AFRICAN TELECOMMUNICATIONS UNION
UNION AFRICAINE DES TÉLÉCOMMUNICATIONS

2nd frequency coordination meeting
on the GE84 Plan Optimization for Africa
Deuxième réunion de coordination des fréquences
sur l'optimisation du Plan GE84 pour l'Afrique
28 June - 2 July 2021

Propagation model tools using Rec. ITU-R P.1812 and P.1546

By *Andrea Manara*
Broadcasting Service Division

Agenda

- Short presentation
  - Rec. ITU-R P.1812 and P.1546 propagation models
  - eTools calculations (new P.1812 fs contours!)
  - Use cases
- Demonstration of propagation calculations in eTools

Comparison Rec. ITU-R P.1812 vs P.1546

Recommendation ITU-R P.1812-5
(08/2019)

A path-specific propagation prediction method for point-to-area terrestrial services in the VHF and UHF bands

Deterministic model
model all the physical phenomena which plays a role in VHF-UHF band

Path specific
Uses terrain profile (elevation above mean sea level).

- 30 MHz - 3 GHz
- 0.25 km - 3000 km
- 1% < time < 50%
- 1% < locations < 99%
- Rx and Tx hgt agl <= 3km

Recommendation ITU-R P.1546-6
(08/2019)

Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 4 000 MHz

Empirical model
based on extensive field measurements and statistical analysis

Path general
The effect of terrain only via:

- Effective antenna height
- Clearance Angle correction
- Tropospheric scattering correction

- 30 MHz - 4 GHz
- 1 km - 1000 km
- 1% < time < 50%
- 1% < locations < 99%
- Rx and Tx hgt agl <= 3km

Can be used for interference and coverage analyses!

Rec. ITU-R P. 1546

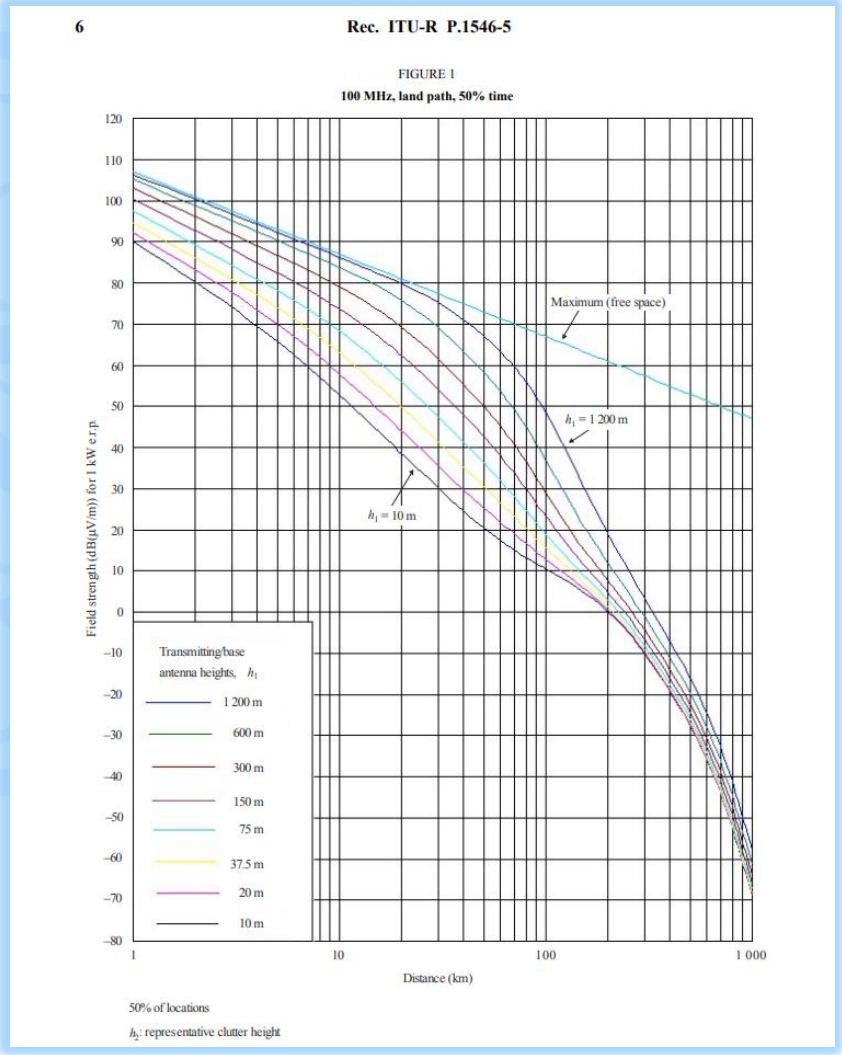
Field-strength curves as functions of *distance*, *antenna height, frequency and percentage time*

- Land, warm sea, cold sea
- 100, 600, 2000 MHz
- time percentage: 1,10,50

Method

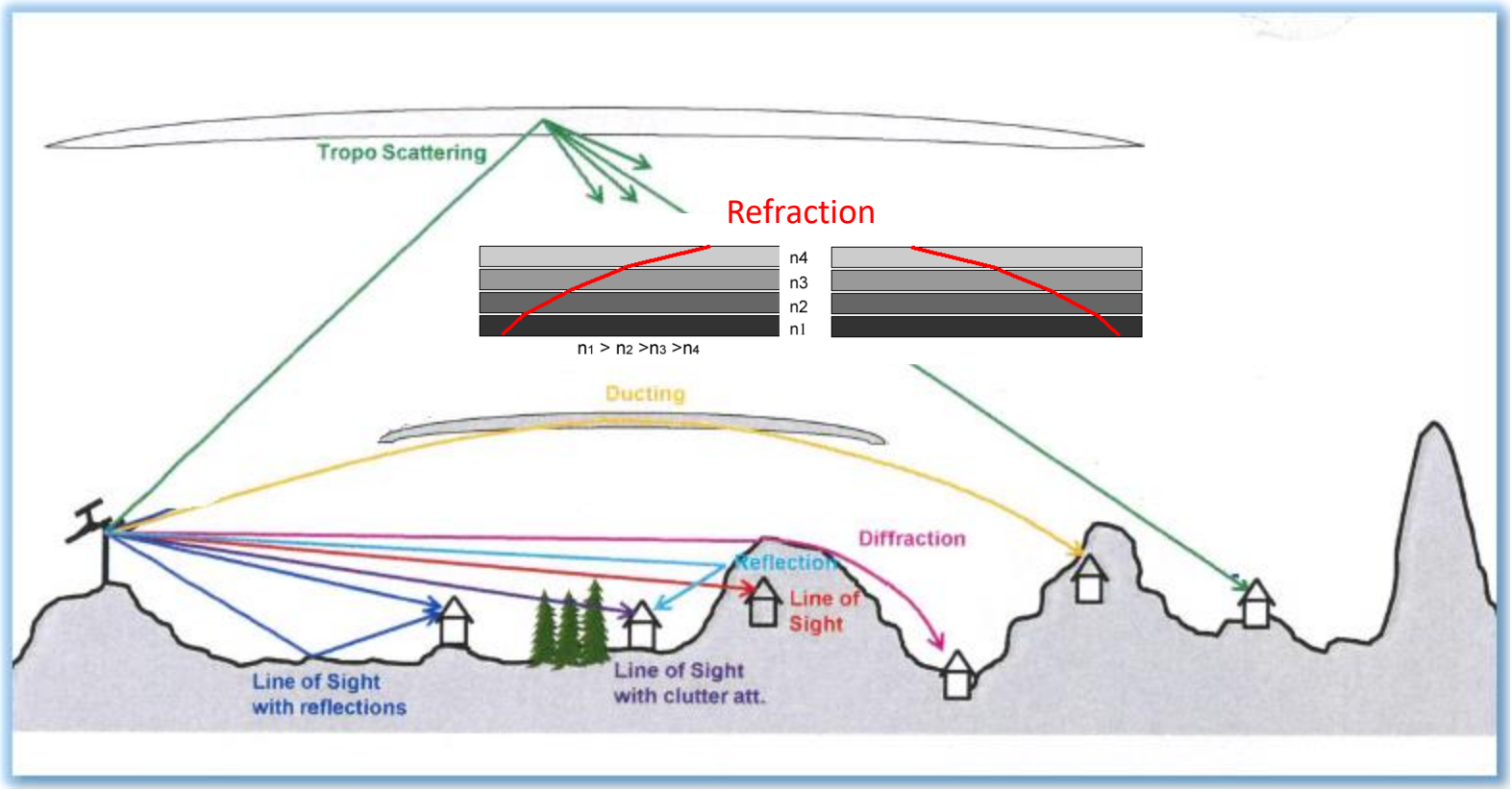
- interpolation/extrapolation
- mixed-path

Important correction for refractivity index!!



Rec. ITU-R P. 1812

Propagation mechanisms in the VHF/UHF band



Adapted from LS Telcom Propagation training material

eTools: Input parameters

ITU-R P.1812

Tx (long)	450000	Tx (lat)	411000		
Tx hgt agl(m)	70	Rx hgt agl(m)	10	Reception type: Outdoor	Polarization: Vertical
Frequency(MHz)	186	Erp(dBW)	10	Tx Clutter Type: Water/sea	Rx Clutter Type: Water/sea
% of time	1	% of location	50	Use Tx clutter height (m)	Use Rx clutter height (m)

Point to Point

Point to Area

Rx (long)	452114	Rx (lat)	410539
Wanted FS (dB(μV/m))	25	Bearing step (degrees EtN)	10

ITU-R P.1546

Point to Area

Tx (long)	0074408	Tx (lat)	450227	Environment type: Rural	
Tx hgt agl(m)	70	Rx hgt agl(m)	10	Wanted FS (dB(μV/m))	20
Frequency(MHz)	186	Erp(dBW)	30		
% of time	1	% of location	50		

Environment Type

Rural

Urban

eBCD 2.0 Broadcasting Online

eTools: Input parameters

ITU-R P.1812

Clutter Type

Bug fix in P1812 software (June 21)

- Clutter is not considered any longer as eTools uses SRTM which considers already the clutter
- Previously eTools was overestimating the losses (attenuation) due to clutter considered twice

Reception Type

Outdoor ▾
Outdoor
Indoor

Polarization

Vertical ▾
Vertical
Horizontal

Percentage of time and location

Coverage Analyses (wanted signal)

GE84 Agreement

FM

50% locations
50% time

Interference Analyses (un wanted signal)

GE84 Agreement

FM (tropo)	**FM (steady)**
50% location **1% time**	**50% location.** **50% time**

Frequency spacing (kHz)	Radio-frequency protection ratio (dB) for a maximum frequency deviation of ± 75 kHz			
	Monophonic		Stereophonic	
	Steady interference	Tropospheric interference	Steady interference	Tropospheric interference
0	36	28	45	37
25	31	27	51	43
50	24	22	51	43
75	16	16	45	37
100	12	12	33	25
150	8	8	18	14
200	6	6	7	7
250	2	2	2	2
300	–7	–7	–7	–7
350	–15	–15	–15	–15
400	–20	–20	–20	–20

eTools: rec. ITU-R P.1812 calculations

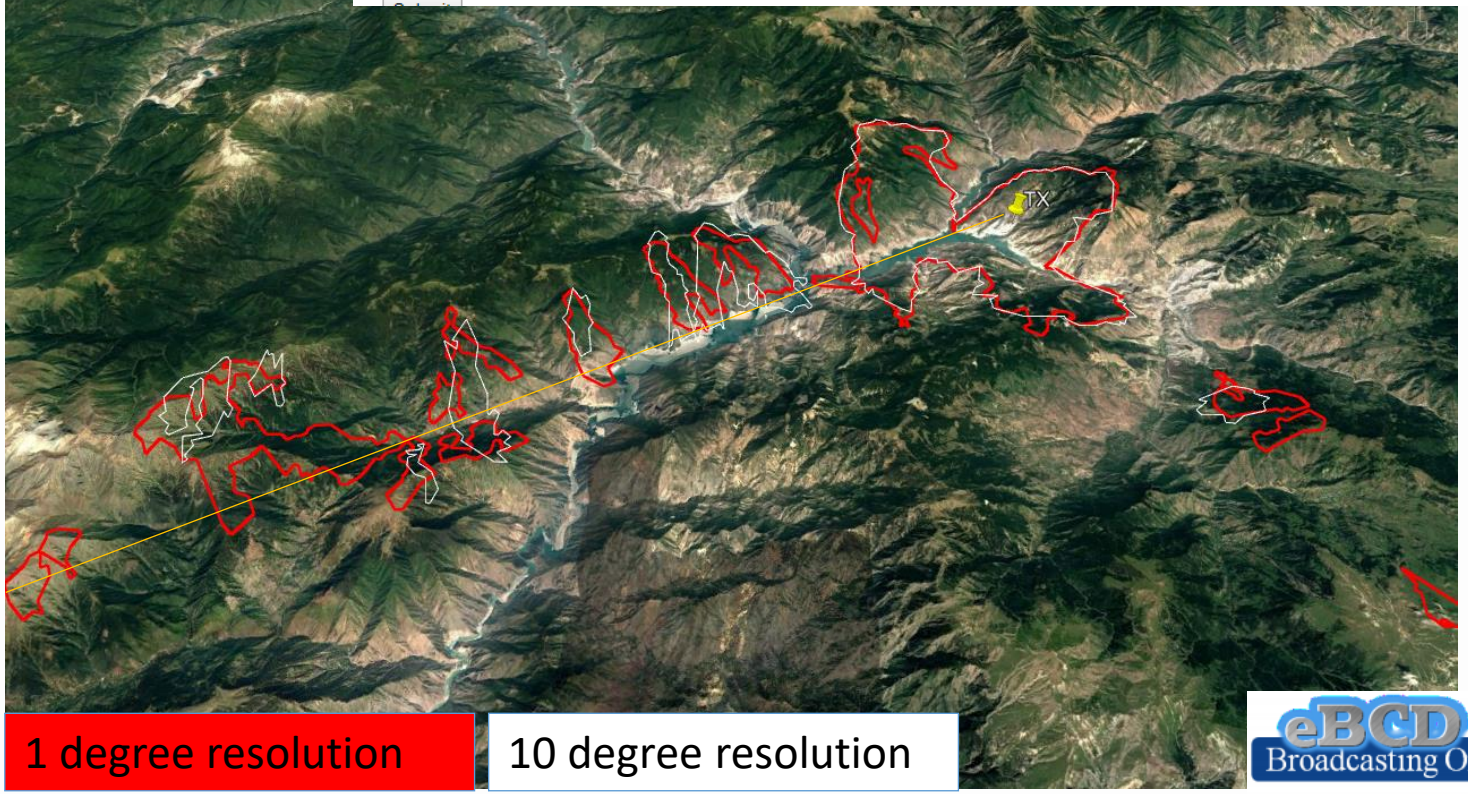
Beta Release!

coverage analyses

NEW

Point to Area

Tx (long)	420000	Tx (lat)	411000	Wanted FS (dB(μV/m))	50	Bearing step (degrees EtN)	10
Tx hgt agl(m)	70	Rx hgt agl(m)	10	Reception type	Outdoor	Polarization	Horizontal
Frequency(MHz)	186	Erp(dBW)	30	Tx Clutter Type	Open/rural	Rx Clutter Type	Open/rural
% of time	50	% of location	95	Use Tx clutter height (m)		Use Rx clutter height (m)	



1 degree resolution

10 degree resolution

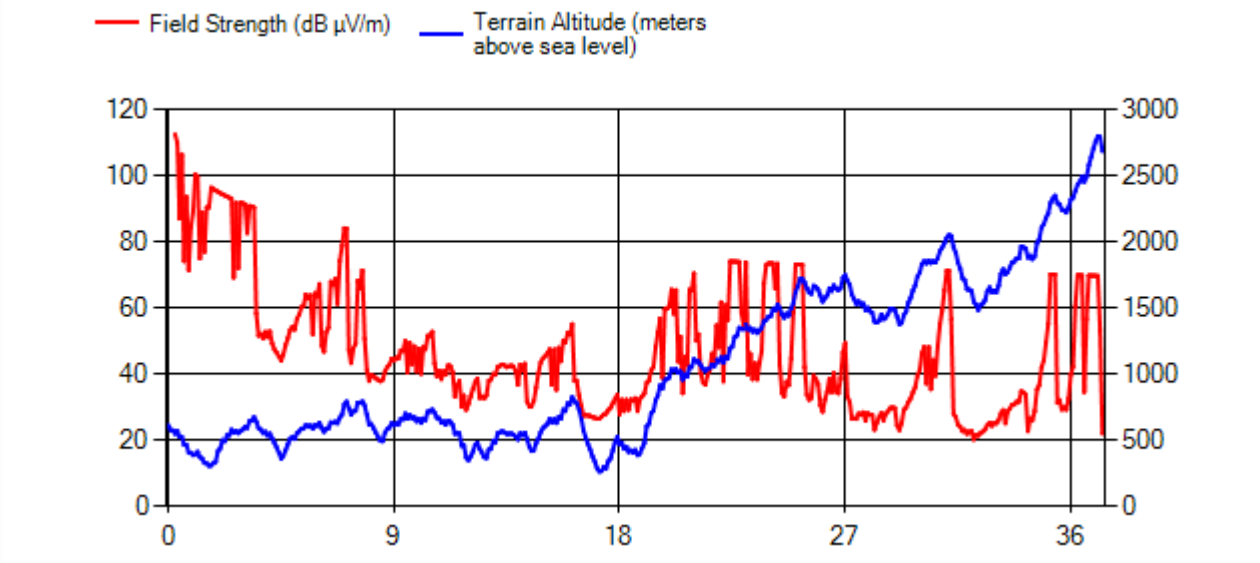
eBCD 2.0 Broadcasting Online

eTools: rec. ITU-R P.1812 calculations

Point to Point

Tx (long)	420000	Tx (lat)	411000	Rx (long)	0413654	Rx (lat)	410000
Tx hgt agl(m)	70	Rx hgt agl(m)	10	Reception type	Outdoor	Polarization	Horizontal
Frequency(MHz)	186	Erp(dBW)	30	Tx Clutter Type	Open/rural	Rx Clutter Type	Open/rural
% of time	50	% of location	95	Use Tx clutter height (m)		Use Rx clutter height (m)	

Distance(km) 37.223 Bearing(degree etn) 240.2568 Effective Earth Radius 8422.02



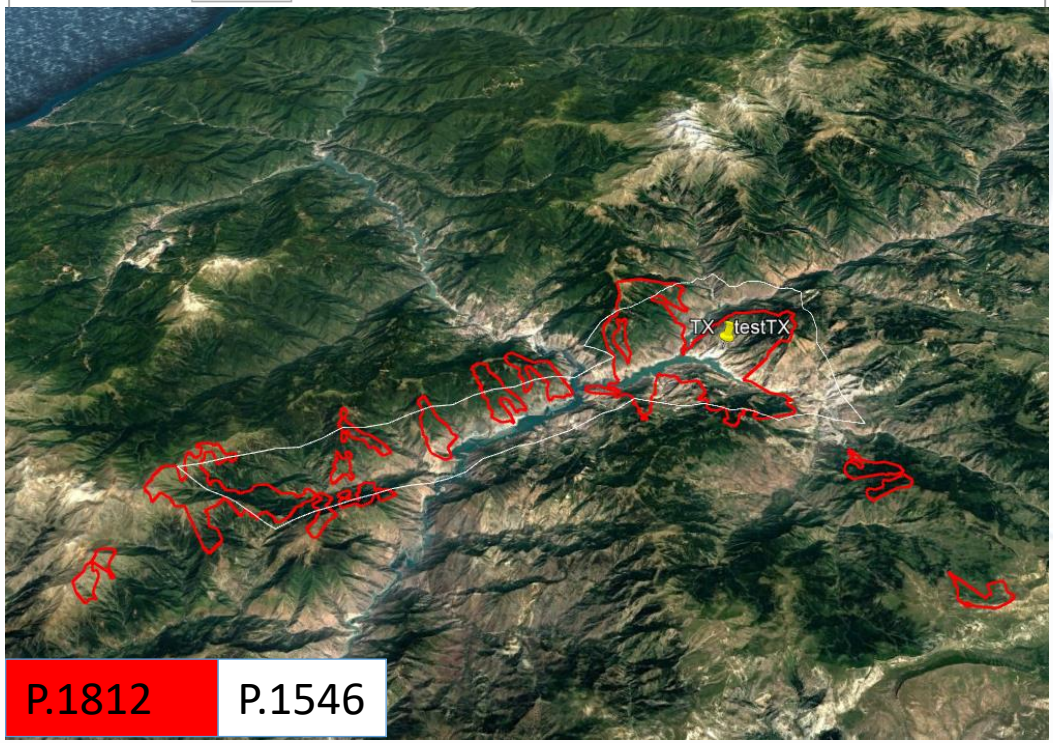
Study FS variation on the path from TX to a RX point in the contours farthest from the TX in the P2A coverage analyses

eBCD 2.0 Broadcasting Online

eTools: rec. ITU-R P.1546 calculations

Point to Area

Tx (long)	420000	Tx (lat)	411000
Tx hgt agl(m)	70	Rx hgt agl(m)	10
Frequency(MHz)	186	Erp(dBW)	30
% of time	50	% of location	50
Environment type	Rural		
Wanted FS (dB(µV/m))	50		



Coverage analyses

Very good agreement with P.1812 results in this case.

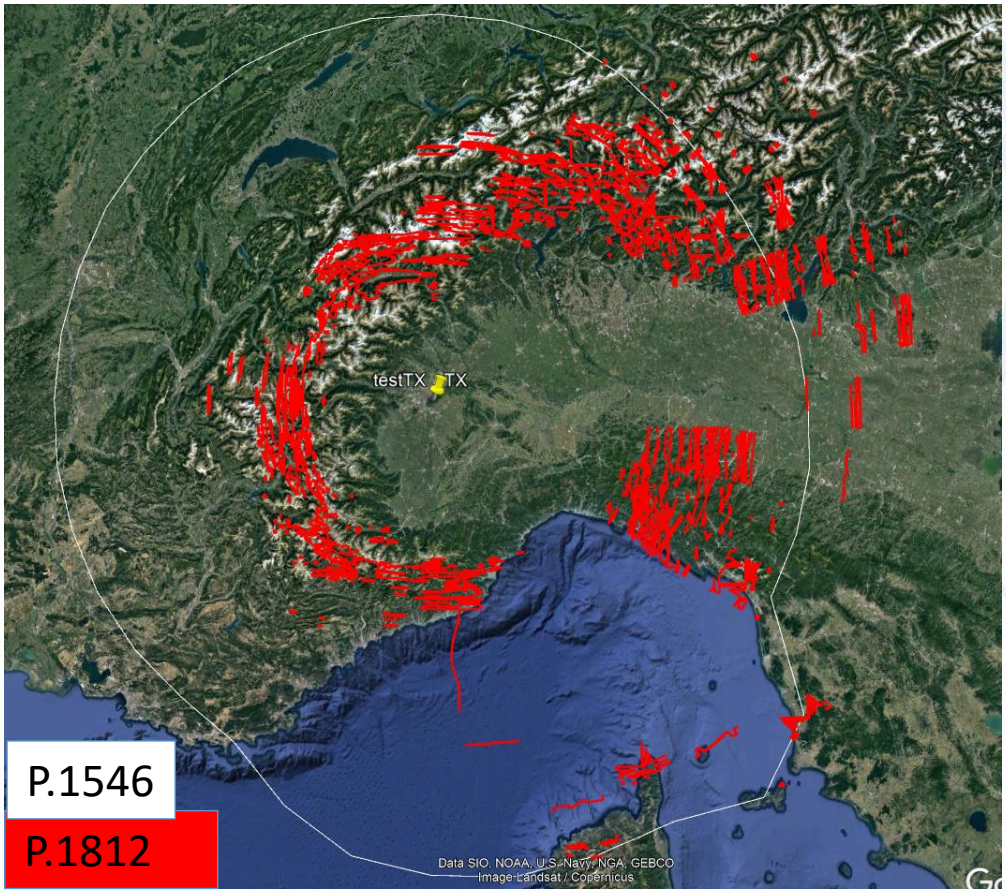
But results can change significantly!

eBCD 2.0 Broadcasting Online

eTools: rec. ITU-R P.1546 calculations

Tx (long)	0074408	Tx (lat)	450227	Environment type	Rural
Tx hgt agl(m)	70	Rx hgt agl(m)	10	Wanted FS (dB(µV/m))	20
Frequency(MHz)	186	Erp(dBW)	30		
% of time	1	% of location	50		

Point to Area



Interference analyses

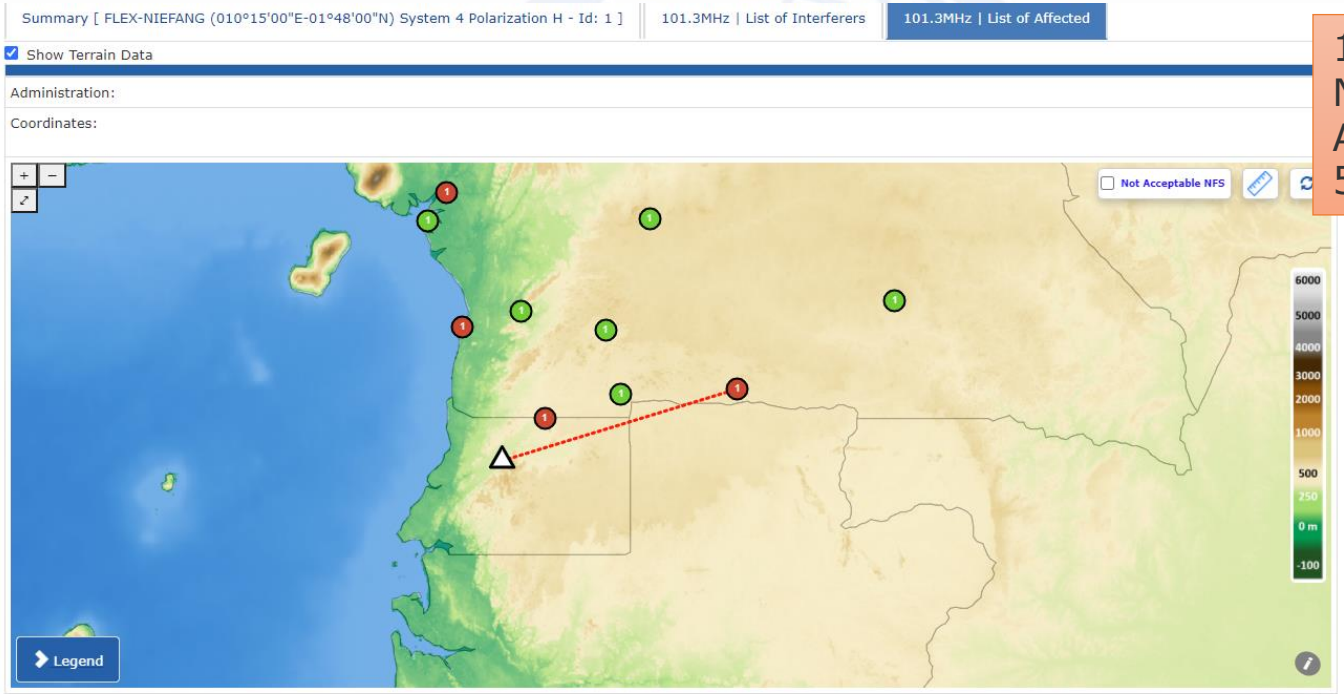
Very different results from P.1812!

eBCD 2.0 Broadcasting Online

Use case: GE84 planning activities

eTools: GE84Opt
implements GE84 propagation curves for interference analyses.

Terrain information considered only via effective antenna height



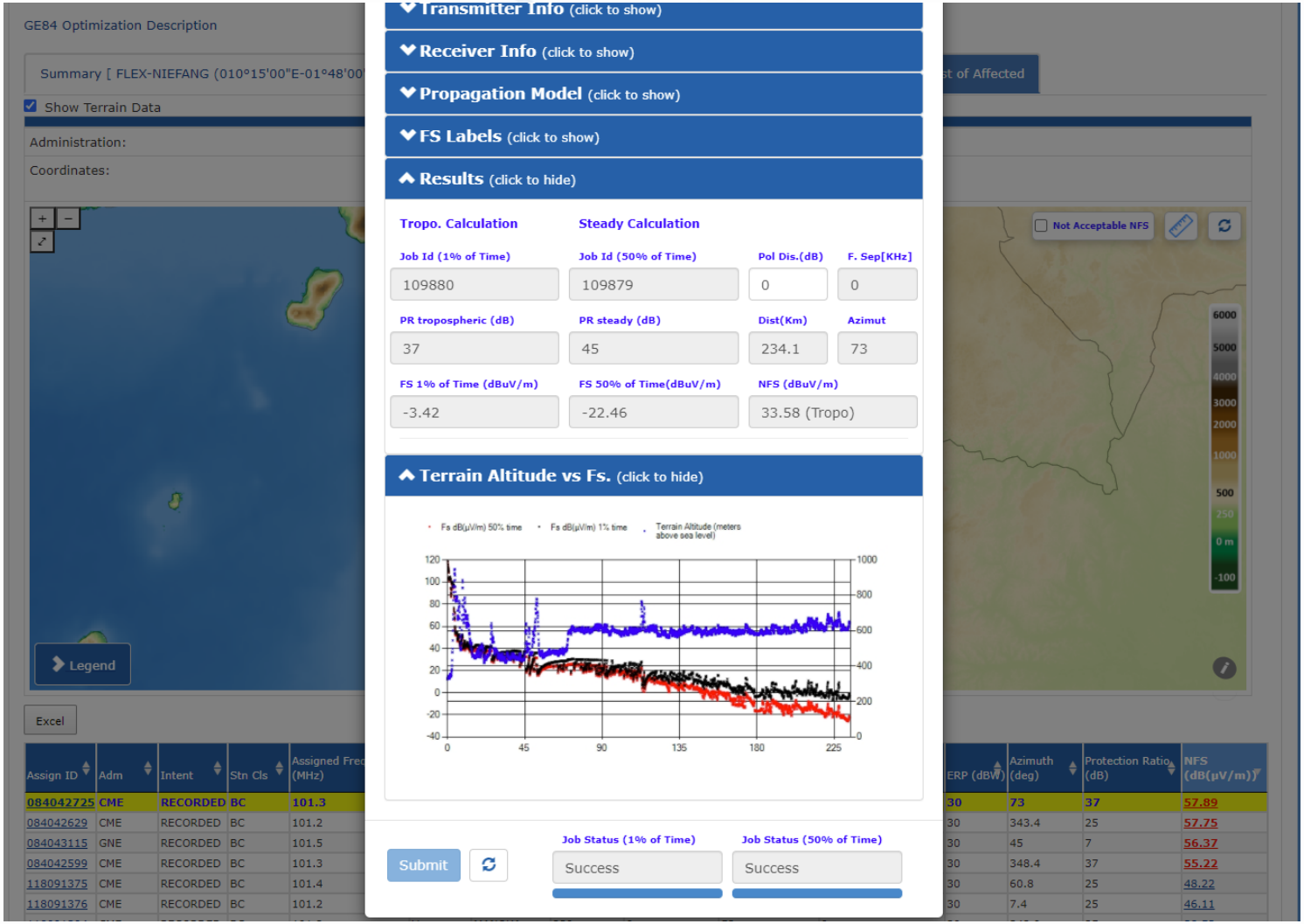
Assign ID	Adm	Intent	Stn Cls	Assigned Frequency (MHz)	Polar	Site Name	Total Distance	Cold Sea Path (Km)	Warm Sea Path (Km)	Super refractivity Path (Km)	ERP (dBW)	Azimuth (deg)	Protection Ratio (dB)	NFS (dB(µV/m))
084042725	CME	RECORDED	BC	101.3	H	OVENG	234	0	0	0	30	73	37	57.89
084042629	CME	RECORDED	BC	101.2	H	KRIBI	132	0	0	0	30	343.4	25	57.75
084043115	GNE	RECORDED	BC	101.5	H	MICOMESENG	58	0	0	0	30	45	7	56.37
084042599	CME	RECORDED	BC	101.3	H	DOUALA	261	0	0	0	30	348.4	37	55.22
118091375	CME	RECORDED	BC	101.4	V	AMBAM	129	0	0	0	30	60.8	25	48.22

101.3 MHz
Non assignable
Acceptable NFS
54 (dB (µV/m))

$FS(1\%time,50\%loc)_{GE84\ curves} = 57.89 - 37 = 20.89\ dB(\mu V/m)$

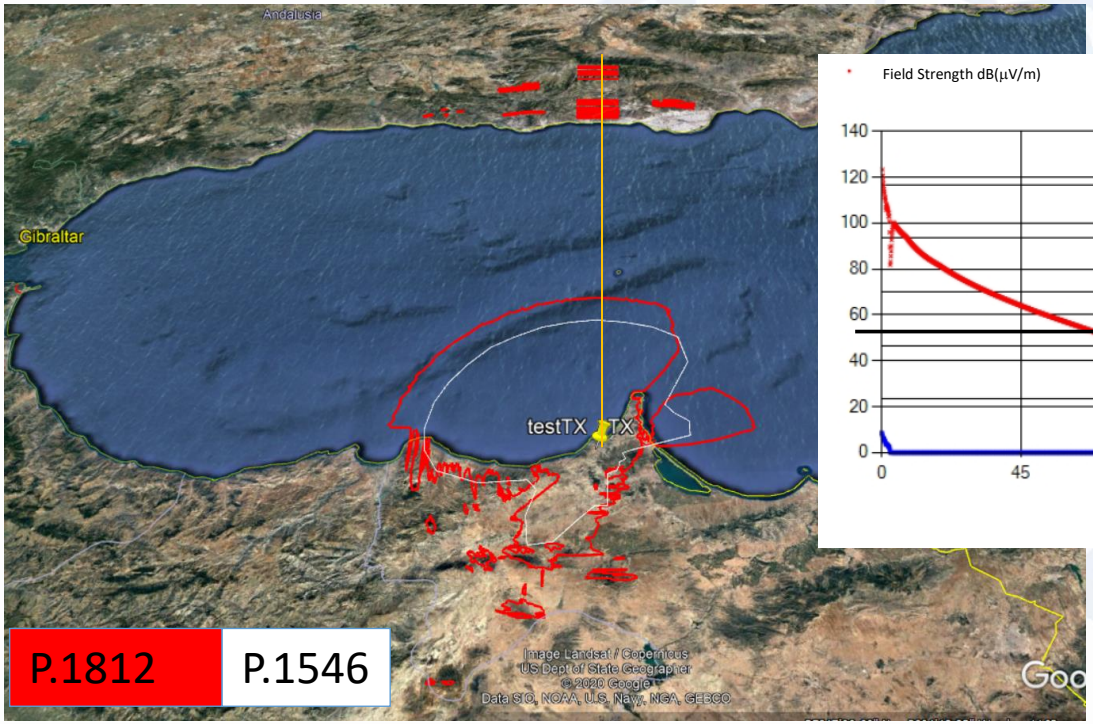
Use case: GE84 planning activities

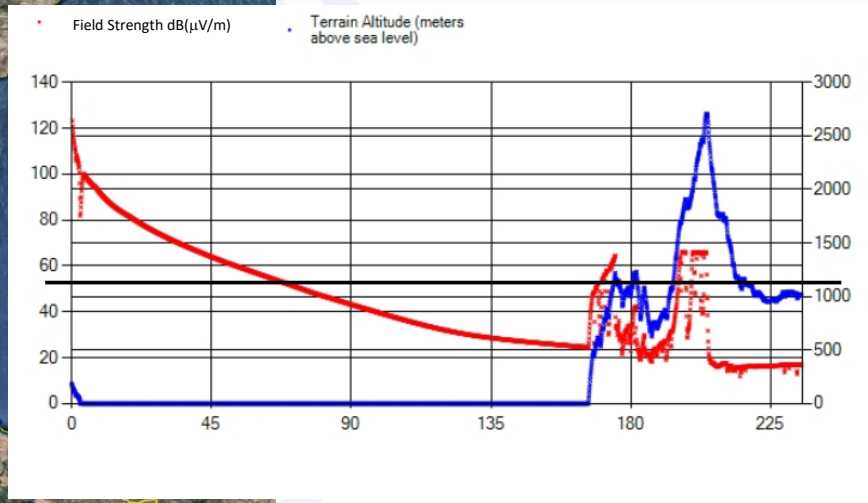
eTools: Rec. ITU-R P.1812 Point to Point field strength calculation (terrain data).



Use case: FM coverage analyses

AZAANEN: P1812P2A Wanted FS = 54 dB(μV/m)





Thank you for your attention!

Questions?

brbcd@itu.int