

Muscle Shoals Amateur Radio Club

Extra License Class
Training
Session 3

Review

- “ Test Pool Question Review
- “ Questions?

Syllabus

- “ Week 1 – 9/4/18: Commission’s Rules (6 question areas)
- “ Week 2 – 9/11/18: Operating Procedures (5 question areas)
- “ **Week 3 – 9/18/18: Radio Wave Propagation (3 question areas)**
- “ Week 4 – 9/25/18: Amateur Radio Procedures (5 question areas)
- “ Week 5 – 10/2/18: Electrical Principles (4 question areas)
- “ Week 6 – 10/9/18: Circuit Components (6 question areas)
- “ Week 7 – 10/15/18: Practical Circuits (8 question areas)
- “ Week 8 – 10/23/18: Signals and Emissions (4 question areas)
- “ Week 9 – 10/30/18: Antennas and Feed-lines/Transmission Lines (8 question areas)
- “ Week 10 – 11/6/18: Safety (1 question area)
- “ Week 11 – 11/13/18: Review and VE application presentation
- “ Week 12 – 11/20/18: Exams (50 questions!)

Topics

- “ **E3 – RADIO WAVE PROPAGATION**
[3 Exam Questions - 3 Groups]
- “ **E3A** Electromagnetic wave; Earth-Moon-Earth communications; meteor scatter; microwave tropospheric and scatter propagation; aurora propagation
- “ **E3B** Transequatorial propagation; long path; gray-line; multi-path; ordinary and extraordinary wave; chordal hop; sporadic E mechanisms
- “ **E3C** Radio-path horizon; less common propagation modes; propagation predictions techniques and modeling; space weather parameters and amateur radio

E3 – Radio Wave Propagation Tutorial

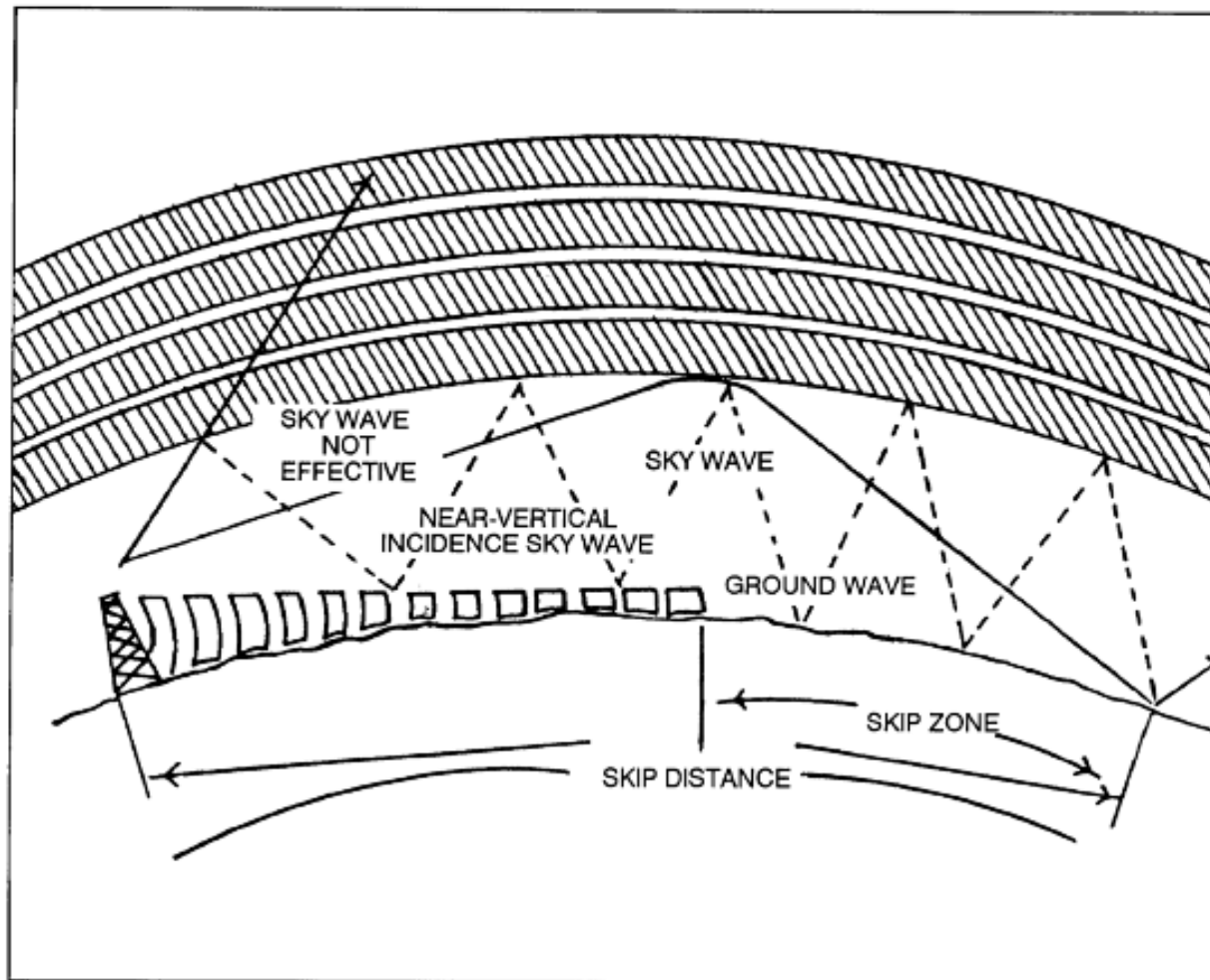
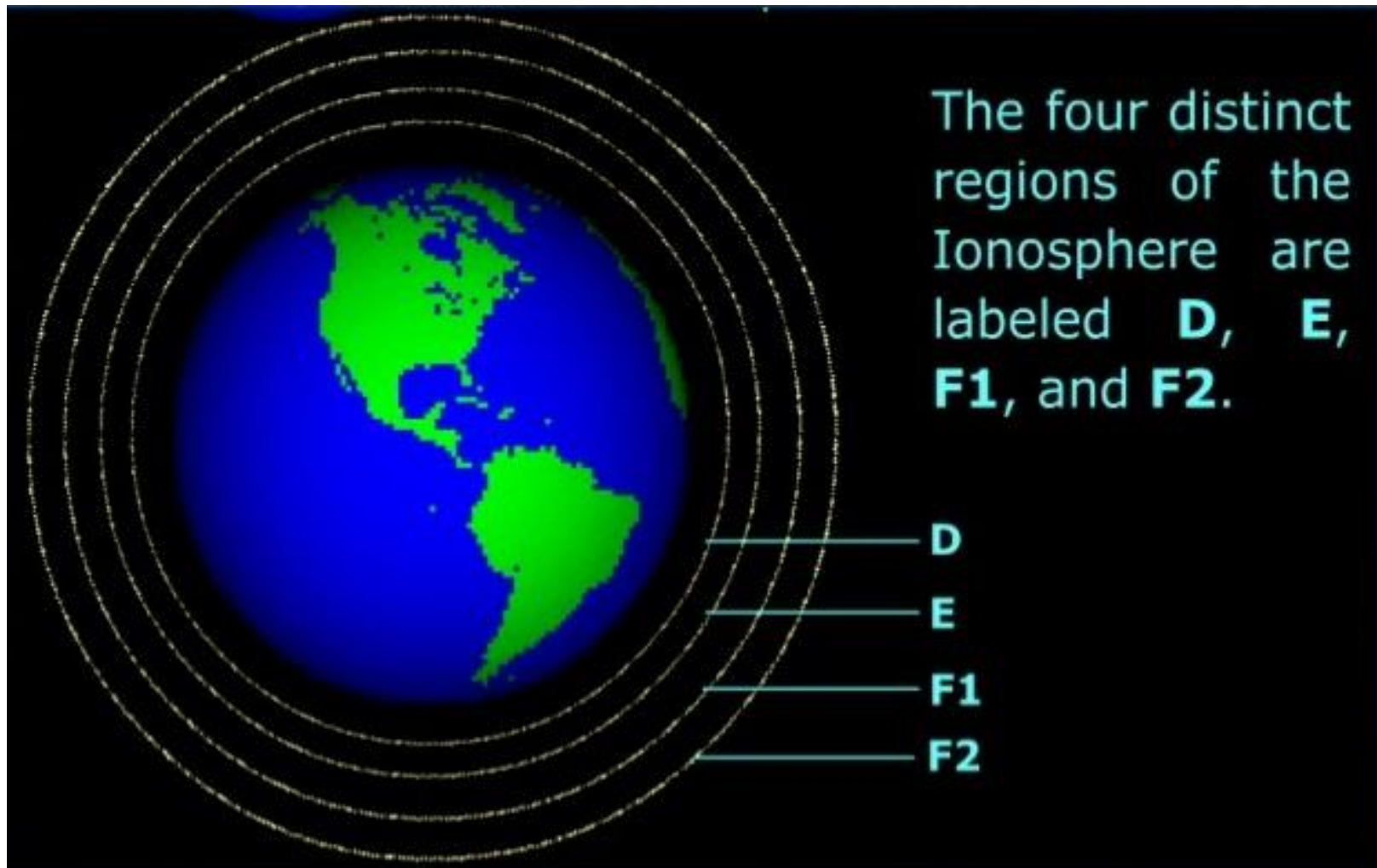
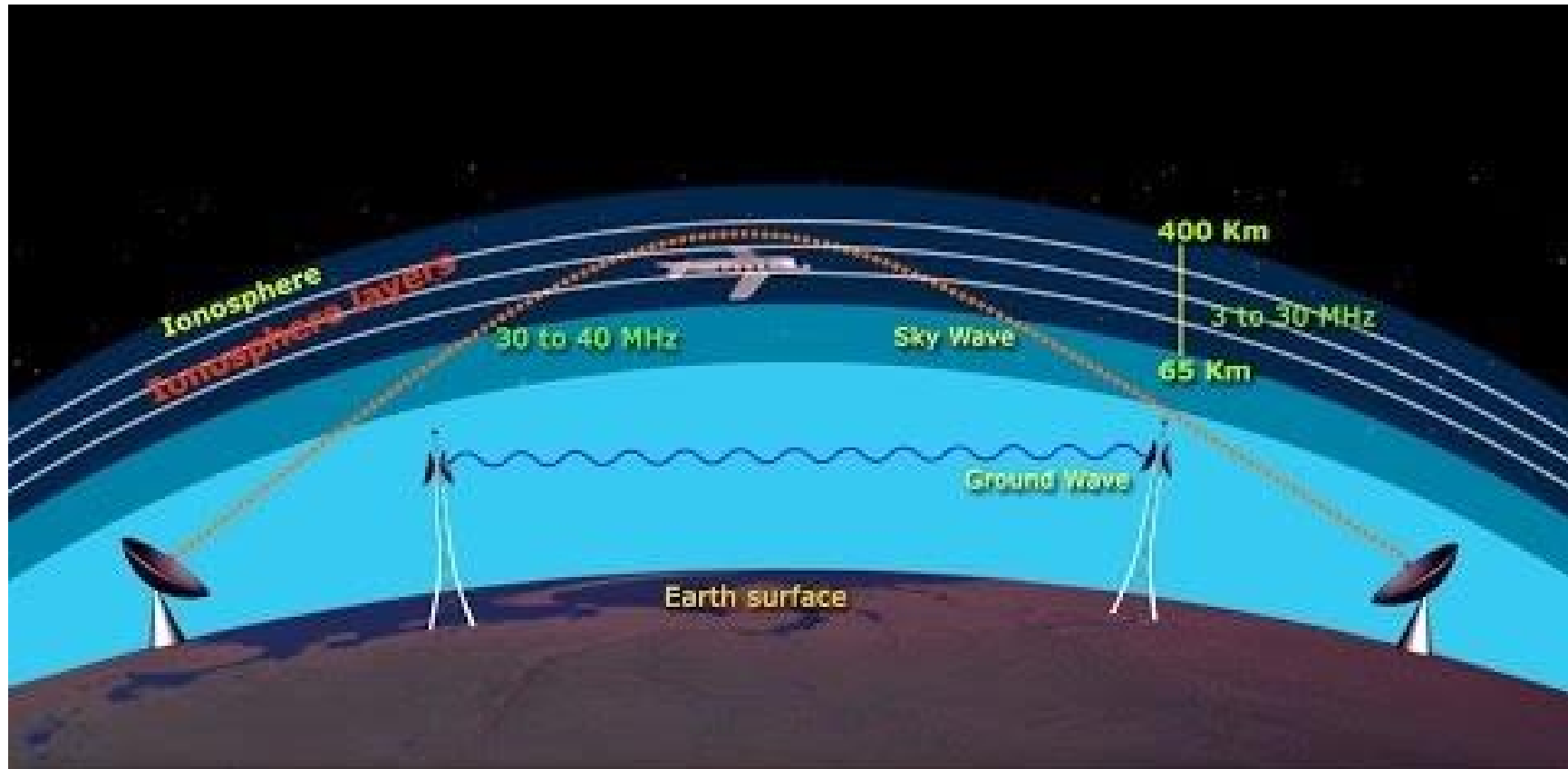


Figure D-4. HF skip zone and use of NVIS.

Tutorial (continued)

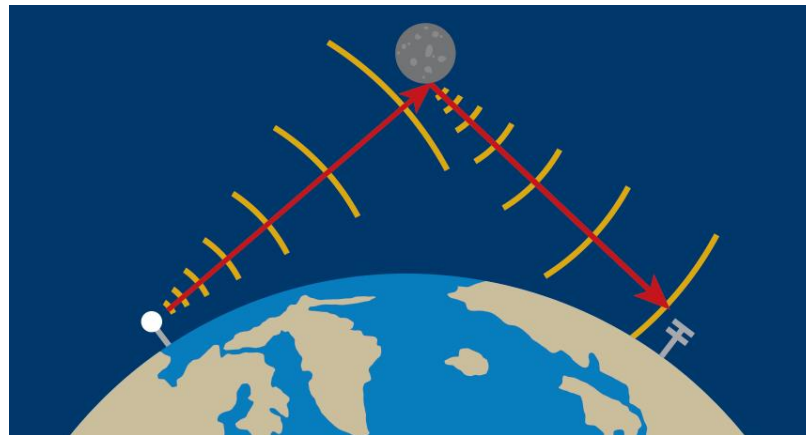


Tutorial (continued)



E3A – Radio Wave Propagation

- ” What is the approximate maximum separation measured along the surface of the Earth between two stations communicating by Moon bounce?
- . **12,000 miles, if the Moon is visible by both**



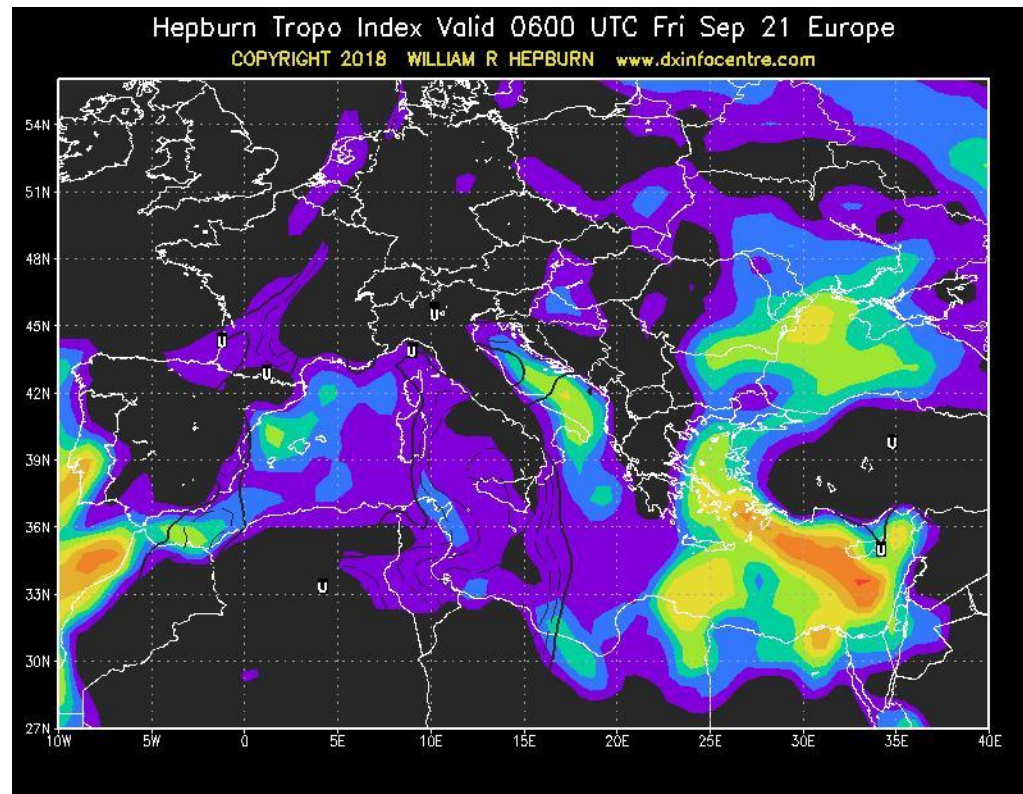
E3A – Radio Wave Propagation (continued)

- “ What characterizes libration fading of an EME signal?
 - . **A fluttery irregular fading**
- “ When scheduling EME contacts, which of these conditions will generally result in the least path loss?
 - . **When the Moon is at perigee**

E3A – Radio Wave Propagation (continued)

” What do Hepburn maps predict?

- . **Probability of tropospheric propagation**



E3A – Radio Wave Propagation (continued)

- “ Tropospheric propagation of microwave signals often occurs along what weather related structure?
 - . **Warm and cold fronts**
- “ Which of the following is required for microwave propagation via rain scatter?
 - . **The rain must be within radio range of both stations**

E3A – Radio Wave Propagation (continued)

- “ Atmospheric ducts capable of propagating microwave signals often form over what geographic feature?
 - . **Bodies of water**
- “ When a meteor strikes the Earth's atmosphere, a cylindrical region of free electrons is formed at what layer of the ionosphere?
 - . **The E layer**

E3A – Radio Wave Propagation (continued)

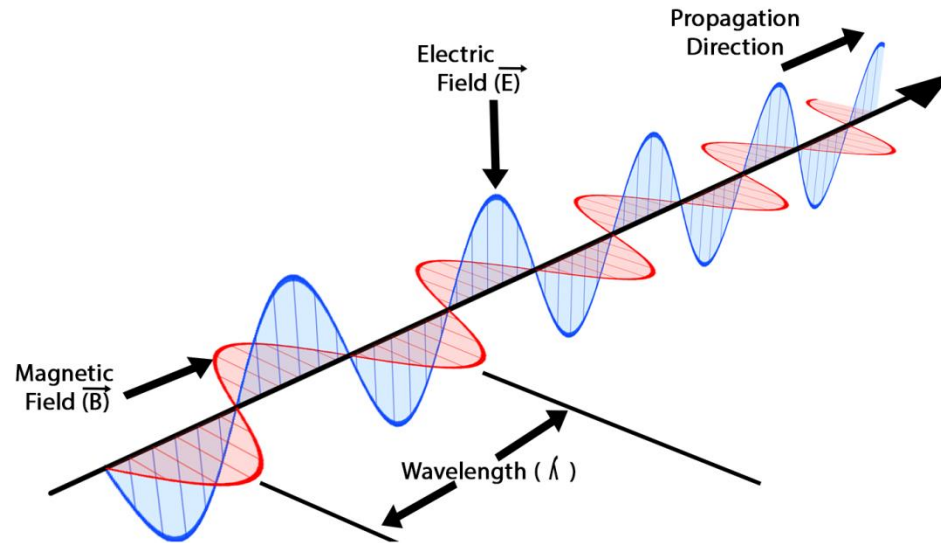
- “ Which of the following frequency range is most suited for meteor scatter communications?
 - . **28 MHz - 148 MHz**
- “ Which type of atmospheric structure can create a path for microwave propagation?
 - . **Temperature inversion**
- “ What is a typical range for tropospheric propagation of microwave signals?
 - . **100 miles to 300 miles**

E3A – Radio Wave Propagation (continued)

- “ What is the cause of auroral activity?
 - . **The interaction in the E layer of charged particles from the Sun with the Earth’s magnetic field**
- “ Which emission mode is best for aurora propagation?
 - . **CW**
- “ From the contiguous 48 states, in which approximate direction should an antenna be pointed to take maximum advantage of aurora propagation?
 - . **North**

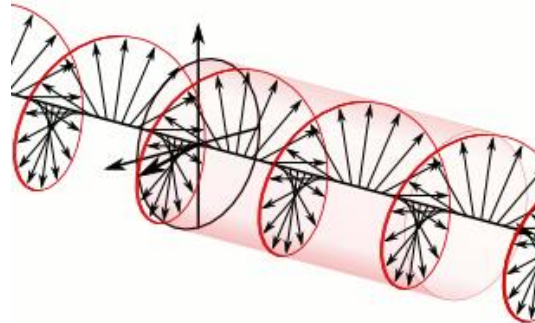
E3A – Radio Wave Propagation (continued)

- ” What is an electromagnetic wave?
- . **A wave consisting of an electric field and a magnetic field oscillating at right angles to each other**



E3A – Radio Wave Propagation (continued)

- “ Which of the following best describes electromagnetic waves traveling in free space?
 - . **Changing electric and magnetic fields propagate the energy**
- “ What is meant by circularly polarized electromagnetic waves?
 - . **Waves with a rotating electric field**



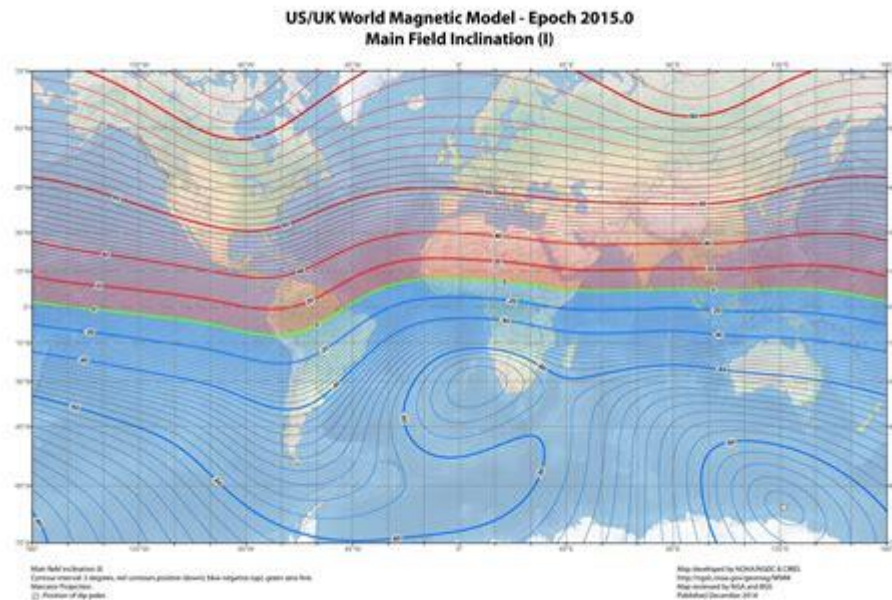
E3B – More Propagation and other modes

- “ Transequatorial propagation;
- “ long path;
- “ gray-line;
- “ multi-path;
- “ ordinary and extraordinary waves; and
- “ chordal hop, sporadic E mechanisms

E3B – Transequatorial Propagation (TEP)

” What is transequatorial propagation?

- . Propagation between two mid-latitude points at approximately the same distance north and south of the magnetic equator



E3B – Transequatorial Propagation (TEP)

- “ What is the approximate maximum range for signals using transequatorial propagation?
 - . **5000 miles**
- “ What is the best time of day for transequatorial propagation?
 - . **Afternoon or early evening**
- “ What is meant by the terms extraordinary and ordinary waves?
 - . **Independent waves created in the ionosphere that are elliptically polarized**

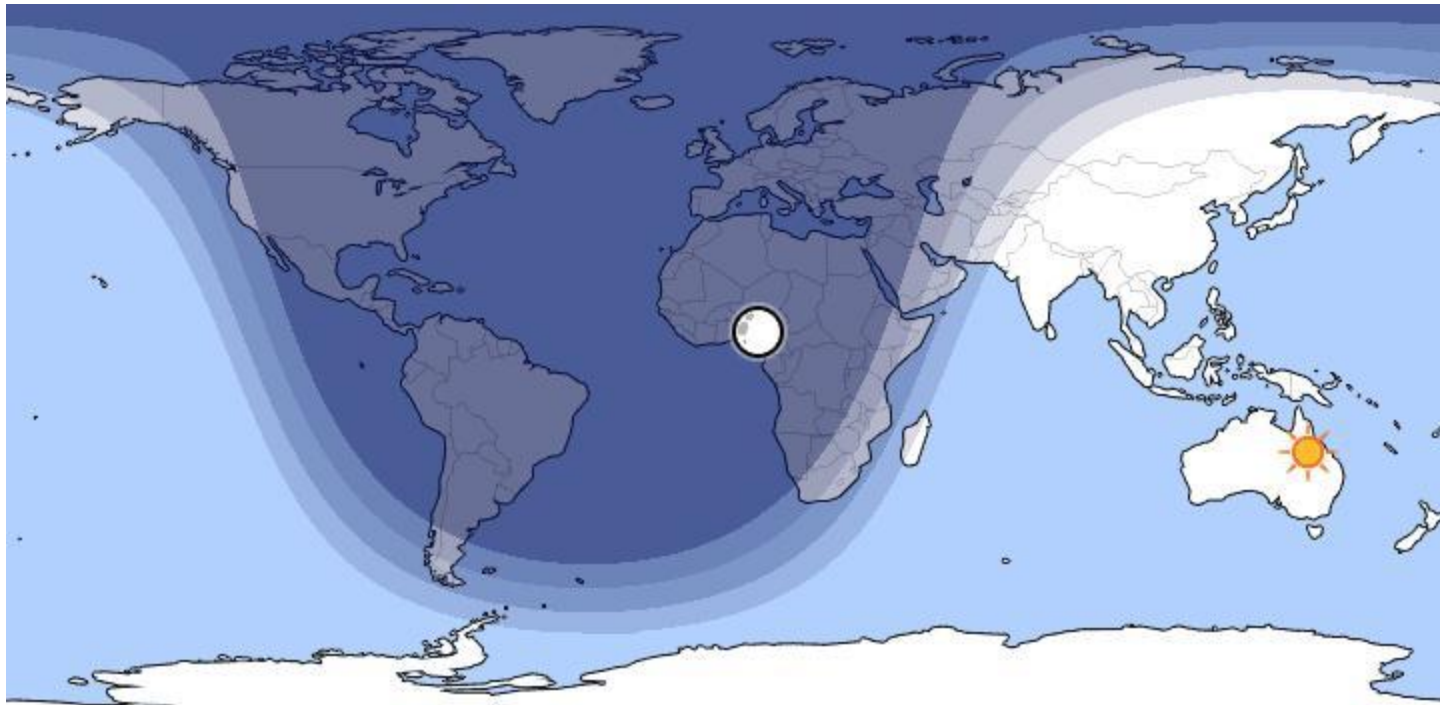
E3B – Long Path Propagation

- “ Which amateur bands typically support long-path propagation?
 - . **160 meters to 10 meters**
- “ Which of the following amateur bands most frequently provides long-path propagation?
 - . **20 meters**
- “ Which of the following could account for hearing an echo on the received signal of a distant station?
 - . **Receipt of a signal by more than one path**

E3B – Gray Line

- “ What type of HF propagation is probably occurring if radio signals travel along the terminator between daylight and darkness?
 - . **Gray-Line**
- “ What is the cause of gray-line propagation?
 - . **At twilight and sunrise, D-layer absorption is low while E-layer and F-layer propagation remains high**

E3B - Gray-line

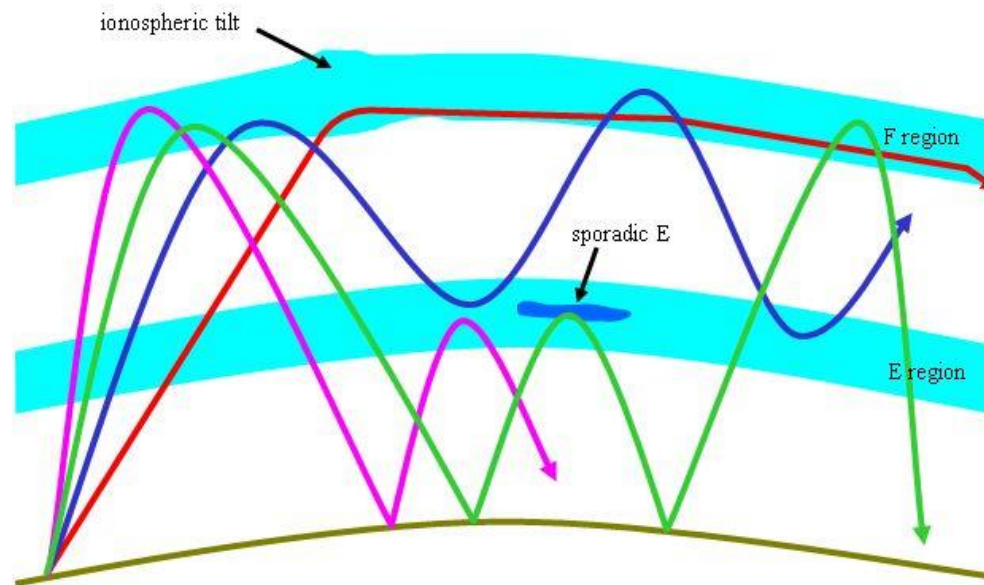


E3B – Sporadic E

- “ At what time of year is Sporadic E propagation most likely to occur?
 - . **Around the solstices, especially the summer solstice**
- “ At what time of day is Sporadic-E propagation most likely to occur?
 - . **Any time**

E3B – Chordal Hop

- ” What is the primary characteristic of chordal hop propagation?
- **Successive ionospheric reflections without an intermediate reflection from the ground**



E3B – Chordal Hop

- “ Why is chordal hop propagation desirable?
 - . **The signal experiences less loss along the path compared to normal skip propagation**
- “ What happens to linearly polarized radio waves that split into ordinary and extraordinary waves in the ionosphere?
 - . **They become elliptically polarized**

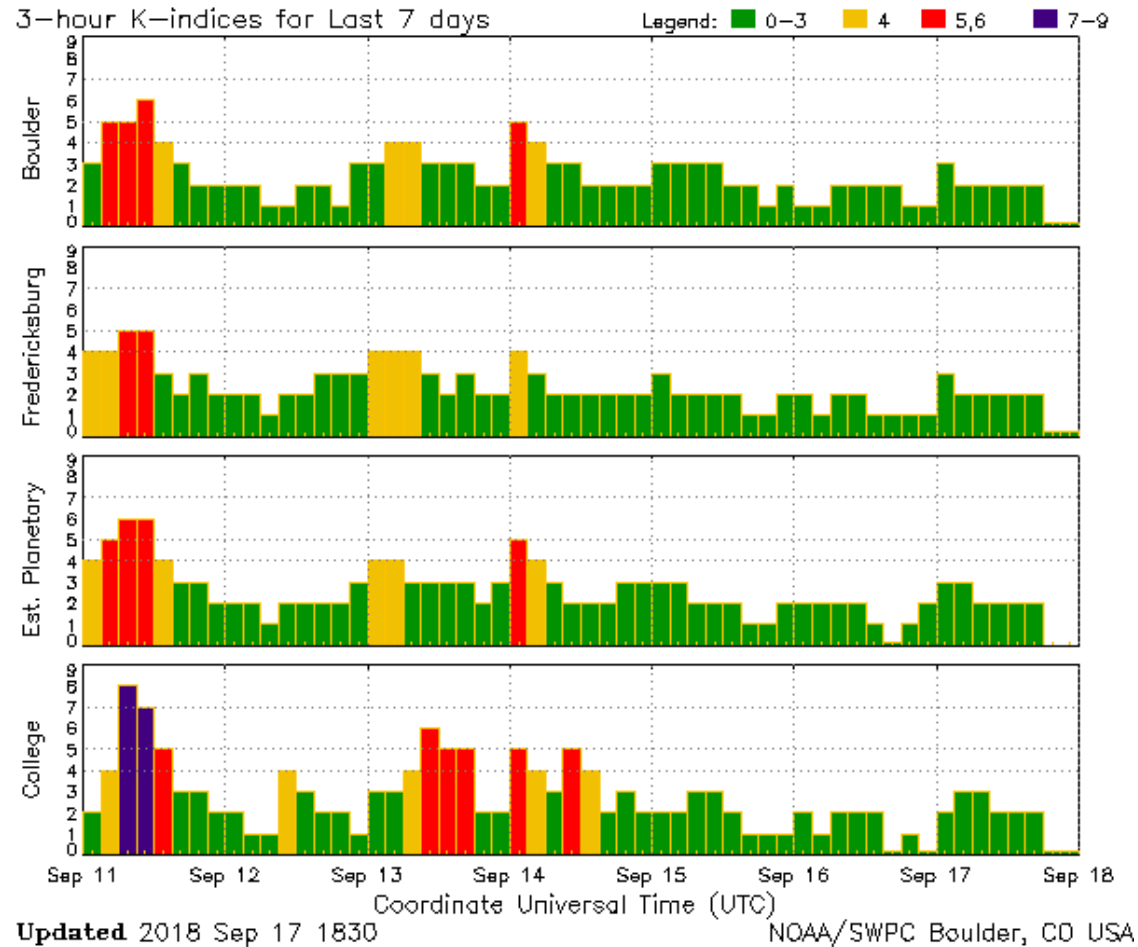
E3C

- “ Radio-path horizon;
- “ Less common propagation modes;
- “ Propagation prediction techniques and modeling; and
- “ Space weather parameters and amateur radio

E3C

- “ What does the term ray tracing describe in regard to radio communications?
 - . **Modeling a radio wave's path through the ionosphere**
- “ What is indicated by a rising A or K index?
 - . **Increasing disruption of the geomagnetic field**
- “ Which of the following signal paths is most likely to experience high levels of absorption when the A index or K index is elevated?
 - . **Polar paths**

E3C – A and K Index chart



E3C - continued

- “ What does the value of B_z ($B_{\text{sub } Z}$) represent?
 - . **Direction and strength of the interplanetary magnetic field**
- “ What orientation of B_z ($B_{\text{sub } z}$) increases the likelihood that incoming particles from the Sun will cause disturbed conditions?
 - . **Southward**

E3C – Solar Flare

- “ By how much does the VHF/UHF radio horizon distance exceed the geometric horizon?
 - . **By approximately 15 percent of the distance**
- “ Which of the following descriptors indicates the greatest solar flare intensity?
 - . **Class X**

E3C – Solar Flare (continued)

- “ What does the space weather term G5 mean?
 - . **An extreme geomagnetic storm**
- “ How does the intensity of an X3 flare compare to that of an X2 flare?
 - . **Twice as great**
- “ What does the 304A solar parameter measure?
 - . **UV emissions at 304 angstroms, correlated to solar flux index**

E3C – Solar Flare (continued)

- “ What does VOACAP software model?
 - . **HF propagation**
- “ How does the maximum distance of ground-wave propagation change when the signal frequency is increased?
 - . **It decreases**
- “ What type of polarization is best for ground-wave propagation?
 - . **Vertical**

E3C – Solar Flare (continued)

- “ Why does the radio-path horizon distance exceed the geometric horizon?
 - . **Downward bending due to density variations in the atmosphere**
- “ What might a sudden rise in radio background noise indicate?
 - . **A solar flare has occurred**

Done for tonight

- “ For next week:
 - . Review exam test pool E3A-E3C.
 - . We will discuss E4 – Amateur Practices.
- “ Questions, Comments?