# ANTENNA AND WAVE PROPAGATION

# Critical Frequency

- The critical frequency is the highest frequency that will returned to earth from an overhead vertical path
- It is directly dependent on the level of ionisation above the observer – may be measured by ionospheric sounders
- Sometimes called: Critical Frequency of Vertical Incidence
- Typical figures are:
  - Summer: High 9MHz, Low 4MHz
  - Winter: High 14MHz, Low 3MHz
- Note: Near Vertical Incidence Skywave (NVIS) exploits this for local communications coverage

# Maximum Usable Frequency (MUF)

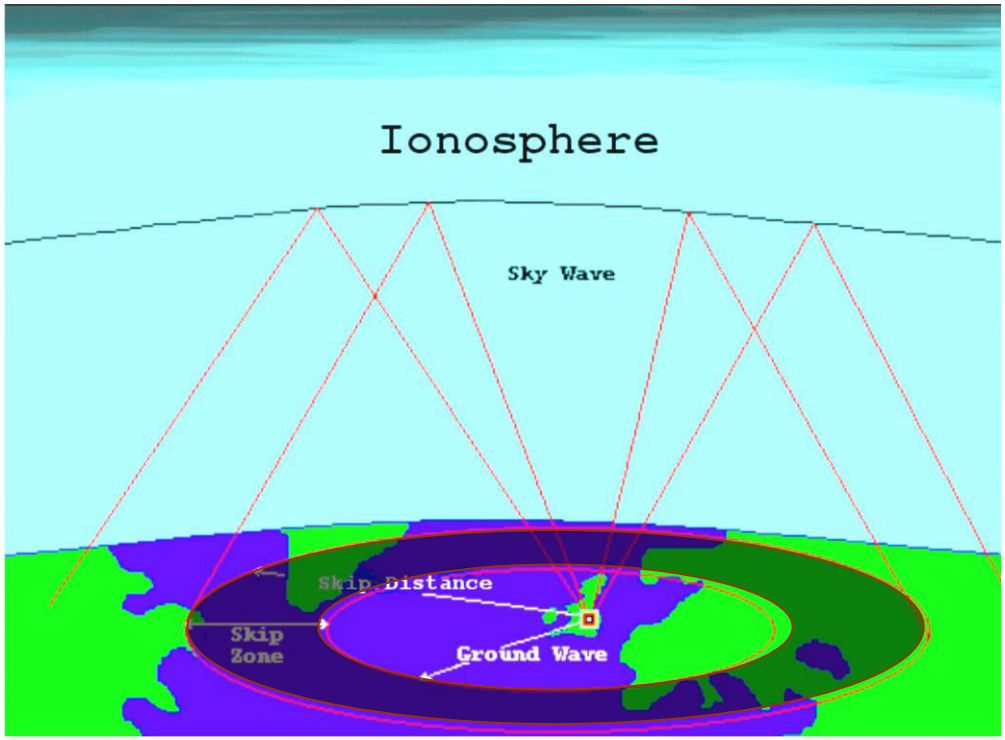
- The Maximum Usable Frequency (MUF) is the highest frequency that will be refracted over a particular path.
- The MUF varies with 24hr day/night cycle, season etc
- The MUF will always be higher than the critical frequency
- Longer paths (with lower angles) will have a higher MUF
- The MUF may be up to five times the critical frequency, depending on the angle
- It is usually advantageous to use highest available frequency
- The MUF varies with solar ionisation:-
  - Overnight the ionisation steadily falls resulting in much lower MUF, to as low as around 2MHz during a sunspot minimum.
  - At mid-day during the maximum of the sunspot cycle, it may reach 40MHz for a long hop.

# Lowest Usable Frequency (LUF)

- Lower frequencies are more liable to absorption in the D layer
- Some propagation charts give a lowest usable frequency to allow for this effect
- If the LUF is greater then the MUF, No propagation by the ionosphere is possible

# Skip Distance

- Between the skip distance and ground wave range is a region that can not be covered
- This is known as the Skip or Dead Zone
- It is quite easy to observe...
- Tune to a distant station in QSO with someone in the UK
- The distant station may be a strong signal, but the UK station is often totally inaudible, despite being located nearer to you



# Fading

- Fading is caused by signals arriving at the receiver by slightly different paths - Multipath
- The path lengths will vary, changing the received phase from each path
- Differences in phase cause the signals to add or cancel
- SSB, CW will fade/drop out, FM can become severely distorted
- If two signals are 180° out of phase, fading results in full cancellation
- The paths with vary with time and propagation mode leading to variable fading
- Fading rates may be slow, fast or a hybrid combination