Six Meters,
the Magic Band

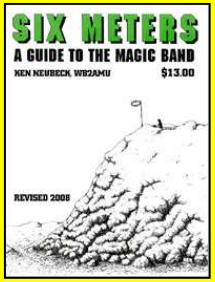
June 13, 2023

Presented by

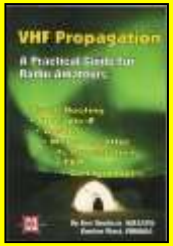
Ken Neubeck WB2AMU

WB2AMU – Ken Neubeck - biography

SIX METERS, A GUIDE TO THE MAGIC BAND. (Author)



VHF PROPAGATION, A PRACTICAL GUIDE (co Author)



Was columnist for CQ VHF Magazine until end of 2013.

Regular speaker on Six Meter and VHF topics at club meetings and conventions

Why is Six Meters called the “Magic Band”?

Six Meters is often quiet but at times, Six Meters can be a Kaleidoscope of propagation modes that can easily be observed!

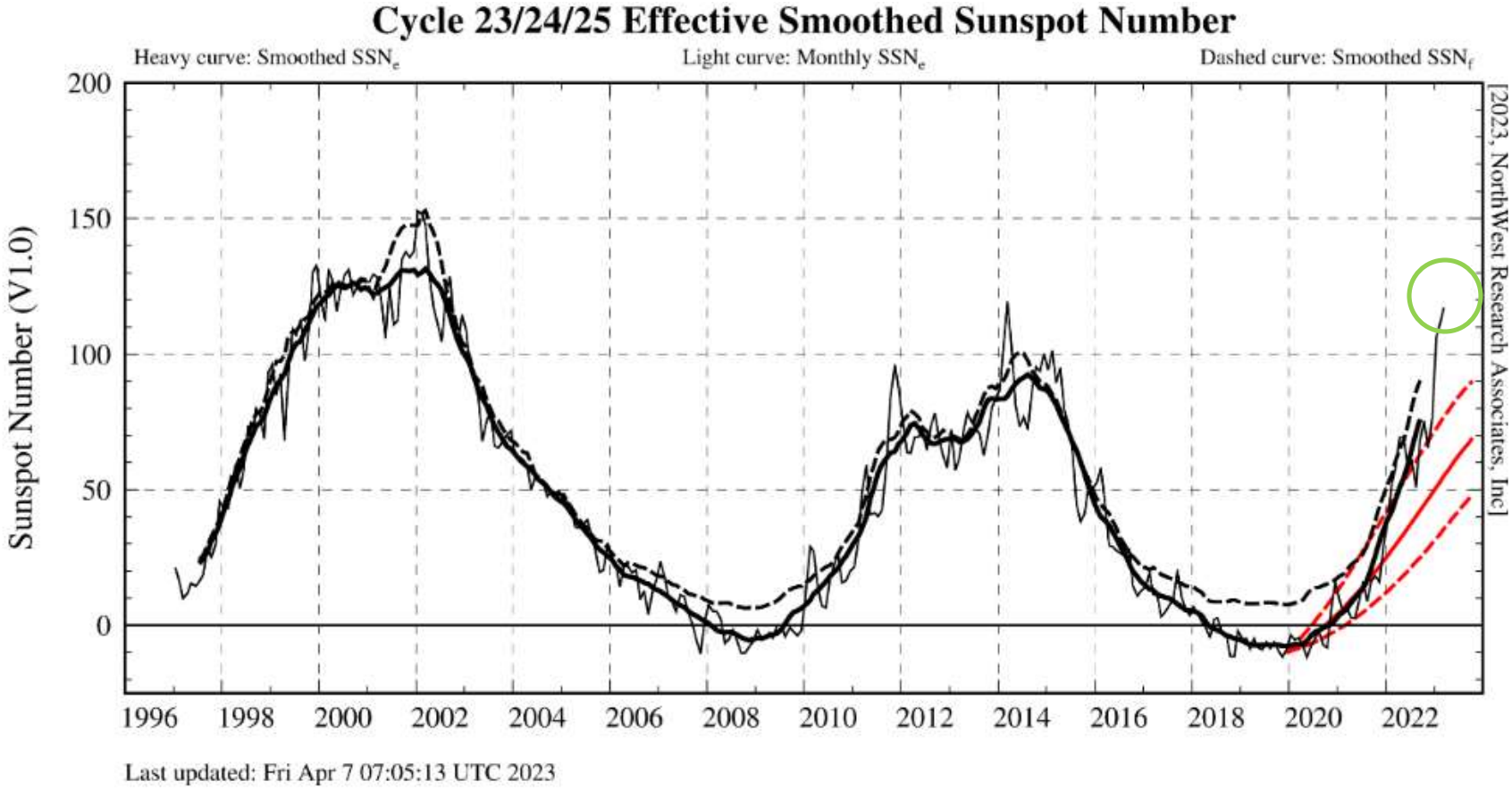
- Sporadic-E (Es)
- Aurora (Au)
- F2
- TEP
- Combination modes (TEP plus Es)

Possibilities for Six Meter DX in Future

- F2 activity above 28 MHz is on the decline from the peaks of the last three cycles – Cycle 22, 23 and 24
- Cycle 25 was originally projected to be worse than Cycle 24, which had only a small amount of F2. However, based on latest observations, many scientists are optimistic.
- There will be some TEP paths as F-layer ionization over the equator will require only moderate amounts of ionization.
- Possible F2 openings in Fall of 2023, most likely in 2024.
- However, the main propagation mode will be multiple-hop Sporadic-E which occurs during summer season of May through early August.

Solar Cycle 25 Potential

- Current plot



Six Meter Sporadic-E

- With F2 on Six being unpredictable in the future, Sporadic-E will be the primary means of working DX on Six Meters for the next two to three years.
- Sporadic-E is the bread-and-butter propagation mode that appears on Six Meters.
- It is a sky wave propagation mode that is observed on Six Meters, particularly during the summer months (May through August)
- Sporadic-E makes the Six Meter band interesting
- Six Meters is the borderline band between HF and VHF and is generally quiet in terms of propagation, so when Sporadic-E occurs, the band becomes exciting!

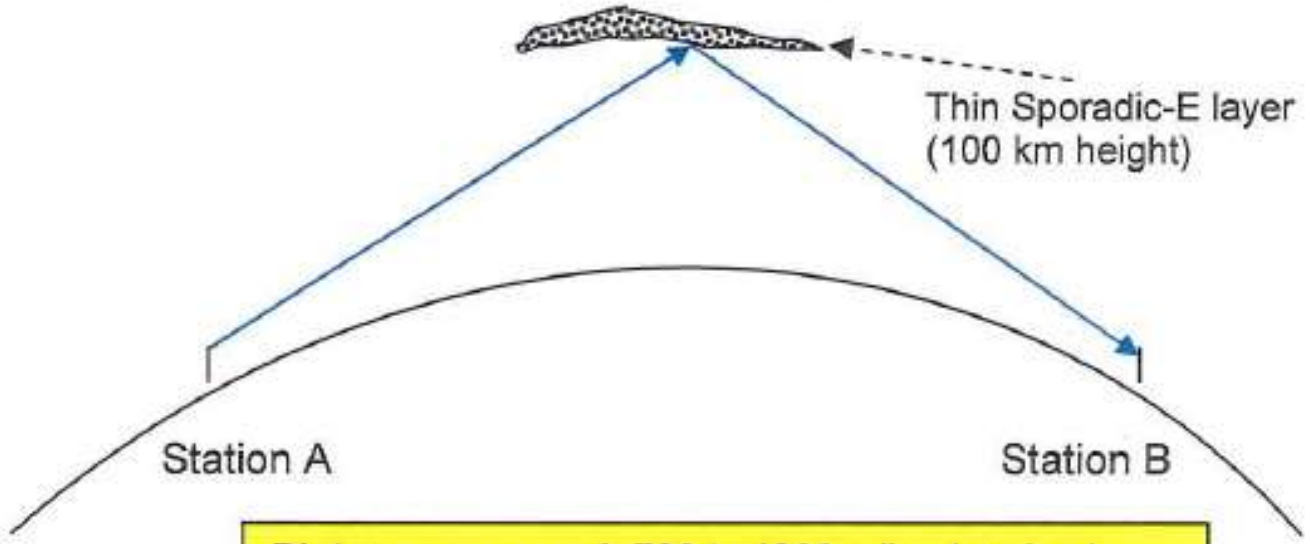
Sporadic-E Facts & Characteristics

- It was first discovered by radio amateurs in 1935 on the Five Meter band.
- Formations occur at 100 km (70 miles) above earth in E-region of ionosphere.
- Formations can reflect radio waves as low as 28 MHz up to 200 MHz as the density of the formation increases.
- Formations lasts for as little as five minutes to as much as several hours. Fading may occur due to non-uniform density.
- Signals can get very loud at times, even with low power!
- Major occurrence during summer months (May – June).
- Minor winter season (November – January).

Sporadic-E Facts & Characteristics (cont)

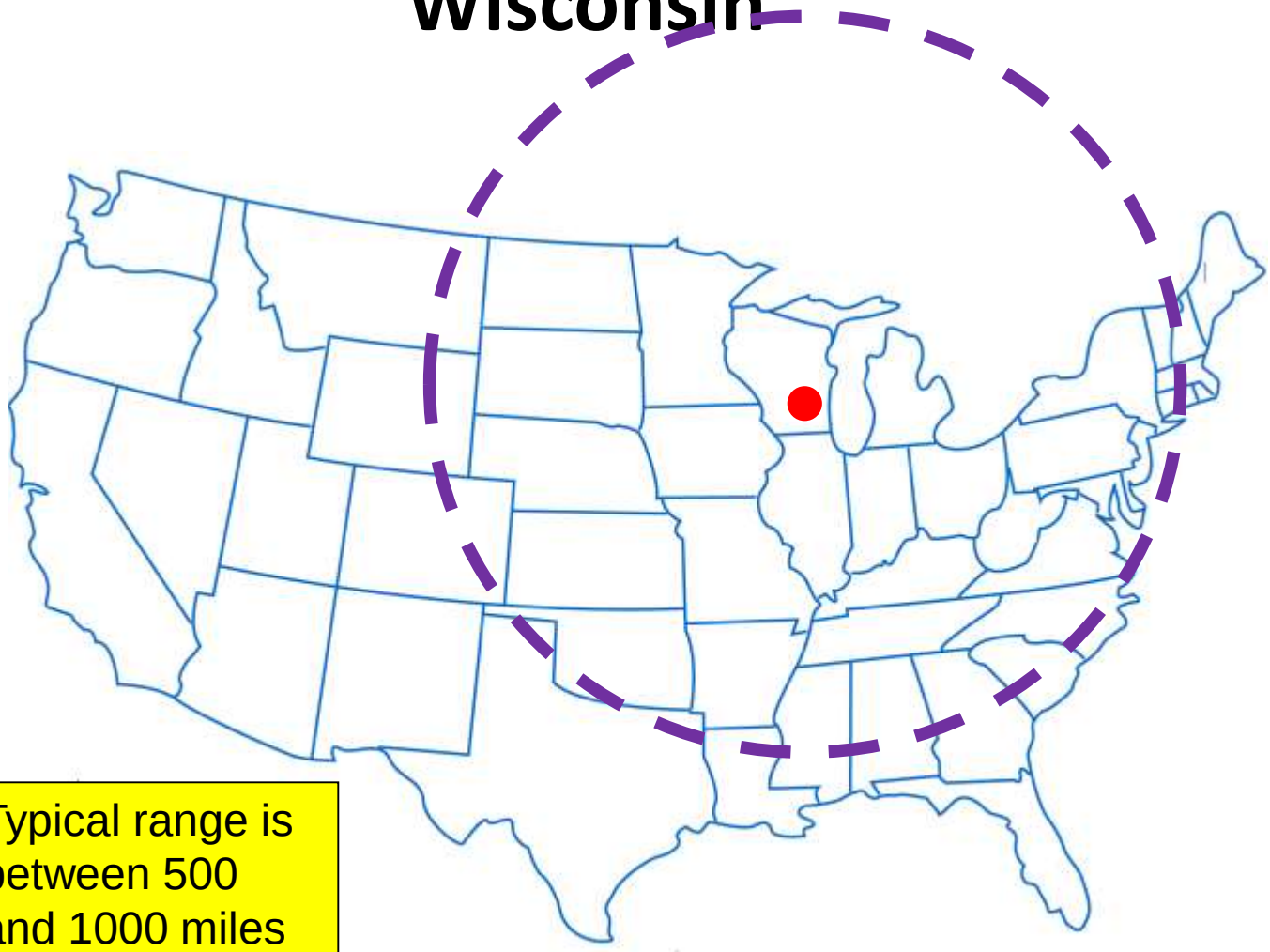
- Formations consists of ions that are iron, magnesium, nickel, silicon and other metals (determined by rocket probes).
- Summer season is significant with the presence of oxygen ions in the E-region as the result of solar radiation.
- During summer season, multiple formations can occur simultaneously, leading into long-range paths for DX contacts on the Six Meter band.
- As formations get denser, higher frequencies can be reflected. At this point, the skip appears shorter in distance (less than 800 miles) on Six Meters and at that point Two Meter Sporadic-E may occur on occasion during the summer.
- Sporadic-E is basically independent of the solar cycle (little variation year-to-year of the solar cycle).

Six Meter Single-Hop Sporadic-E Propagation



Distances covered: 700 to 1200 miles (per hop)
Occurs: major summer season, minor winter season
Duration: 5 minutes to several hours
Modes of operation: SSB, CW, AM, FM

50 MHz Single-hop Sporadic-E range from Wisconsin

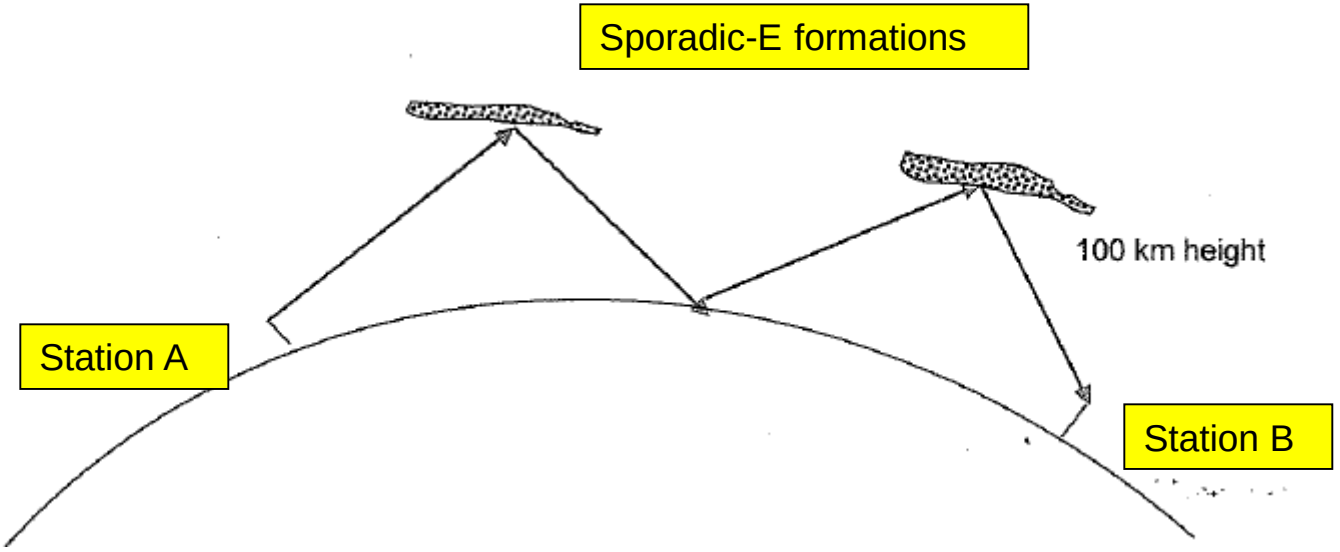


Typical range is between 500 and 1000 miles per single hop

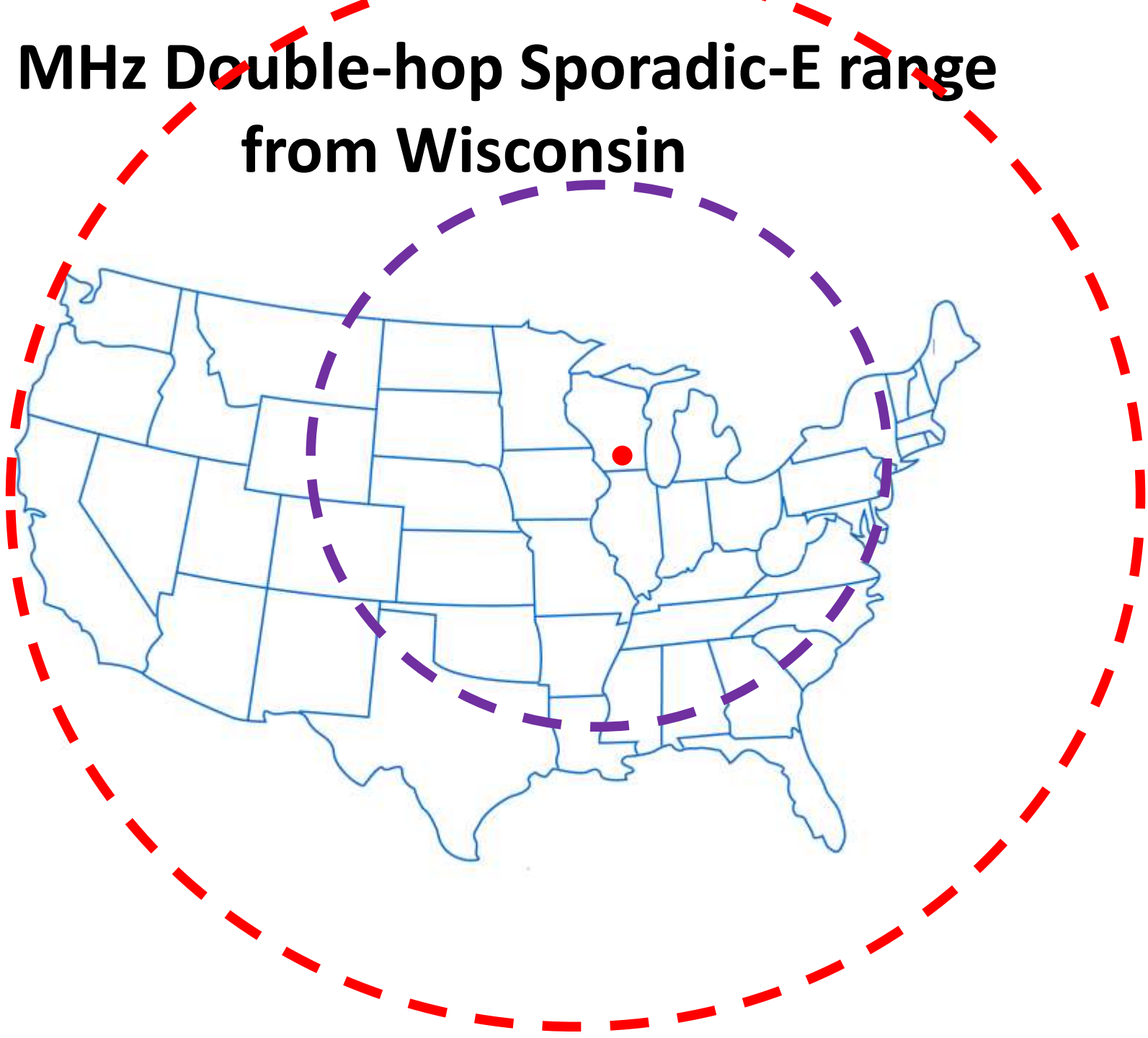
Working Sporadic-E on Six Meters

- The VUCC award is reasonably easy to obtain on Six Meters during one or two summer season of Sporadic-E activity.
- This requires confirmation of 100 grid squares worked on Six Meters.
- A grid square aligns with the geomagnetic division lines (2 degrees wide by 1 degree high.
- From Washington State, it is possible to work most of the western states, and into some of the Midwest states via single hop Sporadic-E

Double-Hop Six Meter Sporadic-E Propagation



50 MHz Double-hop Sporadic-E range from Wisconsin



Six Meters

- The day-to-day SSB and CW operation was significantly reduced during the past two summers because of the influx of digital modes.
- However, the beacons are still present to provide an indication that the band is open.
- SSB and CW is still very widely used during the VHF contests, particularly the ARRL events since stations will walk up the VHF and UHF bands.
- It generally takes longer to complete a digital contact, although improvements continue to be made with regards to the information exchange.

Multiple-Hop Six Meter Sporadic-E

- It is through multiple-hop Sporadic-E that long-range DX becomes possible (two hops or more) on Six Meters.
- Multiple-hop Sporadic-E can occur anytime on Six Meters between during the summertime Sporadic-E season from May and August, with June and July statistically being the best months.
- During June and July, eastern parts of the US and Canada can work into Europe. Spain, Portugal and the Azores are reasonably possible. Western and Midwest states can work into Japan during June and July as well.
- Typical summer can see five to six transatlantic openings between east coast of US and Canada into Europe. Peak time is June and July. Some summers may be more, some may be less.
- Remember, Sporadic-E is unaffected by the solar cycle, so activity is generally consistent each summer.
- Moderate equipment can be used to work domestic stations and DX stations. Simple beams and 100 Watts will do fine.

June 26, 2009 – Multiple-hop Sporadic-E opening

WB2AMU (FN30) into Europe (1800 to 2340 UTC)

Stations worked:

2-hop range	3-hop range	4-hop range
CT1HZE	G0JHC	S57A
CT4NH	MD0CCE	9A5CW
CT1LT	G4RRA	S57RR
	MM0AMW	IK5MEJ
	GI0RQK	
	PA2M	
	GM3SEK	
	GM4ISM	
	PA0RDY	
	GW3YDX	
	G3TBK	
	F8DBF	
	G3LDI	
	ON7GB	
	GI6ATZ	
	EI7IX	

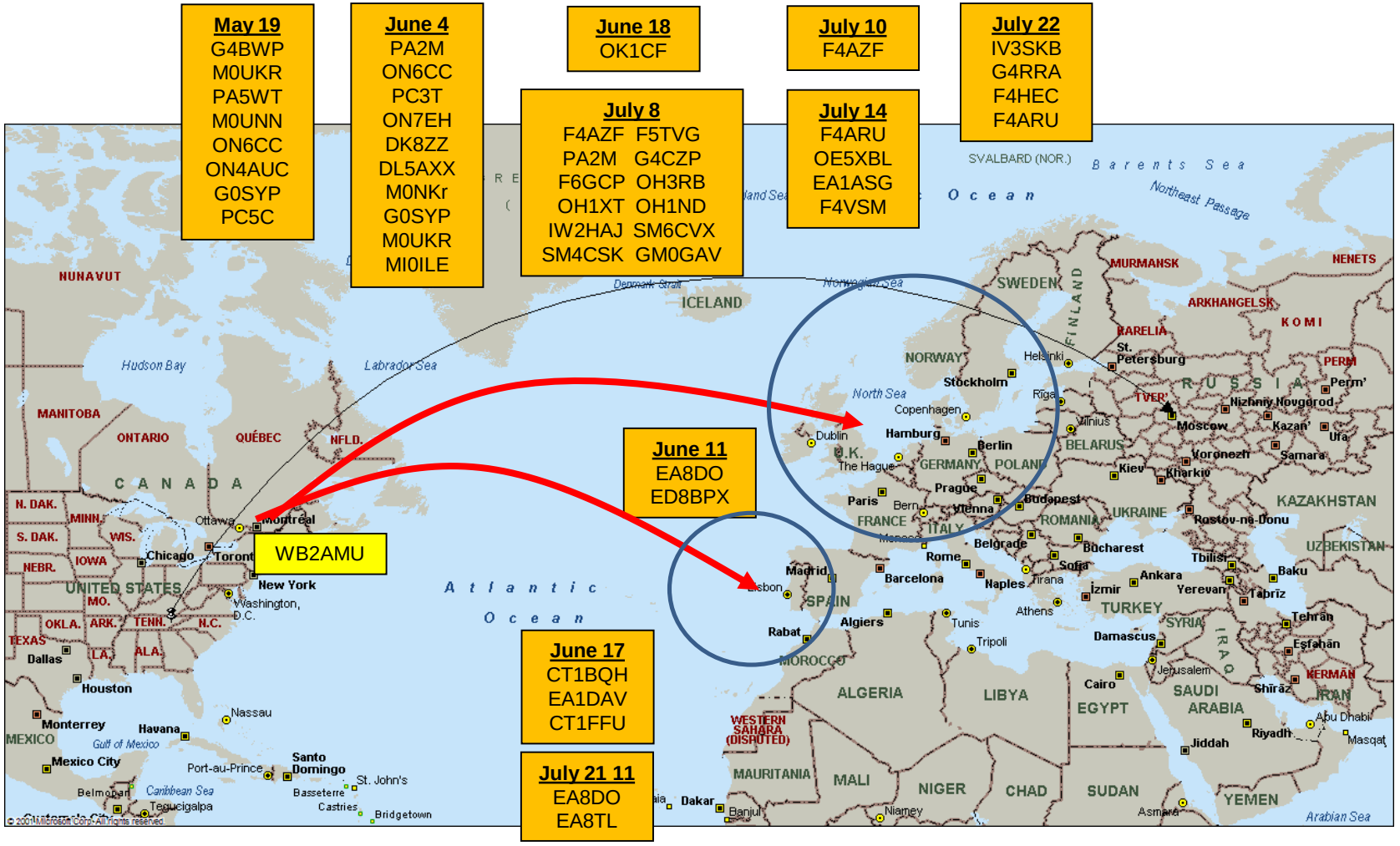
June 26/27, 2009 – Multiple-hop Sporadic-E opening

WB2AMU (FN30) into West Coast USA (2350 to 0230 UTC)

- After the great opening into Europe faded, both US midwest and west coast stations started coming in.
- WB2AMU worked K5TDA and N7KA in New Mexico at 2350 UTC via 2-hop Sporadic-E.
- Additional stations after 0000 UTC of June 27th was VE7SL in British Columbia, W7XA in Arizona, W6OUU in Idaho, K5RC in Nevada, K7XC in Nevada and NT6K in California.
- There was as many as five or six Sporadic-E formations at one time that were in play during the opening.

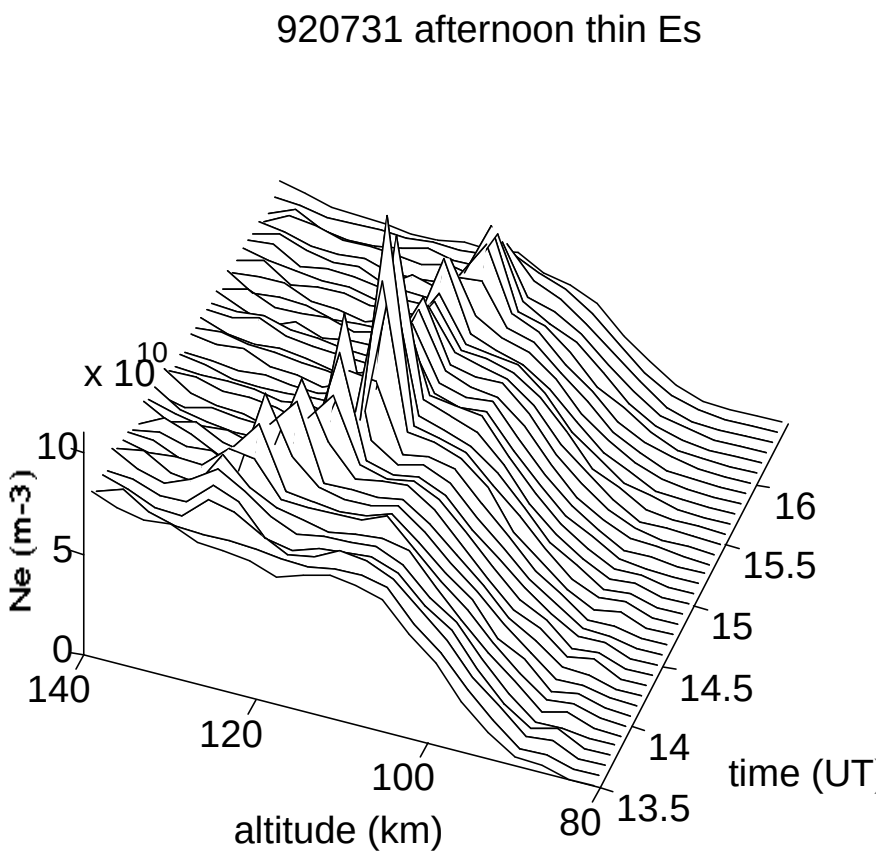
2021 Transatlantic Six Meter Sporadic-E

- Many Transatlantic openings occurred during Summer of 2021! WB2AMU from FN30 in Long Island worked CW and SSB



Sporadic-E Radar Plot

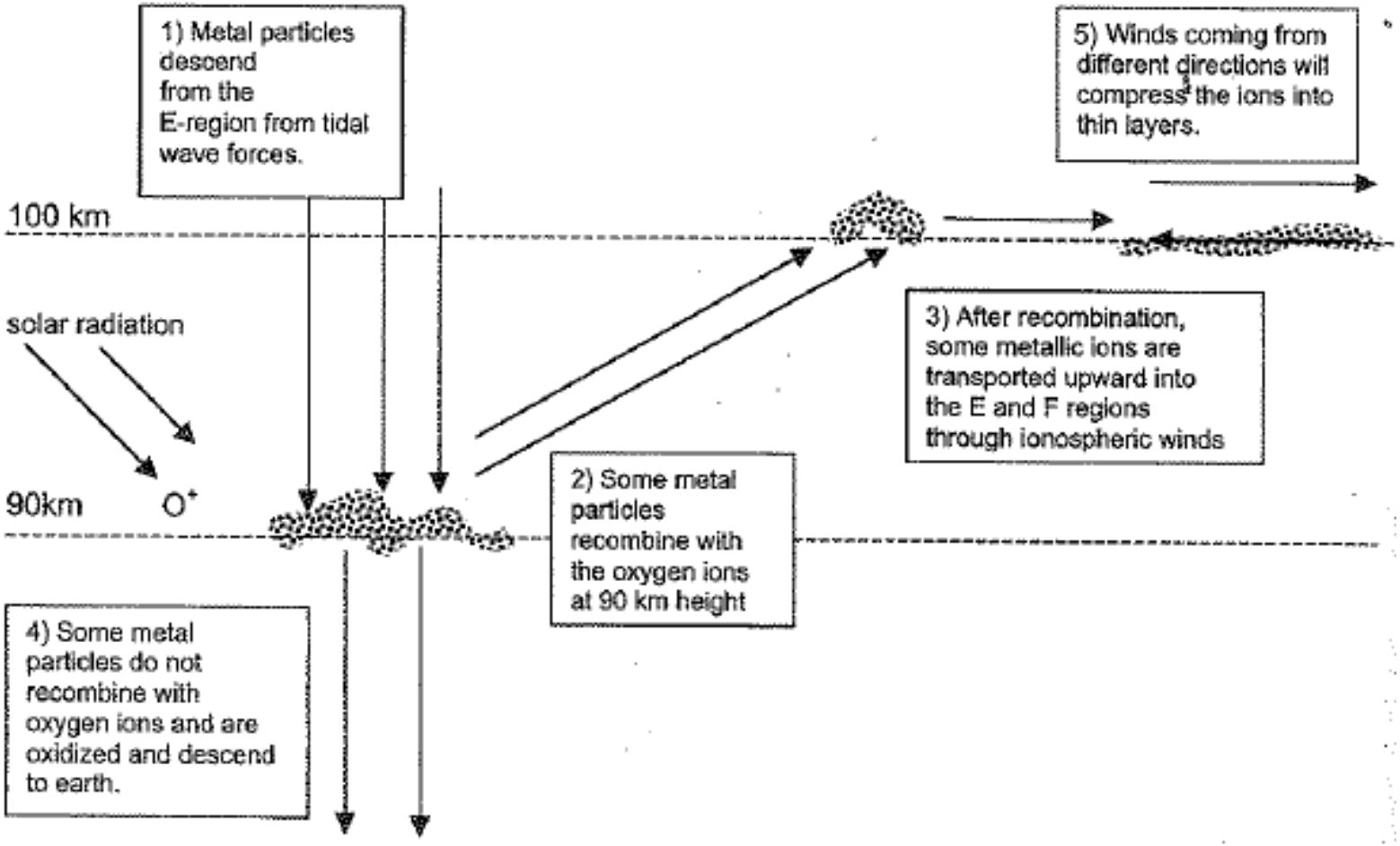
- EISCAT Radar plot shows thin layers descending in altitude.



What causes Sporadic-E?

- Many hams and some scientists believe that thunderstorm activity causes Sporadic-E formation, however, thunderstorm activity is below 10 km altitude – Sporadic-E occurs at 100 km.
- It is believed that oxygen ions at 90 km range recombine with neutral metal particles to form metal ions.
- During summer month, solar radiation creates more oxygen ions at the 90 km range, which combined with metallic particles will create more metal ions.
- Windshear activity in the E-region causes the compression of thin layers. Due to variability of windshear activity, particles collect and form layers.
- Tidal waves or gravity causes the downward motion of ions until it reaches 90 km where the formation breaks up

Sporadic-E Transport Theory



FT-8 Observations on Six Meters

- FT-8 observations show that Sporadic-E is almost a daily occurrence during the summer months. Weak Sporadic-E openings are picked up by this mode.
- FT-8 observation shows that double-hop Sporadic-E are common on a daily basis during June and July, even when they cannot be heard via human hearing!
- FT-8 observations during the spring and fall equinox periods on Six Meters confirm the almost total void of Sporadic-E activity during this time period.
- There are some limitations with FT-8 operations on Six Meters, particularly during periods of high activity during the June ARRL VHF contest where CW and SSB activity is used.

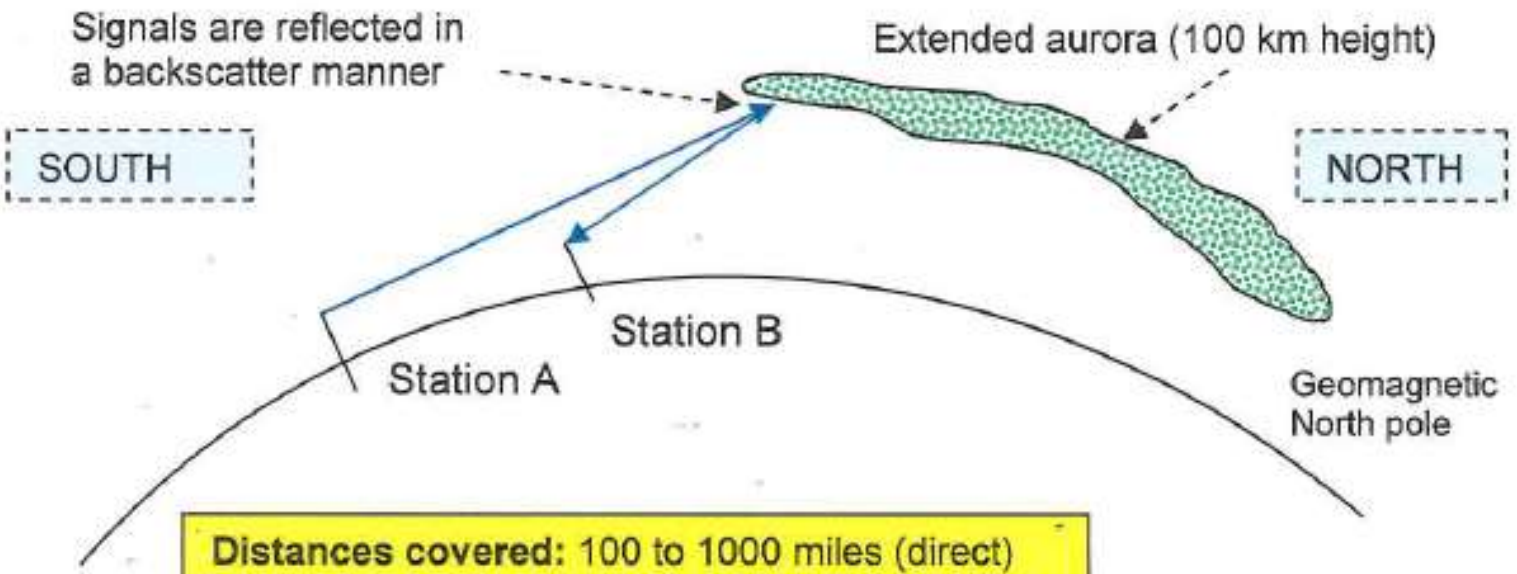
Vortex theory

- Windshear is a critical component in the formation of Sporadic-E.
- Just as important is the presence of collection points where the particles collect to form into layers. This is due to variability in the windshear and wind speed.
- “Circular Swimming Pool effect” as ion particles join together as they approach each other.

Aurora activity on Six Meters

- A few aurora events were observed during the last sunspot cycle during 2015 and 2016 with a few events reaching to mid-latitude levels during this time.
- Cycle 24 was weak with regards to geomagnetic events such as solar flares and CME impact on earth's magnetic field.
- There is optimism with regards to Cycle 25. Even moderate solar activity could still be some increased occurrences of aurora during upcoming spring equinox periods.
- This mode is likely to occur occasionally after a CME impact on earth occurs.

Six Meter Aurora Propagation

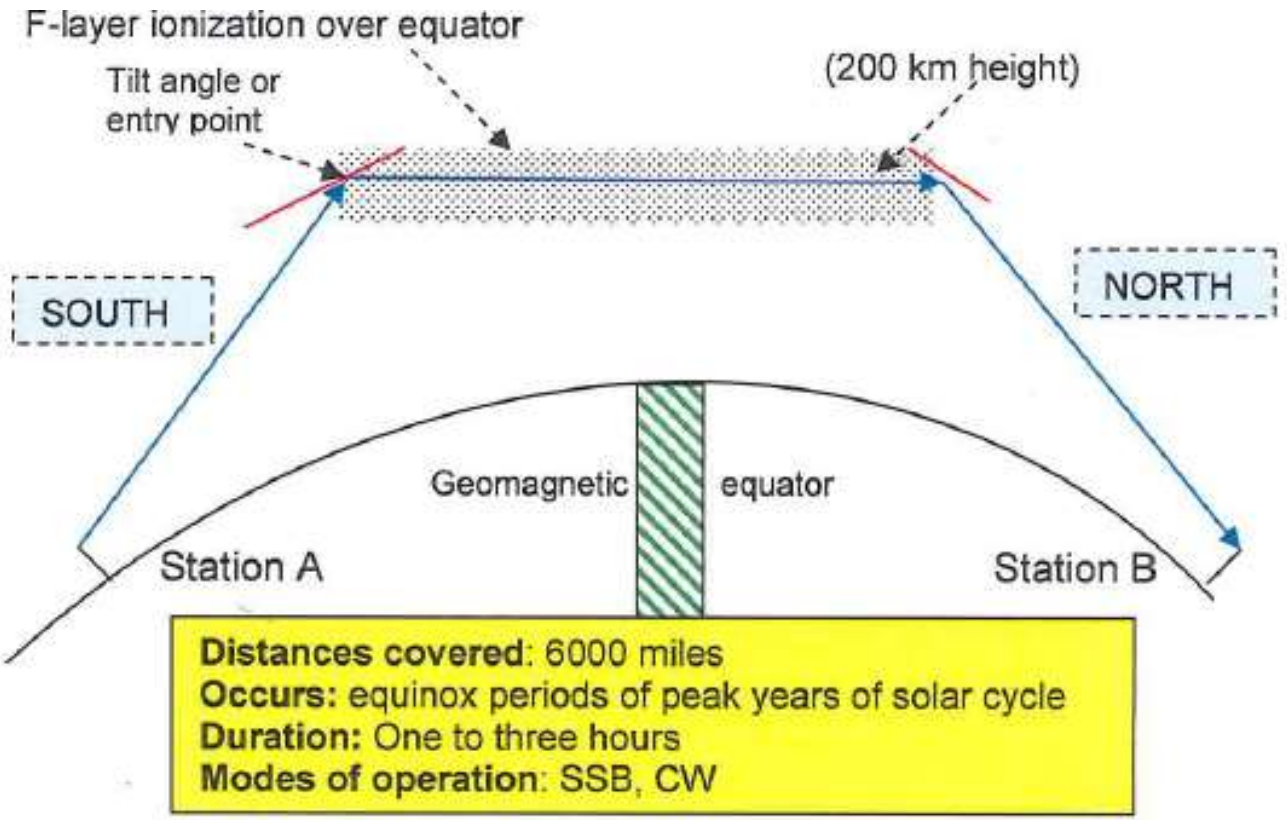


Distances covered: 100 to 1000 miles (direct)
Occurs: Equinox periods, sometimes summer
Duration: 10 minutes to several hours
Modes of operation: CW, SSB

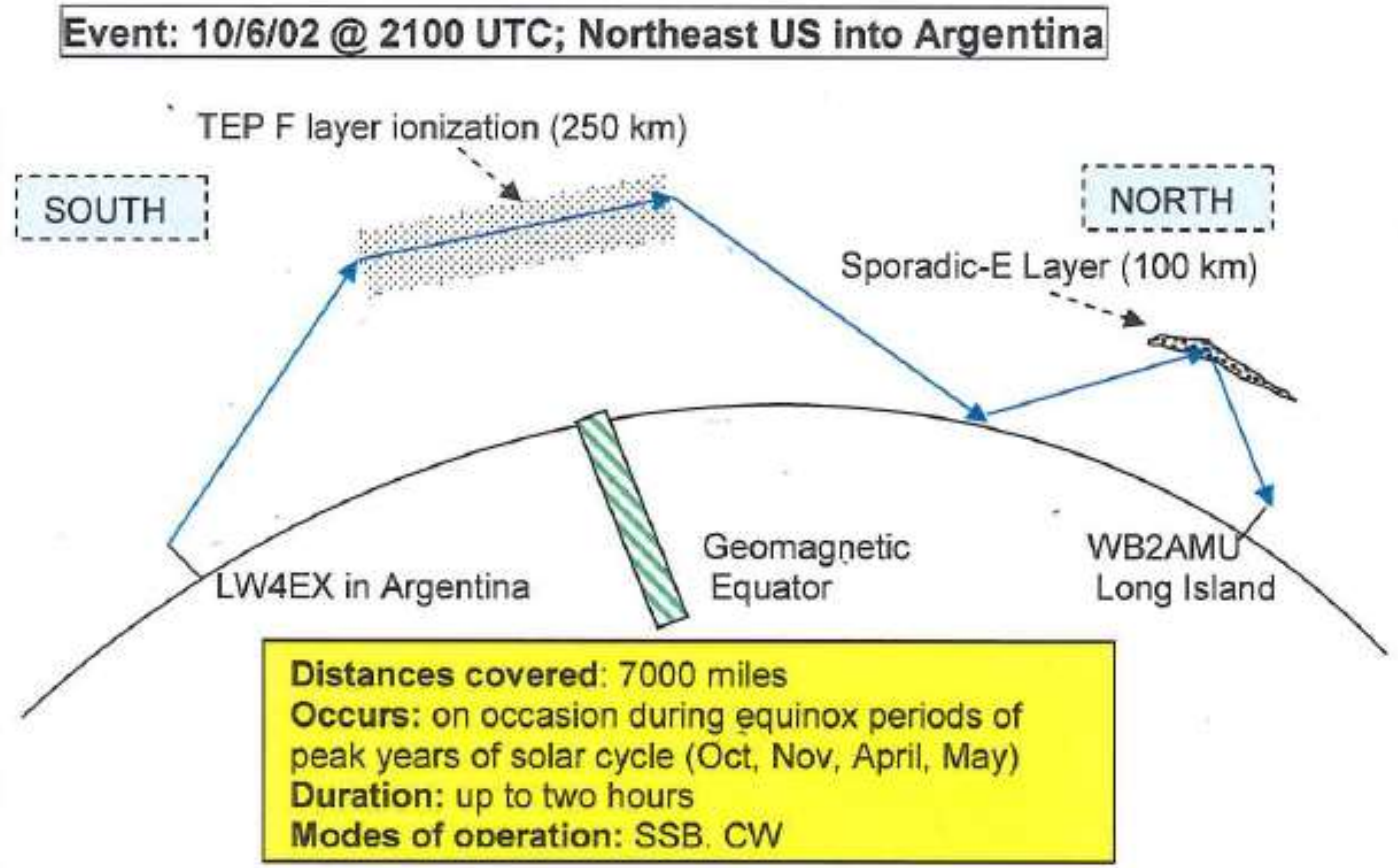
Transequatorial Propagation (TEP)

- Even though conventional F2 propagation on Six Meters has may be diminished due to lower solar activity this cycle, solar cycle can be sufficient enough to aid another form of F-layer propagation that forms over the geomagnetic equator – Transequatorial Propagation (TEP)
- Transequatorial Propagation is prevalent during the equinox periods – April/May and October/November.
- Need lesser amount of ionization for the F layer over the equator to be energized in comparison to F2 layer.
- It is generally a late afternoon/early evening occurrence.
- So even though F2 activity has been low for Cycle 24, TEP activity and similar cross-equatorial propagation was present during Cycle 24 up to 2014. Next time period would be around 2020.

Six MeterTransequatorial (TEP) Propagation

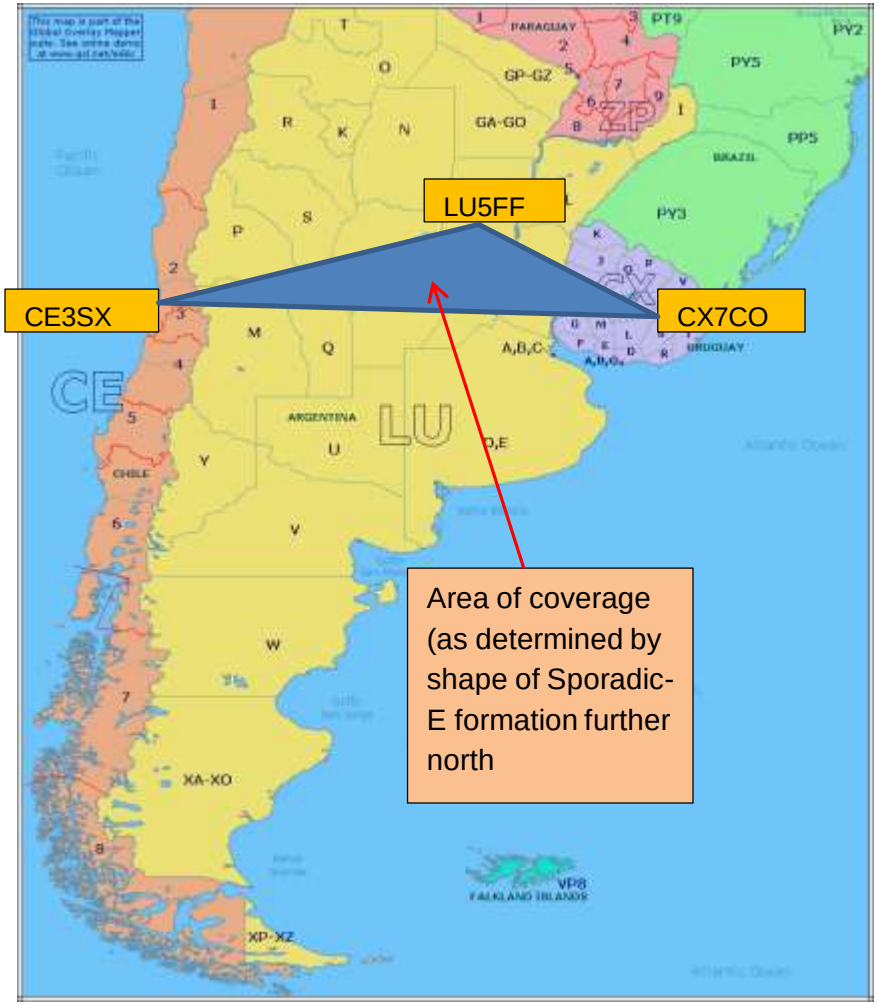


TEP can combine with Sporadic-E



Six Meter TEP plus Sporadic-E (5/12/14)

WB2AMU, Long Island, NY (FN30) into South America



Modes used on Six Meters

- Three primary modes used on Six Meters
  - SSB
  - CW
  - Digital Modes (FT8, WSJT)
- In recent years, digital modes have been the primary mode of communications and there was minimal CW and SSB activity, except during the VHF contests.
- However, during the summer of 2021, while FT8 activity continued to be high, there was significant amounts of DX stations (especially Europe) that used CW and SSB.

Discussion on FT8 and Digital Modes

- WSJT, JT65 and FT8 was designed by Joe Taylor K1JT and Steve Franke K9AN originally to aid in weak signal propagation such as Sporadic-E.
- It is an extremely useful tool in showing the presence of Sporadic-E propagation on the Six Meter band, particularly when signals are below the range of human hearing (12Hz).
- Essentially it is computer plus devices working other computers with simple exchange – signal report, grid and 73.
- At -3db or so, audible tones can begin to be heard. At some point, it makes sense to go to CW and SSB modes when there are strong signals on the Six Meter band.
- Speed is set – about one minute to complete FT8 QSO.
- Limits of FT8- SSB is faster with good opening during the VHF contest and it is easier to “walk” the band with SSB.

Portable Six Meter antennas can be used for all Six Meter propagation modes!

Three element Six Meter Yagi at Field Day site located in Eastern Long Island

Three element Six Meter Yagi at a portable location for the January VHF Contest on hill 250 feet ASL in Central Long Island. Beam is mounted on pole, up 10 feet.

VHF Contests

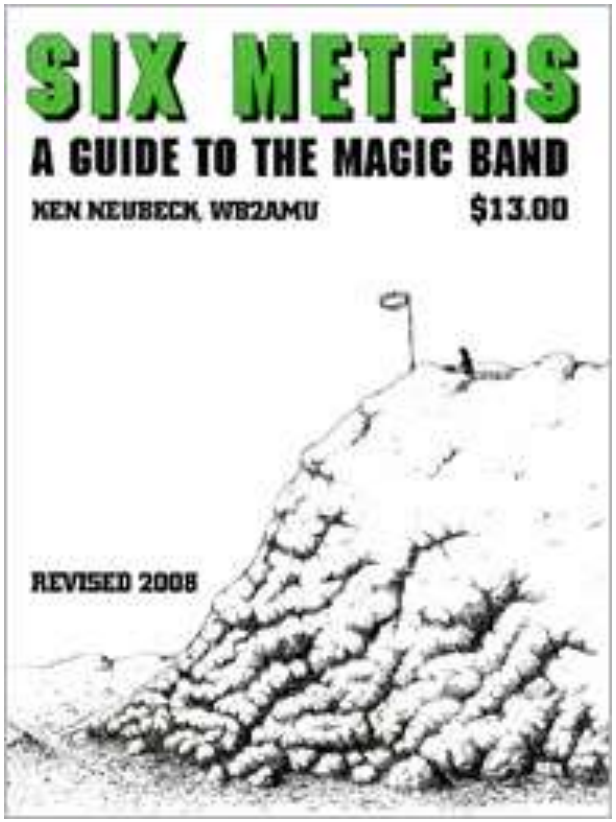
- The three ARRL VHF Contest that are held yearly take place during times of certain propagation modes.
- ARRL January contest: Some short-duration Six Meter Sporadic-E openings and line-of-sight communications. Next event is the weekend of January 19 and 20.
- ARRL June contest: moderate levels of Six Meter Sporadic-E openings that appear during the contest and on occasion, aurora openings.
- ARRL September contest: tropo openings, rare Six Meter Sporadic-E and rare Six Meter aurora openings.
- CQ WW VHF Contest occurs in July.

Tips towards working DX on Six Meters

- Monitor the domestic calling frequency of 50.125 MHz and the DX calling frequency of 50.110 MHz for activity. Also, the beacon portion of the band of 50.060 MHz through 50.080 MHz is important.
- Check digital modes of 50.313 MHz and 50.323 MHz.
- CW is a very important mode towards working DX. Europeans like to frequent between 50.080 and 50.105 MHz.
- Spotting sites on the Internet such as the ON4KST.com site are extremely helpful where there is an interactive map and chat.
- Even though F2 activity has not yet started for Cycle 25 on Six Meters, Sporadic-E will make it possible for east coast US stations to work DX in Europe, Africa, South America and North America, both on digital modes and CW.

SIX METERS, A GUIDE TO THE MAGIC BAND

- Written in 1994 because there was not a lot of information about Six Meters at the time. Published by Worldradio. A total of four editions have been published.



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