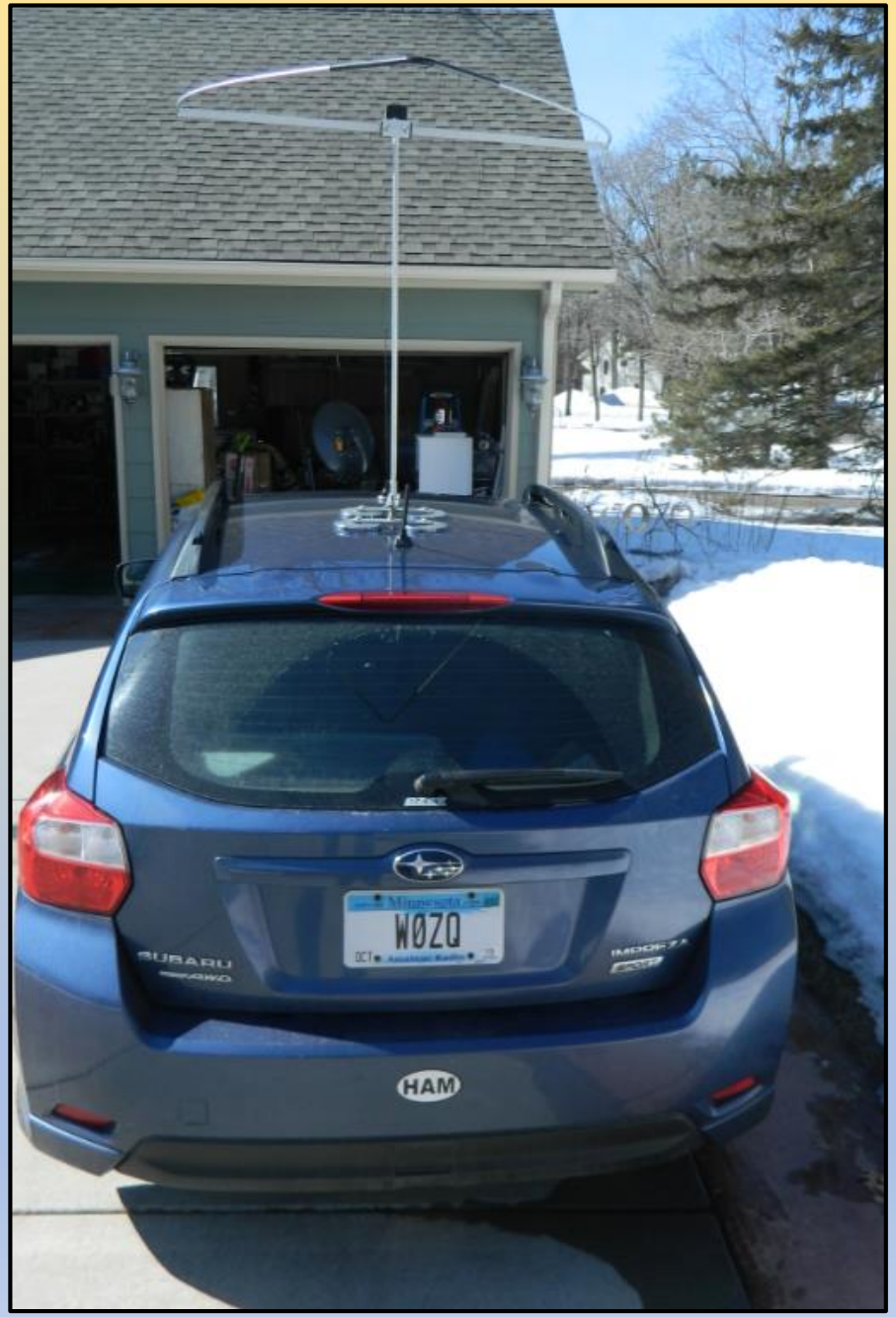


The Impact of Real-World Terrain On 6m Rovers

Jon Platt W0ZQ/R

Challenges For The 6m Rover

- Antennas are BIG (6m is almost 20 feet).
- They are typically mounted low to the ground thus impacting performance.
- Gain is hard to come by.

Can Hilltopping (i.e. terrain) make us LOUDER ?

To know if terrain can improve our 6m rover performance we need to consider the following:

1. **What are the elevation angles (take-off angles) that are optimum for working 6m sporadic E's?**
2. **What are the elevation angles (patterns) for common 6m rover antennas on *flat earth*?**
3. **Using common 6m rover antennas, what is the performance impact of moving from a *flat earth* environment to a *hill top location*?**

What are the elevation angles (take-off angles) that are optimum for working 6m sporadic E's?

In July 2018, Carl Luetzelschwab, K9LA, addressed this topic in his paper titled *"Elevation Angles Required for 6m Sporadic"*. Carl performed calculations of the Earth-ionospheric system using spherical geometry, and coupled this with real World maximum usability frequency data. **Carl concluded that antenna take-off angles (i.e., elevation angles) from 0° to 15° are the most important for 6m sporadic E propagation.**

Take-Off Angle (degrees)	Sporadic E Hop Distance
0	2297 km (1427 miles)
5	1438 km (894 miles)
10	965 km (600 miles)
15	700 km (435 miles)

Next question - What are the elevation angles (patterns) for common 6m rover antennas on *flat earth*?

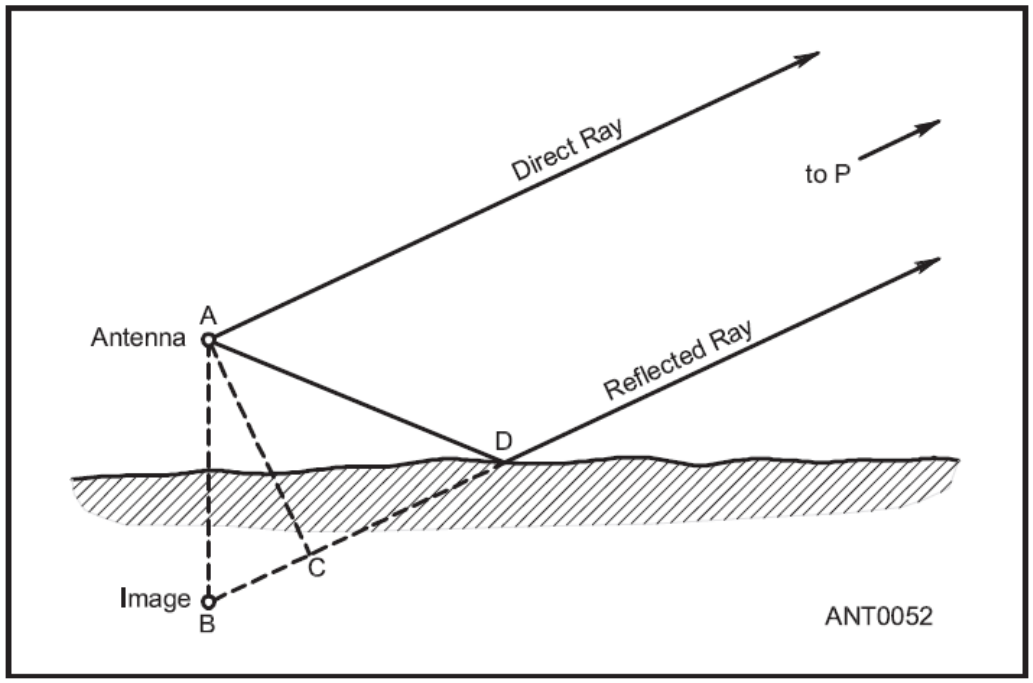


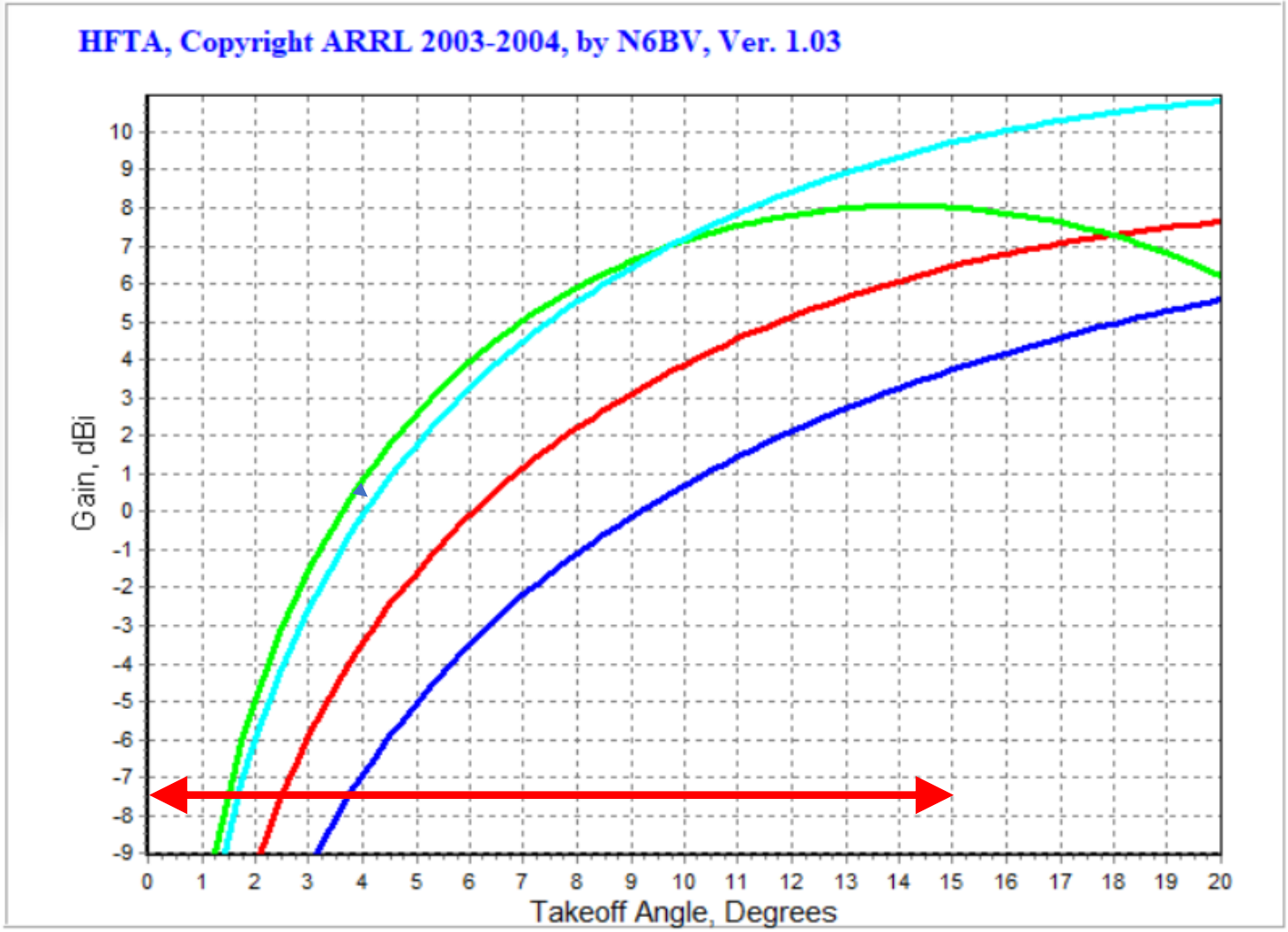
Figure 3.38 — At any distant point, P, the field strength will be the vector sum of the direct ray and the reflected ray. The reflected ray travels farther than the direct ray by the distance BC, where the reflected ray is considered to originate at the image antenna.

Figure 3.38 from the ARRL Antenna Book

Interaction with ground results in peaks and nulls in the antenna's take-off (elevation) pattern.

Flat Earth Performance For Four Common 6m Rover Antennas Using Dean Straw's (N6BV) *High Frequency Terrain Analyzer* (HFTA) Software

Output Graph, HFTA



Freq. = 50.0 MHz
Max. Gain: 11.0 dBi

FLAT.PRO
8 ft
Dipole

FLAT.PRO
12 ft
Dipole

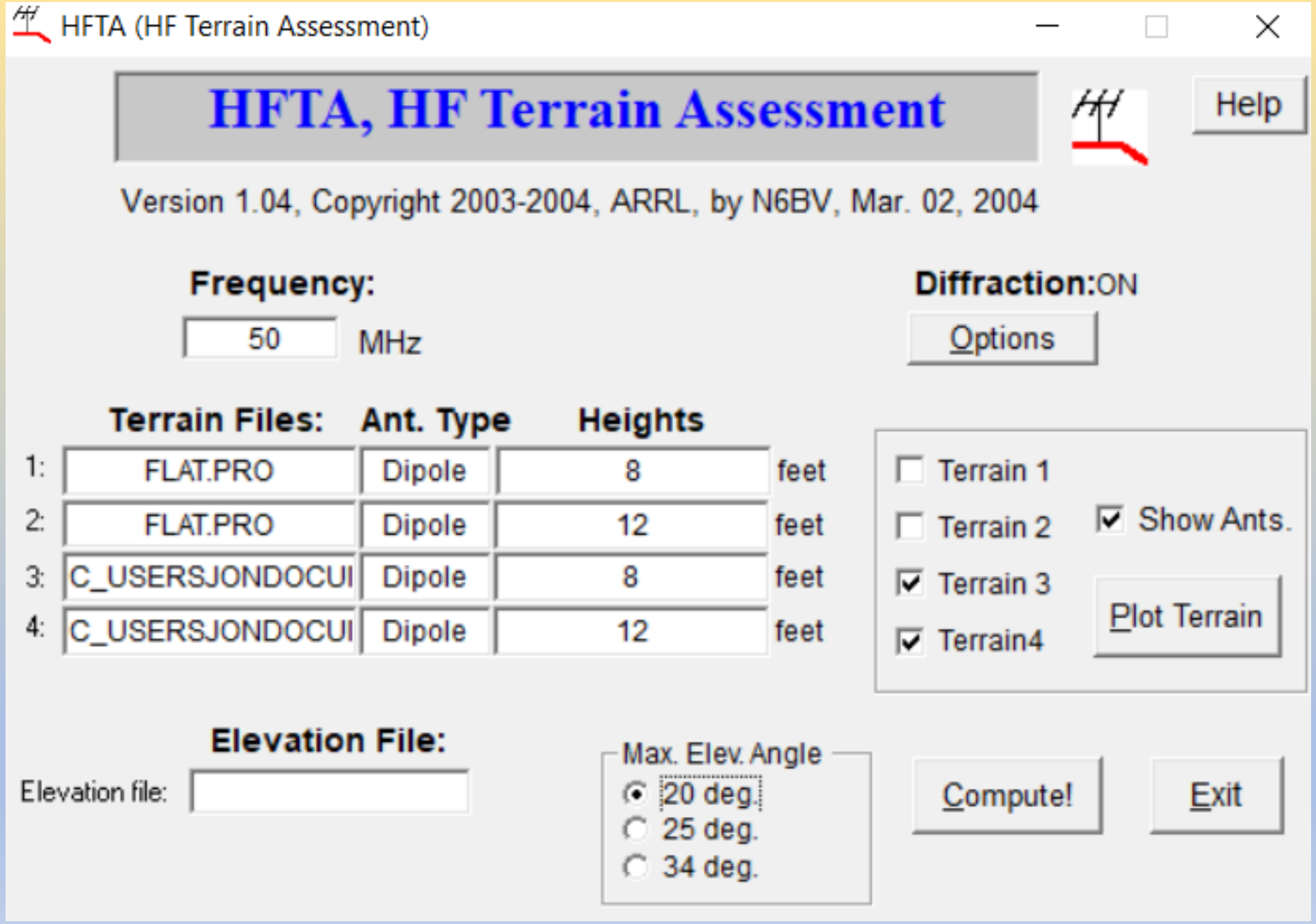
FLAT.PRO
20 ft
Dipole

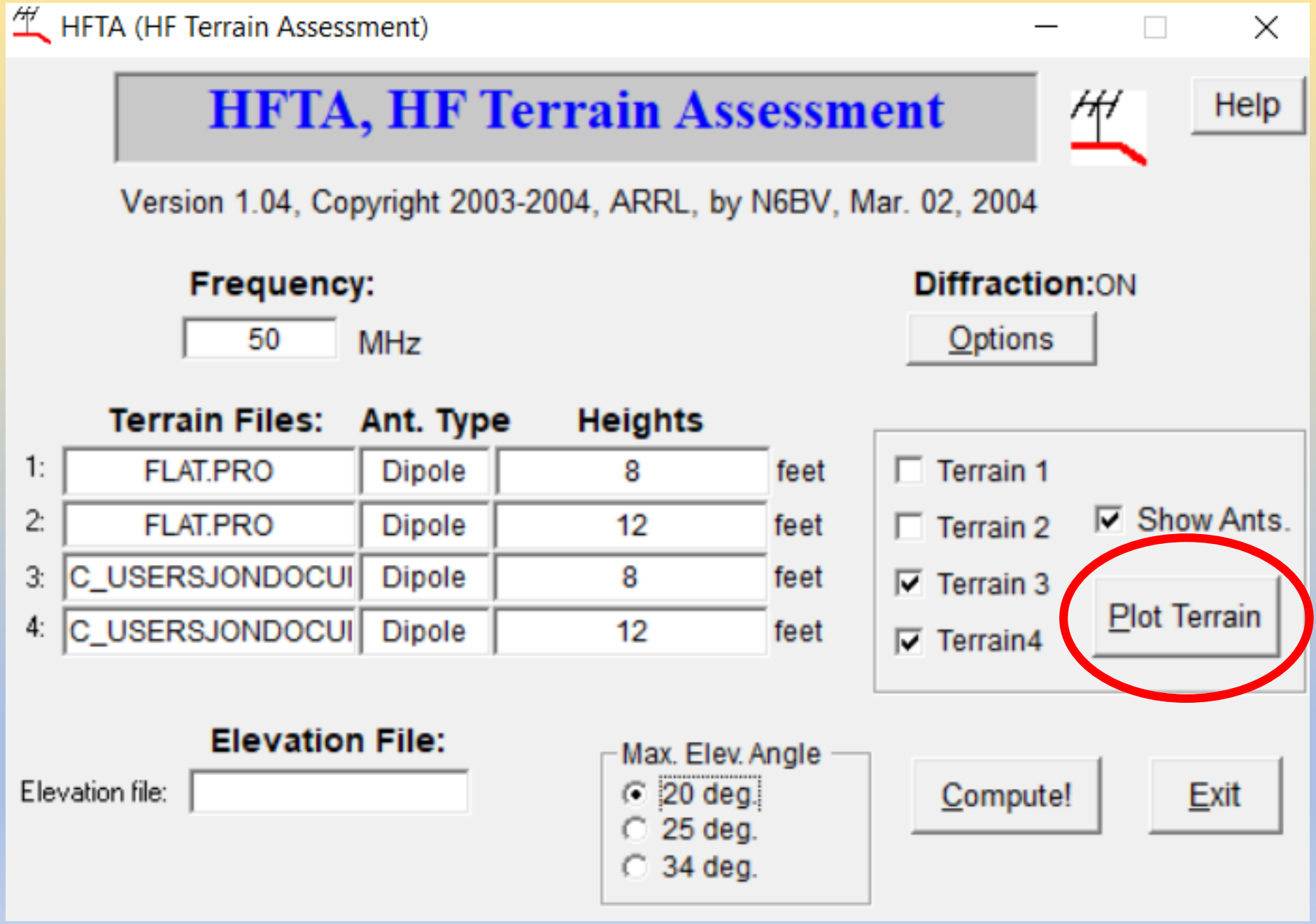
FLAT.PRO
12 ft
2-Ele.

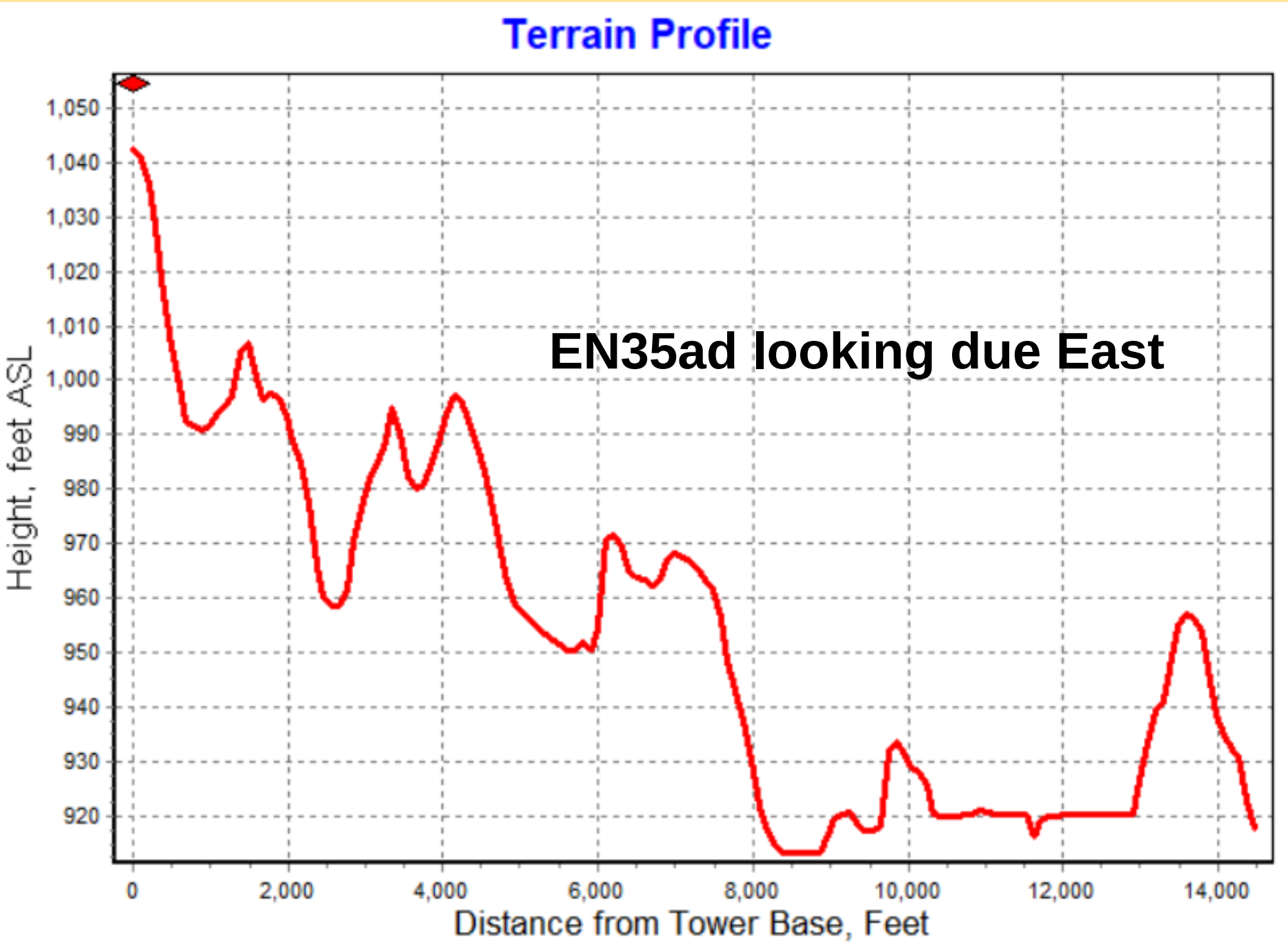
Print | Out File

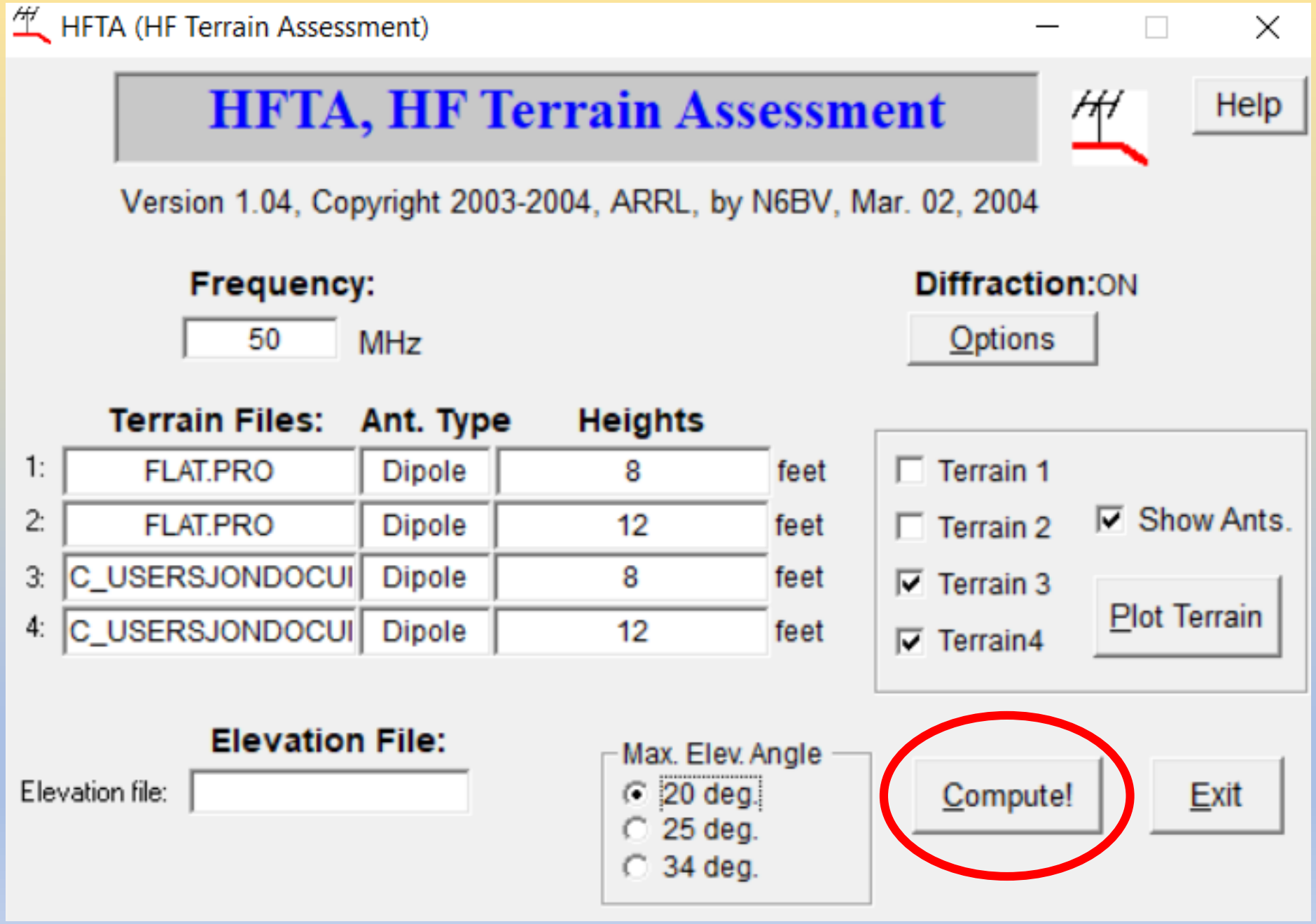
Close

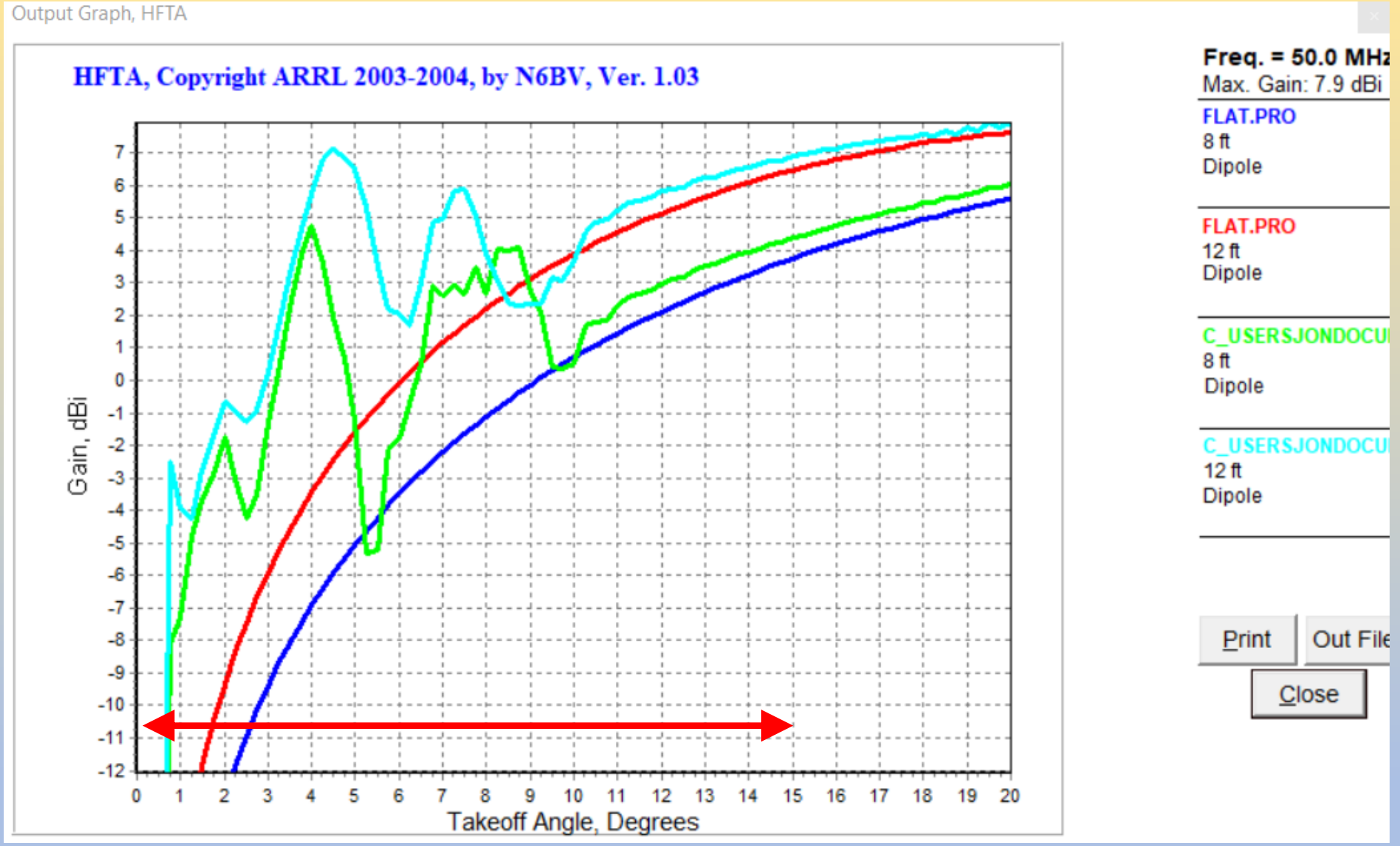
What May Be The 6m Performance Impact Of Moving From *Flat Terrain* To A Hill Top Location?


HFTA (HF Terrain Assessment)
HFTA, HF Terrain Assessment
Help
Version 1.04, Copyright 2003-2004, ARRL, by N6BV, Mar. 02, 2004
Frequency:
50
MHz
Diffraction:ON
Options
Terrain Files:
Ant. Type
Heights
1:
FLAT.PRO
Dipole
8
feet
2:
FLAT.PRO
Dipole
12
feet
3:
C_USERSJONDOCUI
Dipole
8
feet
4:
C_USERSJONDOCUI
Dipole
12
feet
Terrain 1
Terrain 2
Terrain 3
Terrain4
Show Ants.
Plot Terrain
Elevation File:
Elevation file:
Max. Elev. Angle
20 deg.
25 deg.
34 deg.
Compute!
Exit


HFTA (HF Terrain Assessment)
HFTA, HF Terrain Assessment
Help
Version 1.04, Copyright 2003-2004, ARRL, by N6BV, Mar. 02, 2004
Frequency:
50
MHz
Diffraction:ON
Options
Terrain Files:
Ant. Type
Heights
1: FLAT.PRO Dipole 8 feet
2: FLAT.PRO Dipole 12 feet
3: C_USERSJONDOCUI Dipole 8 feet
4: C_USERSJONDOCUI Dipole 12 feet
Terrain 1
Terrain 2
Terrain 3
Terrain4
Show Ants.
Plot Terrain
Elevation File:
Elevation file:
Max. Elev. Angle
20 deg.
25 deg.
34 deg.
Compute!
Exit

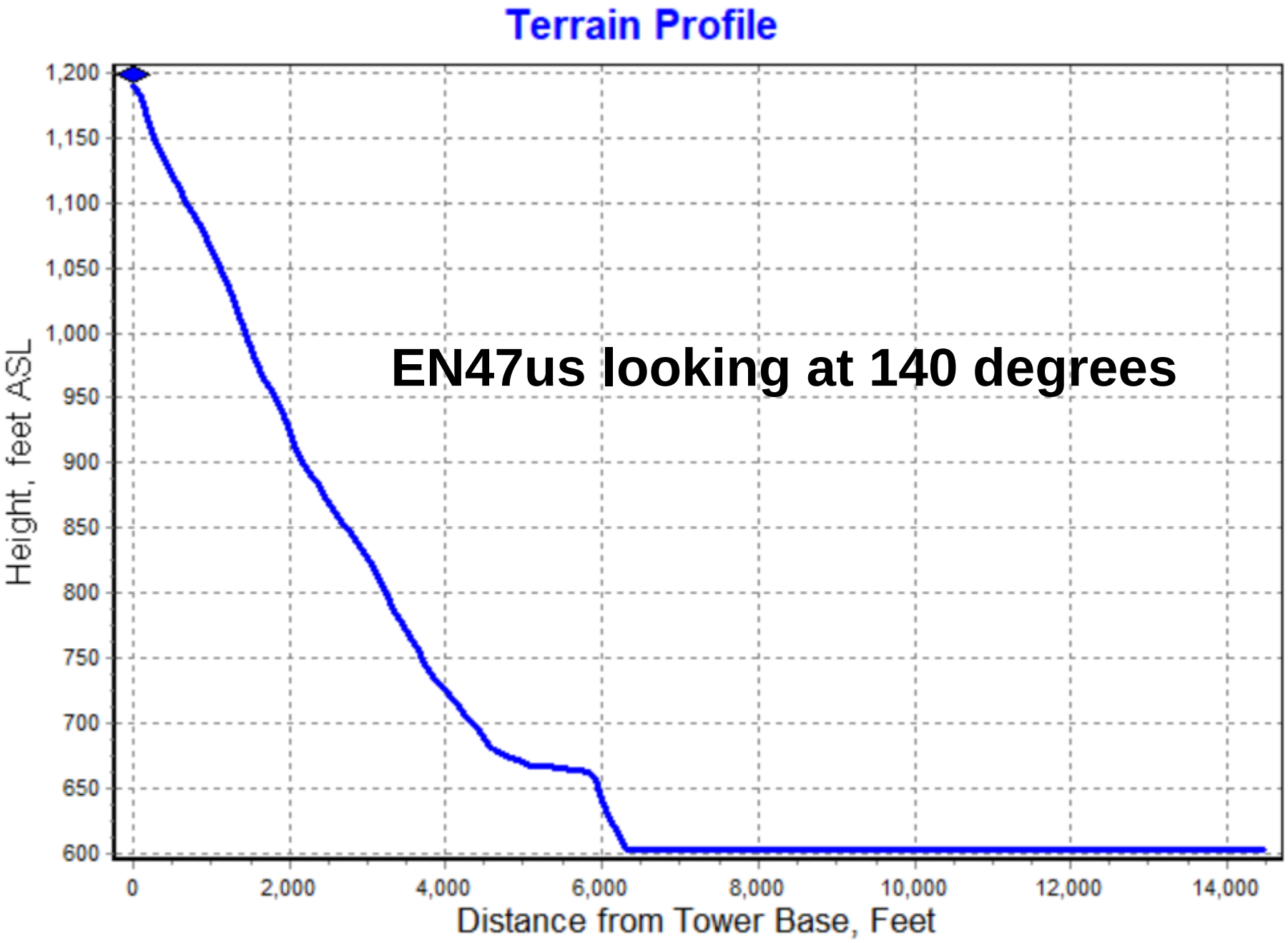

Terrain Profile
EN35ad looking due East
Height, feet ASL
1,050
1,040
1,030
1,020
1,010
1,000
990
980
970
960
950
940
930
920
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
Distance from Tower Base, Feet

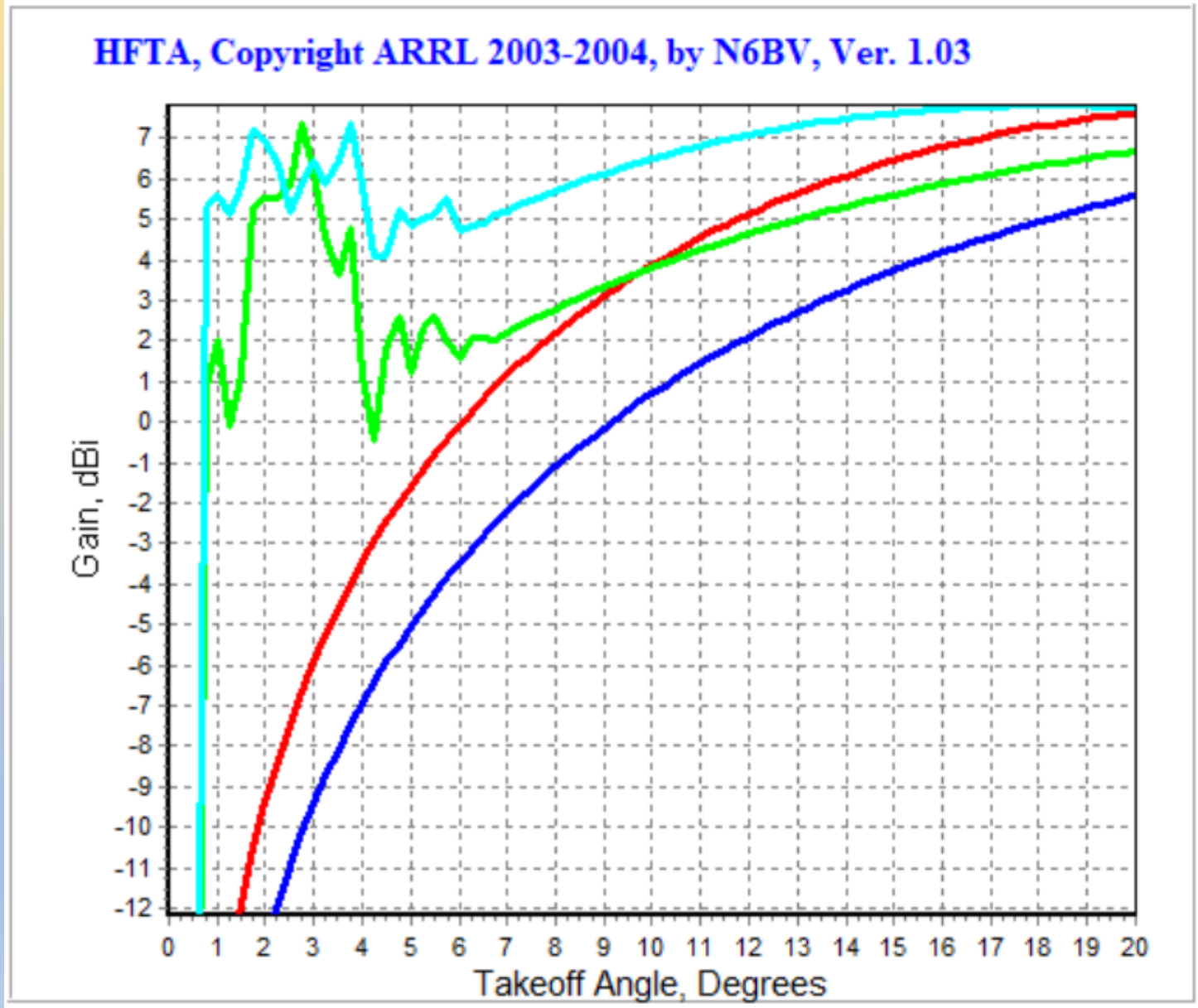

HFTA (HF Terrain Assessment)
HFTA, HF Terrain Assessment
Help
Version 1.04, Copyright 2003-2004, ARRL, by N6BV, Mar. 02, 2004
Frequency:
50
MHz
Diffraction:ON
Options
Terrain Files:
Ant. Type
Heights
1: FLAT.PRO Dipole 8 feet
2: FLAT.PRO Dipole 12 feet
3: C_USERSJONDOCUI Dipole 8 feet
4: C_USERSJONDOCUI Dipole 12 feet
Terrain 1
Terrain 2
Terrain 3
Terrain4
Show Ants.
Plot Terrain
Elevation File:
Elevation file:
Max. Elev. Angle
20 deg.
25 deg.
34 deg.
Compute!
Exit



Summary: ~ 1 to 12 dB improvement !

Hill Top Example #2: Pincushion Mountain
EN47us Grand Marais, Minnesota


Terrain Profile
EN47us looking at 140 degrees
Height, feet ASL
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
Distance from Tower Base, Feet



Freq. = 50.0 MHz
Max. Gain: 7.8 dBi

FLAT.PRO
8 ft
Dipole

FLAT.PRO
12 ft
Dipole

C_USERSJONDOCU
8 ft
Dipole

C_USERSJONDOCU
12 ft
Dipole

Print | Out File

Close

Summary:

- Hill top locations are good, even modest ones.
- 6m improvement may be around 10 dB.
- HFTA can be use to analyze how “good” a location is, or if nulls exist in antenna patterns.

73 W0ZQ/R