Spectrum Management System for Developing Countries (SMS4DC)

Training on SMS4DC
24-26 July, 2023
Livingstone, ZAMBIA

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PERFORMING BASIC ENGINEERING FUNCTIONS

SUMMARY OF PROPAGATION MODELS FUNCTIONS

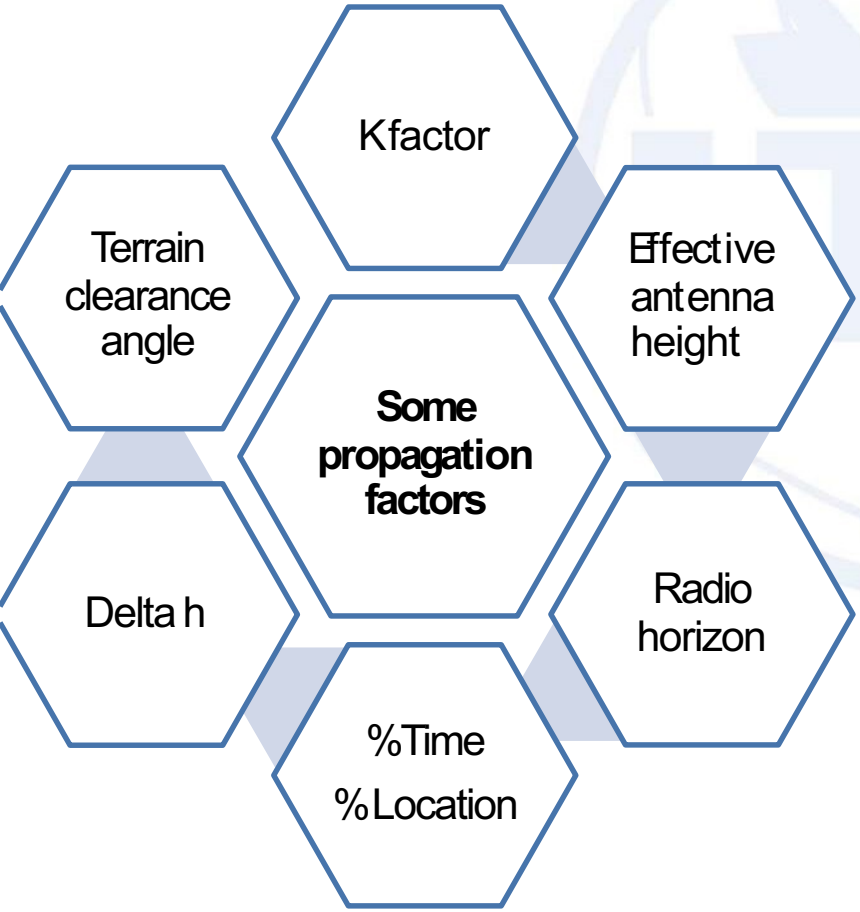
Propagation Models \ Sub-items	Line	Polyline	Area	Link	Contour	Network processor		Earth-space
						Max. Field Strength	Best Server	
Free Space	Y	Y	Y	N	N	Y	Y	N
Line of Sight	Y	Y	Y	N	N	N	N	N
ITU-R P.370	Y	Y	Y	Y	Y	Y	Y	N
ITU-R P.1546	Y	Y	Y	Y	Y	Y	Y	N
ITU-R P.1812	Y	Y	Y	Y	Y	Y	Y	N
Okumura-Hata	N	N	Y	N	N	Y	Y	N
ITU-R P.526 (by diffraction)	N	N	N	Y	N	N	N	N
ITU-R P.526 (Smooth Earth)	N	N	N	Y	N	N	N	N
ITU-R P.452	N	N	N	Y	N	N	N	N
ITU-R P.530	N	N	N	Y	N	N	N	N
ITU-R P.618	N	N	N	N	N	N	N	Y

(1): 'Y' and 'N' stand for "Yes" and "No" respectively.

LIST OF SMS4DC PROPAGATION MODELS

Free space	Unaffected by any consideration other than distance
Line of sight	Propagation between two points for which the direct ray is sufficiently clear of obstacles for diffraction to be of negligible effect.
P.370	VHF and UHF propagation curves for the frequency range from 30 MHz to 1 000 MHz.
P.1546	point-to-area predictions for terrestrial services in the frequency range 30 MHz to 4 000 MHz
Okumura-Hata	Used for path loss prediction in urban areas.
P.1812	Used for prediction method suitable for terrestrial point-to-area services in the frequency range 30 MHz to 3 GH
P.526	Propagation by diffraction
P.452	Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above about 0.1 GHz
P.530	Propagation data and prediction methods required for the design of terrestrial line-of-sight systems.
P.618	Propagation data and prediction methods required for the design of Earth-space telecommunication systems

PROPAGATION TERMS USED IN SMS4DC



Effective Earth-radius factor, k	Ratio of the effective radius of the Earth to the actual Earth radius. For the standard atmosphere, the effective Earth radius is 4/3 that of the actual Earth radius.
Effective antenna height	The effective height of the transmitting antenna is defined as its height over the average level of the ground between distances of 3 and 15 km from the transmitter in the direction of the receiver.
%Time	The applicable time percentage values or range of values of the ITU Recommendation; %time is the percentage of time that the predicted signal is exceeded during an average year.
%Location	The applicable percent location range of the ITU Recommendation; %location is the percentage of locations within, say, a square with 100 to 200 m sides that the predicted signal is exceeded.
Delta h	defines the degree of terrain irregularity
Radio horizon	The locus of points at which direct rays from a point source of radio waves are tangential to the surface of the Earth.

CALCULATION ALONG A LINE

- This function calculates field strength values produced by a station along a path profile at a given receiving height above ground level.
- In the case of the line-of-sight (LOS) model, the “Line” calculation sub- item provides only a visibility analysis along the line from the wanted station.
- To activate the “Line” sub items, a line must be drawn in advance on the DEM using “Draw Line” or “Draw Line from Database” toolbar buttons .

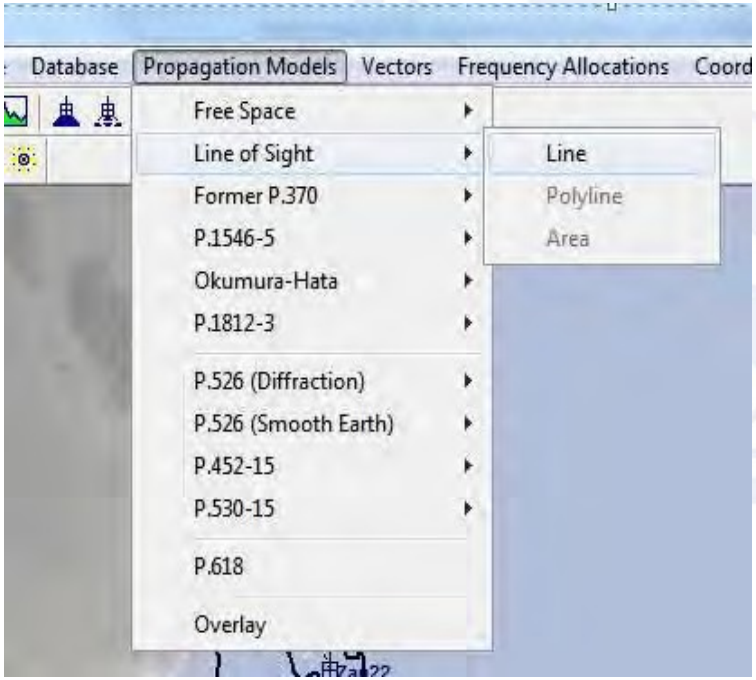
1

	IDst	STname	STlat_deg	STlon_deg	Sth_agl
	5	PRVHF1	24.5750	55.1833	60.0000
	7	Station-235	-2.4000	35.9750	0.0000
	8	TZA11	-3.5000	36.8083	0.0000
	9	TZ2	-3.5583	36.6833	10.0000
	10	IMT700BTS	-5.8833	37.4000	30.0000
1	11	Zan112	-5.9250	39.2583	30.0000
2	12	Zan22	-6.2417	39.3750	30.0000
	13	Tanz11	-6.4500	37.8000	20.0000
	14	Tanz22	-6.5583	38.0167	20.0000
	15	Tav FX1	-6.0917	38.1833	30.0000
	16	Tanz FX22	-5.9000	38.1250	20.0000
	17	tan fx 11 ...	-7.0167	38.1417	20.0000
	18	tanz fx 22 ...	-7.1917	38.3333	20.0000

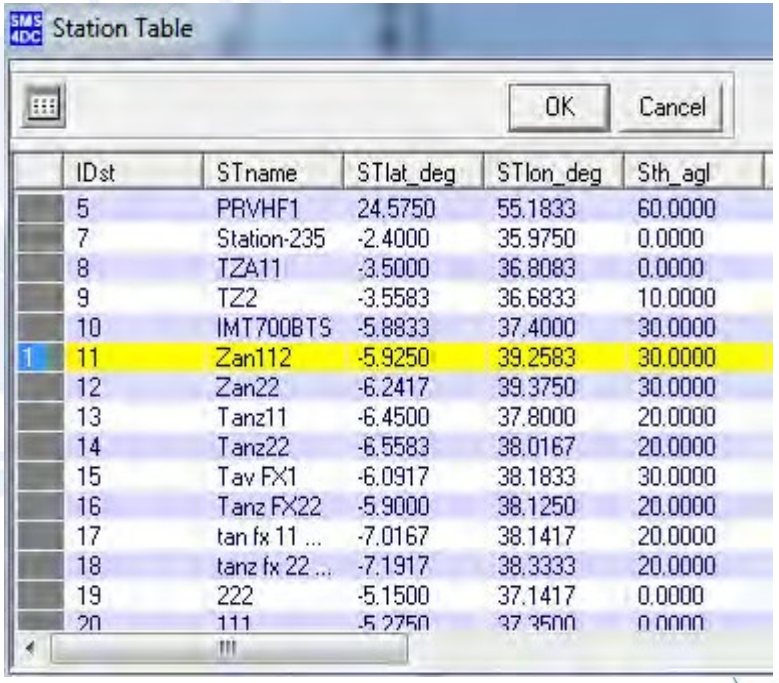
CALCULATION ALONG A LINE

- Geographical coordinates, terrain height, ground-distance from the left point (beginning point of the line) and field strength value (dBìV/m), or visibility status in the case of the LOS model, at the position of the vertical marker are displayed on the status bar

2



Select one of two stations



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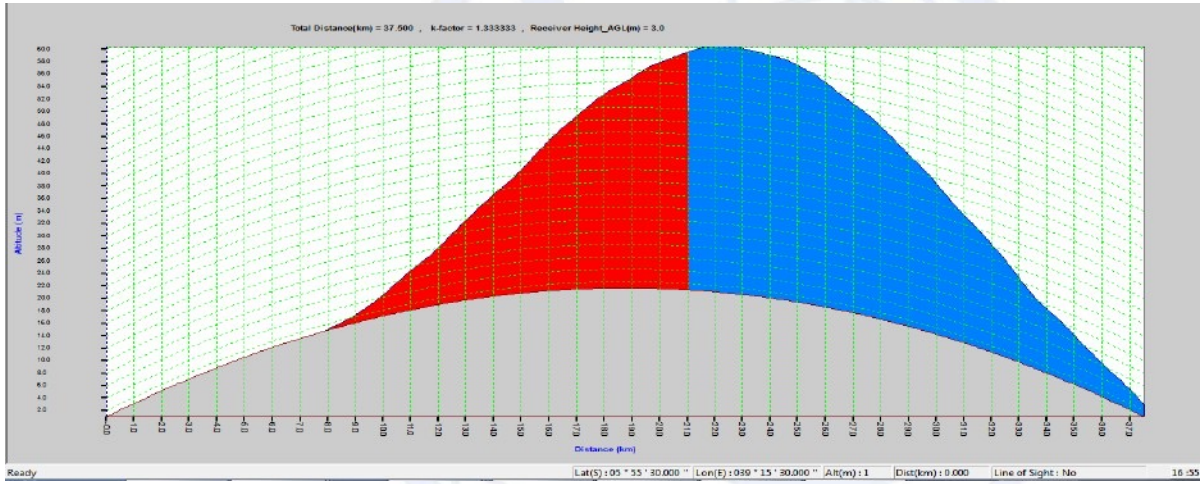
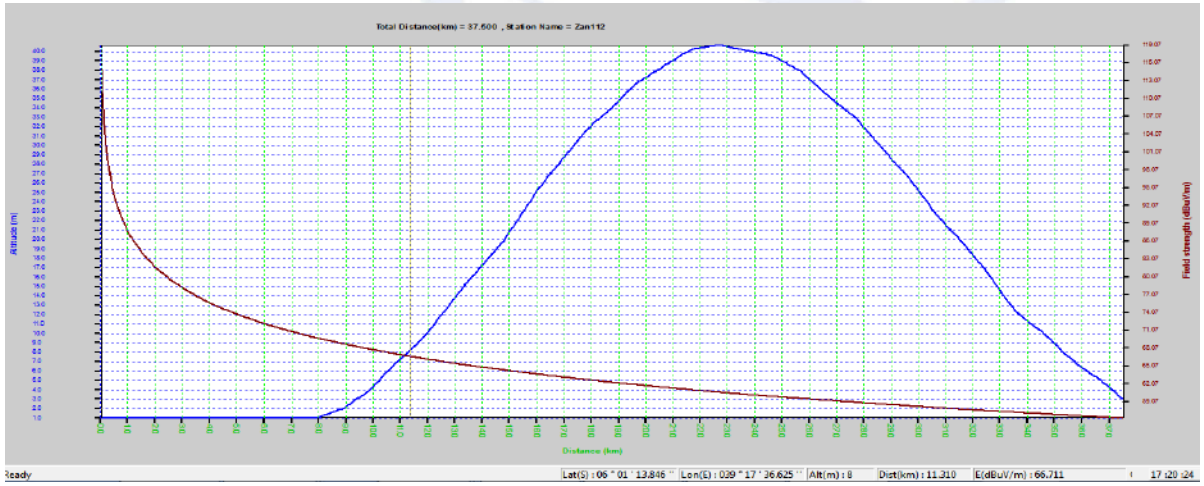
	15	Tav FX1	-6.0917	38.1833	30.0000
	16	Tanz FX22	-5.9000	38.1250	20.0000
	17	tan fx 11 ...	-7.0167	38.1417	20.0000
	18	tanz fx 22 ...	-7.1917	38.3333	20.0000
	19	222	-5.1500	37.1417	0.0000
	20	111	-5.2750	37.3500	0.0000

CALCULATION ALONG A LINE

- The graph is equipped with a vertical marker which is movable horizontally by the mouse while holding the left click.

3

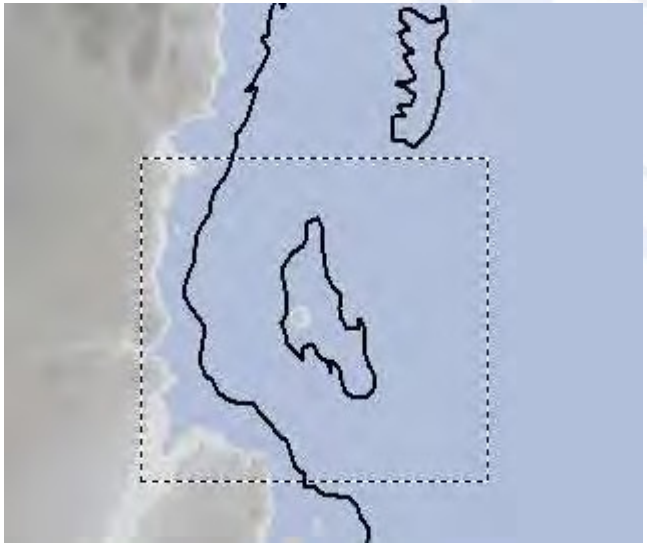


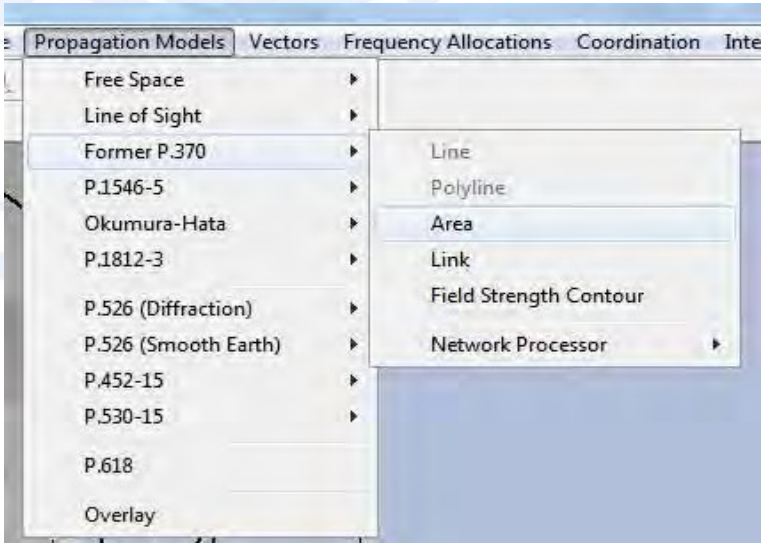


Blue : No LOS, and red: LOSto the concerned station

AREA CALCULATION

- Calculates of field strength values produced by a selected station inside a rectangular area at a given receiving height above ground level.
- To activate the “Area” sub-items a rectangular area must be drawn in advance on the DEM using the “Draw Box” or “Draw Box from Database” toolbar buttons.
- In the case of the line-of-sight (LOS) model, the “Area” calculation sub-item provides only a visibility analysis along the line from the wanted station
- By choosing “Area” sub-item, a spreadsheet of stations in the database is opened and users may select a station inside the area by a mouse left click on the corresponding row of the record-select column.





AREA CALCULATION

Select station

IDst	STname	STlat_deg	STlon_deg	Sth_agl
5	PRVHF1	24.5750	55.1833	60.0000
7	Station-235	-2.4000	35.9750	0.0000
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10	IMT700BTS	-5.8833	37.4000	30.0000
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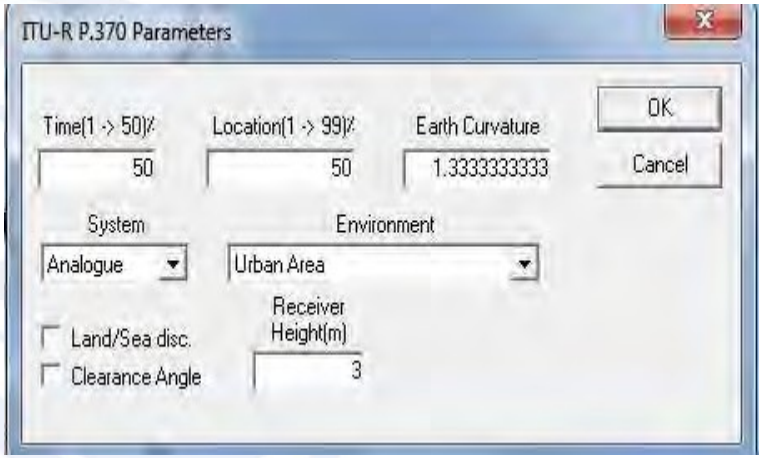
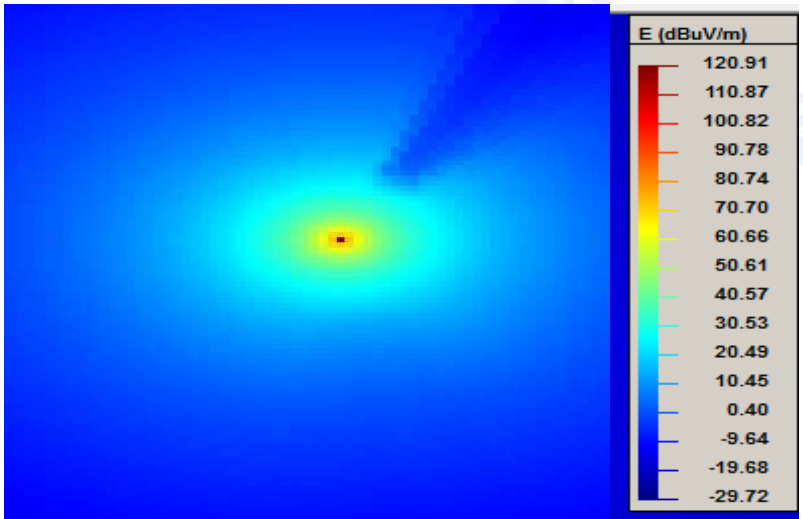
19	222	-5.1500	37.1417	0.0000
20	111	-5.2250	37.3500	0.0000

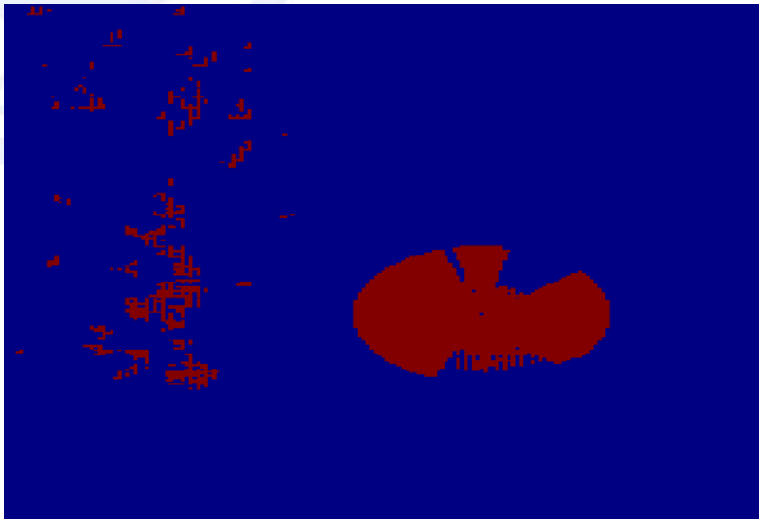
Set parameters



Area Calculation P370

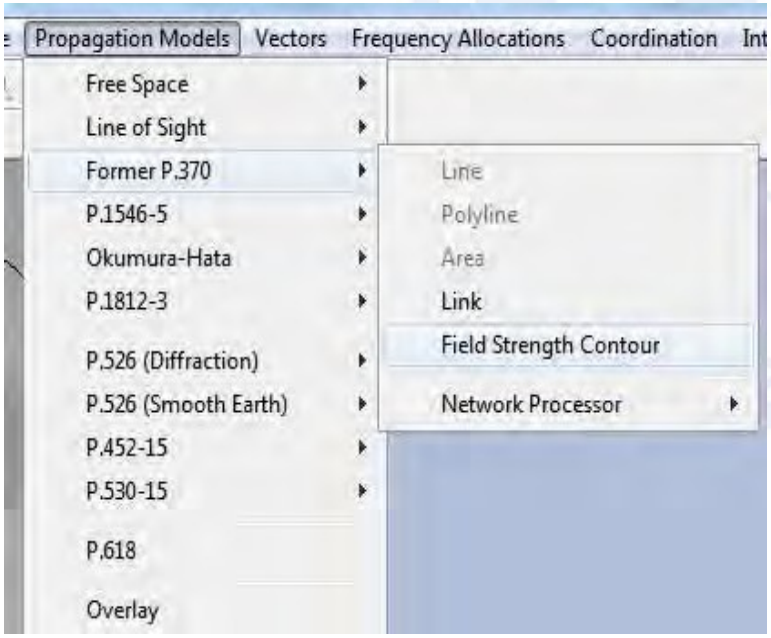


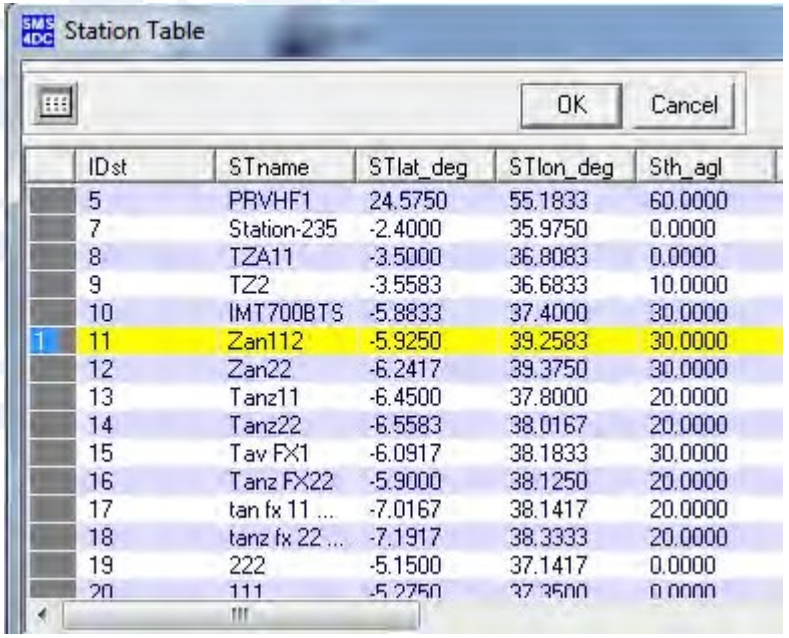
Calculation LOS



FIELD STRENGTH CONTOUR

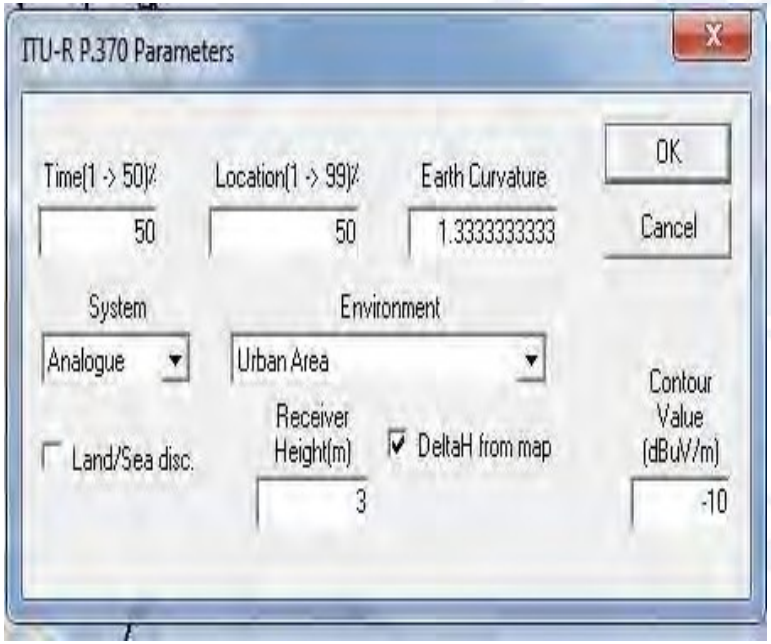
- This function saves and displays field strength contours around a selected station where the field strength values inside the contour are higher than a given threshold.
- A dialogue box of the propagation model requests the user to enter a threshold value for this parameter.



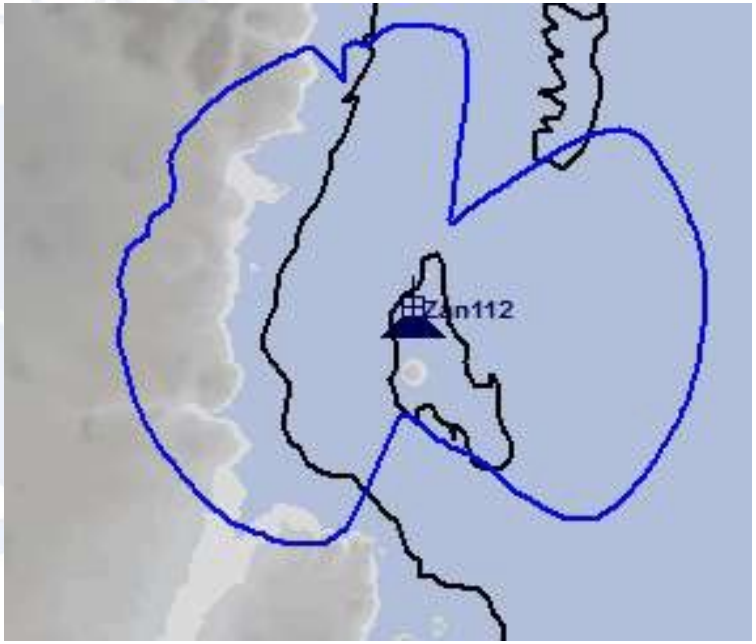


FIELD STRENGTH CONTOUR

Choose contour parameters



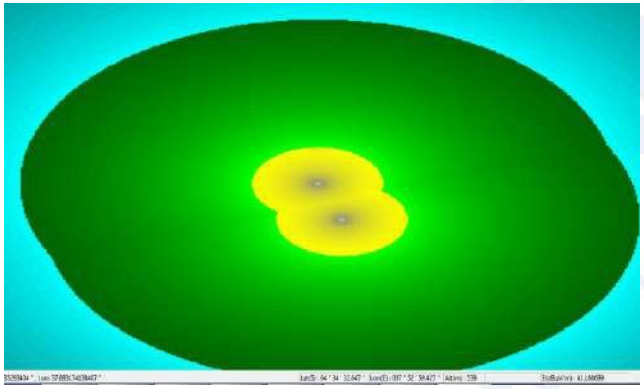
Field Strength Contour – P.370



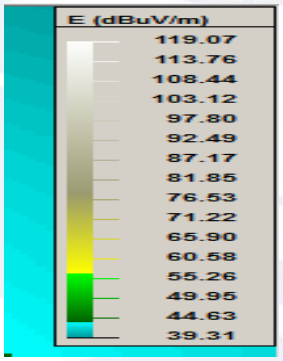
FIELD STRENGTH CONTOUR

- Using tools menu of the area calculation window the following items can be showed

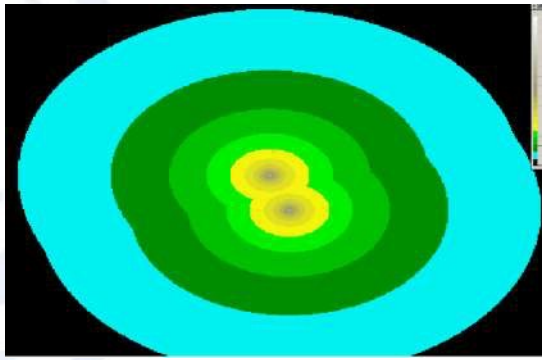
Change color



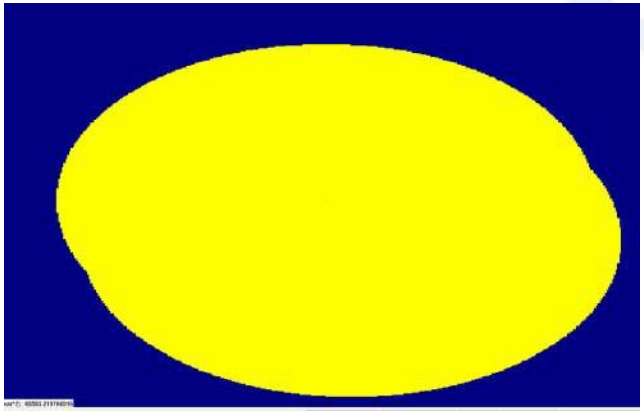
Show legend



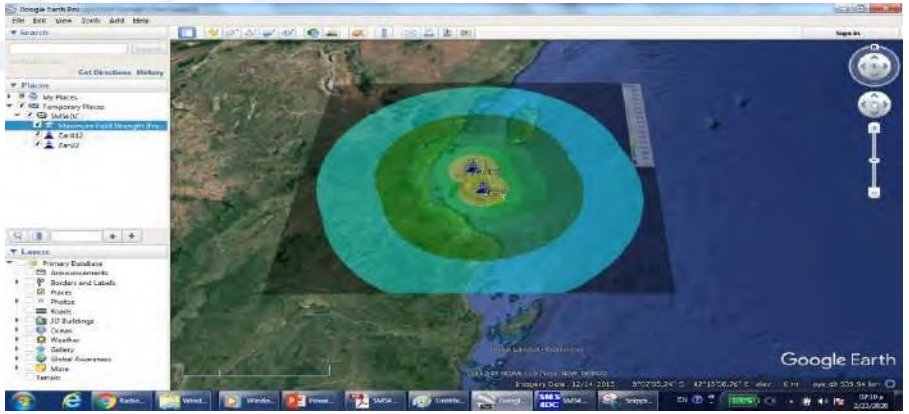
Contour



Coverage

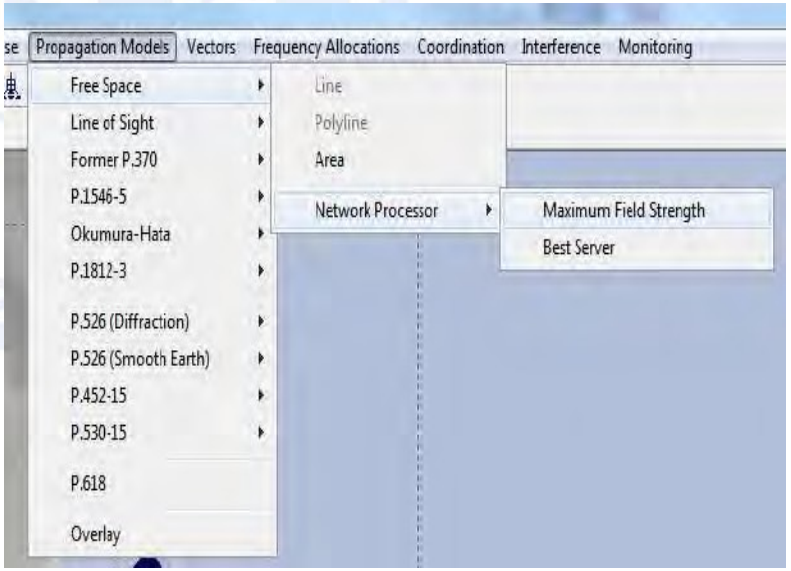


Export results to google earth



MAXIMUM FIELD STRENGTH

- This item calculates and displays the maximum value of field strength values produced by more than one transmitting stations at any point inside a predefined rectangular area.
- Prior to the selection of this sub-item, a rectangular area must be selected using the “Draw Box” or “Draw Box from Database” toolbar buttons.



MAXIMUM FIELD STRENGTH

Select more than one station nearby

Station Table

OK Cancel

	IDst	STname	STlat_deg	STlon_deg	Sth_agl
	5	PRVHF1	24.5750	55.1833	60.0000
	7	Station-235	-2.4000	35.9750	0.0000
	8	TZA11	-3.5000	36.8083	0.0000
	9	TZ2	-3.5583	36.6833	10.0000
	10	IMT700BTS	-5.8833	37.4000	30.0000
1	11	Zan112	-5.9250	39.2583	30.0000
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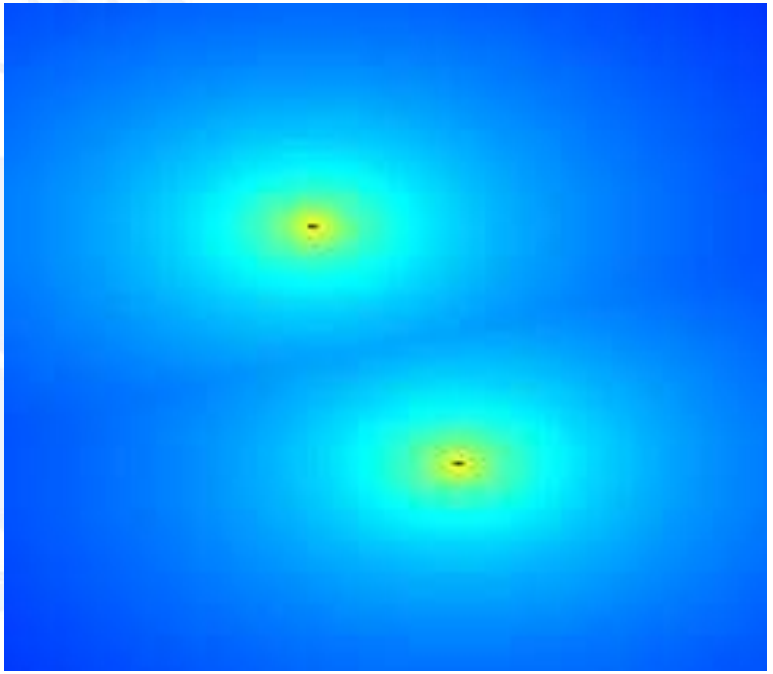
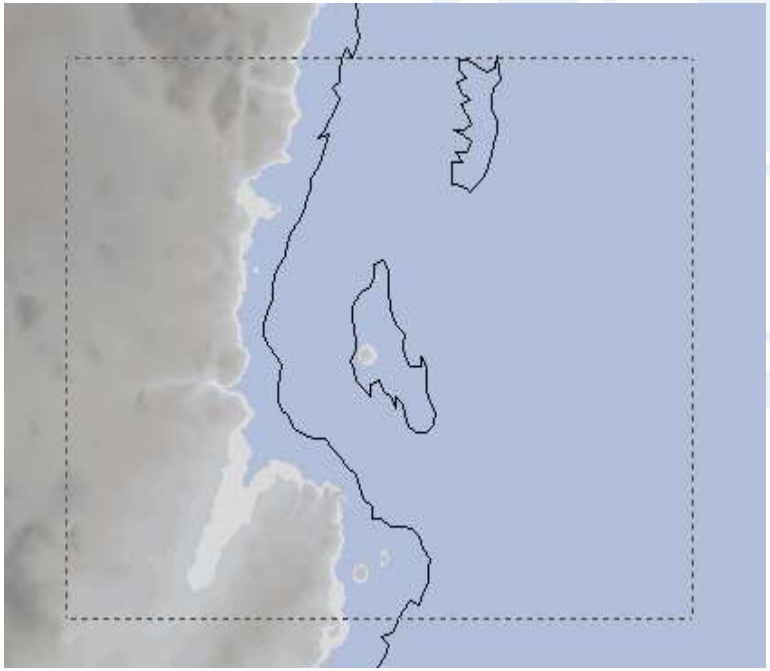
	18	tanz fx 22 ...	-7.1917	38.3333	20.0000
	19	222	-5.1500	37.1417	0.0000
	20	111	-5.2750	37.3500	0.0000

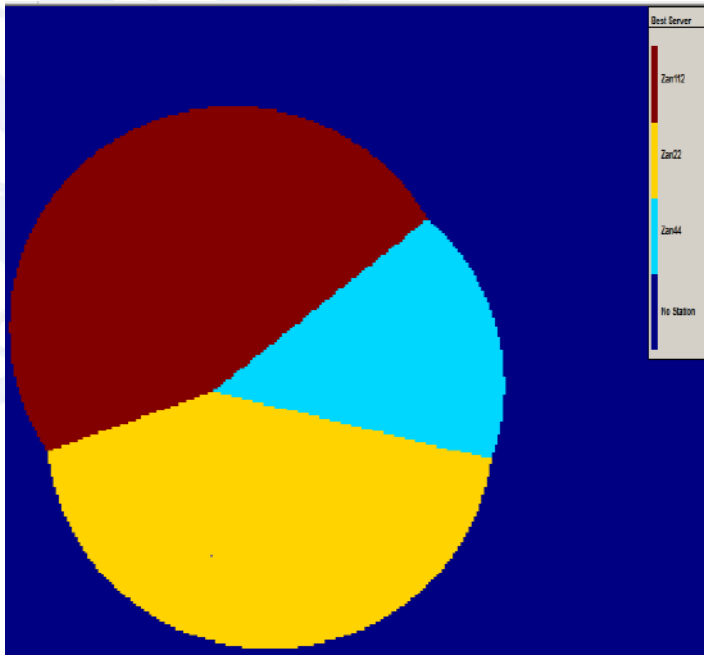
Free Space Maximum Field Strength



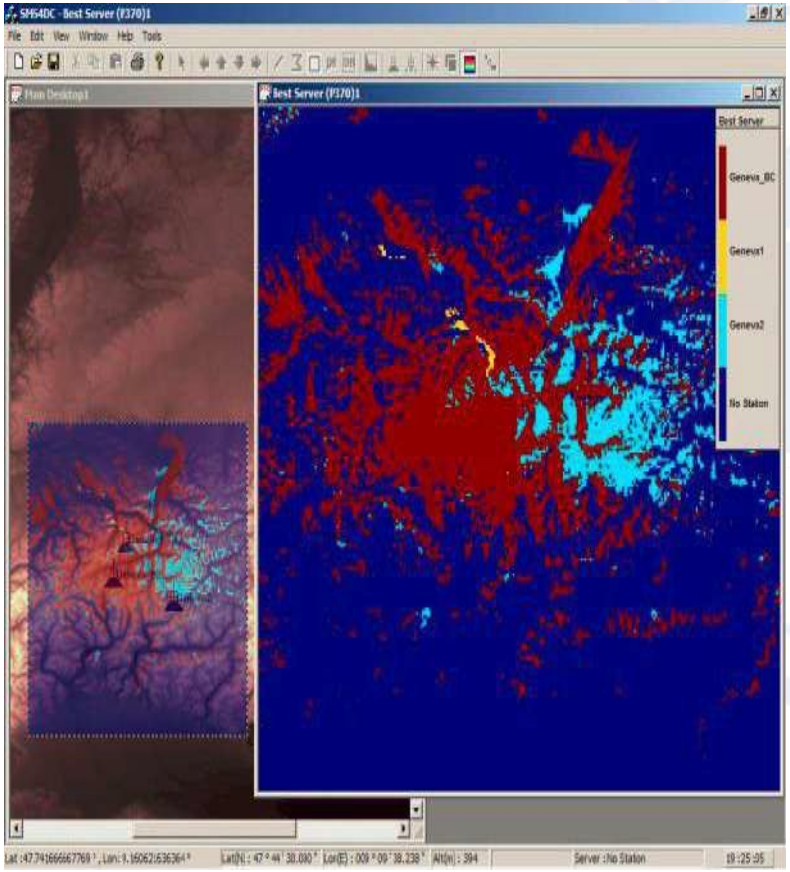
BEST SERVER

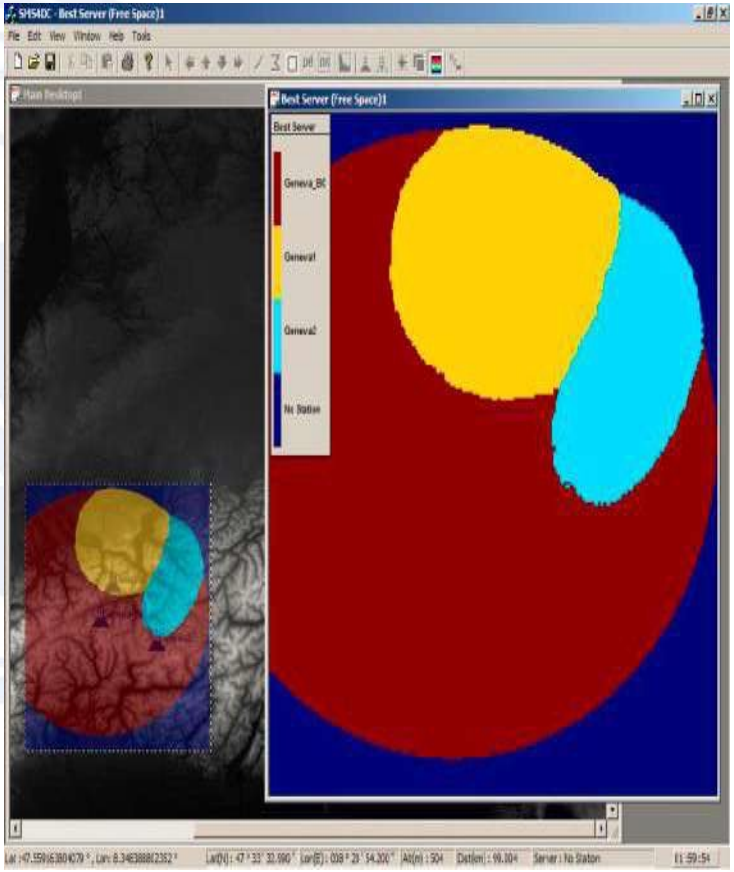
- This function calculates and displays the best serving station, among various stations, at each point inside a predefined rectangular area.
- Prior to the selection of this sub-item, a rectangular area must be selected using the “Draw Box” or “Draw Box from Database” toolbar buttons.





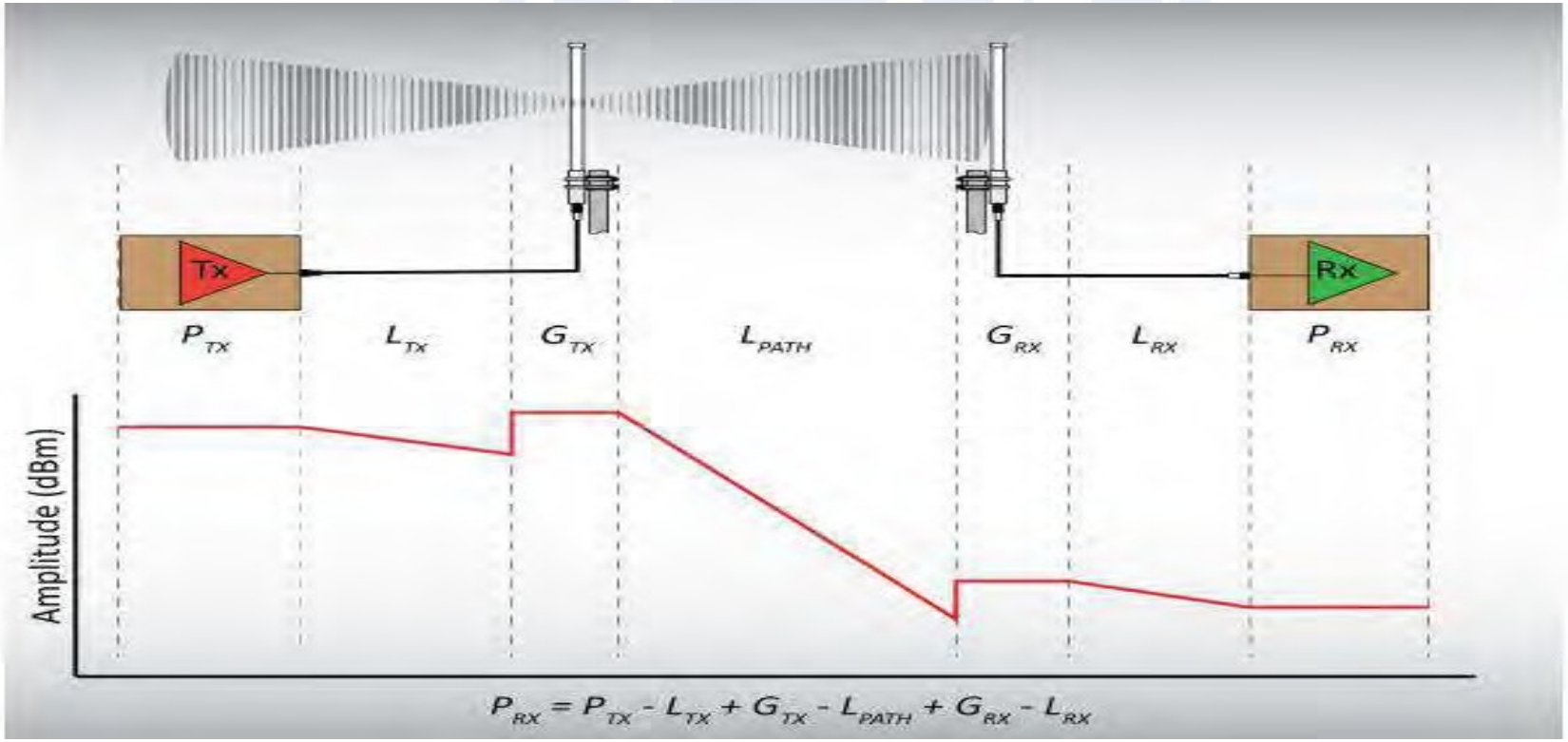
BEST SERVER


SM54DC - Best Server (P370)1
Best Server (P370)1
Best Server
Geneva_BC
Geneva1
Geneva2
No Station


SM54DC - Best Server (Free Space)1
Best Server (Free Space)1
Best Server
Geneva_BC
Geneva1
Geneva2
No Station

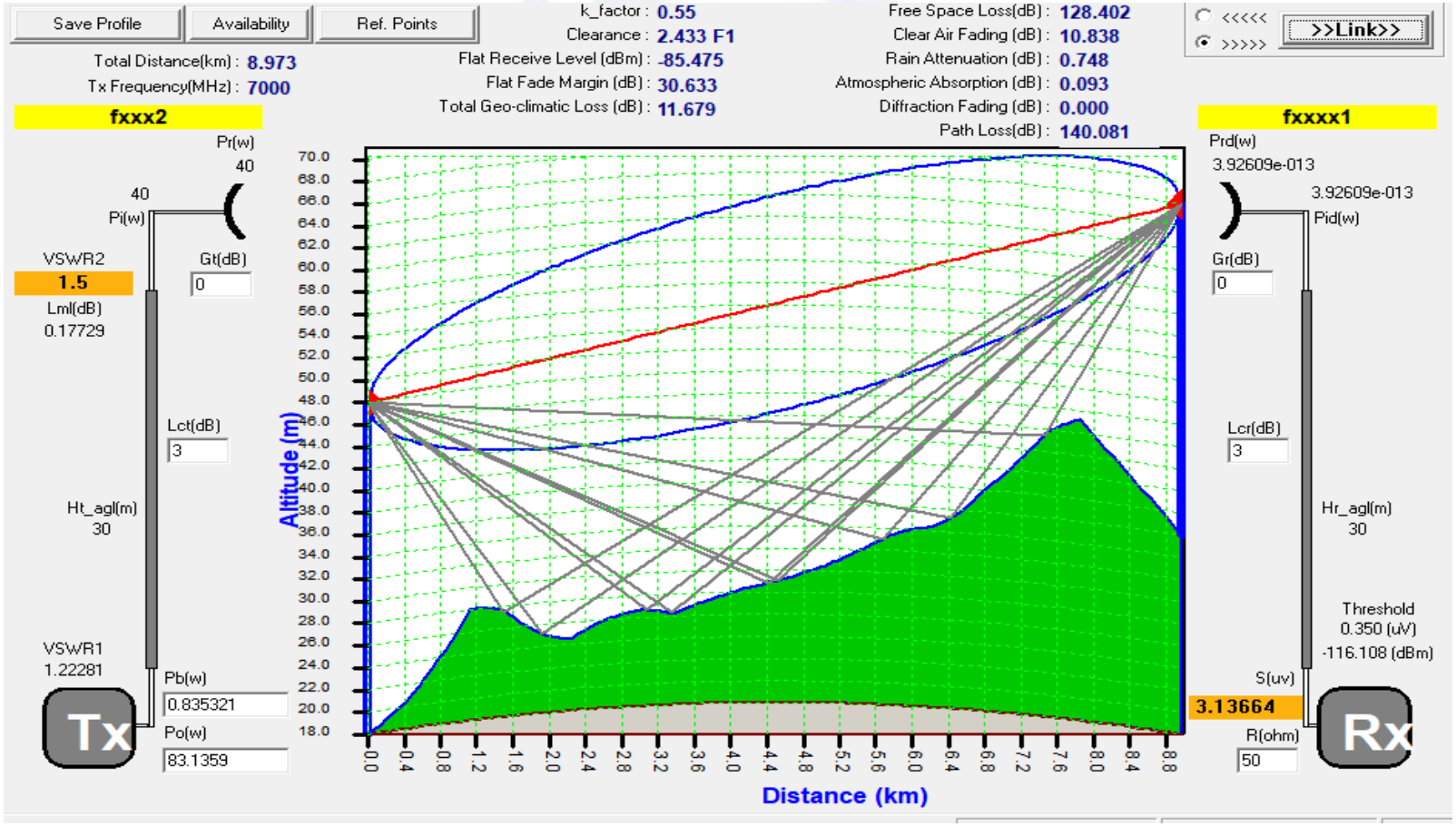
LINK BUDGET CALCULATION

- Link budget calculation, displays calculation results between two stations as well as providing a visual user-interface to optimize the link characteristics.
- The link calculation contains: a path profile diagram, the Fresnel zone, Earth curvature and those technical characteristics of a link that are relevant to the propagation model in use.



Source:
Campbell Scientific, Inc

LINK BUDGET CALCULATION



PROPAGATION LOSS

- Attenuation due to atmospheric gases
- Diffraction fading due to obstruction or partial obstruction of the path,
- Fading due to multipath, beam spreading and scintillation,
- Attenuation due to variation of the angle-of arrival/launch,
- Attenuation due to precipitation,
- Attenuation due to sand and dust storms
- Total Loss = [Free Space Loss]+ [Atmospheric Gaseous Loss]+ [Rain Attenuation]+ [Clear Air Fading]+ [Diffraction Loss]+ [NFD].
- Flat Receive Level = PT + GT – [Free Space Loss] – [Atmospheric Gaseous Loss] – [Diffraction Loss] + GR – [Receiver Insertion Loss]
- Fade Margin = [Flat Receive Level] – [Receiver Threshold]

PROPAGATION LOSS

- Attenuation due to atmospheric gases
- Diffraction fading due to obstruction or partial obstruction of the path,
- Fading due to multipath, beam spreading and scintillation,
- Attenuation due to variation of the angle-of arrival/launch,
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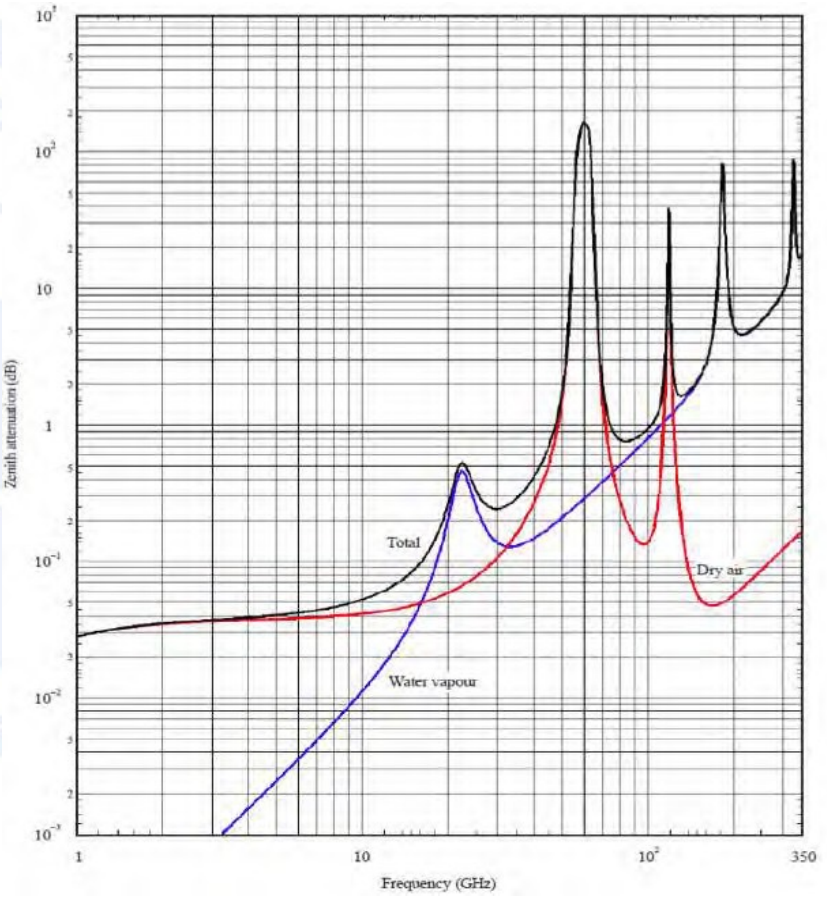
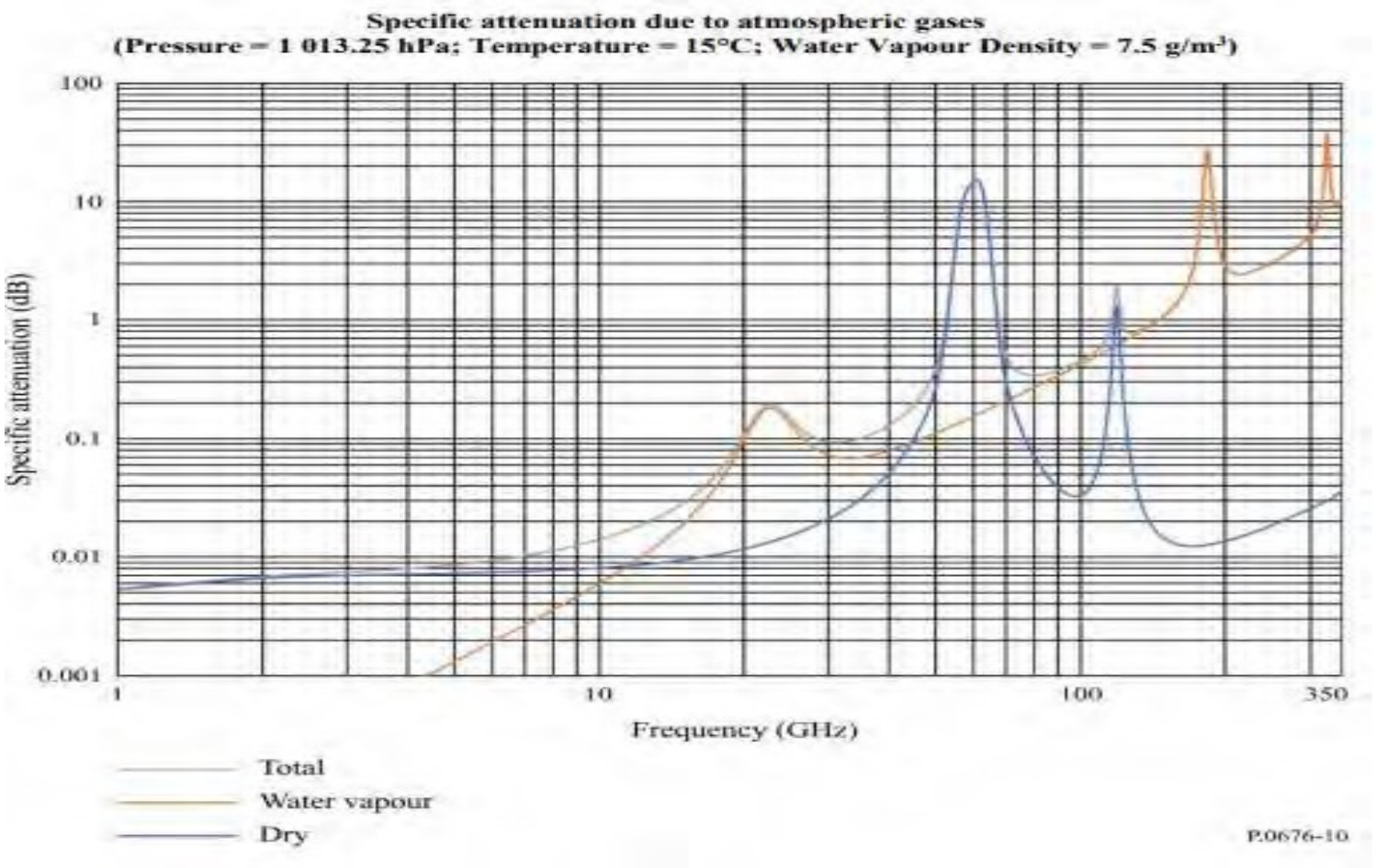
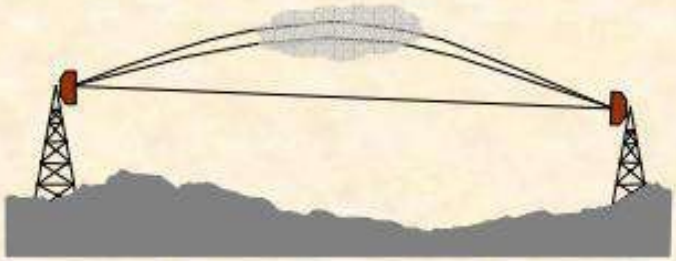


PROPAGATION LOSS

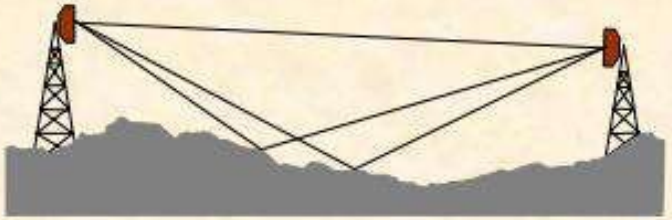
- Atmospheric gases considerable loss above 10 GHz



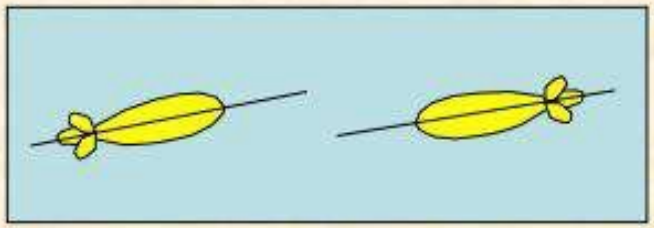
PROPAGATION LOSS



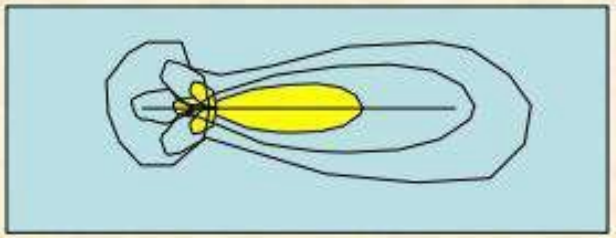
atmospheric Multipath



surface Multipath



Antenna Decoupling
(governs the minimum beamwidth)



Beam Spreading
(defocusing)

Thank you!