

The background of the cover is a composite image. The top portion shows a dark space with a bright sun in the upper left corner, emitting a red, glowing beam of light that curves across the sky. Below the space, the horizon of the Earth is visible, showing a blue sky and a dark blue ocean. The lower portion of the image shows a detailed view of a landmass with green and brown terrain. The red beam of light is a prominent feature, originating from the sun and pointing towards the Earth's surface.

The BeamFinder User Manual
Manuscript

Dr. Volker Grassmann, DF5AI

March 11, 2003

Copyright (C) Dr. Volker Grassmann, 2002-2003

All rights reserved.

No part of this manual may be used or reproduced in any form or by any means, or stored in a database or retrieval system, without prior written permission of the author except in the case of brief quotations embodied in critical articles and reviews. Authorised users of the BeamFinder software may, of course, store this manual together with the BeamFinder software for reference and backup purposes.

Apple, Macintosh, Mac OS, Power PC, AppleEvent, BubbleHelp and SimpleText are all registered trademarks of Apple Computer, Inc., FileMaker Pro is a registered trademark of Filemaker Inc.

In loving memory of

Nora & Ben

License Agreement

Program usage

You may:

- use the program BeamFinder on any computer or network;
- permit other individuals to use the program either directly or on a computer network, but not more than one user per licensed program at the same time;
- make copies of the program in machine readable form solely for archival purposes, provided that you reproduce all proprietary notices on each copy.

You may not:

- modify, translate, reverse engineer, decompile, disassemble, create derivative work based on, or copy (except for the archival copy) the program or the BeamFinder world map or the accompanying documentation;
- rent, transfer or grant any rights in the program or accompanying documentation in any form to any other person without prior written consent of the author;
- remove any proprietary notices, labels or marks on the program and any accompanying documentation.

Failure to comply with any of the above restrictions will terminate the license. This license is not a sale. Title and copyrights to the program, the world map and the accompanying documentation remain with the author.

Limitation of liability

In no event will the author be liable for any damages, lost profit, lost data, loss of use, including but not limited to special, incidental, consequential or indirect damages arising from the use of the program, however caused and on any theory of liability, even if the author has been advised of the possibility of such damages. You acknowledge that the license fee reflects this limitation of liability.

General

This agreement is the entire agreement. If any provision of this Agreement is held invalid, the remainder of this Agreement shall continue in full force and effect.

Contents

License Agreement	4
Program usage	4
Limitation of liability	4
General	4
Welcome to BeamFinder	10
Installation	12
System requirements	12
Installation	12
Getting started	13
About this manual	13
Overview	14
The grid map of the world	15
Inside BeamFinder	18
Basic functions	22
Introduction	22
Setting the user's home location	23
Entering geographical data and targets	26
Long and short path calculations	30
Plotting grid squares	31
Plotting the antenna pattern	32
Range circles and radials	34
The "from-to-operator"	36
Display skip markers	38
Range of vision (radio horizon)	41
Calculating elevation and line-of-sight data	43
Calculating geomagnetic field data	44
Creating a map title	46
The site information table	48
The "smart mouse cursor"	50
The "rubberband"	51
Analysing radio wave propagation	52
Introduction	52
Penetration path into the atmosphere	53
Ionospheric "hot spots"	Fehler! Textmarke nicht definiert.
Ionospheric dx targets	Fehler! Textmarke nicht definiert.
The Sporadic-E analyser	60
Hot spot analysis in Aurora/FAI propagation	65
Dx target analysis in Aurora/FAI propagation	68
Aurora/FAI scatter curve	70
Aurora/FAI synoptics	73
Bar chart analyses	75
Controlling BeamFinder	77
Introduction	77

File functions	78
Clearing the map	79
Controlling the Command Editor	80
Preferences	82
Scripts and AppleEvents	86
Introduction	86
Using scripts in BeamFinder	87
Using Apple Events	90
Appendix	94
Device identifier	94
Using the European grid locator	95
References	97
Quick reference chart	99

Figures

Figure 1	BeamFinder example analyzing transatlantic propagation on 6m	10
Figure 2	DF5AI's DX Toolbox directory	12
Figure 3	Map dimensions (in pixels)	15
Figure 4	Map window	16
Figure 5	BeamFinder zoom levels	17
Figure 6	BeamFinder modules	18
Figure 7	Command Editor window	20
Figure 8	Home location dialog	23
Figure 9	Geographical target dialog	27
Figure 10	Antenna-beam-width dialog	32
Figure 11	Dialog for drawing range circles and radials	34
Figure 12	3 rd -party-observation dialog	36
Figure 13	Skip marker dialogs	38
Figure 14	Skip markers	39
Figure 15	Extrapolated skip propagation	40
Figure 16	Height-above-ground dialog	41
Figure 17	Elevation and line-of-sight (LOS) data	43
Figure 18	Geomagnetic field data	44
Figure 19	Geomagnetic Inclination and declination	45
Figure 20	Map title dialog	46
Figure 21	Site informations dialog	48
Figure 22	Layer penetration dialog	53
Figure 23	"Hot spots" dialog	55
Figure 24	Ionospheric "hot spots" (1-skip propagation)	56
Figure 25	Interpreting the hot-spot analysis	57
Figure 26	Ionospheric "hot spots" (2-skip propagation)	57
Figure 27	Ionospheric dx targets (2-skip propagation)	59
Figure 28	Height colors	59
Figure 29	Sporadic-E analyser dialog	61
Figure 30	Plot results of the Sporadic-E analyser	62
Figure 31	Sporadic-E range circle for long distance communications	63
Figure 32	Aurora/FAI-hot-spot dialog	65
Figure 33	Aurora/FAI hot spots analysis	66
Figure 34	Aurora/FAI dx target analysis	69
Figure 35	Scatter curve dialog	70
Figure 36	Aurora/FAI scatter curve	71
Figure 37	Scatter curve dialog	73
Figure 38	Distance bar chart	75
Figure 39	Clear data dialog	80
Figure 40	Locator preferences	82
Figure 41	Color preferences	83
Figure 42	Map preferences	84
Figure 43	Model preferences	84
Figure 44	Sample script	89
Figure 45	Example of a logbook database	90
Figure 46	FileMaker Pro script using Apple Events	92

Figure 47 Specify Apple Events in the Filemaker Pro (1)	92
Figure 48 Specify Apple Events in the Filemaker Pro (2)	93
Figure 49 Extensions to the European grid locator system	95

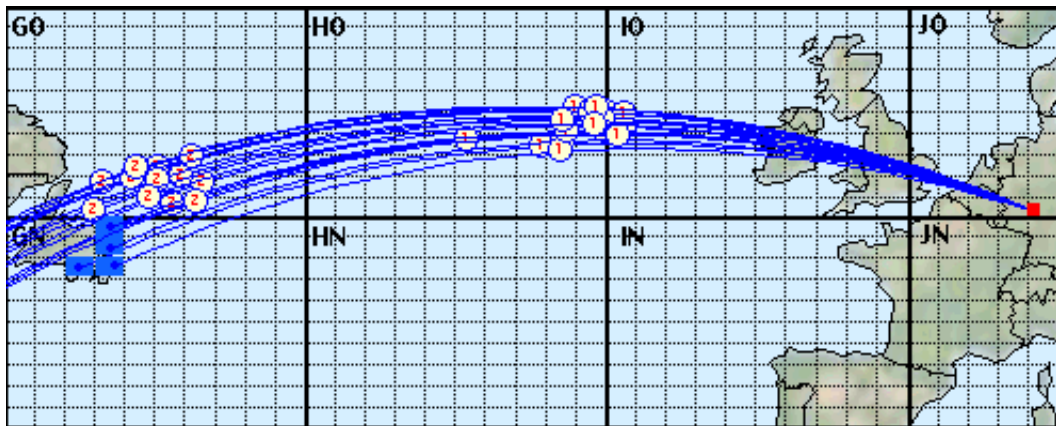
Tables

Table 1	Home location	25
Table 2	Geographical targets	29
Table 3	Calculations along the short and the long path	30
Table 4	Plotting grid squares	31
Table 5	Antenna pattern	33
Table 6	Circles and radials	35
Table 7	3 rd -party-data, the "from-to-operator"	37
Table 8	Skip markers	40
Table 9	Range of vision	42
Table 10	Enabling and disabling the elevation display	43
Table 11	Enabling and disabling the geomagnetic field data display	45
Table 12	Map title	47
Table 13	Site infromations	49
Table 14	The "smart mouse cursor"	50
Table 15	The "rubberband"	51
Table 16	Layer penetration	54
Table 17	Hot-spot analysis	57
Table 18	Ionospheric dx access area	59
Table 19	Sporadic-E analyser	64
Table 20	Aurora/FAI hot spot analysis	67
Table 21	Aurora/FAI dx targets	69
Table 22	Aurora/FAI scatter curve	72
Table 23	Aurora/FAI synoptic	74
Table 24	Bar chart analyses	76
Table 25	Save file functions	78
Table 26	Clear map	79
Table 27	Command editor functions	81
Table 28	Preferences	85
Table 29	Applications using BeamFinder scripts	87
Table 30	Device identifiers	94

Welcome to BeamFinder

BeamFinder is a software tool designed to conduct analyses for radio amateurs interested in radio wave propagation studies. BeamFinder enables the user to apply sophisticated scientific models in practical VHF dxing, e.g. Sporadic-E, Aurora, FAI, E- and F-layer multiple-hop propagation and other types of radio wave propagation.

Figure 1 BeamFinder example analysing transatlantic propagation on 6m



BeamFinder may also be considered a multi-purpose geographical instrument optimised to the requirements of radio amateurs, i.e. BeamFinder may display observational data, calculated results and dx statistics on a large screen map of the world. BeamFinder's easy-to-use graphical user interface (GUI) considers quantities the radio amateur is already familiar with, e.g. grid squares, geographical coordinates, distances, antenna headings and frequencies. The user may design scripts and may upload data files from the harddisk using the build-in BeamFinder Command Language (BFCL). BeamFinder is compatible with alternative applications as commands and data may be launched remotely by using Apple Events.

The making of BeamFinder was an effort of many years and is based on the author's professional work in ionospheric research. Studying radio wave propagation combines elements from engineering, communications, geophysics and solar-terrestrial research in a fascinating discipline. Because radio waves ignore manmade boundaries, this discipline also stimulates the international cooperation between scientists, engineers, technicians and, of course, between radio amateurs.

So many people have helped me in the preparation of BeamFinder and its accompanying documentation that it is impossible to acknowledge them all personally. I have gained much from the many conversations on the 2m-band with my friends and fellow radio amateurs. I have been inspired by many ham radio magazines and their authors discussing radio propagation phenomena and ex-

periments. I am grateful to Reiner Hess from XCAD AG for supporting the Beam-Finder web appearance and to The Living Earth Inc. And the NOAA National Geophysical Data Center for providing valuable data supporting the design of the screen map of the world. I am grateful to my wife Aileen for the corrections and for making this manual somewhat more acceptable to English readers.

I hope BeamFinder will support amateur radio propagation studies and would encourage in particular the young people's interest in science and engineering.

Enjoy ...

Installation

System requirements

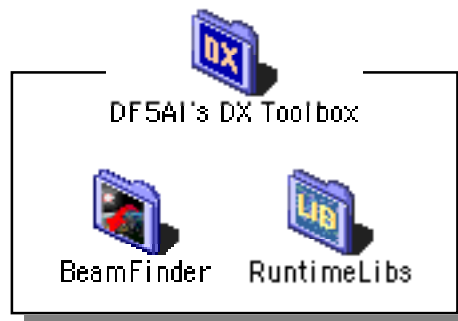
In order to use BeamFinder, you need the following:

- an Apple Macintosh Power PC (PPC) running at least System MAC OS 8.0 (BeamFinder does not support native Mac OS X at the present time),
- a minimum of 60 megabytes free RAM (Random Access Memory),
- a hard disk with approximately 12 megabytes available to store BeamFinder and related files,
- a computer monitor supporting high resolution and a minimum of 32,768 screen colors.

Installation

Copy the **BeamFinder** folder into the **DF5AI's DX Toolbox** directory, see Figure 2. Please make sure that the **Runtime Libs** folder is also available in the toolbox directory.

Figure 2 DF5AI's DX Toolbox directory



To open the BeamFinder application from the Finder, double-click on the BeamFinder icon.

When you want to quit using the application, choose the **Quit** item in the **File** menu.

Getting started

About this manual

It is assumed that the user is familiar with the basic operations of Macintosh computers i.e. clicking, double-clicking and dragging. Familiarity is also assumed with the Macintosh user interface, such as pulldown menus, windows, dialog boxes, buttons, radio buttons and checkboxes. If you are not familiar with these you are requested to review the documentation of your operating system.

The following fonts, styles, symbols and terminology is used in this manual:

- Descriptions and labels adopted from BeamFinder's graphical user interface are displayed in bold characters. For example: **Quit** denotes the item in the pulldown menu **File** which forces the BeamFinder application to quit.
- Text and information to be entered by the user are highlighted, as in **HideLoc**. The same style indicates results and outputs generated by BeamFinder.
- Commands and parameters in the BeamFinder command language (BFCL) are shown in the format **Keyword parm1 parm2 [parm3]** where **keyword** denotes the command code and **parm** a parameter required for code execution. The parameters may represent a numerical value, a text string or a geographical coordinate. Optional parameters are written in brackets e.g. **[parm]**.
- Numerical parameters are represented by a leading "#" character. For example: **ShowAnt #bwidth** denotes the syntax of the "ShowAnt" command and **ShowAnt 3 4** represents its usage in practice.
- String parameters are indicated by a "\$"-sign. For example: **SetMapTitle\$mytitle** denotes the syntax of the "SetMapTitle" command and **SetMapTitle Logbook2002** denotes a practical example.
- Grid locators are indicated by a leading "&" character e.g. **SetRef &myloc** where **&myloc** may correspond to JO40DF or any other grid locator, for example: **SetRef JO40DF**.
- Shaded areas provide additional informations the user may find useful.
- The following characters denote special keys on the Macintosh keyboard: **⌘** – Command-key, **⇧** – Shift-key, **⌥** – Alt-key, **CTRL** – Control-key. The sequence **⇧⌘M** denotes, for example, the following: hit the "M" key on the keyboard while keeping the Shift and Command-key depressed.

Overview

BeamFinder provides unique functions, analyses and graphical features in amateur radio propagation studies:

General

- easy-to-use graphical user interface
- English operation language
- advanced mathematical and physical models
- applicable in all geographical regions
- BFCL (BeamFinder Command Language)
- build-in parser and Command Editor
- mouse operations on the world map
- keyboard operations
- file operations
- remote control using Apple Events
- customisation of the user interface
- autoexe file to be loaded on start-up
- program and model parameters restored when re-launching the program
- supports Maidenhead grid locators
- supports the grid system of Europe preceding the Maidenhead system
- supports Apple Bubble Help
- optimised runtime performance
- fast execution code

Graphics

- large screen world map
- fast scroll functions to change the map view
- map navigation tools
- clickable navigation map
- “home” and “last target” centering tool
- map zoom ranging from 0.3 to 4.0
- two map orientations centering the screen map to the Greenwich meridian or, alternatively, to the 180° meridian
- plots radio beams along the short path
- plots radio beams along the long path
- plots Maidenhead grid squares
- plots beamer maps
- versatile colour settings, e.g. for geographical targets, atmospheric layers etc.
- “smart mouse cursor” displays the actual grid locator
- “rubberband” feature previews the path of radio waves
- precise great-circle-distance, line-of-sight and elevation calculations
- dynamic calculations corresponding to the actual mouse position on the map
- saving map views to harddisk

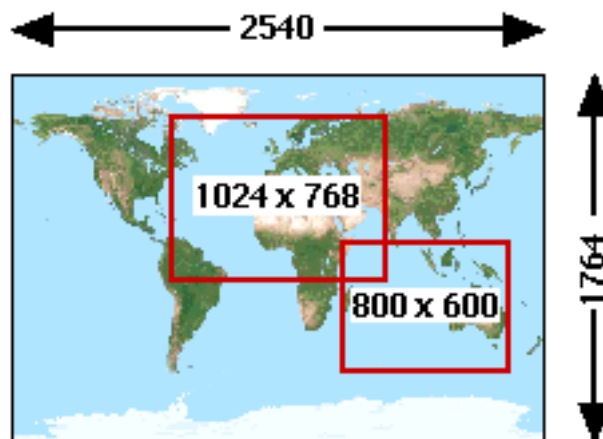
Radio propagation and geophysics

- Multiple-hop propagation analysis (segmenting and extrapolating mode)
- Sporadic-E monitor
- MUF predictions and estimated Sporadic-E dx targets
- calculates “hot spots” of Sporadic-E
- calculates total Aurora and FAI access area
- calculates “hot spots” of Aurora and FAI
- calculates curves of backscattering
- estimates Aurora and FAI positions in real time
- estimates Aurora/FAI dx targets in realtime
- plots the zero-elevation radio horizon and range of vision
- penetration path of radio waves into the atmosphere
- distance and azimuth bar chart analyses
- site information panel
- Earth magnetic field data supports all world and atmosphere locations.

The grid map of the world

The screen map of the world is probably BeamFinder’s most eye-catching feature. The map shows continents, oceans, political borders and the worldwide Maidenhead grid locator system. Because of its large size your computer screen may not be capable to display the total map area, but only a section depending on the size of your computer screen (see Figure 3). However, you may change the map view by using BeamFinder’s zoom controls and its navigation tools (see below).

Figure 3 Map dimensions (in pixels)

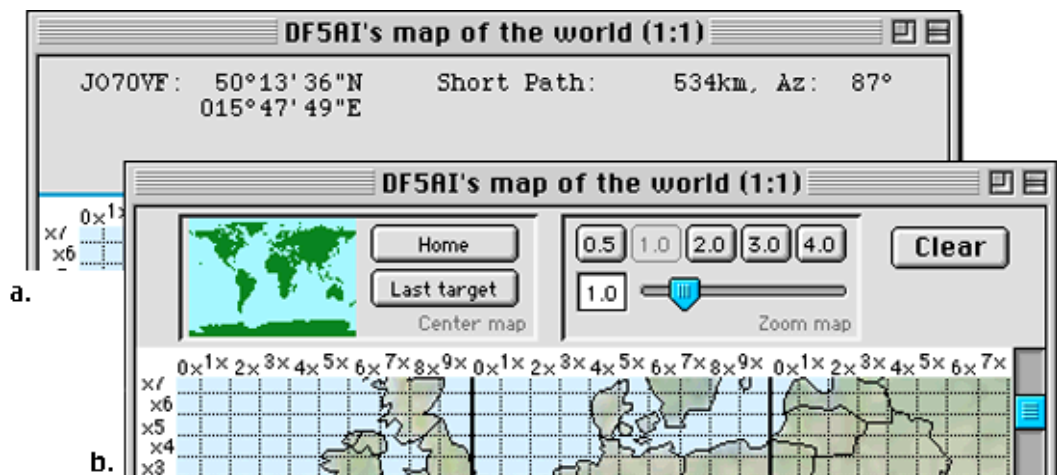


The map window shows the actual segment of the map of the world and also some numerical informations (see Figure 4). The geographical information remain available as long as the mouse cursor is positioned within the map area. However, if the mouse cursor is positioned somewhere else the geographical in-

formation is replaced by BeamFinder's zoom and navigation tools. Hence, moving the mouse cursor on and off the map toggles the header display in accordance to Figure 4a and Figure 4b, respectively.

Explore: Move the mouse cursor across the screen map and watch the geographical informations in the map header. Note that you may identify geographical coordinates, grid locator, distance and azimuth of any place in the world without typing data on the keyboard. Click any place on the screen map and see what happens.

Figure 4 Map window



Centering the screen map

Note the small navigator map in the upper left corner of the map window in Figure 4b. Clicking a place on the small navigator map centers the main map to the corresponding location, i.e. the actual view of the continents and oceans may be easily changed by clicking target areas in the navigator map.

Explore: Move the mouse cursor on the navigator map and start exploring the world by clicking Australia, Greenland and other places and watch the main map change its view.

The **Home** button (see Figure 4b) centers the main map to the user's home location, which is indicated by a small square on the main map. The same function is available by selecting the **Center home** item in the **Edit** menu.

Clicking a place in the main map defines a geographical target in BeamFinder and enables the **Last target** button (see Figure 4b). Clicking the **Home** and the **Last target** button toggles the map center from home to the actual target location and vice versa. The **Last target** button is not available if a geographical target has not yet been defined.

Scrolling the screen map

The map of the world scrolls in longitudinal and latitudinal directions by dragging the horizontal and the vertical slider in the map window, respectively. The arrow keys on the keyboard may be used for the same purpose, however, this feature requires the mouse cursor positioned in the map area.

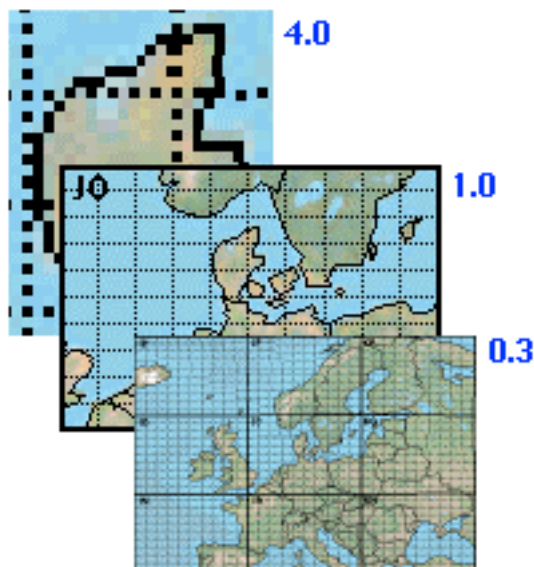
An alternative method of scrolling the map of the world is obtained when moving the mouse with the Shift-key depressed. In this case any scroll direction is available i.e. horizontal, vertical and even diagonal corresponding to the direction in which the mouse is moved. Using the mouse as a scrolling device temporarily replaces the cross-hair cursor by the so-called hand icon.

Zooming the screen map

The map of the world may be zoomed in the range of 0.3 to 4.0 (see Figure 5). The zoom level is controlled either by the corresponding buttons in the map header, by the zoom slider or, alternatively, by the zoom edit field (see Figure 4b).

Note: BeamFinder refuses map views smaller than the actual size of the map window. Please downsize the map window if small zoom levels are currently not available.

Figure 5 BeamFinder zoom levels

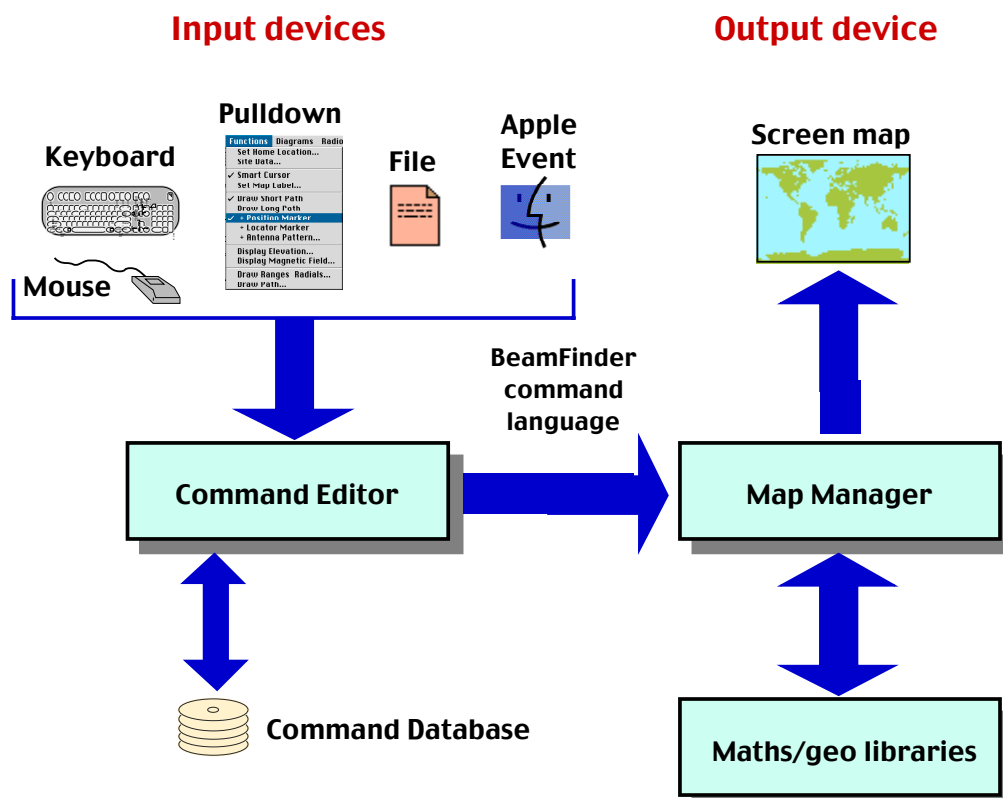


Inside BeamFinder

The Map Manager

Figure 6 is a schematic diagram of BeamFinder's core modules. All drawings on the screen map originate from the Map Manager which controls the data processing in the background, for example by splitting user commands into individual tasks and processes, demanding calculations from BeamFinder's mathematical library and, finally, compiling the results and generating the graphical output by using appropriate routines in the Macintosh operating system.

Figure 6 BeamFinder modules



The Command Editor

The BeamFinder user will never communicate directly with the Map Manager, but will interact with the Command Editor. This module receives the data send by the input devices, i.e. the mouse, the keyboard, the pulldown menu, harddisk files and Apple Events. The Command Editor analyses the input data with its parameters and appends the command to the Command Database. The Command Editor finally forwards the database items to the Map Manager and receives the

Map Manager's acknowledgement when an item has been processed successfully. Hence, whenever BeamFinder receives an input command the Command Editor is responsible for scanning and validating the command before it is handed over to any other BeamFinder module.

The BeamFinder command language (BFCL)

Communication between the Command Editor and the Map Manager is achieved with text strings. For example: if the user wishes to change the actual grid square of the user's home location, the corresponding command is **SetRef JO40DF**. If the user wishes to do the same thing using geographical coordinates, the command string is **SetRef 50°13'45"N 8°17'30"E** where 50°13'45"N and 8°17'30"E are to the geographical latitude and longitude, respectively. In other words, the BeamFinder command language accepts key words and a number of trailing parameters.

Pulldown menue, dialog boxes and keyboard commands

Use of the pulldown menu and its dialogs will therefore generate a text string to be send to the Command Editor. The user may alternatively type the corresponding command in the command edit field (see the botton of the Command Editor window in Figure 7).

Explore: Choose the **Set home coordinates...** item from the **Edit** menu. Enter the Maidenhead grid locator JO40DF, click the **Check** button and, finally, click the **Okay** button. Watch the SetRef command in the Command Editor window displayed at the end of the list. Now, type **SetRef JO52CJ** in the edit field at the bottom of the Command Editor. Note the list in the Command Editor window showing identical lines in both cases.

Uploading ASCII files from harddisk

Because BeamFinder is controlled by text commands, the user may also upload a list of text commands from the harddisk, i.e. the user may design scripts and may implement self-running analyses, plots and calculations very easily.

Explore: Choose the **Open data...** item from the **File** menu which opens the file selection dialog. Navigate to the **BF Examples** folder which is part of the BeamFinder package and select the file **6m-Transatlantic**. If the program should ask **clear data table before loading** you may click one of the buttons, i.e. **Yes** or **No**. You may use the "SimpleText" text editor on your computer to view the text commands stored in that file.

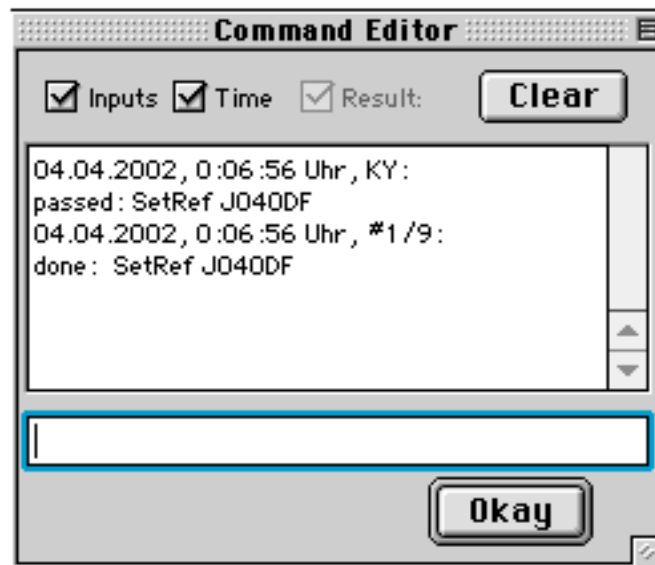
Receiving AppleEvents

BeamFinder may also receive text commands from another application via the AppleEvent pipeline implemented in the Macintosh operating system. This feature is useful if, for example, BeamFinder needs to receive actual dx observations from an electronic log book database.

Protocols and device identifiers

The Command Database is a component of the Command Editor and protocols incoming commands and the results of the build-in parser which validates the command syntax and the integrity of its parameters. The database also tracks the command's execution status reported by the Map Manager.

Figure 7 Command Editor window



The Command Editor provides detailed information about BeamFinder's internal activities when enabling the checkboxes **Input** and **Time** in the Command Editor window (see Figure 7). The example in Figure 7 is explained as follows:

- Line 1: The Command Editor has received an incoming command on **04.04.2002, 00:06:56** CPU time. The device identifier **KY** indicates that the command originated from the keyboard.
- Line 2: The incoming command is **SetRef JO40DF** and has successfully passed the Command Editor.
- Line 3: The Map Manager processed the command on **04.04.2002** at **00:06:56** CPU time. The command corresponds to the first item in the Command Database. However, the Map Manager has already processed a total of nine items since program launch as indicated by the label **#1/9**.
- Line 4: The command execution has been completed successfully (**done**).

Note: A complete list of device identifiers is given in Table 30 on page 94 in the appendix.

Clearing the data and clearing the map of the world

Clearing the data in the Command Editor and clearing the drawings on the map are totally independent actions:

- Clearing the data empties the Command Database without changing the map and its actual drawings (see the **Clear** button in the Command Editor window and also the **Clear command list** item in the **Edit** menu).
- Clearing the map erases existing drawings (see the **Clear** button in the map window and also the **Clear map** item in the **Edit** menu). However, the Command Database is not affected, i.e. all commands remain available and may be restarted on demand.

Separating the graphical data from the Command Editor data is an advantage because it provides the user with more flexibility. For example, if the user wishes to redraw the data using a different colour, the map can be cleared without affecting the existing data in the Command Editor. After having changed the colours, the user may force the Command Editor to resend all existing commands to the Map Manager by selecting the **Restart all commands** item in the **Edit** menu.

Basic functions

Introduction

The best way to understand BeamFinder's basic functions is to use the program and explore its menus and controls in practice.

Note: New users are advised to enable the BubbleHelp feature in the Macintosh operating system while exploring the program.

Studying the manual will enable the user to apply BeamFinder more efficiently because useful background knowledge, hints and other types of useful information not available in the program is supplied therein. This chapter enables the user to apply the following functions and features:

- configuring BeamFinder to the user's home location
- plotting the path of radio waves on the map of the world considering short and long path radio propagation
- plotting grid squares to display dx results and band openings
- creating beamer maps, range circles and antenna bearings
- analysing third-party observations, e.g. by adopting dx cluster information
- plotting the antenna beamwidth, displaying the geographical area illuminated with the actual antenna direction
- displaying elevation data in the map header
- displaying geomagnetic field data in the map header
- using the site information table
- enabling the smart cursor feature to identify Maidenhead grid locators
- enabling the rubberband feature to preview the path of radio waves
- using BeamFinder's graphical user interface
- operating BeamFinder's build-in command language

Setting the user's home location

Usage

Before using BeamFinder the user is advised to store his personal geographical data in the program, as the majority of commands and functions refer to the user's home location, e.g. when calculating great-circle-distances, antenna headings etc..

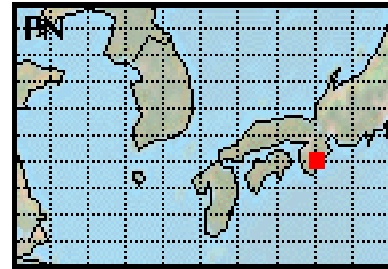
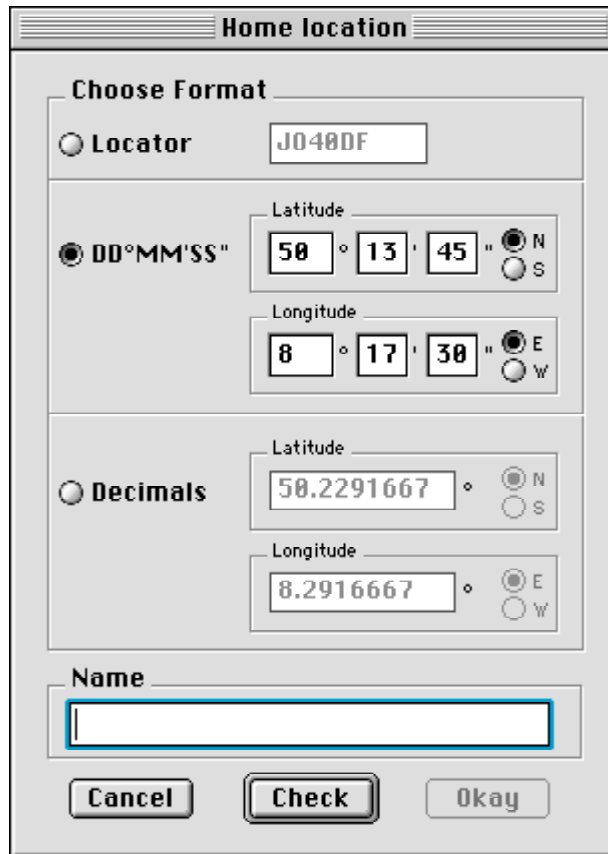


Figure 8 Home location dialog



Using the dialog

Choose the **Set home coordinates...** item from the **Edit** menu to open the dialog in Figure 8. Enter your personal Maidenhead grid locator or, alternatively, your geographical coordinates and click the **Check** button. Finally, press the **Okay** button to apply your settings. The **Name** field in the dialog is optional. A small square indicates your home location on the screen map.

Note: The **Okay** button is not accessible if BeamFinder detects illegal statements or data is missing. Please correct and click the **Check** button again.

Using the command language

To use the BeamFinder Command Language (BFCL), the user may enter the command

SetRef &myLoc

or, alternatively, the command

SetRef #latitude #longitude

in the Command Editor where **&myLoc** denotes the user's Maidenhead grid locator and **#latitude** and **#longitude** the geographical latitude and longitude, respectively. For example: the command **SetRef JO40DF** defines the grid square JO40DF as the home location in BeamFinder. The command **SetRef 50°13'45"N 8°17'30"E** defines 50°13'45" northern latitude and 8°17'30" eastern longitude as the home location.

Important note: Please always enter the geographical latitude prior to the geographical longitude.

Formating geographical coordinates

BeamFinder accepts various formats for geographical coordinates. The following formats are equivalent :

50°13'45"N 8°17'30"E,
50°13'45" 8°17'30",
50/13/45N 8/17/30E,
50/13/45 8/17/30,
50.2291667 8.2916667.

The hemispheres are denoted by **N**, **S**, **E** and **W** respectively. BeamFinder assumes northern latitudes and longitudes east of Greenwich if the corresponding specifier is not available.

Using the mouse

The user's home location may be defined by depressing the **⌘** - key on the keyboard and by clicking the desired location on the map of the world.

The preferences file in the system folder

Typically, there is no need to enter the user's home location on program start as this data is permanently stored in the preference file in the system folder. However, this is only true if the dialog shown in Figure 8 was used, i.e. the preferences file does not consider the actual home location when typing the SetRef command manually, when loading it from a harddisk file or, alternatively, when using the mouse as described above. This behaviour allows the user to change the home location temporarily without affecting the setting of his true home location in the preference file.

Note: Please distinguish between the preference file in the system folder and the Preference dialog discussed further below. The preference file represents a feature in the operating system, while the Preference dialog is part of BeamFinder's graphical user interface.

Summary

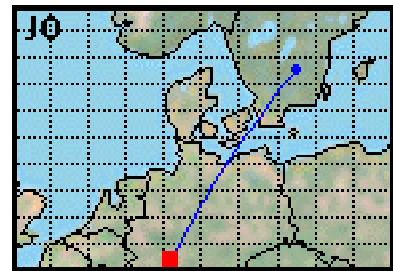
Table 1 Home location

GUI (dialog)	Menu	Edit
	Item	Set home coordinates...
	Action	Enter data
GUI (mouse)	Action	Click desired location while depressing the ⌘ - key Note: Resultant home location is not considered by the preference file in the system folder.
BFCL		<ul style="list-style-type: none"> • SetRef &myLoc – set Maidenhead grid locator • SetRef #myLatitude #myLongitude – set geographical coordinates <p>Note: Resultant home location is not considered by the preference file of the system folder.</p>

Entering geographical data and targets

Usage

Processing geographical data is one of BeamFinder's core functions. The geographical data is used to calculate the target distance and heading and to draw a connection between the user's home location and the corresponding target. The connection corresponds to the path of radio waves traveling between these geographical positions.



Settings

Please apply the following settings before entering a geographical target:

- Enable the **Short path** or, alternatively, the **Long path** item in the **Display** menu,
- enable the **Target marker** item in the **Display** menu if you wish to place a small bullet marker at the end of the path.

Using the mouse

By clicking any location on the map of the world, BeamFinder will consider the corresponding position to be the geographical target.

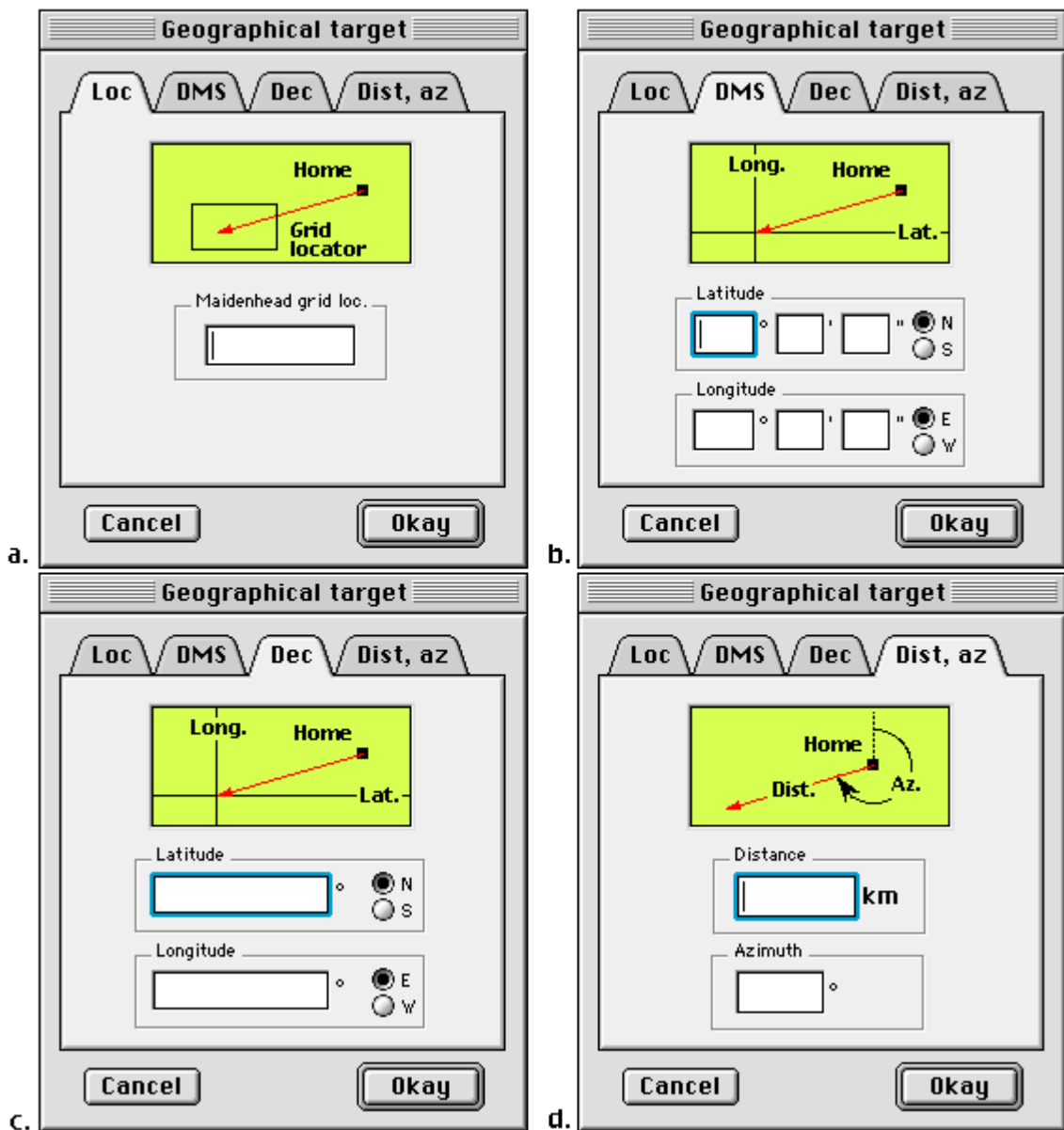
Using the dialog

Select the **Geographical target...** item in the **Functions** menu and choose one of the panels shown in Figure 9 to enter the geographical data.

Note: You may access the dialog faster by using the shortcut **F1** on the keyboard.

You may change the actual panel selection at any time, however, any existing input data is erased when switching the format.

Figure 9 Geographical target dialog



Using BeamFinder’s Command Language

Situations may arise where the user wants to enter geographical targets as quick as possible, e.g. in the hot phase of a Sporadic-E band opening. Target data of any format may be typed directly into the edit field at the bottom of the Command Editor window (see Figure 7 on page 20). BeamFinder will automatically identify the type of data, i.e. grid locator data and geographical coordinates.

Entering grid locators

Maidenhead grid locators may be entered in the full six-digit code or, alternatively, in the short form providing only four digits. For example: the formats **JO40DF** and **JO40** are both accepted by BeamFinder.

Missing digits in the grid locator may be replaced by an asterisk. BeamFinder will therefore also accept the following grid locators:

JO40** (equivalent to **JO40**, see above),
JO40*F,
JO40D*,
JO*0DF,
JO4*DF,
JO*0,
JO4*
and even **JO****.

Missing digits in the grid locator are replaced by an appropriate estimate which will, of course, reduce the accuracy of data. BeamFinder cannot accept grid locators such as ****40DF**.

Note: When entering **JO** instead of **JO**** BeamFinder assumes the grid square in accordance to the predecessor of the Maidenhead grid system, i.e. the European grid system used in the 1970s and 1980s. Please refer to the paragraph “Using the European grid locator” on page 95 in the appendix for more details.

Entering geographical coordinates

Geographical coordinates may be entered in different formats, please refer to the paragraph “Formating geographical coordinates” on page 24 of this manual.

Entering distance and azimuth

Situations might arise in which the target coordinates are unknown, however the antenna direction and, possibly, the distance is available. In this case the **DrawPath** keyword is required, i.e.

DrawPath #distance #azimuth

where **#distance** and **#azimuth** denote the numerical value of the great-circle-distance (or its estimate) in kilometers and the antenna direction in degrees. For example: **DrawPath 1250 234** will draw a radio path of 1250 km length in the direction of 234° azimuth.

Summary

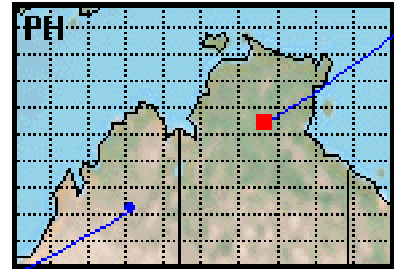
Table 2 Geographical targets

GUI (dialog)	Menu	Functions
	Item	Geographical target...
	Action	<p>Select one of the following panels:</p> <ul style="list-style-type: none"> • Loc – enter grid locator, see Figure 9a • DMS – enter geographical coordinates in degrees, minutes, seconds, see Figure 9b • Dec – enter decimal geographical coordinates, see Figure 9c • Dist, az – enter distance and azimuth, see Figure 9d
GUI (mouse)	Action	Click target location on the map
BFCL		<p>Type one of the following commands:</p> <ul style="list-style-type: none"> - &targetLoc – Maidenhead grid locator - #latitude #longitude – geogr. coord. - DrawPath #distance #azimuth

Long and short path calculations

Usage

The short path is defined the shortest great-circle-distance connecting two places on the surface of the Earth. However, there are situations in which radio waves travel more efficiently through the ionosphere by using the longest distance i.e. the long path around the Earth. BeamFinder allows the user to select short and long path calculations, or both at the same time.



Enabling and disabling short path calculations

The short path function is activated and deactivated by using the **Short path** item in the **Display** menu or, alternatively, by typing the keywords **ShowSPath** and **HideSPath**, respectively, in the Command Editor.

Enabling and disabling long path calculations

The long path function is enabled and disabled by using the **Long path** item in the **Display** menu or, alternatively, by typing the keywords **ShowLPath** and **HideLPath**, respectively, in the Command Editor.

Summary

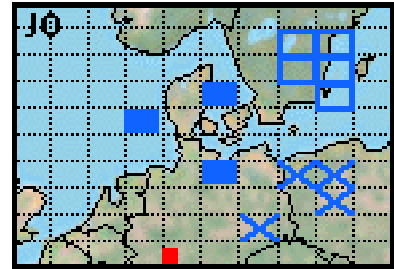
Table 3 Calculations along the short and the long path

GUI	Menu	Display
	Item	Short path or, alternatively Long path
	Action	Enable, disable menu item
BFCL		<ul style="list-style-type: none"> • ShowSPath – enables short path calculations • HideSPath – disables short path calculations • ShowLPath – enables long path calculations • HideLPath – disables long path calculations

Plotting grid squares

Usage

Radio amateurs often communicate in terms of grid squares when discussing the characteristics of a band opening or when comparing their dx results. BeamFinder provides plot functions to display grid squares on the map of the world. In combination with the “from-to-operator” (see page 36), the user may generate displays of almost any situation in VHF dxing.



Enabling and disabling grid squares

Select the **Preferences...** item in the **Edit** menu to select one of the three drawing styles i.e. crossed, rectangular and filled grid squares, respectively. Please refer to the paragraph “Preferences” on page 82 of this manual for more details.

The function may be enabled and disabled by using the **Grid marker** item in the **Display** menu or, alternatively, by typing the keywords **ShowLoc** and **HideLoc**, respectively, in the Command Editor. To plot a grid square please apply the instructions outlined in the paragraph “Entering geographical data and targets” on page 26.

Note: If you wish to display grid squares without drawing the path of radio waves and without drawing any target markers on the map, please disable the following items in the **Display** menu: **Short path**, **Long path** and **Target marker**.

Summary

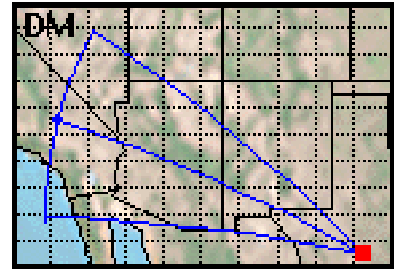
Table 4 Plotting grid squares

GUI	Menu	Display
	Item	Grid markers
	Action	Enable, disable menu item
BFCL		<ul style="list-style-type: none"> - ShowLoc – enables grid squares - HideLoc – disables grid squares

Plotting the antenna pattern

Usage

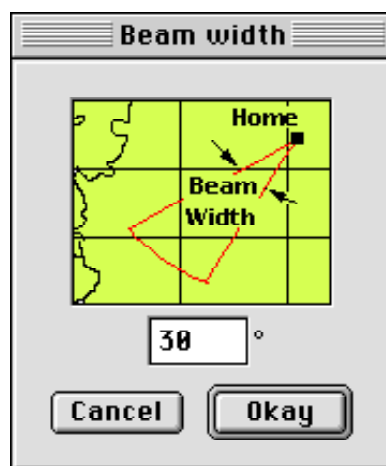
In long-distance communication it is often not obvious which regions of the world are being illuminated with the actual antenna direction. BeamFinder allows the radio operator to draw the antenna's main lobe on the map, i.e. the operator may easily identify the dx access area corresponding to the actual antenna direction.



Using the dialog

Select the **Antenna pattern...** item in the **Display** menu to enter the desired antenna beam width (see Figure 10). The function may be disabled by de-selecting the **Antenna pattern...** item in the **Display** menu. To plot the antenna beam, the user is requested to notice the instructions outlined in the paragraph "Entering geographical data and targets" on page 26.

Figure 10 Antenna-beam-width dialog



Using the command language

The following command enables the antenna function:

ShowAnt #bwidth

where **#bwidth** denotes the antenna beamwidth in degrees. For example: the command **ShowAnt 33** shows a 33 degrees antenna lobe targeting the geographical position on the map of the world.

The command

HideAnt

may be used to disable the function.

Summary

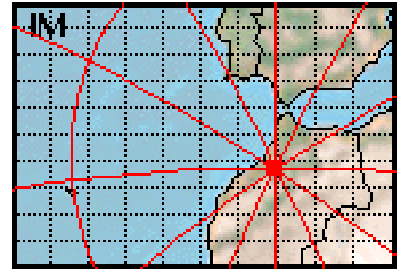
Table 5 Antenna pattern

GUI	Menu	Display
	Item	Antenna pattern...
	Action	Enter data
BFCL		<ul style="list-style-type: none"> • ShowAnt #bwidth – displays antenna beam width • HideAnt – disables function

Range circles and radials

Usage

A beamer map is a map of the world providing range circles centered around the user's home location with radials indicating the antenna direction to distant continents. Beam-Finder allows the user to draw the entire wind rose or, alternatively, to draw individual range circles and radials.

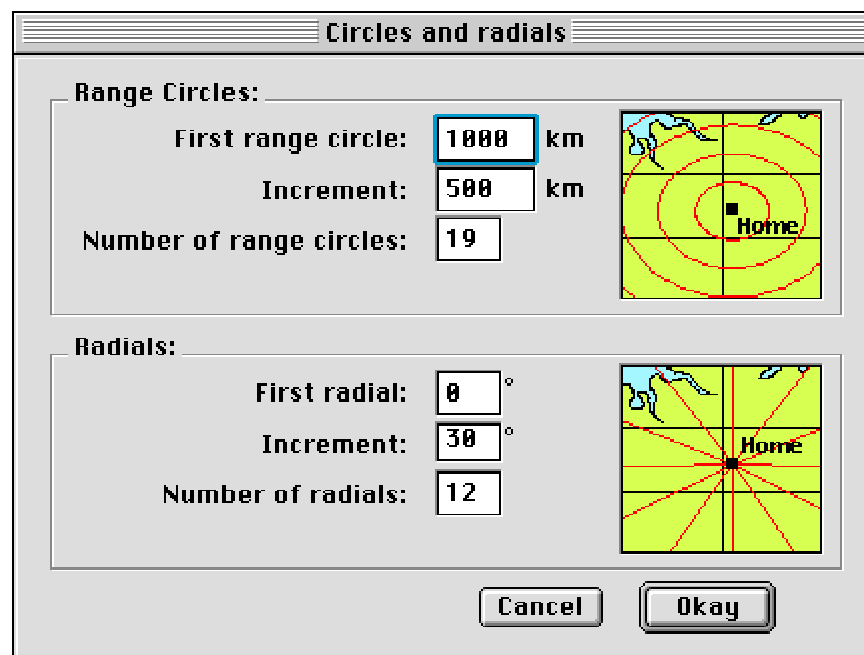


Using the dialog

Select the **Circles and radials...** item in the **Functions** menu to access the dialog displayed in Figure 11. Enter the diameter of the first range circle and the desired spacing between the circles as well as the number of circles required. Also enter the analogous data to define the radials.

Note: If you wish to disable either the range circles or the radials you may enter zero for the corresponding number of objects to be drawn.

Figure 11 Dialog for drawing range circles and radials



Using the command language

Alternatively the user may enter the command

DrawRange #diameter

in the Command Editor where **#diameter** denotes the radius (in kilometers) of the circle to be drawn. In order to draw a radial you may use the command

DrawRadial #azimuth

in the Command Editor where **#azimuth** denotes the azimuth in degrees. For example: **DrawRange 1250** draws a radius of 1250 kilometers and **DrawRadial 32** draws a line in the direction of 32° azimuth.

Note: The **DrawRange** command draws one circle at a time, i.e. if you wish to draw a number of circles you have to apply the command sequentially. The same holds for the **DrawRadial** command.

Note: The shape of the range circles may appear non-circular on the map of the world because of the map projection.

Summary

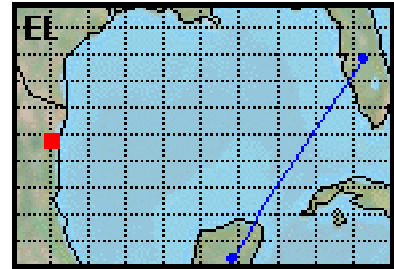
Table 6 Circles and radials

GUI	Menu	Functions
	Item	Circles and radials...
	Action	Enter data
BFCL		<ul style="list-style-type: none"> • DrawRange #diameter – draw s range circle • DrawRadial #azimuth – draws radial

The “from-to-operator”

Usage

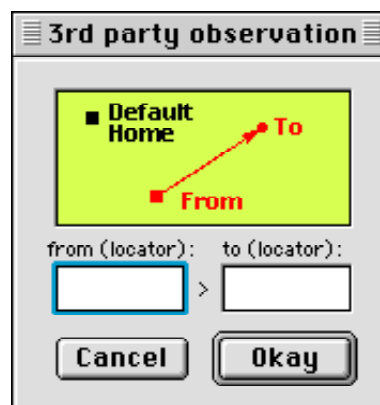
BeamFinder generally refers to the user’s home location when calculating distances and azimuths. Drawings therefore originate from that square on the map which indicates the user’s home location. However, the Beam-Finder user may also plot observational data from other radio amateurs. This function is particularly useful if the user wishes to display dx cluster data, for example.



Using the dialog

Select the **3rd party data...** item in the **Functions** menu to access the dialog displayed in Figure 12. Enter the two grid squares, i.e. the geographical locations defining the terminals of the wave path which needs to be displayed. Note that the resulting path of radio waves does not connect the user’s home location to the geographical target, but an alternative home location corresponding to another radio operator.

Figure 12 3rd-party-observation dialog



Using the command language

The following command may be applied to draw 3rd party data by using the BeamFinder Command Language:

&fromSquare > &toSquare

where **&fromSquare** and **&toSquare** denotes the grid square from where the path of radio waves originates and where it terminates, respectively. For example: the command **EL50SD > EL97GT** will draw a path from the grid square EL50SD to the square EL97GT.

Should the full six-digit locator code not be available you may also use its short form, e.g. **EL50 > EL97**.

Note: The “>” symbol is called the “from-to-operator” which will also appear in another format further below. Please note both the leading and trailing blank which are required for operation, i.e. BeamFinder would refuse the statement **JO40DF>IO64WA**, for example, but will accept **JO40DF > IO64WA**.

Summary

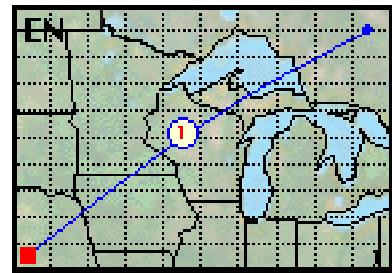
Table 7 3rd-party-data, the “from-to-operator”

GUI	Menu	Functions
	Item	3rd party data...
	Action	Enter data
BFCL	&fromSquare > &toSquare – draws the path of radio waves connecting the geographical targets &fromSquare and &toSquare .	

Display skip markers

Usage

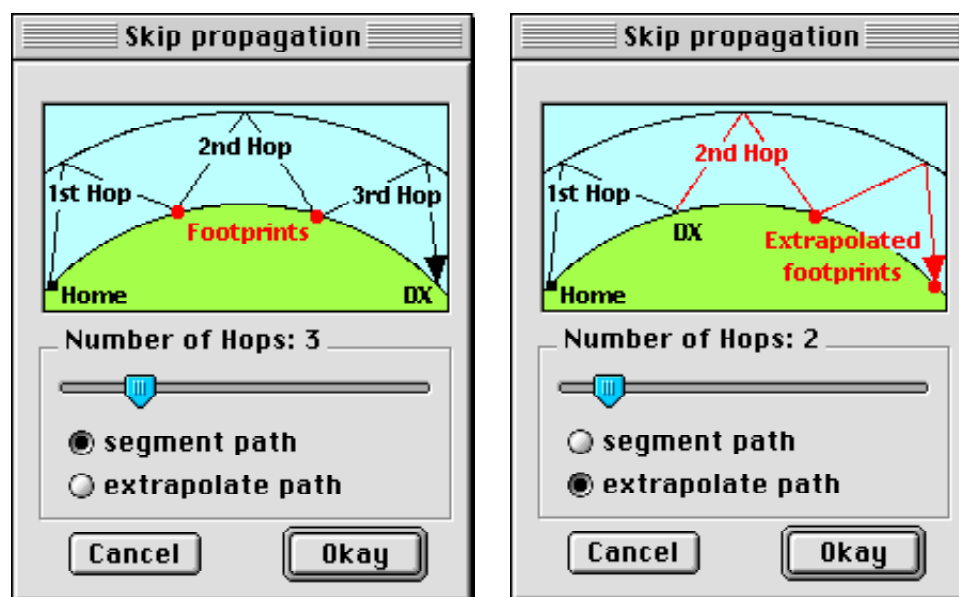
In a simplified form, ionospheric skip propagation may be described by a zigzag path of radio waves bouncing between the ionospheric layer and the surface of the Earth. BeamFinder can display the footprints of such a zigzag path on the map of the world and allows the operator to extrapolate a single hop propagation to a multiple hop scenario. This allows, for example, a what-if analysis of Sporadic-E, i.e. what dx targets might become available if the current Sporadic-E band opening develops into a double-hop scenario.



Using the dialog

Select the **Skip markers...** item in the **Display** menu to access the dialog displayed on the left hand side of Figure 13. Drag the slider to the number of skips to be analysed. To disable the skip markers, drag the slider to its outer left position.

Figure 13 Skip marker dialogs



The user may extrapolate a single-hop to a multiple hop scenario by clicking the **extrapolate path** button in the dialog. Refer to the paragraph further below to understand the difference between the **segment path** and **extrapolate path** option.

Using the command language

The following commands enable the skip marker function by using the Beam-Finder Command Language:

```
ShowSkips s#skips,  
ShowSkips e#skips
```

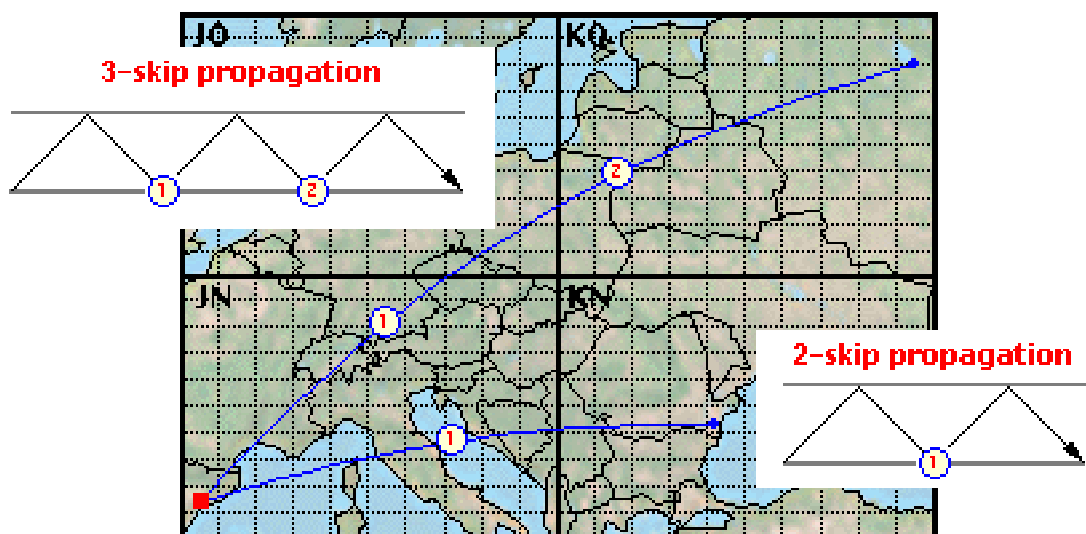
where **#skips** denotes the number of skips to be analysed. For example: the command **ShowSkips s2** enables the skip marker option using the **segment path** option in the case of a double-hop scenario. The command **ShowSkips e3** enables the **extrapolate path** option by extrapolating single-hop propagation to a 3-skip scenario. To quit the skip maker function use the command:

```
HideSkips.
```

Interpreting the results

When selecting the **segment path** option, circular markers indicate the geographical locations where the zigzag ray path hits the Earth's surface (see the explanations in Figure 14).

Figure 14 Skip markers



Selecting the **extrapolate path** option allows the radio operator to identify the touch-down area of the radio waves if an existing single-hop situation would develop into a multiple-hop scenario. For example: a radio operator in Poland observing Sporadic-E signals from the south of Sweden on the 2m-band is alerted to possible signals from Scotland (see Figure 15). In order not to miss an opportunity, he may decide to check the signals from the Scotch radio beacons.

Figure 15 Extrapolated skip propagation



It is, however, important to note that BeamFinder's skip markers are not based on any ionospheric models, but are purely geometrical in nature. The **segment path** option divides a given path length by the number of skips and the **extrapolate path** option multiplies the path length by the number of skips. Hence, the skip marker function is a fairly simple method of evaluating multiple-skip propagation. Nevertheless, it may often provide useful information for the radio operator.

Summary

Table 8 Skip markers

GUI	Menu	Display
	Item	Skip markers...
	Action	Enter data
BFCL		<ul style="list-style-type: none"> • ShowSkips s#skips – enables the “segment path” option • ShowSkips e#skips – enables the “extrapolate path” option • HideSkips – disables skip markers

Range of vision (radio horizon)

Usage

The radio horizon defines the geographical region in which, for example, a balloon remains in view without disappearing below the observer's topographic horizon. Its radius depends, of course, on the object's height above ground, i.e. the radio horizon corresponding to a balloon, for example, is much smaller compared to that of a satellite. The radio horizon function is also useful for analysing the area in which the user may access Sporadic-E clouds, Aurora and FAI backscatter volumes or any other phenomena in the upper atmosphere.

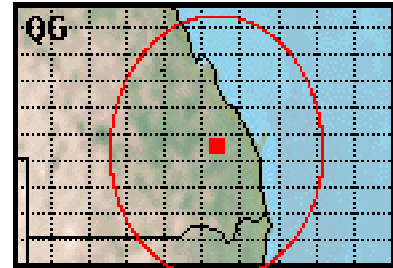
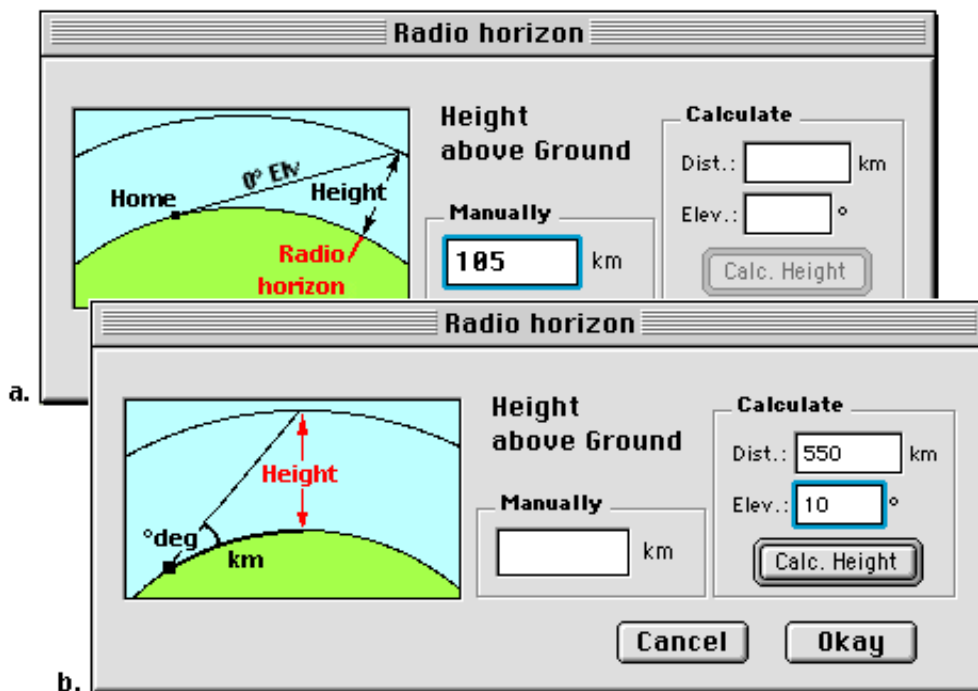


Figure 16 Height-above-ground dialog



Using the dialog

Select the **Range of vision...** item in the **Functions** menu to access the dialog displayed in Figure 16a. Enter the object's height above ground and press the **Okay** button. If the height data is not available, the user may calculate this using the object's actual distance and elevation (see Figure 16b). Press the **Calc. height** button to transfer the calculated result to the edit field on the left.

Using the command language

Alternatively, the user may enter the command

DrawHorizon #height

in the Command Editor, where **#height** denotes the object's height above ground in kilometers. For example, the command **DrawHorizon 105** will draw the radio horizon corresponding to the E-Region in the ionosphere. Any Sporadic-E layer within the circle may be accessed from the user's home location or, in other words, the user cannot access any Sporadic-E patch located outside of this area.

Note: The shape of the radio horizon may appear non-circular on the map of the world because of the map projection.

Summary

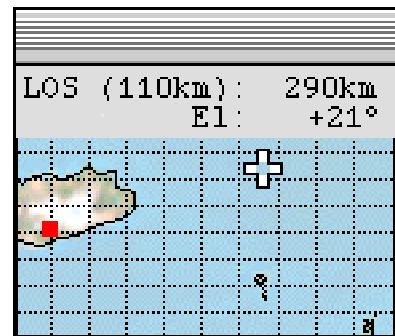
Table 9 Range of vision

GUI	Menu	Functions
	Item	Range of vision...
	Action	Enter data
BFCL	DrawHorizon #height – draws range of vision	

Calculating elevation and line-of-sight data

Usage

In BeamFinder, the mouse cursor acts as a geographical pointing device moving over the oceans and continents of the screen map. By specifying a height, the mouse cursor may also simulate an airborne object in the atmosphere. This function adds extra data to the map header, i.e. the elevation and the line-of-sight distance (LOS) corresponding to the position in space which is represented by the mouse cursor. The calculations take the curvature of the Earth into consideration.



Enabling and disabling elevation and line-of-sight data

Select the **Elevation data...** item in the **Display** menu to access the dialog box similar to the one of Figure 16. Enter the height and watch the extra line available in the map header (see Figure 17). To quit the function, click the **Elevation data...** item in the **Display** menu again.

Figure 17 Elevation and line-of-sight (LOS) data

J054EL:	54°29'23"N	Short Path:	494km,	Az:	16°
	010°20'47"E	LOS (110km):	510km,	El:	+10°

Summary

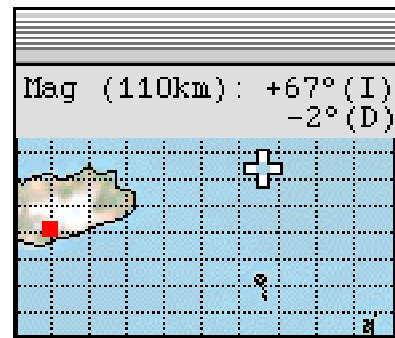
Table 10 Enabling and disabling the elevation display

GUI	Menu	Display
	Item	Elevation data...
	Action	Enter data
BFCL		n/a

Calculating geomagnetic field data

Usage

BeamFinder can calculate the spherical harmonics of the Earth's magnetic field using the latest coefficients available. The geomagnetic data is used, for example, to calculate the geometry of Aurora and FAI backscattering. The geomagnetic field data is also available in the map header in which the magnetic dip (inclination) and declination may be displayed which correspond to the actual mouse position on the screen map. The function may be used, for example, to identify the so-called conjugate magnetic point of the user's home location for analysing trans-equatorial radio propagation (TEP).



Enabling and disabling elevation and line-of-sight data

Select the **Geomagnetic field data...** item in the **Display** menu to access the dialog box similar to the one of Figure 16. Enter the height and watch the extra line available in the map header (see Figure 18). To quit the function, click the **Geomagnetic field data...** item in the **Display** menu again.

Figure 18 Geomagnetic field data

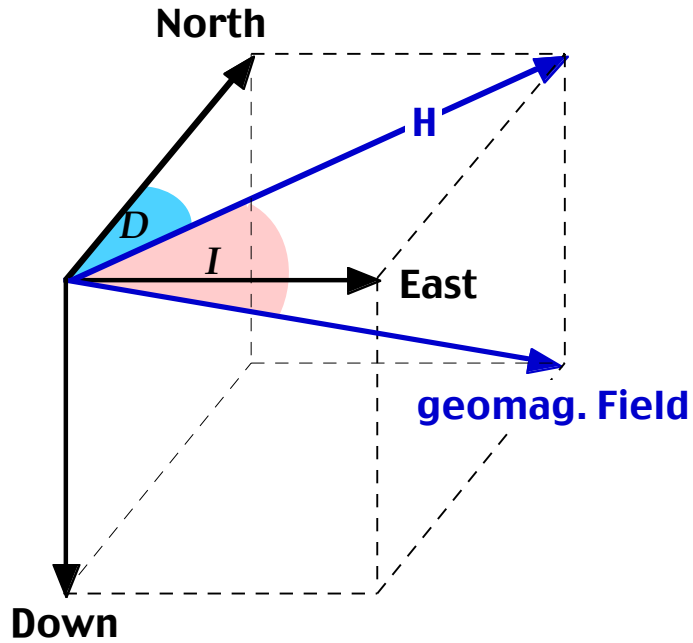
```
IN99PJ: 49°23'16"N      Short Path: 652km, Az: 265°
        000°42'31"W     Mag (110km): +65°(I), -3°(D)
```

Geomagnetic inclination and declination

Figure 19 shows the North, East and Down component of the topographical coordinate system. The geomagnetic declination is defined as the angle between the north and the horizontal component of the Earth's magnetic field (see the H component in the figure). Deflections to the east and west are indicated by positive and a negative declination, respectively. The geomagnetic inclination (or

geomagnetic dip) is defined the angle between the horizontal component of the field vector and the field vector itself. The inclination is counted positive in the northern hemisphere and negative in the southern hemisphere.

Figure 19 Geomagnetic Inclination and declination



Summary

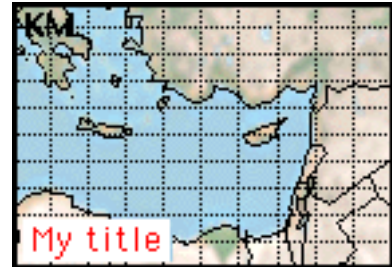
Table 11 Enabling and disabling the geomagnetic field data display

GUI	Menu	Display
	Item	Geomagnetic field data...
	Action	Enter data
BFCL		n/a

Creating a map title

Usage

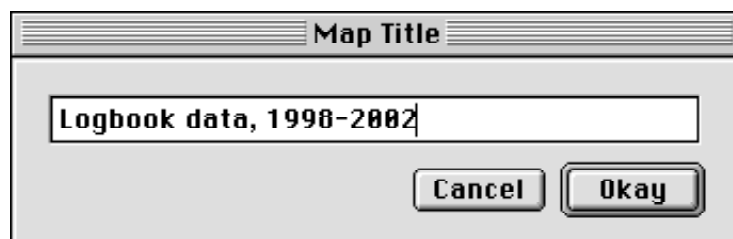
A user-defined title can be given to make the map display more intelligible and to provide additional information describing the actual map display, e.g. the date and time of observational data. The title is also useful if you wish to submit your personal dx report to an amateur radio magazine or if you decide to publish your dx results on your personal homepage.



Using the dialog

Select the **Map title...** item in the **Edit** menu to access the dialog displayed in Figure 20. Enter the map title and press the **Okay** button. The title appears in the lower left corner of the map window. Clearing the edit field removes an existing title from the map window.

Figure 20 Map title dialog



Using the command language

The following command creates a title in the map window:

```
SetTitle $myTitle
```

where **\$myTitle** denotes the string to be displayed. For example: **SetTitle Logbook data, 1998-2002** will place the title “Logbook data, 1998-2002” in the

map window. The string is removed by the same command without any parameter, i.e. **SetTitle**.

Note: The string parameter may include any number of blanks (see the example above).

Summary

Table 12 Map title

GUI	Menu	Edit
	Item	Map title...
	Action	Enter data
BFCL		<ul style="list-style-type: none">• SetTitle \$anyString – displays map title• SetTitle – removes an existing title

The site information table

Usage

BeamFinder handles different types of geographical information depending on the function and analysis to be processed. The following dialog allows the user to study the data for any position on the surface of the Earth or within the atmosphere.

Using the dialog

Select the **Site information...** item in the **Functions** menu to access the dialog in Figure 21. Enter the geographical position and the height above ground and press the **Check** button to update the site information table. Quit the dialog by pressing the **Done** button.

Figure 21 Site information dialog

Site informations	
<p>Input data</p> <p><input checked="" type="radio"/> Locator <input type="text" value="J040DF"/></p> <p><input type="radio"/> DD°MM'SS"</p> <p>Latitude: <input type="text" value="50"/> ° <input type="text" value="13"/> ' <input type="text" value="45"/> " <input checked="" type="radio"/> N <input type="radio"/> S</p> <p>Longitude: <input type="text" value="8"/> ° <input type="text" value="17"/> ' <input type="text" value="38"/> " <input type="radio"/> E <input checked="" type="radio"/> W</p> <p><input type="radio"/> Decimals</p> <p>Latitude: <input type="text" value="50.2291667"/> ° <input checked="" type="radio"/> N <input type="radio"/> S</p> <p>Longitude: <input type="text" value="8.2916667"/> ° <input type="radio"/> E <input checked="" type="radio"/> W</p> <p>Height (0-800km) <input type="text" value="100"/> km</p>	<p>Site data</p> <p>Locator: J040DF</p> <p>Decimal coordinates: +50.22917 +8.29167</p> <p>Geographical coordinates: 50°13'45"N 008°17'30"E</p> <p>Geocentric position vector: X: +4096.371km Y: +596.988km Z: +4973.701km</p> <p>Radius spherical Earth (*): 6371.040km, 71.134km/°long.</p> <p>Radius elliptical Earth (*): 6352.306km</p> <p>Topo: N E Z X: -0.761km -0.144km -0.633km Y: -0.111km +0.990km -0.092km Z: +0.640km -0.000km -0.769km</p> <p>(*) at ground level</p> <p>Geomagnetic field: Total : 0.46105 Gauss Decl. : -0.0° Dip : +65.6°</p> <p>Geomagnetic field vector: North : +0.19053 Gauss East : -0.00002 Gauss Vert. : +0.41984 Gauss</p> <p>Mag: U E S X: +0.891km -0.144km +0.431km Y: +0.130km +0.990km +0.063km Z: +0.436km +0.000km -0.900km</p> <p>Radio horizon: Long: -7.6° to +24.2° Lat : +60.3° to +40.1°</p>
<p><input type="button" value="Check"/> <input type="button" value="Done"/></p>	

Types of data

The site information table displays the following information:

- locator: the Maidenhead grid locator
- decimal coordinates: the geographical coordinates in decimal notation
- geographical coordinates: geographical latitude and longitude in degrees, minutes and seconds
- geocentric position vector: the X, Y and Z component of the position vector used by BeamFinder
- radius spherical Earth: the length of the position vector using a spherical model of the Earth and the length of a 1° latitudinal segment in kilometers
- radius elliptical Earth: the length of the position vector using an elliptical model of the Earth
- topo: the N, E and Z component of the topographical coordinate system expressed in X,Y and Z vector components
- geomagnetic field: the total field strength of the geomagnetic field in Gauss (nT) and its declination and inclination
- geomagnetic field vector: the N, E and vertical component of the Earth magnetic field vector
- Mag: the UP, E and S component of the Earth magnetic field expressed in X, Y and Z vector components
- radio horizon: visible range in longitude and latitude; this data is only available when entering non-zero height data

Summary

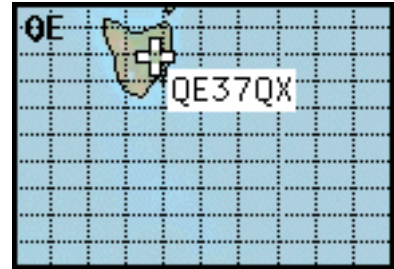
Table 13 Site information

GUI	Menu	Functions
	Item	Site information...
	Action	Enter data
BFCL		n/a

The “smart mouse cursor”

Usage

The user may identify the actual Maidenhead grid locator by considering the horizontal and vertical ruler of the map window. However, a more convenient method is provided by the “smart mouse cursor” feature which displays the actual grid locator beside the mouse cursor. The “smart mouse cursor” updates automatically when moving the mouse across the map.



Enabling and disabling the smart mouse cursor

Enable or disable the **Smart cursor** item in the **Display** menu to use and to quit the feature, respectively.

Summary

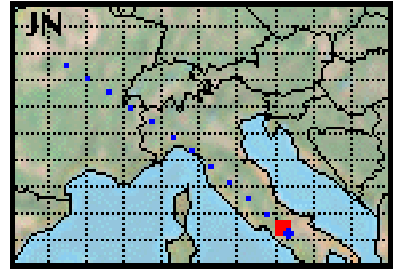
Table 14 The “smart mouse cursor”

GUI	Menu	Display
	Item	Smart cursor
	Action	Enable, disable menu item
BFCL		n/a

The “rubberband”

Usage

The so-called rubberband is a graphical feature displaying dot marks along the radio path. This function is highly dynamical because the dot marks permanently change in accordance to the actual mouse position on the map of the world. The rubberband is a calibrated tool providing dot marks each 100 km.



Enabling and disabling the rubberband

Enable or disable the **Rubberband (100km/dot)** item in the **Display** menu to use and to quit the feature, respectively.

Summary

Table 15 The “rubberband”

GUI	Menu	Display
	Item	Rubberband (100km/dot)
	Action	Enable, disable menu item
BFCL		n/a

Analysing radio wave propagation

Introduction

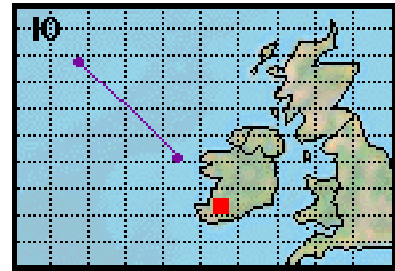
BeamFinder supports radio propagation studies by a large number of unique analysis tools emerging from the practice of vhf dxing. Studying this chapter the user is enabled to apply the following analyses:

- Evaluating the penetration path of radio waves into the atmosphere,
- identifying ionospheric "hot spots" in the Sporadic-E dxing,
- analysing the maximum dx access area corresponding to 1-, 2- and 3-hop propagation,
- using the Sporadic-E monitor for calculating the maximum-usable-frequency (MUF), the frequency of optimum traffic (FOT), the geographical position of Sporadic-E patches and for estimating possible dx targets,
- identifying "hot spots" of Aurora and FAI backscattering,
- analysing the maximum dx radius in Aurora and FAI propagation,
- calculating the scatter curve in Aurora and FAI radio propagation,
- estimating the geographical positions of Aurora and FAI in realtime,
- predicting possible dx in an Aurora and FAI bandopenings,
- plotting bar charts of observational data.

Penetration path into the atmosphere

Usage

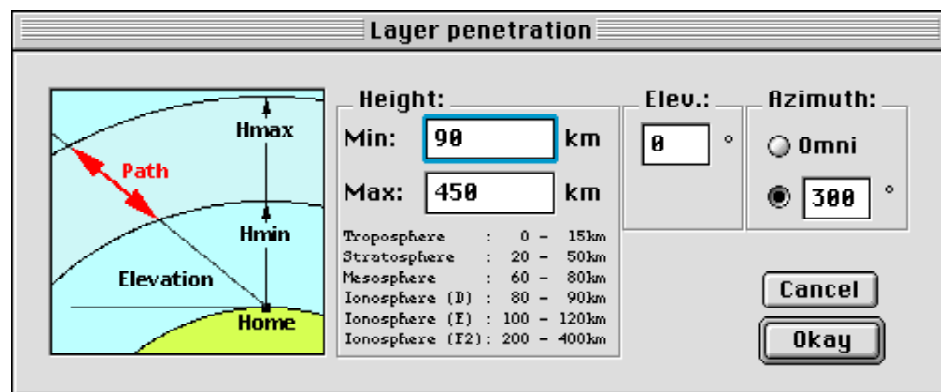
BeamFinder displays the penetration path of radio waves into the atmosphere. This function is in particular useful with satellite and moon-bounce communication at low antenna elevation. As an example: Moonbounce operators claim geomagnetic storms may degrade the signal-to-noise ration in EME operation. Using this function, the EME-operator may identify EME-signals travelling through the polar ionosphere.



Using the dialog

Select the **Layer penetration...** item in the **RadioProp** menu to enter the height layers in the atmosphere and to enter the actual antenna direction, see Figure 22.

Figure 22 Layer penetration dialog



Using the command language

Alternatively you may enter the command

DrawLayer #minheight #maxheight #elevation

in the Command Editor where **#minheight** denotes the lower layer boundary, **#maxheight** the upper layer boundary (in kilometers) and **#elevation** the antenna elevation (in degrees). This command draws two circles corresponding to the heights of layer entry and exit.

Alternatively, the user may also specify the actual antenna azimuth i.e.

DrawLayer #minheight #maxheight #elevation #azimuth

where **#azimuth** denotes the antenna azimuth in degrees. This command displays a line segment along the antenna beam. As an example: **DrawLayer 100 400 12 286** draws the penetration path through the E- and F-layer in the ionosphere (100 km and 400 km, respectively) assuming the antenna beams at 12° elevation and 286° azimuth.

Summary

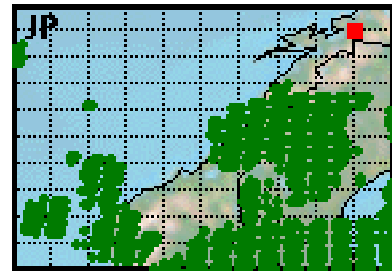
Table 16 Layer penetration

GUI	Menu	RadioProp
	Item	Layer penetration...
	Action	Enter data
BFCL		1) DrawLayer #minheight #maxheight #elevation – draws layer penetration for omnidirectional antennas, i.e. neglecting antenna azimuth 2) DrawLayer #minheight #maxheight #elevation #azimuth – draws layer penetration for directional antenna, i.e. considering antenna azimuth

Reflection areas in the ionosphere

Usage

Assuming the Earth is surrounded by a spherical mirror at high altitude, we would see the image of the continents and oceans mirrored in the sky. This situation is somewhat comparable to a radio antenna in ionospheric skip propagation because it "sees" radio waves in the sky mirrored from the ionosphere. BeamFinder may simulate this situation by projecting the ionospheric mirror on the world map. This function identifies the geographical position of the reflection areas in the ionosphere ("hot spots") resulting in an unusual display of the continents.

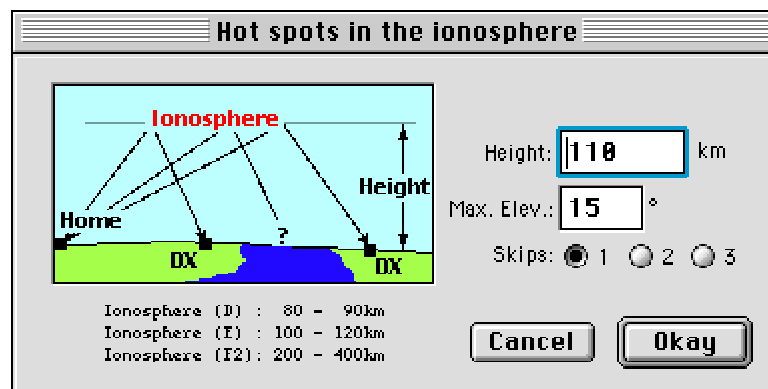


Using the dialog

Select the **Reflection areas...** item in the **RadioProp** menu to open the dialog displayed in Figure 23. Enter the height of the ionospheric layer (in kilometers) and the maximum antenna elevation (in degrees). The user may select 1-, 2- and 3-skip propagation by using the corresponding radio button.

Note: In typical situations, the maximum elevation should not exceed approximately 15° . However, the setting only affects the size of the so-called dead-zone in ionospheric skip propagation which surrounds the user's home location, see Figure 23.

Figure 23 "Hot spots" dialog



Using the command language

Alternatively you may enter the command

```
DrawEsSpots #skips #height #elevation
```

in the Command Editor where **#skips** denotes the number of ionospheric skips (1, 2 and 3, respectively), **#height** the layer height in kilometers and **#elevation** the maximum antenna elevation in degrees. As an example: the command **DrawEsSpots 2 110 10** analyses 2-skip propagation via the E-layer in the ionosphere (110 km) at a maximum antenna elevation of 10°.

Interpreting the results

Figure 24 displays the example of a hot-spot analysis assuming 1-skip propagation. Note that the green area reflects the shape e.g. of the British Isles, the Iberian peninsula, Italy and other parts of Europe. This feature denotes the reflecting areas in the ionosphere from where the skip is directed to Ireland, England, Spain and so on.

Figure 24 Ionospheric "hot spots" (1-skip propagation)

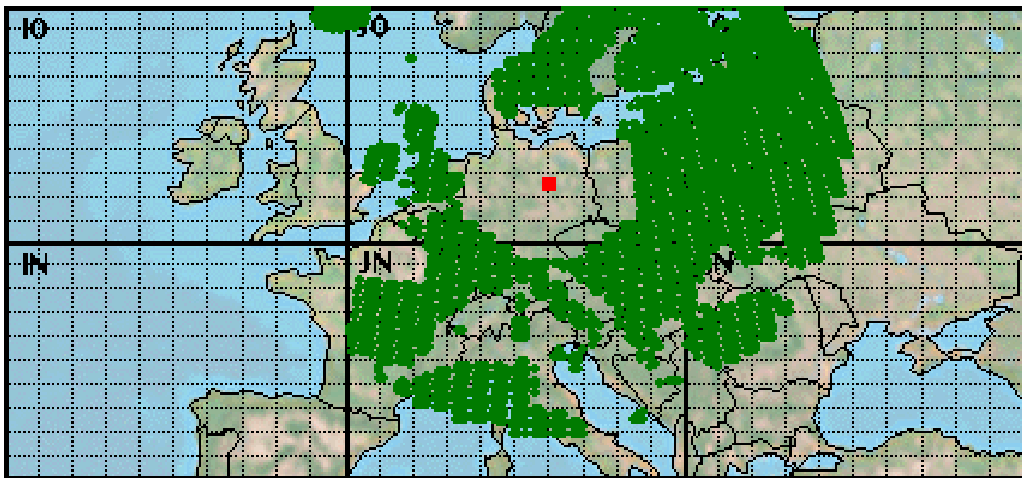


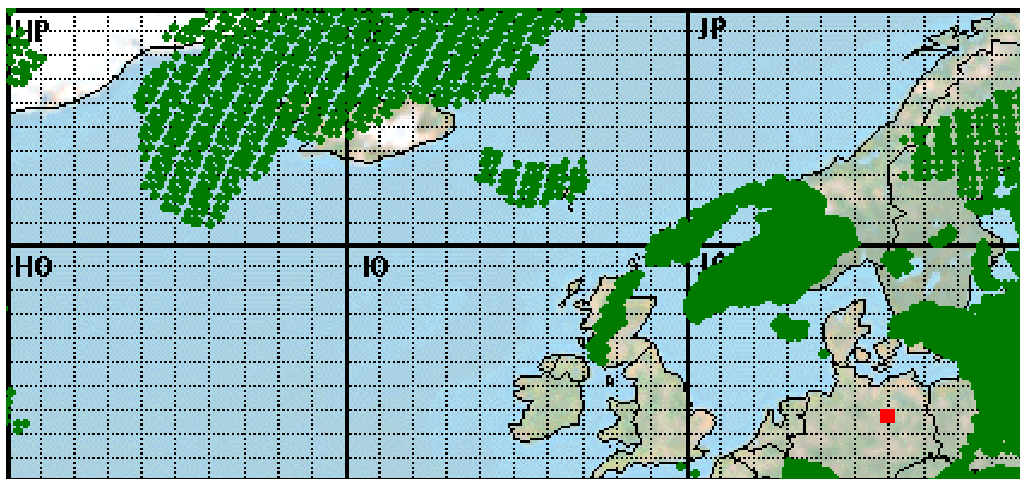
Figure 25 displays a closer view for the example of Ireland. Note the blue rays emerging from the home location (red square) to the northern and southern tip of Ireland. The corresponding reflection area in the ionosphere is located in the middle between the two ray paths, i.e. the green area may be interpreted the projection of Ireland onto the ionosphere. Thus, whenever the user wants to communicate to Irish radio stations the skip must pass the displayed area in the ionosphere, the skip will miss the geographical target otherwise.

Figure 25 Interpreting the hot-spot analysis



Figure 24 and Figure 25 analyse the situation of single skip propagation. A very different view is obtained in the case of two and three skip propagation. Note, for example, the double image of Iceland and Greenland in Figure 26 indicating the corresponding "hot spots" in double-hop propagation.

Figure 26 Ionospheric "hot spots" (2-skip propagation)



Summary

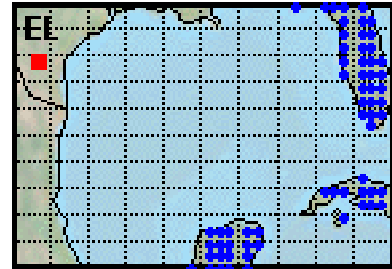
Table 17 Hot-spot analysis

GUI	Menu	RadioProp
	Item	Ionospheric hot spots...
	Action	Enter data
BFCL		DrawEsSpots #skips #height #elevation – draws the reflection areas ("hot spots") in the ionosphere

Dx range in ionospheric skip propagation

Usage

The skip distance in ionospheric radio propagation depends on the layer height and the antenna's vertical beam width. Long skip distances are achieved with low antenna elevation and vice versa. BeamFinder enables the user to predict the maximum dx access area in the case of 1-, 2- and 3-skip propagation.



Using the dialog

Select the **Dx target areas...** item in the **RadioProp** menu to open the dialog similar to the one displayed in Figure 23. Enter the height of the ionospheric layer (in kilometers) and the maximum antenna elevation (in degrees). The user may analyse 1-, 2- and 3-skip propagation by clicking the corresponding radio button.

Note: The maximum antenna elevation only affects the size of the so-called dead-zone surrounding the user's home location.

Using the command language

Alternatively you may enter the command

```
DrawEsDX #skips #height #elevation
```

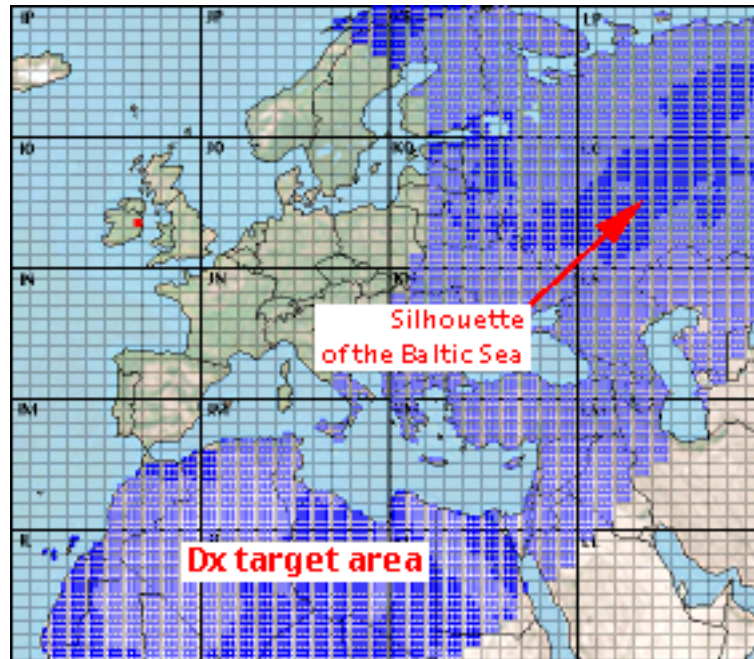
in the Command Editor where **#skips** denotes the number of ionospheric skips (1, 2 and 3, respectively), **#height** the layer height in kilometers and **#elevation** the maximum antenna elevation in degrees. As an example: the command **DrawEsDX 2 110 10** analyses double-hop propagation via the E-layer at a height of 110 km and at a maximum antenna elevation of 10°.

Interpreting the results

Figure 27 shows the example of an Irish radio station and its dx target area in the case of double-hop propagation via the ionosphere. The blue area denotes the geographical regions in which the second skip returns to Earth. Please note the silhouettes of the seas and oceans in dark blue color which correspond to iono-

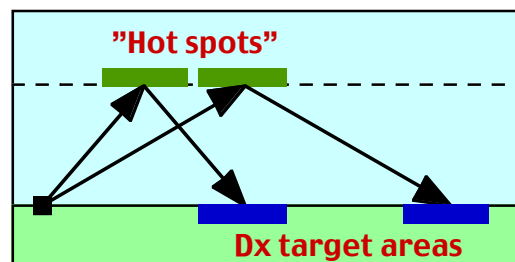
spheric skips hitting oceans and seawater along its zigzag path between the ionosphere and the ground. Hence, considering the dark blue areas allows the radio operator to identify skip propagation across ocean terrain which is believed to provide better reflections at ground level in multiple-skip propagation.

Figure 27 Ionospheric dx targets (2-skip propagation)



Note: BeamFinder considers different colors to indicate ground targets and atmospheric targets, respectively. The green color in Figure 24 therefore denotes areas in the ionosphere, the blue color in Figure 27 correspond to areas at ground level, see Figure 28.

Figure 28 Height colors



Summary

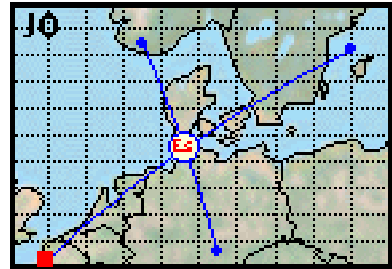
Table 18 Ionospheric dx access area

GUI	Menu	RadioProp
	Item	Dx access area...
	Action	Enter data
BFCL		DrawEsDX #skips #height #elevation – plotting the dx access area in ionospheric skip propagation

The Sporadic-E analyser

Usage

Sporadic-E propagation is a very directive propagation mode in general i.e. watching radio operators establishing Sporadic-E connections does not guarantee any Sporadic-E spot at the user's home location. BeamFinder's unique Sporadic-E analyser identifies possible Sporadic-E conditions available to the user based on observations made by other stations. The Sporadic-E analyser calculates the geographical position of the Sporadic-E and estimates the corresponding dx target and the frequencies suitable for spotting Sporadic-E at the user's home location.



Using the dialog

Geographical analysis

Select the **Sporadic-E analyser...** item in the **RadioProp** menu to open the dialog displayed in Figure 29. Enter the grid locator of the station that actually establishes any Sporadic-E connection and enter the grid locator of the corresponding Sporadic-E target. Press the **any frequency** button if you wish to analyse the Es-geography without taking frequencies into consideration.

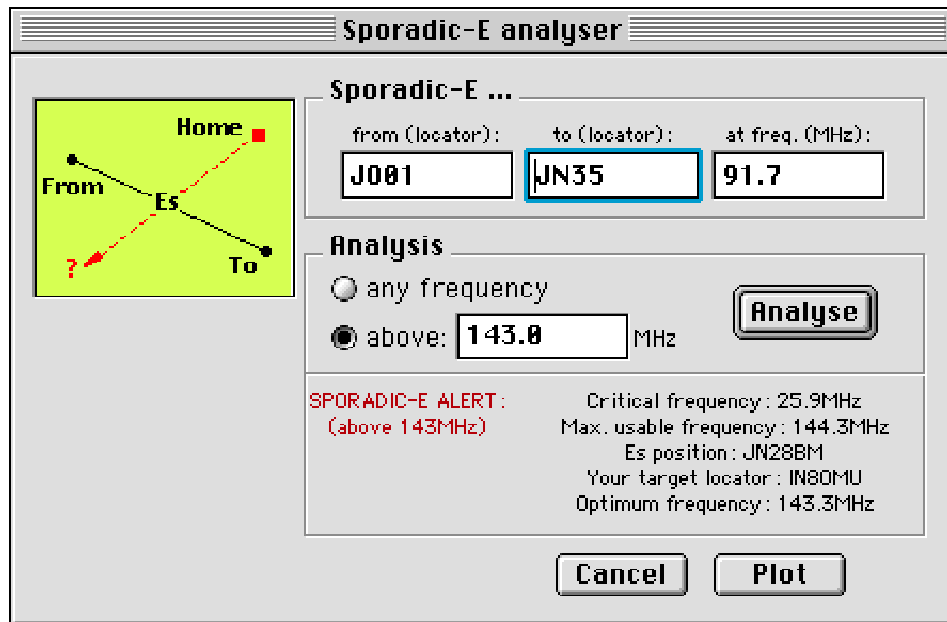
Press the **Analyse** button to start the calculation. The result may be transferred to the screen map by selecting the **Plot** button.

Extended analysis (geography and frequencies)

Alternatively you may press the **above** button to enter the minimum operating frequency you prefer. In this case you have to enter also the Sporadic-E operating frequency of the two radio stations from above.

Press the **Analyse** button to start the calculation. The result may be transferred to the screen map by selecting the **Plot** button.

Figure 29 Sporadic-E analyser dialog



Using the command language

Geographical analysis

Alternatively you may enter the command

FindEs &fromSquare &toSquare

in the Command Editor where **&fromSquare** and **&toSquare** denote the Maidenhead grid locators of the radio stations reporting Sporadic-E. As an example: the command **FindEs JO01 JN35** analyses the Sporadic-E link between JO01 and JN35 and estimates possible Sporadic-E targets in respect to the user's home location.

Extended analysis (geography and frequencies)

If you wish to consider frequencies you may enter the command

FindEs &fromSquare &toSquare #opsFreq #yourFreq

in the Command Editor where **#opsFreq** denotes the operating frequency (in Megahertz) of the radio stations from above and **#yourFreq** the minimum frequency (in Megahertz) you wish to monitor. As an example: the command **FindEs JO01 JN35 91.7 143** analyses the Sporadic-E link established between JO01 and JN35 on 91.7 MHz and estimates whether the same Sporadic-E region may support Sporadic-E observations above 143 MHz from the user's home location.

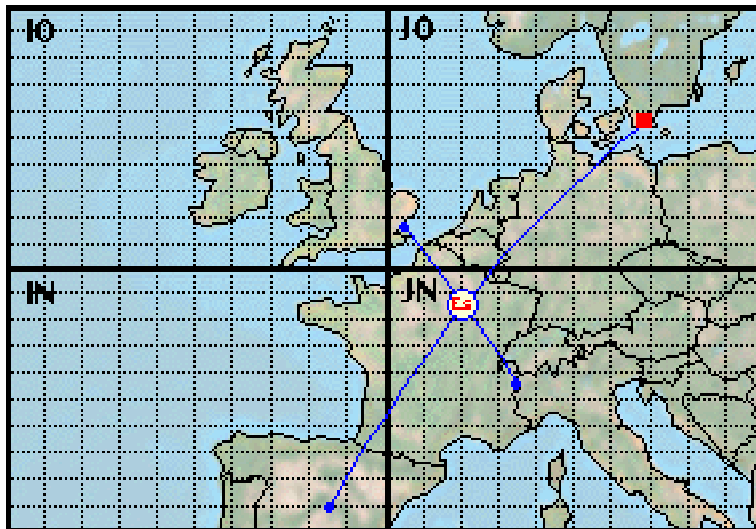
Interpreting the results

The Sporadic-E analyser provides numerical and geographical informations, see Figure 29 and Figure 30, respectively. The dialog in Figure 29 states the **critical frequency** as well as the **maximum usable frequency (MUF)** which both denote a geophysical quantity. The frequency relevant to the user is however the **operating frequency** which the user may monitor for possible Sporadic-E observations (± 200 kHz or so). The **Es position** calculates the grid locator corresponding to the Sporadic-E patch in the ionosphere. **Your target locator** finally estimates the position of a possible dx target which might be available in the current situation.

Figure 30 shows an example of the Sporadic-E analyser's plot results. Note the Sporadic-E link between JO01 (England) and JN35 (Italy) and the corresponding position of Sporadic-E in the ionosphere, see the "Es" bullet. The path between the south of Sweden (home location) and Spain denotes the Sporadic-E analyser's prediction. In the case the Sporadic-E analyser denies any Es observation from the user's home location no path is displayed on the screen map, of course. This may result from geographical reasons or, alternatively, from the frequency setting in the extended analysis described above.

Note: The Sporadic-E analyser assumes single hop propagation in all cases i.e. multiple-hop scenarios cannot be evaluated by the Sporadic-E analyser.

Figure 30 Plot results of the Sporadic-E analyser



Optimum usage of the Sporadic-E analyser

It is important to understand that no significant data is achieved if the user enters his personal Sporadic-E observations into the Sporadic-E analyser. On the other, applying Sporadic-E observations made by radio stations at a distance of many thousand kilometers also provides little informations in general because the corresponding Sporadic-E patch probably remains invisible below the user's local horizon i.e. the Sporadic-E cannot be accessed from the user's home location. Optimum conditions in Sporadic-E dxing are obtained if the Sporadic-E patch is viewed just above the local horizon because longest skip distances and highest operating frequencies are supported by this scenario.

Figure 31 Sporadic-E range circle for long distance communications

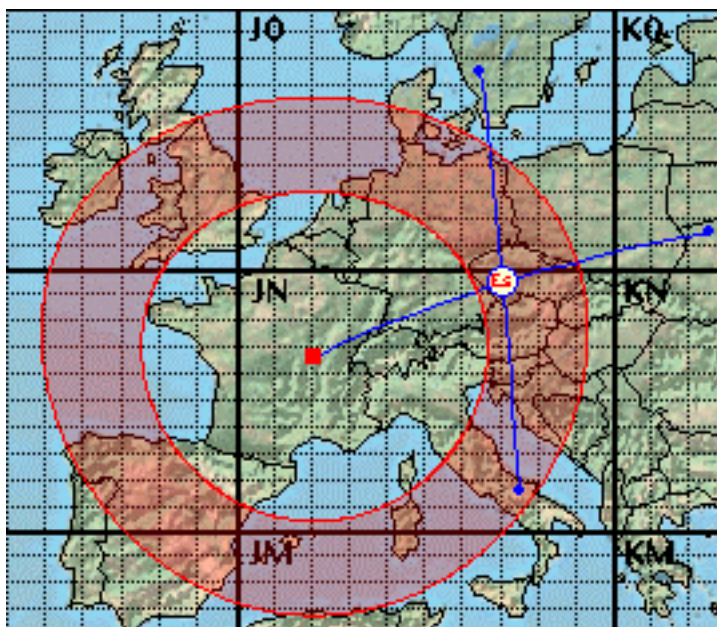


Figure 31 shows, as an example, the geographical ring area in which Sporadic-E clouds would appear between 0° and 5° elevation in respect to a radio station in central France. The Sporadic-E link between Sweden and Italy represents optimum data to the Sporadic-E analyser because of the geographical position of the Sporadic-E cloud which locates within the ring area, see the "Es" bullet in Figure 31.

Explore: Connect your computer to your favourite dx cluster in Packet radio or the internet to retrieve realtime Sporadic-E informations from the 10m-, 6m- and the 2m-band, respectively. Alternatively, you may refer to ham radio magazines providing Sporadic-E dx informations from the past to feed the Sporadic-E analyser with real observational data. Experiment with the data and explore which type of data is most useful in the hot phase of a Es-bandopening.

Summary

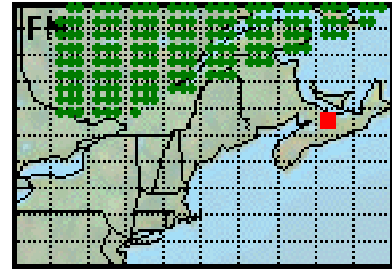
Table 19 Sporadic-E analyser

GUI	Menu	RadioProp
	Item	Sporadic-E analyser...
	Action	Enter data
BFCL		<ul style="list-style-type: none">• FindEs &fromSquare &toSquare – geographical analysis• FindEs &fromSquare &toSquare #opsFreq #your-Freq – extended analysis (geography and frequencies)

Hot spot analysis in Aurora/FAI propagation

Usage

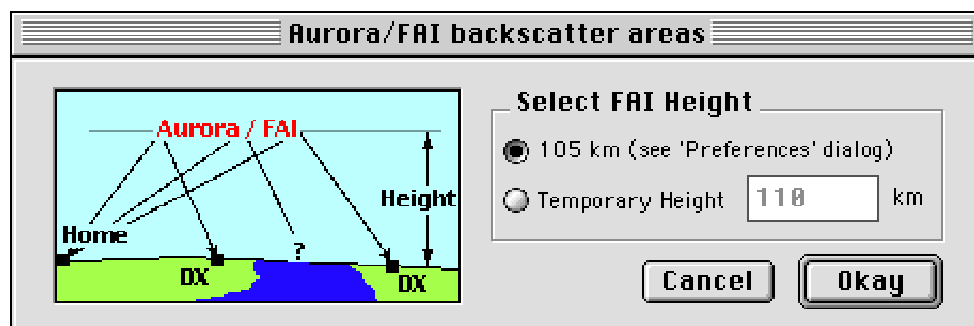
BeamFinder incorporates the model of backscattering of radio waves caused by irregularities in the E-layer which are oriented along the Earth magnetic field lines. This model can precisely describe the corresponding scatter geometry i.e. the geographical orientation of the transmitter and the receiver, respectively, in respect to the scatter volume and its local magnetic field lines. The following function calculates the regions in the ionosphere fulfilling the geometrical requirements for Aurora and FAI propagation.



Using the dialog

Select the **A/FAI hot spots...** item in the **RadioProp** menu to open the dialog displayed in Figure 32 in which the user specifies the height of backscattering.

Figure 32 Aurora/FAI-hot-spot dialog



In typical situations it is recommended to adopt the height setting of the preferences dialog i.e. by enabling the radio button **xxx km (see 'Preferences' dialog)** where xxx corresponds to the slider position in the preferences dialog, see Figure 43 in the paragraph "Preferences on page Fehler! Textmarke nicht definiert." of this manual. However, if the user wishes to consider any other height without affecting the preferences the **Temporary height** button may be used to enter an alternative value.

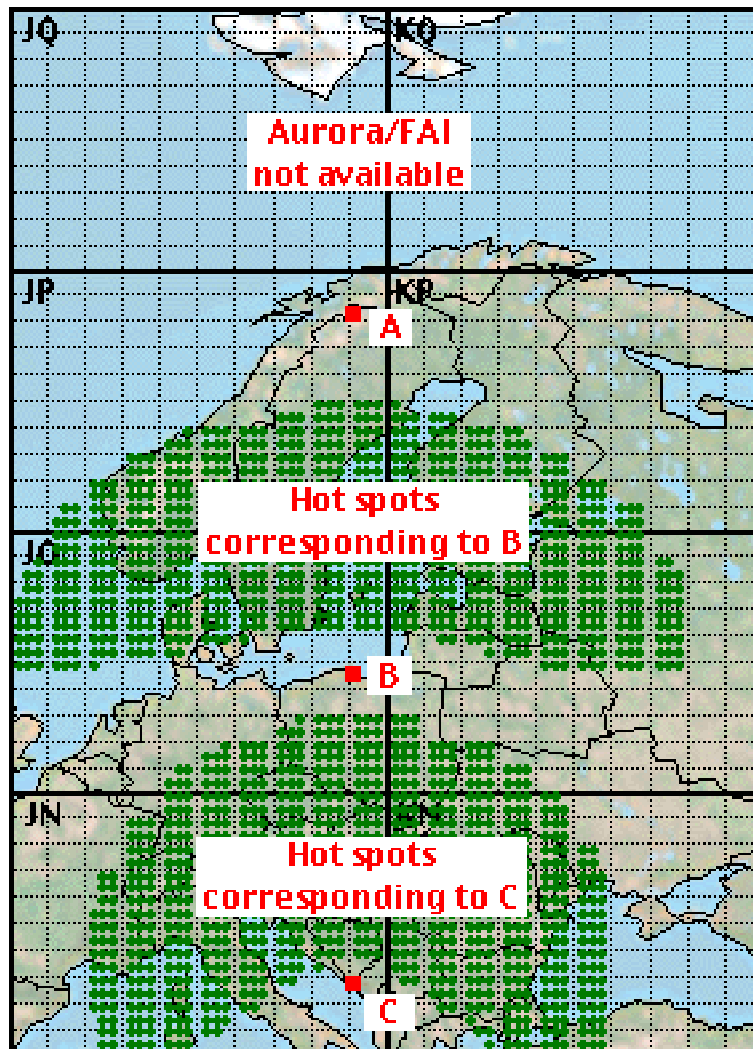
Using the command language

The following command may be used to launch the function from the Command Editor:

DrawFAISpots #height

where **#height** denotes the height of the scatter volumes in kilometers. As an example: the command **DrawFAISpots 105** calculates the regions in 105 km height where the scatter geometry is fulfilled in respect to the user's home location.

Figure 33 Aurora/FAI hot spots analysis



Interpreting the results

The radio operator in B and C, see Figure 33, may observe Aurora and FAI backscattering if field-aligned irregularities would exist in the corresponding green areas. Field-aligned irregularities may also exist outside of these areas, of course, but cannot be utilized because the backscattering would not meet the geometrical requirements. The green areas therefore identify E-layer regions suitable for Aurora and FAI propagation and may be called "hot spots" for this reason. Please note that no green areas exist corresponding to the location A i.e. Aurora backscattering is not available in the far north which is a consequence of too high geomagnetic inclination in high latitudes.

Summary

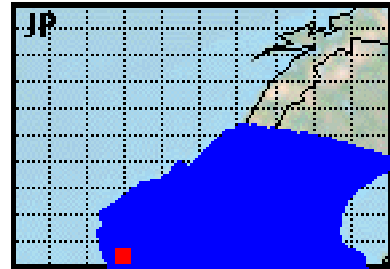
Table 20 Aurora/FAI hot spot analysis

GUI	Menu	RadioProp
	Item	A/FAI hot spots...
	Action	Enter data
BFCL		DrawFAISpots #height – calculates hot spots of Aurora and FAI backscattering

Dx target analysis in Aurora/FAI propagation

Usage

The function discussed in this paragraph is closely related to the “Hot spot analysis in Aurora/FAI propagation”, see page 65 of this manual. Based on the hot spot analysis BeamFinder may calculate the corresponding dx access area i.e. the geographical area in which dx stations may be expected when observing Aurora or FAI propagation.



Using the dialog

Select the **A/FAI dx targets...** item in the **RadioProp** menu to open the dialog similar to the one shown in Figure 32. Please refer to the discussion on page 65 of this manual to use the dialog.

Using the command language

The following command launches the dx analysis from the Command Editor:

DrawFAIDX #height

where **#height** denotes the height of the scatter volumes in kilometers. As an example: the command **DrawFAIDX 105** calculates the dx access region of Aurora/FAI corresponding to a height of 105 kilometers.

Interpreting the results

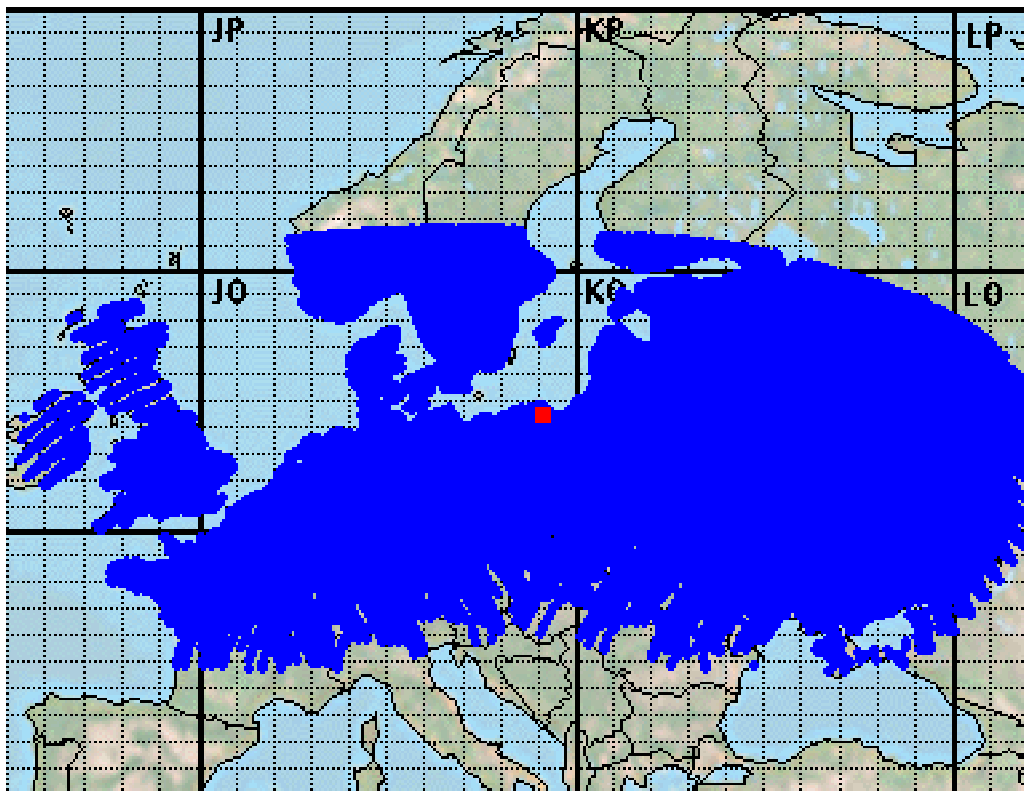
The results displayed in the

Figure 34 correspond to the location B discussed in Figure 33 of the hot spot analysis. The blue area indicates all the Aurora/FAI dx targets available to the radio operator at the baltic sea coast. Please note the sharp border in the north indicating the highest northern latitudes available for Aurora dxing. There is no such border in the south i.e. the availability of Aurora and FAI fades away resulting in an irregular pattern caused by BeamFinder's calculation method.

Note: Figure 33 and

Figure 34 provide different colors i.e. green and blue areas, respectively, because very different height levels are shown in both cases. The green areas in the hot spot analysis correspond to regions in the E-layer of the ionosphere, the blue area discussed in this paragraph corresponds, on the other hand, to geographical targets at ground level. Please refer to Figure 28 for more details.

Figure 34 Aurora/FAI dx target analysis



Summary

Table 21 Aurora/FAI dx targets

GUI	Menu	RadioProp
	Item	A/FAI dx targets...
	Action	Enter data
BFCL		DrawFAIDX #height – displays maximum dx access area in Aurora/FAI propagation

Aurora/FAI scatter curve

Usage

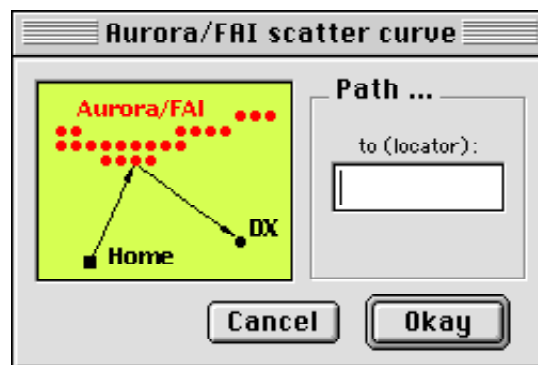
In FAI propagation tests the transmitting and receiving antenna must target an identical scatter volume, the test will probably fail otherwise. BeamFinder may calculate all the scatter volumes which are principally available in the test i.e. the program will calculate and display the so-called scatter curve. With this information appropriate antenna directions may be planned and scheduled very precisely.



Using the dialog

Select the **A/FAI scatter curve...** item in the **RadioProp** menu to open the dialog displayed in Figure 35. Enter the target grid locator of the station which participates in the test.

Figure 35 Scatter curve dialog



Using the mouse

The target location may also be defined by depressing the **⌘** - key on the keyboard and by clicking the desired location on the map of the world.

Using the command language

The following command launches the dx analysis from the Command Editor:

```
FAI &targetLoc
```

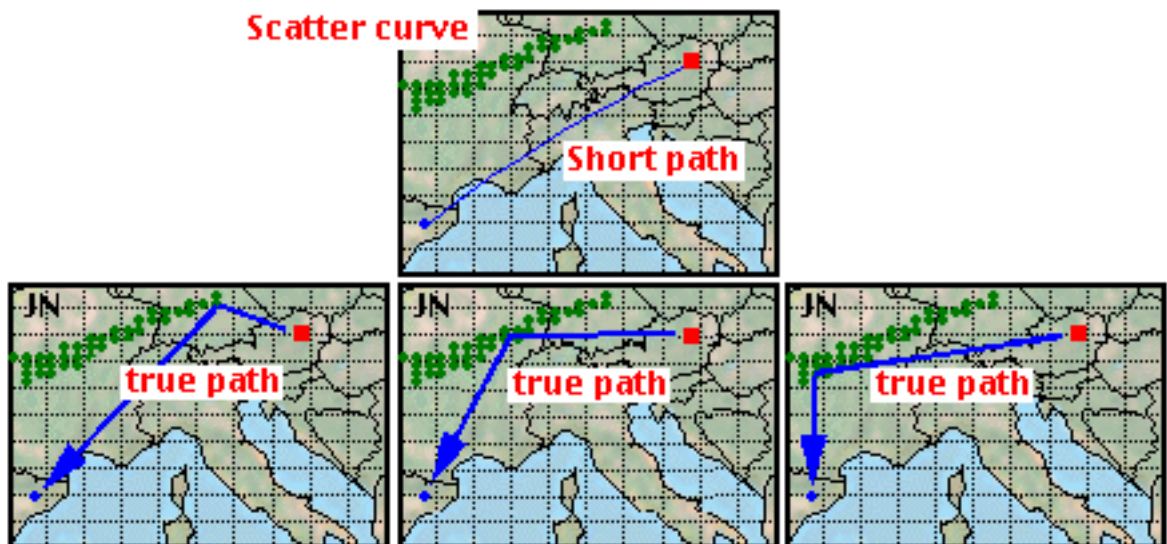
where **&targetLoc** denotes the target grid locator of the station participating in the test. As an example: the command **FAI IO64WR** draws the scatter curve corresponding to the grid square IO64WR and the user's home location. If the full grid locator is not available, its short form may be applied as an alternative i.e. **FAI IO64**.

Interpreting the results

The example in Figure 36 displays the scatter curve corresponding to a station in Vienna and another station in the northern part of Spain near Barcelona. The scatter curve is given in green color.

Note: The height of FAI backscattering is specified in the preferences, see **Fehler! Textmarke nicht definiert.** of this manual.

Figure 36 Aurora/FAI scatter curve



BeamFinder also calculates the short path between the two stations, however, in FAI backscatter geometry this path does not correspond to the true path of the radio waves. The true path of the radio waves is actually unknown to BeamFinder because the stations may align to different segments along the scatter curve, see the lower panel in Figure 36. Choosing one end of the scatter curve reduces the distance between one of the stations and the scatter volume and, at the same

time, extends the distance from the other station's perspective. Selecting the midpoint of the scatter curve might be a good compromise in practice.

Explore: Calculate the scatter curve corresponding to a station at a distance of approximately 1000 kilometers in respect to your home location. Enable the **Elevation data...** item in the **Display** menu, see the paragraph "Calculating elevation and line-of-sight data" on page 43 for more details. Make shure that the elevation data is calculated in accordance to the height setting in the preferences, see page **Fehler! Textmarke nicht definiert.** in this manual. Now, move the mouse cursor along the scatter curve and watch the elevation and line-of-sight data in the map header.

Summary

Table 22 Aurora/FAI scatter curve

GUI (dialog)	Menu	RadioProp
	Item	A/FAI scatter kurve...
	Action	Enter data
GUI (mouse)		Click desired location while depressing the ⌘ - key
BFCL		FAI &targetLoc – display scatter curve

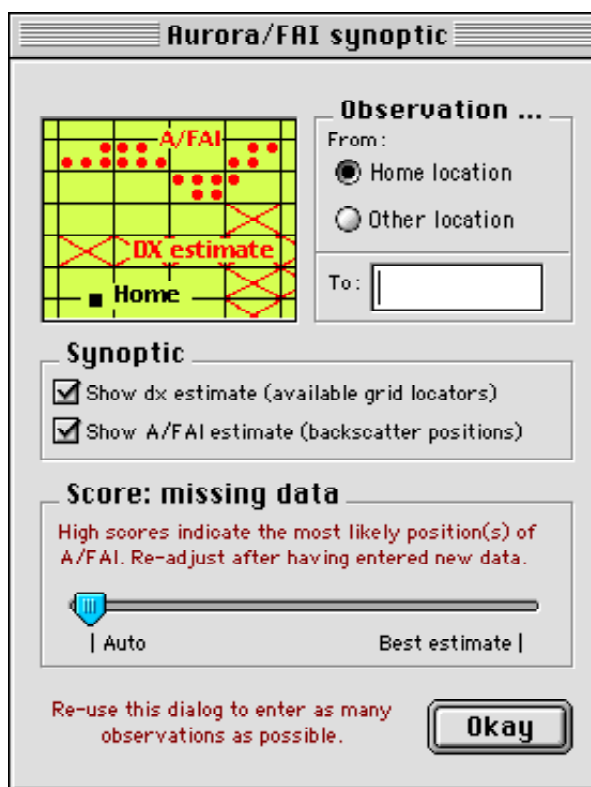
Aurora/FAI synoptics

Usage

Using the dialog



Figure 37 Scatter curve dialog



Using the command language

Summary

Table 23 Aurora/FAI synoptic

GUI (dialog)	Menu	RadioProp
	Item	A/FAI synoptic...
	Action	Enter data
GUI (mouse)		Click desired location while depressing the CTRL -key on the keyboard to define a scatter volume
BFCL		&targetLoc A - hlkjhlkj &targetLoc F - lkjöl

Bar chart analyses

Usage

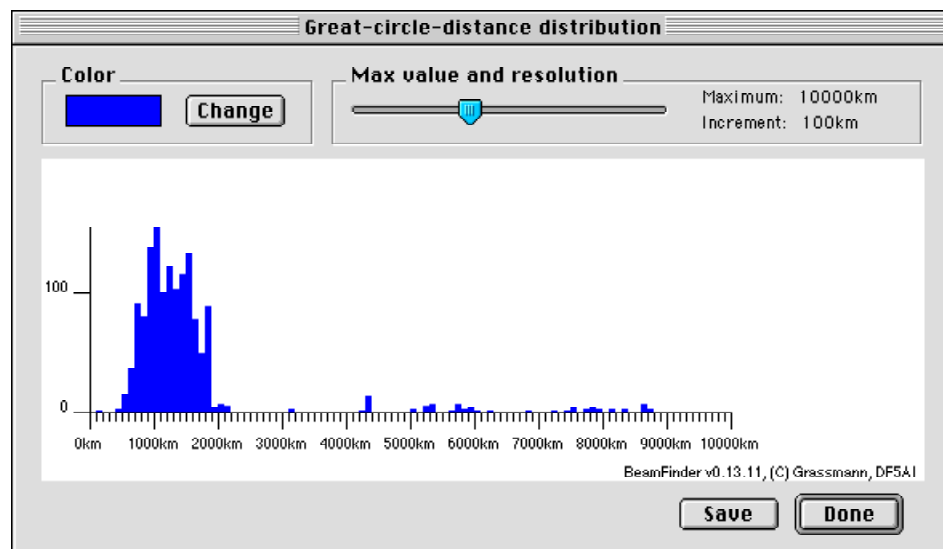
BeamFinder provides bar charts analysing the great-circle-distance and the azimuth corresponding to the data actually available in the Command Editor. This function is useful, as an example, if the user wishes to analyse the results of a contest or a bandopening. The azimuth bar chart is in particular useful when analysing dx data over a long period of time because the resulting profile may indicate the most effective antenna directions for dx purposes.

Drawing the chart

Select the **Distance bar chart...** or, alternatively, the **Azimuth bar chart...** in the **Functions** menu. The function loads the geographical data from the Command Editor and displays the result in a dialog, see Figure 38.

The color of the bar chart may be changed by pressing the **Change** button which opens the color selection box of the operation system. Drag the slider back and forth to adjust the horizontal scaling of the diagram.

Figure 38 Distance bar chart



Summary

Table 24 Bar chart analyses

GUI	Menu	Functions
	Item	<ul style="list-style-type: none">• Distance bar chart... – display distance bar chart• Azimuth bar chart... – displays azimuth bar chart
	Action	Adjust scale by using the slider
BFCL		n/a

Controlling BeamFinder

Introduction

BeamFinder provides versatile functions to manipulate data, graphics and to handle disk files. BeamFinder also enables the user to customize the appearance of the map of the world and its graphical objects.

With this chapter the user may apply the following features:

- Saving the current map display to harddisk,
- erasing existing drawings from the map of the world,
- saving data from the Command Editor to harddisk,
- loading data from harddisk into the Command Editor,
- erasing the data in the Command Editor,
- restarting the data in the Command Editor,
- changing the graphical appearance of the Maidenhead grid squares,
- changing the colors to be used with map drawings,
- changing the map orientation,
- selecting the appearance of the zoom control in the map window,
- tuning model parameters used by BeamFinder's calculations.

File functions

Usage

Any map display may be saved to harddisk by using BeamFinder's save map functions. The function creates a PICT file on the user's harddisk corresponding to the actual size of the map window.

Saving the map

Select the **Save map as...** item in the **File** menu to access the file selector dialog in which the user specifies the name and the location of the map file. As soon as a file name is available BeamFinder will also enable the **Save map** item in the **File** menu. This function overwrites the initial map file with a new copy of the map window display.

Summary

Table 25 Save file functions

GUI	Menu	File
	Item	<ul style="list-style-type: none"> • Save map – saves map using existing file name • Save map as... – saves map under another file name
	Action	Enter file name if required
BFCL		n/a

Clearing the map

Clear map

Select the **Clear map** item in the **Edit** menu to clear the map. The same function is obtained by pressing the **Clear** button in the map window. Enter

ClearMap

in the Command Editor to clear the map by using BeamFinder's Command Language.

Autoclear map

The user may instruct BeamFinder to clear previous drawings before placing any new objects on the screen map. To enable this function select the **Auto clear map** item in the **Edit** menu.

Summary

Table 26 Clear map

GUI	Menu	Edit
	Item	<ul style="list-style-type: none"> • Clear map – clears the map • Auto clear map – clears the map automatically before drawing any new object
	Action	Clear map: click item Auto clear: enable/disable item
BFCL	ClearMap – clears the screen map	

Controlling the Command Editor

Usage

BeamFinder is actually controlled by text commands which are stored and maintained by the Command Editor, see the paragraph “The Command Editor” on page 18 of this manual. The Command Editor window provides a list of the most recent commands processed by BeamFinder. This paragraph describes the methods the user may apply to manipulate the command list.

Loading commands from harddisk

Select the **Open data...** item in the **File** menu to load a text file from harddisk containing BeamFinder commands. BeamFinder loads the data and will immediately start processing the data.

However, before uploading the informations from harddisk BeamFinder may prompt the user if data already exists in the Command Editor, see Figure 39. Clicking the **No** button appends the file data to the existing informations, clicking the **Yes** button will erase existing data from memory i.e. the new data will overwrite the old data in the Command Editor.

Figure 39 Clear data dialog



Saving commands to harddisk

Select the **Save data as...** item in the **File** menu to save the command list to harddisk using the file name and location specified by the user. The **Save data** item in the **File** menu overrides the text file by using the file name from above.

Clear command list

To clear all data in the Command Editor select the **Clear command list** item in the **Edit** menu or, alternatively, press the Clear button in the Command Editor window.

Note: Clearing the command list does not affect the screen map. To clear the screen map apply the corresponding clear function described in paragraph “Clearing the map” on page 79 of this manual.

Restart all commands

The command list is actually a history file displaying the commands which have been recently processed by BeamFinder. However, the user may force the program to re-execute the commands in the same sequence they were initially entered. This function is useful if the user wishes to redraw the map with alternative styles and settings. To do so select the **Restart all commands** item in the **Edit** menu.

Summary

Table 27 Command editor functions

GUI (1)	Menu	File
	Item	<ul style="list-style-type: none"> • Open data... – opens data file • Save data – save data using an existing file name • Save data as... – save data using another file name
	Action	Enter file name if required
GUI (2)	Menu	Edit
	Item	<ul style="list-style-type: none"> • Clear command list – clears all data in the Command Editor • Restart command list – executes all commands from the beginning
	Action	Click item
BFCL		n/a

Preferences

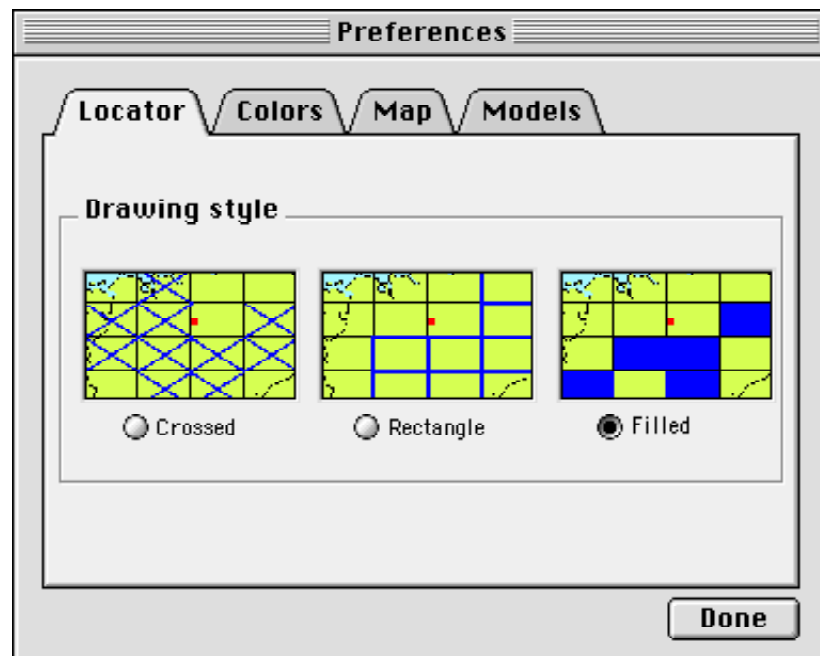
Usage

The preferences dialog enables the user to control the appearance of the drawings and graphics and to tune the parameters of the Aurora/FAI model of back-scattering. BeamFinder stores the user settings in the preference file in the system folder i.e. the data is restored on startup when launching BeamFinder the next time.

Setting preferences

The locator preferences controls the appearance of the grid squares when enabling the **Grid marker...** item in the **Edit** menu, see Figure 40. Please refer to page 31 of this manual where the grid marker function is explained in full detail.

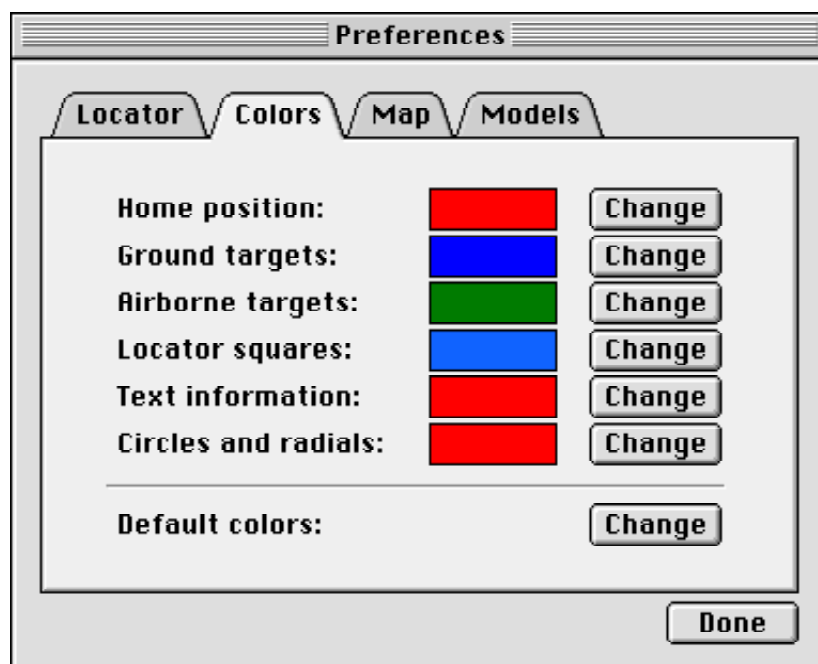
Figure 40 Locator preferences



BeamFinder's screen map considers six types of graphical objects with individual color settings, see Figure 41.

- Home position denotes the square which indicates the user's home location on the map of the world.
- Ground targets denotes positions on the surface of the Earth including the path of radio waves and dx access areas.
- Airborne targets correspond, as an example, to hot spots in the ionosphere or to any other non-ground based objects.
- Locator squares correspond to the Maidenhead grid squares.
- Text information denotes text labels, legends and map titles.
- Circles and radials correspond to range circles, radials and the windrose when drawing beamer maps.

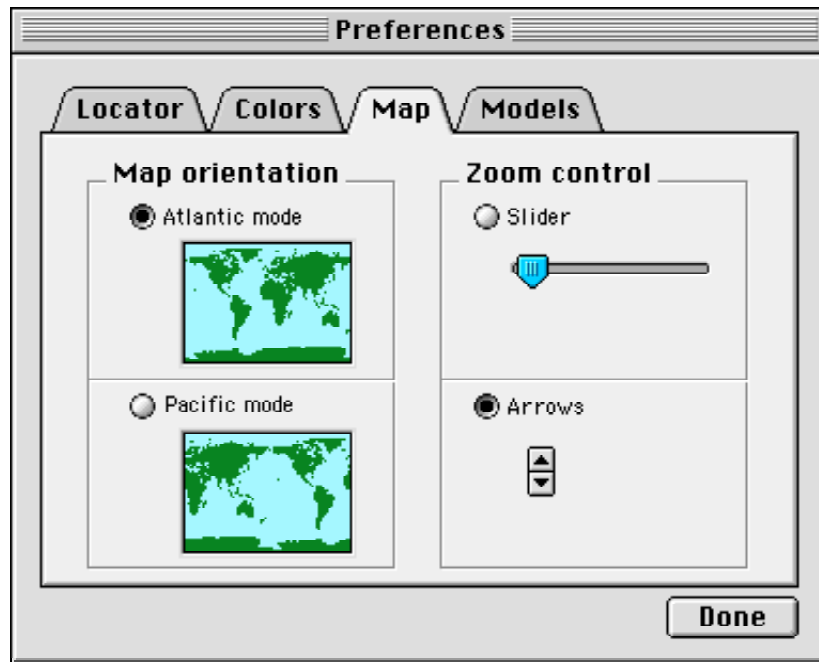
Figure 41 Color preferences



The map of the world provides two orientations i.e. the **Atlantic mode** and the **Pacific mode**, respectively. The Atlantic mode is advantageous to users e.g. in Europe and Africa. The Pacific mode, on the other hand, is most suitable for users located e.g. at the west coast of North and South America, in the Far East, in Australia and New Zealand, respectively.

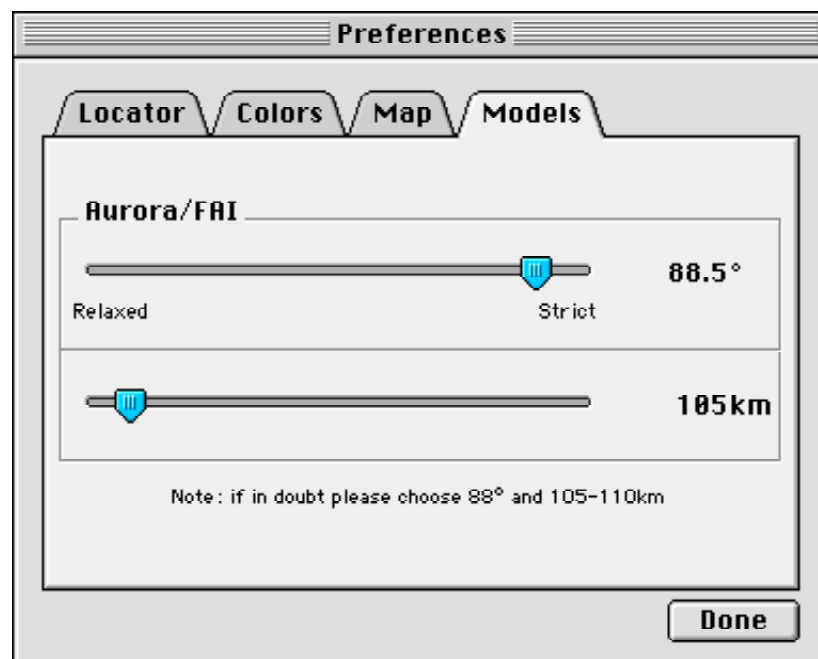
The map orientation may be changed at any time by using the dialog displayed in Figure 42 i.e. existing drawings on the map of the world are not affected when switching from one mode to the other.

Figure 42 Map preferences



The map preferences also enables the user to change the type of zoom controls in the header area of the map window, see Figure 4 on page 16 of this manual.

Figure 43 Model preferences



BeamFinder incorporates a sophisticated model of Aurora and FAI backscattering of radio waves in the ionosphere. There are two important parameters in this model i.e. the angle between the Earth magnetic field line and the difference of the k-vectors in the vicinity of the scatter volume and, on the other hand, the height of the scatter volume above ground level. The corresponding values may be changed by dragging the sliders displayed in Figure 43.

Note: Changing the model parameters is not recommended if the user is not familiar with Booker's model of backscattering, see the References in the Appendix of this manual.

Summary

Table 28 Preferences

GUI	Menu	Edit
	Item	Preferences...
	Action	Select one of the following <ul style="list-style-type: none"> • Locator – grid squares preferences • Colors – color preferences • Map – map preferences • Models – model parameter
BFCL		n/a

Scripts and AppleEvents

Introduction

The user may control BeamFinder manually by using its graphical user interface or, alternatively, automatically by using BeamFinder scripts and Apple Events.

Using scripts in BeamFinder

Usage

In this manual BeamFinder commands have already been discussed as an alternative method of entering data i.e. typing a command into the Command Editor is fully equivalent to the usage of the graphical user interface which involves menus, dialogs, buttons and other types of controls. However, the primary focus of the BeamFinder Command Language (BFCL) is advanced data processing by using scripts i.e. text files including statements compatible to the syntax of the BeamFinder Command Language. BeamFinder's capabilities are in fact significantly enhanced by using scripts, see the following list of possible applications.

Table 29 Applications using BeamFinder scripts

Automated program control	<ul style="list-style-type: none"> - launching recurring analyses without typing data manually - recovering standard displays e.g. user defined beamer maps, range circles etc. - generating configuration files specific to Sporadic-E, Aurora or any other dx situation
Data processing	<ul style="list-style-type: none"> - uploading large data volumes for analysis purposes - generating dx reports including observational data from many operators - comparing observational data on a worldwide scale - plotting the geographical locations of stations and operators the user considers important - plotting the geographical distribution of radio beacons e.g. on 2m, 6m, shortwave or any other frequency band - plotting other types of dx indicators e.g. VOR data
Linking external applications	<ul style="list-style-type: none"> - importing informations from databases and spread sheets e.g. electronic logbooks and station lists - enabling alternative applications to adopt BeamFinder's graphical capabilities e.g. programs retrieving dx cluster informations from the internet
Archiving and exchanging materials	<ul style="list-style-type: none"> - retrieving useful analyses and displays - creating the user's library of important dx events - creating a worldwide dx database in the internet - exchanging observational data between operators - exchanging experimental data e.g. FAI scatter curves - submitting dx reports to ham radio magazines - generating figures and displays in publications and articles

Creating BeamFinder scripts

Creating BeamFinder scripts is a very simple procedure:

- Launch an empty file in your preferred text editor e.g. the SimpleText editor which is part of the Macintosh standard installation,
- enter BeamFinder commands and its accompanying parameters line by line i.e. you may not queue commands in a single line,
- save the file to harddisk, make sure that the text format is selected if the editor considers different types of file formats,
- choose the **Open data...** item in the **File** menu to launch the script, see the paragraph “Controlling the Command Editor” on page 80 of this manual for more details.

Placing comments in the script file

Any line starting with the / character (slash) is considered a comment by BeamFinder. Comments do not have any effect and may therefore be used for documentary purposes.

As an example: the line

/ this is a comment

represents a comment line which may be placed anywhere in the script file.

Sample script

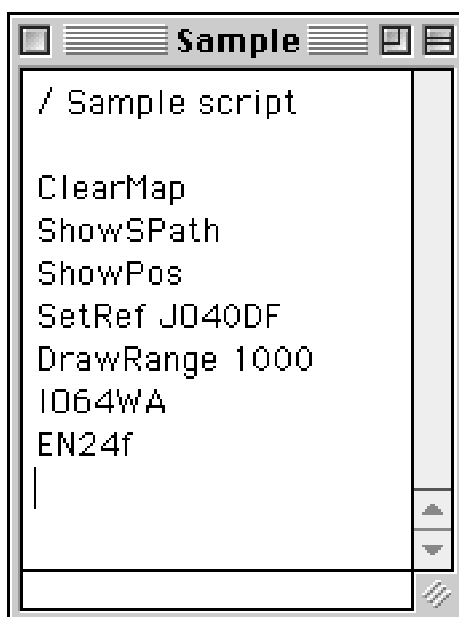
Figure 44 demonstrates a simple example of BeamFinder scripts which is explained line by line for educational purposes:

/ Sample script (empty line)	this is a comment, see the paragraph above empty lines may be included anywhere in the script file, empty lines do not have any effect on the code execution of the script
ClearMap	erases any existing drawings on the map of the world, please refer to the paragraph “Clearing the map” on page 79 of this manual
ShowSPath	enables short path analyses, see the para- graph “Enabling and disabling short path cal- culations” on page 30 of this manual
ShowPos	enables the target marker function of Beam- Finder, see the paragraph “Entering geo- graphical data and targets” on page 26 of this manual
SetRef JO40DF	defines the Maidenhead grid square JO40DF as the user’s home location, see the para-

DrawRange 1000	graph “Setting the user’s home location” on page 23 of this manual draws a range circle of a diameter of 1000 km, see the paragraph “Range circles and radials” on page 34 of this manual
IO64WA	draws the path of radio waves to the target grid square IO64WA, see again the paragraph “Entering geographical data and targets” on page 26 of this manual
EN24f	draws the path of radio waves to the target locator EN24f, note that this grid square corresponds to the locator system preceding the nowadays Maidenhead system, see the paragraph “Using the European grid locator” in the Appendix of this manual

Please note that BeamFinder scripts are easy to read once the user is familiar with the BeamFinder Command Language. The user is advised to study and to run the example scripts available in the **BF Examples** folder of the BeamFinder directory.

Figure 44 Sample script



```
/ Sample script  
ClearMap  
ShowSPath  
ShowPos  
SetRef J040DF  
DrawRange 1000  
IO64WA  
EN24f  
|
```

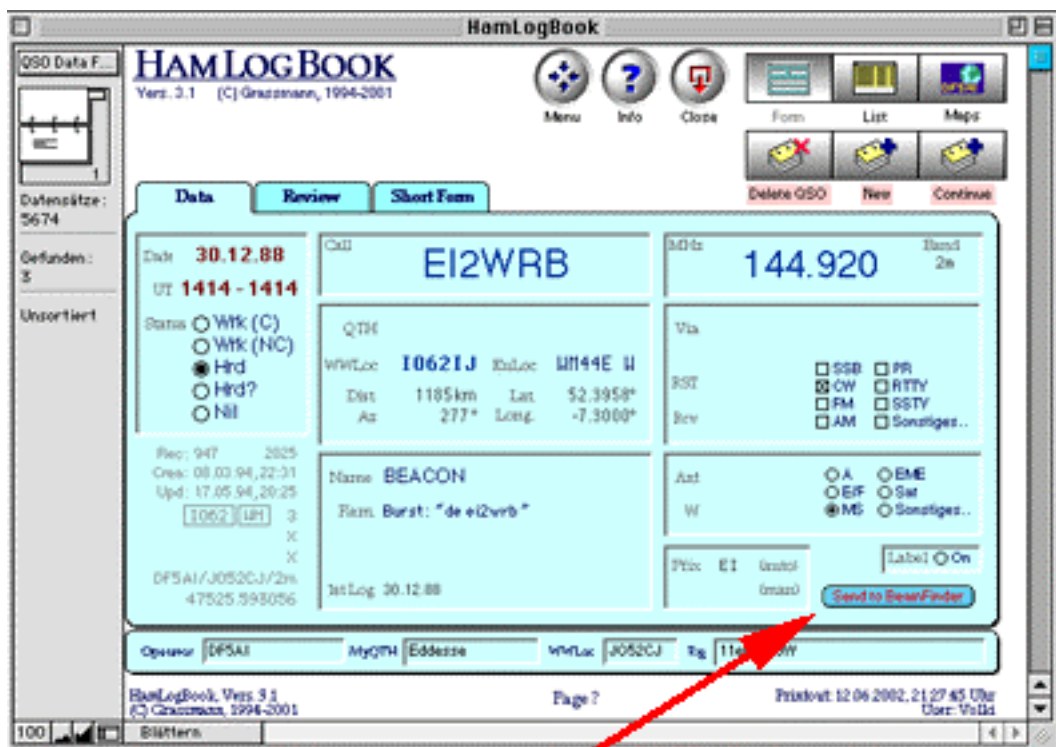
Using Apple Events

Usage

Apple Events are system-level commands sent between applications on Apple Macintosh computers. This powerful feature is also available with BeamFinder i.e. the BeamFinder application may receive BFCL commands from any other Macintosh application.

Figure 45 shows the example of an electronic logbook designed with the FileMaker Pro database. Pressing the Apple Event button in the database tells BeamFinder to draw the corresponding path of radio waves i.e. the radio operator may update BeamFinder's screen map by using the controls of the FileMaker database.

Figure 45 Example of a logbook database



Apple Event button

Event class and Event ID

BeamFinder accepts the Event class

aevt

in conjunction with the Event ID

Bfdr or **quit**.

The Event ID **Bfdr** transfers a BFCL command as a string parameter, the Event ID **quit** may be used to shut down BeamFinder.

Configuring FileMaker Pro databases

In order to discuss the implementation of Apple Events in more detail a Filemaker Pro database is used as a sample project. The database may represent, as an example, a logbook database feeding the BeamFinder application with actual grid square informations by using Apple Events.

Note: Instead of using Apple Events the user may also decide to apply BeamFinder's scripting capabilities by exporting grid square informations from the database into a text file which BeamFinder may upload.

It is good practice in database programming to consider a separate data field in the following in order not to affect any original items in the database. The data field **Command** is therefore assumed available in the database maintaining the BFCL command to be send to BeamFinder. The BeamFinder command must, of course, correspond to a legal statement in accordance to the syntax of the BeamFinder Command Language. The data field **Command** may therefore maintain text strings such as **IO64WA**, **FAI JN49**, **JN18 A** or any other BFCL command.

Note: The **FAI** command is described in the paragraph "Aurora/FAI scatter curve" on page 70 of this manual. The **A**-suffix is described in the paragraph "Aurora/FAI synoptics" on page 73 of this manual.

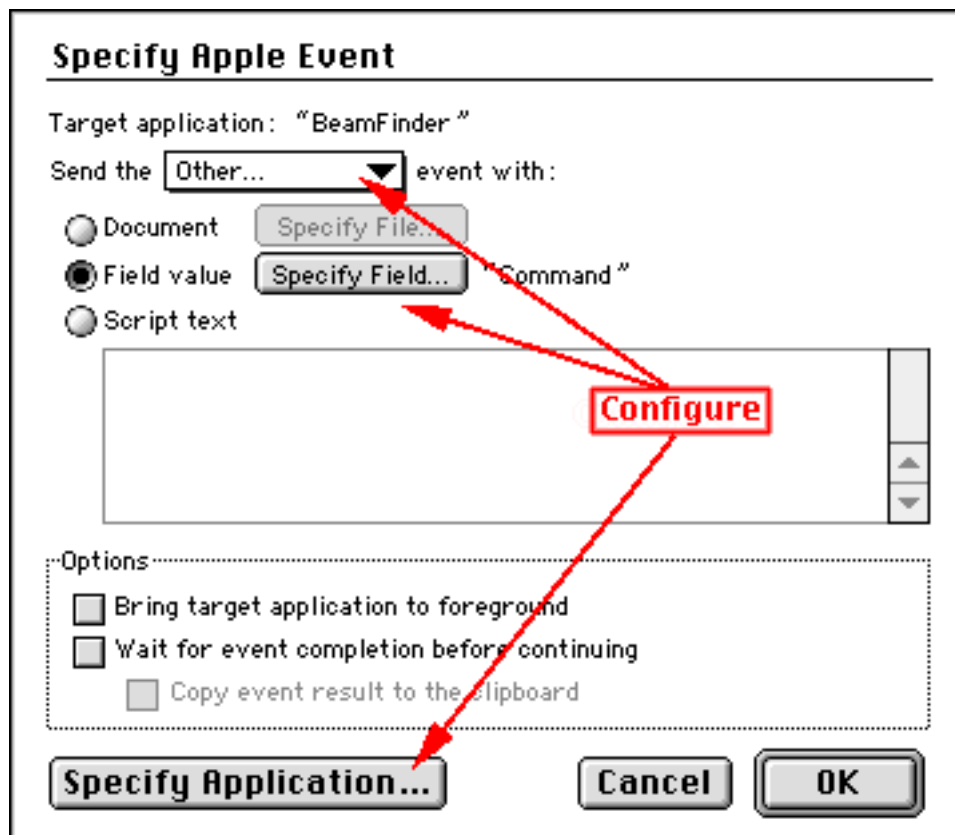
Step 1: Allocate an empty FileMaker Pro skript within the FileMaker pro application. Name the script "Launch BF command" or any use any other preferred name.

Step 2: FileMaker Pro opens the dialog displayed in Figure 46. Select **Send Apple Event [...]** in the list on the left hand side of the dialog to define a new script command in FileMaker Pro. Doing so the **Send Apple Event [...]** becomes available on the right hand of the dialog too. Double click that command to define its parameters.

Figure 46 FileMaker Pro script using Apple Events



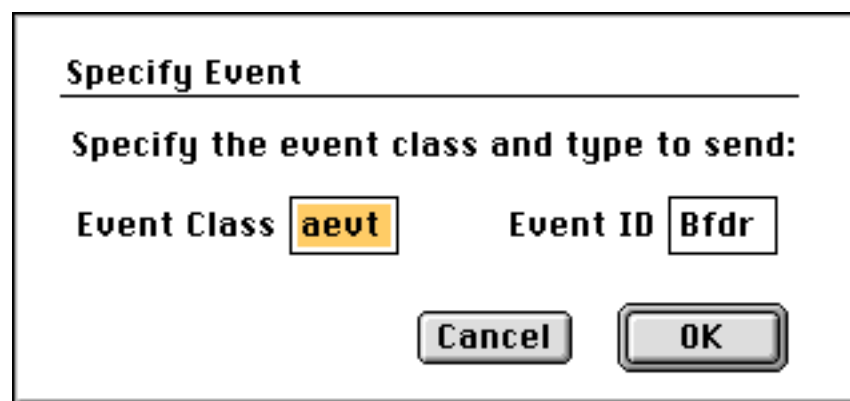
Figure 47 Specify Apple Events in the Filemaker Pro (1)



Step 3: FileMaker Pro opens another dialog, see Figure 47, where you must specify the Apple Event parameters. Press the **Specify Application ...** button to select the BeamFinder application as target application. Click the radio button **Field value** and, finally the button **Specify field** to select the **Command** field we have initially discussed.

Step 4: Select the **Send Other... event with** item to open the dialog shown in Figure 48. Enter the Event Class and the Event ID as shown in the figure.

Figure 48 Specify Apple Events in the Filemaker Pro (2)



Note: The user is requested to consult the Filemaker Pro documentation for more details on the design of FileMaker scripts

Whenever the FileMaker Pro script is launched the database will send the actual content of the **Command** field to the BeamFinder application.

Appendix

Device identifier

The device identifier indicates the input device from which an incoming command originates. The device identifier may be displayed in the Command Editor window when enabling the **Inputs** checkbox.

Table 30 Device identifiers

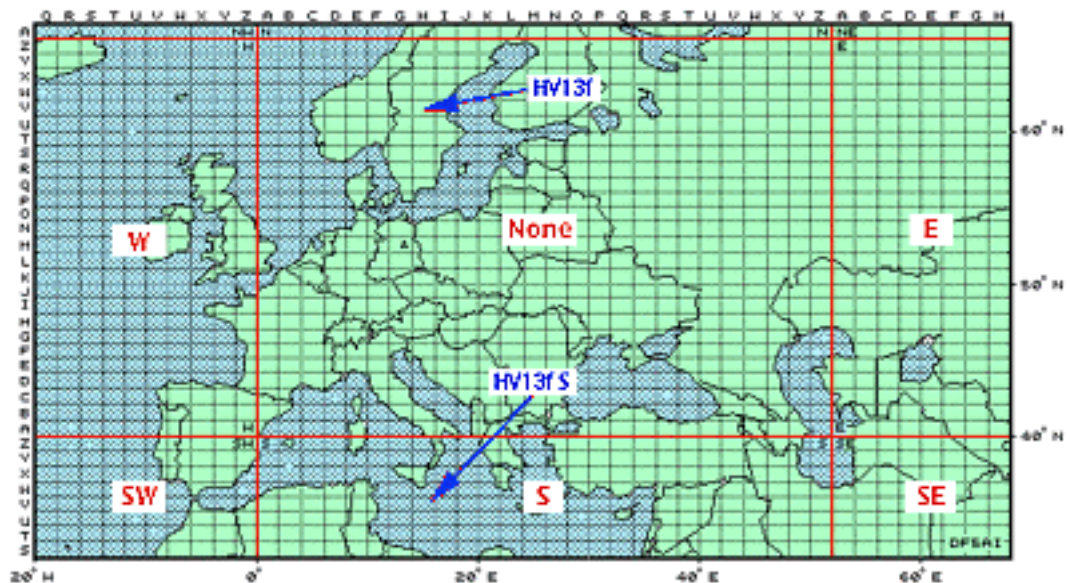
Input device	Identifier
Internal	--
Mouse	MS
Menu	MN
Keyboard	KY
Harddisk file	FI
Apple Event	AE

Using the European grid locator

European grid system

In the 1980s the Maidenhead system was introduced by the International Amateur Radio Union (IARU) Region 1 Conference to replace the previous system which was used by European radio amateurs for many years. In fact, there was a need for a global system which does not involve any ambiguities resulting in the same grid code for different geographical locations. The grid locator **HV13f**, as an example, corresponds to a place in Sweden and also to the island of Malta in the Mediterranean Sea.

Figure 49 Extensions to the European grid locator system



Grid extensions introduced by the QTH_LOC program

The existence of ambiguous grid locators was in particular a problem to the early home and personal computers used by radio amateurs to calculate geographical distances and antenna headings. It was therefore also a problem to BeamFinder's predecessor i.e. the QTH_LOC program which was introduced in the 1980s, see QTH_LOC's screen map of Europe in Figure 49.

The European grid system comprises 676 grid squares ranging from the AA-square at the west coast of Spain to the ZZ-square in the north-eastern part of the former USSR. The same set of 676 grid squares is repeated outside of central Europe resulting in a total number of nine sets indicated by the red frames in Figure 49 (note that the sets adjacent to central Europe are only partly visible in this map).

In the central European area the QTH_LOC program considers the grid code "as it is" e.g. **HV13f** corresponding to the grid square in Sweden. However, when specifying a grid locator outside of central Europe a suffix is required i.e. "N", "NE", "E", "SE", "S", "SW", "W" and "NW" corresponding to the directions north, north-east, east and so on. As an example: the island of Malta now corresponds to **HV13f S**, see Figure 49.

Using the European grid system in BeamFinder

The European grid system may be used in the BeamFinder Command Language whenever a Maidenhead grid locator is also applicable. However, the European grid system is not available in the dialog boxes of the graphical user interface.

Note: You may apply the European grid system when entering data in the Command Editor or when editing a text file to be uploaded from harddisk. You cannot apply European grid squares when using the dialog boxes from the pulldown menu.

BeamFinder applies identifiers which are identical to the arrangement in QTH_LOC, however, the @-character is required to separate the grid code and its suffix e.g. **HV13f@S**.

European grid locators may be entered in its full five-digit code or, alternatively, in its short form providing only two characters. As an example: the formats **HV** and **HV@S** are both accepted by BeamFinder.

References

Langverzögerte Radioechos, Beobachtungen und Deutungen
Grassmann, V., UKW-Berichte 3/92, S. 163-169

Ein Verfahren zur Ortsbestimmung von erdmagnetfeld-parallelen Irregularitäten in der E-Region

Grassmann, V., Kleinheubacher Berichte, Band Nr. 35, S. 123-134, FTZ Darmstadt, 1992

Die Beobachtung des Mehrton-Effektes

Grassmann, V., UKW-Berichte 3/91, S. 175-178

Incoherent-Scatter: Grundlagen und Anwendungen

Grassmann, V., UKW-Berichte 3/91, S. 170-174

Long delayed echoes

Grassmann, V., URSI-News, 1990

QTH-LOC: Funkstrecken am Computer

Grassmann, V., Dubus, 1, S. 37-39, 1990

Zum Dopplereffekt bei Aurora-Verbindungen

Grassmann, V., Dubus, 3, S. 59-61, 1989

Ein einfaches Modell zur Identifizierung von Sporadisch-E

Grassmann, V., Dubus, 2, S. 128-132, 1988

Amadeus - Satelliten-Bahnverfolgung de Luxe

Grassmann, V., Beam, 5, S. 32-34, 1988

Gibt es einen FAI-Scatterer über Budapest?

Grassmann, V., Dubus, 1, S. 21-23, 1988

Aurora - Ein Computerprogramm zur Analyse von Aurora- und FAI Rückstreuungen

Grassmann, V., Dubus, 1, S. 18-21, 1988

Long delayed echoes on EME-circuits

Grassmann, V., Dubus, 3, S. 244-245, 1987

Rückstreuungen ultrakurzer Wellen an Feldlinien-orientierten Irregularitäten

Grassmann, V., Dubus, 3, S. 182-189, 1987

Vorhersage der Schaueraktivität bei Meteor-Scatter-Verbindungen

Grassmann, V., Dubus, 2, S. 169-170, 1986

Verschlechterung des Signal/Rauschverhältnisses durch Drehung der Polarisationssebene

Grassmann, V., Dubus, 2, S. 155-156, 1986

Der Mehrton-Effekt

Grassmann, V., Dubus, 1, S. 89-90, 1986

A scattering theory of VHF transequatorial propagation

Ferguson, J. A., Booker, H. G., Journal of Atmospheric and Terrestrial Physics, Vol. 45, No. 8/9, pp. 641-657, 1983

Ionospheric Scatter by Field-Aligned Irregularities at 144 MHz

Kneisel, T. F., K4GFG, QST, 1982

IARU Region 1 locator

Rasvall, F., Dubus, 3, S. 174-177, 1980

Die Untersuchung von Irregularitäten in der F-Schicht der äquatorialen Ionosphäre mit Hilfe der transäquatorialen Kurzwellenausbreitung

Röttger, J., Dissertation, Universität Göttingen, 1974

Analyse von Rückstreubeobachtungen ultrakurzer Wellen an Polarlichtern

Czechowsky, P., Diplomarbeit, Max-Planck-Institut für Aeronomie, 1966

Quick reference chart

SetRef	
New target location	
DrawPath	
> operator	
SetRange	
SetRadial	
Remarks (! operator)	
ClearMap	
ClearData	
SetTitle	
ShowPos	
HidePos	
ShowSPath	
HideSPath	
ShowLPath	
HideLPath	
ShowLoc	
HideLoc	
ShowAnt	
HideAnt	
ShowHops	
HideHops	
DrawVisRange	
DrawLayer	
CheckEs	
FAI	
A suffix	

Abbildung 1. Reference table of BeamFinder commands and its cooresponding pulldown-menus.