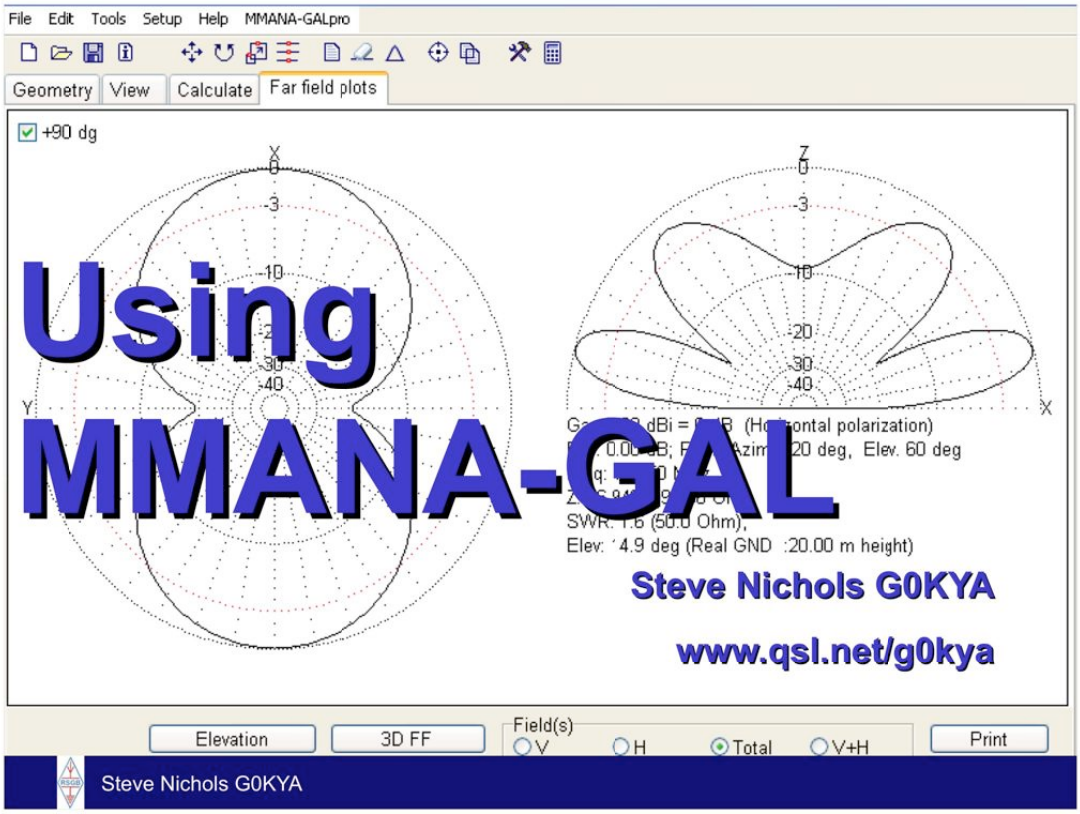
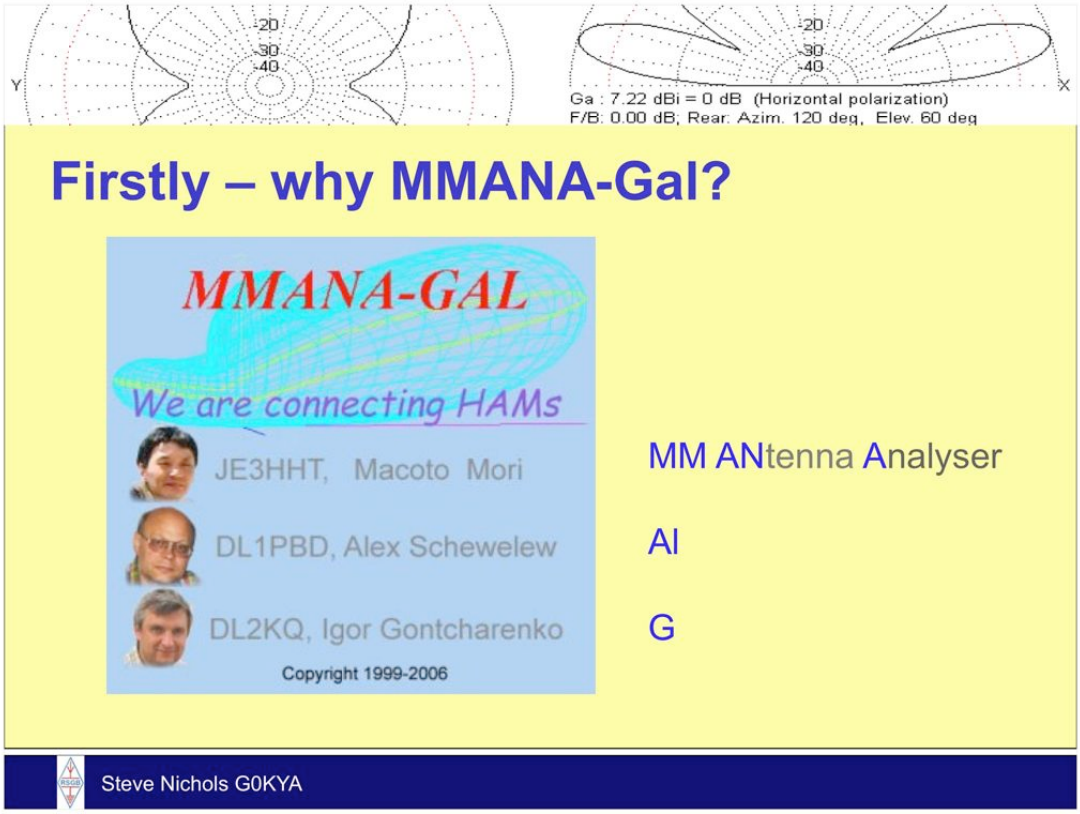
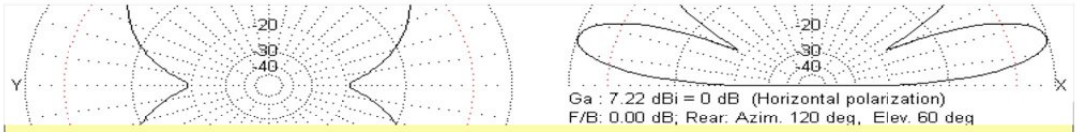


This is a presentation I gave at Norfolk Amateur Radio Club on antenna modelling with MMANA-GAL, what is and what you can use it for. After looking at how you model antennas I look at some typical applications.



The name MMANA-GAL is an amalgam of the main people responsible for it as you can see.



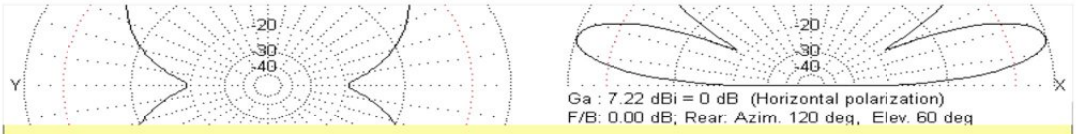
What is it?

A free antenna modelling program based on the NEC (Numerical Electromagnetic Code) engine.

Jerry Burke and A. Poggio wrote the NEC/MOM family of programs at Lawrence Livermore Labs in 1981, under contract to the US Navy.

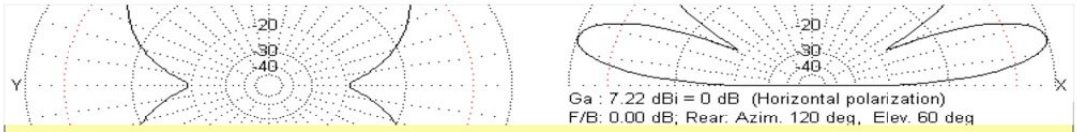
If you want more power see MMANA-GAL Pro ($99), EZNEC ($89) or EZNEC Pro 5 ($500)

It is free, it does have limitations in terms of the number of segments it can handle, but you are unlikely to exceed these. It can't handle coax stubs etc as far as I can see.



What does it feature?

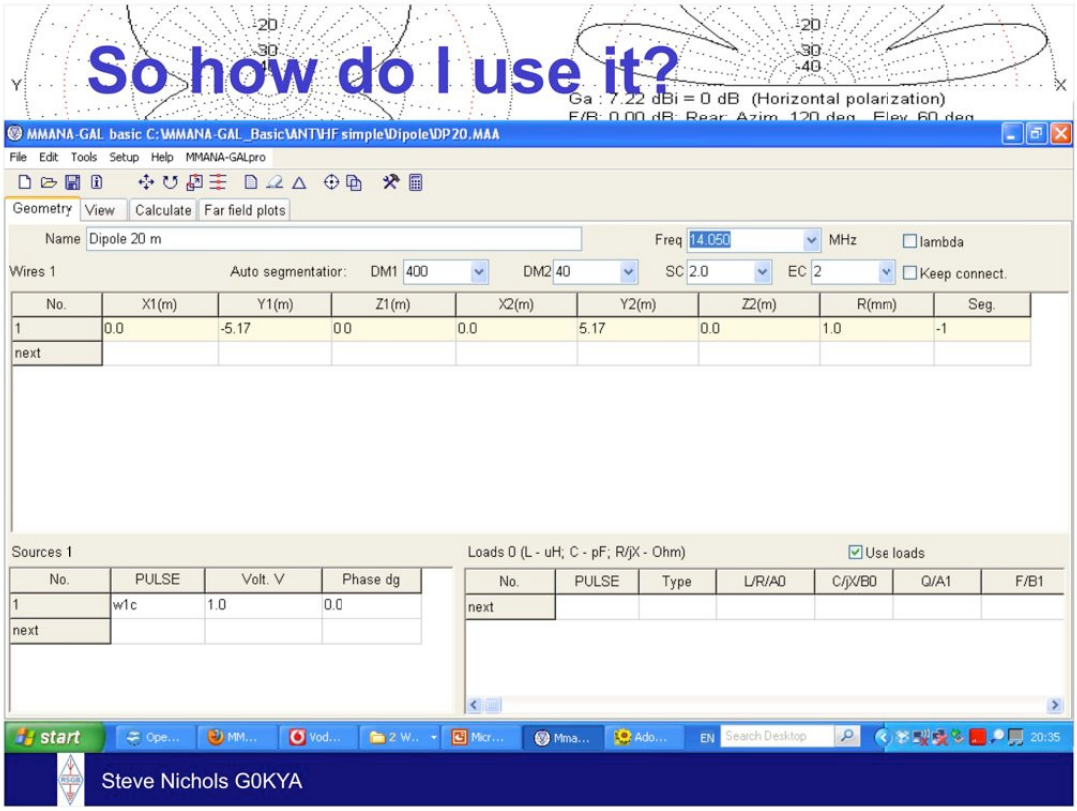
- Create multi element antenna designs and test for performance and matching
- Viewer for horizontal and vertical beam radiation patterns
- 3D radiation pattern
- Automatic antenna optimiser with respect to jX, SWR, Gain, F/B, Elevation, and Current
- Frequency characteristics chart maker
- Data file generator



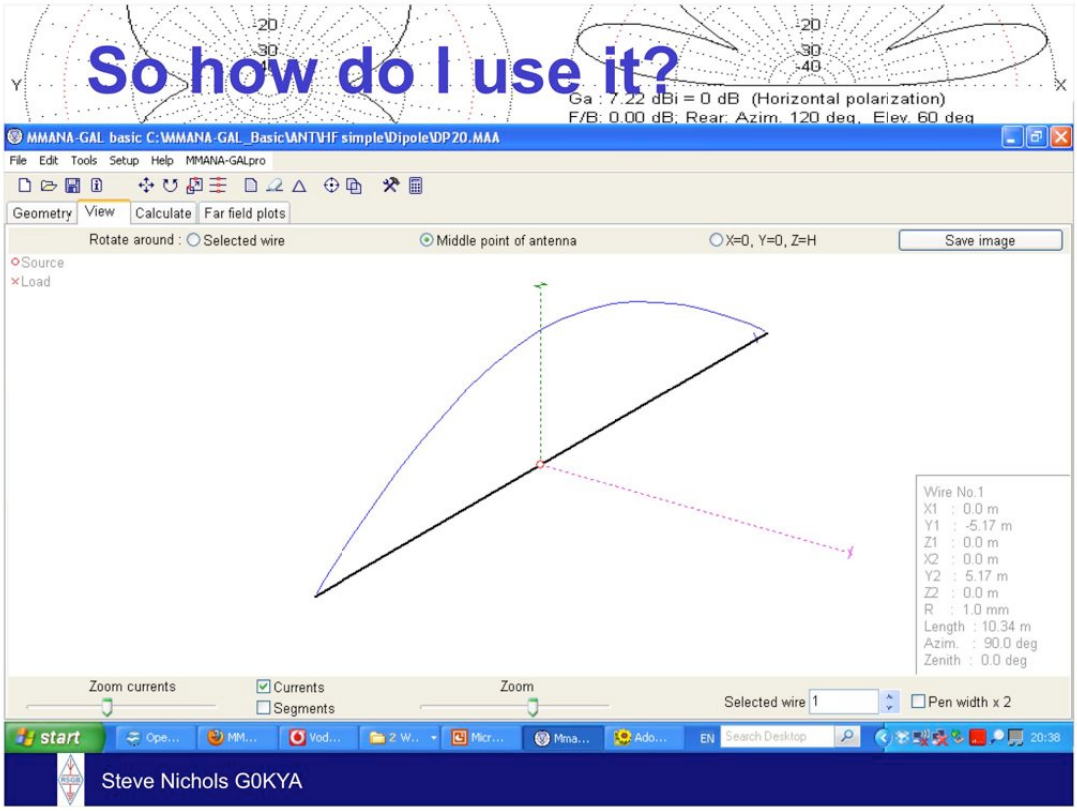
What do I need to know?

- The antenna design is made up of straight **WIRES**
- We can include **LOADS** (made up of L and C eg traps/loading coils)
- To this we then apply a **SOURCE** of a specific impedance at a point on one of the wires.

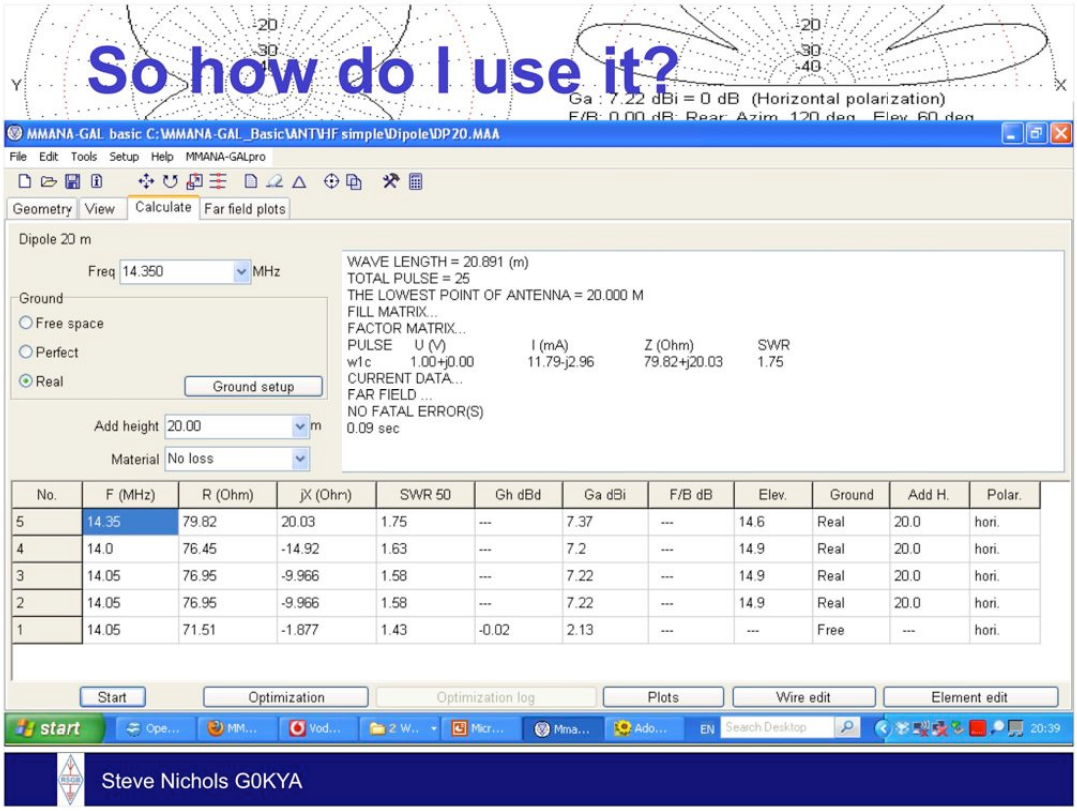
The terms wires, loads and source refer to the input functions in the program.



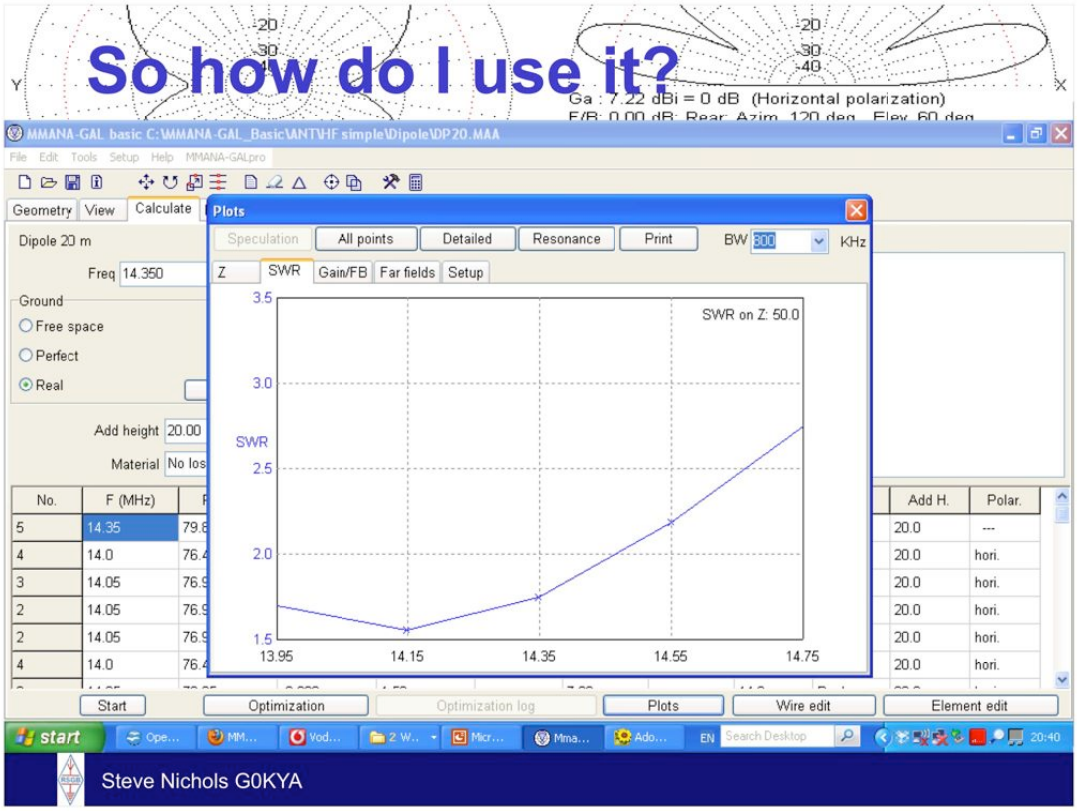
Here I have made a dipole. It is 10.34m (2 x 5.17m) long with wire of radius 1mm. We are feeding it in the middle (w1c – wire 1, centre). There are no loading coils or traps. Just leave the auto segmentation as it is



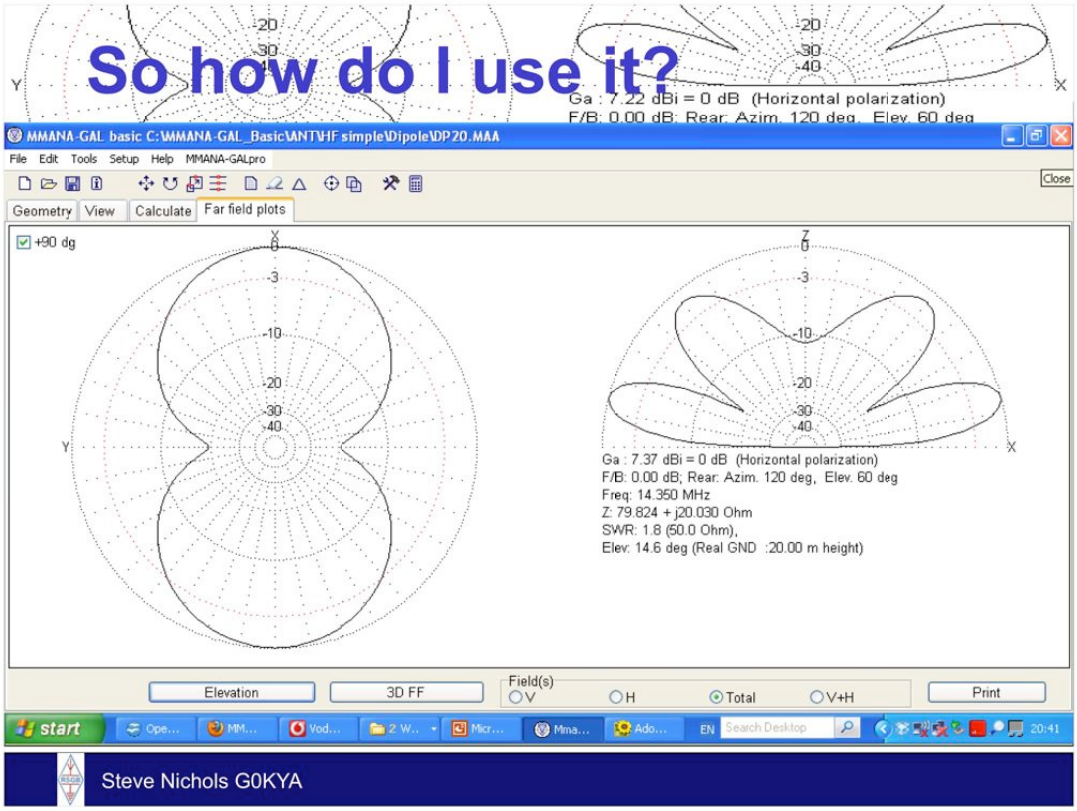
This is the current distribution on the dipole. The little red blob in the middle is the feedpoint. We can see the current maximum (which does the radiating) is in the centre.



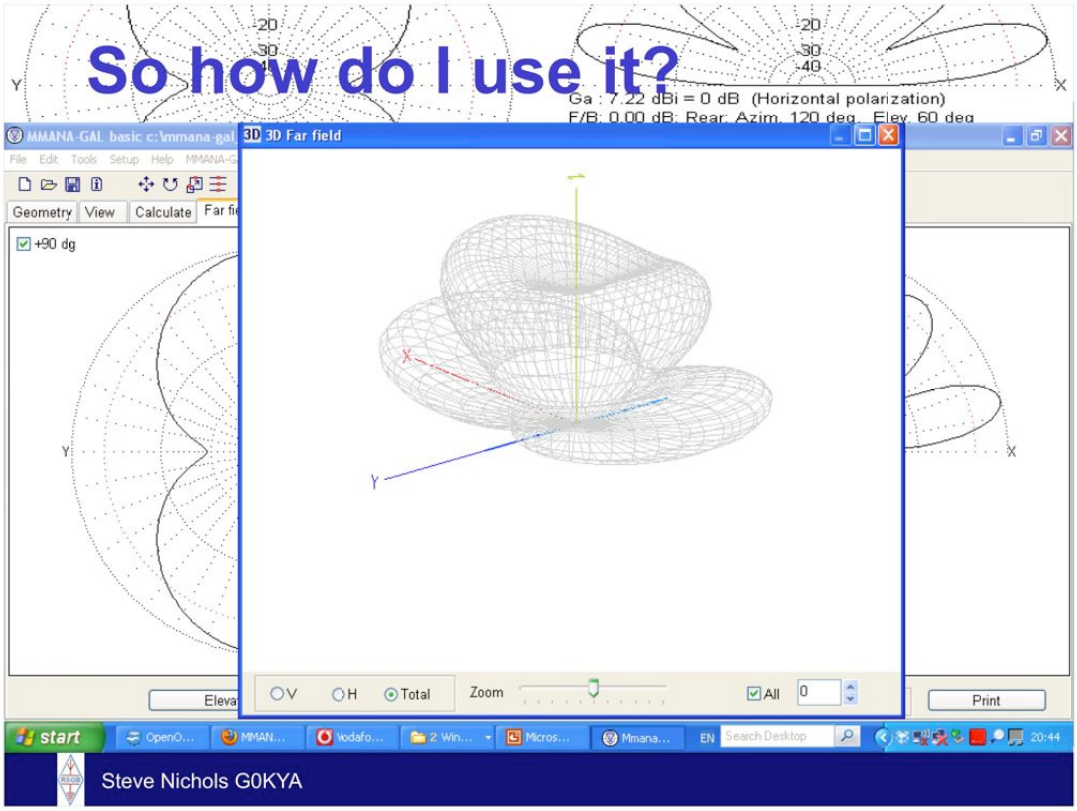
Here we placed it 20m above ground and ran it at a number of frequencies in the 20m band. You can see the modelled SWR varies 1.43:1 to 1.75:1 Maximum gain is at 14.6 degrees to the horizon. Note: I forget to specify copper wire – it is assuming no losses in the wire.



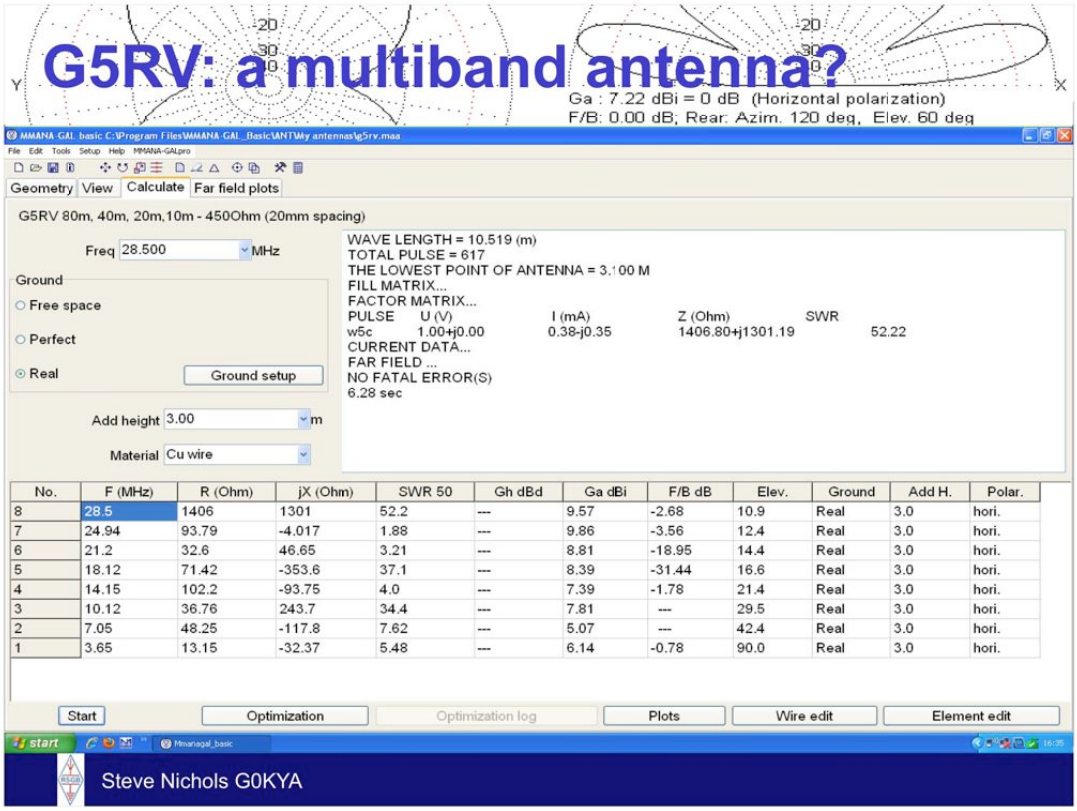
You can get a simulated SWR curve – your measured result may be better at the end of a length of coax due to losses. Note impedance is 50 Ohms.



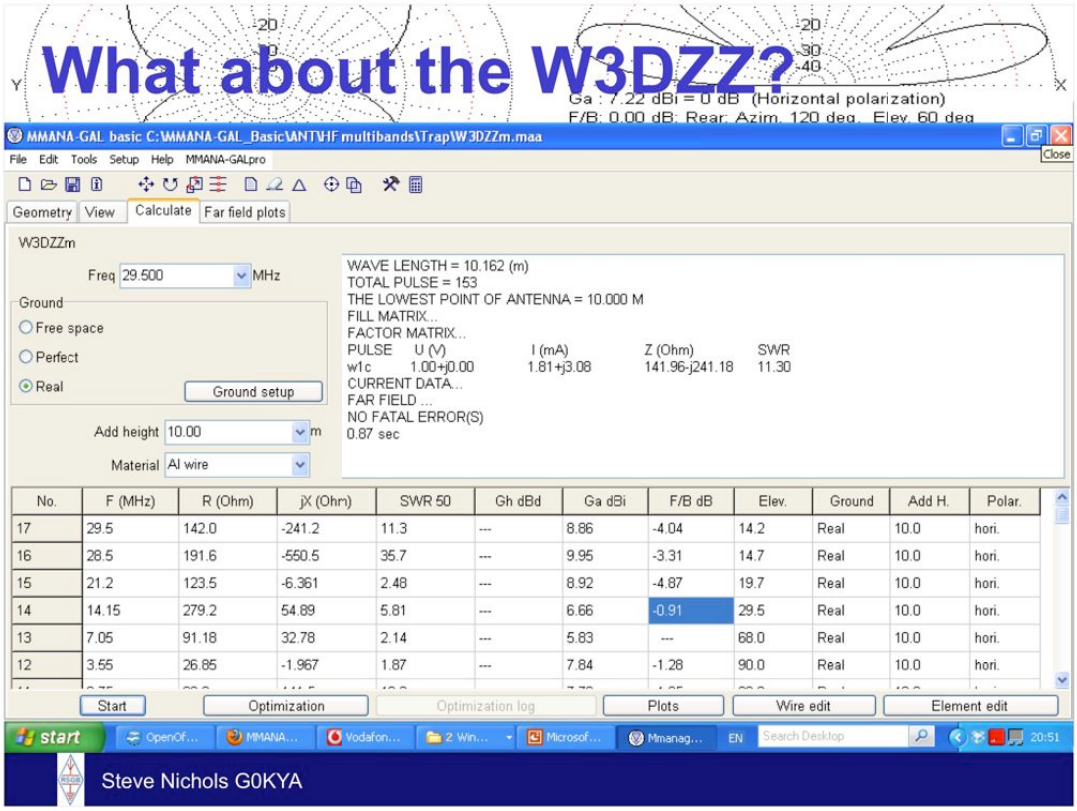
These are the predicted radiation patterns – left hand is looking down on the antenna. Make sure you set the elevation angle you wish to view – this is at the 14.6 degrees maximum. You can select vertical or horizontal polarisation or total radiation.



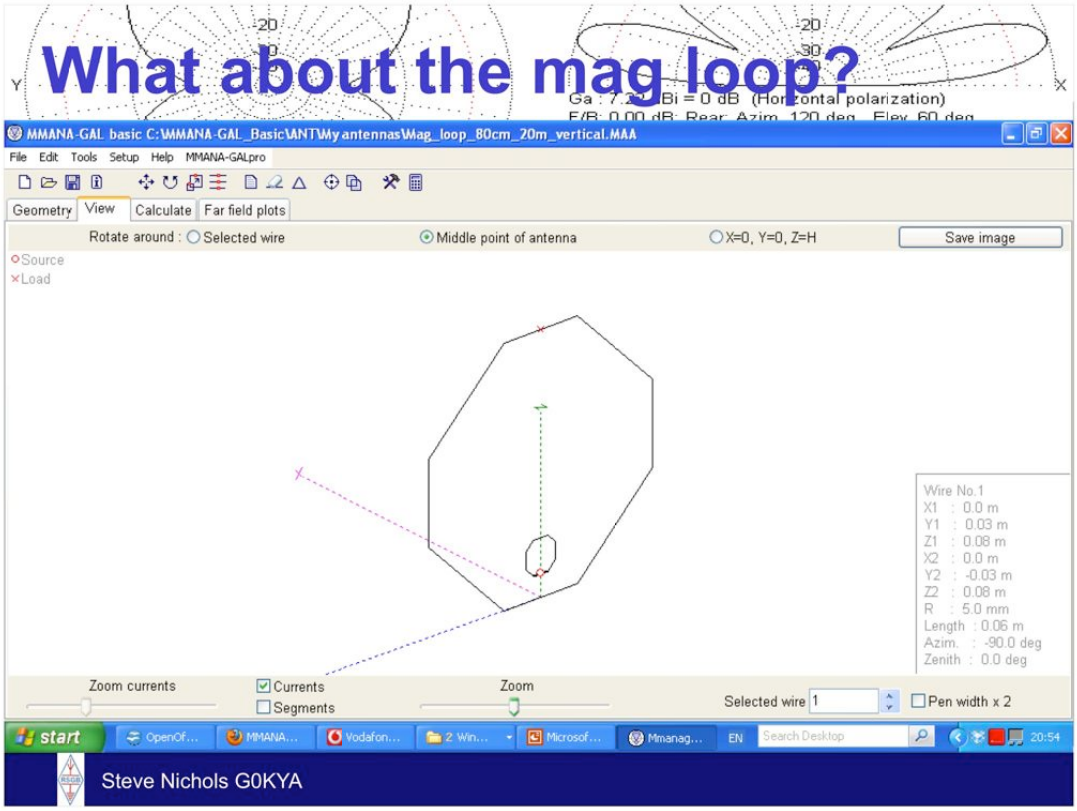
You can also get a 3D view



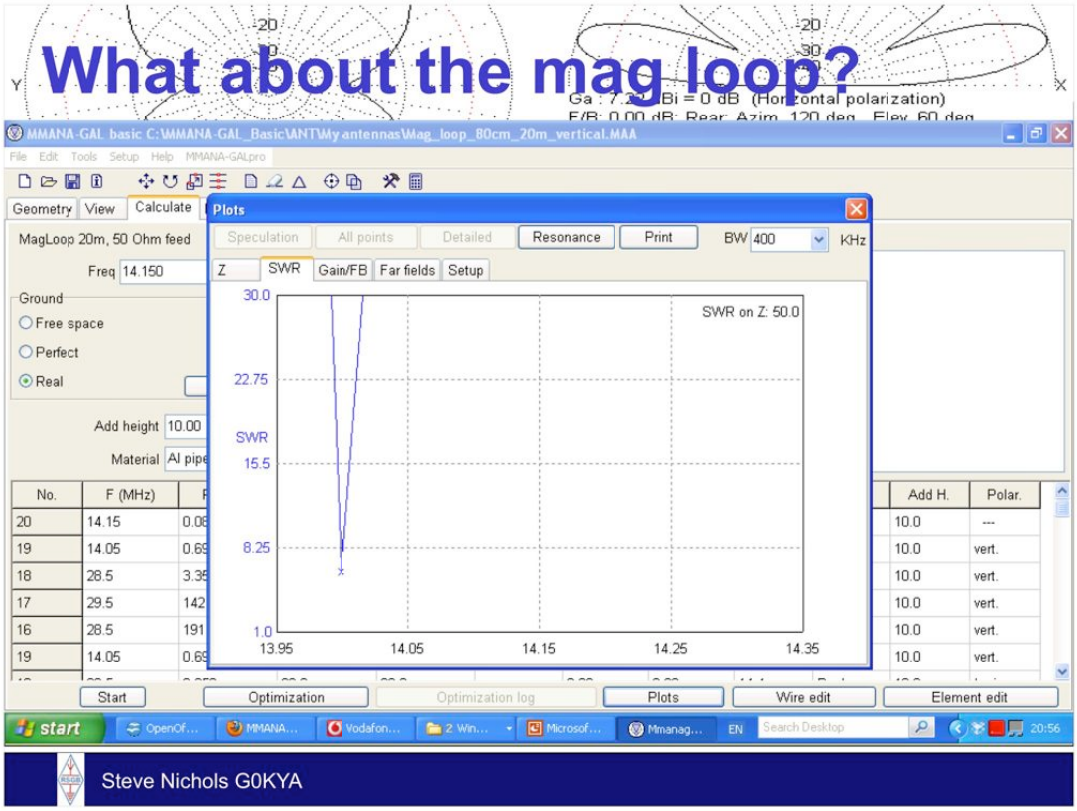
As an example, this is a run on a simulated G5RV antenna. As you can see the predicted SWR figures are not very low on most bands. So is it a true multiband antenna?



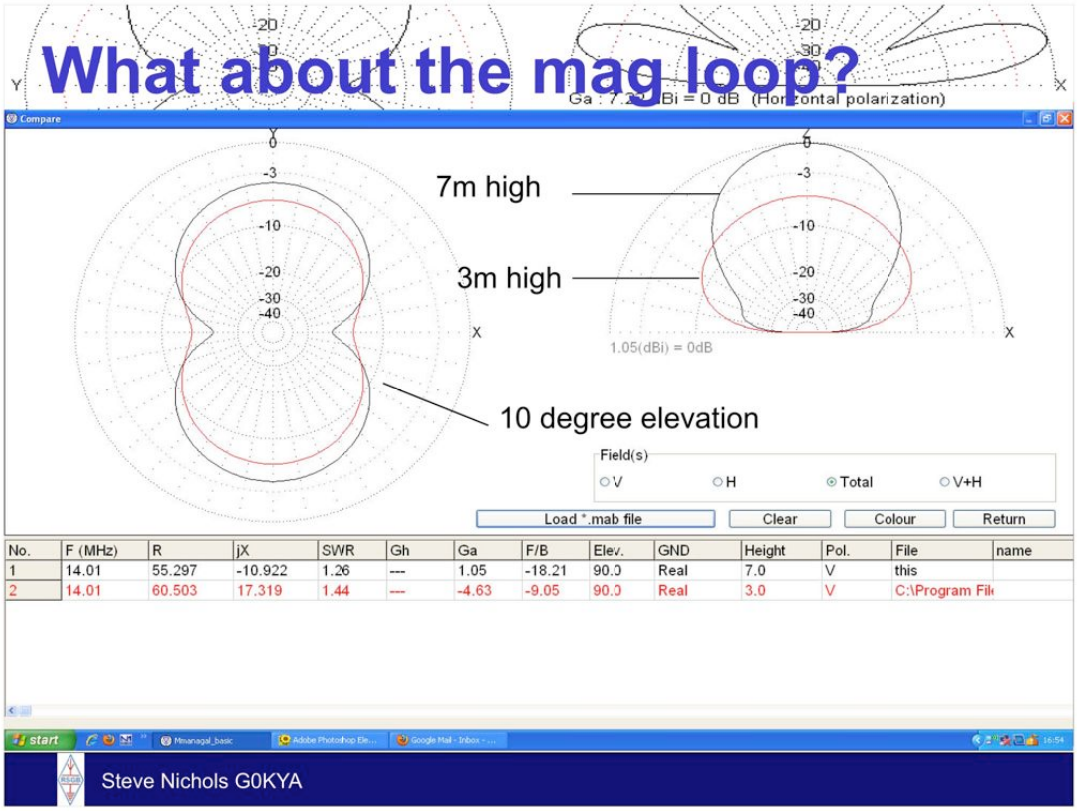
The W3DZZ (80/40m trap dipole) looks like it matches OK on 80m and 40m, but may not be a good match on every band.



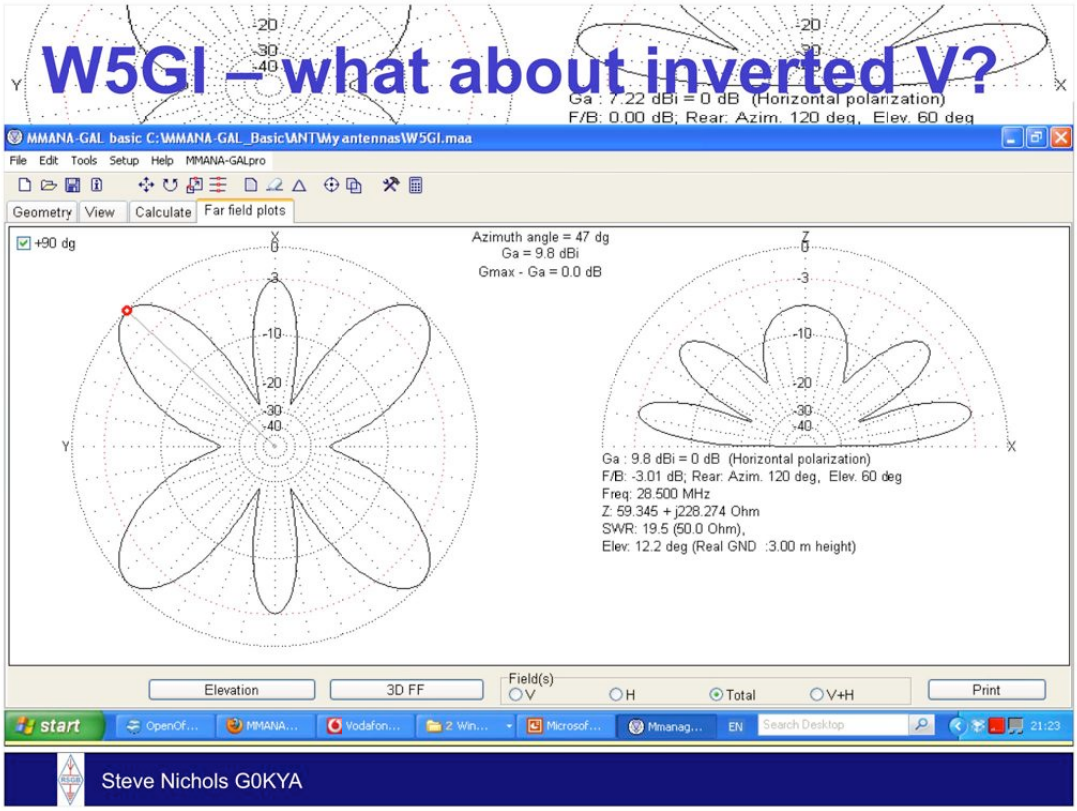
You can model mag loops using straight sections – this model comes with the package.



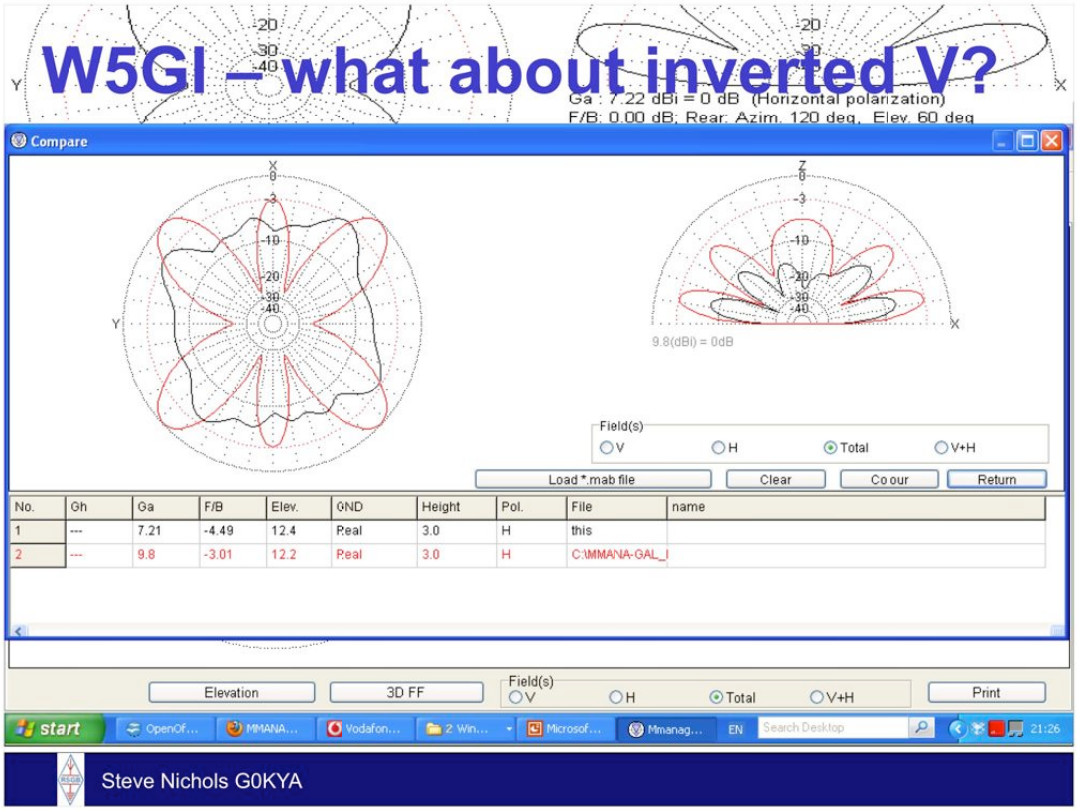
Note the sharp SWR and narrow bandwidth of a mag loop at its resonant frequency.



You can see how the radiation pattern may change as a vertical mag loop is raised. It might be better all round at 3m and not 7m according to the model.

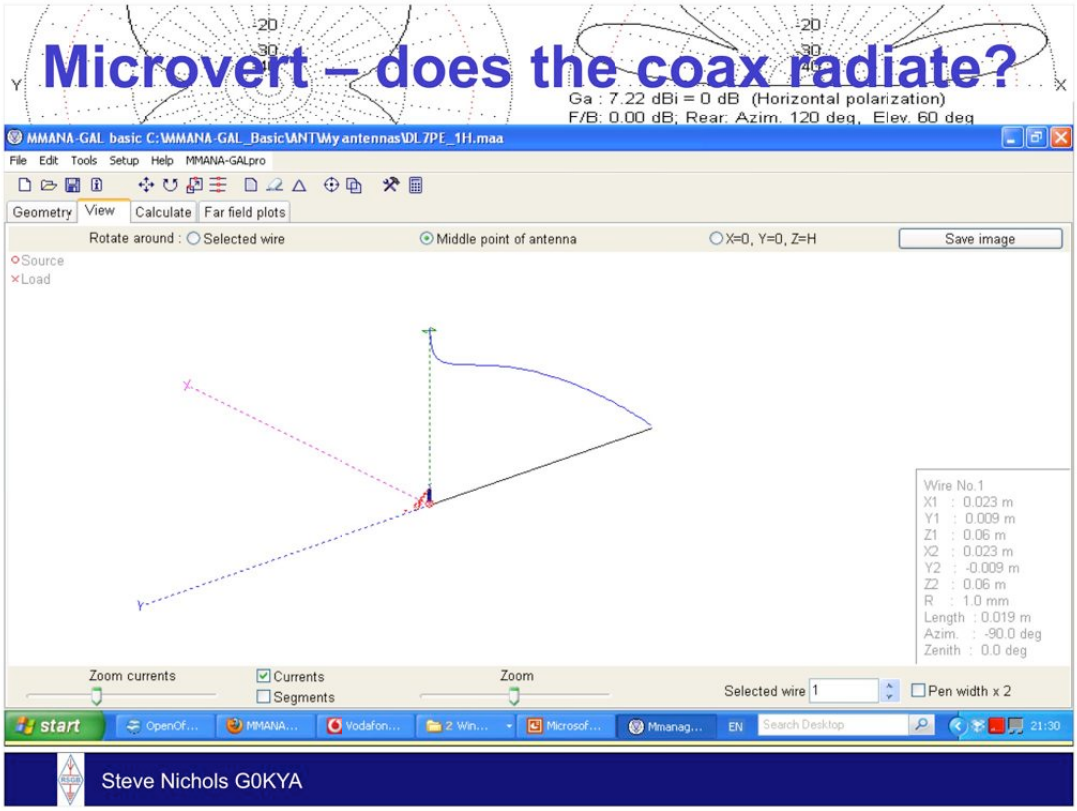


Note the nice petal-shaped predicted radiation pattern for a flat-top-mounted W5GI Mystery Antenna



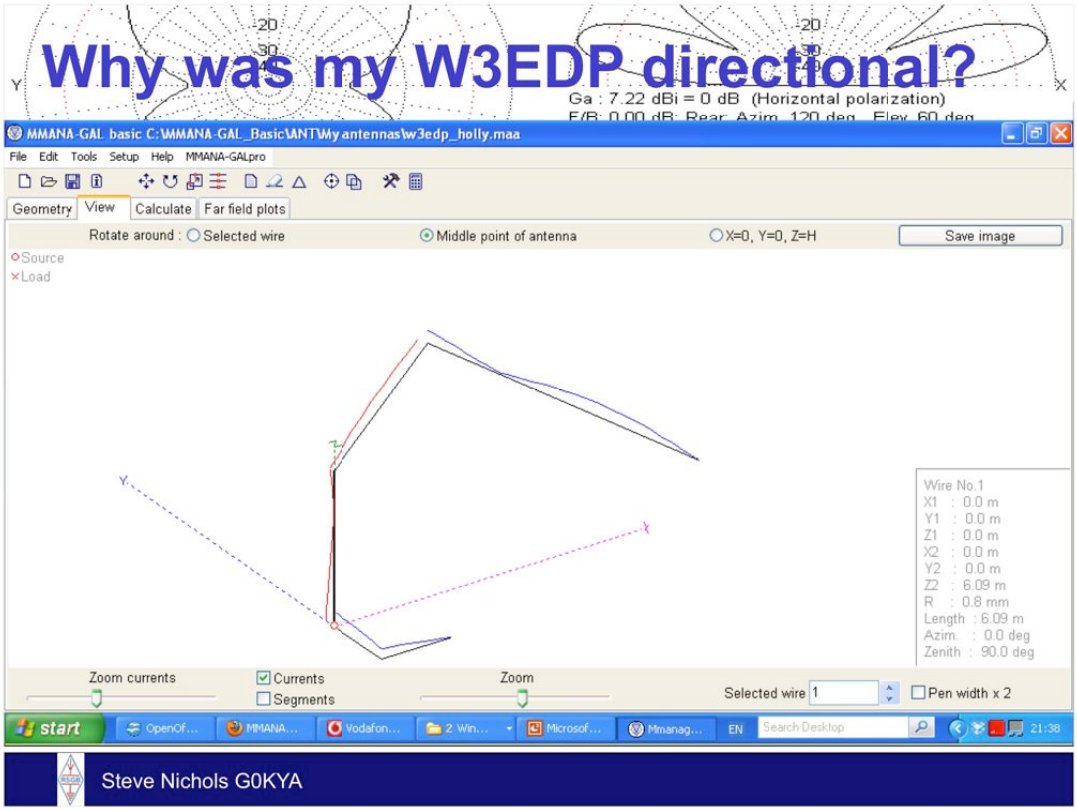
But mount it as an inverted V and it all goes pear-shaped. It becomes more omnidirectional, but you lose those lobes. The same thing happens with the G5RV and most "long" antennas on the higher bands.

The Microvert is a tiny antenna fed with a quarter wave of coax to which you only connect the inner.. You have a choke at the other end of the coax.

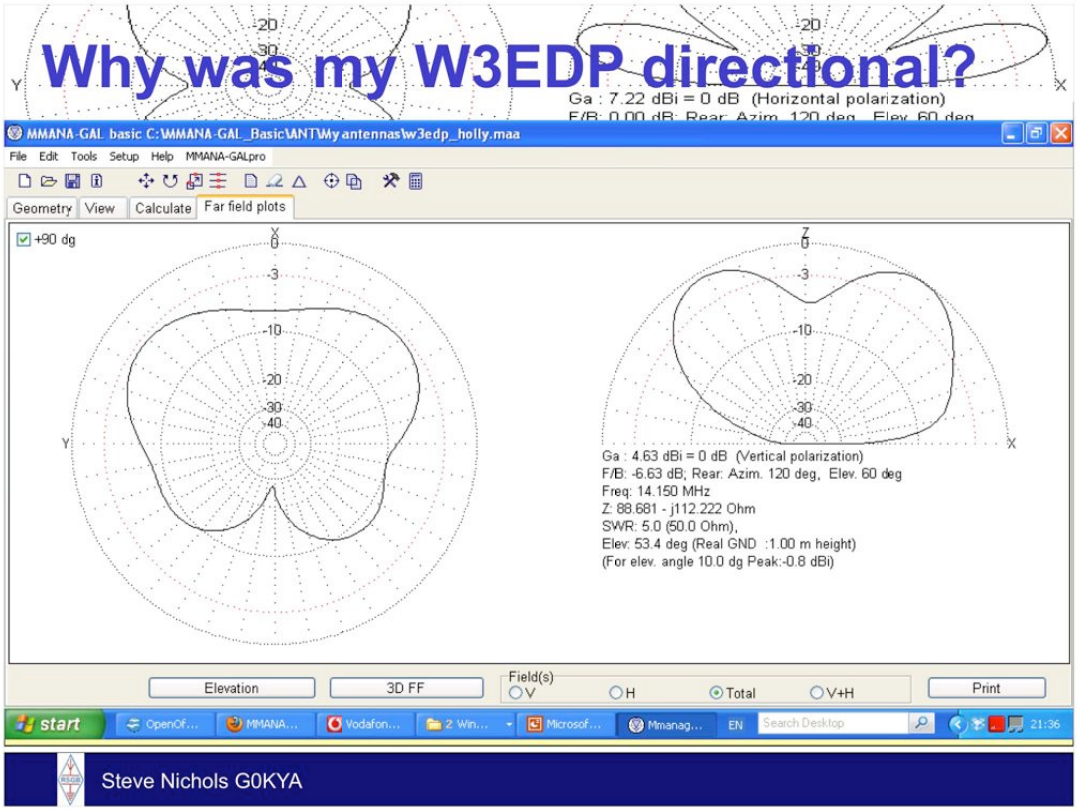


You can see the prediction is that the coax does most of the radiation – that's where the maximum current is. To be fair, the antenna is designed to include the feeder as part of the overall antenna system..

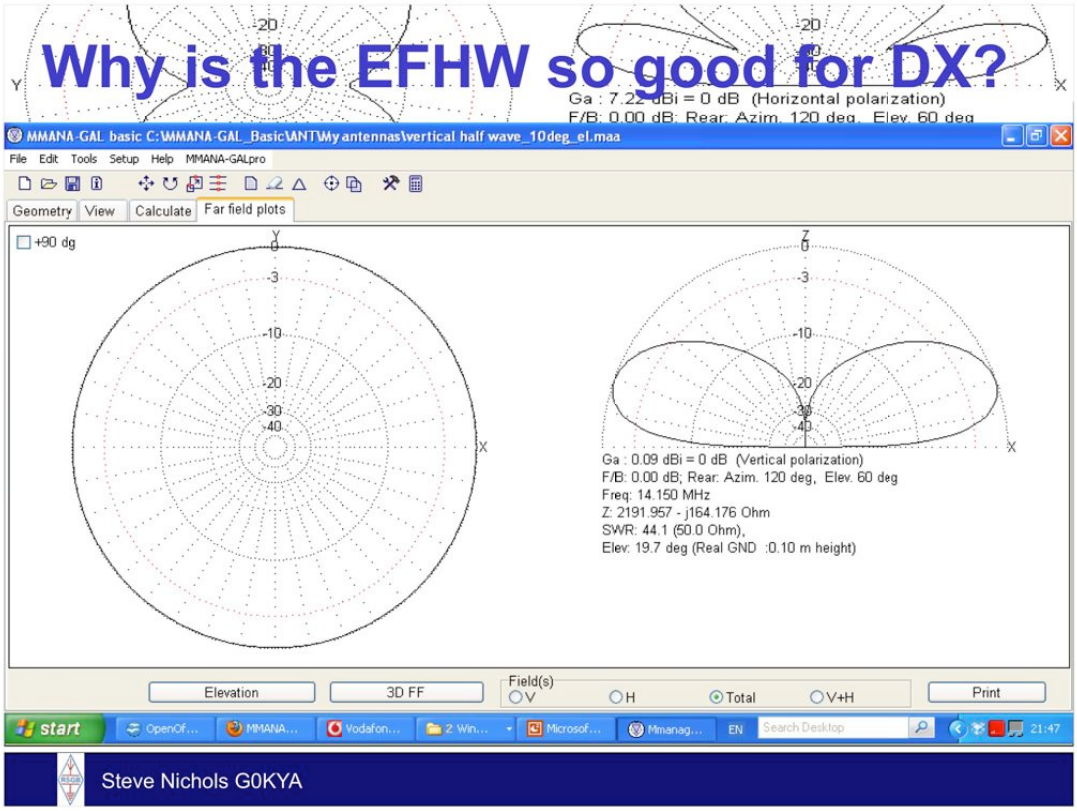
It works (I have one for 40m). It isn't as good as a dipole, but if you live in a flat it gets you on the air.



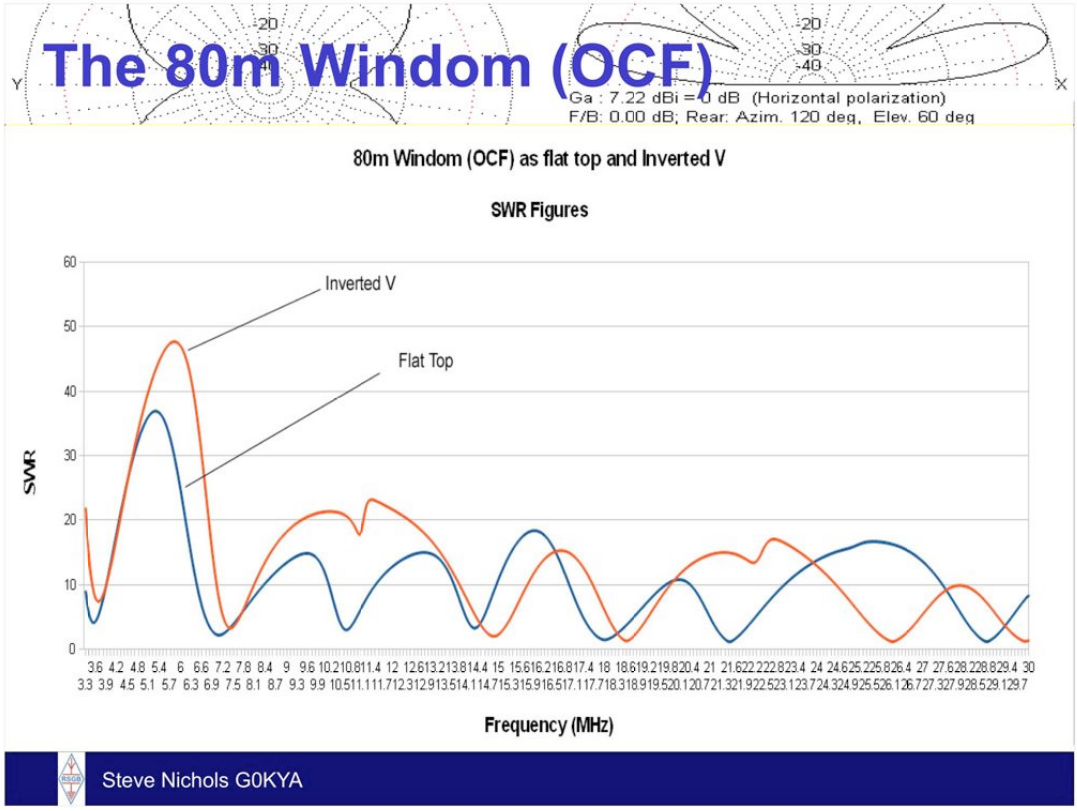
I had an 85ft end fed over my house (W3EDP. It worked reasonably well but had some nulls. Let's see where ...



Now we can see that the model suggested it had a big null to the north and worked better south east and south west on 20m. That is what I found.



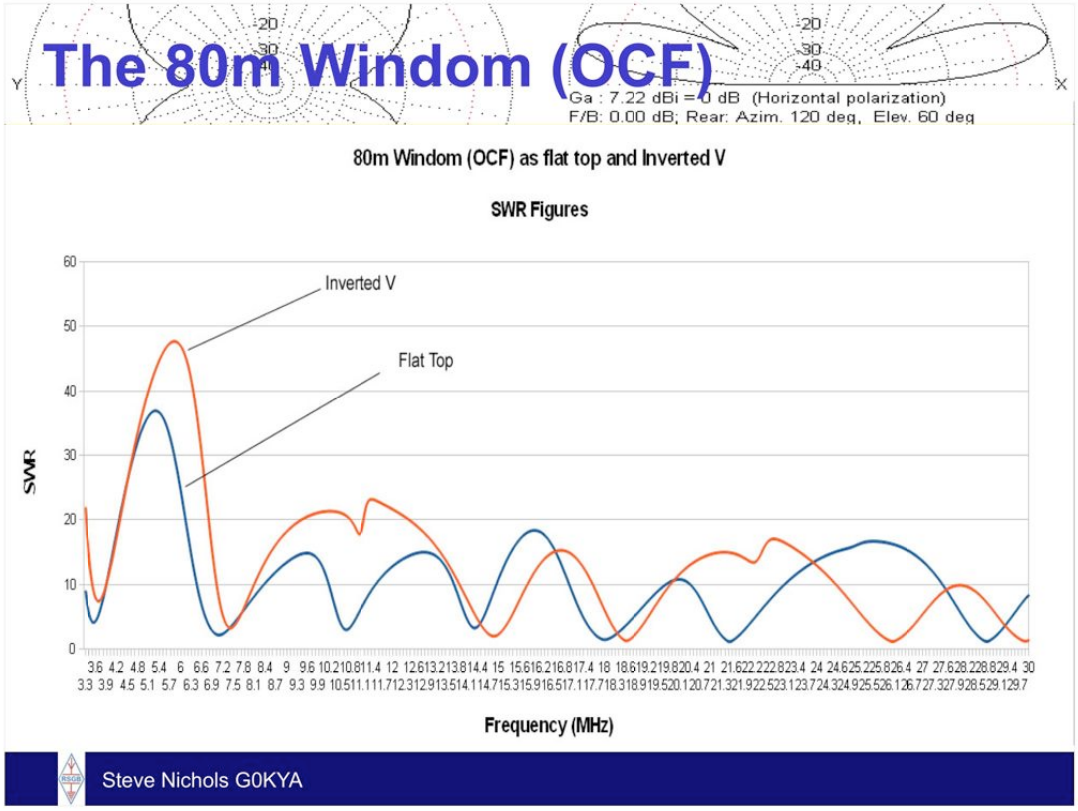
My End Fed Half Wave (EFHW) design is omni-directional and a good low-angle radiator. I just had to find a way to match the 2000-2500 Ohm impedance – see the downloadable instructions at g0kya.blogspot.com.



This is a model of the classic 80m Windom (off centre fed dipole) antenna – 136ft (11.82m one leg, 29.63m the other – fed with a 4:1 balun). You can see the low SWR points when mounted flat top.

They change if the antenna is mounted as an inverted V. Not many manufacturers or books tell you this, but it seems to be the case in practice.

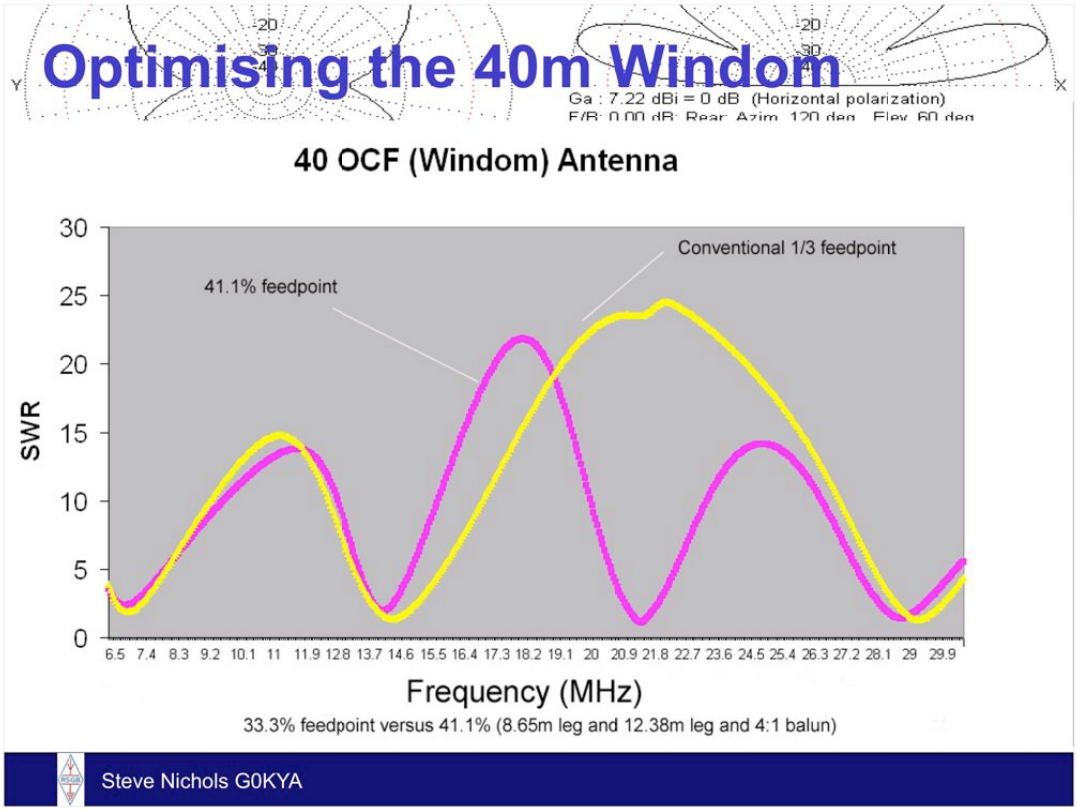
To produce these graphs I used MMANA-Gal's ability to output a .csv file of values across a whole range of frequencies (3-30MHz). I then imported these into OpenOffice Calc to graph them.



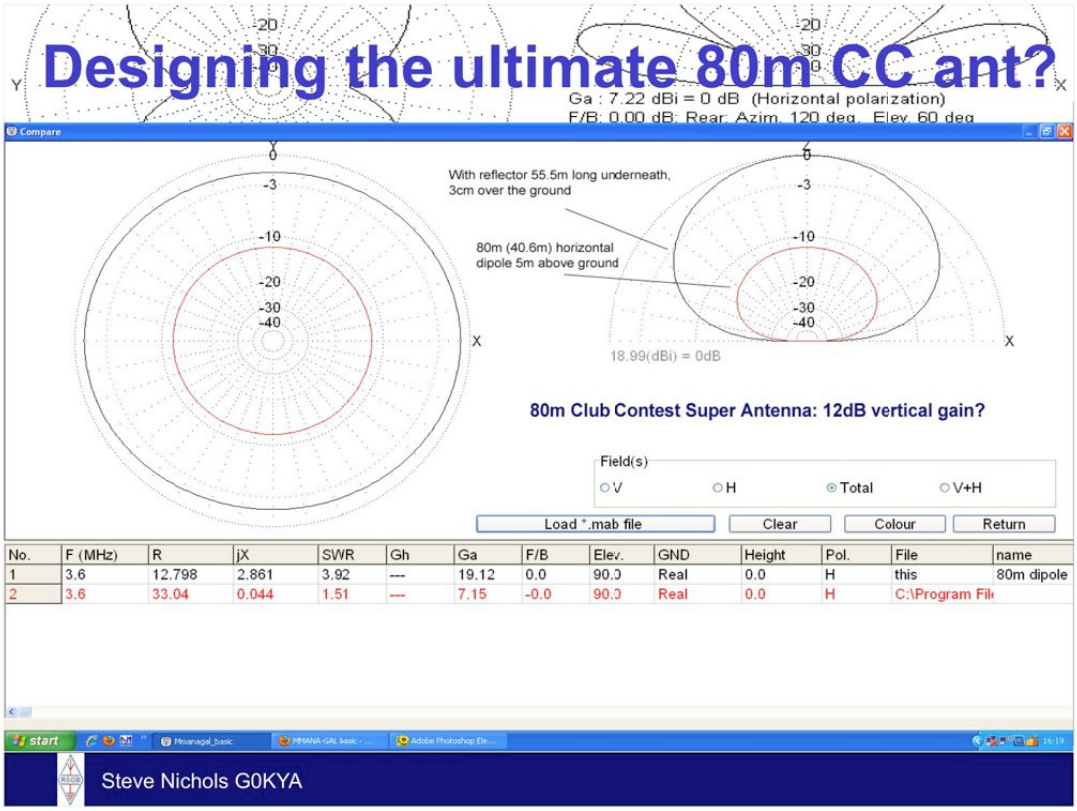
This is a model of the classic 80m Windom (off centre fed dipole) antenna – 136ft (11.82m one leg, 29.63m the other – fed with a 4:1 balun). You can see the low SWR points when mounted flat top.

They change if the antenna is mounted as an inverted V. Not many manufacturers or books tell you this, but it seems to be the case in practice.

To produce these graphs I used MMANA-Gal's ability to output a .csv file of values across a whole range of frequencies (3-30MHz). I then imported these into OpenOffice Calc to graph them.

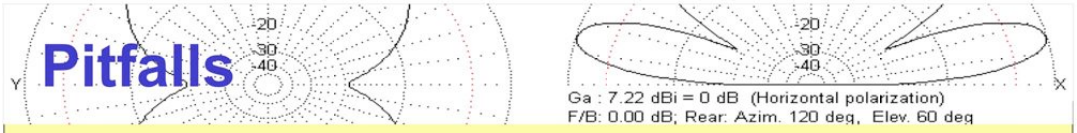


Here you can see that feeding a 40m Windom at a special point (not the one third/two third point) gives you 15m too. These results were output from MMANA-GAL and then imported into a spreadsheet. The 8.65m/12.38m OCF Windom gives you 40m, 20m, 15m and 10m. That is, you gain 15m.



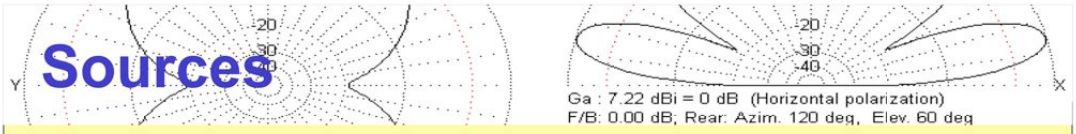
Putting a 55.5m reflector just 3cm off the ground under an 80m horizontal dipole could give great NVIS gain if the model is to be believed. But does it? It is still to be tried.

Pitfalls



- The software assumes your antenna has nothing around it
- And what about your earth conductivity/dielectric constant – do you know what they are?
- Make sure you choose the right impedance (defaults to 75 Ohm)
- Make sure you set the elevation you want to test
- With inverted Vs you'll need Pythagoras to help you
- PVC-coated wire will have to be shorter than predicted (90-95%)
- Real-life SWR values will be far better than predicted due to coax losses
- Don't apply a “source” to an angled joint – put a short piece of straight wire in and feed that
- It's a simulation – real-life installations might not behave that way

Sources



- MMANA-GAL software:
http://hamsoft.ca/pages/mmana-gal.php

- Quick Start Tutorial:
http://kalepafarm.mystarband.net/mmanaquickstart.htm

- YouTube – many tutorials, just search