



Spectrum Management System for Developing Countries (SMS4DC)

Training on SMS4DC

24-26 July, 2023

Livingstone, ZAMBIA

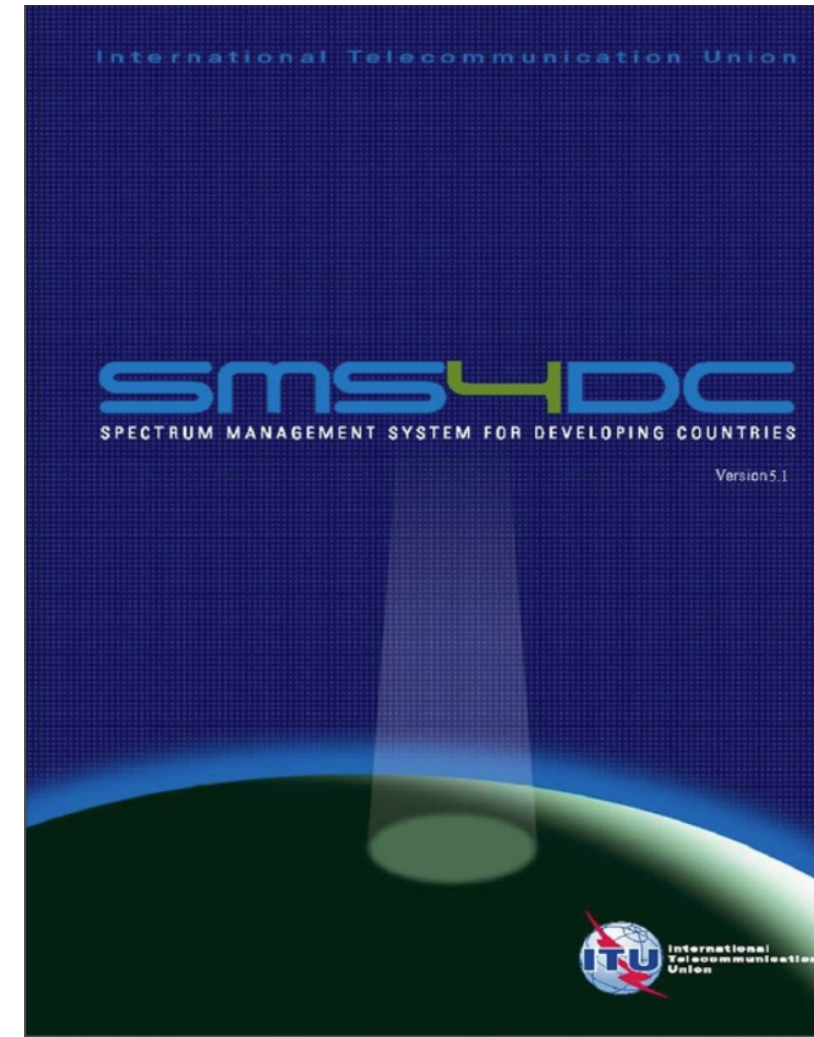
Ahmed BORAUD

ahmed.boraud@gmail.com



ITU Spectrum Management System for Developing Countries (SMS4DC)

- SMS4DC is software designed by ITU based on ITU recommendations
- Developed to assist the administrations of developing countries to undertake their spectrum management responsibilities more effectively;
- SMS4DC covers terrestrial fixed, mobile, sound and television broadcasting services in the bands above 30 MHz, including GE-06 as well as frequency coordination of Earth stations






SMS4DC Development Cycle

- **2007:** *SMS4DC Version 1.0*
- **2008:** *SMS4DC Version 2.0 (Addition of Digital TV planning tools (GE06))*
- **2009:** *SMS4DC Version 3.0 (Addition of Google Earth and monitoring interface)*
- **2012:** *SMS4DC Version 4.0 (link to ESMERALDA monitoring software of Thales and additional enhancements)*
- **2014:** *SMS4DC Version 4.1 (Update of Article 5 according to WRC12, import from new BRIFIC & interface with appendix 7)*
- **2015:** *SMS4DC Version 5.0 (Revised propagation models based on the latest version of P.452, P.530 and P. 1812, P.1546 + 11343).*
- **2017: SMS4DC Version 5.1**
 - *Results of WRC-15*
 - *Revision of the Radio Regulations Article 5 module and update of the international frequency allocation*
 - *HCM*
 - *Spectrum Fee Calculation Example*



SMS4DC subscribers



 **V.5.0**

 **V.4.1**

 **V.4.0**

Until Dec 2016



Key Functions of SMS4DC

- Comprehensive database (MS Access) of user/license details, with data fields in accordance with ITU recommendations;
- Provides **complete process** from: frequency application, frequency assignment, licensing, ITU plans and Bilateral frequency coordination procedures;
- Imports **coordination data** from ITU BRIFIC & SRS CD-ROM database;
- **Producing electronic notices, print license, invoice & spectrum fee**
- **Security features:** *The designated system administrator can define an individual account for each SMS4DC user up to 6 levels of access to the different processes (e.g. licensing, assignment etc). Each user account is named and password protected.*



SMS4DC Configuration

Single user

Workstation



- Main application
- Database
- Reports
- Maps

Multi user



Server

- Database
- Reports
- Maps

Workstation B



-Main application

Workstation A



-Main application



Administrative Functions of SMS4DC

➤ **Administrative Functions**

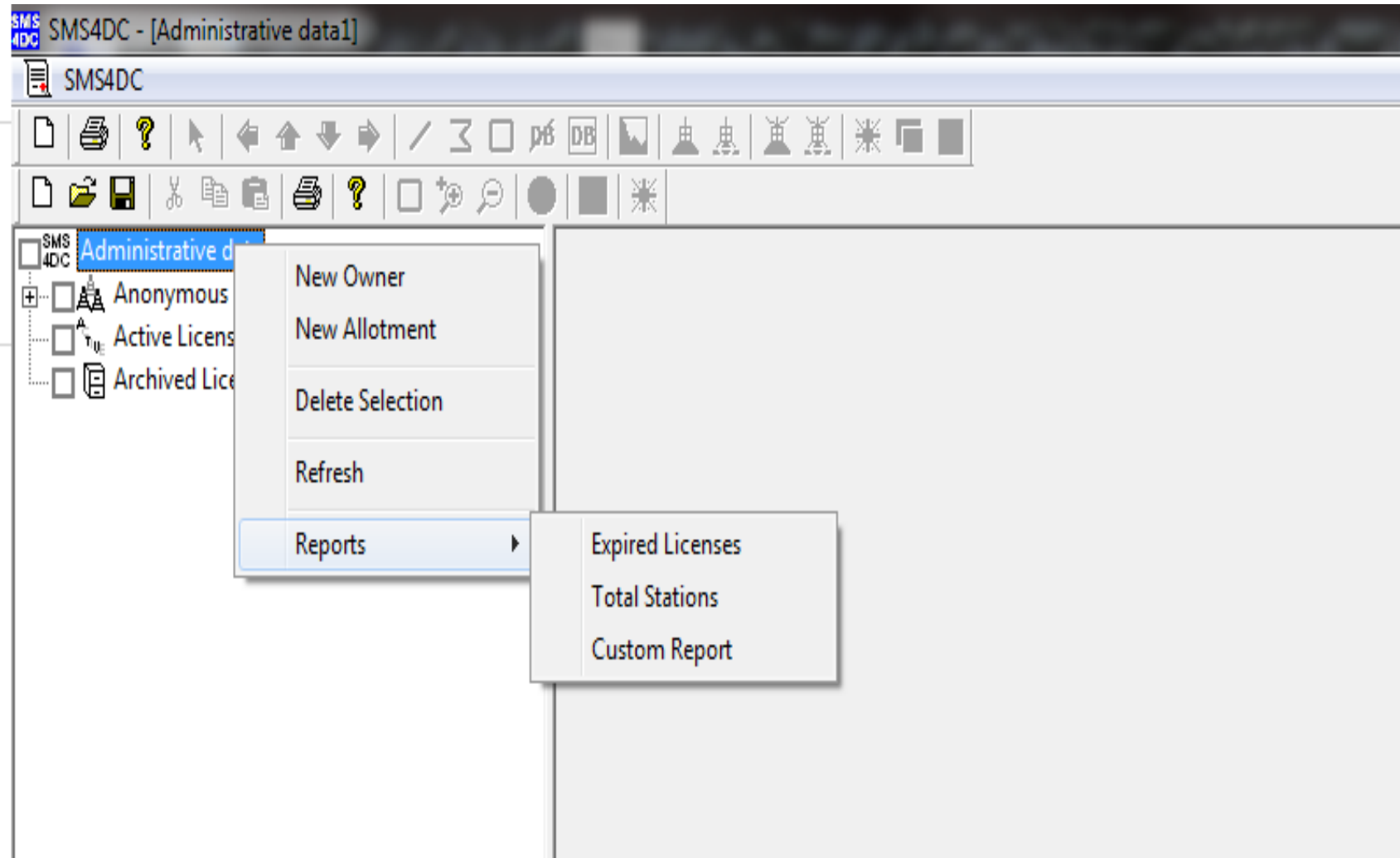
- *Comprehensive database (MS Access) of user/license details, with data fields in accordance with ITU recommendations;*
- *Provides complete process from: frequency application, frequency assignment, licensing, ITU plans and Bilateral frequency coordination procedures;*
- *Imports coordination data from ITU BRIFIC & SRS CD-ROM database;*
- *Producing electronic notices, print license, invoice & spectrum fee*
- *Security features: The designated system administrator can define an individual account for each SMS4DC user up to 6 levels of access to the different processes (e.g. licensing, assignment etc). Each user account is named and password protected.*

➤ **Graphical User Interface Functions (including Map Displays)**

➤ **Engineering Analysis Functions**



SMS4DC License Database GUI

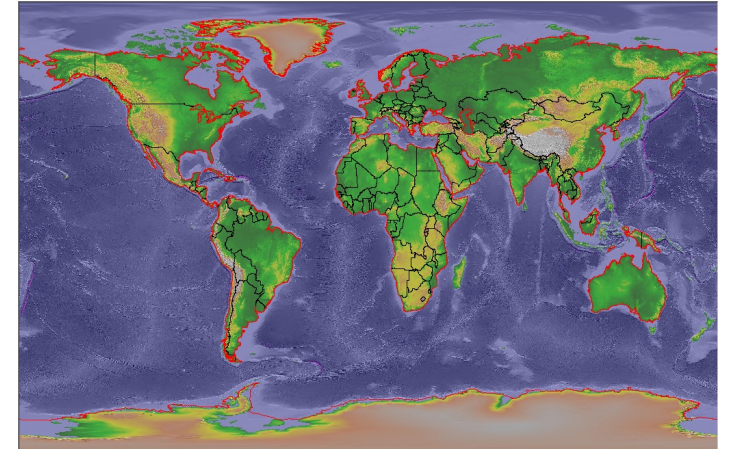


Easy generation of customizable reports for Licenses and their status



GIS Functions of SMS4DC

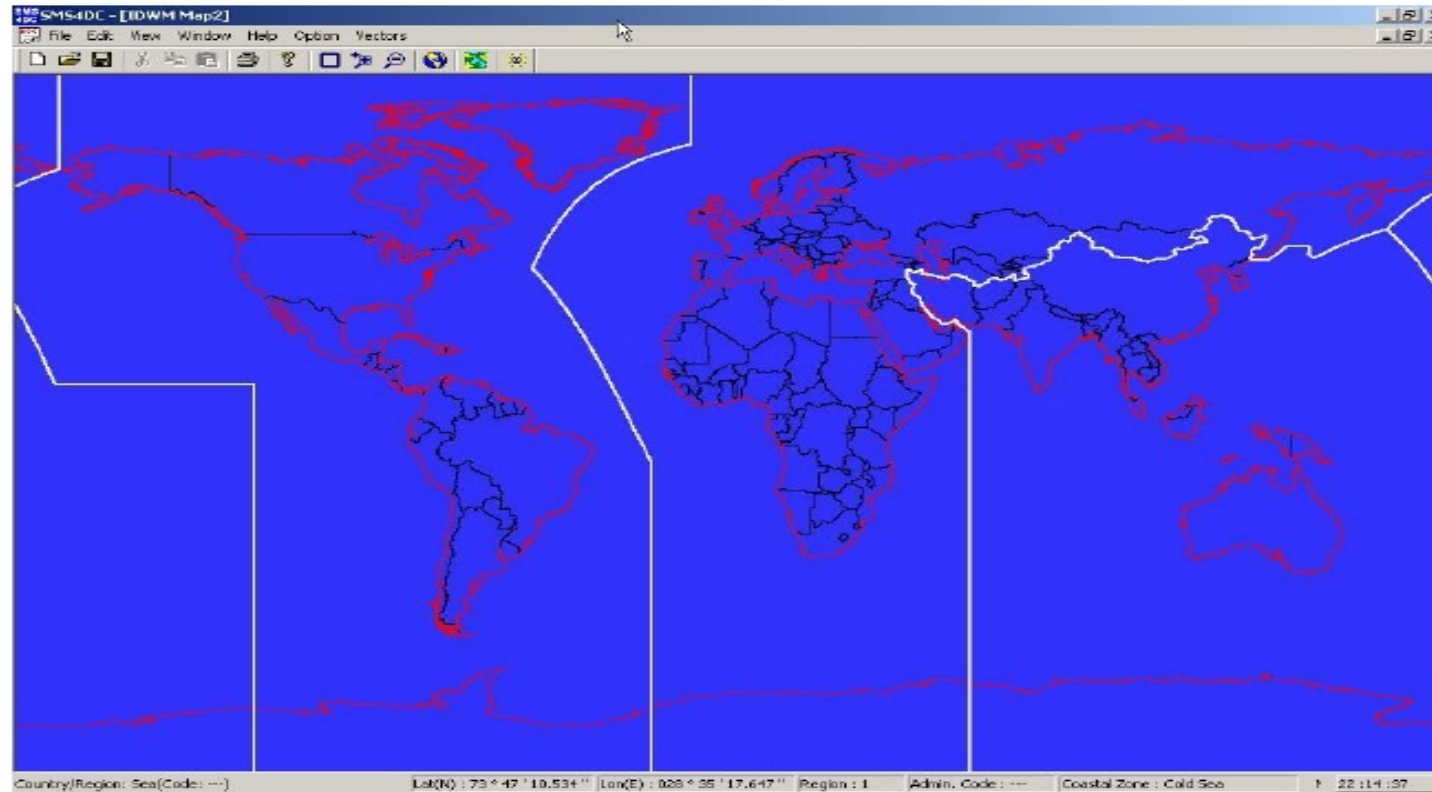
- **User friendly interface with text menus and icon-tool bars;**
- **Display views**
 - *International Digital World Map (IDWM)*
 - *Digital Elevation Map (DEM) (2-D and 3-D)*
- **Data entry/Assigning of new stations on DEM by mouse point-and-click**
- **Export of maps, overlays and vectors to Google Earth Searching and displaying stations on DEM**





GIS Functions of SMS4DC

IDWM Menu: *The IDWM is used to draw political boundaries of countries on the desktop of SMS4DC*





GIS Functions of SMS4DC

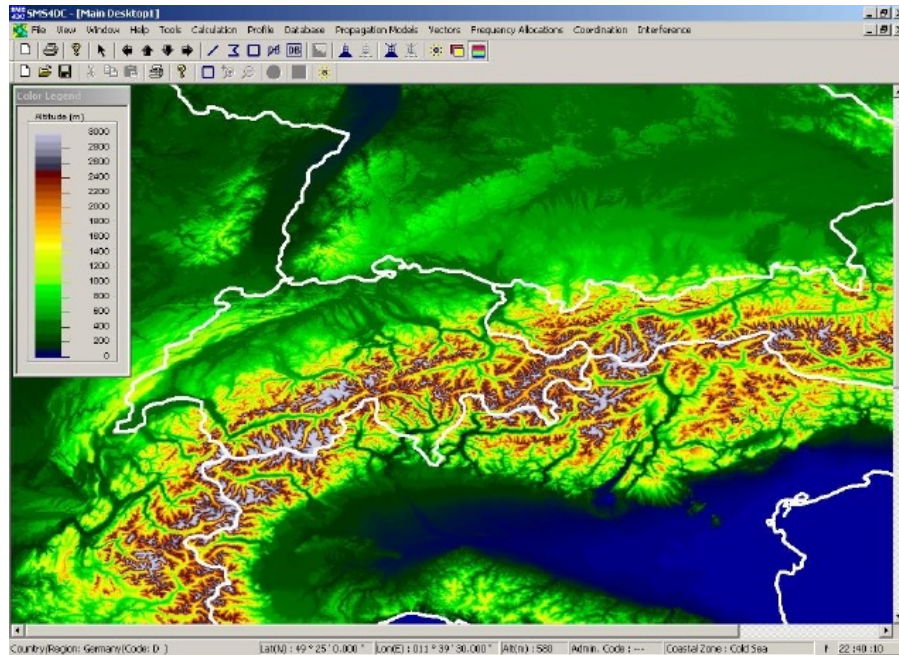
The image displays the GIS interface of SMS4DC, highlighting three main menu categories: Database, Propagation Models, and Vectors. Each menu is shown in a separate inset window with arrows pointing to its corresponding icon in the main toolbar.

- Database Menu:** Includes options for station management (Display, Move, Add, Search, Remove), link display, import (IFIC, SRS), licensing, audit trail, users, backup, and receiving area display (Service Area, Allotment Area, GE06 Plan Entry, Converted Assignment).
- Propagation Models Menu:** Lists various models such as Free Space, Line of Sight, Former P. 370, P. 1546, Okumura-Hata, P. 526 (Diffraction/Smooth Earth), P. 452, P. 530, P. 618, and Overlay.
- Vectors Menu:** Contains drawing and handling tools like Draw Circle, Draw from File, Draw Country Border, Remove from Display, and Vector Handling.

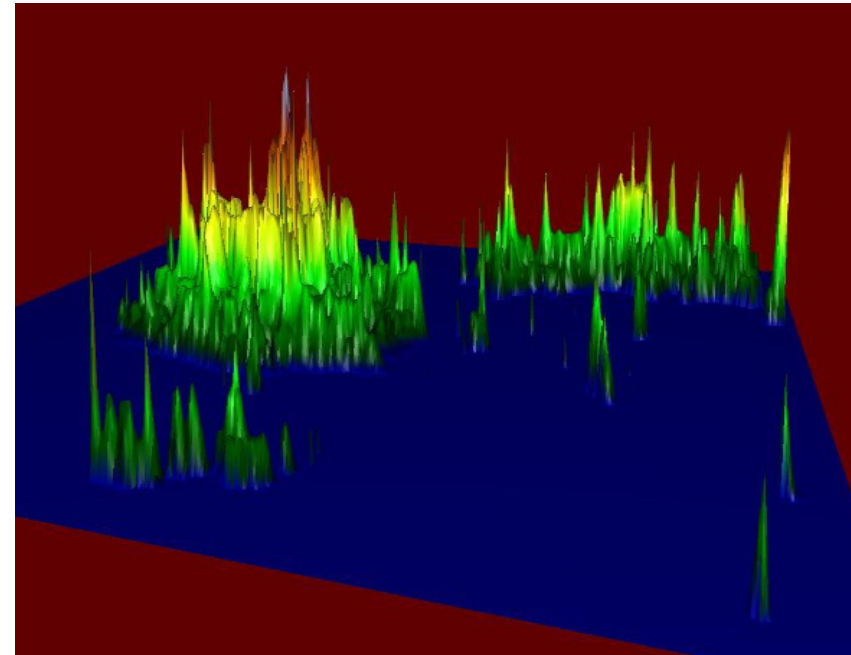
Digital Elevation Model (DEM) Menu



GIS Functions of SMS4DC



**Digital Elevation Model
(DEM) 2D and 3D views**

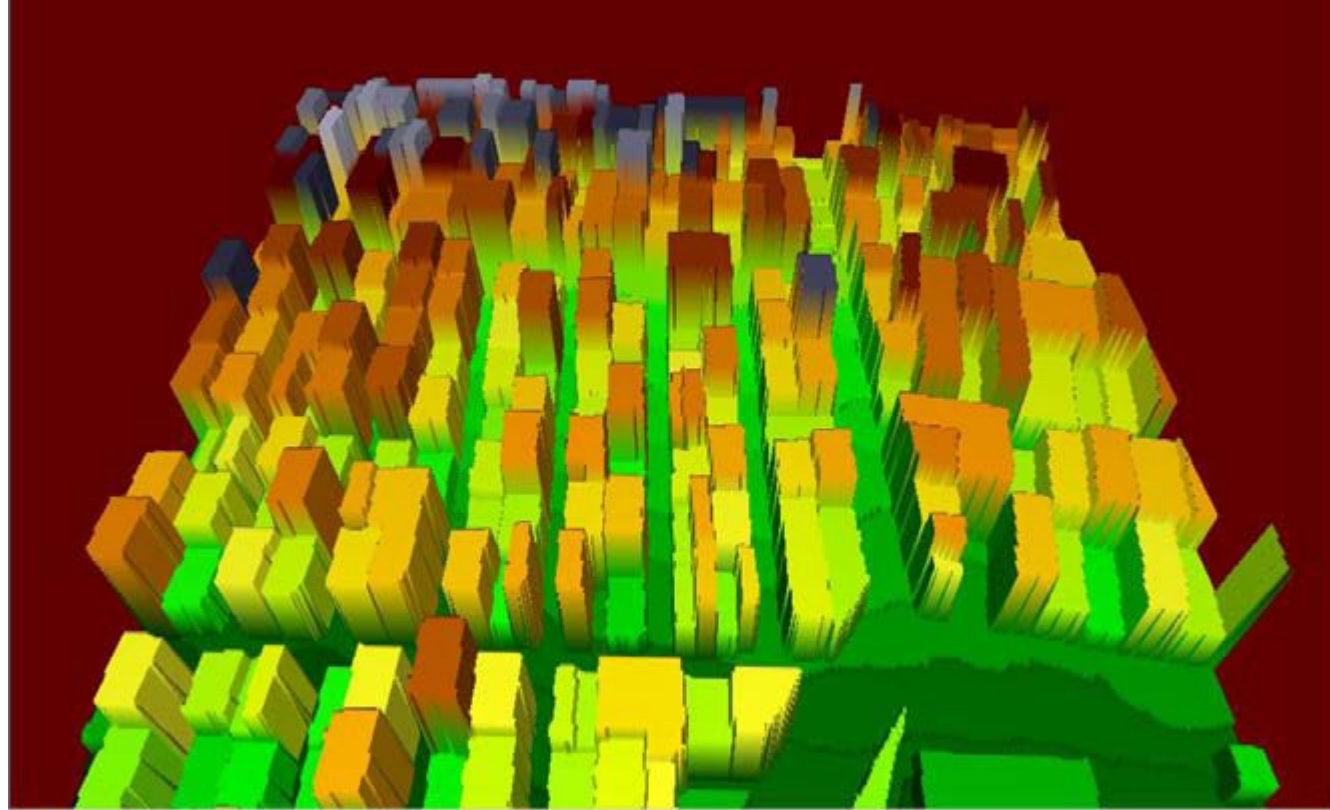


Map Display in 3D

**Based on the Global Land One- kilometer Base Elevation model
(GLOBE)**



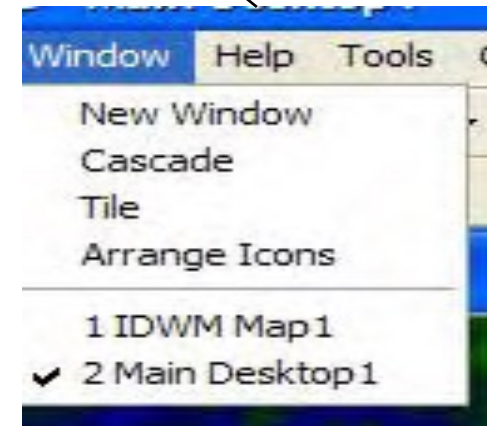
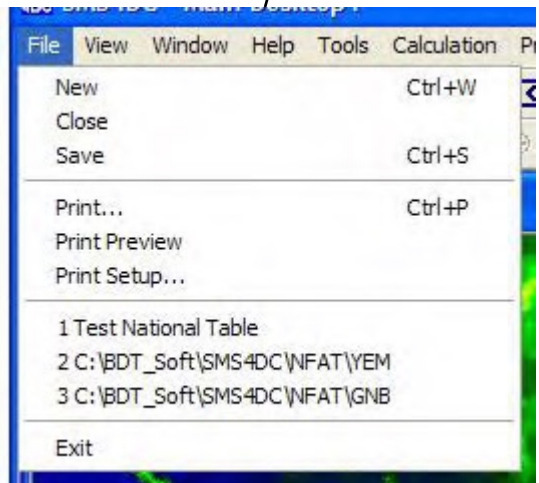
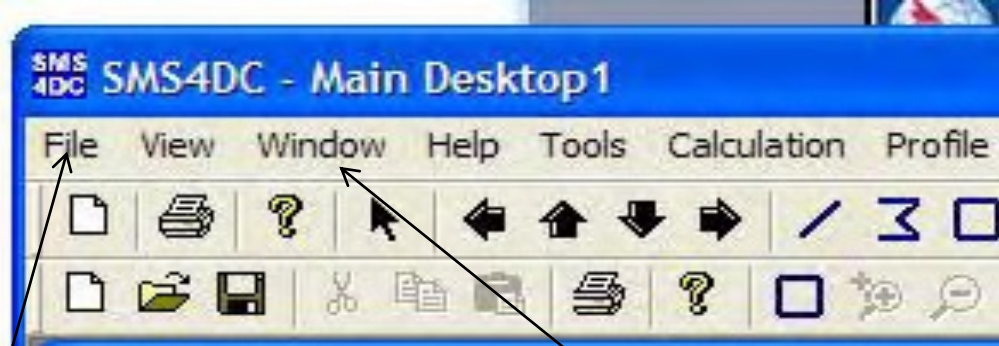
GIS Functions of SMS4DC



Raster Map 1m resolution



DEM menu





DEM menu

The image shows a software interface with three main menu categories: Database, Propagation Models, and Vectors. Each category has a corresponding icon in a toolbar below the menu labels. The Database menu is open, showing options for station management and display. The Propagation Models menu is also open, listing various models like Free Space, Line of Sight, and P. 526. The Vectors menu is open, showing options for drawing and handling vectors.

Database Menu:

- Display Selected Station(s)
- Station(s) in Desktop
- Move Station
- Add Station
- Search Station
- Remove Station(s) from Display
- Display Links
- Import from IFIC
- Import from SRS
- Licensing
- Audit Trail
- Users
- Backup
- Display Selected Earth Station(s)
- Earth Station(s) in Desktop
- Move Earth Station
- Add Earth Station
- Search Earth Station
- Remove Earth Station(s) from Display
- Display Receiving Area
- Display Service Area(FXM)
- Display Service Area(GE06 BC,BT)
- Display Allotment Area
- Define Allotment Area
- Display GE06 Plan Entry
- Display Converted Assignment(s)

Propagation Models Menu:

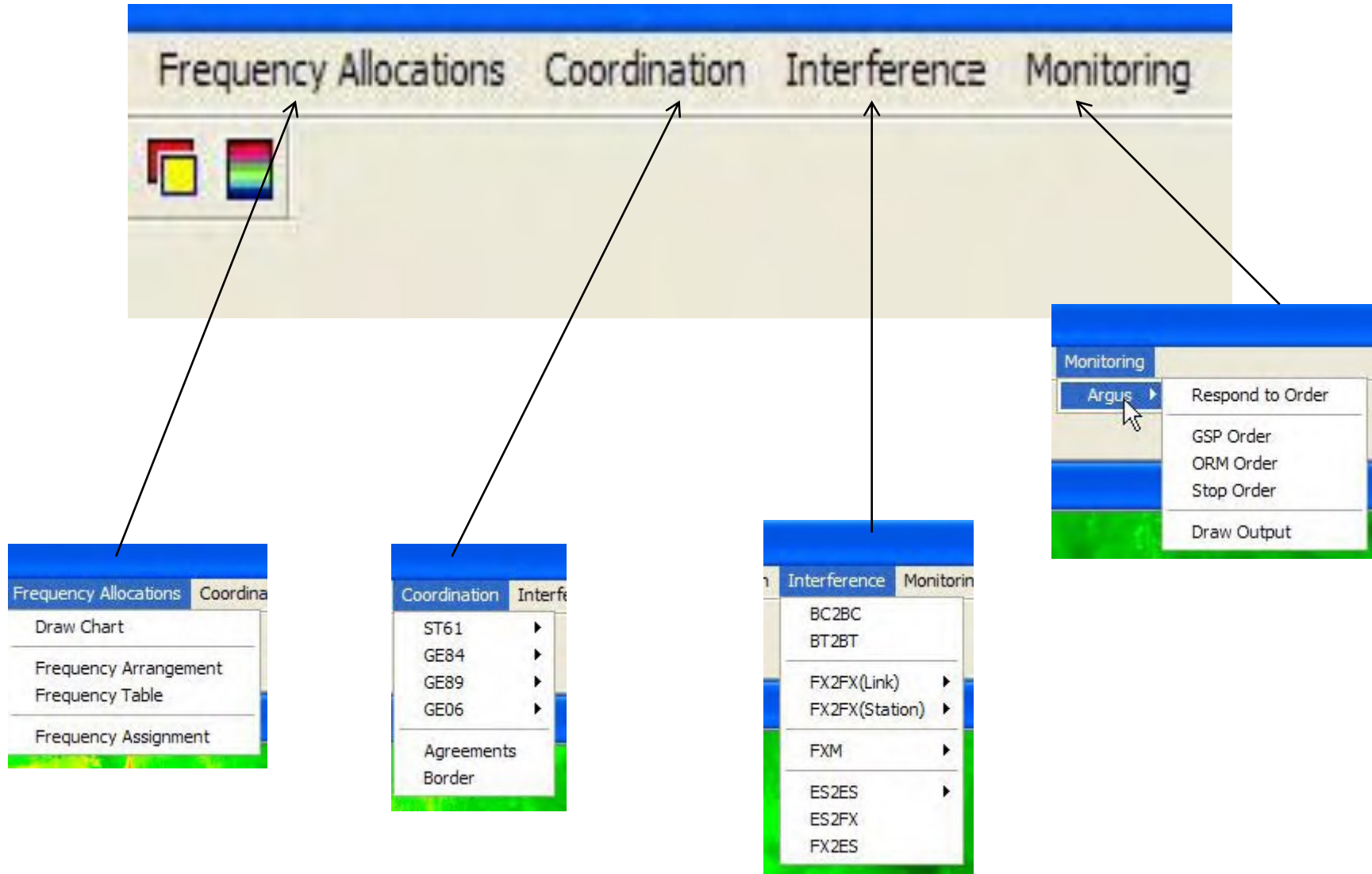
- Free Space
- Line of Sight
- Former P. 370
- P. 1546
- Okumura-Hata
- P. 526 (Diffraction)
- P. 526 (Smooth Earth)
- P. 452
- P. 530
- P. 618
- Overlay

Vectors Menu:

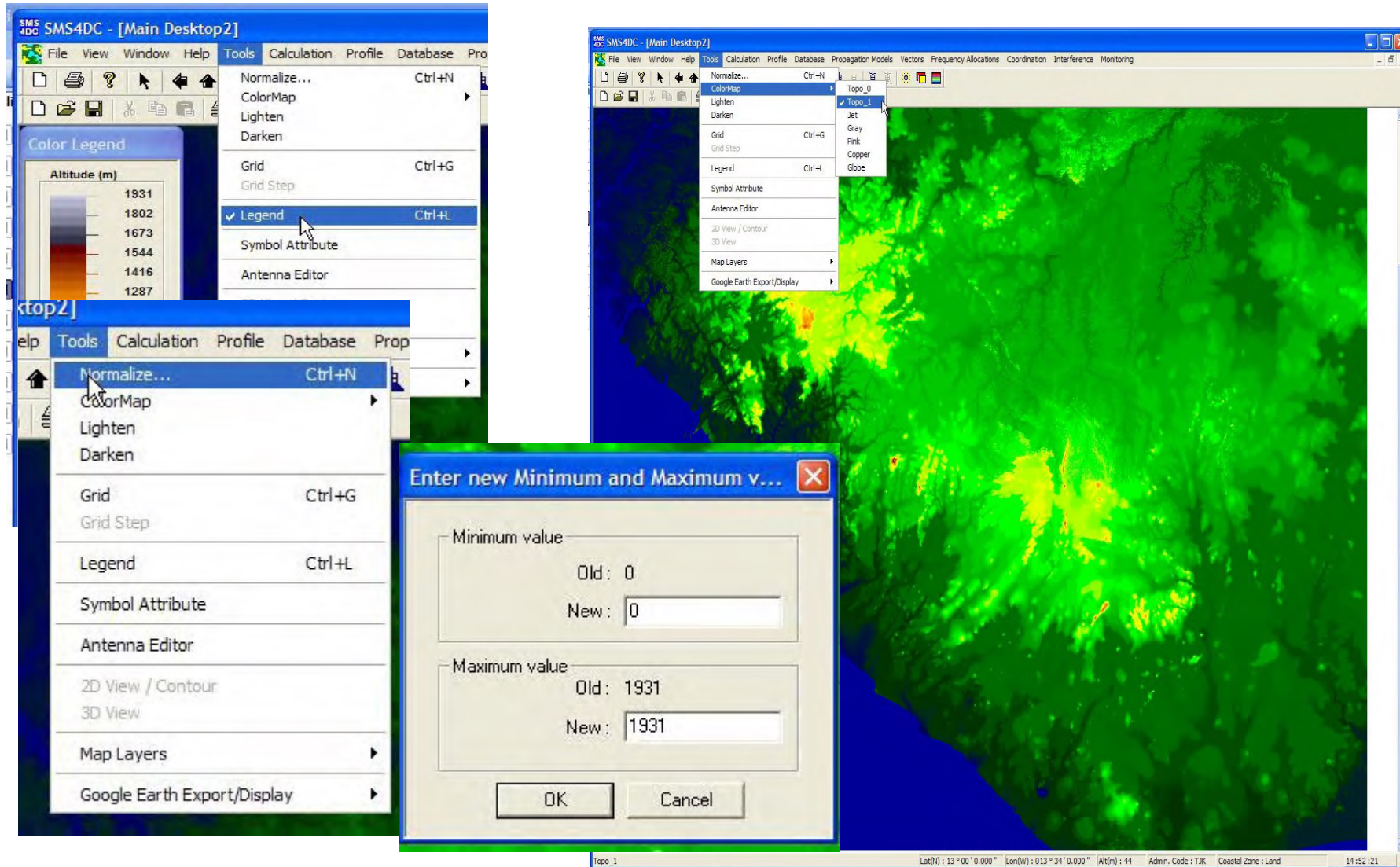
- Draw Circle
- Draw from File
- Draw Country Border
- Remove from Display
- Vector Handling



DEM menu



DEM menu



The image shows the SMS4DC software interface with the DEM menu open. The menu items are:

- Normalize... (Ctrl+N)
- ColorMap
- Lighten
- Darken
- Grid (Ctrl+G)
- Grid Step
- Legend (Ctrl+L)
- Symbol Attribute
- Antenna Editor
- 2D View / Contour
- 3D View
- Map Layers
- Google Earth Export/Display

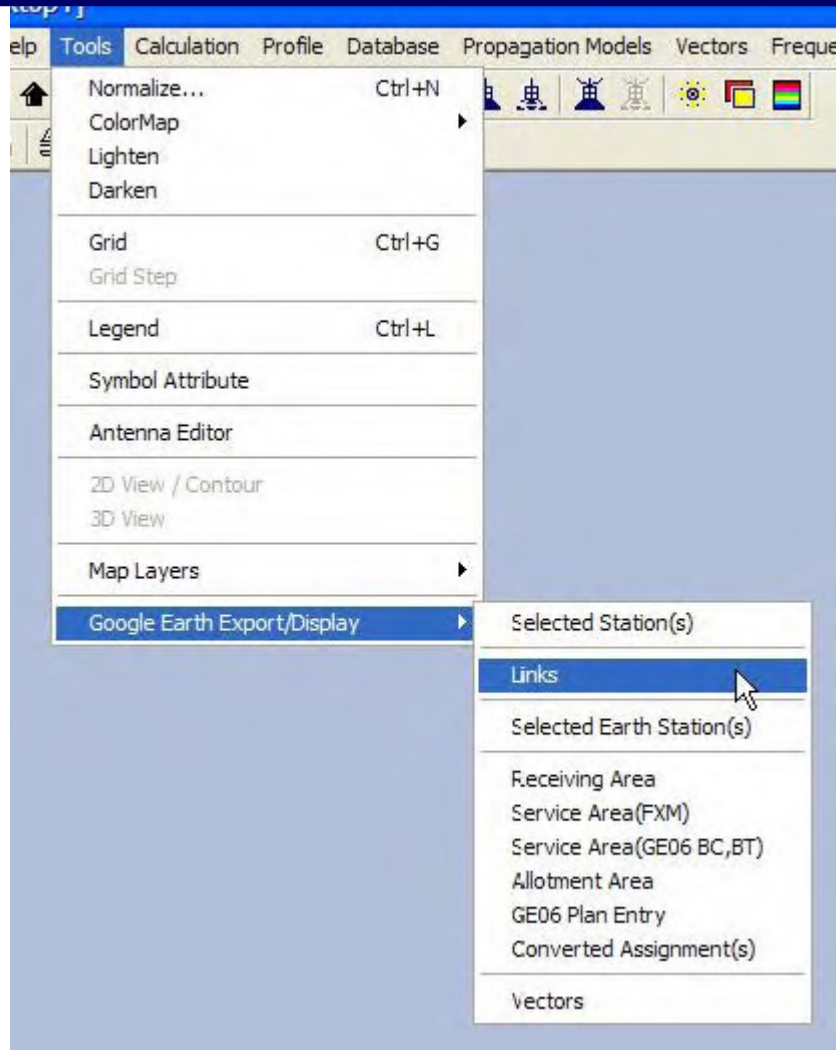
A dialog box titled "Enter new Minimum and Maximum v..." is open, showing the following values:

Value Type	Old Value	New Value
Minimum value	0	0
Maximum value	1931	1931

The background shows a topographic map with a color legend for Altitude (m) ranging from 1287 to 1931. The legend shows a color gradient from blue (low) to red (high).



Export of maps, overlays and vectors to Google Earth Searching and displaying stations on DEM(1)



The 'Link Table' dialog box displays the following data:

HopID	TxD	TxName	TxLat	TxLon	TxFrq	TxEmission	TxHagl	Tx
1	14	Fiji Fixed 003	-16.6167	178.2833	1350.6125	F3E--	40.0000	
2	15	Fiji Fixed 004	-16.7750	178.5333	1492.6125	F3E--	50.0000	



GIS Functions of SMS4DC

The screenshot displays the SMS4DC interface. On the left, a 'Link Table' window shows a table with columns: HopID, TxID, TxName, and TxLat. The first row is highlighted in yellow.

HopID	TxID	TxName	TxLat
3	27	EUPEN	50
4	29	EUPEN	50
5	31	EUPEN	50
6	33	EUPEN	50
9	53	Boukhouali	34
10	55	ZAGORA 1	30

Below the table is a 'Save As' dialog box. The 'Save in' field is set to 'Reports'. The file name is 'Links.kml' and the 'Save as type' is 'Google Files (*.kml)'. The 'Show' checkbox is checked.

The main window is Google Earth, showing a map of the Iberian Peninsula. Several stations are marked with blue icons and labels: DESIERTO, DON BENITO, (Seville), Andalucía (Andalusia), Málaga (Malaga), Gibraltar, Strait of Gibraltar (Tanger), Tanger, and MEHDIA. The map also shows geographical features like the Alboran Sea and the Strait of Gibraltar. The Google Earth interface includes a search bar, navigation controls, and a status bar at the bottom showing coordinates (37°06'04.34" N, 2°46'42.77" W) and an altitude of 717.91 km.

Export of maps, overlays and vectors to **Google Earth** Searching and displaying stations on DEM)



Engineering Analysis Functions of SMS4DC

Enhanced analysis tools to assist a spectrum engineer in frequency assignment, national and international frequency coordination and interference calculation for the Land Mobile, Fixed and Broadcast services and satellite Earth Station coordination;

The image shows a software dialog box titled "New Station Parameters". It contains the following fields and controls:

- Service Type:** F - Fixed
- Class of Station:** FX - Fixed station, i.e. station in the fixed service
- Station Name:** Fiji Fixed 001
- Latitude:** 18 S 58 30.0, Latitude(deg.): -18.975
- Longitude:** 178 E 23 0.0, Longitude(deg.): 178.383333
- Height_asl(m):** 32
- Power(W_eirp):** 10
- Frequency(MHz):** 1500.0
- Insertion Loss(dB):** 3
- Rx Sensitivity(μV):** 0.35
- Emission:** 16k0F3E--
- Antenna Name:** FX1500_Yagi
- Azimuth(deg.):** 0
- BeamWidth_E(deg.):** 60
- Elevation(deg.):** 0
- BeamWidth_H(deg.):** 40
- Gain(dB):** 30
- Polarization:** V
- Height_agl(m):** 50

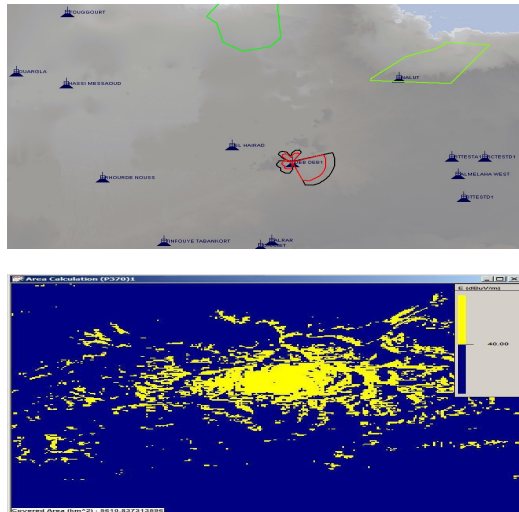
Buttons: Assign Antenna, Show Pattern, Save, Cancel.

New Radio station parameters in-line with ITU coordination requirements



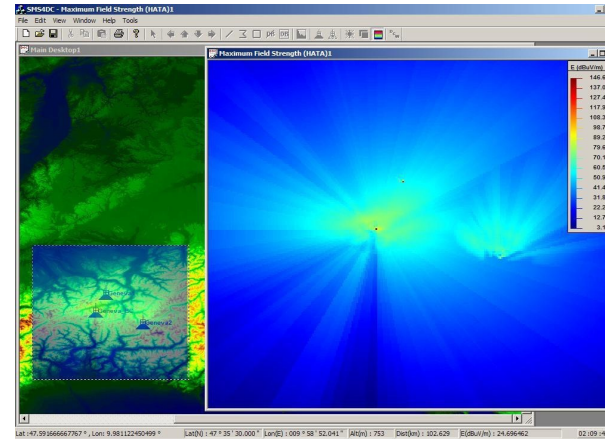
Engineering Analysis Functions of SMS4DC

Calculation of coverage area, field strength, field strength contour, network coverage and best server calculations



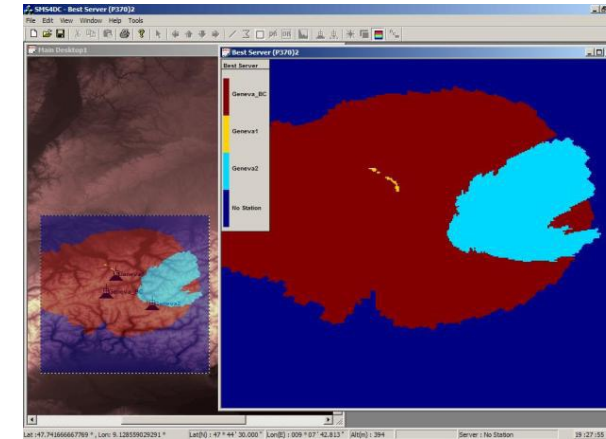
Coverage area

Item to calculate area in km² Where inside the area, the field strength value is higher than a threshold value.



Maximum Field Strength

Item to calculate and visualize the maximum values produced by more than one transmitting stations at any point inside a predefined rectangular area.



Best Server

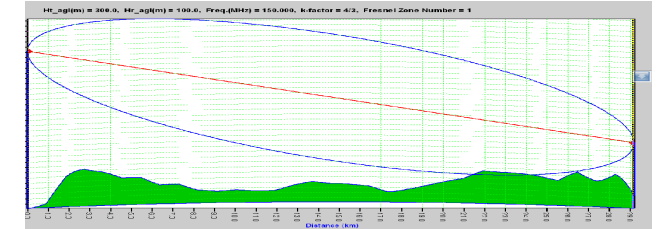
Item to calculate and visualize the best serving station at each point among various stations inside a predefined rectangular area.



Engineering Analysis Functions of SMS4DC

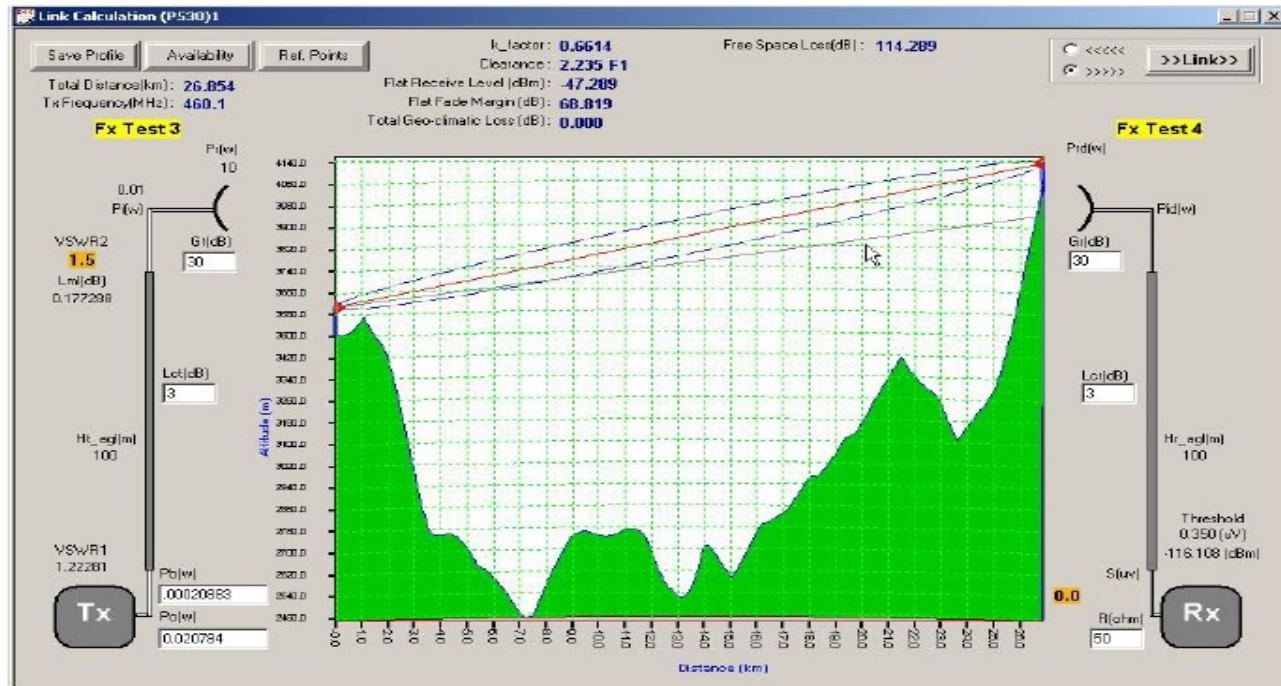
For fixed service (point-to-point radio links):

- Link budget calculations
- Link availability
- Path profiles
- Fresnel zone clearance



Fresnel Zone:

- Measure for multipath effect
- Mostly used for Aperture antenna
- Number of zone each one represents
- degree of out phase reflect signal from the LOS signal
- First Fresnel Zone includes 90% of radiation pattern (LOS component).





I T **hank** **U**

**“Committed to
connecting the WORLD”**