

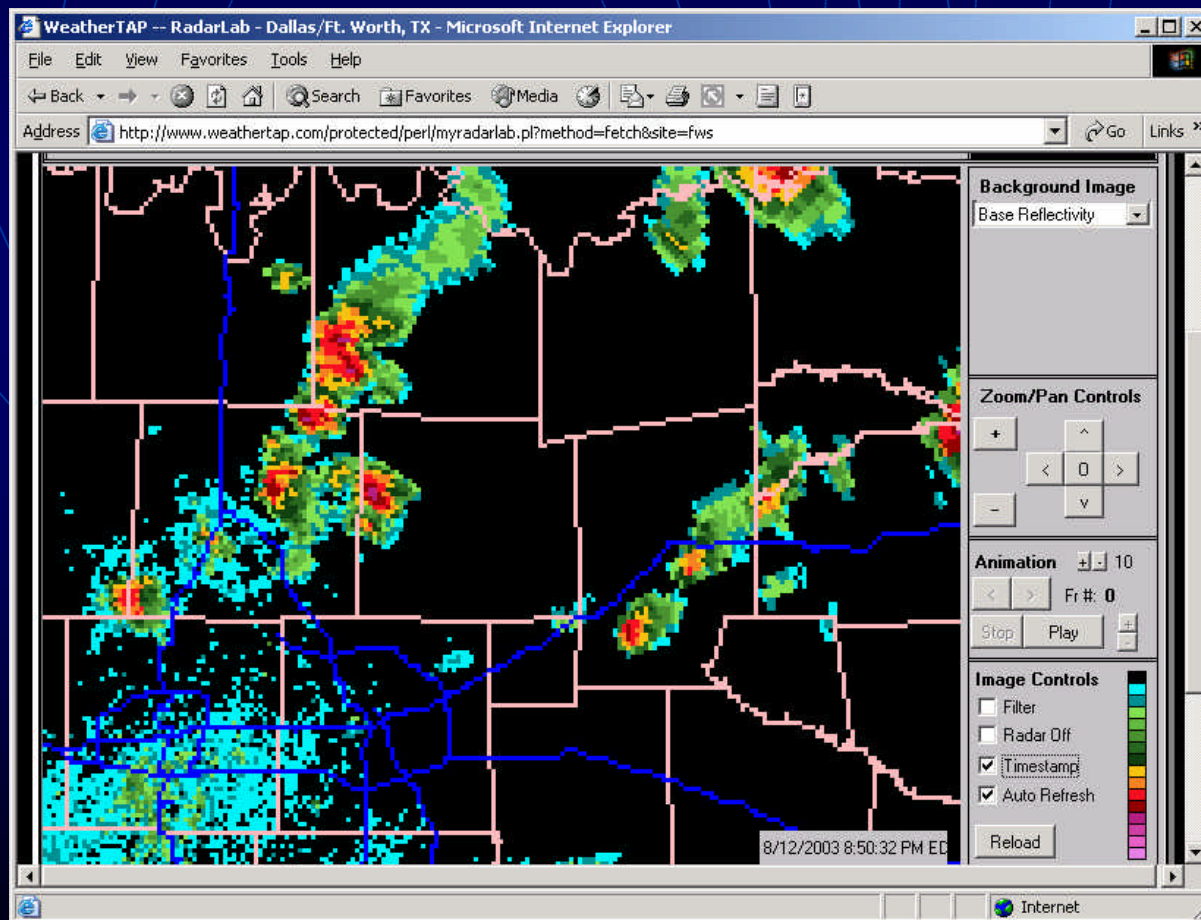
A map of the United States showing microwave rainscatter data. The map features a grid of county boundaries. The data is represented by a color scale where blue indicates lower values and green/yellow indicates higher values. A large, dense area of high values (yellow/green) is centered in the central United States, particularly over the Great Plains region. Several smaller, isolated areas of high values are scattered across the country, including one in the Northeast and another in the Southeast. The text 'Microwave rainscatter' is overlaid in white, bold font in the upper-middle section of the map.

Microwave rainscatter

NTMS

Joe Jurecka – N5PYK

Garden variety thunderstorms at 10cm



Best
rainscatter
cells typically
have cores of
highest
reflectivity.

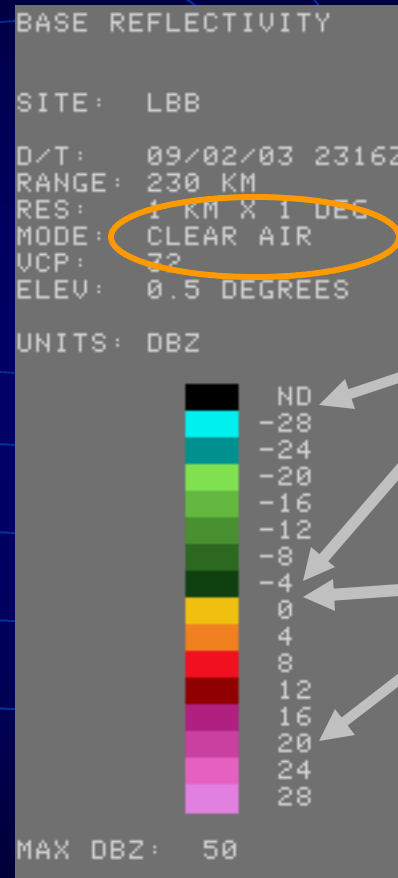
Reflectivity is
measured in
dBZ.

dBZ Scale

dBZ	Rainfall rate (in/hr)
65	16+
60	8.00
55	4.00
52	2.50
47	1.25
41	0.50
36	0.25
30	0.10
20	Trace

The "Z" in dBZ is equivalent reflectivity.

The WSR-88D operates in two modes with different colorations. It is important to know what you are looking at. Rainscatter is most feasible when in precipitation mode...where cells are 40dbZ or more



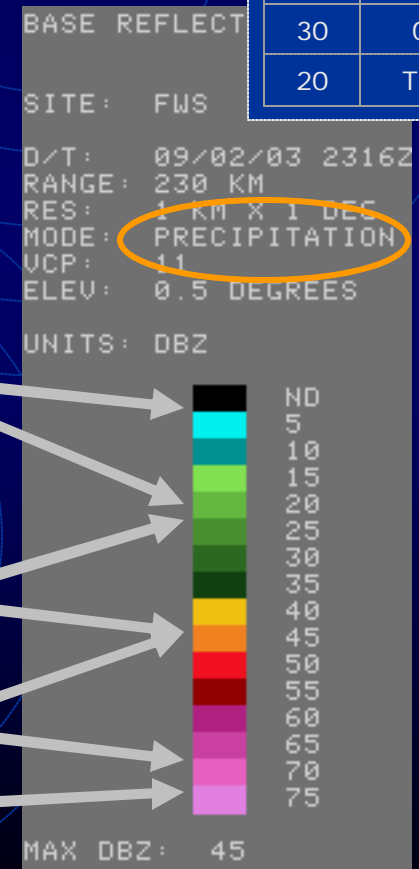
Clouds/bugs/airmass boundaries

Light rain/drizzle

Moderate rain

Thunderstorm

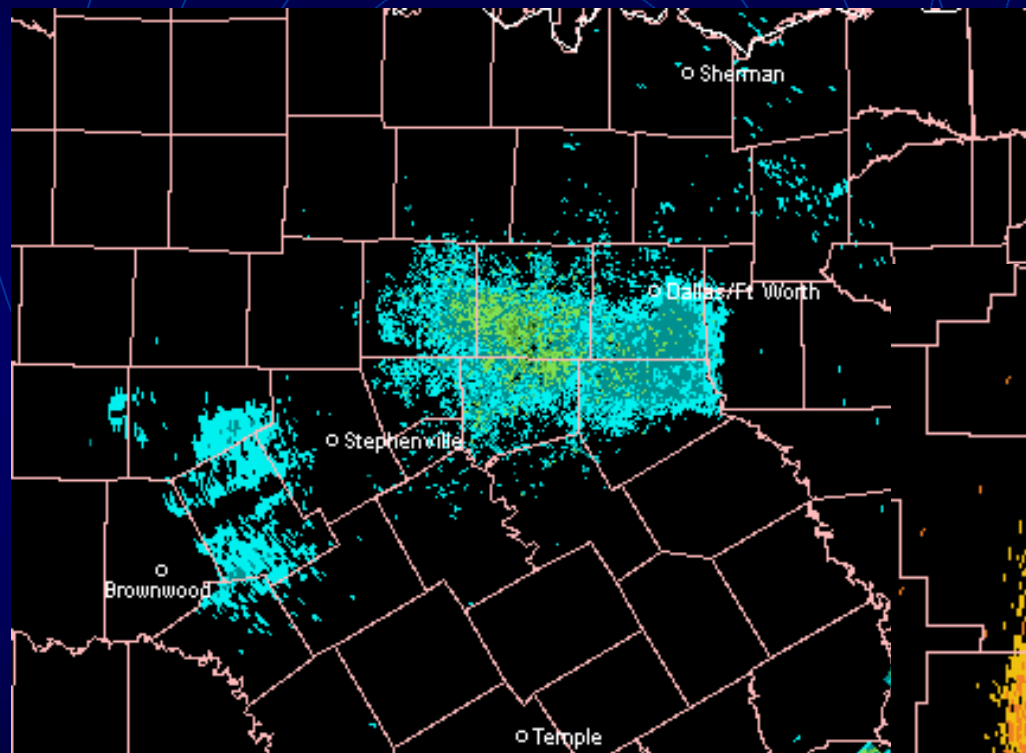
Nasty hail



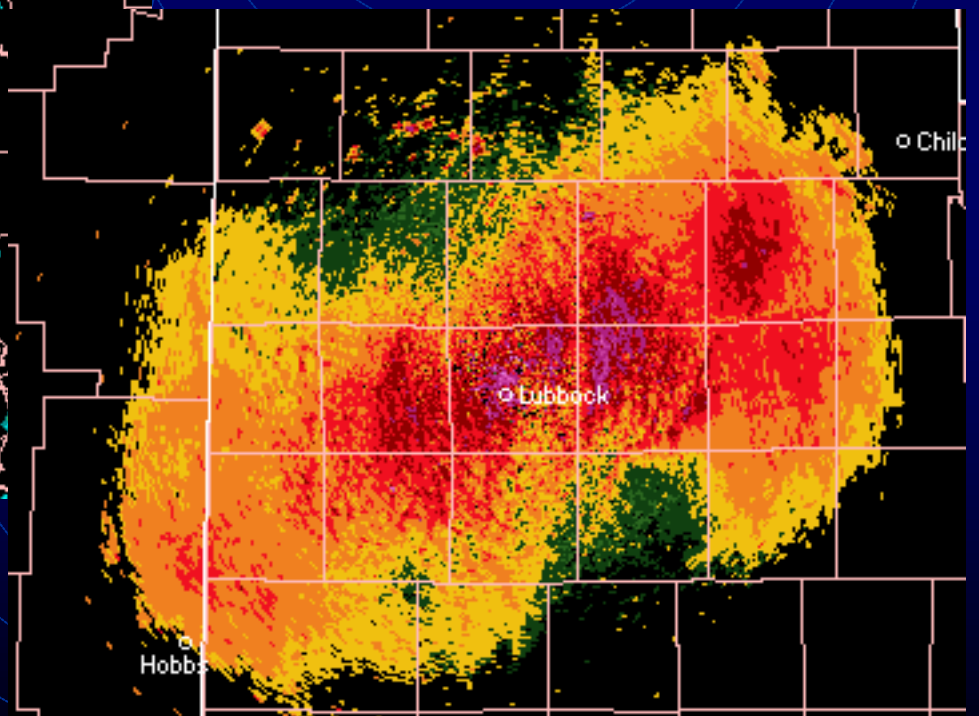
$$Z[\text{dBZ}] = 10 \cdot 10\log(Z [\text{mm}^6/\text{m}^3])$$

Basically, a measure of how much liquid is in a given volume

Comparison of non-precip detection



Precip mode



Clear air mode

Station requirements

- At least 100mW to 30dB dish
- Reasonable noise figures ok (<5dB)
- Aviation weather radar can easily see strong cells out to 300nm with 1W average power and 300kHz IF bandwidths.
- Narrow band weak signal has a strong edge!
- 10 GHz *IS* the optimal RS band

Geometry

- Best propagation via rain scatter is in a straight line, forward or reflected. Side scatter is less effective, but usable.



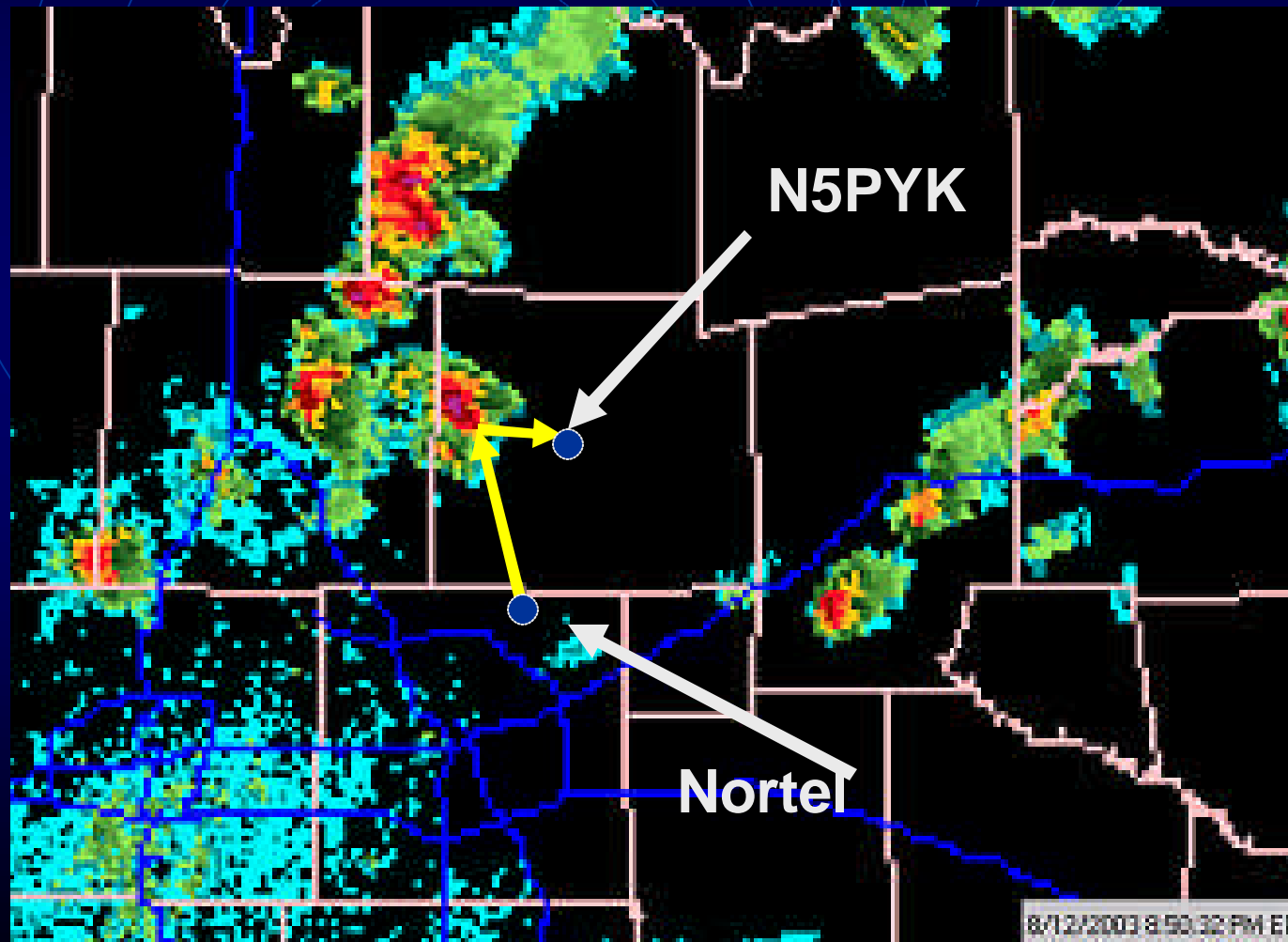
Distances achievable

- A good springtime cell, with 60K tops can provide usable signals so long as both stations can “see” the cell
- “Line of sight (mi) ” $\sim 1.4 * \text{sqrt} [\text{tops (ft)}]$
 $1.4 * \text{sqrt}(60000) = 340 \text{ mi}$

Contacts near 700 mi may be possible if the geometry is right and the cell is intense!

The range equation states we should be able to do upwards of 50mi to a 1meter target with a typical rover setup. Just imagine the return from a thunderstorm with a square miles of intense precipitation!

Example rainscatter



The geometry was certainly not optimum, but signal levels were very strong due to the proximity.

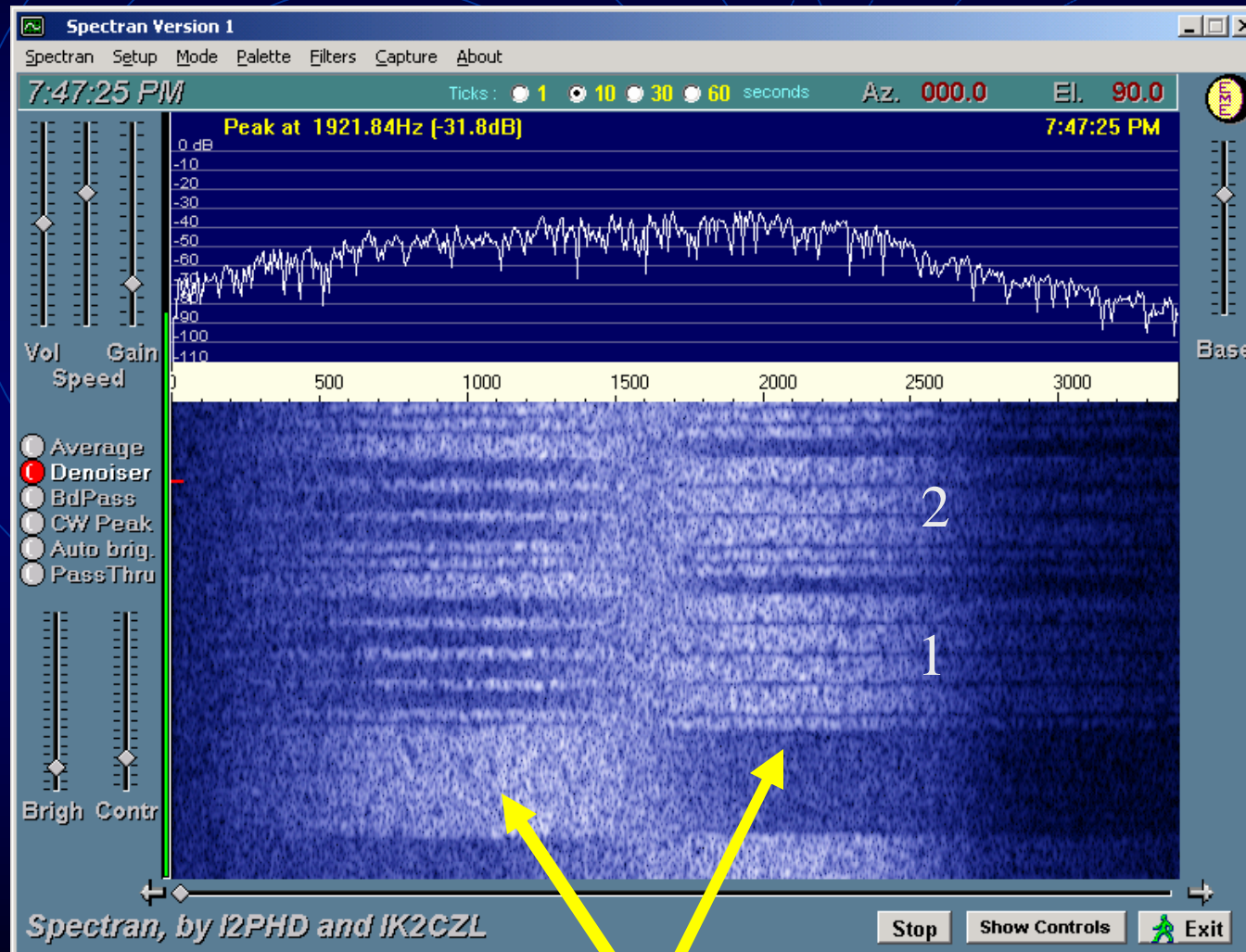
Total path:
~20 miles

Almost no
direct signal

Looking WNW from shack



Ok, so what is the signal like?



Substantial spreading of the signal can be expected with rainscatter. SSB is not the mode of choice...CW is king here.

Signals at least 20dB out of noise



Mark and space of NT5NT Beacon

The background of the slide is dark blue with several sets of concentric circles in a lighter blue color, creating a ripple effect.

I'd like to try it...what do I do?

Easy!

Get your 10 GHz station operational!

Know at least a little CW

then...

Call up another microwaver when rain is in the general area!

Useful links

- Radar range applet
<http://www.comapples.com/tonyt/Applets/Monostatic/Monostatic.html>
- Radar equation
http://www.rfcafe.com/references/electrical/radar_eqn.htm
- Radar imagery in the USA
<http://www.srh.noaa.gov/ftproot/radar1/mosaic/DS.p19r0/ar.us.conus.shtml>
- College of DuPage radar mosaics
<http://weather.cod.edu/analysis/analysis.1km.html>
- WA1MBA Rainscatter description
<http://www.wa1mba.org/10grain.htm>
- OZ1FF Paper on rain scatter in Europe
http://www.oz1ff.dk/Pages/Presentations/Rain_Scatter.PDF