ECE 215 Spring 2025

Objective 3.4:
Line of Sight

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I can calculate the maximum line-of-sight (LOS) distance between two terrestrial objects.

Wireless Channels

- Surface/Ground Wave
- Sky Wave
- Forward Scatter
- Line of Sight

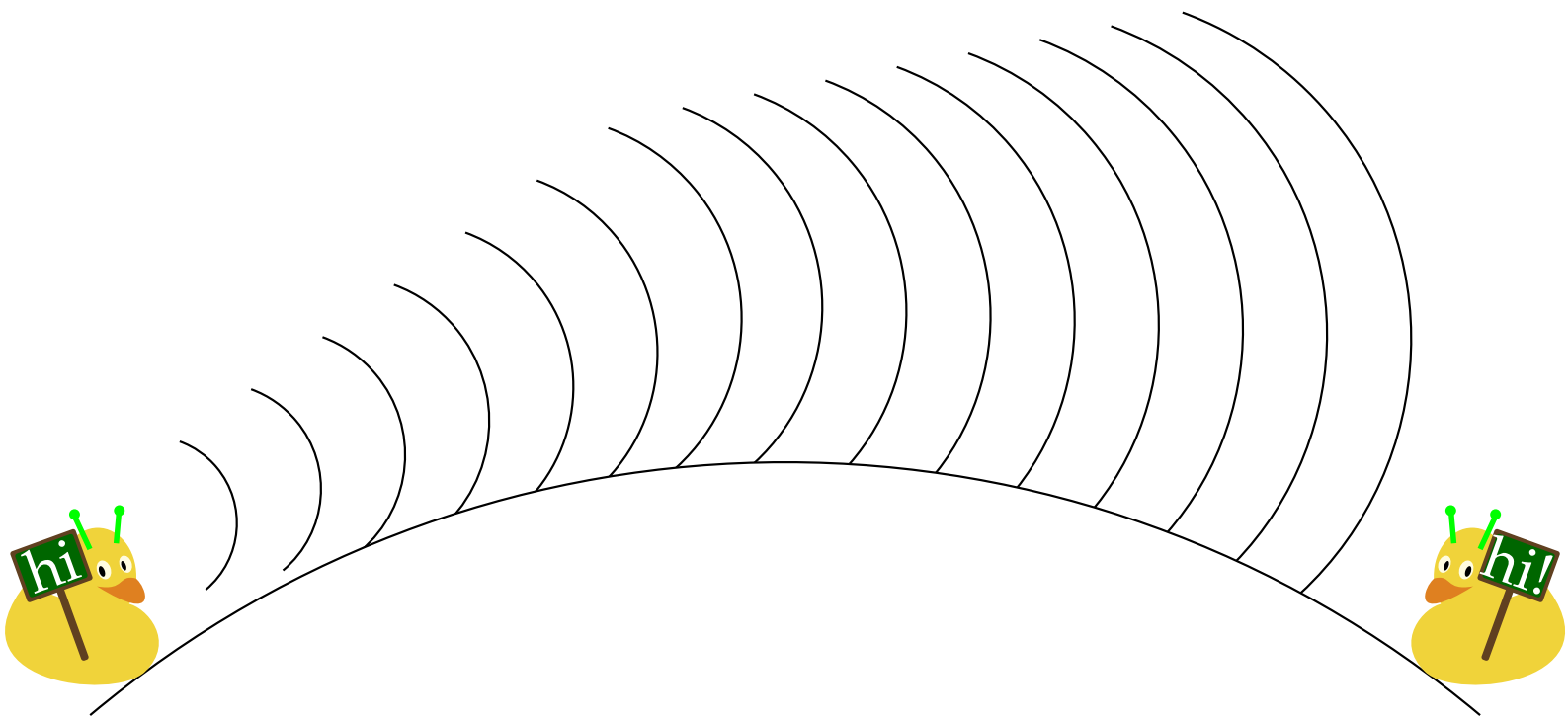
Note

Wireless channels are a subset of the 4 COMMUNICATION channels:

- Wireless
- Wired / Cable
- Fiber optics
- Waveguides

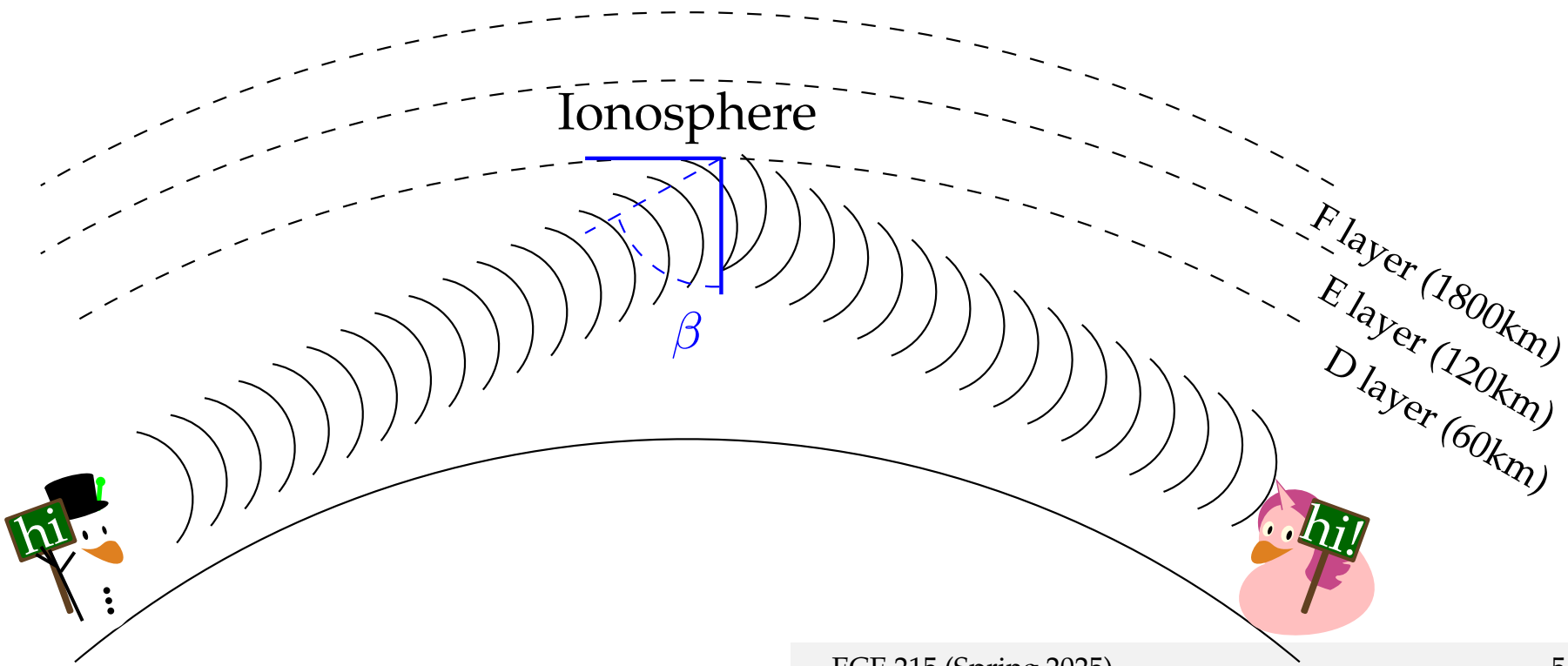
Surface Waves: Bend it like Beckham...

- Wave "hugs" the Earth's surface
- Only works at VLF & LF ($f_c \leq 3$MHz)
- Commonly used in AM broadcast radio

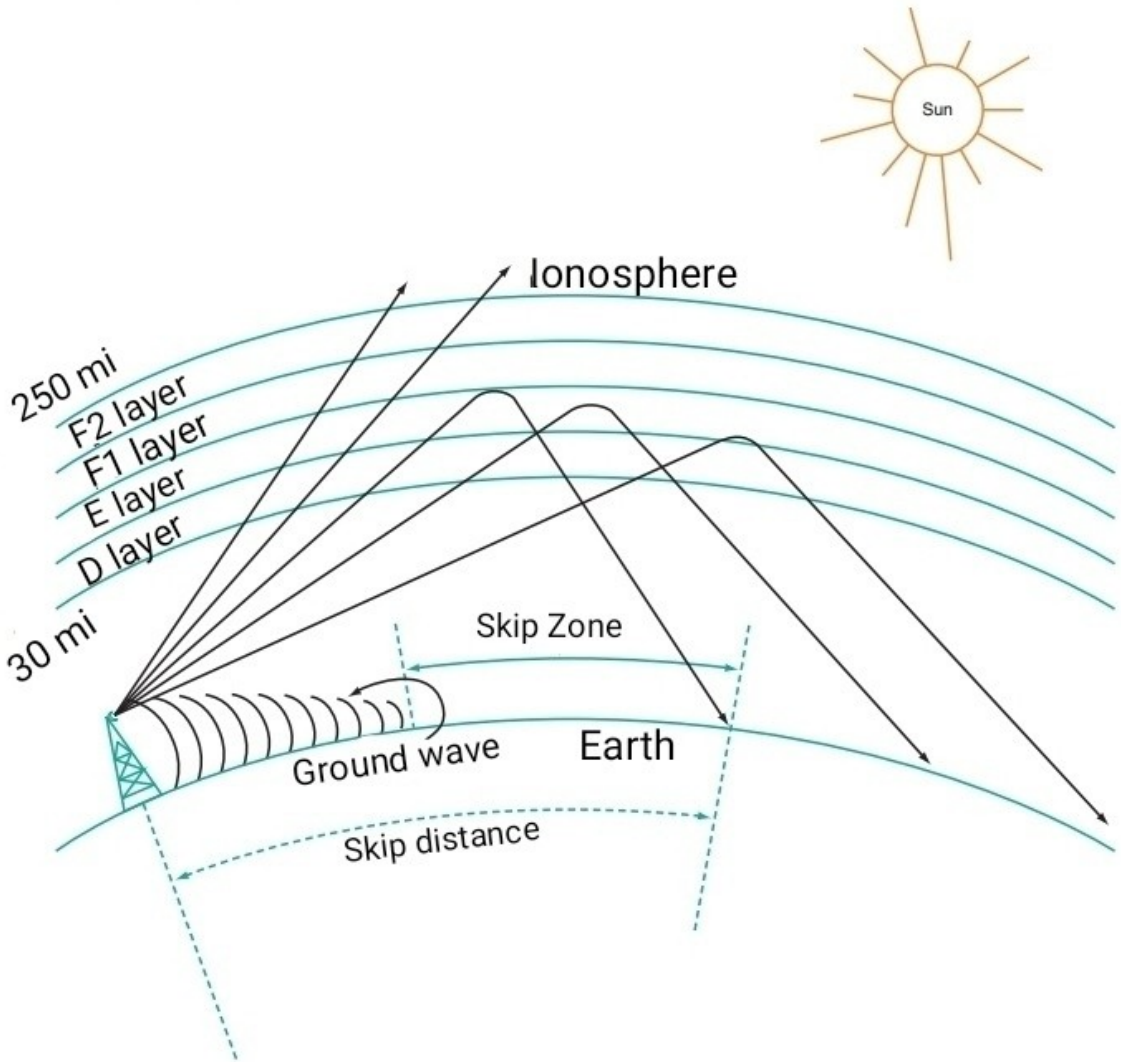


Sky Wave - Skipping Rocks

- Certain frequencies can be "bounced" off the ionosphere
- Useful in the HF bands ($f_c \leq 30$MHz)
- Commonly used for radio broadcast and over-the-horizon radar (OTHR)
- Larger β gives better bounce

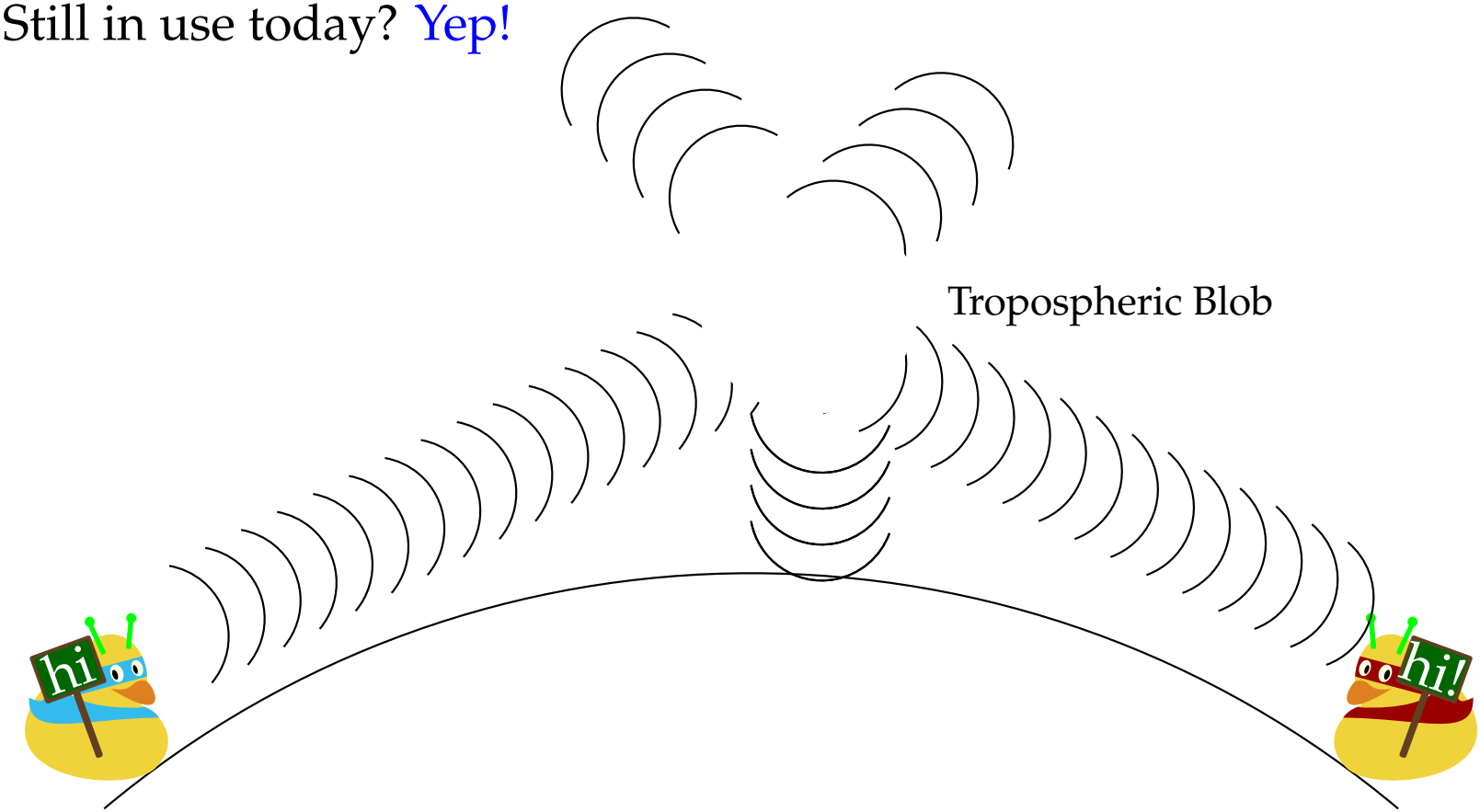


Make it a Combo - Sky Wave + Surface Wave



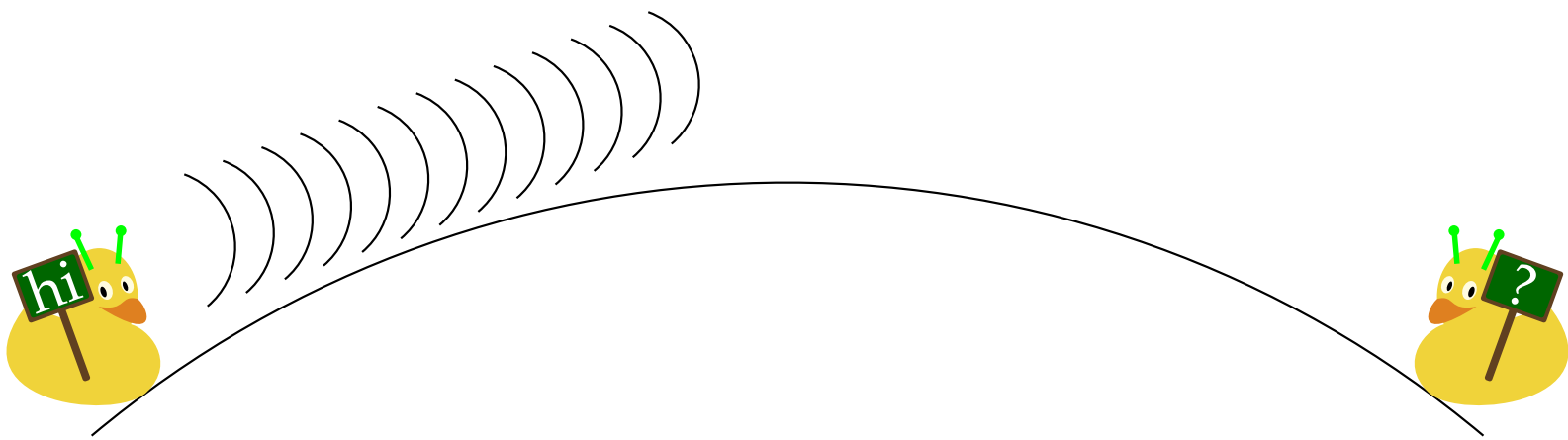
Forward Scatter (aka Troposcatter)

- Occurs when a signal strikes discontinuities in the troposphere and the signal is scattered omnidirectionally
- Useful in the UHF and SHF bands ($300\text{MHz} \leq f_c \leq 30\text{GHz}$)
- Still in use today? Yep!



Line of Sight

- All electromagnetic signals can propagate by LOS
- Distance limited by curve of the earth
- Common uses:
  - Satcomm
  - Cell Phones
  - Secure military communications (BFT2, Link 16, etc.)



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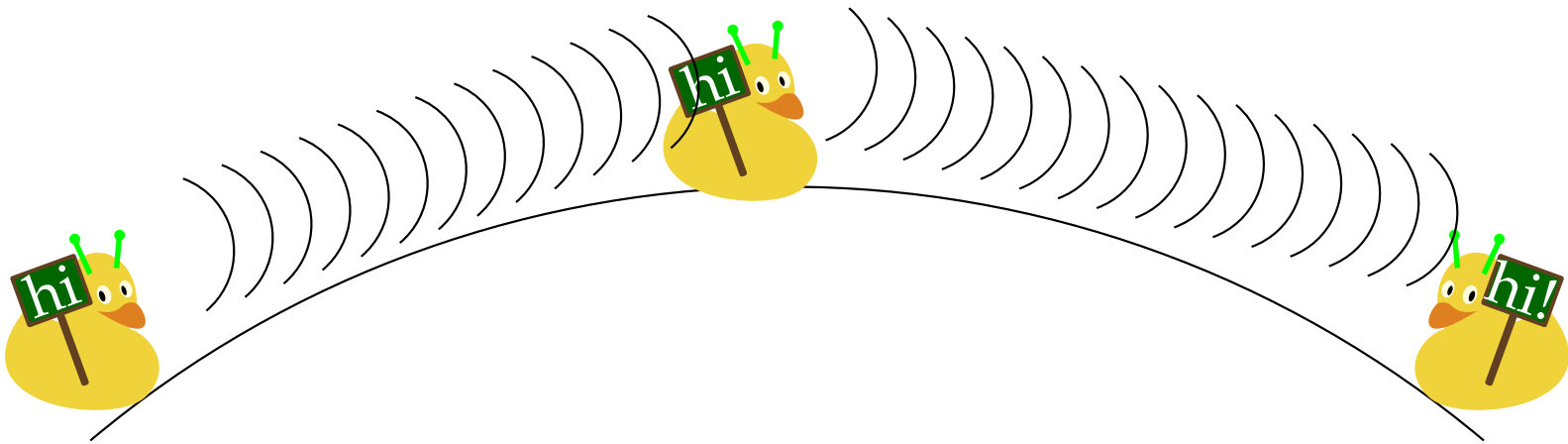
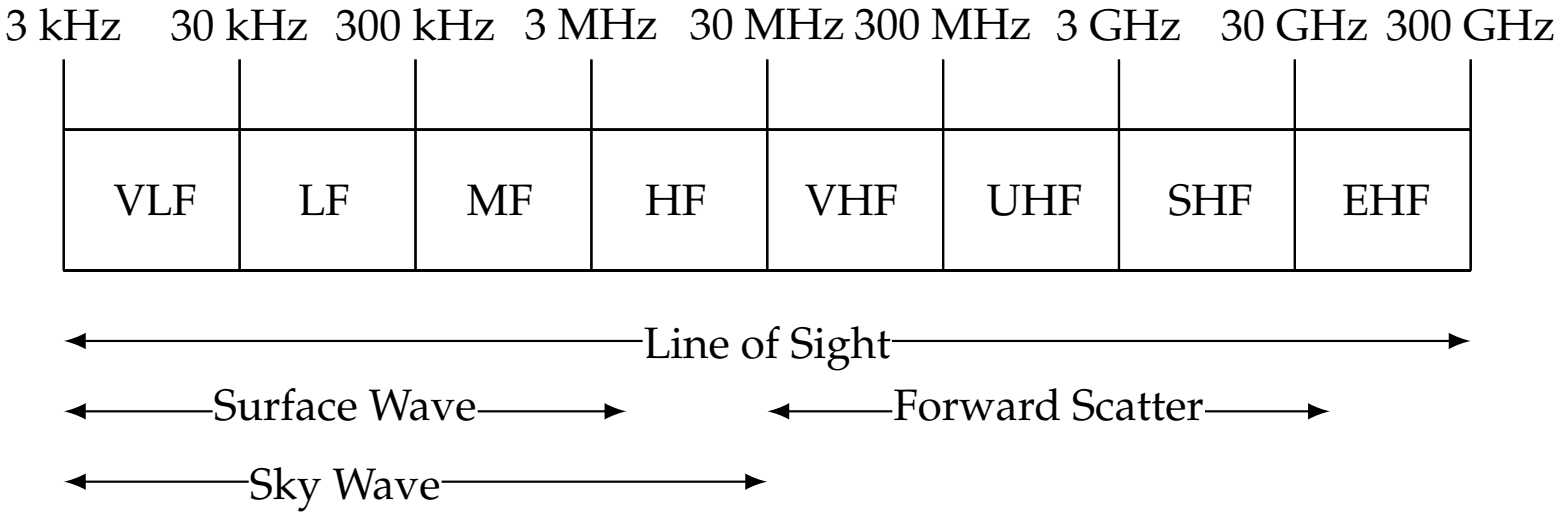
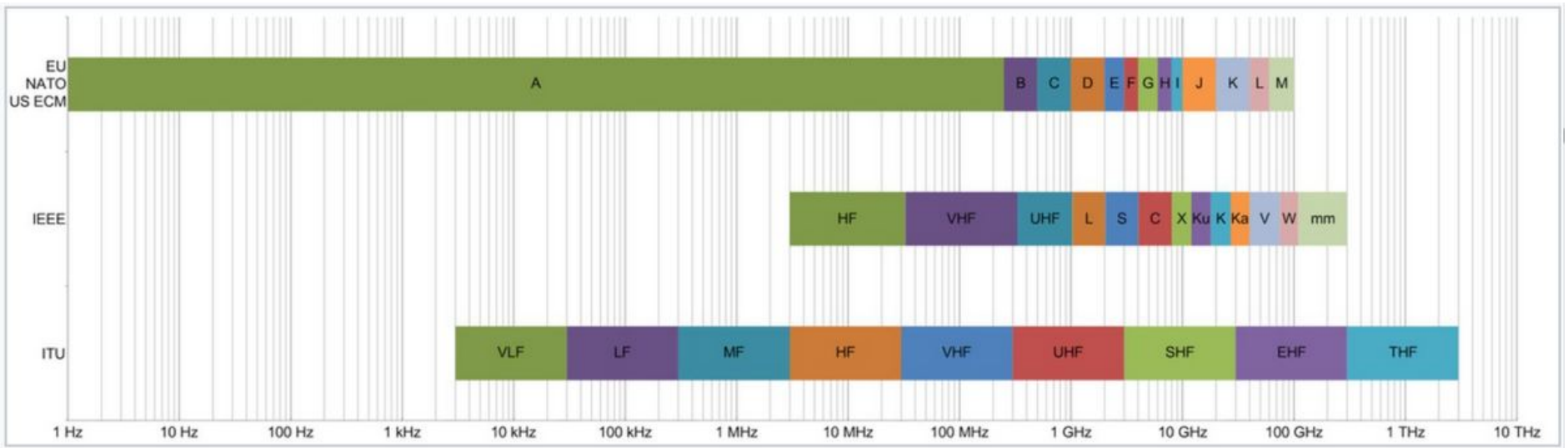


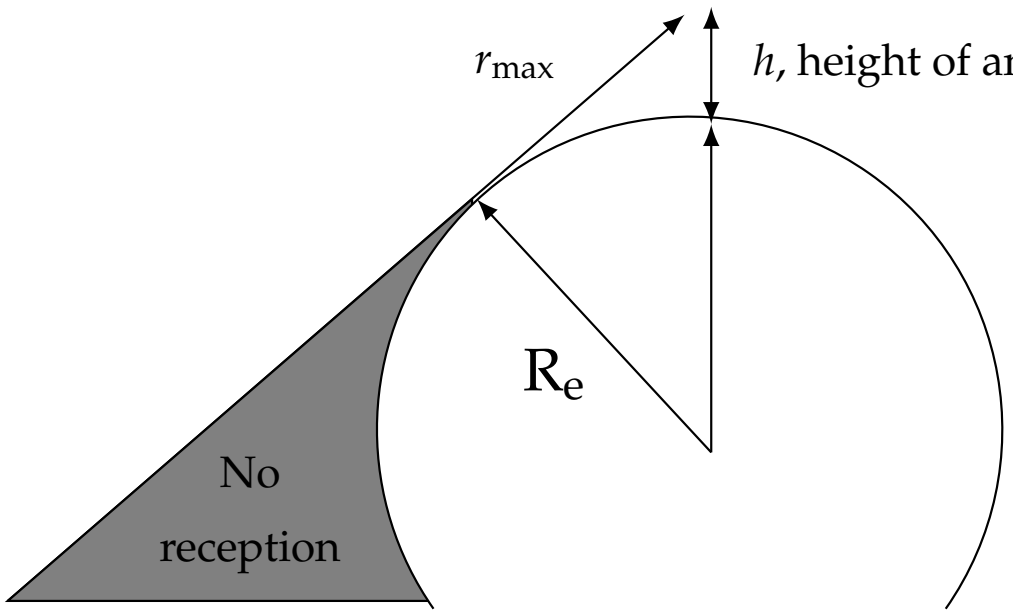
RF Spectrum Summary





LOS Distance Calculation

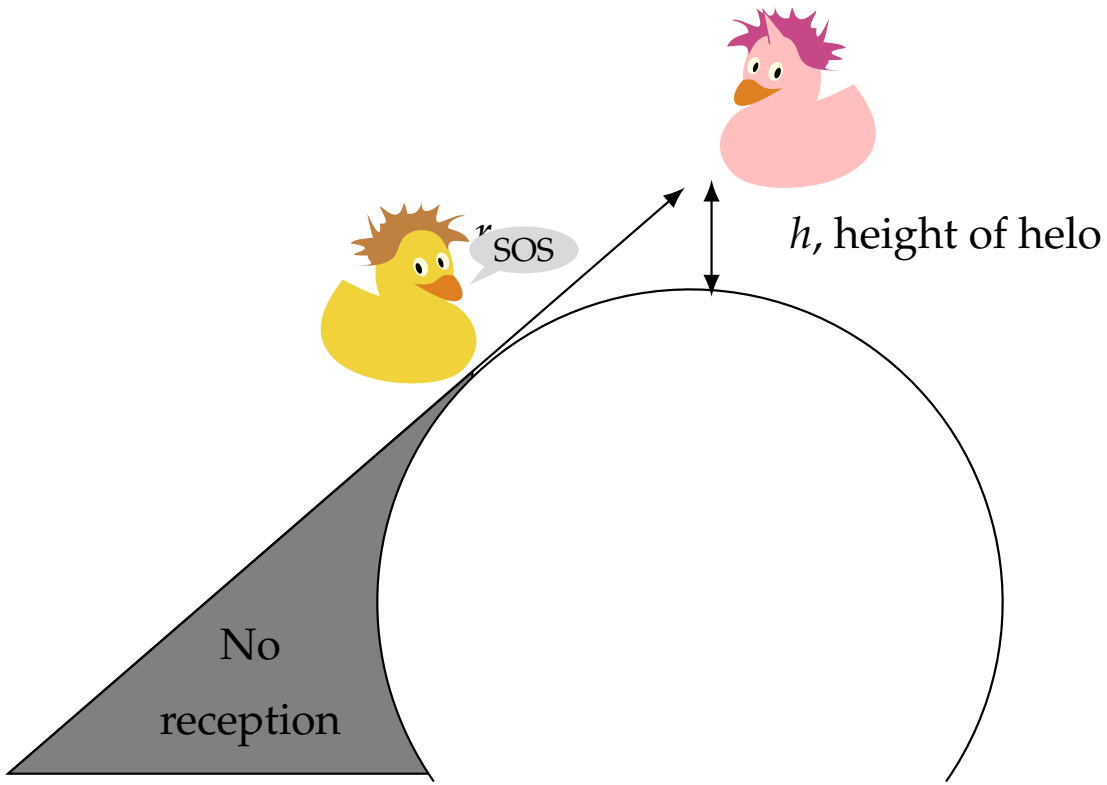
- Calculating LOS distance uses basic trigonometry...



...see reading for assumptions and derivation.

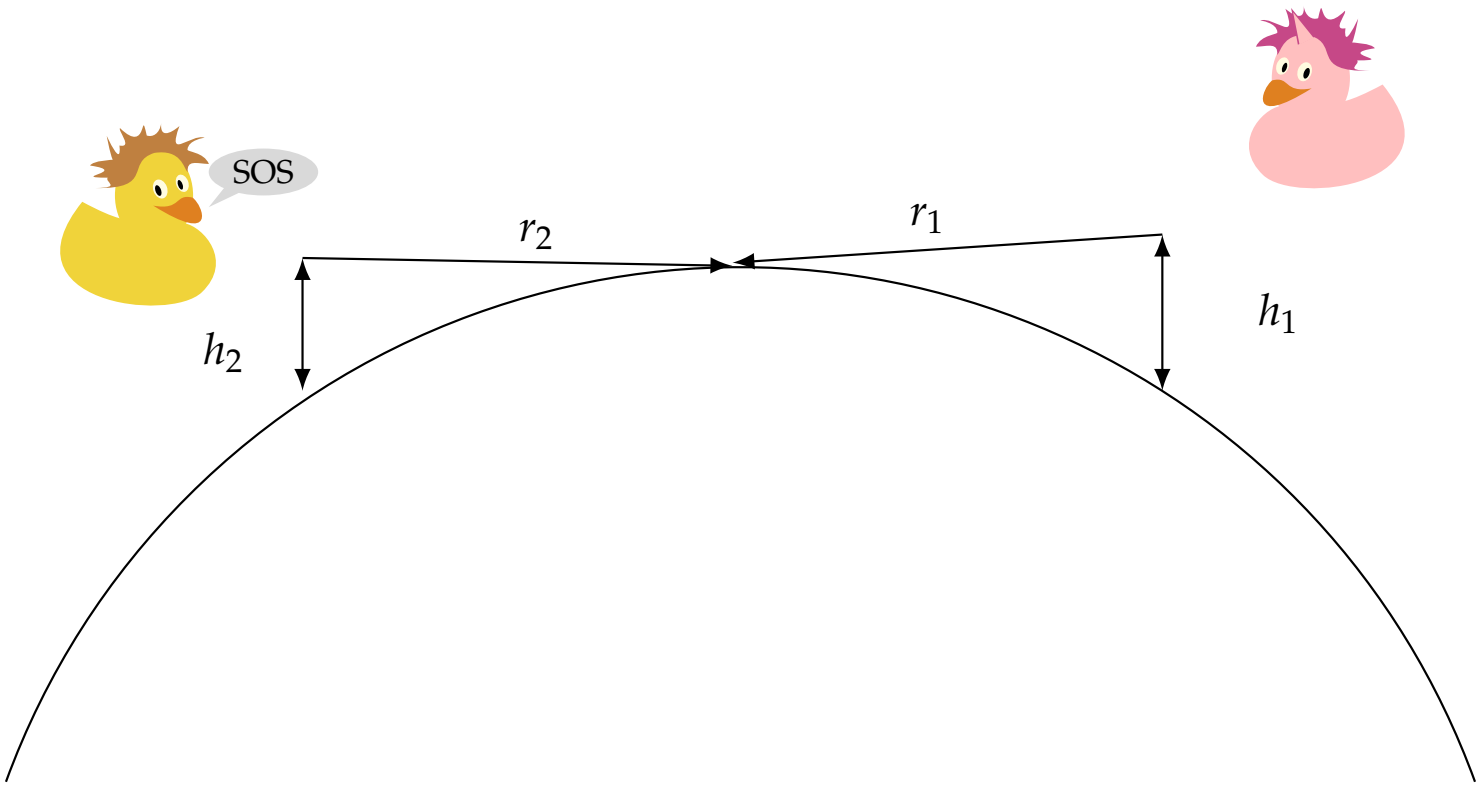
LOS Distance Calculation

During a CSAR mission, an HH-60 is searching for a downed airman at 2000 feet AGL. Assuming relatively flat terrain, how close will the helo have to be to the airman to establish LOS comms?



LOS Distance Calculation 2

Now, assume the airman climed to the top of a 50 foot hill, how much distance did he buy himself?



Activity

The City of Colorado Springs' website states you can see 5 different states (Colorado, Arizona, New Mexico, Kansas, and Utah) from the top of Pikes Peak on the clearest days. Can you *really* see Kansas from the top of America's Mountain? What about the other states?

- Calculate the line of sight distance from the top of Pikes Peak
- Compare to the distance to the border of Kansas
- If you are still not convinced your yes/no answer is correct, ask ChatGPT or the Google!
- Then do some detective work on the other states