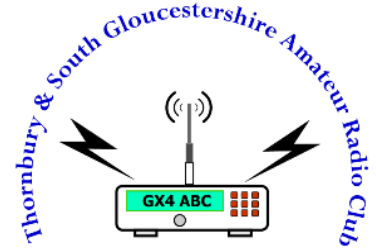


VHF Propagation Overview

5-Oct-2016

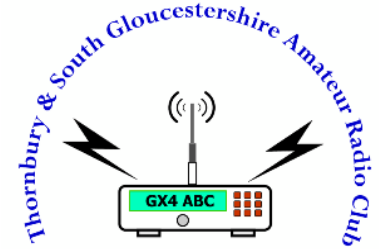
GORVM

VHF Propagation



- Where in the radio spectrum is VHF?
 - 30MHz to 300MHz
 - for radio amateurs its 50MHz, 70MHz & 144MHz or 6m, 4m & 2m
- Name some types of VHF propagation?
- Beacons
 - What are they?
 - Why are they so important?

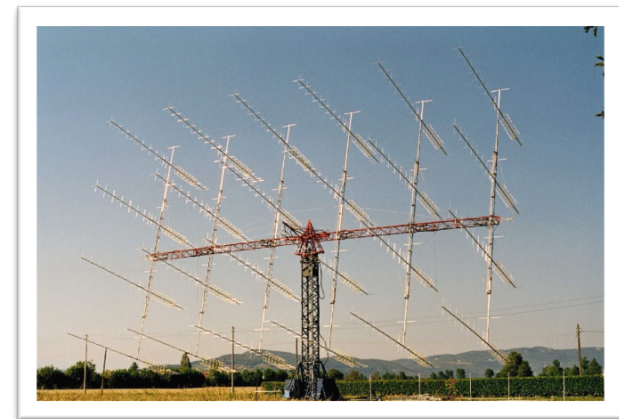
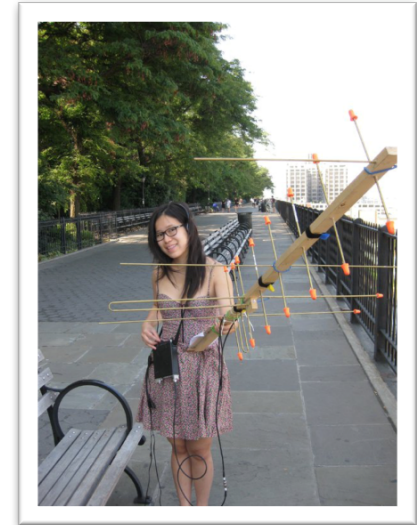
VHF Propagation



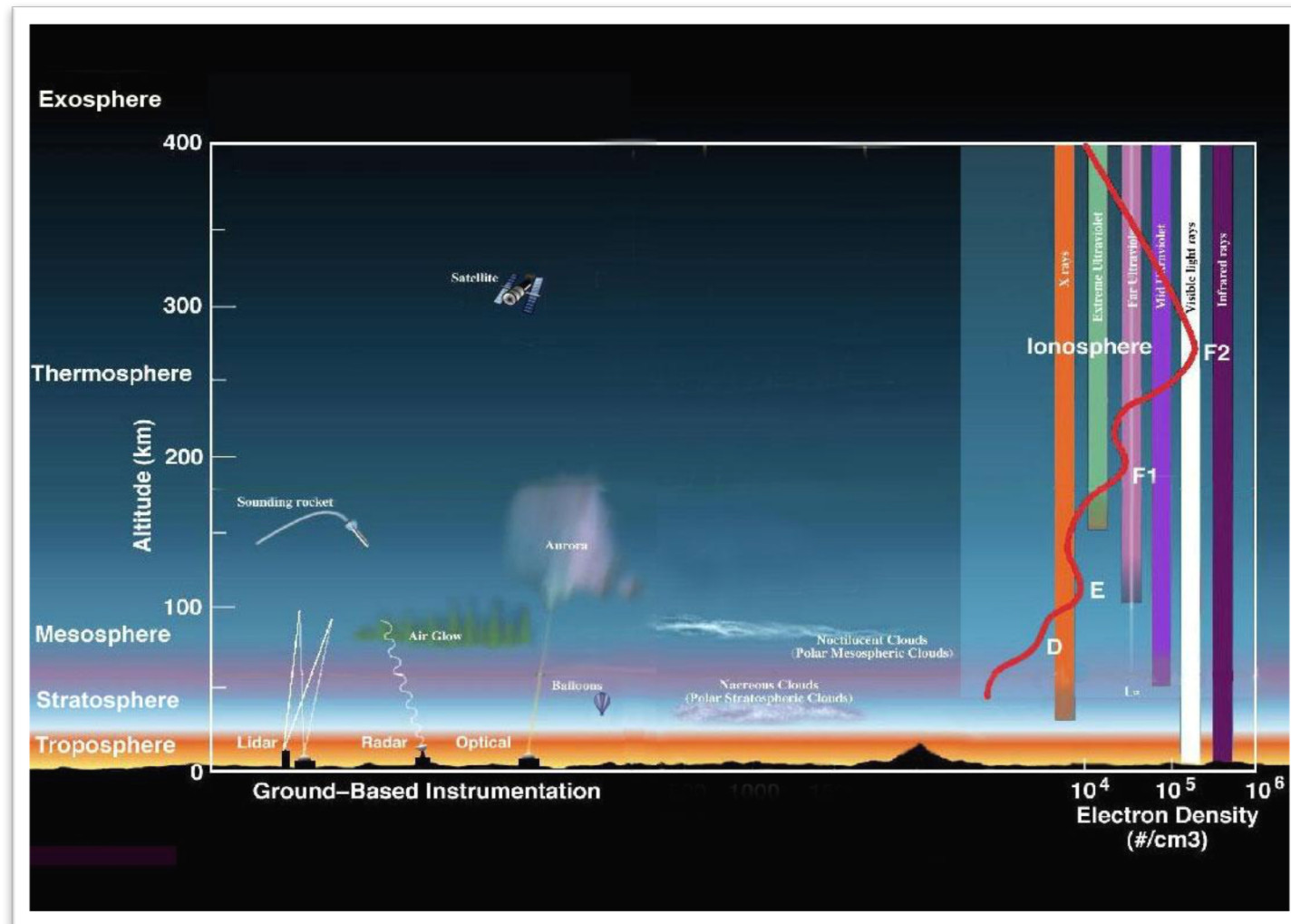
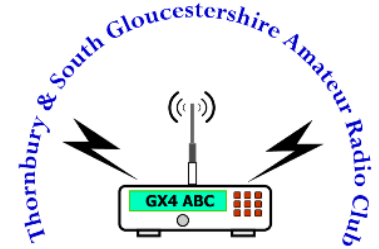
- Modes

- Ground wave
- Tropospheric
- Ionospheric
- Aurora
- Meteor scatter

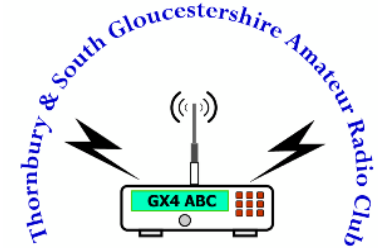
- Moon bounce
- Man-made satellite.



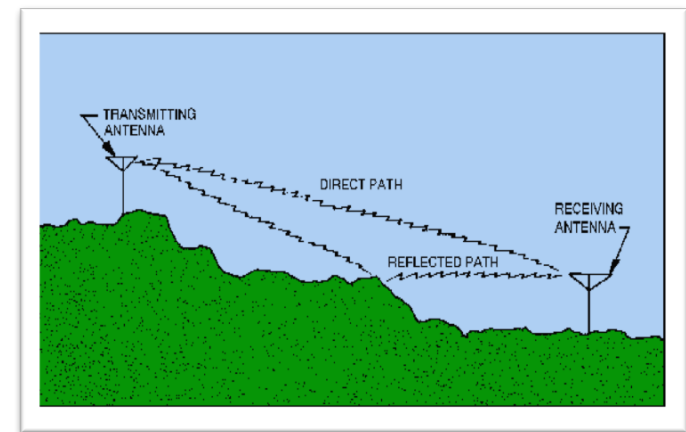
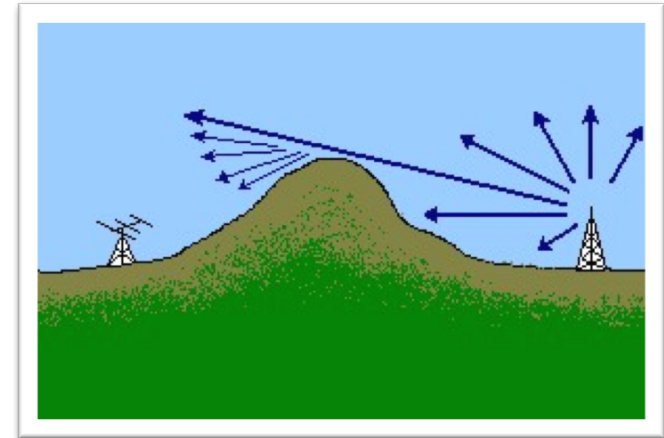
VHF Propagation



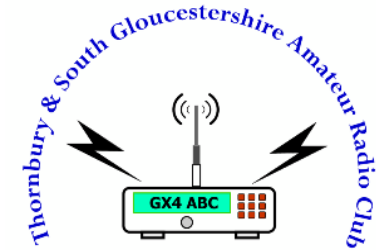
Ground Wave



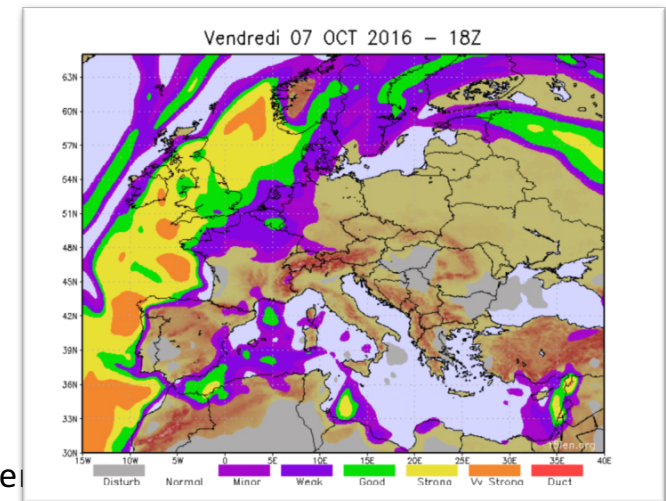
- Direct path
- Reflection
 - Angle of incidence equal angle of reflection
 - Big buildings & mountains can be useful!
- Diffraction
 - bending around corners of obstacle or aperture into a region of shadow of the obstacle.
- Scatter (All modes)
 - process whereby radio signals are forced to deviate from a straight trajectory by localised non-uniformities in the medium through which they pass.
 - Examples: Side, back and forward scatter.



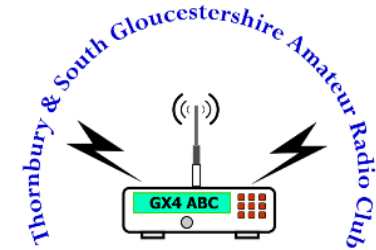
Tropospheric



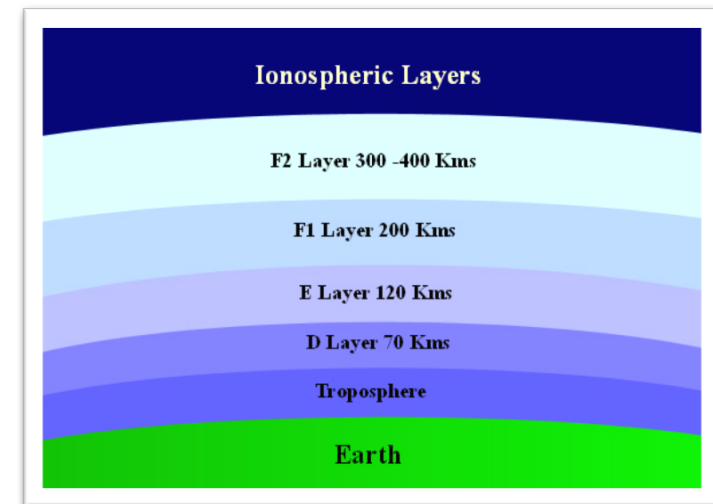
- Where is the troposphere?
 - starts at the surface - goes up to 7 to 20km (4 to 12miles)
- Distances achievable
 - Single enhancement effect : approx. 1600km/1000miles
 - Modes: All
- When does it occur?
 - during very settled, warm anticyclonic weather (high pressure), weak signals from distant stations improve in strength
 - favours signals travelling along the prevailing isobar pattern (rather than across it)
 - such weather conditions can occur at any time, but generally the summer and autumn months are the best periods.
- What is it?
 - boundary/temperature gradients between layers in the troposphere
 - temperature inversions & fog.
- Prediction
 - Two excellent Internet sites: See [[HEPB](#)] and [[FLEN](#)]



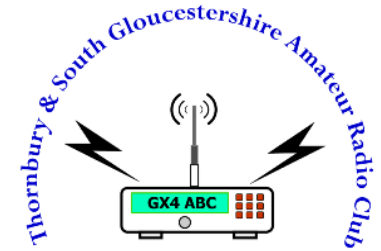
Ionospheric



- E-Layer & F-Layer when solar activity is high
 - E-Layer : 6m, 4m & 2m
 - F-Layer : 6m
- Distances achievable (single hop)
 - F2 Layer – approx. 3200km/2000miles
 - E Layer – approx. 1500kms/1000miles
- Modes:
 - All
- Es – Dense patches of ionisation
- When does it occur?
 - periods of high solar activity
 - Es - Spring
- Prediction
 - monitor solar activity [[SACT](#)]
 - real-time MUF & Critical frequency Internet sites. [[RMUF](#)]
 - real-time contact maps. [[DXMP](#)]



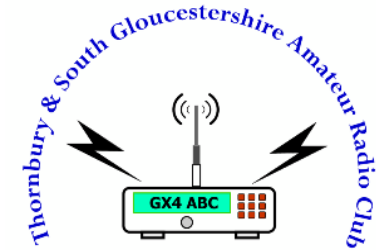
Aurora



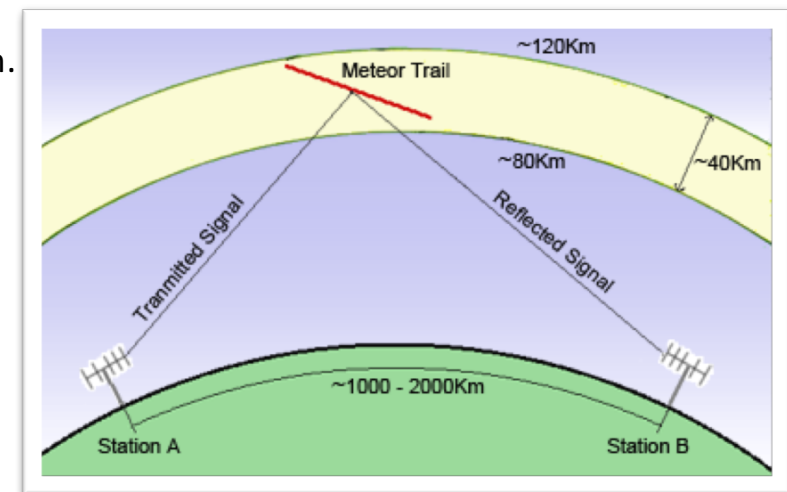
- High energy particles from Sun interacting with atoms in Earth atmosphere
 - Blue : Ionised Nitrogen
 - Green : Oxygen
 - Red : Excited Nitrogen.
- Particles dragged into polar regions as they follow Earth's magnetic field lines
- Curtains of incoming particles refract radio signals
- Both stations need 'sight' of aurora
- Listen to the North/North East
- Nasty Distorted/raspy sounding signals
- Modes:
 - All, but narrowband more effective, less distorted
- Auroral propagation needs an active Sun
 - Not necessarily dependent on 11yr cycle
- Prediction: [[SACT](#)], [AUOV], [[DXMP](#)], [BOO2]



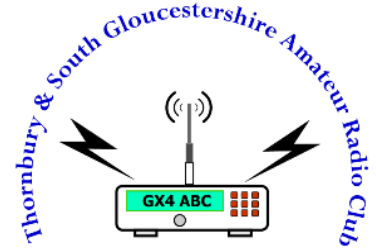
Meteor scatter







- Billions of particles, meteors, enter Earth's atmosphere every day
- Small fraction have properties useful for communication
- As meteors burn up, they create a trail of ionized particles in the E-layer that can persist for up to several seconds
- A single two-way exchange may need several meteors
- Distance over which contacts can be established determined by:
 - altitude at which the ionisation is created
 - location over the surface of the Earth where the meteor is falling
 - angle of entry into the atmosphere
 - relative locations of stations attempting communication.

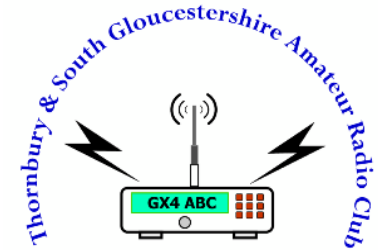


Meteor scatter



- Due to short reflection duration:
 - contacts arranged out-of-band (e.g. [ON4KST](#))
 - Information transmitted repeatedly for a time-period
- High-speed Morse (up to 800wpm !) superseded by:
 - FSK441, JT6M    
- Ionised trails can also be caused by aircraft
 - Aircraft fly to known schedules!
 - Aircraft location info on Internet:
 - [\[PFND\]](#), [\[FRAD\]](#) & [\[RADV\]](#)

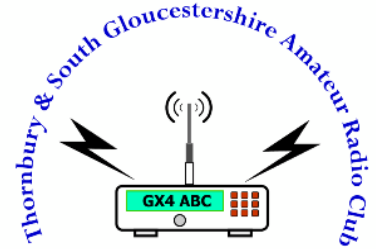
Moon bounce (EME)



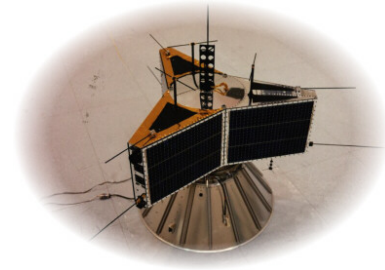
- Not strictly propagation
- Proposed by GPO in 1940
- Developed by US after WWII. Echo's received in 1946.
 - teletype link between Pearl harbour and Washington!
- Moon must be above horizon of both stations
- Weak signals – low noise, low loss, high gain systems needed
- Return delay:
 - 2.4 secs at perigee
 - 2.7 secs at apogee
 - 2.56 secs on average.
- 6m to 6cms (50 MHz to 47 GHz) used successfully for EME
 - popular bands: 2m, 70cms & 23cms
- Modes: JT65B, Morse, even phone – but latter needs greater link budget
- Big arrays not necessary with a mode like JT65
 - Successful contacts with 100w and a single Yagi.



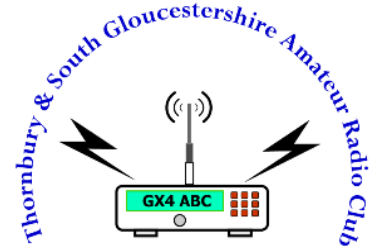
Man-made satellite



- Not strictly propagation
- Popular mode for working long distance...
 - Long distance – two geographically distant points on the Earth
- Two-way: telephony and digital modes (FM, SSB and CW)
- One-way: telemetry reception (data and some Morse!)
- Big subject and very relevant to modern communications
- AMSAT is the international AMateur SATellite body. AMSAT-UK is UK body
 - Huge resource for amateur satellite information
- OSCAR - Orbital Satellite Carrying Amateur Radio
- Global communications
 - Store and forward messaging using AX.25 (ISS & earlier generation satellites)
 - Both ground stations have satellite visibility.
- Better experience with steerable (Az & El) antenna's
- Need to take account of Doppler.

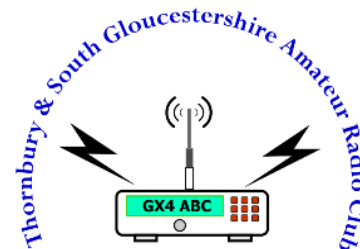


Hints & Tips



- Get on the bands and listen
 - beacons
 - noise levels
 - activity.
- Monitor solar activity
- Monitor weather systems
- Watch Internet sites:
 - Real-time MUF & Critical frequency Internet sites
 - DX Maps – real-time contacts
 - Watch the weather (TV, Radio, atmospheric pressure charts)
 - Hepburn & F5LEN.

References & Links



[HEPB] - Hepburn : http://www.dxinfocentre.com/tropo_nwe.html

[FLEN] - F5LEN : <http://tropo.f5len.org/forecasts-for-europe/>

[DXMP] - DXMaps : <http://www.dxmaps.com/spots/map.php?Lan=E&Frec=144&ML=M&Map=EU&DXC=N&HF=N&GL=N>

[METO] - Met office: <http://www.metoffice.gov.uk/mobile/surface-pressure/>

[RSGB] - RSGB : <http://rsgb.org/main/get-started-in-amateur-radio/operating-your-new-station/vhfuhf-propagation/>

[AUPR] – RSGB : <http://rsgb.org/main/technical/propagation/auroal-propagation/>

[AUOV] - Auroral oval (Apple Appstore)

[RMUF] - Realtime MUF map : <http://www.spacew.com/www/realtime.php>

[SACT] – Solar Ham : <http://www.solarham.net>

[MMMV] – Make More Miles on VHF : <http://www.mmmvvhf.de/index.php>

[PFND] – Plane Finder : <http://planefinder.net>

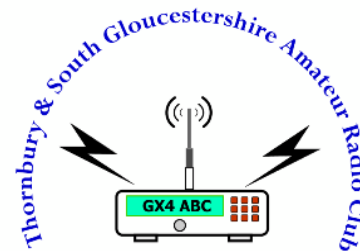
[FRAD] – Flight Radar : <http://www.flightradar24.com>

[RADV] – Virtual Radar : <http://www.radarvirtuel.com>

[BOK1] - VHF UHF Manual, G.R.Jessop, G6JP, Fourth Edition, ISBN 0-900612-63-0

[BOO2] - Radio Auroras, Charlie Newton, G2FKZ, ISBN: 9781-9050-8681-8

[BOO3] - Amateur Radio Operating Manual, Third edition, R.J. Eckersley, G4FTJ, ISBN 0-9006612-69-X



The End

Thank you