1

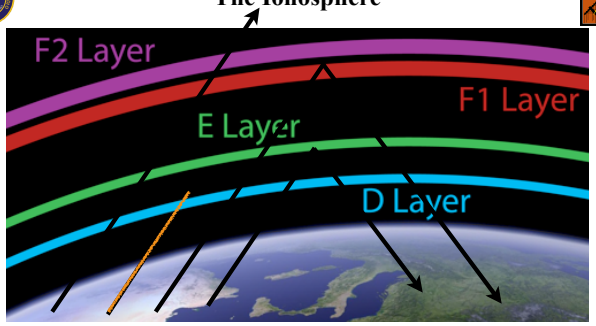
General Class Unit 1B
Question Pool §3

Radio Wave Propagation

3 Questions

2

The Ionosphere



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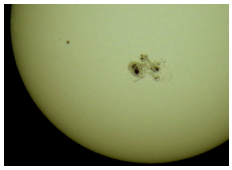
Solar Effects on RF Propagation

- Radio propagation is affected by two main factors:
  - Sunspots
  - Solar flares

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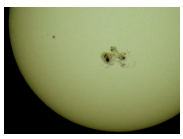
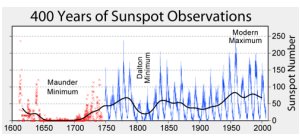
Solar Effects on RF Propagation

- Sunspots have an 11-year cycle going from a minimum to a maximum and back.
- The sunspot number is a measure of solar activity based on counting sunspots and sunspot groups.
- *Higher sunspot numbers generally indicate a greater probability of good propagation at higher frequencies.*
- The least reliable bands for long distance communications during low solar activity are *15 meters, 12 meters, and 10 meters.*

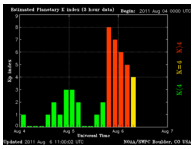
G3A01 G3A04

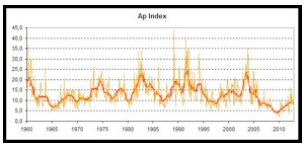
Solar Effects on RF Propagation

5

G3A12 G3A13

- The solar K-index indicates *the short-term stability of Earth's magnetic field*.
- The solar A-index indicates *the long-term stability of Earth's geomagnetic field*.
  - The A-index is an average of the K-index from select sites around the world.





Solar Effects on RF Propagation

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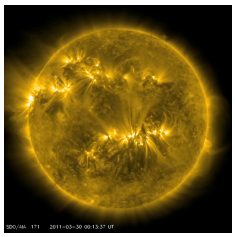
G3A10

- What causes HF propagation conditions to vary periodically in a roughly 28-day cycle is *the sun's rotation on its axis*.

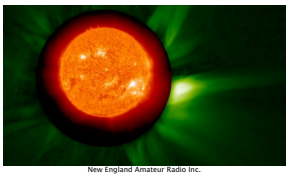


Solar Effects on RF Propagation

7

G3A03 G3A11

- Different solar emissions have different travel times to Earth.
- Increased ultraviolet and X-ray radiation from solar flares take *8 minutes* to affect radio propagation on Earth.
- Charged particles from coronal mass ejections take about *20 – 40 hours* to affect radio propagation on Earth.

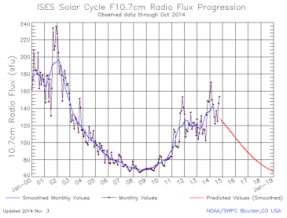


Solar-Flux Index

8

G3A05

- The solar-flux index is *a measure of solar radiation at 10.7 centimeters wavelength*.



Geomagnetic Storms

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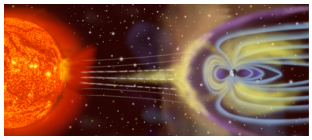
G3A06 G3A08 G3A09

- A geomagnetic storm is *a temporary disturbance in Earth's magnetosphere*.
- Following a geomagnetic storm there will be *degraded high-latitude HF propagation.*
- One benefit that high geomagnetic activity has on radio communications is *auroras that can reflect VHF signals*.

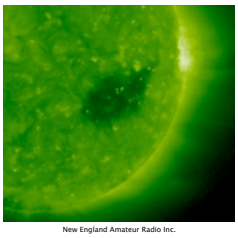


Coronal Holes

10

G3A14

- The charged particles coming out of a solar coronal hole cause *HF communications to be disturbed*.



Solar Effects on RF Propagation

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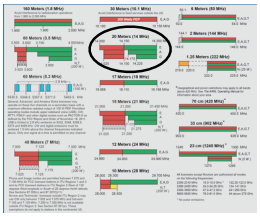
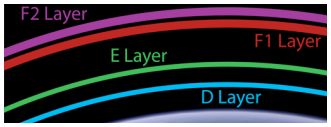
G3A02 G3A07

- A sudden ionospheric disturbance *disrupts signals on lower frequencies more than those on higher frequencies* during the daytime.
- The 20-meter band usually supports worldwide propagation during daylight hours *at any point in the solar cycle*.





The Ionosphere

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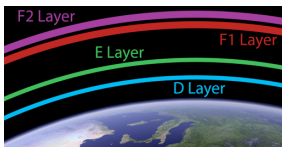
G3C01 G3C05 G3C11



- *The D layer* is the closest to the surface of the Earth.
- Long-distance communication on the 40-meter, 60-meter, 80-meter, and 160-meter bands more difficult during the day because *the D layer absorbs signals at these frequencies during daylight hours*.
- *The D layer* absorbs most long skip signals during daylight hours on frequencies below 10 MHz.

The Ionosphere

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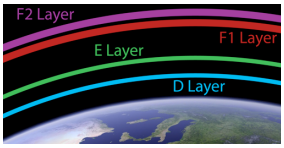
G3C03 G3C02



- The F2 layer is mainly responsible for the longest distance radio wave propagation *because it is the highest ionospheric region.*
- The ionosphere reaches its maximum height *where the sun is overhead.*

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Single Skip Path Distances

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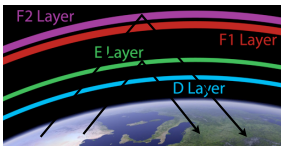
G3B10 G3B09



- The approximate maximum distance along the Earth's surface that is normally covered in one hop using the E region is *1,200 miles*.
- The approximate maximum distance along the Earth's surface that is normally covered in one hop using the F2 region is *2,500 miles*.

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Antennas and Propagation

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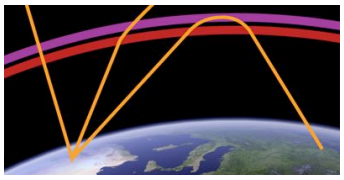
G3C04



- The "critical angle" is *the highest takeoff angle that will return a radio wave to Earth under specific ionospheric conditions.*

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Antennas and Propagation

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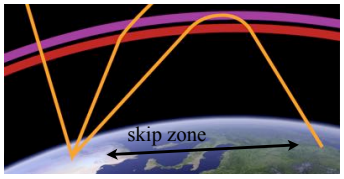

- The skip zone is a region where a radio transmission can not be received located between regions both closer and farther from the transmitter where reception is possible.

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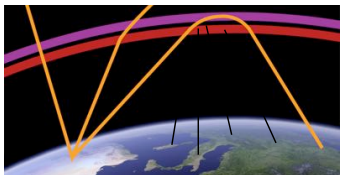
HF Scatter



- *Scatter* propagation allows signals to be heard in the transmitting station's skip zone.
- HF scatter signals in the skip zone are usually weak because *only a small part of the signal energy is scattered into the skip zone*.

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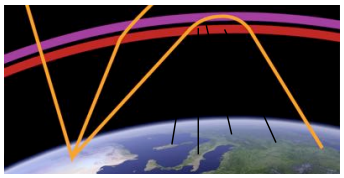
17 G3C09 G3C08

HF Scatter



- A characteristic of HF scatter signals is *they have a fluttering sound*.
- HF scatter signals often sound distorted because the *energy is scattered into the skip zone through several different radio wave paths*.

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18 G3C06 G3C07

NVIS

- Near Vertical Incidence Skywave (NVIS) propagation produces *short distance MF or HF propagation using high elevation angles*.
- Has a high vertical angle radiation for working stations within a radius of a few hundred kilometers.

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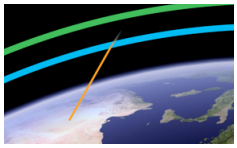
Lowest Usable Frequency



- Lowest Usable Frequency (LUF)
  - *The Lowest Usable Frequency for communications between two points*.
  - Frequencies below the LUF *are completely absorbed by the ionosphere*.

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20 G3B07 G3B06

Maximum Usable Frequency

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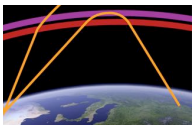
G3B08 G3B03



- Maximum Usable Frequency (MUF)
  - *The Maximum Usable Frequency for communications between two points*.
- Frequencies above the MUF escape out into space and are not reflected back to Earth.
- When selecting a frequency for lowest attenuation when transmitting on HF, *select a frequency just below the MUF*.

Maximum Usable Frequency

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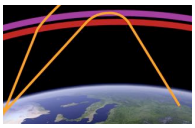
G3B02 G3B04



- Factors that affect the MUF
  - *Path distance and location*
  - *Time of day and season*
  - *Solar radiation and ionospheric disturbances*
- A reliable way to determine if the MUF is high enough to support skip propagation between your station and a distant location on frequencies between 14 and 30 MHz is to *listen for signals from an international beacon in the frequency range you plan to use*.

LUF and MUF

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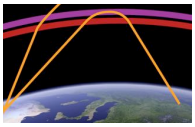
G3B05 G3B11



- Usually radio waves with frequencies below the MUF and above the LUF *are bent back to Earth*.
- If the LUF exceeds the MUF, then *no HF radio frequency will support ordinary skywave communications over the path*.

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