rain rates (10-30 mm h^{-1}), capable of getting some very high rain rates (> 30 mm h^{-1})

Conclusions - Land Pixels

For pixels in Intense Convective Systems (including their accompanying stratiform regions):

Land pixels in 2A12 V 7, compared to mean of all 2A12, 2A25, 2B31, Version 6 and Version 7 estimates :

2A12 Version 7 has 17% more total rain *(11% less than 2A12 V 6)*

2B31 Version 7 has 7% more total rain *(2% less than 2B31 V 6)*

2A25 Version 7 has 25% less total rain *(21% more than 2A25 V 6)*

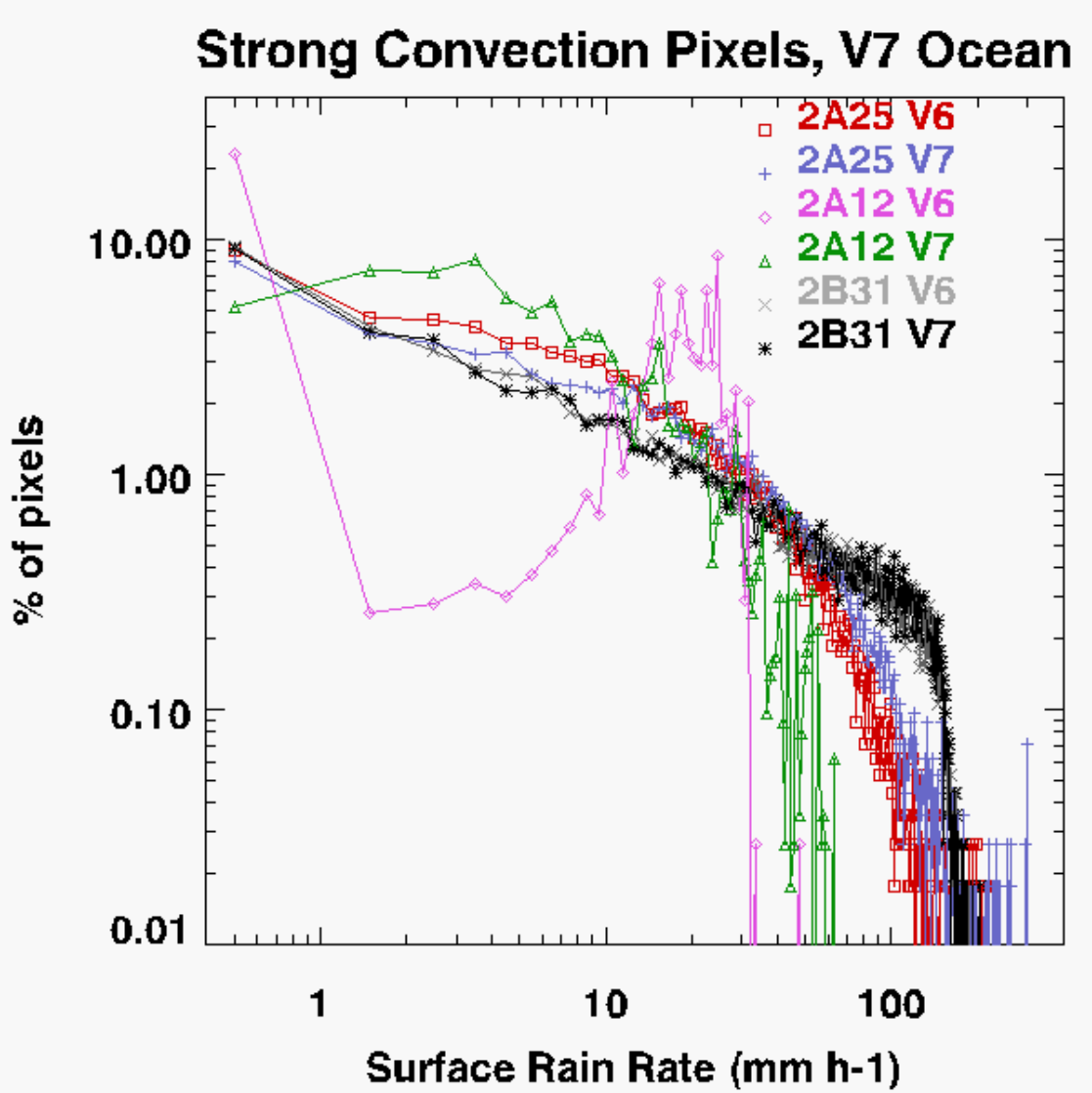
Land rain estimates generally look improved over V 6

Ocean Rain Rates - Strong Convection

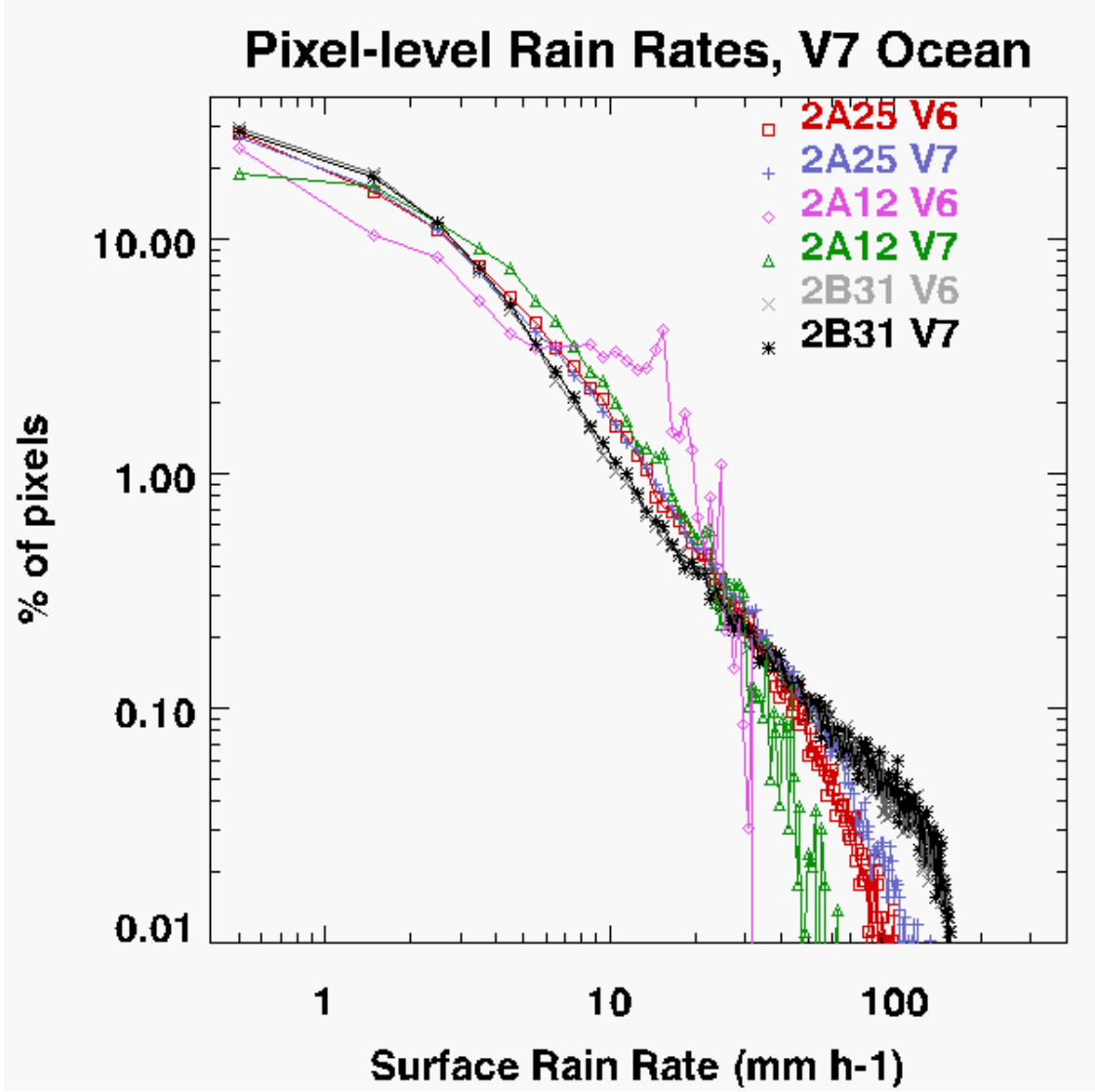
Pixels with either:

30+ dBZ at 8 km (from 2A25 V 7) or

37 GHz PCT < 220 K (1B11 V 7)



Ocean Rain Rate - all pixels for comparison

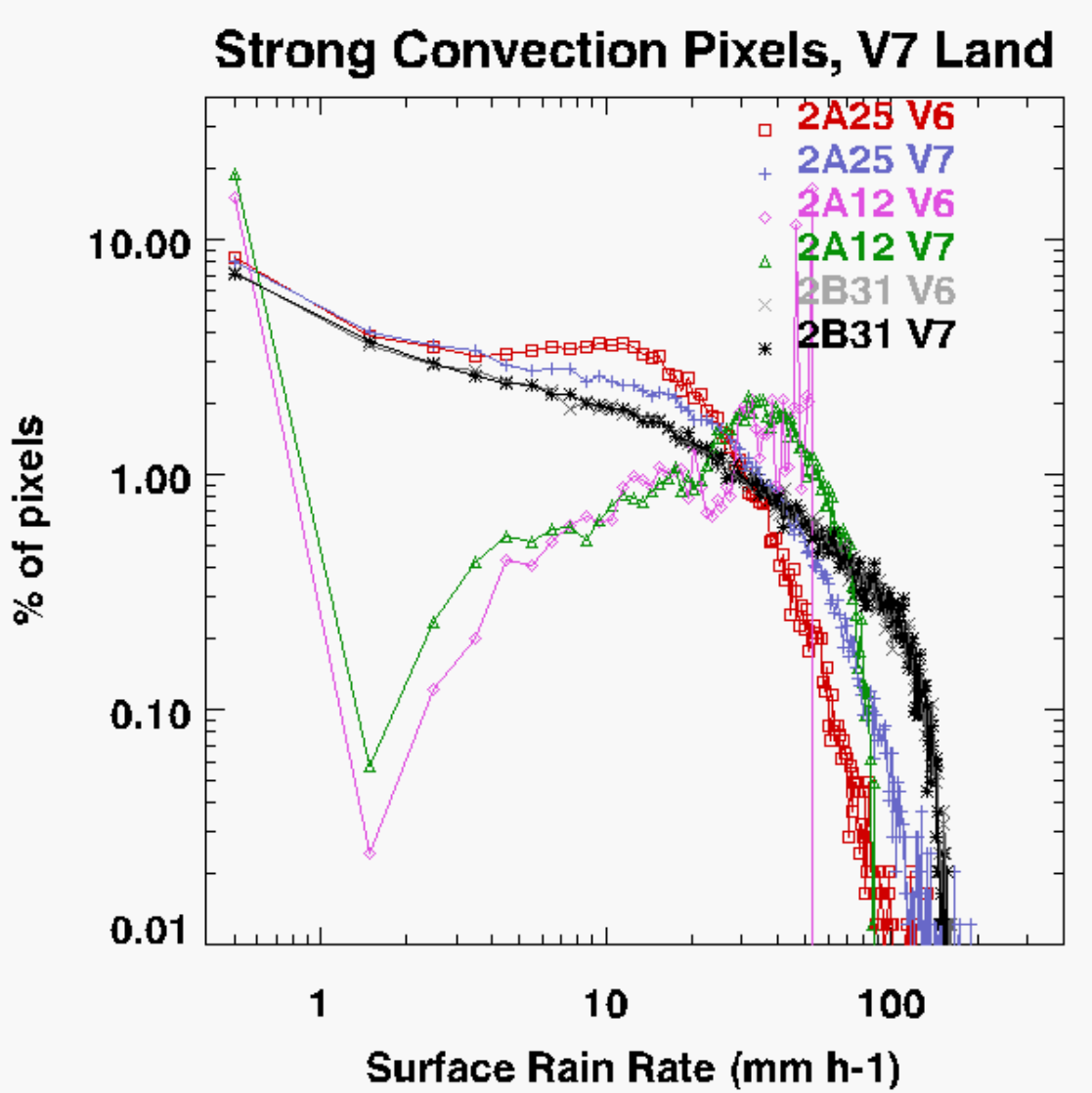


Land Rain Rates - Strong Convection

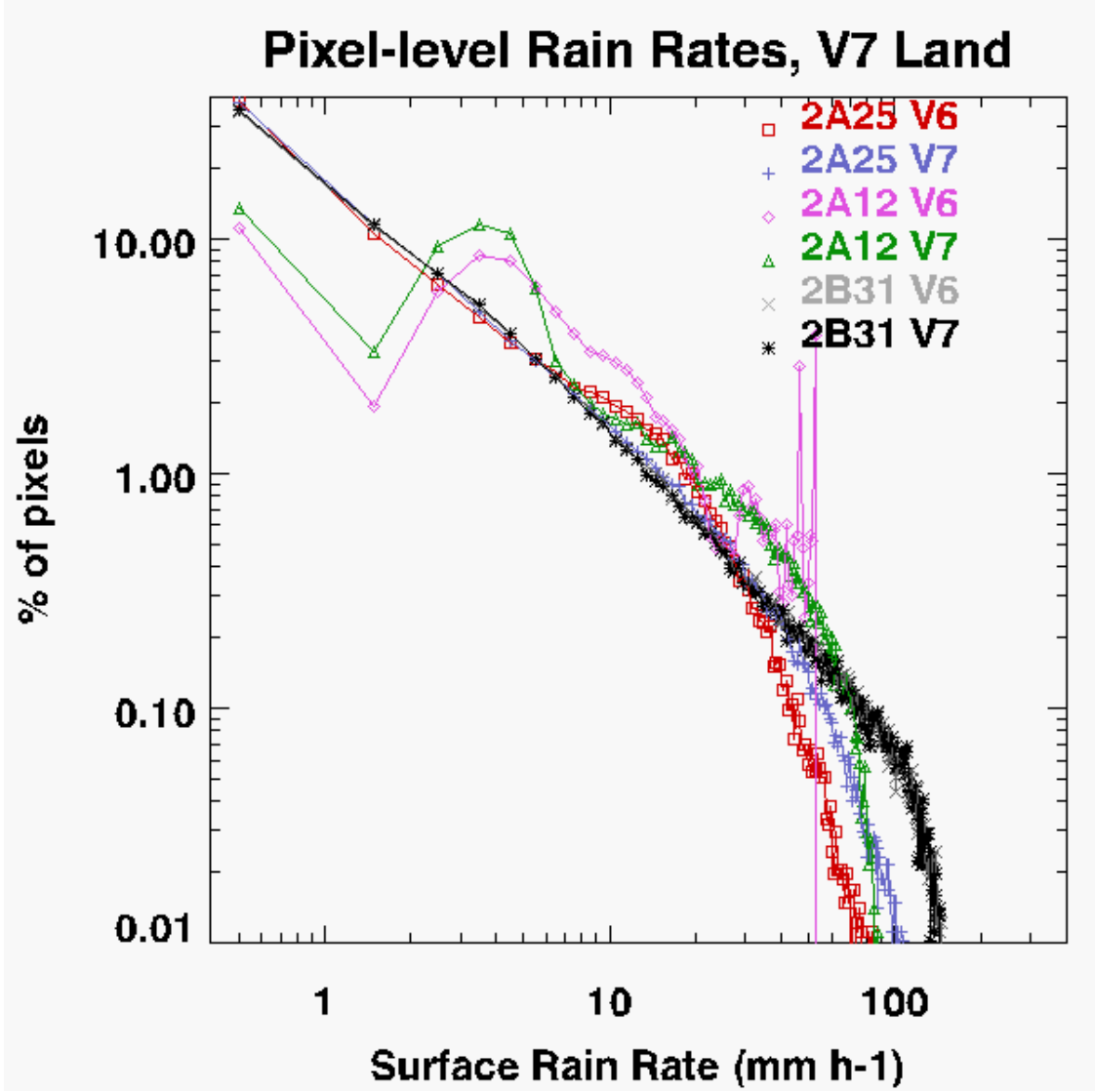
Pixels with either:

30+ dBZ at 8 km (from 2A25 V 7) or

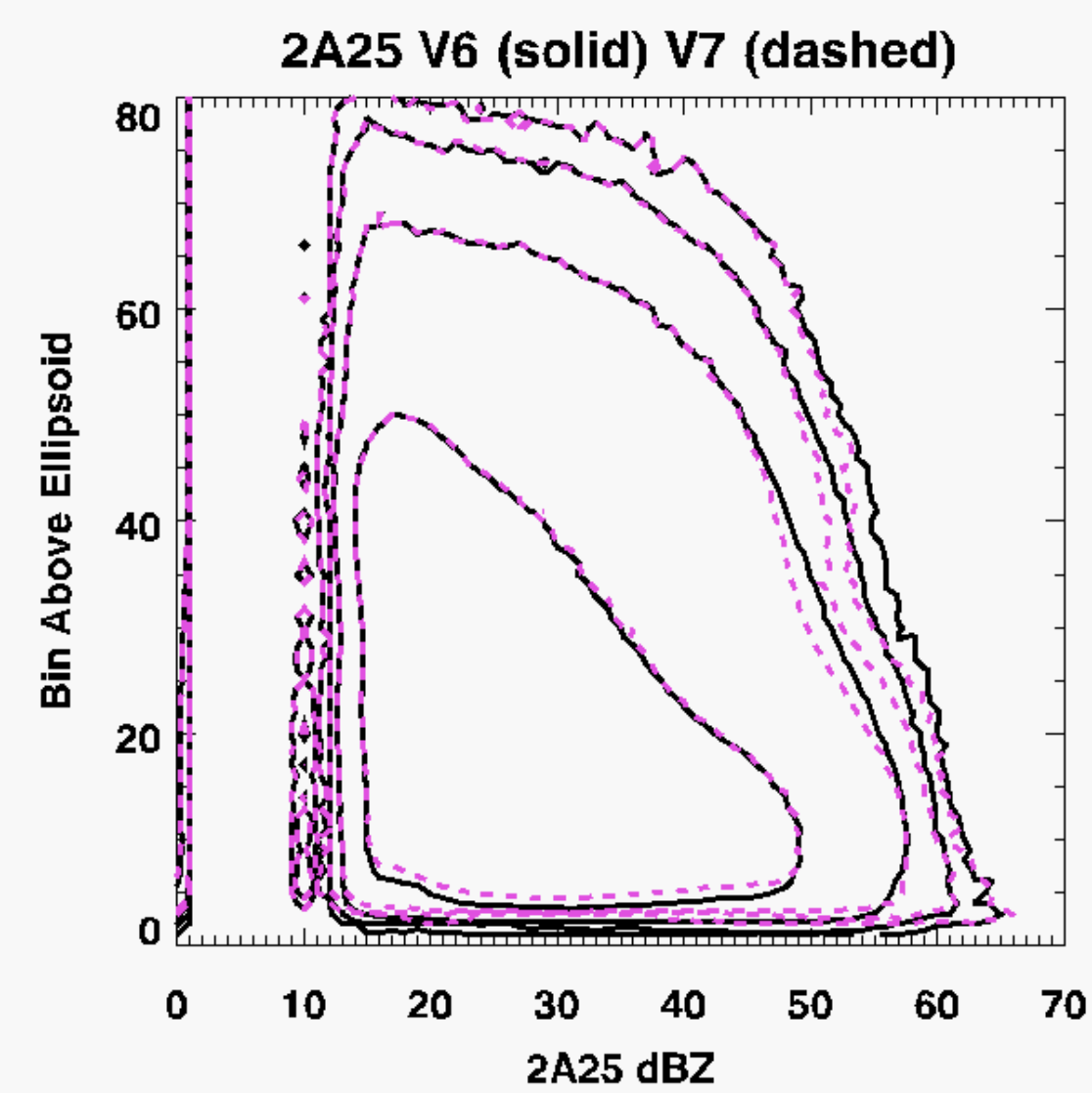
37 GHz PCT < 220 K (1B11 V 7)



Land Rain Rate - all pixels for comparison

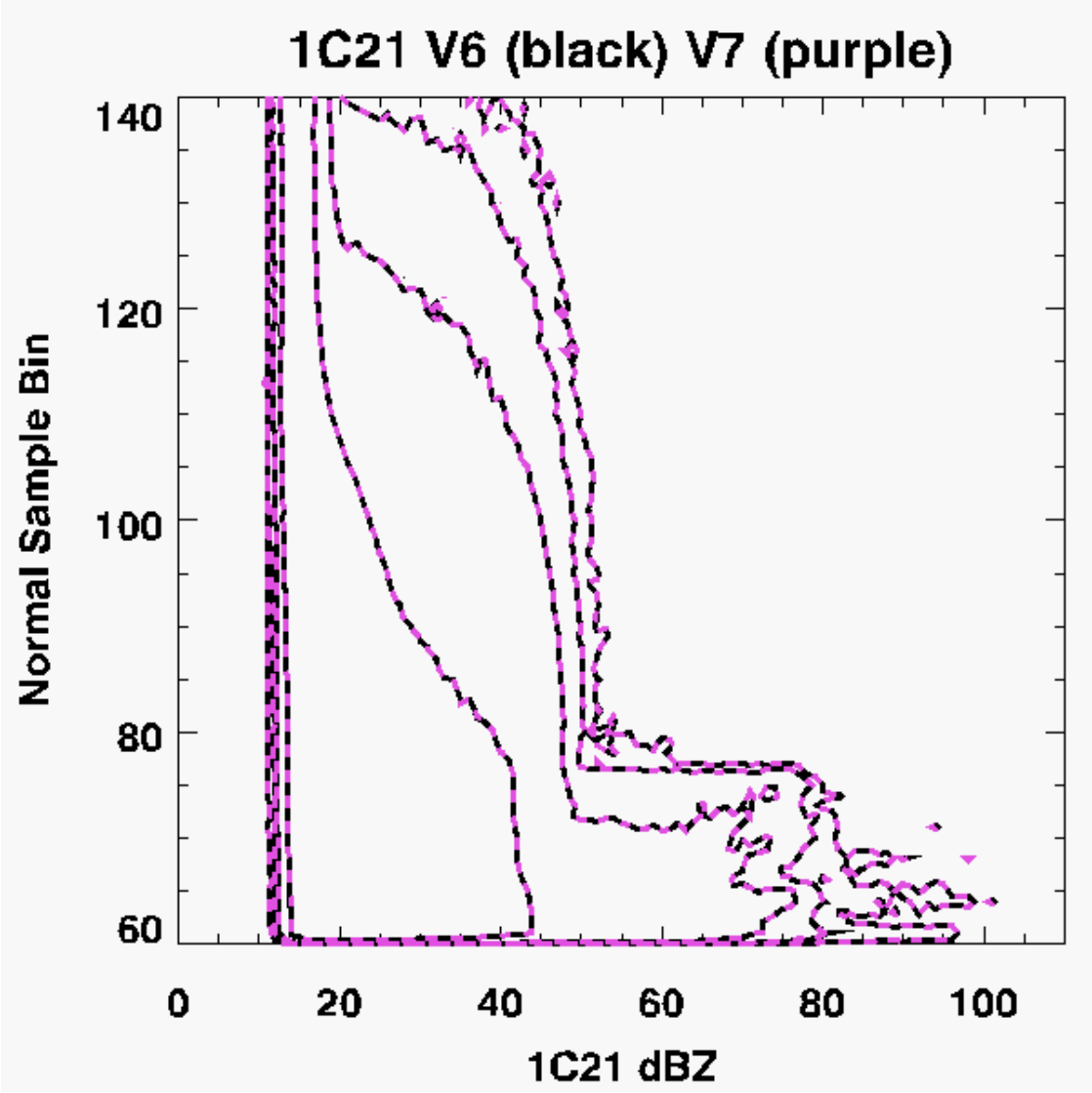


2A25 reflectivity profile PDFs



For strongest convection, 2A25 V 7 has weaker reflectivities between ~ 5 - 12 km than in V 6.

1C21 reflectivity profile PDFs



No systematic change in 1C21 profile is noticeable to me