PPL Theory
Aeronautical Radio Operation

CAE Oxford
Aviation Academy

RARO 1 – Radio Wave Propagation

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2. Related Documents

Related Documents	Document Identification

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Amendments made to this document since the previous version are listed below. All amendments to this document have been made in accordance with CAE OAAM's document management procedure.

Slide	Changes

CHARACTERISTICS OF RADIO WAVES

Radio Waves vs. Sound Waves

- What is the purpose of the radio?

Sound Waves	Radio Waves

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- Note: Both types of waves can be attenuated (weakened)

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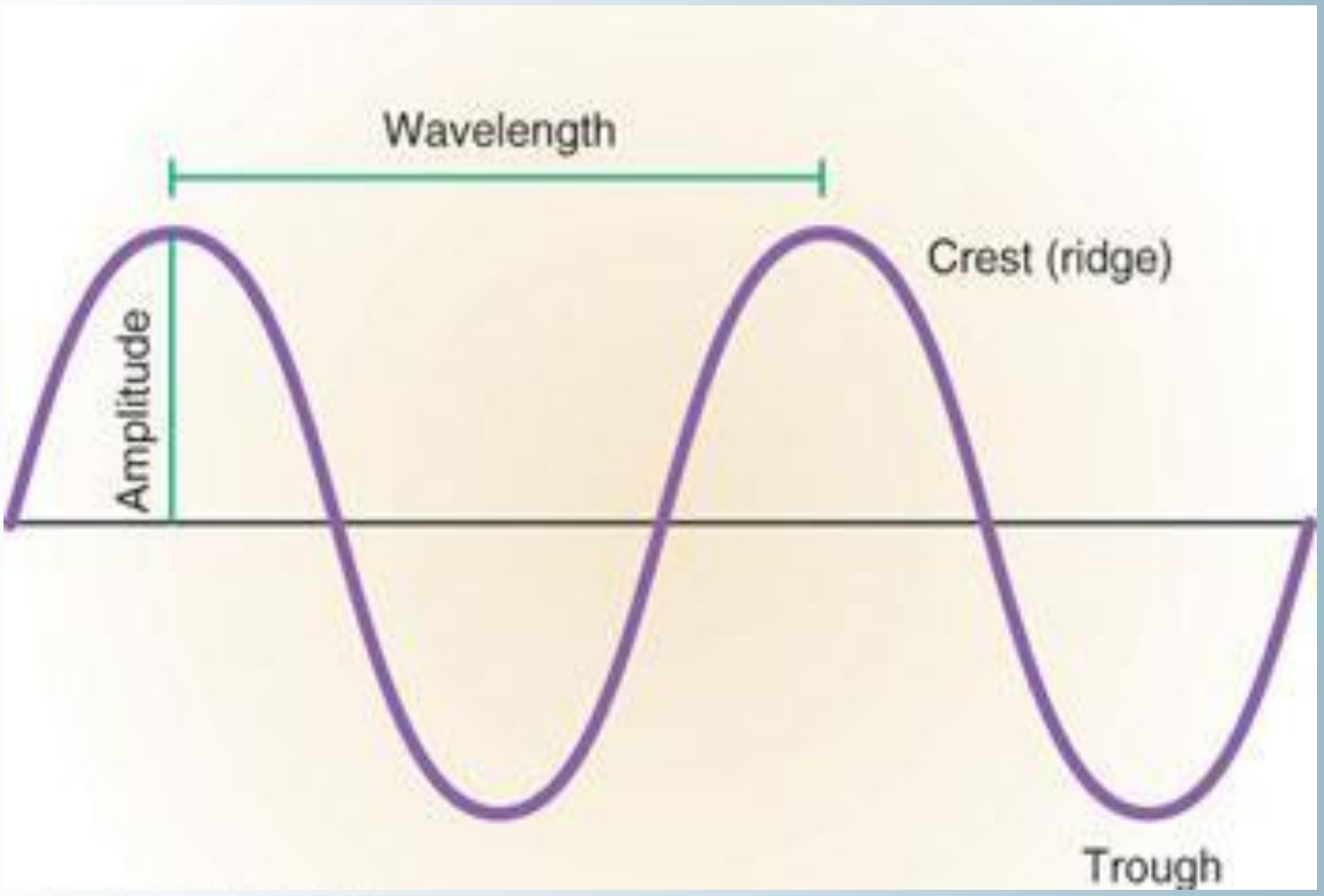
- Increases our situational awareness as we can hear what others are doing
- Allows quick communication with ground stations that can assist us in certain in-flight emergencies

Frequency Bands



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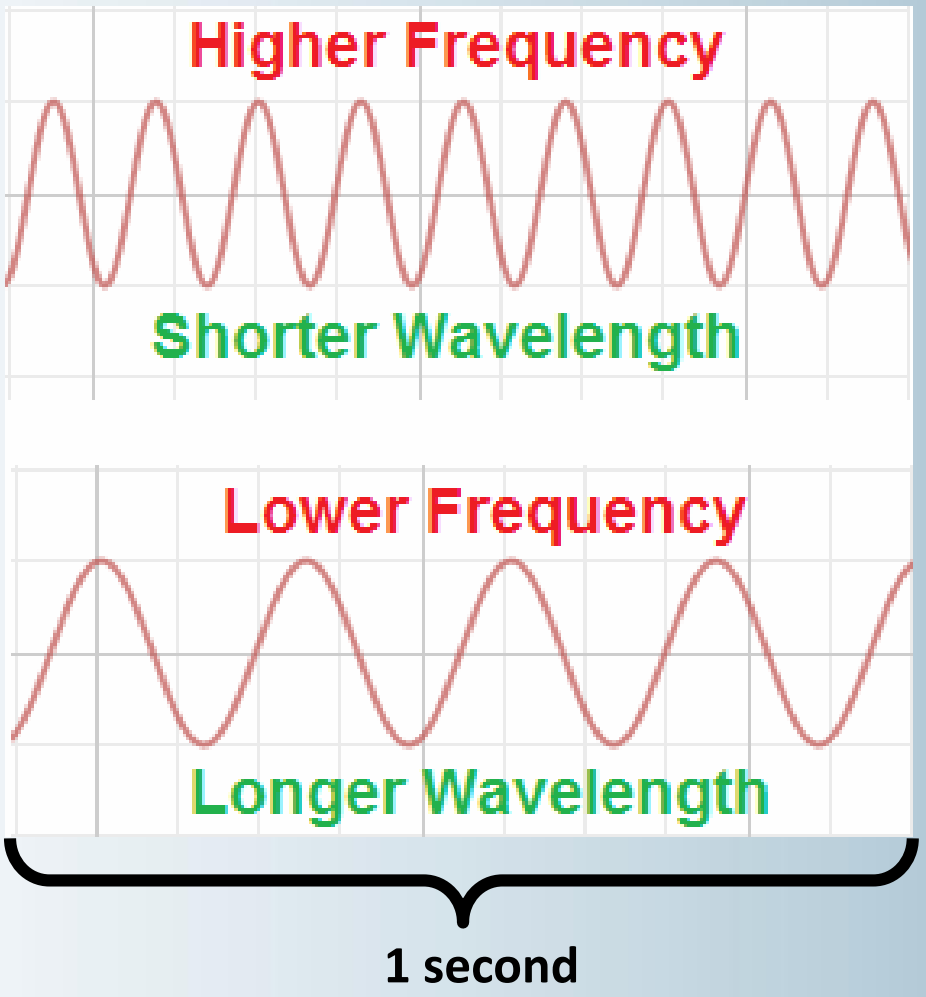

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Super High Frequency (SHF)	3 GHz – 30 GHz	Not commonly used in aviation
Extra High Frequency (EHF)	30 GHz – 300 GHz	

QUESTIONS/COMMENTS?

WAVE PROPAGATION

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- The degree to which radio waves are affected by a medium is dependent on their frequency

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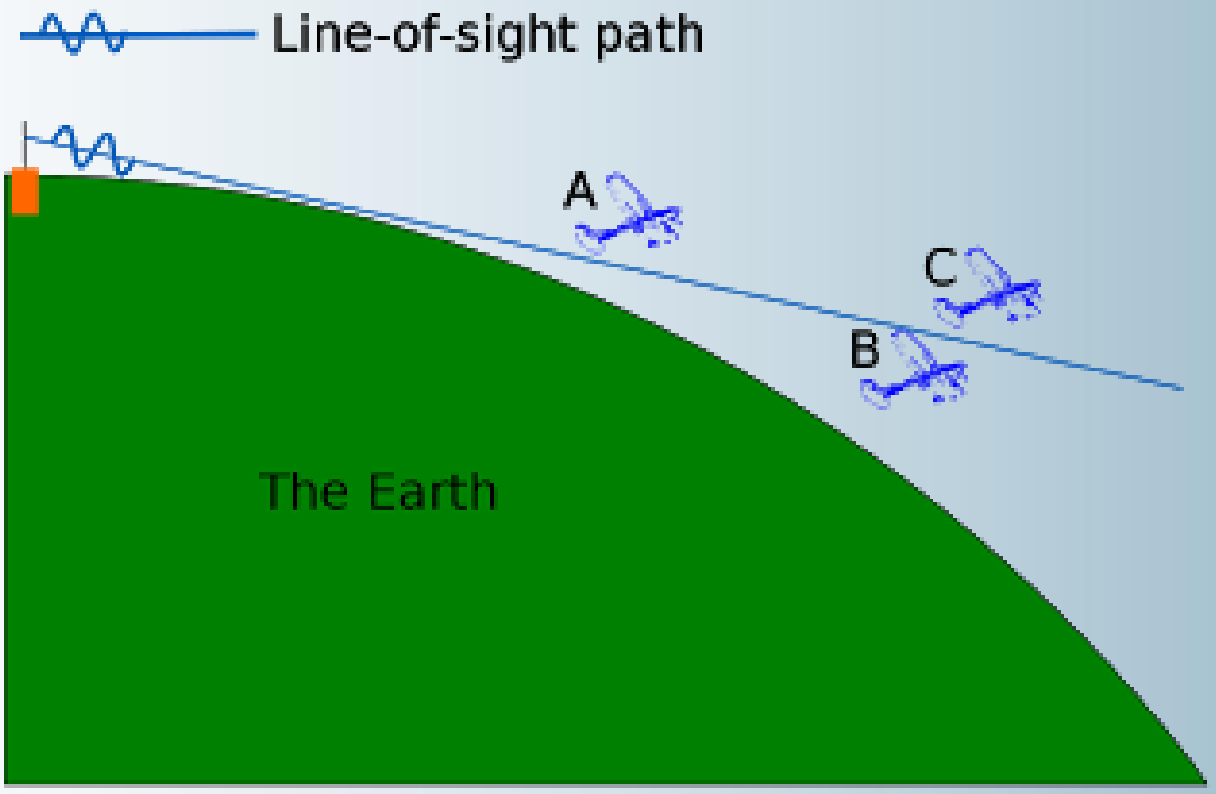

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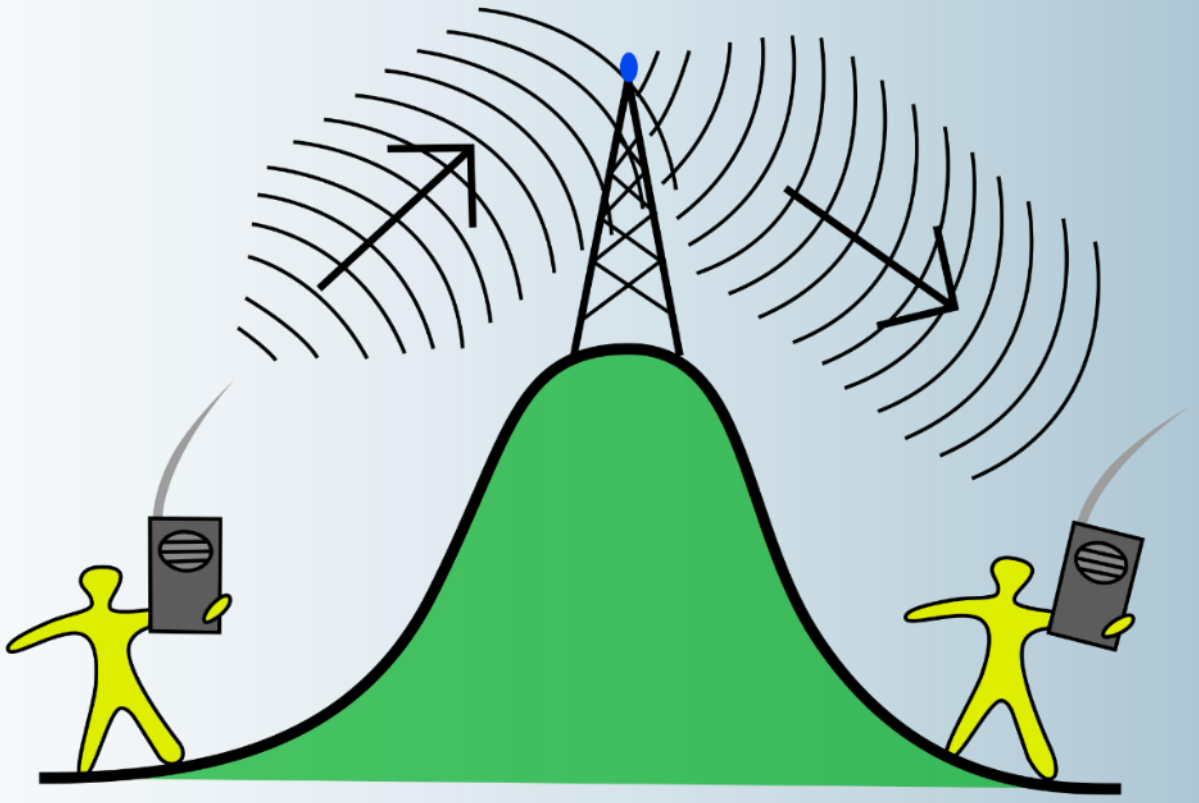
- **Is there any way to extend VHF coverage beyond line of sight?**

Wave Propagation – Reflection



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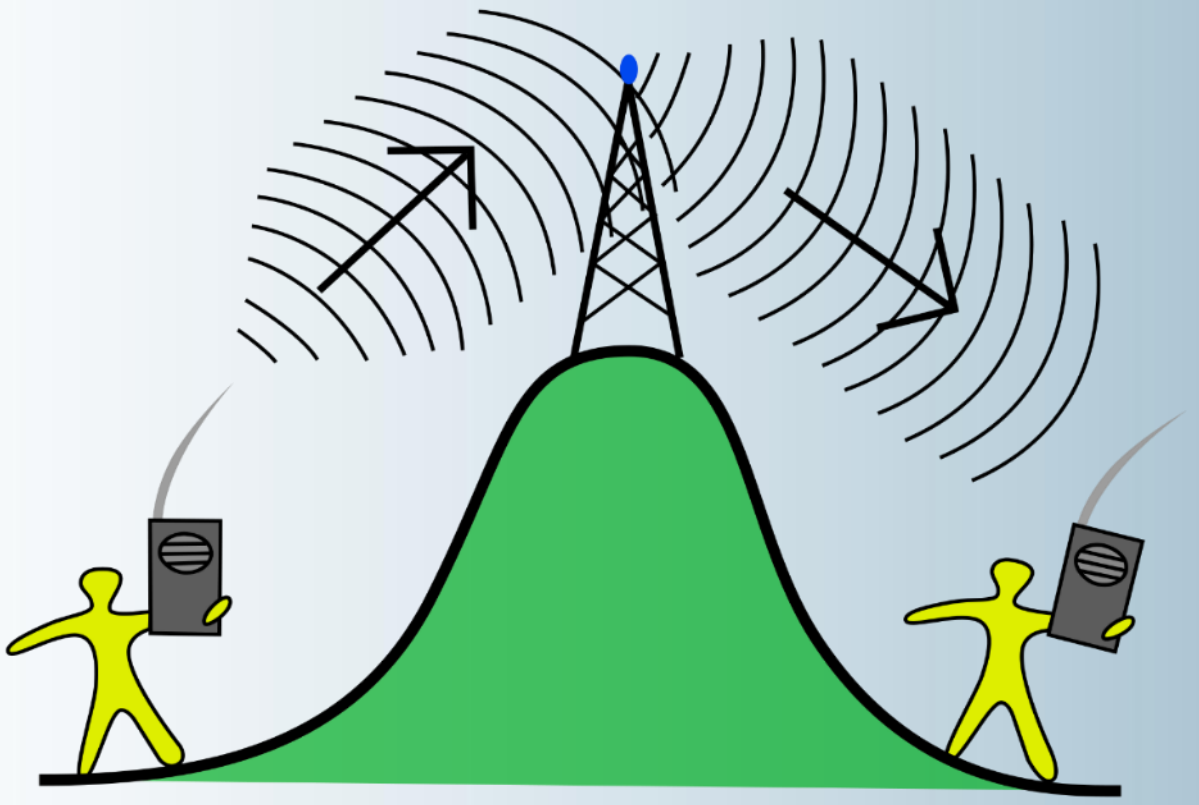
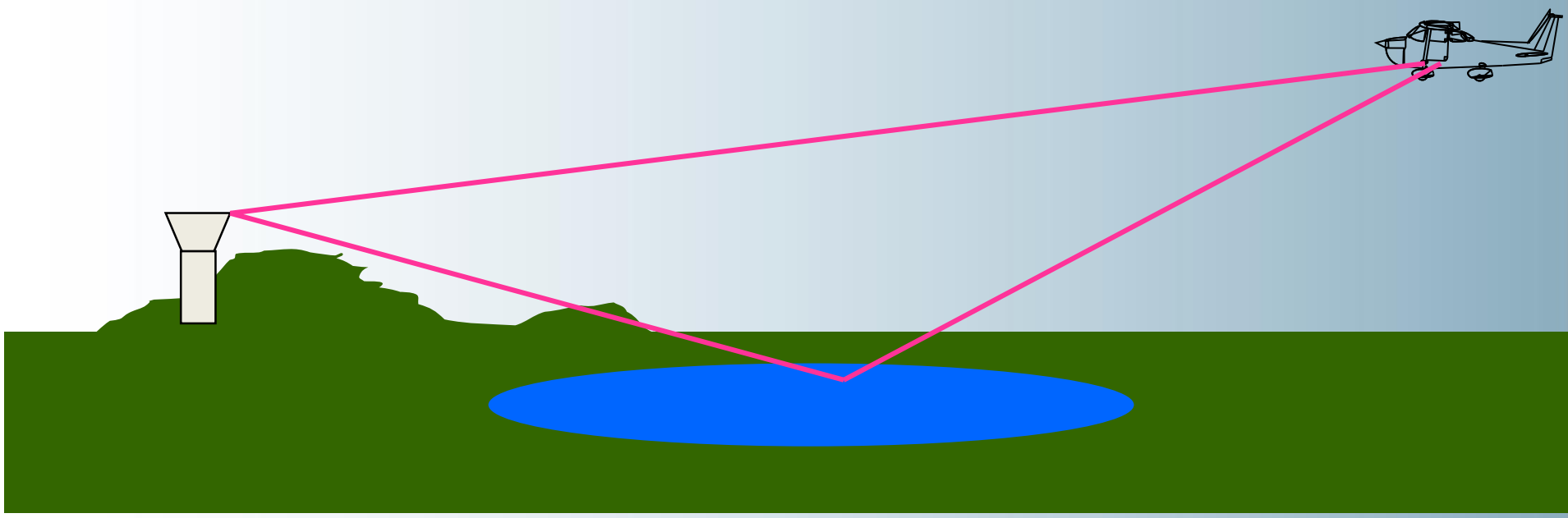
- Space Waves may be reflected off a repeater station to extend beyond line of sight coverage



Wave Propagation – Phase Comparison



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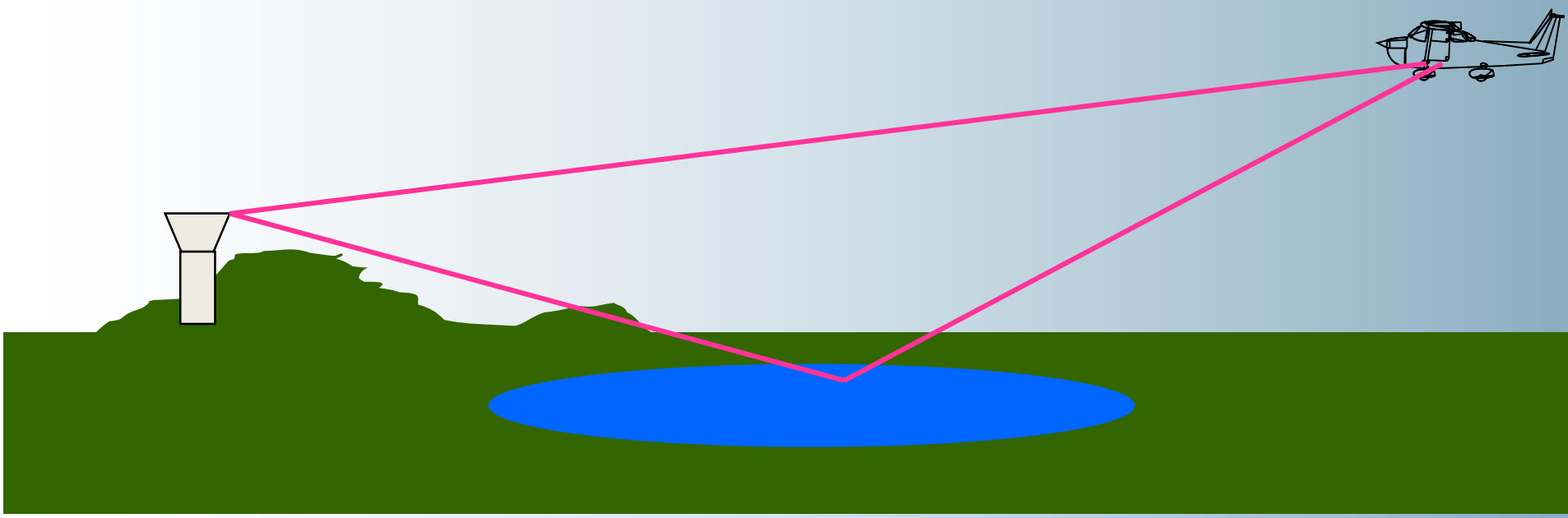

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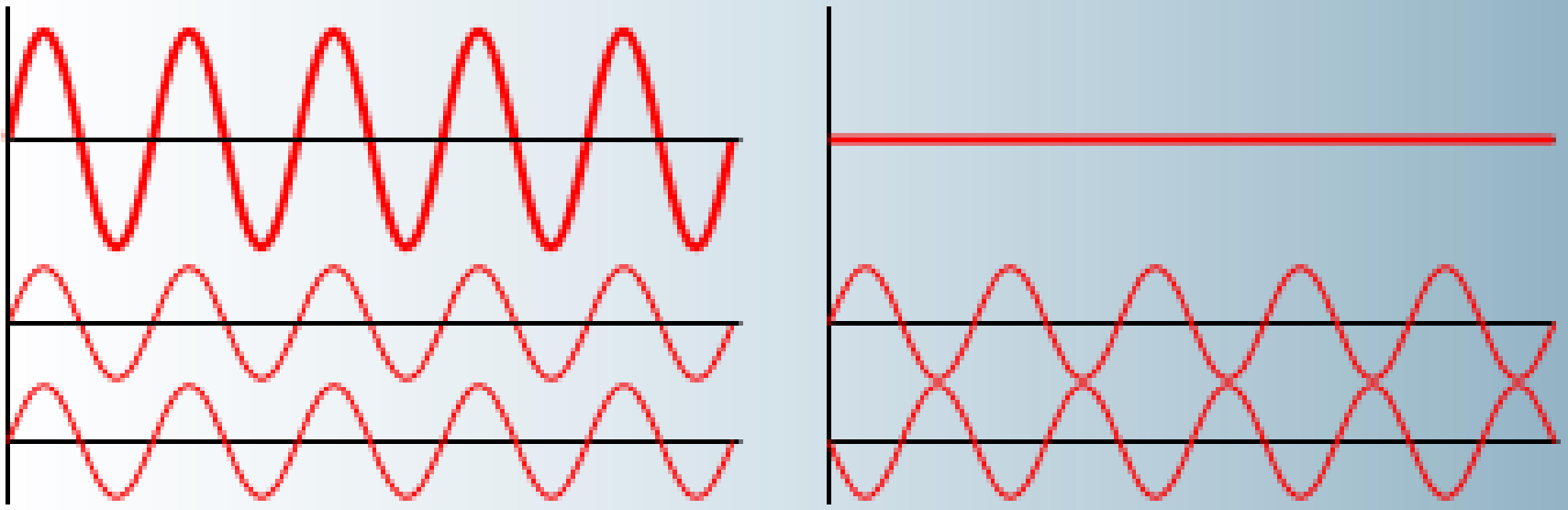

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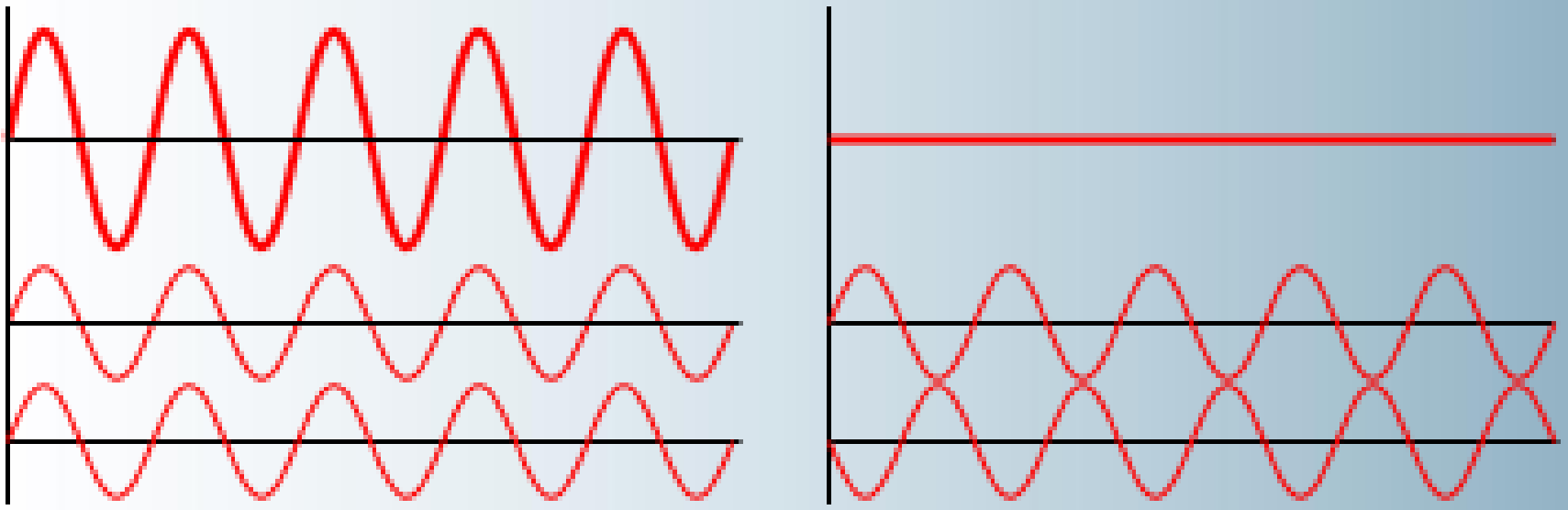

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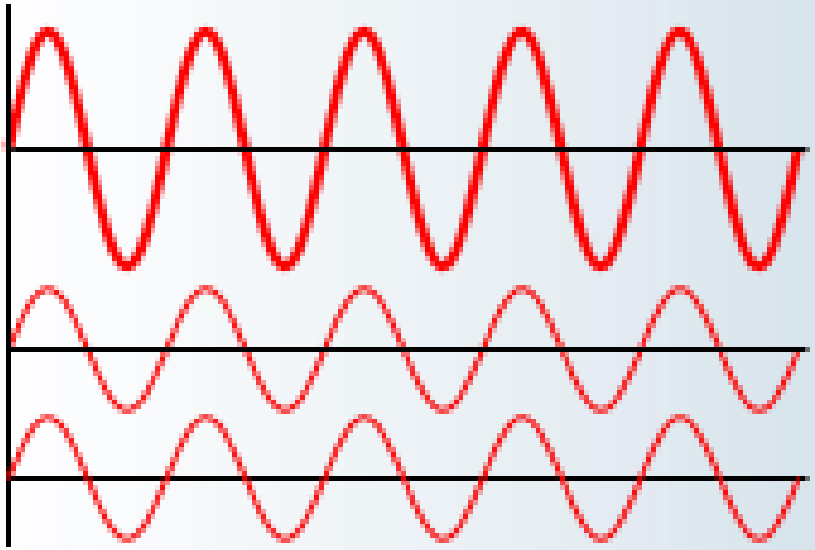

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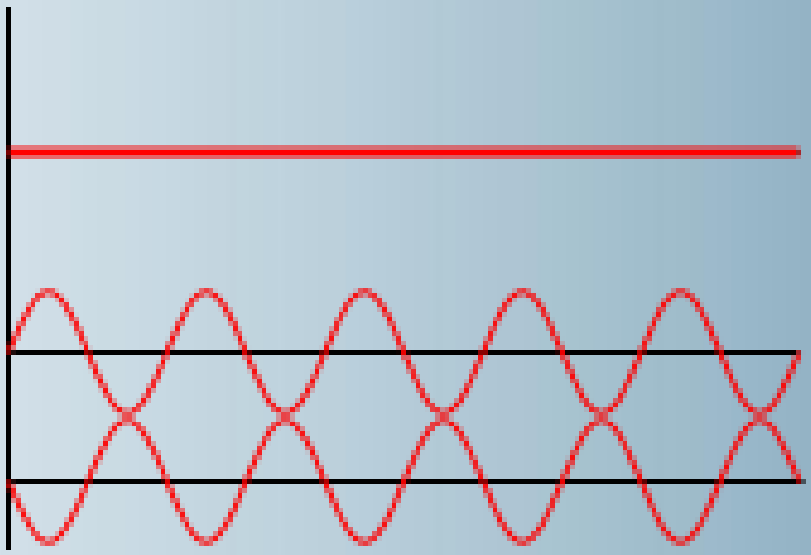

Anti-phase: Signal cancels out completely

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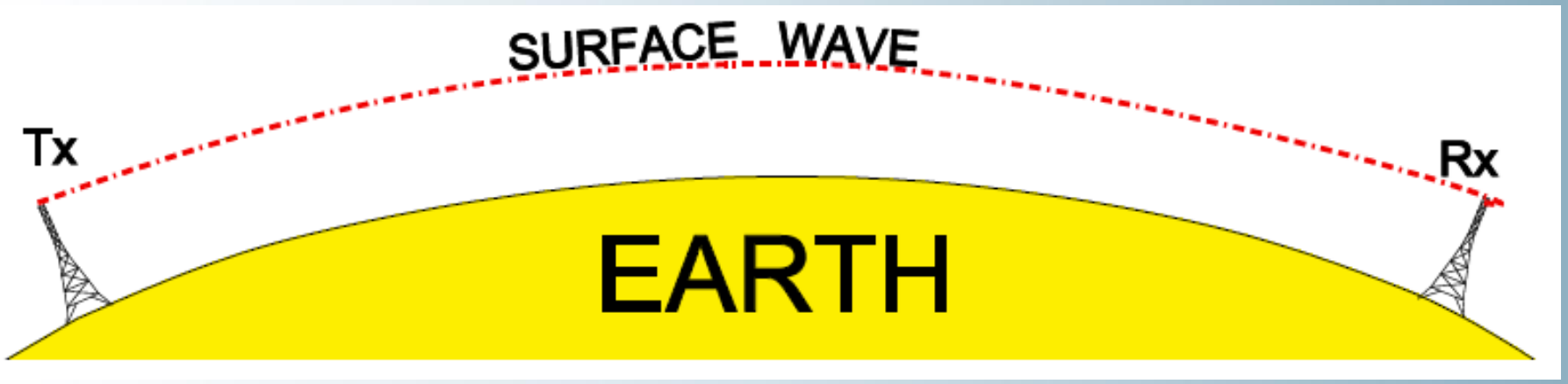

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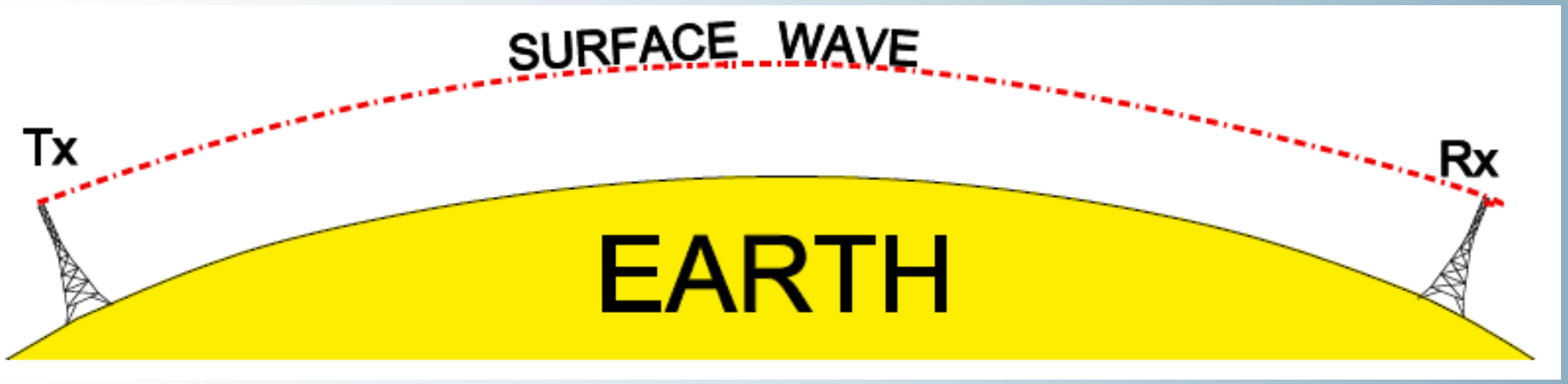

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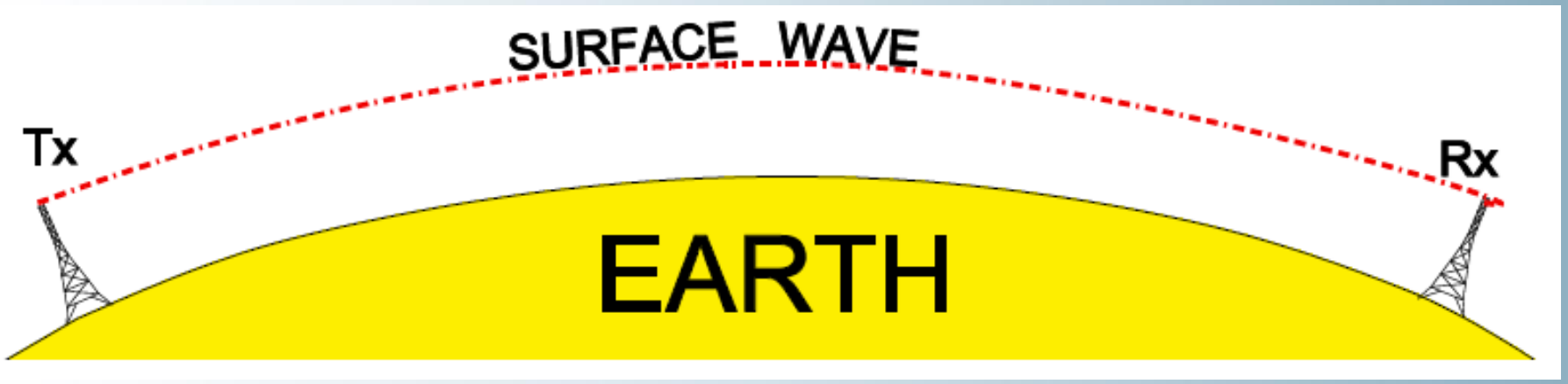

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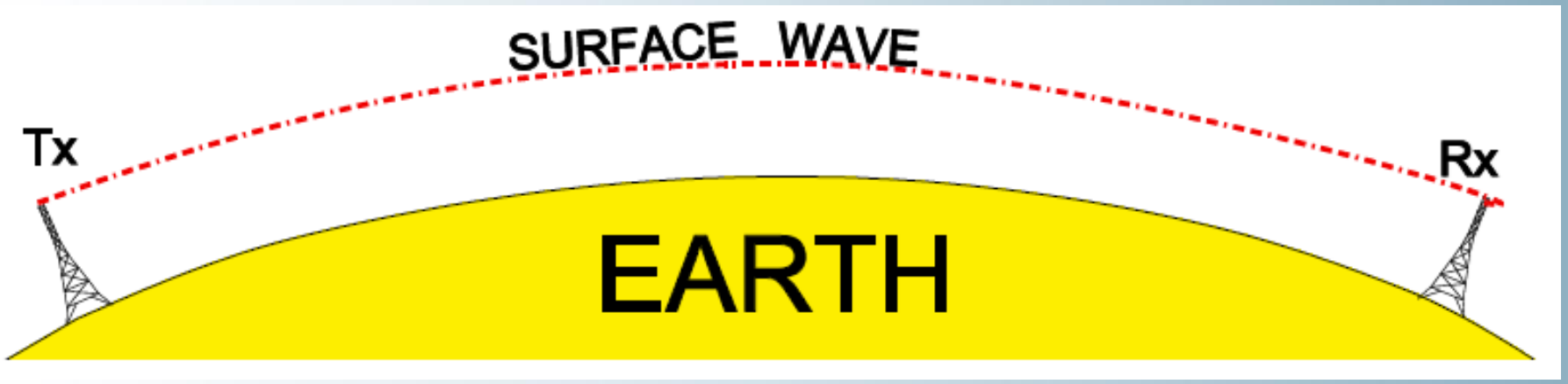

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- **Typically LF and MF, but can be as high as 3 MHz (HF)**

QUESTIONS/COMMENTS?

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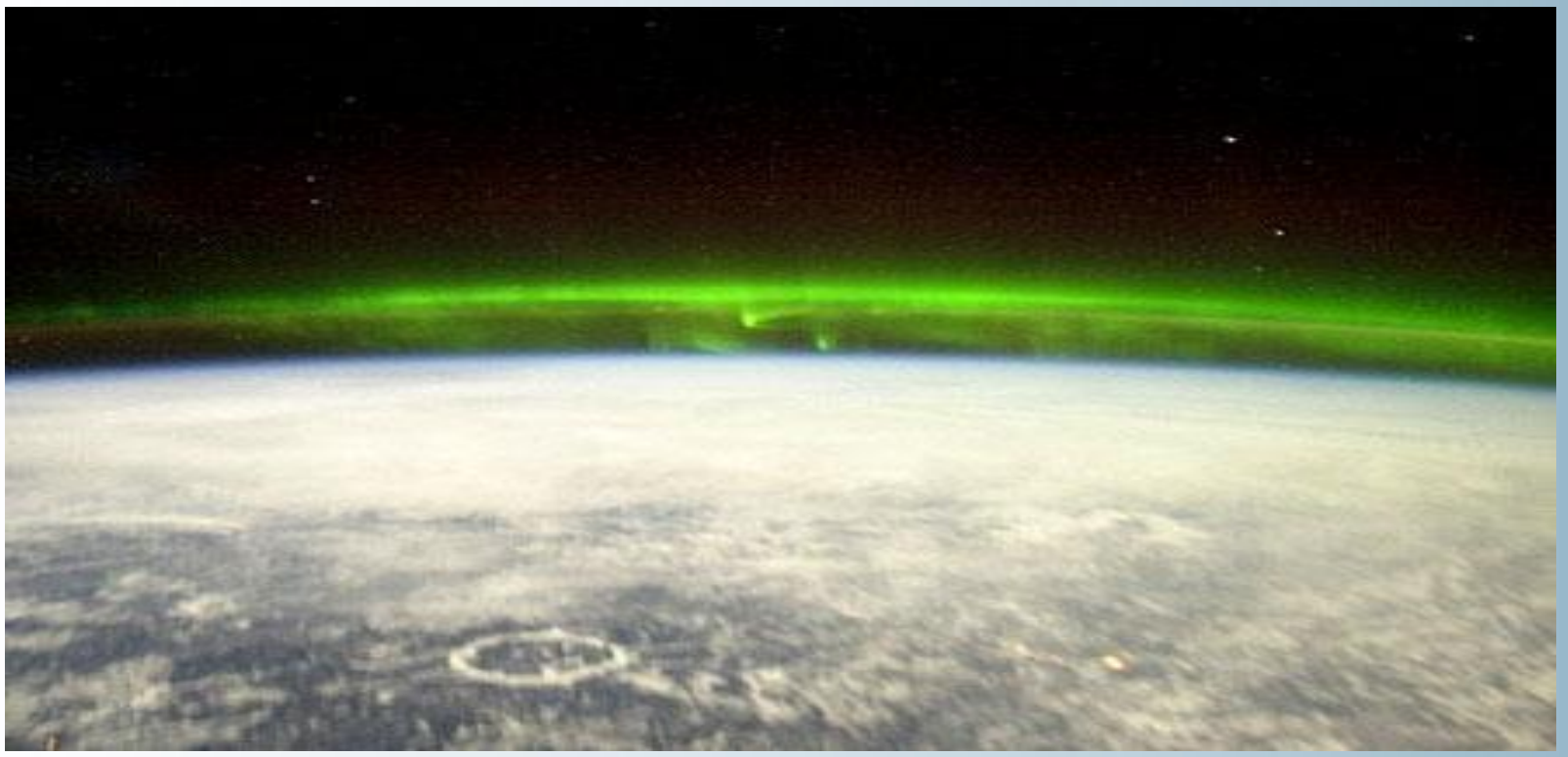

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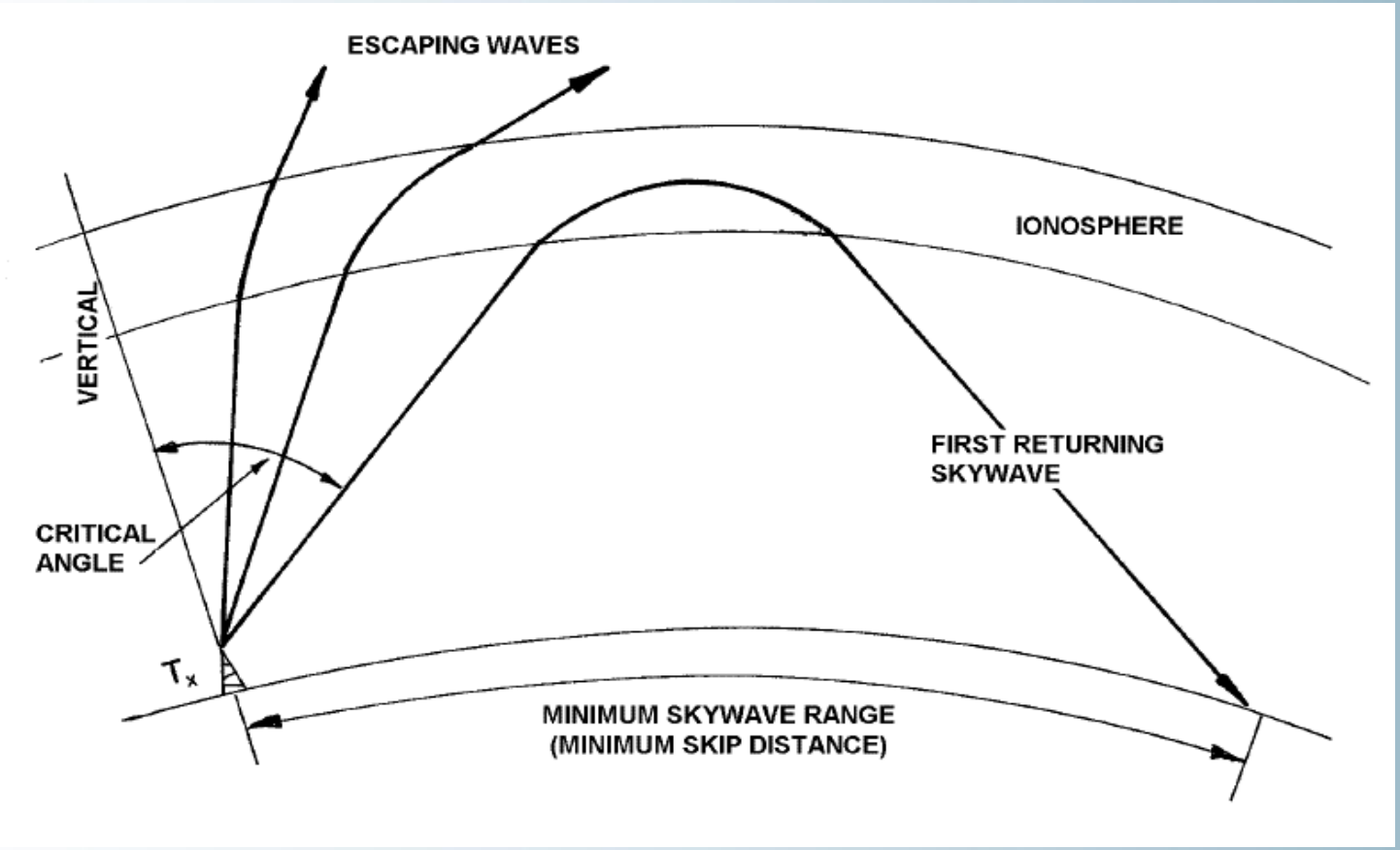

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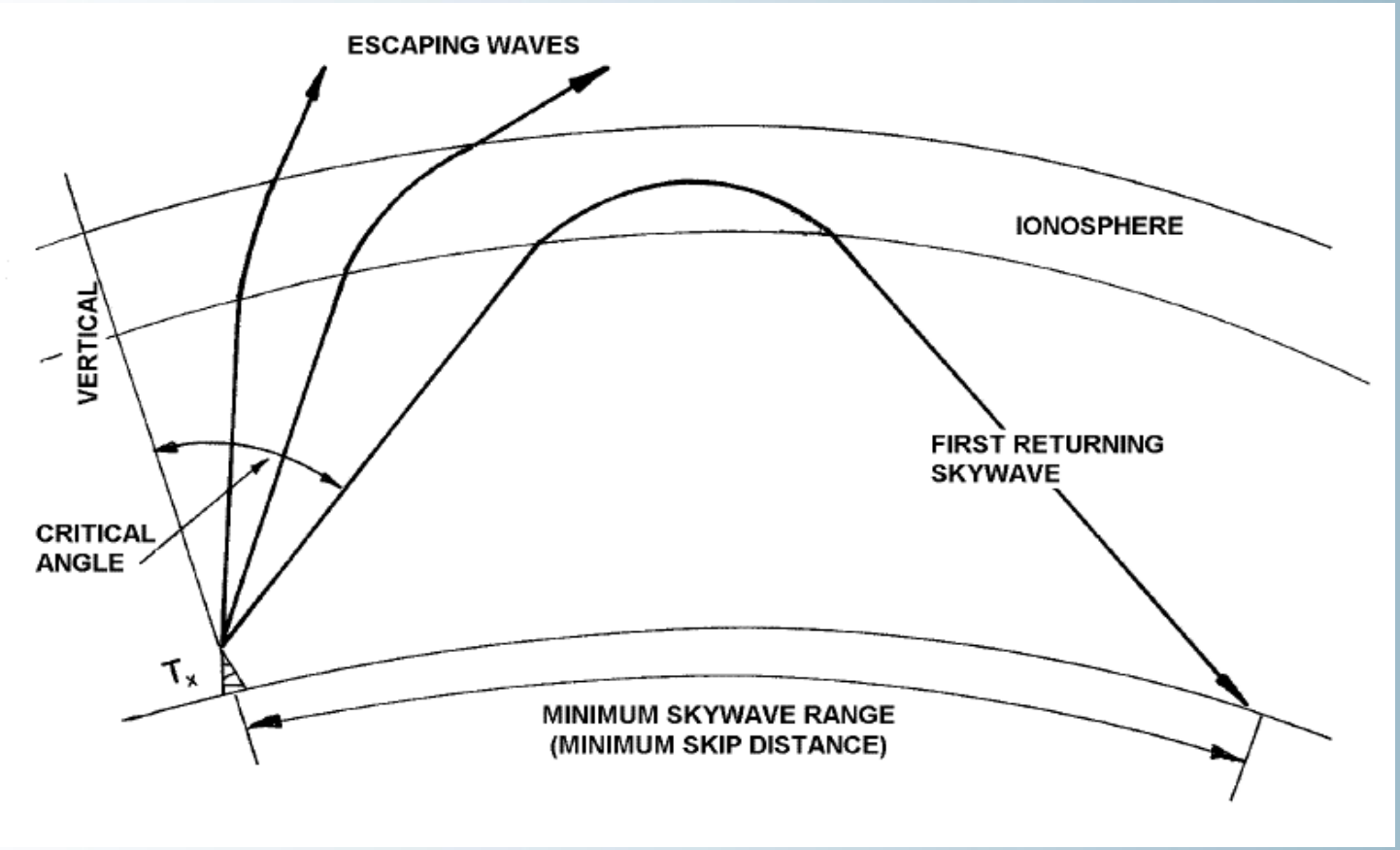

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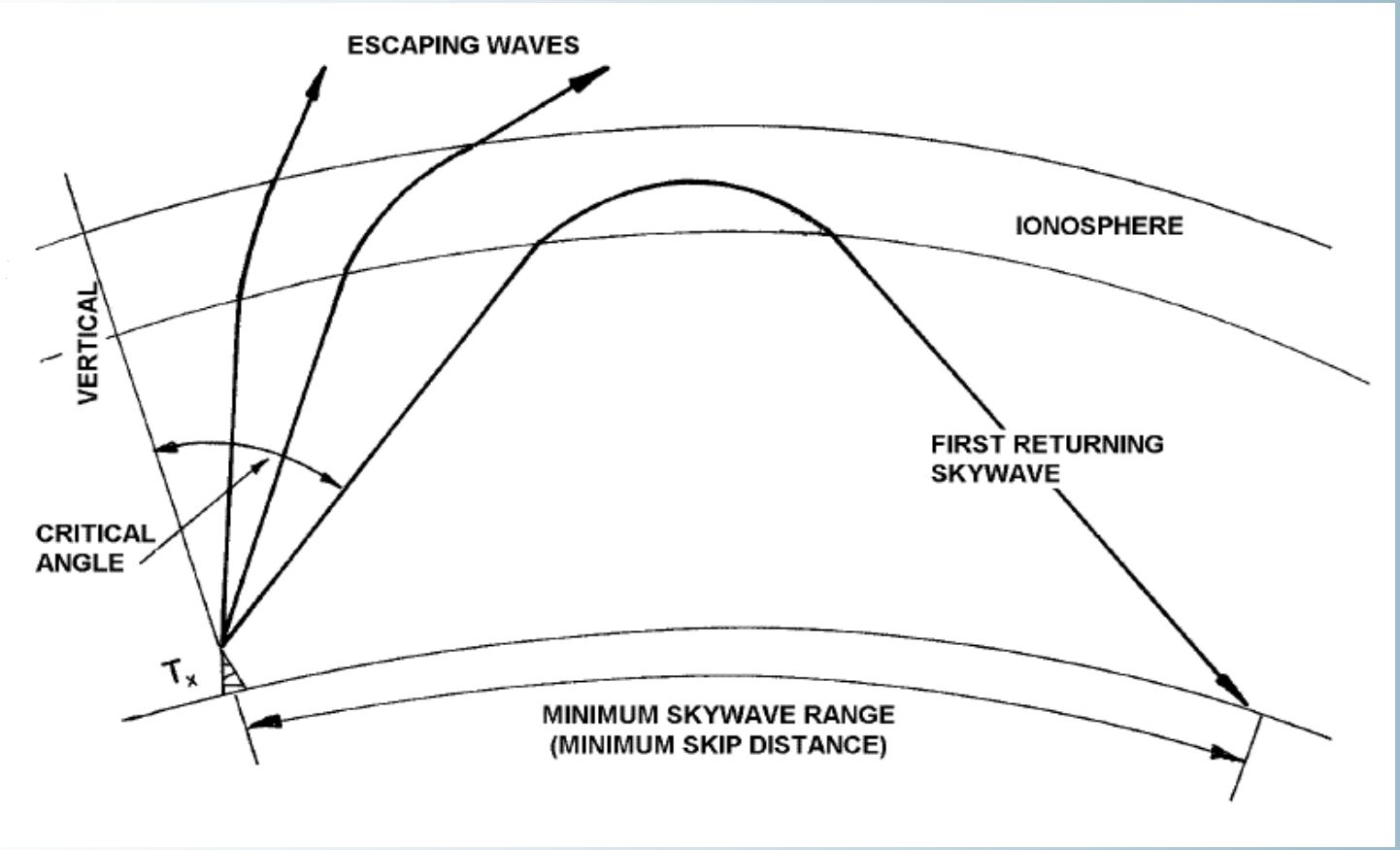

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- However, at a certain angle, waves will begin to be refracted in such a way that they are reflected back to earth

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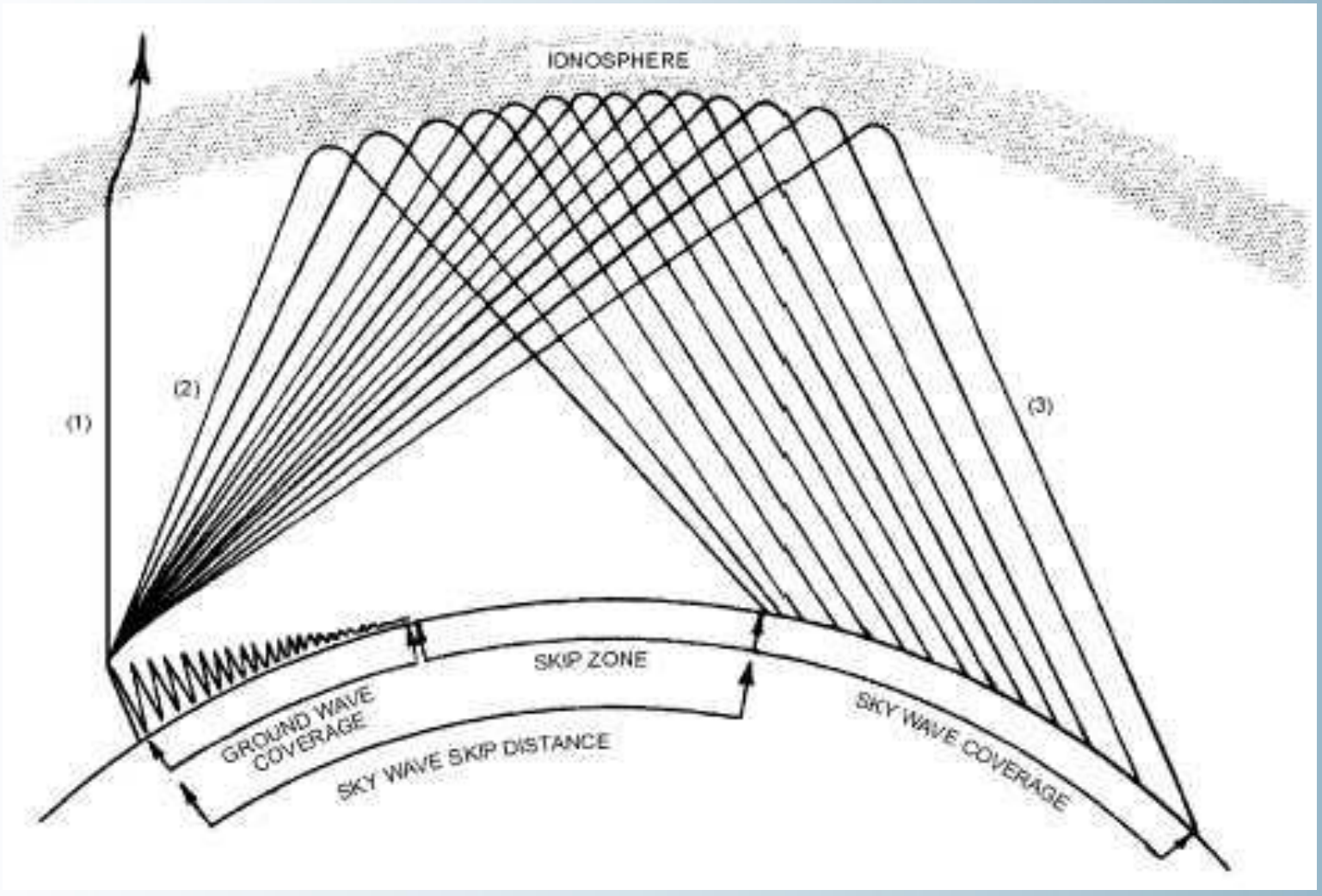

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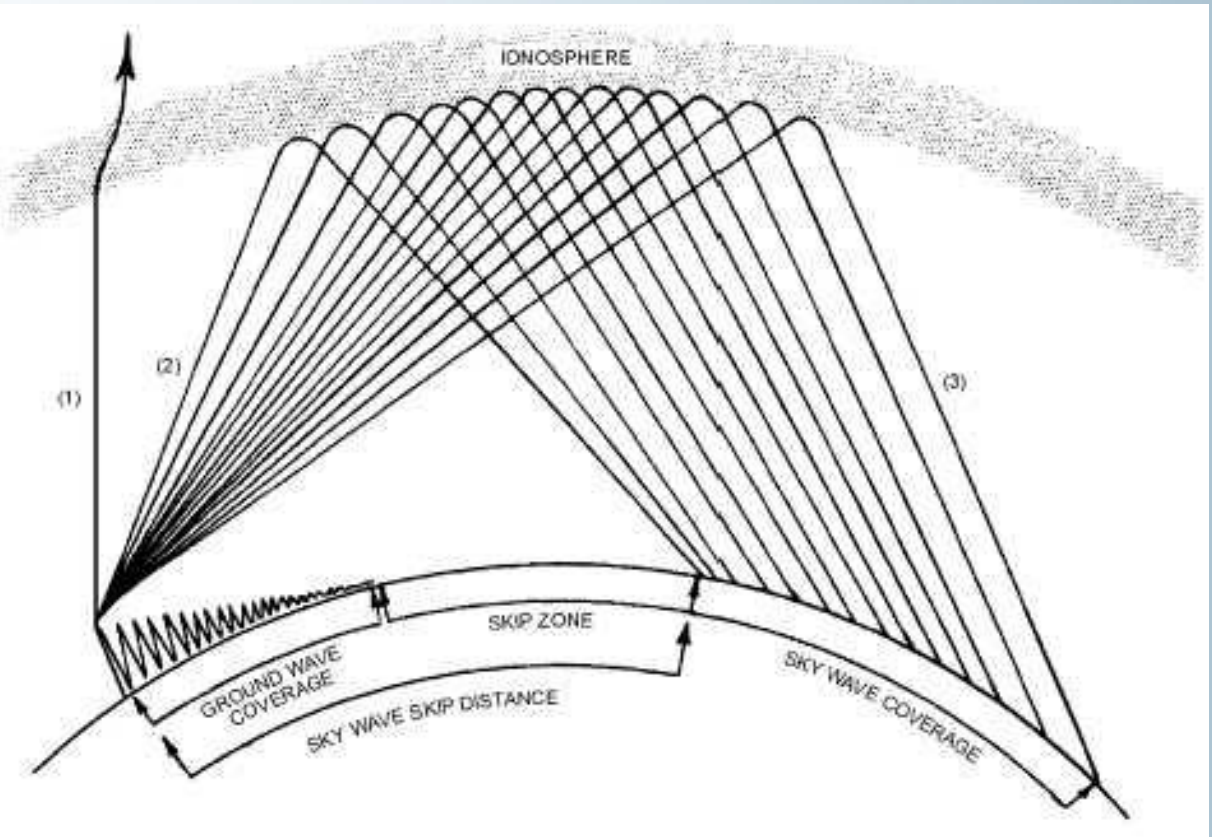

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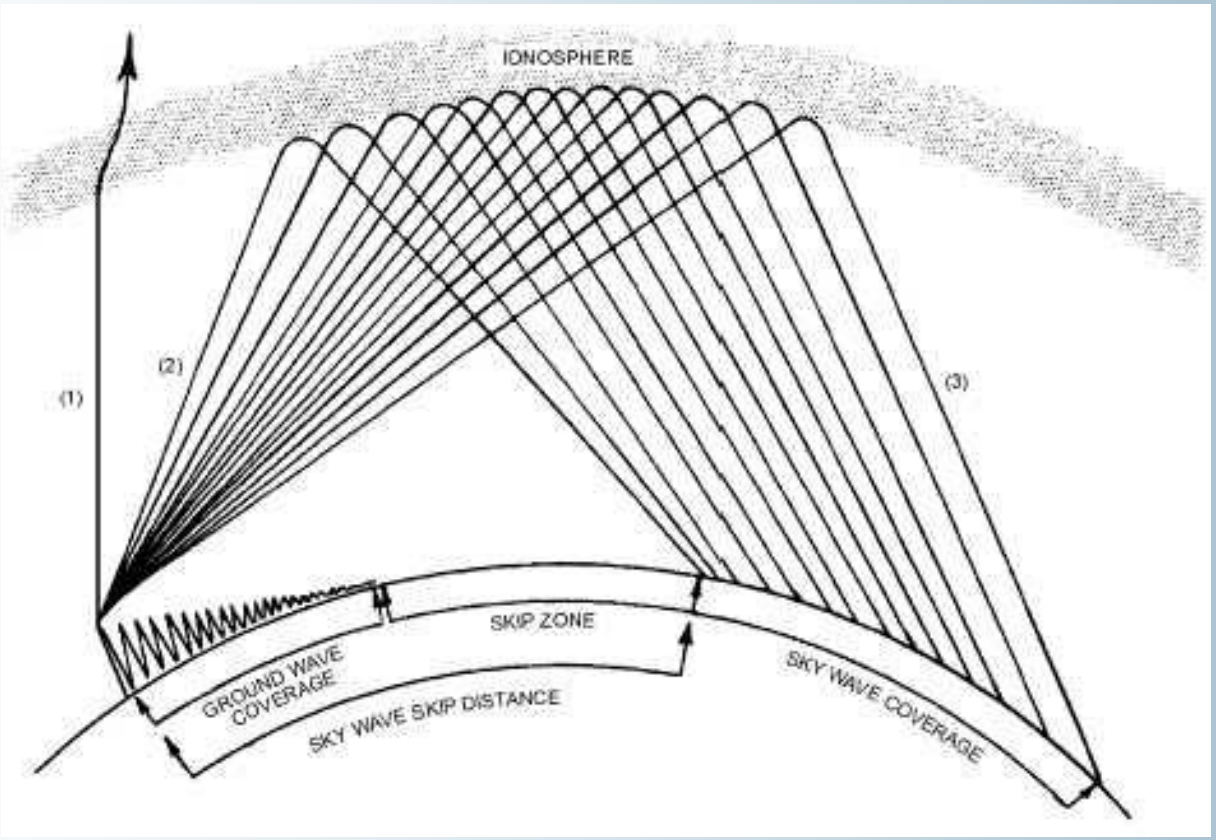

- Reflection off the ionosphere allows radio range to extend as much as 3,000nm
- **High Frequency Band (long range communications)**

Wave Propagation – Summary

Frequency Band	Propagation Path
LF	Surface Wave (Groundwave)
MF	Surface Wave (Groundwave)
HF	Sky Wave
VHF	Space Wave (Direct Wave)

QUESTIONS/COMMENTS?

FACTORS AFFECTING RECEPTION

Factors affecting Wave Propagation

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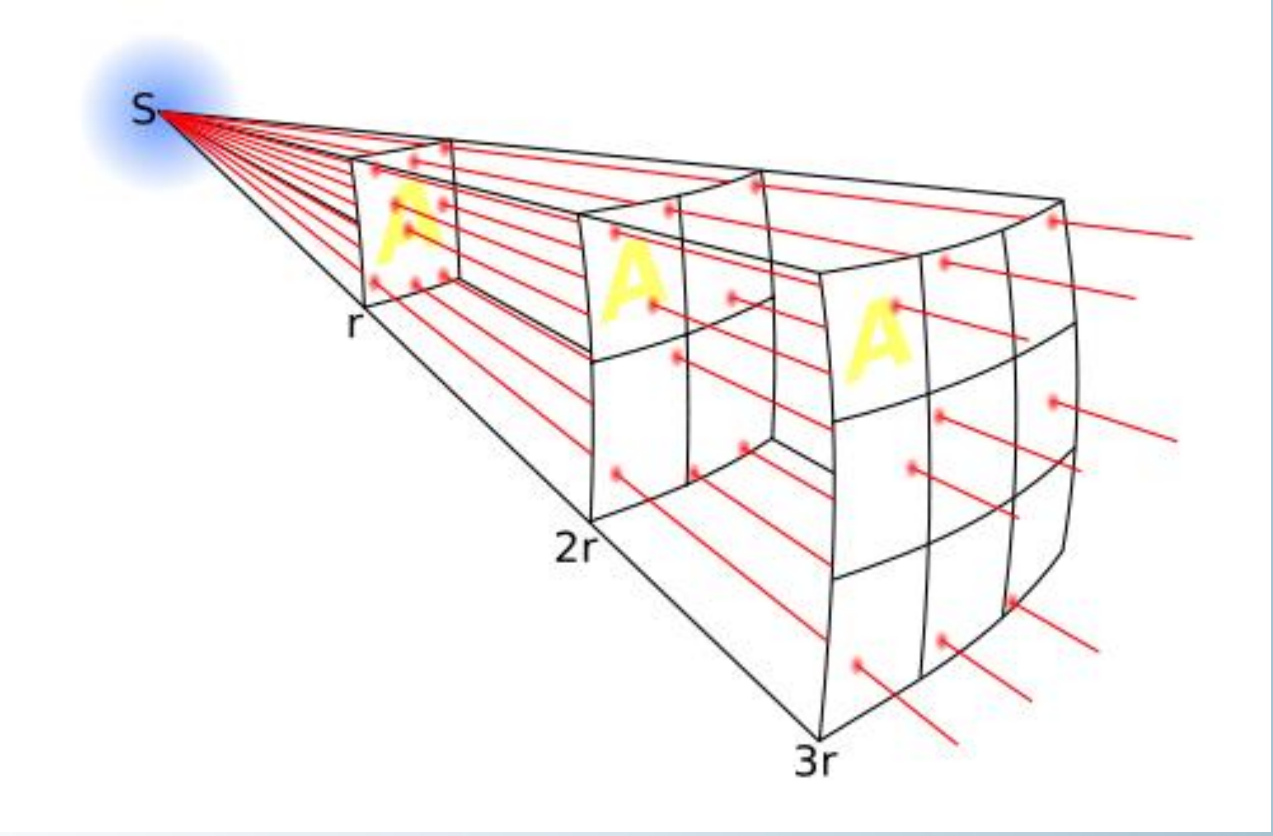

Factors affecting Wave Propagation

Ionosphere – The height and thickness of the ionosphere varies and this varies the propagation and reception of sky waves. During the day, more ionisation occurs, resulting in more sky wave propagation. There is much less sky wave propagation at night as ionising radiation is largely absent.

Factors affecting Wave Propagation

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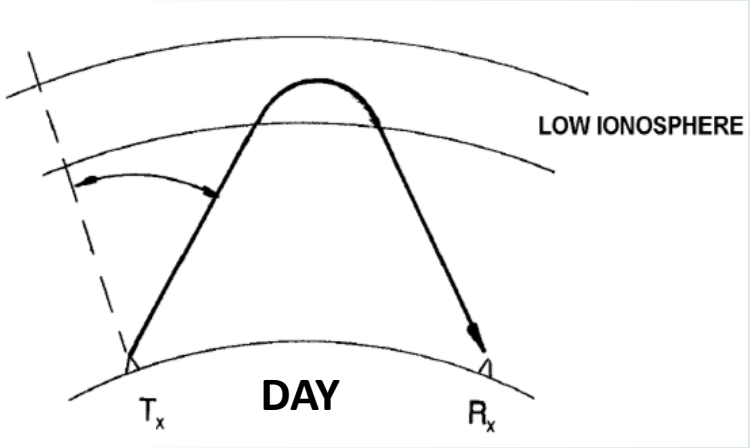

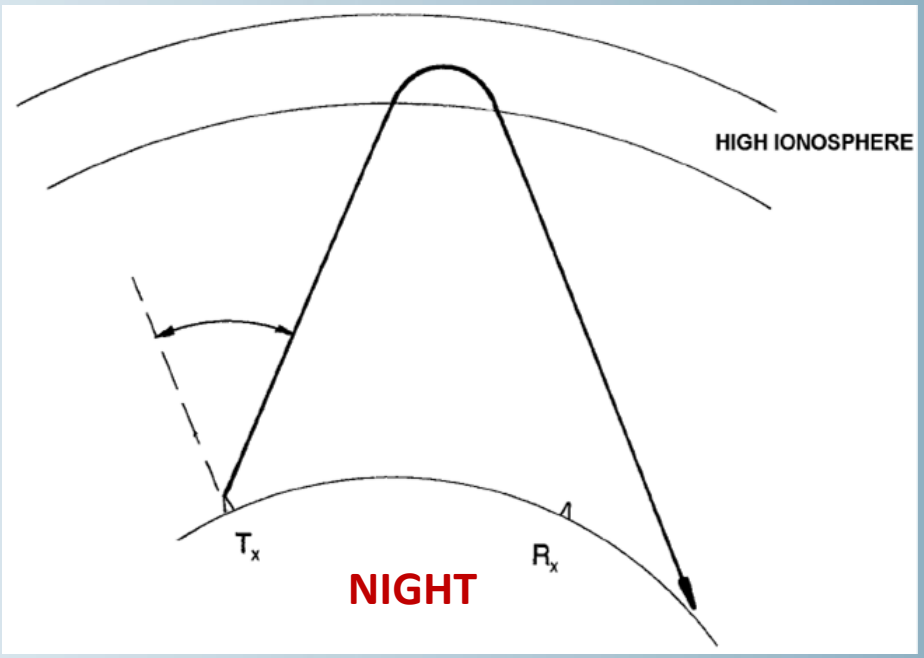

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Thunderstorms – Lightning can severely interfere with radio waves, in particular HF and lower frequencies. It can also affect navigation aid reception, resulting in faulty indications.

Factors affecting Wave Propagation

Electrical Equipment Interference

Man-made:

- Ignition interference – caused by the extra-high voltage on reciprocating engines.
- Power distribution lines – from leaking insulators, causing arcing to nearby receivers

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Adjacent channel interference:

- Signals on adjacent frequencies often interfere with desired signals, causing severe interference to radio reception.

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- Some aircraft flying beyond VHF coverage also carry HF radio as a back-up to maintain communications

QUESTIONS/COMMENTS?