

Field-Map

SOFTWARE



HARDWARE

CATALOGUE

Field-Map is a product of IFER - Monitoring and Mapping Solutions, Ltd.

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What is Field-Map

Field-Map is a system for computer aided field data collection with primary emphasis to forestry.

It is a highly flexible system. Its use starts from the level of single tree measurement, through the level of research or inventory plot, up to the landscape level. Field-Map has been designed primarily for the purposes of forest inventory but it has functionality for a number of different field data collection tasks like forestry mapping,

attributing forest stands for forest management planning, carbon offset monitoring, landscape mapping, standing volume assessment, measurement of research plots, inventory and monitoring of nature reserves, etc.

Field-Map product line combines flexible real-time GIS software with electronic equipment for mapping and dendrometric measurement.



Field-Map system has been originally developed for the purpose of the national forest inventories. Currently it is the only software and hardware solution that is being used in numerous national forest inventories (NFIs).

The idea behind Field-Map for NFIs is a continuous development of the software product, which is flexible enough to cover all requirements of various NFI methodologies. Such a solution is significantly more efficient than costly development and maintenance of a specific solution in individual countries.

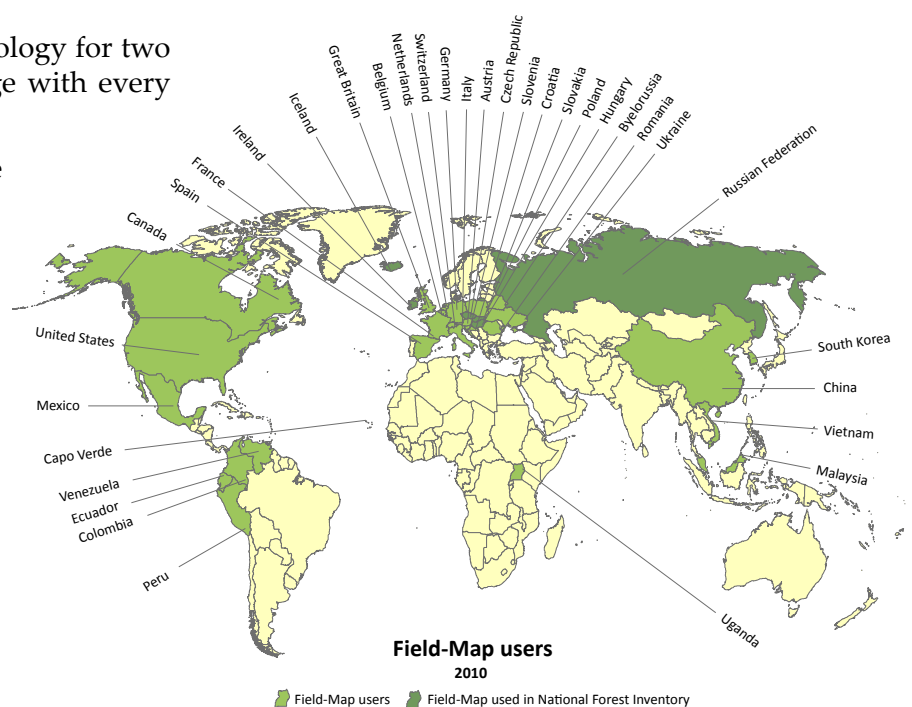
Another very important aspect of Field-Map is the support of multiple field teams. The largest project is represented by the National Forest Inventory of Russian Federation with nearly 300 field teams.

Practical information

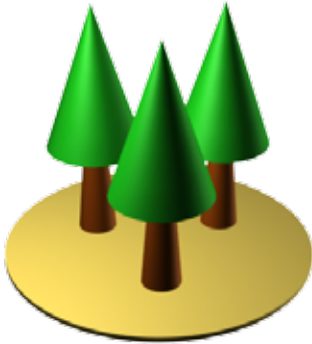
Training of the Field-Map technology for two forest engineers is free of charge with every purchase of Field-Map bundle.

New versions of the software are released every year. One year of free technical support including software upgrades is provided with every Field-Map bundle license. Software updates and demo versions can be downloaded from the web pages www.field-map.com.

Technical support using hot line via e-mail, phone or fax is available to Field-Map customers. The guarantee period for the software is two years, for the hardware part is one year.







Field-Map technology description

Flexible database structure

Field data collection projects such as forestry monitoring, measuring and mapping are based on well defined methodology of field observations. In order to fulfill various requirements of a particular field data collection project Field-Map provides a number of elements that enable complete adjustment of field database. Some features (e.g. special attribute types or multi-plot approach) are specific for Field-Map and qualify it for a wide range of different data collection projects up to the most complex ones e.g. national forest inventory projects commonly containing hundreds of attributes in tens or even hundreds of tables.

- User-defined database structure: user-defined data collection methodology = database structure = Field-Map project. Field-Map project also contains metadata describing the structure and content of the database.
- Relational hierarchical database = multiple layers arranged in tree-like database structure supporting one-to-many, one-to-one and many-to-one relationships
- Multiple layers in each Field-Map project, multiple attributes for each layer
- Various attribute types (numeric, alphanumeric, memo, logical, date, time,

picture/photo, video, voice memo)

- Attributes with lookup list for easy and error-free input of data particularly useful for keyboard-less field computers (usually about 80% of attribute values are entered using lookup lists)
- Advanced attributing (height, diameter, counter, line length, lookup lists, conditional lookup lists, quick switch on/off of lookup list items, default values)
- Multi-plot approach

Multiple plots/sites = multiple implementation of the methodology for number of plots/sites

Multiple plots in single database (e.g. thousands of plots of a forestry monitoring project)

Easy management of multi-plot and multi-team projects

- Any-time database structure customization without losing existing data
- Industry-standard data formats used for data storage (ArcView shapefiles for map entities, Paradox, MS Access or MSSQL for attributes)

Support for measurement devices

Field-Map is based on efficient use of electronic or traditional measurement devices such as laser range-finder, electronic compass, GPS or electronic caliper. Field-Map natural and easy combination of measurement devices with the data storage and computing facilities of field computer enables user to obtain maximum effect from the technology.

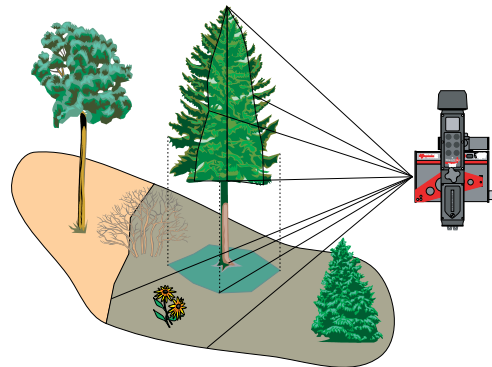


Typical hardware components of Field-Map set includes laser rangefinder and electronic inclinometer, electronic compass, field computer, GPS receiver and electronic calliper (last two not shown in the picture)

Field-Map supports a broad range of electronic measurement devices. The main equipment, which is usually the most important for forestry mapping and measurement is a combination of laser rangefinder + electronic inclinometer + electronic compass (RIC). Field-Map fully exploits the potential of RIC to measure distances and vertical and horizontal angles for three-dimensional mapping of forest structure.

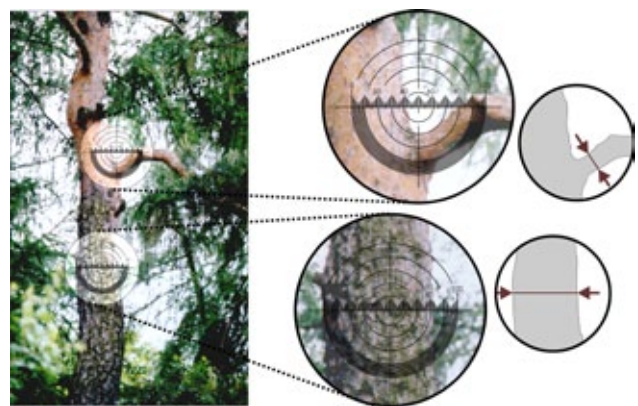
GPS is used by Field-Map both for navigation and mapping. A combined use of GPS and RIC as managed by Field-Map software enables to solve mapping, navigation and measurement tasks in

forestry conditions, i.e., under the canopy where GPS commonly does not work well.



Typical use of the laser rangefinder + electronic inclinometer + electronic compass for forestry – mapping, tree height measurement, upper tree diameter measurement, stem profile measurement, crown projection mapping, crown profile delineation

Field-Map is the only software product which fully supports optical scope for remote diameter measurement. Using optical scope mounted on laser range-finder allows measuring tree diameter at any height. Field-Map supports measurement of single diameters and also measurement of whole stem profiles.



Measurement of upper stem diameter and branch diameter.

Additional supported equipment such as electronic calipers for tree diameter measurement or geodetic equipment such as LTI angle encoder or Leica or Sokkia tachymeters might be used.

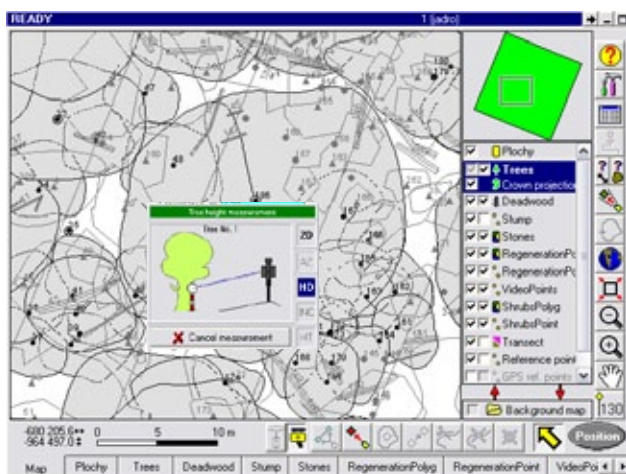
Field-Map can be used on PC compatible computers (MS Windows 95, 98, 2000, XP, Vista, 7), no extra hardware parameters are required. Field-Map requirements do not exceed the requirements of the MS Windows OS itself.

Import/export functionality

Field-Map has been specifically developed for keyboardless field computers that are operated by pen. It can be also used on computers with monochromatic displays. In order to support real-time communication with measurement devices, field computer needs to provide Field-Map with at least one serial port (RS232, USB or Bluetooth).

Field-Map communication with external measurement devices is based on standard NMEA0183 protocol and in some cases (Leica and Sokkia tachymeters) on specific protocols. That means that Field-Map can support a broad range of different products, i.e. virtually any GPS on the market.

Field-Map settings provide user-friendly tools for connecting measurement devices. User-friendly approach to the use of measurement devices is further emphasized by the Measurement Assistant, which provides user with online animated help during measurement process.



Field-Map Measurement Assistant provides real-time help during field measurement

Field-Map benefits from the use of electronic measurement devices but it can also be used in conjunction with traditional measurement devices such as mechanical compasses, measurement tapes, hypsometers etc. In such a case the readings from the devices are entered to the computer by the operator.

Field-Map technology is often implemented into ongoing projects where large sets of data have already been collected. At the same time Field-Map usually represents a part of the overall technological solution and must be able to exchange data with other software solutions. Field-Map also provides multi-team support, i.e. ability of maintaining distributed database in a number of field computers operated by several field teams. Field-Map has the necessary functionality for those tasks.

Both mapping entities and attributes can be imported from existing databases with old measurements. An efficient wizard supports import of mapping entities (points, lines, polygons) with attached attributes from a number of different formats (ArcView Shapefiles, Digital exchange format dxf, Microstation design file dgn, Autocad drawing database dwg, ArcInfo Coverage). Specific Field-Map tools are available for pre-processing of mapping data, which are stored in database tables.

Another wizard is available for importing attribute information. Data of single tables or even sets of tables can be imported from different formats (MS Access, MS Excel, dBase, Paradox, ASCII text files) or even transferred via clipboard.

Field-Map database uses ArcView shapefiles for the storage of mapping data and Paradox or MS Access tables for attributes. Thus the Field-Map native data can be directly used without any conversion. If other formats are required Field-Map offers export facilities of attribute tables to dBase, Excel, XML or ASCII text files. Mapping data are available in local Cartesian co-ordinates of projected co-ordinates and can be further processed for consequent use. Particularly the local co-ordinates can be automatically converted to selected map projections and data of number of plots (such as monitoring plots) can be combined into single Shapefile.

Teaming support is very important feature for those cases when one data collection project is accomplished by a number of field teams. When the fieldwork is finished the newly collected data are transferred into the main database.

Field navigation

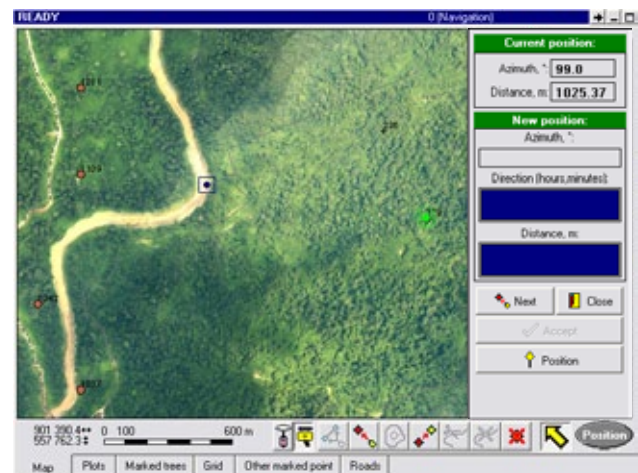
Navigation to target co-ordinates is one of the specific tasks of field data collection. The co-ordinates of target point (e.g. center of monitoring plot) are known, but the point cannot be identified in the field – it has to be found just by co-ordinates with reasonable accuracy.

GPS represents a good tool for navigation and it is fully supported by Field-Map. However, in forest conditions (i.e. under forest canopy and sometimes on slopes) GPS is commonly inefficient because of unavailable GPS signal or significantly increased measurement error.

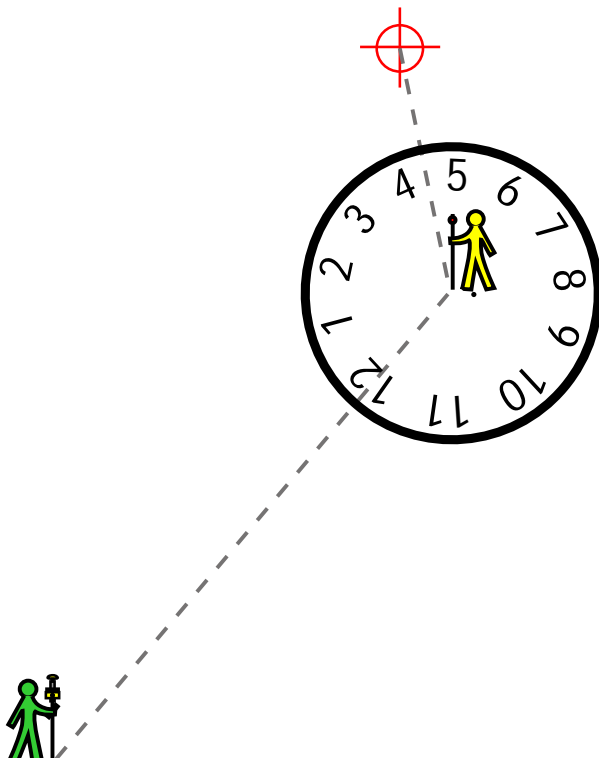
Therefore Field-Map offers advanced navigation functionality combining use of GPS and laser rangefinder + electronic inclinometer + electronic compass (RIC) and selecting the appropriate equipment based on actual conditions. In practice it means that GPS is used for positioning and navigation in open areas and RIC is used under canopy. In order to make navigation with RIC efficient the so called clockwise navigation has been developed. This approach significantly increases fieldwork productivity and enables to switch between GPS and RIC whenever it is convenient.

Another advantage of Field-Map navigation methods is a support of optimized movement in the terrain. Under harsh conditions of dense young forest stands or inaccessible steep slopes it is possible to make “detours” and approach target point using easier passes.

In addition to measurement devices the navigation in Field-Map can benefit from existing maps. Orthorectified aerial photos or available vector or raster maps can be used as a background maps in Field-Map and provide user with visual check of navigation.



Field navigation to target co-ordinates using GPS, laser rangefinder + electronic inclinometer + electronic compass and existing background maps (e.g. orthorectified aerial photo)



“Clockwise” navigation for laser rangefinder + electronic inclinometer + electronic compass. FM operator (green) says to the poleman (yellow) that the target point is located on 4:30.

Mapping

Field mapping and visualization of point/line/polygon layers represents an important part of Field-Map functionality. Field-Map has all functionality for creating and editing of digital maps in the field including attributing and advanced GIS functionality.

Mapping can be based on local Cartesian coordinate system or a selected map projection. The first approach is often used when mapping the interior of monitoring plots. In such a case the centre [0,0,0] is located in the plot centre and co-ordinates of other objects are related to this centre. The second approach benefits from Field-Map ability to support virtually any map projection worldwide. Parameters of map projections are predefined in Field-Map as well as parameters of geotransformation of WGS1984 geographic system into the projection. Geotransformation parameters as well as map projection parameters are user-defined and can be adjusted if necessary. Thus it is for instance possible to use different sets of geotransformation parameters for different parts of the country in order to increase accuracy. Map projection functionality of Field-Map enables using all measurement devices and obtaining final maps in projected co-ordinates directly on the screen of field computer during fieldwork.

Real-time creating and visualization of the produced map right in the field increases productivity and quality of the result.

Field-Map provides many useful features for visualization of field maps such as user-defined point and line symbols and labels that can be of fixed-size or scalable. During mapping Field-Map shows the actual position of the measurement equipment as well as e.g. traces of laser measurements. Zooming to user-defined or predefined scale, panning and showing the entire map are standard Field-Map features.

Together with edited layers Field-Map can present on the screen of field computer background maps which showing context. Field-Map supports many different raster and vector formats (TIFF, MrSID, ESRI Grid, Imagine, ERDAS GIS, Band Interleaved By Line, Band Interleaved By Pixel, Band Sequential, Sun Raster, IMPELL Bitmap, SVF, GIF, BMP, JPEG/JFIF, Shapefiles, Digital Exchange Format, MicroStation Design File, Autocad drawing database, ArcInfo coverage).

Field-Map works with point, line, polygon layers and special layer types such as trees, deadwood and transects. Additional layer types are derived from the basic ones and have additional features that are relevant for forestry projects.

Mapping procedure is user-friendly and straightforward. New points or lines can be added via pen sketching on the screen of field computer, passing measurement data from measurement devices or by direct entering of known co-ordinates. Points and lines can be moved or deleted. Free line editing using drag-and-move of selected line segment by cursor is useful for on-screen digitizing.

Advanced mapping functions allow copying points and lines between layers, creating grids, buffers, parallel or offset lines, smoothed lines and closed traversing.

Field-Map supports building of polygonal layers and has all necessary functions for it. Automatic line snapping and functions for cleaning and building topologically correct polygons give possibility of work with lines and centroids/label points of future polygons during fieldwork. When polygon boundary mapping is finished then Field-Map can build polygonal layers and transfer attribute values to polygons. Efficiency of building polygons by Field-Map is further increased by the possibility of involvement of lines from different layers during data processing. Thus it is not necessary to duplicate lines in different layers.

During mapping of monitoring plots Field-Map benefits from its "continuous positioning". That means that equipment operator can freely move in order to, e.g., find the best view for mapping of new entity. Using a system of temporary reference points allows rapid georeferencing by shooting with laser to a reference point. It is not necessary to measure all entities from the center of the plot.

During mapping in dense forest with understorey Field-Map benefits from automatic re-calculation of slope distances to horizontal distances.

Prior to field mapping it is possible to lock individual attributes or whole layers (limited attributing, limited pen mapping, limited mapping). Thus it is possible to effectively manage the way of editing of data during fieldwork.

Tree measurements

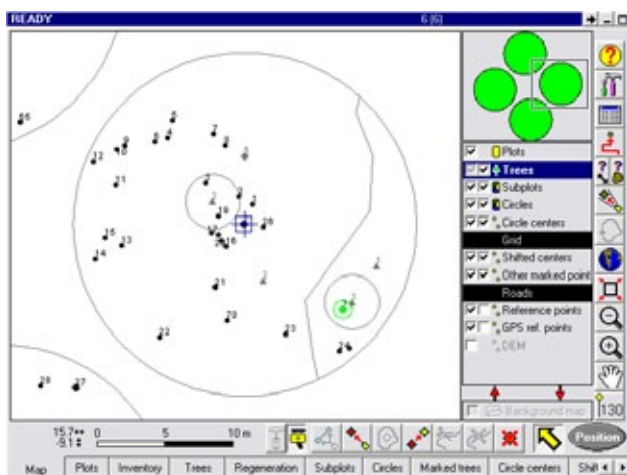
Field-Map has been developed primarily for forestry and it has a number of specific functions for tree measurement.

Field-Map supports user-defined shape and size of plot (polygonal, circular and rectangular plots; plots without mapping), fixed-size, variable-size, concentric circle, segmented plots, interpretation plots and templates.

Tree layer in Field-Map is the descendant of point layer with many additional features such as visualization of tree basal areas and crown projections in the map. Trees can have specific attributes such as diameter at breast height, tree height, stem volume, branch length, crown projection, crown surface or crown volume.

Tree position within a monitoring plot is mapped using laser rangefinder + electronic inclinometer + electronic compass (RIC) and reflector which is put to surface of the tree stem. Field-Map automatically checks whether the tree is inside/outside the plot – it is not necessary to mark plot boundary in the field, the fieldwork is more efficient.

In those cases when trees are not visually marked it might be sometimes necessary to recover the tree number during fieldwork. Field-Map has a function for finding tree identity based on its position – select tree using laser.

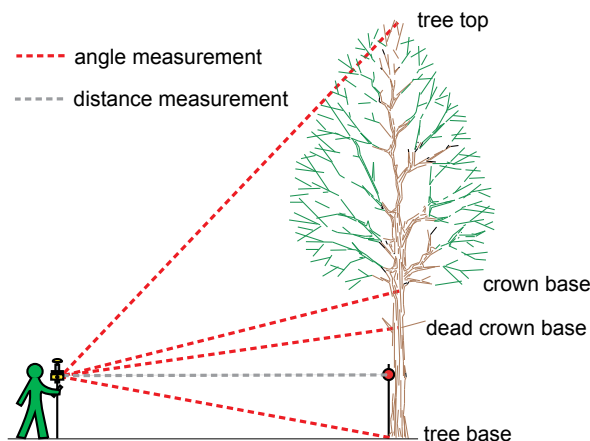


Example of mapping tree position at segmented plot

Tree diameters can be recorded in the memory of electronic caliper and later downloaded into field computer. The other option is a wireless connection and online recording of tree diameters. In both cases the position of the trees in the map is adjusted upon a download of tree

diameters. Tree position in the map represents a position of the center of the tree stem.

Tree height measurement uses laser range-finder and electronic inclinometer for assessing horizontal distance to a tree and inclination to the top and bottom of a tree.



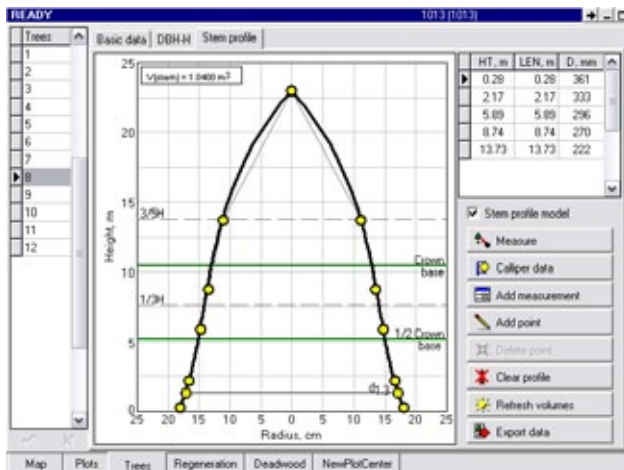
Tree height and crown base measurement

Field-Map has five different modes for tree height measurement:

1. **Distance using position** – distance to a tree is not measured but calculated from the known position of the equipment and position of the tree. This mode is suitable for less dense stands where several tree heights can be measured from one spot.
2. **Distance+base using position** – same as mode 1 + inclination to the stem base is calculated from known Z co-ordinates of the equipment position and position of the tree. This mode is suitable for stands with large trees often with undergrowth, where it is difficult to find a place from which both the bottom and the top of the tree are visible.
3. **Distance measurement** – distance and all inclinations are measured. Typically used in dense stands where frequent movement of the equipment is necessary in order to get a good view to tree tops.
4. **Distance+base using main pole** – same as mode 3 but the distance and inclination to the tree bottom is measured using a measurement pole. Suitable for dense stands where an extensible pole can reach above understorey.
5. **Direct height measurement** – uses built-in measurement procedure of LTI Forest PRO. Similar to mode 3.

For slanted trees it is possible to record the angle of a tree. Field-Map then automatically calculates both tree height (i.e. the shortest distance from the ground to the tree top) and tree length (i.e. the distance from the tree bottom to the tree top).

Tree volume can be calculated based on direct measurement of stem profile. Using measurement of series of diameters along the tree stem the stem profile is measured and the stem volume is automatically calculated.



Direct measurement of stem profile

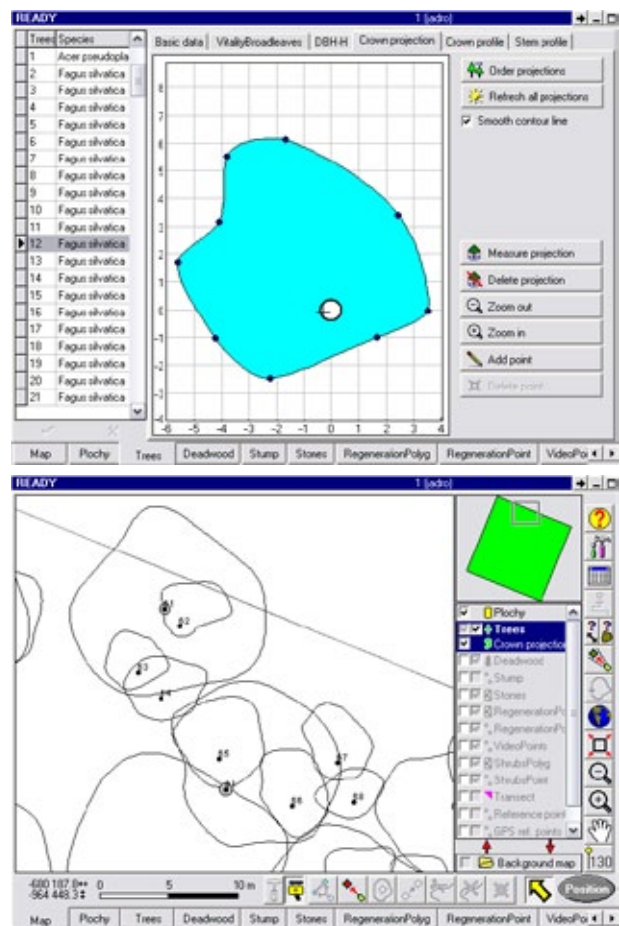
Tree volume can alternatively be calculated using existing volume tables or models. The parameters of volume equations are species specific.

Implementation of volume equations in Field-Map can be done using Field-Map scripting. The script automatically calculates tree volumes based on changing values of tree diameter at breast height and tree height, and stores the results in a predefined attribute.

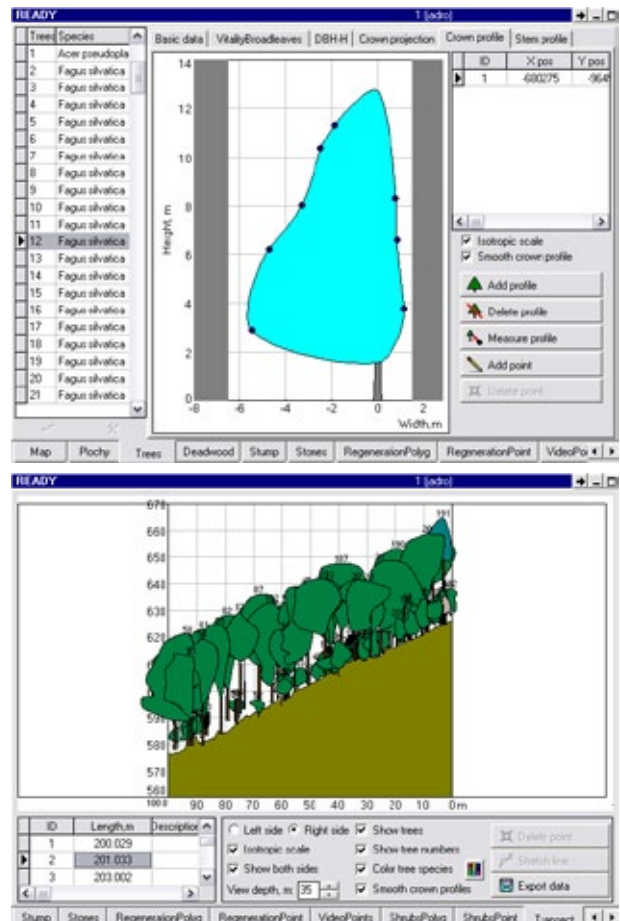
For projects where a more detailed description of forest canopy structure is required Field-Map provides a support for mapping of horizontal map projections and vertical crown profiles. Area of crown projection as well as surface and volume of the crown is automatically calculated by Field-Map.

More detailed measurement of tree branches is covered by Field-Map using measurement of branch diameters and branch length.

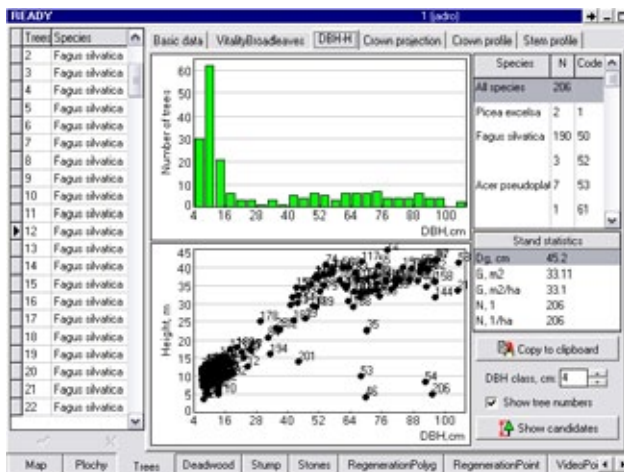
Main dendrometric characteristics can be visualized for monitoring plot and for individual tree species. It also includes the related stand/species characteristics (basal area, mean diameter, number of trees).



Mapping of tree crown projections



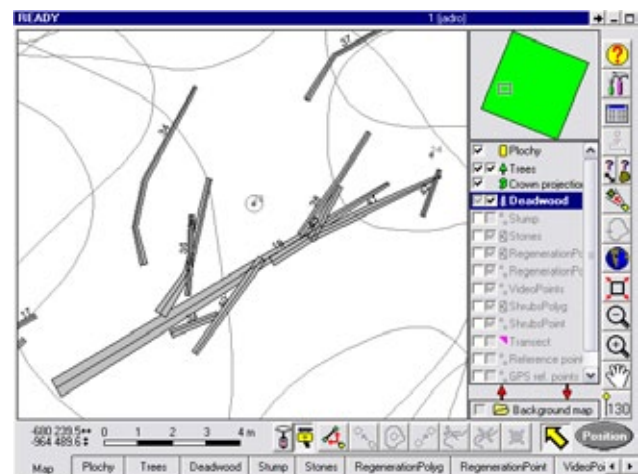
Measurement of crown profiles



Visualization of tree diameter distribution, diameter-height relationship and calculated stand parameters

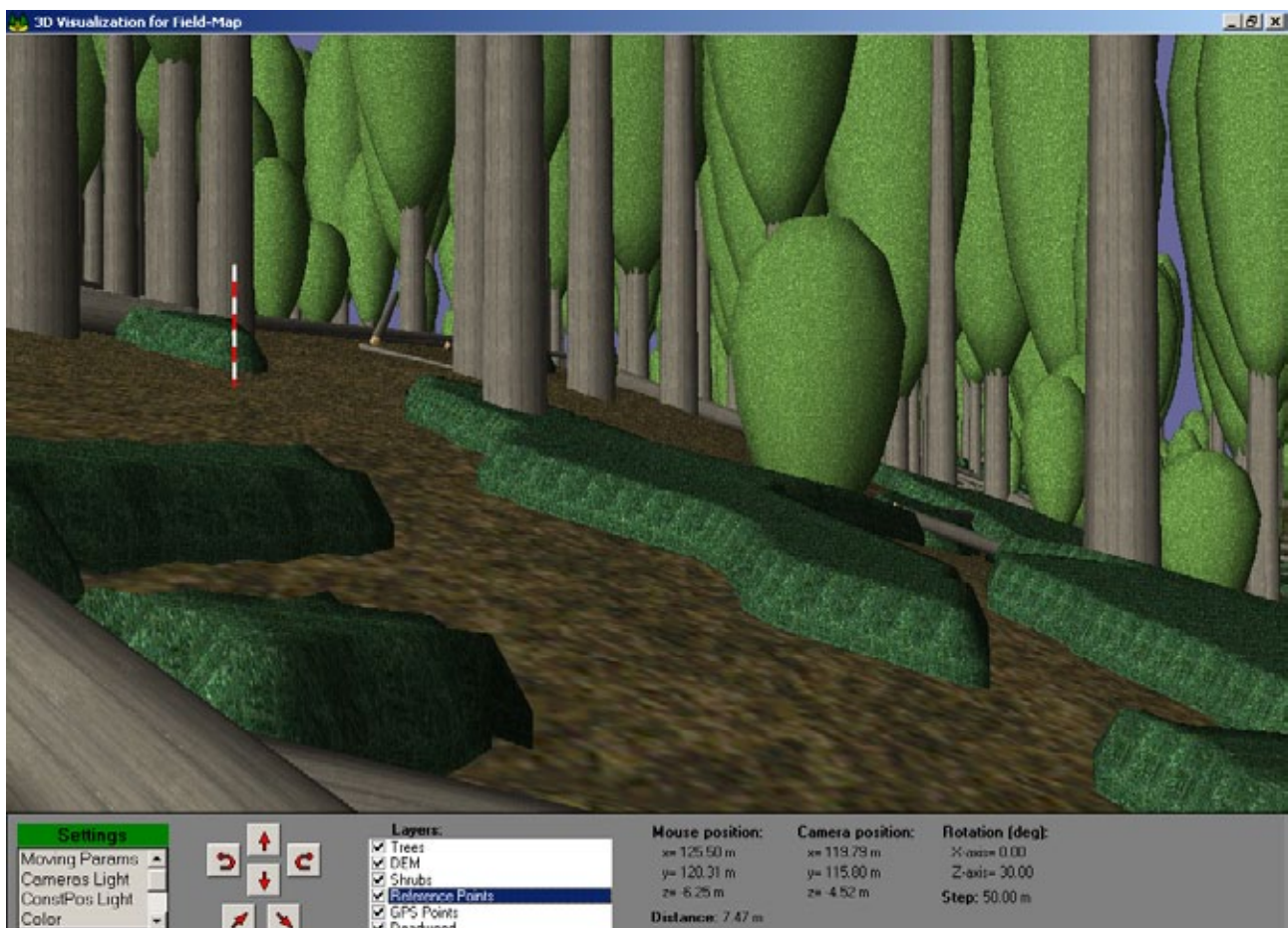
In addition to the standing trees Field-Map supports mapping and measurement of deadwood lying on the ground. Every piece of deadwood is represented by its central line and diameters related to the line vertices. Polygon delineating deadwood contours is stored in the map. As well as for standing trees the volume of deadwood is automatically calculated based on the measured data and individual pieces can be described by the set of user-defined attributes.

Volume is automatically calculated based on length and diameters of deadwood segments. Field-Map can automatically “cut” deadwood piece at the plot boundary and calculate only the volume that belongs to the plot.



Mapping and measurement of deadwood

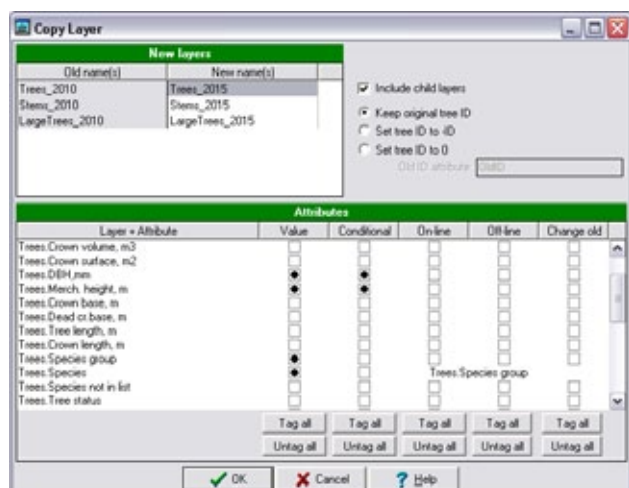
Field-Map 3D Forest represents an extension that has been designed for three dimensional visualization of Field-Map data. Data of mapping and tree measurement are taken directly from the Field-Map database.



Field-Map 3D Forest screen

Repeated measurements

Prior the fieldwork the data of previous measurement are downloaded into field database. It is possible to define the behavior of individual attributes: Attributes may or may not be verified. Verification can be performed either when entering the attribute value or at any time later on user's request.

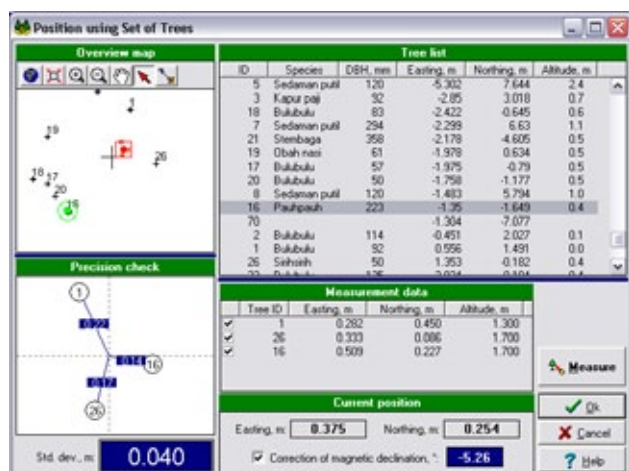


Preparation of validation scheme for repeated measurement

Field-Map support of repeated measurement in the field covers following steps:

Step 1: Finding plot center

In case of hidden plot numbering i.e. when plot is not visibly marked in the field it is necessary to navigate to the plot center. Navigation is done using the above described navigation tools to the plot center. The navigation is usually ensured with an accuracy of several meters and therefore Field-Map identifies the plot center using the existing map of tree positions. Using several trees that can be distinguished both on the map and in the field it is possible to identify the plot center with accuracy better than 10-20 cm.



Finding plot center using existing map of trees

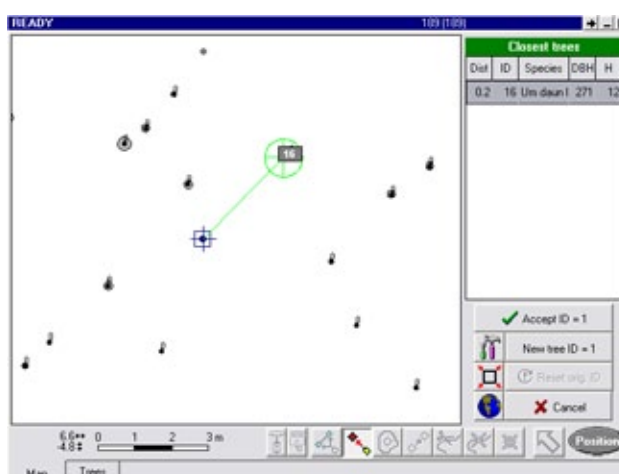
Step 2: Recovering tree numbers

Re-establishment of tree numbers is necessary in order to keep time series of measurement on the level of individual trees. In case of so called hidden tree numbering the trees can be identified using tree co-ordinates and also tree description.

Recovering of tree numbers uses the same procedure as mapping of trees. Get equipment positioned, start tree mapping and shoot with laser rangefinder to a tree. Upon shooting to the tree Field-Map map shows a trace of the laser beam (from equipment position to the target) and a circle of search tolerance.

Due to the accuracy limits of measurement equipment it is hardly possible to reach exactly the same co-ordinates of target trees when measuring to the target position on the tree trunk surface. In practice there is always some difference in terms of centimeters. Hence, a direct identification using tree co-ordinates is not possible. Therefore, Field-Map uses a search tolerance for searching neighboring trees.

In practice, shooting to every tree is seldom needed. Especially in less dense forest stands it is possible to identify trees visually and click on the tree position just by pen into the map. If a new (ingrowth) tree is mapped then it is necessary to give it a new ID.



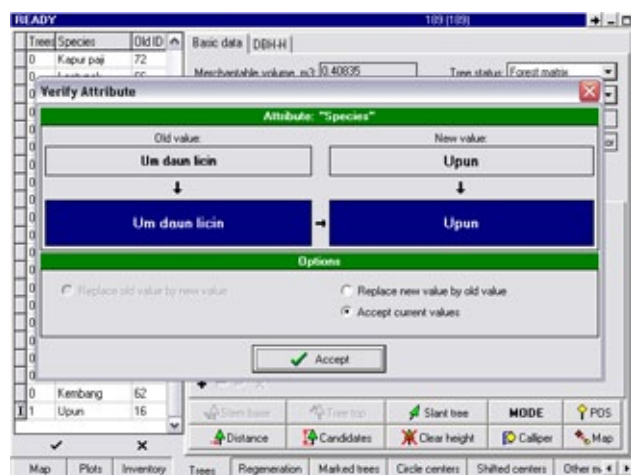
Recovering tree numbers

If a tree position has been mapped incorrectly in the previous measurement, Field-Map offers a "Move tree" function to correct the tree position. A description of any change done to the old map layer is automatically stored in OldChangesLog table, which is a part of the Field-Map project.

Step 3: **Attributing**

On-line verification is run automatically whenever the attribute value has changed. The new value is compared with the old one and if a difference is identified, a confirmation dialog appears. The user then has three options to choose from:

- Both the old and the new value are accepted, i.e. the change is approved and recorded
- The old value is found to be correct and the new value is replaced by the old value
- The new value is found to be correct and the old value is replaced by the new one; in such a case, the description of the change is automatically recorded in the OldChangesLog table ensuring that all changes to the old data are described accordingly and can be reversed if necessary.



Resolving changes of attribute values

Validation of data

Verification and validation of data is done using built-in tools and user-defined checks. The data are passing the following steps of validation:

1. Locking layers and attributes
2. Min/Max values
3. Lookup lists and conditional lookup lists
4. Conditional layer appearance
5. Verification of data of repeated measurement
6. Identification of missing data
7. Complete check of database integrity
8. User-defined rules (scripting)

Some of these steps prevent entering invalid data, the others enable user to identify inconsistent data. Most of the data validation routines are performed in the field. Thus the data is validated during fieldwork and checked before the field team leaves the monitoring plot.

The system of data validation can be fully adjusted according to the specific methodological requirements. User-defined scripts can be connected to OnValidate and OnChange events which automatically run when data are entered or edited. Thanks to the comprehensive possibilities of Field-Map Object Pascal scripting, it is possible to perform simple or complex calculations and validations that compare values of selected attributes with other relevant data.

User-developed extensions

Field-Map represents an open system that can be adjusted by users in many ways. The most important adjustment channel is accessed through "Field-Map extensions".

Field-Map uses its own scripting language based on the Object Pascal programming language. User-written scripts for additional, user-defined functionality (on-change, on-validate events, on-demand routines), written in Field-Map Object Pascal, allow adjustments of data collection routines.

On-demand extensions and user-defined data forms can also be prepared in a form of dynamic libraries (DLL). The predefined headers of these libraries enable integration of the extensions within Field-Map.

Data processing tools

Field-Map itself has functionality for pre-processing of data (Field-Map Data Processing Tools):

■ Calculation of missing tree heights

Usually only part of the trees is measured for the height during fieldwork. Field-Map provides tool for modeling of relationship between diameter at breast height and tree height by species (and strata if required). Based on the model which is parameterized for measured sample trees it is possible to calculate height for those tree which were not measured in the field. Support of user defined height curve functions (models).

■ Tree-volume calculation using user-defined volume equations

Volume calculation based on German local volume equations can be performed already during field measurement using user-defined scripts connected to OnChange event of relevant attributes. The other option is to calculate tree volumes during data processing phase.

■ User-defined classification

Continuous data of field measurement can be grouped into classes according to the user-defined classification scheme. Classification is often used for diameter distribution, age distribution etc.

■ User-defined re-classification

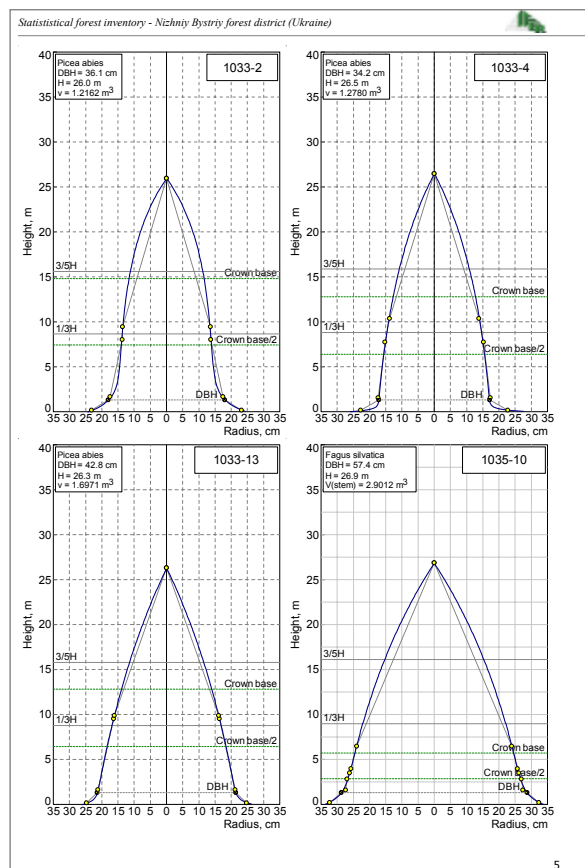
Classified data can be re-classified according to the user-defined re-classification scheme. Typical example of re-classification is grouping of the species into species groups.

■ Aggregation

Minimum, maximum, count, total, sample variance, standard deviation, standard error, mean and median can be calculated. It is for instance possible to calculate mean and standard error of tree defoliation by monitoring plots and store resulted values into relevant attributes of monitoring plots.

■ SQL updates

SQL commands can be used within Field-Map Data Processing Tools in order to calculate and store new attribute values. Newly created attributes are automatically added to Field-Map database structure.



Statistical forest inventory - Nizhny Bystryi forest district (Ukraine)

Number of trees per hectare (normalized mean) by diameter class and species group (tree DBH above 12 cm)
Кількість дерев на гектар (нормалізоване середнє) по ступеням товщини і групам порід (товщина більше 12 см)

Diameter class (5cm) Ступені товщини (по 5см)	Species / Number of trees Порода / Кількість дерев			
	Norway spruce Сірий сосна	beech + other broad. Бук + інші листяні	All Всі	All Всі
	1/ha (n=610)	1/ha (n=610)	1/ha (n=610)	1/ha (n=610)
12 - 17 cm	1 068 (736 - 1 400)	1 358 (1 272 - 1 445)	1 355 (1 270 - 1 441)	1 355 (1 270 - 1 441)
17 - 22 cm	1 029 (722 - 1 336)	1 041 (977 - 1 106)	1 041 (978 - 1 104)	1 041 (978 - 1 104)
22 - 27 cm	874 (601 - 1 147)	789 (738 - 841)	795 (744 - 846)	795 (744 - 846)
27 - 32 cm	585 (402 - 868)	584 (543 - 624)	584 (545 - 622)	584 (545 - 622)
32 - 37 cm	371 (260 - 476)	437 (411 - 462)	426 (389 - 462)	426 (389 - 462)
37 - 42 cm	270 (180 - 359)	366 (339 - 393)	348 (320 - 376)	348 (320 - 376)
42 - 47 cm	244 (137 - 352)	307 (282 - 332)	298 (273 - 323)	298 (273 - 323)
47 - 52 cm	328 (0 - 1 888)	276 (253 - 298)	276 (255 - 298)	276 (255 - 298)
52 - 57 cm	249 -	220 (192 - 248)	220 (193 - 247)	220 (193 - 247)
57 - 62 cm	-	204 (183 - 225)	204 (183 - 225)	204 (183 - 225)
62 - 67 cm	-	182 (159 - 205)	182 (159 - 205)	182 (159 - 205)
67 - 72 cm	-	141 (122 - 160)	141 (122 - 160)	141 (122 - 160)
72 - 77 cm	-	128 (101 - 156)	128 (101 - 156)	128 (101 - 156)
77 - 82 cm	-	135 (110 - 161)	135 (110 - 161)	135 (110 - 161)
82 - 87 cm	-	113 (84 - 133)	113 (84 - 133)	113 (84 - 133)
87 - 92 cm	-	74 (34 - 114)	74 (34 - 114)	74 (34 - 114)
92 - 97 cm	-	81 (64 - 97)	81 (64 - 97)	81 (64 - 97)
97 - 102 cm	-	115 (91 - 139)	115 (91 - 139)	115 (91 - 139)
102 - 107 cm	-	68 (0 - 145)	68 (0 - 145)	68 (0 - 145)
107 - 112 cm	-	89 (49 - 129)	89 (49 - 129)	89 (49 - 129)
112 - 117 cm	-	103 (63 - 142)	103 (63 - 142)	103 (63 - 142)
117 - 122 cm	-	68 (34 - 101)	68 (34 - 101)	68 (34 - 101)
122 - 127 cm	-	68 -	68 -	68 -
All	512 (387 - 626)	637 (583 - 691)	628 (578 - 681)	628 (578 - 681)

Mean tree height by dimension class and species group
Середня висота дерев по класам розміру і групам порід

Dimension class Клас розміру	Species / Tree length Порода / Довжина дерева			
	Norway spruce Сірий сосна	beech + other broad. Бук + інші листяні	All Всі	All Всі
	m (n=610)	m (n=610)	m (n=610)	m (n=610)
0.1 - 0.4 m	0.2 (0.2 - 0.2)	0.2 (0.2 - 0.2)	0.2 (0.2 - 0.2)	0.2 (0.2 - 0.2)
0.4 - 1.3 m	0.6 (0.0 - 1.6)	0.8 (0.7 - 0.9)	0.8 (0.7 - 0.9)	0.8 (0.7 - 0.9)
1.3 m - 7 cm	-	4.1 (3.5 - 4.7)	4.1 (3.5 - 4.7)	4.1 (3.5 - 4.7)
7 - 12 cm	-	9.3 (8.0 - 10.6)	9.3 (8.0 - 10.6)	9.3 (8.0 - 10.6)
12 - 17 cm	17.5 (0.1 - 34.8)	15.5 (14.9 - 16.1)	15.5 (14.9 - 16.1)	15.5 (14.9 - 16.1)
17 - 22 cm	20.0 (14.8 - 25.2)	18.2 (17.5 - 18.9)	18.3 (17.6 - 19.0)	18.3 (17.6 - 19.0)
22 - 27 cm	22.2 (19.2 - 25.1)	20.5 (19.7 - 21.3)	20.6 (19.8 - 21.3)	20.6 (19.8 - 21.3)
27 - 32 cm	24.9 (23.5 - 26.3)	22.6 (21.9 - 23.3)	22.9 (22.2 - 23.6)	22.9 (22.2 - 23.6)
32 - 37 cm	26.6 (24.6 - 28.6)	23.2 (22.5 - 24.0)	23.6 (22.9 - 24.3)	23.6 (22.9 - 24.3)
37 - 42 cm	26.6 (24.0 - 29.2)	25.1 (24.1 - 26.0)	25.3 (24.4 - 26.2)	25.3 (24.4 - 26.2)
42 - 47 cm	27.6 (25.9 - 29.3)	25.7 (24.8 - 26.6)	26.0 (25.0 - 27.0)	26.0 (25.0 - 27.0)
47 - 52 cm	28.3 (0.0 - 53.8)	26.5 (25.3 - 27.6)	26.5 (25.3 - 27.6)	26.5 (25.3 - 27.6)
52 - 57 cm	29.7 -	27.0 (25.5 - 28.5)	27.1 (25.6 - 28.6)	27.1 (25.6 - 28.6)
57 - 62 cm	-	28.4 (26.9 - 29.9)	28.4 (26.9 - 29.9)	28.4 (26.9 - 29.9)
62 - 67 cm	-	29.5 (27.8 - 31.2)	29.5 (27.8 - 31.2)	29.5 (27.8 - 31.2)
67 - 72 cm	-	29.1 (27.3 - 30.9)	29.1 (27.3 - 30.9)	29.1 (27.3 - 30.9)
72 - 77 cm	-	28.1 (26.1 - 30.1)	28.1 (26.1 - 30.1)	28.1 (26.1 - 30.1)
77 - 82 cm	-	30.6 (28.5 - 32.7)	30.6 (28.5 - 32.7)	30.6 (28.5 - 32.7)
82 - 87 cm	-	28.8 (25.6 - 31.9)	28.8 (25.6 - 31.9)	28.8 (25.6 - 31.9)

Field-Map v. 5

6

Example results of statistical forest inventory.

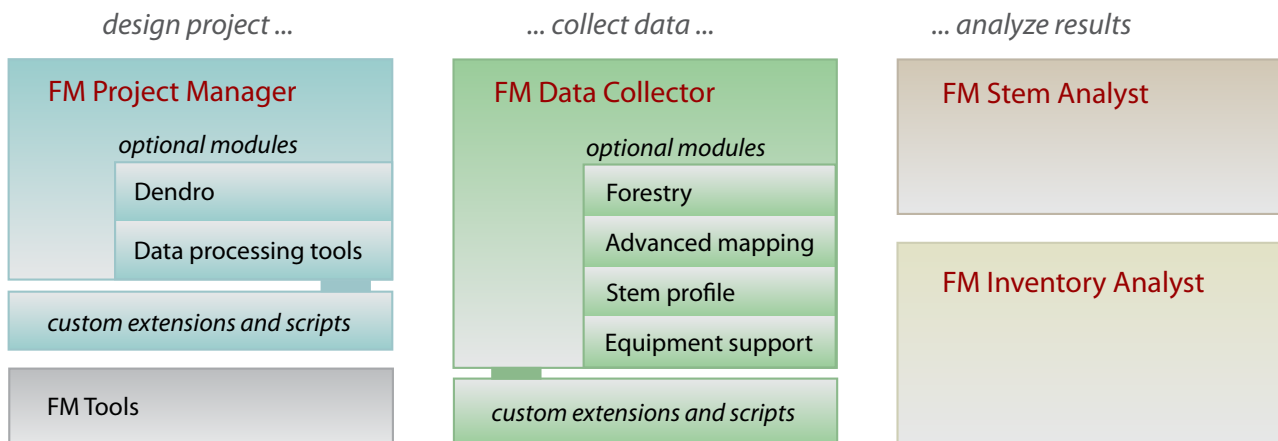




Field-Map software

Field-Map software consists of four separate parts:

- Field-Map Project Manager
- Field-Map Data Collector
- Field-Map Stem Analyst
- Field-Map Inventory Analyst



On top of the basic programs there are additional applications (FM tools) for file conversion and data handling including software module Field-Map Forest3D for 3D visualization. These are delivered together with the main Field-Map applications.

Standard workflow of a Field-Map project is to prepare the database structure in Field-Map Project Manager (FMPM), copy the database (folder with database files) to field computer, use Field-Map Data Collector (FMDC) to collect data in the field, come back from the field, copy the data back to the desktop computer and analyze the data using Field-Map Stem Analyst (FMSA) and/or Field-Map Inventory Analyst (FMIA).

Any other database management systems or geographic information systems can be used to analyze data since Field-Map can export data to a number of industry standard file formats.

Field-Map Project Manager (FMPM)

Using FMPM, the user can easily define a structure of a database (i.e. Field-Map project) based on his/her own methodology.

Within one project, user can define many different layers with many different attributes. Field-Map supports multi-level relational database.

A user can define shape and location of many plots or study sites within a single project.

Using FMPM the project preparation is very fast and intuitive. No programming is necessary to develop a custom software application.

Detail list of FMPM features:

■ Flexible system

With FMPM you can easily define the shape and size of inventory plots, attributes to be measured in the field, lookup lists with predefined values, mutual relations between attributes and more. Thus the database becomes adjusted to your methodology and not the other way around.

■ No programming skills required

To develop field data collection projects you need to define database structure of the project. With FMPM you do not need any programming skills to achieve that.

■ Relational database

Multiple layers arranged in database structure supporting one-to-many, one-to-one and many-to-one relationships.

■ Open environment

If you want to extend Field-Map capabilities, you can write your own scripts in Object Pascal and embed them in the project.

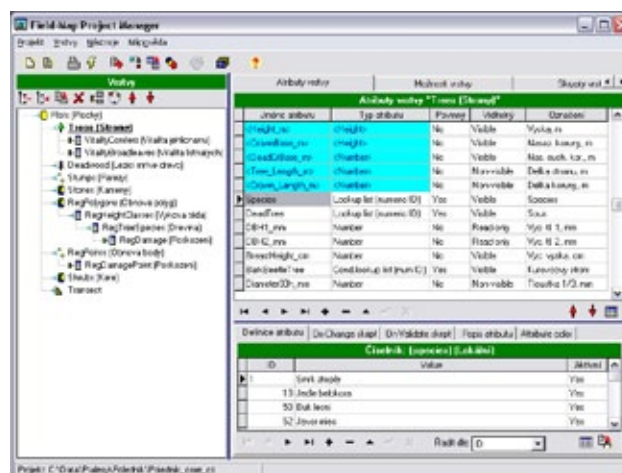
■ Number of attribute types

Types of simple attributes include number, string, logical, date, time, picture, movie, voice memo, height, diameter and length.

Then there are lookup tables and conditional lookup tables, which are user defined lists of values.

■ Export to industry standard formats

Export to MS Access, Paradox, Excel, DBase, XML and Shapefiles



Field-Map Project Manager screen

■ Support for multiple team field work

Automatically synchronize and backup data from many teams into a single database.

■ Checking the data

Various data checking routines are included in Field-Map ranging from simple checks such as checking the type of the variable to more advanced checking routines involving values and conditions from more attributes.

■ Design network of inventory plots

With create set of plots function you can create collection of plots with predefined parameters. You can have different parameters for specific parts of the plot (e.g. concentric circles where trees of certain dimensions are to be measured. Automatic checks are then performed in the field)

■ Support for repeated measurements

repeated measurement of trees on permanent plots is supported by number of functions. The previous measurements are dynamically linked to current measurements enabling online verification of the parameters.

■ Using digital background map

You can define collection of aerial images and shapefiles to show in the background of your map screen.

■ Conversion between co-ordinate systems

You can convert geographical data from local co-ordinates to any map projection

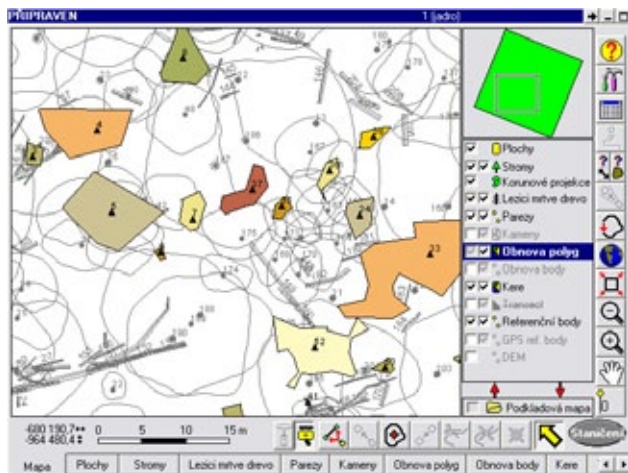
■ Print project structure

Structure of your project can be printed or saved to PDF for use in your project reports.

Field-Map Data Collector (FMDC)

Having database structure ready you can start the fieldwork immediately.

User interface is automatically adjusted according to the project structure.



Field-Map Data Collector screen

FMDC directly supports field electronic measurement devices (GPS, laser rangefinder, electronic inclinometer, electronic compass and electronic caliper) and gives the user the possibility to map and measure in the field. The basic principle is very simple: the user gets the position (using GPS, map or local co-ordinate system) and using measurement devices it records position and dimensions of trees.

General mapping functionality enables mapping of points, lines and polygons.



Field-Map Data Collector runs in tablet field computers

Special GIS features are used for trees, deadwood and transects. Each entity can be described by attributes.

FMDC has extensive functionality to increase productivity of fieldwork. Continuous geo-referencing gives the user possibility of free movement within a plot, number of different methods of tree height measurement simplify work in harsh conditions, etc. After collecting data, the user can immediately verify it, by using visualization and validity checking routines.

Detail list of FMDC features:

■ Mapping

FMDC is used for mapping basic GIS entities (points, lines and polygons) and also special forestry entities (e.g. trees, deadwood, transect). The mapping can be done using GPS, laser rangefinder and compass electronic tachymeter, drawing by pen on tablet computer or typing the data from keyboard.

■ Importing digital maps and data

Supported formats are ESRI Shapefiles, ArcInfo Coverages, Digital Exchange Format, MSAccess, DBase, MSeExcel, Paradox and XML

■ Detail tree measurement

You can measure horizontal crown projections, vertical crown profiles and stem profiles. Everything is instantly drawn on the screen of the field computer and volumes are automatically calculated.

■ Mapping of deadwood

Deadwood lying on the ground can be mapped and described by sections. Volume of the deadwood is calculated automatically.

■ Building polygons from lines

Create topological or non-topological polygons from mapped lines.

■ Navigation in the field

Use GPS or compass and laser rangefinder to navigate in the field. The combination of laser rangefinder and electronic compass is especially useful under dense canopy.

■ Checking the data

Check missing or incomplete data. Define what is an error and what is not.

■ Continuous georeferencing

A set of temporary reference points measured by laser range-finder and marked by reference poles, can be established in the field. It allows the user to move freely within the study area without losing the georeference of the actual measurement point.

■ User extensions

It is possible to easily connect user defined modules and extended functions (e.g. volume tables)

■ Repeated measurements

A forest inventory is typically repeated after some period of time. In the second round the trees must be identified and remeasured. There is a number of functions related to the repeated measurements included in FMDC, e.g. identification of the trees by coordinates, on-line checking of the previously measured values, etc.

■ Transects

Transect (profile diagram) is a virtual line in the forest showing the profiles of trees and tree crowns. You can choose to color tree species, reduce the number of visualized trees by reducing distance from the transect line, etc. Picture of the transect can be exported for use in your reports.

■ Tree heights

there are 5 modes for tree height measurement and 2 modes for slanted tree measurement. You can choose the optimal one depending on the required accuracy, the desired measurement speed and the local measurement conditions.

■ Remote diameter measurement

Using a special optical scope combined with laser range-finder you can measure stem or branch diameters in upper parts of the tree.

■ Various size and shape of plots

You can choose size and shape of sample plots directly in the field or predefine it in the

office.

■ Support of electronic devices

A number of measurement devices can communicate with the FMDC application. These devices can be connected via cable, Bluetooth or radio signal. Typical devices working with FMDC are laser rangefinder with electronic compass or electronic



Field-Map Data Collector provides communication with external electronic devices.

tachymeter, GPS or electronic caliper.

■ Segments and concentric circles

FMDC supports division of the plot into several concentric circles. For each circle, you can define a threshold diameter to be measured.

■ Coordinates systems

Support for conversion between coordinate systems

■ Background digital maps

FMDC can display background maps containing vector and/or raster formats

■ GIS functions

Other functions for working with maps include: create parallel line, create buffer, create grid, offset line, union polygons, etc.

Field-Map Data Collector (FMDC) is available for Windows. Field-Map Data Collector Lite (FMDC LT) is available for Pocket PC 2002 (and higher) and Windows Mobile platforms.

The FMCD LT version has a limited functionality. For specific differences between the two versions, see the following table.

Features supported in Field-Map vs. Field-Map LT

	Field-Map LT	Field-Map
Geographic entities		
Point	■	■
Line		■
Polygon		■
Tree	■	■
Deadwood		■
Transect		■
Attributes		
Numeric	■	■
Alphanumeric	■	■
Logical	■	■
Date, Time	■	■
Memo		■
Picture, Video, Voice		■
Category – lookup list	■	■
Height and Diameter	■	■
Database relationship		
One to one	■	■
One to many	■	■
Many to one		■
Data organization		
Multiple plots	■	■
Multiple layers	■	■
Multiple attributes	■	■
Plot types		
Circular	■	■
Rectangular	■	■
Polygonal	■	■
User defined plot size	■	■
Concentric circles	■	■
Georeferencing		
Local coordinates	■	■
Predefined projections	■	■
User defined projections	■	■
Continuous georeferencing	■	■
Field navigation		
Using GPS	■	■
Using laser + compass	■	■
External devices		
NMEA – 0183 compliant	■	■
GPS	■	■
Laser rangefinders	■	■
Electronic compass	■	■
Electronic caliper	■	■

	Field-Map LT	Field-Map
Import		
ESRI Shapefiles	■	■
ArcInfo Coverages		■
Digital Exchange File		■
Microstation		■
MSAccess		■
DBase		■
Paradox		■
Plain text		■
Tiff		■
MrSid		■
ArcInfo Grid		■
Imagine		■
ERDAS		■
Band Interleaved		■
Sun raster		■
GIF		■
BMP	■	■
JPEG	■	■
Export		
MSAccess		■
DBase		■
Excel		■
XML	■	■
Forest Functions		
Crown projection		■
Crown profile		■
Stem profile	■	■
Basic tree height	■	■
Slant tree		■
Upper diameter	■	■
Utility		
Build polygons		■
Close traverse		■
“Conditional” layer		■
“Conditional” lookup list		■
Virtual keyboard	■	■
Buffer		■
Grid		■
Parallel line		■
Smooth line		■
Other		
Custom extensions		■

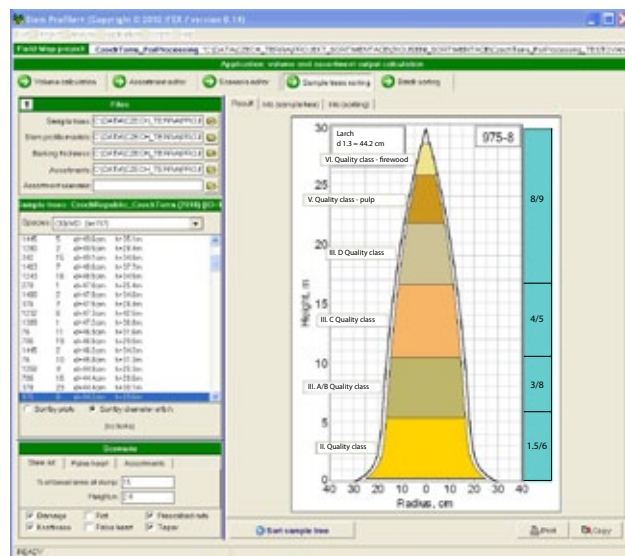
Field-Map Stem Analyst (FMSA)

FMSA is a software tool used for two main tasks:

- Defining parameters for global stem curve model.
- Defining assortments on the inventory plot.

The parameters for global stem curve model are defined based on measured stem profiles. One can measure sections of felled trees or use so called six point method on standing trees.

Prior to the assortment calculation the stump height can be defined as percentage of the tree height, as a fixed height or can be derived from a specified diameter.



The output of the data analysis consist of:

- Global stem curve model for individual species or species groups
- Model statistics
- Charts showing diameter and volume residuals of the model
- Profiles of individual sample stems
- Stem volume calculation

To get sufficient data for the calculations, there are several measurements performed in the field:

- Virtual division of the stem parts based on quality
- Measurement of the branch knot diameters and their count
- Damage classification
- Measurement of heights of stem forks

Assortments module features:

- Definition of assortments
Dimensions, quality, financial value - these are called flexible assortments.
- Definition of assortments scenarios
Preference of certain assortments, allowed damage classes and decay degrees, etc.
- Selection of global stem curve model
- Calculation of assortments broken down by volume classes.
- Preparation of data for further evaluation using Field-Map Inventory Analyst.

Data are measured in the field using Field-Map Data Collector. Field-Map Stem Analyst is then used in the office for data processing.



Field-Map Inventory Analyst (FMIA)

FMIA is a software application for evaluation of statistical forest inventories. It provides user with easy handling and processing of field data databases. Data can be completed, pre-processed and processed in order to obtain final statistical results and output. Automatically generated output consists of classified tables of results and graphs. As option the user may complete the result with methodological remarks, terminology definitions and comments.

FMIA covers the following tasks:

- **Calculation of secondary and derived variables using predefined models and in-built functions**

e.g. calculation of height for those tree which were not measured in the field,

calculating tree volume using user defined or local volume equations etc.

- **Post-stratification**

- **Aggregation**

aggregating data of specific data layers and calculating descriptive statistics;

e.g. summarizing deadwood logs within a plot, calculating mean log volume, sample variance, standard deviation, standard error etc.

- **Classification**

user defined classifying of continuous data values into classes;

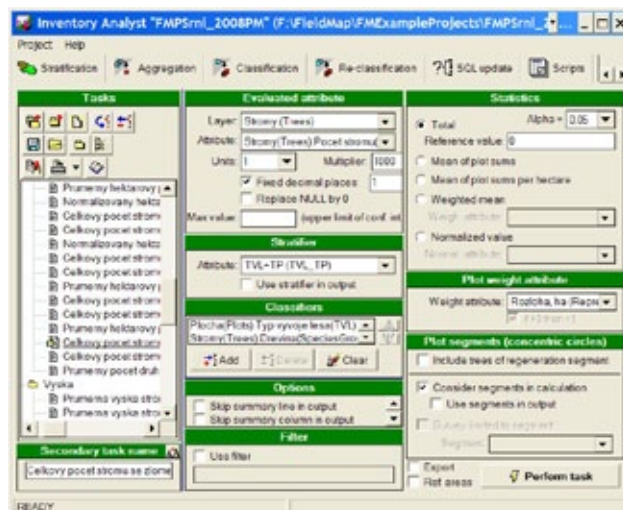
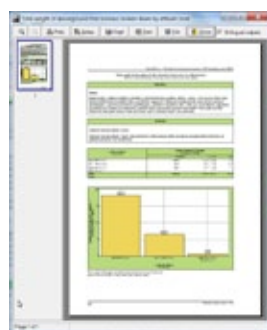
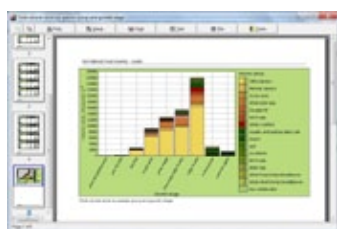
e.g. age to age classes, tree diameter into diameter classes, etc.

- **Re-classification**

re-grouping of discrete data values; e.g. tree species into species groups etc.

- **SQL update or scripts**

using SQL commands or user defined scripts to create and calculate derived variables.



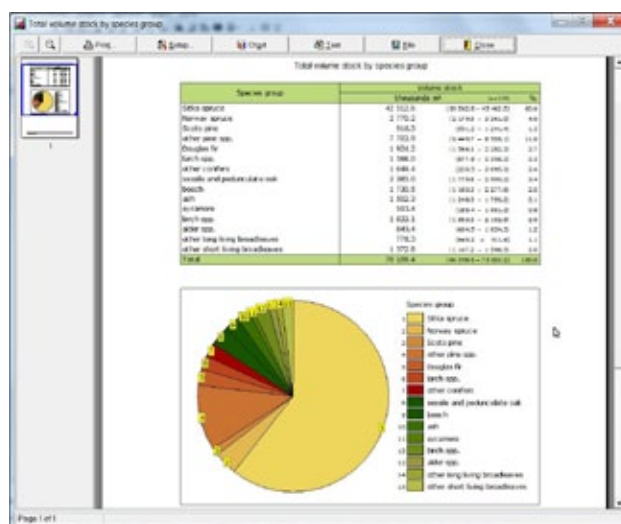
- **Statistical data processing**

The tasks of statistical data processing can be formulated using interactive forms and used repeatedly.

Outputs of calculation are presented in a form of tables and charts. Each task can be supplemented by user's comments, methodology descriptions and definitions.

Main advantages of using Inventory Analyst:

- Easy and fast data preparation (data preprocessing)
- Calculated values are added into the source database
- Easy definition of statistical tasks (import/export of definitions of the statistical tasks)
- Automatic creating of printable outputs including charts
- Possibility of multilingual outputs







Field-Map hardware

Field-Map hardware consists of several parts. A field computer running the Field-Map software is the hearth of the system. The software provides smooth communication with external devices.

The hardware is usually delivered in sets designed to suit a particular need and can be divided into the following basic categories:

- Field computers
- Range-finders, inclinometers and compasses
- GPS
- Accessories

Ursus

Hardware set for complex mapping of 3D forest structure where a lot of measurements is taken from one place. This is usually very detailed mapping of large plots.

Electronic compass

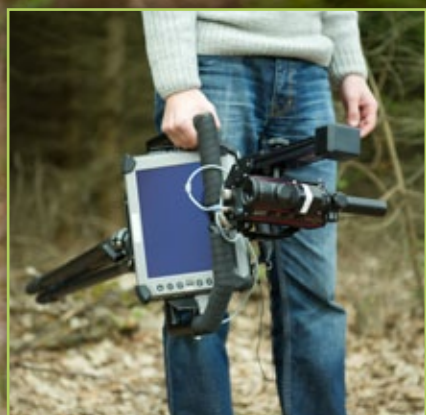
Optical scope

Laser range-finder

Computer frame

Field-Map software

Rugged tablet computer



Carbon tripod

Antelope

Suitable for complex mapping which requires a lot of movement of the equipment. This is typically detailed mapping of small inventory plots.

Electronic compass

Optical scope

Laser range-finder

Computer frame

Rugged tablet computer

Field-Map software



Monopod



Total weight: 7.7 kg

Hippo

A lighter hardware set for higher number of measurements taken from one place. It enables higher-precision measurements of horizontal angles on plots where a compass cannot be used due to magnetic anomalies.

Multifunctional laser range-finder

Angle encoder

Rugged tablet computer

Carbon tripod

Total weight: 6 kg

Rhino

This combination of devices is suitable for high precision measurements (with an emphasis on distance measurement precision) taken from one place. It can be used on plots with magnetic anomalies.



Optical scope



Laser range-finder



Angle encoder

Rugged tablet computer

Field-Map software

Computer frame



Carbon tripod

Total weight: 8.5 kg

Butterfly

Hardware set for simple projects where weight of the equipment matters the most but the highest possible precision of measurement is still required. Two PDA alternatives.

Electronic compass

Optical scope

Laser range-finder

Monopod

Rugged pocket PDA

Field-Map LT software

PDA frame



Dragonfly

The lightest of all monopod/tripod alternatives. Suitable for simple mapping at individual tree level and simple inventory projects. Two PDA alternatives available, both running Field-Map LT software.

Electronic compass and
laser range-finder

Rugged PDA

Field-Map LT software

Monopod



Total weight: 2.5 kg

Elephant

Wireless connection between the field computer and laser range-finder/compass via bidirectional Bluetooth solution reaching up to 100 m is fully supported by Field-Map software and enables many various working designs. Weight of the equipment as well as the specific working tasks might be distributed between two members of the field team aiming at maximum efficiency of fieldwork.

Bluetooth



Harness

Rugged tablet computer

Field-Map software



Total weight: 5.1 kg

Grasshopper

Grasshopper is the lightest set. Although it only runs Field-Map LT software, it is successfully used for precision inventory measurements of dendrometric parameters. Different field computer alternatives are available depending on user's preferences: conveniently large screen vs. full alphanumeric keyboard.

Electronic compass
and laser range-finder

Field-Map LT software

Rugged Notepad

Total weight: 1.2 kg

Parrot

Hardware set for GPS mapping.
Precise GPS in combination with
digital maps makes orientation in
the field faster and easier.



GPS antenna

GPS

Rugged tablet computer

Field-Map software

Total weight: 2 kg

Birdie

A combination of light equipment and full-featured mapping software. Easily operated by a single worker. Together with an optional electronic caliper, this set is a quick and convenient solution for forest management planning measurements.

Electronic compass and
laser range-finder

GPS



Electronic caliper

Ultra mobile computer

Field-Map software

Total weight: 1.5 kg

Stork

Light equipment with full-featured software held on monopod for easy movement in the terrain.

Electronic compass and laser range-finder

Ultra mobile computer

Field-Map software

Monopod

Total weight: 2.8 kg

Emu

High precision measurement devices combined with a mobile computer running full-featured software, attached to monopod for easy mapping.

Electronic compass

Optical scope

Laser range-finder

Wireless connection via
Bluetooth serial adapter

Ultra mobile computer

Computer frame

Field-Map software

Monopod



Total weight: 4.1 kg

Hardware components



Armor X7 tablet computer

Fully rugged compact handheld computer, runs full Windows XP or 7 on a 1024 x 600 widescreen sunlight readable display.

Weight:	1300/1500 g (including 2 batteries [standard/high capacity])
Size:	22,5 x 15 x 3,5 cm
Power supply:	Li-ion battery (4-5 hours [standard]/8-10 hours [high capacity])
Temperature range:	-20°C to +60°C
Resistance:	dust and rain (IP 65)
Processor:	Intel® N450 Pineview-M 1.66 GHz
Memory:	2 or 4 GB, DDR2 SDRAM, 40GB/80GB mSATA/SSHD
Display:	7" WSVGA 1024 x 600 Touch or Dual Mode



Armor X10gx tablet computer

The tablet offers connectivity capabilities such as Gobi™ Wireless Broadband, RF Switching, Integrated GPS, 802.11n Connectivity, Bluetooth® Wireless and is MIL-STD-810G and IP67 certified.

Weight:	2200 g (including handle and one battery)
Size:	28 x 21,6 x 4,5 cm
Power supply:	Li-ion battery (4 hours)
Temperature range:	-20°C to +60°C
Resistance:	dust and rain (IP 67)
Processor:	Intel® Core2 Duo™ 1.2GHz Processor SU9300
Memory:	2GB/4GB DDR3 800MHz SDRAM
Display:	10.4" XGA 1024 x 768 Transmissive sunlight-readable LCD



Recon pocket PC

Light and rugged Pocket PC computer with serial port and Bluetooth. This pocket PC computer runs Field-Map LT only (for more details, see the Features supported in Field-Map vs. Field-Map LT table in the software section).

Weight:	490 g including rechargeable powerboot module
Size:	16,5 x 9,5 x 4,5 cm
Power supply:	3800 mAh NiMH rechargeable pack (12-30 hours)
Temperature range:	-30°C to +60°C
Resistance:	waterproof (IP 67)
Processor:	400 MHz Inter XScale
Memory:	64-128 Mo SDRAM
Display:	240 x 320 pixels (1/4 VGA) color with LED front light



Archer Ultra Rugged PDA

A rugged PDA built for the field. It is waterproof and dustproof (IP67) featuring long battery life, sunlight readable display, and operation in extreme temperature. Integrate GPS, WiFi and RFID.

Weight:	482 g
Size:	16,5 x 8,9 x 4,3 cm
Power supply:	Lightweight Li-Ion battery pack, 14.04 W-h (20 hours)
Temperature range:	-30°C to +55°C
Resistance:	waterproof and dustproof (IP 67)
Processor:	Intel XScale PXA270, 520 MHz
Memory:	128 MB low power RAM
Display:	240 x 320 pixels (QVGA), sunlight-readable LCD



Mesa Rugged Notepad

A rugged handheld tablet PC with a speedy Windows Mobile® 6.5.3 operating system that features enhanced pan and flick gestures, improved memory management, and finger-friendly screens. Provides a battery life that lasts all day (up to 16 hours).

Weight:	998 g including two batteries
Size:	13,6 x 22,0 x 5,1 cm (Geo models)
Power supply:	two slots for Li-Ion batteries, 18.87W-h (16 hours)
Temperature range:	-20°C to +50°C
Resistance:	waterproof and dustproof (IP 67)
Processor:	806 Mhz PXA320
Memory:	256 MB RAM
Display:	640 x 480 pixels, color VGA, high visibility backlit LCD



Allegro MX Rugged Handheld

Ultra-rugged Allegro MX Field PC with a robust full alphanumeric keyboard is built to perform in the most demanding outdoor environments.

Weight:	840 g
Size:	25,6 x 13,3 x 7,9 cm
Power supply:	Rechargeable 4000mAh NiMH battery (8-10 hours)
Temperature range:	-30°C to +54°C
Resistance:	waterproof and dustproof (IP 67)
Processor:	624Mhz PXA270
Memory:	128MB RAM
Display:	320 x 240 pixels, daylight readable color LCD



SX Blue II GPS

GPS with good performance in forestry applications and other difficult mapping environments where GPS reception is limited. Working with WAAS, EGNOS, MSAS and compatible.

Weight:	464 g including battery
Size:	14,1 x 8,0 x 4,7 cm
Power supply:	Field replaceable Li-ion pack (10 hours)
Resistance:	waterproof (IP 67)
DGPS Horizontal Accuracy:	< 60 cm 2dRMS, 95% confidence
Horizontal Accuracy:	< 2,5m 2dRMS, 95% confidence
Antenna weight (without cable):	79g (with removable magnet mount)
Antenna size:	5.5 diam. x 2.2 cm



SX Blue II B GPS

GPS with good performance in forestry applications and other difficult mapping environments where GPS reception is limited. Working with WAAS, EGNOS, MSAS and compatible. The GPS has built-in DGPS Beacon receiver

Weight:	517 g including battery
Size:	14,1 x 8,0 x 4,7 cm
Power supply:	Field replaceable Li-ion pack (11 hours)
Resistance:	waterproof (IP 67)
DGPS Horizontal Accuracy:	< 60 cm 2dRMS, 95% confidence
Horizontal Accuracy:	< 2,5m 2dRMS, 95% confidence
Accuracy: (SBAS, Beacon)	< 30cm HRMS, < 25cm CEP
Antenna weight (without cable):	262g (with removable magnet mount)
Antenna size:	7.6 x 7.8 cm

	SX Blue II	SX Blue II-L	SX Blue II-B	SX Blue III	SX Blue III-L
GPS Frequency	L1	L1	L1	L1/L2	L1/L2
SBAS	■	■	■	■	■
OmniSTAR®*	VBS			VBS / XP /HP	
Radio Beacon	■				
External Differential Input**	RTCM 2.3	RTCM 2.3	RTCM 2.3	RTCM 3.0, CMR, CMR+, ROX	RTCM 3.0, CMR, CMR+, ROX
RTK Base/Rover Options	■	■	■	Standard	■
Bluetooth Port	■	■	■	■	■
RS-232 Port	■	■	■	■	■
USB Port	■	■	■	■	■
20Hz Option	■	■	■	■	■
Battery Autonomy (Approximate)	15 hours	9.5 hours	12 hours	9 hours	7.5 hours

* For more information on OmniSTAR parameters, see the OmniSTAR website: <http://www.oxts.com>.

** Various Differential-GPS correction formats.



Qstarz GPS BT-Q1000XT

GPS module with Bluetooth communication.

Weight:	100 g
Size:	7,2 x 4,7 x 2,0 cm
Number of channels:	66 CH performance tracking
Temperature range:	-10 oC / +60 oC
GPS chip:	MTK II GPS module
Antenna (internal)	Built-in patch antenna with LNA
GPS Protocol	NMEA 0183
Horizontal Accuracy	3.0m 2D-RMS<3m CEP(50%) without SA



Forest Pro

Rugged and waterproof laser range-finder and inclinometer built for every working environment.

Weight:	1000 g
Size:	15.2 x 6.4 x 12.7 cm
Power supply:	2 AA batteries (20 hours)
Temperature range:	-30 to +60°C
Resistance:	waterproof (IP 67)
Accuracy (distance):	3 - 5 cm typical
Accuracy (inclination):	0.1°
Measurement range:	up to 575 m



Impulse

Rugged and waterproof laser range-finder and inclinometer built for every working environment. A removable foliage filter enables to measure to non-reflective targets such as trees as well as reflective targets such as measuring pole reflectors.

Weight:	1000 g
Size:	15.2 x 6.4 x 12.7 cm
Power supply:	2 AA batteries (20 hours)
Temperature range:	-30 to +60°C
Resistance:	waterproof (IP 67)
Accuracy (distance):	3 - 5 cm typical
Accuracy (inclination):	0.1°
Measurement range:	up to 575 m



	Impulse 100	Impulse 200	Impulse 200 LR	Impulse 200 XL	Impulse XL	Forest Pro
Measures Height, HD, VD and INC		■	■	■		■
Measures also without reflector	■	■	■	■	■	
Max Range up to 250 m	■	■				
Max Range up to 500 m			■			■
Max Range up to 1000 m				■	■	
Built-in Serial Port	■	■	■	■		■



TruPulse

Compact and lightweight laser range-finder and inclinometer combined with electronic compass. Data communication is available through standard serial port or via optional Bluetooth.

Weight:	220 g
Size:	12 x 5 x 9 cm
Power supply:	2 AA batteries
Temperature range:	-20 to +60°C
Resistance:	water and dust (IP 54)
Accuracy (distance):	±30 cm; typical
Accuracy (inclination):	±0.25°; typical
Accuracy (azimuth):	±1 °; typical
Range measurement	up to 1 000 m; typical

TruPulse “Dendroscope”

The optional reticle for the laser range-finder TruPulse makes it possible to measure tree and branch diameters at various heights. The accuracy of diameters measured by the scope depends on the measurement distance. Usually the measurement error is within 1-2 cm for diameters around 30-50 cm. Moreover, TruPulse Dendroscope has an additional reticle for angle count sampling (basal area factors 0.16, 1, 2 and 4). The Dendroscope provides the functionality of relascope® including automatic slope correction.

Zoom:	7x
Accuracy (diameter):	3%; typical



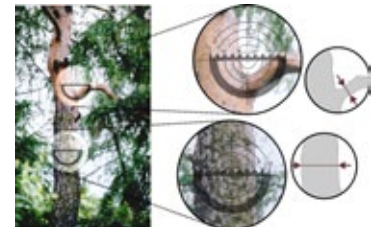
	TruPulse 200	TruPulse 200 B	TruPulse 200 Dendroscop	TruPulse 200 B Dendroscop	TruPulse 360	TruPulse 360 B	TruPulse 360 Dendrosc.	TruPulse 360 B Dendrosc.
Horizontal, Vertical and Slope distance	■	■	■	■	■	■	■	■
Inclination and Height	■	■	■	■	■	■	■	■
Built-in Compass (Azimuth)					■	■	■	■
Missing Line Routine					■	■	■	■
Advanced Targeting Modes	■	■	■	■	■	■	■	■
Built-in Serial Port	■	■	■	■	■	■	■	■
Bluetooth® Communication		■		■		■		■
Remote diameter			■	■			■	■
Angle count function			■	■			■	■



Scope for diameter measurement

The optional scope for laser range-finder makes it possible to measure tree and branch diameters at various heights. The scope includes optical zoom. The accuracy of diameters measured by the scope depends on the measurement distance and actual zooming factor. Usually the measurement error is within 1-2 cm for diameters around 30-50 cm.

Weight:	460 g
Size:	27 x 4 cm
Zoom:	1.5x - 3.5x
Temperature range:	-30 to +60°C
Accuracy (diameter):	3%



Criterion RD 1000 relascope

In-scope LED offers adjustable brightness levels and projects a measurement bar scale. Attachable Magnifier can be used in situations that require maximum measurement resolution.

Weight:	550 g
Dimension:	(7 cm x 5 cm x 16.5 cm)
Operating temperature:	-30° C to +60° C
Power:	3.0 volts DC nominal.
Diameter accuracy:	± 6 mm up to 24 m away
Inclination accuracy:	±0.1°
Height accuracy:	3 cm
IP:	54



MapStar Compass Module II

The MapStar compass module for measuring horizontal angles integrates seamlessly with ForestPro and Impuls laser range-finders.

Weight:	570 g
Size:	31 x 5 x 2.5 cm
Power supply:	2 AA batteries (16 hours)
Temperature range:	-30 to +50°C
Resistance:	Water and dust (IP 54)
Azimuth accuracy:	+/- 0.3 °
Azimuth resolution:	0.01°





MapStar TruAngle

The TruAngle calculates a turned horizontal angle that can be referenced to any desired point or direction. It works in conjunction with TruPulse, ForestPro and Impulse laser rangefinders providing the best possible accuracy. The TruAngle is never affected by local magnetic interference.

Weight:	1000 g
Size:	14,2 x 11,7 x 11,7 cm
Power supply:	2 batteries type AA (8 hours)
Temperature range:	-30 to +50°C
Resistance:	IP 54
Azimuth accuracy:	- 0,05° on tripod
Azimuth resolution:	0,01°



MapStar Angle Encoder

The MapStar Angle Encoder calculates a turned horizontal angle that can be referenced to any desired point or direction. It works in conjunction with ForestPro and Impulse laser rangefinders providing the best possible accuracy. The MapStar Angle Encoder is never affected by local magnetic interference.

Weight:	1600 g
Size:	11 x 10 x 6,5 cm
Power supply:	2 batteries type C (7 hours)
Temperature range:	-30 to +50°C
Resistance:	IP 54
Azimuth accuracy:	- 0,05° on tripod
Azimuth resolution:	0,01°





Measuring pole

Measuring pole is used in measurements with laser, where reflective targets are needed.

Weight:	400 g
Length:	2 m
Transport length:	1 m



Circular reflector

Circular reflector with metal clamp. Lasers can bounce of the circular reflector up to 50-60 m.

Weight:	110 g
Size:	9 cm diameter



Cylindrical reflector

Cylindrical reflector with metal clamp. Lasers can bounce of the cylindrical reflector up to 30-40 m.

Weight:	180 g
Size:	6 cm diameter and 8 cm height



Level for reference pole

Level to be attached to basic measuring pole.

Weight:	42 g
Diameter:	2 cm



Telescopic measuring pole

Height of the reflective target can be adjusted up to 4,6 m.

Weight:	2800 g
Maximum length:	4,6 m
Minimum length:	1,50 m



Reflective prism

Lasers can bounce off the prism from the distance up to 200 m.

Weight:	490 g
Size:	7 x 5 cm



Attachment pole for reflective prism

Extension to be used together with telescopic measuring pole.

Weight:	145 g
Length:	18 cm



Tripod Gitzo Mountaineer 6X

Light and durable carbon fibre tripod with extra levelling knot.

Weight:	1370 g
Minimum height:	65 cm
Maximum height:	161 cm
Load capacity:	12 kg



Monopod Manfrotto 691B

Robust three section monopode with rubber grip and quick leg lock system.

Weight:	780 g
Minimum height:	67 cm
Maximum height:	161 cm
Load capacity:	12 kg



Harness

Harness is adapted to body shape for easy computer carrying, user can keep hands free. It can be folded close to body for easy walking.

Weight:	2300 g
Size:	60 cm



PDA frame

PDA frame for fixing pocket computer on monopod or tripod. The frame contains serial port plug.

Weight:	280 g
Size:	21 x 12 cm



Frame for Hammerhead computer (without port replicator)

Computer frame enables to fix a field computer to a monopod or tripod. The computer pad is made inclinable for easy reading of the computer screen.

Weight:	1300 g
Size:	43 x 28 cm



Frame for Armor X10gx computer (including port replicator)

Computer frame including port replicator with two COM ports.

Weight:	1500 g
Size:	43 x 28 cm



Frame for Armor X7

Inclinable frame for Armor X7 tablet computer. The frame is shown mounted on monopod.

Weight:	1260 g
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Bracket for TruPulse Laser range-finder

Monopod mounting for TruPulse laser range-finder.

Weight:	444 g
Height:	22 cm



Cable 4 pin LTI - 4 pin LTI

Cable connecting LTI laser range-finder with MapStar compass module.

Weight:	28 g
Length:	60 cm



Cable 4 pin LTI - DB9 pin (COM)

Cable connecting MapStar compass module with field computer.

Weight:	38 g
Length:	60 cm



Cable 3 pin LTI - DB9 pin (COM)

Cable connecting Bluetooth serial line expander with field computer.

Weight:	28 g
Length:	30 cm



Cable 3 pin LTI - 3 pin LTI

Cable connecting Bluetooth serial line expander with MapStar compass module.

Weight:	16 g
Length:	22 cm



Port replicator for Hammerhead and Armor X10 computers

Lightweight and small Universal Port replicator offers a way to add additional COM, USB, VGA, and PS/2 connectors to Armor computers.

Weight:	200 g
Size:	58 x 91 x 20 mm
Resistance:	IP 50
Compliance:	RoHS and Lead-free





Bluetooth serial line expander

Bluetooth Serial Line Expander is a wireless serial adapter based on Bluetooth technology. It enables the RS232 serial devices to communicate wirelessly throughout the range up to 100m.

Weight:	250g (2 pieces)
Size:	6 x 5,5 x 2,5 cm
Power supply:	1 AA battery (24 hours)



External rechargeable battery

External Lithium-ion rechargeable battery allows to work entire day without need to recharge the computer.*

Voltage:	14,4 V
Capacity:	5 Ah
Weight:	520 g
Size:	76 x 65 x 37 mm



Internal battery for field computer

Suitable for Armor X10, Armor M10 and Hammerhead computers.*

Weight:	165 g
Capacity:	2,4 Ah



Internal batteries for Armor X7 field computer

Two lithium polymer 2-cell battery packs.*

Weight:	280 g
Capacity:	5,9 Ah each

* For further advice, please refer to the Lithium-Ion Battery Maintenance Guidelines leaflet provided by IFER Ltd. together with your delivery.



Panoramic head for tripod

Easy to turn and fix head for tripod.

Weight:	207 g
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GPS mounting

GPS mounting for MapStar compass module.

Weight:	120 g
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Protecting case for field computer

The protected case is made of waterproof fabric. It is supplied with shoulder strap for carrying. It helps to protect computer screen from scratches.

Weight:	180 g
Size:	36 x 29 cm



Carrying and protecting case for Field-Map sets

Carrying case is made from waterproof fabric. It is supplied with shoulder strap for carrying. It is mainly designed to protect equipment against heavy rain.

Weight:	300 g
Size:	87 x 55 cm
Resistance:	Waterproof



Carrying case for external Li-On battery

Carrying bag for external battery.

Weight:	60 g
Size:	13 x 9 x 4 cm



Carrying case for cylindrical reflector

Carrying bag for cylindrical reflector to protect the reflector from scratches.

Weight:	60 g
Size:	13 x 9 x 4 cm

What is IP

The IP Code (or International Protection Rating) consists of the letters IP followed by two digits and an optional letter. It classifies the degrees of protection provided against the intrusion of solid objects (including body parts like hands and fingers), dust, accidental contact, and water in electrical enclosures. The standard aims to provide users more detailed information than vague marketing terms such as waterproof.

The digits indicate conformity with the conditions summarized in the tables below. Where there is no protection rating with regard to one of the criteria, the digit is replaced with the letter X.

First digit in the IP code	Object size protected against	Effective against
0	-	No protection against contact and ingress of objects
1	>50 mm	Any large surface of the body, such as the back of a hand, but no protection against deliberate contact with a body part
2	>12.5 mm	Fingers or similar objects
3	>2.5 mm	Tools, thick wires, etc.
4	>1 mm	Most wires, screws, etc.
5	dust protected	Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment; complete protection against contact
6	dust tight	No ingress of dust; complete protection against contact

Second digit in the IP code	Protected against	Details
0	not protected	-
1	dripping water	Dripping water (vertically falling drops) shall have no harmful effect.
2	dripping water when tilted up to 15°	Vertically dripping water shall have no harmful effect when the enclosure is tilted at an angle up to 15° from its normal position.
3	spraying water	Water falling as a spray at any angle up to 60° from the vertical shall have no harmful effect.
4	splashing water	Water splashing against the enclosure from any direction shall have no harmful effect.
5	water jets	Water projected by a nozzle against enclosure from any direction shall have no harmful effects.
6	powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.
7	immersion up to 1 m	Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time (up to 1 m of submersion).
8	immersion beyond 1 m	The equipment is suitable for continuous immersion in water under conditions which shall be specified by the manufacturer. Normally, this will mean that the equipment is hermetically sealed. However, with certain types of equipment, it can mean that water can enter but only in such a manner that produces no harmful effects.

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