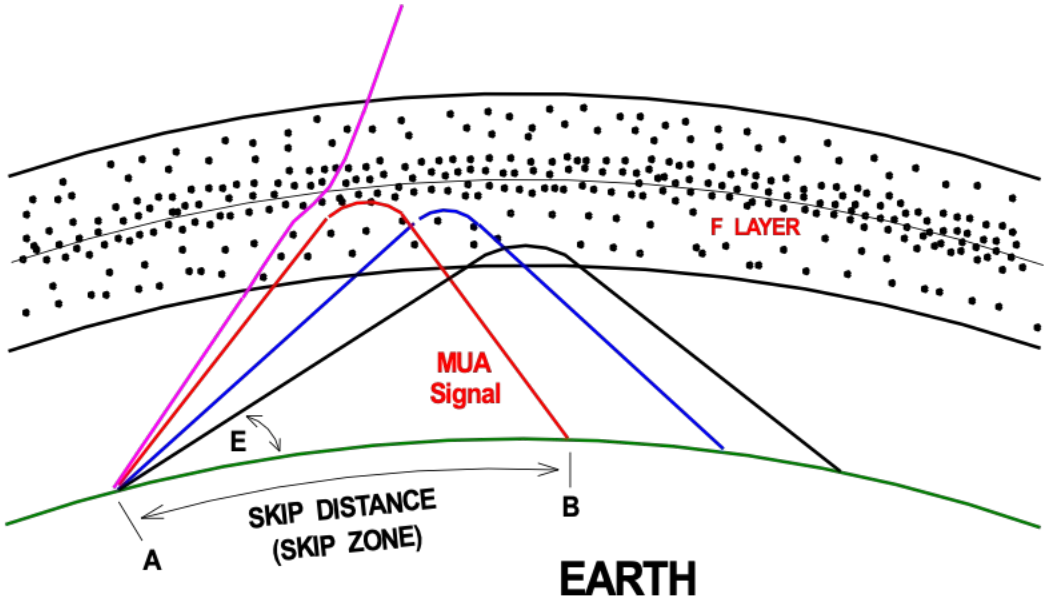
Skip Distance Test Introduction

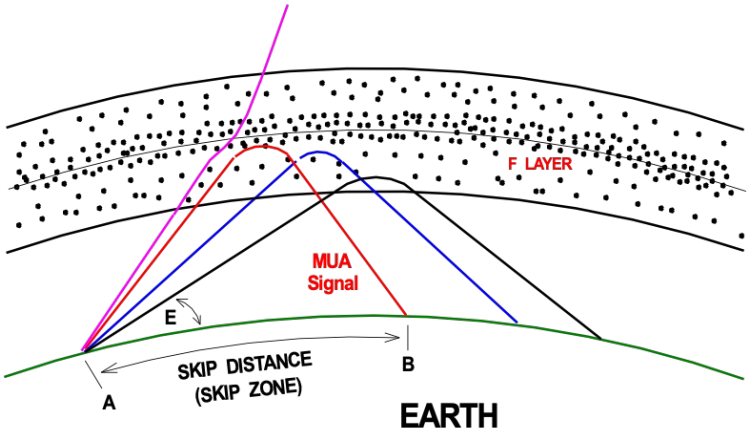


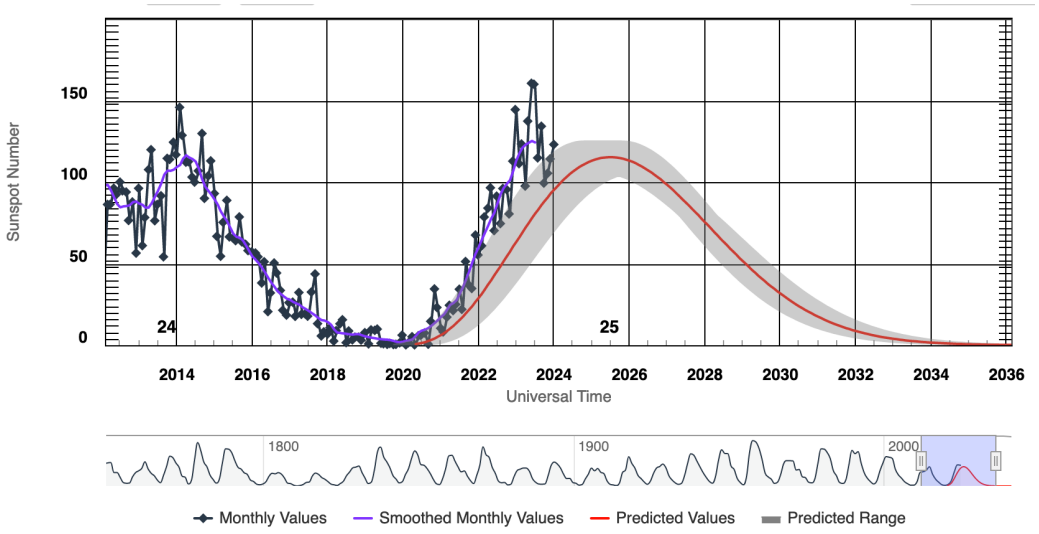
Ken Larson KJ6RZ

February 2024

www.skywave-radio.org

Skip Distance Tests

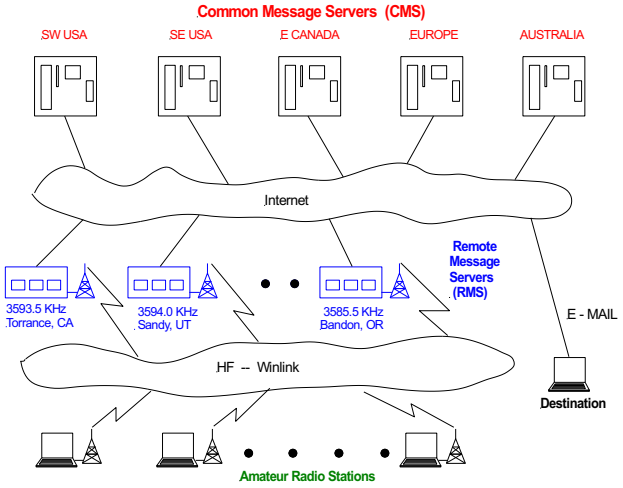




Solar Sunspot Cycle 25

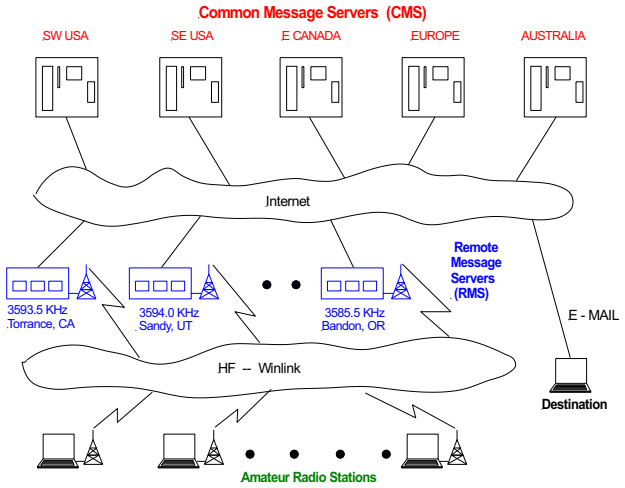
- A series of tests were conducted to study the presence and characteristics of skip zones occurring on the 20, 40, and 80 meter frequency bands
- The tests were conducted in January 2018 near solar minimum and again in February 2024 during the ascending phase of Solar Cycle 25
- The occurrence of skip zones depend on:
  - The solar cycle,
  - Time of day,
  - The ionosphere's critical frequency, and
  - The HF operating frequency

Test Requirements



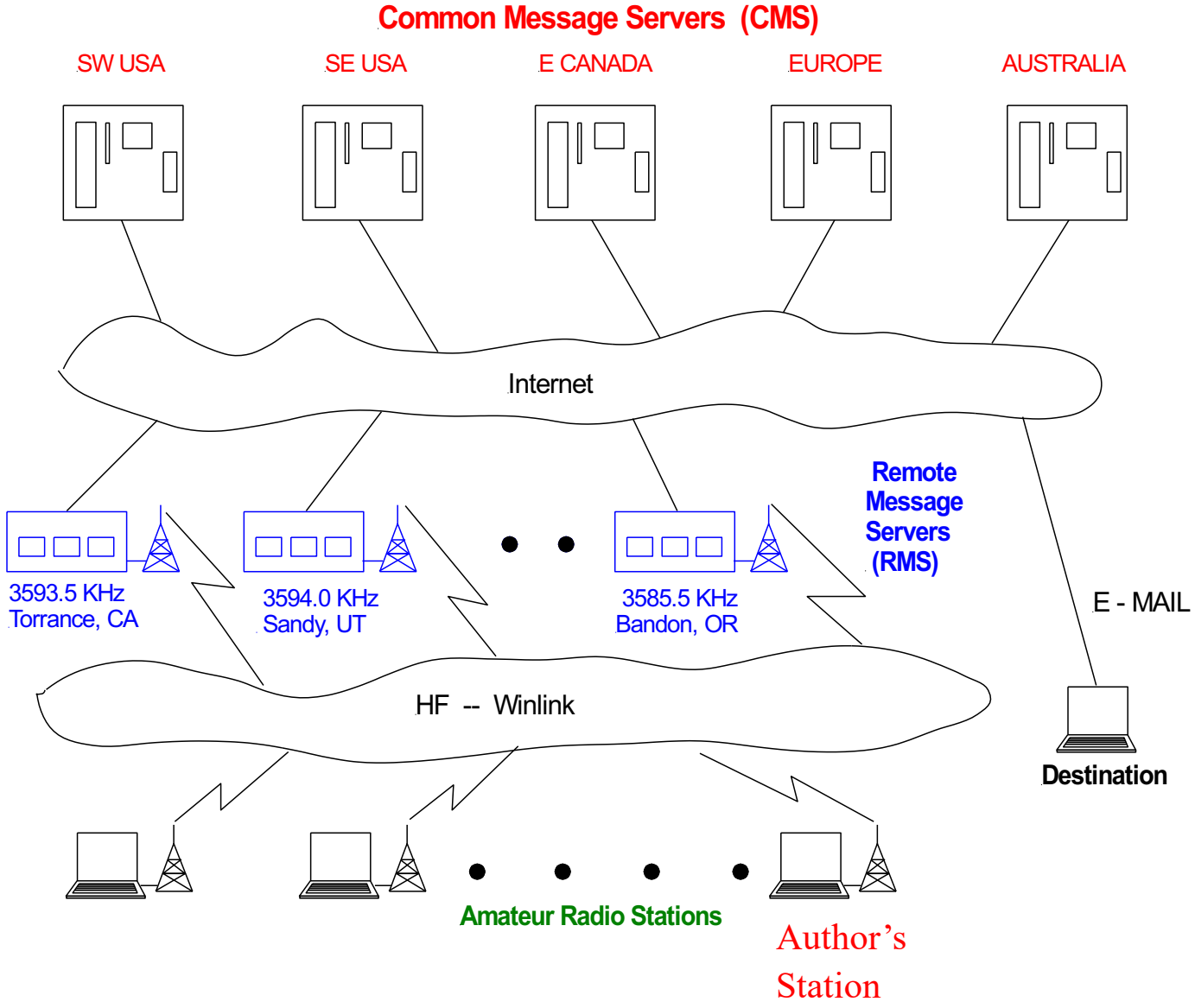
- The tests were conducted from the author's radio station (KJ6RZ) located in Thousand Oaks, CA about 40 miles northwest of Los Angeles
- To conduct the experiment a set of test stations with the following requirements were required
  - Stations positioned uniformly from close in (11 miles from the author's stations) out to 1,000 miles
  - Stations operating continuously 24 hours a day 7 days per week on the 80, 40, and 20 meter frequency bands
  - The ability to connect with a specific test station, transfer a minimum amount of data, and disconnect from the station
  - Receive a report from the test station including the duration of the contact

WinLink RMS Stations

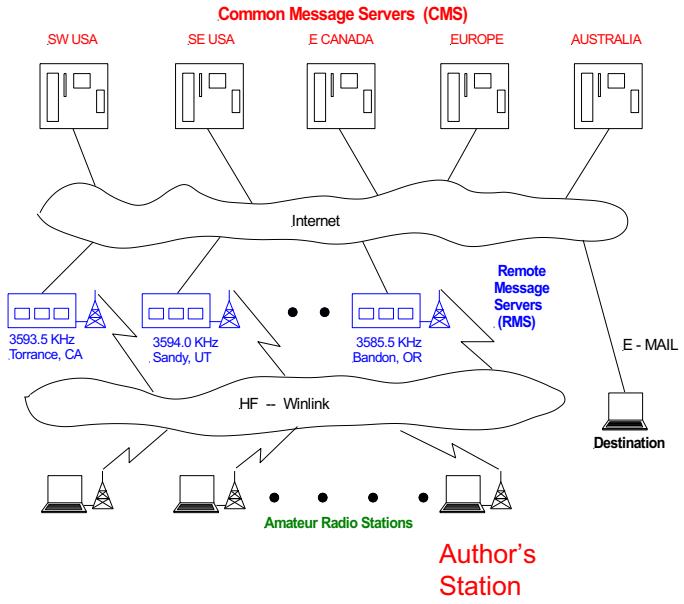


- WinLink Remote Message Server (RMS) stations satisfy the requirements for performing this experiment
- RMS stations are located throughout the United States and Canada and in particular, for this experiment, throughout the Western United States
- RMS stations provide the required reports
  - The message exchange for a very good connection lasts 16 to 18 seconds (0:16 – 0:18 minutes),
  - A poor connection requiring some retransmissions takes 35 to 60 seconds to complete,
  - A very poor connection requiring extensive retransmissions lasts 1 to well over 2 minutes
  - A station that can not be contacted at all is signified by a no-connection (nc) contact
- The author's station was operated at 10 to 50 watts using Inverted V horizontal antennas on 80, 40, and 20 meters

The WinLink Network



Normal WinLink Operation

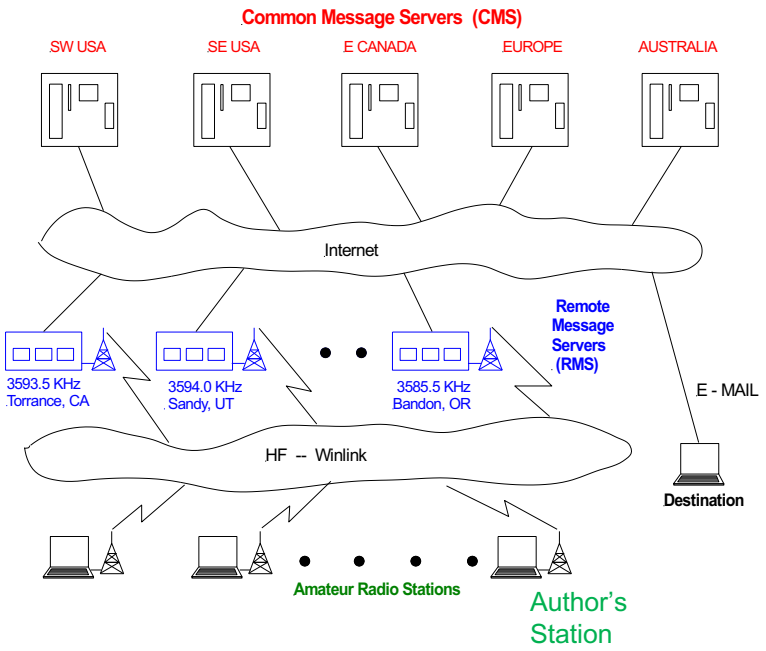


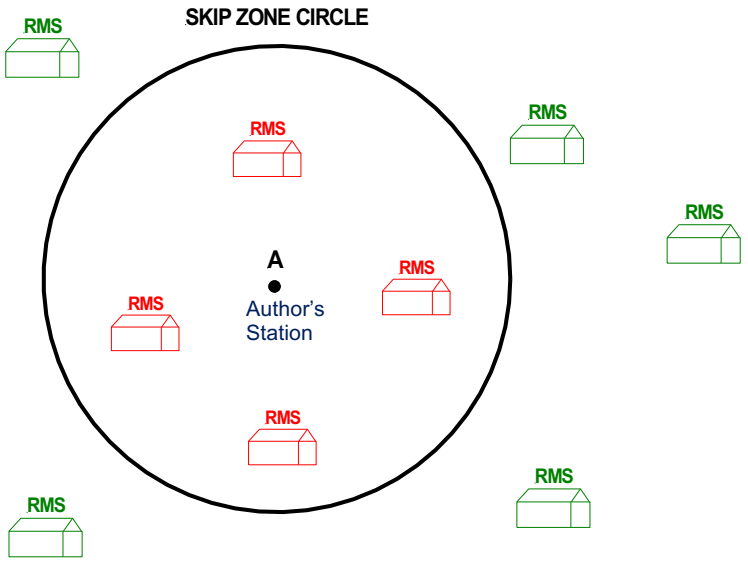
For this skip distance experiment communications was limited to that between the author's station and selected RMS stations since the message segments of the author's transmissions were empty.

That is, the internet and CMS servers were not involved

- WinLink is primarily intended for sending e-mail messages to distant recipients when e-mail service is not available at the sending location
- For example:
  - From remote often mountainous regions
  - From ships at sea
  - During natural disasters
- Normally an e-mail message is transmitted by HF radio to a selected RMS station
- The RMS station forwards the message via the internet to one of 5 Common Message Severs (CMS)
- The message is copied to all 5 CMS servers
- One of the servers forwards the message through the internet to the addressed destination
- The e-mail recipient can respond by simply sending a replay which goes to all 5 CMS servers
- The radio operator receives the reply the next time he or she connects to **any** RMS station

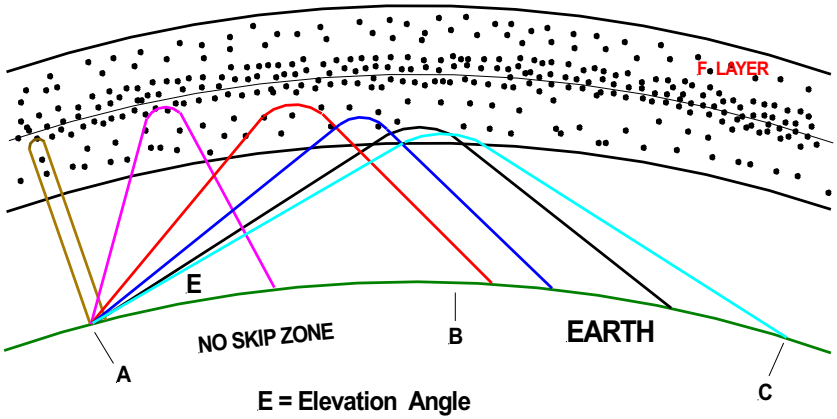
Winlink Operation continued



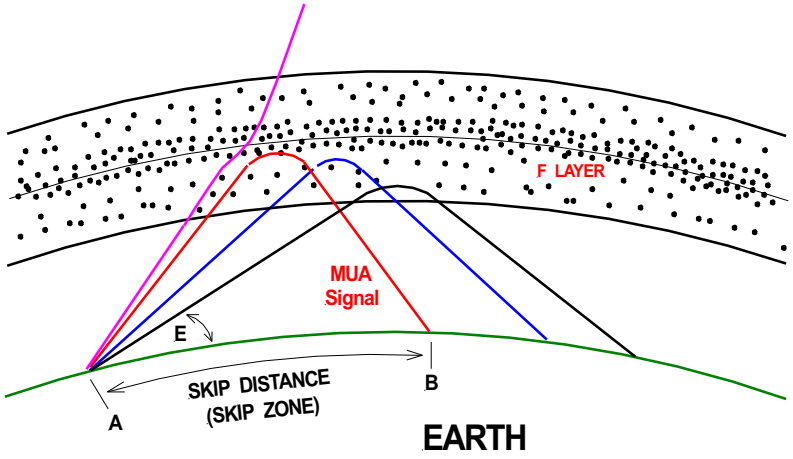


- RMS stations within the skip zone (red RMS houses) can not be reached
- Stations that can be contacted are outside the skip zone (green houses)
- The size of the skip zone, that is the skip distance, must be known to determine which RMS stations can be reached and which can not
- This information is extremely important for emergency communications and is the driving force in conducting this experiment

When Will A Skip Zone Be Present ?



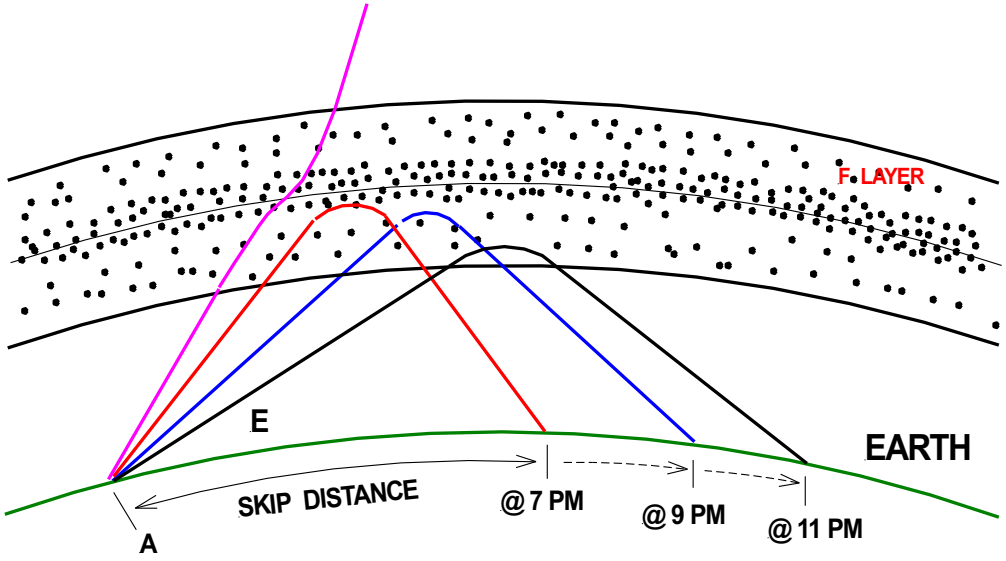
No Skip Zone if $f_c > f_o$

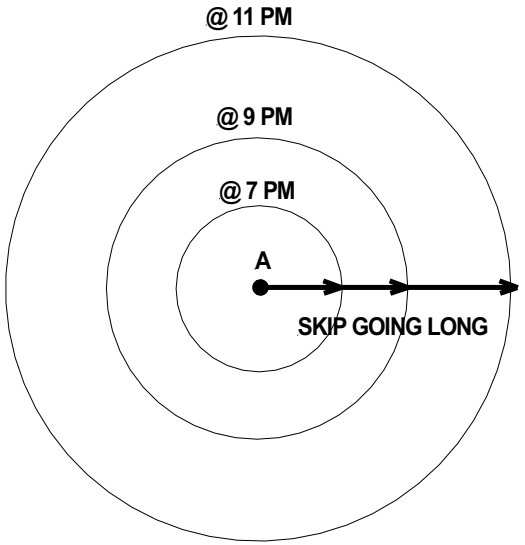


Skip Zone Present if $f_c < f_o$

- A skip zone will NOT occur if the critical frequency f_c is above the station's operating frequency f_o that is if $f_c > f_o$
- In this case, a station utilizing Near Vertical Incident Skywave (NVIS) propagation can communicate with all stations from the base of its antenna out hundreds of miles
- However, if the reverse is true if $f_c < f_o$ then there will be a skip zone as demonstrated by this experiment

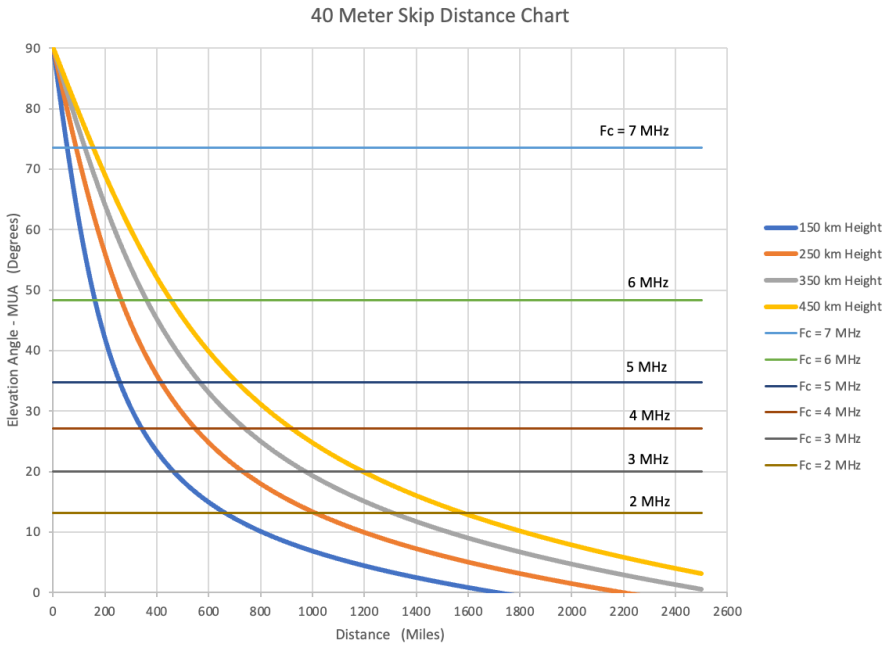
Skip Going Long





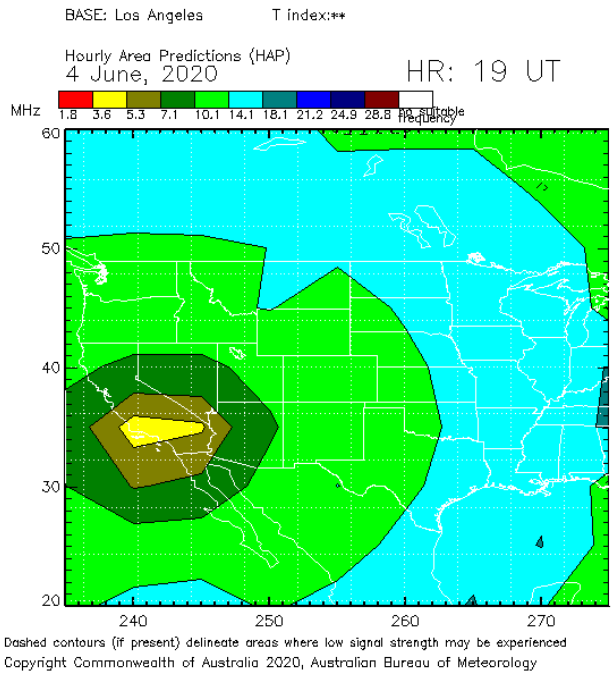
- A skip zone exists whenever the critical frequency f_c is below the station's operating frequency f_o , again when $f_c < f_o$
- Under these conditions the skip zone typically becomes larger at night, producing a longer skip distance, as the critical frequency drops further and further below a station's operating frequency
- That is, "the skip distance goes long" at night as the critical frequency drops
- This experiment demonstrated this phenomena

Skip Distance Charts



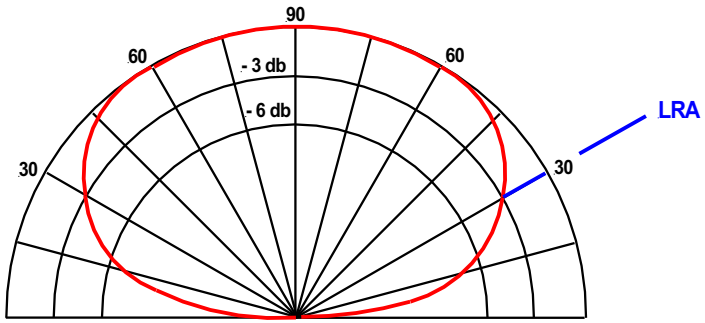
- Skip distance charts have been developed by the author to estimate current skip distance based on real time critical frequency and F2 region peak electron density information
- The charts are available under the "Tools" tab of the www.skywave-radio.org website
- The question is, do these charts provide a reasonably accurate estimate of current skip distance?
- The skip distance experiment answered that question and happily the answer is YES

HAP Charts

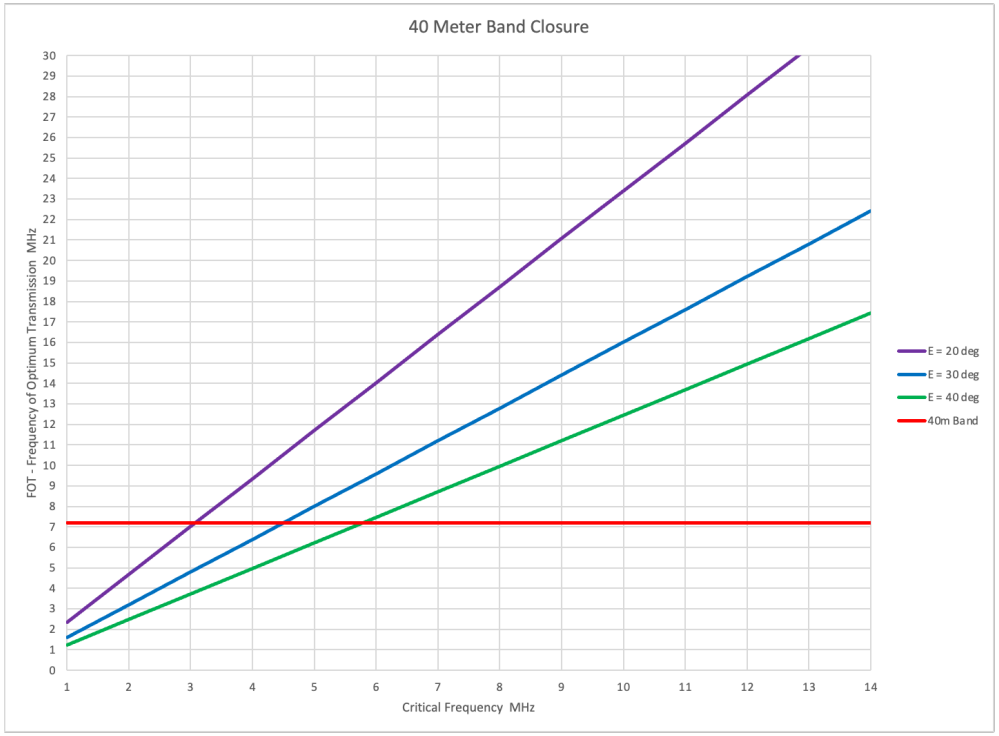


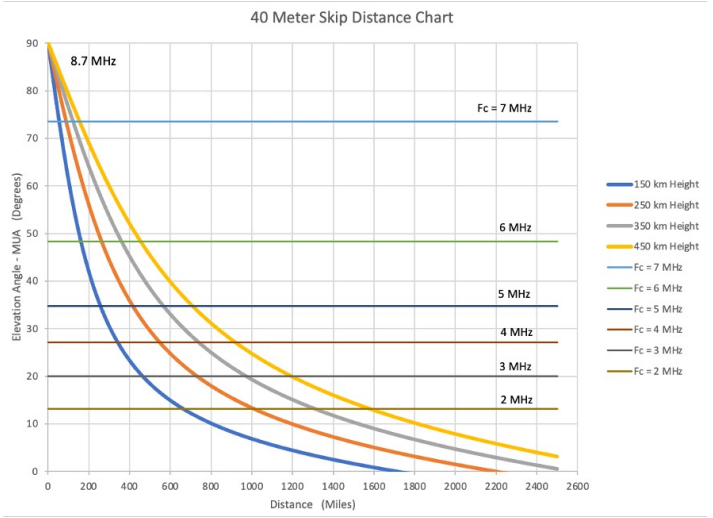
- Hourly Area Prediction (HAP) charts are produced by the Australian Bureau of Meteorology
- These charts, available under the "Tools" tab of the www.skywave-radio.org website, also provide an estimate of current skip distance
- Again the question, do these charts provide a reasonably accurate estimate of current skip distance?
- The skip distance experiment answered this question as well and again happily the answer is YES

Band Closure Estimate



- In addition, the skip distance experiment developed techniques for predicting when a frequency band will become dead





40 Meter Ground Wave Test Data – For 1/19/2024

Time	Frequency MHZ	Call	Distance Miles	Signal Qual	Contact Duration (min)	Power Watts	Antenna	Tries	Comments
						200	Yellow		8.2 MHz
17:09	7102.100	W6BI	11		0:22			QRM	Simi Valley, CA
17:10	7106.500	KD6LLB	13		0:18				Oxnard, CA
17:24	7101.500	NR6V	20		0:16				Northridge, CA
17:13	7100.500	AJ7C	31		0:16				Culver City,CA
17:15	7100.000	KN6BKT	48		0:18				San Gabrile, CA
17:16	7106.000	N7OP	52		0:18				Lancaster, CA
17:00	7106.500	KT2KT	86		0:18				Bakersfield, CA

Time	Frequency MHZ	Call	Distance Miles	Signal Qual	Contact Duration (min)	Power Watts	Antenna	Tries	Comments
						200	Yellow		2.5 MHz
21:00	7102.100	W6BI	11		0:17				Simi Valley, CA
21:01	7106.500	KD6LLB	13		1:17				Oxnard, CA
21:04	7101.500	NR6V	20		nc			2	Northridge, CA
21:05	7100.500	AJ7C	31		nc			2	Culver City,CA
21:20	7100.000	KN6BKT	48		nc				San Gabrile, CA
21:11	7106.000	N7OP	52		nc				Lancaster, CA
21:14	7102.000	K9NEY	68		nc			2	
21:16	7106.500	KT2KT	86		nc			2	Bakersfield, CA

- Finally, the experiment demonstrated the existence of ground wave propagation
- At 17:00 hours with a critical frequency of 8.2 MHz there was no 40 meter skip zone ($f_c > f_o$)
- All close in 40 meter stations were reached from 11 out to 86 miles via NVIS propagation
- At 21:00 hours and critical frequency of 2.5 MHz the 40 meter band was dead
- However, Simi Valley and Oxnard (at 11 and 13 miles respectively) could still be reached at a transmitting power of 200 watts, demonstrating the existence of ground wave propagation