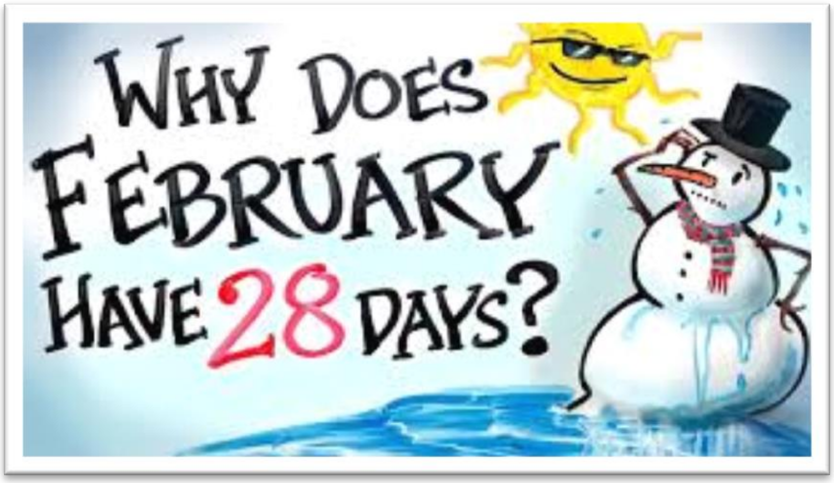

Good question

The Aero Aerial

The Newsletter of the Aero Amateur Radio Club
Middle River, MD
Volume 15, Issue 2
February 2019

Editor Georgeann Vleck KB3PGN

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Vice-President	Jerry Cimildora N3VBJ
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Corresponding Secretary	Pat Stone AC3F
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Club Nets	Joe Miko WB3FMT
Contests	Bob Venanzi ND3D Charles Whittaker KB3EK

Website: http://w3pga.org
Facebook: https://www.facebook.com/pages/Aero-Amateur-Radio-Club/719248141439348

About the Aero Amateur Radio Club

Meetings

The Aero Amateur Radio Club meets at 7:30 pm on the first and third Wednesdays of the month at Essex SkyPark, 1401 Diffendall Road, Essex. Meetings begin at 7:30 p.m. local time. Meetings are canceled if Baltimore County Public Schools are closed or dismiss early.

Repeaters

W3PGA **2 M :** INPUT : 147.84 MHz, OUTPUT : 147.24 MHz, PL 123.0
W3PGA **70 Cm:** INPUT : 444.575 MHz, OUTPUT : 449.575 MHz, PL123.0
W3JEH **1.25 M:** INPUT : 222.24 MHz, OUTPUT : 223.84 MHz

Club Nets

Second Wednesday Net – 10 Meters (28.445 MHz) @ 8 p.m. Local Time
Fourth Wednesday Net – 2 Meters (147.24 MHz Repeater) @ 8 p.m. Local Time
Fifth Wednesday Net – 70 Centimeters (449.575 MHz Repeater) @ 8 p.m. Local Time

Radio License Exams

The Aero Amateur Radio Club sponsors Amateur Radio License Exams with the ARRL VEC. Examination sessions are throughout the year. Walk-ins are welcome; arrive no later than 30 minutes after start time. $15 charge.

2019 Examination Schedule

Time:	1:15 pm	1:15 pm	
Dates:	Sunday, March 10	Sunday, May 5	
Where:	White Marsh Library	White Marsh Library	

White Marsh Library, 8133 Sandpiper Circle, White Marsh, MD
Contact: Patricia Stone AC3F, email: ac3f@juno.com, landline: 410-687-7209

LOCAL AREA NETS

Day	**Time**	**Freq. (MHz)**	**Net Name**
Daily	9 – 10 am	145.330	Oriole Net
Daily	6 pm	3.820	Maryland Emergency Phone Net
Daily	6:30 – 7 pm	145.330 no PL	Balto. Traffic Net (b/u 146.670 PL 107.2)
Daily	7 pm & 10 pm	3.643	MD/DC/DE Traffic Net
2nd Tue	7:30 pm	146.670	Baltimore County RACES Net
2nd Wed	8 pm	28.445	Aero ARC Net
4th Wed	8 pm	147.240	Aero ARC Net
5th Wed	8 pm	449.575	Aero ARC Net
Fridays	7:30 pm	145.330	Back in the Day Net
When activated by NOAA		147.030	SkyWarn (primary)

NET REPORTS

1-9-19: 28.445 HMz, 20:00 local to 20:30 local.

W3PGA NCS Joe Essex, W3JEH Ron Perry Hall, KB3VAE Richard Middle River, NE3A Kenny Middle River, W3VRD Phil Essex

5 members on the net
Ray Augustiniak and Robert Ballou reported receiving mostly noise.

1-23-2019: 147.24r MHz, 20:00 local to 21:03 local.

W3PGA NCS Joe Essex, KC3FBM Franklin Parkville, KB3JVP Ken Middle River, KC3FBL Jim Parkville, KC3KKZ Bill Rosedale

5 members on the net

1-30-19: 449.575r MHz, 20:00 to 21:05 Local

W3PGA NCS Joe Essex, KC3FBM Franklin Parkville, KB3QWC Larry Middle River, KB3JVP Ken Middle River, AC3F Pat Middle River, KC3KKZ Bill Rosedale, KB3VAE Rich Middle River, W3JEH Ron Perry Hall, KC3IPK Dave   Balto City, K3TEL Arnold Towson, KC3FBL   Jim Parkville

10 club members and 1 visitor on the net

Reminders

Aero Snow Plan

If Baltimore County Schools are **closed** on a meeting Wednesday, then there will be **No meeting**, in its place there will be a 2 meter net at 8:00 pm. If schools have an **early dismissal** due to weather on a meeting Wednesday, there will be **no meeting** at the Essex Skypark, and we will have a 2 meter net at 8:00 pm. If Baltimore Co has a **late opening** (2 hours late), then there will be a **meeting** at the airport. If **we get snow** on the days before the meeting, I will drive to the airport to see if it is safe to

have a meeting. They don't plow the parking lot. I will send out an email as to whether there will be a meeting. If you have any questions, please call me at 443-956-0197.
Joe Miko

Club Dues

Dues are due in January. See Club Treasurer Warren at the next meeting.

VE CORNER

by Pat Stone, AC3F

Bill Day KC3KKZ passed his Extra during the shut down and now has a new call…AC3DX.

I haven't been able to write a report from the January session because the FCC hasn't issued the calls for our examinees yet. Our next test session will be Sunday, March 10 at 1:15PM in the White Marsh Library. Hope to see you then.

VE Testing Snow Plan

If Baltimore County Libraries are closed for a testing day (Saturday or Sunday) the VE Testing session for that day will be canceled. Testing applicants that have pre-registered will be notified by phone. Due to the scheduling requirements of Baltimore County Library, we can't schedule a makeup session. Testing will resume on the next scheduled testing date. VE's will be notified by phone in the event of a closure.

UPCOMING HAMFESTS and EVENTS

Saturday, February 2, 2019: Richmond Frostfest
Location: Richmond Raceway Complex, 600 East Laburnum Avenue, Richmond, VA 23218
Website: http://frostfest.com

Sponsor: Richmond Amateur Telecommunications Society (RATS)
Type: ARRL Convention
Talk-In: 146.880+ (PL 74.4)
Contact: Robert Marshall , KI4MCW, PO Box 70613, Henrico, VA 23255, Phone: 804-620-7287
Email: ki4mcw@frostfest.com

Take The Bus To FrostFest!!!

FrostFest is the largest winter Amateur Radio Event in the Mid-Atlantic Region. It's coming up again on Saturday, February 2, 2019 at the Richmond Raceway Complex in Richmond, VA. You know you want to be there, but likely you don't want to drive the two hours plus each way.

The Anne Arundel Radio Club has the answer. Take the bus. We are looking for 45 to 55 hams who can make their way to the Park & Ride at the intersection of U.S. Rte. 50 and MD Rte. 424 by 6:00 am on the morning of FrostFest. That's when we plan to leave, returning to the same location between 4:00 pm and 6:00 pm later that day. The $45 fee includes early admission to FrostFest at 8:00 am, 30 minutes before the gates open to the general public. Talk ham radio all the way down and back, or take a nap. It's up to you.

Right now we are just collecting info on those interested, but with enough interest we will start collecting funds. We need to have a minimum number of paid-up riders by January 1 or we will have to cancel. So please, **click here** to let us know you want join us. We'd love to take you with us to FrostFest.

Source: www.W3VPR.org

Sunday, March 24, 2019: WINTERFEST
Location: Northern Virginia Community College, Annandale Campus, Richard J. Ernst Cultural Center, 8333 Little River Turnpike, Annandale, VA 22003
Sponsor: Vienna Wireless Society
Website: http://viennawireless.net/wp/events/winterfest
Talk-In: 146.910- (77.0), WD5DBC Tyson's Corner, VA
Contact: Harry Mamaux, K3NF, Phone: 703-395-6721 | Email: k3nf@cox.net

Saturday, April 27, 2019: Delaware State Convention (Delmarva Radio & Electronics EXPO)
Location: Cheer Community Center, 20520 Sand Hill Road, Georgetown, DE 19947
Sponsor: Sussex Amateur Radio Association
Website: http://radioelectronicsexpo.com
Talk-In: 147.090+ (PL 156.7), WS3ARA Millsboro, DE - Sussex ARA
Contact: Herbert Quick, KF3BT, Phone: 302-629-4949, Email: herb@hamiltongraphics.com

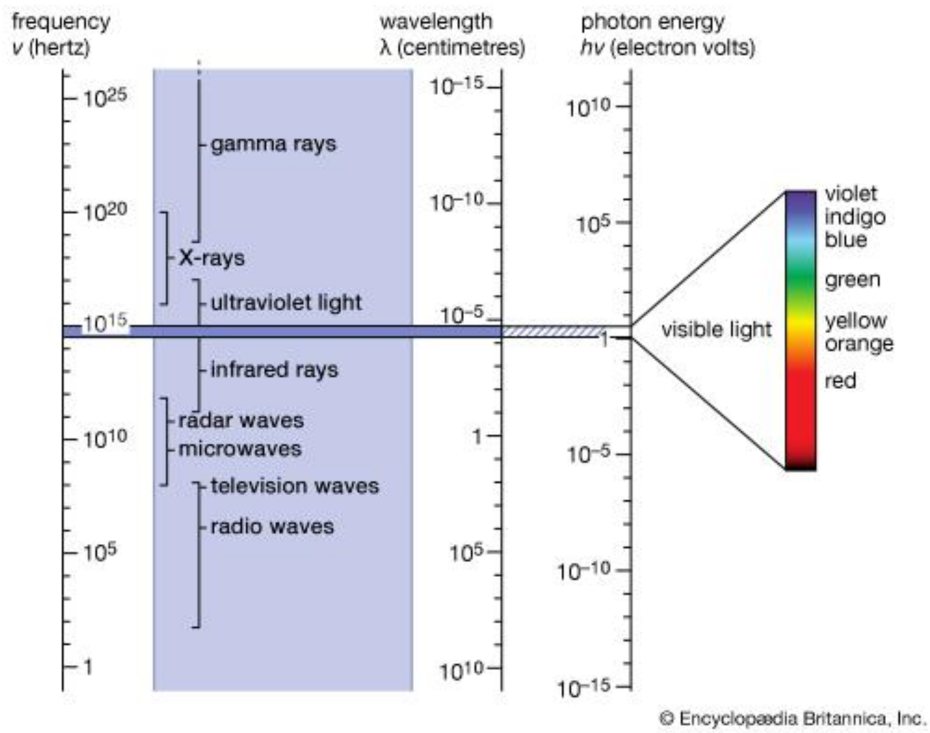
Saturday, April 27, 2019: York Hamfest
Location: Elicker's Grove Park, 511 Roth Church Road, Spring Grove, PA 17362
Sponsor: York Hamfest Foundation
Website: http://www.yorkhamfest.org
Talk-In: 147.330+ (PL 123.0), W3MUM PennMar, PA
Contact: Duane Sterner, KB3QLQ, Phone: 717-332-1385, Email: duane.sterner@yahoo.com

You may view upcoming Hamfests at: http://www.arrl.org/hamfests-and-conventions-calendar

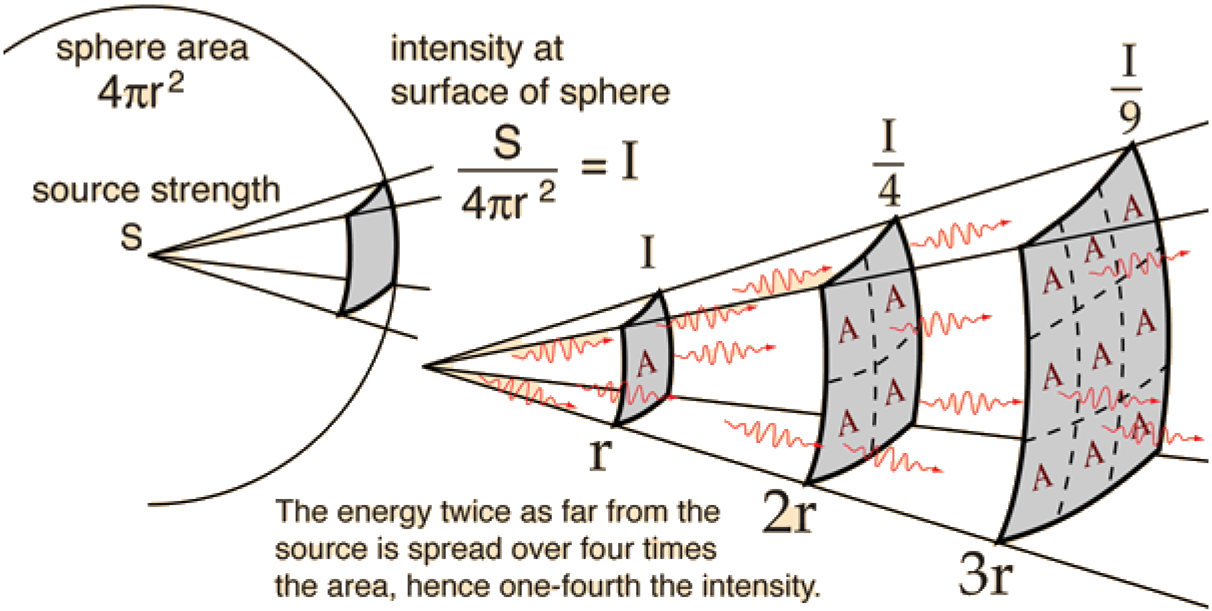
Radio Propagation - Getting Around!

by Joe Miko, WB3FMT

Radio waves are electromagnetic waves (EM) just like light waves but only longer.



The part of the electromagnetic spectrum that we see is called the visible light spectrum. It ranges from 380 nm Deep Violet nanometers to 780 nm Dark Red. Red light is the lowest frequency and violet is the highest frequency. Visible light has frequencies ranging from $4*10^{14}$ Hz to $8*10^{14}$ Hz (400 THz to 800 THz) and wavelengths from $3.8*10^{-7}$ m to $7.5*10^{-7}$ m (380 nm (violet) to 750 nm (red)). Like water waves the electromagnetic waves spread out and get weaker with increasing distance from the source.



Radio Waves - The Long and Short of It

Radio waves are a type of electromagnetic (EM) radiation with wavelengths in the electromagnetic spectrum longer than infrared light. They have frequencies from **300 GHz** to as low as **3 kHz**, and corresponding wavelengths from 1 millimeter to 100 kilometers.

	Frequency	Common Uses
VLF	3-30 kHz	underwater communications
LF	30-300 kHz	AM radio
MF	300-3000 kHz	AM radio
HF	3-30 MHz	AM radio, long distance aviation communications
VHF	30-300 MHz	FM radio, television, short range avaiation communications, weather radio
UHF	300-3000 MHz	television, mobile phones, wireless networks, Bluetooth, satellite radio, GPS
SHF	3-30 GHz	satellite television and radio, radar systems, radio astronomy
EHF	30-300 GHz	radio astronomy, full body scanners

Where is the Horizon – It Depends on Your Height!

Stand on the shore at Ocean City looking towards the East, how far can you see? A six-foot-tall person, eyes are about 5 ½ feet off the ground. Your horizon would be about 3.3 miles. Therefore, you see the mast of a sail boat before you see the hull! Kinda proves the Earth is round.

$d \approx 4.12 * \sqrt{h}$

for (h) height in meters and (d) in kilometers

$d \approx 1.41 * \sqrt{h}$

for (h) in feet and (d) distance in miles

Most ham radio antennas are between 30 to 70 feet, this added to your property elevation, together this becomes your antenna height. For example, if you were standing on the roof of Kenwood High School you would be about 150 feet above sea level. The ground level of the school is 100 feet not including the structure. This makes your height and increases your horizon distance.

$d \approx 1.41 * \sqrt{h}$

$h=100 +50$ feet

$d \approx 1.41 * 12.24$

for (h) in feet and (d) distance in miles

$d \approx 17.26$ miles this also becomes the radio foot print, providing nothing eats the signal like trees, buildings and hills.

Getting out the signal

Radio waves are EM just like light and don't go around corners or obstacles without help. This is where the physics of EM, the Earth and the Sun come into play.

As seen above, radio waves run from Very Low Frequencies (VLF) 3 to 30 kilohertz, up to 300 Gigahertz, Extremely High Frequency (EHF). The VLF tend to follow the curvature of the Earth whereas EHF frequencies follow straight lines, they are not refracted or reflected by the Earth or its atmosphere and escape the Earth.

Ground Wave Propagation

Ground Wave propagation is a method of radio wave propagation that uses the area between the surface of the earth and the ionosphere for transmission. The ground wave can propagate a considerable distance over the earth's surface particularly in the low frequency and medium frequency portion of the radio spectrum.

Ground wave radio signal propagation is ideal for relatively short distance propagation on these frequencies during the daytime. Sky-wave ionospheric propagation is not possible during the day because of the attenuation of the signals on these frequencies caused by the D region in the ionosphere. In view of this, lower frequency radio communications stations need to rely on the ground-wave propagation to achieve their coverage.

Typically, what is referred to as a ground wave radio signal is made up of a number of constituent waves. If the antennas are in the line of sight, then there will be a direct wave as well as a reflected signal. As the names suggest, the direct signal is one that travels directly between the two antennas and is not affected by the locality. There will also be a reflected signal as the transmission will be reflected by a number of objects including the earth's surface and any hills, or large buildings that may be present. In addition to this, there is a surface wave. This tends to follow the curvature of the Earth and enables coverage beyond the horizon. The sum of all these components is known as the ground wave. Beyond the horizon the direct and reflected waves are blocked by the curvature of the Earth, and the signal is purely made up of the diffracted surface wave. It is for this reason that surface wave is commonly called ground wave propagation.

Effect of Frequency on Ground Wave Propagation

As the wavefront of the ground wave travels along the Earth's surface it is attenuated. The degree of attenuation is dependent upon a variety of factors. Frequency of the radio signal is one of the major determining factors as losses rise with increasing frequency. As a result, it makes this form of propagation impracticable above the bottom end of the HF portion of the spectrum (3 MHz). Typically, a signal at 3.0 MHz will suffer an attenuation that may be in the region of 20 to 60 dB more than one at 0.5 MHz dependent upon a variety of factors in the signal path including the distance. In view of this it can be seen why even high-power HF radio broadcast stations may only be audible for a few miles from the transmitting site via the ground wave. **1**

Ground wave is most useful during the day at 1.8 (160 meters) and 3.5 MHz (80 meters), when the D layer absorption makes skywave propagation more difficult. 2

Effect of the Ground

The surface wave is also very dependent upon the nature of the ground over which the signal travels. Ground conductivity, terrain roughness, and the dielectric constant all affect the signal attenuation. In addition to this, the ground penetration varies, becoming greater at lower frequencies, and this means that it is not just the surface conductivity that is of interest. At the higher frequencies this is not of great importance, but at lower frequencies penetration means that ground strata down to 100 meters may have an effect.

Despite all these variables, it is found that terrain with good conductivity gives the best result. Thus, soil type and the moisture content are of importance. Salty sea water is the best, and rich agricultural, or marshy land is also good. Dry sandy terrain and city centers are by far the worst. This means sea paths are optimum, although even these are subject to variations due to the roughness of the sea, resulting on path losses being slightly dependent upon the weather. It should also be noted that in view of the fact that signal penetration has an effect, the water table may have an effect dependent upon the frequency in use. **3**

Ducting and Mirages

Radio waves are refracted by natural gradients in the index of refraction of air with altitude, due to changes in temperature, humidity and pressure. Refraction under standard atmospheric conditions extend the radio horizon somewhat beyond the visual line of sight. Favorable weather conditions further enhance normal tropospheric refraction, lengthen the useful; VHF and UHF range by several hundreds of miles and increasing signal strength. Higher frequencies are more liable to refraction, so its effects may be observed in the microwave bands before they are apparent at lower frequencies. **4**

The same thing happens with the bending of light waves when you see a light house, past your normal line of sight. This is called a mirage.

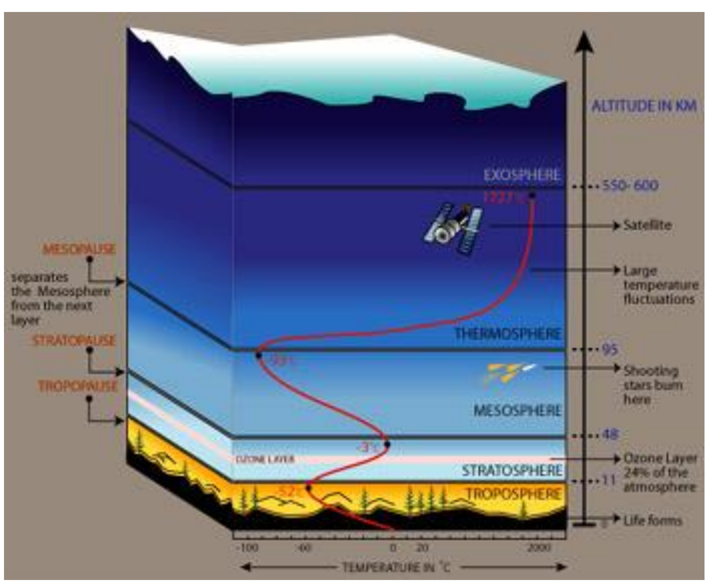
Ducting takes place when refraction is so great that radio waves are bent back to the surface of the Earth. When tropospheric ducting conditions exist over a wide geographic area, signals may remain very strong over distances of 930 miles or more. Ducting results from the gradient created by a sharp increase in temperature with altitude, quite the opposite of normal atmospheric conditions. A simultaneous drop in humidity contributes to increase refractivity.

Normally, temperature steadily decreases with altitude, at the rate of 3.3° F for every 1,000 in elevation. But at times the temperature increases over an area, this is called an inversion.

Skywave Propagation

The method by which radio waves travel through the ionosphere and back to Earth is called skywave propagation, sometimes referred to as skip. Skywave propagation has a far greater range than line-of-sight and ground-wave propagation.

Earth Atmosphere Levels



The Earth has five atmospheric levels.

The first level at sea level is called the **Troposphere** and extends 4 to 10 miles.

The **Stratosphere** and extends to a height of 30 to 35 miles. This is where the temperature begins to rise again.

The next layer is the **Mesosphere**, extending from 30 miles to 60 miles, in which temperatures fall again, often reaching the coldest reading in the entire atmosphere (around -212° F at about 60 miles).

The outermost layer is called the **Thermosphere**, extends from 55 to 435 miles. Here the atmospheric temperature can increase to hundreds or thousands of degrees Fahrenheit. **5**

The average orbit height of the U.S.A.'s International Space Station orbit is approximately 254 miles. **6.**

The **Exosphere** is beyond the thermosphere and applies to anything above 435 miles. In this layer, temperature no longer has any meaning.

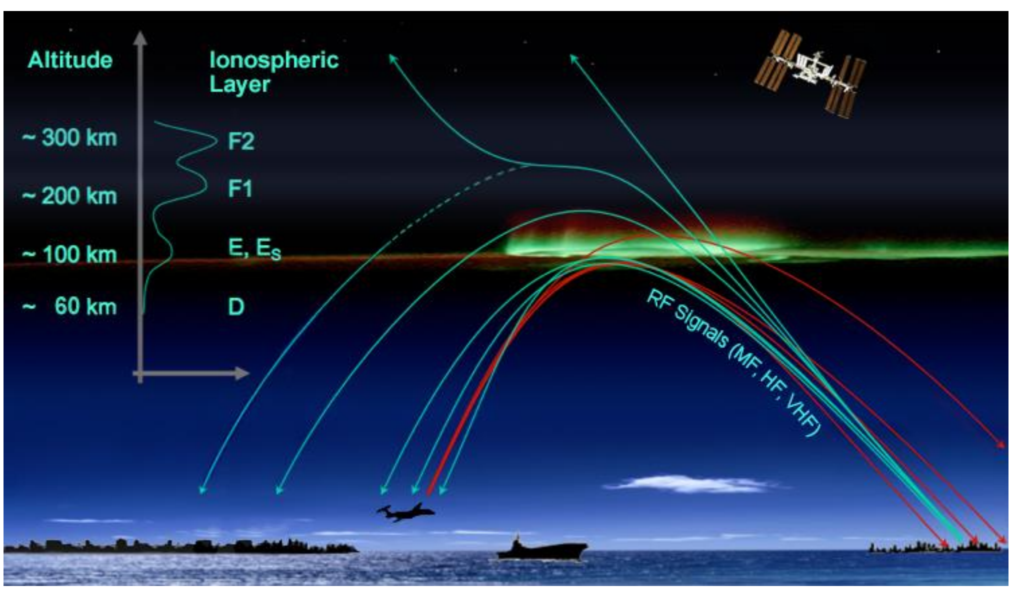
Ionosphere

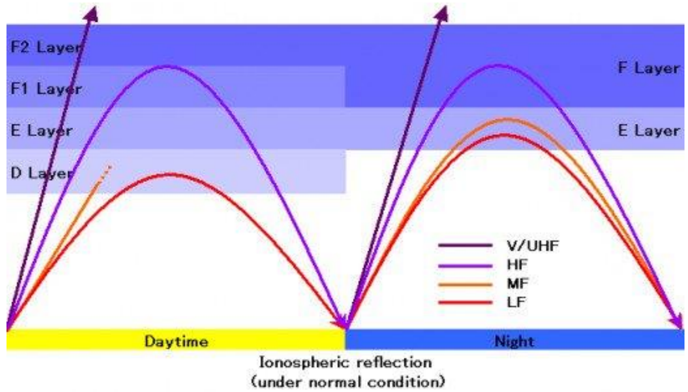
The ionosphere consists of layers of the upper atmosphere that have enough ions and free electrons to affect the transmission of radio waves. It begins at a level of 18 to 28 miles and extends to 250 miles. This is a region of the atmosphere that overlays other regions. In this region, the air becomes ionized (electrified) from the sun's ultraviolet rays and cosmic rays.

This area affects the transmission and reflection of radio waves. It is divided into three regions: the D Region (at 35 to 55 miles), the E Region (Heaviside-Kennelly Layer, 55 to 95 miles and the F Region (Appleton Layer 95 – 250 miles). **7**

The F Layer is further divided into F_1 and F_2.

During the daylight hours, the upper atmosphere both the E and F1 and F2 layers, but at night the E layer dissipates and the F1 and F2 layers are combined.

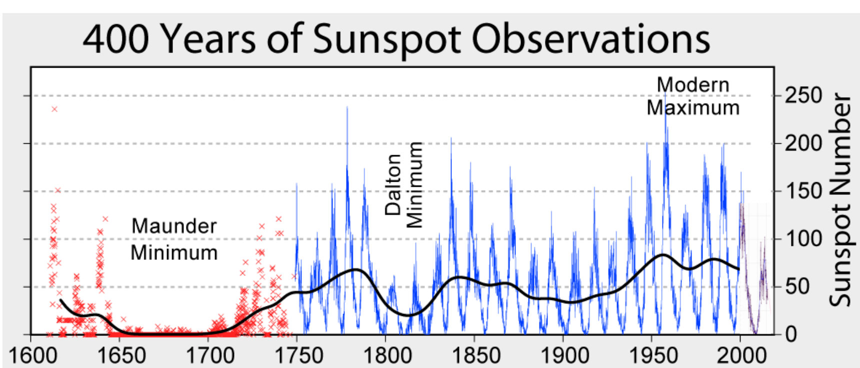




Sun's Condition – The Solar Cycle

The Sun is the driving engine of our upper atmosphere. The sun goes through 11-year cycles. We are currently in sunspot cycle 24. Man started to monitor the Sun in March of 1755, this is when man discovered an average 11-year cycle between sunspots. The average cycle begins when sunspots reverse in polarity, and they start to appear in the upper latitudes of the Sun's surface. Sunspots come in pairs and for a particular cycle the positive pole spot will lead the negative pole spot, this reverses at the start of the next solar cycle, also the sunspots would start appearing above the 25° North or South latitudes and as the cycle progresses the spots migrate towards the equator of the Sun.

Sunspots are magnetic storms on the sun's surface. They appear dark because they are cooler areas against the solar surface. The visible solar surface has an average temperature of 10,000° F whereas sunspots are about 8,000° F. Sunspots range in size from a mere 621 miles (1000 km) to larger than the Planet Jupiter which is 88,846 miles wide (142,984 km). The Sun rotates once every 26 days at the equator and 36 days at the poles.



Sunspot taken from Essex MD. Sunspot in the upper left is the size of the planet Jupiter.

Solar Storms

During the peak of the 11-year solar cycle, the average solar radiation increases along with the number of flares and the daily number of sunspots. The more sunspots, the hotter the sun's surface becomes, and the more ultraviolet and X-ray radiation is directed toward the Earth.

The Sun's radiation comes in the form of the solar wind, sunspots, solar flares, and coronal mass ejections (CME). Any or all can disrupt Earth- and space-based communications. Since we are only 500 seconds from the Sun, a solar event does not take long to affect us. CME's take longer because they contain solar plasma, taking 2 to 4 days to reach the Earth.

Space Weather

Space weather is monitored 24 hours a day. It is a joint effort between the National Oceanographic and Atmospheric Administration (NOAA), the National Aeronautics Space Administration and the United States Air Force. Their web site is https://www.swpc.noaa.gov/

Space weather impacts numerous facets of everyday life, from where airplanes can safely fly, to how accurately a farmer plows his field. In addition, there are a large variety of phenomena that are driven by the variability of the sun over periods ranging from hours to years. SWPC provides information for novices and experts alike about the impacts and phenomena of Space Weather.

- **Impacts**
  - Earth's Climate
  - Electric Power Transmission
  - GPS Systems
  - HF Radio Communications
  - Satellite Communications
  - Satellite Drag
- **Partners and Stakeholders**
  - Commercial Service Providers
  - Federal Agencies
  - International Organizations
  - International Service Providers

- Space Weather Research

- **Phenomena**
  - Aurora
  - Coronal Holes
  - Coronal Mass Ejections
  - Earth's Magnetosphere
  - F10.7 cm Radio Emissions
  - Galactic Cosmic Rays
  - Geomagnetic Storms
  - Ionosphere
  - Ionospheric Scintillation
  - Radiation Belts
  - Solar EUV Irradiance
  - Solar Flares (Radio Blackouts)
  - Solar Radiation Storm
  - Solar Wind
  - Sunspots/Solar Cycle
  - Total Electron Content

- **Additional Info**
  - NOAA Space Weather Scales

Real time Assessment using Time Signals by US's WWV and Canada's CHU

There are ways to track and determine what the state of the upper atmosphere is in.

One can tune in the **National Institute of Standards and Technology** (NIST) time tone and geophysical broadcast. The NIST broadcast time signals on its radio stations **WWV**. Listed below are the frequencies and the Effective Radiated Power (ERP) of each transmitter.

2.5 MHz   ERP 2.5 kW
5.0 MHz 10 kW ERP
10.0 MHz 10 kW ERP
15.0 MHz 10 kW ERP
20.0 MHz ERP 2.5 kW
25.0 MHz ERP 2.5 kW restarted last year (2017)

Each transmitter is connected to a dedicated antenna, which has a height corresponding to approximately one-half of its signal's wavelength, and the signal radiation patterns from each antenna are omnidirectional. The time tones are broadcast from Ft. Collins CO, 75 miles North of Denver.

CHU Canada

Canada also has a time service located in Ottawa, its call sign is CHU and it broadcast time signals on:

3.330 MHz ERP 3 kW
7.850 MHz   ERP 10 kW
14.670 MHz ERP 3 kW

Beacons

Automated *beacons* in the higher amateur bands can also be useful adjuncts to propagation watching. Beacons are ideal for this purpose because most are designed to transmit 24 hours a day. One of the best organized beacon systems is the International Beacon Project, sponsored by the Northern California DX Foundation (NCDXF) and International Amateur Radio Union (IARU). The beacons operate 24 hours a day at:

14.100 MHz
18.110 MHz
21.150 MHz
24.930 MHz
28.200 MHz

Eighteen beacons on five continents transmit in successive 10-second intervals (each beacon transmits once every 3 minutes). More on this system can be found at the Northern California DX Foundation website www.ncdxf.org **8**

The 2018 ARRL Handbook has a 3-page, Propagation Summary by Band summary 19.4. was copied to produce the charts below.

Propagation Summary, by Band

See section 19.8 for a discussion of propagation on these bands.

LOW FREQUENCY (LF) BANDS 135.7-137.8 kHz (2200 meters) and 472-479 kHz (630 meters)

OUR ONLY MEDIUM FREQUENCY (MF) BAND 1.8-2.0 MHz (160 meters)

Top band, as it is sometimes called, suffers from daytime D layer absorption. Daytime communication is limited to ground-wave coverage and a single E hop out to about 1500 km for well-equipped stations (running the full legal limit, quarter-wave verticals with a good ground system, and a low noise receiving environment). At night, the D layer quickly disappears, and worldwide 160-meter communication becomes possible via F2 layer skip and ducting. Atmospheric and man-made noise limits propagation. Tropical and mid latitude thunderstorms cause high levels of static in summer, making winter evenings the best time to work DX at 1.8 MHz. A proper choice of receiving antenna (Beverage, 4-square, small loop) can often significantly reduce the amount of received noise to improve the signal-to-noise ratio.

HIGH FREQUENCY (HF) BANDS (3-30 MHz)

A wide variety of propagation modes are useful on the HF bands. The lowest two bands in this range share many daytime characteristics with 160 meters. The transition between bands primarily useful at night or during the day appears around 10 MHz. Most long-distance contacts are made via F2 layer skip. Above 21 MHz, more exotic propagation, including TE, sporadic E, aurora and meteor scatter, begins to be practical.

3.5-4.0 MHz (80 meters for the lower end, 75 meters for the higher end)

The lowest HF band is similar to 160 meters in many respects. Daytime absorption is significant, but not quite as extreme as at 1.8 MHz. At night, signals are often propagated halfway around the world. As at 1.8 MHz, atmospheric noise is a nuisance, making winter the most attractive season for the 80/75 meter DXer.

5.3-5.4 MHz (60 meters)

The distance covered during daytime propagation will fall in between that achievable on the 80 meter and 40 meter bands. At night, worldwide propagation is possible in spite of the relatively low power limit. Signal strengths will typically be higher than on 80 meters but not as high as on 40 meters.

7.0-7.3 MHz (40 meters)

The popular 40 meter band has a clearly defined skip zone during the day due to insufficient ionization to refract high angles. D layer absorption is not as severe as on the lower bands, so short-distance skip via the E and F layers is possible. During the day, a typical station can cover a radius of approximately 800 km (500 miles). At night, reliable worldwide communication via F2 is common on the 40 meter band. Atmospheric noise is much less troublesome than on 160 and 80 meters, and 40 meter DX signals are often of sufficient strength to override even high-level summer static. For these reasons, 40 meters is the lowest-frequency amateur band considered reliable for DX communication in all seasons. Even during the lowest point in the solar cycle, 40 meters may be open for worldwide DX throughout the night.

10.1-10.15 MHz (30 meters)

The 30 meter band is unique because it shares characteristics of both daytime and nighttime bands. D layer absorption is not a significant factor. Communication up to 3000 km (1900 miles) is typical during the daytime, and this extends halfway around the world via all-darkness paths. The band is generally open via F2 on a 24-hour basis, but during a solar minimum, the MUF on some DX paths may drop below 10 MHz at night. Under these conditions, 30 meters adopts the characteristics of the daytime bands at 14 MHz and higher. The 30 meter band shows the least variation in conditions over the 11-year solar cycle, thus making it generally useful for long-distance communication anytime.

14.0-14.35 MHz (20 meters)

The 20 meter band is traditionally regarded as the amateurs' primary long-haul DX favorite. Regardless of the 11-year solar cycle, 20 meters can be depended on for at least a few hours of worldwide F2 propagation during the day. During solar-maximum periods, 20 meters will often stay open to distant locations throughout the night. Skip distance is usually appreciable and is always present to some degree. Daytime E layer propagation may be detected along very short paths. Atmospheric noise is not a serious consideration, even in the summer. Because of its popularity, 20 meters tends to be very congested during the daylight hours.

18.068-18.168 MHz (17 meters)

The 17 meter band is similar to the 20 meter band in many respects, but the effects of fluctuating solar activity on F2 propagation are more pronounced. During the years of high solar activity, 17 meters is reliable for daytime and early-evening long-range communication, often lasting well after sunset. During moderate years, the band may open only during sunlight hours and close shortly after sunset. At solar minimum, 17 meters will open to middle and equatorial latitudes, but only for short periods during midday on north-south paths.

21.0-21.45 MHz (15 meters)

The 15 meter band has long been considered a prime DX band during solar cycle maxima, but it is sensitive to changing solar activity. During peak years, 15 meters is reliable for daytime F2 layer DXing and will often stay open well into the night. During periods of moderate solar activity, 15 meters is

basically a daytime-only band, closing shortly after sunset. During solar minimum periods, 15 meters may not open at all except for infrequent north-south transequatorial circuits.
Sporadic E is observed occasionally in early summer and midwinter, although this is not common and the effects are not as pronounced as on the higher frequencies.

24.89-24.99 MHz (12 meters)

This band offers propagation that combines the best of the 10 and 15 meter bands. Although 12 meters is primarily a daytime band during low and moderate sunspot years, it may stay open well after sunset during the solar maximum. During years of moderate solar activity, 12 meters opens to the low and middle latitudes during the daytime hours, but it seldom remains open after sunset. Periods of low solar activity seldom
cause this band to go completely dead, except at higher
latitudes. Occasional daytime openings, especially in the lower latitudes, are likely over north-south paths. The main sporadic E season on 24 MHz lasts from late spring through summer and short openings may be observed in mid-winter.

28.0-29.7 MHz (10 meters)

The 10 meter band is well known for extreme variations in characteristics and a variety of propagation modes. During solar maxima, long-distance F2 propagation is so efficient that very low power can produce strong signals halfway around the globe. DX is abundant with modest equipment. Under these conditions, the band is usually open from sunrise to a few hours past sunset. During periods of moderate solar activity, 10 meters usually opens only to low and transequatorial latitudes around noon. During the solar minimum, there may be no F2 propagation at any time during the day or night.

Sporadic E is fairly common on 10 m, especially May through August, although it may appear at any time. Short skip, as sporadic E is sometimes called on the HF bands, has little relation to the solar cycle and occurs regardless of F layer conditions. It provides single-hop communication from 300 to 2300 km (190 to 1400 miles) and multiple-hop opportunities of 4500 km (2800 miles) and farther.

Ten meters is a transitional band in that it also shares some of the propagation modes more characteristic of VHF. Meteor scatter, aurora, auroral E and tansequatorial propagation provide the means of making contacts out to 2300 km (1400 miles) and farther, but these modes often go unnoticed at 28 MHz. Techniques similar to those used at VHF can be very effective on 10 meters, as signals are usually stronger and more persistent. These exotic modes can be more fully exploited, especially during the solar minimum when F2 DXing has waned.

VERY HIGH FREQUENCY (VHF) BANDS (30-300 MHz)

A wide variety of propagation modes are useful in the VHF range. F layer skip appears on 50 MHz during solar cycle peaks. Sporadic E and several other E layer phenomena are most effective in the VHF range. Still other forms of VHF ionospheric propagation, such as field-aligned irregularities (FAI) and transequatorial propagation (TE), are rarely observed at VHF. Tropospheric propagation, which is not a factor at HF, becomes increasingly important above 50 MHz.

50-54 MHz (6 meters)

The lowest amateur VHF band shares many of the characteristics of both lower and higher frequencies. In the absence of any favorable ionospheric propagation conditions, well-equipped 50 MHz stations work regularly over a radius of 300 km (190 miles) via tropospheric scatter, depending on terrain, power, receiver capabilities and antenna. Weaksignal troposcatter allows the best stations to make 500 km (310 mile) contacts nearly any time. Weather effects may extend the normal range by a few hundred km, especially during the summer months, but true tropospheric ducting is rare.

During the peak of the 11-year sunspot cycle (especially during the winter months), worldwide 50 MHz DX is possible via the F2 layer during daylight hours. F2 backscatter providesan additional propagation mode for contacts as far as 4000 km (2500 miles) when the MUF is just below 50 MHz. TE paths as long as 8000 km (5000 miles) across the magnetic equator are common around the spring and fall equinoxes of peak solar cycle years. Sporadic E is probably the most common and certainly the most popular form of propagation on the 6 meter band.

Singlehop E-skip openings may last many hours for contacts from 600 to 2300 km (370 to 1400 miles), primarily during the spring and early summer. Multiple-hop Es provides transcontinental contacts several times a year, and contacts between the US and South America, Europe and Japan via multiple-hop E-skip occur nearly every summer.

Other types of E layer ionospheric propagation make 6 meters an exciting band. Maximum distances of about 2300 km (1400 miles) are typical for all types of E layer modes. Propagation via FAI often provides additional hours of contacts immediately following sporadic E events. Auroral propagation often makes its appearance in late afternoon when the geomagnetic field is disturbed. Closely related auroral E propagation may extend the 6 meter range to 4000 km (2500 miles) and sometimes farther across the northern states and Canada, usually after midnight. Meteor scatter provides brief contacts during the early morning hours, especially during one of the dozen or so prominent annual meteor showers.

144-148 MHz (2 meters)

Ionospheric effects are significantly reduced at 144 MHz, but they are far from absent. F layer propagation is unknown except for TE, which is responsible for the current 144 MHz terrestrial DX record of nearly 8000 km (5000 miles). Sporadic E occurs as high as 144 MHz less than a tenth as often as at 50 MHz, but the usual maximum single-hop distance is the same, about 2300 km (1400 miles). Multiple-hop sporadic E contacts greater than 3000 km (1900 miles) have occurred from time to time across the continental US, as well as across Southern Europe.

Auroral propagation is quite similar to that found at 50 MHz, except that signals are weaker and more Doppler-distorted. Auroral E contacts are rare. Meteor-scatter contacts are limited primarily to the periods of the great annual meteor showers and require much patience and operating skill. Contacts have been made via FAI on 144 MHz, but its potential has not been fully explored.

Tropospheric effects improve with increasing frequency, and 144 MHz is the lowest VHF band at which terrestrial weather plays an important propagation role. Weather-induced enhancements may extend the normal 300 to 600 km (190 to 370 mile) range of well-equipped stations to 800 km (500 miles) and more, especially during the summer and early fall. Tropospheric ducting extends this range to 2000 km (1200 miles) and farther over the continent and at least to 4000 km (2500 miles) over some well-known all-water paths, such as that between California and Hawaii.

222-225 MHz (135 cm)

The 135 cm band shares many characteristics with the 2 meter band. The normal working range of 222 MHz stations is nearly as far as comparably equipped 144 MHz stations. The 135 cm band is slightly more sensitive to tropospheric effects, but ionospheric modes are more difficult to use. Auroral and meteor-scatter signals are somewhat weaker than at 144 MHz, and sporadic E contacts on 222 MHz are extremely rare. FAI and TE may also be well within the possibilities of 222 MHz, but reports of these modes on the 135 cm band are uncommon. Increased activity on 222 MHz will eventually reveal the extent of the propagation modes on the highest of the amateur VHF bands

ULTRA-HIGH FREQUENCY (UHF) BANDS (300-3000 MHz) AND HIGHER

Tropospheric propagation dominates the bands at UHF and higher, although some forms of E layer propagation are still useful at 432 MHz. Above 10 GHz, atmospheric attenuation increasingly becomes the limiting factor over long-distance paths. Reflections from airplanes, mountains and other stationary objects may be useful adjuncts to propagation at 432 MHz and higher.

420-450 MHz (70 cm)

The lowest amateur UHF band marks the highest frequency on which ionospheric propagation is commonly observed. Auroral signals are weaker and more Doppler distorted; the range is usually less than at 144 or 222 MHz. Meteor scatter is much more difficult than on the lower bands, because bursts are significantly weaker and of much shorter duration. Although sporadic E and FAI are unknown as high as 432 MHz and probably impossible, TE may be possible.

Well-equipped 432 MHz stations can expect to work over a radius of at least 300 km (190 miles) in the absence of any propagation enhancement. Tropospheric refraction is more pronounced at 432 MHz and provides the most frequent and useful means of extended-range contacts. Tropospheric ducting supports contacts of 1500 km (930 miles) and farther over land. The current 432 MHz terrestrial DX record of more than 4000 km (2500 miles) was accomplished by ducting over water.

902-928 MHz (33 cm) and Higher

Ionospheric modes of propagation are nearly unknown in the bands above 902 MHz. Auroral scatter may be just within amateur capabilities at 902 MHz, but signal levels will be well below those at 432 MHz. Doppler shift and distortion will be considerable, and the signal bandwidth may be quite wide. No other ionospheric propagation modes are likely, although highpowered research radars have received echoes from auroras and meteors as high as 3 GHz.

Almost all extended-distance work in the UHF and microwave bands is accomplished with the aid of tropospheric enhancement. The frequencies above 902 MHz are very sensitive to changes in the weather. Tropospheric ducting occurs more frequently than in the VHF bands and the potential range is similar. At 1296 MHz, 2000 km (1200 mile) continental paths and 4000 km (2500 mile) paths between California and Hawaii have been spanned many times. Contacts of 1000 km (620 miles) have been made on all bands through 10 GHz in the US and over 1600 km (1000 miles) across the Mediterranean Sea. Well-equipped 903 and 1296 MHz stations can work reliably up to 300 km (190 miles), but normal working ranges generally shorten with increasing frequency.

Other tropospheric effects become evident in the GHz bands. Evaporation inversions, which form over very warm bodies of water, are usable at 3.3 GHz and higher. It is also possible to complete paths by scattering from rain, snow and hail in the lower GHz bands. Above 10 GHz, attenuation caused by atmospheric water vapor and oxygen become the most significant limiting factors in long-distance communication

Ham Radio Propagation

Radio propagation is normally enhanced during the time of solar maximum, the increased sunspot activity during a sunspot cycle. We are currently in sunspot cycle 24. But a major disruption to communications can occur during extreme and severe solar actives such as solar flares and coronal mass ejections. This chart provides information from the ARRL Handbook and other ham radio publication/articles about propagation.

Radio Propagation caused by the Solar Sunspot Cycles

Band Freq	**Range mi Day time Night Time**	**Atmospheric Region (D,E, F) Day**	**Night**	**Solar Minimum**	**Solar Maximum**	**Notes**
160 m 1.8 – 2.0 MHz	90 mi 900 mj	Extreme daytime D absorption E Hop	Night time via F2 layer	None	None	Winter evenings best
80 m 3.5 – 4.0 MHz	250 mi	Less than 160mi	Night time via F2 layer	None	None	Best in Winter
60m 5.330.5MHz	<500 mi	Less absorption on D layer		May be open for worldwide DX	None	5 channel USB 50wERP only
40m 7.0 -7.3 MHz	500 mi worldwide	Less absorption on D layer		May be open for worldwide DX	None	Good for all seasons
30m 10.1 – 10.15 MHz	1,900 mi 500 mi	Open via F2	Up to 12,000mi at night	Degraded during solar minimum	None	Good for long distance communications
20m 14 – 14.35 MHz	5,000 mi	F2 propagation		None	Only open during daylight hours	Atmospheric noise not a problem
17 m 18.068–	5,000 mi Close after	F2 propagation		None	Only open during daylight	

18.168 MHz	sunset				hours	
15m 21 – 21.45 MHz	5,000 mi Close after sunset	F2, E early summer & mid-winter		None	Prime DX band	Day time only
12m 24.89 – 24.99 MHz	5,000 mi Close after sunset	E layer		Day time during low cycles	Well after sunset during maximums	Late spring thru summer
10m 28 – 29.7 MHz	190 – 1,400 m	F2, E skip			Low power maximum distance	
6m 50 – 54 MHz	190 mi	Tropospheric scatter			Worldwide DX is possible	Auroral and meteor scatter
2m 144 – 148 MHz	1,400 mi	Transequatorial spread	E layer Aurora	None	None	Auroral and meteor scatter
1.25m 222 – 225 MHz	1,400mi	Transequatorial spread	E layer Aurora but < 2m	None	None	Auroral and meteor scatter
70cm i 420 – 450 Mhz	950 mi	Some E layer	E layer Aurora but < 2m	None	None	Auroral and meteor scatter
33cm 902 – 928 MHz	190 mi	Tropospheric ducting	E layer Aurora but < 70cm	None	None	Auroral and meteor scatter

"Radio Waves and Communications Distance" *W1FB QST January 1985*

Band (MHz)	Meters	Typical Distance Day	Typical Distance Night
1.8	160	0 -50	0 – 3,000
3.5	80	0 – 100	0 – 3,000
7	40	0 – 1,000	0 – 3,000
10.1	30	0 – 2,000	0 – 4,000
14	20	0 – 4,000	0 – 100
21	15	0 – 4,000	0 – 100
28	10	0 - 5,000	0 – 100

Modified Frequency Distance Chart

Band MHz	Meters	Typical Distance Day	Typical Distance Night	Usage
1.8	160	0 -50	0 – 3,000	night
3.5	80	0 – 100	0 – 3,000	night and local day
7	40	0 – 1,000	0 – 3,000	night and local day
10.1	30	0 – 2,000	0 – 4,000	CW and digital
14	20	0 – 4,000	0 – 100	worldwide day and night
18	17			worldwide day and night
21	15	0 – 4,000	0 – 100	primarily a daytime band
24.8	12			primarily a daytime band
28	10	0 - 5,000	0 – 100	daytime during sunspot highs
50	6			Local to world-wide
144	2			Local and medium distance
222	1.25			Local
430	70 cm			Local
902	33 cm			Local

Refrences:

1, Wikipedia, Ground Wave Propagation

2 ARRL Handbook, pg 19.6

3 , Wikipedia, Ground Wave Propagation

3 ARRL Handbook Chapter 19.25

4 The Handy Weather Answer Book, pg 4

5 The Handy Weather Answer Book, pg 55

6 Google

7 The Handy Weather Answer Book, pg 772

8 The ARRL 2019 Handbook, pg 19.21

9 The ARRL 2019 Handbook, pg 19.4 - 6

From the Skies over Mt. Essex

SKY Events for February 2019

Feb 1^{st} - Space Columbia disintegrates on re-entry in 2003.

Feb 2^{nd} – Groundhog Day six weeks of ☀ or ⛄, Saturn is 0.6° S of the Moon at 02:00 EST (7UT),

Feb 4^{th} –New Moon

Feb 7^{th} – Neptune is 3° N of Moon.

Feb 12^{th} – First Quarter Moon

Feb 14^{th} – Aldebaran 1.7° S of Moon.

Feb 18^{th} – Moon is 0.6° S of Beehive (M44) 23:00 EST (4UT), Saturn is 1.1° S of Venus 09 EST (14UT).

Feb 19^{th} – Full Moon, "Snow " for Traditional and the "Moon of the Raccoon" for the Dakota Sioux American Indian. Also a Super Moon 221,734 mi (356,846km)

Feb 21^{st} – Zodiacal Light visible in N lat. in the West after evening twilight next 2 weeks.

Feb 26^{th} –Last Quarter

Feb 27^{th} – Mercury greatest elongation E (18°

Planet Lookout at mid-Month
Sunrise 06:58 EST and Sunset 17:43 EST

Mercury Evening Rise 07:31, Set 18:44; Mag -1.2; Size 5.4 arc seconds

Venus Morning Rise 04:23, Sets 14:15; Mag -4.2 and 17>3 arc seconds.

Mars Evening Rises 09:34, Sets 22:55, Mag 1.0 and 5.7 arc seconds wide.

Jupiter Morning, rises 02:49, Sets 21:29; Mag-2.0 size 34.8 arc seconds.

Saturn Morning. Rises 04:41 Sets 14:24; Mag 0.6 size 15.4 arc seconds.

Uranus Evening **Rises** 09:35 Sets 22:45; Mag 5.8 size 3.4 arc seconds.

Neptune Morning Rises 07:46 Sets 19:14; Mag +7.9 size 2.4 arc seconds.

There's a Time for the Seasons -

The planet Earth experiences four seasons. In the Northern hemisphere we have Spring, Summer, Fall and Winter at the same time the Southern hemisphere has Fall, Winter, Spring and Summer. I am not sure I would like Christmas in a hot climate, like they have in Australia, I would prefer to have my Christmas as they have in Austria.

But it's not just the north or south of the equator that makes a difference, it's your latitude and whether you live on the coast line or mid-continent. Here in Maryland we get four seasons, hot and muggy is our name for summer. If you live in upstate New York, you have winter, Mudd, almost summer, and fall.

In reality there are multiple dates for the seasons: 1 **Astronomical** and 2 **Meteorological**. The astronomical seasons are defined by the Earth's position in its orbit around the Sun. These are somewhat fixed dates: Spring Vernal Equinox March 20, Summer Solstice, June 21, Fall Autumnal Equinox September 21 and Winter Solstice December 21.

The other one is the Meteorological Season which is based on the Annual Cycle of Temperature. The Spring date using Meteorological standards starts on March 1^{st} and goes to the last day of May; Summer starts on June 1^{st}, Fall on September 1^{st} and Winter on December 1^{st}.

The Annual Cycle of Temperature generally follows the following chart:

Maximum temperature (late July)

Minimum temperature (late January)

Radiant energy absorbed (high point about June 21)

Radiant energy absorbed (low point about December 21)

The precise duration for the northern seasons are: spring 92.7 days, summer 93.65 days, autumn 89.84 days and winter with 88.99 days.

Just a note: in January we are 2 million miles closer to the sun than in July. In January the sunlight striking the Earth is 6% stronger than in July, but not enough to offset the effect of the tilted axis. And January is still colder than July in the Northern Hemisphere. Ref: National Audubon Society *Field Guide to Weather,* pgs 67 -74