ANTENNA MODELLING

Quin Collier G3WRR

SRCC meeting 21st September 2015

OUTLINE OF PRESENTATION

- WHY YOU MIGHT WISH TO TRY ANTENNA MODELLING
- DEMONSTRATION OF SOME OF THE AVAILABLE SOFTWARE TOOLS
  - (INCLUDING SOME INTERESTING ANTENNA PATTERNS)
- HF FOCUSED, BUT PRINCIPLES ALSO APPLY TO VHF
- (TIME PERMITTING) – “AUDIENCE PARTICIPATION GAME” TO DESIGN AN ANTENNA AND SEE HOW IT SHOULD PERFORM

DON'T PANIC!

YOU DON'T HAVE TO DO ANY OF THIS STUFF TO MAKE CONTACTS…

JUST GET SOME WIRE UP IN THE AIR:

- **AS LONG AS POSSIBLE**
- **AS HIGH AS POSSIBLE**
- **PREFERABLY CENTRE FED**
- **THE G5RV IS NOT THE ONLY ANSWER!**

DO THAT AND YOU <u>WILL</u> MAKE CONTACTS

IS IT REALLY AS SIMPLE AS THAT?

YES!

AND NO…..

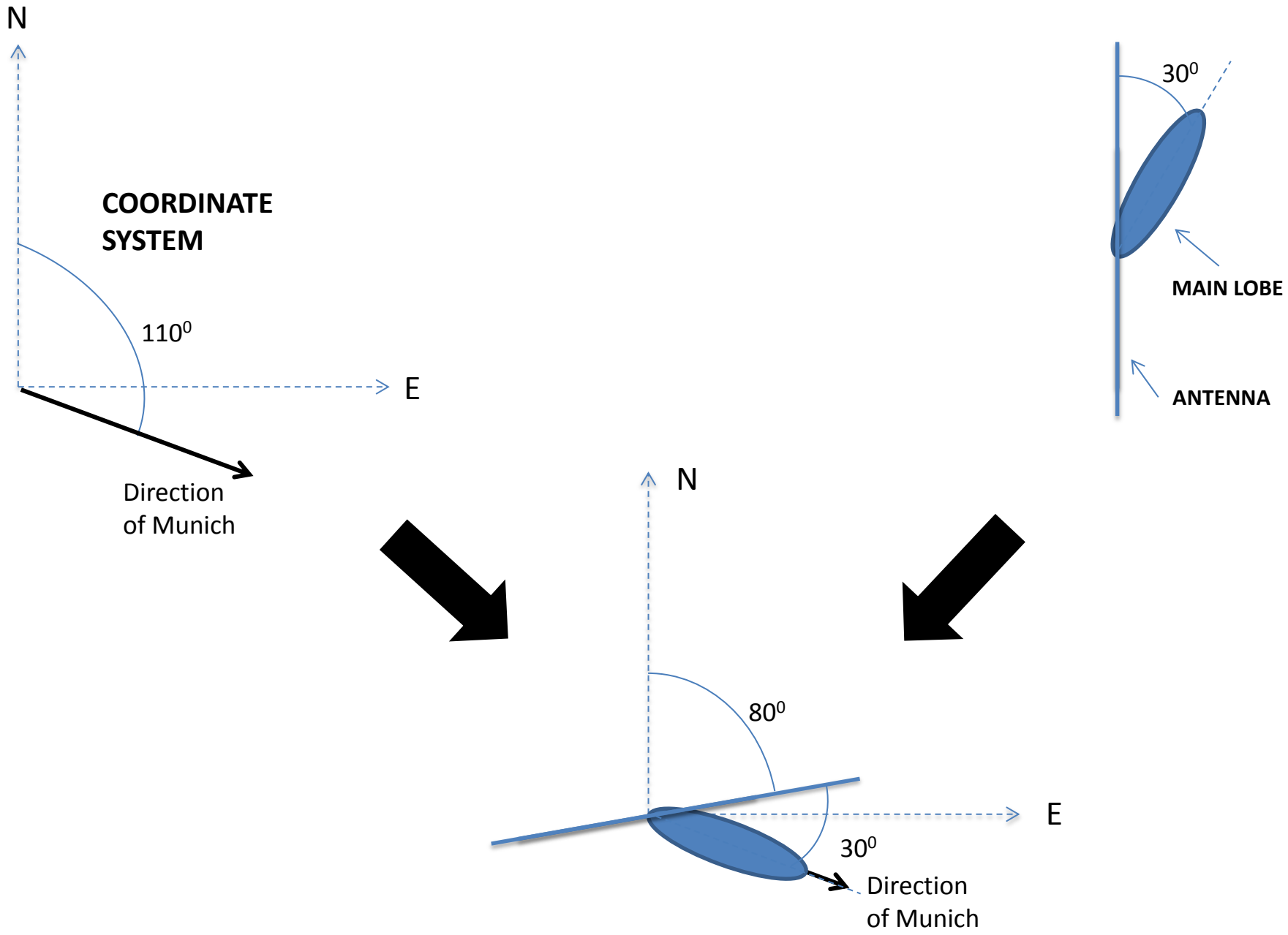
ANTENNA OPTIMISATION FOR A PARTICULAR JOB

(eg. for best skeds with Boris in Bavaria)

YOU NEED TO:

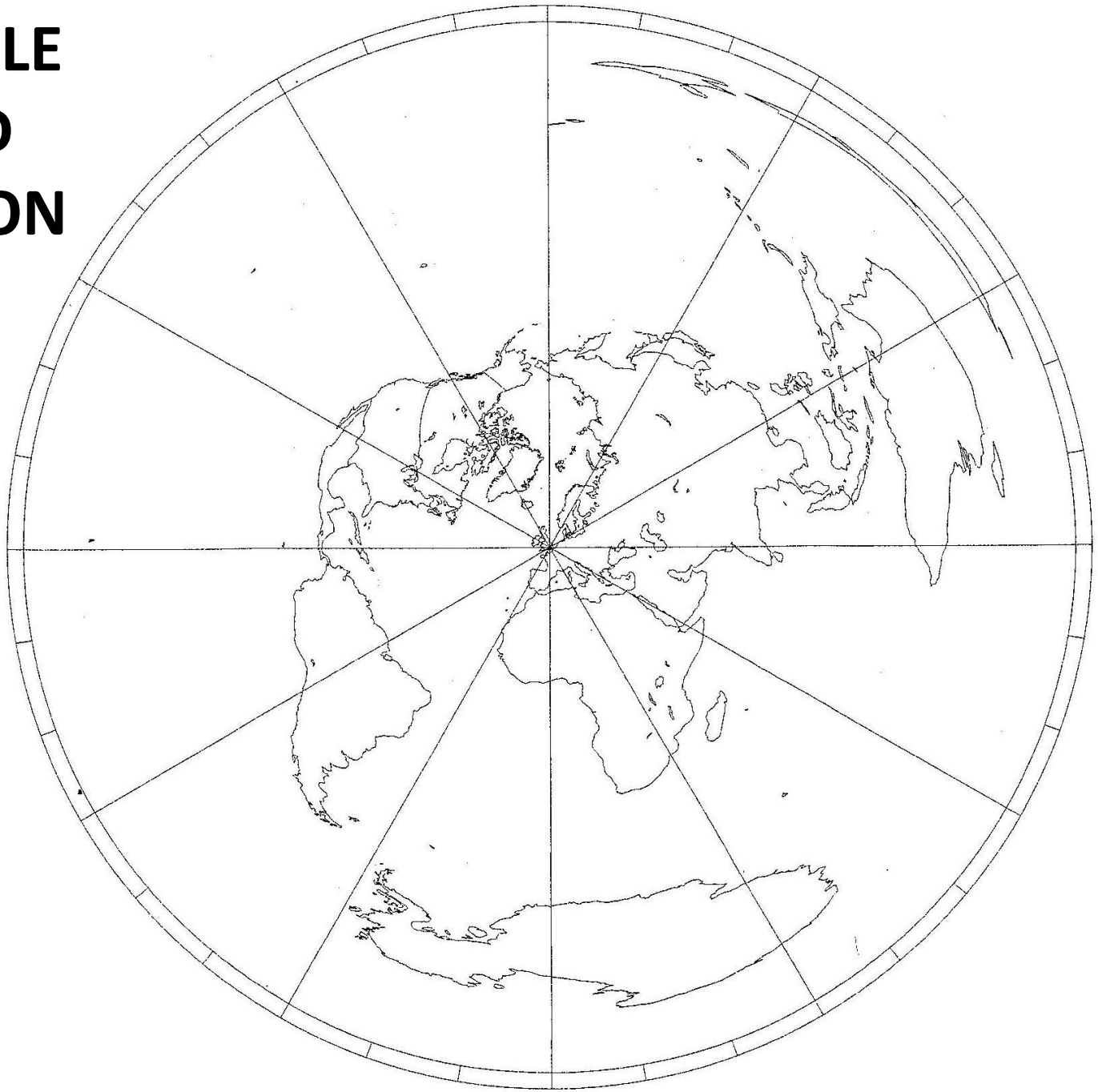
- **WORK OUT WHERE YOU NEED THE ANTENNA TO FIRE**
- **WORK OUT THE ANTENNA'S RADIATION PATTERN**
- **MATCH THE ABOVE TWO**
- **TOOLS ARE AVAILABLE FOR FIRST TWO**

OPTIMISATION OF ANTENNA ORIENTATION

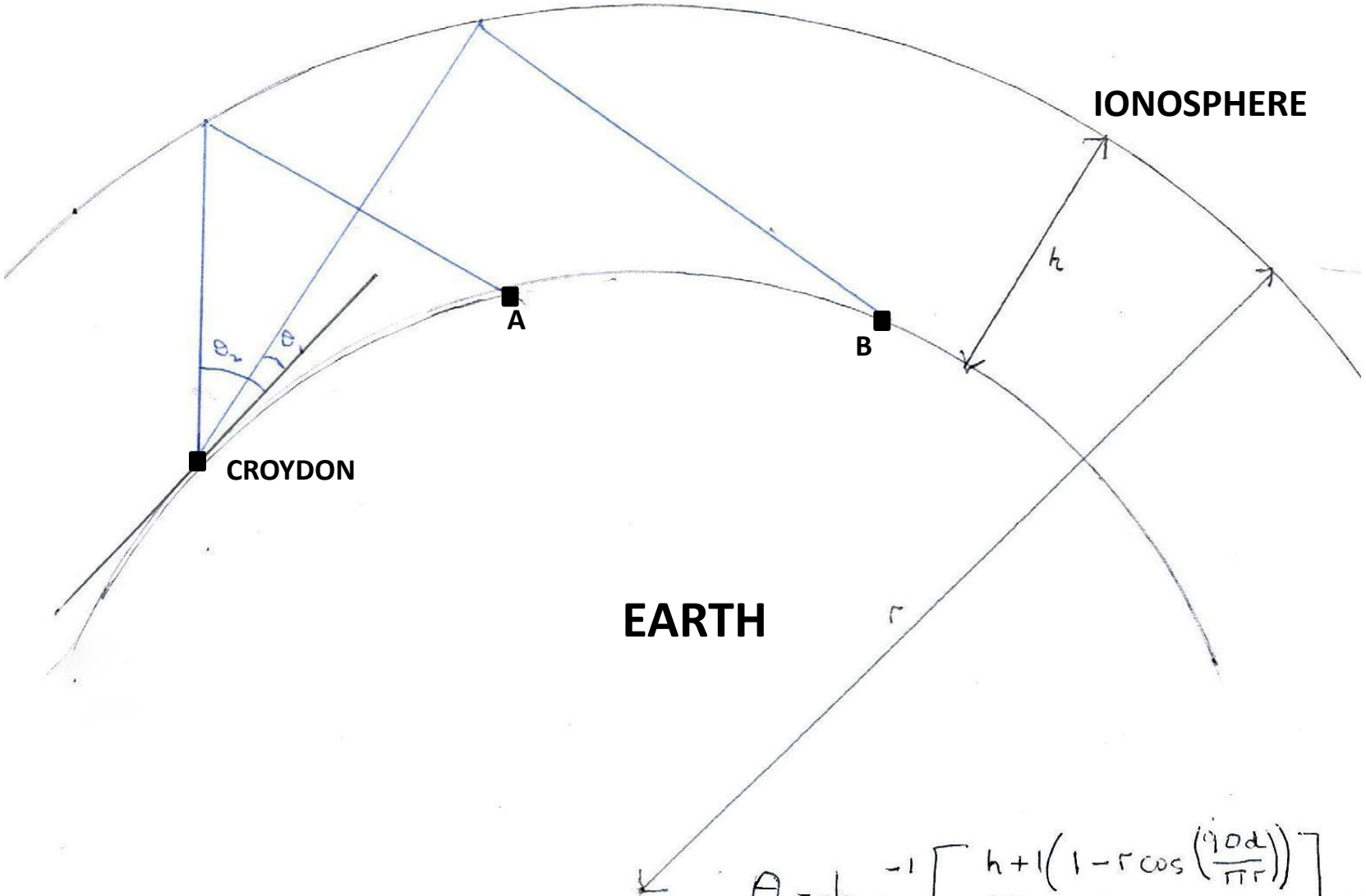


GREAT CIRCLE MAP BASED ON CROYDON

(source W6ELProp)



THE IMPORTANCE OF ELEVATION ANGLE



$$\theta = \tan^{-1}\left[\frac{h+1\left(1-r\cos\left(\frac{90d}{\pi r}\right)\right)}{r\sin\left(\frac{90d}{\pi r}\right)}\right]-\left(\frac{90d}{\pi r}\right)$$

BUT HELP IS AT HAND!

W6ELProp

- FREEWARE
- AVAILABLE AT http://www.qsl.net/w6elprop/

ENTER:

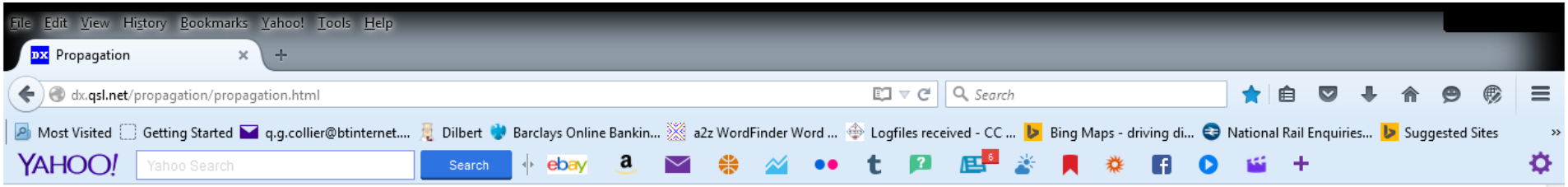
- LOCATION OF BOTH STATIONS
- DATE
- SOLAR FLUX
- K INDEX

(LATTER TWO AVAILABLE FROM http://dx.qsl.net/propagation/propagation.html)

GIVES YOU:

- AZIMUTH ANGLE (ie. DIRECTION) FOR TARGET STATION
- ELEVATION ANGLE FOR TARGET STATION
- and LOTS OF OTHER USEFUL STUFF

DEMO OF W6ELProp



Propagation

This page contains a dynamic collection of propagation information gathered from many different sources. This data is extremely useful for ham radio operators and shortwave listeners to help determine whether or not long distance radio communications are possible.

The current time is: 07:36 UTC on Thursday, September 17, 2015

Current Solar Indices from WWV
17-Sep-2015 at 0605 UTC SFI = 109 A = 12 K = 3
Conditions during the last 24 hours
No space weather storms were observed for the past 24 hours.
Forecast for the next 24 hours
No space weather storms are predicted for the next 24 hours.

Solar Wind Data

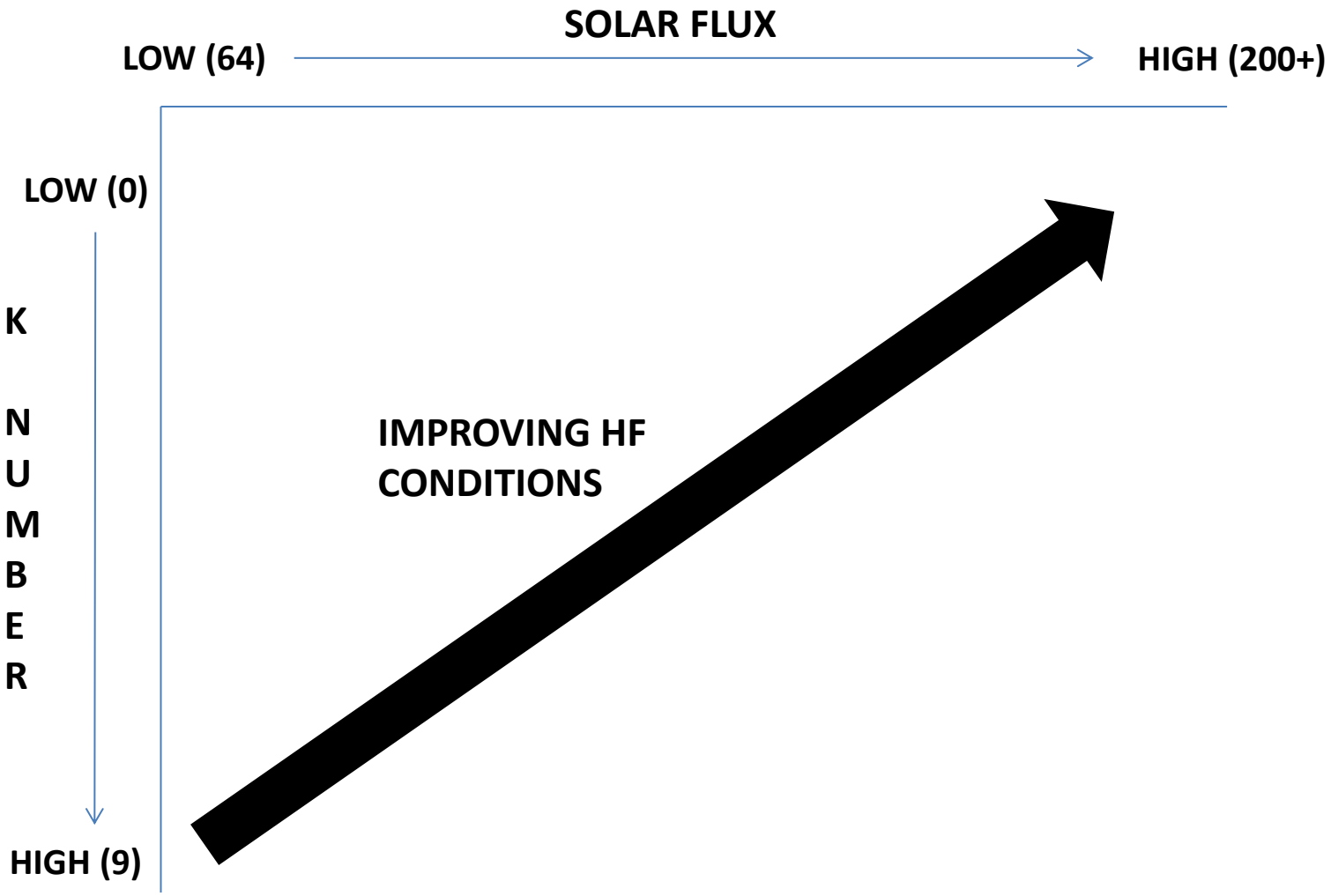
Provides solar wind velocity and energetic particle intensity
Updated at: 0729Z on September 17, 2015

Velocity (km/s):	534.8
Density (protons/cm^3):	4.0

Penticton Observatory SFI Measurement

WWV only updates its SFI reading once a day at 2100Z

THE RELATIONHIP BETWEEN SOLAR FLUX & K NUMBER



ANTENNA OPTIMISATION FOR A PARTICULAR JOB

(eg. for best skeds with Boris in Bavaria)

YOU NEED TO:

- **WORK OUT WHERE YOU NEED THE ANTENNA TO PUT BEST SIGNAL**
- **WORK OUT THE ANTENNA'S RADIATION PATTERN**
- **MATCH THE ABOVE TWO**
- **TOOLS ARE AVAILABLE FOR FIRST TWO**

HELP IS AT HAND (AGAIN)….

EZNEC

- NOT FREE
- BUT QUITE REASONABLE (from $99)
- AVAILABLE VIA http://www.eznec.com

LETS YOU DEFINE AN ANTENNA:

- IN TERMS OF x, y, z COORDINATES
- MULTIPLE ELEMENTS SUPPORTED
- ALSO FEEDERS, TRAPS, STUBS, ETC
- GROUND CONDITIONS
- LOSSES

SHOWS YOU LOADS OF STUFF….

- DIAGRAM OF ANTENNA & CURRENT DISTRIBUTION
- RADIATION PATTERN:
  - 3 DIMENSIONAL
  - AZIMUTH PATTERN
  - ELEVATION PATTERN
- IMPEDANCE & SWR
- (OVERLAY OF PATTERNS)

Demo of EZNEC

EFFECT OF GROUND CONDITIONS

	FREE SPACE – "STARTER FOR TEN"	FREE SPACE – TWEAKED LENGTH	PERFECT GD. – FREE SPACE LENGTH	REAL GD. – FREE SPACE LENGTH	REAL GD. – TWEAKED LENGTH
LENGTH (ft)	66	68	68	68	69
HEIGHT (ft)	-	-	66	66	66
RESONANCE (kHz)	7247	7035	7116	7116	7014
SWR	1.47	1.47	1.52	1.52	1.55
MAX GAIN (dB)	2.02 (symmetrical)	2.05 (symmetrical)	7.93 @ 32^0	6.26 @ 28^0	6.28 @ 32^0
GAIN AT 0^0 (dB)	2.02 (symmetrical)	2.05 (symmetrical)	0	0	0
GAIN AT 90^0 (dB)	2.02 (symmetrical)	2.05 (symmetrical)	-6.93	-2.78	-2.77

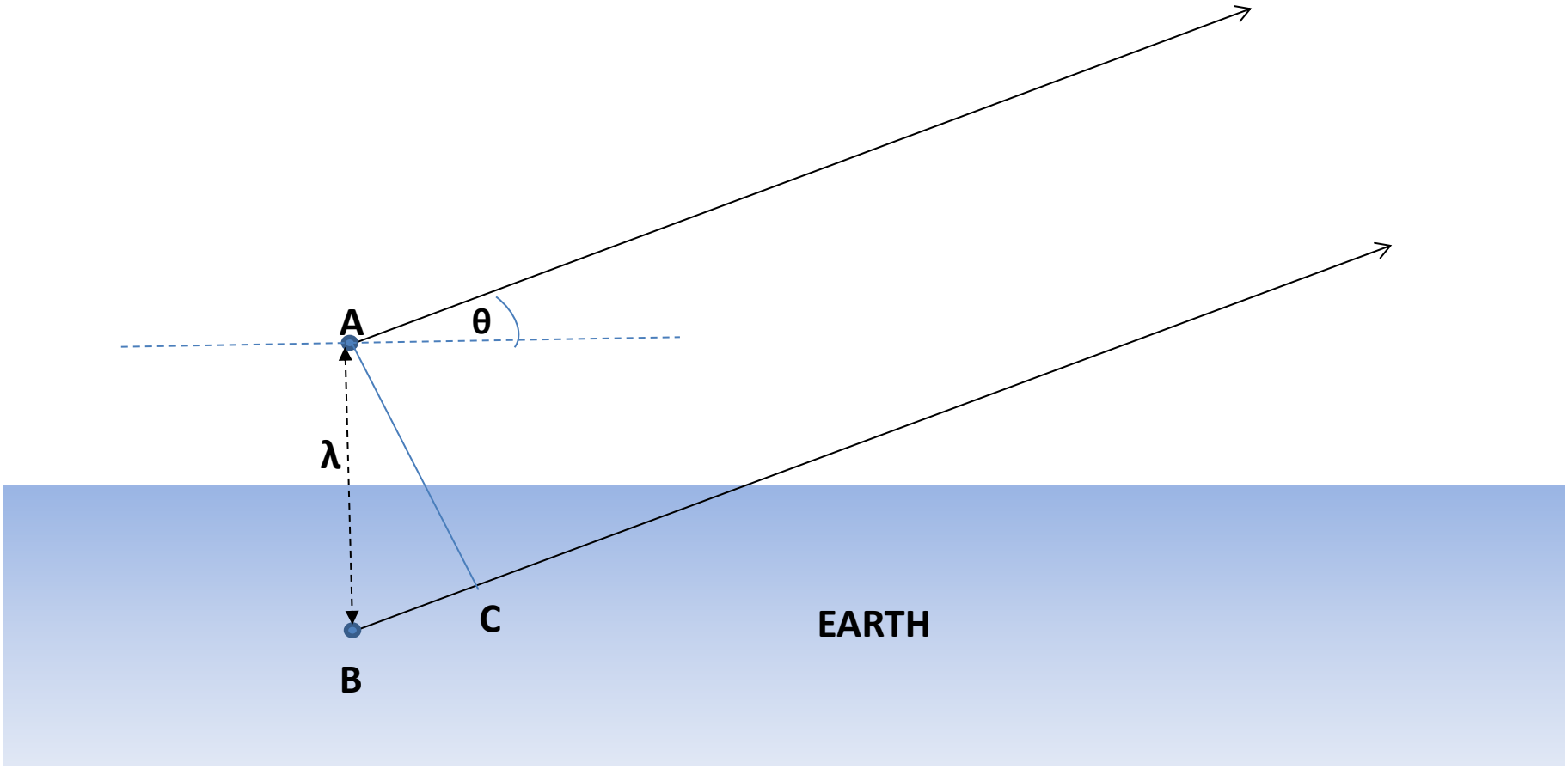
AND NOW IN ENGLISH…..

- **IN THE REAL WORLD WE CAN IGNORE FREE SPACE AND PERFECT GROUND CASES**

- **CHANGES OF LENGTH HAVE MAJOR IMPACT ON RESONANT FREQUENCY, BUT MUCH LESS ON GAIN**

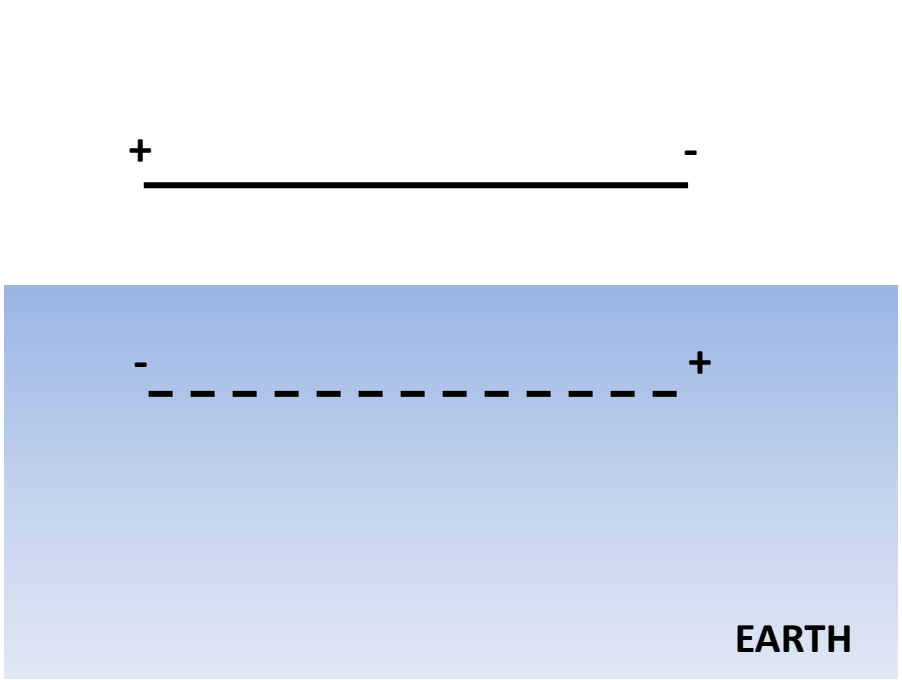
- **CHANGES IN GROUND CONDITIONS HAVE SLIGHT IMPACT ON MAXIMUM GAIN AND ASSOCIATED ANGLE, BUT MORE ON NEAR VERTICAL ANGLES**

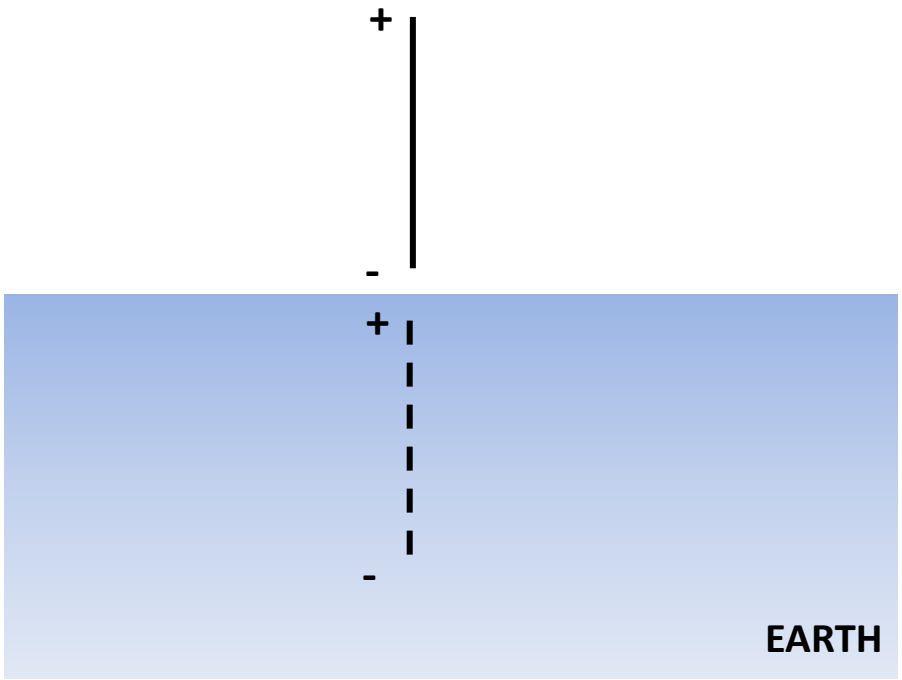
WHY DOES THE EARTH AFFECT THE PATTERN?



Path difference at distant point = BC = λ sin θ. As θ varies, path difference varies, so waves from A & B alternately add & subtract

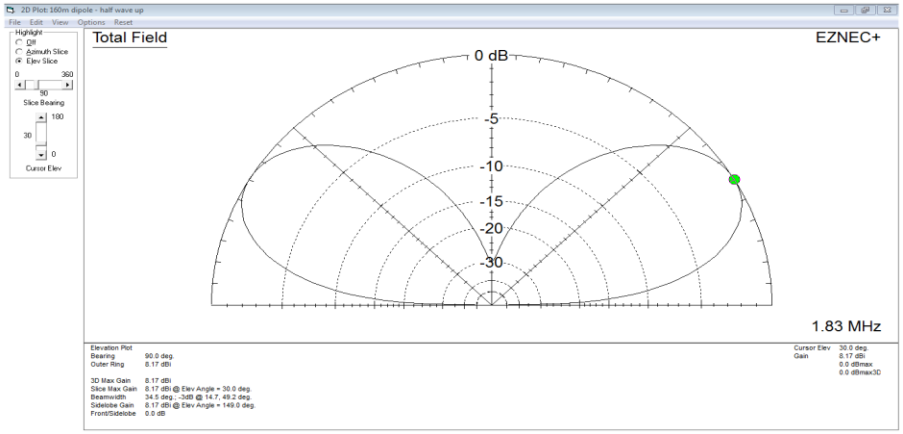
WHY DO VERTICAL & HORIZONTAL ANTENNA PATTERNS DIFFER?

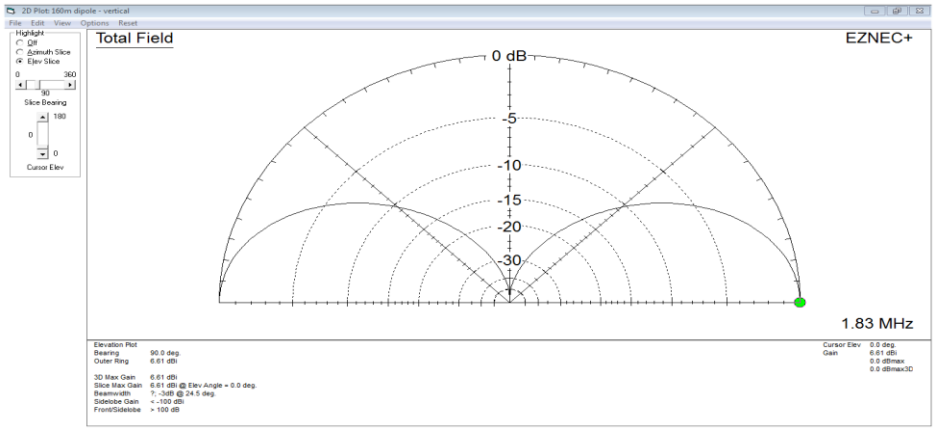




180^0 PHASE CHANGE

NO PHASE CHANGE





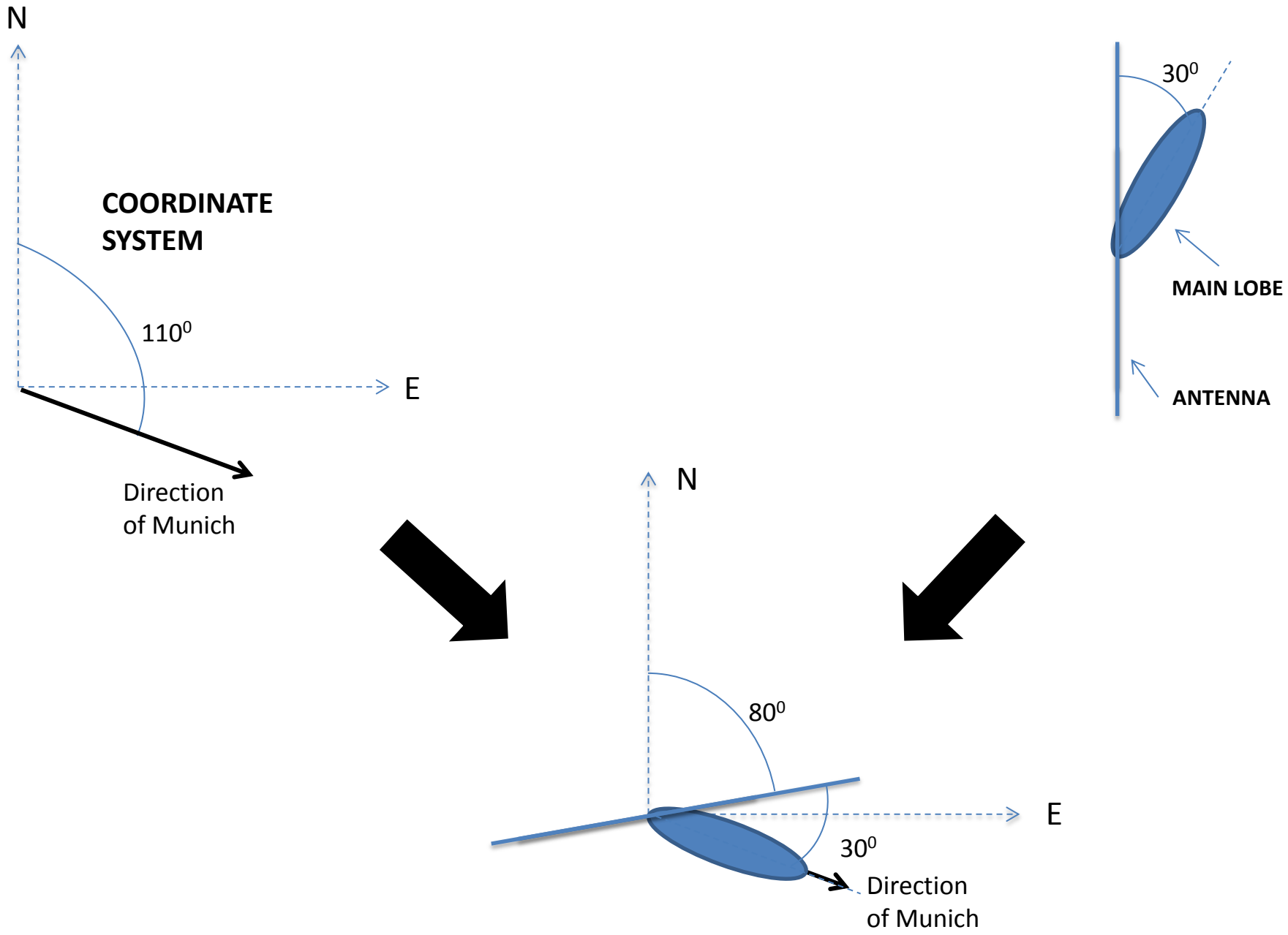
BUT WHAT ABOUT BORIS?!

- **THIS IS ALL VERY WELL, BUT WHAT ABOUT MY SKEDS?**

- **I NEED SOME HELP TO CHOOSE BETWEEN OPTIONS!**

- **THE CAVALRY ARE AT HAND AGAIN….EZNEC HAS TRACEVIEW - A “PROGRAM WITHIN PROGRAM” FEATURE TO ALLOW RESULTS TO BE COMPARED….**

OPTIMISATION OF ANTENNA ORIENTATION



(Go to EZNEC)

USEFUL WEBSITES

- **W6ELProp - http://www.qsl.net/w6elprop/**
- **EZNEC - http://www.eznec.com**
- **DX.QSL.NET - http://dx.qsl.net/propagation/propagation.html**
- **SOLARHAM - http://www.solarham.net/**

ANTENNA MODELLING GAME

AIM (JUST FOR FUN…):

- **DESIGN SINGLE ELEMENT ANTENNA LENGTH**
- **SEE WHAT PATTERN AND SWR LOOK LIKE!**

DECIDE:

- **ANTENNA LENGTH**
- **ANTENNA HEIGHT (SAME OR DIFFERENT BOTH ENDS?)**
- **WHERE TO FEED IT**

THAT’S ALL FOLKS!

Questions?