Preliminary Analysis of ABFM Data
WSR “11 x 11 Volume Integral”

Harry Koons

25 May 2004

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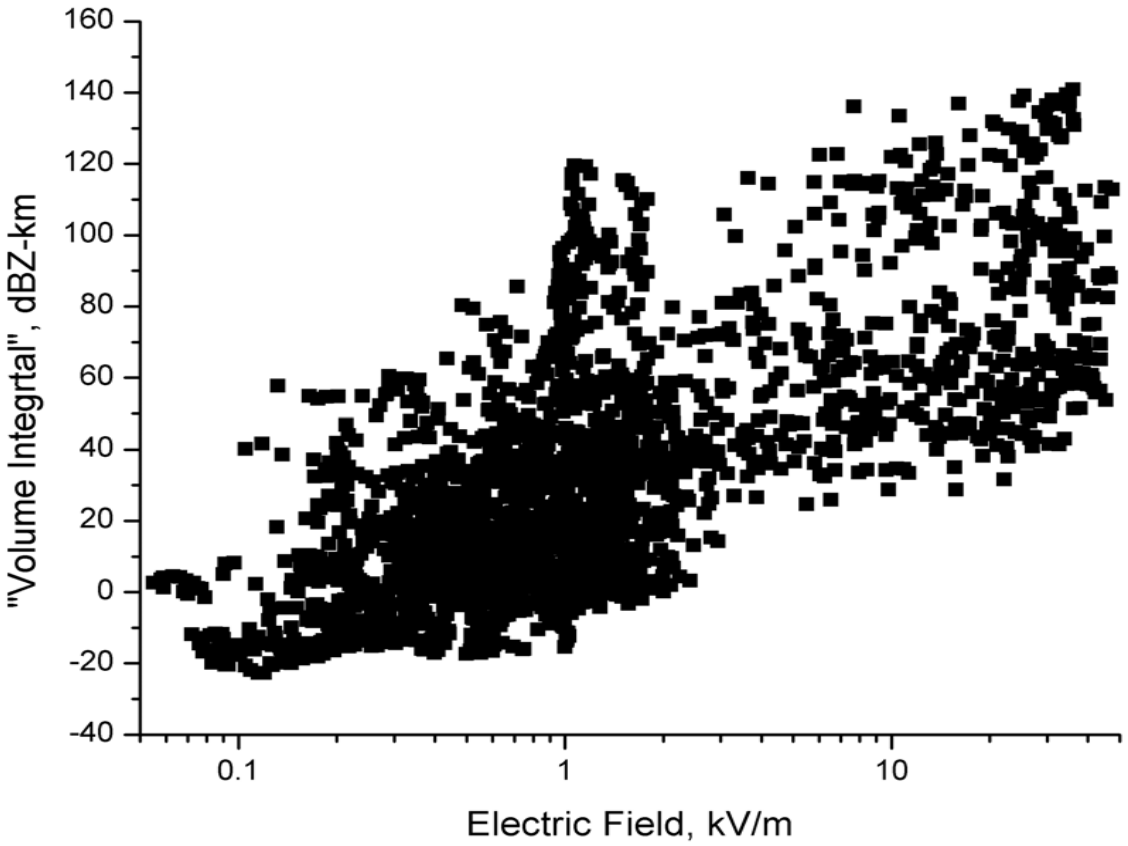
Scatter Plot of dBZ-km vs Emag
WSR “11 x 11 Volume Integral”



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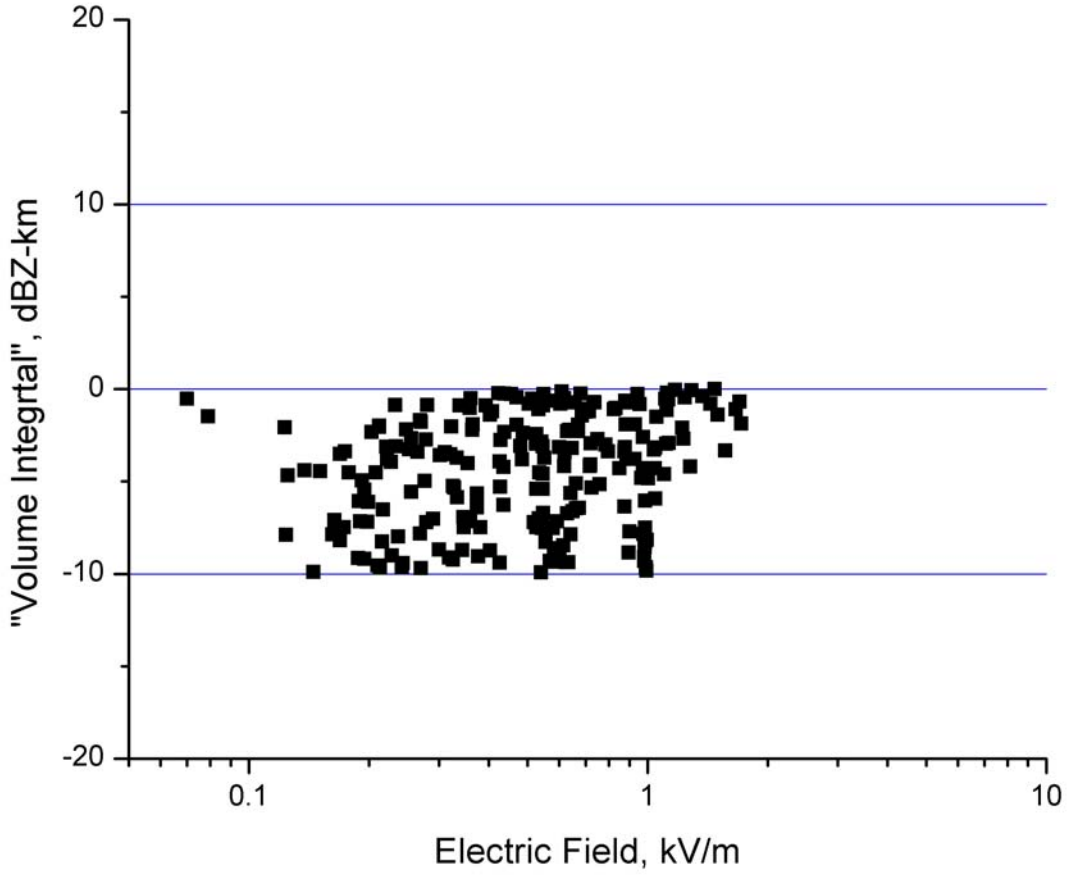
Approach

- **Objective is to determine the probability of an extreme electric field intensity for a given radar return**
- **Use the statistics of extreme values to estimate the extreme electric field intensities**
  - **Reference: *Statistical Analysis of Extreme Values,* Second Edition, R. -D. Reiss and M. Thomas, Birkhäuser Verlag, Boston, 2001**
- **As an example analyze WSR "11x11 Volume Integral"**
  - **Determine extreme value distribution functions for 10-(dBZ-km)-wide bins**
    - **For example the –5-(dBZ-km) bin is defined to be the range:**

      $$-10 < \text{dBZ-km} \leq 0$$
  - **Use Frac11x11 ≥ 0.1 selected from Frac11x11 ≥ 0.05 database**

Scatter Plot of dBZ-km vs Emag
WSR “11 x 11 Volume Integral” –5 dBZ-km bin



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Sample Statistics
-10 < dBZ-m ≤ 0

- **Sample Size, N = 230**
- **Minimum = 0.02 kV/m**
- **Maximum = 1.72 kV/m**
- **Median = 0.54 kV/m**
- **Mean = 0.59 kV/m**

Choose Peaks Over Threshold (POT) Method for Extreme Value Analysis

- **u = 0.674 kV/m (high threshold)**
- **k = 75 (right end of the stability zone)**

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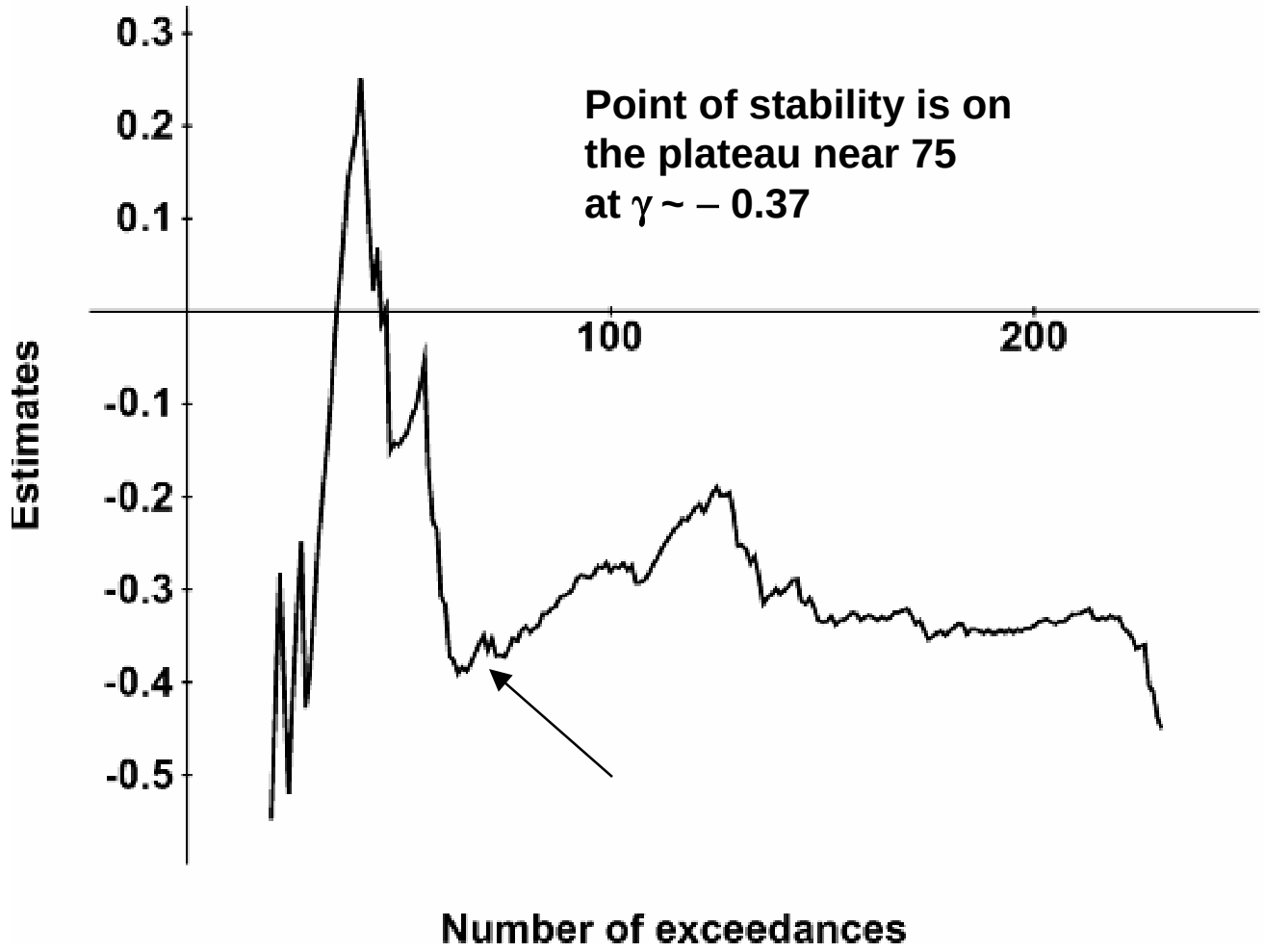
Gamma Diagram



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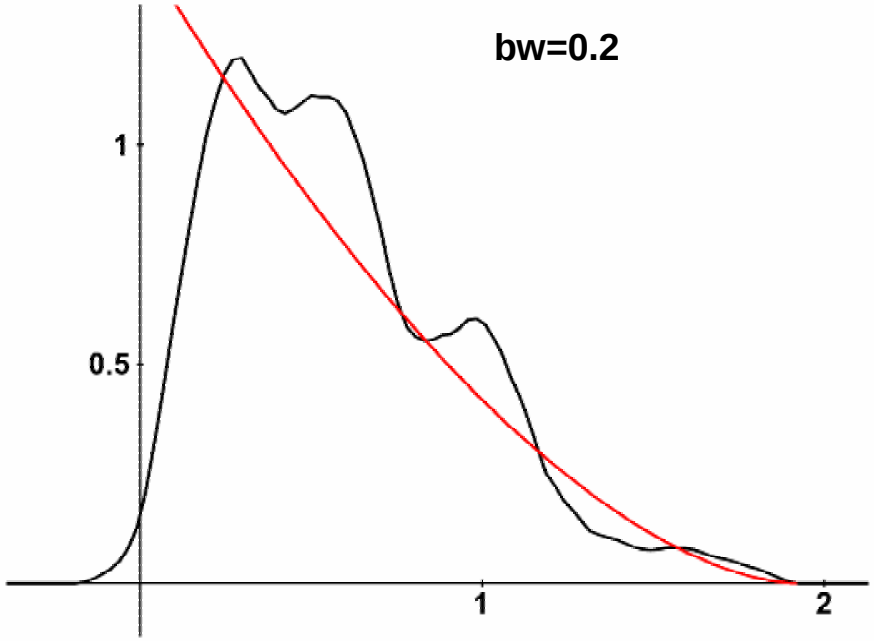
Kernel Density Function and Model Density Function

- Peaks Over Threshold Method (POT)
  - N = 230 samples between –10 and 0 dBZ-km
  - u = 0.67 kV/m (high threshold)
- MLE (GP)
  - k = 75 (mean zone of stability)
  - γ = –0.372
  - μ = 0.026 (~left end point)
  - σ = 0.705
  - RE = 1.920



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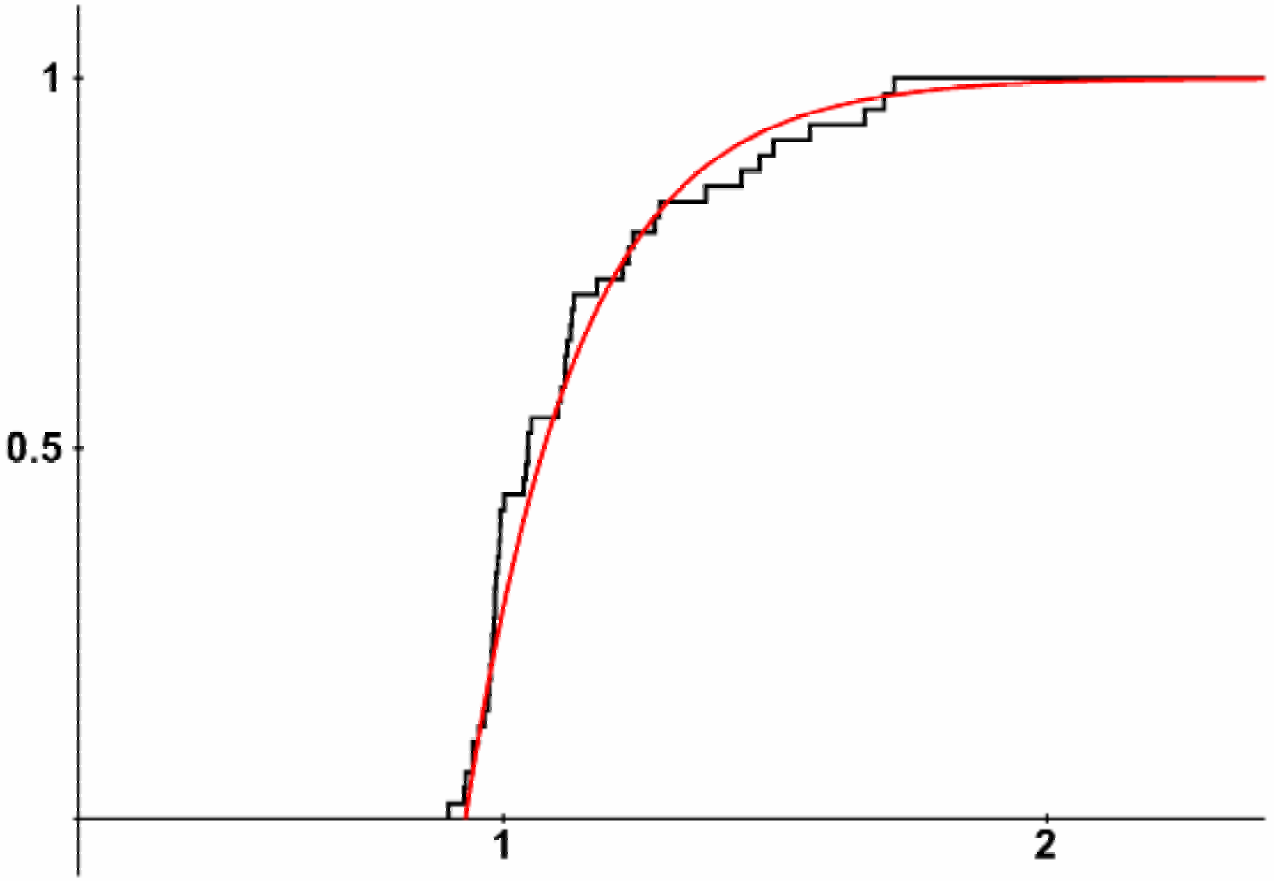
Sample and Model Distribution Functions



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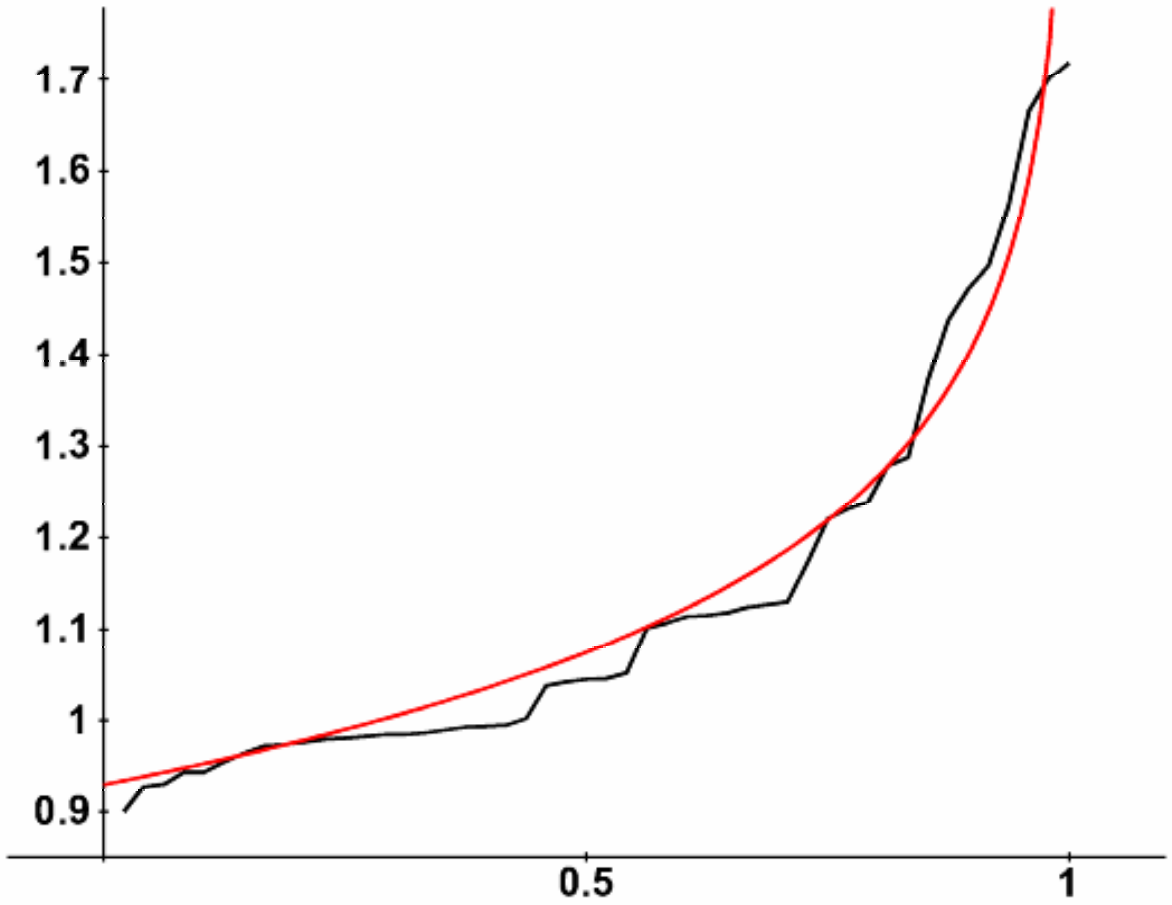
Sample and Model Quantile Functions



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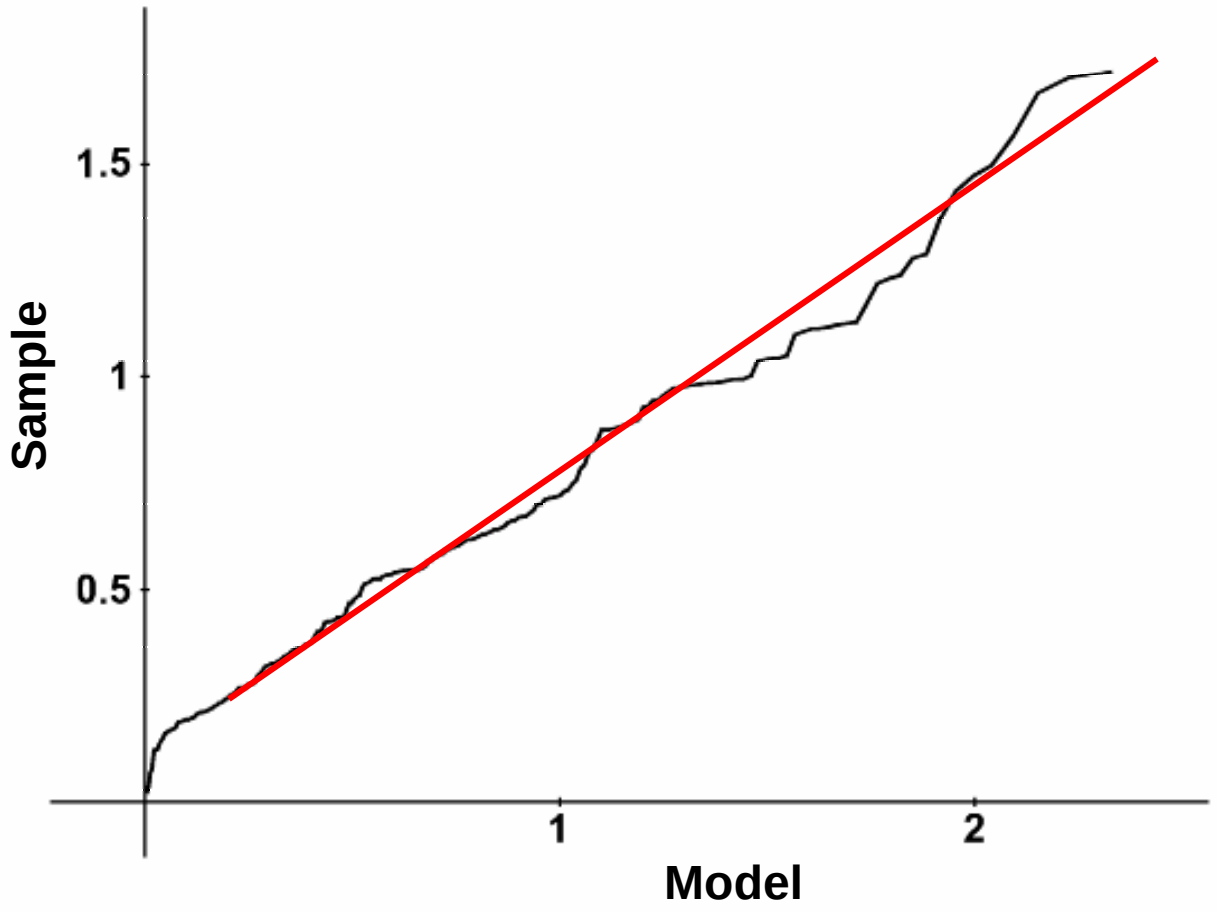
Q – Q Plot



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T-Sample Electric Field Intensity
-10 < dBZ-km ≤ 0

T, Sample	Level, kV/m
100	1.58
1,000	1.78
10,000	1.86
100,000	1.89
1,000,000	1.91
10,000,000	1.92

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Extend Analysis to Other Bins

- Use bins centered at –5, +5, and +15 dBZ-km
- Kernel Density Plot
- Sample Statistics
- Model Parameters
- T-Sample Electric Field Intensity

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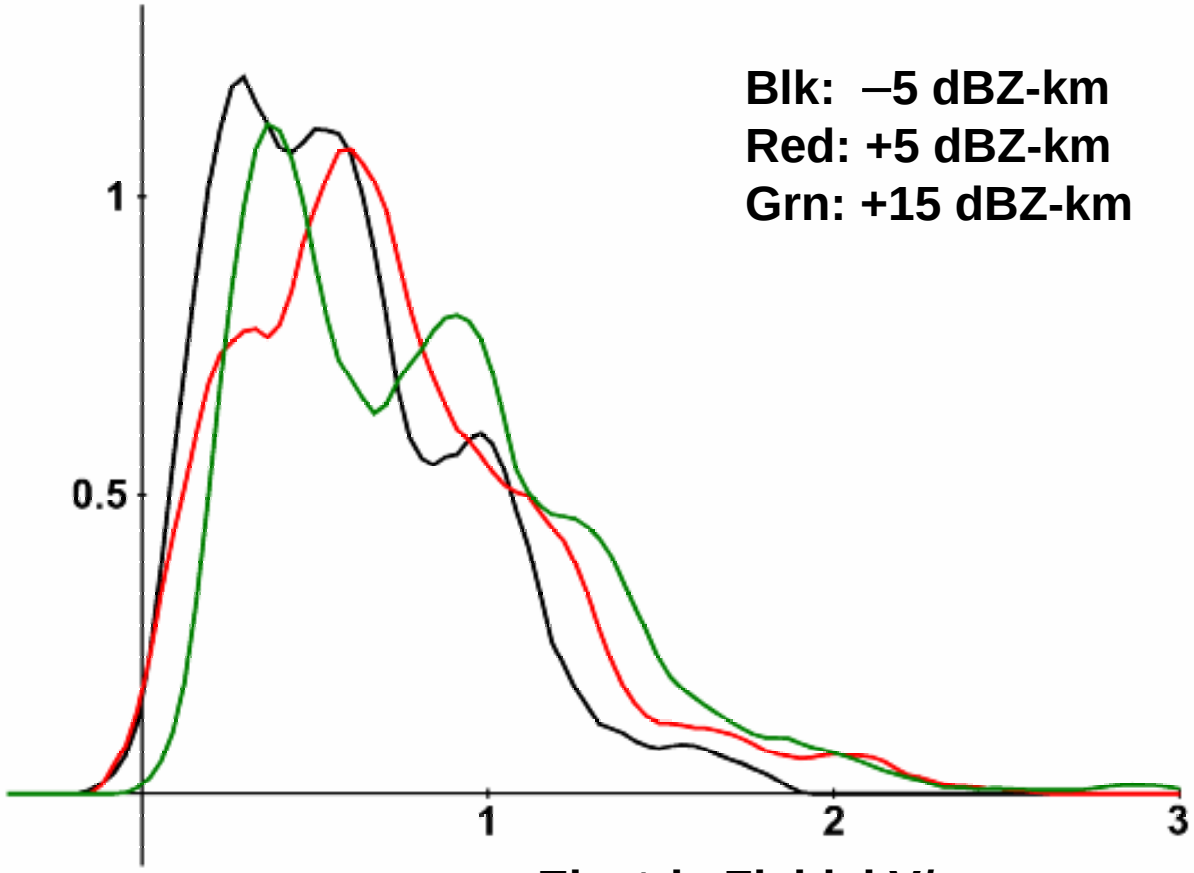
Sample Kernel Densities

WSR, -10 dBZ Threshold, “11 x 11 Volume Integral”



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Sample Statistics and Model Parameters
WSR, -10 dBZ Threshold, “11 x 11 Volume Integral”

	❼5 dBZ-m	+5 dBZ-km	+15 dBZ-km
N	230	445	436
k	75	173	93
u(k), kV/m	0.67	0.61	1.18
γ	❼0.372	❼0.157	.05
μ	0.026	0.309	.72
σ	0.705	0.527	.29
Right Endpoint, kV/m	1.92	3.66	none
E_{max}, kV/m	1.72	2.41	2.94

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T-Sample Electric Field Intensity, kV/m
WSR, -10 dBZ Threshold, “11 x 11 Volume Integral”

T-Sample	–5 dBZ-km	+5 dBZ-km	+15 dBZ-km
100	1.58	2.03	2.22
1,000	1.78	2.53	3.11
10,000	1.86	2.88	4.11
100,000	1.89	3.11	5.23
1,000,000	1.91	3.28	6.50
10,000,000	1.92	3.40	7.93

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Sample Statistics and Model Parameters

WSR, +15 dBZ-km, "11 x 11 Volume Integral"

	+15 dBZ-km -10 dBZ Thresh.	+15 dBZ-km 0 dBZ Thresh.
N	436	440
E_{max}, kV/m	2.94	2.94
k	93	78
u(k), kV/m	1.18	1.20
γ	0.05	0.06
μ	0.72	0.65
σ	0.29	0.30
Right Endpoint, kV/m	none	none

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T-Sample Electric Field Intensity, kV/m
WSR, +15 dBZ-km, "11 x 11 Volume Integral"

T-Sample	+15 dBZ-km -10 dBZ Thresh.	+15 dBZ-km 0 dBZ Thresh.
100	2.22	2.25
1,000	3.11	3.24
10,000	4.11	4.37
100,000	5.23	5.67
1,000,000	6.50	7.16
10,000,000	7.93	8.87
E_{max} observed	2.94	2.94

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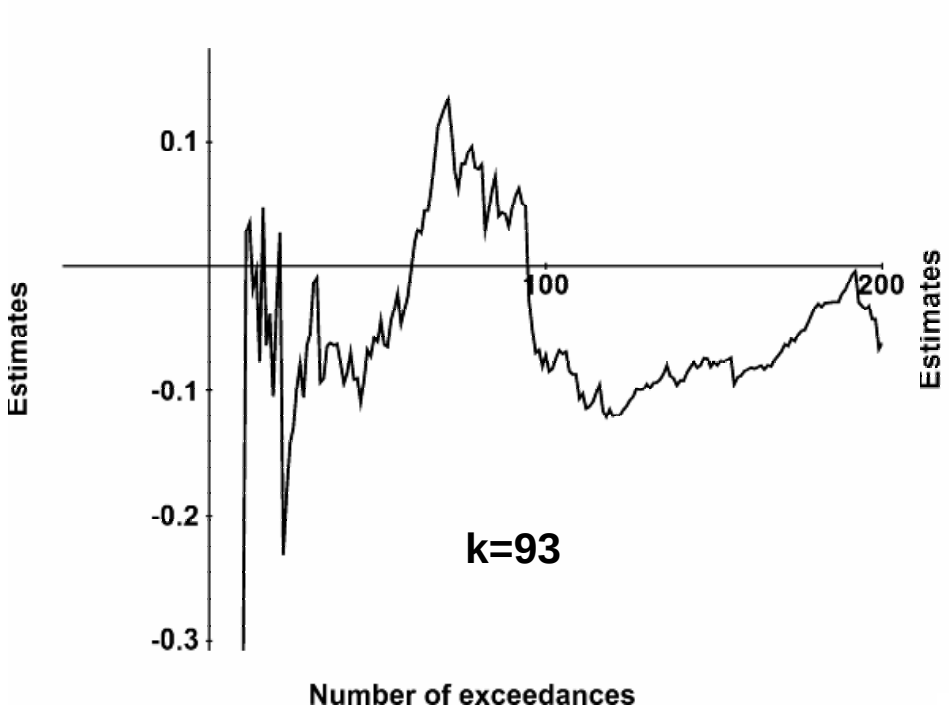
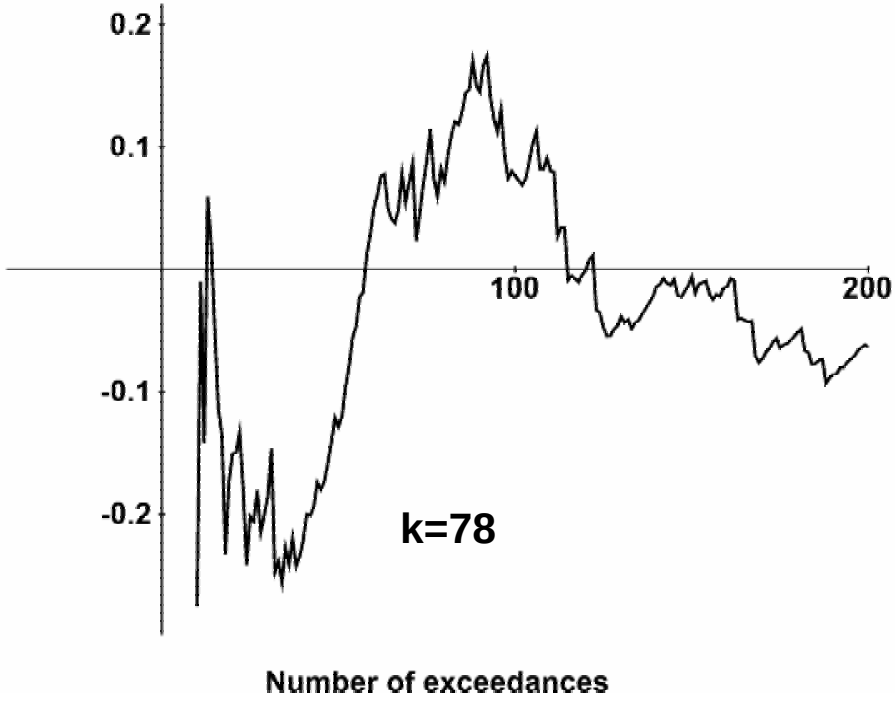
Gamma Diagrams (γ vs. k)
WSR "11 x 11 Volume Integral," +15 dBZ-km

-10 dBZ Threshold



0 dBZ Threshold



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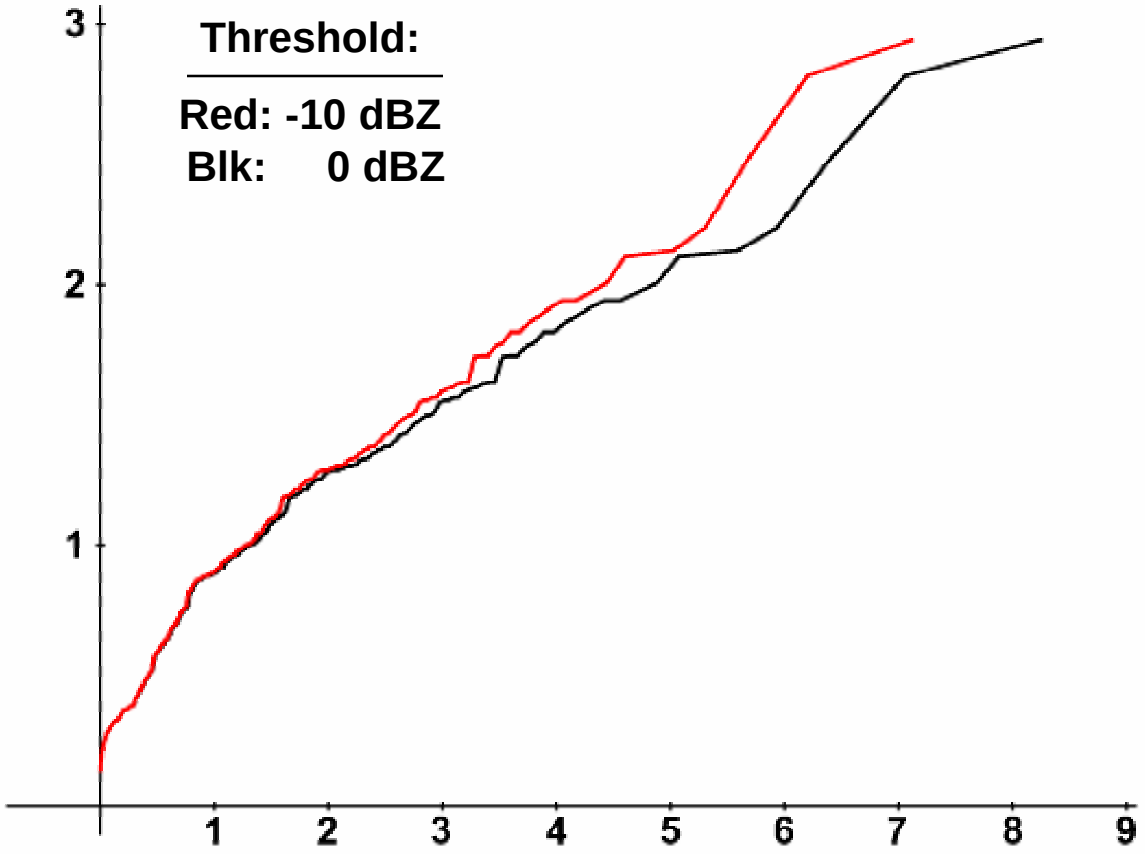
Q-Q Plot
WSR “11 x 11 Volume Integral,” +15 dBZ-km



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Revised Values for WSR "11x11 Average"

- I found an error in my previous analysis using the peaks-over-threshold method for the WSR "11 x 11 average" and the WSR "3 x 3 x3 cube – Average"
  - The parametric fits were properly done to the exceedances
  - The T-sample levels were improperly calculated because I interpreted T to be 1/p where p is the probability. In fact T = k/(N*p), so I had effectively offset the results in the T-sample columns.
  - The next two charts, 21 and 22, have the corrections.
    - The only two rows on chart 21 that are different are u and μ.
- The results are about 200 V/m higher that the previous ones at each T-sample
- I have not had time to correct the results for the 3 x3 x 3 cube.
  - I expect the correction will be about the same.

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Sample Statistics and Model Parameters
WSR "11 x 11 Average"

	-2 dBZ	0 dBZ	+2 dBZ	+4 dBZ
u, kV/m	0.88	1.18	1.15	1.25
N	173	271	369	418
k	24	32	57	84
γ	0.0	0.0	0.0	0.0
μ	0.58	0.53	0.63	0.66
σ	0.15	0.30	0.28	0.37

revised 5/21/2004

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T-Sample Electric Field Intensity, kV/m
WSR “11 x11 Average”

T-Sample	-2 dBZ	0 dBZ	+2 dBZ	+4 dBZ
100	1.28	1.93	1.92	2.36
1,000	1.63	2.63	2.56	3.22
10,000	1.98	3.33	3.20	4.07
100,000	2.33	4.03	3.84	4.92
1,000,000	2.67	4.73	4.48	5.78
10,000,000	3.02	5.43	5.13	6.63

revised 5/21/2004

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