

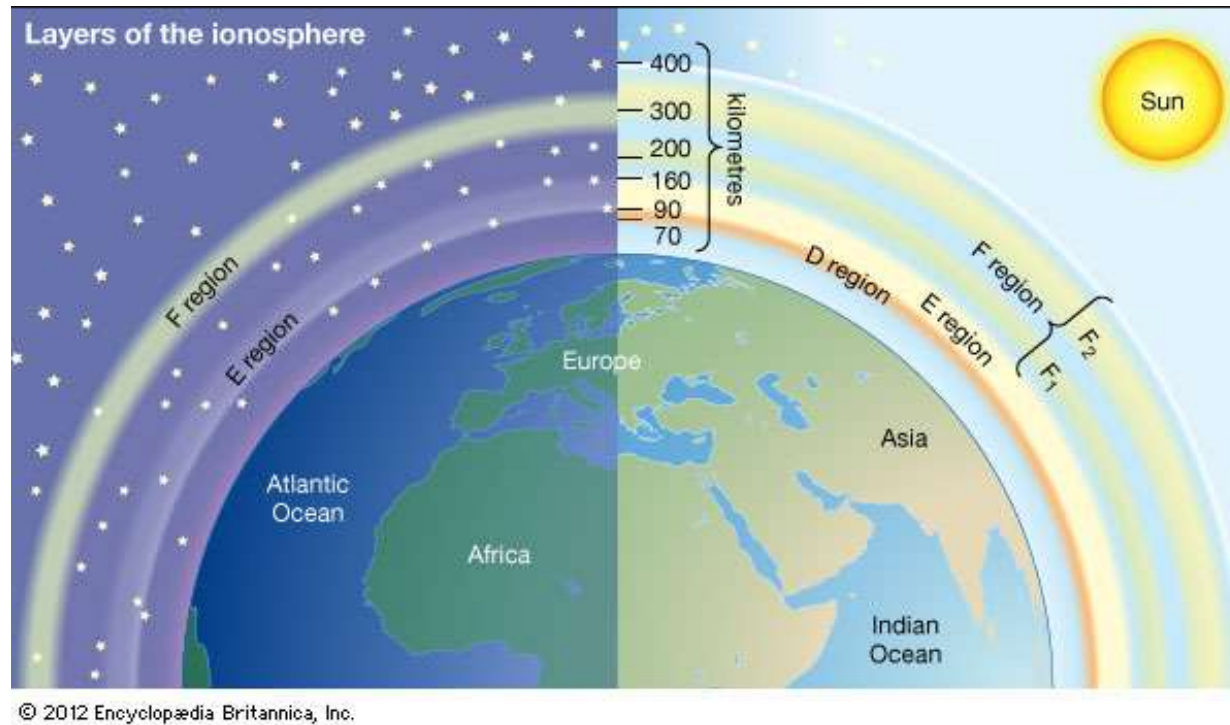
Propagation

Technician Exam Preparation Class
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Session 10

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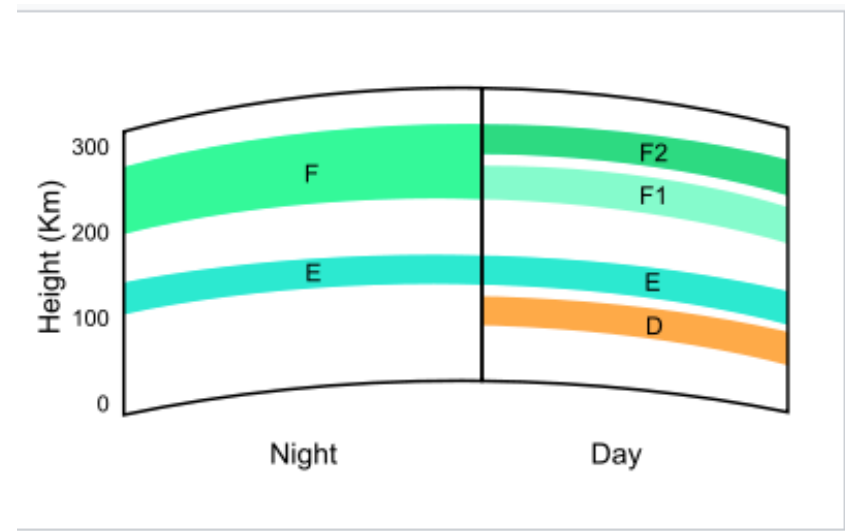
The Ionosphere



The Ionosphere enables the propagation of HF radio signals around the world.

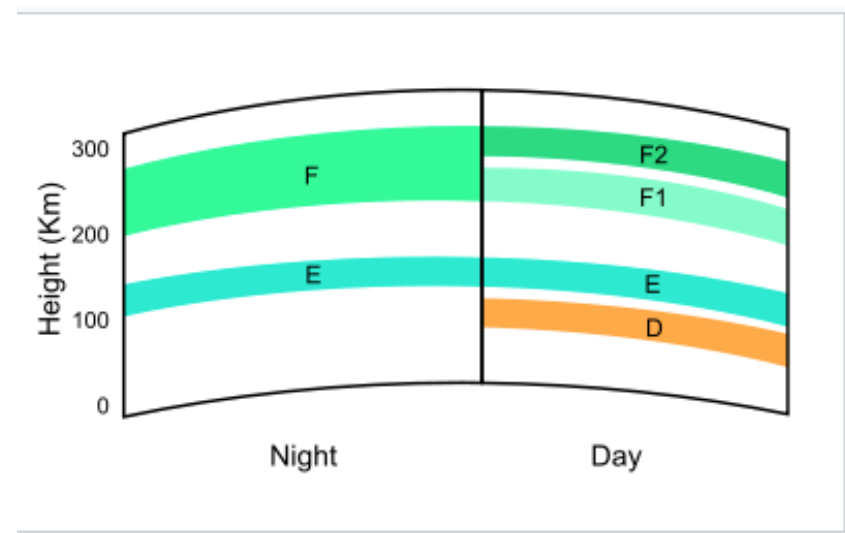
The 'D' Layer

- Appears during daytime
- Closest to the earth (35 to 55 miles above the earth surface)
- Many more neutral molecules rather than ionized molecules
- Significantly attenuates medium frequency and high frequency (below 10 MHz) radio waves



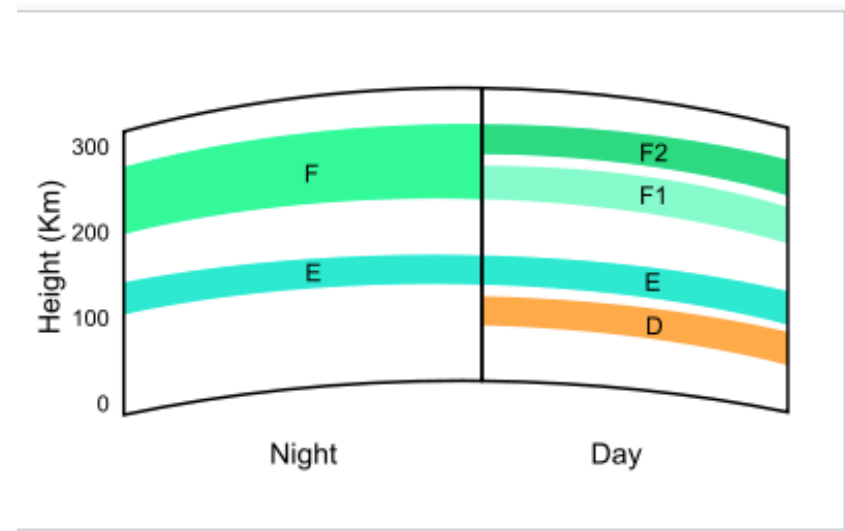
The 'E' Layer

- Appears during daytime
- Middle ionospheric layer (55 to 95 miles)
- Significant amounts of ionized oxygen molecules
- Reflects radio frequencies below 10 MHz and may attenuate higher frequencies
- Occasionally sporadic E events occur where frequencies up to 50 MHz are reflected



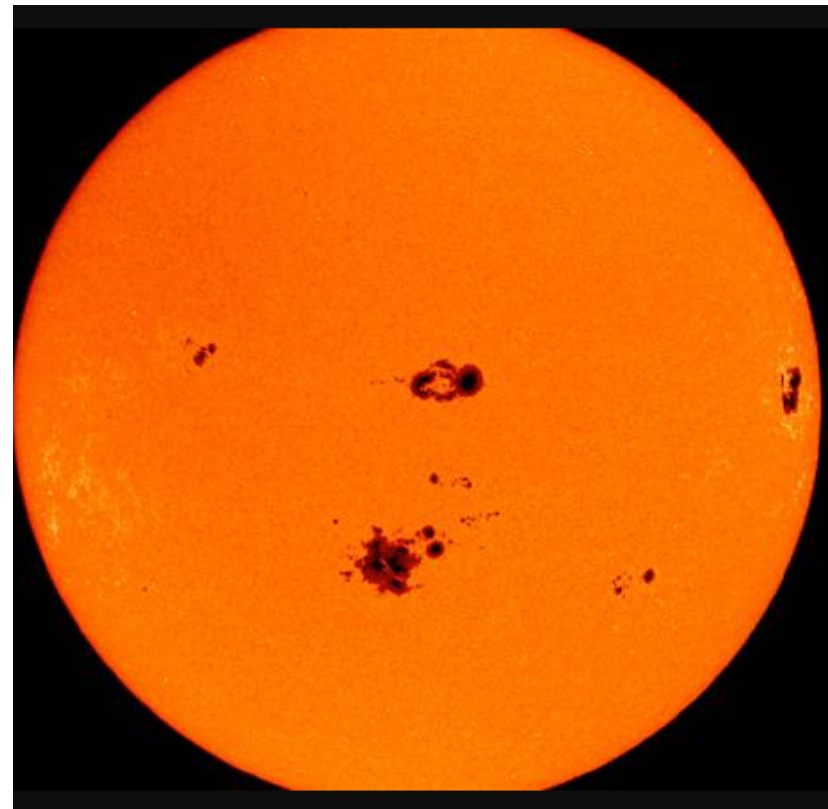
The 'F' Layers

- Splits into the F1 / F2 layers during daytime
- Combines into one F layer during the night
- Highest ionospheric layer (90 to 130 miles)
- Responsible for almost all of the high frequency (above 10 MHz) skywave propagation



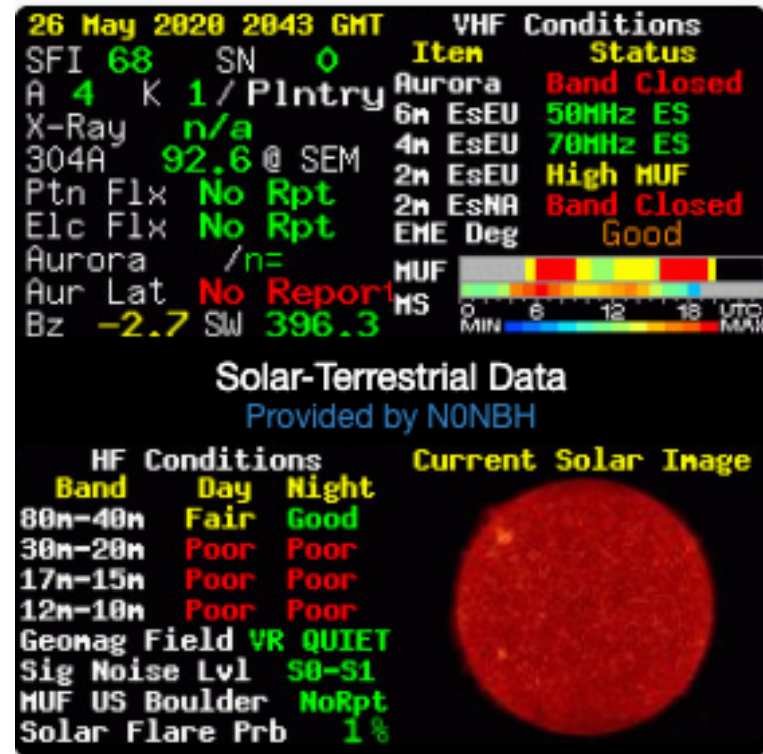
Sunspots Play a Significant Role in Propagation

- Sunspots are dark regions on the face of the sun caused by magnetic field concentrations
- Sunspots emit considerable magnetic and photon activity which is what ionizes the ionosphere
- Sunspots ebb and flow in 11 year cycles. We are currently at a sunspot minimum between cycle 24 and cycle 25
- The Solar Flux Index indicates how ionized the ionosphere is. An index of 70 or less indicates very poor conditions. On the date this slide was prepared, the solar flux was 72



Propagation Forecast

- Propagation forecasts such as the one on the right are commonly available on the Internet
- Notice that on this date there were no sunspots while there was a bright spot sending solar wind degrading propagation
 - See <http://qrz.com/>



Propagation Factoids

- VHF and UHF frequencies are generally not affected by the ionosphere; they travel in a straight line forever
- VHF and UHF radio waves are affected by vegetation — trees and such. In winter these radio waves travel further due to lack of foliage
- VHF radio waves in vertical polarization tend to “bend” over hills or tall buildings. This is called **knife-edge diffraction**.
- Occasionally (usually in summer) temperature layers may occur opening tropospheric “ducts” which can carry VHF radio waves very long distances of 300 miles or so
- Frequencies below 220 MHz are generally unaffected by fog or rain. Microwave radio waves can be significantly affected by rain and water vapor in the air
- VHF/UHF radio signals carry further than the visual line of sight as the earth seems less curved to radio waves than to light

More Factoids

- While VHF and higher frequencies are not reflected by the ionosphere, they can be reflected by meteors, aurora, airplanes, and the moon
 - Six and two meter waves reflect off auroras giving a fluttery distorted signal, a characteristic of aurora scatter
 - Six meter frequencies work best with meteor scatter
- The ten meter band is an amazing band during periods of high sunspot activity with very long distance propagation possible from just before sunrise until shortly after sunset. Note that Technicians have phone (SSB) privileges on portions of the ten meter band!
- Sporadic E propagation, mentioned earlier, occasionally occurs during late spring and summer on the 10, 6, and 2 meter bands where propagation of thousands of miles is possible

Space Weather Woman

- Dr. Tamitha Skov
- Produces a weekly propagation forecast published on YouTube
- [https://
www.youtube.com/
channel/UCkXjdDQ-
db0xz8f4PKgKsag](https://www.youtube.com/channel/UCkXjdDQ-db0xz8f4PKgKsag)



**Jot down any questions
you may have to ask
during the online meeting**