Antenna height basics

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******************Disclaimer – This is a basic outline, there is much math and engineering involved in RF radiation**************

************If you have questions please ask me or another Elmer***********

MW and HF up to 30 mhz
- Will penetrate buildings/trees
- Travels along ground (refraction) and sky wave

Vhf up to 300mhz
- Is somewhat absorbed buildings and trees
- Lower VHF frequencies have short skywave distances
- Higher VHF is transitioning to line of sight
- VHF has unique Propagation Like meteor scatter, tropospheric reflection, ducting, EME, northern/southern light reflection

Uhf up to 3000 mhz
- Is absorbed and or reflected by trees, hills, buildings, weather formations
- The lower range also has unique and peculiar effects, EME, Meteor scatter
- For the most part line of sight with little refraction

The higher the frequency the more likely reflection and multi-path interference will occur

Refraction. The ground or objects affect on bending the radio wave. The lower the frequency the higher er the refraction.

The higher the frequency the higher the antenna is required for increased distances
- AM Broadcast and Shortwave antenna are near the ground FM broadcast and TV the antenna is high

Why, The lower frequencies part of the radio wave is traveling along the earth and “drags” Much like
- Physical horizon of the earth
- Radio Horizon of the earth

Think of putting a stick or an oar in moving water, top tilts forward in relations to the bottom, the smaller the stick the less tilt.

Physical horizon
- d = distance to horizon miles
- h1 = near height of device feet
- h2 = far height of device feet
- k ≈ 1.414 refracted horizon
  ≈ 1.23 geometric horizon

* refraction K ≈ constants ‘about equality’ is based on ‘Ideal Gas Law’ but thermal stratification, gas densities, and gas/fluid movement gives us the ‘about’
* wavelength and dielectric constants vary inversely, long wavelengths bend (refract more)
* assuming perfect circle (no hills, trees)

$d \approx k \cdot \sqrt{h1}$

the height of an object ‘over’ the horizon to be seen

$d \approx k \cdot (\sqrt{h1} + \sqrt{h2})$

ok you are five feet you can see

$d \approx 1.23 \cdot \sqrt{5} \approx 2.75$ miles

50 feet

$d \approx 1.23 \cdot \sqrt{50} \approx 8.78$ miles

100 feet

$d \approx 1.23 \cdot \sqrt{100} \approx 12.3$ miles

however

your radio can ‘see’

$d \approx 1.41 \cdot \sqrt{5} \approx 3.16$miles

50 feet

$d \approx 1.41 \cdot \sqrt{50} \approx 9.99$ miles

100 feet

$d \approx 1.41 \cdot \sqrt{100} \approx 14.14$ miles

to an object equal height over the horizon

5 feet

$d \approx 1.41 \cdot (\sqrt{5} + \sqrt{5}) \approx 6.32$miles

50 feet

$d \approx 1.41 \cdot (\sqrt{50} + \sqrt{50}) \approx 19.98$ miles

100 feet

$d \approx 1.41 \cdot (\sqrt{100} + \sqrt{100}) \approx 28.28$miles