

**Do more with less**

October 10th 2009

Thanks to ARI Modena for hosting the event



Let's start with some easy questions

can 2 element beams be good enough ?

Yes

High towers and long booms  
.....always the answer ?

No

Single 6 element long boom antenna  
.....or short boom phased 2 over 2 stack ?

Neck to Neck

Why KH7XS Is so strong on 40 meters ?

Location

## Well most of us would probably disagreed

Let's start with two element beams "Conventional"

- Typical gain 4.5dBd
- Typical F/B 12-15dB
- 0.1 wave length boom, driven director configuration
- 0.2 wave length boom, driven reflector configuration (50 ohms)
- Best compromise, decent gain & fair F/B 0.15 boom length

Now, let's look at three element beams

- Center band optimized gain 6.1dBd
- Center band optimized F/B 20 dB
- Center band optimized boom length 0.25 wave length
- Big step forward from two element beams

## Two elements versus three elements on 40M

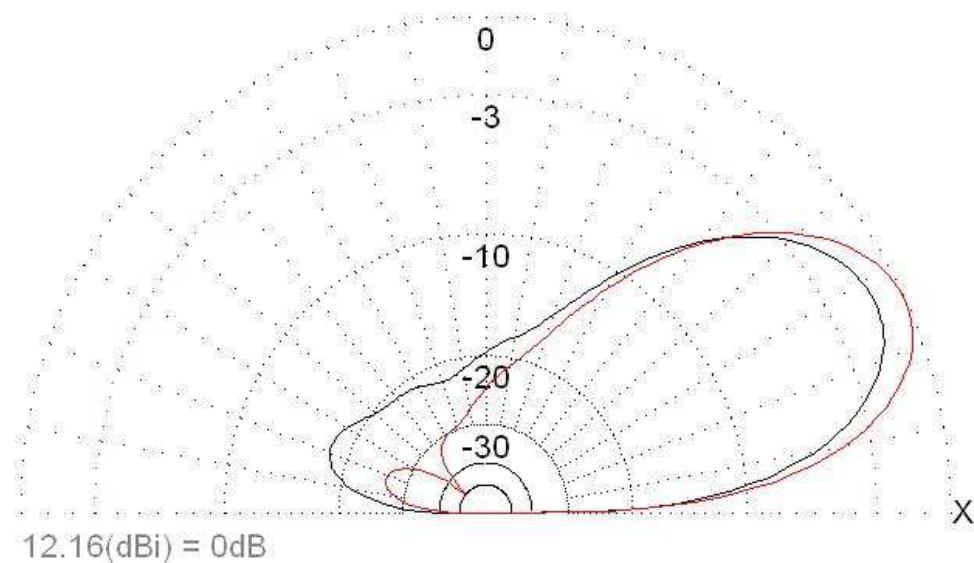
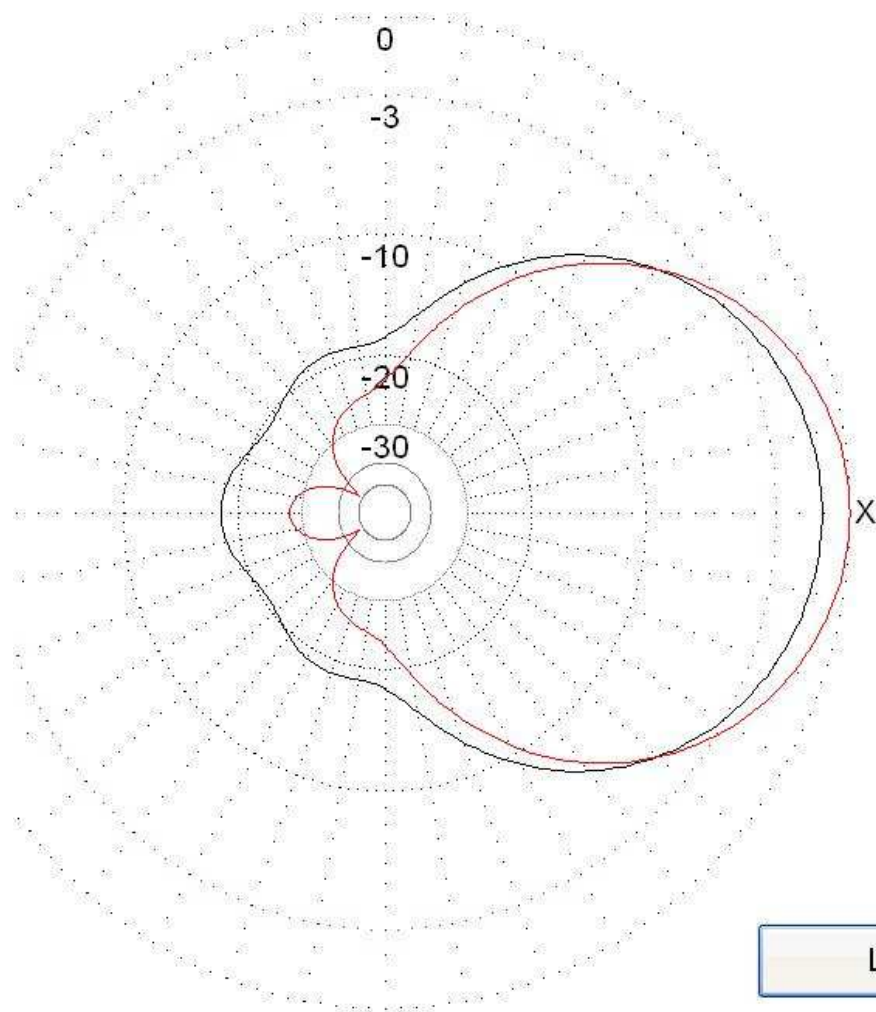
### Two elements:

- boom length @ 0.15 = 6,40 meters
- band width 150 Khz @ 1:1.5
- medium weight
- square meters = 140

### Three elements:

- boom length @ 0.25 = 10,60 meters
- band width 50 Khz @ 1:1.5
- heavy weight
- square meters = 235

½ wave height compared plots



Field(s)

V     H     Total     V+H

Load \*.mab file

Clear

Colour

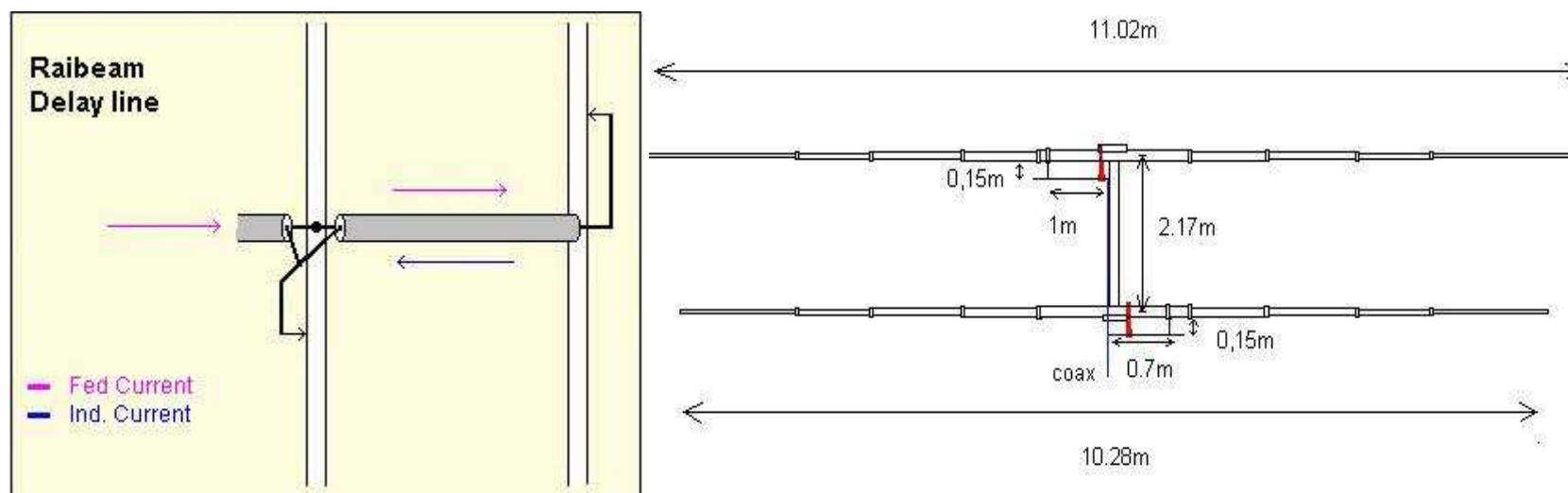
Return

Which one would you pick ?

3 ele

What about a two element beams “Phased”

- Typical gain 4.9 dBd
- Typical F/B 19 dB
- 0.1 boom wave length



20 meters Raibeam

## Two elements phased versus three element beams on 40M

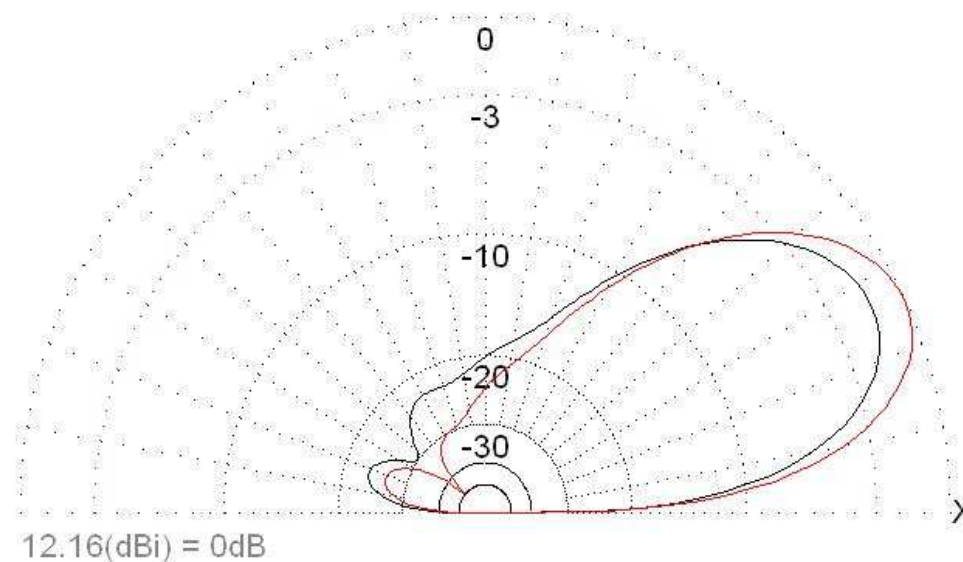
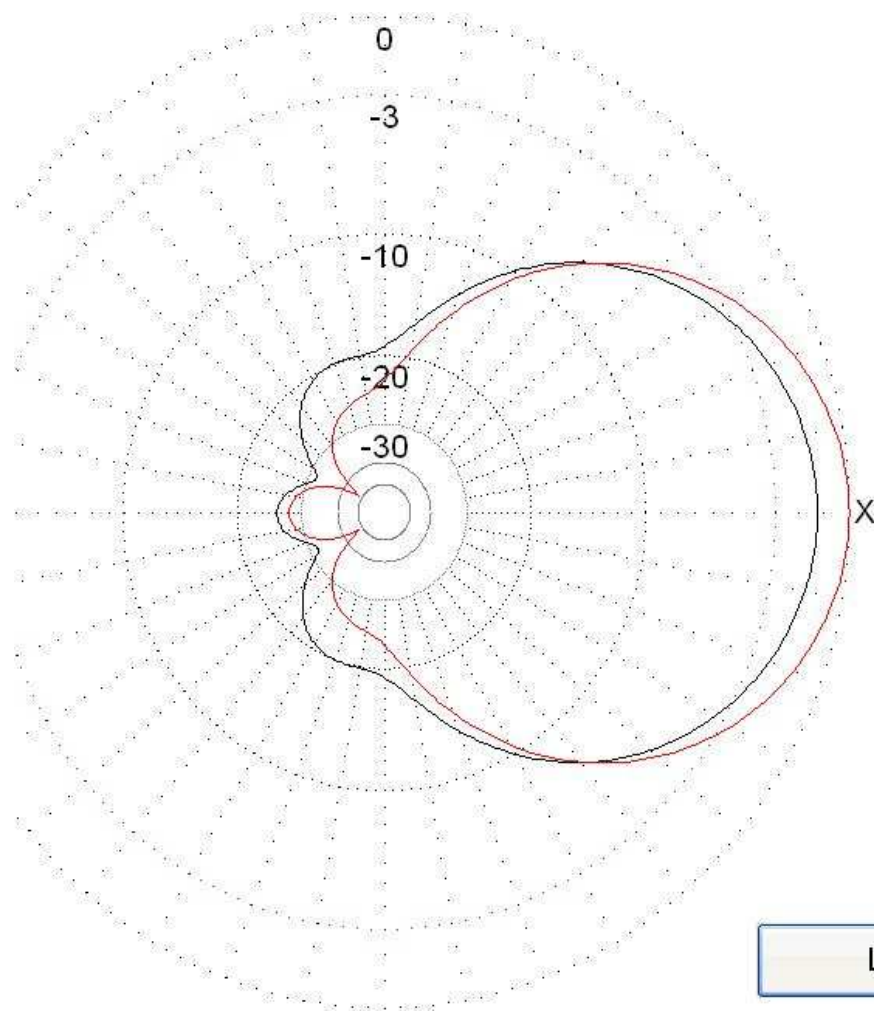
### Two elements phased:

- boom length @ .1 = 4,20 meters
- band width 100 Khz @ 1:1.5
- light weight
- square meters = 92

### Three element beams:

- boom length @ .25 = 10,60 meters
- band width 50 Khz @ 1:1.5
- heavy weight
- square meters = 235

½ wave height compared plots



Field(s)

V     H     Total     V+H

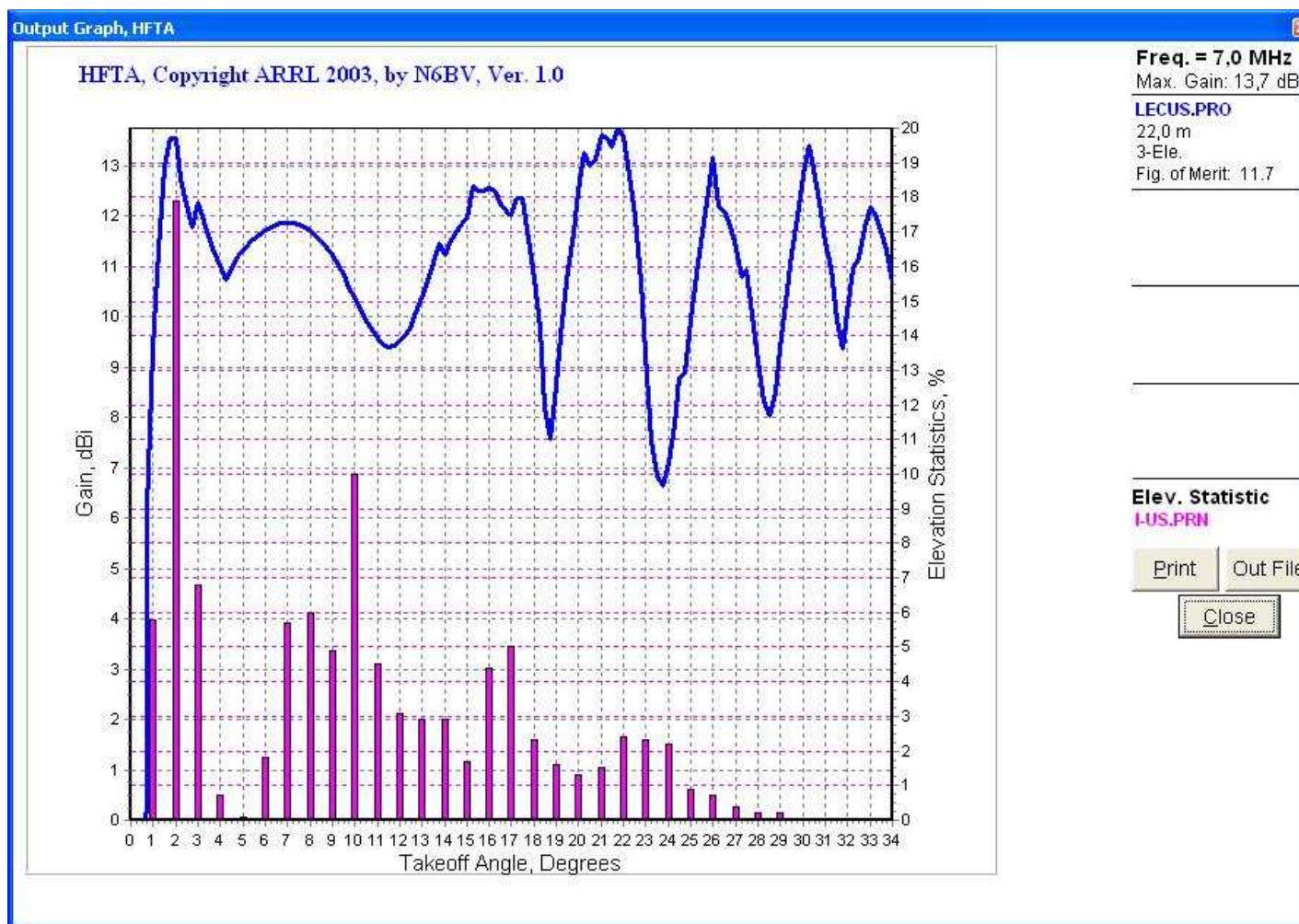
Load \*.mab file

Clear

Colour

Return

2 ele phased (Raibeam) @22 meters (I4LEC's site)



Main lobe @ 2 degrees (13.7dBi), second lobe @7 degrees (12dBi)

## Which one would I pick ?

Why two elements phased (Raibeam style)

- Good F/B (almost as good as 3 ele)
- Fair Gain (just 1.2 dB less than 3 ele)
- Good band width (150 Khz @ 2.1SWR)
- Lower take off angle @ low height (0.35)  
(due to phasing high angle cancellation)
- Light weight (35 Kg)
- Easy to build
- Simple matching system (1/2 T)
- Takes any power (coax rate)
- Almost 1/3 third square meter area

2 ele

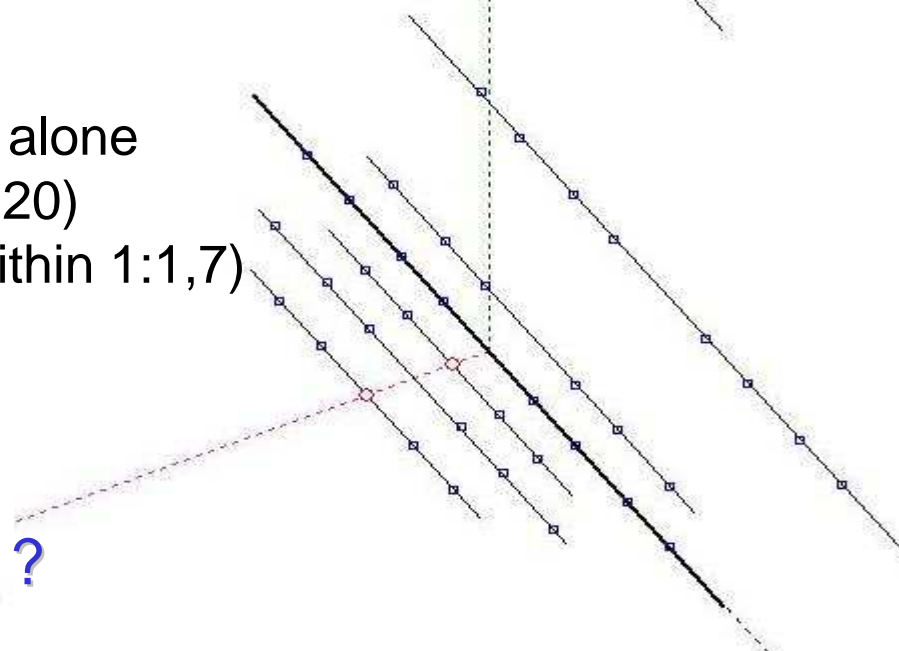
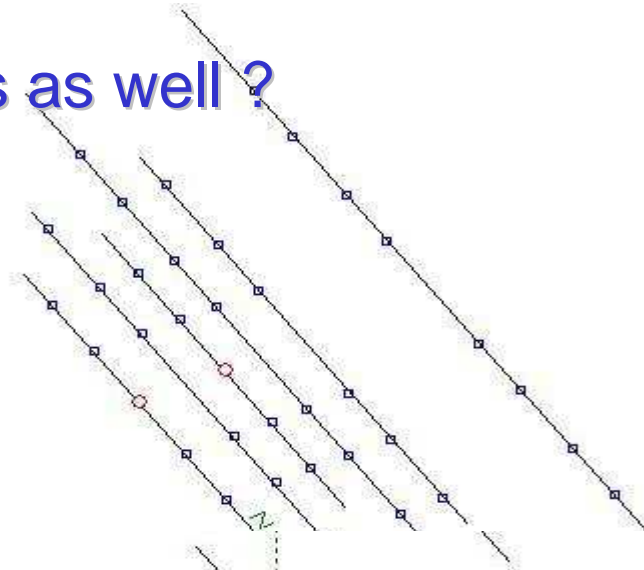


Could it be good for other bands as well ?

Yes

Three monobander phased beams:

- total boom length = 4 meters
- small foot print = 32 sqm
- light weight
- independent feed lines
- no interaction
- same characteristics as alone
- bands coverage (10-15-20)
- broad band operation within 1:1,7)



Do I need another one ?

Yes

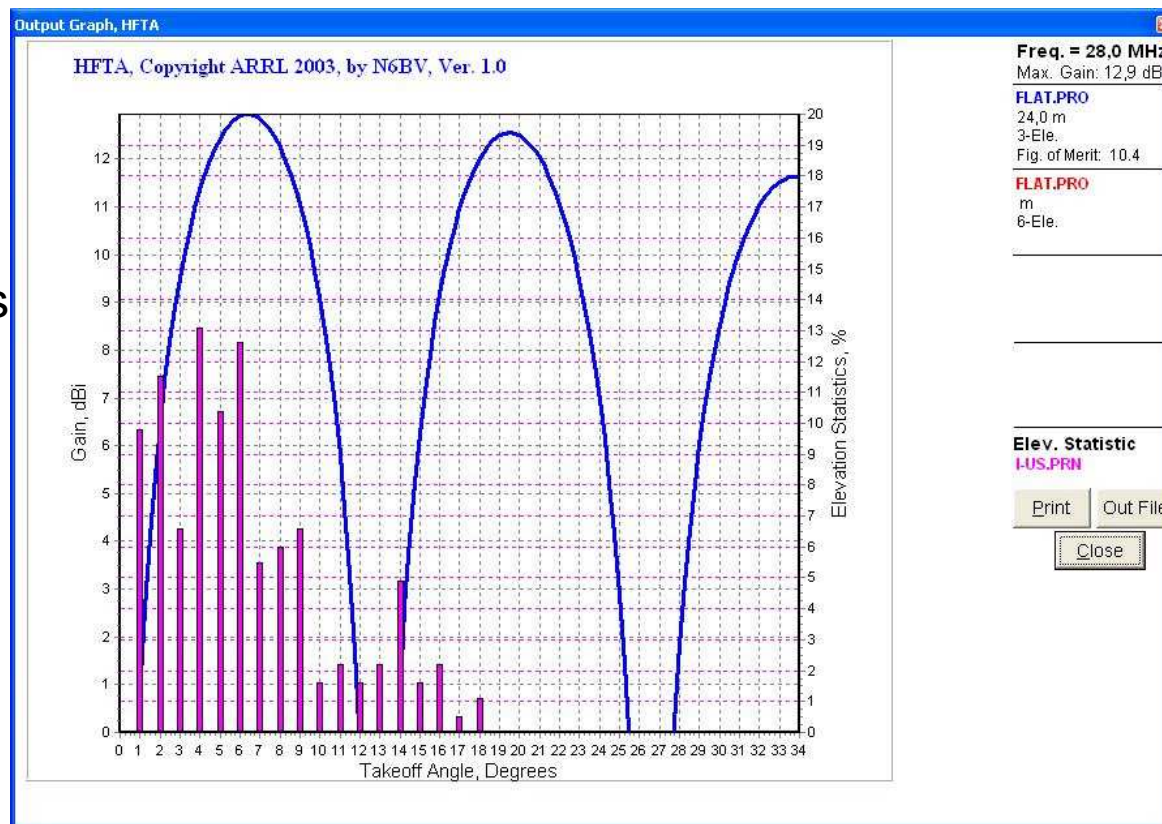
How high should I put it ?

Let's see

From a flat location, looking US  
@ 24 meters on 28Mhz

- fig. of Merit 10.4\*
- max. gain 12.9 dBi @ 6 degrees
- @ 20 degrees 12.5 dBi
- big null around 12-14 degrees

Overall a fairly good system



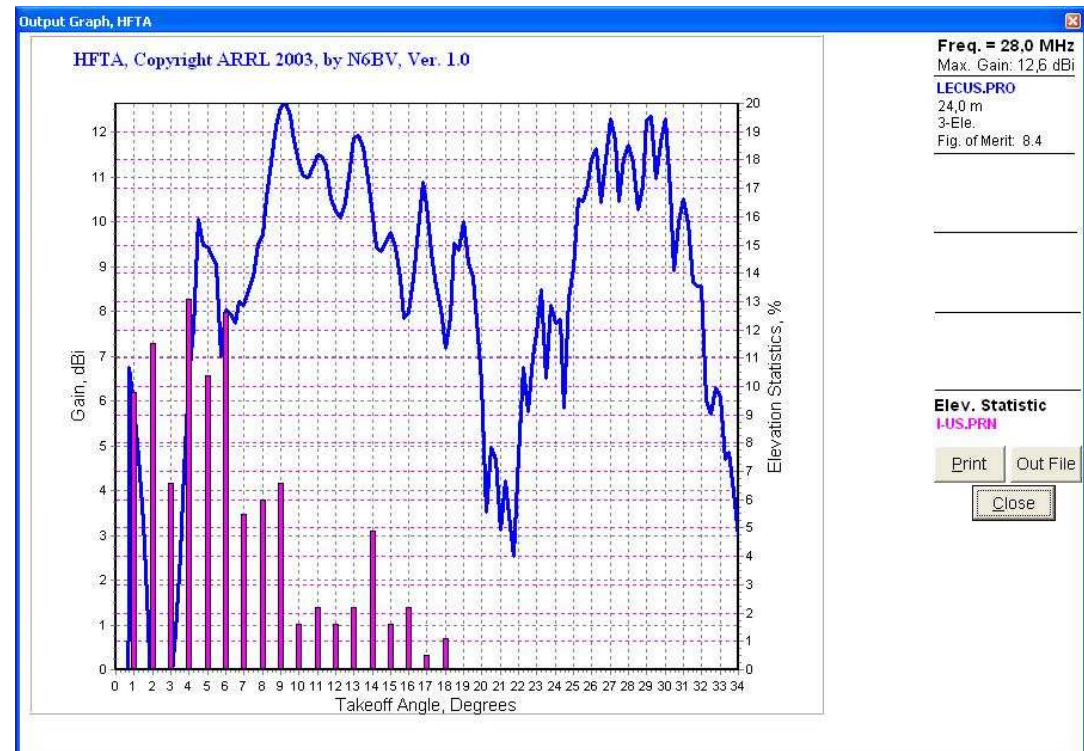
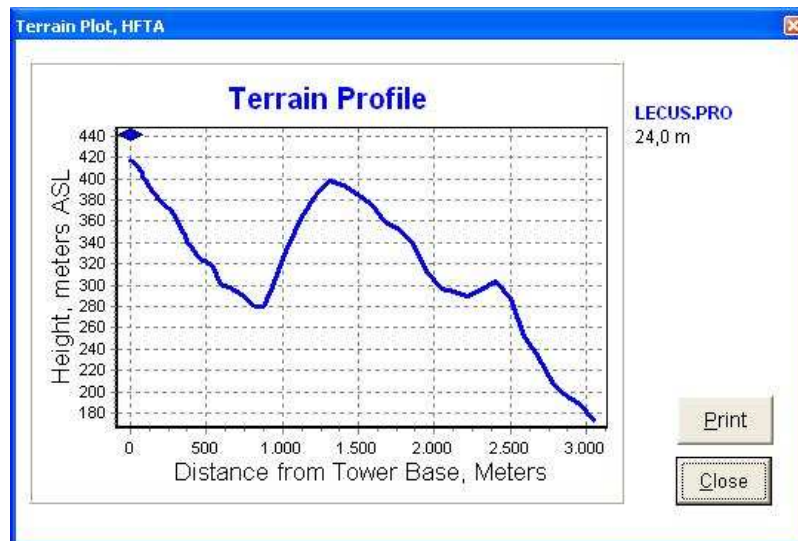
\*Fig. of Merit for each curve. This is a weighted statistical average computed by multiplying the gain at each angle by the statistical percentage that the band is open at that angle. The products for all the angles are averaged to compute the Figure of Merit, which is calibrated in dBi.

## What about 24 meters @ I4LEC's location looking US ?

From a I4LEC's location, looking US  
@ 24 meters on 28Mhz (top ant.)

- fig. of Merit 8.4 “-2 v/s flat”
- gain @1 degree 6.8dBi “+4.8dB v/s flat”
- gain @5 degrees 9.5dBi “-3dB v/s flat”
- gain @14 degrees 9.5dBi “+7.5dB v/s flat”
- @9 degrees max. gain 12.6dBi
- **big null around 2-3 degrees**

**How can I fulfil the big null & recover the lost gain @ 5 degrees?**

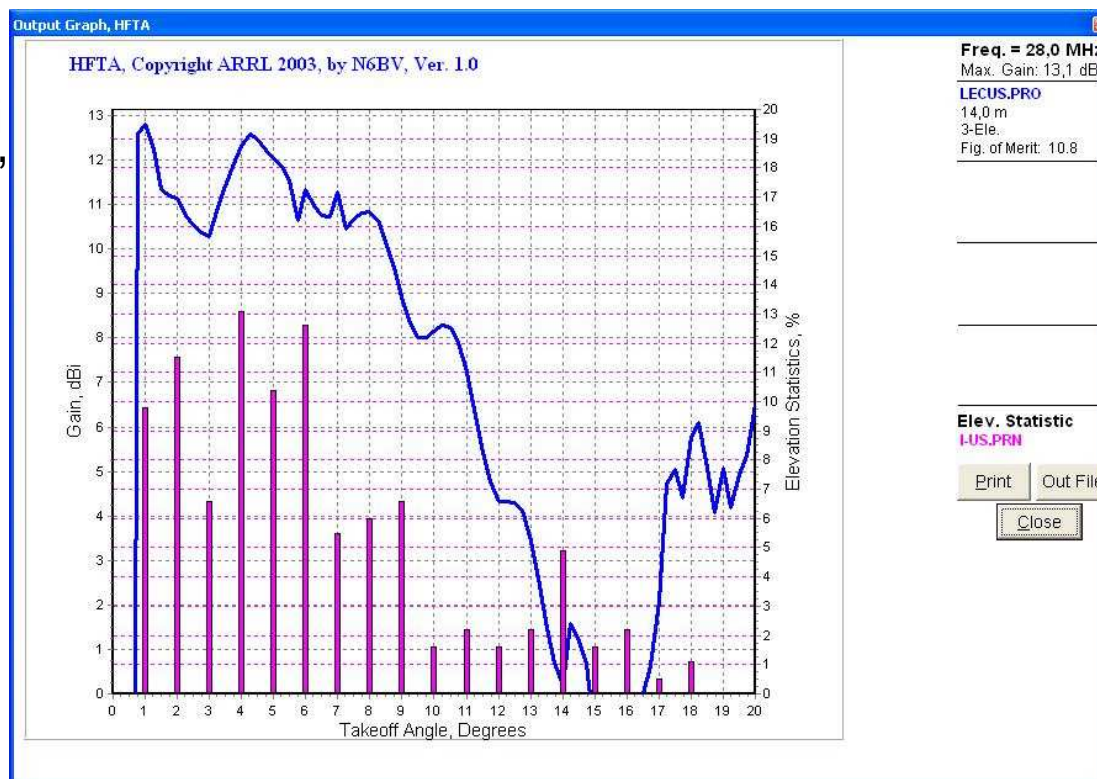


## By putting a lower antenna

From a I4LEC's location, looking US @ 14 meters on 28Mhz (bottom ant.)

**How can fulfil the big null @ 14 degrees?**

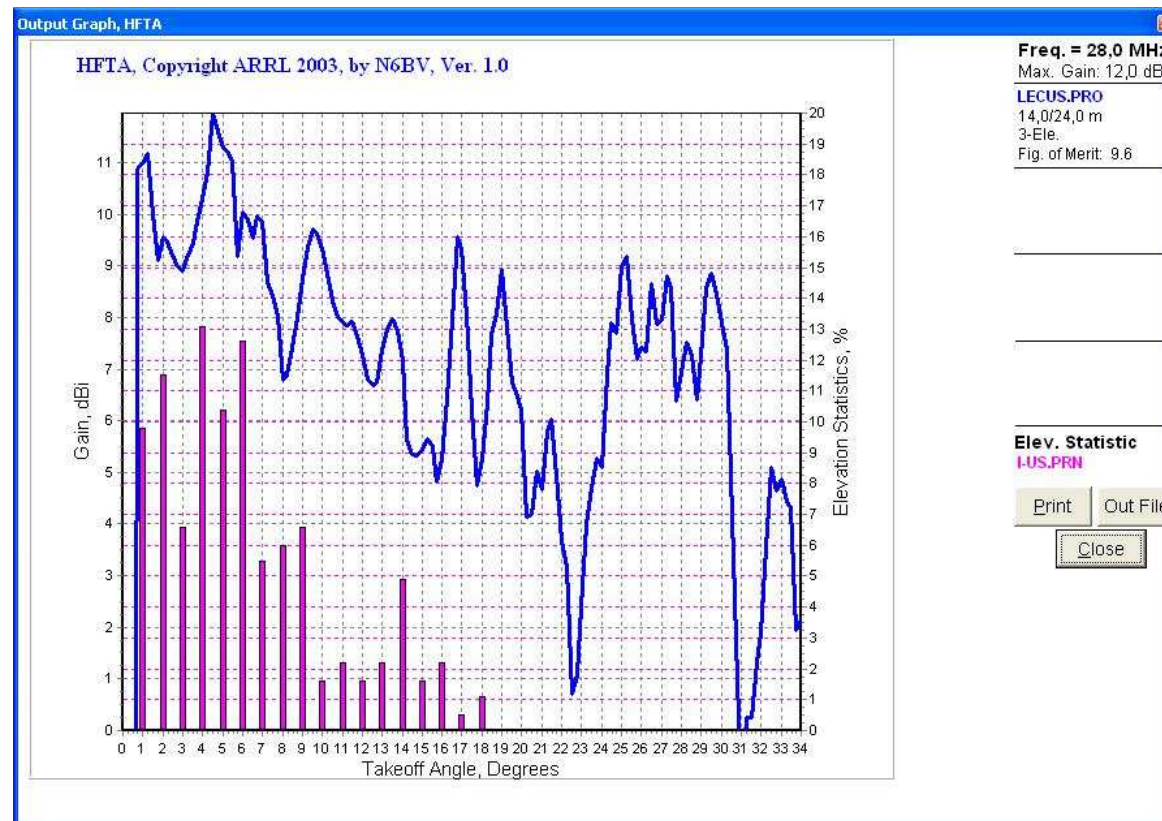
- fig. of Merit 10.8  
“+0.4 (flat), +2.4 (lec's top)”
- max. gain @ 1 degree 12.8dBi  
“+10.8dBi (flat), +6dBi (lec's top)”
- gain @ 5 degree 12dBi  
“0dBi (flat), +2.5dBi (lec's top)”
- gain @ 14 degrees 0.5 dBi  
“-1.5 (flat), -9dBi (lec's top)”



From a I4LEC's location, looking US  
@ 14&24 meters on 28Mhz

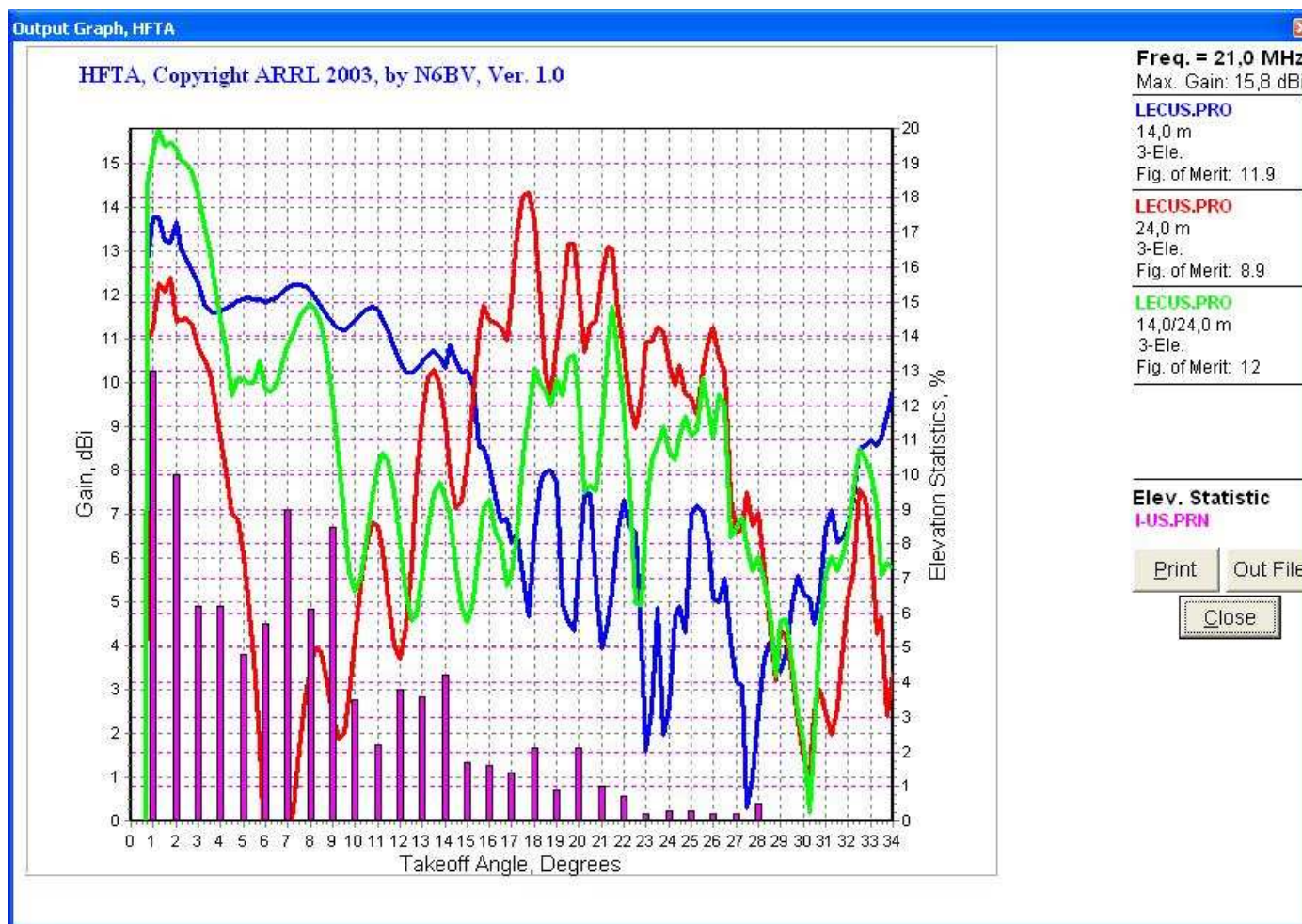
By stacking the two antennas

- fig. of Merit 9.6 “-0.8 (flat), +1.2 (lec's Top), -1.2 (lec's Bottom)”
- gain @1 degree 11.4dBi “+9.4 (flat), +4.5, (lec's Top), -1.4 (lec's Bottom)”
- max. gain @5 degrees 12dBi “0 (flat), +2.5 (lec's Top), 0 (lec's Bottom)”
- @ 2-3 degrees (no longer big null) 9.5dBi
- @ 14 degrees (no longer big null) 6 dBi



What about 15m ?

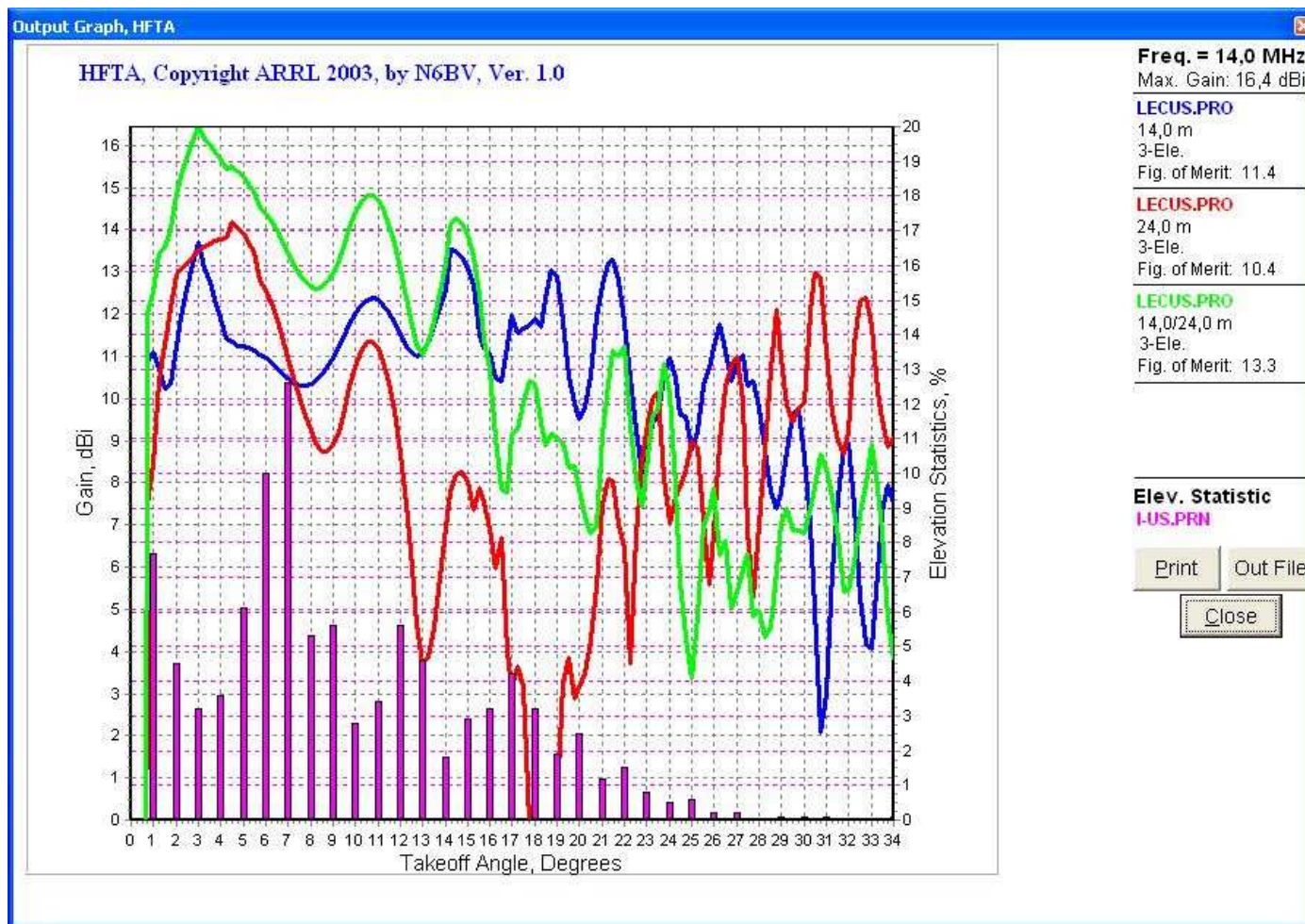
Even better !



From a I4LEC's location, looking US

And 20m ?

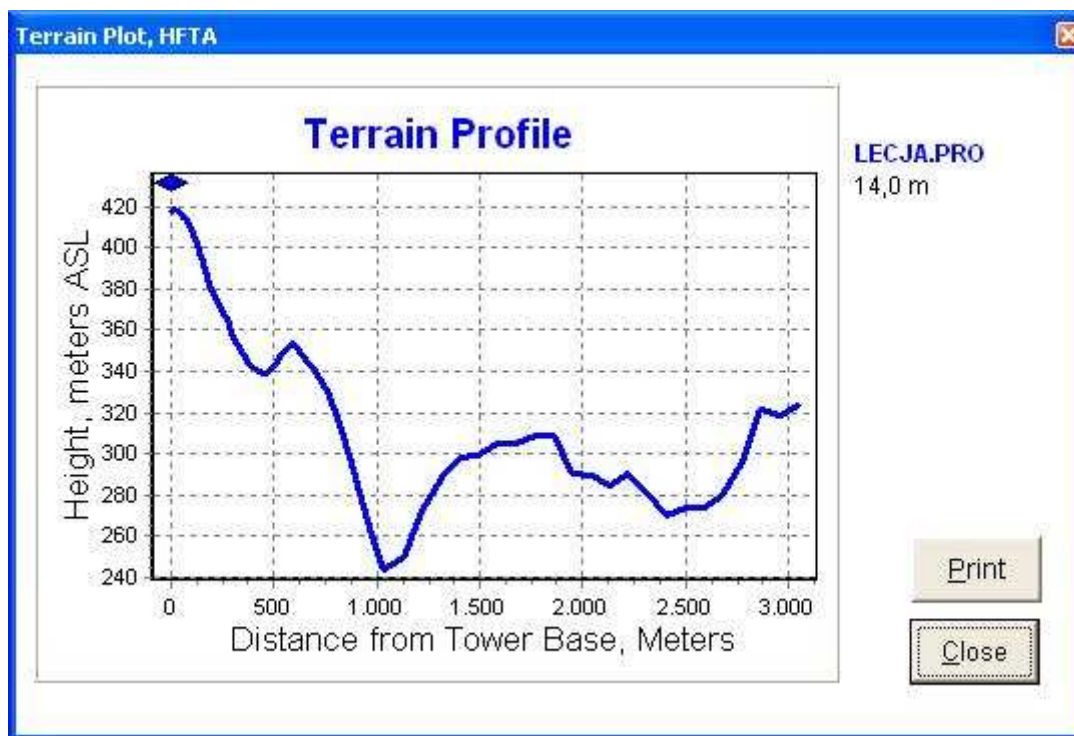
Wow !



From a I4LEC's location, looking US

How is the terrain towards Ja's, better or worse ?

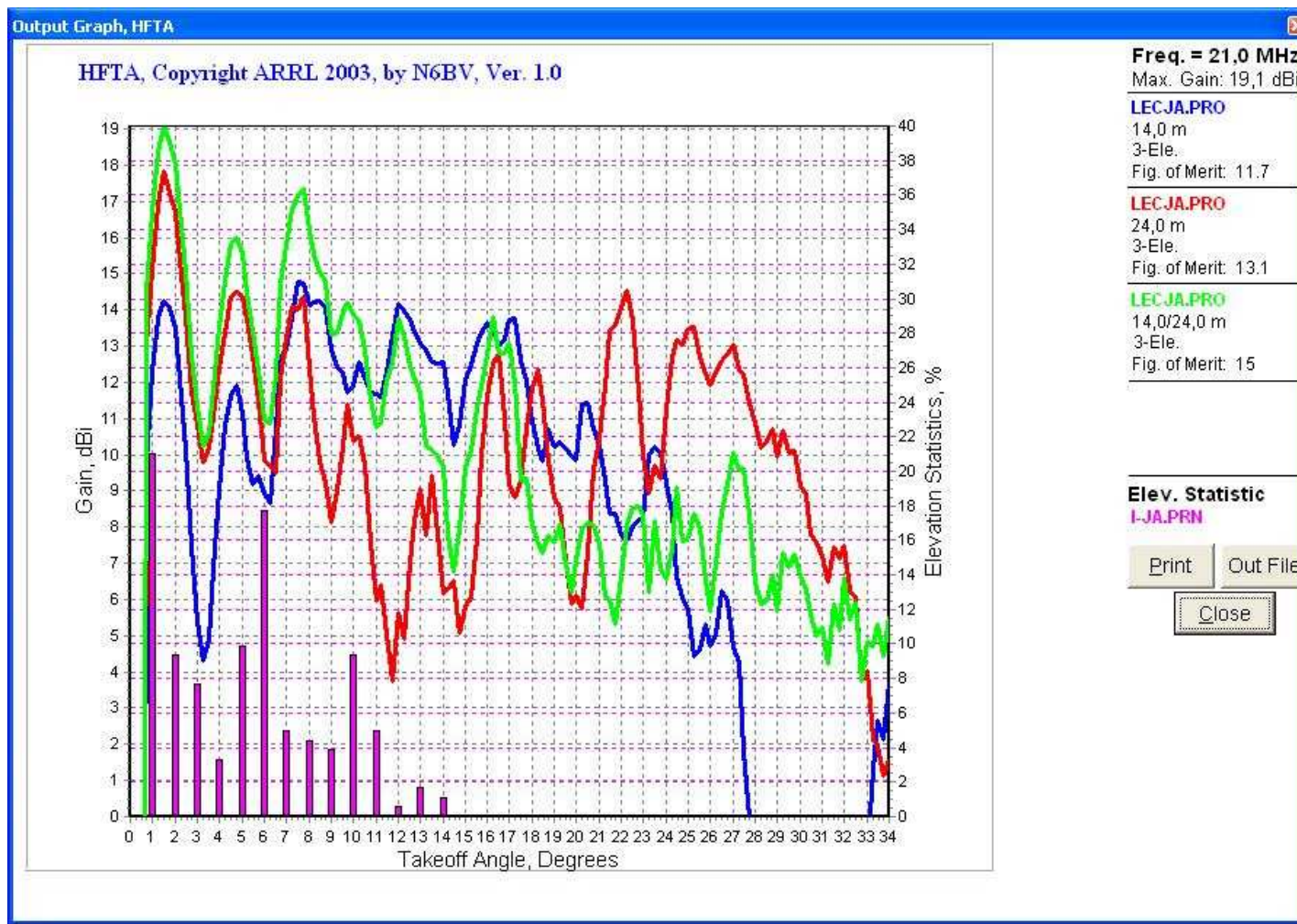
Better



From a I4LEC's location, looking Ja

Do I need a second antenna toward Ja's ?

Not really



From a I4LEC's location, looking Ja

On a flat location @ 28Mhz towards US, should I choose a 2 ele over 2 ele phased or a single 6 ele yagi on top ? **Either one**

**2 over 2 phased**

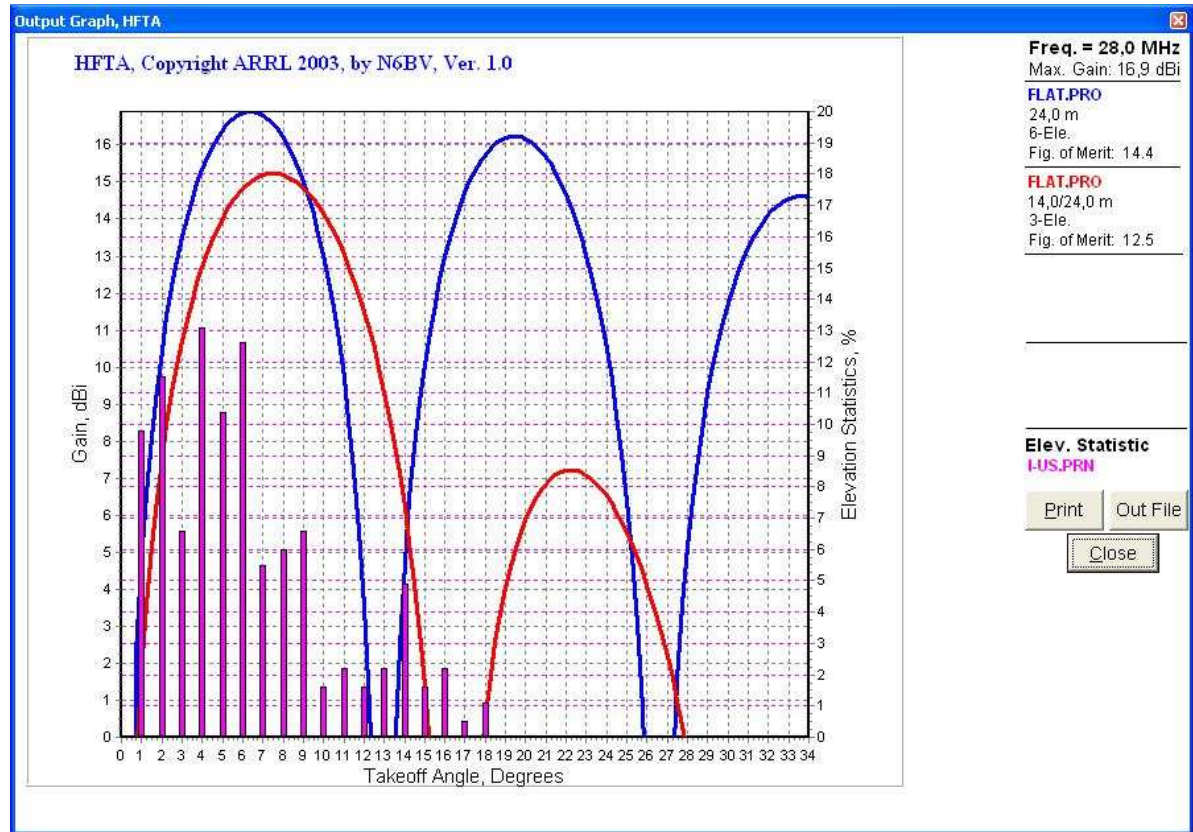
fig. of merit = 12.5  
 main lobe gain = 15dBi  
 2nd lobe gain = 7dBi (useless)  
 big null @ 15-18 degrees  
 (not important 4%)

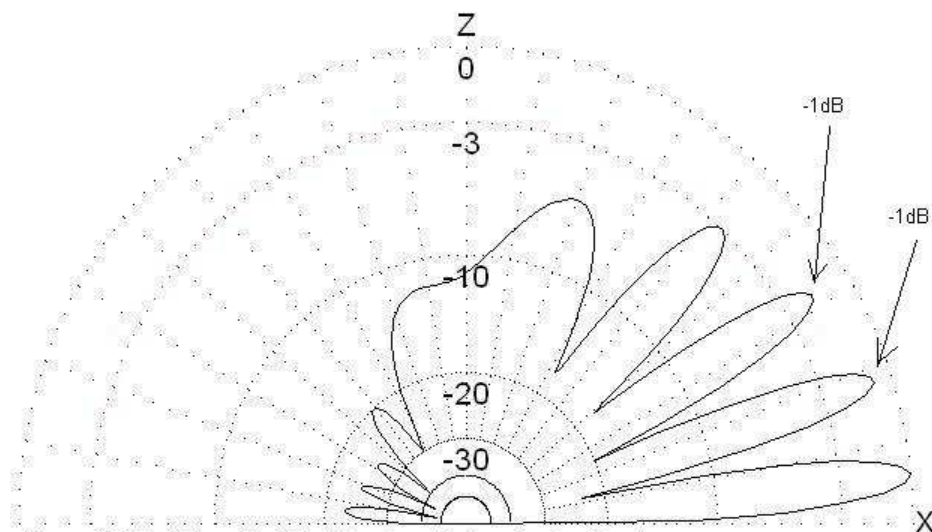
@12-14 degrees gain = 9dBi

**6 ele yagi**

fig. of merit = 14.4 (+1.9)  
 main lobe gain = 16.9dBi (+1.9)  
 2nd lobe gain = 16dBi (+9)  
 (almost useless)

big null @ 12-14 degrees (relatively important 8%)

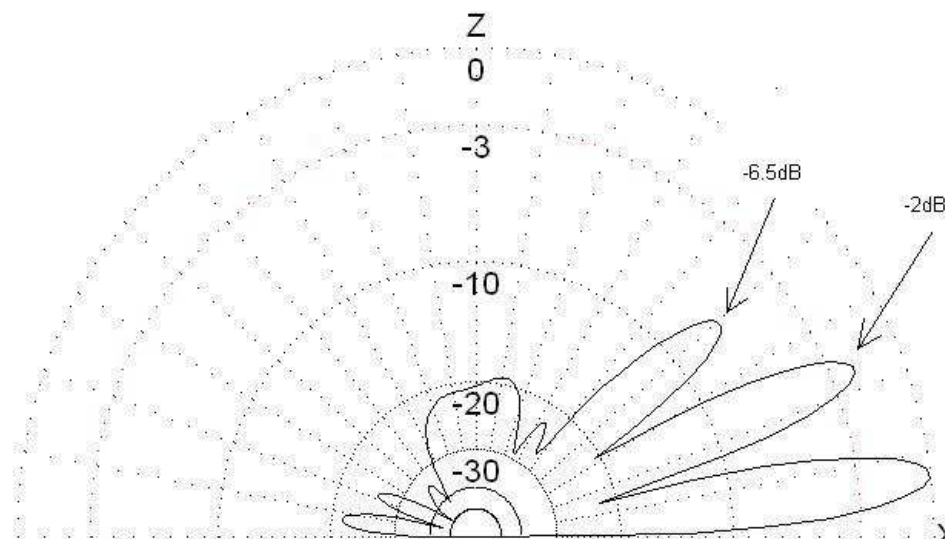




Ga : 12.5 dBi = 0 dB (Horizontal polarization)  
 F/B: 19.21 dB; Rear: Azim. 120 dg, Elev. 60 dg  
 Freq: 28.400 MHz  
 Z: 12.819 + j0.727 Ohm  
 SWR: 1.1 (12.0 Ohm),

## 2 ele @ 24 meters

## 6 ele @ 24 meters



Ga : 16.65 dBi = 0 dB (Horizontal polarization)  
 F/B: 21.14 dB; Rear: Azim. 120 dg, Elev. 60 dg  
 Freq: 28.500 MHz  
 Z: 34.874 - j23.033 Ohm  
 SWR: 1.9 (50.0 Ohm),

HFTA, for long yagis, does not take into account 2nd, 3rd lobe gain drop (which depends from antenna height), @24m -2 db for the second & -6.5dB for the third !!

# Do more with less

@I4LEC's location on 28Mhz towards US, should I choose a 2 ele over 2 ele phased or a single 6 ele yagi on top ?

**2 over 2 phased**

## 2 over 2 phased

main lobe gain = 11.2dBi

2nd lobe gain = 12dBi (-1)

3rd lobe gain = 10dBi (-1)

## 6 ele yagi

main lobe gain = 10.2 dBi

"-1"

2nd lobe gain = 14dBi

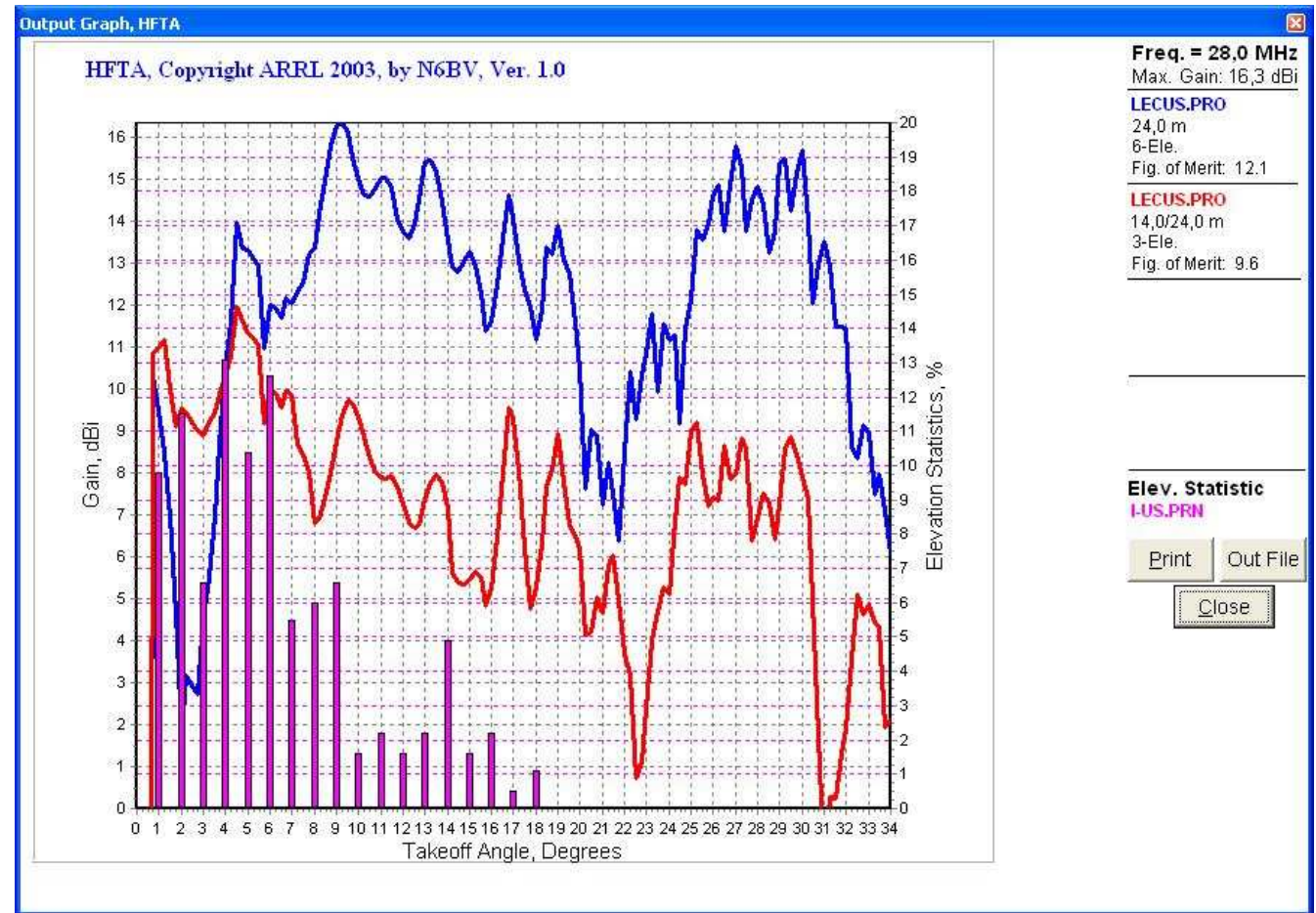
"- 2 (drop) = 12 (+1)"

3rd lobe gain = 16.2dBi

"- 6.5 (drop) = 9.7 (+0.7)"

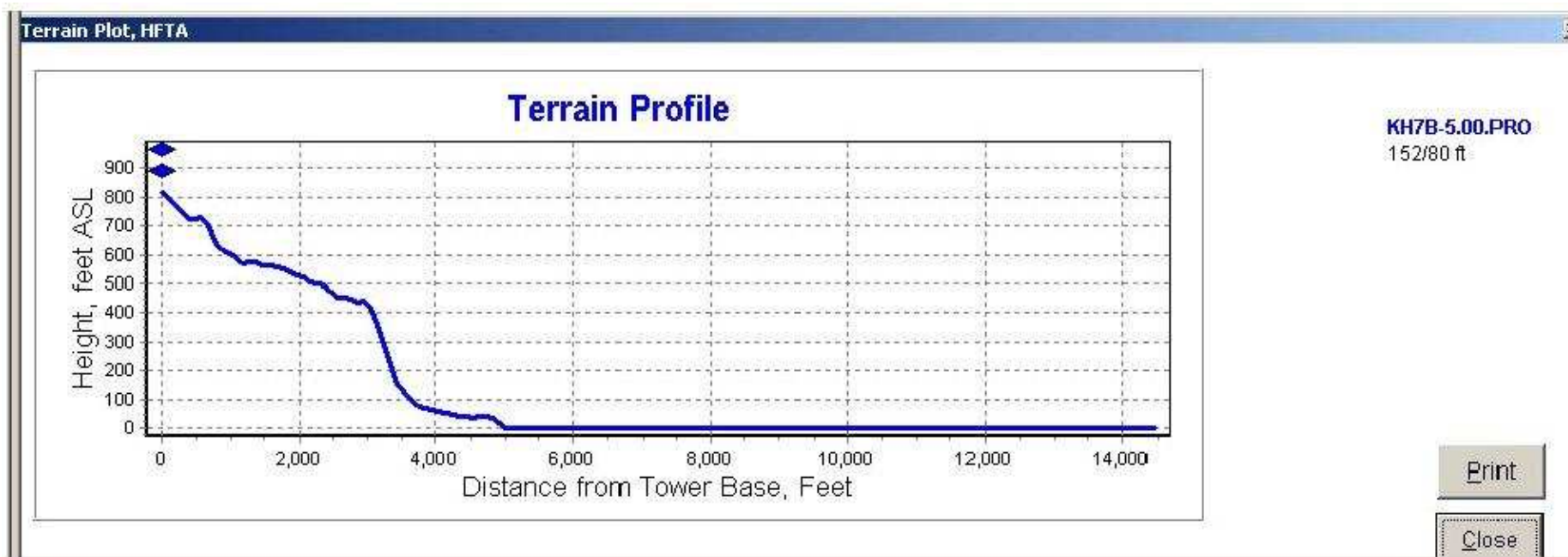
big null @ 2-3 degrees

"- 6dB"



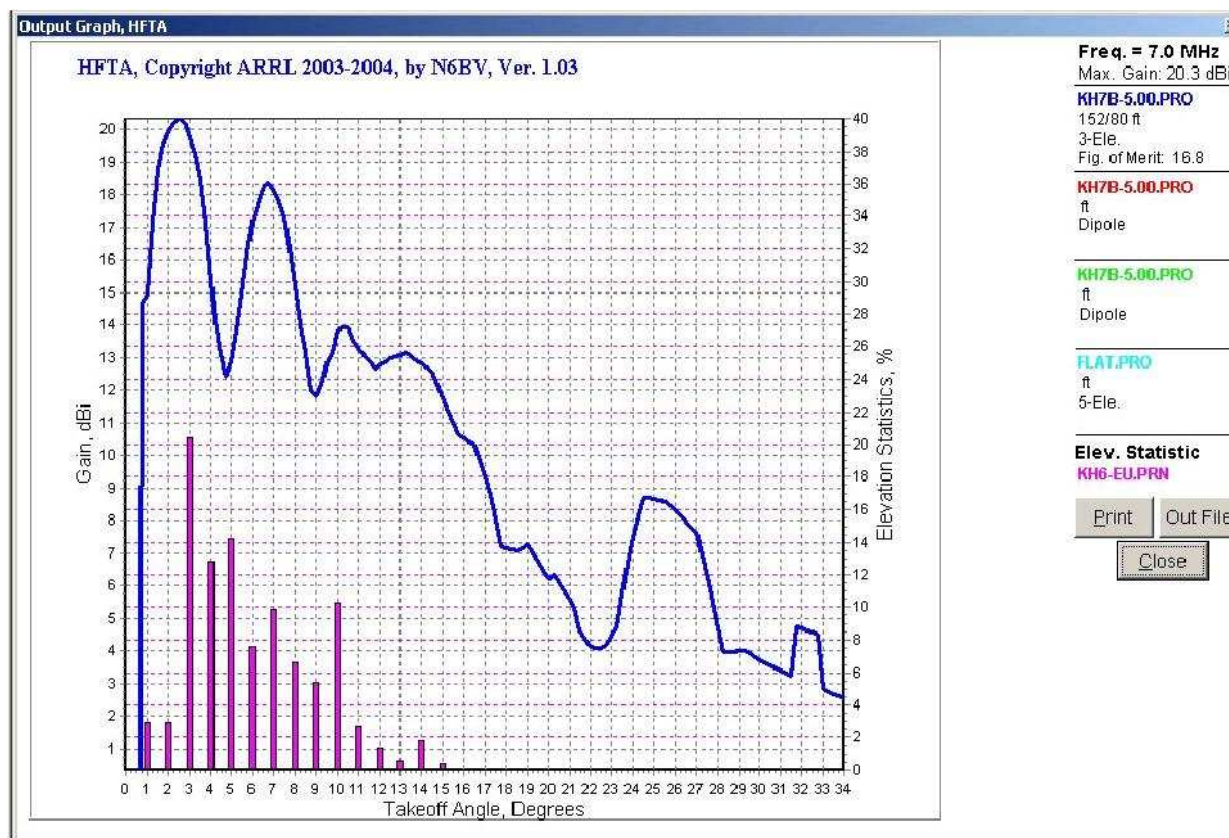
HFTA, for long yagis, does not take into account 2nd, 3rd lobe gain drop (which depends from antenna height), @24m -2 db for the second & -6.5dB for the third

Why Bill (KH7XS) is so strong on 40m



Terrain towards short path Europe @KH7XS

Stacked array of 4 over 4 @25 & @50 meters



I'm enclosing my HFTA for 40 to EU. It really is my favorite band since the antenna works so well. Check out the gain at 1 degree!

Main lobe @ 2.5 degrees (20.3dBi), second lobe @7 degrees (18.3dBi)

**Do more with less**



**Thank you**