Progress on a Common AMSR-E/TMI Level-3 Oceanic Rainfall Algorithm

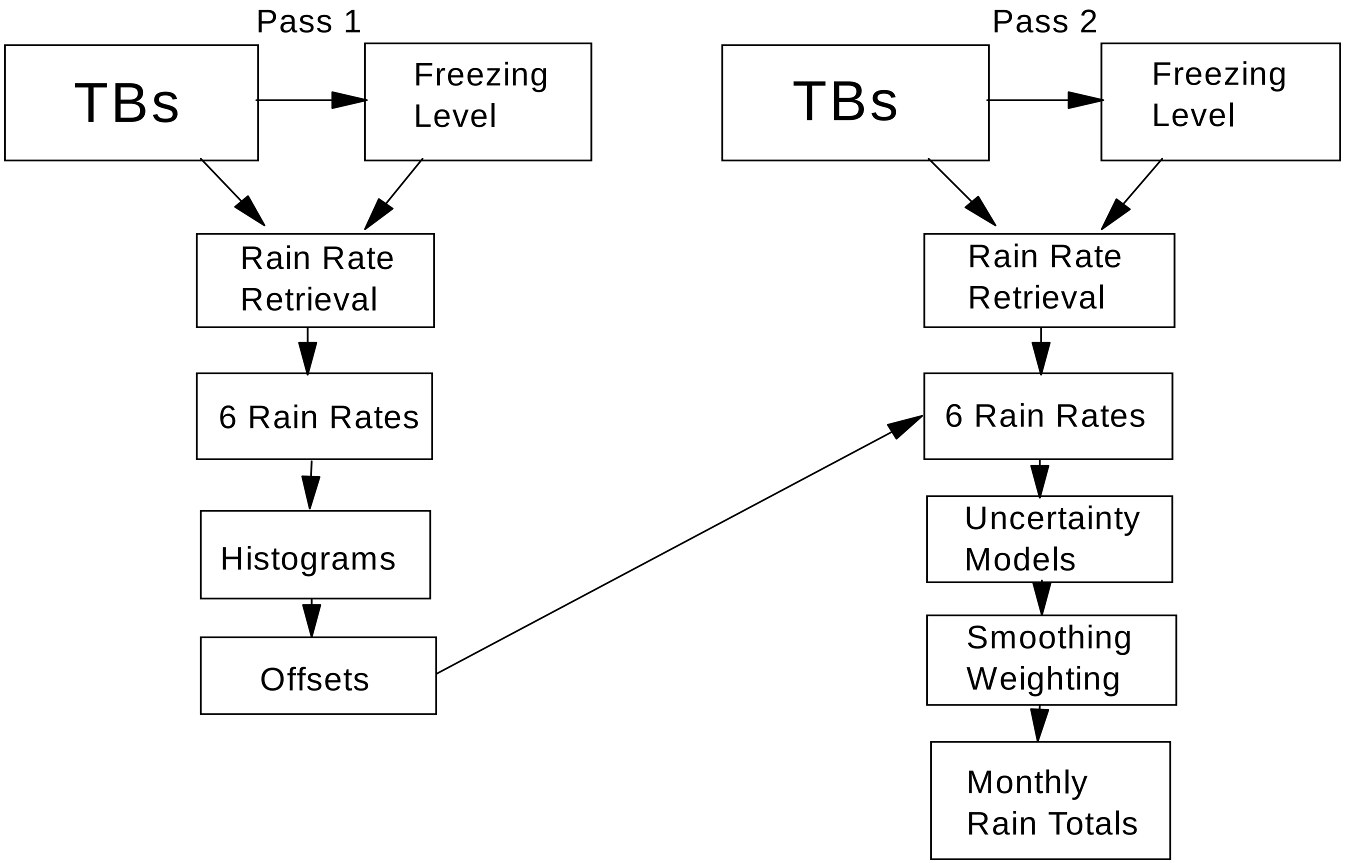
Thomas Wilheit & Richard Weitz

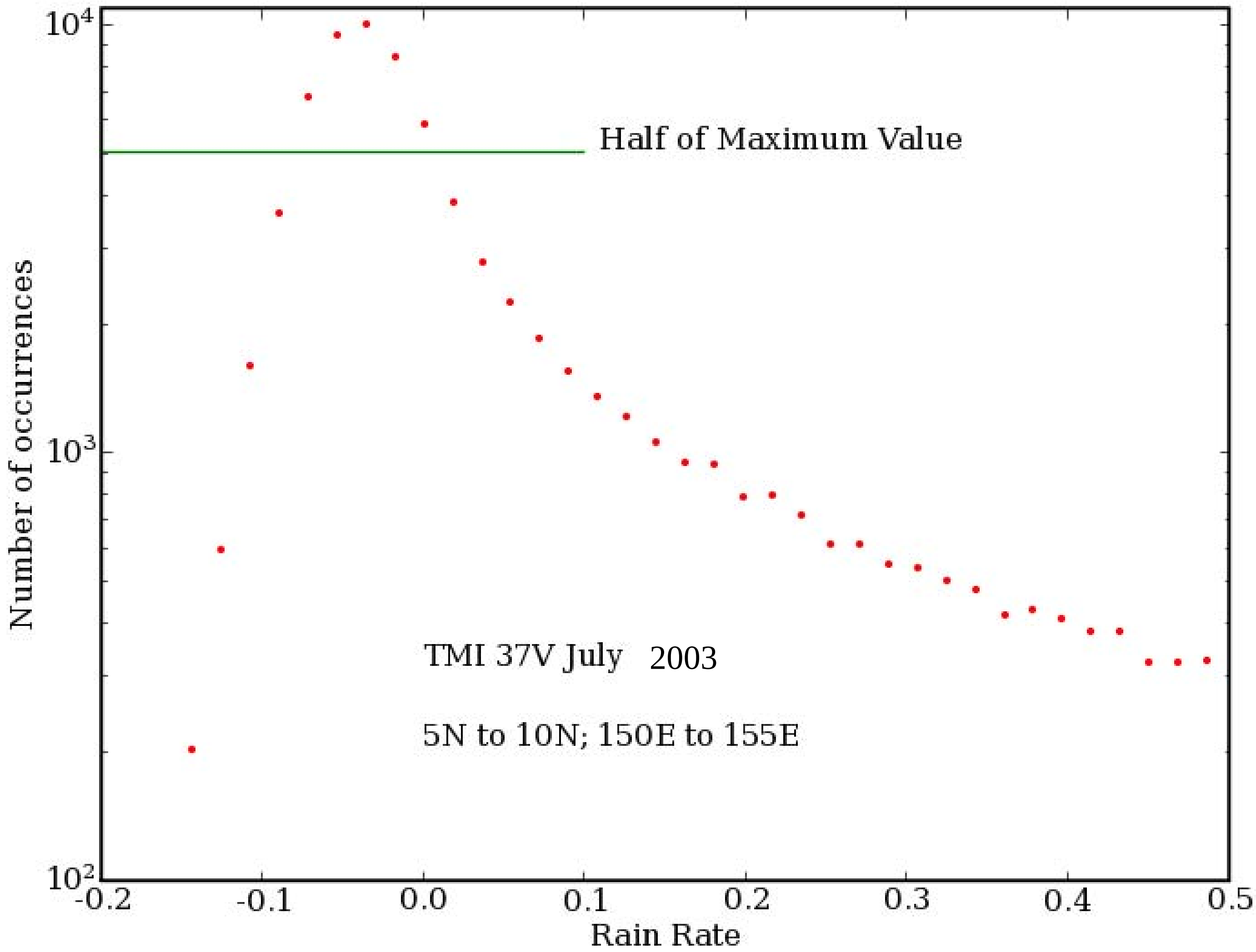
Department of Atmospheric Science

Texas A&M University

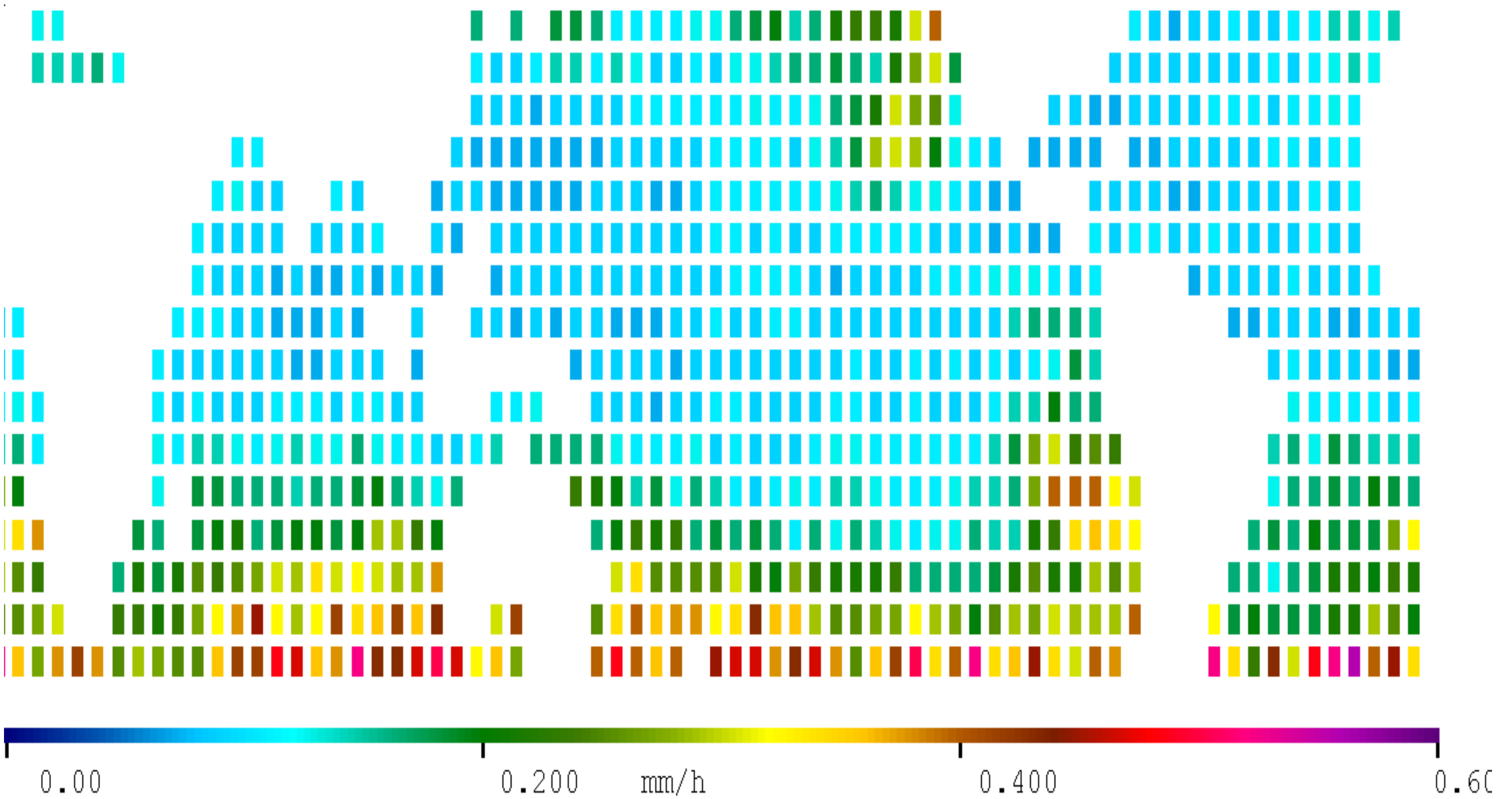
College Station, TX; USA

Two Pass Level 3 Oceanic Rainfall Algorithm

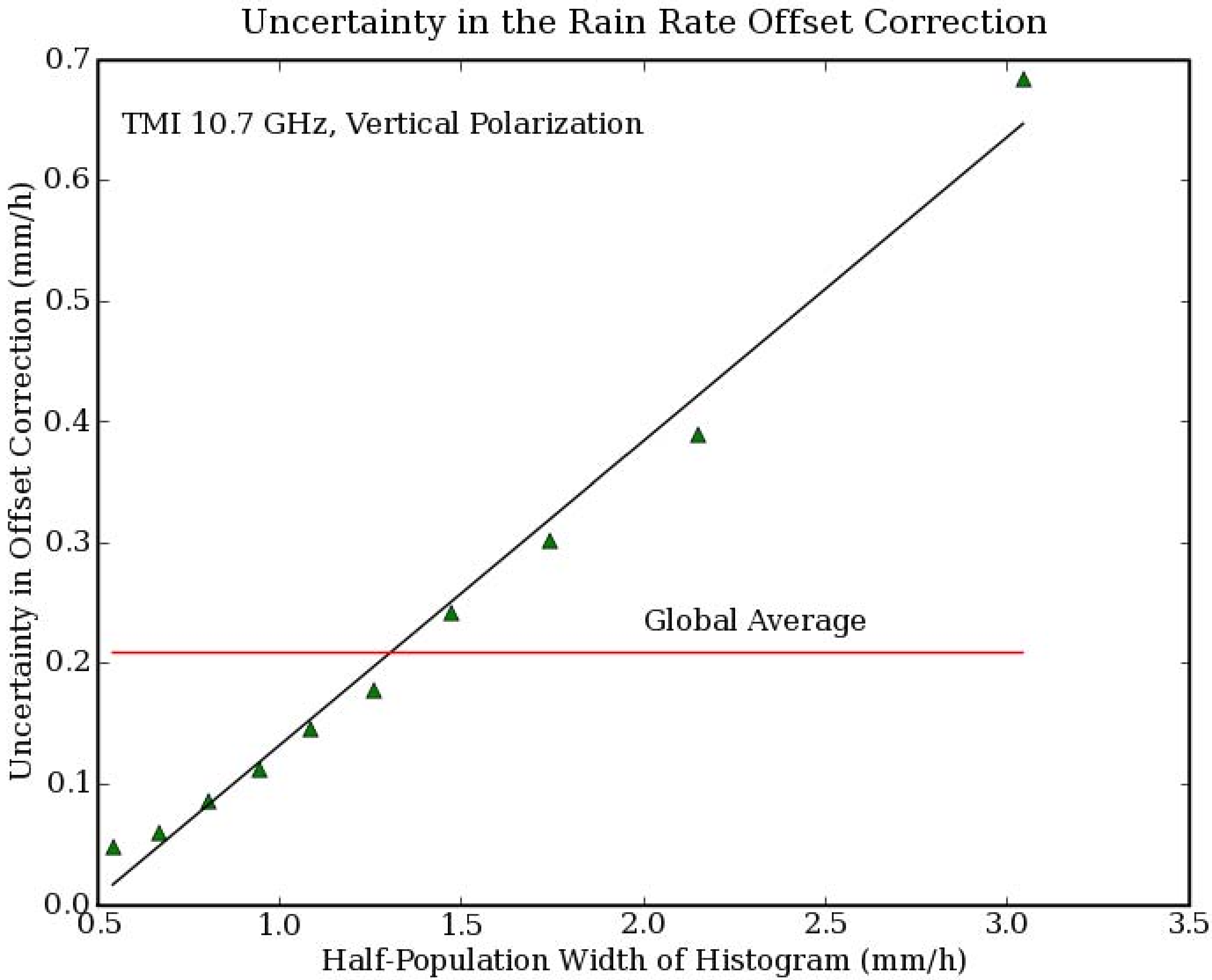




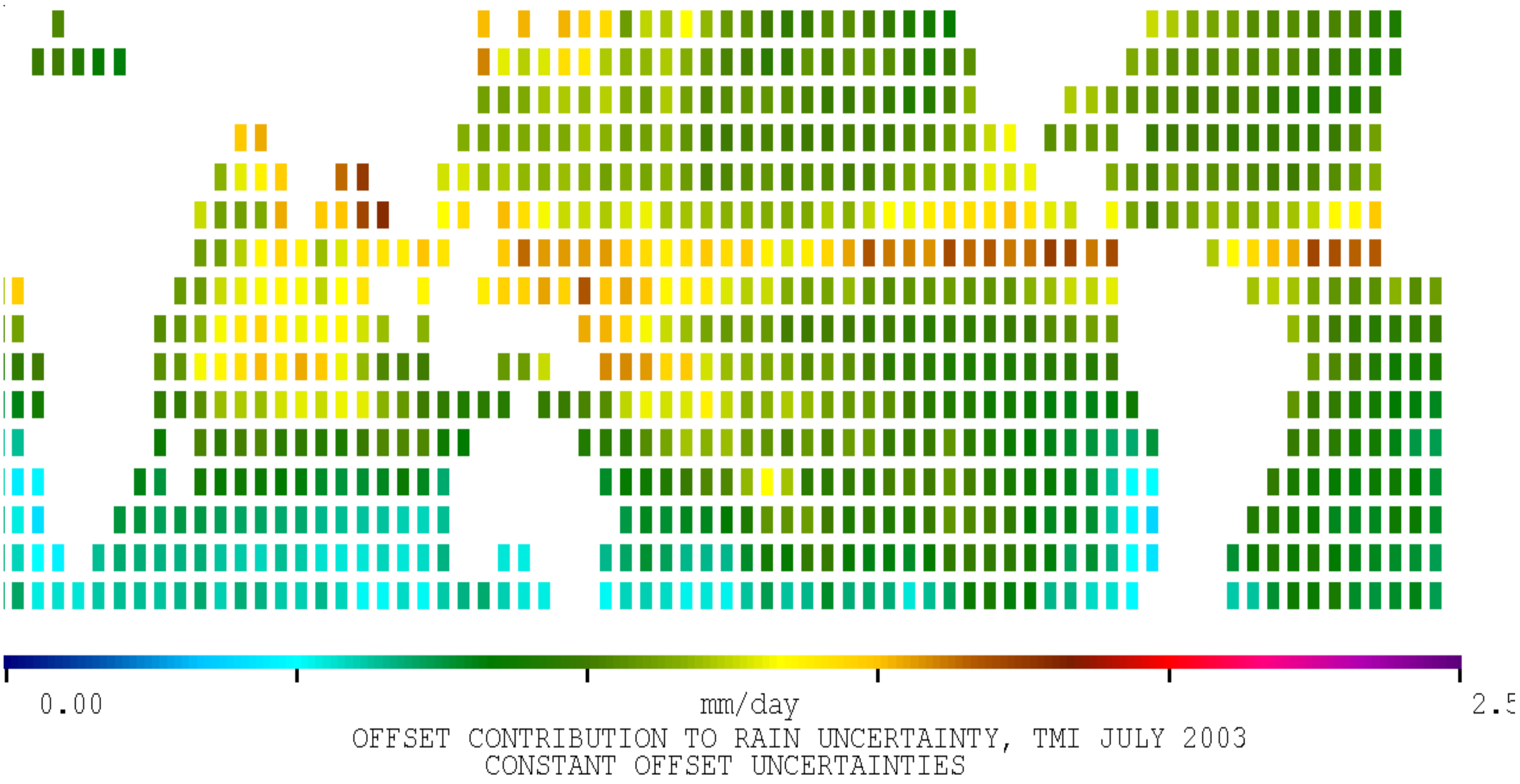
Half of Maximum Value
TMI 37V July 2003
5N to 10N; 150E to 155E
Number of occurrences
Rain Rate
10^4
10^3
10^2
-0.2
-0.1
0.0
0.1
0.2
0.3
0.4
0.5

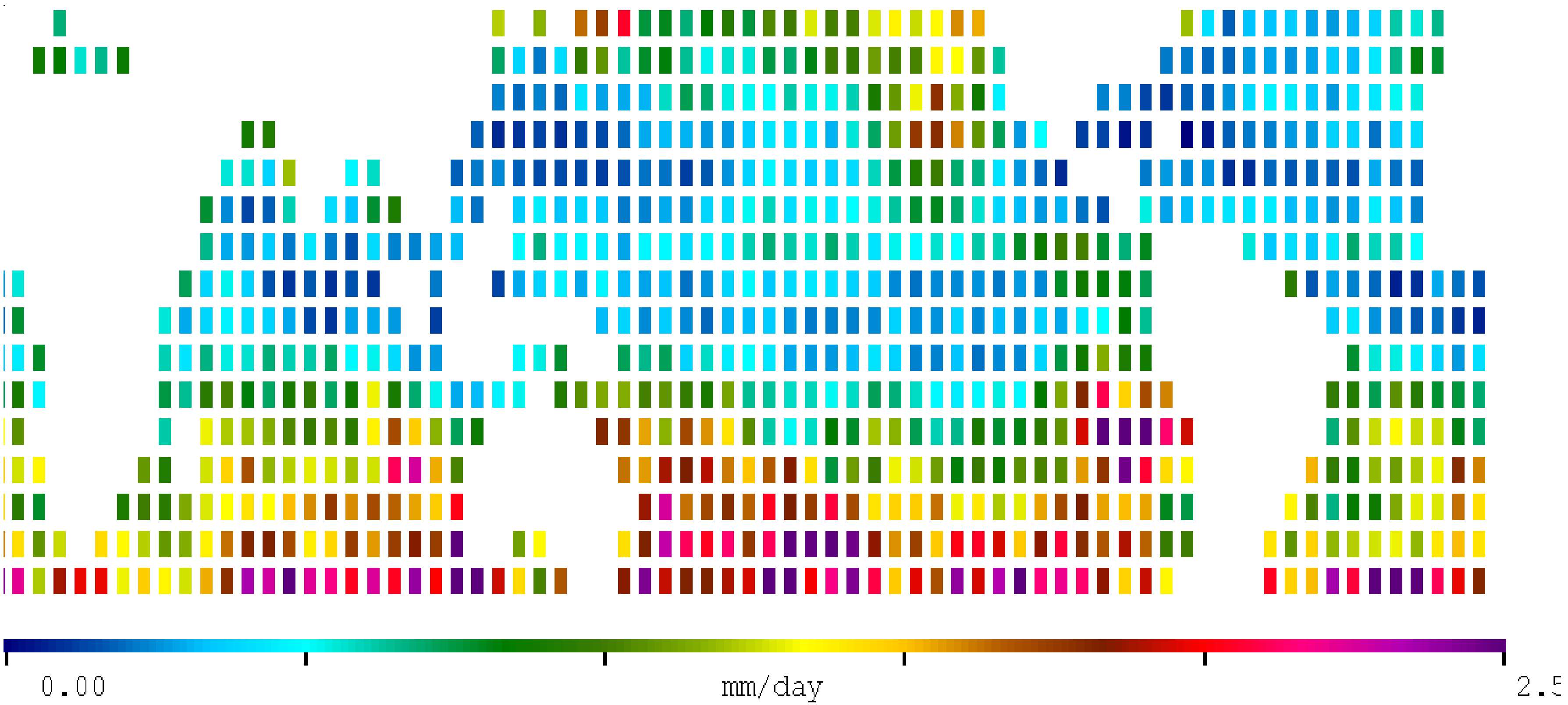


FULL WIDTH OF HALF POPULATION OF HISTOGRAMS JULY 2003
TMI 37V CHANNEL

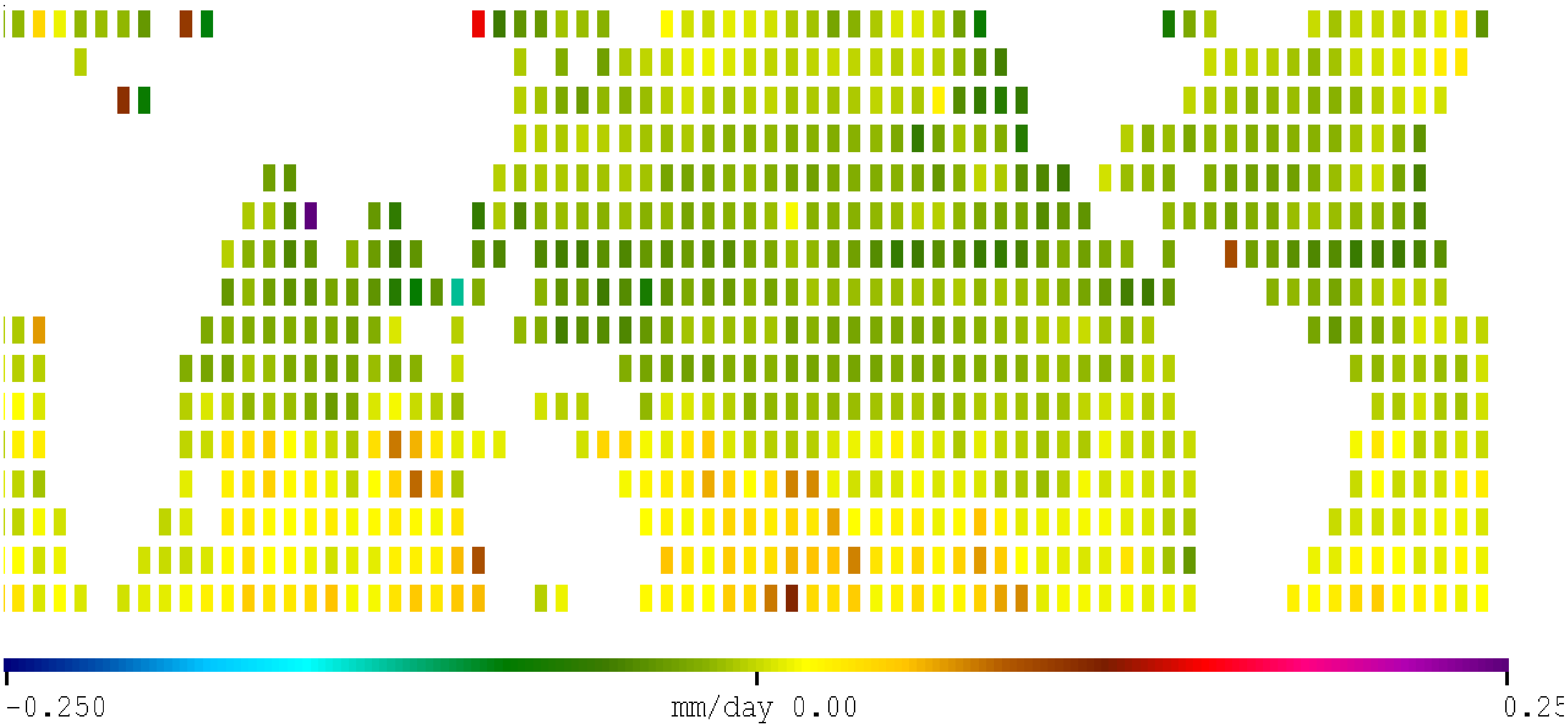


Uncertainty in the Rain Rate Offset Correction
TMI 10.7 GHz, Vertical Polarization
Global Average
Uncertainty in Offset Correction (mm/h)
Half-Population Width of Histogram (mm/h)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.5
1.0
1.5
2.0
2.5
3.0
3.5

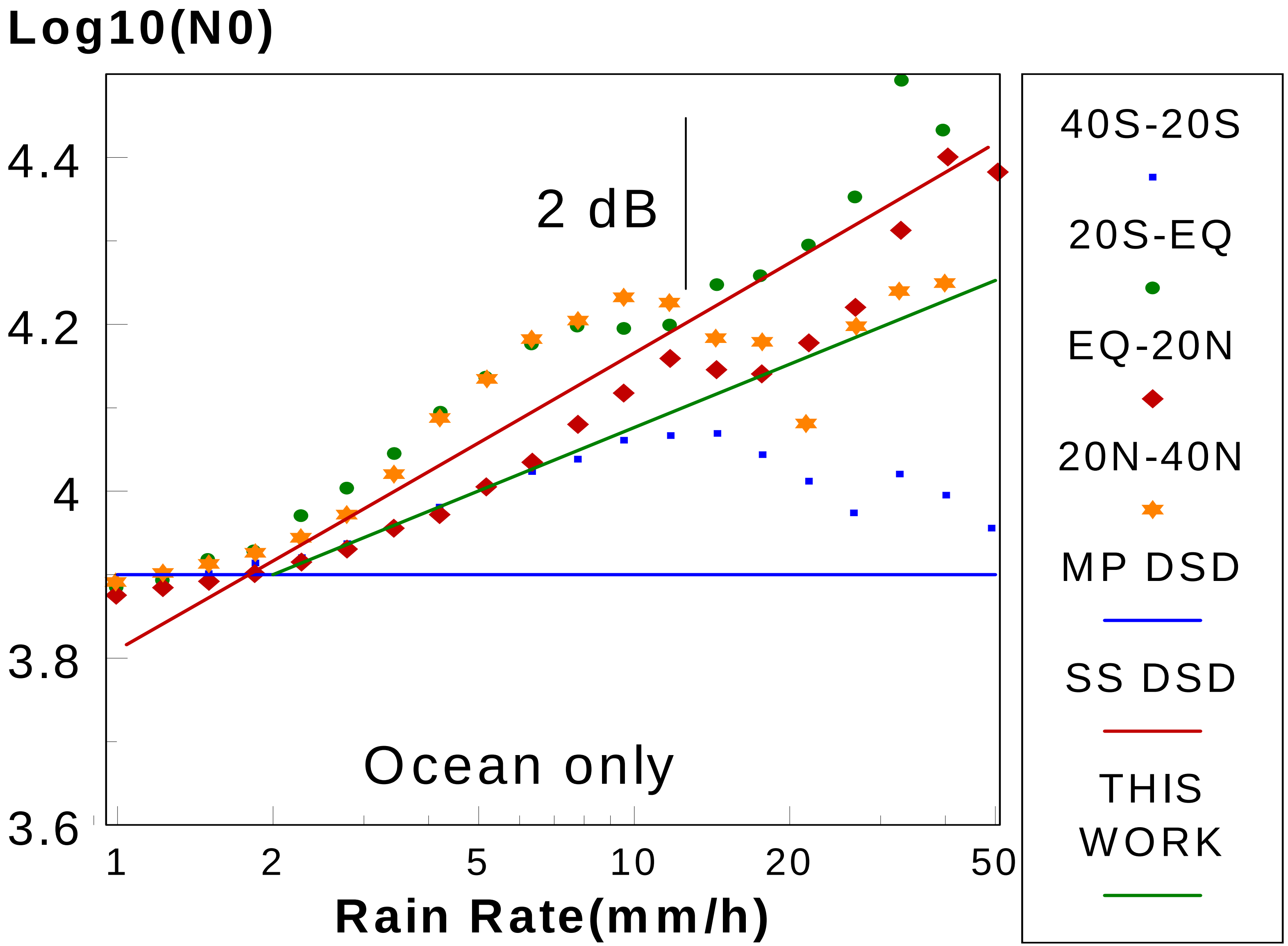

0.00
mm/day
2.5
OFFSET CONTRIBUTION TO RAIN UNCERTAINTY, TMI JULY 2003
CONSTANT OFFSET UNCERTAINTIES



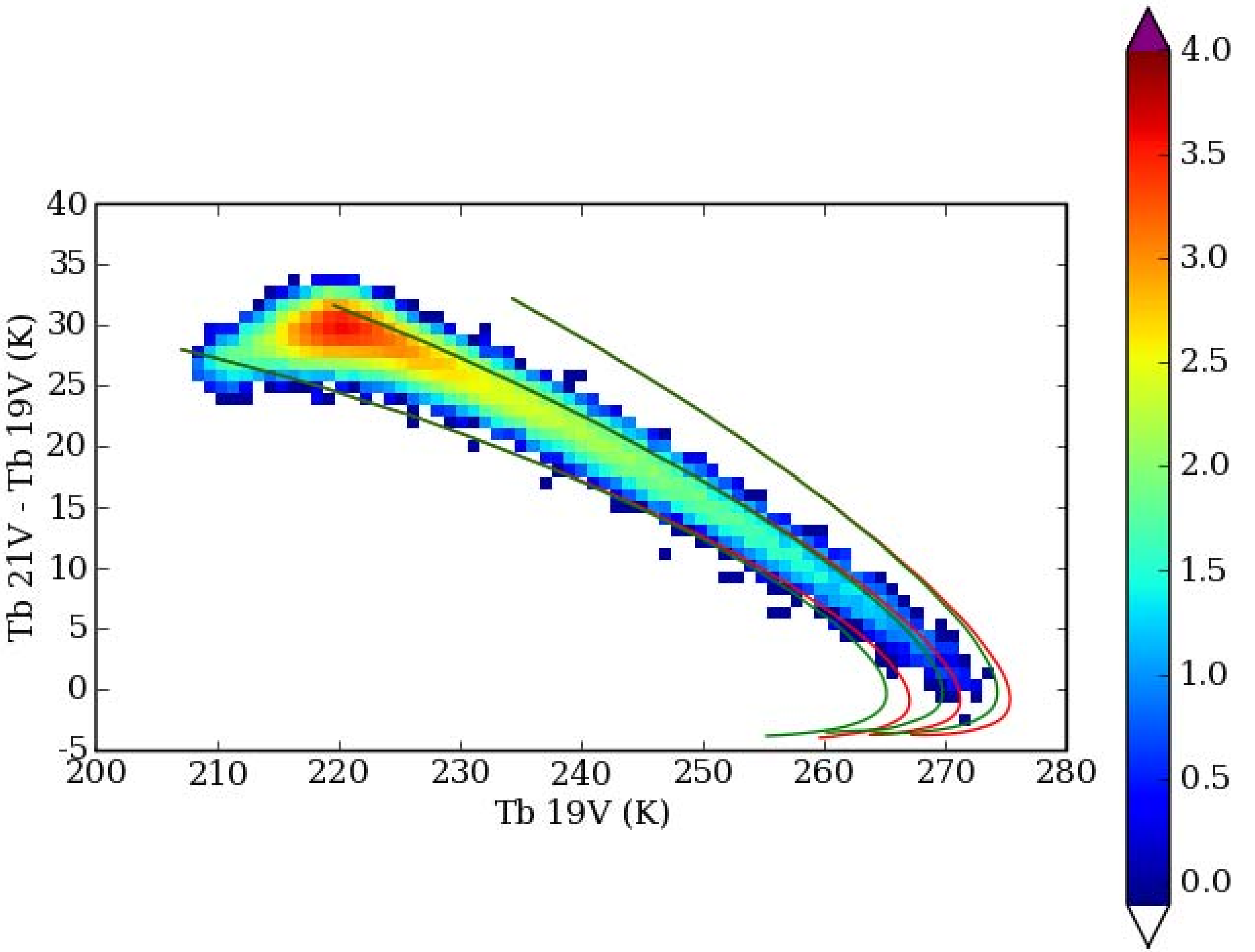
OFFSET CONTRIBUTION TO RAIN UNCERTAINTY, TMI JULY 2003
VARIABLE OFFSET UNCERTAINTIES



CHANGE IN MONTHLY RAIN UNCERTAINTIES
TMI JULY 2003



Log10(N0)
4.4
4.2
4
3.8
3.6
1
2
5
10
20
50
Rain Rate(mm/h)
2 dB
Ocean only
40S-20S
20S-EQ
EQ-20N
20N-40N
MP DSD
SS DSD
THIS WORK



Tb 21V - Tb 19V (K)
Tb 19V (K)
40
35
30
25
20
15
10
5
0
-5
200
210
220
230
240
250
260
270
280
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

TRMM Precipitation Radar Data for 1998

Profiles expressed as Surface Rain Rate & Slope

Surface Rain Is Desired Quantity but Column Mean is Closer to What the Radiometer Measures

Two Ways of Computing TBs

1) Compute TBs at Radar Resolution and Smooth to Radiometer Res

   Approximates Actual Measurement

1) Smooth Rain Field to Radiometer Resolution <u>Then</u> Compute TBs

   Implicit in Interpretation

   Don’t Know Structure in General Case

   The Difference is the Beam Filling Error

   Vertical Profile Error Remains

Can Only Be Corrected in a Statistical Sense

How can we make sense of this mess?

Expand Tb(RR) around <RR> (mean RR over FOV)

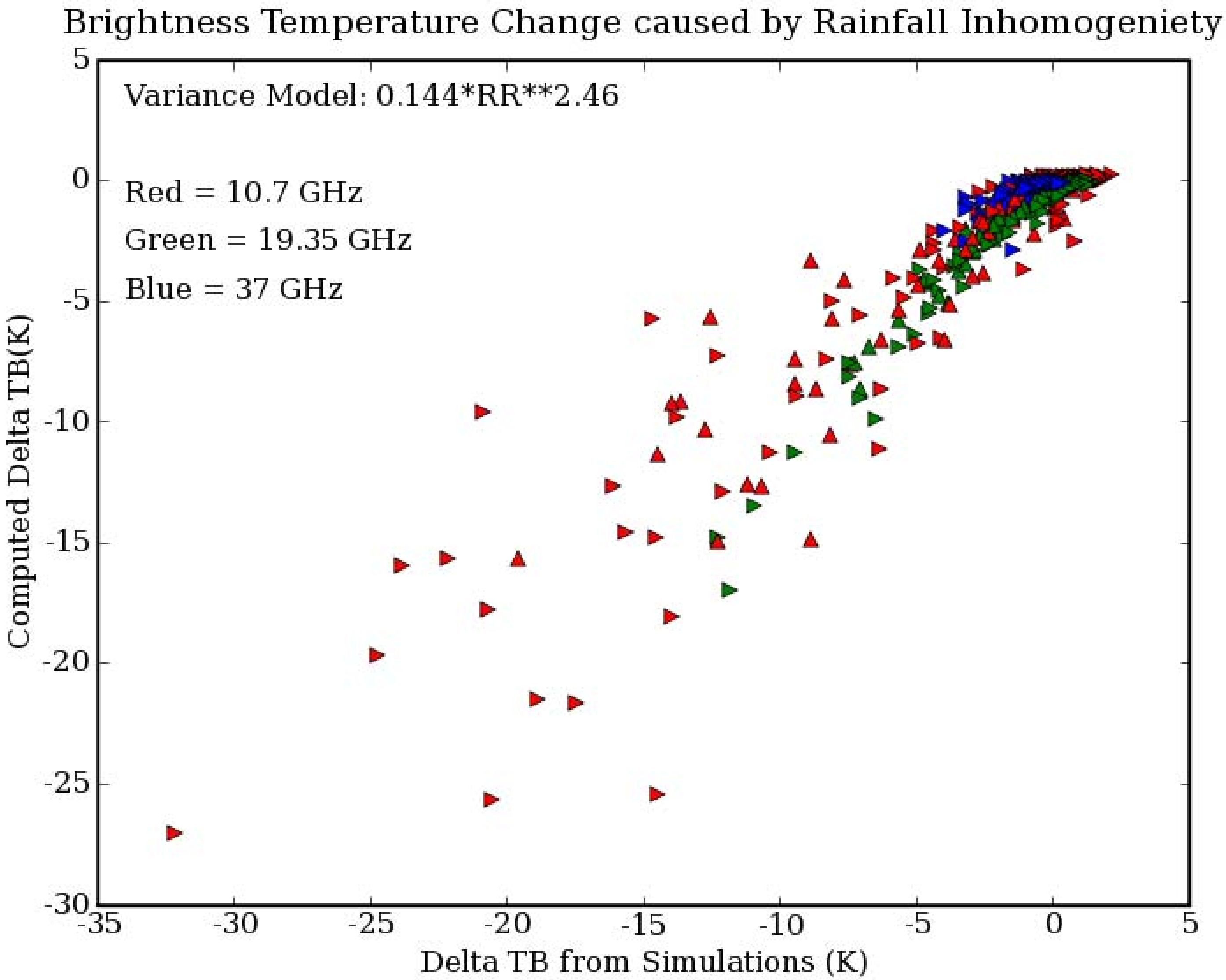
$$\Delta Tb = \frac{1}{2}\frac{\partial^2 Tb}{\partial RR^2}\sigma_{RR}^2$$

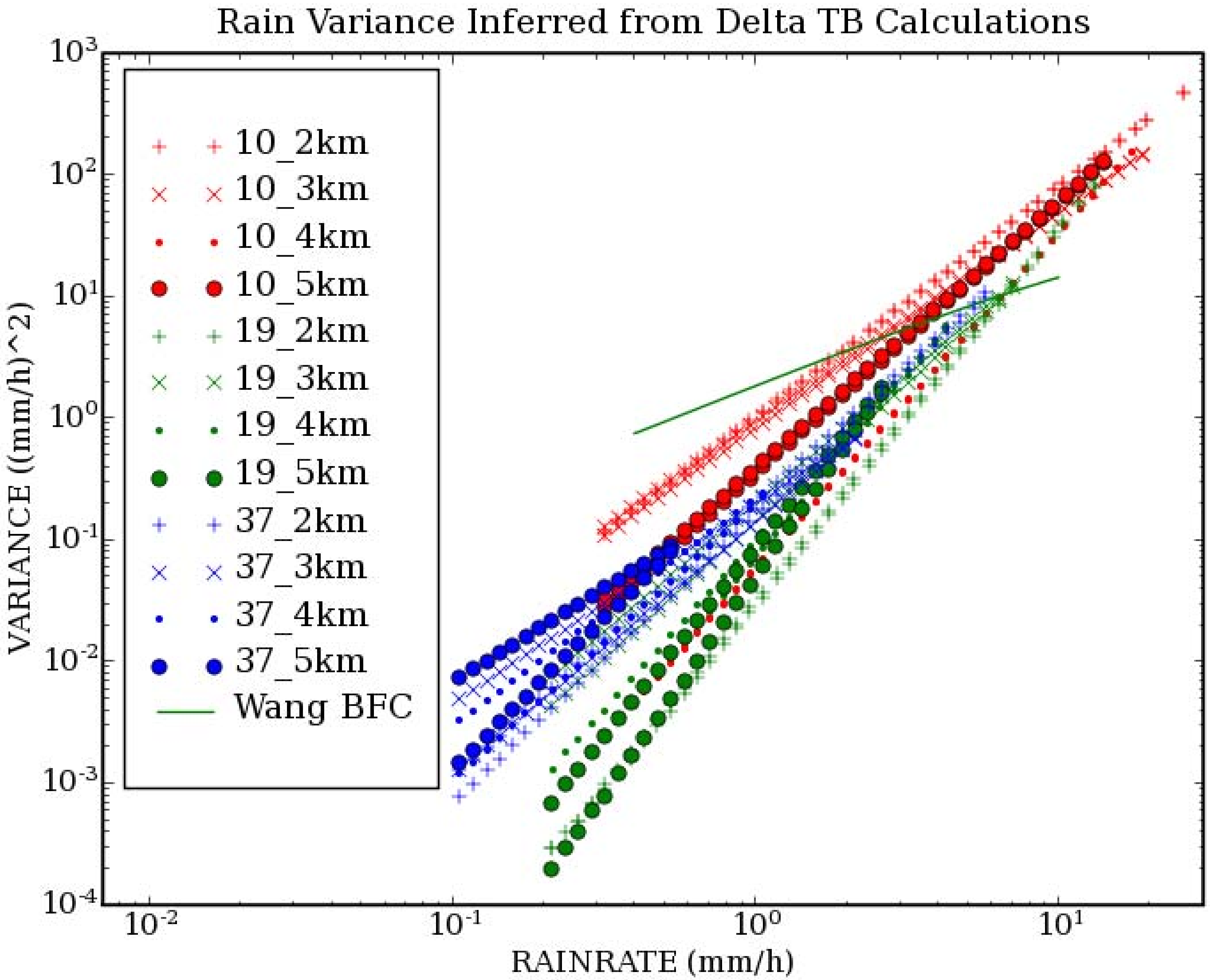
To a Very Good Approximation:

$$Tb = T_0 + (280K - T_0) * (1 - \exp(RR / R_c) + A * RR$$

R_c , T_0 and *A* are Functions of Freq., Pol. and Freezing Level

Thus, ΔTb Can be Expressed as σ_{RR}^2 over FOV


Brightness Temperature Change caused by Rainfall Inhomogeniety
Variance Model: 0.144*RR**2.46
Red = 10.7 GHz
Green = 19.35 GHz
Blue = 37 GHz
Computed Delta TB(K)
Delta TB from Simulations (K)
5
0
-5
-10
-15
-20
-25
-30
-35
-30
-25
-20
-15
-10
-5
0
5


Rain Variance Inferred from Delta TB Calculations
VARIANCE ((mm/h)^2)
RAINRATE (mm/h)
10_2km
10_3km
10_4km
10_5km
19_2km
19_3km
19_4km
19_5km
37_2km
37_3km
37_4km
37_5km
Wang BFC
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-2}
10^{-1}
10^{0}
10^{1}

Conclusions

Improved description of Offset Uncertainty

Reduces Net Uncertainty in Most Locations

Improved Drop Size Distribution

Slight Reduction of Uncertainty but firmer basis

Improved Beam Filling Correction

In Progress