International Civil Aviation Organization

NINTH MEETING OF SPECTRUM REVIEW WORKING GROUP (SRWG/9)

Bangkok, Thailand, 07 – 09 May 2025

Agenda Item 8: Frequency Interference in the Region

8.1 5G and Radio Altimeter
8.2 GNSS interference
8.3 Other issues

ATMOSPHERIC CONDITIONS CONDUCIVE LONG-RANGE INTERFERENCE

(Presented by Australia / Airservices Australia)

SUMMARY

This paper presents several examples of Long-Range Interference occurrences experienced on operational VHF channels during extreme atmospheric conditions and the use of Frequency Finder to confirm assignment details.

1. INTRODUCTION

1.1 As part of managing Aviation VHF RF spectrum use in Australia, Airservices Australia has a duty of care to maintain interference-free communications in this spectrum. Maintaining co-channel separation distances between VHF outlets is paramount.

1.2 With Reference to
ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation
(Doc 9718) - Volume I ICAO spectrum strategy, policy statements and related information.
6.2.6 – Service Sharing
6.2.7 - Planning of frequency assignments
This activity follows on from allocation planning or sharing studies. Its purpose is to prepare frequency assignment plans between cooperating countries for their region or area, or by countries for application within national boundaries, or to identify individual assignments on a case-by-case basis. For terrestrial services, it employs the dimensions of frequency, distance and time separation in calculations which would use some or all of the following parameters:

- **location of required service**;
- frequency of operation and transmission bandwidth;
- **power** and directive gain of antenna;
- propagation characteristics;
- protection required by proposed service;
- protection required by other existing services on same or adjacent frequencies;
- **time of day, season or year of operation**.

A frequency assignment can be made when each new (or modified) frequency assignment simultaneously satisfies the protection requirement for each direction of

transmission (the new/modified frequency assignment will not cause harmful interference to existing frequency assignments and in turn, existing frequency assignments shall not cause harmful interference to the new/modified frequency assignment). The task of creating and maintaining a frequency assignment plan for a region is usually extensive, requiring computer-based tools. Assignments are made to transmitting stations subject to the requirement to protect the received signal in a given area (designated operational coverage) from harmful interference.

2. DISCUSSION

2.1 With reference to Radio Frequency Spectrum Requirements for Civil Aviation (Doc 9718) - Volume II — Frequency assignment planning criteria for aeronautical radio communication and navigation systems.
Free-space propagation model [1]

Figure 1 refers to commonly used term of Radio Horizon which will extend beyond the LoS Horizon.

The line of sight distance is given by the following equation,

$$d_l = \sqrt{2Rh} \approx 3.57 * \sqrt{h}$$

The radio horizon is given by the following equation,

$$d_r = 4.12 * \sqrt{h}$$

where,
'*h*' is the height of the antenna
'*R*' is the radius of the earth
'd_l' is the total line of sight, and
'd_r' is the radio horizon (actual service range)

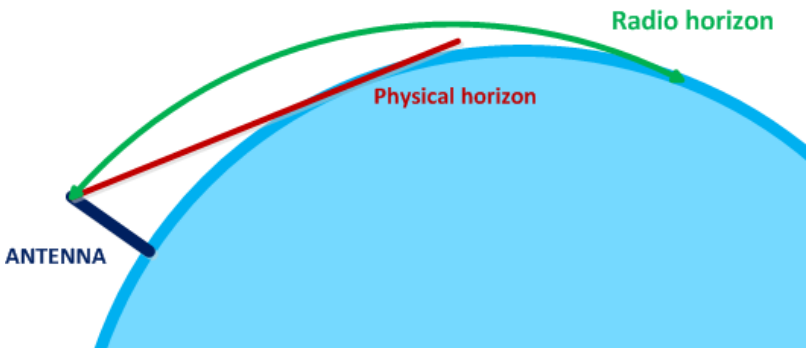

Figure 1 : Radio horizon versus physical horizon

Ducting — The change in refractive index is normally gradual, but under certain atmospheric conditions a layer of warm air may be trapped above cooler air, often over the surface of water. The result is that the refractive index will decrease far more rapidly with height than is usual. The rapid reduction in refractive index (and therefore dielectric constant) may cause complete bending down, as illustrated in the Figure 2. The unusual atmospheric condition traps the radio waves in a duct. Extreme bending of the radio waves between the top of the atmospheric duct and reflection of the radio waves from the surface of the Earth may propagate the radio waves over extreme long distances (e.g. more than 500 NM). Other phenomena such as sand storms may also cause ducting of radio waves.

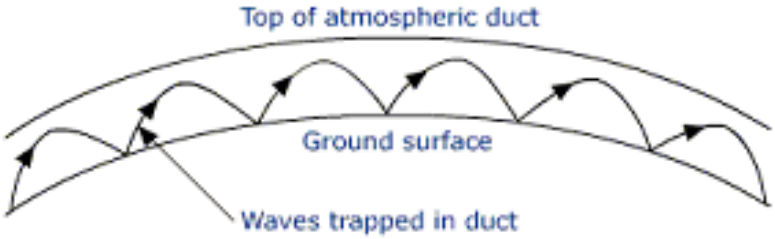

Figure 2: Propagation through ducting

Sporadic E-layer — The sporadic E (Es) layer is a layer in the ionospheric E region with a dense electron density and thin altitudinal thickness at altitudes of around 100 km above the earth. Sporadic E propagation bounces signals off smaller "clouds", or “patches”, of an unusually high density of accumulation of metallic ions in the lower E region in the earth’s ionosphere. This occasionally allows for long-distance communication at VHF frequencies not usually well suited to such communication. Sporadic E-layer propagation has been observed in both the northern hemisphere and southern hemisphere.

These patches can cause anomalous propagation of VHF radio waves by reflecting radio waves that normally penetrate through the ionosphere.

Figure 3 illustrates anomalous long-distance propagation of VHF radio waves by the Es layer.

Signal levels were often observed to propagate over long distances (800–2 000 km) and may be the source of potentially harmful interference. UHF and higher frequencies are not reflected by the Es layer.

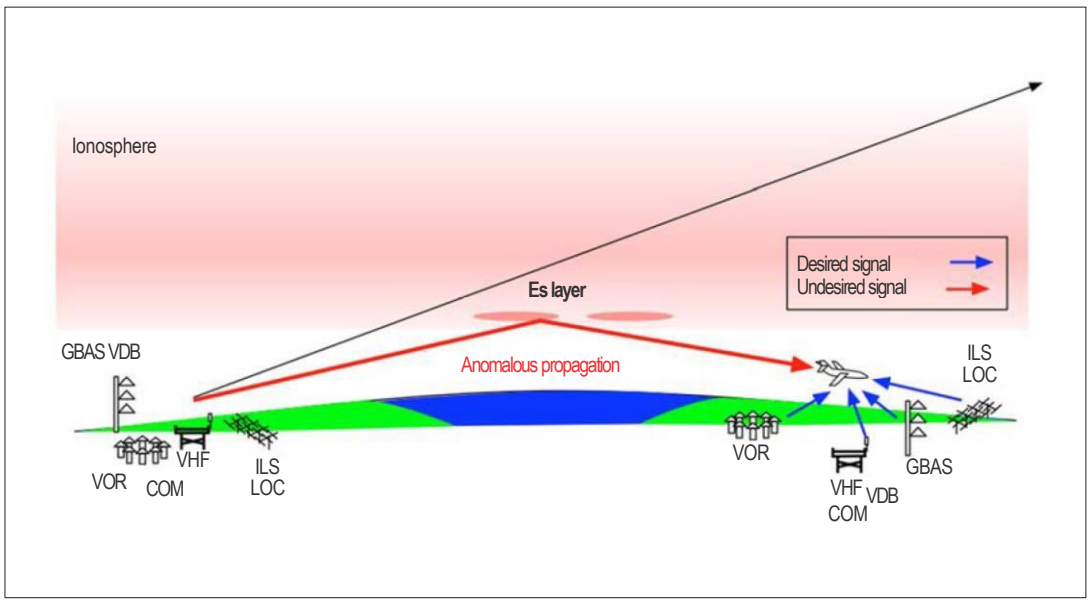

Figure 3 : Propagation of VHF radio waves by the sporadic E-layer (Es layer)

1. Volume II — Frequency assignment planning criteria for aeronautical radio communication and navigation systems
1.3 Propagation modelling

2.2 **Examples of recent occurrences where was identified.**

References : The tables and Google Earth images have been generated by Frequency Finder version FF2023.03R, with all distances calculated in nautical miles NM.

In the week beginning Monday 11th December 2023, interference to multiple frequencies at separate sites on the east coast of Australia for approximately 5 days was experienced. Airservices accesses a Tropo Index Prediction website for analysis of expected "VHF Ducting", detail in Fig 4 for the date in question.

The following examples provided utilizing the Frequency Finder DB testing functions for

- 119.7 MHz Noumea La Tontouta – Mt Edith
- 126.2 MHz Noumea La Tontouta ATIS – Amberly APP
- 128.3 MHz Noumea La Tontouta (FIS-L) – Woronora (APP-I)

And from the week beginning 18th February 2024

- 118.2 MHz Tarin Rock (ACC-U) – Summertown (APP-I)

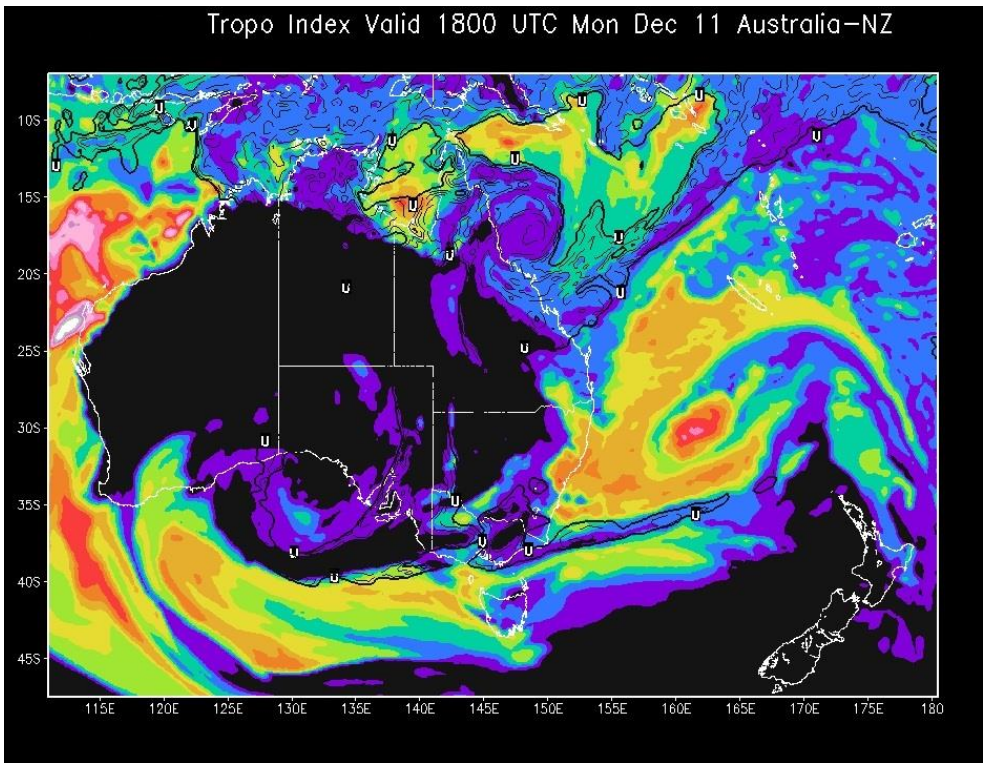

Fig 4 : Tropo Index Prediction Australia – New Zealand region

2.2.1 119.7 MHz Noumea La Tontouta – Mt Edith

This Air Traffic Control sector using Mt Edith 119.7 MHz handles regular passenger transport in the major air route between Brisbane and Sydney, both approach and departures.
Significant periods of French language breakthrough was experienced by Air Traffic Control operators using this facility, audio levels were the same as expected from aircraft in the sector airspace.
Consideration was made to NOTAM the frequency useable during this time.
At the time there was no contact the Noumea territory to determine if they were experiencing any reciprocal breakthrough.
And at this stage there are no considerations of a frequency change.
Situation is consistently monitored for further occurrences.
Unfortunately no RF levels were able to be measured to determine the signal level being received during this occurrence.
Frequency Finder Co-channel calculations provided : Table 1 and Figure 5

Radio Horizon	Record number	Service	Region	Full_name	Location	DOC	OK	Closest station	Required separation	Margin
261	1	ACC-U	APAC	Australia	Mt Edith	ACC-U C-260/450	Compatible	0	0	443
135	2	APP-L	APAC	New Caledonia	NOUMEA LA TONTOUTA	APP-L C-50/120	Compatible	1149	706	443

Table 1 : 119.7 MHz Co-channel calculations

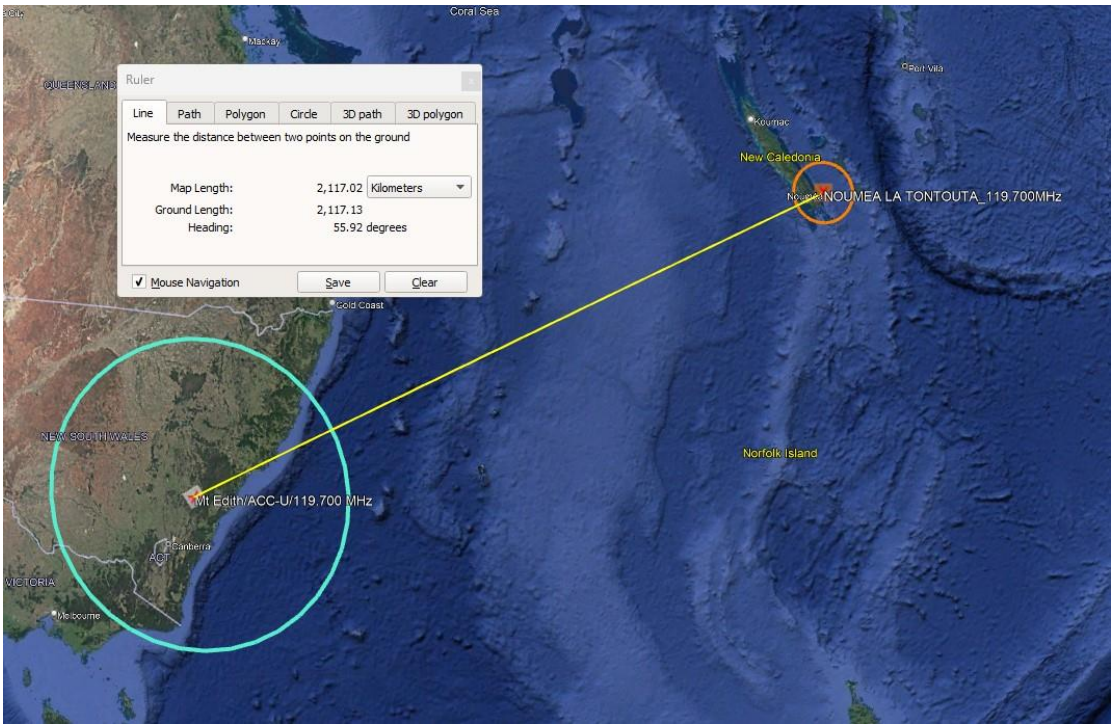

Fig 5 : 119.7 MHz La Tontouta – Mt Edith

2.2.2 126.2 MHz Noumea La Tontouta ATIS – Amberly APP

Airservices Australia was requested to assist in the identification of the ATIS service being heard by aircraft on the Amberley 126.2 MHz VHF outlet.
Breakthrough was significant enough to cause issues with approach services.
Initially when Frequency Finder was interrogated there were no ATIS service for La Tontouta using 126.2 MHz in the database.
The TAC Plates for La Tontouta indicated the ATIS was in fact on 126.2 MHz.
This was brought to the attention of the ICAO APAC office who coordinated with DSNA France to have the FF updated in February 2024 to reflect this assignment.
The table and figure were produced following the FF update.
Unfortunately no RF levels were able to be measured to determine the signal level being received during this occurrence.
Frequency Finder Co-channel calculations provided : Table 2 and Figure 6

Radio Horizon	Record number	Service	Region	Full_name	Location	DOC	OK	Closest station	Required separation	Margin
135	1	APP-L	APAC	Australia	Amberley	APP-L C-50/120	**Compatible**	0	0	159
261	2	ATIS	APAC	New Caledonia	NOUMEA LA TONTOUTA	ATIS B-200/450	**Compatible**	805	646	159
194	3	CTAF	APAC	Australia	VIC; POINT COOK	CTAF 75/250	**Compatible**	736	454	282

Table 2 : 126.2 MHz Co-channel calculations

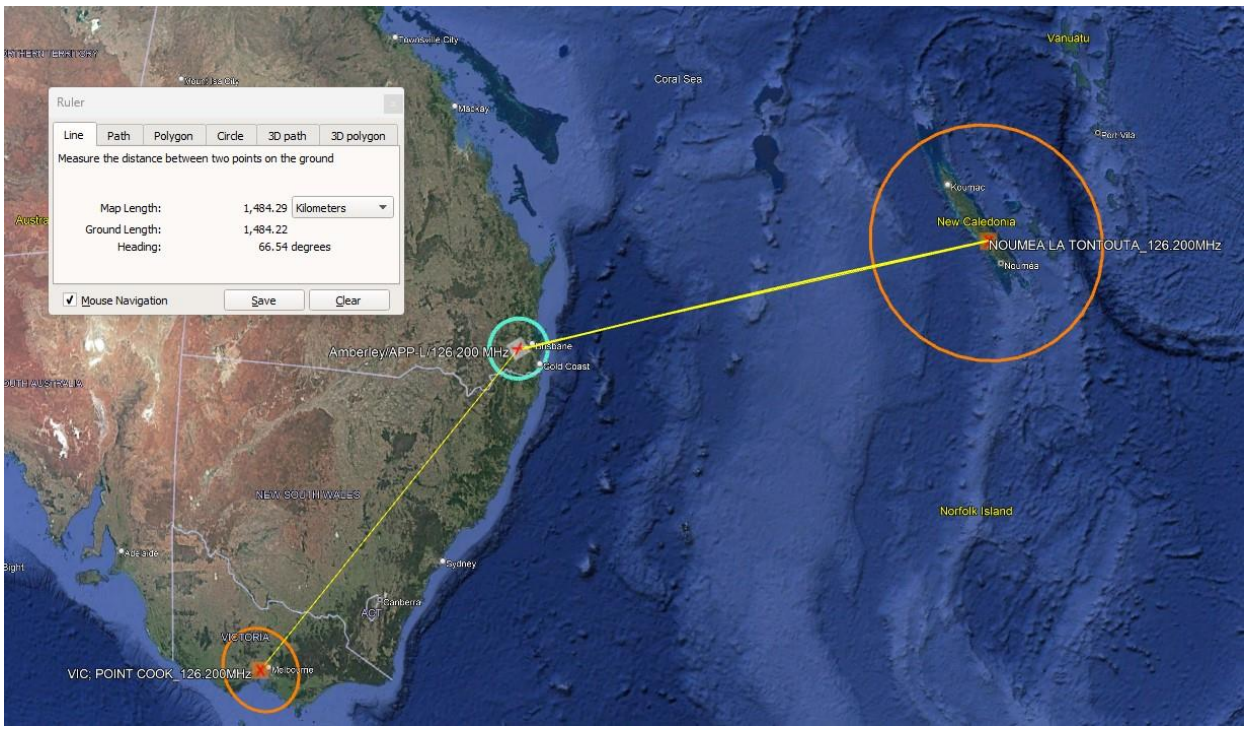

Fig 6 : 126.2 MHz La Tontouta ATIS – Amberly APP

2.2.3 128.3 MHz Noumea La Tontouta (FIS-L) – Woronora (APP-I)

This critical approach service has a back up system assigned to the Sydney TAR site, which was also affected by the French language breakthrough.
Operational recorded audio indicates that the ATC operator believed the received transmissions were from an aircraft in his sector, causing confusion and added workload.

Historically prior to 2019 Airservices operated an Approach service on 128.3 MHz in the Brisbane TCU which was also impacted by French language breakthrough, during the airspace review for the new Brisbane airport parallel runway operations, Safety Change Assessment & Reporting Determination (SCARD) recommended a frequency change to avoid this occurrence in the future.
The Brisbane approach frequency was changed to 133.45 MHz in 2019.
Unfortunately no RF levels were able to be measured to determine the signal level being received during this occurrence.
Frequency Finder Co-channel calculations provided : Table 3 and Figure 7

Radio Horizon	Record number	Service	Region	Full_name	Location	DOC	OK	Closest station	Required separation	Margin
194	1	APP-I	APAC	Australia	Woronora	APP-I C-75/250	Not compatible	0	0	-523
194	2	APP-I	APAC	Australia	Sydney TAR	APP-I C-75/250	Not compatible	15	538	-523
194	3	FIS-L	APAC	New Caledonia	NOUMEA LA TONTOUTA	FIS-L C-194/250	**Compatible**	1080	657	423
194	4	FIS-L	APAC	New Caledonia	MOUT GOUEMBA	FIS-L C-194/250	**Compatible**	1105	657	448
194	5	FIS-L	APAC	New Caledonia	NOUMEA LA TONTOUTA	FIS-L C-194/250	**Compatible**	1105	657	448

Table 3 : 128.3 MHz Co-channel calculations

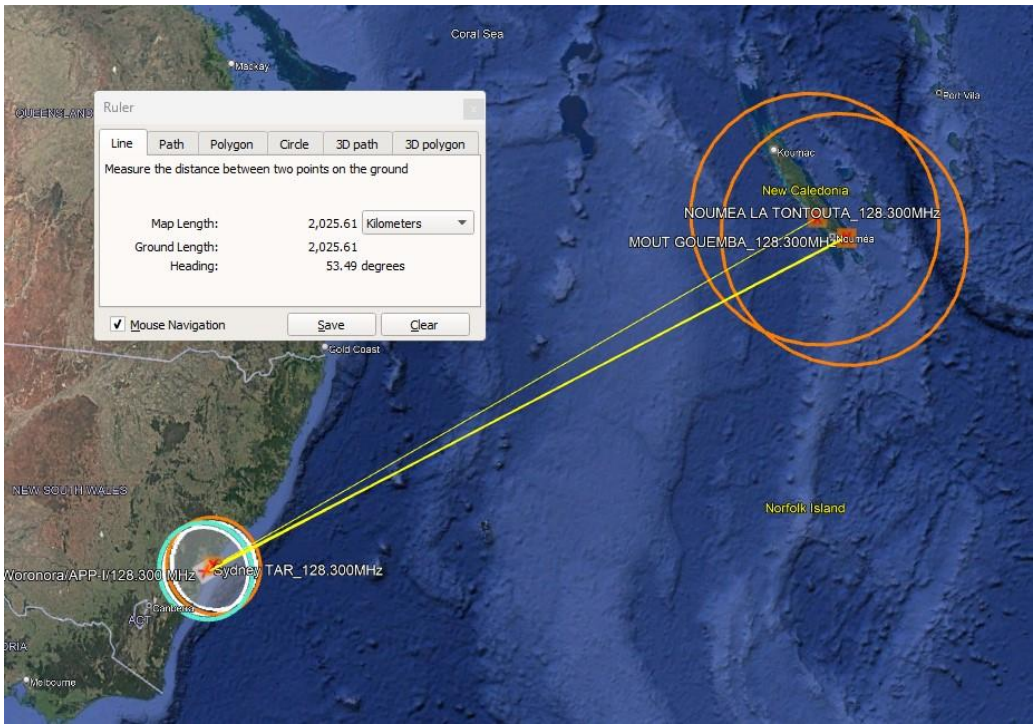

Fig 7 : 128.3 MHz La Tontouta (FIS-L) – Woronora (APP-I)

2.2.4 118.2 MHz Tarin Rock (ACC-U) – Summertown (APP-I)

As an example this issue is not restricted to activity across international borders, but that it can impact co-channel reuse in a country as large as Australia.
The site of 118.2 MHz Summertown provides APP service for the Adelaide TCU was being impacted by transmissions being made on the ACC-U service from the site Tarin Rock. As expected with approach services being impacted at a critical phase of a flight there was extra workload imposed on the ATC operators using this frequency.
Figure 9 indicates the extreme atmospheric conditions that contributed to the extended range of 118.2 MHz. The most surprising aspect of this event was how far south in latitude these conditions occurred.
Frequency Finder Co-channel calculations provided : Table 4 and Figure 8

Radio Horizon	Record number	Service	Region	Full_name	Location	DOC	OK	Closest station	Required separation	Margin
261	1	ACC-U	APAC	Australia	Tarin Rock	ACC-U C-260/450	Not compatible	0	0	-12
261	2	ACC-U	APAC	Australia	Halls Creek	ACC-U C-260/450	Not compatible	1030	1042	-12
194	3	APP-I	APAC	Australia	Adelaide TAR	APP-I C-75/250	Compatible	1017	790	227
194	4	APP-I	APAC	Australia	Summertown	APP-I C-75/250	Compatible	1026	790	236

Table 4 : 118.2 MHz Co-channel calculations

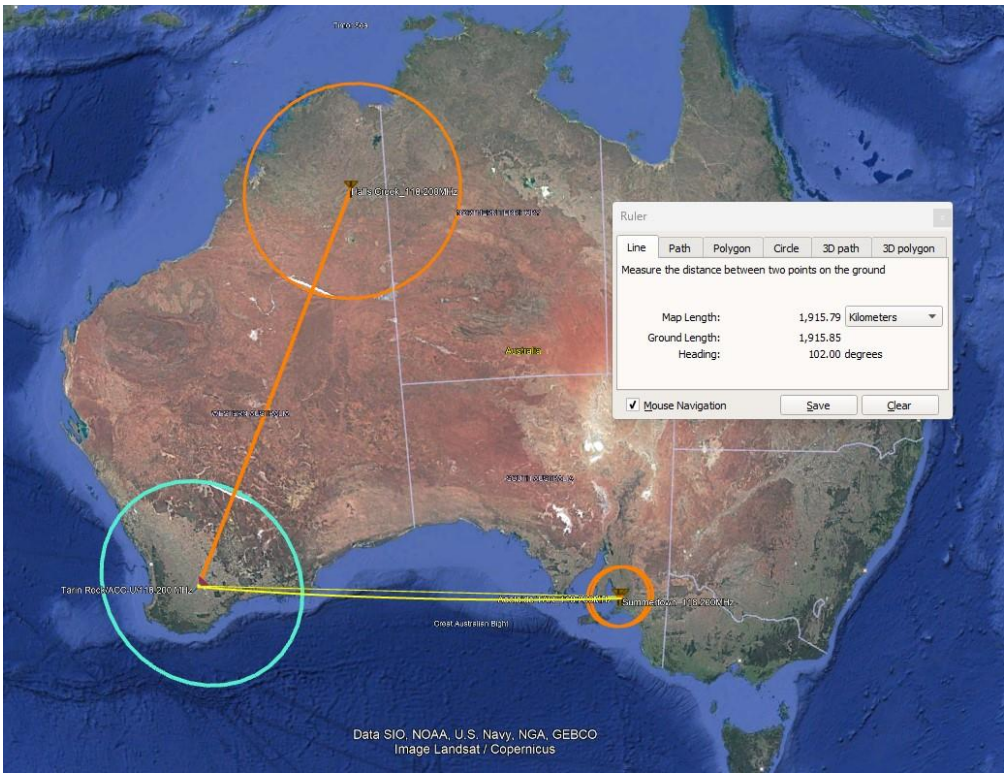

Fig 8 : 118.2 MHz Tarin Rock (ACC-U) – Summertown (APP-I)

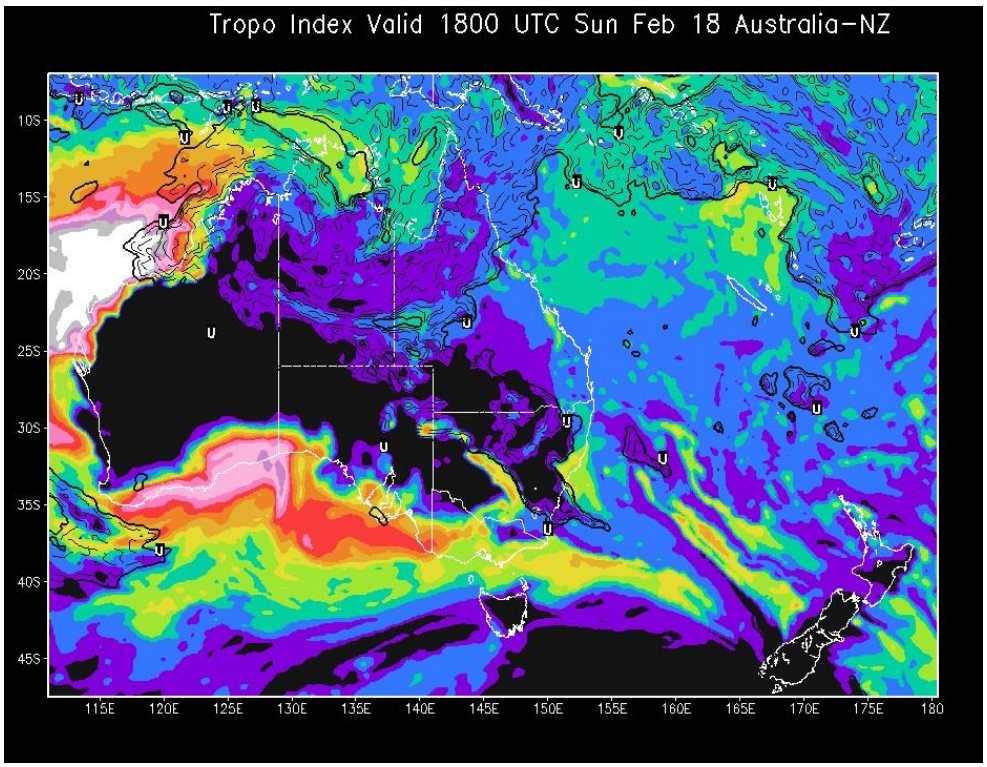

Fig 9 : Tropo Index Prediction Australia – New Zealand region

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;
b) discuss the issue and propose way forward; and
c) discuss any relevant matter as appropriate

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