

6.5

Shallow Rain from the TRMM PR: A Five-Year Climatology (1998 to 2002)

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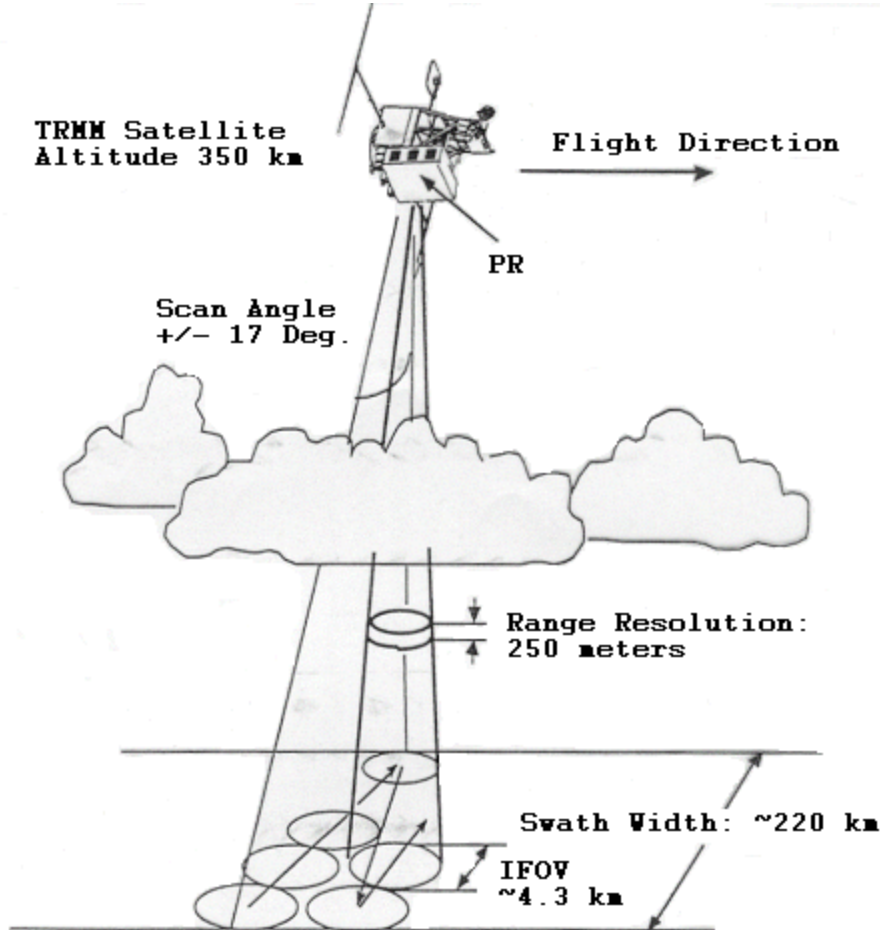
ENSCO, Inc.
Aerospace Sciences and Engineering Division
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31st International Conference on Radar Meteorology



Innovation Starts Here
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Precipitation Radar Characteristics & Products



Observation Concept of the PR

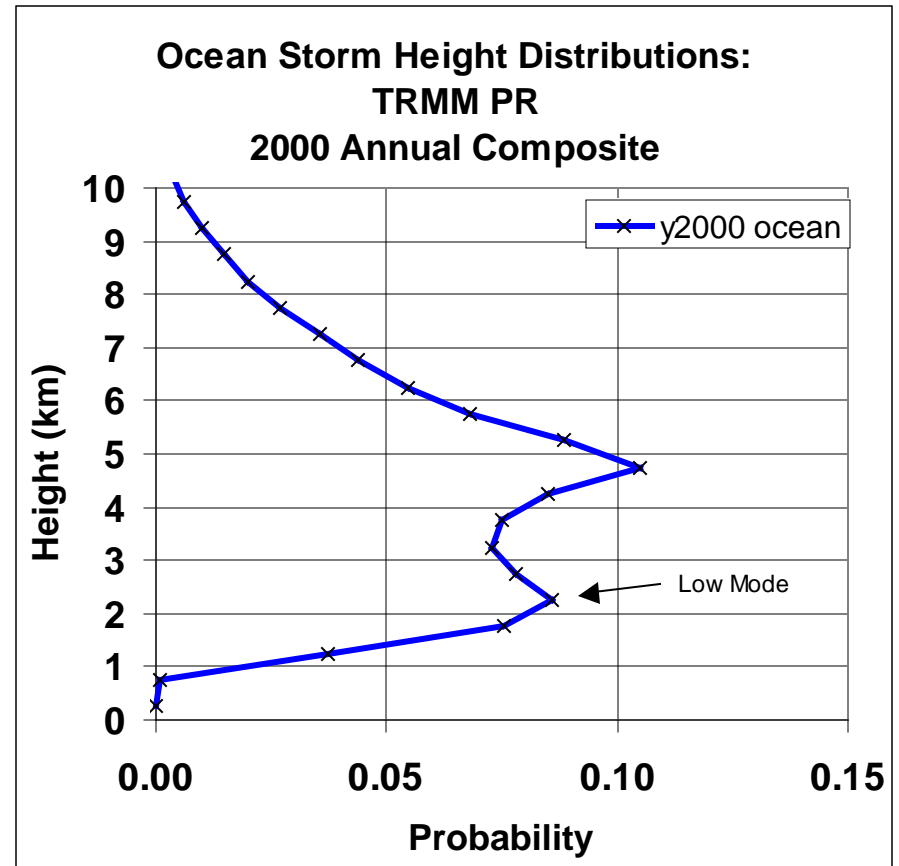
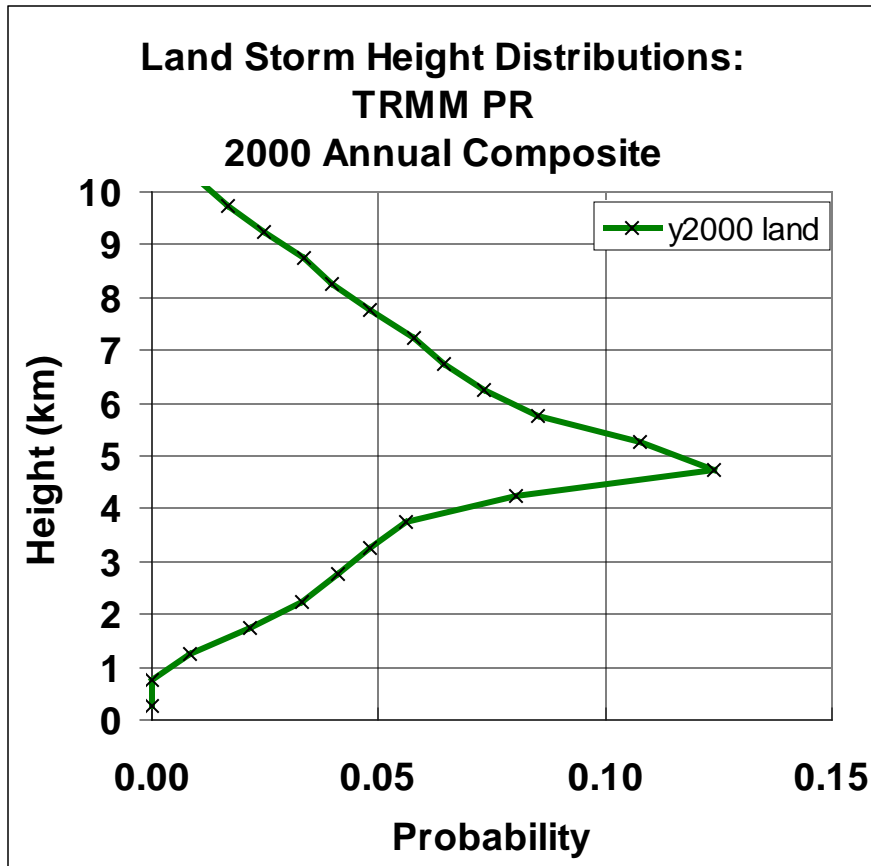
- Product 3A25
- Space Time Statistics of Level 2 PR Products
- 5 x 5 Lat/Lon Resolution

“Storm” Height
(Echo Top Height)

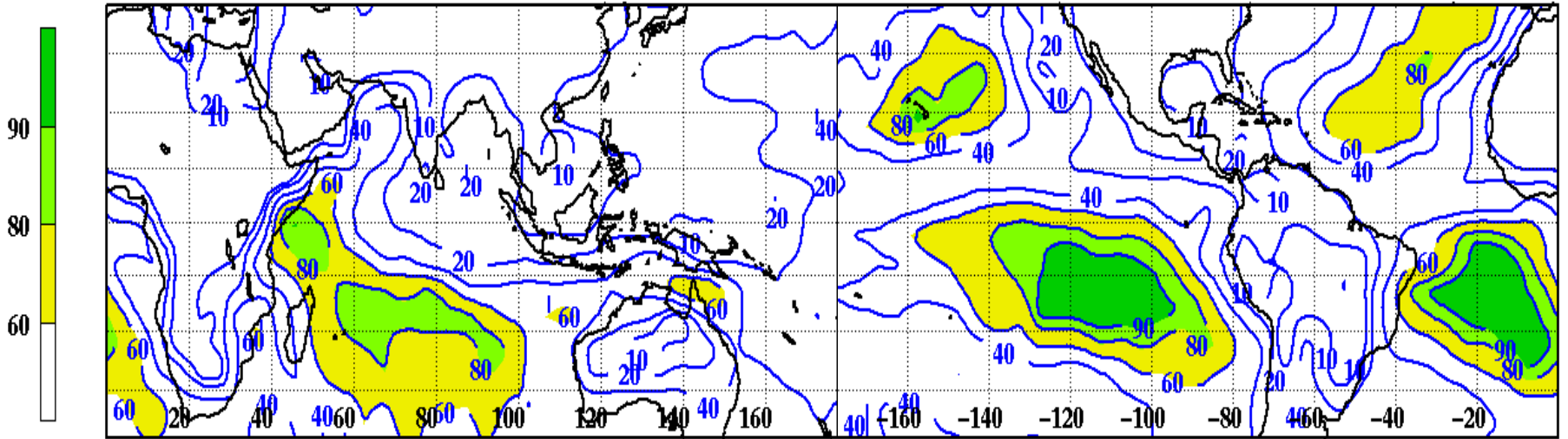
PR Sensitivity ~ 17 dBZ
(~ 0.5 mm/hr)

Surface Rainfall

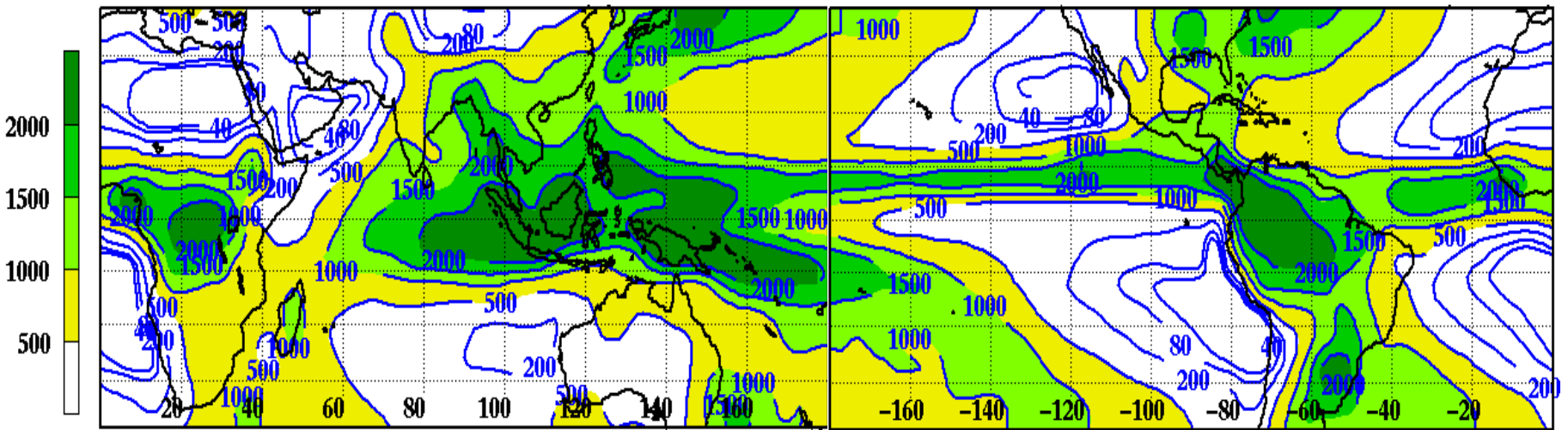
Land/Ocean Contrast in Storm Height Distributions



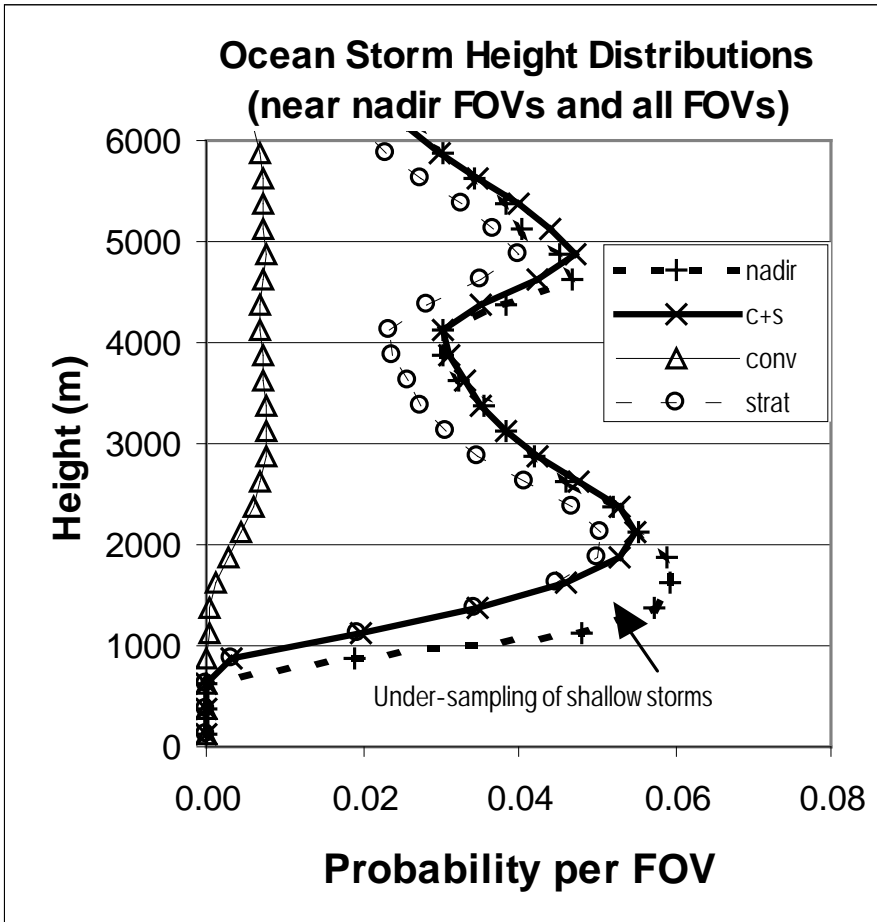
Percentage of echo tops < 3 km



Annual Average Rainfall (mm/yr)



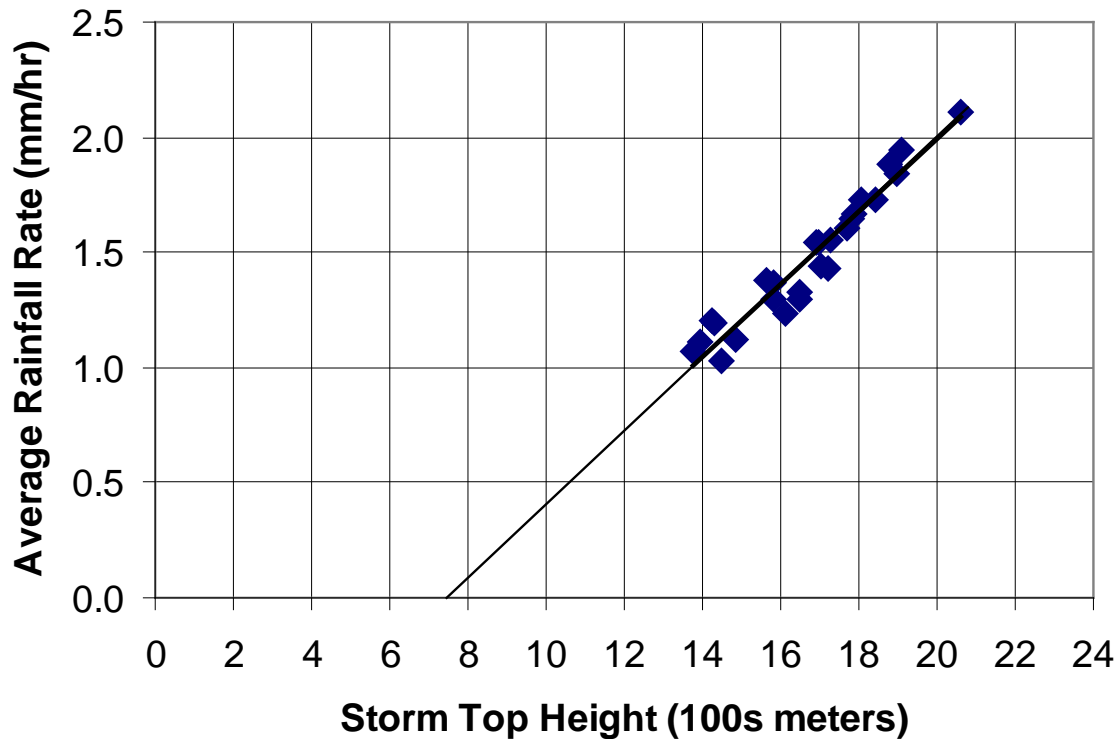
ISSUES:



- **Under-sampling (Beam Width)**
- **Re-Classification (Z-R)**
- **PR Sensitivity (17 dBZ)**
- **Missing “Warm rain”
in product 3A25**

Rainfall Rate Parameterization for Shallow Convection

**Rainfall Rate Parameterization
for Shallow Convective Storms**

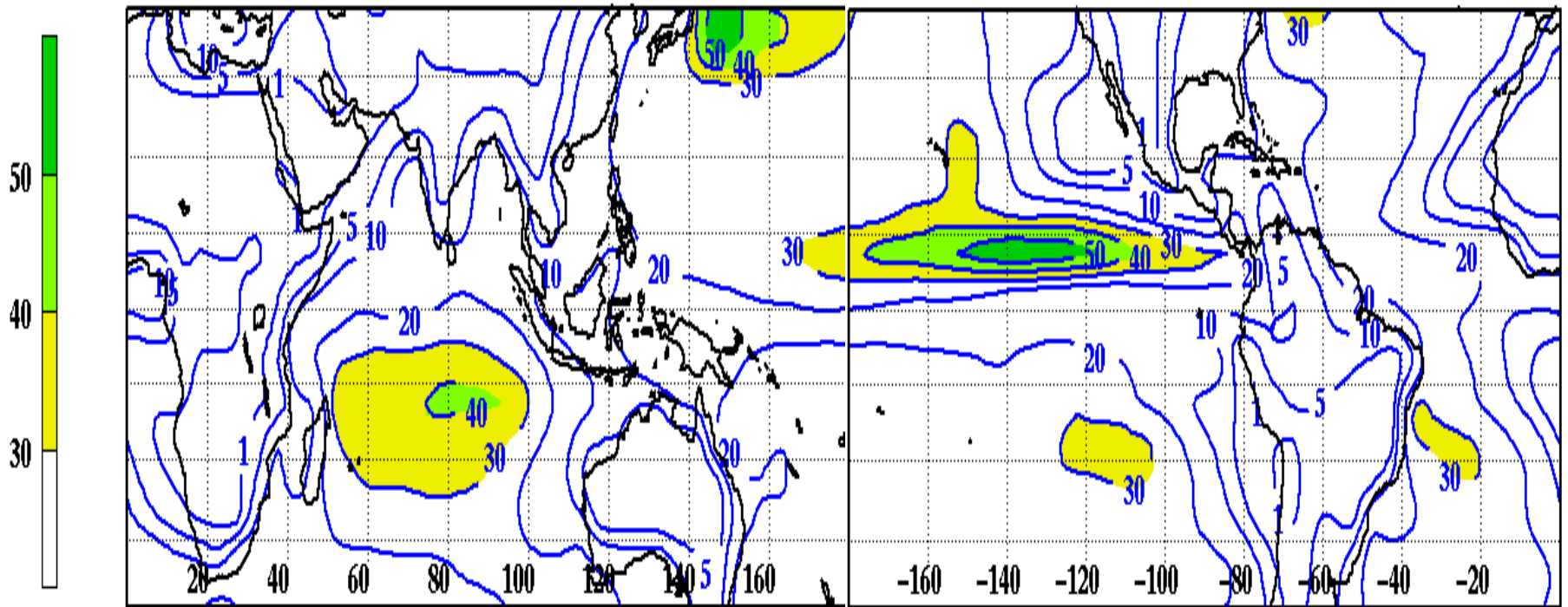


**Developed from
regions where
shallow echo tops
are dominant**

$$R_c(\text{mm/hr}) = 0.16 * (H - 7.3)$$

**R_c is the average
rainfall rate where raining;
and H is storm top height**

Rainfall Correction Due to Under-sampling of Shallow Echoes (mm/yr)



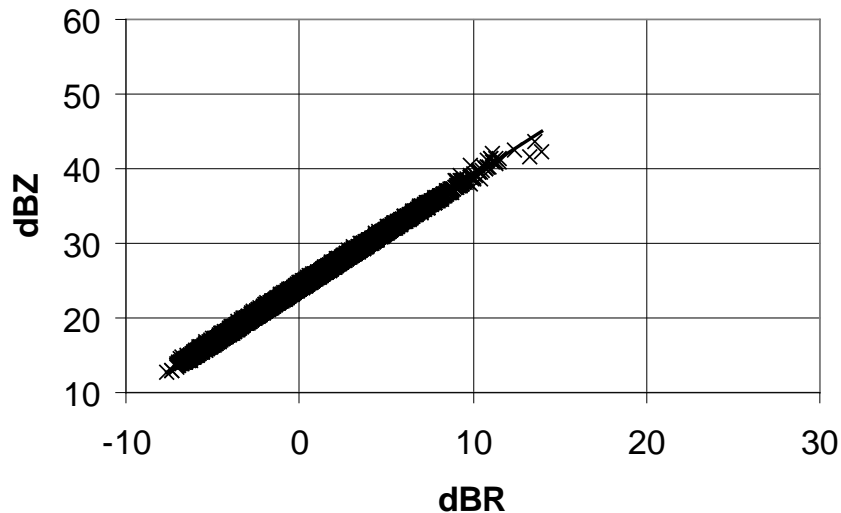
Comparison of TRMM Z-R Relations (Convective & Stratiform)

Higher Convective Rainfall Rate at same dBZ value

Re-Classification: Multiplicative Factor ~ 1.38

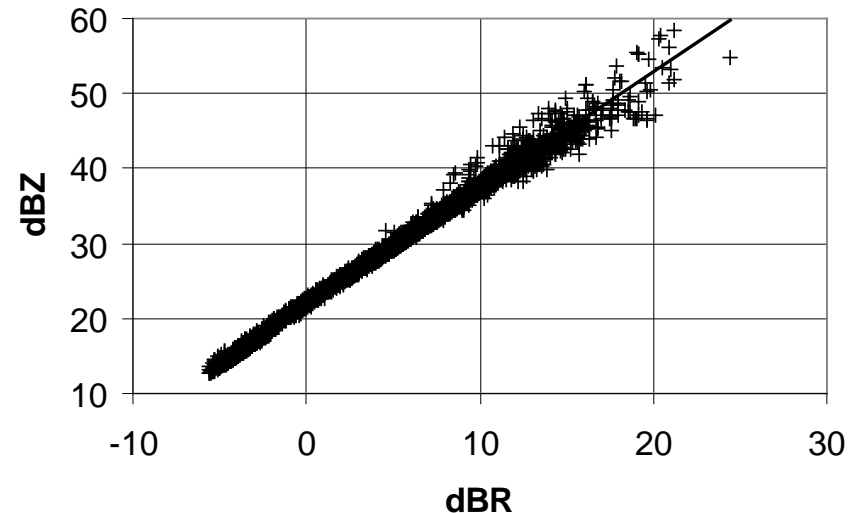
Stratiform Classification

$$Z = 260 \cdot R^{1.49}$$



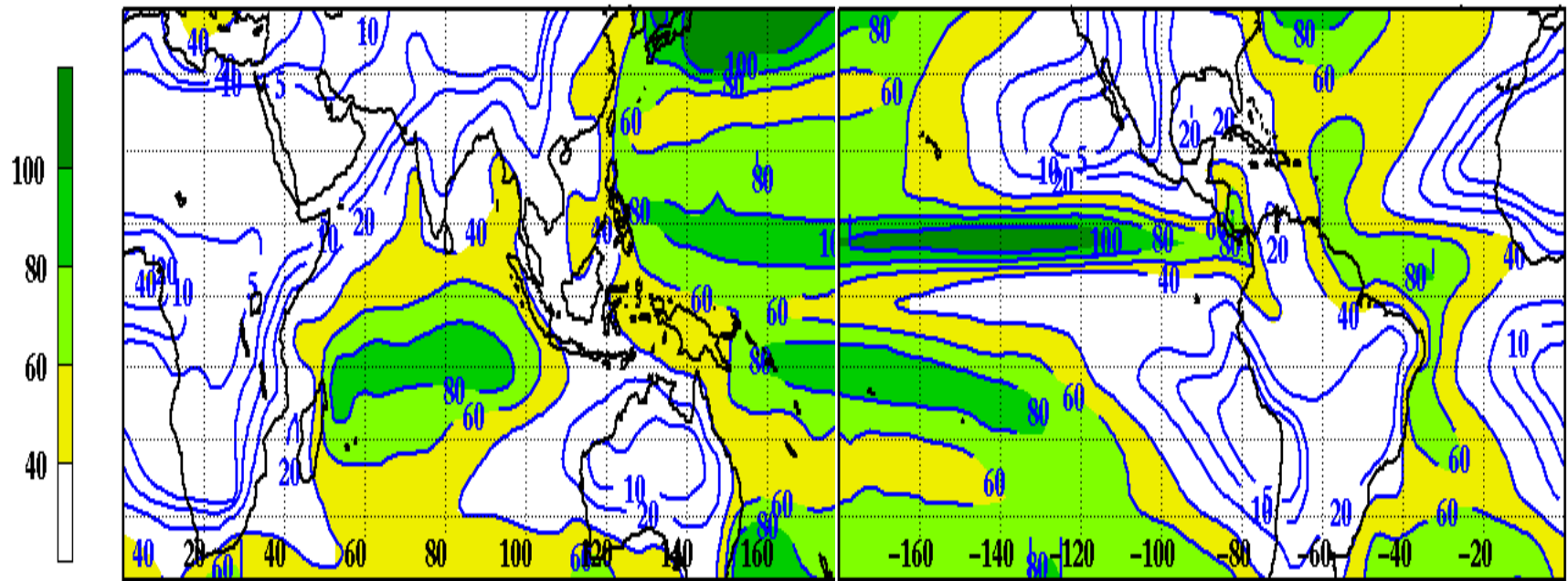
Convective Classification

$$Z = 160 \cdot R^{1.52}$$



Shallow Isolated Echoes: Products 2A23 & 2A25 (Schumacher and Houze 2003)

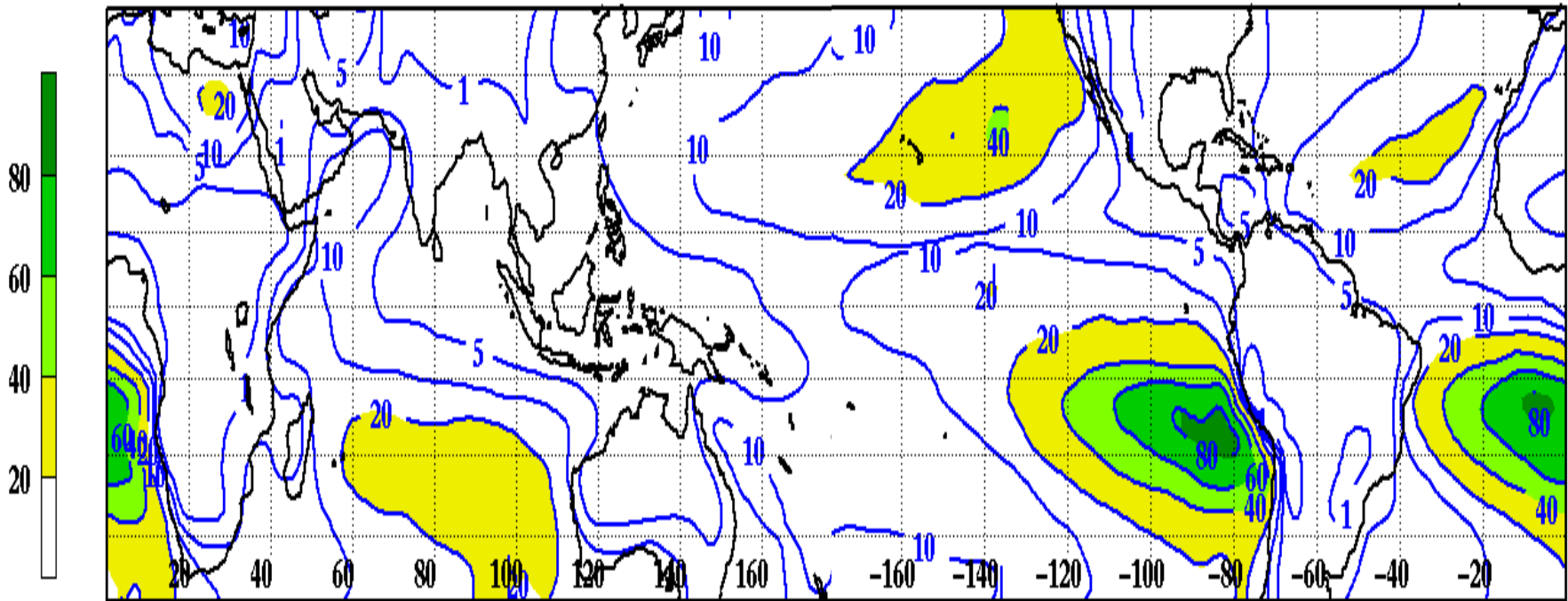
Rainfall Correction due to Re-classification of Shallow Storms from Stratiform to Convective



mm/year

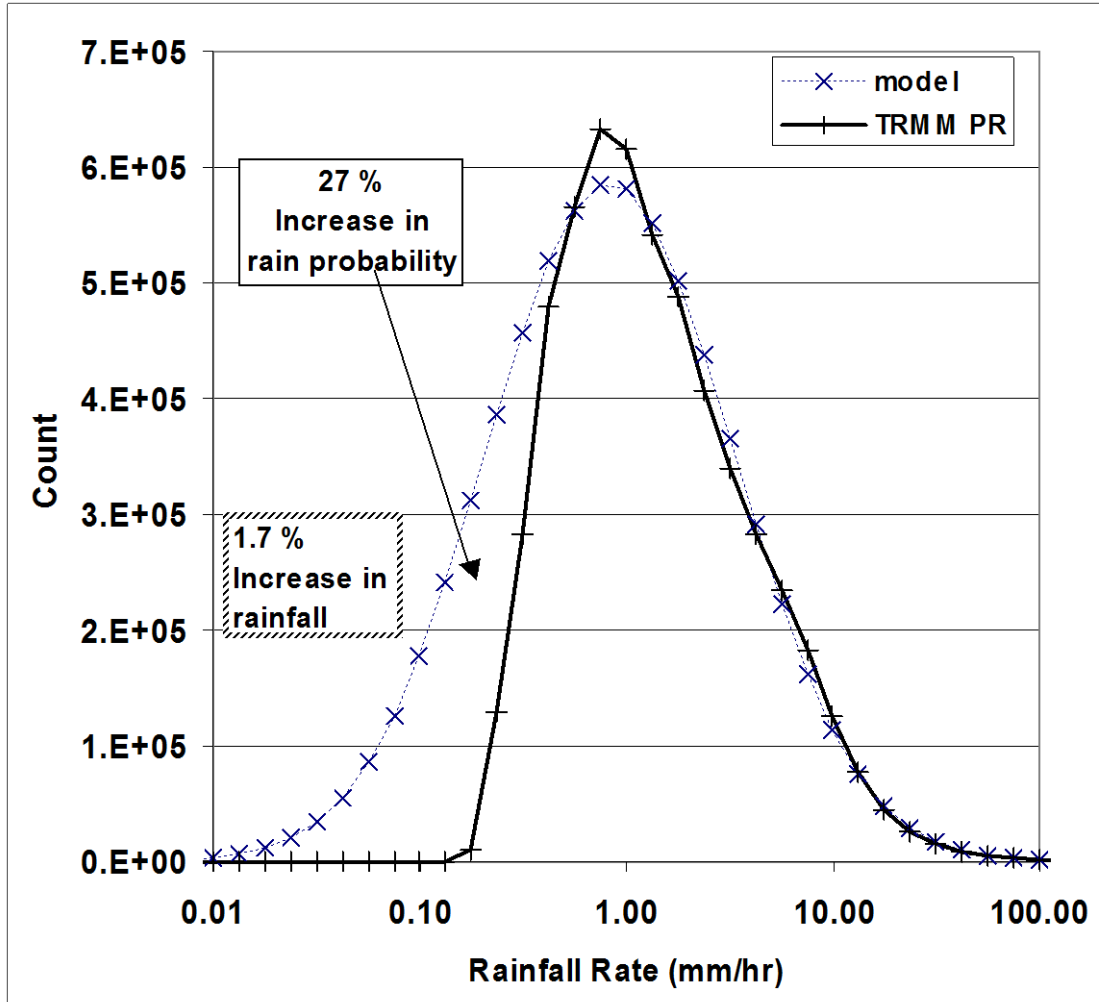
Effect of First Two Corrections on Annual Rainfall

$100 * (\text{Under-sampling} + \text{Re-classification}) / \text{Annual Total}$



Percentage Increase

Lognormal Fit to PR Rainfall Rate Distribution



**Zonally Averaged
Rainfall Rate Distributions
over Oceans**

~ 15:1 Ratio

$$\frac{\% \text{ Increase in Rain Probability}}{\% \text{ Increase in Rainfall}}$$

Zonal Average Summary Over Oceans

Corrections to Annual Rainfall over Oceans

Table 1. Zonally averaged annual rainfall (mm) from product 3A25 and corrections for the following:

A) Under-sampling; B) Re-classification;
C) 17 dBZ Sensitivity & D) "Warm" rain

Latitude	3A25	A	B	C	D	Total
37.5	1116	25	80	21	29	155
32.5	919	23	62	18	24	127
27.5	692	18	43	14	18	93
22.5	513	17	40	11	14	82
17.5	603	18	43	10	17	88
12.5	906	20	49	11	24	104
7.5	1682	29	76	16	41	162
2.5	1156	19	50	11	29	108
-2.5	915	16	43	9	24	92
-7.5	1051	21	53	12	26	112
-12.5	759	22	52	11	20	105
-17.5	536	24	50	11	16	101
-22.5	489	22	44	13	15	93
-27.5	593	20	44	15	17	97
-32.5	733	22	56	19	21	118
-37.5	781	21	65	19	22	127
Average	840	21	53	14	22	110

- Under-sampling (Beam Width)

2.5 %

- Re-Classification (Z-R)

6.3 %

- PR Sensitivity (17 dBZ)

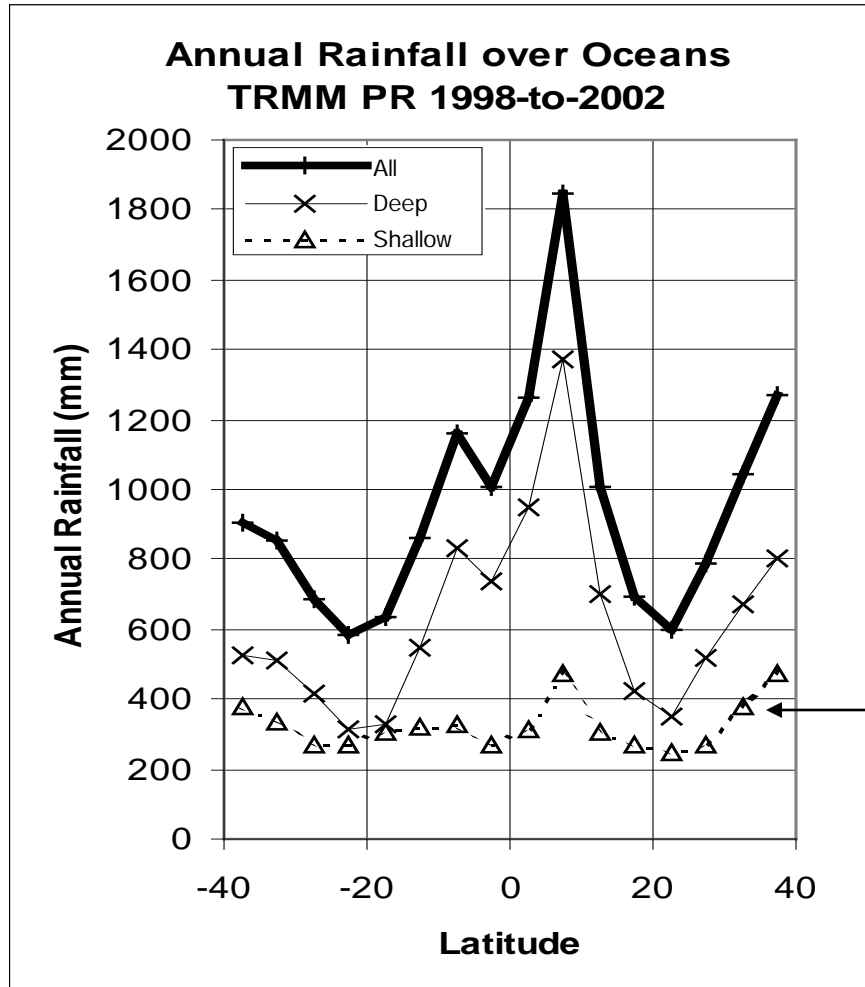
1.7 %

- Missing "Warm rain" (3A25)

2.6 %

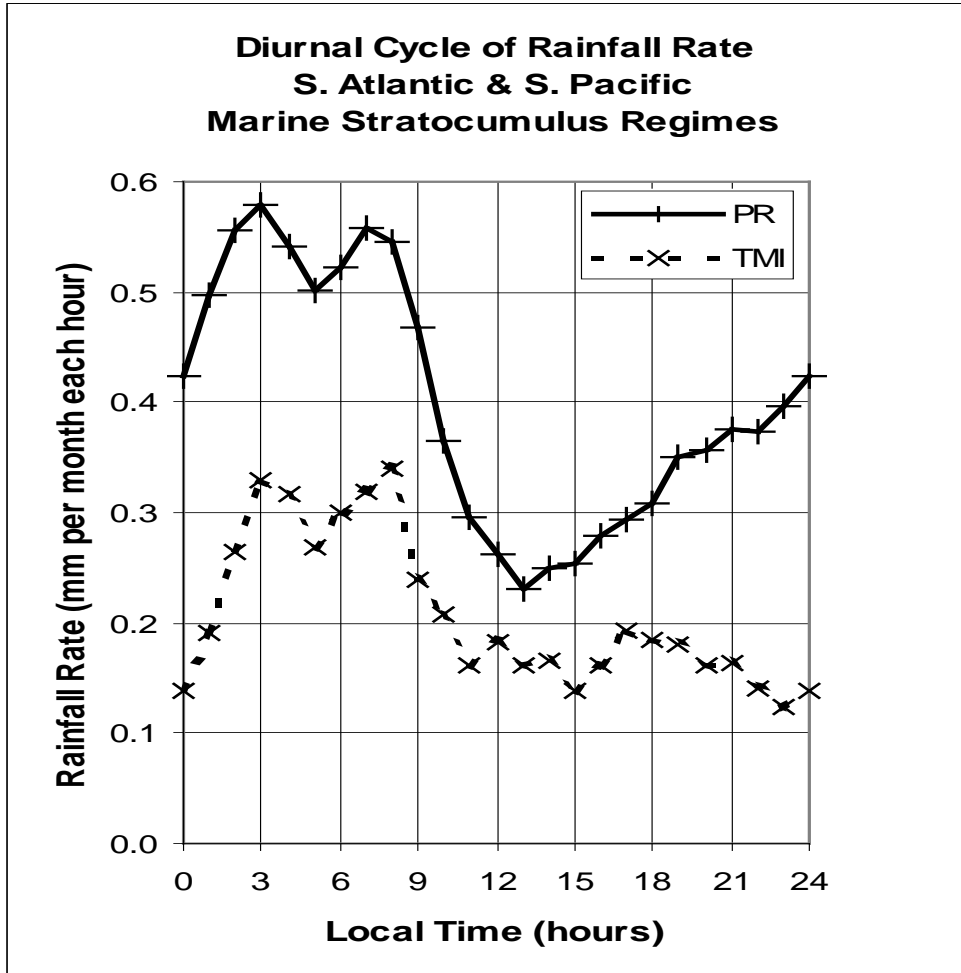
All Factors: 13.1 % Increase

Rainfall from All, Deep and Shallow Echoes



**34% of Total Rainfall
from Echoes with Tops
Lower than 3 km**

Analysis of Diurnal Cycle from Product 3G68



**4 Corrections would
increase Rainfall by
68 %
In Regions dominated
By Shallow Echoes**