Propagation and the Solar Cycle

A presentation by Greg, KB1AWM for
The Trident Amateur Radio Club

What is RF Propagation?

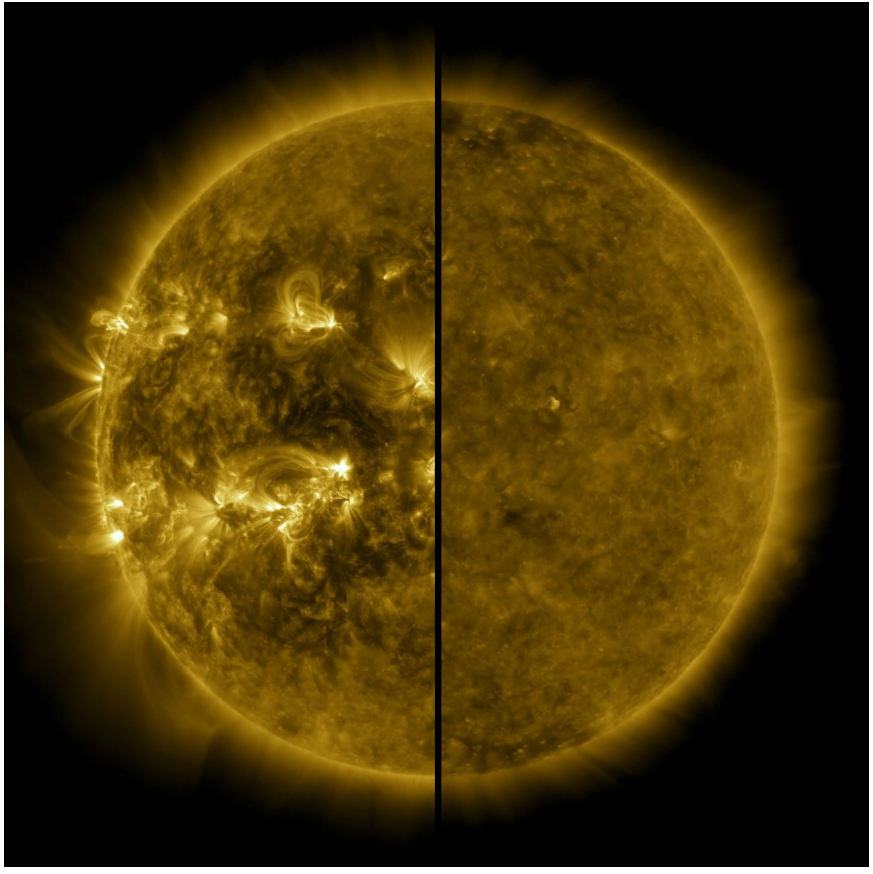
- It is how RF travels from a transmitter to a receiver
- Many kinds:
  - Line of sight
  - Ground wave
  - Ionospheric:
    - **F-Layer**
    - Sporadic-E
    - Aurora
    - Etc.

Terms

- MUF or Maximum Usable Frequency:
  - Measured by labs using an Ionosonde, a specialized radar.
- SFI or Solar Flux Index:
  - A measure of the 10.7cm wavelength RF noise form the Sun, correlates with solar activity
- SSN or Smooth Sunspot Number:
  - A measure of active sunspots on the surface of the sun, smoothed over a time period. High numbers equal a more active number of sunspots over recent history.

Solar Cycle

- ~11 year cycle from low activity, to high activity and back again.
- Cycle 25 started December 2019, currently at/near peak.
- Typical SFI: low-end ~70, peak: 180-220
- Sun rotates every 24-30 days, so sunspots can go to the back side, and come back a few weeks later.

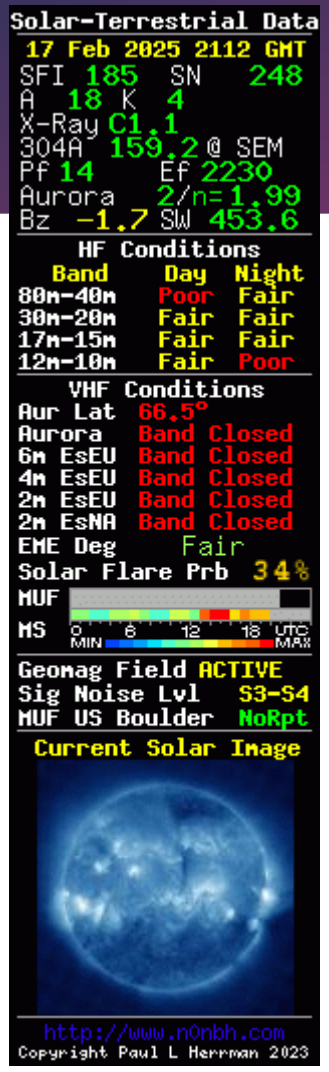


Monitoring Solar Weather

- https://www.hamqsl.com/solar.html
- A-Index and K-Index measure activity in the magnetosphere.
  - CMEs
  - Solar Flares
  - Solar Wind
- High values negatively effect HF propagation

The General Relationship between A and K Values

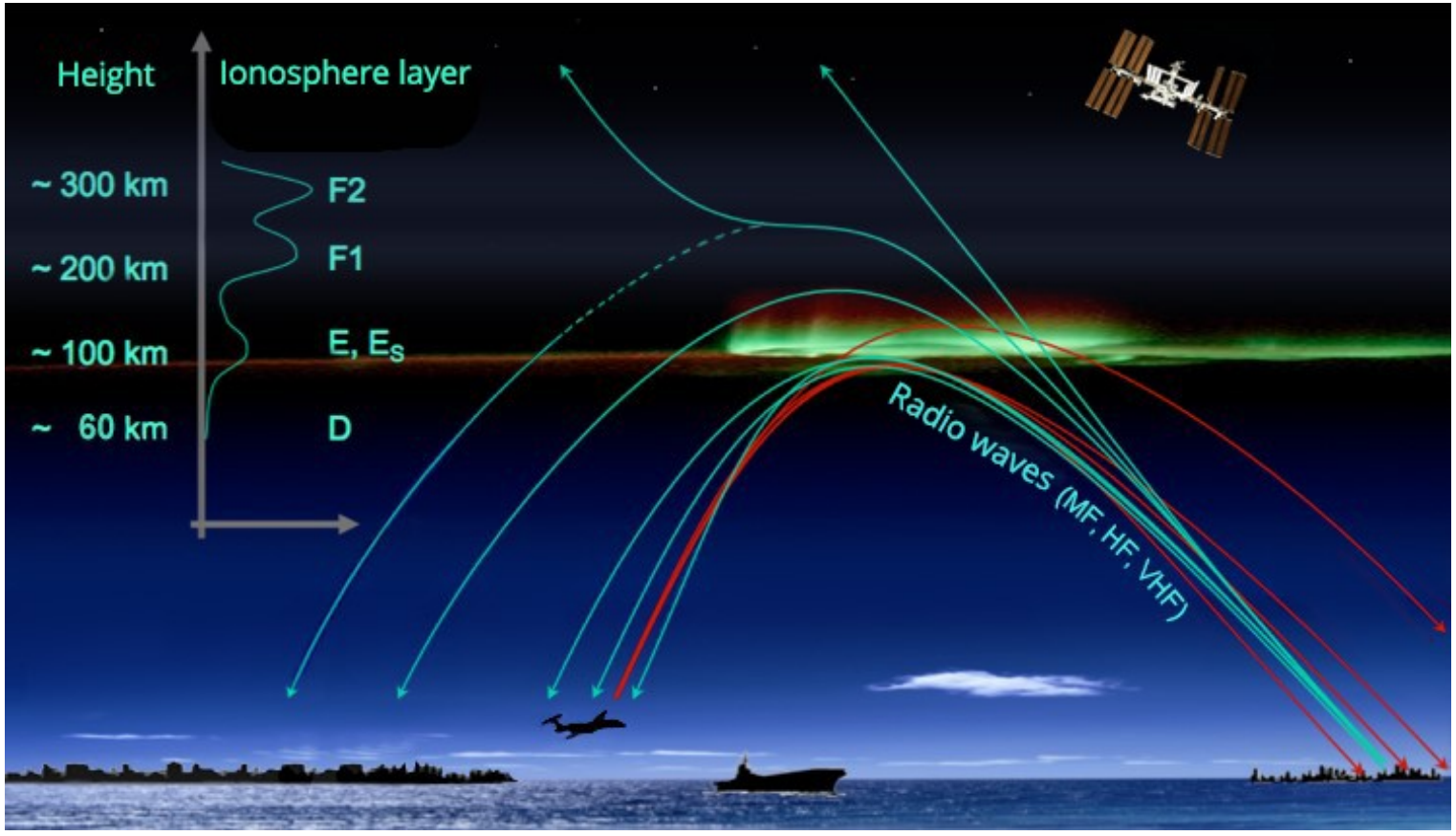
A	*K*	*Comments*
0	0	Quiet
2	1	Quiet
3	1	Quiet
4	1	Quiet to unsettled
7	2	Unsettled
15	3	Active
27	4	Active
48	5	Minor storm
80	6	Major storm
132	7	Severe storm
208	8	Very major storm
400	9	Very major storm



Solar Flux Index

- 65 - 85: 160M-40M
- 85-100: +30M, 20M
- 100-125: +17M, 15M
- 125-160: +12M
- 160+: +10M
- 225+: +6M

Ionospheric Layers

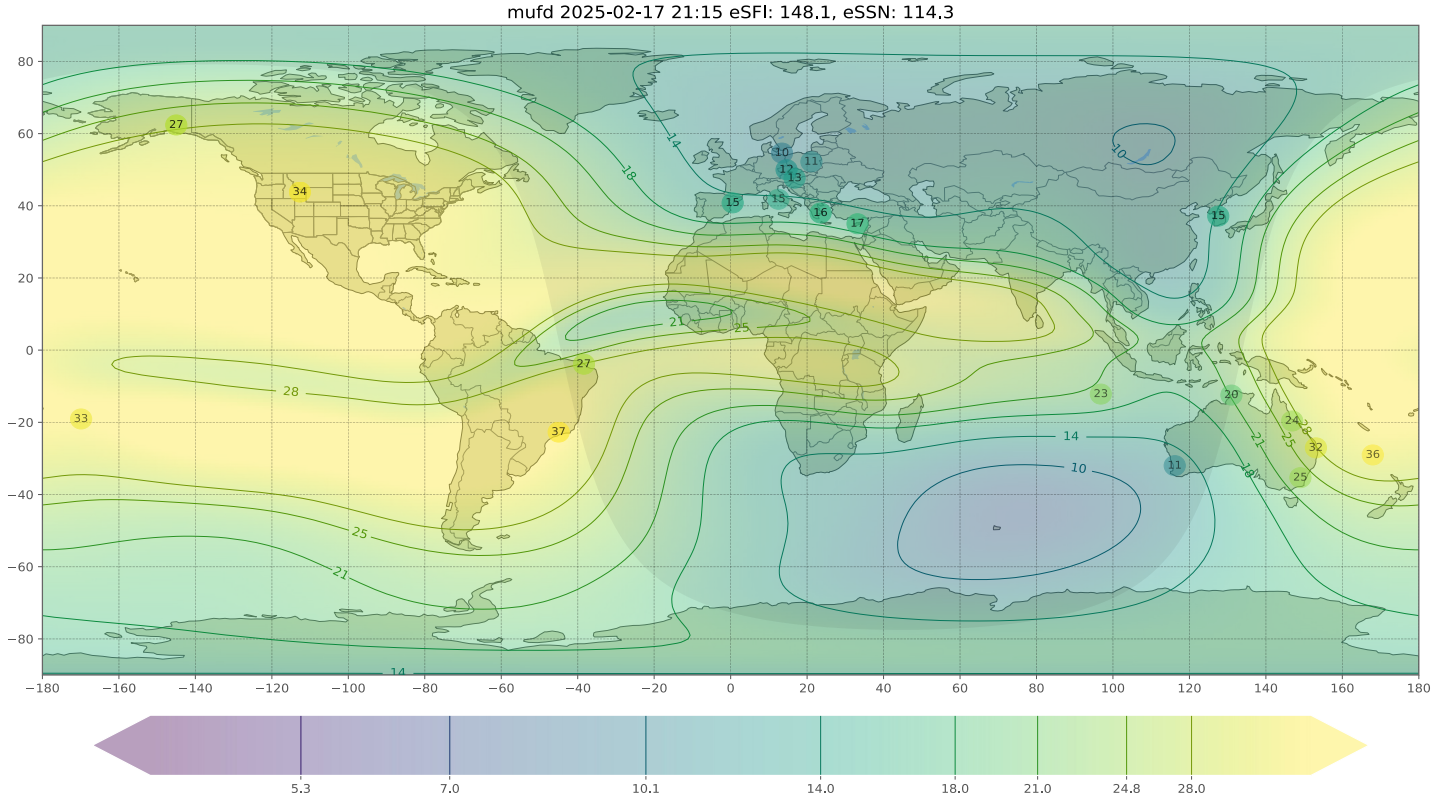


Ionospheric Layer

- D-Layer:
  - Absorbs RF signals. Lower frequencies have highest attenuation. i.e. 160M and 80M are completely dead to ionospheric prorogation during the day. Effect is limits on 30M and up. 40M is moderately effected.
- E-Layer:
  - Can be charged in a way to reflect RF back to earth. This happens sporadically and thus referred to as Sporadic-E propagation.
- F-Layer:
  - The highest layer, it is responsible for the best long distance RF propagation. Splits into two layers F1 and F2 during the day, and only F2 remains at night. F1 has a lower MUF.

MUFs

- Maps: https://prop.kc2g.com (Google “MUF map”)



Bands (Peak Solar)

- 80M works best late at night
- 40M open all night as well as around the gray line.
- 20M-30M open all day, but best at night.
- 15M-17M fantastic in the day, and can continue to work well into the evening.
- 10M-12M best DX bands in the day, start to shut down just after sunset.
- 6M daytime F2 can happen when the SFI >200 for many days in a row. Longest skips.

Bands (Low Solar)

- 160M works great at night during the bottom of the cycle
- 80M works best most of the night
- 40M open all day, with best propagation at night.
- 20M-30M open daytime for DX most days.
- 10M-17M open occasionally during the day for short period with a short burst of solar energy (new sunspot, CMEs, etc).

Seasons

- Summer: doldrums
  - Increased D-layer absorption, even effecting higher bands
  - Higher altitude F2 layer, causing reflections that don’t bounce back to earth
- Fall and Spring: most balanced
- Winter: great conditions, but short days. May need to consider short-path vs long-path.

Gray Line

- Terminator between day and night plus an area on either side.
  - E.g. shortly before dawn to shortly after dawn, or the same for dusk
- Allows you to reach opposite side of the world where both locations are in daytime (or nighttime)