HF Propagation

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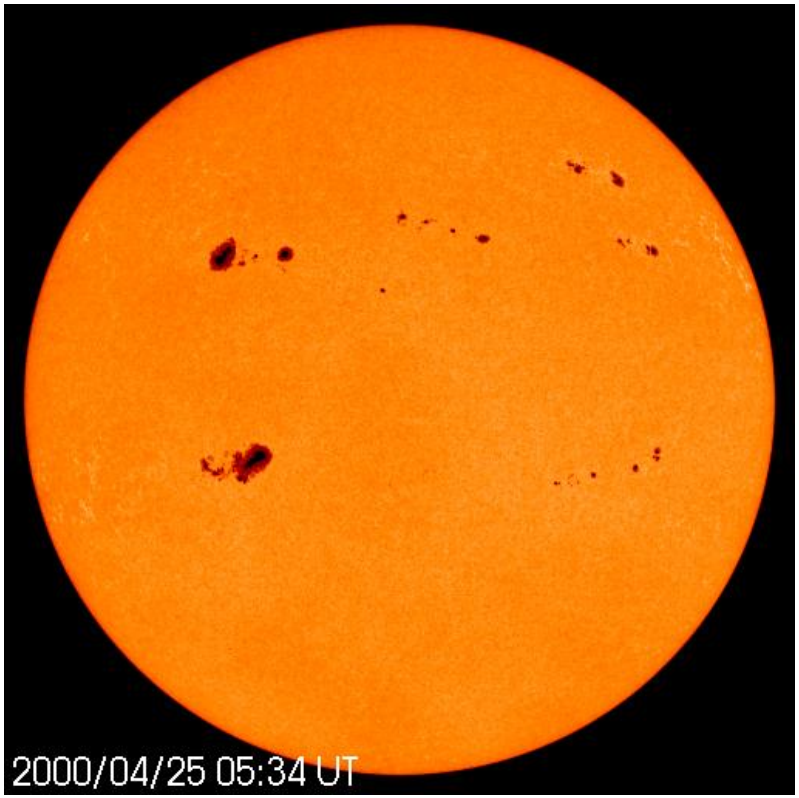
Presented To Region 4 Theory Class by
Ger EI4GXB by kind permission of G0KYA

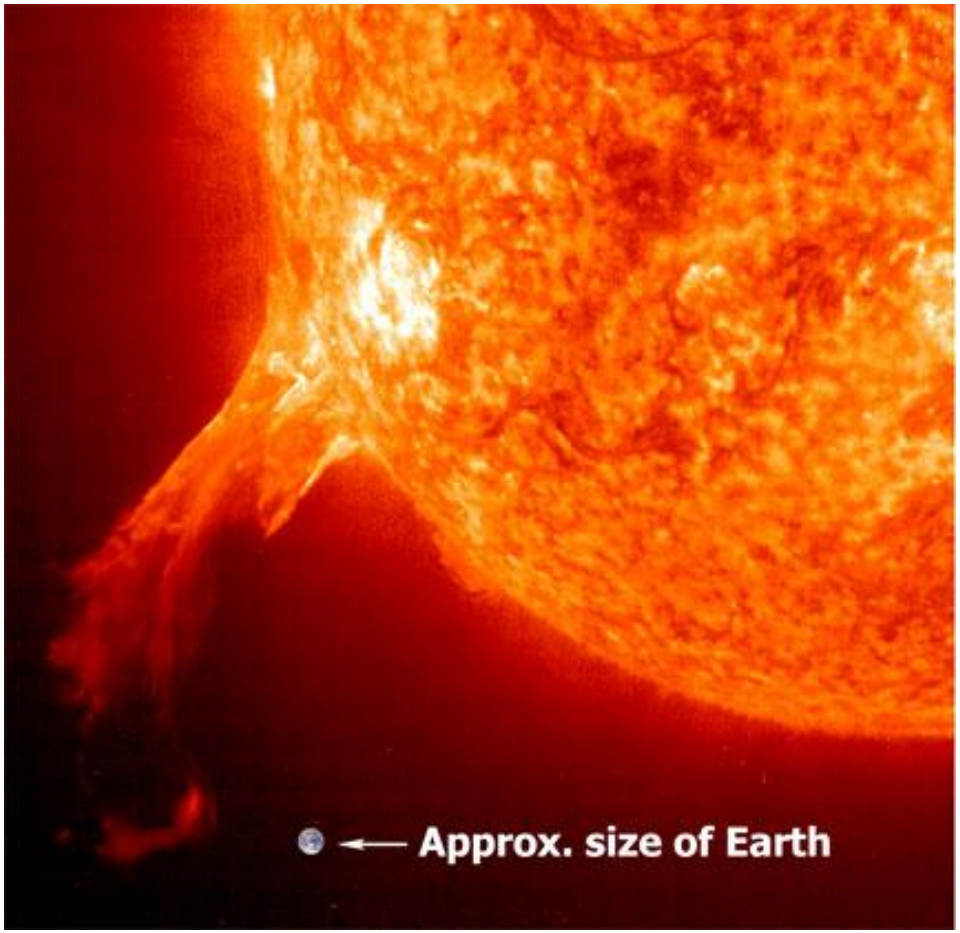
A brief run down on solar physics

- The sun emits massive amounts of electromagnetic ionising radiation (UV/soft X rays)
- Put simplistically, the more sunspots, the more UV. Flux can be as low as 65 or as high as 274 (2001)
- We measure the solar output at 2,800 MHz (10.7cm) to give us a “solar flux” figure



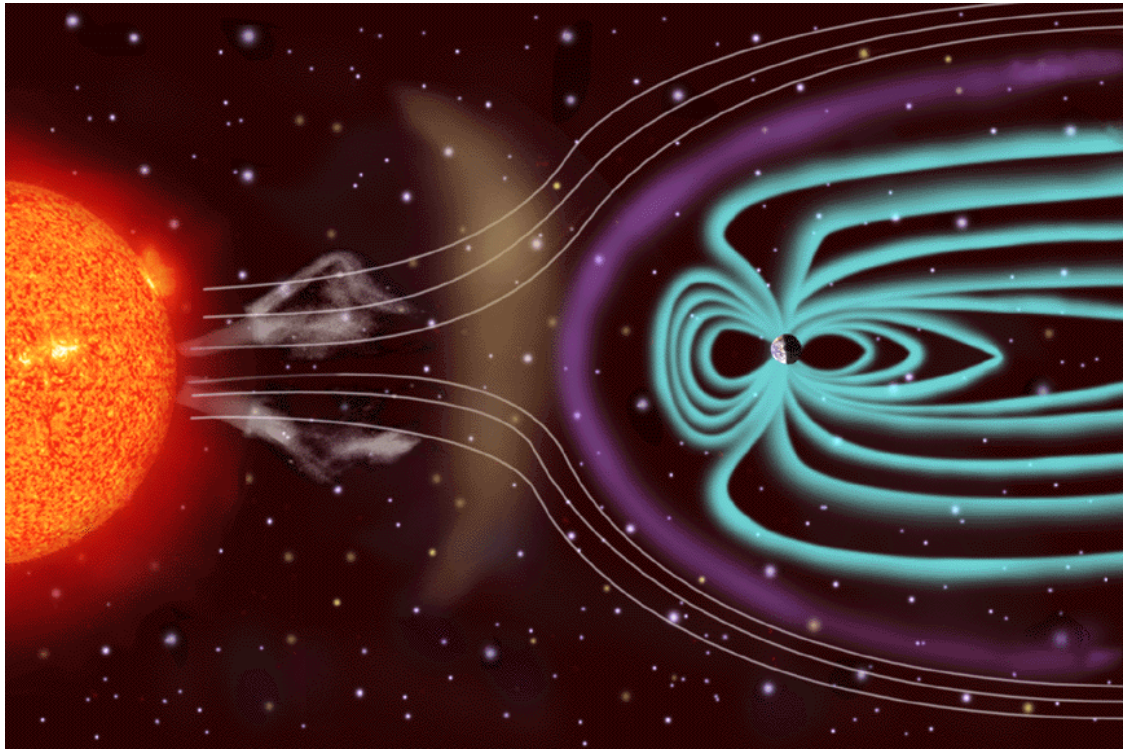
A brief run down on solar physics

- The sun also emits massive clouds of charged particles via solar flares and coronal mass ejections/coronal holes



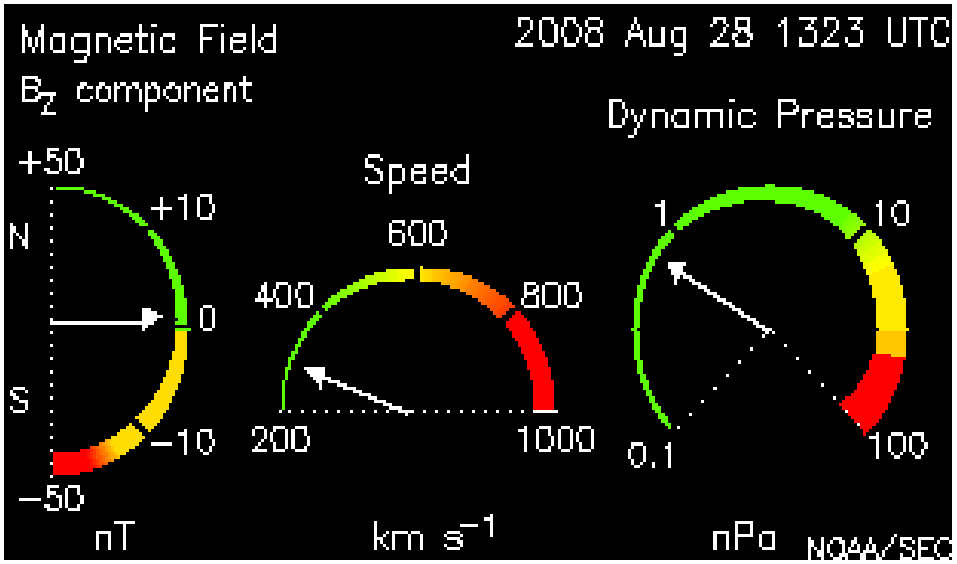
A brief run down on solar physics

- These can head towards the earth, where the particles can be channelled towards the poles
- This is more likely when the Interplanetary Magnetic Field (B_z) points “south”



A brief run down on solar physics

- To measure this see the gauge at www.solarcycle24.com
- B_z going south and an increased solar wind speed (450km/s+) are generally bad news for HF



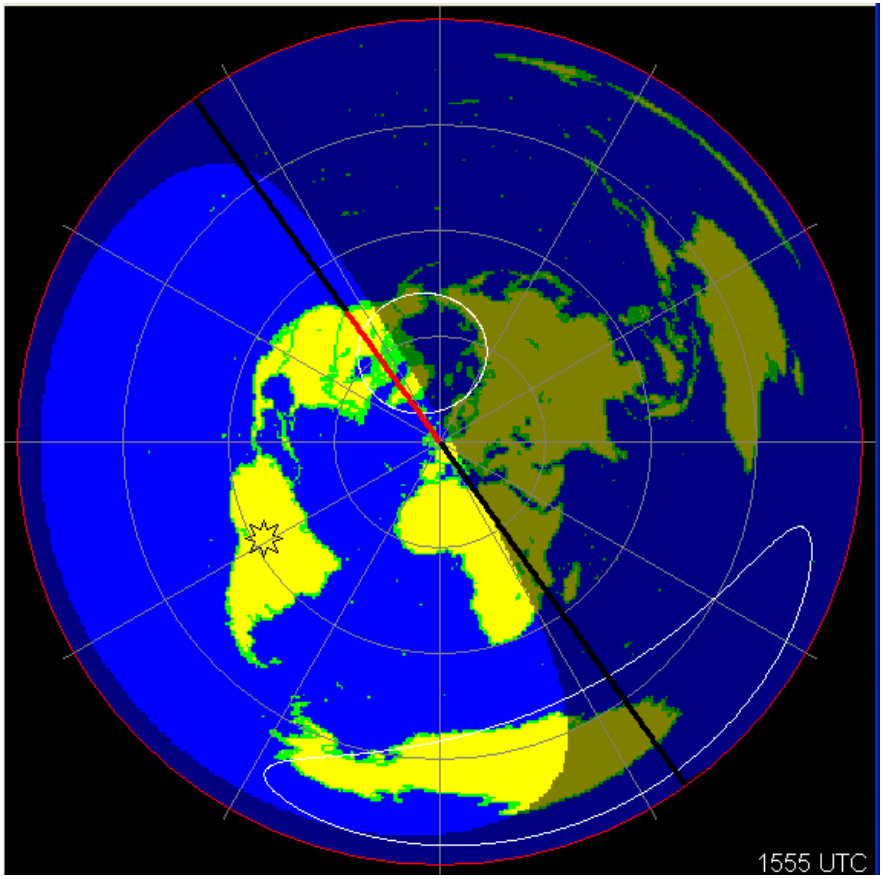
A brief run down on solar physics

- The K index shows the three-hourly effect of these particles impacting the geomagnetic field
- The A index is an average of this over 24 hours.

Aurora – K index is 5

A brief run down on solar physics

- If your signals follow a polar path that cuts through the auroral zone(s) (eg G<>VE7 long or short path) and the K index is high you will have problems.

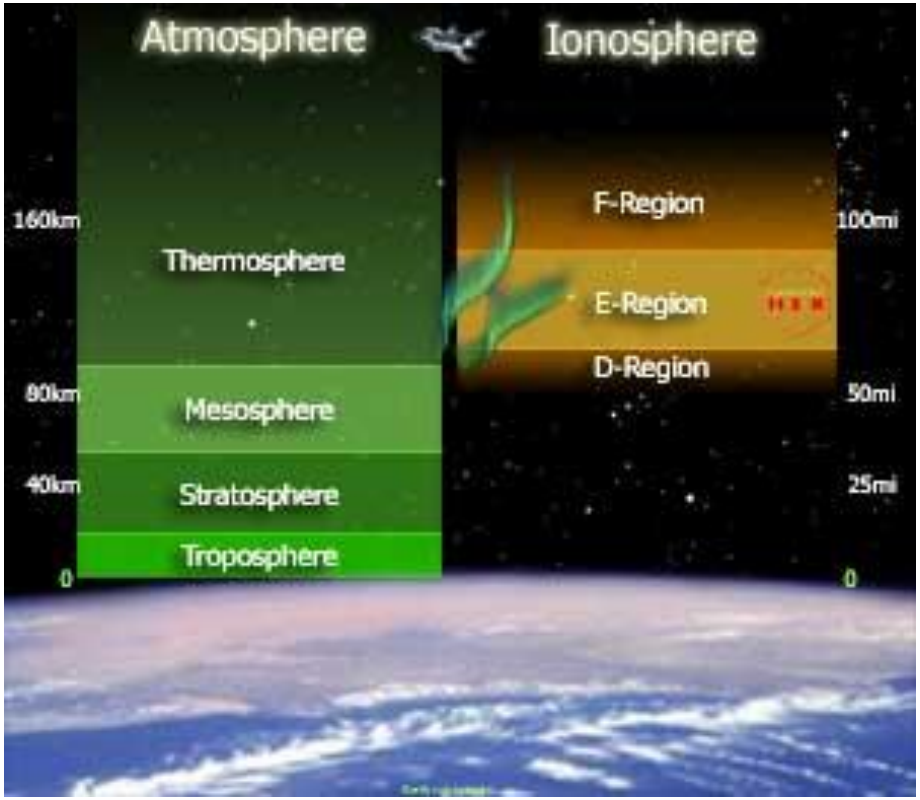


What about the ionosphere?

- **F-region**: The region used to propagate signals in the HF spectrum, notably 1.8MHz – 30MHz range

- **E-region**: 95-150km, contains mostly 0_2+ ions. The region used to propagate signals in the lower HF spectrum, notably 1.8MHz – 7MHz

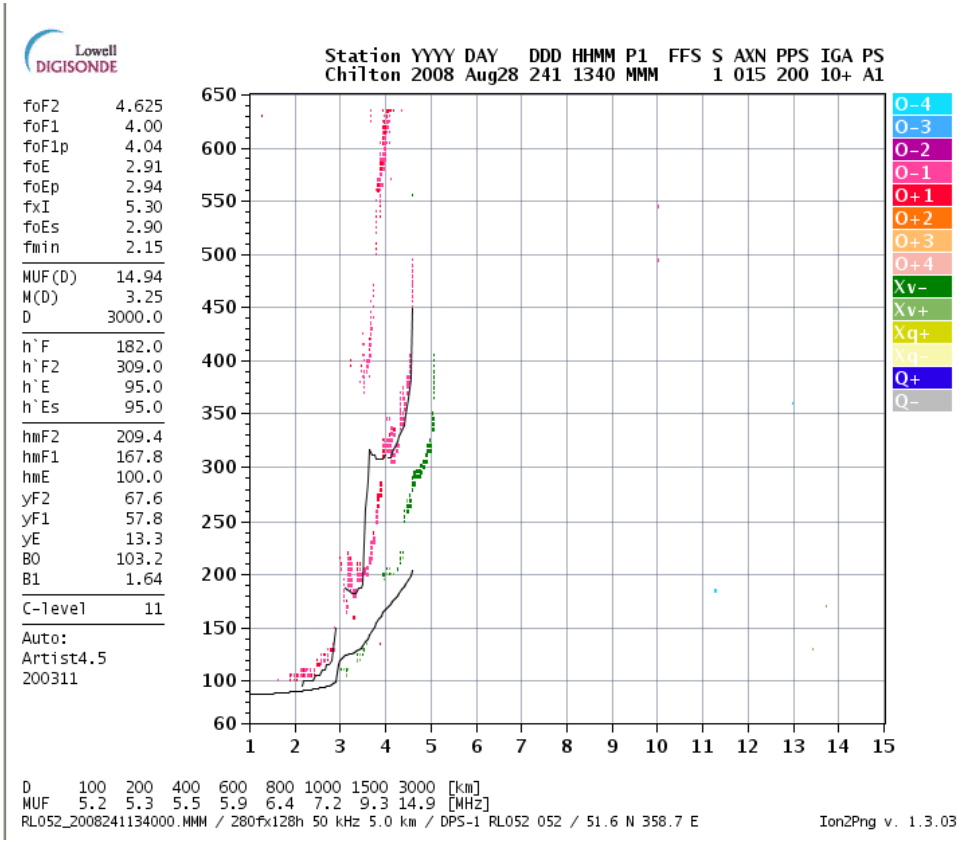
- **D-region**: 75-95 kilometres up, relatively weak ionisation due to its position at the bottom. For our purposes this is an **absorption** region, cutting down signals on 1.8 – 7MHz.



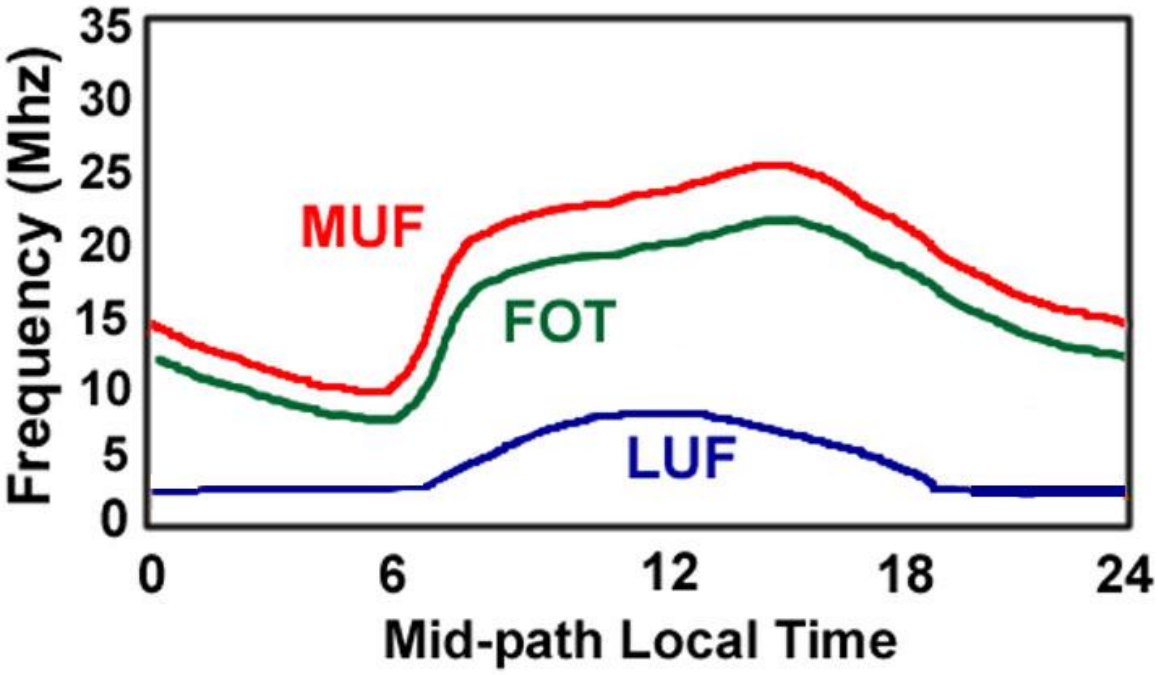
What does an ionogram tell us?

- The maximum usable frequency over a 100km path (5.2MHz) - 3000km path (14.9 MHz)
- The f_0F_2 critical (straight up) frequency (4.625MHz)
- The f_0E critical frequency (2.91MHz)
- The f_0E_s Sporadic E critical frequency (2.9MHz)
- And much more

Source; http://www.ukssdc.ac.uk/



Putting it all together:



The MUF also increases – the FOT gives the highest "probability" for the contact you want to make.

So what do we need to consider when operating?

- Solar flux levels
- Geomagnetic disturbance (A and K index)
- Direction signals need to travel
- Time of day/ time of year
- East-west/ North South/ Polar?
- Frequencies/Bands open
- Path – long/short, hops over sea/land

Putting it all together

- Higher solar flux levels are generally good for HF
- High K and A indices are generally bad – results in absorption and breakdown of the F region.
- A Chilton ionogram/ Solar Flux /K index/ Solar wind speed and IMF will give you a real-time indication of what bands you should concentrate on.
- Spring/Autumn/Winter is better than Summer as the ionospheric composition is “better” and the MUF is higher during the day. Night MUFs are higher in summer.
- The opposite is true in the southern hemisphere
- Spring/Autumn good for trans-equatorial contacts
- As the sun gets higher D layer absorption grows, but the MUF rises, so follow the MUF up during the day and down at night.