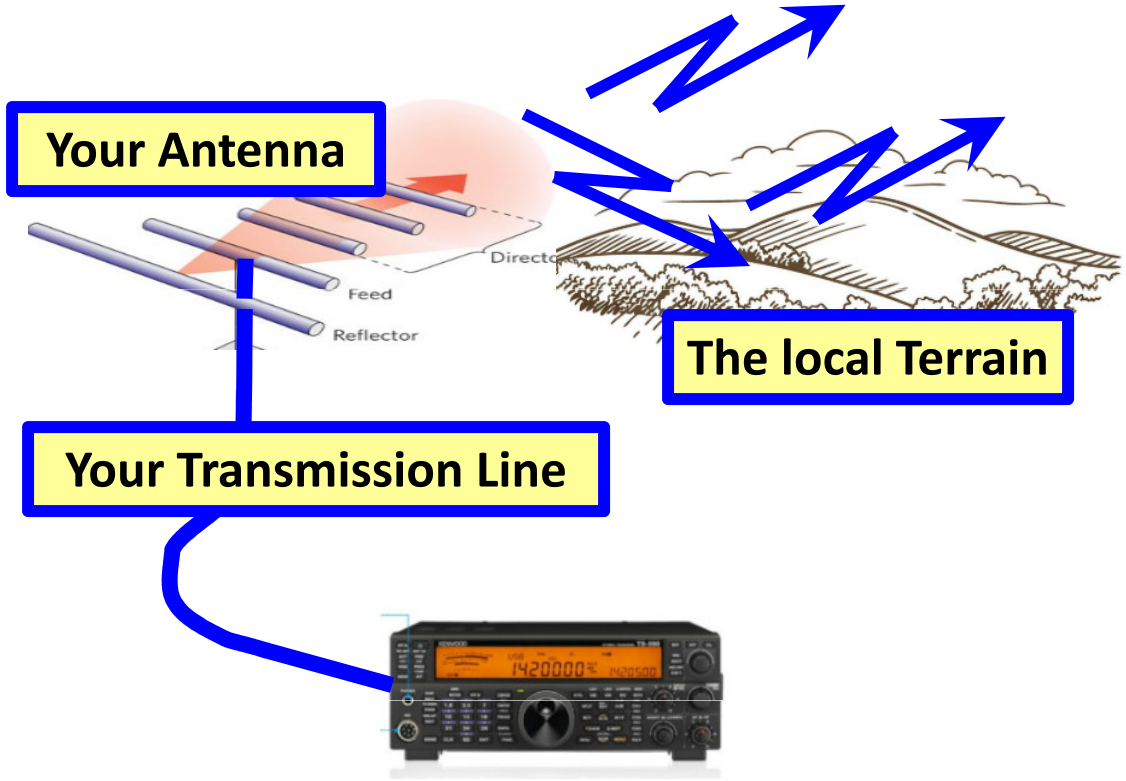
Modeling Antenna Systems – II

Your Antenna System is the second most important part of your station.





Larry Banks, W1DYJ

Licensed: 1961 (KN1VFX)
W1DYJ since 1966

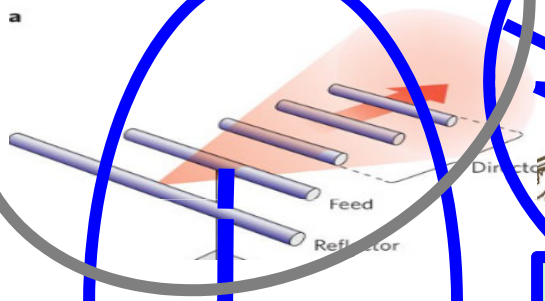
10B DXCC [inc. 60m]
DXCC Worked-304 Conf-302
DXCC Trident 200 [PH:246 CW:252 DIG:279]
DX Challenge: 1990
8B WAS
6M VUCC [Conf: 762 grids]
As of 11 November 2026
All Low Power

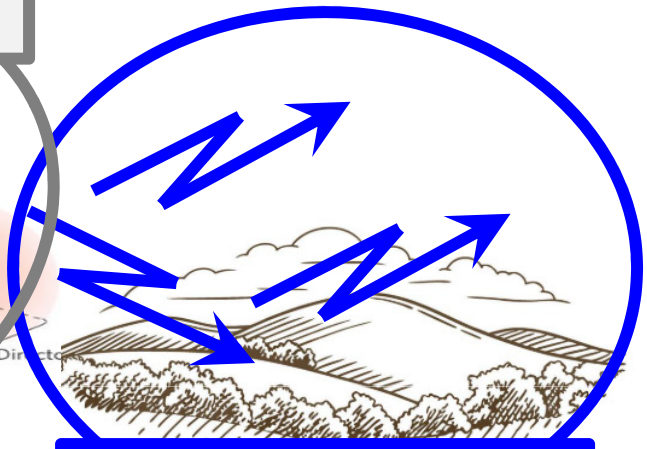
W1DYJ ~ Larry Banks

Modeling Antenna Systems – II

This presentation will help you learn how to analyze your antenna's transmission line system (using TLW) and understand the effect of your local terrain (using HFTA.)

Part I – Antenna Characteristics





Part II – The Effect of Terrain



Part II – The Transmission Line

W1DYJ ~ Larry Banks

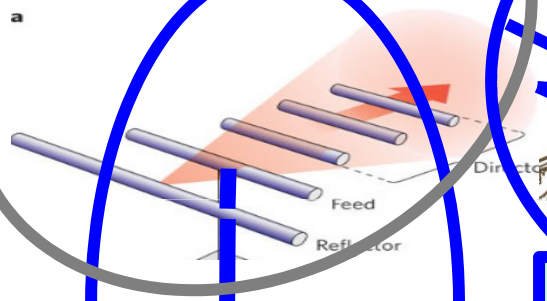
Life Member

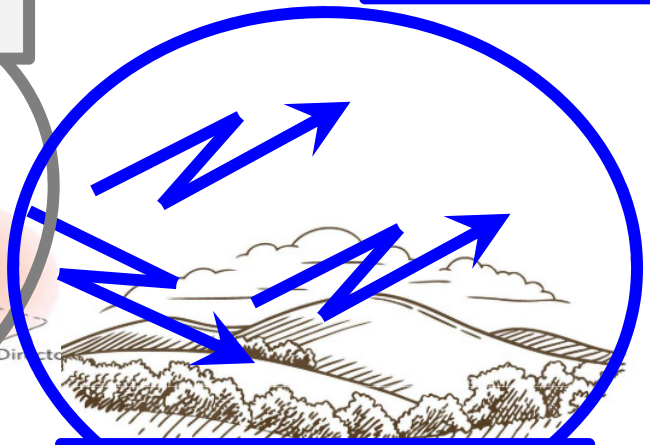
INDEXA

Modeling Antenna Systems – II

Why Analyze (model) your antenna system?

Part I – Antenna Characteristics





Part II – The Effect of Terrain

Part II – The Transmission Line



W1DYJ ~ Larry Banks

Life Member

NORTHERN CALIFORNIA DX FOUNDATION, INC.

International DX Association

INDEXA

Modeling Antenna Systems – II

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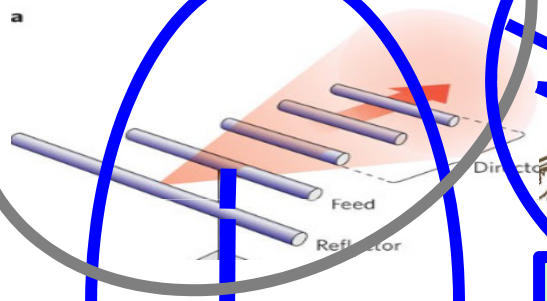

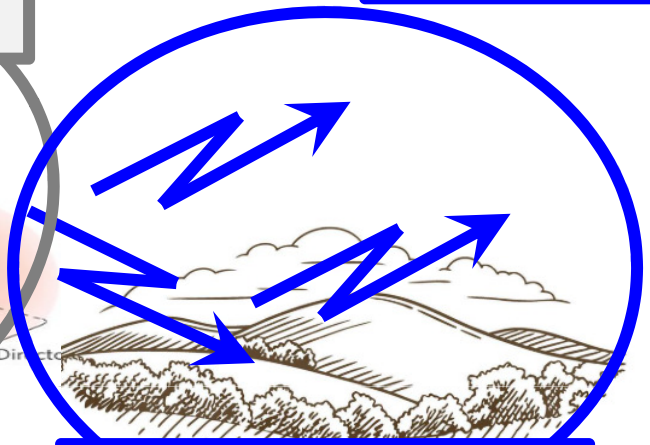

Part II – The Effect of Terrain

Part II – The Transmission Line



Much cheaper and faster than building and rebuilding them!

W1DYJ ~ Larry Banks

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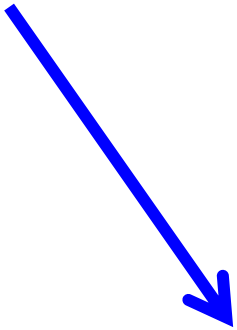
Modeling Antenna Systems – II – Agenda

- The motivation behind my interest in antennas
- A quiz
- Modeling Transmission Lines
- The Effects of Terrain
- Appendix



The Goal:

You will learn some theory and gain some additional understanding about your antenna systems.

https://www.qsl.net/w1dyj/

Modeling Antenna Systems – II – Agenda

- The motivation behind my interest in antennas
- A quiz
- Modeling Transmission Lines
- The Effects of Terrain

"All models are wrong. Some are useful"

British Statistician ***George Box***, 1976

Modeling Antenna Systems – II

The motivation behind my interest in antennas

- New novice KN1VFX – 1961-62
- *I knew nothing about antennas*
- I built an 80m CW transmitter and my Dad, brother and I bought an SX-140
- I fed my end-fed random wire out of my 2nd floor bedroom window
- I heard nothing

Modeling Antenna Systems – II

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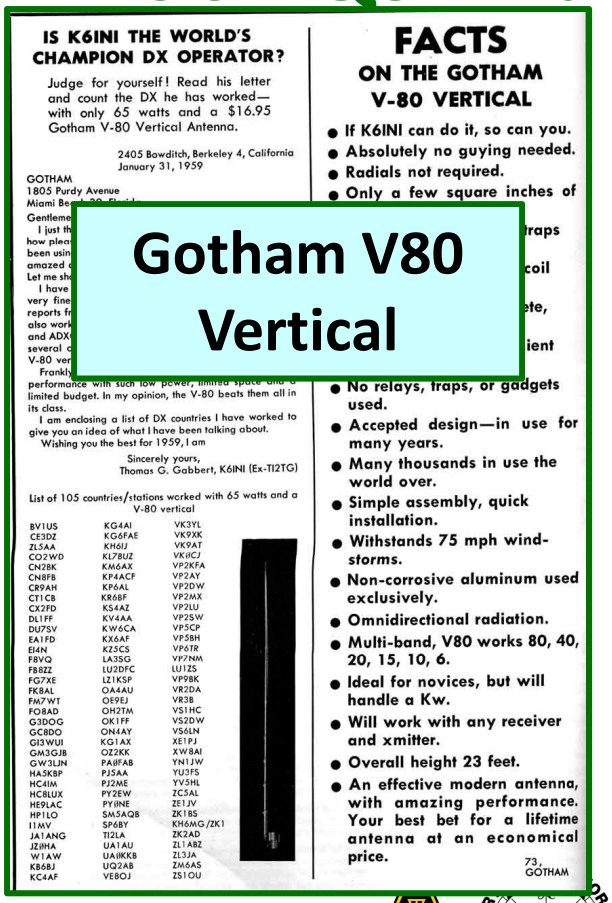
My first "real" antenna
$16.95 was "big bucks"
for a junior in HS in 1962
[~$185 today]

A 1962 QST Ad



IS K6INI THE WORLD'S CHAMPION DX OPERATOR?

Judge for yourself! Read his letter and count the DX he has worked—with only 65 watts and a $16.95 Gotham V-80 Vertical Antenna.

2405 Bowditch, Berkeley 4, California
January 31, 1959

GOTHAM
1805 Purdy Avenue
Miami Be

Gentleme
I just th
how plea
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V-80 ver
Frankl
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CN8FB	KP4ACF	VP2AY
CR9AH	KP6AL	VP2DW
CT1CB	KR6BF	VP2MX
CX2FD	KS4AZ	VP2LU
DL1FF	KV4AA	VP2SW
DU7SV	KW6CA	VP5CP
EA1FD	KX6AF	VP5BH
EI4N	KZ5CS	VP6TR
F8VQ	LA3SG	VP7NM
F8BZZ	LU2DFC	LU1ZS
FG7XE	LZ1KSP	VP9BK
FK8AL	OA4AU	VR2DA
FM7WT	OE9EJ	VR3B
FO8AD	OH2TM	VS1HC
G3DOG	OK1FF	VS2DW
GC8DO	ON4AY	VS6LN
GI3WUI	KG1AX	XE1PJ
GM3GJB	OZ2KK	XW8AI
GW3LJN	PA9FAB	YN1JW
HA5KBP	PJ5AA	YU3FS
HC4IM	PJ2ME	YV5HL
HC8LUX	PY2EW	ZC5AL
HE9LAC	PY9NE	ZE1JV
HP1LO	SM5AQB	ZK1BS
I1MV	SP6BY	KH6MG/ZK1
JA1ANG	TI2LA	ZK2AD
JZ0HA	UA1AU	ZL1ABZ
W1AW	UA9KKB	ZL3JA
KB6BJ	UQ2AB	ZM6AS
KC4AF	VE8OJ	ZS1OU

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- Withstands 75 mph wind-storms.
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73,
GOTHAM

Gotham V80 Vertical

Modeling Antenna Systems – II

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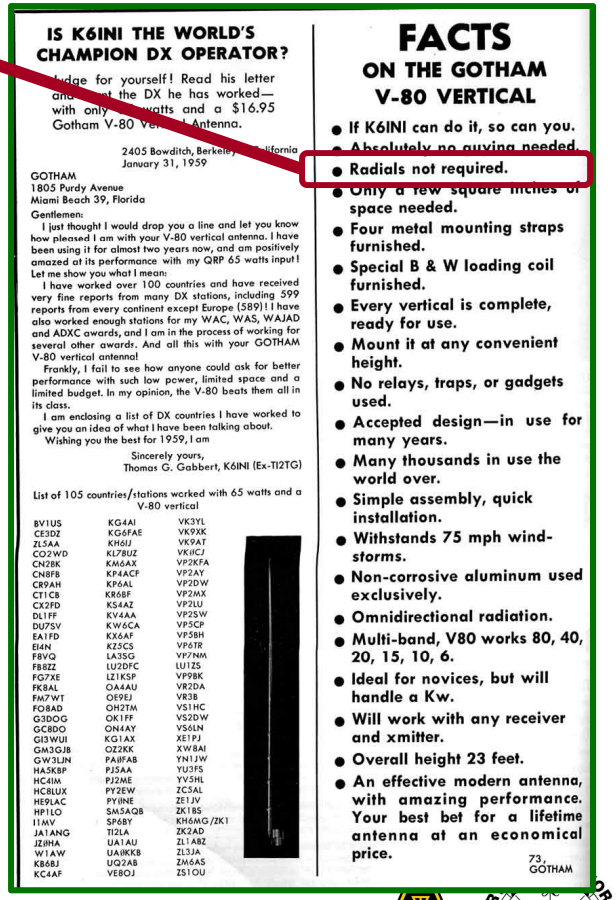

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GOTHAM
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Miami Beach 39, Florida

Gentlemen:

I just thought I would drop you a line and let you know how pleased I am with your V-80 vertical antenna. I have been using it for almost two years now, and am positively amazed at its performance with my QRP 65 watts input! Let me show you what I mean:

I have worked over 100 countries and have received very fine reports from many DX stations, including 599 reports from every continent except Europe (589)! I have also worked enough stations for my WAC, WAS, WAJAD and ADXC awards, and I am in the process of working for several other awards. And all this with your GOTHAM V-80 vertical antenna!

Frankly, I fail to see how anyone could ask for better performance with such low power, limited space and a limited budget. In my opinion, the V-80 beats them all in its class.

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- Every vertical is complete, ready for use.
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- Accepted design—in use for many years.
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Modeling Antenna Systems – II

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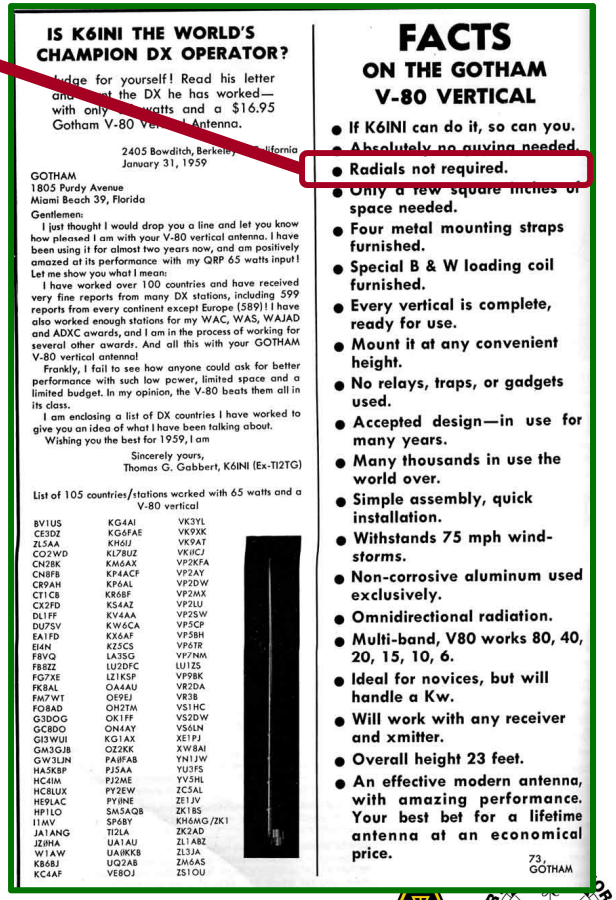
- **I do not believe antenna advertisements**
- **I learned that *you need to understand the physics* of antennas**
- **This led me to antenna modeling**



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F8VQ	LA3SG	VP7NM
F8BZZ	LU2DFC	LU1ZS
FG7XE	LZ1KSP	VP9BK
FK8AL	OA4AU	VR2DA
FM7WT	OE9EJ	VR3B
FO8AD	OH2TM	VS1HC
G3DOG	OK1FF	VS2DW
GC8DO	ON4AY	VS6LN
GI3WUI	KG1AX	XE1PJ
GM3GJB	OZ2KK	XW8AI
GW3LJN	PA9FAB	YN1JW
HA5KBP	PJ5AA	YU3FS
HC4IM	PJ2ME	YV5HL
HC8LUX	PY2EW	ZC5AL
HE9LAC	PY9NE	ZE1JV
HP1LO	SM5AQB	ZK1BS
I1MV	SP6BY	KH6MG/ZK1
JA1ANG	TI2LA	ZK2AD
JZ0HA	UA1AU	ZL1ABZ
W1AW	UA9KKB	ZL3JA
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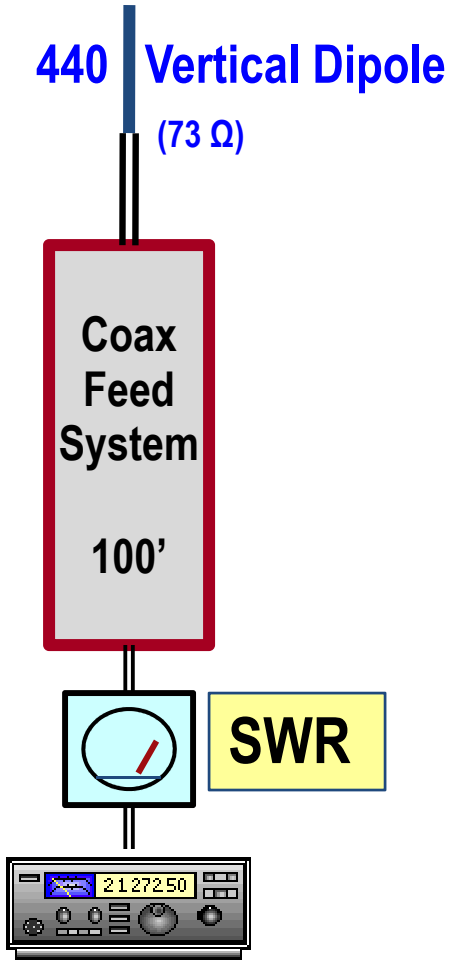
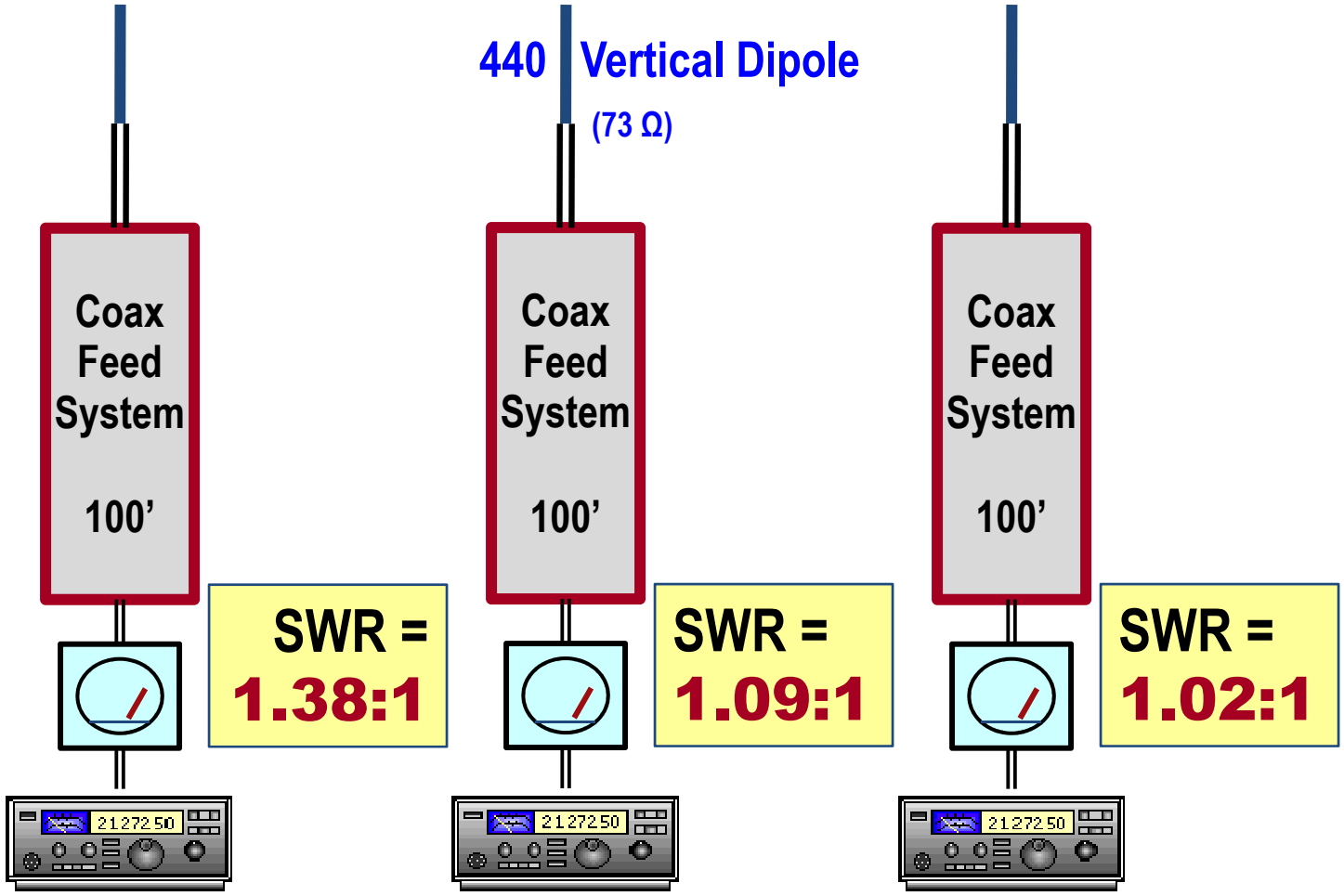
A Quiz!


440
Vertical Dipole
(73 Ω)
Coax
Feed
System
100’
SWR
2127250
50W 440 FM

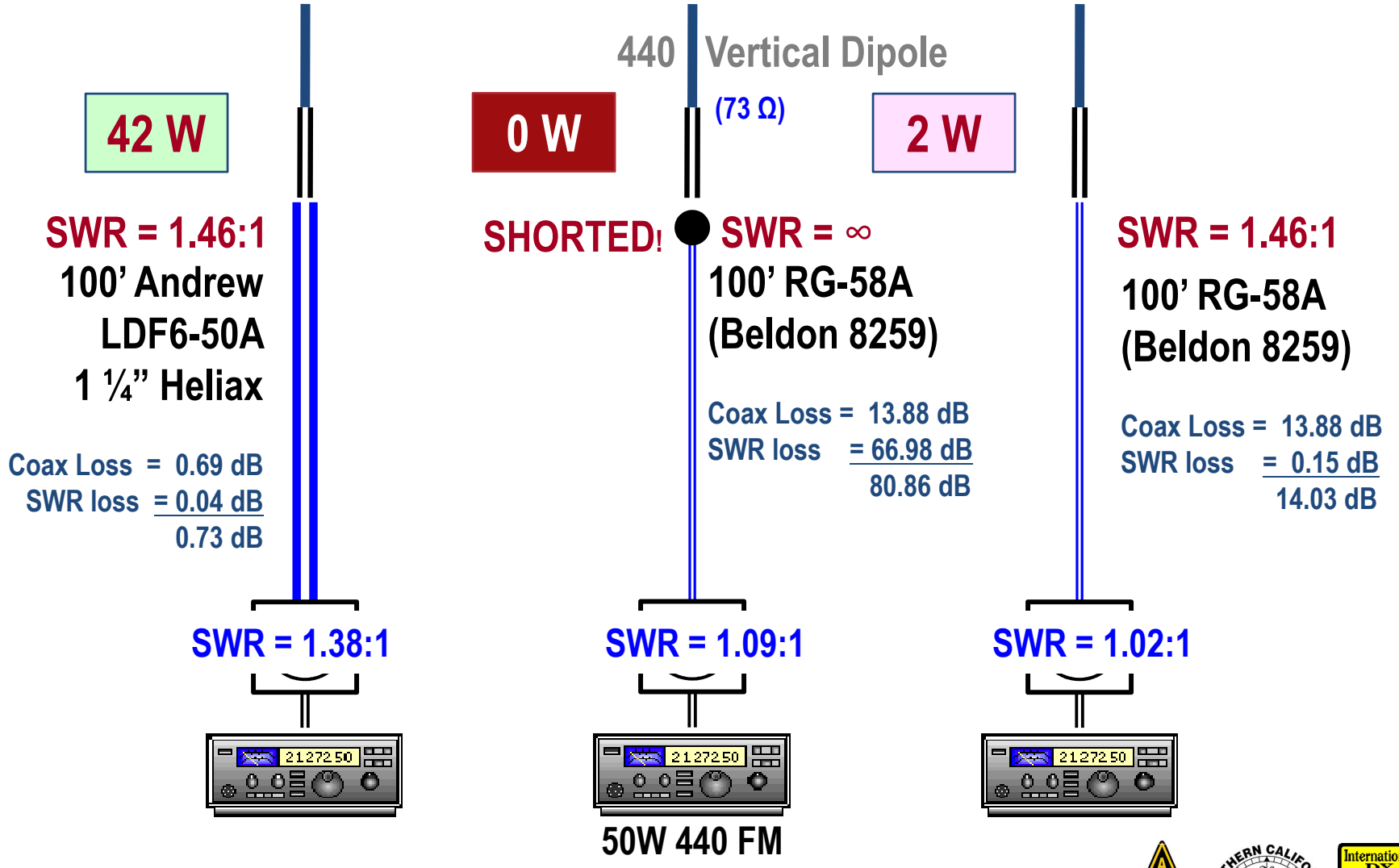
A Quiz!

Question: Which is the better situation?



A Quiz!

Answer: ***Beware the Myth of Low SWR!***



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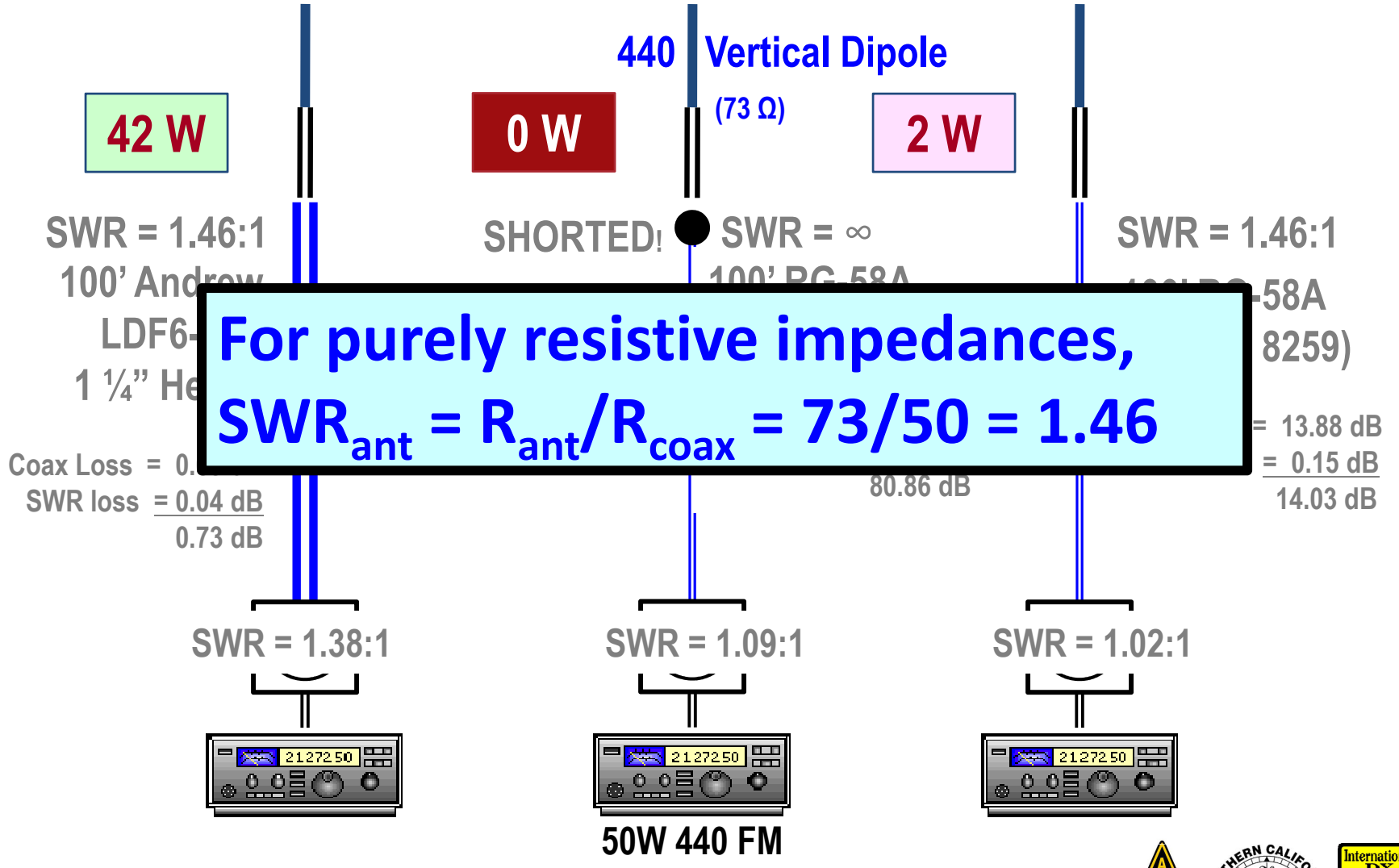
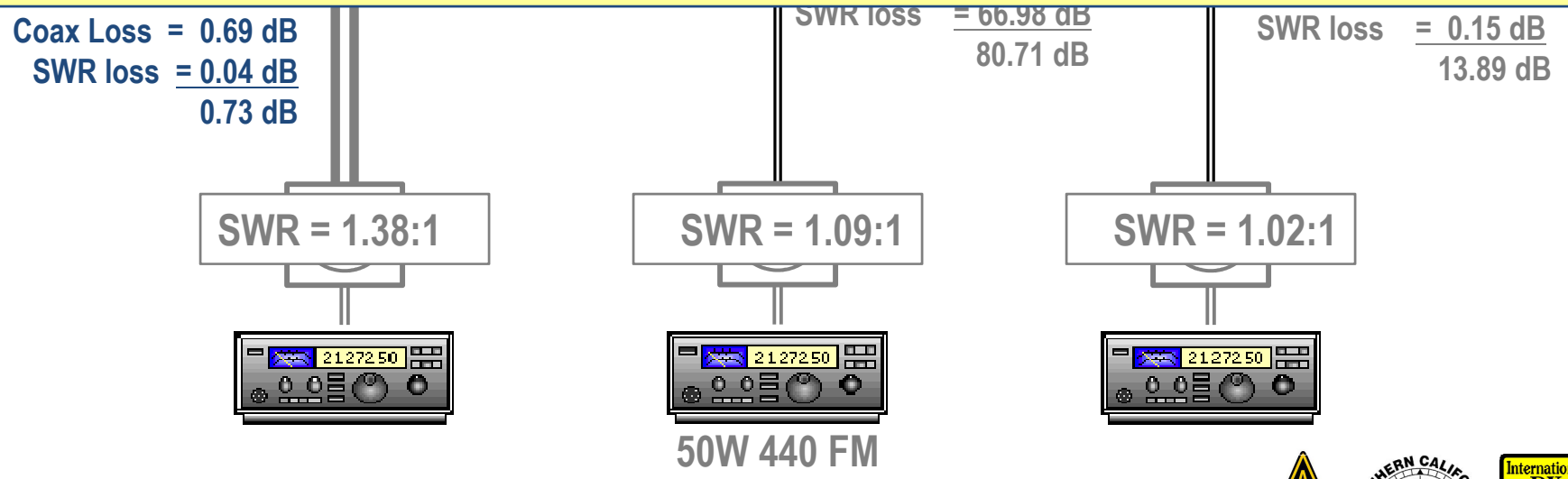


A Quiz!

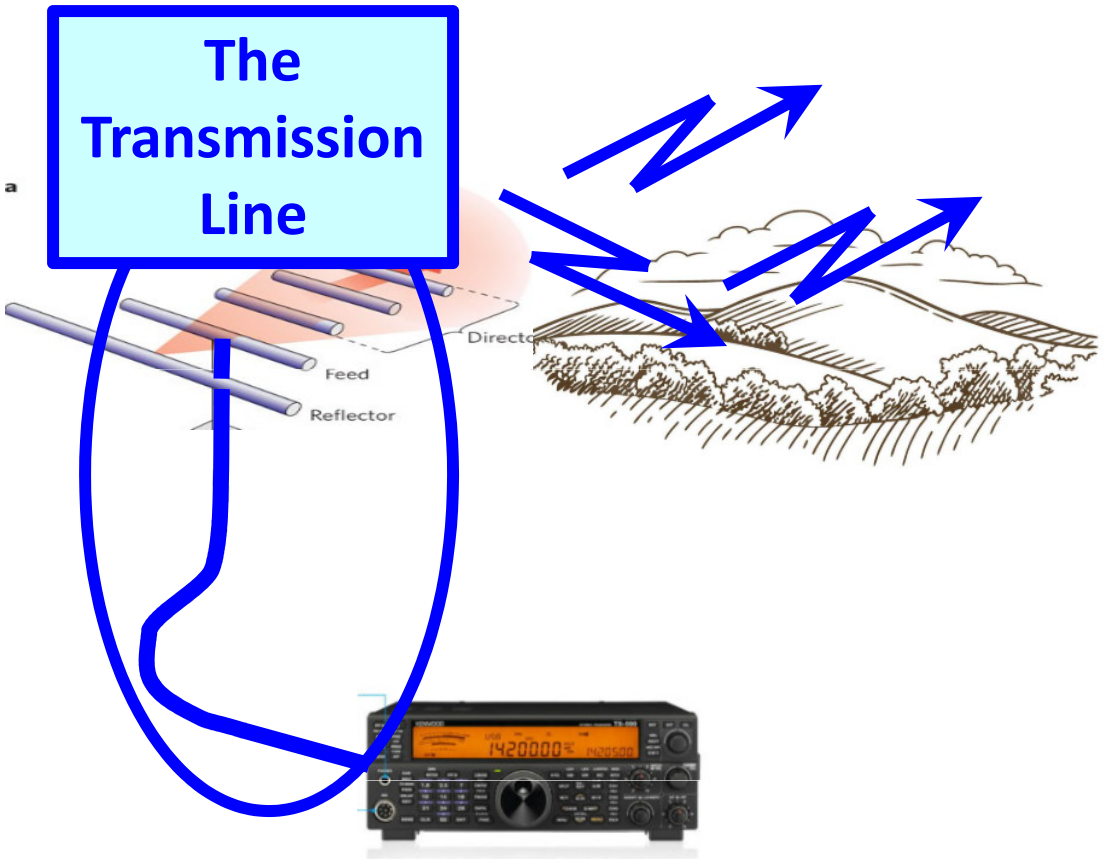
It's really too bad that SWR is so easy to measure in the shack – it can be very misleading.

Remember: the "ideal" SWR is generated with a broadband, matched dummy load!



Modeling Antenna Systems – II

The Old Way of Analyzing your Transmission Line System



W1DYJ ~ Larry Banks

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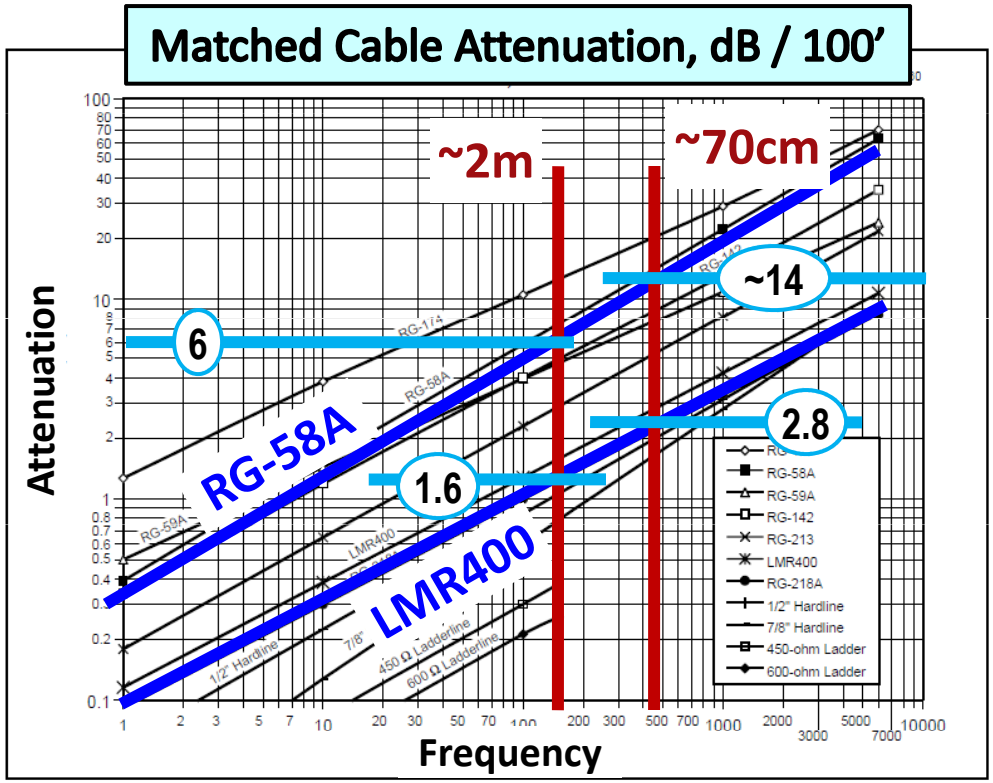


Fig 23.25
ARRL Antenna Book 24th Edition [2019]

Modeling Antenna Systems – II

The Old Way of Analyzing your Transmission Line System

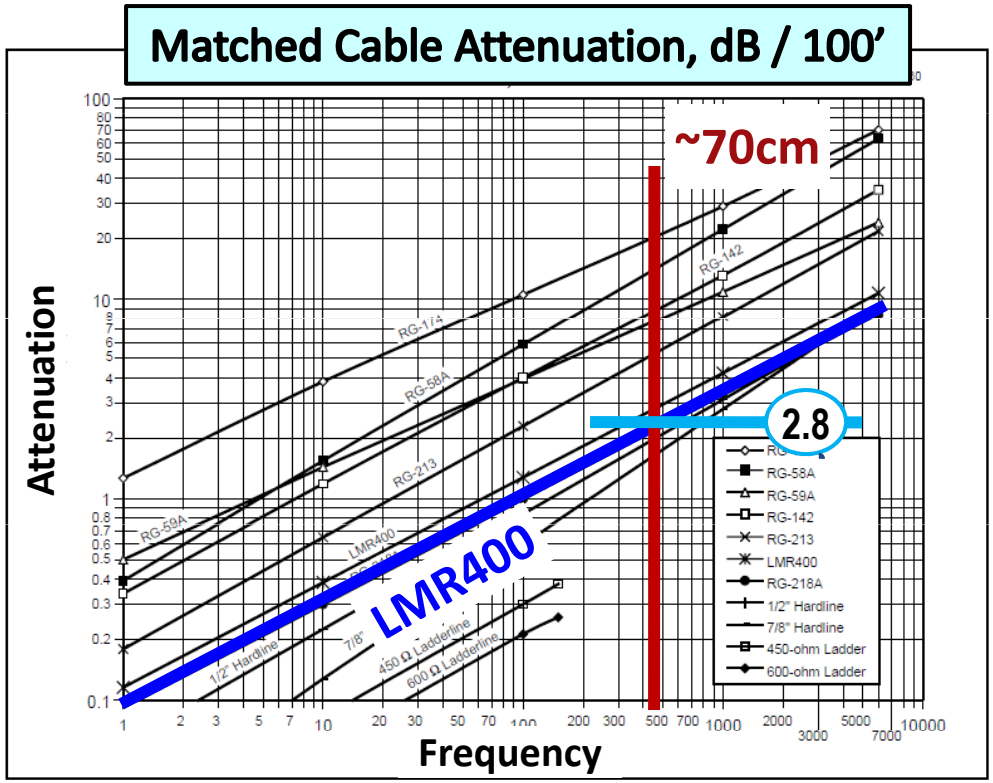


Fig 23.25
ARRL Antenna Book 24th Edition [2019]

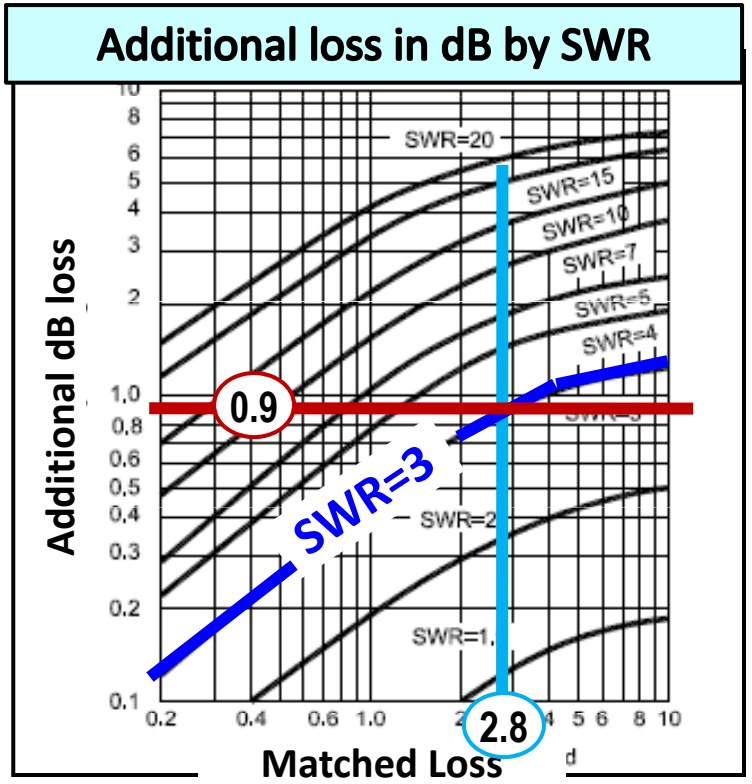
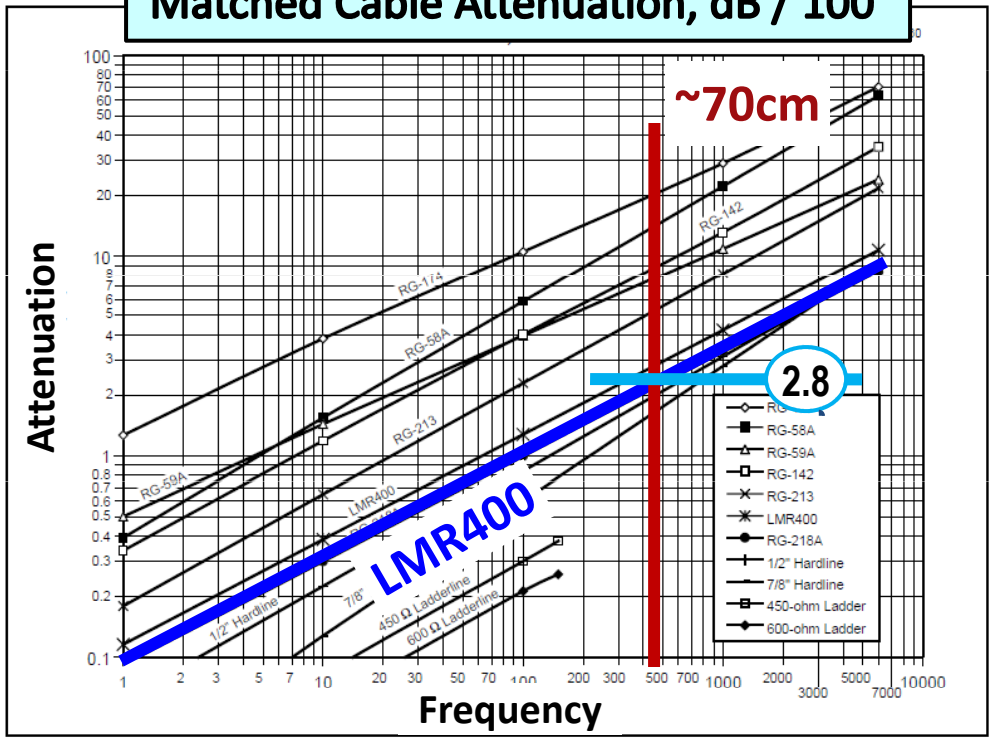


Fig 23.15
ARRL Antenna Book 24th Edition [2019]

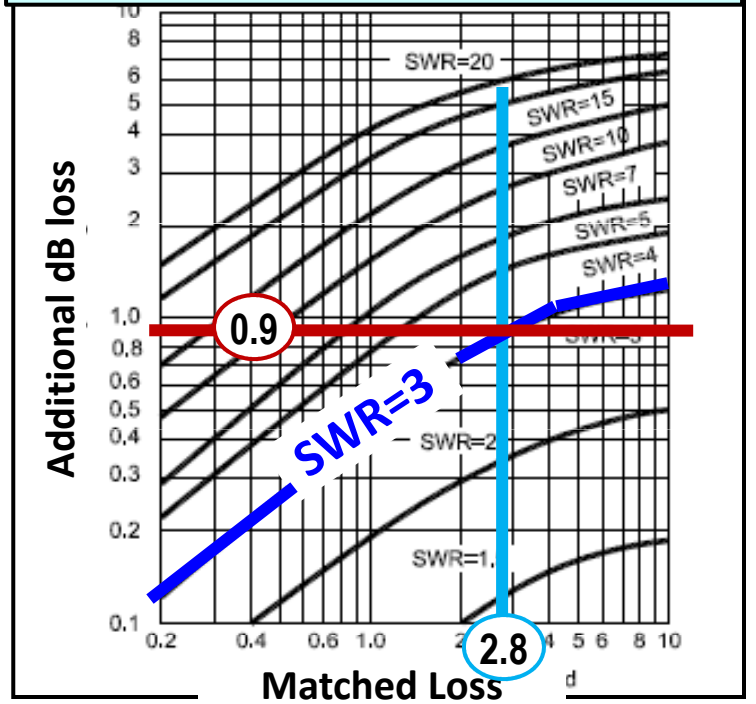
Modeling Antenna Systems – II

The Old Way of Analyzing your Transmission Line System

Matched Cable Attenuation, dB / 100'



Additional loss in dB by SWR



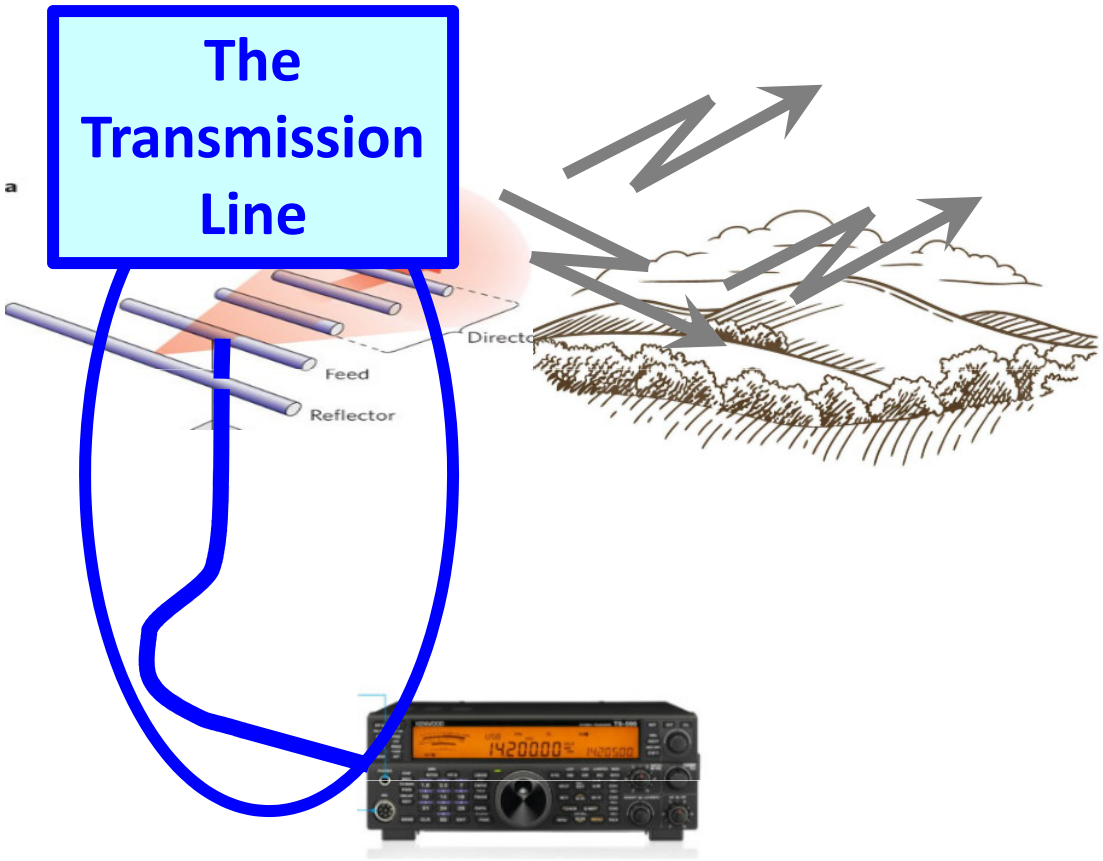
Total loss of 100' LMR400 feeding a 440 antenna @ 3:1 SWR = 2.8 + 0.9 = 3.7dB

23.15
24th Edition [2019]

Modeling Antenna Systems – II

The Old Way of Analyzing your Transmission Line System

The New Way of Analyzing your Transmission Line System



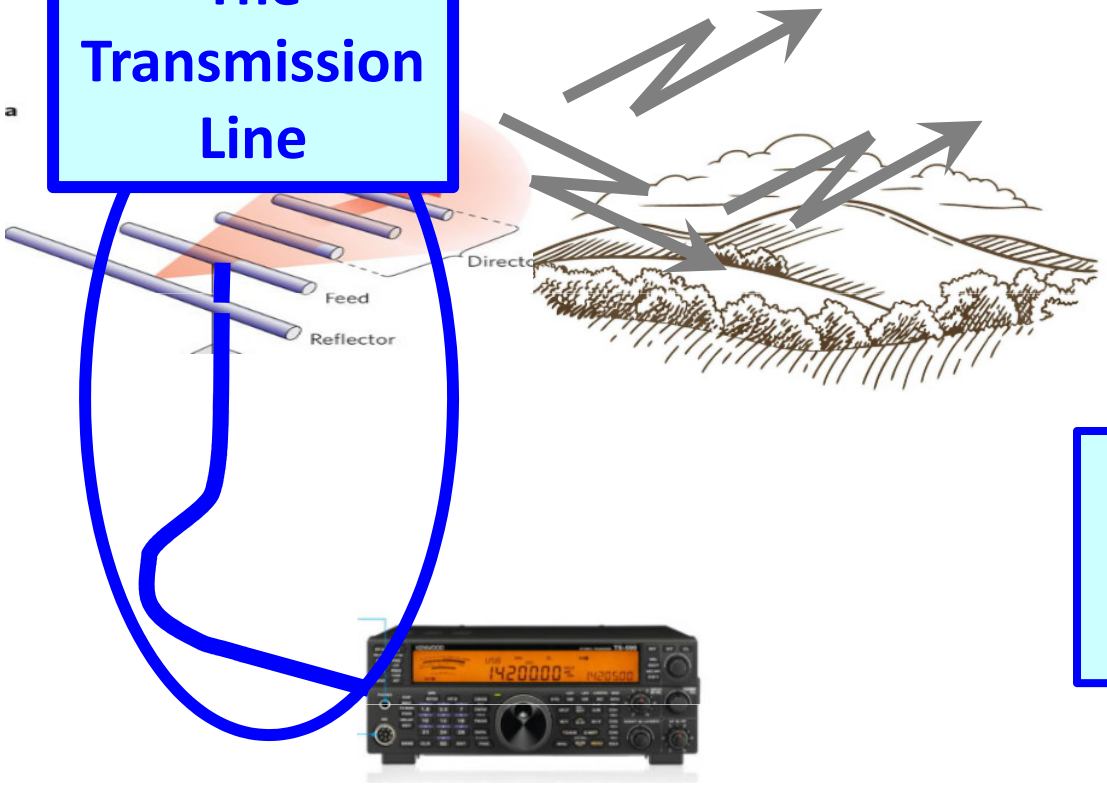
W1DYJ ~ Larry Banks

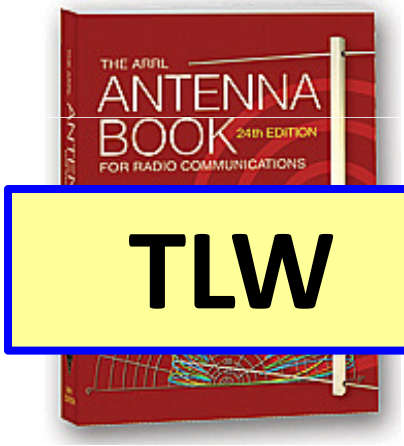
Modeling Antenna Systems – II

The Old Way of Analyzing your Transmission Line System

The New Way of Analyzing your Transmission Line System

The Transmission Line





TLW

TLDetails

(Transmission Line Details)

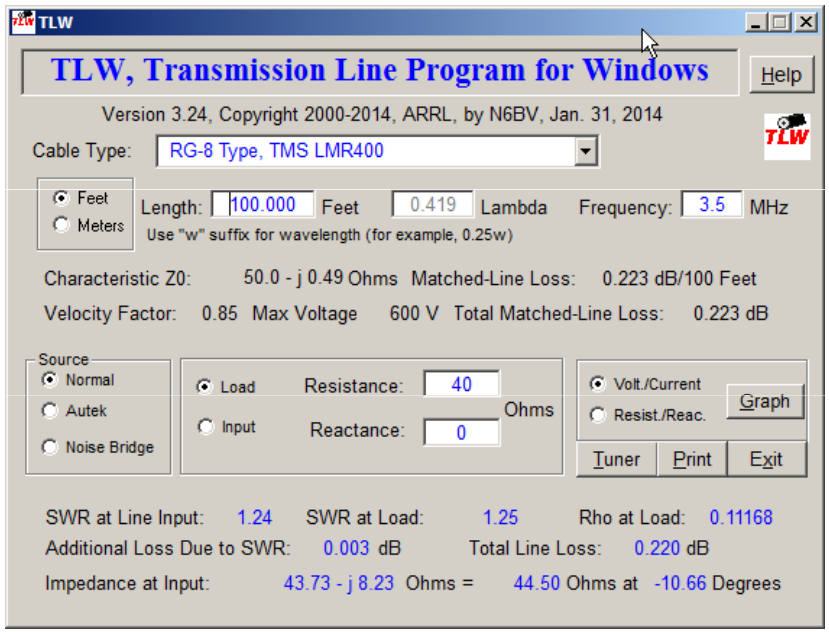
Dan Maguire (AC6LA)

W1DYJ ~ Larry Banks

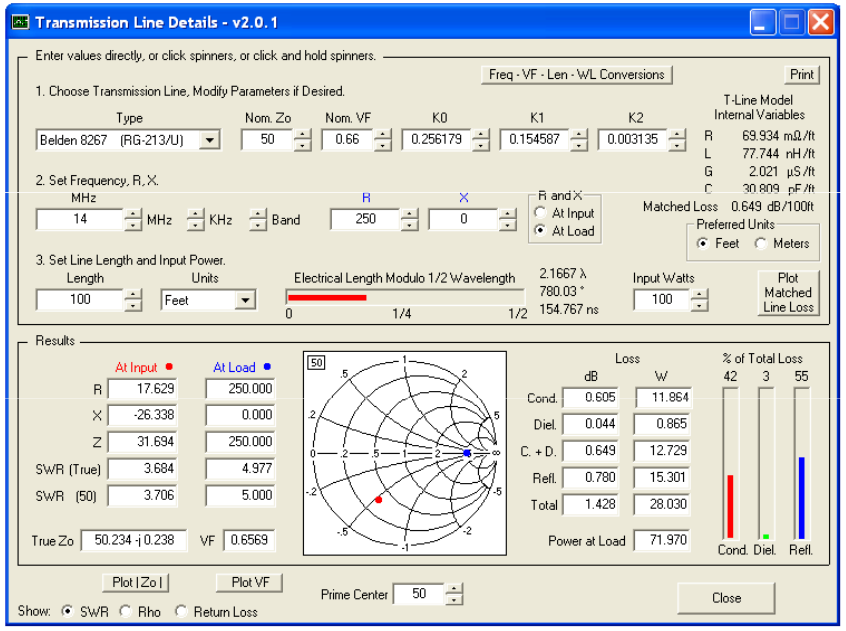
Modeling Antenna Systems – II

The New Way of Analyzing your Transmission Line System

Transmission **L**ine program for **W**indows



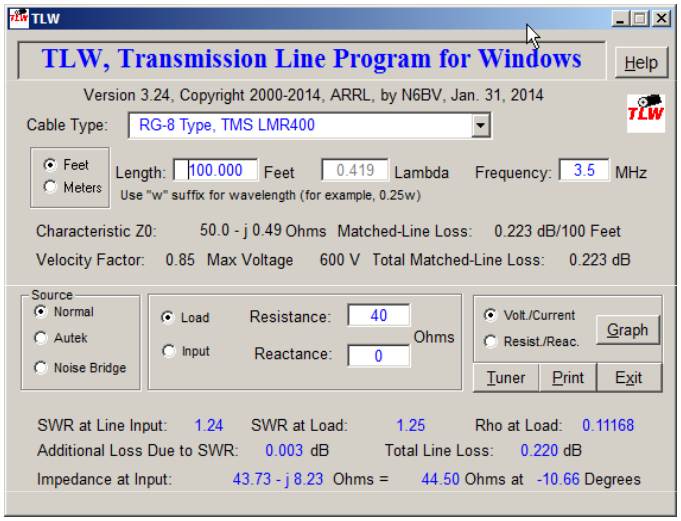
TLDetails [ac6la.com](ac6la.com)



Modeling Antenna Systems – II – *TLW*

TLW – Transmission Line Program for Windows

R. Dean Straw ~ N6BV (SK) ©ARRL

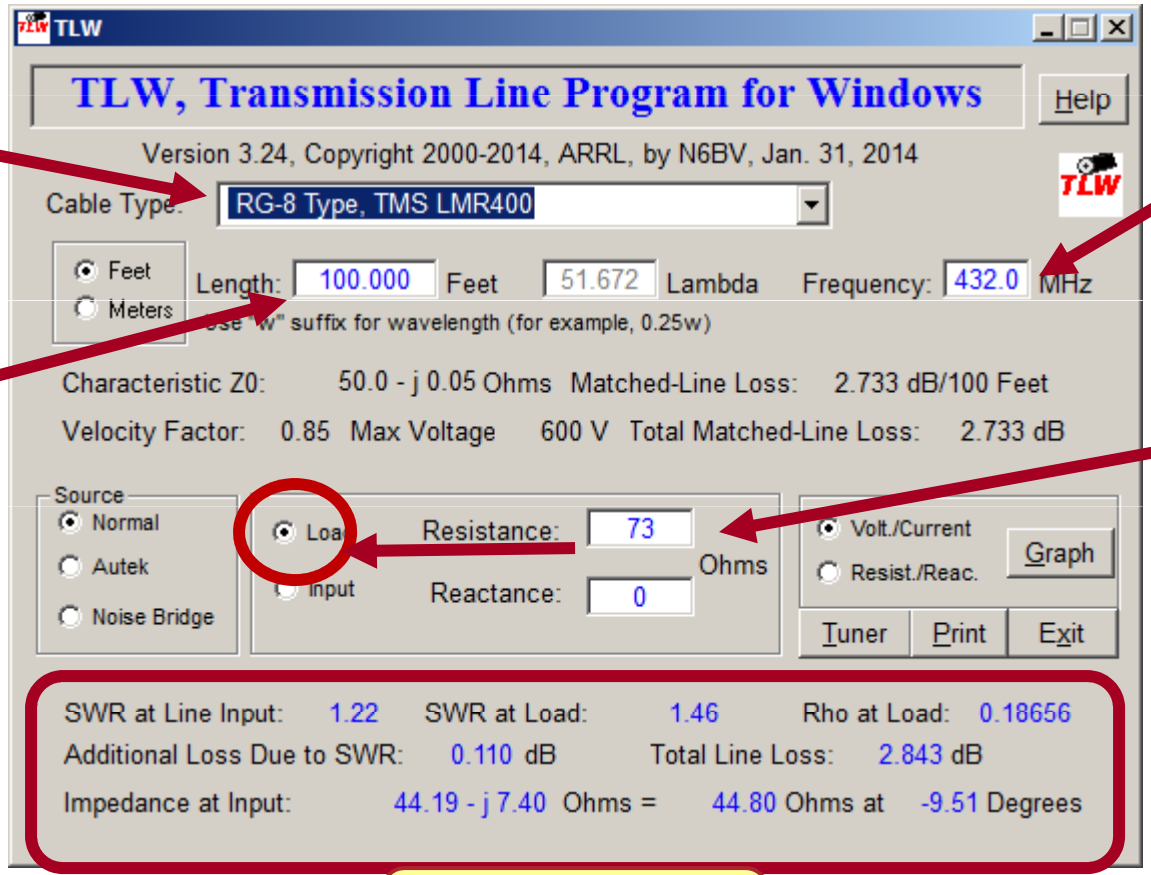


Basic Purpose:

- **Input = cable type & length, operating frequency, and impedance at antenna or rig**
- **Output = SWR at input, load, and feedline loss**

Modeling Antenna Systems – II – *TLW*

Coax Loss to a Dipole



(1) Choose cable type

(2) Choose cable length

(3) Specify frequency

(4) Enter load (antenna) impedance

(5) The Results

Modeling Antenna Systems – II – *TLW*

Coax	SWR @ Rig @70cm	Total Loss @70cm	Power 70cm
1 ¼" Heliax	1.38:1	0.73 dB	42 W
½ " Heliax	1.31:1	1.54 dB	35 W
LMR 400 "RG8"	1.22:1	2.83 dB	26 W
8267 RG213	1.12:1	5.28 dB	15 W
LMR 240"RG8X"	1.12:1	5.37 dB	14 W
LMR 200 "RG58"	1.08:1	7.14 dB	10 W
9258 "RG8X"	1.05:1	9.08 dB	5 W
8259 "RG58A"	1.02:1	13.89 dB	2 W

50 W @ Transmitter / 100' Coax / 73 Ω Antenna @ 440MHz

$dB = 10 \log_{10} (W_i/W_o) \rightarrow \quad W_o = W_i / 10^{dB/10}$

Modeling Antenna Systems – II – *TLW*

Coax	SWR @ Rig @70cm	Total Loss @70cm	Delivered Power			
			70cm	2M	10M	80M
1 ¼" Heliax	1.38:1	0.73 dB	42 W	46	48	49
½ " Heliax	1.31:1	1.54 dB	35 W	41	46	49
LMR 400 "RG8"	1.22:1	2.83 dB	26 W	34	43	47
8267 RG213	1.12:1	5.28 dB	15 W	26	38	46
LMR 240"RG8X"	1.12:1	5.37 dB	14 W	25	37	45
LMR 200 "RG58"	1.08:1	7.14 dB	10 W	19	33	43
9258 "RG8X"	1.05:1	9.08 dB	5 W	16	32	43
8259 "RG58A"	1.02:1	13.89 dB	2 W	9	25	40

50 W @ Transmitter / 100' Coax / 73 Ω Antenna

$dB = 10 \log_{10} (W_i/W_o) \rightarrow \quad W_o = W_i / 10^{dB/10}$

Modeling Antenna Systems – II – *TLW*

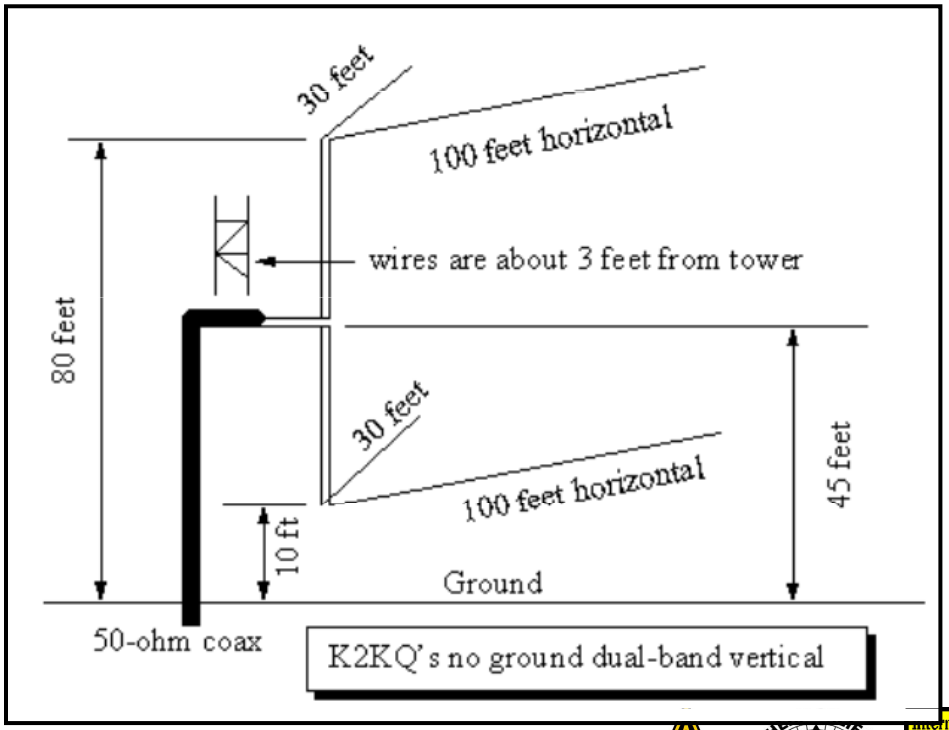
Additional Loss with SWR – a Practical Example

160m / 80m / 75m / 40m / 30m

"K2KQ" Shortened Center-Fed Double-L Fan Vertical

K2KQ Double-L

Don Toman, SK



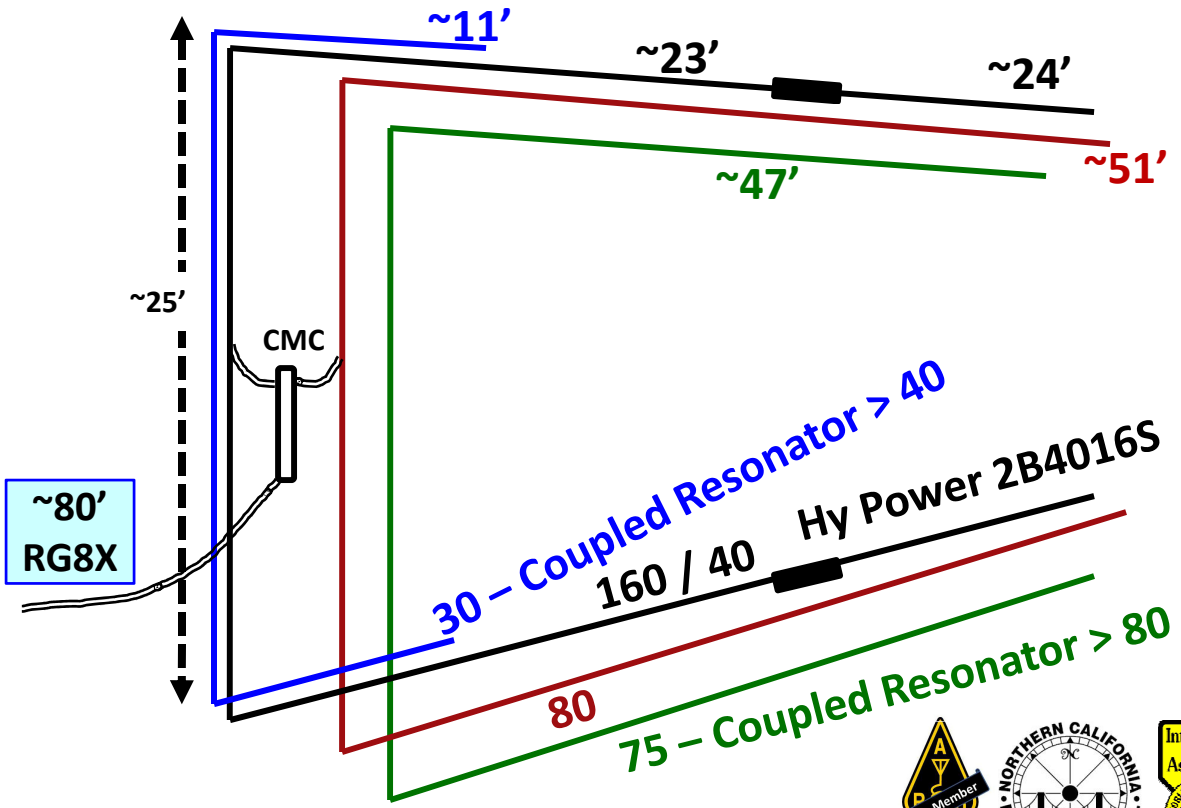
Modeling Antenna Systems – II – *TLW*

Additional Loss with SWR – a Practical Example



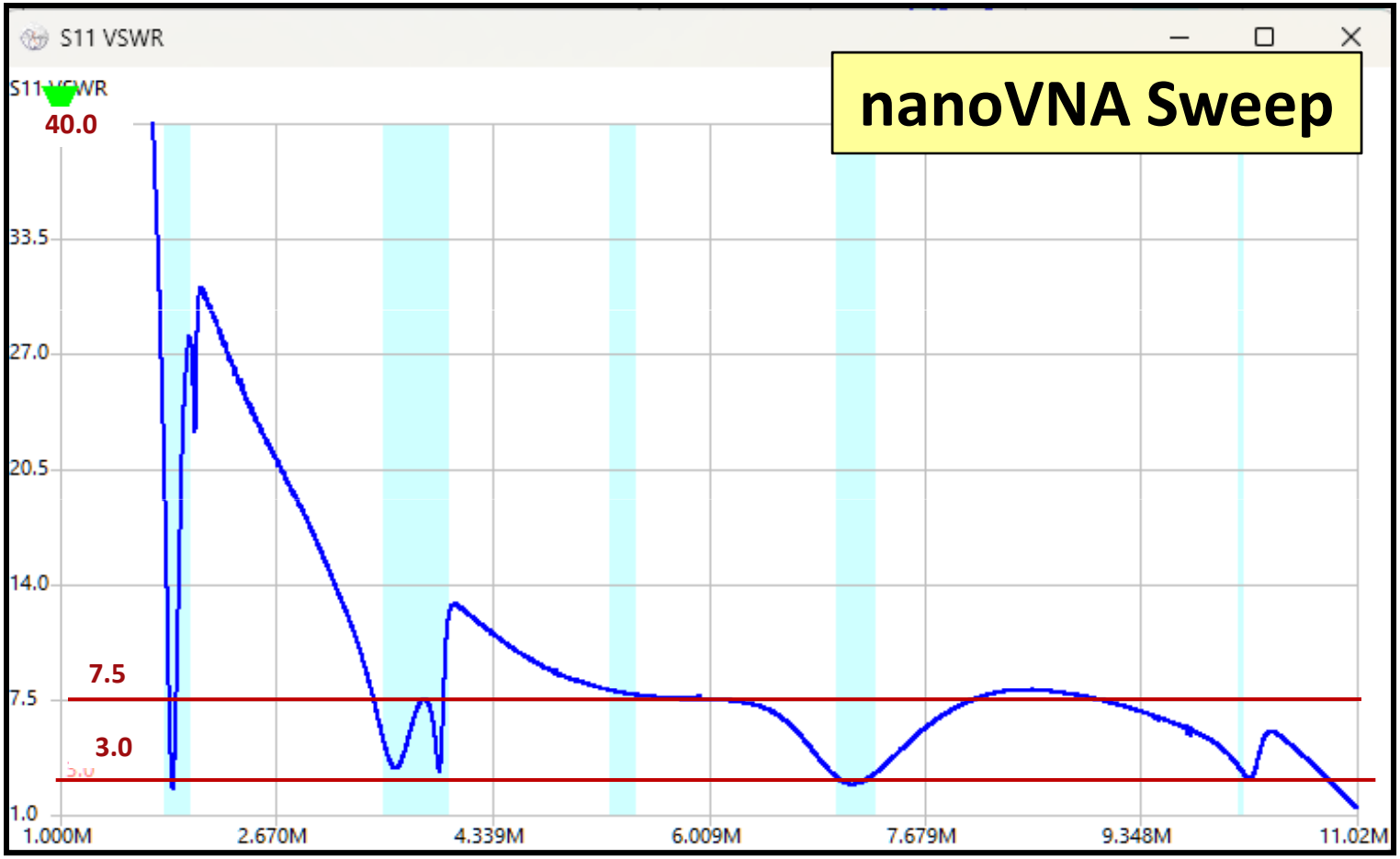
160m / 80m / 75m / 40m / 30m

"K2KQ" Shortened Center-Fed Double-L Fan Vertical



Modeling Antenna Systems – II – *TLW*

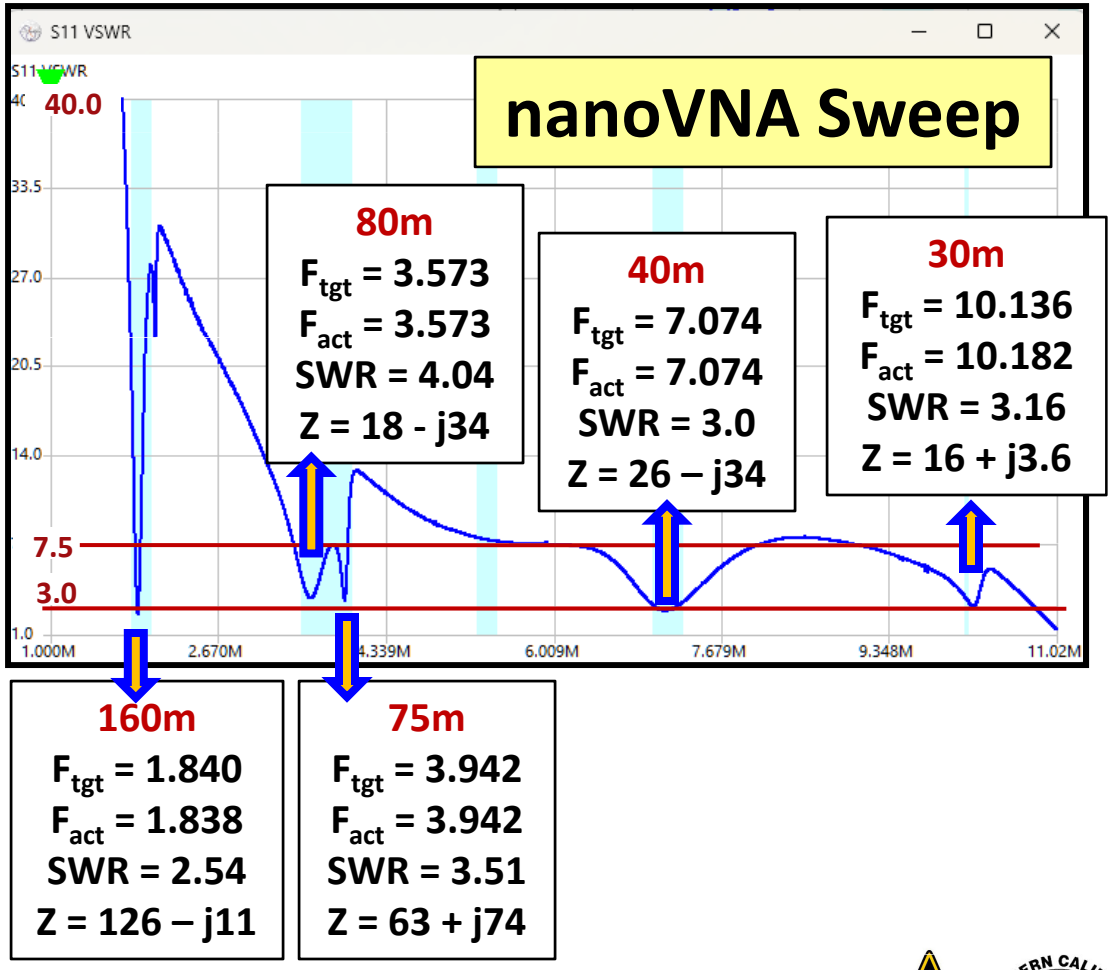
160 / 80 / 75 / 40 / 30 K2KQ Shortened Fan Double-L



Modeling Antenna Systems – II – *TLW*

160 / 80 / 75 / 40 / 30 K2KQ Shortened Fan Double-L

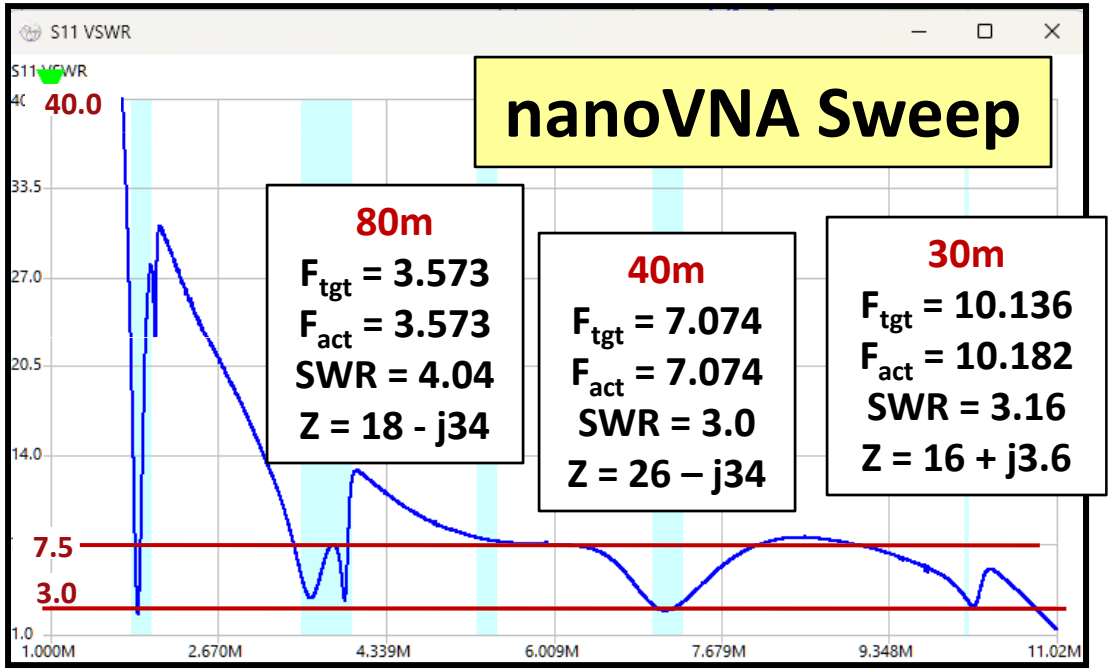




Modeling Antenna Systems – II – *TLW*

160 / 80 / 75 / 40 / 30 K2KQ Shortened Fan Double-L





nanoVNA Sweep

80m
F_{tgt} = 3.573
F_{act} = 3.573
SWR = 4.04
Z = 18 - j34

40m
F_{tgt} = 7.074
F_{act} = 7.074
SWR = 3.0
Z = 26 – j34

30m
F_{tgt} = 10.136
F_{act} = 10.182
SWR = 3.16
Z = 16 + j3.6

160m
F_{tgt} = 1.840
F_{act} = 1.838
SWR = 2.54
Z = 126 – j11

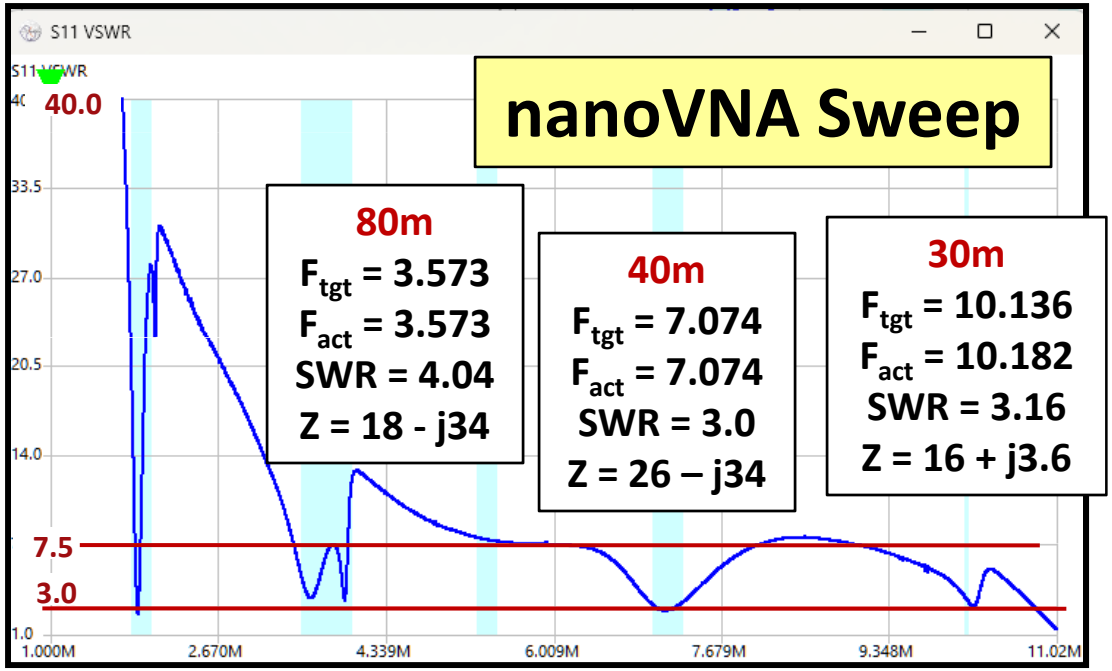
75m
F_{tgt} = 3.942
F_{act} = 3.942
SWR = 3.51
Z = 63 + j74

OMG!!!
SWR > 2:1

Modeling Antenna Systems – II – *TLW*

160 / 80 / 75 / 40 / 30 K2KQ Shortened Fan Double-L





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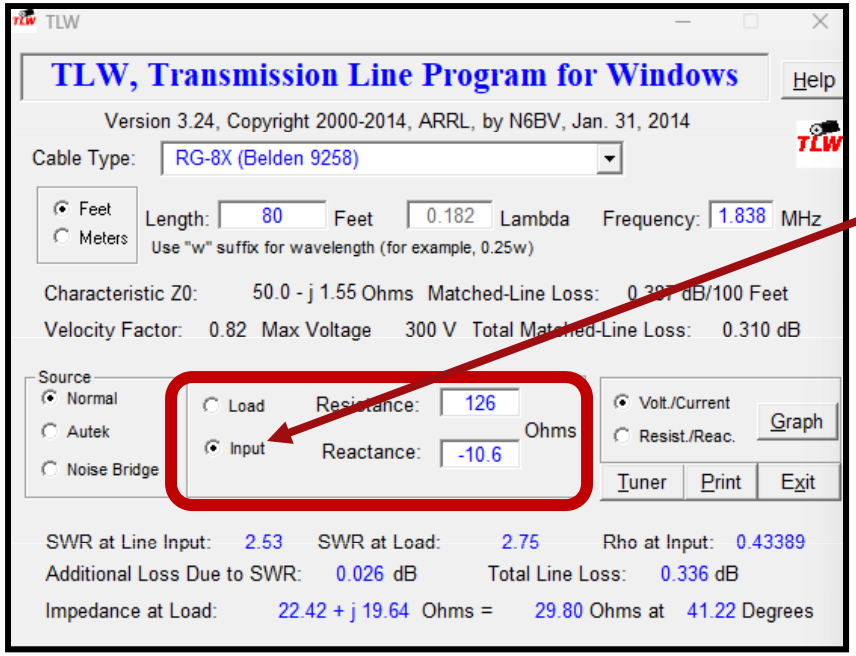
F_{tgt} = 1.840
F_{act} = 1.838
SWR = 2.54
Z = 126 – j11

75m
F_{tgt} = 3.942
F_{act} = 3.942
SWR = 3.51
Z = 63 + j74

How much power am I losing in my *Transmission Line* due to the high SWR?

Modeling Antenna Systems – II – *TLW*

160 / 80 / 75 / 40 / 30 K2KQ Shortened Fan Double-L



Notice: "Input" is checked

On 160 >>>

Effect of 80' of RG8X (Belden 9258)

Example: 160m / 1.838 MHz.

Z = 126 – j10.6 Ω

nanoVNA SWR: 2.54 TLW SWR: 2.37

TTL dB loss = 0.336 dB (SWR_{add} = 0.026)

Power delivered = 92%

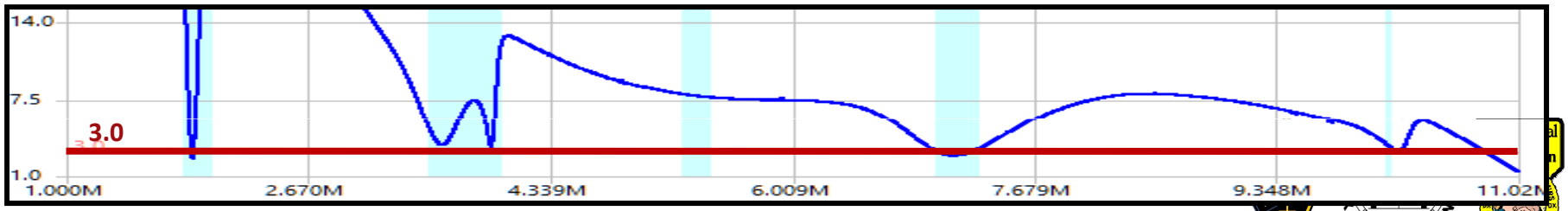
$$W_o = W_i / 10^{dB/10}$$

Modeling Antenna Systems – II – *TLW*

160 / 80 / 75 / 40 / 30 K2KQ Shortened Fan Double-L

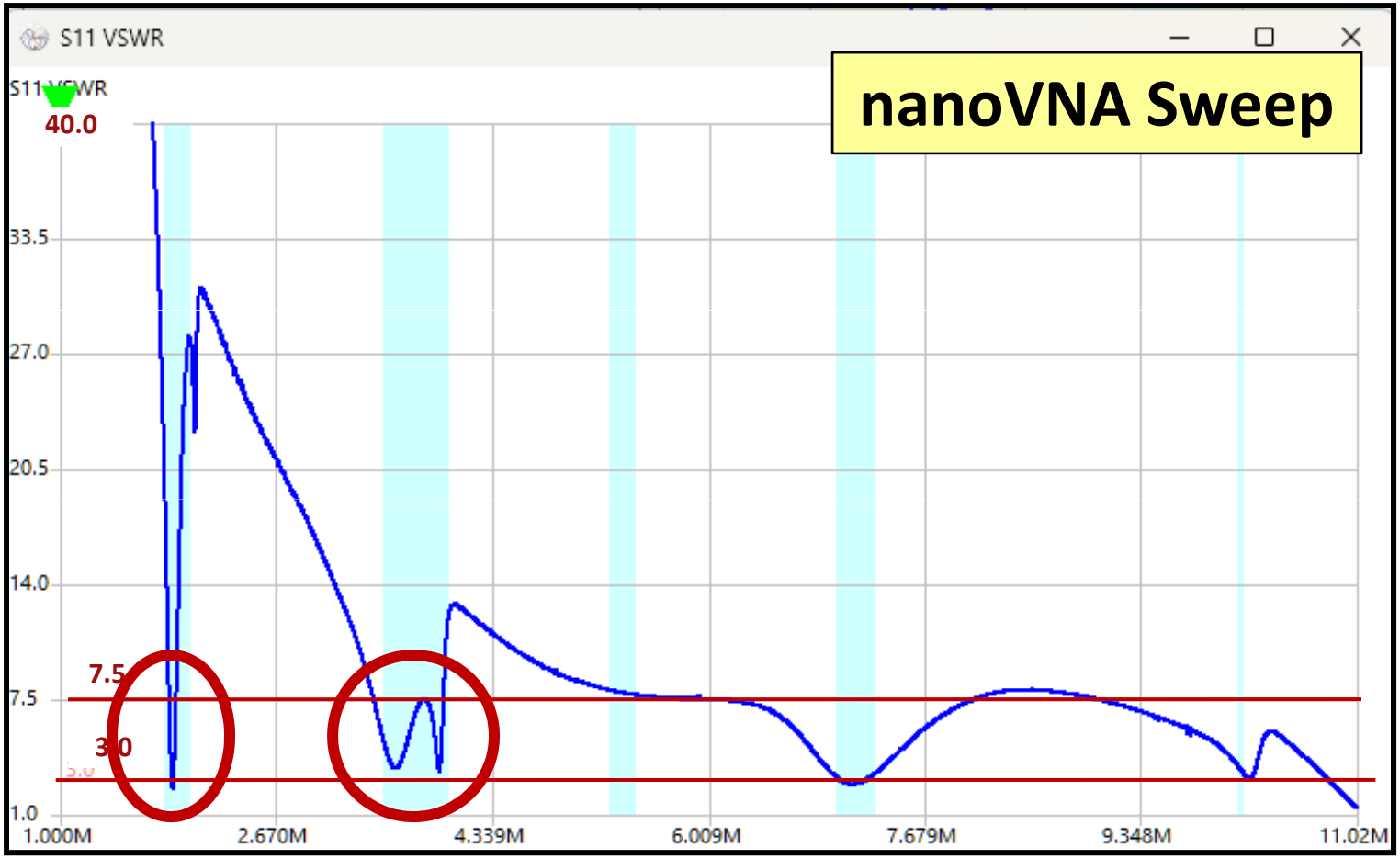
Percent Power at Target Frequencies

Freq	Z nVNA	SWR nVNA	SWR TLW	dB loss Total	*[dB SWR add]*	% PWR @ ANT
160m - 1.840	92 –j 54	2.63	2.58	0.379	*[0.069]*	92
80m - 3.573	19 –j 34	4.04	3.84	0.723	*[.0269]*	85
75m - 3.942	63 +j 74	3.51	3.62	1.25	*[0.770]*	75
40m - 7.074	26 –j 34	3.00	2.92	1.01	*[0.341]*	79
30m - 10.136	15 +j 5.0	3.50	3.51	1.83	*[1.008]*	66



Modeling Antenna Systems – II – *TLW*

160 / 80 / 75 / 40 / 30 K2KQ Shortened Fan Double-L

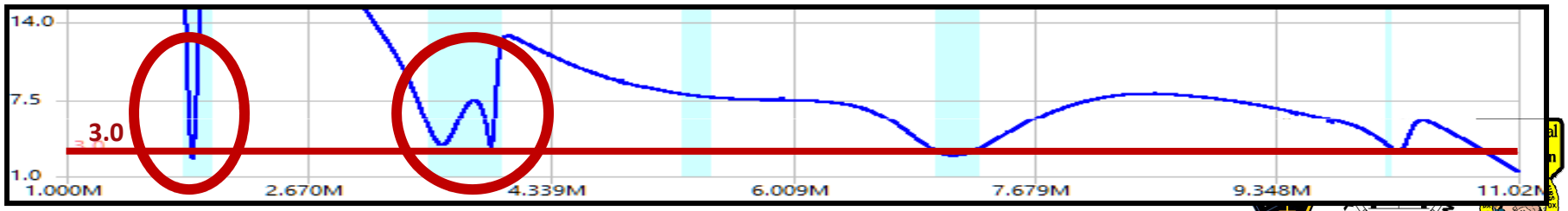


Modeling Antenna Systems – II – *TLW*

Percent Power at Band Edges and Other Frequencies

Band	Freq	Z nVNA	SWR nVNA	dB loss Total	% PWR @ ANT
160	1.840	92 +j 54	2.63	0.38	92
	1.800	4.9 +j 24	12.6	6.8	21
	1.875	4.8 –j 17	11.6	1.8	66
	1.900	2.6 –j 7.7	20.0	6.4	23
80	3.573	19 –j 34	4.04	0.72	85
	3.500	55 –j 101	5.57	1.4	72
	3.600	15 –j 18	3.94	0.67	86
75	3.942	63 +j 74	3.51	1.25	75
	3.700	10 +j 23	5.97	1.79	66
	3.834	18 +j 69	8.44	3.72	42
	4.000	26 +j 106	11.21	6.41	23

Band	Freq	Z nVNA	SWR nVNA	dB loss Total	% PWR @ ANT
40	7.074	26 –j 34	3.00	1.01	79
	7.000	43 –j 58	3.29	1.06	78
	7.300	14 +j 10	3.62	1.73	67
30	10.136	15 +j 5.0	3.50	1.83	66
	10.100	13 +j 4.5	3.92	2.1	62
	10.150	15 +j 4.9	3.35	1.76	67



Modeling Antenna Systems – II – *TLW*

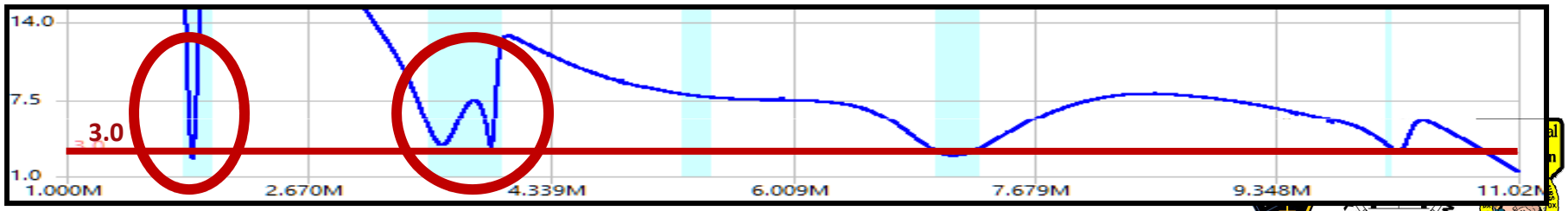
Percent Power at Band Edges and Other Frequencies

Band	Freq	Z nVNA	SWR nVNA	dB loss Total	% PWR @ ANT
160	1.840	92 +j 54	2.63	0.38	92
	1.800	4.9 +j 24	12.6	6.8	21
	1.875	4.8 –j 17	11.6	1.8	
	1.900	2.6 –j 7.7	20.0		
80	3.573	19 –j 34			
	3.500	55 –j			
	3.600				
75	3.942				75
	3.700			1.79	66
	3.834	18	8.44	3.72	42
	4.000	26 +j 106	11.21	6.41	23

Band	Freq			dB loss Total	% PWR @ ANT
				01	79
				1.06	78
			3.62	1.73	67
		5 +j 5.0	3.50	1.83	66
	.100	13 +j 4.5	3.92	2.1	62
	10.150	15 +j 4.9	3.35	1.76	67

QUIZ #2

How can I improve this?



Modeling Antenna Systems – II – *TLW*

Improving the Response

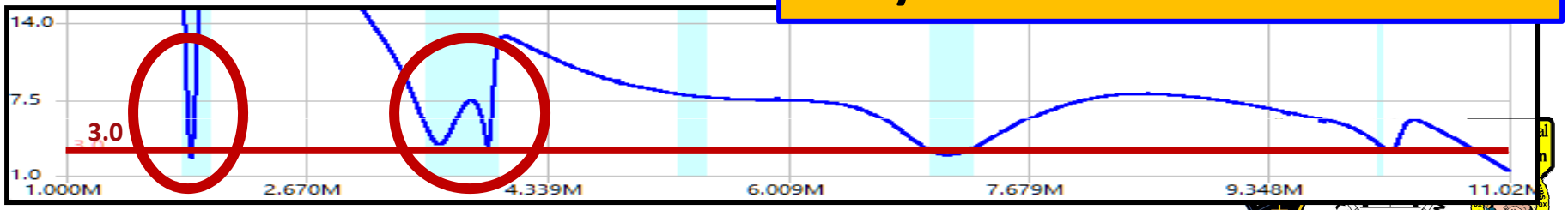
Band	Freq	Z nVNA	SWR nVNA	dB loss Total	% PWR @ ANT
160	1.840	92 +j 54	2.63	0.38	92
	1.800	4.9 +j 24	12.6	6.8	21
	1.875	4.8 –j 17	11.6	1.8	
	1.900	2.6 –j 7.7	20.0		
80	3.573	19 –j 34			
	3.500	55 –j			
	3.600				
75	3.942				75
	3.700			1.79	66
	3.834	18	8.44	3.72	42
	4.000	26 +j 106	11.21	6.41	23

Band	Freq			dB loss Total	% PWR @ ANT
				01	79
				1.06	78
			3.62	1.73	67
		5 +j 5.0	3.50	1.83	66
	.100	13 +j 4.5	3.92	2.1	62
	10.150	15 +j 4.9	3.35	1.76	67

QUIZ #2

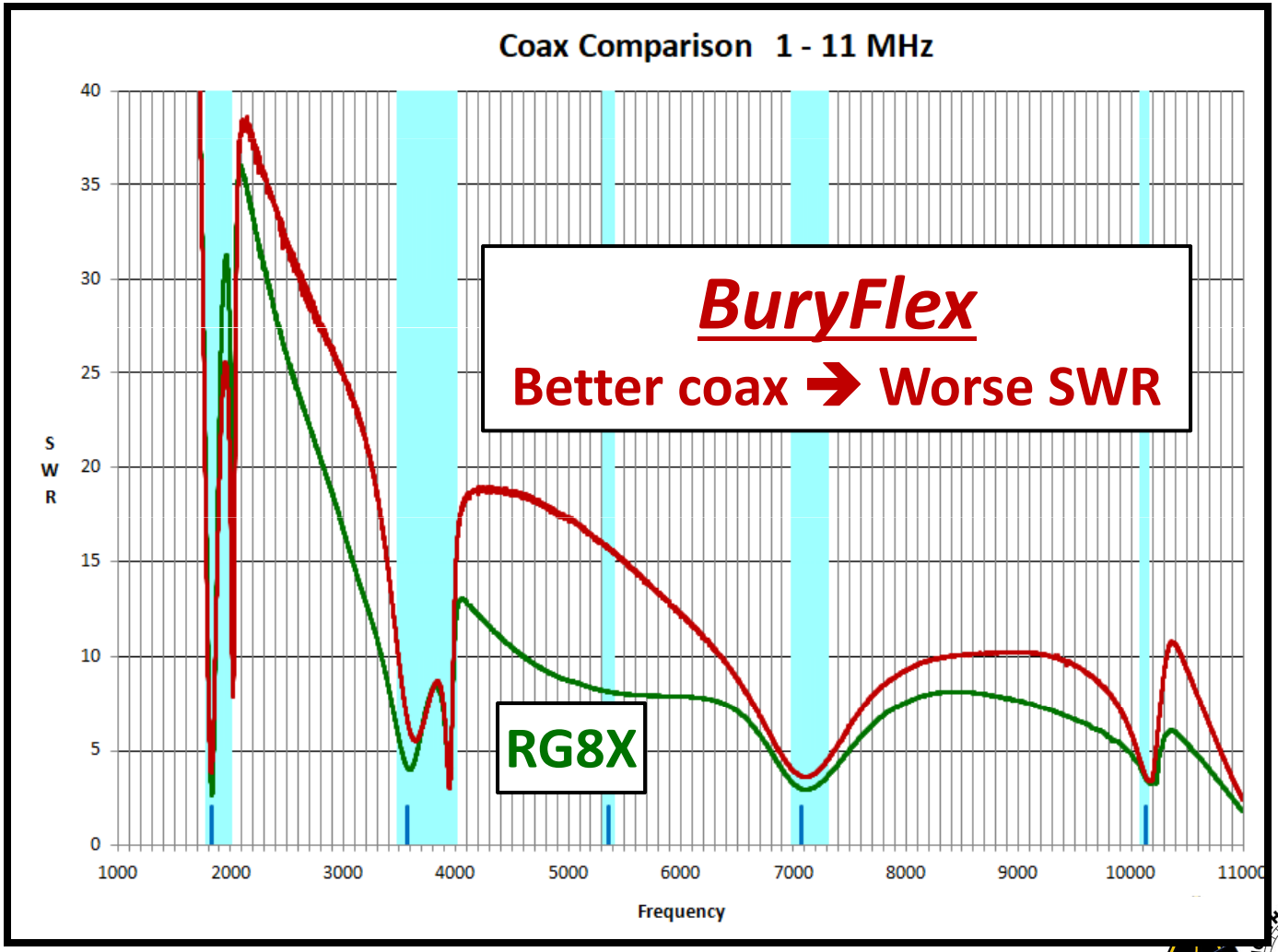
How can I improve this?

- ✓ **Remote Auto-Tuner at Antenna** [LDG RT-100]
- ✓ **Better Coax: RG8X ➔ BuryFlex**
- ✓ **…your idea!!!!**



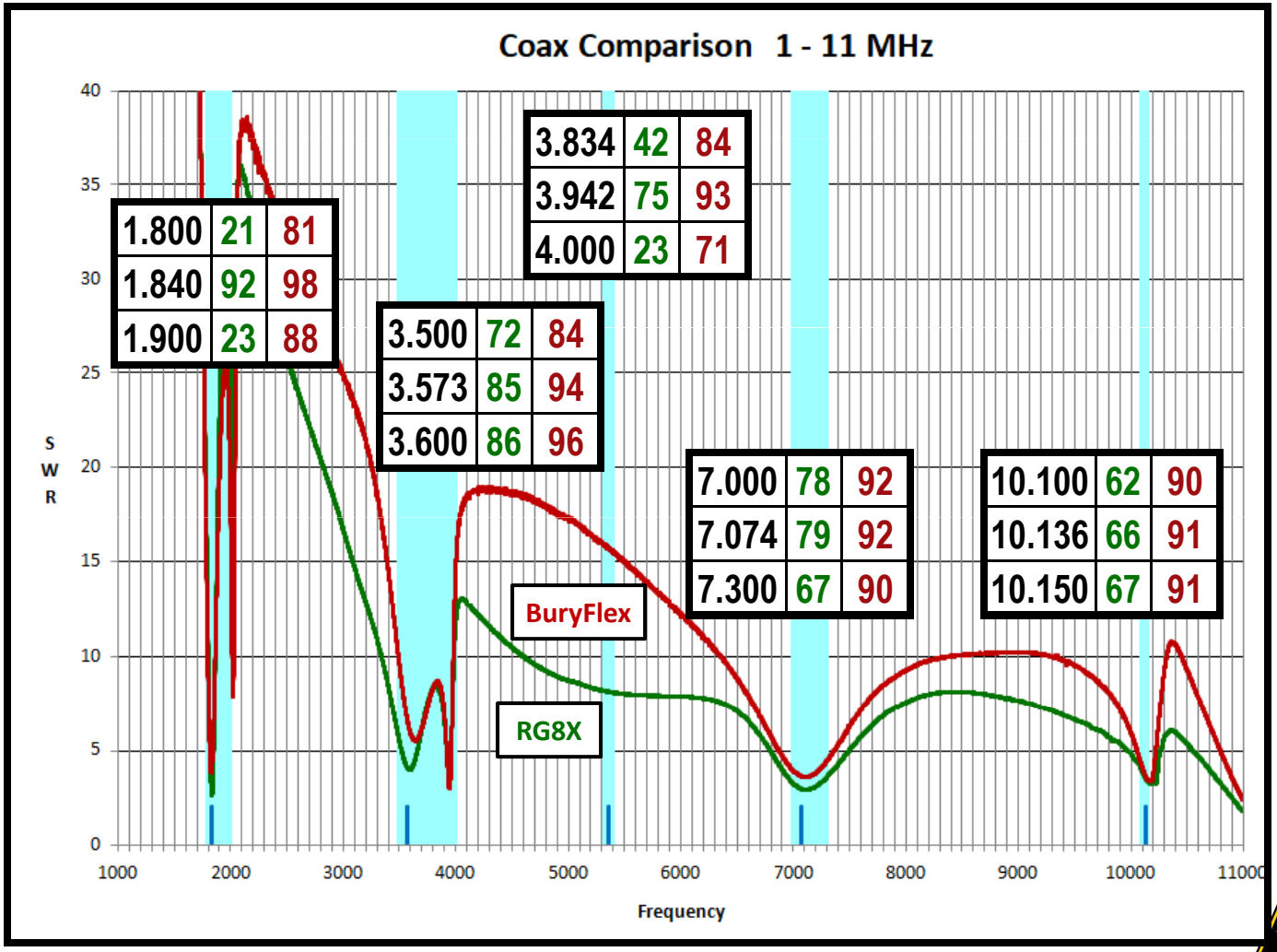
Modeling Antenna Systems – II – *TLW*

Improving the Response



Modeling Antenna Systems – II – *TLW*

Improving the Response



KEY

Freq	8X	BF

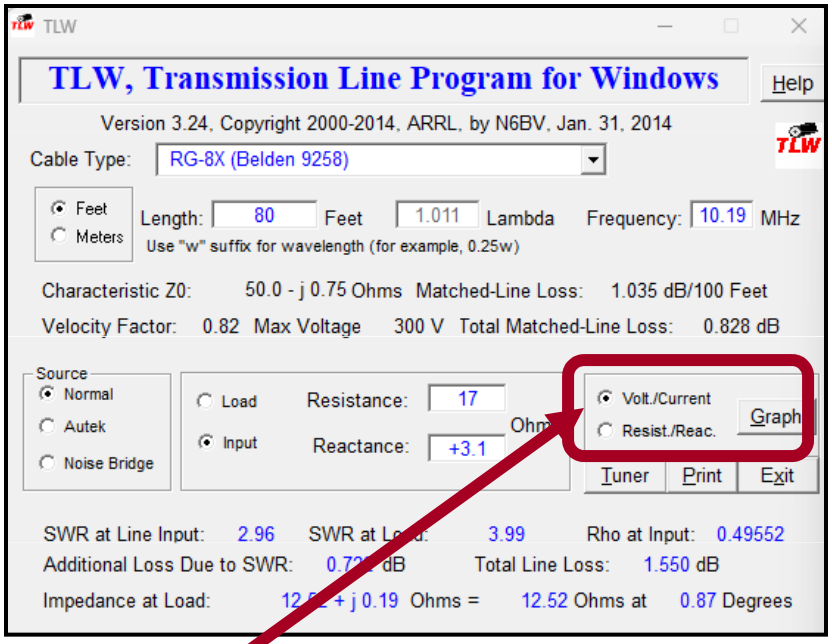
Note:

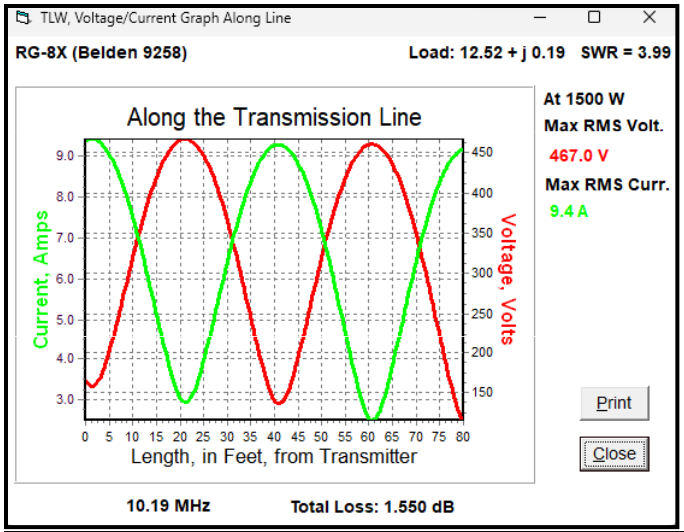
Does not include "tuner" losses

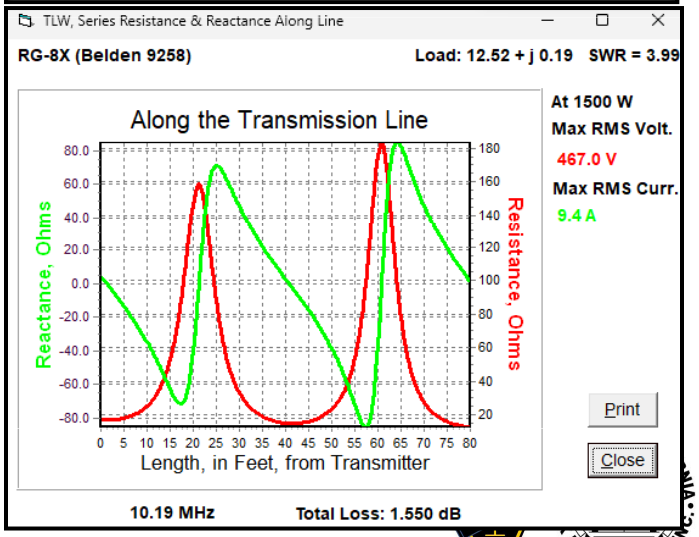
Modeling Antenna Systems – II – *TLW*

Additional TLW Feature

Fan Double-L — 30m Coax Data





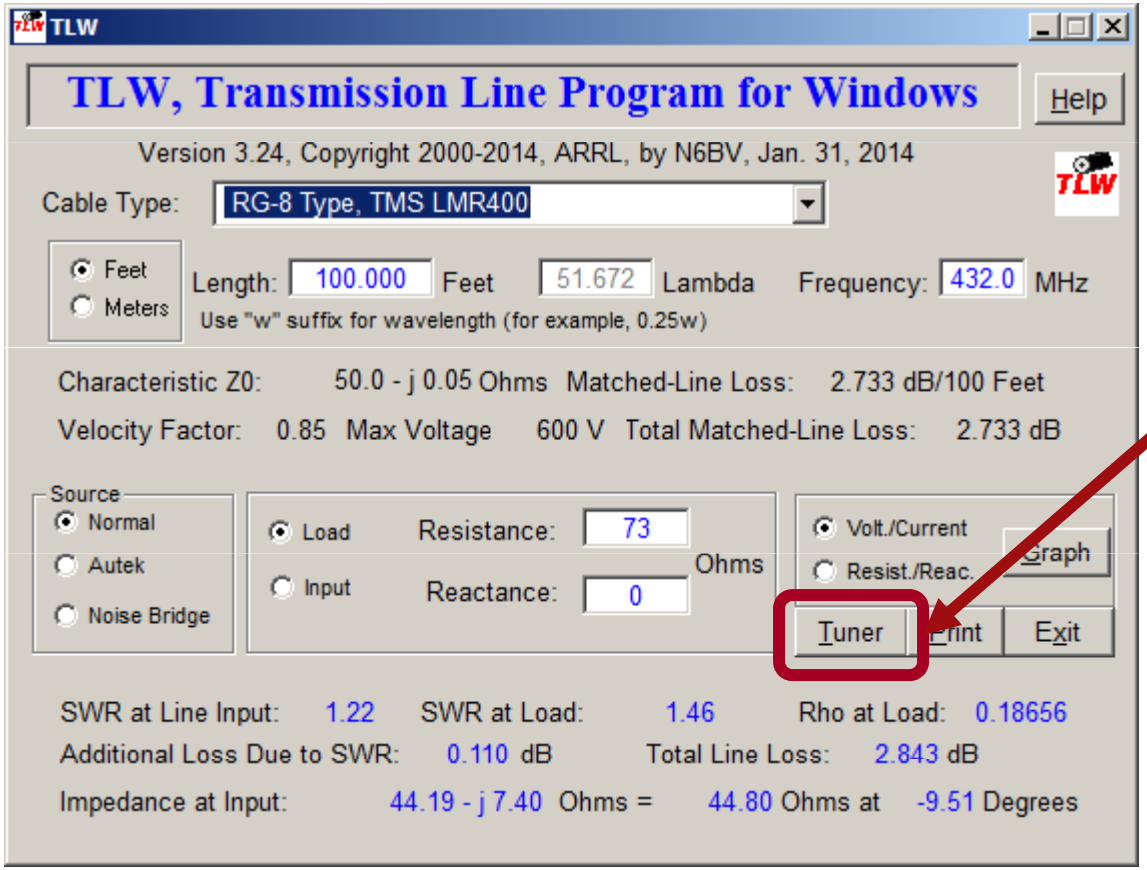


Voltage, Current, Resistance, and Reactance on the transmission line.

AC6LS's TLDetails ???

Modeling Antenna Systems – II – *TLW*

Left to you for Homework…



You can use TLW to help you design a TransMatch.

NOTE: Antenna Tuners **DO NOT** tune the antenna!

AC6LS's TLDetails ???

Modeling Antenna Systems – II – *TLW*

Summary:

- It's really too bad that SWR is so easy to measure in the shack
- It is only one parameter in the understanding of your ***Antenna System***
- However, do measure it, document it, and use it as one measure of your ***Antenna System's*** health – it will tell you if something has changed

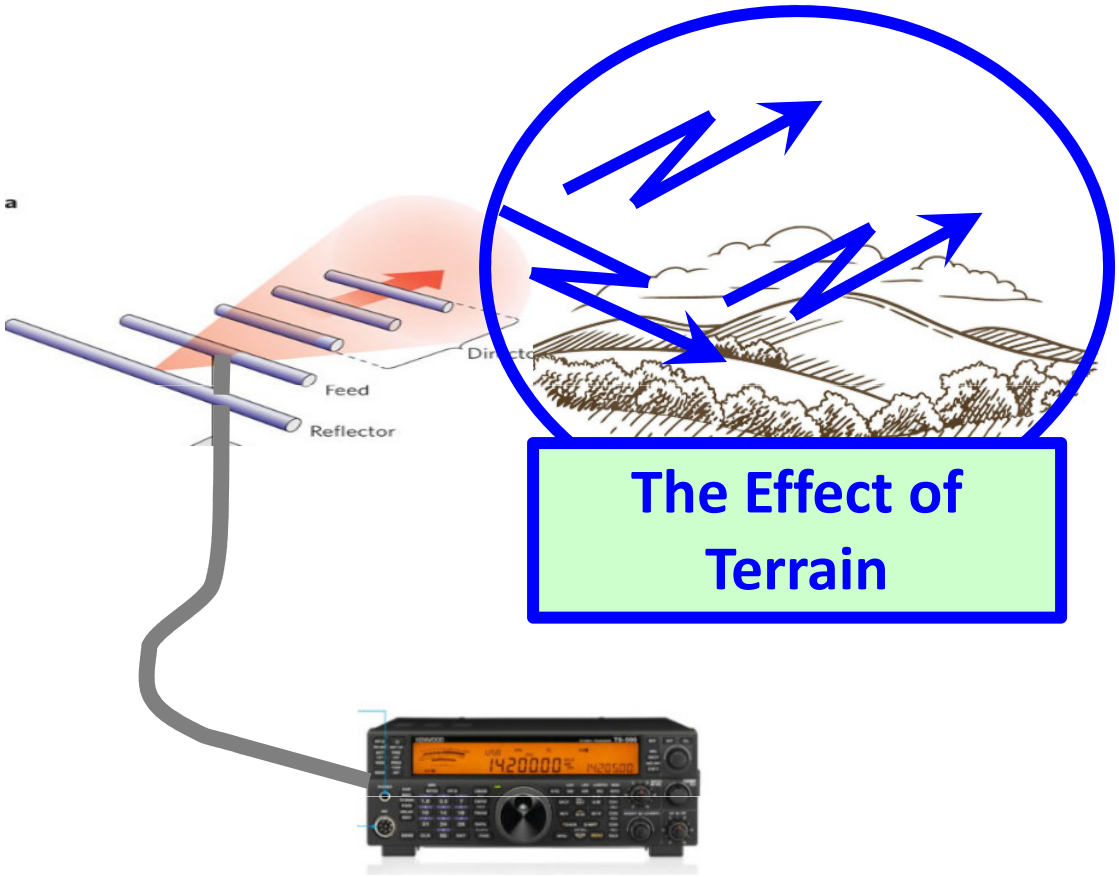
Modeling Antenna Systems – II – *TLW*

Summary:

- It's really too bad that SWR [illegible] easy to measure in the shack
- It is only one par[illegible] understandi[illegible] ***tenna System***
- Howev[illegible]e it, document it, and use it as [illegible]easure of your ***Antenna System's*** health – it will tell you if something has changed

Questions?

Modeling Antenna Systems – II



W1DYJ ~ Larry Banks

Modeling Antenna Systems – II

How Does the Terrain Effect your RF Signal?

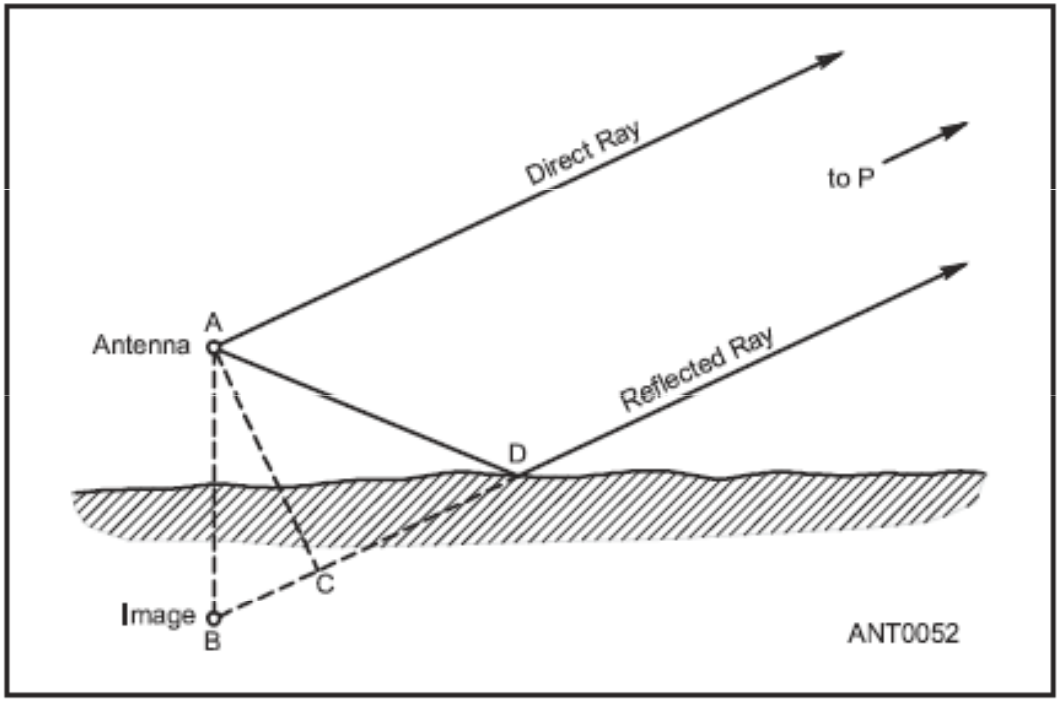
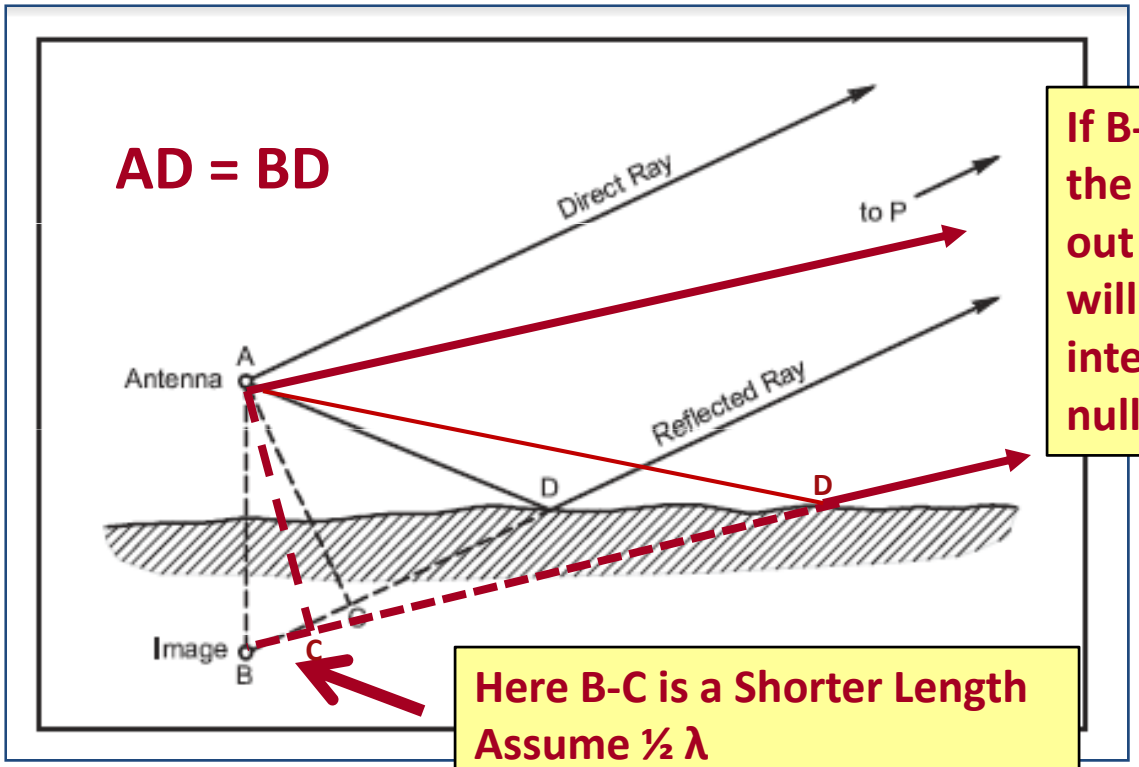


Fig 3.38
ARRL Antenna Book 24th Edition [2019]

Modeling Antenna Systems – II

How Does the Terrain Effect your RF Signal?

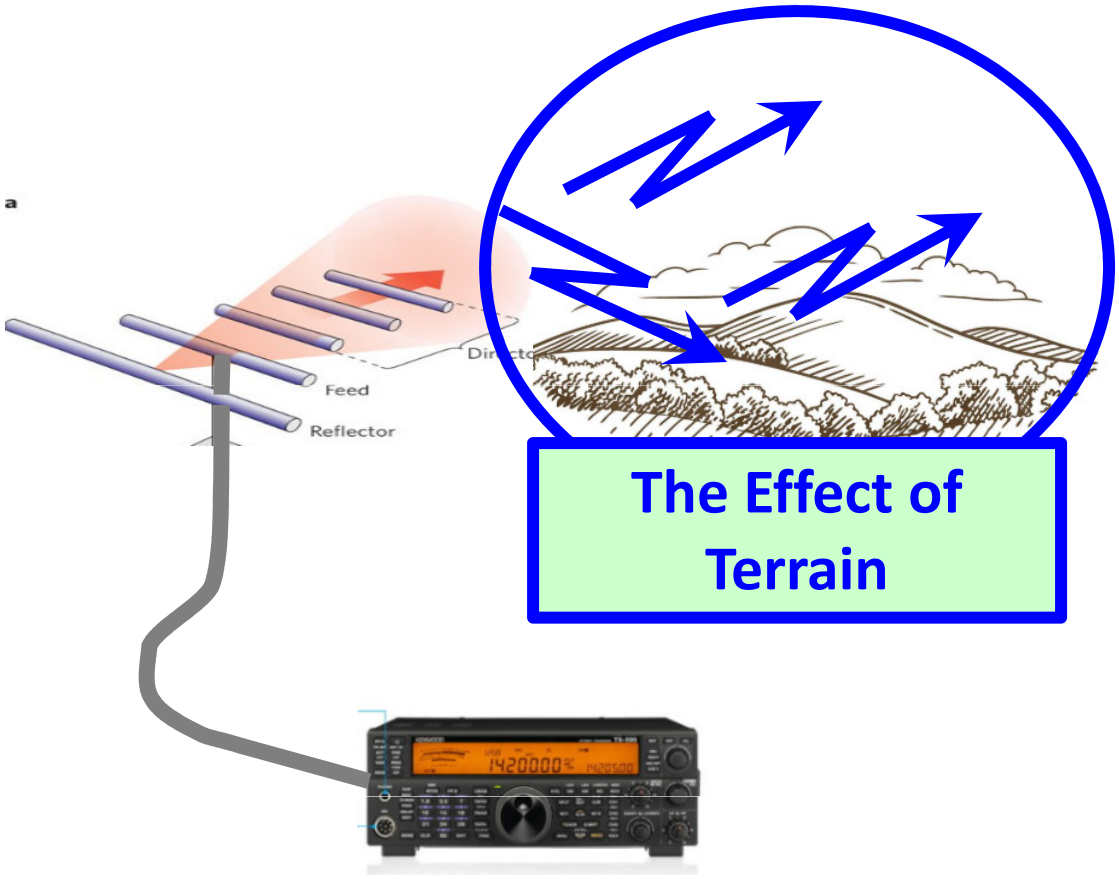


If B-C = 1/2 λ, then the two rays are out of phase, there will be destructive interference >> a null

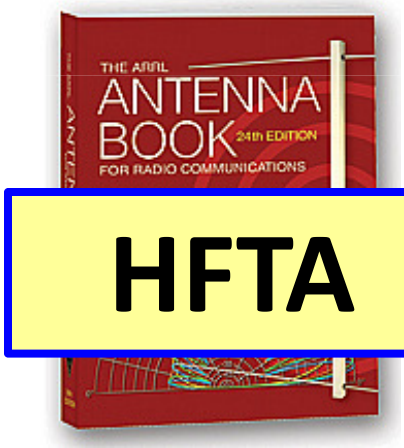
Here B-C is a Shorter Length
Assume ½ λ

Modeling Antenna Systems – II

How Does the Terrain Effect your RF Signal?



The Effect of Terrain



HFTA

OpenHFTA
An open-source rewrite on GitHub

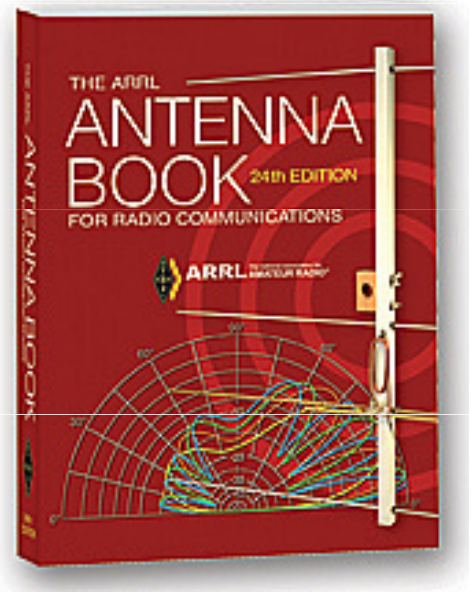
K6TU's TERA
$$$ - But does Verticals

W1DYJ ~ Larry Banks

Modeling Antenna Systems – II

HFTA – High Frequency Terrain Assessment

R. Dean Straw ~ N6BV (SK) ©ARRL



Purpose:

Assesses the effect of uneven local terrain on the transmission and reception of HF signals.

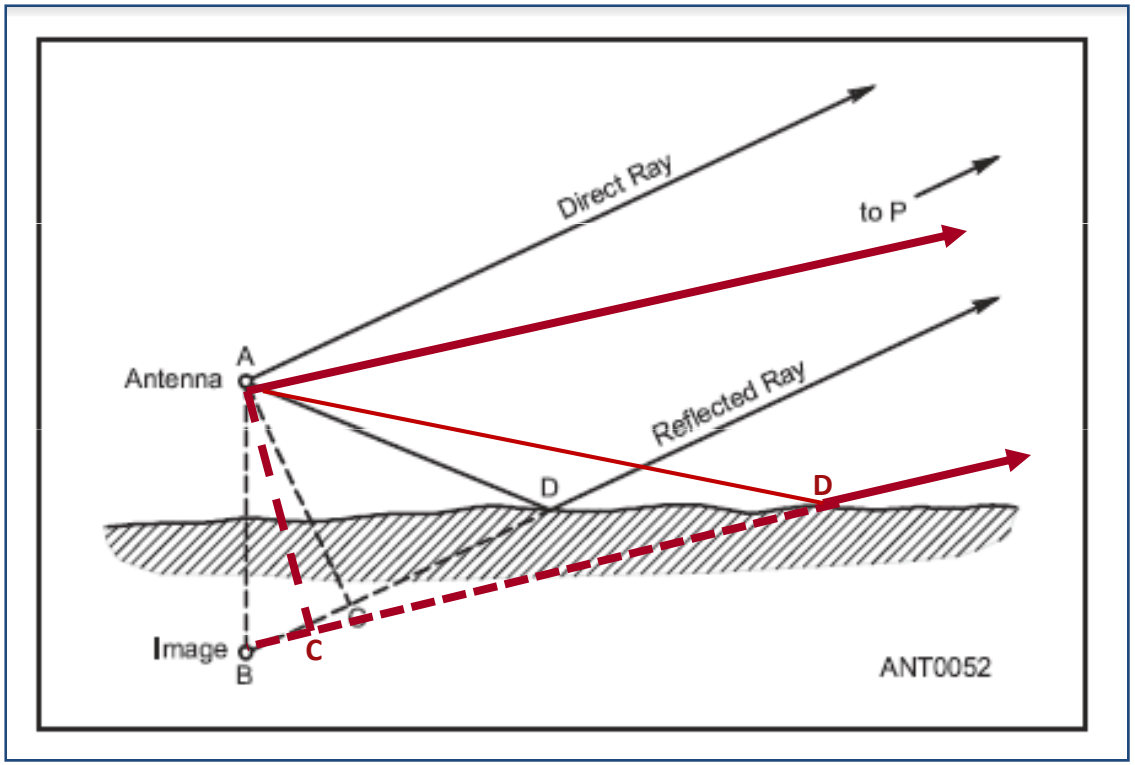
Modeling Antenna Systems – II — *HFTA*

Sub-Agenda

- Overview of HFTA
- What are Elevation Statistics?
- What are Terrain Files?
- Using HFTA

Modeling Antenna Systems – II — HFTA

What problem does HFTA attempt to solve?



Modeling Antenna Systems – II — HFTA

What problem does HFTA attempt to solve?

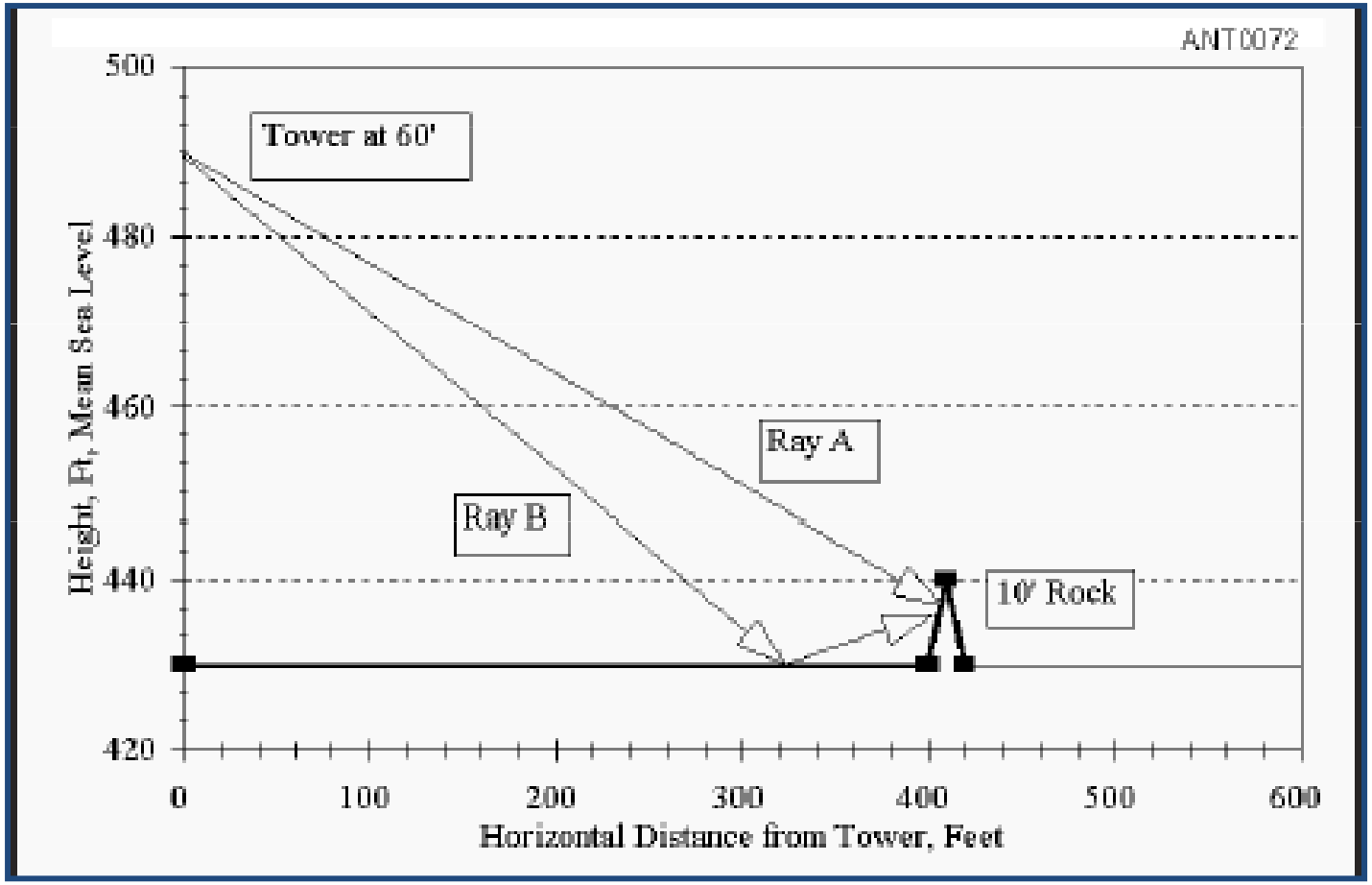


Fig 14.30 ©ARRL Antenna Book

Modeling Antenna Systems – II — HFTA

What problem does HFTA attempt to solve?

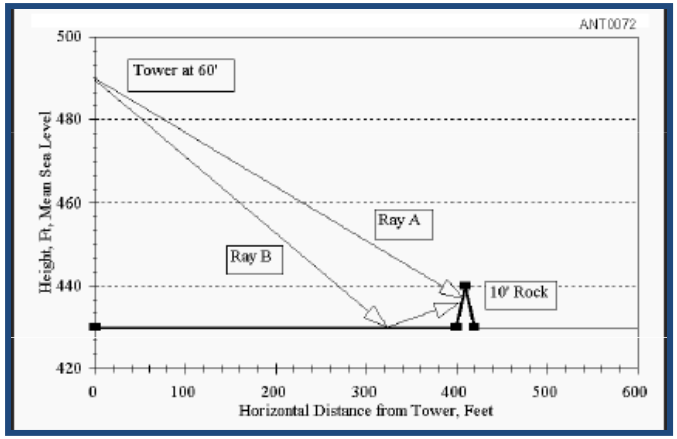


Fig 14.30 ©ARRL Antenna Book

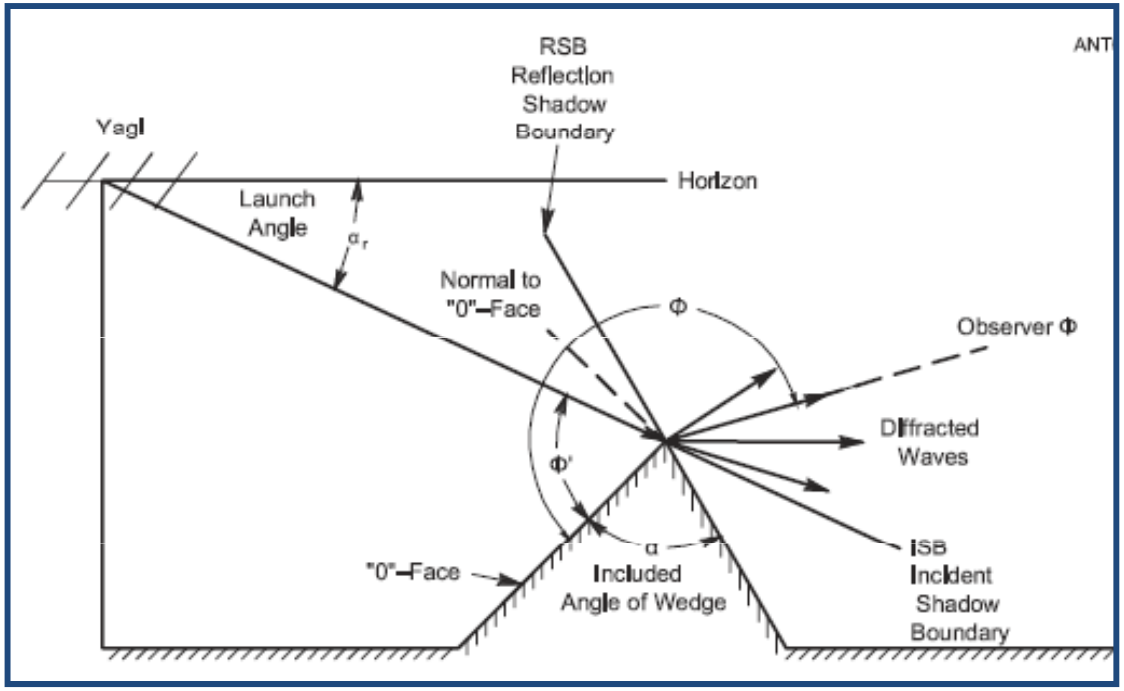


Fig 14.29 ©ARRL Antenna Book

HFTA takes into account diffraction and reflections with your local terrain

Modeling Antenna Systems – II — HFTA

Attributes

- HFTA is a ray-tracing program designed to evaluate the effect of foreground terrain on the elevation pattern of up to four multi-element HF monoband Yagis in a stack.
- Models horizontally polarized Yagis, and "works" with simple horizontal dipoles
- Takes into account the effects of horizontal ground-reflection and diffraction
- Includes ***Elevation Statistics Files***
- Windows version of an earlier DOS program "YT"

Modeling Antenna Systems – II — HFTA

Limitations

- Does not work with vertical polarization
- Free-space gain assumed for default Yagis:
  example: 4-el model is 8.5 dBi
- Does not take into account mutual impedance ground effects
- Uses only the terrain data in one direction

Additional Requirement

- Requires a *local terrain data file*

Modeling Antenna Systems – II — HFTA

Sub-Agenda

- Overview of HFTA
- **What are Elevation Statistics?**
- What are Terrain Files?
- Using HFTA

Modeling Antenna Systems – II — HFTA

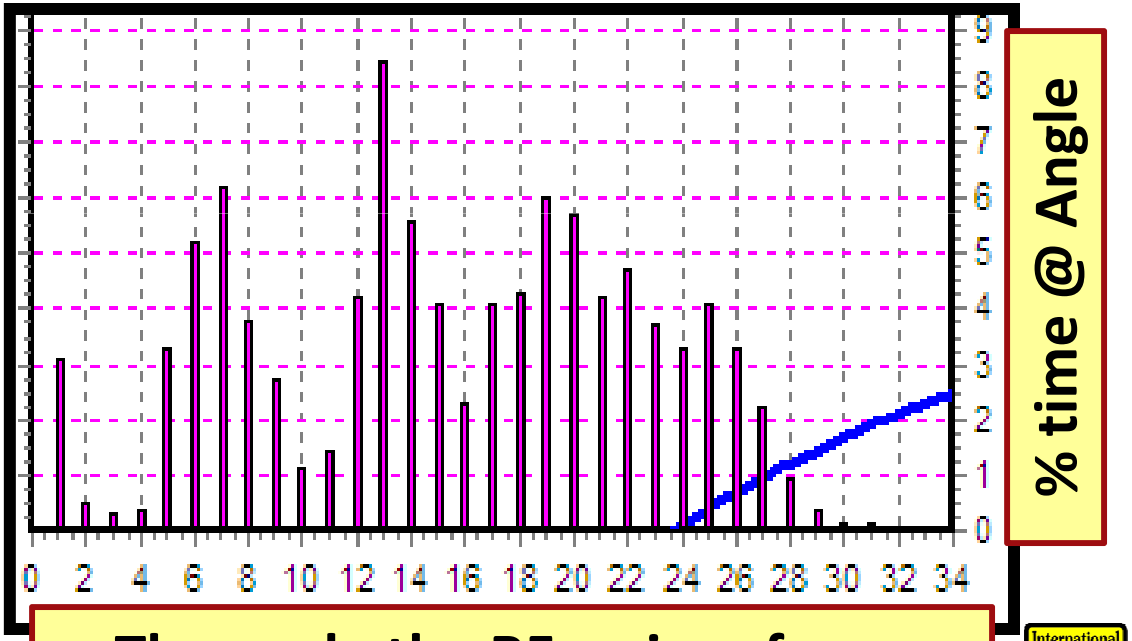
What are Elevation Statistics?

Fundamentally → Where is the DX?

At what angle (from the horizon) does the RF arrive?

Remember this simple truth:

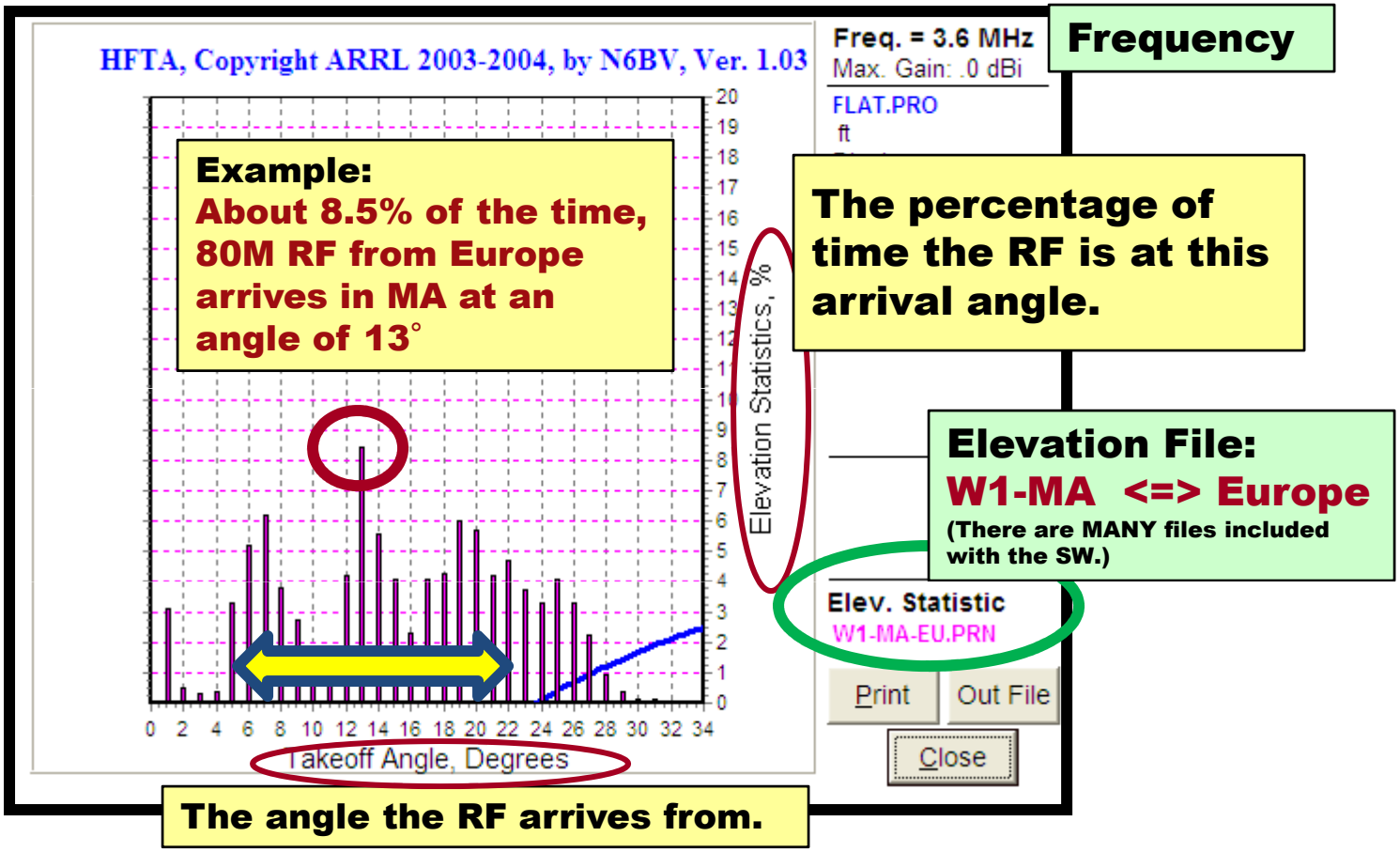
The ionosphere controls the elevation angle of the received RF at your location, not your antenna!



Modeling Antenna Systems – II — HFTA

Note:
This data is an overall average of all time; i.e. for any time, any day, any season, any part of the 11-year sunspot cycle.

Specific propagation "today" will be very limited in angle.



Frequency

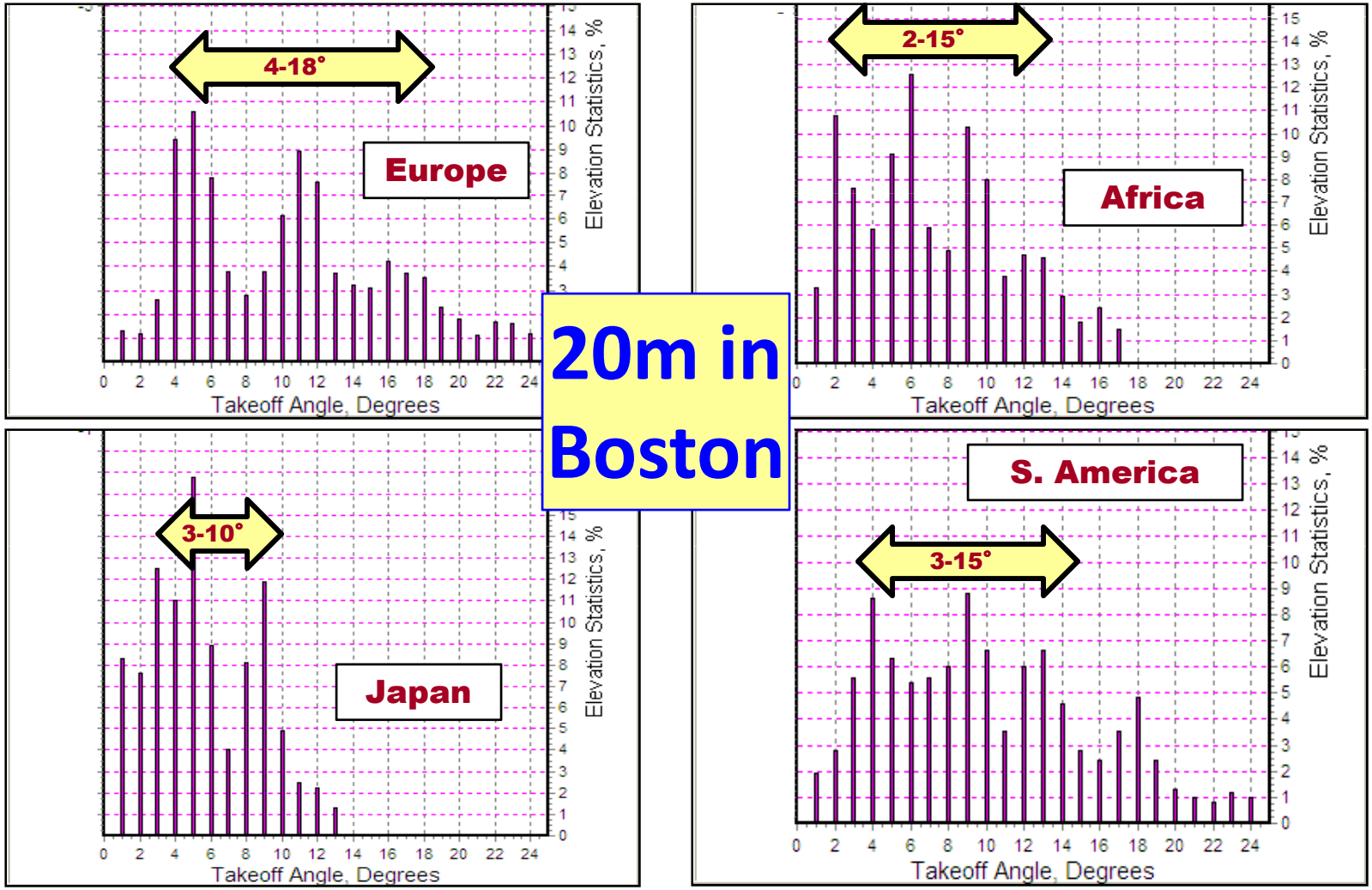
The percentage of time the RF is at this arrival angle.

Elevation File:
W1-MA <=> Europe
(There are MANY files included with the SW.)

The angle the RF arrives from.

Conclusion, <u>from this one graph</u>:
About 80% of the time, European 80M RF arrives at arrival angles between 5 → 22°

Modeling Antenna Systems – II — HFTA



Modeling Antenna Systems – II — HFTA

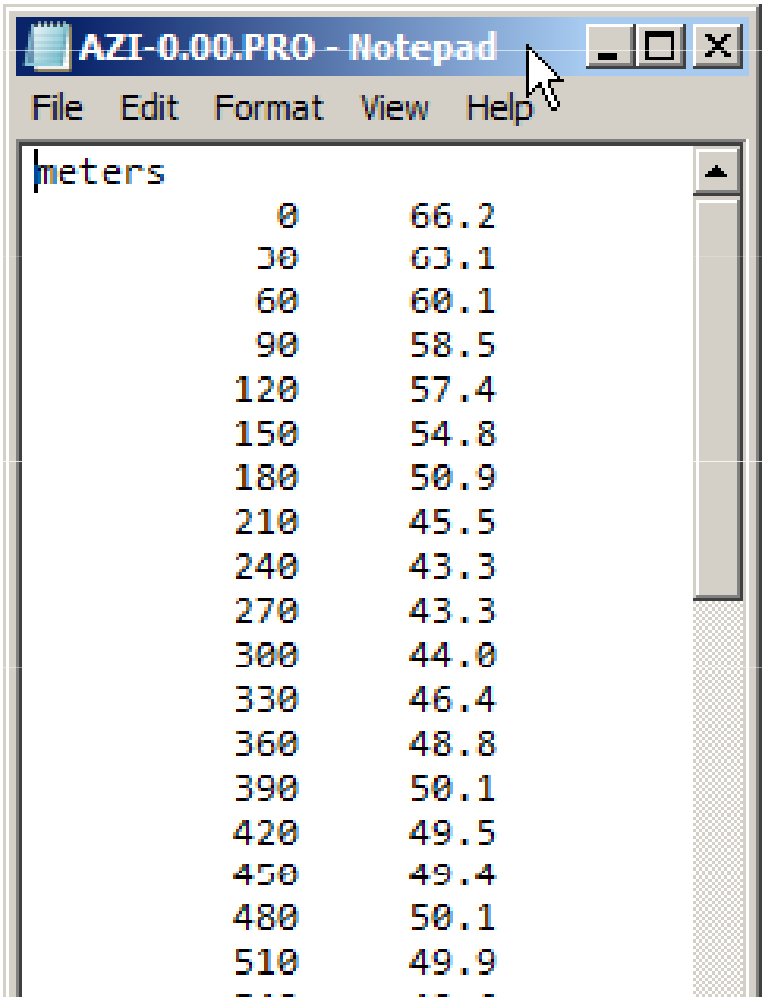
Sub-Agenda

- Overview of HFTA
- What are Elevation Statistics?
- **What are Terrain Files?**
- Using HFTA

Modeling Antenna Systems – II — HFTA

What are Terrain Files?

ASCII files that describe the terrain profile in all 360° directions from your antenna site.



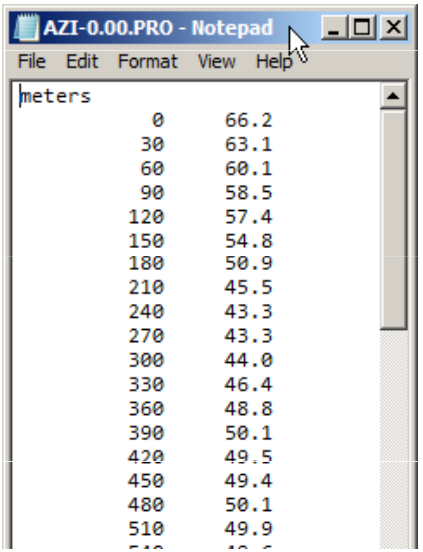
Modeling Antenna Systems – II — HFTA

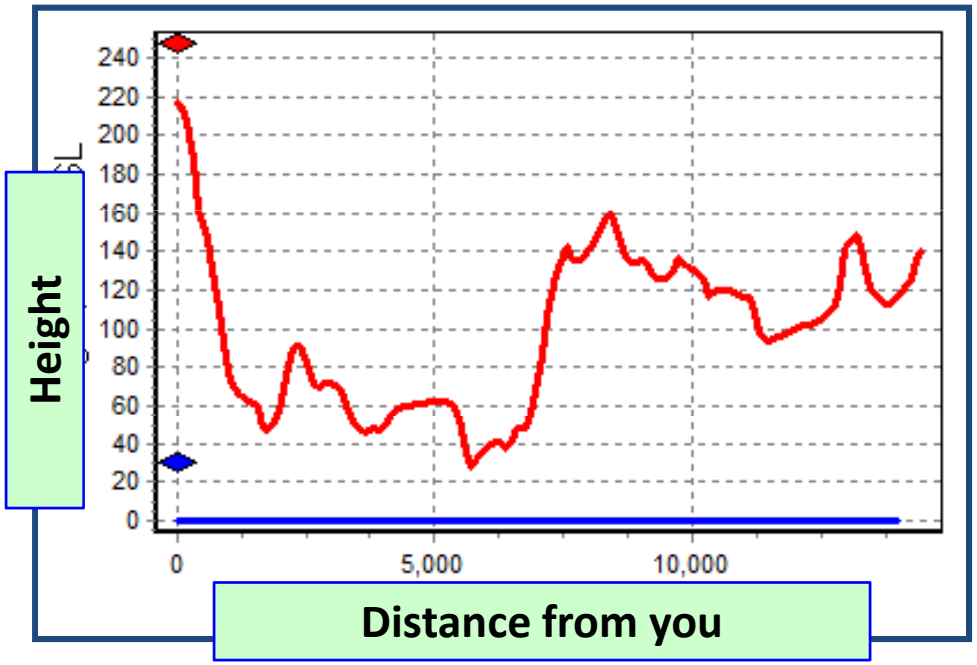
What are Terrain Files?

It used to be difficult to obtain:

- *Measure from a topo map*
- *Pull from xxx.gov web site*
- *Use MicoDEM to generate*

ASCII files that describe the terrain profile in all 360° directions from your antenna site.





Modeling Antenna Systems – II — HFTA

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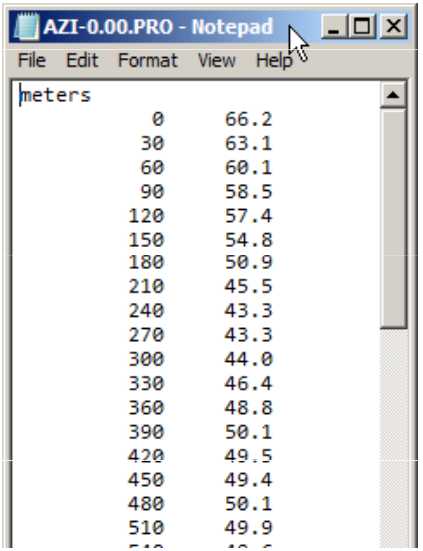
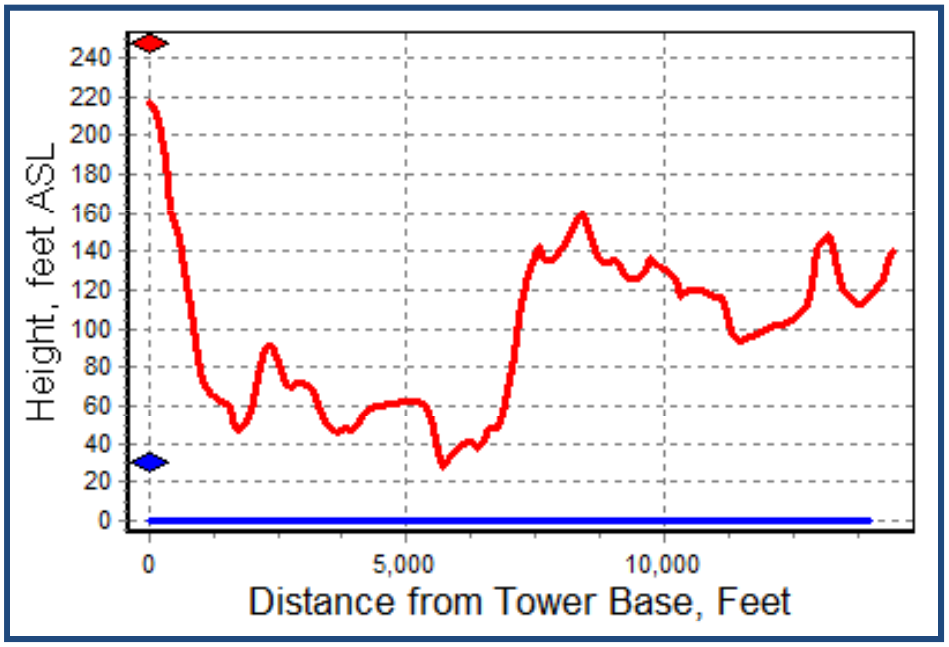




Now it's easy:

- *https://paas.k6tu.net*
- *Create a free account*
- *>> HF Terrain Analysis*
  - *At bottom under "Documentation"*
- *Read directions & request a Profile*
- *Download*

Modeling Antenna Systems – II — HFTA

Sub-Agenda

- Overview of HFTA
- What are **Elevation Statistics**?
- What are **Terrain Files**?
- **Using HFTA**

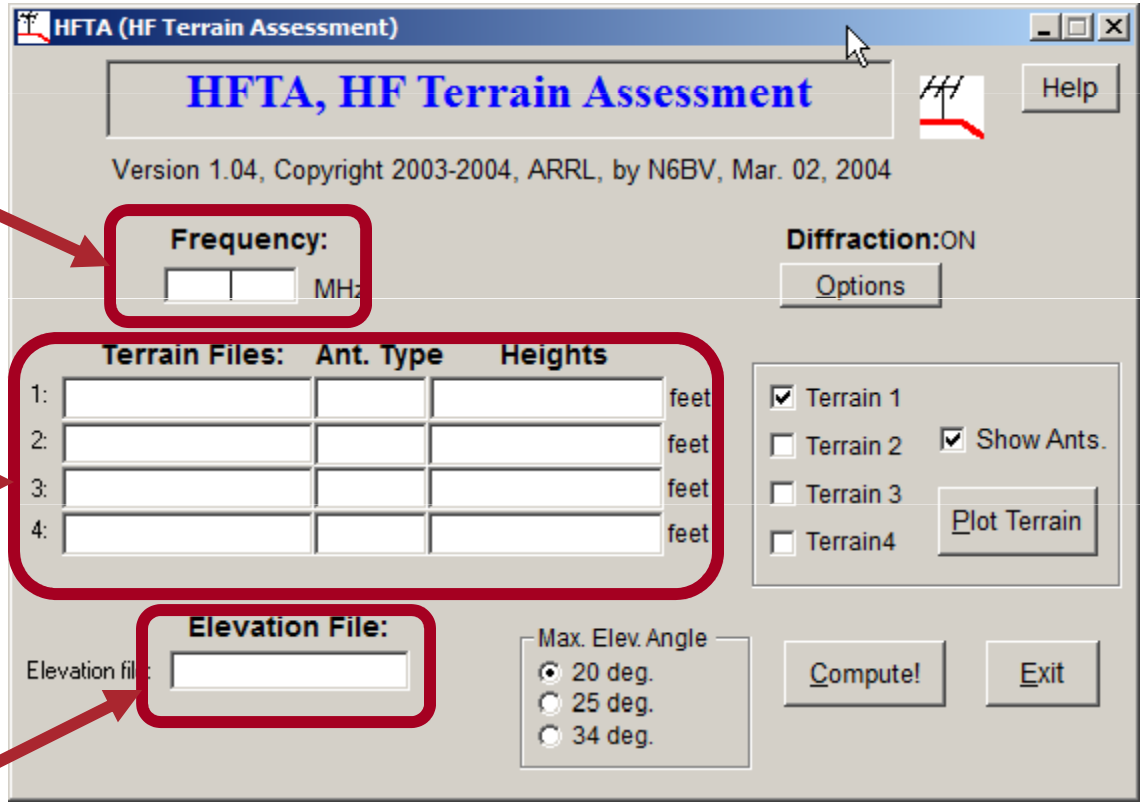
Modeling Antenna Systems – II — HFTA

Initial Screen

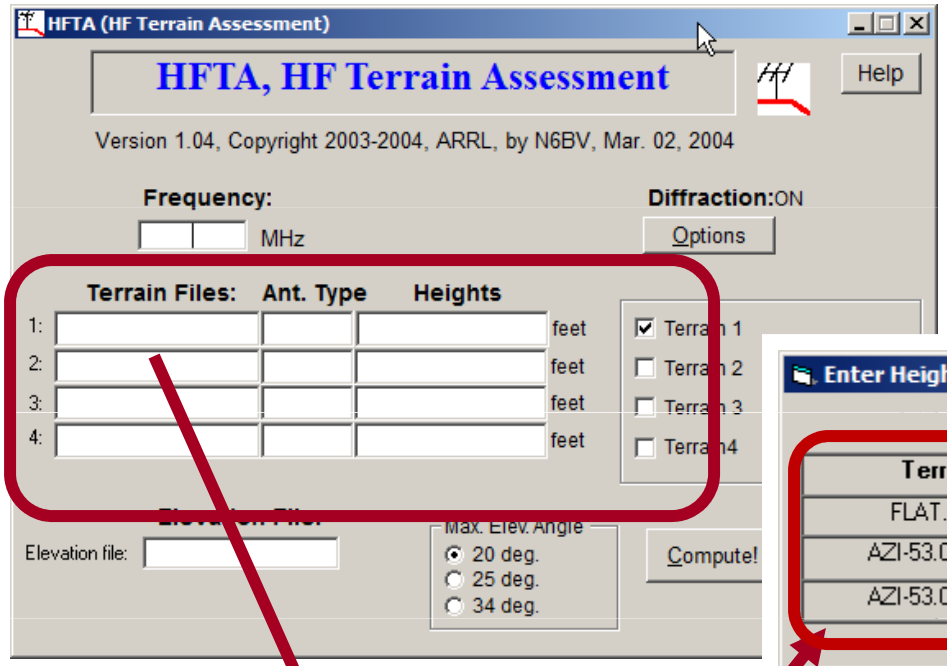
Enter the frequency of interest

Select your terrain file, antennas, & heights

Choose one of HFTA's elevation statistic files

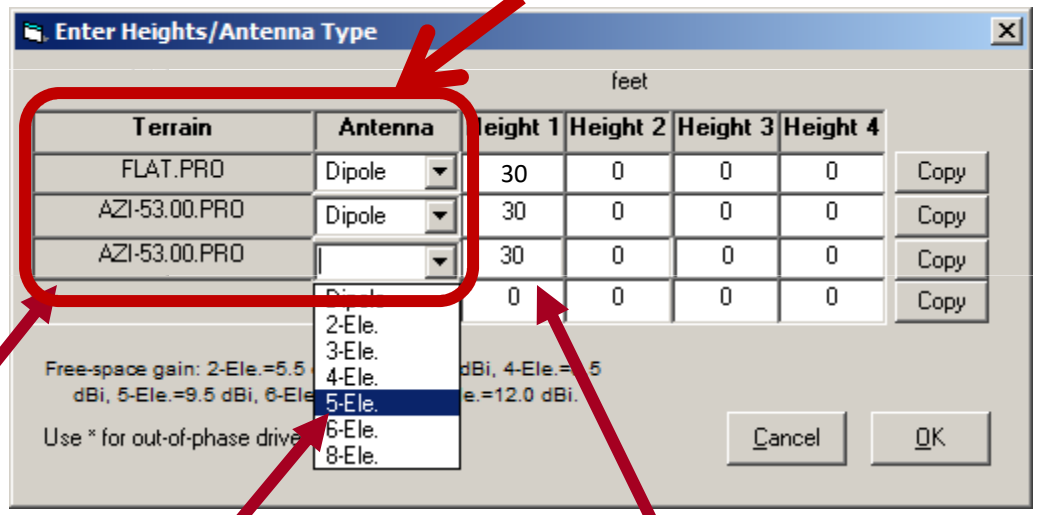


Modeling Antenna Systems – II — HFTA



Select Antenna Types & Heights

FLAT.pro	Dipole
AZI-53.00.pro	Dipole
AZI-53.00.pro	5-el

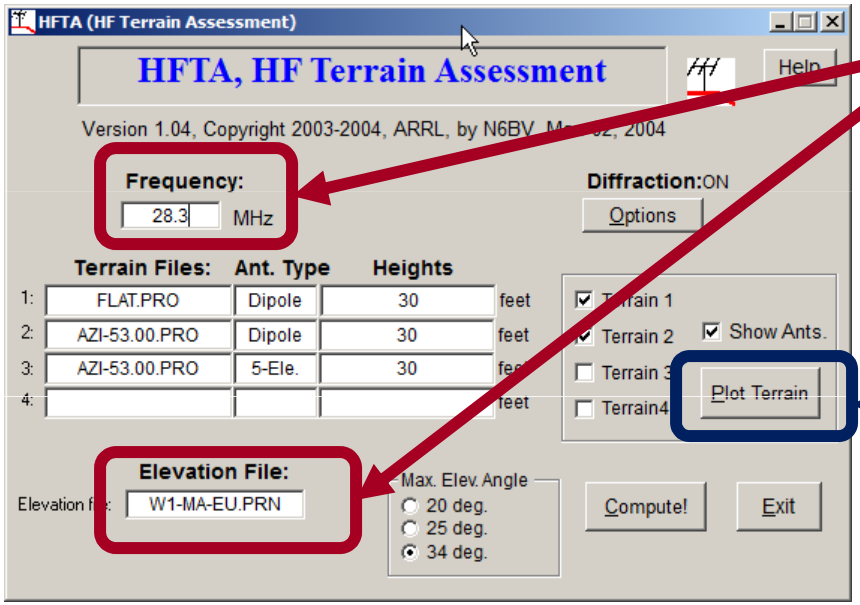


Clicking here opens up the folder with *your* terrain files

Then select the antenna type…

…and enter the height

Modeling Antenna Systems – II — HFTA

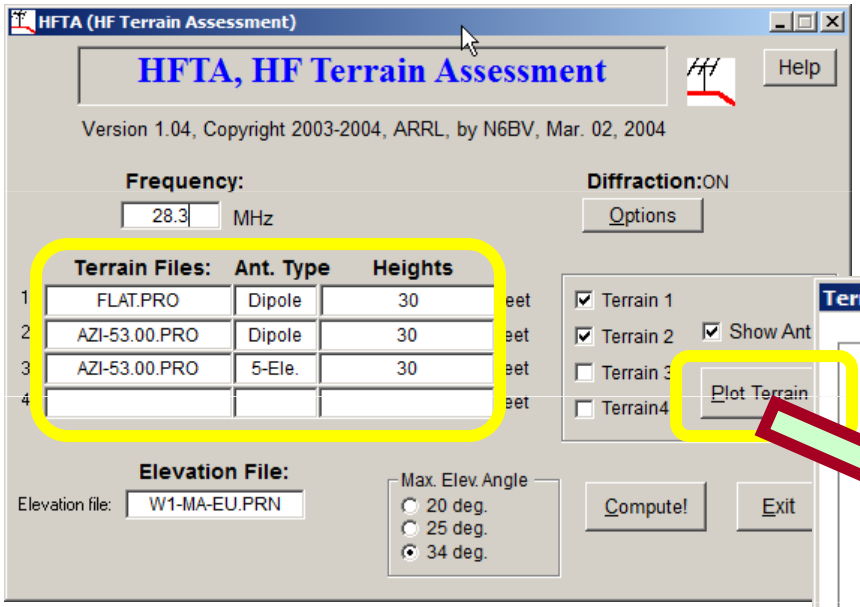


Enter Freq / Select Elevation File

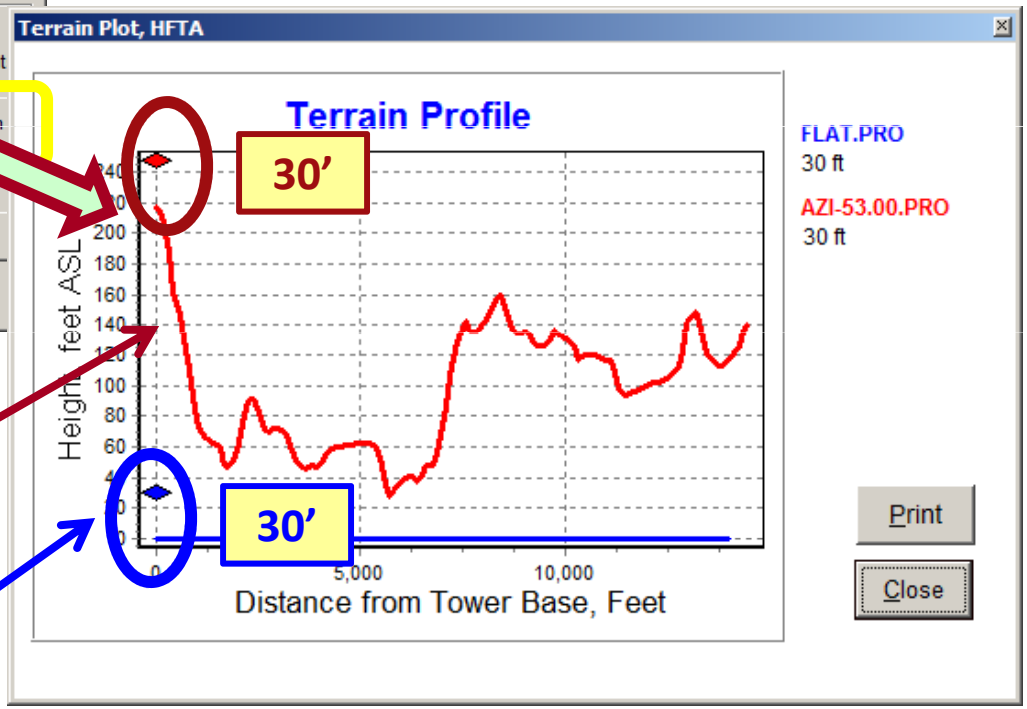
As a check, first click on *Plot Terrain*

Elevation File:
W1-MA <=> Europe

Modeling Antenna Systems – II — HFTA



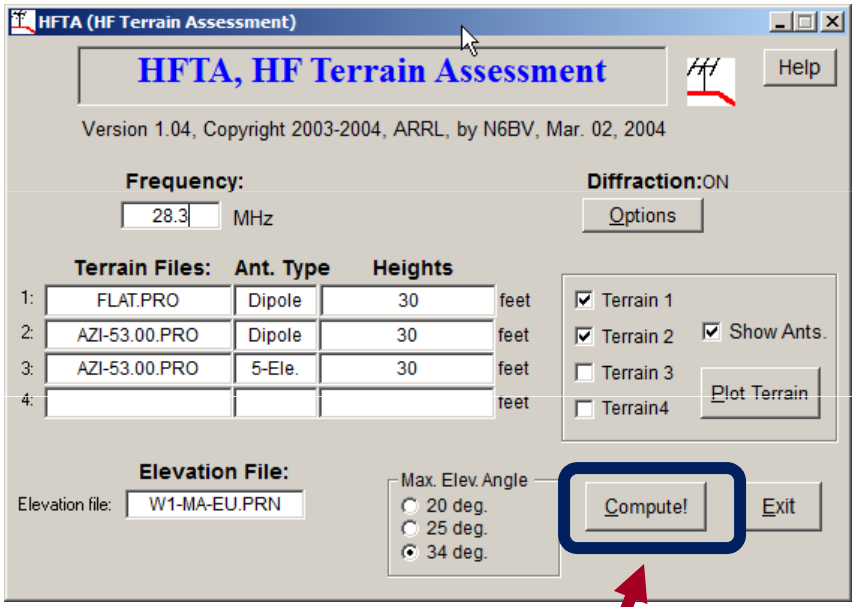
Terrain from
W1DYJ @ 53°→ England



AZI-53.pro

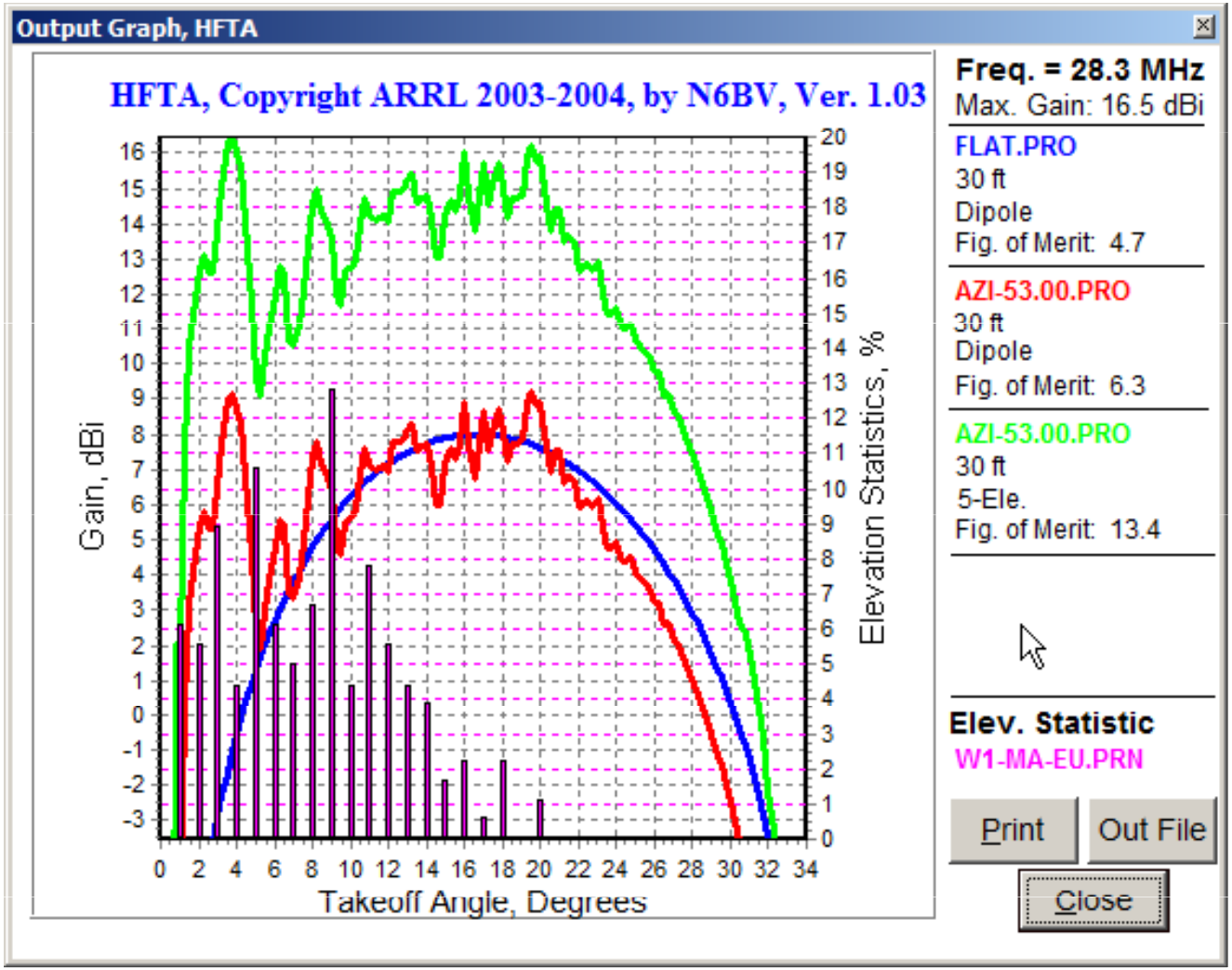
Flat.pro

Modeling Antenna Systems – II — HFTA

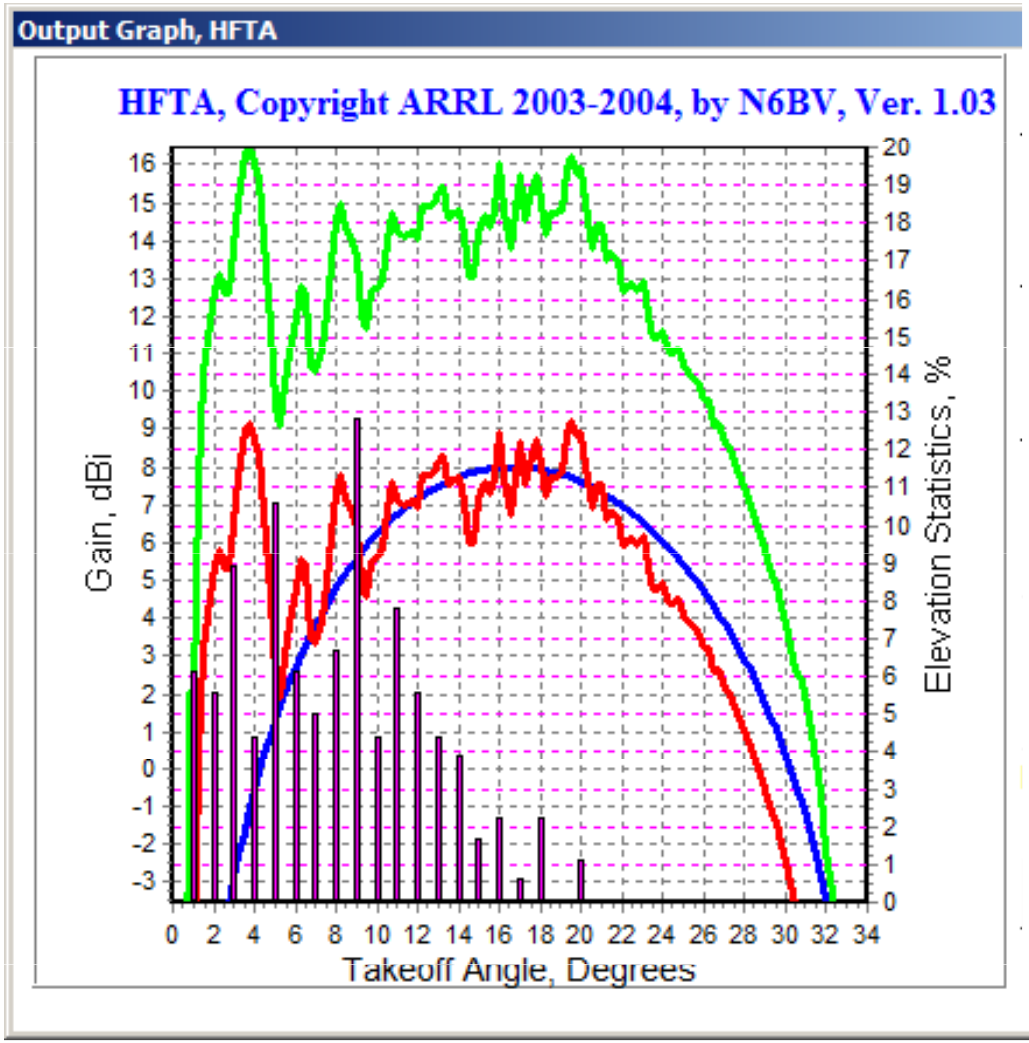


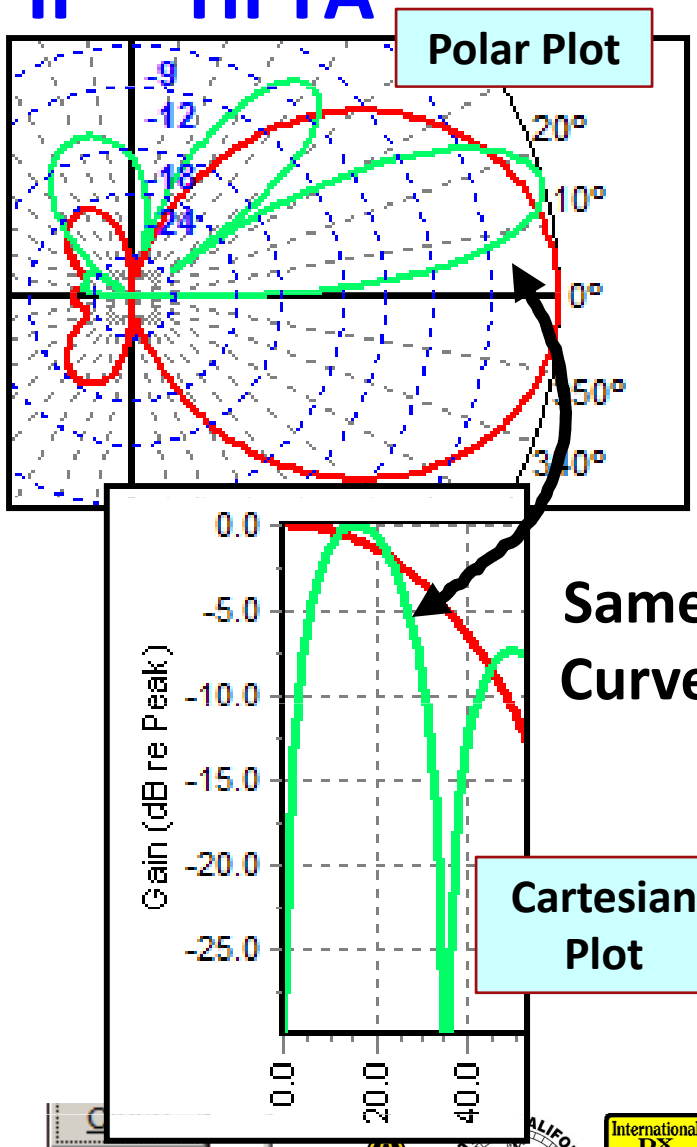
Then: Compute

Modeling Antenna Systems – II — HFTA

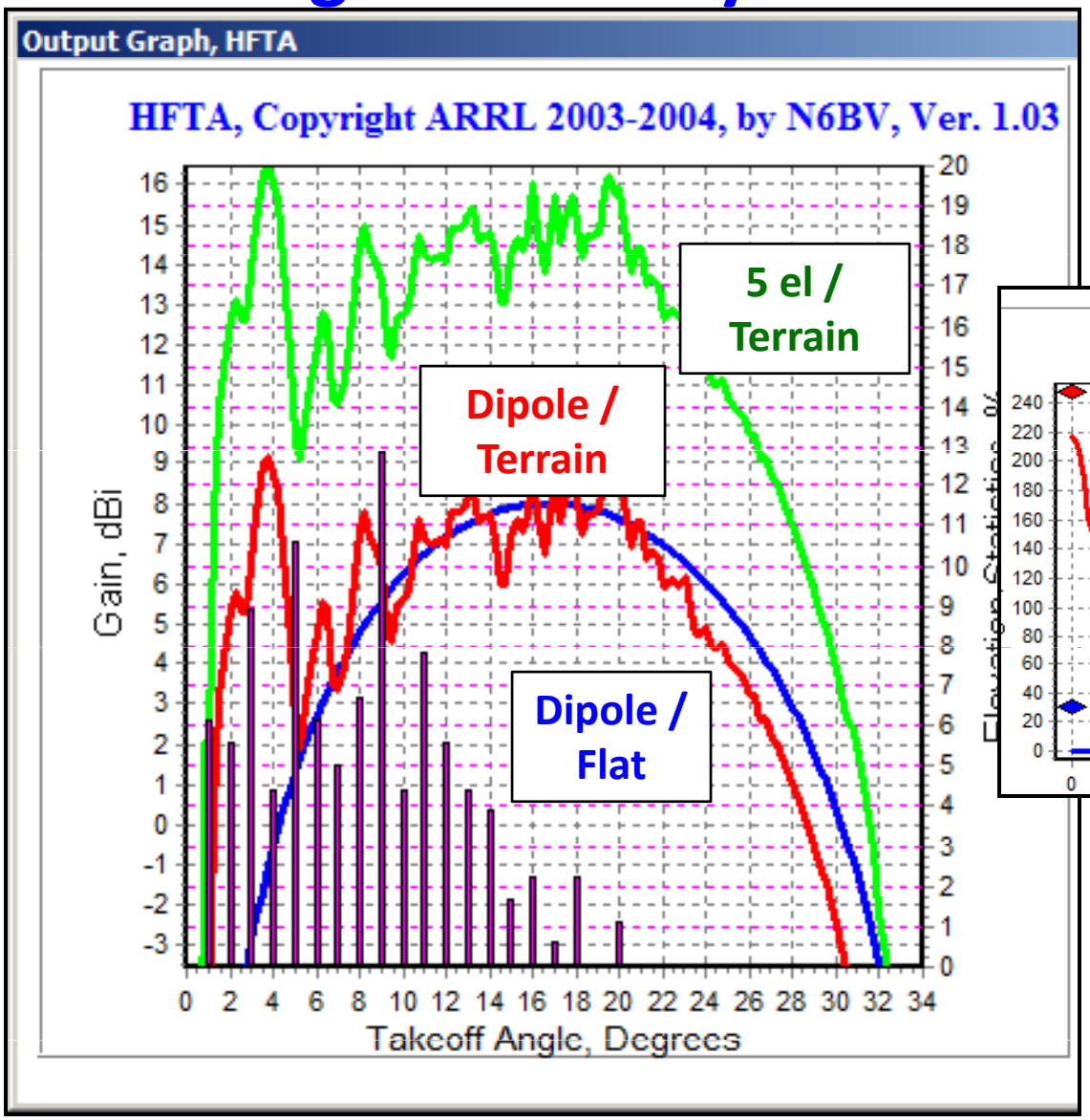


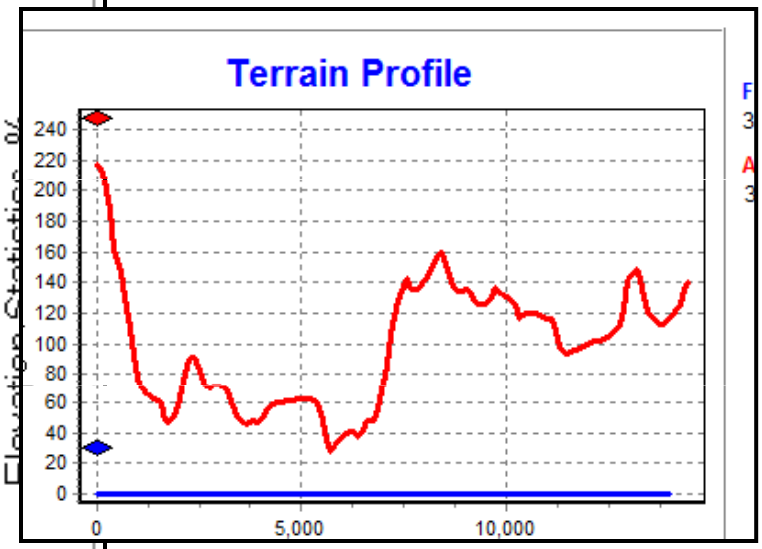
Modeling Antenna Systems – II — HFTA



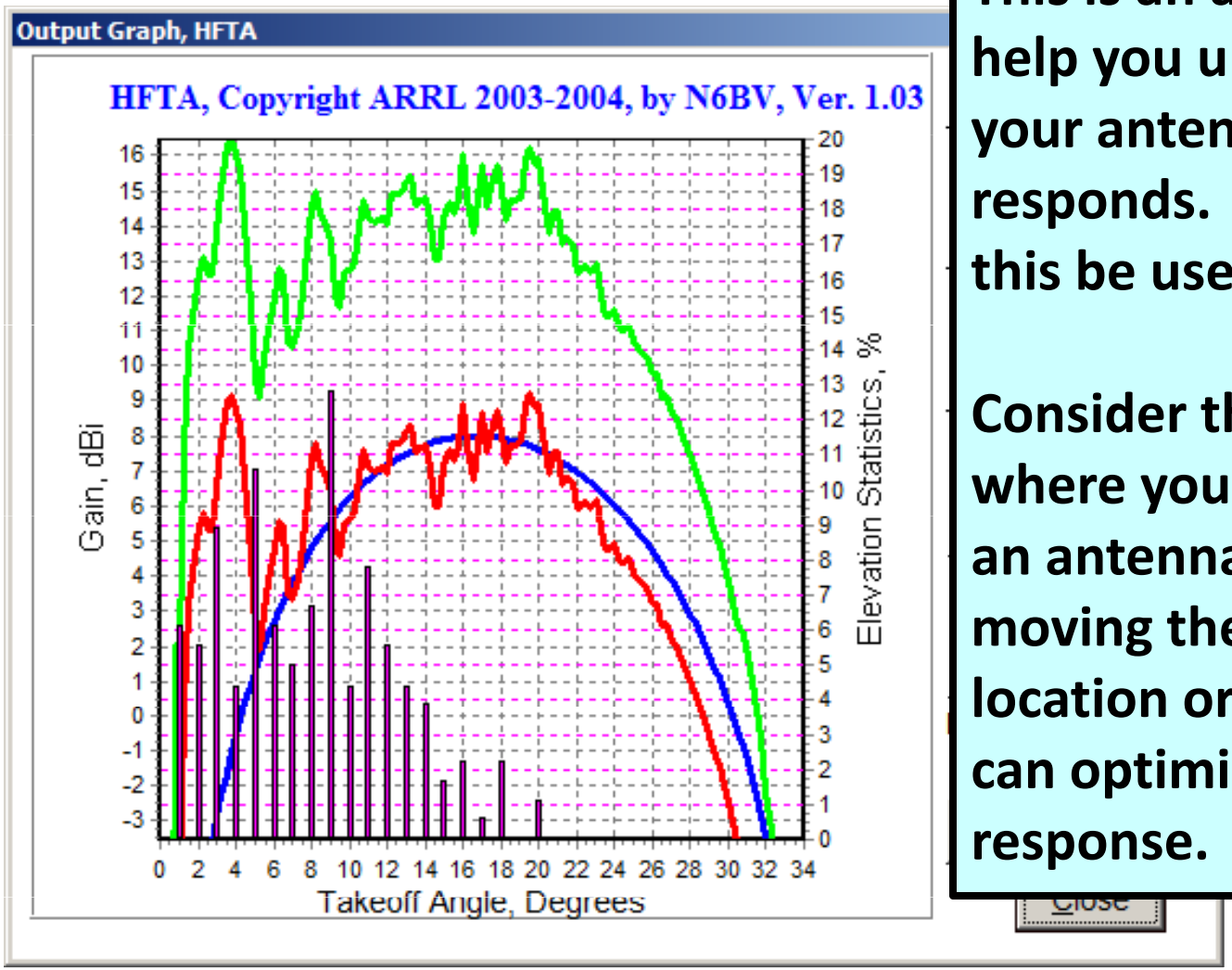


Modeling Antenna Systems – II — HFTA





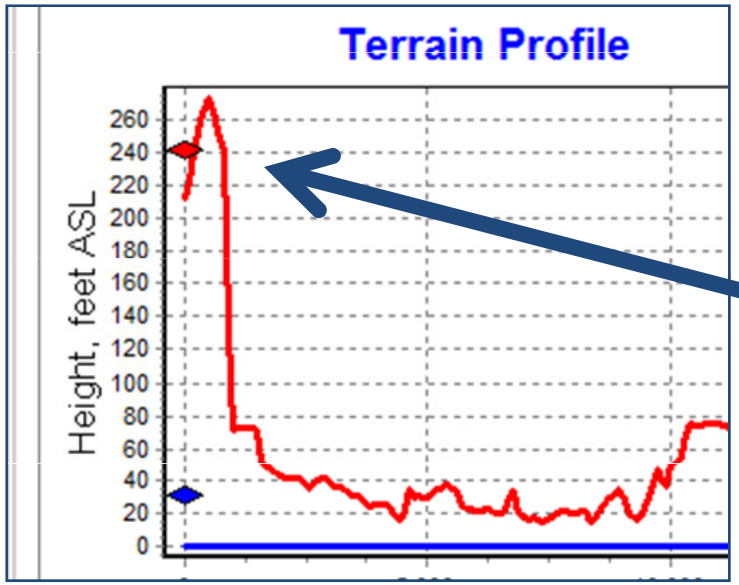
Modeling Antenna Systems – II — HFTA



This is an analysis. It will help you understand how your antenna system responds. But how can this be useful?

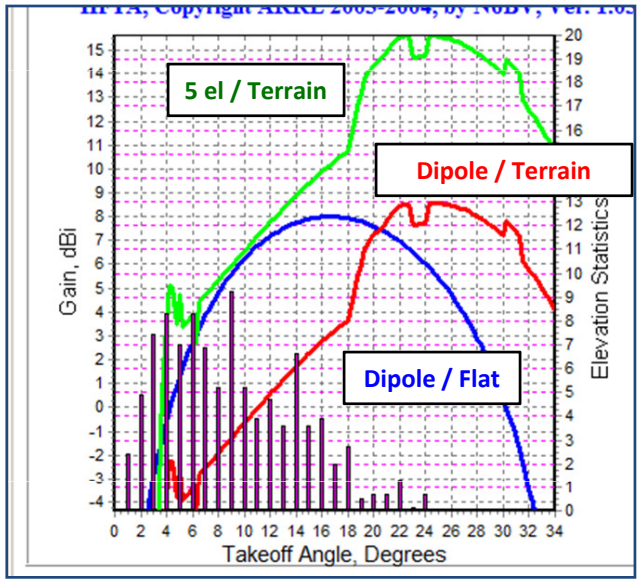
Consider the situation where you are DESIGNING an antenna system. By moving the tower location or height, you can optimize this response.

Modeling Antenna Systems – II — HFTA



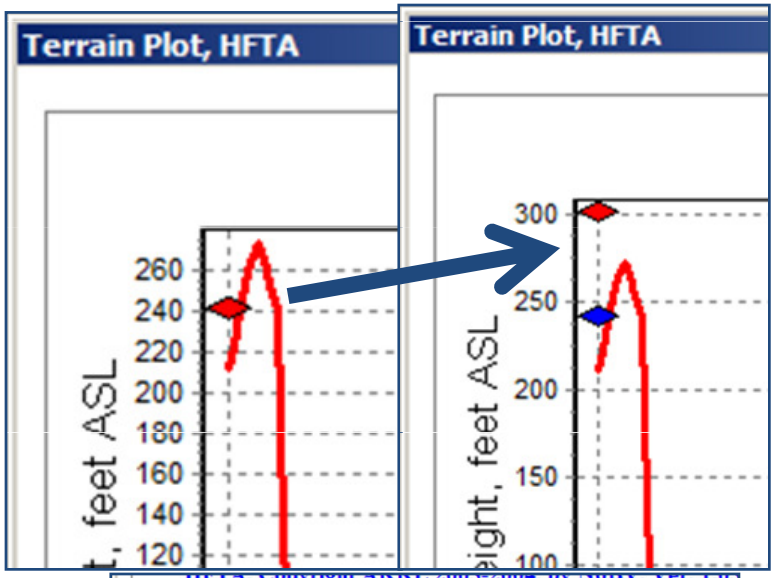
HB 5 el 10M Yagi @ 33 BBHR

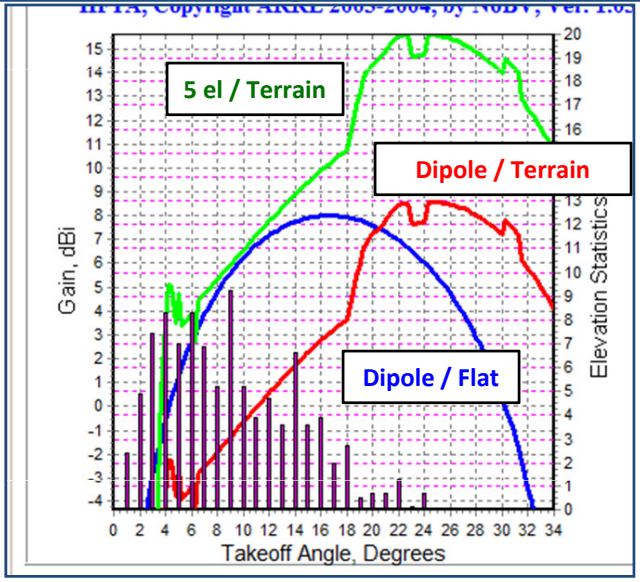
Note that my Yagi is BEHIND the hill to my south…



…and as a result, the Yagi's response is where there are no signals being receive from South America

Modeling Antenna Systems – II — HFTA

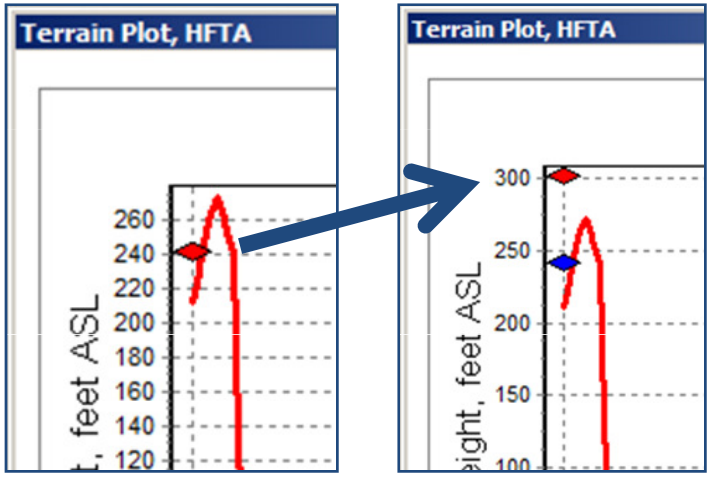




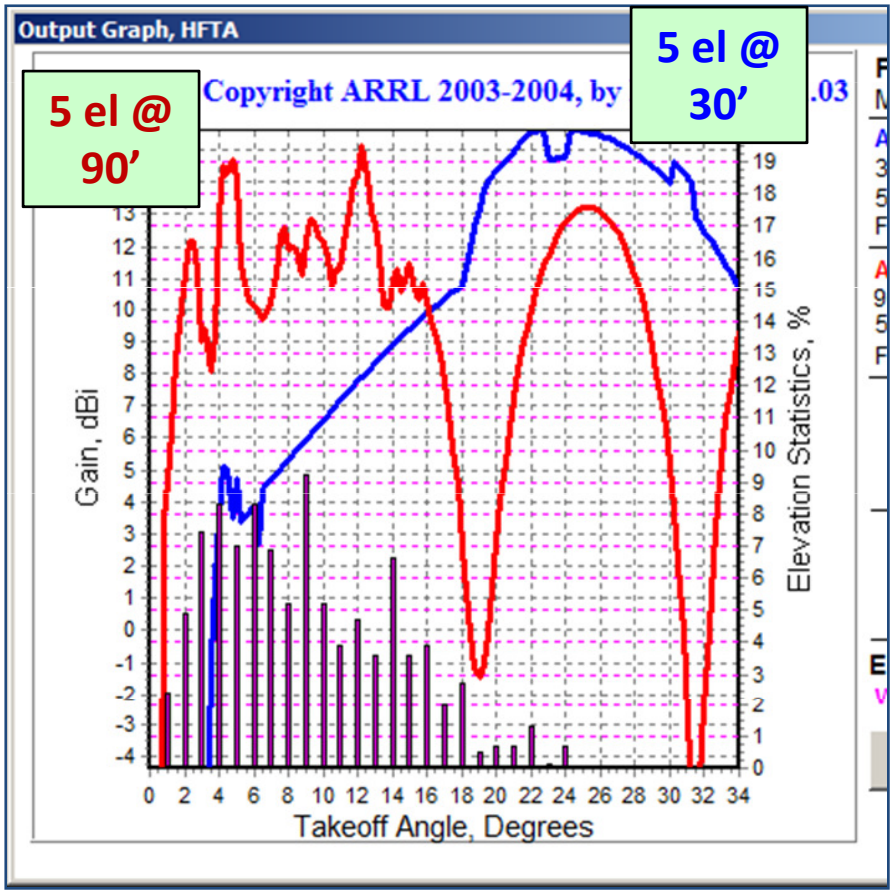
Example: How to improve my 10M Yagi to South America

Increase antenna height: 30' → 90'

Modeling Antenna Systems – II — HFTA

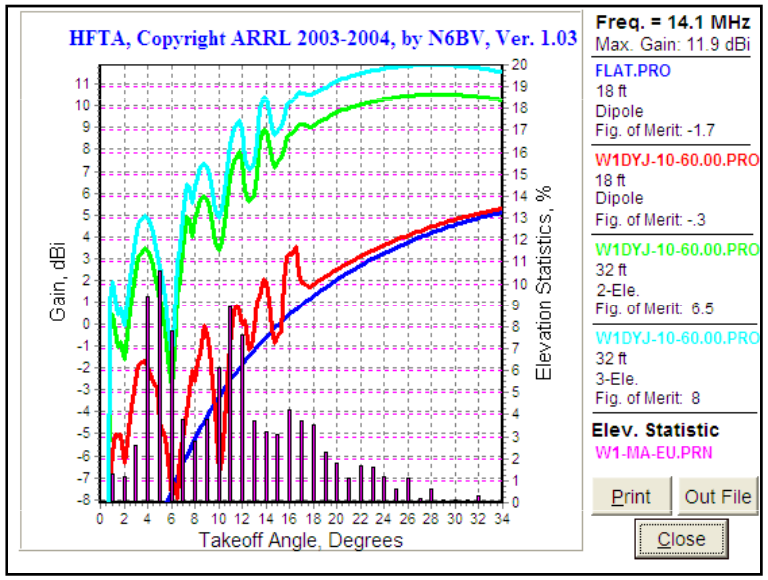


Increase antenna height: 30’ → 90’



Modeling Antenna Systems – II — HFTA

Lots of steps. Uses standard Yagis. Helps you understand your local terrain's effects to plan/assess your antenna system.



Modeling Antenna Systems – II

- **You Can't Beat Physics**
  - Understanding antenna systems
    - EFFECTS OF TRANSMISSION LINES
    - LOCAL TERRAIN
  - ✓All antennas are COMPROMISES
  - ✓All models are SIMPLE EXAMPLES of reality
  - ✓Your real antenna WILL NOT MATCH your model

Modeling Antenna Systems – II

Summary

We've looked at:

TLW – Transmission Lines

HFTA – Effects of Terrain

We've seen how these software programs can be used to analyze and plan your antenna systems

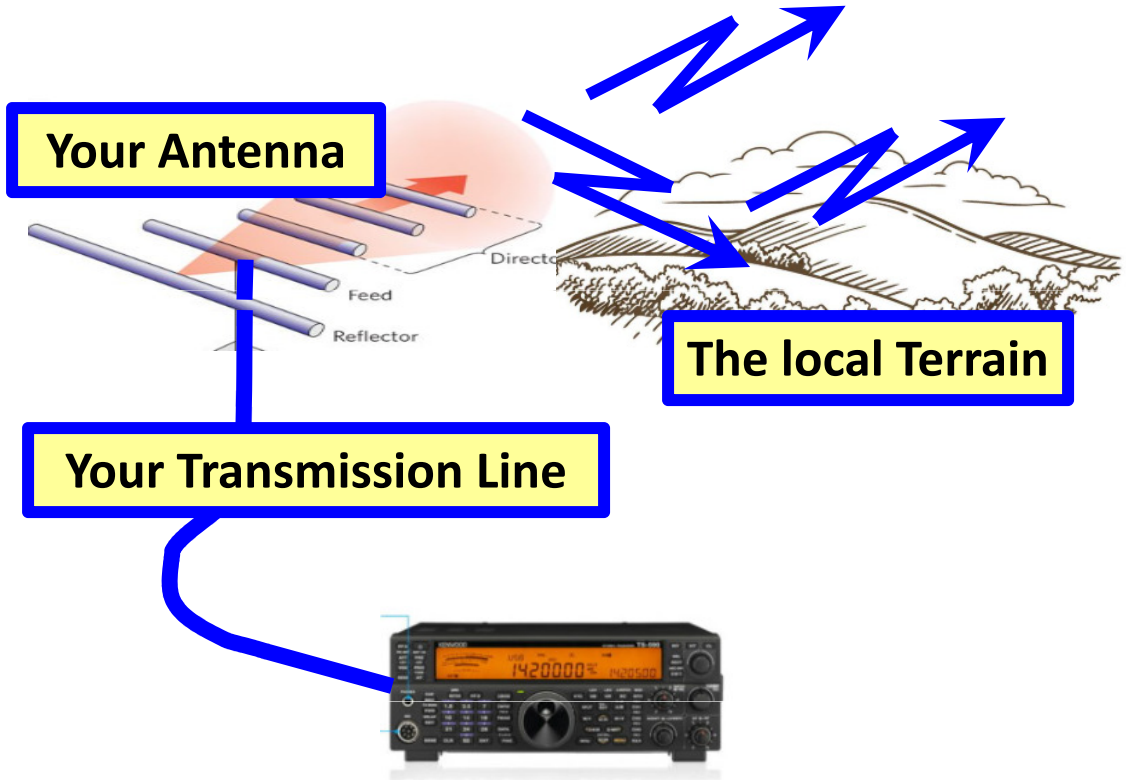
Questions???

"All models are wrong. Some are useful"

British Statistician *George Box*, 1976

Modeling Antenna Systems – II

Your Antenna System is the second most important part of your station.

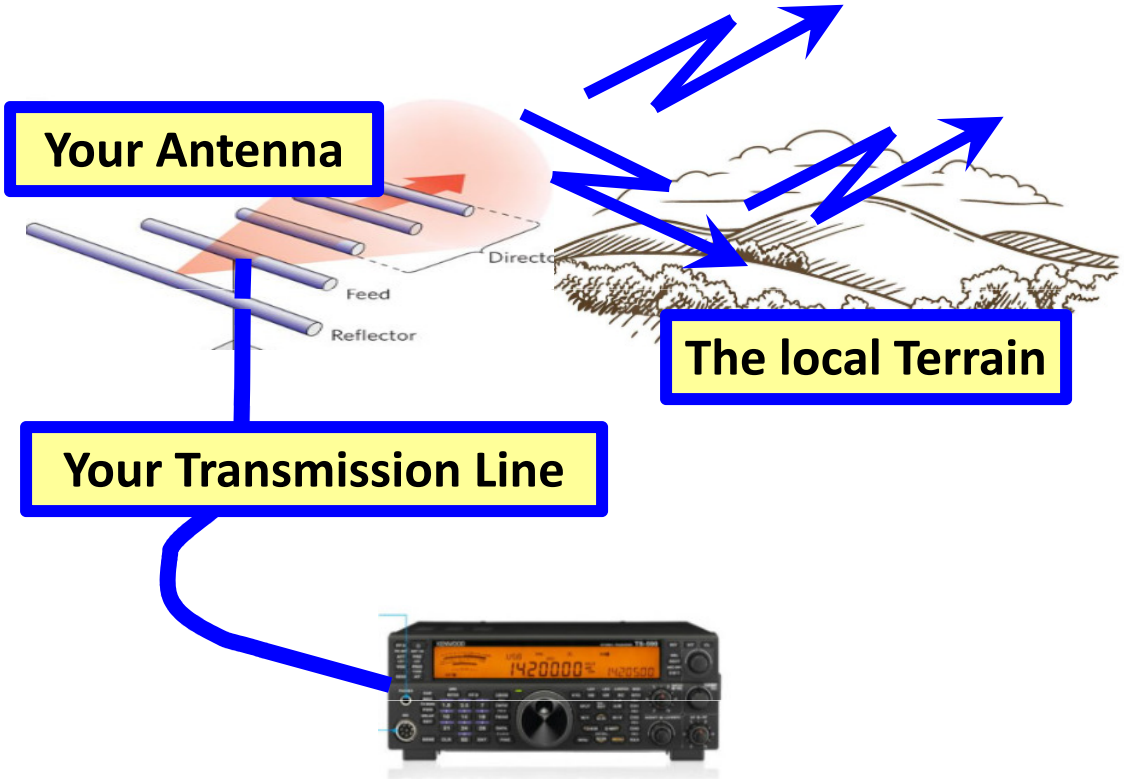


QUIZ #3

What is the most important part of your station?

Modeling Antenna Systems – II

Your Antenna System is the second most important part of your station.



The most important is what's between your ears!

Thank You!

Appendix

- Abstract / Bio
- W1DYJ History
- W1DYJ Logger Qs
- W1DYJ Antennas
- W1DYJ Terraine

https://www.qsl.net/w1dyj/

Abstract Antenna Modeling Part II
Transmission Lines and the Effect of Terrain

Your Antenna System is the second most important part of your station. This presentation will help you learn how to analyze your antenna transmission line system (using TLW) and understand the effect of your local terrain (using HFTA.)

Licensed in 1961 as novice KN1VFX, Larry became W1DYJ in 1966. With three EE degrees from MIT, he spent his professional career from 1969 to 1993 developing and managing diagnostic cardiac systems for Hewlett-Packard Medical R&D. He then moved to HR to provide project management, technical, and OSHA training for HP Medical and then Agilent when it spun off in 1995. Starting in 2001 Larry managed Agilent's, and Avago/Broadcom's WW Learning Management Systems, finally retiring in 2012. He now spends his time chasing DX and contesting in Woburn, MA, playing with antennas, traveling with his wife Maren, and attending jazz and classical concerts. He is the net manager and newsletter editor for the MMRA, publications editor for HamXposition, and a member of the YCCC.

My History

- Mom was a high School cafeteria worker. Dad was an electrician and had a dual workshop: ***woodworking*** and ***electronics*** , my two continuing favorite hobbies. They both highly valued education.
- As a kid: I "played" in his workshop, had an erector set,
  and read all the Tom Swift books…
- Built a crystal radio when I was 12 (1958) –the first station heard was the BBC
  and I was hooked on radio.
- Obtained my ham radio license at 15 in 1961 (a junior in HS).
- Went to MIT (SBEE'67, SMEE'69, EE'70)
  in part because of my ham radio experience.
- Hired (1969) by HP Medical (Waltham/Andover MA) developing hospital cardiac instrumentation (electrocardiographs, then real-time cardiac ultrasound)
  in part because of my practical experience with ham radio.
- Moved to HP/Agilent Corp Ed (project management experience) in 1993
- "Retired" in 2005 when Agilent split up; then part-time consulted for Avago (now Broadcom) as their eLearning platform WW Program Manager
- Finally retired (for real) in 2012 – now play with ham radio

My Logged Qs ...as of 6 August 2026

Mode	#	1st Q		BND	#Qs FT8
FT4	652	8/2019			
FT8	**7288**	**8/2017**	>>>>>>>>>>>	160	443
JT65	97	6/2017		80	498
MSK144	1	5/2017		60	330
PSK31	63	5/2003		40	446
PSK63	1	3/2017		30	589
Q65	1	8/2024		20	407
RTTY	11741	1/2017		17	449
==========				15	482
Total digital	19849			12	423
				10	490
PH	29422	7/1994		6	2098
CW	21076	9/2014		2	557
FM	86	11/1993		0.7	76

Total Qs 70315

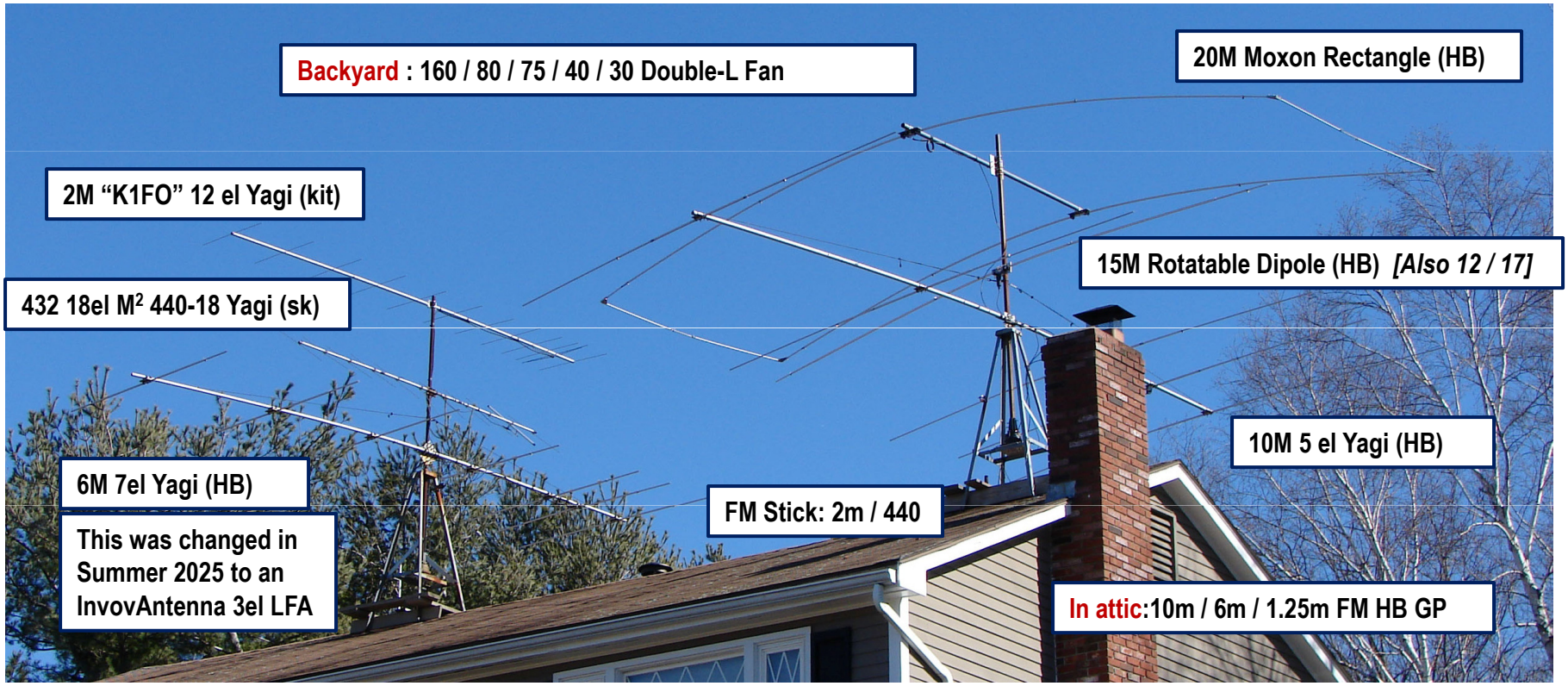
W1DYJ Antennas in Woburn MA



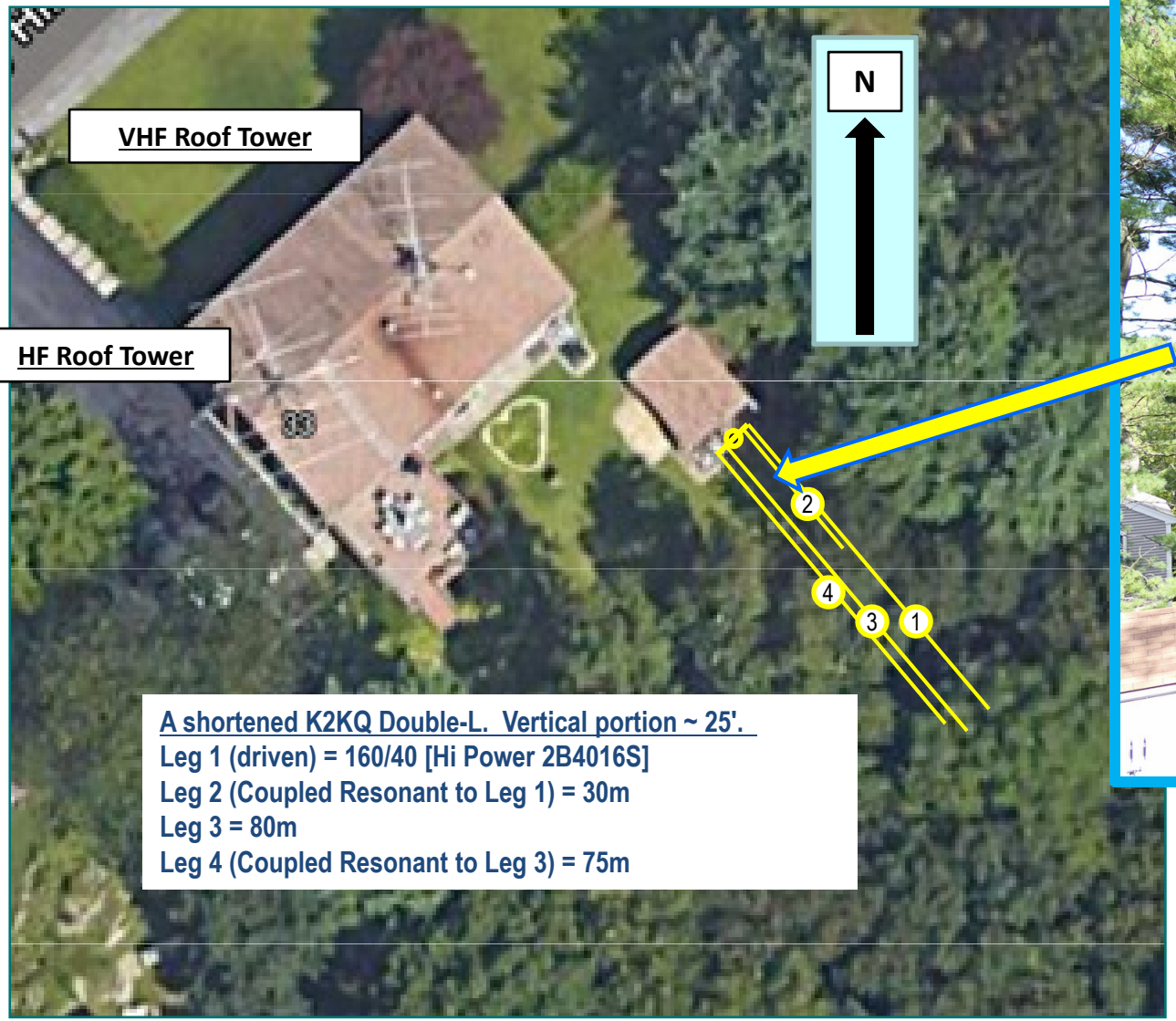
W1DYJ Antennas in Woburn MA



W1DYJ Antennas in Woburn MA - 2025



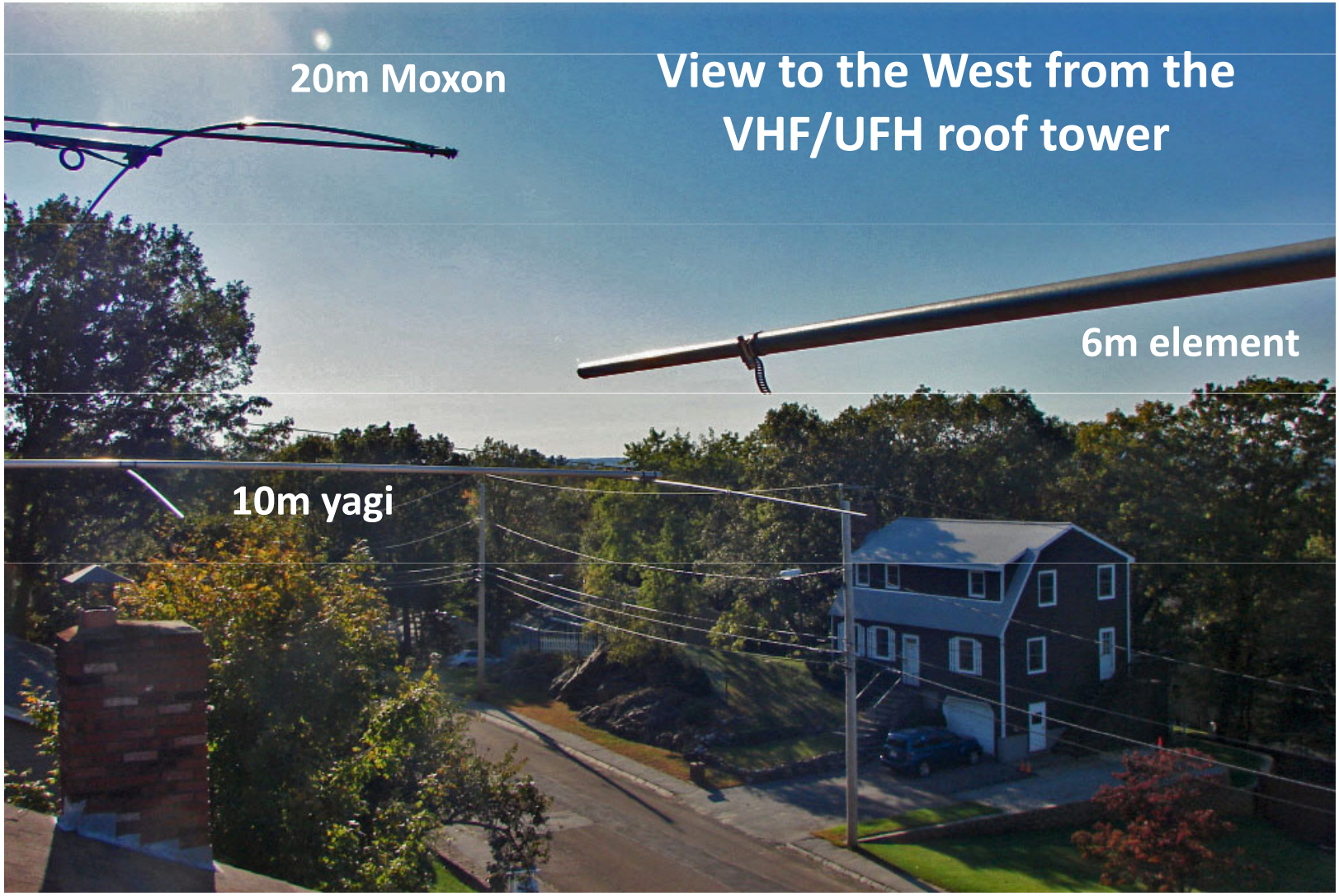
W1DYJ Low-HF Antennas - 2026





A shortened K2KQ Double-L. Vertical portion ~ 25'.
Leg 1 (driven) = 160/40 [Hi Power 2B4016S]
Leg 2 (Coupled Resonant to Leg 1) = 30m
Leg 3 = 80m
Leg 4 (Coupled Resonant to Leg 3) = 75m

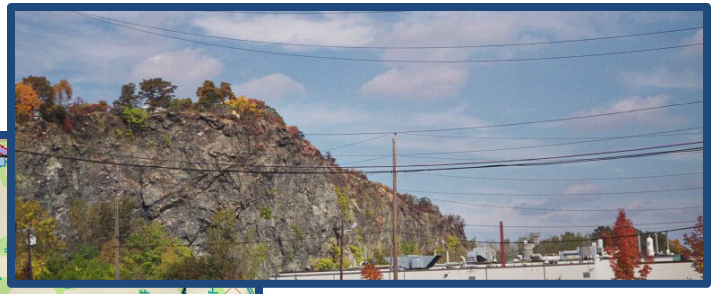
33 Blueberry Hill Rd – Woburn ca.2000



33 Blueberry Hill Rd – Woburn ca.2000



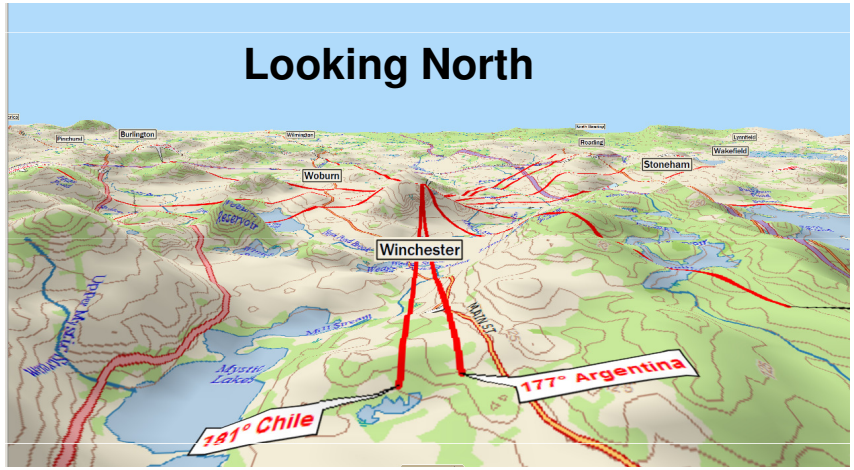
DX Azimuths @ 33 BBHR

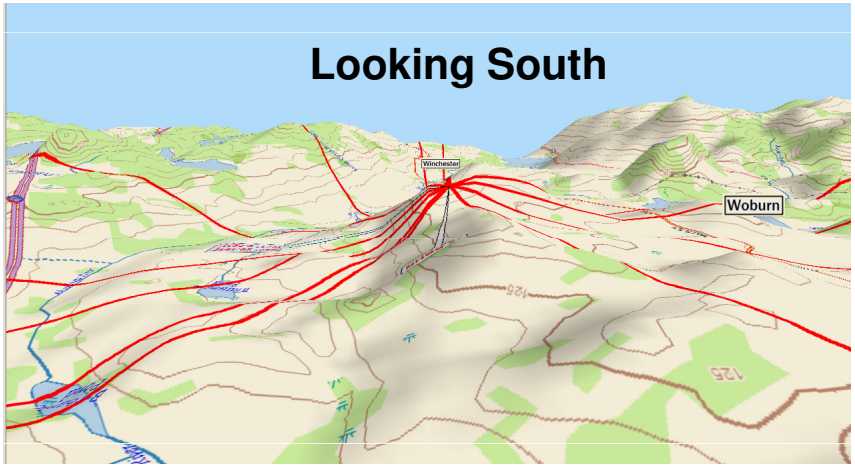


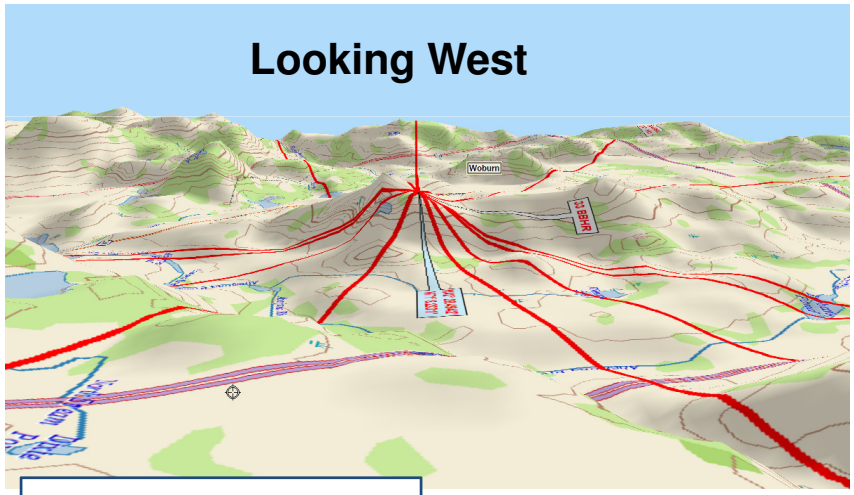


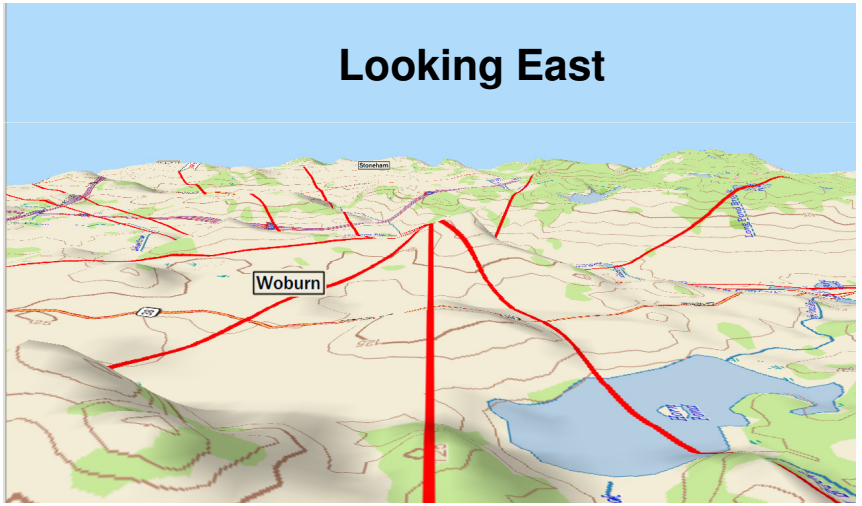
Delorme Topo USA 7.0

33 BBHR 3D Maps







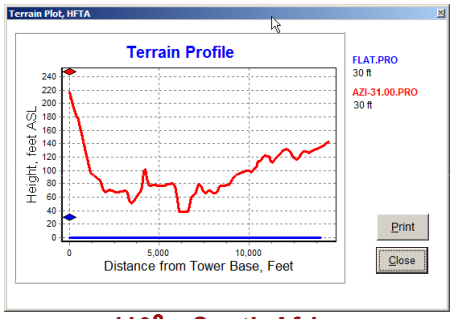


Delorme Topo USA

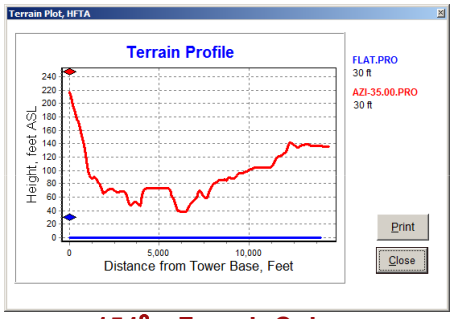
Note: Vertical dimensions are enhanced by a factor of 8

HFTA – Local Terrain @ 33 BBHR

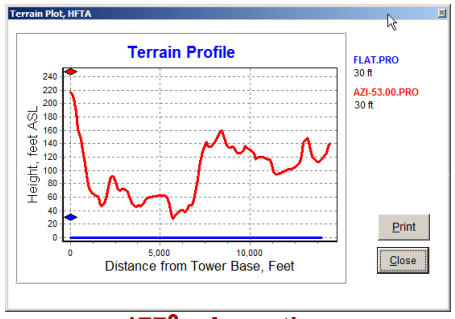
31° India



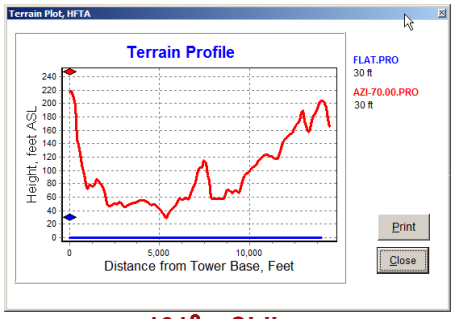
35° Iceland / EurRussia



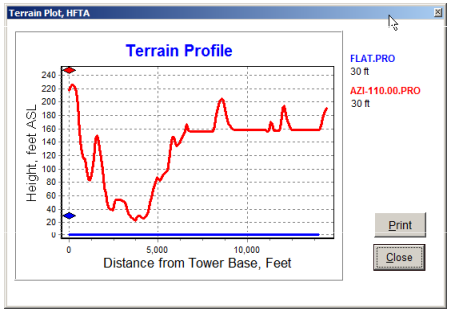
53° England



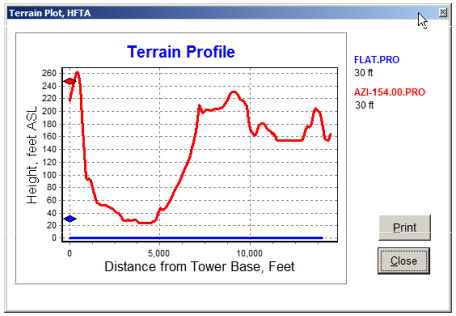
70° Spain



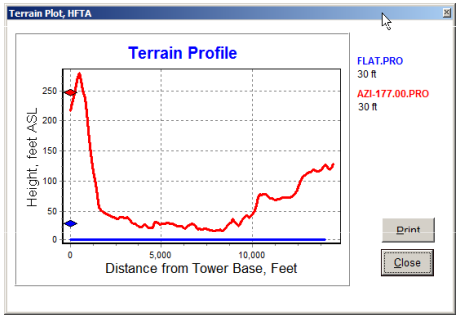
110° South Africa



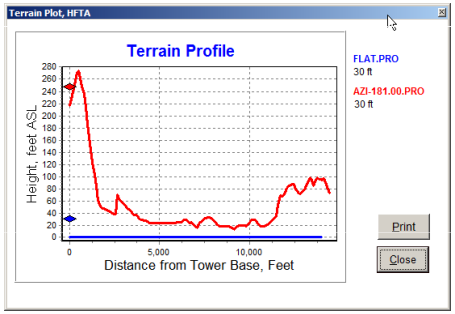
154° French Guiana



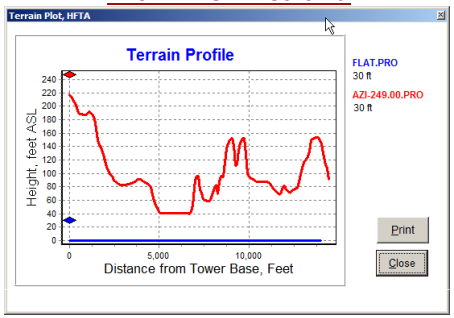
177° Argentina



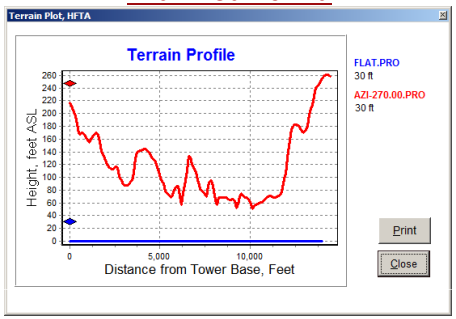
181° Chile



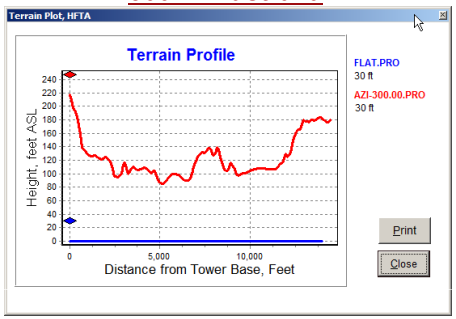
249° New Zealand



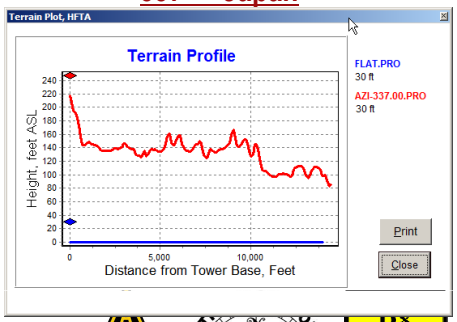
270° California



300° Australia



337° Japan

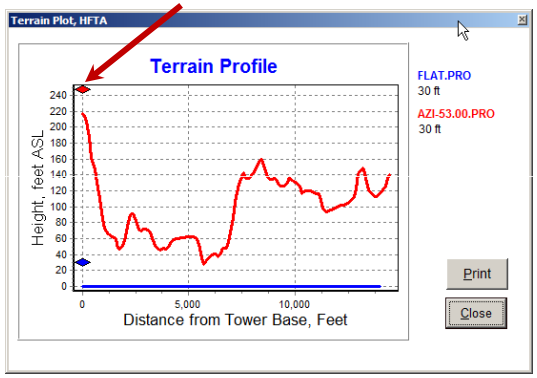


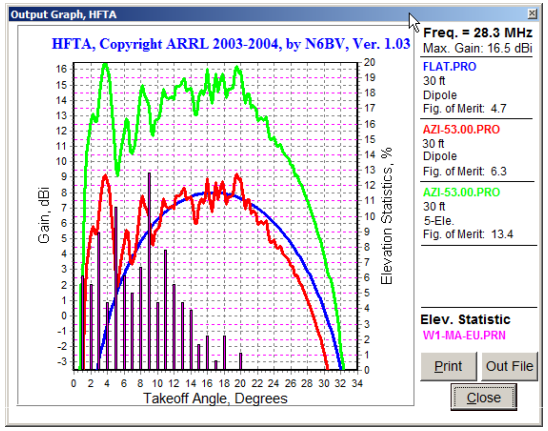
HFTA– HB 5 el 10M Yagi @ 33 BBHR



53° England

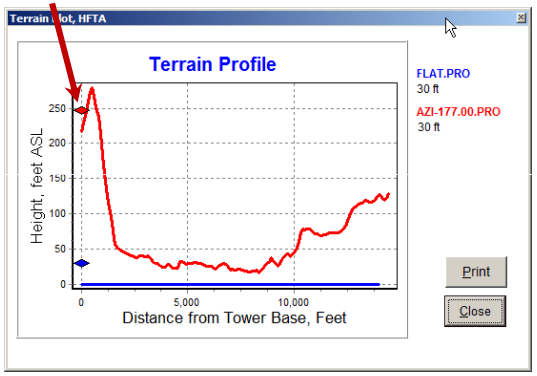
Note: Antennas are IN FRONT of Hill

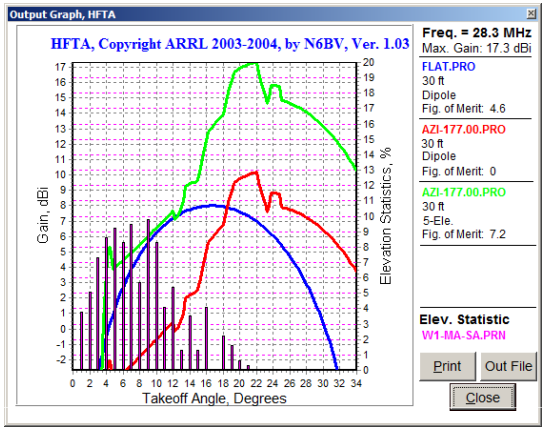




177° Argentina

Note: Antennas are BEHIND Hill





337° Japan

Note: Antennas are IN FRONT of Hill

