# Quantifying the Variability of Rain Over Areas: Implications for Validation Experiments

A. R. Jameson
RJH Scientific, Inc., El Cajon, CA

## Networks of size $\mathscr{D}$ act like high-pass filters for $\lambda > 4 \mathscr{D}$

$\lambda / \mathscr{D}$

$\Delta^2 = \sin^2(2\pi k/\mathscr{D})$ for $|k/\mathscr{D}| \lesssim .25$
$= 1$ for $|k/\mathscr{D}| > 0.25$

Magnitude, Δ^2

$k/\mathscr{D}$, km^{-2}
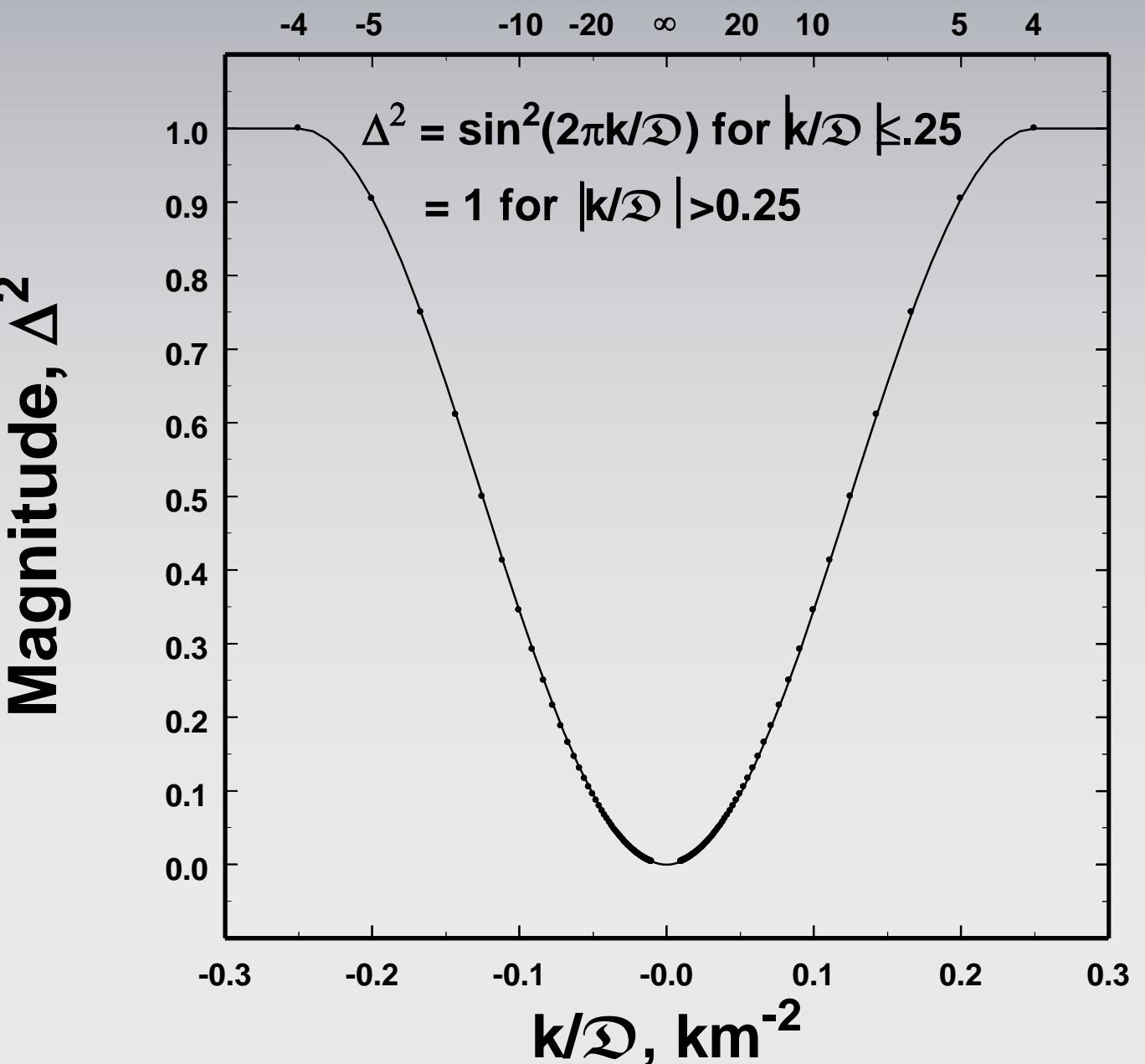
This decreases the observed correlation distances

Effect of Domain Size on Observed Exponential Correlation Distances

$\mathscr{L}_{Intrinsic}$

$\mathscr{L}_{Observed}$

1:1

Domain Size
$\mathscr{D} = 0.1$ km
0.2 km
0.5 km
1.0 km
2.0 km
4.0 km
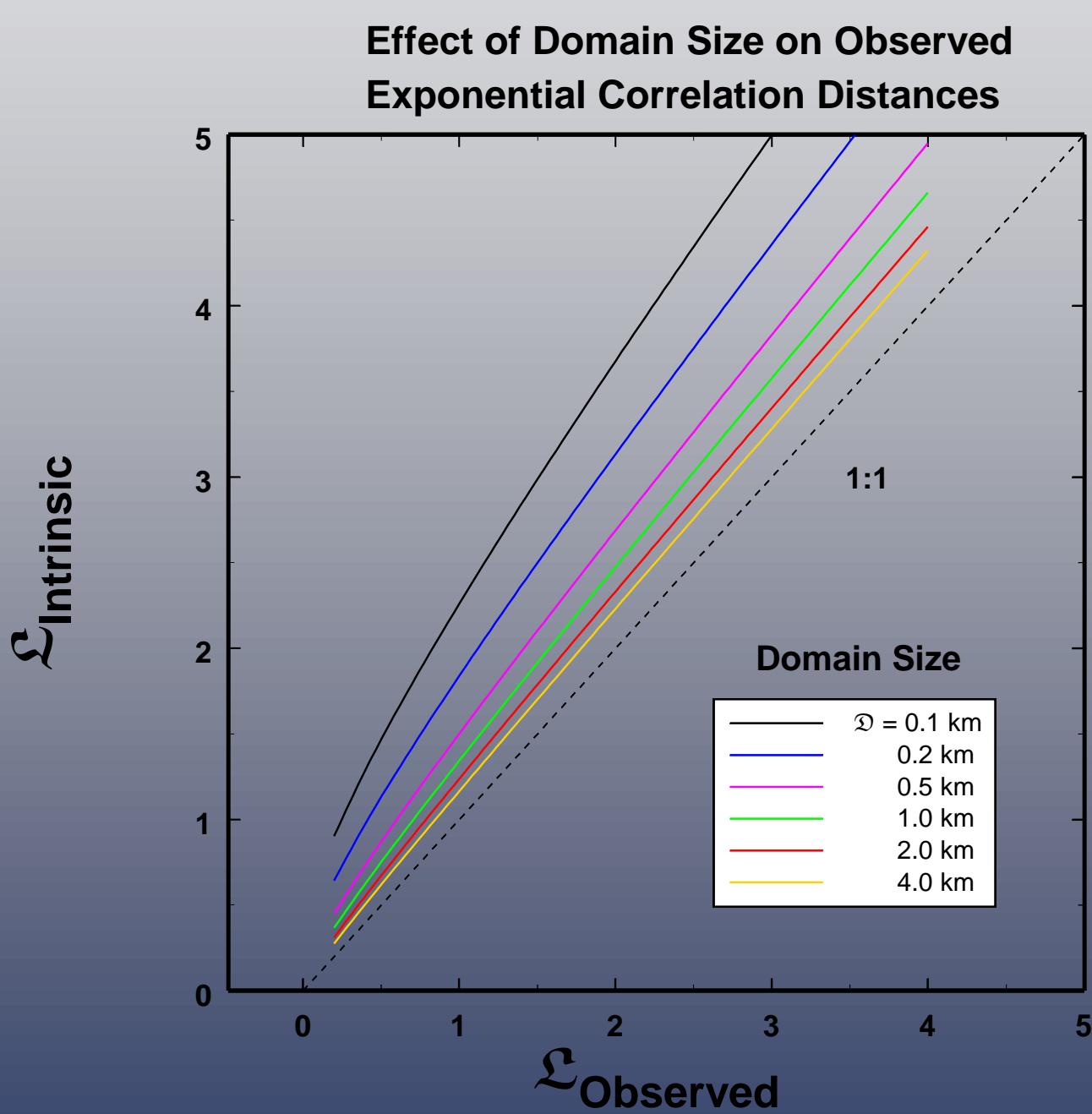
While enhancing the role of high frequency (large k), small scale variability

Intrinsic
Network Filtered

Variance Spectrum

$\mathscr{L} = 2$ km
$\mathscr{D} = 1$ km

k, km^{-1}
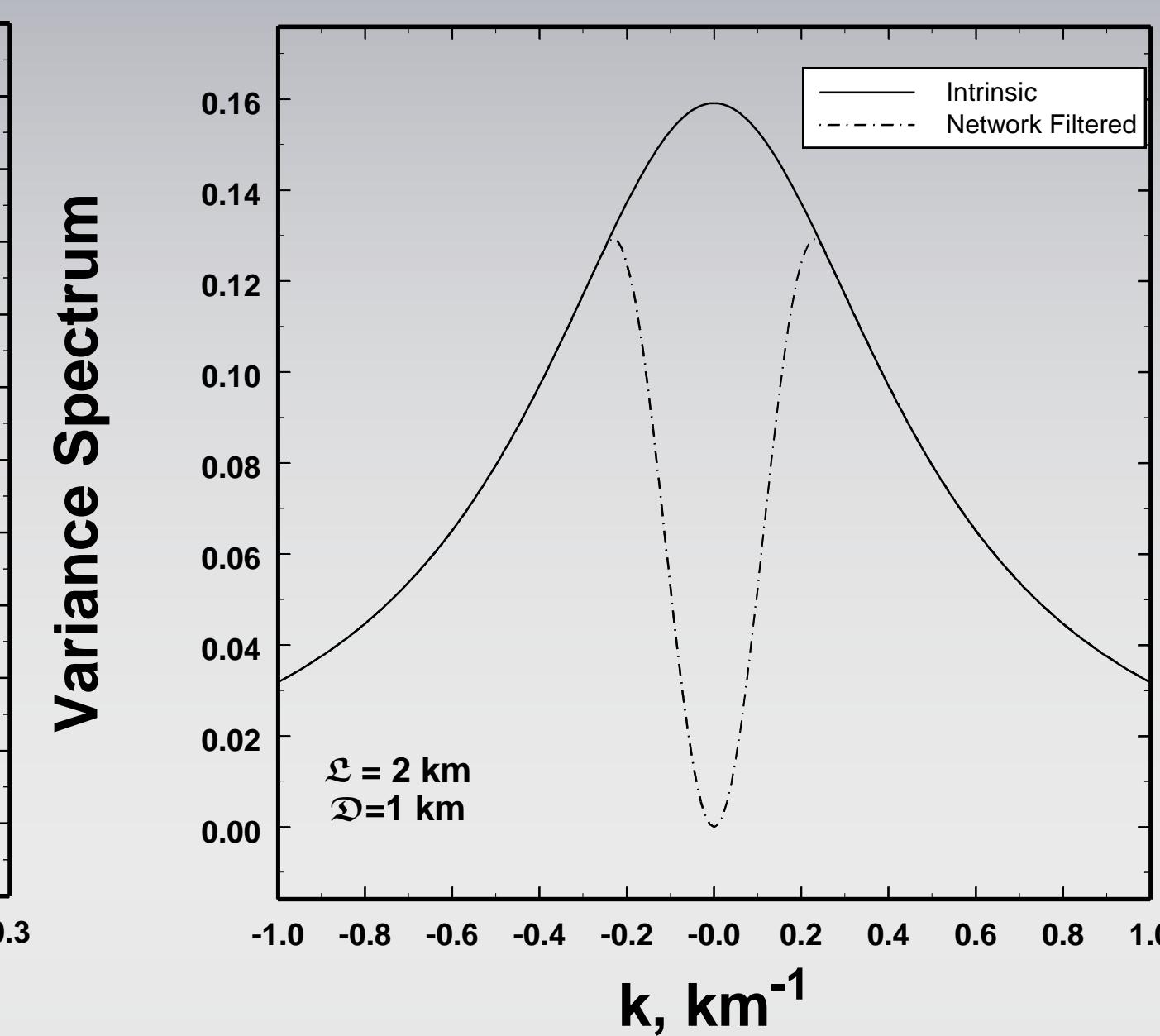
A beam of a remote sensor of size $\mathscr{D}$ acts like a low-pass filter which enhances the role of low frequency (small k), large scale variability while suppressing high frequency, small scale variability and the total variance

Intrinsic
Network Filtered
1.0 km Uniformly Illuminated Radar Beam

Variance Spectrum

Total Variances
13.70
1.75

$\mathscr{L} = 2$ km
$\mathscr{D} = 1$ km

k, km^{-1}
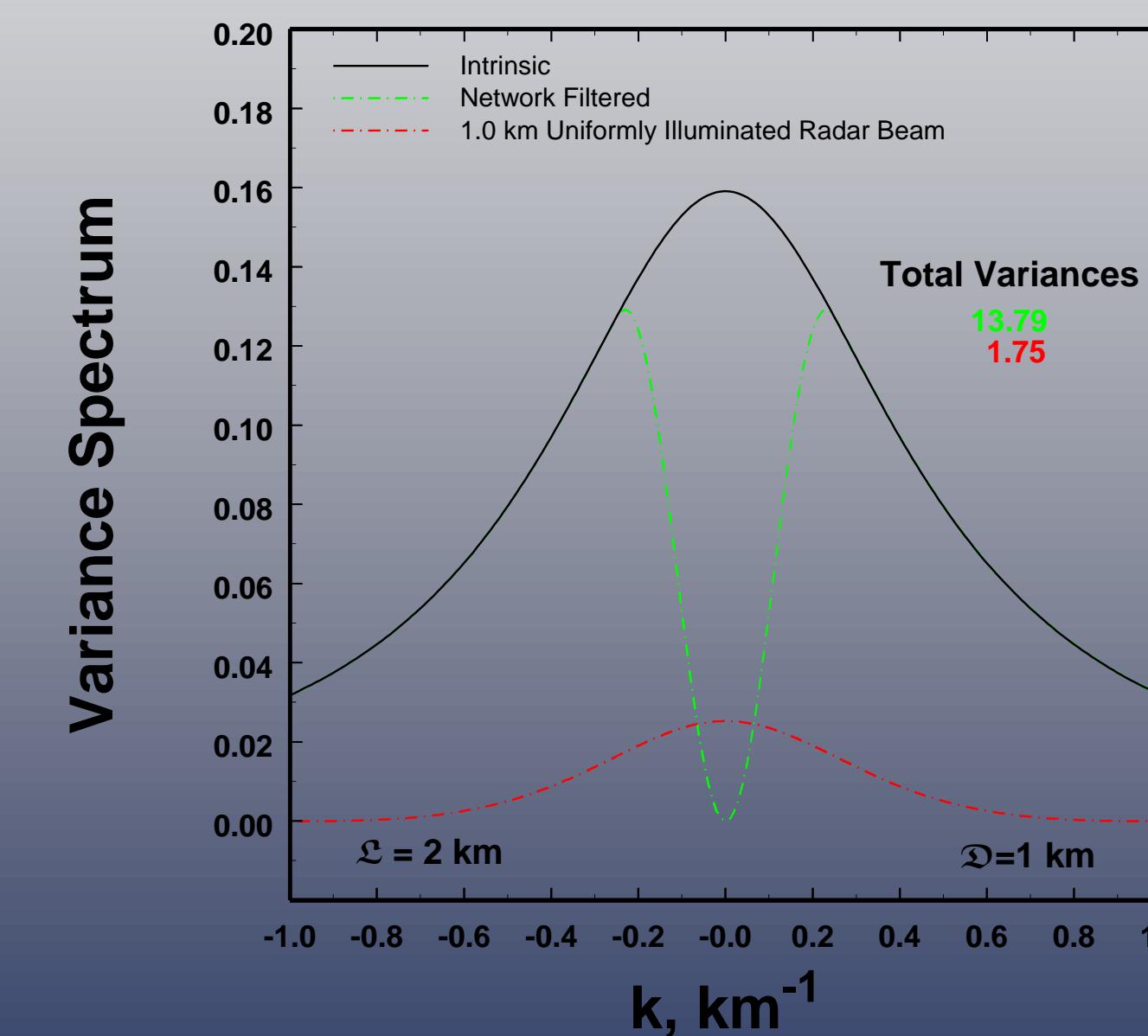
This produces differences between values from networks and remote sensors

Input Z, dBZ
a
Y, Km
X, Km

Z, dBZ 1 km networks, 16 Disdrometers
b
Y, Km
X, Km

1 Km Radar Beam Z, dBZ
Y, Km
X, Km

1 km Beam Radar Z, mm^6 m^{-3}
1:1
1 km Disdrometer Network Z, mm^6 m^{-3}
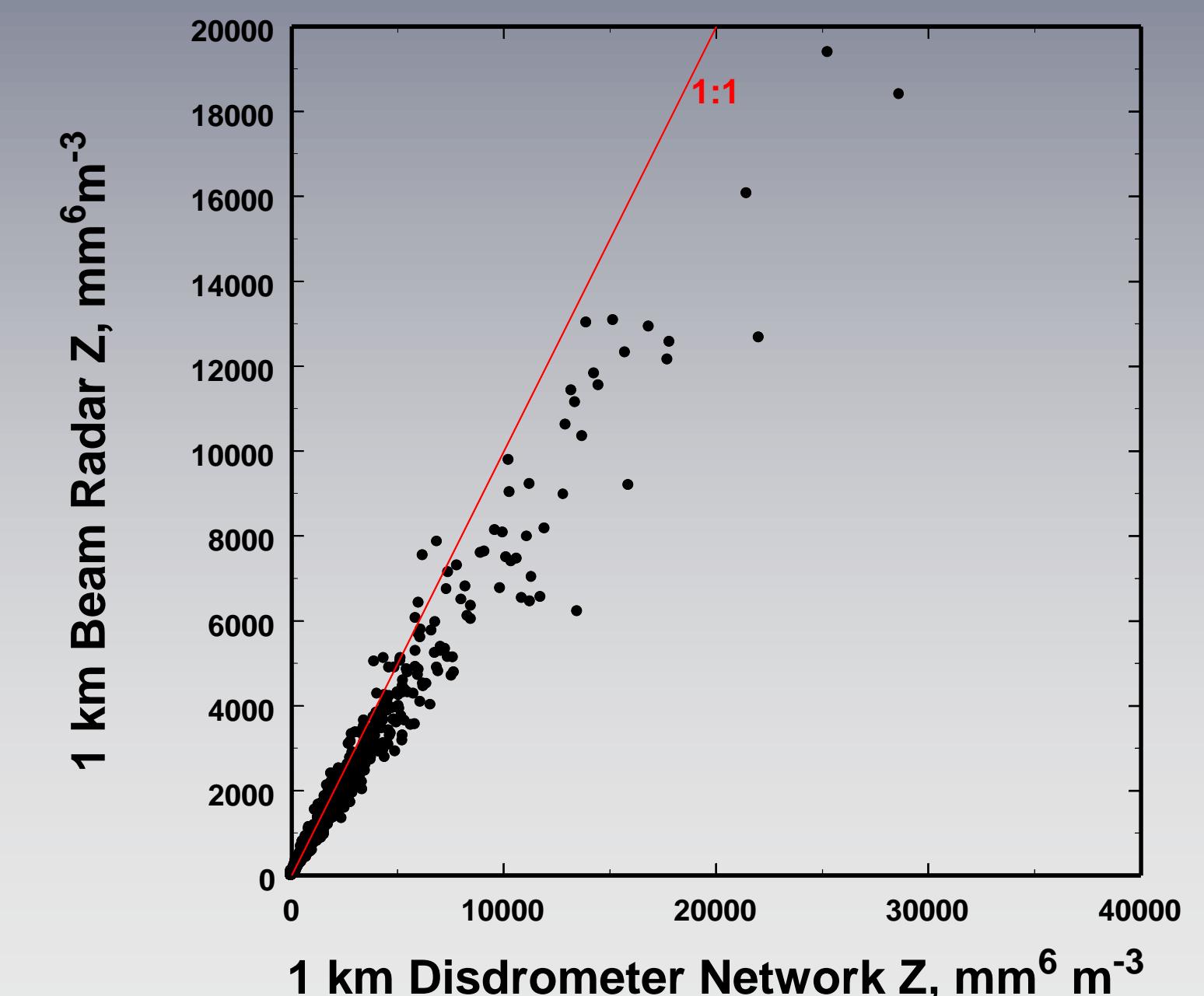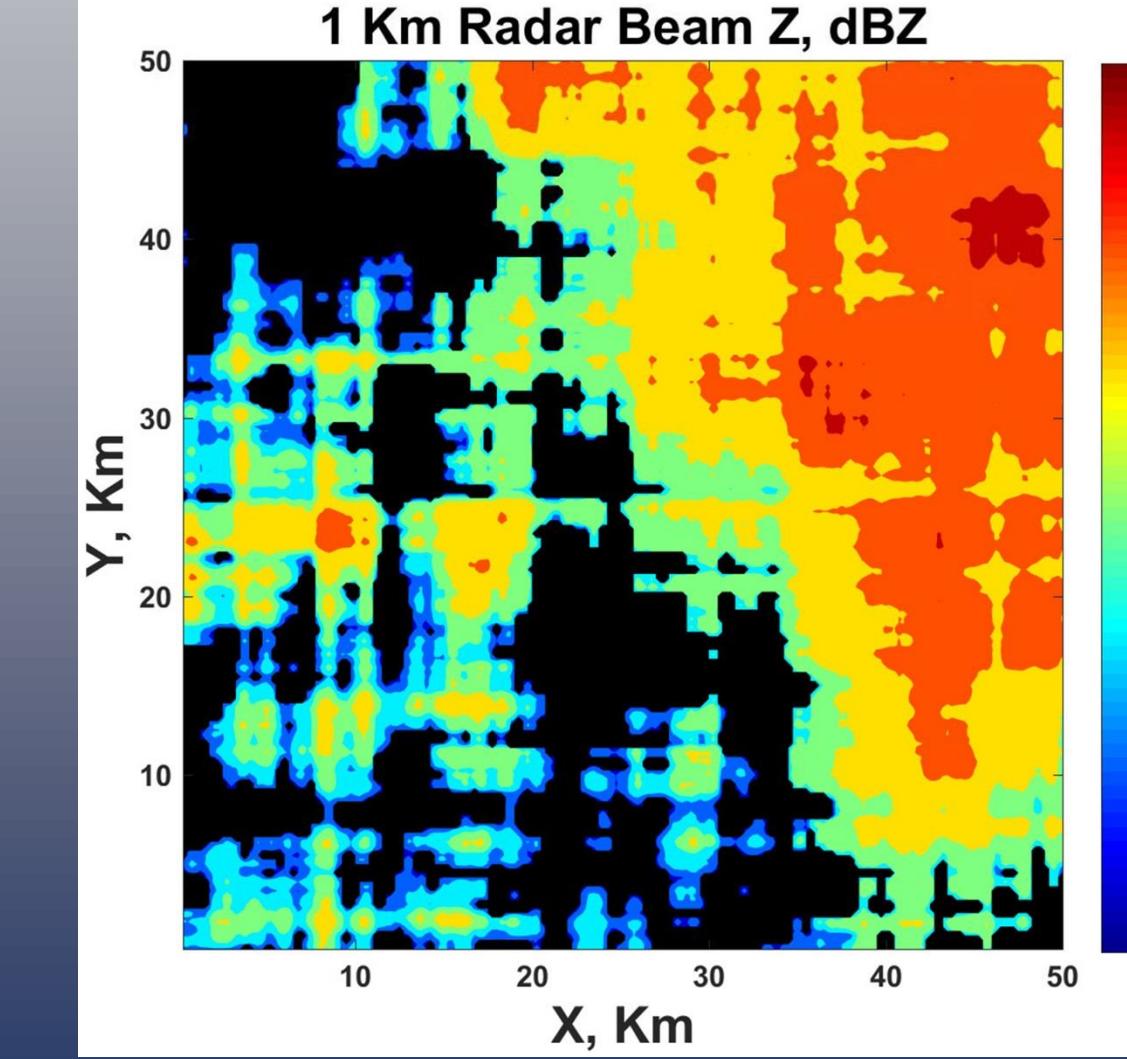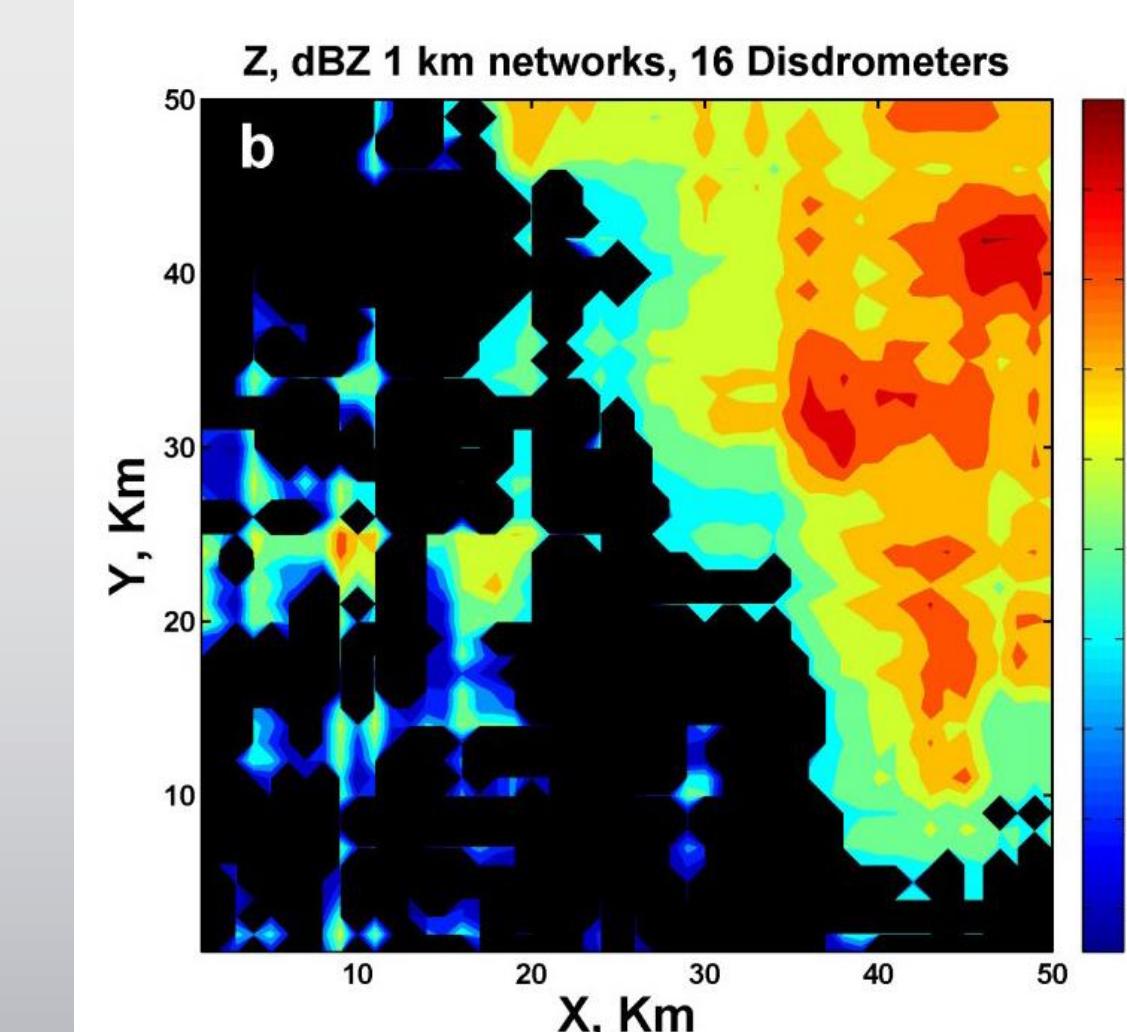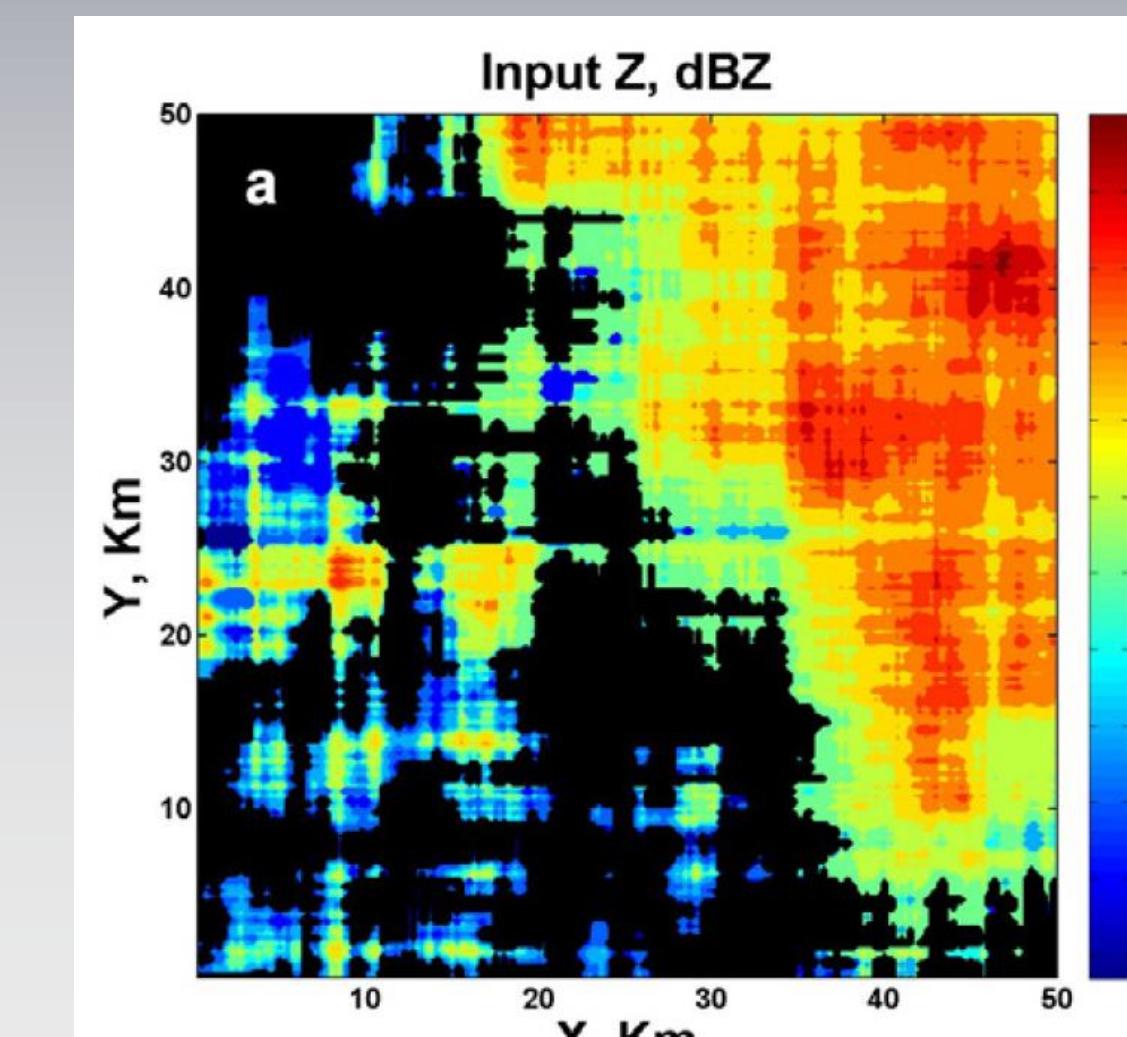
Implication

Spatial filtering differences between networks and remote sensors complicate comparisons for validation experiments, differences further compounded by temporal filtering. Potential solutions are discussed in Jameson 2016b.

References

Jameson, A.R., 2016a: Quantifying drop size distribution variability over areas: Some implications for ground validation experiments. *J. Hydromet.*, 17, 2689-2698 DOI:10.1175/JHM-D-16-0094.1.

Jameson, A.R., 2016b: Spatial and temporal network sampling effects on the correlation and variance structures of rain observations, . *J. Hydromet.*, DOI: 10.1175/JHM-D-16-0129.1.