



Spectrum Management System for Developing Countries (SMS4DC)

Training on SMS4DC

24-26 July, 2023

Livingstone, ZAMBIA

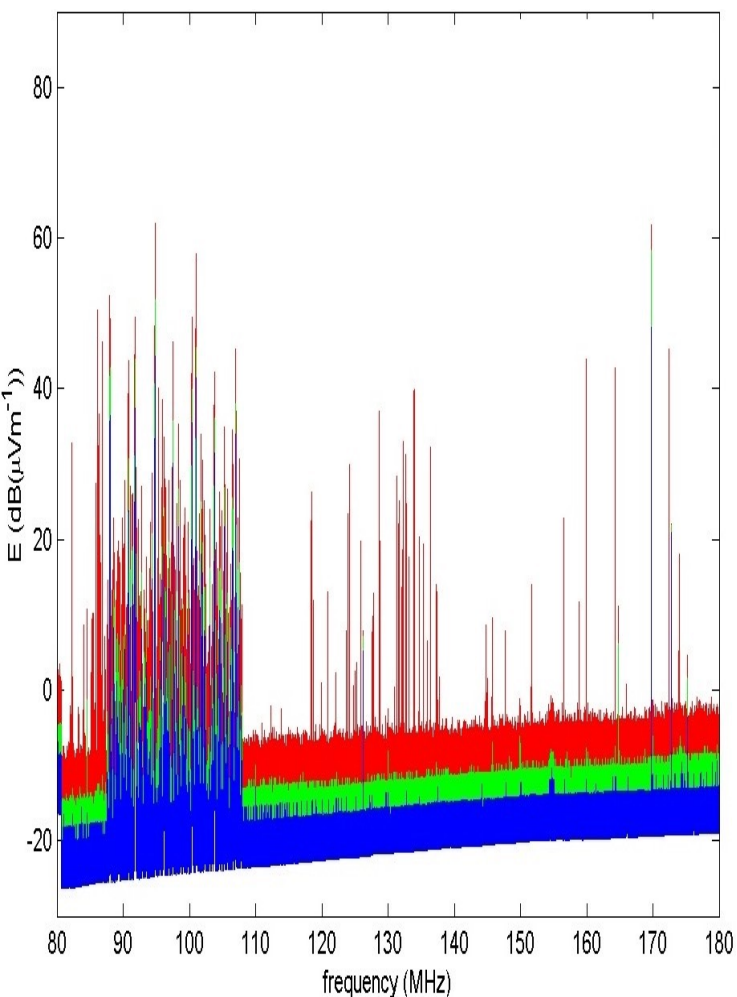
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INTERFERENCE MITIGATION

INTERFERENCE DEFINITION / TYPES



The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.



TYPES OF INTERFERENCE

Power sources (50 Hz): due to leakage, arcing neon signs (continual arc) fluorescent light fixtures.

Co-channel: same frequency various power levels - strongest signal captures receiver.

Adjacent Channel: is interference caused by extraneous power from a signal in an adjacent channel. ACI may be caused by inadequate filtering

Intermodulation: unrelated frequency mixes with another signal generating a signal on or close to the receive frequency.

Harmonic signals are usually unwanted signals which are exact multiples of the operating frequency.

Out of band emissions Out-of-band emission is emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process.



IMPORTANT PARAMETERS

Protection ratio, PR

The required difference in dB between the level of the wanted signal and the level of the interfering signal to achieve the required quality of reception.

Minimum field strength $(C/N)(db)$

It is a minimum field strength level which is necessary to fulfil the signal quality for coverage.

Wanted field strength (E_w)

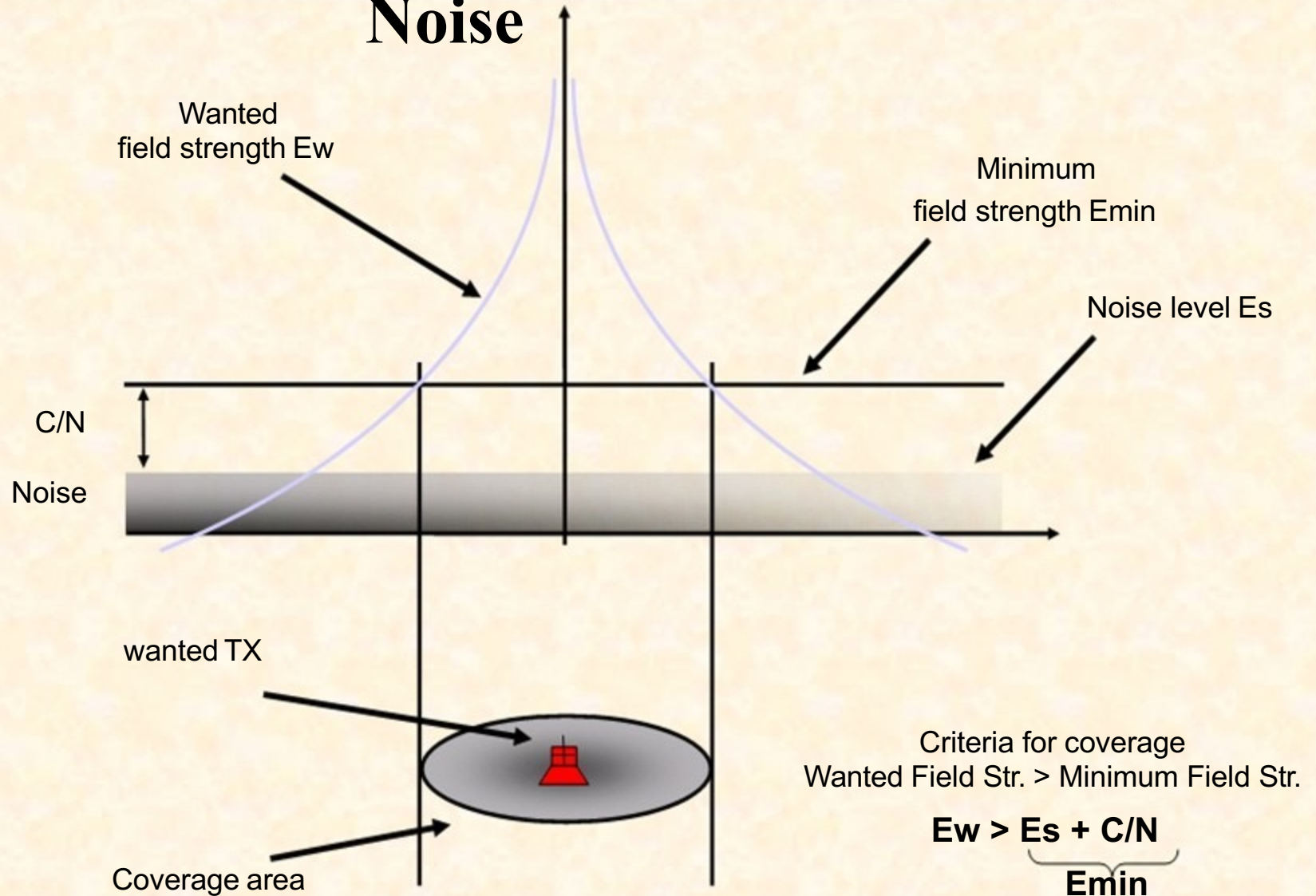
The required field strength of a wanted signal to achieve the required quality of reception, considering multiple interfering signals and their corresponding protection ratios. $E_w > E_n$

Nuisance field strength (E_n)

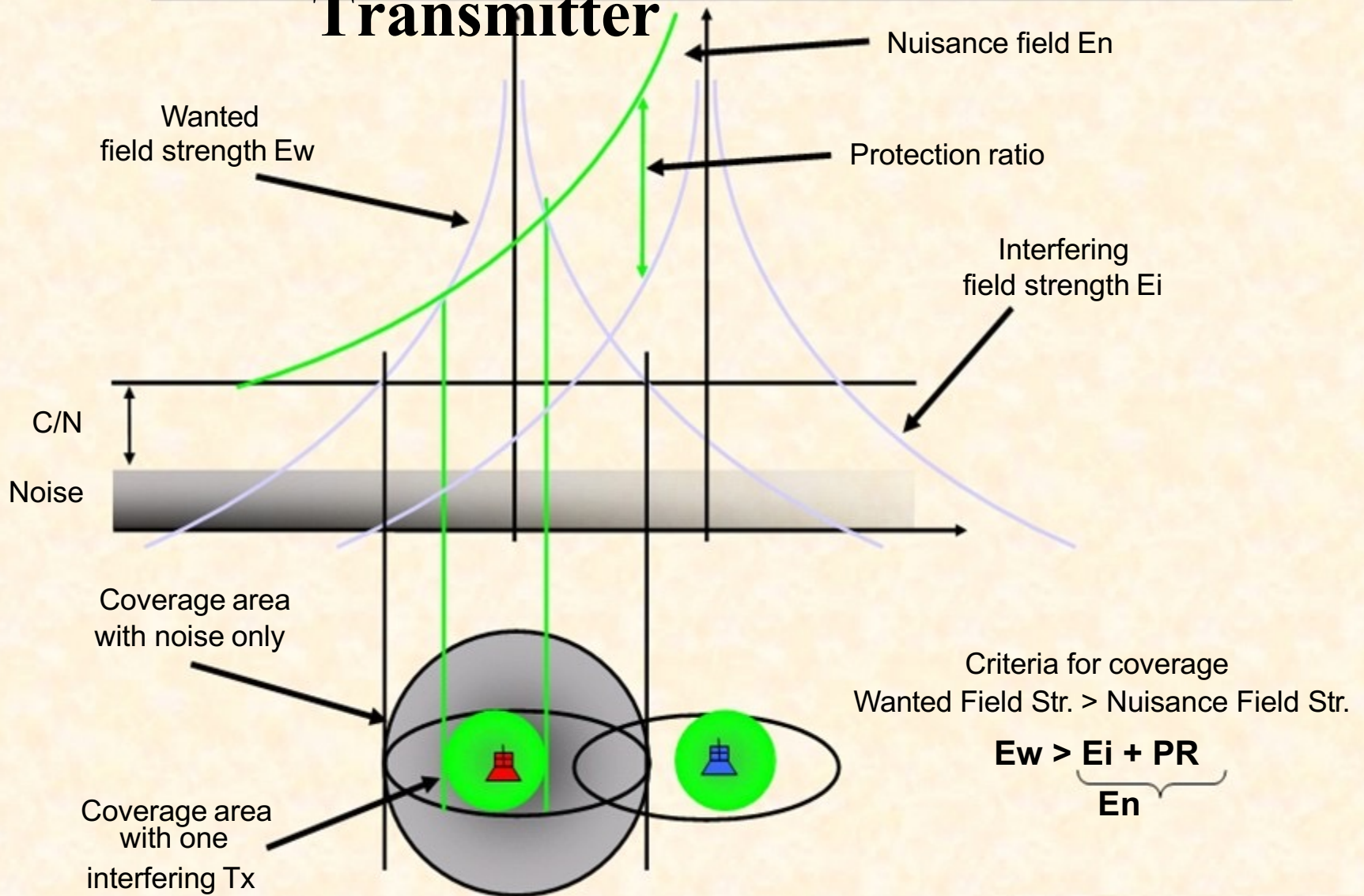
The equivalent required field strength of a wanted signal to achieve the required quality of reception, considering a single interfering signal and its corresponding protection ratio.

$$E_n = E_i(\text{interference field strength}) + PR$$

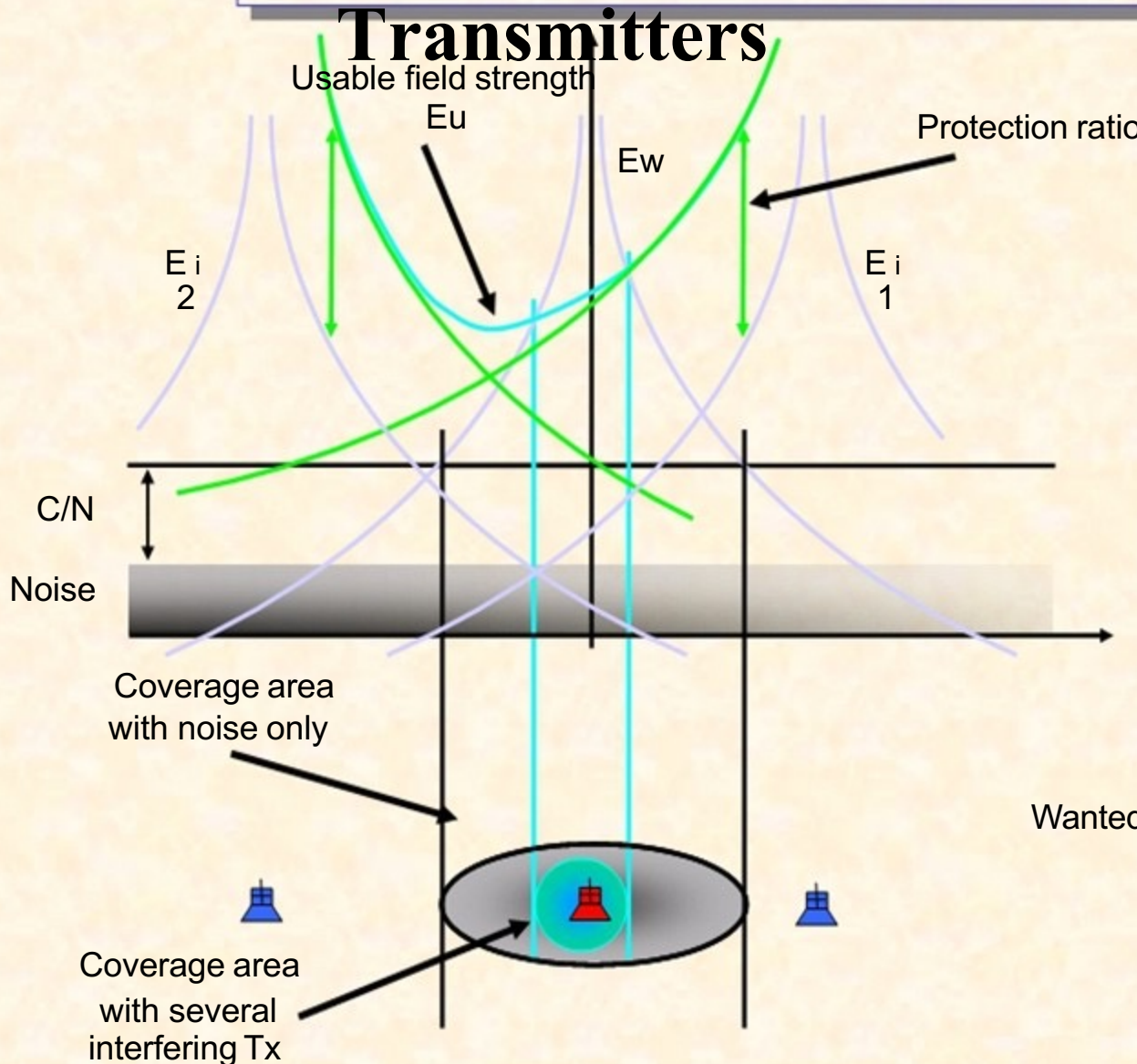
Interference by Noise



Interference by one Transmitter



Interference by several Transmitters



Criteria for coverage

Wanted Field Str. > Usable Field Str.

$$E_w > \sum_{j=1}^n E_{i_j} + E_u$$



SOUND BROADCASTING STATION

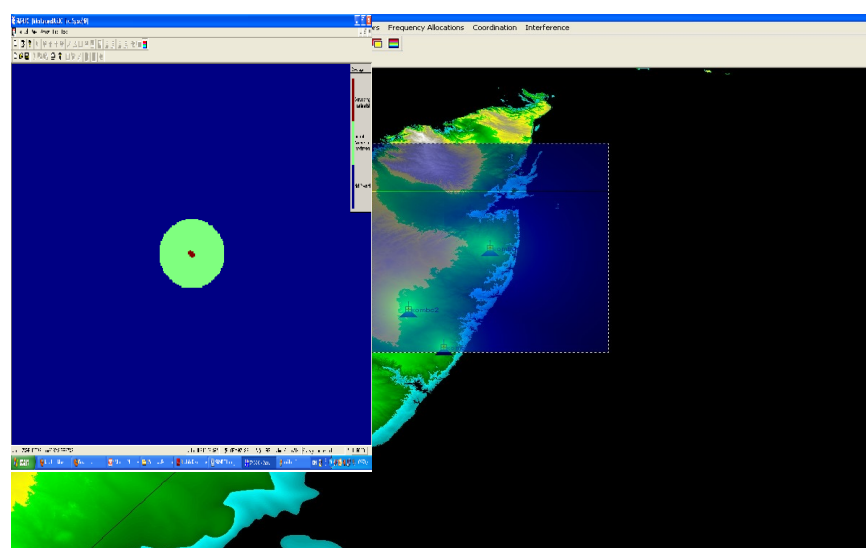
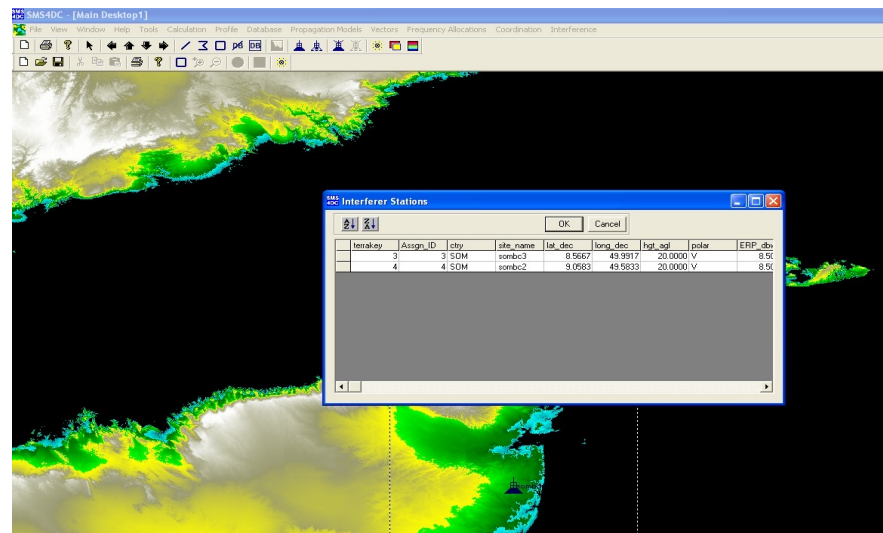
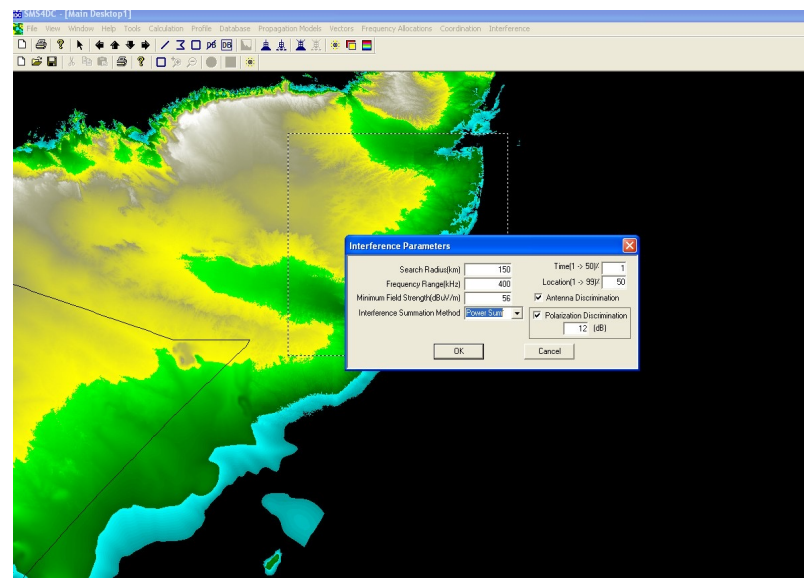
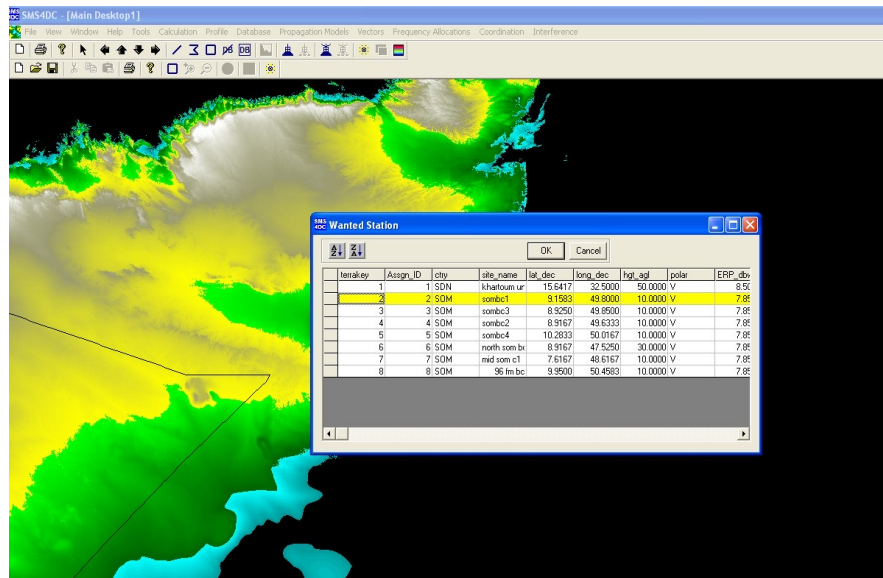
BC - BC (FM sound broadcasting stations):

Is to calculate aggregated interference level of interferer BC stations on a directional receiver of wanted BC station.

By selecting of BC2BC item the list of all FM sound broadcasting station is presented as in figure 1.1 below. After selecting a wanted bc station Dialog box of Interference Parameters is opened to set search conditions for victim BC stations figure 1.2.

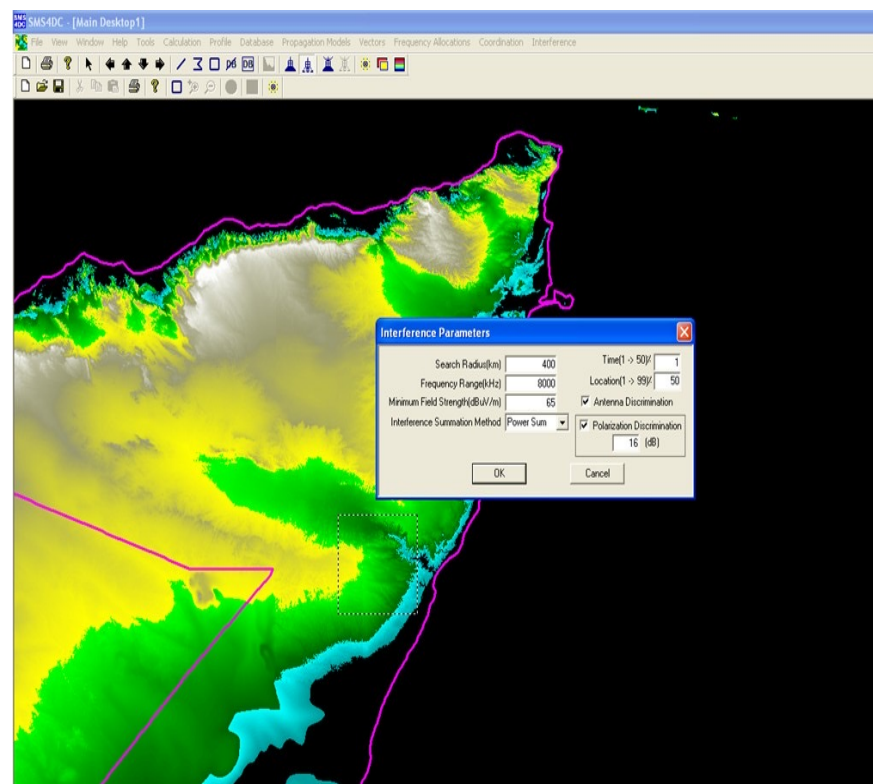
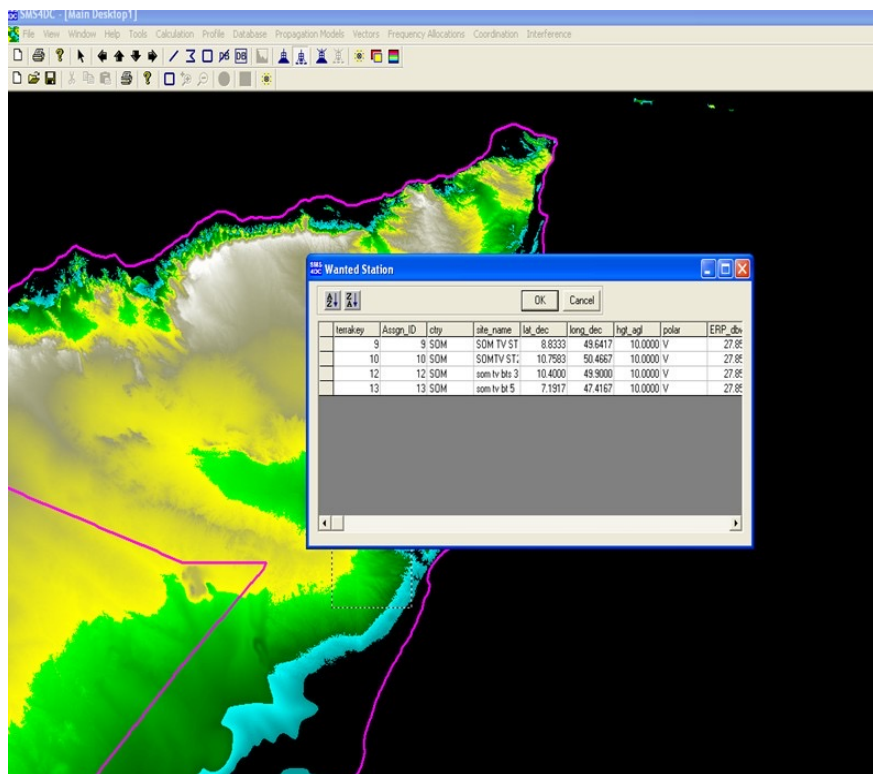


SOUND BROADCASTING STATION

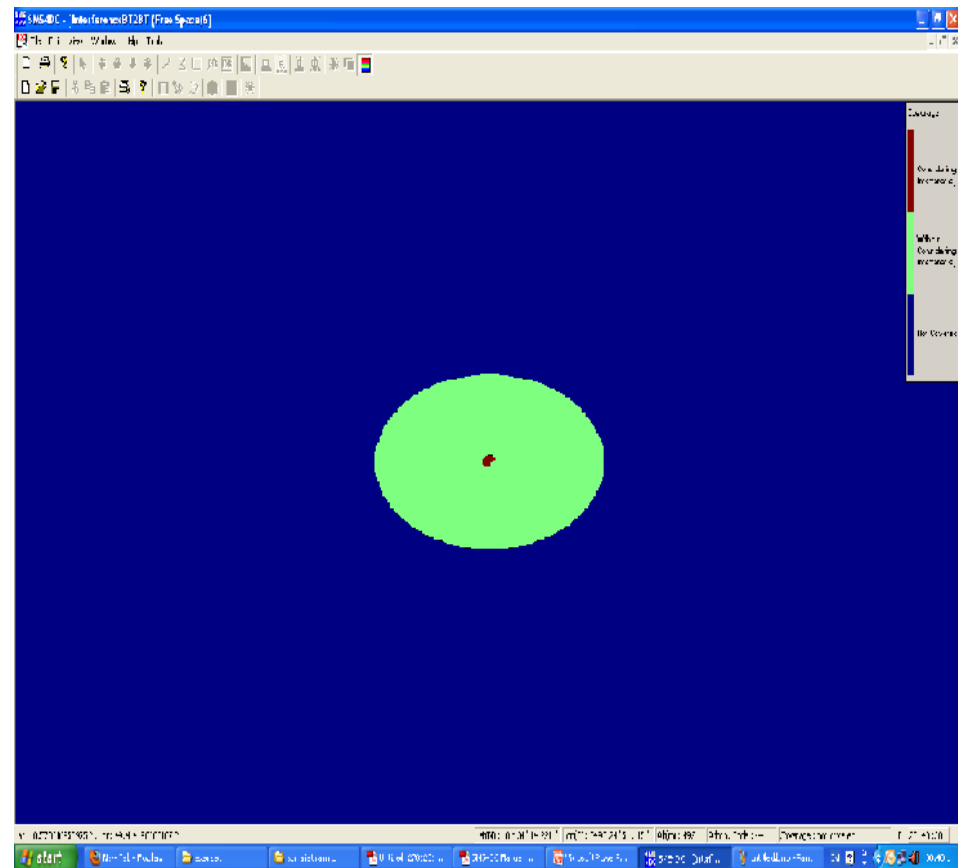
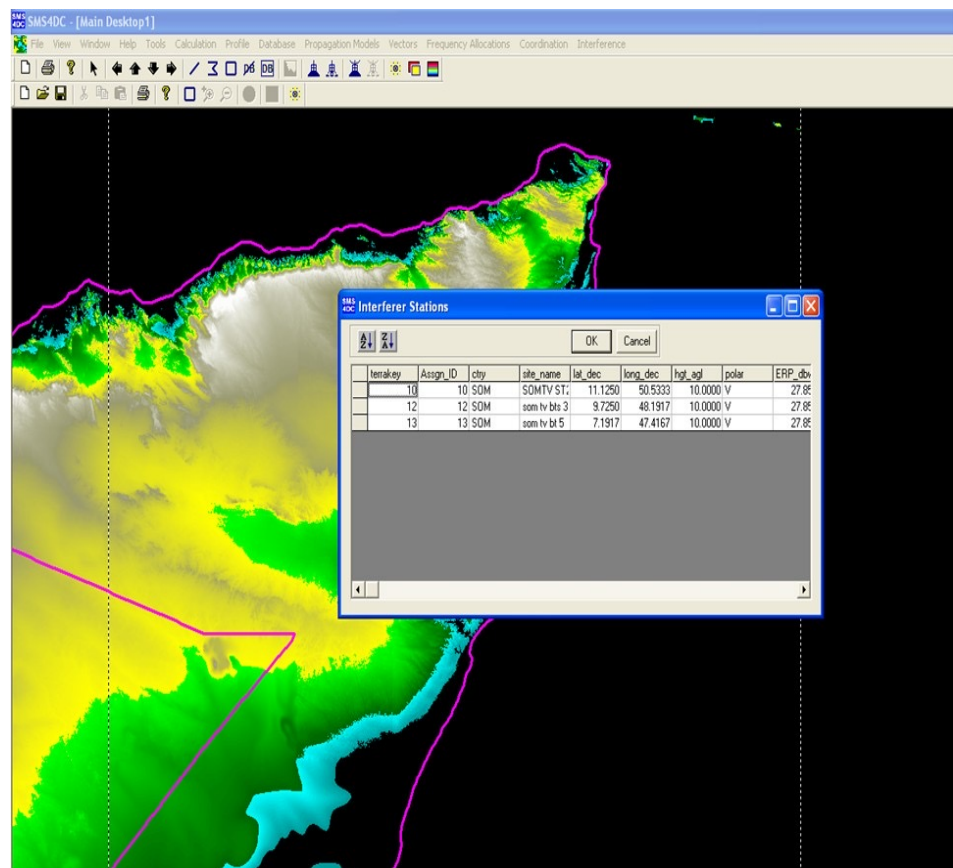


TV BROADCASTING

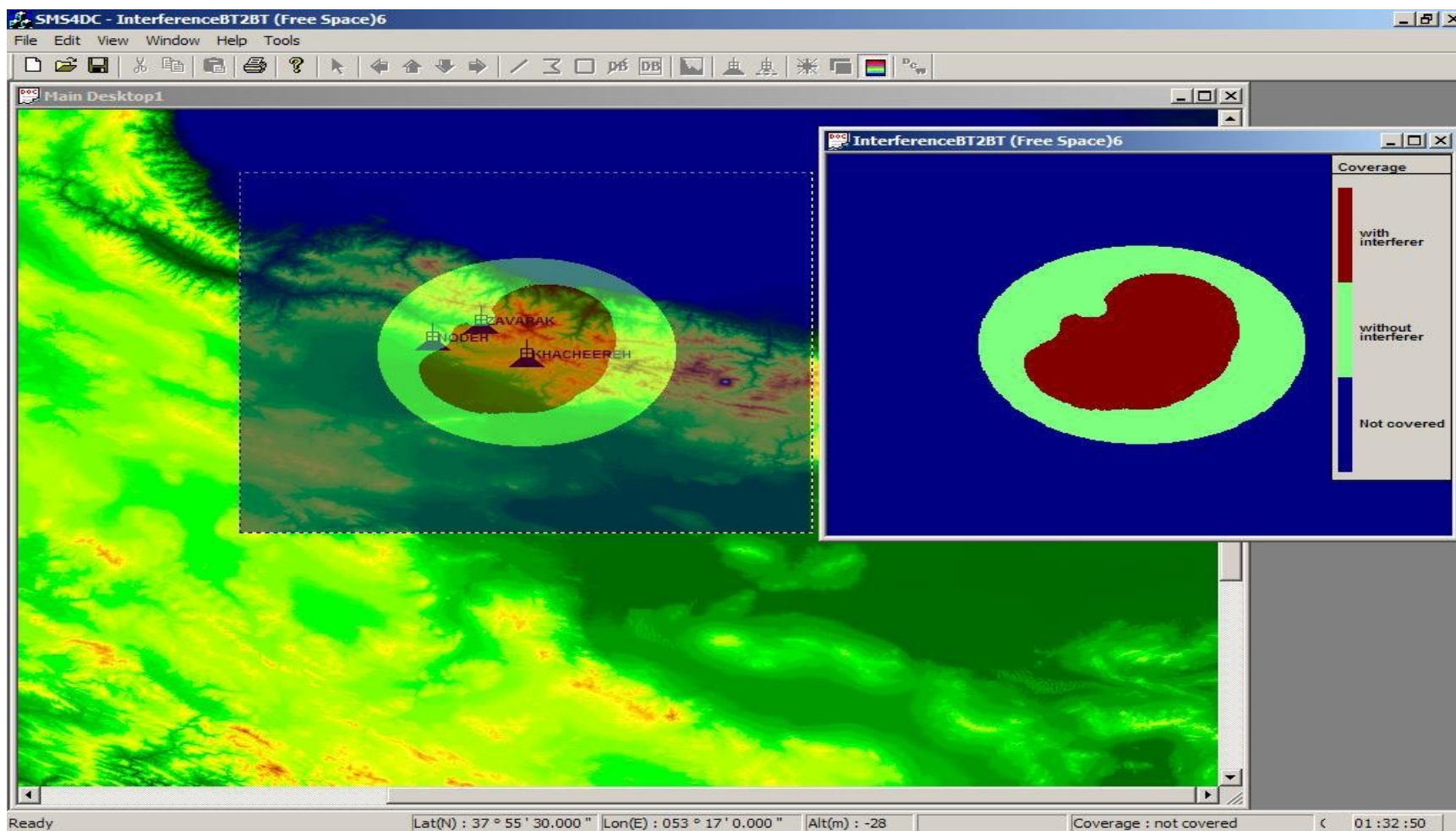
BT2BT: Item to calculate aggregated interference level of interferer BT stations on a receiver of wanted BT station, The procedure of BT to BT interference calculation is same as BC to BC.



TV BROADCASTING

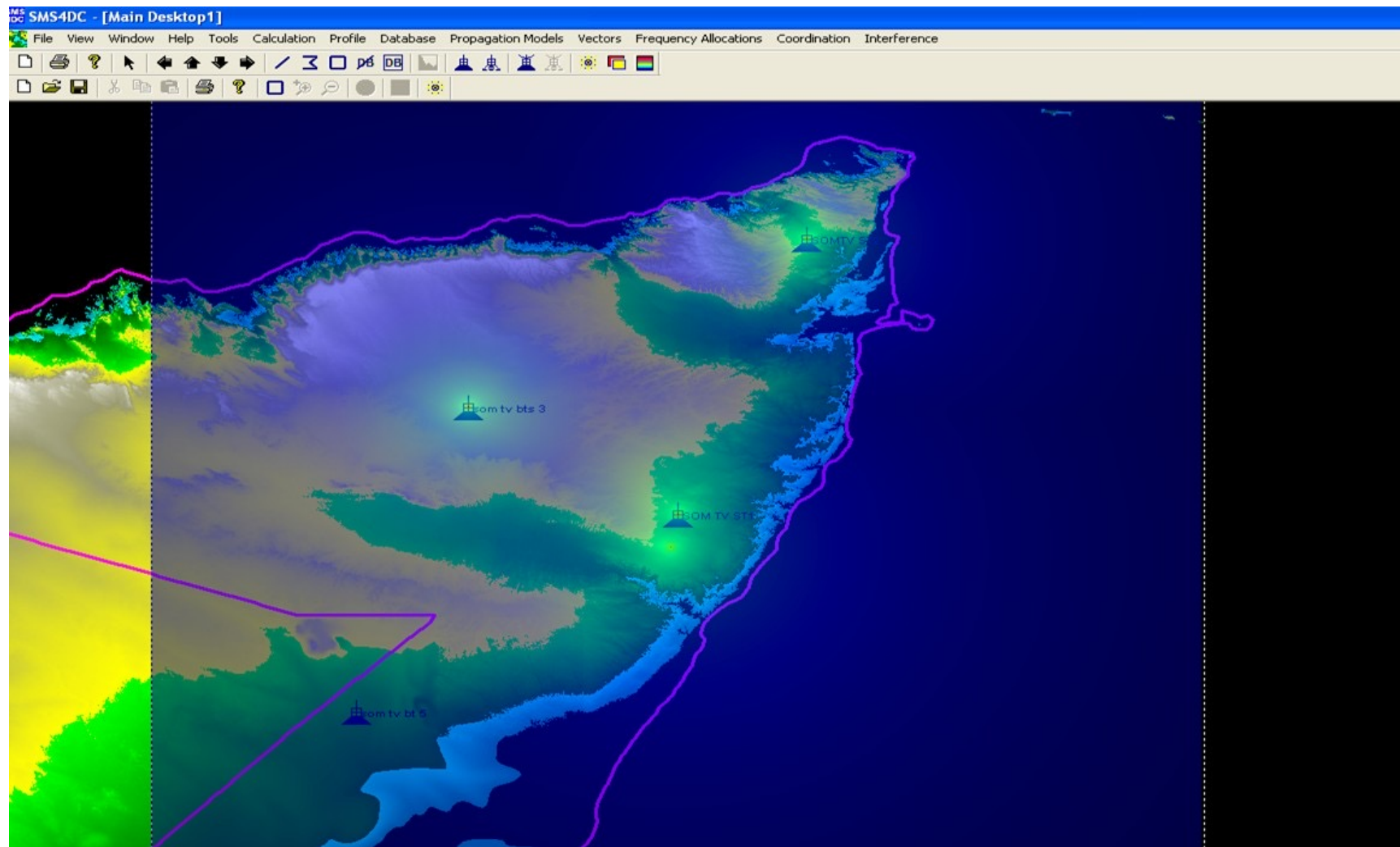


TV BROADCASTING



TV BROADCASTING

Usable field strength on receivers of wanted TV broadcasting station inside a selected area





POINT TO POINT INTERFERENCE

FX2FX (link):

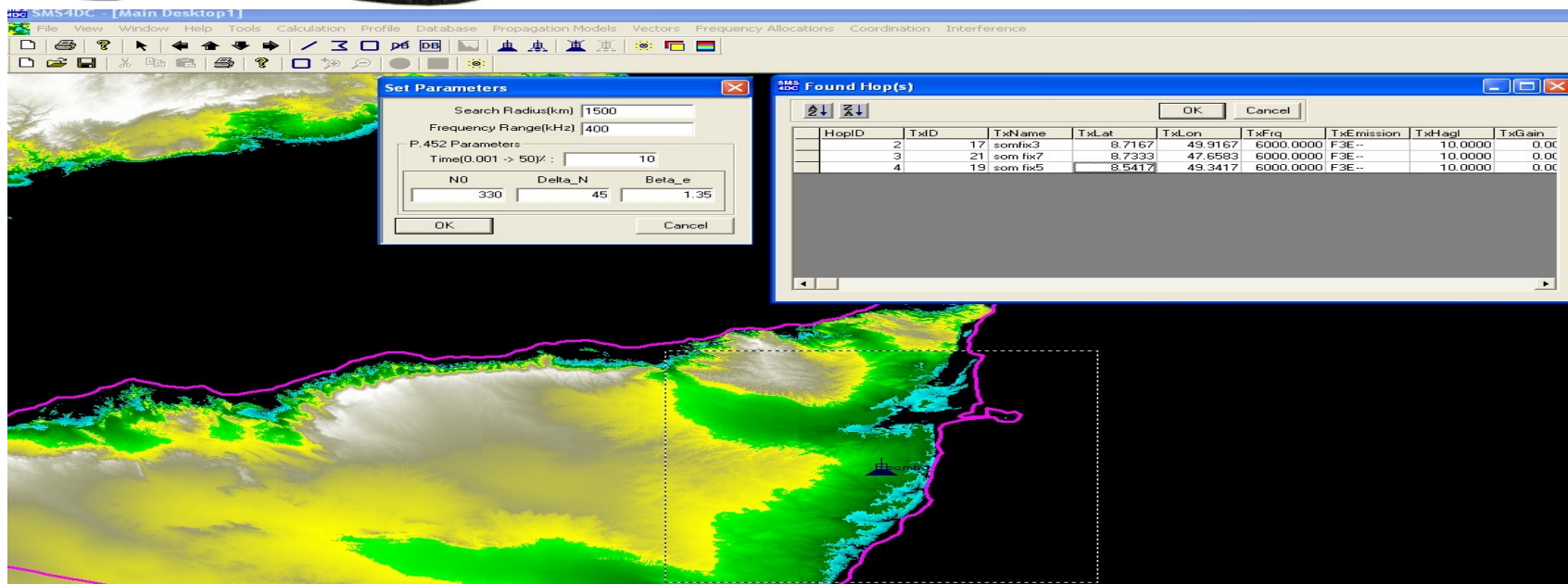
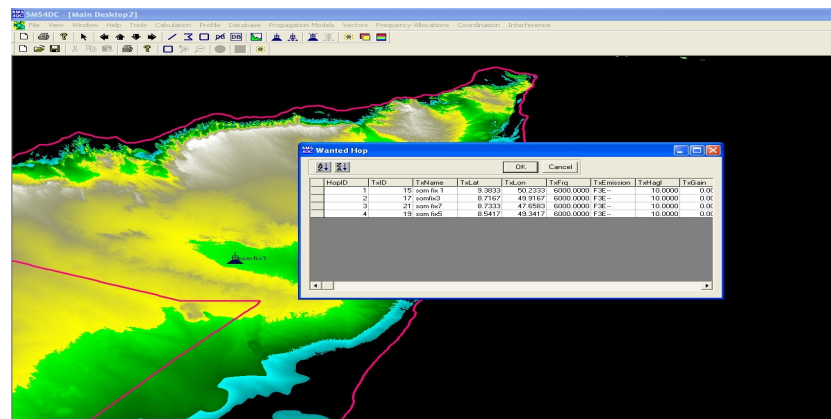
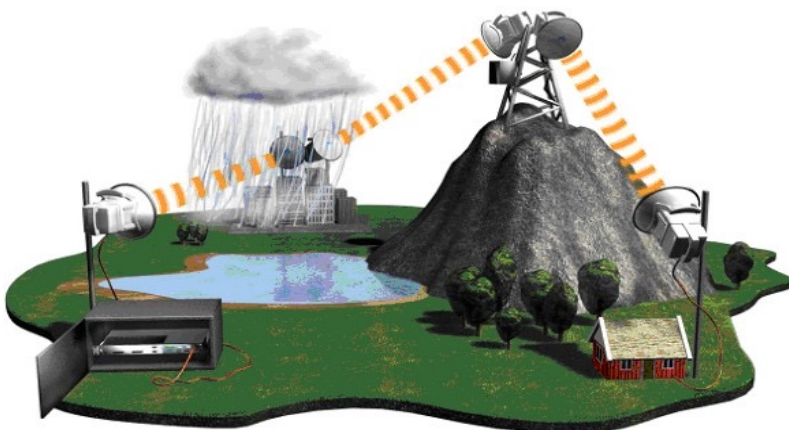
Item to calculate interference of stations of different point – to – point hops on each other by consideration antenna radiation patterns and XPD in accordance with ITU-R

P.452 recommendation.

This item contains two sub-items “Interference to” and “Interference from” enabling user to calculate the caused interference by wanted hop transmitter on receivers of other hops or the caused interference of other hops transmitter on wanted hop receiver, respectively.

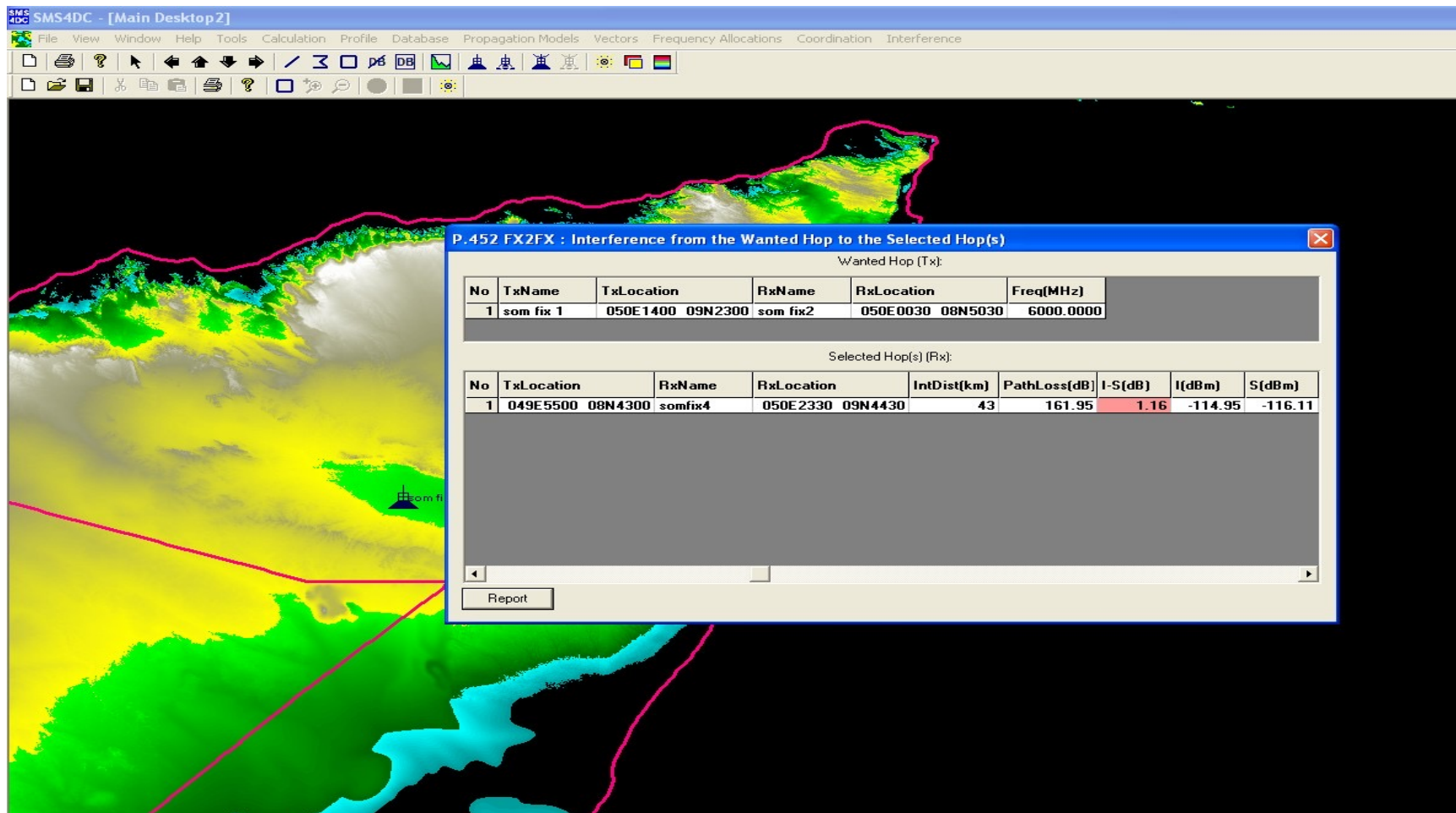
Choosing one of the sub items under this item opens the spreadsheet of available links, then by selecting one of the wanted link an set the parameters and by finalizing interferer (or victim) link selection. Then the calculation result is displayed including The wanted hop information and interference calculation results.

POINT TO POINT INTERFERENCE



POINT TO POINT INTERFERENCE

Interference occurrence is highlighted by red text background



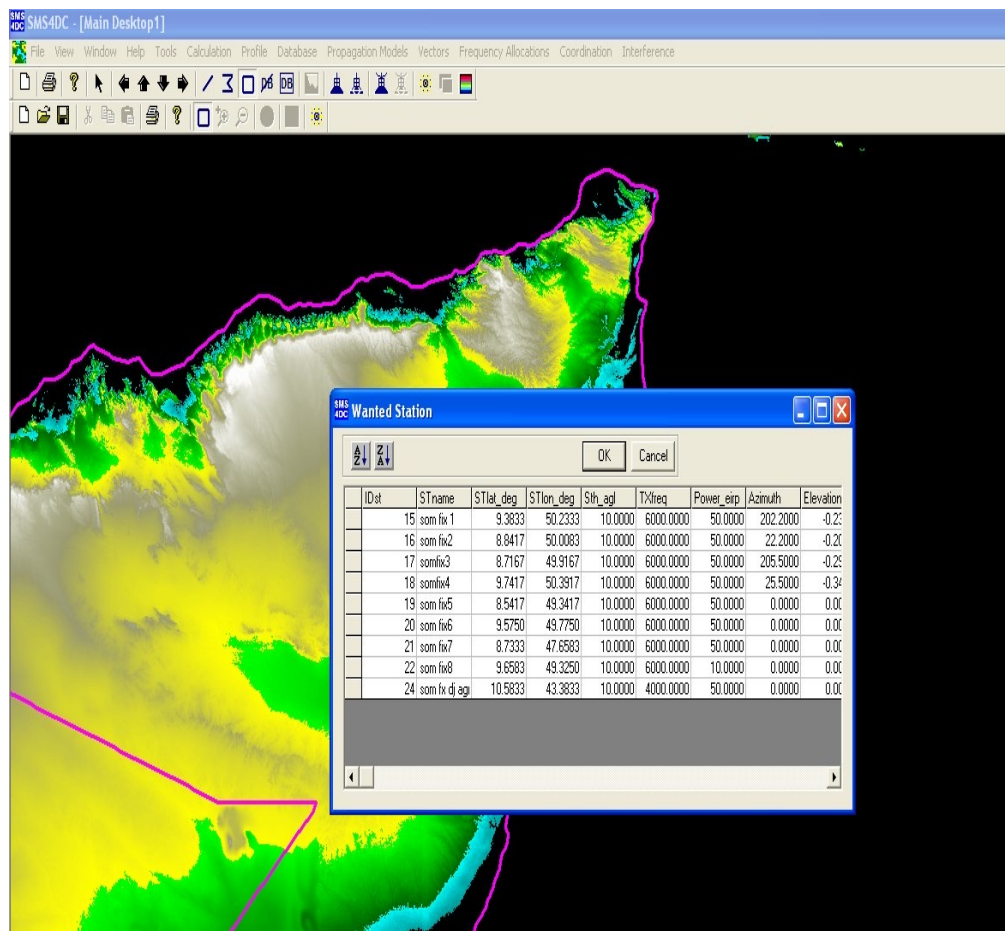
FIXED STATIONS INTERFERENCE

List of available fixed stations

“FX2FX (station): ietm to calcule the interference of fixed station on each other in accordance of ITU-R recommandation P.452.

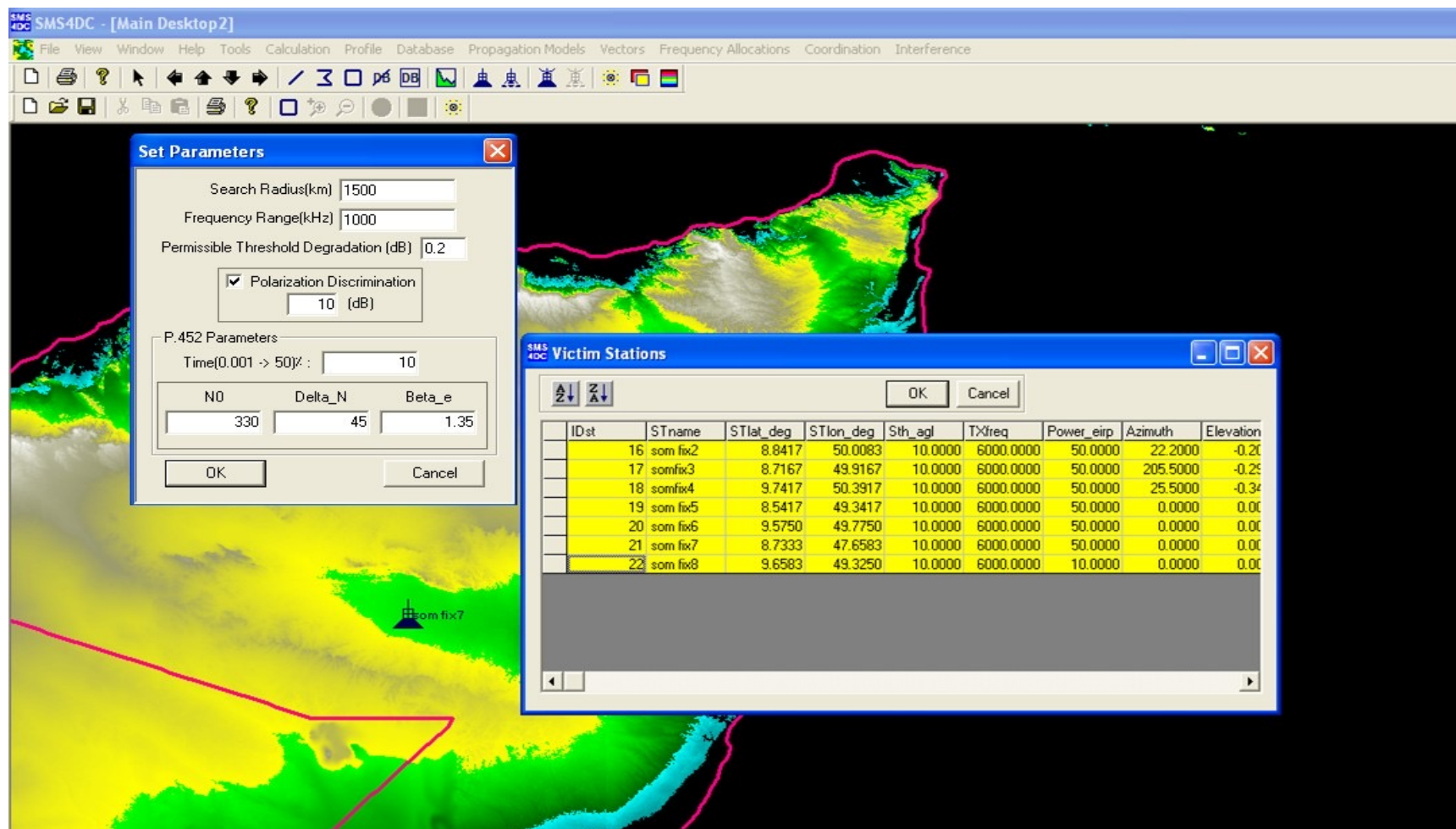
This item contains two sub items “Interference to” and “Interference from” by choosing one of the sub items under this item opens the spreadsheet of available fixed stations.

Then select one of the stations and set the parameters and by finalizing interferer (or victim) link selection. Then the calculation result is displayed including The wanted hop information and interference calculation results



FIXED STATIONS INTERFERENCE

Set Parameter dialog box and fixed stations meeting relevant conditions



The screenshot displays the SMS4DC software interface. The main window shows a map with a red outline of a landmass. Overlaid on the map are two dialog boxes:

Set Parameters Dialog Box:

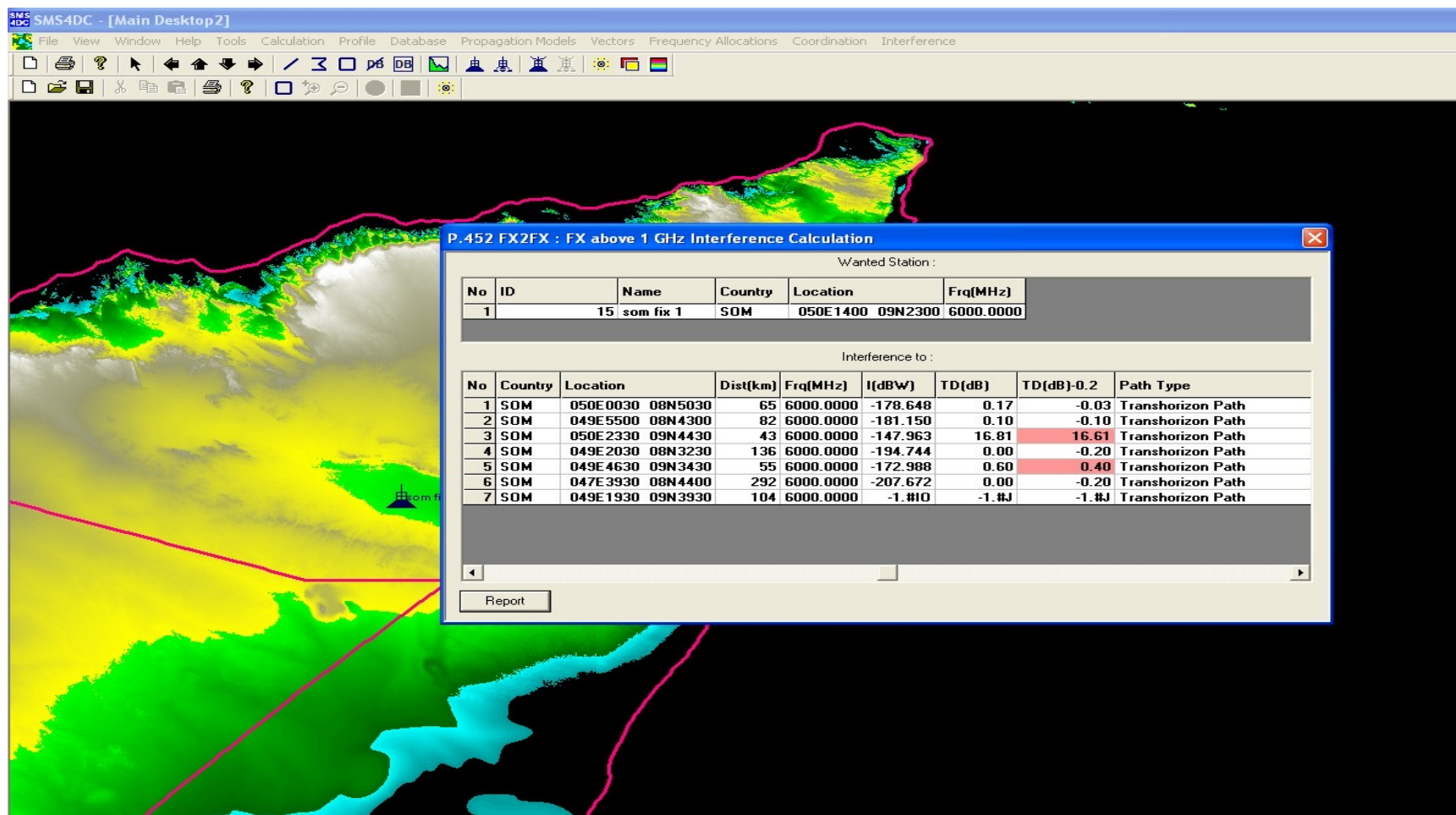
- Search Radius(km): 1500
- Frequency Range(kHz): 1000
- Permissible Threshold Degradation (dB): 0.2
- ☒ Polarization Discrimination
- (dB)
- P.452 Parameters:
 - Time(0.001 -> 50)%: 10
 - N0: 330
 - Delta_N: 45
 - Beta_e: 1.35
- Buttons: OK, Cancel

Victim Stations Dialog Box:

IDst	STname	STlat_deg	STlon_deg	Sth_agl	TXfreq	Power_eirp	Azimuth	Elevation
16	som fix2	8.8417	50.0083	10.0000	6000.0000	50.0000	22.2000	-0.20
17	som fix3	8.7167	49.9167	10.0000	6000.0000	50.0000	205.5000	-0.20
18	som fix4	9.7417	50.3917	10.0000	6000.0000	50.0000	25.5000	-0.34
19	som fix5	8.5417	49.3417	10.0000	6000.0000	50.0000	0.0000	0.00
20	som fix6	9.5750	49.7750	10.0000	6000.0000	50.0000	0.0000	0.00
21	som fix7	8.7333	47.6583	10.0000	6000.0000	50.0000	0.0000	0.00
22	som fix8	9.6583	49.3250	10.0000	6000.0000	10.0000	0.0000	0.00

FIXED STATIONS INTERFERENCE

Dialog box of interference of wanted fixed TX on victim fixed receiver



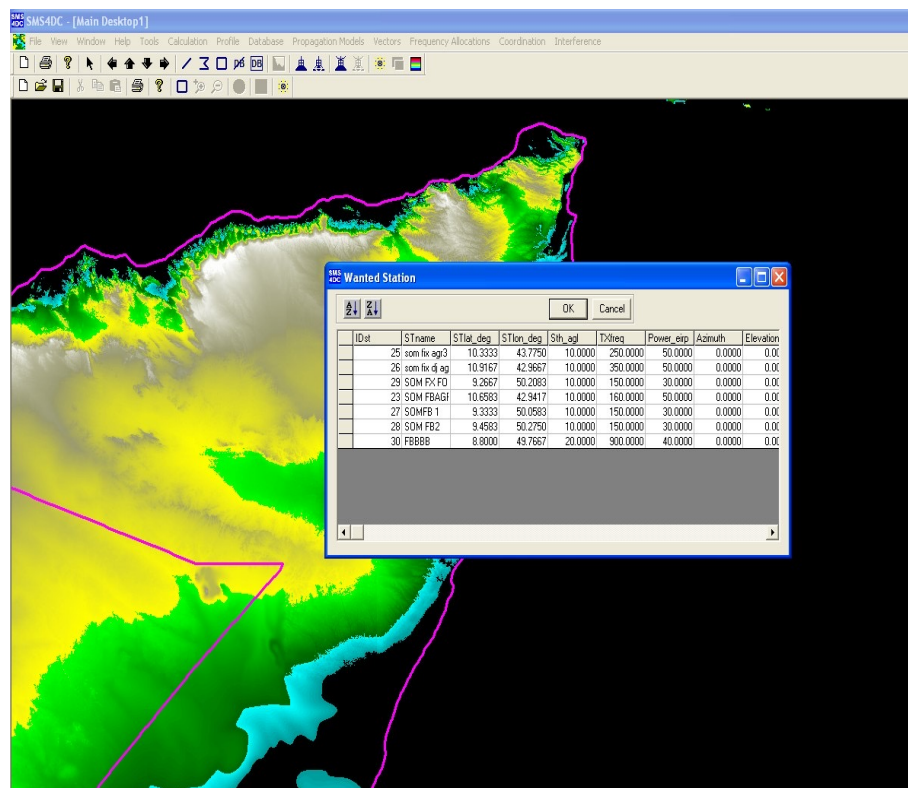
INTERFERENCE FROM FIXED STATION TO MOBILE STATION AND VICE VERSA

The item “FXM” in “Interference” menu implemented for calculation of interference produced/experienced by stations in land mobile service (any frequency) and fixed service (below 1GHz) on each other.

FXM consist of the following subitems:

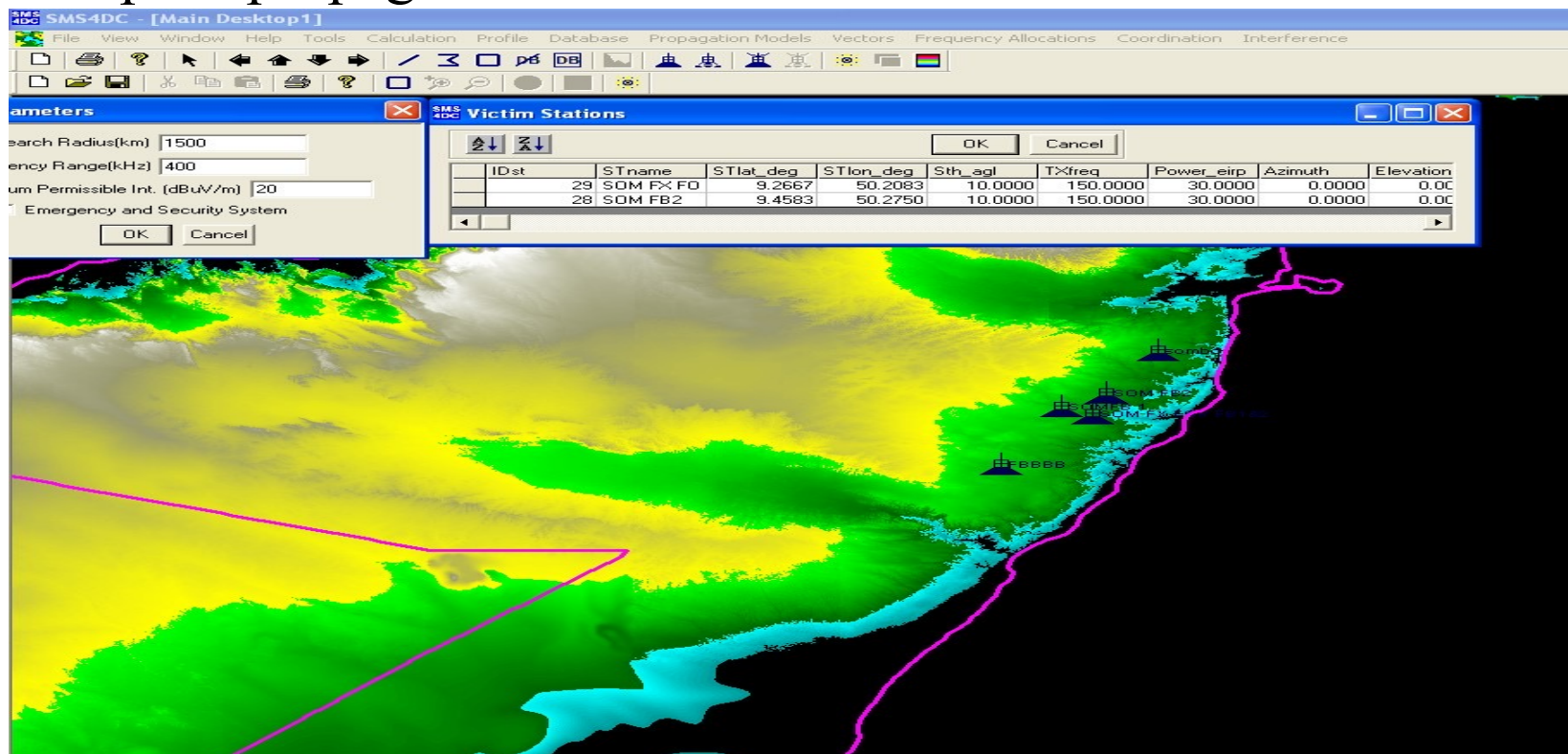
- Interference to (Free Space and P.1546)
- Interference from (Free Space and P.1546)

List of fixed (below 1GHz), and land mobile base stations



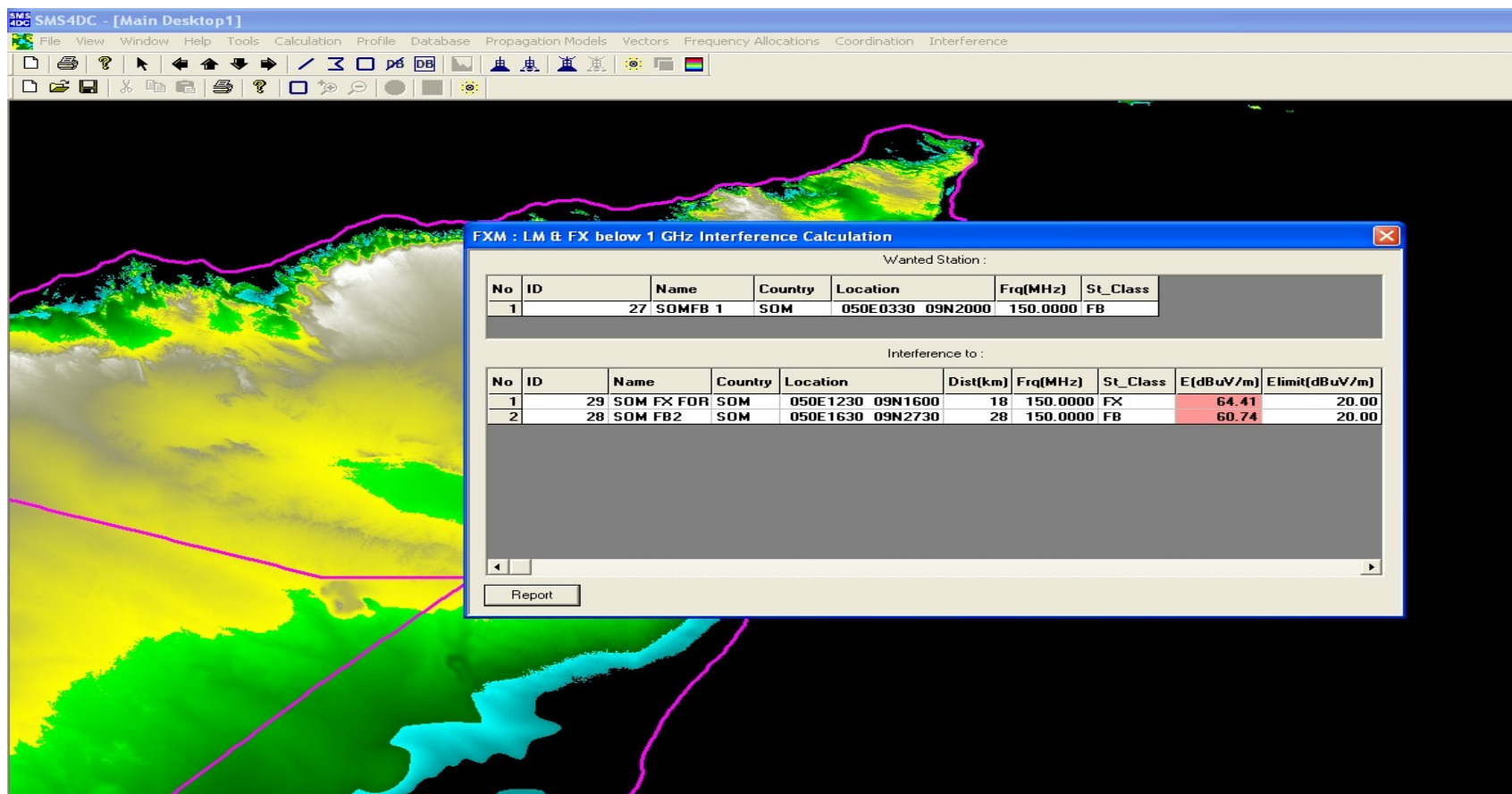
INTERFERENCE FROM FIXED STATION TO MOBILE STATION AND VICE VERSA

Set Parameter dialog box for setting searching condition and Spreadsheet list of found fixed, base and mobile stations using free space propagation model



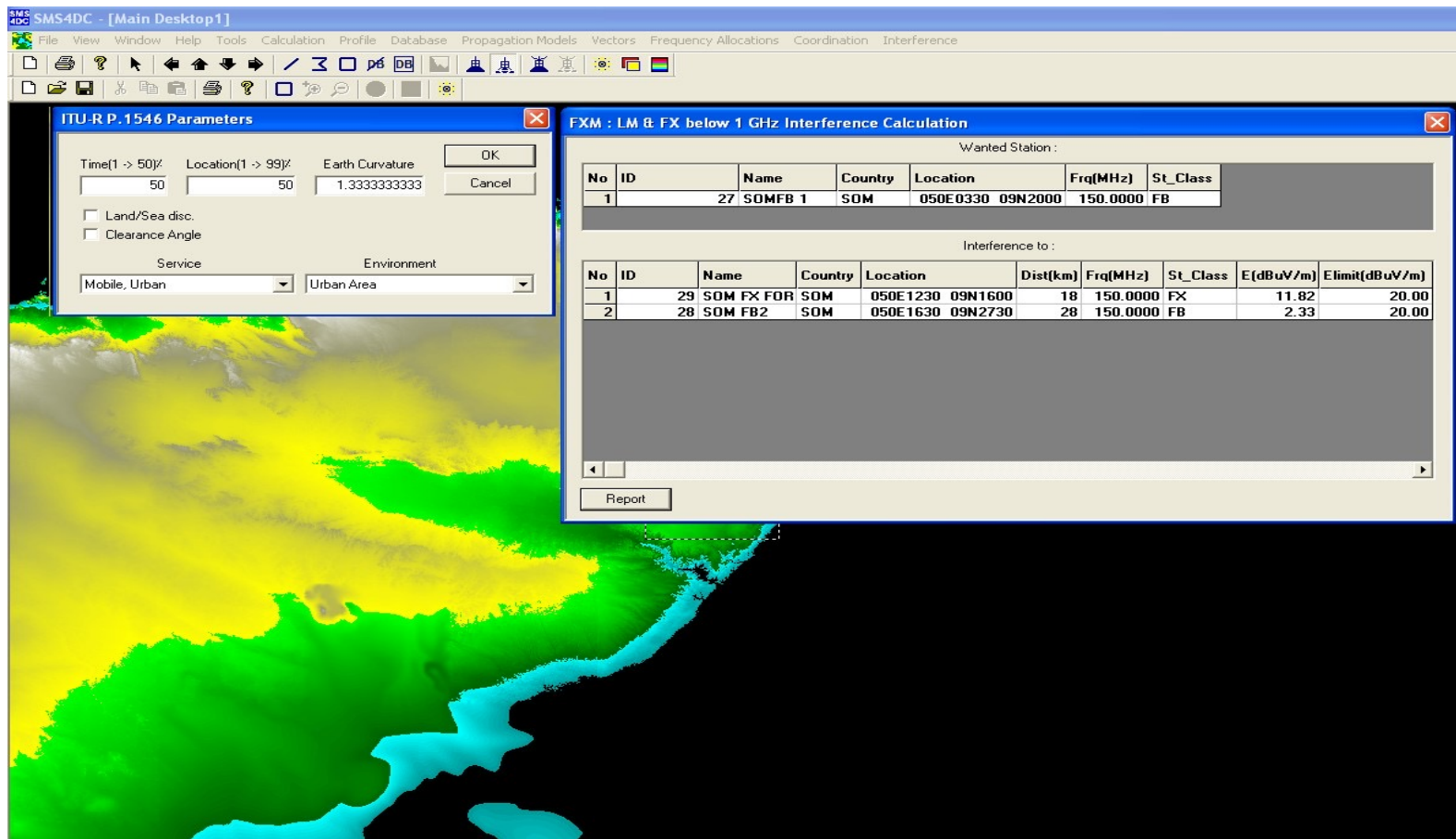
INTERFERENCE FROM FIXED STATION TO MOBILE STATION AND VICE VERSA

Result of interference calculation of wanted TX on victim RXs using free space propagation model



INTERFERENCE FROM FIXED STATION TO MOBILE STATION AND VICE VERSA

P1546 propagation model parameters and result of interference calculation of wanted TX on victim RXs (below 1GHz)





Thank you!

