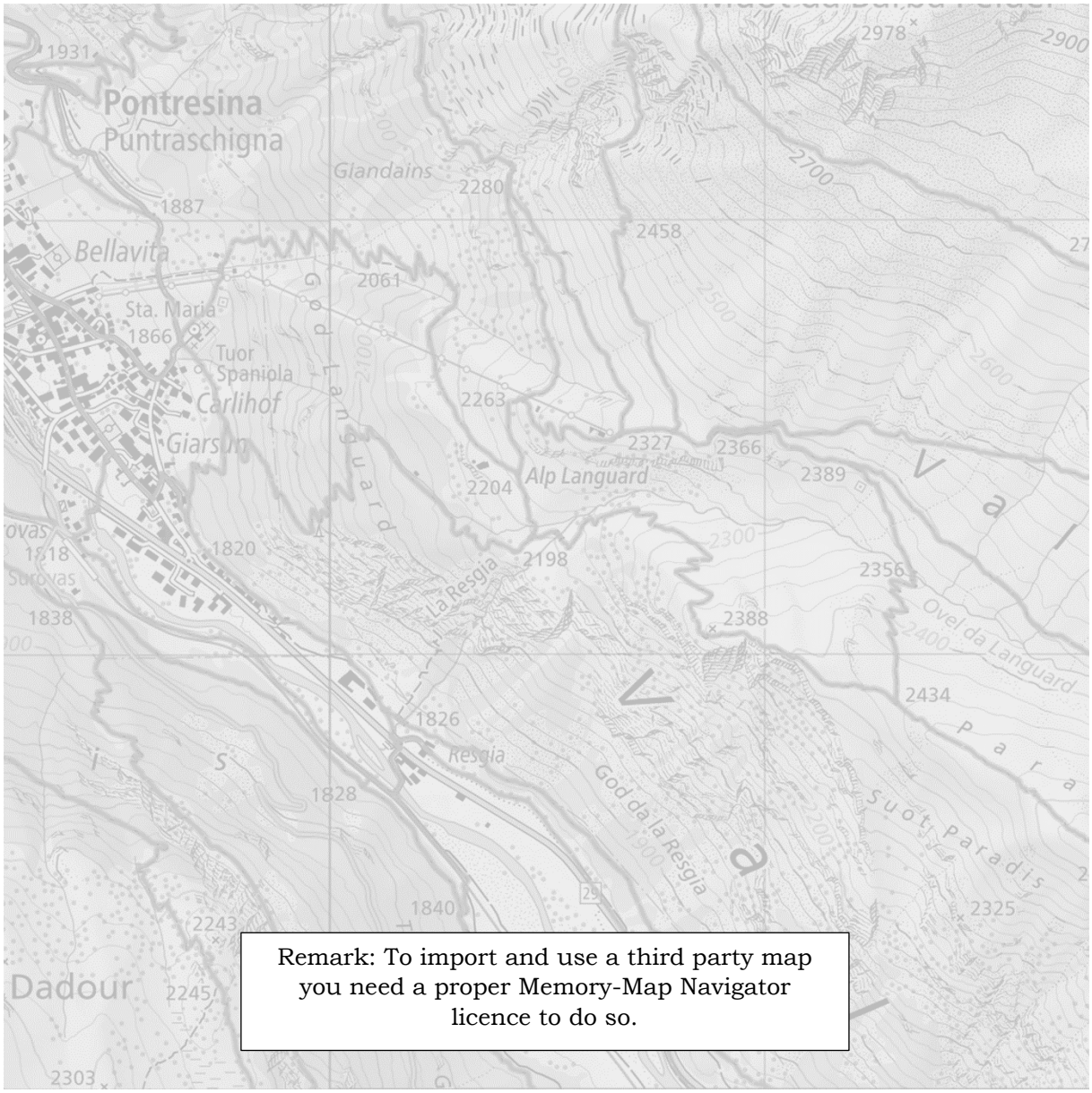
Project Maps for Memory Map (M4MM)
The cookbook

By Hans Kok (info@hzns.nl)

Version: 1.0.0 (Pontresina) July 1. 2022



Remark: To import and use a third party map you need a proper Memory-Map Navigator licence to do so.

Change log

This change log covers 'The cookbook'.

Version	Date	Remarks
0.6.0 (Zwolle)	August 6. 2021	Full initial version of the project, including the complete documentation and the application M4MM. It replaces all earlier versions. • Added Print function to the application and implemented in 'The cookbook'. • Changed vertex polygon to boundary (in text, more in line of Memory-Map nomenclature) in application and 'The cookbook'. • Changed data structure of JPR data (`cu` is now contour unit (unit of height); `cs` (coordinate system) became `gs` (grid system) and cu (coordinate system unit) became gu (grid system unit) in the application and in 'The cookbook'. •
0.7.0 (Woombah)	November 1. 2021	• Change of data structure (dot size and pixel size double precision). • Added scale selection box to the application and implemented in 'The cookbook'. • Implementation of scale and resolution as estimated values. • Changed handling images (up to 2 G byte of pixel information). • Some editorial changes (text and images) in relation to small changes in the application.
0.8.0 (Blaine)	November 21. 2021	• Change of development environment (Microsoft Visual Studio 2022 (Basic) community).
0.9.0 (Whistler)	March 15. 2022	• Added `ITRF92`, `ITRF2008` and `GDA94` to application. • Updated Paint.Net instructions (to latest version 4.3.8). • Added GIMP instructions
1.0.0 (Pontresina)	July 1. 2022	• Checked and updated "The Cookbook". •

Test log

Version M4MM	Application	Version application
0.6.0 (Zwolle)	Memory-Map	5.4.4 (build 1113) and 6.4.3 (build 1278)

	Gdal	3.0.4, 3.1.4 and 3.3.0
	QGIS	3.10.14 (LTR), 3.16.8 (LTR) and 3.20.0
	MOBAC	2.1.4 and 2.2.0
	Paint.Net	3.2.15, 3.2.16
	PDF-Exchange Editor	9.0 (build 352.0), 9.1 (build 354.0)
0.7.0 (Woombah)	Memory-Map	5.4.4 (build 1113), 6.4.3 (build 1278)
	Gdal	3.3.1
	QGIS	3.16.11 (LTR) and 3.20.3
	MOBAC	2.2.0 (build 2584)
	Paint.Net	4.3.2
	PDF-Exchange Editor	9.1 (build 354.0)
0.8.0 (Blaine)	Memory-Map	5.4.4 (build 1113), 6.4.3 (build 1278)
	Gdal	3.3.2
	QGIS	3.16.11 (LTR) and 3.22.0
	MOBAC	2.2.0 (build 2584)
	Paint.Net	4.3.2
	PDF-Exchange Editor	9.2 (build 357.0)
0.9.0 (Whistler)	Memory-Map	5.4.4 (build 1113), 6.4.3 (build 1278)
	Gdal	3.1.4 and 3.4.1
	QGIS	3.22.4 (LTR) and 3.24.0
	MOBAC	2.2.2 (build 2628)
	Paint.Net	4.3.8
	GIMP	2.10.30
	PDF-Exchange Editor	9.2 (build 359.0)
1.0.0 (Pontresina)	Memory-Map	5.4.4 (build 1113), 6.4.3 (build 1278)
	Gdal	3.1.4 and 3.4.3
	QGIS	3.22.7 (LTR) and 3.24.3
	MOBAC	2.2.3.2 (build 2678)
	Paint.Net	4.3.11
	GIMP	2.10.30
	PDF-Exchange Editor	9.3 (build 361.0)

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Introduction

About the project Maps for Memory-Map

The document you just opened is 'The cookbook' for the project Maps for Memory-Map (M4MM). The aim of the project is to make more maps available for Memory-Map. If you have a licence to import third party maps you may search for these maps on the internet. You may, like me, be disappointed of the amount of ready to use maps. This project M4MM may be the solution. It helps you to create your own maps.

Besides 'The cookbook' there is an application M4MM which automates several steps of the conversion process, a 'Cover document' which is a general description of the project and 'Technical document' which gives a lot of technical background information about the development of the project and the application.

The project uses besides the application M4MM some other applications. The first one is the Geospatial Data Abstraction Library (GDAL). Its provides the necessary functionality to extract information from several graphical image files and to convert graphical images files to other formats without losing the necessary georeferenced information.

A second application is QGIS, a geographical information system. Its provides additional functionality to handle images with georeferenced information. If you install QGIS you don't need to install GDAL, QGIS contains GDAL.

The third application is one to handle raster graphical images. Although you may choose you own, the auteurs choice is Paint.Net. It can handle large images (above 10,000 by 10,000 pixel) and doesn't has (in most cases) a color cast when reducing color depth. GIMP may an alternative which has an option to reduce color depth without losing GeoTIFF-data.

The fourth application is a PDF reader/viewer/editor with the following functions: an export function to a graphics file format, preferably PNG and 8 bit color depth, selecting layers to be exported and changing the export resolution. The auteurs choice is PDF Exchange Editor. In its free version it provides all the necessary functionality.

The last application you may need is a text editor. The choice is all yours. The only important thing: it must read and write plain text like Windows Notepad. For small changes a simple editor is added to the application M4MM.

About this document

'The cookbook' is an users document, it will provides the user with the 'recipes' (workflows) and instruments to convert images of a map into an usable map for Memory-Map. It consists of six parts. The first one is this Introduction. The second part contains the Workflows. They will tell you step by step what to do to create a map for Memory-Map. Part three is more or less the manual for the application M4MM, which automates as much as possible steps (to prevent small errors resulting in disappointments). Part four is an addition to the official Memory-Map manual. It explains in more detail the subjects like 'Calibration', 'Merging maps', 'Boundary' and 'Map grids'. The fifth part describes the steps done with third party applications. The last part give some background information of related subjects.

About the history

In 2019 I started a project to develop some small applications to covert several georeferenced map formats into an image with a Memory-Map calibration file. In 2020 I made the step to integrate these applications and develop a more inclusive project based on workflows. In 2021 the project became mature; all documentation in place and the application in its first beta version (0.6.0/august 2021). In the autumn of 2021 some functions were added or extended and some flaws were solved (0.7.0). The application was compiled for 64 bits Windows. In November 2021 a new beta version was released (0.8.0). The release candidate (0.9.0) was released in march 2022 with adding GIMP as graphics application and some

refinements in the conversion of pixel coordinates. The format release is 1.0.0 in July 1. 2022.

About the author

As a retired officer of the Dutch army I learned to appreciate a good map. When the multi folded ones became an electronic handheld, I was an early user. On a holyday in 2004 in Canada I learned to use Memory-Map, navigating through the terrain without an internet connection. After buying a third party map licence I became an enthusiast collector of offline electronic maps. If necessary I created them myself (for all my holydays).

Building applications with Visual Basic is one of my other hobbies. The project M4MM is the synergy between both hobbies.

I do have a website www.hzns.nl where you can find additional information to make your own map and where to find on- and offline maps.

About legal stuff

Maps for Memory-Map (M4MM)

The project M4MM (including the application) provides information and tools 'As is'. The use of the information and the application is on your own risk. Direct or indirect damage by using this application is users responsibility/risk, not the application-builders, even if you get lost somewhere in the bush. Redistribution of any part of the project M4MM by a third party (commercial of non-commercial) is prohibit. Download the application direct from https://www.hzns.nl.

The information used to build the tools for the project M4MM (application and documentation) was collected from open sources, manuals and observations of the behaviour Memory-Map. The code of Memory-Map was never reverse-engineered, decompiled or disassembled.

GDAL

The application of the project M4MM uses GDAL/OGR which is licensed under an MIT/X style license with the following terms: Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the 'Software'), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

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Workflows

The intention

The workflows describe the processes to convert the source files/maps to the Memory-Map QCT-files. Step by step they will tell you what to do. There will links to subjects (with more explanation) in M4MM explained, Relevant Memory-Map functions explained and Some third party software explained. A special case is Preparing M4MM. In this flow the installation of M4MM and necessary applications will be explained.

The workflows will describe the process in their full extent. If you want to convert a set of map, you may leave some steps out (for example the examining step).

Preparing M4MM

The best way to prepare the application M4MM project is to install all the supporting applications before installing the application M4MM. In this case you don't have to bother about the installation of these applications during the conversion of a map. May be it is also a good moment to familiarize with these applications.

M4MM relays on the functionality of GDAL. So before installing M4MM it is necessary to install GDAL or QGIS.

M4MM needs a graphics application which can reduce the color depth of an image. If you haven't one, you may consider Paint.NET or GIMP. These application can handle very large files (in pixel and in bytes) and does not have a colorcast (in the standard setup).

If you are going to handle GeoPDF-files you need application which can convert PDF-files into a graphics-file (PNG or TIFF). If you haven't one you may consider PDF Exchange Editor.

If you are going to create maps using MOBAC you are advised to install this application before installing M4MM.

The last step is installing M4MM. Just download the software from www.hzns.nl, unzip the files and run setup. When the installation is finished, run M4MM for the first time and find the file `OSGEo4W.bat`.

From Image to QCT with Memory-Map (native)

Memory-Map itself has an option to calibrate maps. To do so you need a PNG-file of your image with a color depth of 256 colors or less. If necessary You need to convert your image to these specifications. You can do this with nearly any pixel based graphics application. If you haven't your own "preferred" application Paint.NET or GIMP are good options.

Warning: In the Memory-Map Navigator version 6 is a bug in the calibration functionality. It will be explained in the paragraph Calibration step by step/First option. If you have or can find a version 5.4.4. use that version to calibrate your map.

The first step is to exam you image, the second step will be, if necessary, the conversion of the image. The following steps will be the import, the selecting of the grid to be used, the actual conversion, the checking of the calibration and finish with adding information to your map.

The first step is examining your image. Start with the nature of the image itself, the file format (look at the files extension like `.GIF`, `.PNG` `.BMP` or `.JPG`) and the color depth. The later can be done with M4MM's info tool *Image-file* or looking at the file properties (Windows). You also need to find the geographical information about your map like projection, used grids/coordinates and geodetic datum, maybe you need to look for source for your calibration coordinates (more information). In some special cases you may need to look for a specific grid of your map.

The second step is, if necessary, the conversion of the image file to a PNG-file with a 8 bit color depth. Use a raster based graphics program. In the paragraphs about Paint.Net and or GIMP you will find the "how to do" for those applications.

The third step is importing your map, a strait forward procedure.

The following step is selecting the grid you are going to use to calibrate the map. If your map has one or more grids, use one of them, if possible Latitude/Longitude with decimal degrees (+/- dd.ddddd). If no grid is provided use the Latitude/Longitude with decimal degrees too. In some cases you may need to create and install an additional grid.

The fifth step is the actual calibration and the sixth te checking of that calibration. The fifth and sixth may an iterative process.

When you satisfied with the calibration the last step is adding data to the map. In the window *Edit Map Data* (6.4.3: *Map* > *Map Properties* > *Edit Map Properties*/ 5.4.4: *Map* > *Edit Map Properties*).

If you have scanned a paper map you may have a number of small maps. Consider to merge these maps into on bigger map.

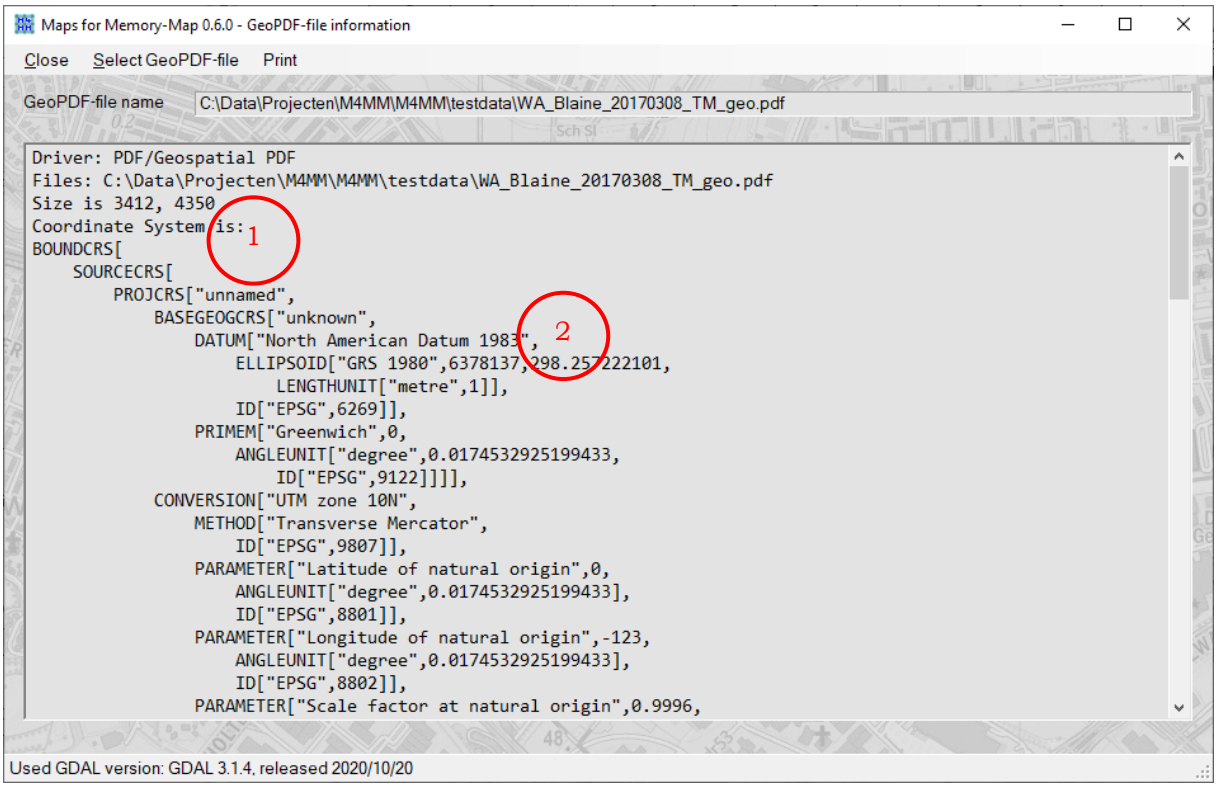
If you want to calibrate a series of maps do some prototyping and create base on your experience your own "Workflow".

From GeoPDF to QCT

- If you convert a GeoPDF- map for the first time please read the whole workflow before starting the process.
- If a PDF-map doesn't contain usable georeferenced data the process ends with step four and you must calibrate manually using Memory-Map.

The first step of the process is to check the file for usable georeferenced data. In the second step the image structure of the file will be examined. In the third step the export resolution will be established. In step four the PDF-File will be converted to a PNG-image In step five the JPR-file will be created and in the last step the map (PNG- and JPR-file) will be loaded into Memory-map to create a QCT-file.

Step 1: Not every PDF-file of a map contains proper georeferenced data. To check this open file in M4MM using the menu option *Information > GeoPDF-file*. The hidden meta data in the PDF-file will presented as "Well Known Text" version 2.0 (WKT).



If the fourth or fifth line contains the words "`Coordinate System is:`"(1) the PDF-file is georeferenced. If in the first ten lines the phrase "`DATUM`"(2) followed by "`World Geodetic System 1984`", "`WGS 84`", "`North American Datum 1983`", "`NAD 83`", "`Geocentric Datum of Australia 1994`", "`GDA 94`" or "`European Terrestrial Reference System 1989`" or "`ETRS 89`" is found, the georeferenced data can be converted to a JPR-file. In all other cases you may continue to step two, but the map must calibrated manually.

Step 2: To examining the image structure of the PDF-file it must be opened using a PDF-viewer/-editor. In this manual PDF-Xchange editor is used. When you opened your file, have a look on the layers of the file (activated the *Layers pane).* If there are no layers the nature of the image, pixel orientated or vector orientated must be determinated. To do so use the zoom tool. In a vector image the lines and characters stay sharp, in a pixel image the pixel structure will become visible. In case of layers the situation is more defuse. You have prioritize the layers. If the most important layers are pixel orientated (for example an aerial photo) you treat the PDF-file as a pixel-image, in other cases (for example the pixel-layer is the altitude shadow layer) treat the PDF-file as a vector-image.

Step 3: It needs a little bit tweaking to establish the best export resolution.

- For vector-images is 254 DPI a good (start) value, it means 100 pixel per cm. Create a provisional version and have a look on your image in an image viewer. Check if you can read the text and the image has (more or less) the same appearance as in your PDF-viewer/-editor. If the text isn't readable try an higher resolution (381 DPI/150 pixel per cm, 508 DPU/200 pixel per cm). If you like to shrink map You may try 127 DPI/50 pixel per cm). A lower resolution leads mostly to unreadable text. My advice: use 254 DPI.
- Most pixel-images are scanned maps. This means, most likely, a standard resolution is used. A good starting resolution is 150 DPI. Create a provisional version and view your image in an image viewer. Check if you can read the text and the image has (more or less) the same appearance as in your PDF-viewer/-editor. Special attention to lines (for example undotted lines must be undotted) and map symbols (are they understandable). If they aren't try a higher resolution (300 DPI). If you like to shrink your map, you may try 96 DPI or even 72 DPI.

Step 4: Having established the resolution (by trial and error) the production can start. Depending on the PDF-viewer/-reader use the export- or save-function. The "target"-file must be a PNG image-file (Memory-Map can only handle these type) with an 8 bit color depth (256 colors or less) and this image-file must have the same name as the (Geo)PDF-file (`yourmap.pdf` to `yourmap.png`).

Step 5: With M4MM the JPR-file will be created. Follow the instructions for the option *Build JPR-file > From a GeoPDF-file*. M4MM communicates with you:

- During the file selection M4MM checks the PDF-file for georeferenced data. If no usable data were found the application will tell you so.
- If a corresponding image-file is found (for example `yourmap.pdf` and `yourmap.png`) M4MM will ask you, during data extraction, which data (name and size) may be used for extraction.
- The next question is about a collar. In case there is no collar the boundary (boarder of the usable area of the map) will be constructed, based on the georeferenced data (corners of the map).
- In case there is a collar M4MM will check for a useable `NEATLINE` (area of interest) to construct a boundary. If you agree M4MM constructs the boundary based on that `NEATLINE`. If not, the boundary will be constructed based on the corners of the image. Be aware: the NEATLINE isn't always the same as the boundary. After creating a QCT-file check it!.
- If enough data are available you can change the resolution (DPI) during the building stage. The scale of the map changes accordingly.

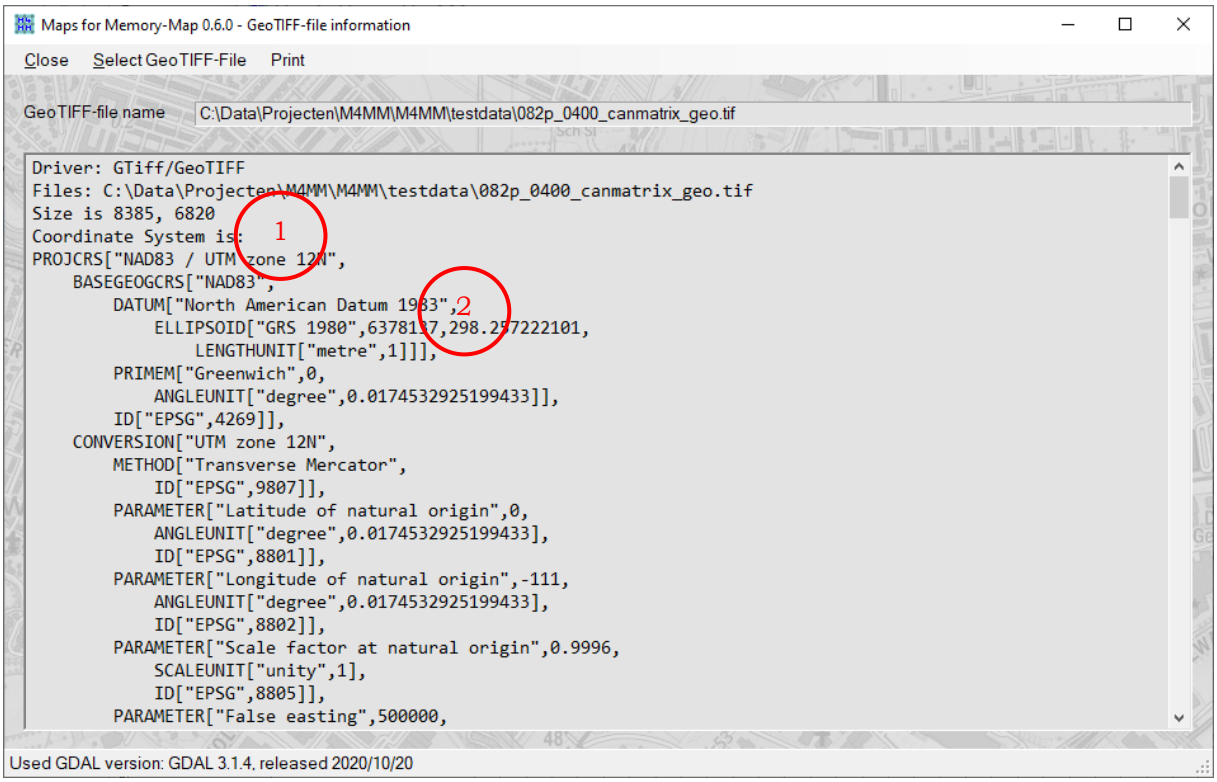
Step 6: Creation of the QCT-file is described in part three of this manual. Before opening Memory-Map copy your PNG- and JPR file in a directory Memory-Map can find

From GeoTIFF to QCT

- If you convert a GeoTIFF-map for the first time, please read the whole workflow before starting the process.
- If a TIFF- doesn't contain usable georeferenced data the process ends with step four and you must calibrate manually using Memory-Map.

The first step of the process is to check the file for usable georeferenced data and in step two color depth is established. Step three is decision time: which next step are necessary. Step four converts the color depth using QGIS. In step five the JPR-file will be created. Step six is about converting your image of TIFF-file to a PNG-file and in the last step the map (PNG- and JPR-file) will be loaded into Memory-map to create a QCT-file.

Step 1: Not every TIFF-file of a map contains proper georeferenced data. To check this open file in M4MM using the menu option *Information > GeoTIFF-file*. The hidden meta data in the TIFF-file will presented as "Well Known Text" version 2.0 (WKT).



If the fourth or fifth line contains the words "`Coordinate System is:`"(1) the TIFF-file is georeferenced. If in the first ten lines the phrase "`DATUM`"(2) followed by "`World Geodetic System 1984`", "`WGS 84`", "`North American Datum 1983`", "`NAD 83`", "`Geocentric Datum of Australia 1994`", "`GDA 94`", "`European Terrestrial Reference System 1989`", "`ETRS 89`", "`OSGB 36`" or "`British National Grid`" is found, the georeferenced data can be converted to a JPR-file. In all other cases you may continue to step two, but the map must calibrated manually.

Step 2: Memory-Map can only handle images with a color depth of 8 bit (256 colors) or less. To establish the need to convert a image, you must check the color depth. You can do this the M4MM option *Information > Image-file*.

Step 3: If your TIFF-file has usable georeferenced data and an 8 bit color depth, you can directly start with creating your QCT-file (step 7). In this case you don't need a JPR-file. If you have TIFF-file has usable georeferenced data a wrong color depth and installed QGIS you may continue with step 4. If you use GIMP you may continue with step 4 too. In the same case you installed only GDAL continue with step 5.

Step 4: QGIS and GIMP have the functionality to reduce the color depth without losing the georeferenced data. You will find the description in the QGIS paragraph "Converting GeoTIFF-file to 8 bit color depth" in this manual or the GIMP paragraph "Reduce the color depth to 8 bit (256 colors)". When done you can continue with step 7.

Step 5: With M4MM the JPR-file can be created. The details are described in part two of this manual. M4MM communicates with you:

- During the file selection M4MM checks the TIFF-file for georeferenced data. If no data were found the application will tell you so.
- M4MM will ask you about a collar. In case there is no collar the boundary (border of the usable area of the map) will be constructed, based on the georeferenced data (corners of the map).
- In case there is a collar M4MM will check for a useable `NEATLINE` (area of interest) to construct a boundary. If you agree M4MM constructs the boundary based on that `NEATLINE`. If not, the boundary will be constructed based on the corners of the image. Be aware: the NEATLINE isn't always the same as the boundary. After creating a QCT-file check it!.
- If enough data available you can change the resolution (DPI) during the building stage. The scale of the map changes accordingly.

Step 6: In this step the color depth will be reduced and the format of the TIFF-file to PNG using an external application. There are three reasons for changing the format: first the file will be compacter, second it can't contain georeferenced data (and can't interfere in creating a QCT-file) and third it doesn't destroy your original image. Important: Edit the JPR-file: change the Image Type in to PNG (`it=png`).

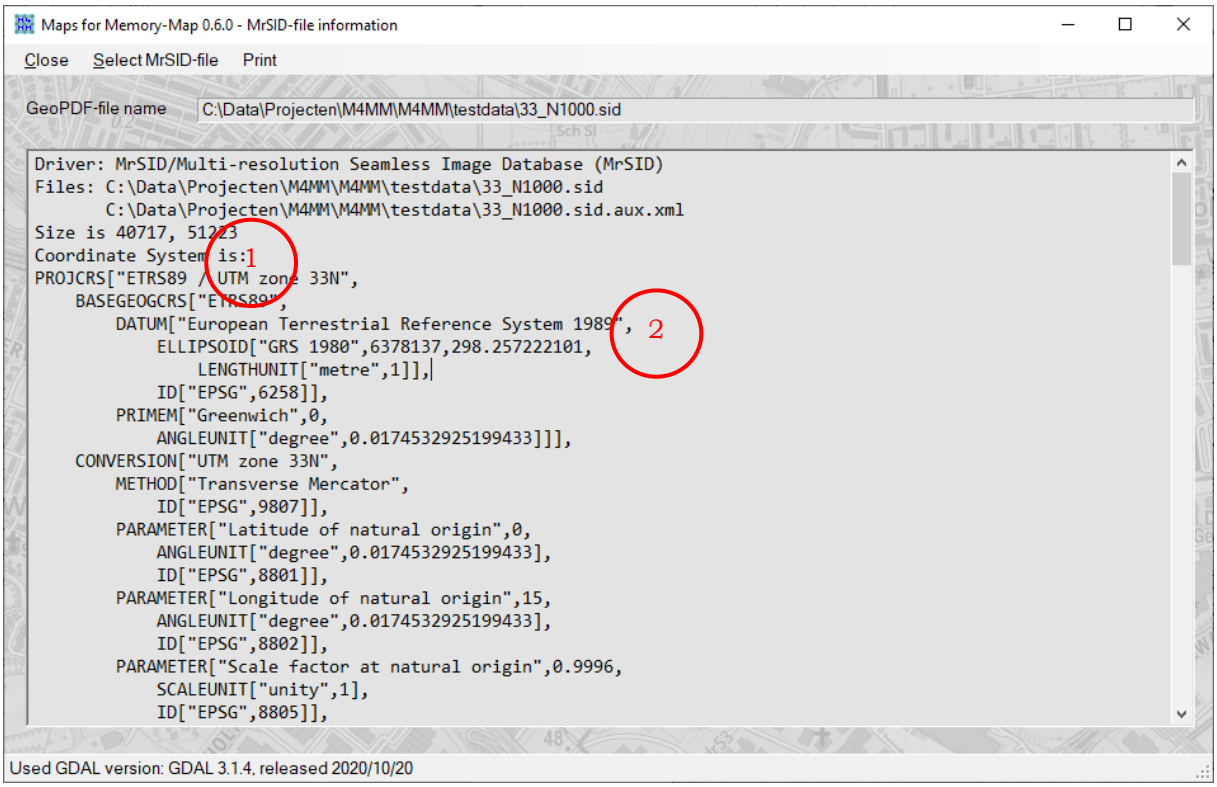
Step 7: Creation of the QCT-file is described in part three of this manual. Before opening Memory-Map copy your PNG- with related JPR-file in a directory where Memory-Map can find them.
If you have a GeoTIFF-file with proper georeferenced data and with a color depth of 8 bit or less you can directly create a QCT-map without a JPR-file. Just place your TIFF-file in a directory where Memory-Map can find it; no JPR-file is needed.

From MrSID to QCT

- If you convert a MrSID-map for the first time please read the whole workflow before starting the process.
- If a MrSID-map doesn't contain usable georeferenced data the process ends with step four and you must calibrate manually (using the Memory-Map manual).

The first step of the process is to check the file for usable georeferenced data. In step two the MrSIDD-File will be converted to a PNG-image. Step three is to establish the color depth of the PNG-image. In step four the color depth will reduced, if necessary, to 8-bit (256 colors). In step five the JPR-file will be created and in the last step the map (PNG- and JPR-file) will be loaded into Memory-map to create a QCT-file.

Step 1: Not every MrSID-file of a map contains proper georeferenced data. To check this open file in M4MM using the menu option *Information > MrSID-file*. The hidden meta data in the MrSID-file will presented as "Well Known Text" version 2.0 (WKT).



If the fourth or fifth line contains the words "`Coordinate System is:`"(1) the MrSID-file is georeferenced. If in the first ten lines the phrase "`DATUM`"(2) followed by "`World Geodetic System 1984`", "`WGS 84`", "`North American Datum 1983`", "`NAD 83`", "`Geocentric Datum of Australia 1994`", "`GDA 94`", "`European Terrestrial Reference System 1989`" or "`ETRS 89`" is found, the georeferenced data can be converted to a JPR-file. In all other cases you may continue to step two, but the map must calibrated manually.

Step 2: To convert the image of a MrSID-file to a PNG-file use the option *Tools > Convert MrSID-files* option in M4MM. Although Memory map can handle the TIFF-format there are two reasons to use the PNG-format: first the file will be compacter and second it doesn't contain georeferenced data (and can't interfere in the process of creating a QCT-file).

Step 3: Memory-Map can only handle images with a color depth of 8 bit (256 colors) or less. To establish the need to convert a image, you must check the color depth. You can do this the M4MM option *Information > Image-file*. If the color depth is 8 bit you can continue with step 5.

Step 4: In this step the color depth will be reduced to 8-bit using an external application. If the converted MrSID-file has a color depth of more than 24 bit, be aware of transparency.

Step 5: With M4MM the JPR-file will be created. Follow the instructions for the option *Build JPR-file > From a MrSID-file*. M4MM communicates with you:

- During the file selection M4MM checks the MrSIDD-file for georeferenced data. If no usable data were found the application will tell you so.
- If a corresponding image-file is found (for example `yourmap.sid` and `yourmap.png`) M4MM will ask you, during data extraction, which data (size and name) may be used for extraction.
- If enough data available you can change the resolution (DPI) during the building stage. The scale of the map changes accordingly.

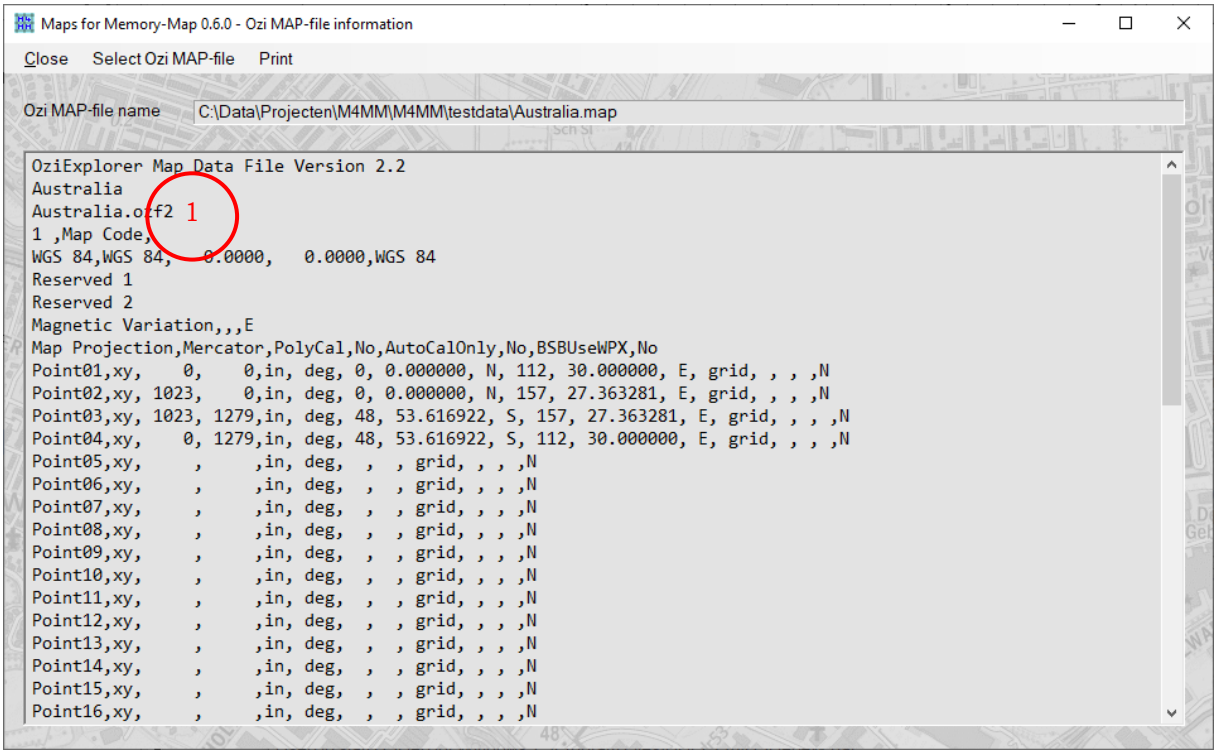
Step 6: Creation of the QCT-file is described in part three of this manual. Before opening Memory-Map copy your PNG-(or TIFF-) and JPR-file in a directory where Memory-Map can find them.

From OziExplorer to QCT

- If you convert a Ozi MAP-file and/or a Ozi map image file (OZF2/OZFX3) for the first time please read the whole workflow before starting the process.
- If you want to convert a OZF2/OZFX3-file you need the corresponding MAP-file.

In step 1 the MAP-file will be explored. Step 2 is about converting an OZF2/OZFX3-file to the PNG-format. In step 3 the color depth will be explored and in step 4 this depth will be reduced. In step 5 the JPR-file will be created and in step 6 the QCT file.

Step 1: Explore the MAP-file using the option *Information > Ozi Explorer-file* of M4MM.



In line three(1) you will find the name of the corresponding image file of the map. If the extension is `png`, `tif` or `tiff` you can continue to step 3. In case of `ozf2` or `ozfx3` continue to step 2. In case of `bmp`, `gif` or `jpg` you can continue to step 3 but change in step 5 the image format to `png`.

Step 2: To convert the image of a OZF2/OZFX3-file to a PNG-file use the option *Tools > Convert OZF/OZFX3-files* option in M4MM. Although Memory map can handle the TIFF-format there are two reasons to use the PNG-format: first the file will be compacter and second it doesn't contain georeferenced data (and can't interfere in the process of creating a QCT-file).

Step 3: Memory-Map can only handle images with a color depth of 8 bit (256 colors) or less. To establish the need to convert a image, you must check the color depth. You can do this the M4MM option *Information > Image-file*. If the color depth is 8 bit you can continue with step 5.

Step 4: In this step the color depth will be reduced to 8-bit using an external application. If a PNG-file has a color depth of more than 24 bit, be aware of transparency. In case of a GIF-, JPG- or BMP-file change the image format to PNG.

Step 5: With M4MM the JPR-file will be created. Follow the instructions for the option *Build JPR-file > From a Ozi MAP-file*. If you converted the OZF2/OZFX3-file to a PNG-file (step 2) you must edit the JPR-file: change the "Image Type" in to PNG (`it=png`). You can do this with the tool *Edit JPR-files* or with an external text editor.

Step 6: Creation of the QCT-file is described in part three of this manual. Before opening Memory-Map copy your PNG- and JPR-file in a directory where Memory-Map can find them.

From MOBAC to QCT

Mobile Atlas Creator (MOBAC) is an application which can create maps for all kind of map applications. It is a pity Memory-Map isn't one of them. But with a little detour it is possible, by creating a map for OziExplorer (a PNG-file and a corresponding MAP-file) and convert this set. If you convert , by MOBAC created, MAP- and PNG-files for the first time, please read the whole workflow before starting the process.

In the first step the maps (PNG- and MAP-file) will be created. In step two the color depth will be explored and in step three this depth will be reduced. In step four the JPR-file will be created and in step five the QCT file.

Step 1: Use MOBAC to create a set of maps (PNG- and MAP-file).

Step 2: Memory-Map can only handle images with a color depth of 8 bit (256 colors) or less. MOBAC generates an PNG-image with a color depth of 24 bit. In this step the color depth must be reduced to 8-bit using an external application.

Step 3: With M4MM the JPR-file will be created. Follow the instructions for the option *Build JPR-file > From a MOBAC MAP-file*. If you want to change the name of your map this is the moment. Be aware the name of your PNG-file must be the same as your JPR-file (`yourmap.png` and `yourmap.jpr`)

Step 4: Creation of the QCT-file is described in part three of this manual. Before opening Memory-Map copy your PNG- and JPR-file in a directory where Memory-Map can find them.

Editing JPR-file

Although you can use an external application to edit a JPR-file M4MM provides a rudimental edit option.

There are several reasons to edit a JPR-file. In some cases M4MM advices to do to so. You may want to add information to a JPR file which wasn't provided by M4MM or you may change some parameters (like changing the name of the map).

First you must open your JPR-file. You can do this with menu option *Edit JPR-files* or with an text editor. The option *Edit JPR-file* has the advantage of detailed information of JPR-files (*JPR information* textbox). When ready save the new JPR-file.

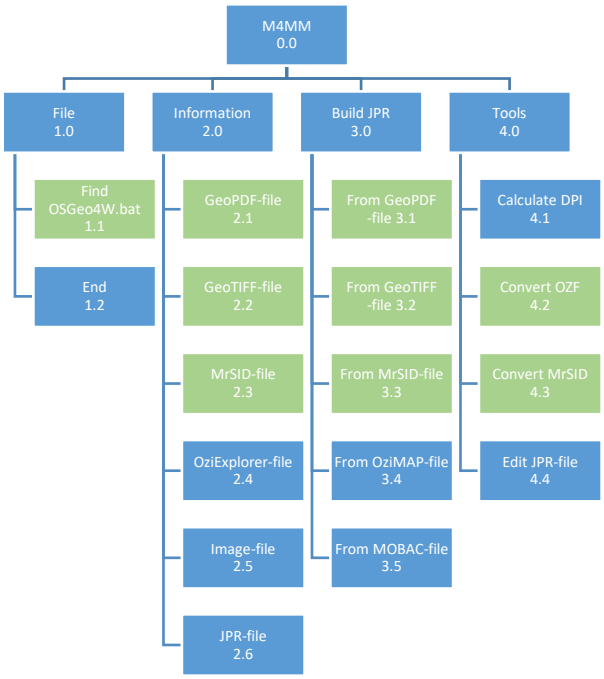
If you your map isn't imported yet, do in now (Importing maps).

If your map is already imported in Memory-Map delete the existing QCT-file to prevent a mismatch of old and new data. When done, import you map again.

M4MM explained

0.0 Menu structure M4MM

In the diagram below you see the menu structure of the application. In this part of the manual you will find the description all the menu options of the application.



To use the green marked options you need to install the GDAL environment OSGeo(4W) for Windows. Otherwise these options aren't accessible.

In menu options 2.1 to 2.4, 2.6, 3.1 to 3.5 and 4.4 have a print function (portrait and landscape). This function is only mend for using in combination with a physical printer. When printing to a file every physical page must be saved separately.

1.0 File

In this menu group you will find the items related to setup and closing the application.

1.1 Find OSGeo4W.bat

M4MM uses the functionality of GDAL. To do so, the application must "know" where to find the GDAL environment "OSGeo for Windows". By clicking on this menu option a file selection window will open to select a batch file `OSGEo4W.bat` which is essential to use GDAL. The most likely location for this file is "`c:\Program Files\QGIS x.x`" (`x.x` stand for the QGIS version) if you installed QGIS and "`c:\OSGeo4W64`" or "`c:\OSGeo4W`" in case of a standalone version of GDAL. The selected environment "OSGeo for Windows" will be shown at the bottom of the main window.

1.1 End

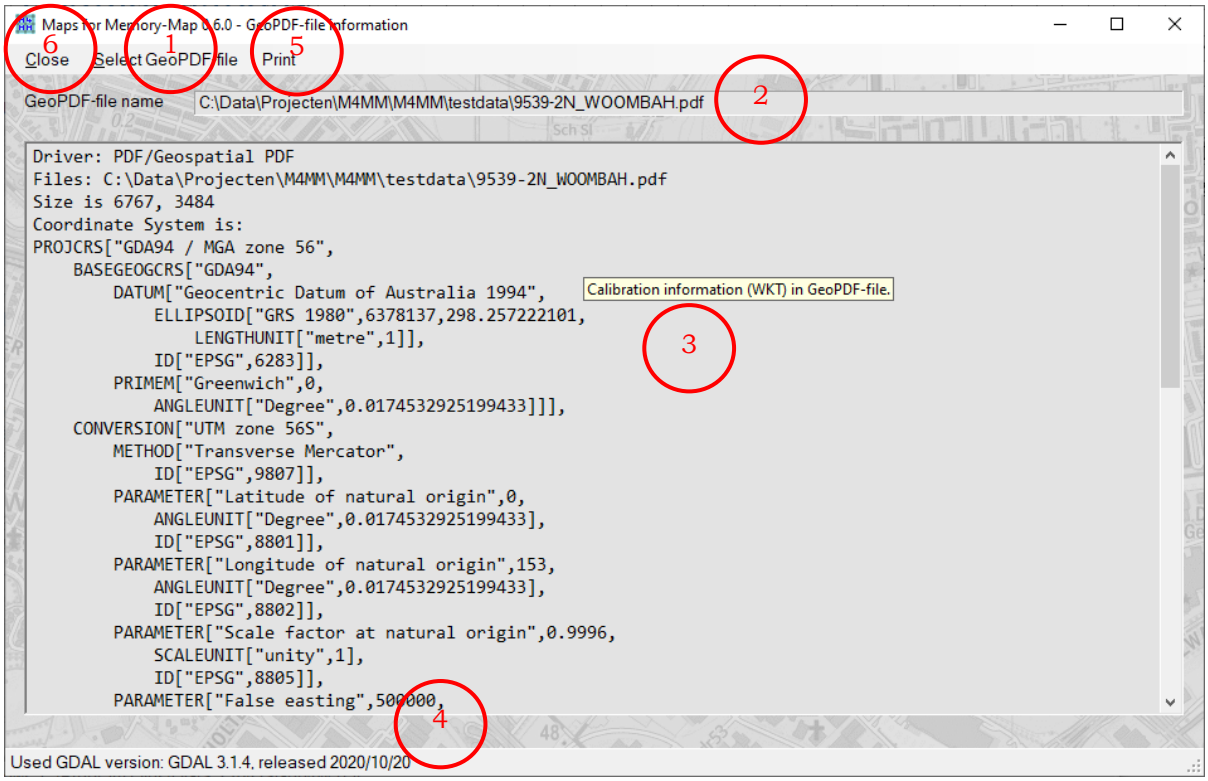
This menu option is an extra possibility to close the application to the standard Windows options (single click on the top right corner "X" or the double click on the top left corner icon).

2.0 Information

In this menu group you will find items, which can be used to gather information from files.

2.1 GeoPDF-file

With this menu option you can extract image properties and geographical information from a GeoPDF-file. This information is collected using `GDALINFO` and will be presented as Well Known Text 2.0 (WKT).



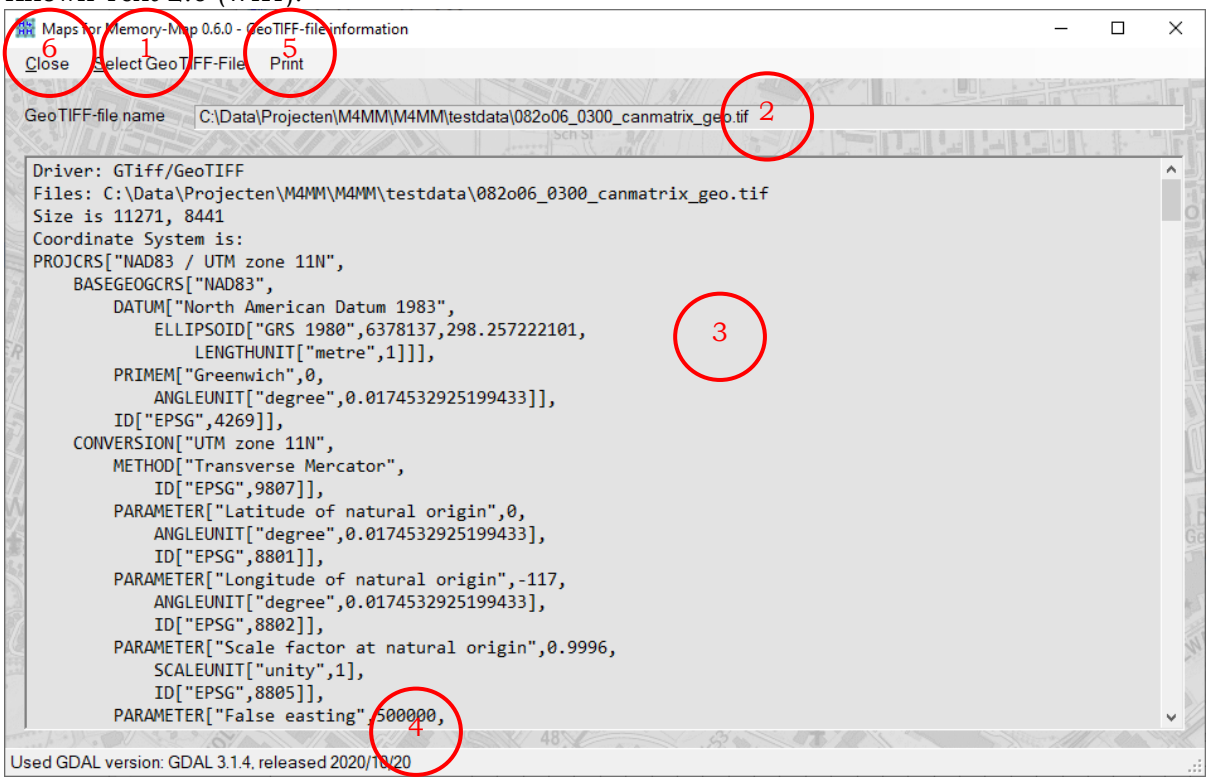
By selecting the menu option *Information* > *GeoPDF-files* in the main window a file selection dialog will be launched to select a GeoPDF-file. When a file is selected the *GeoPDF-file Information* window will open. To select another GeoPDF-file use the menu option *Select GeoPDF-file*(1) in the *GeoPDF-file Information* window.

The file name with full path will be presented(2) as well the WKT(2.0) (3). At the bottom of the window you will find the exact information about the used version of GDAL(4). To print the WKT use the menu option *Print*(5). You can select to print with or without the color data, in landscape or portrait format. You can close this procedure using menu option *Close*(6).

Remark:
the character “)” may not be included in the full filename with path and extension. In this case the WKT data cannot be retrieved.

2.2 GeoTIFF-file

With this menu option you can extract image properties and geographical information from a GeoTIFF-file. This information is collected using `GDALINFO` and will be presented as Well Known Text 2.0 (WKT).



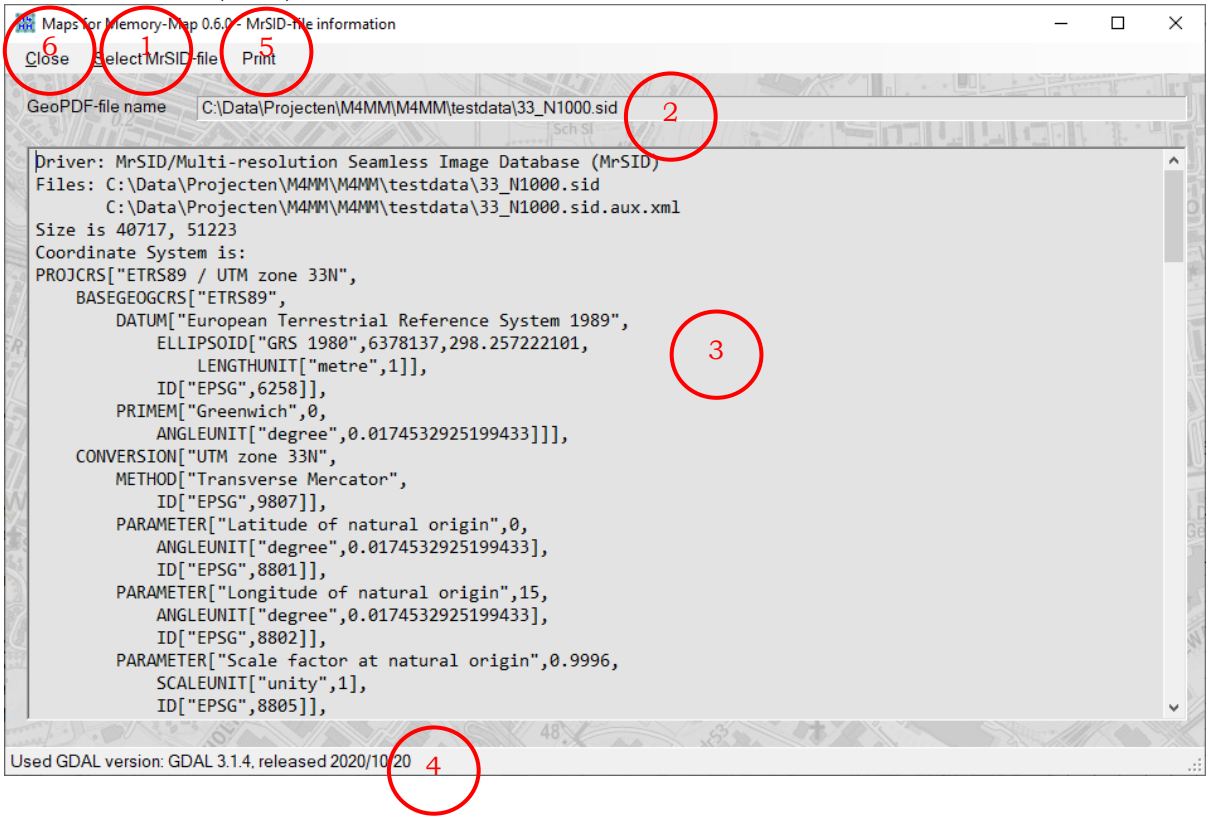
By selecting the menu option *Information* > *GeoTIFF-files* in the main window a file selection dialog will be launched to select a GeoPDF-file. When a file is selected the *GeoTIFF-file Information* window will open. To select another GeoPDF-file use the menu option *Select GeoTIFF-file*(1) in the *GeoTIFF-file Information* window.

The file name with full path will be presented(2) as well the WKT(2.0) (3). At the bottom of the window you will find the exact information about the used version of GDAL(4). To print the WKT use the menu option *Print*(5). You can select to print with or without the color data, in landscape or portrait format. You can close this procedure using menu option *Close*(6).

Remark:
the character ")" may not be included in the full filename with path and extension. In this case the WKT data cannot be retrieved.

2.3 MrSID-file

With this menu option you can extract image properties and geographical information from a MrSID-file. This information is collected using `GDALINFO` and will be presented as Well Known Text 2.0 (WKT).



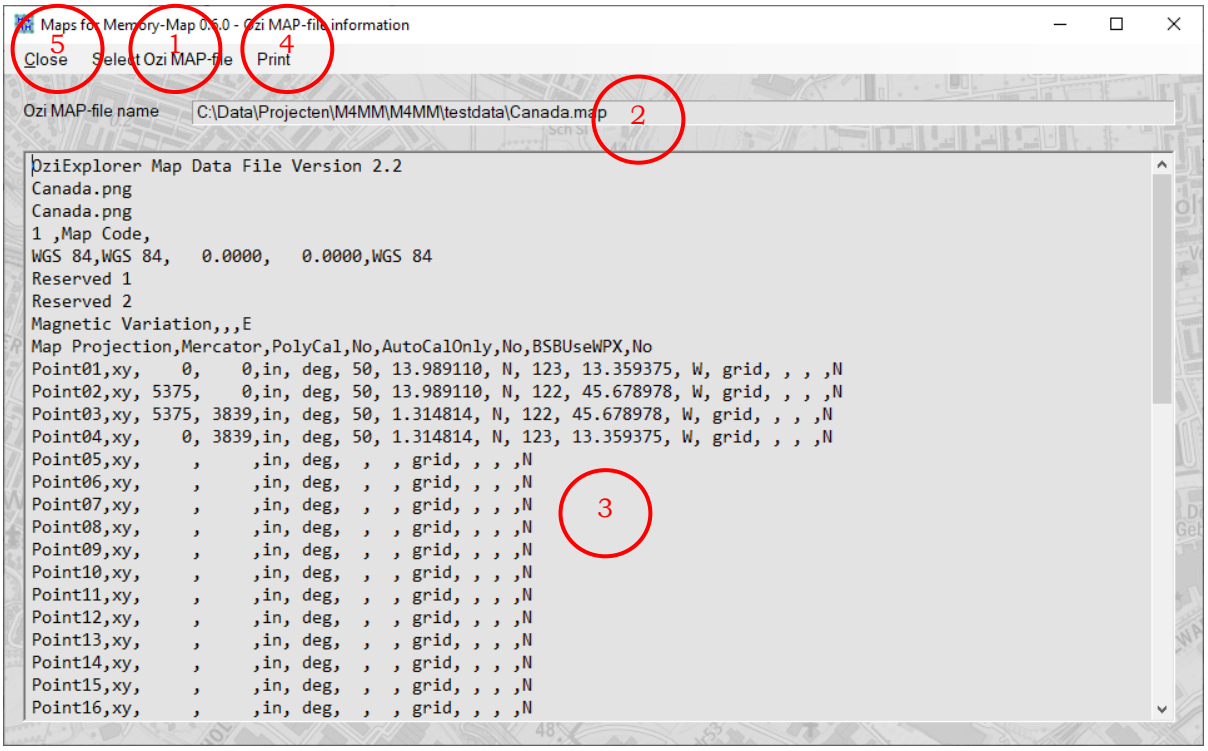
By selecting the menu option *Information* > *MrSID-files* in the main window a file selection dialog will be launched to select a MrSID-file. When a file is selected the *MrSID-file Information* window will open. To select another MrSID-file use the menu option *Select MrSID -file*(1) in the *MrSID -file Information* window.

The file name with full path will be presented(2) as well the WKT(2.0) (3). At the bottom of the window you will find the exact information about the used version of GDAL(4). To print the WKT use the menu option *Print*(5). You can select to print with or without the color data, in landscape or portrait format. You can close this procedure using menu option *Close*(6).

Remark:
the character “)” may not be included in the full filename with path and extension. In this case the WKT data cannot be retrieved.

2.4 Ozi Explorer-file

With this option menu you can read the content of Ozi MAP-file which contains the OziExplorer calibration data. This option can also be used to view MAP-files created by MOBAC.

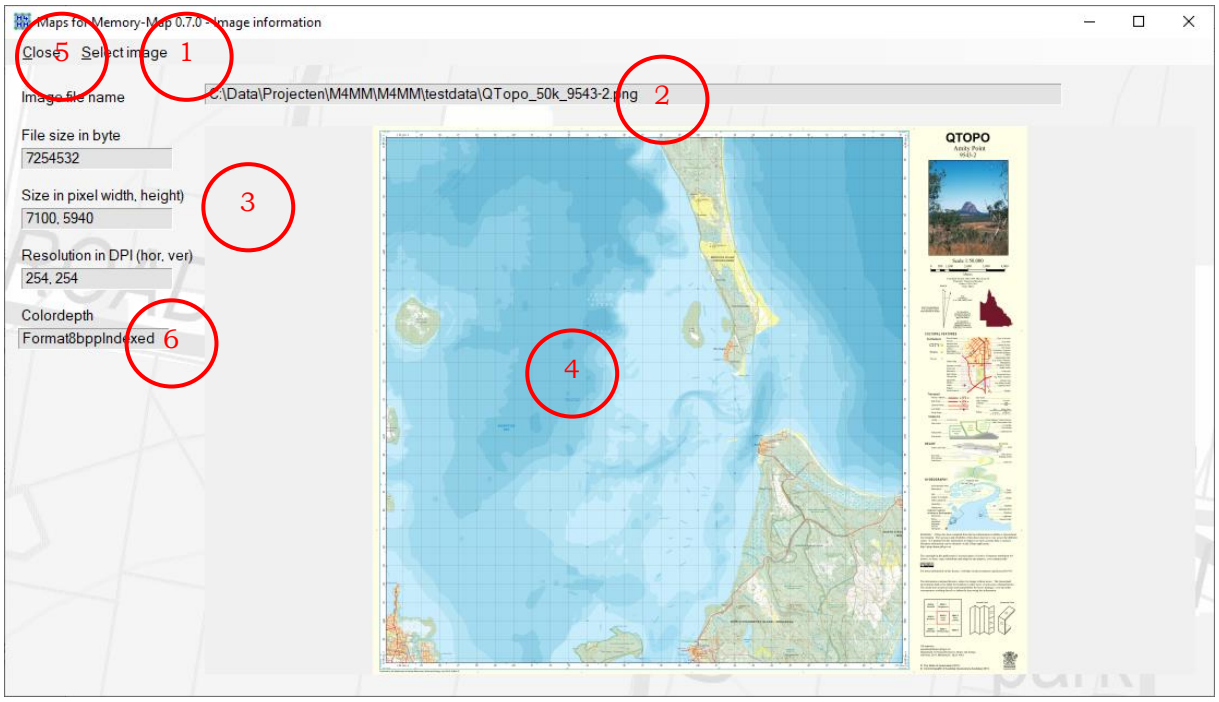


By selecting the menu option *Information* > *Ozi-Explorer-file* in the main window a file selection dialog will launched to select a Ozi MAP-file. When a file is selected the *Ozi-MAP-file Information* window will open. To select another MAP-file use the menu option *Select Ozi MAP-file*(1) in the *Ozi MAP-file Information* window.

The file name with full path will be presented(2) as well the content(3). To print the Content of the MAP-file use the menu option *Print*(4) , in landscape or portrait format. You can close this procedure using menu option *Close*(5).

2.5 Image-file

With this menu option you can extract some essential data from an PNG/TIFF-file and view the image. Only files with less than 2 G byte of pixel information can be screened (due of limitations of Visual Basic).



By selecting the menu option *Information* > *Image-file* in the main window a file selection dialog will launched to select a image-file. When a file is selected the *Image-file Information* window will open. To select another image-file use the menu option *Select Image* (1) in the *Image-file Information* window.

The file name with full path will be presented(2) as well the data(3) and the image(4).

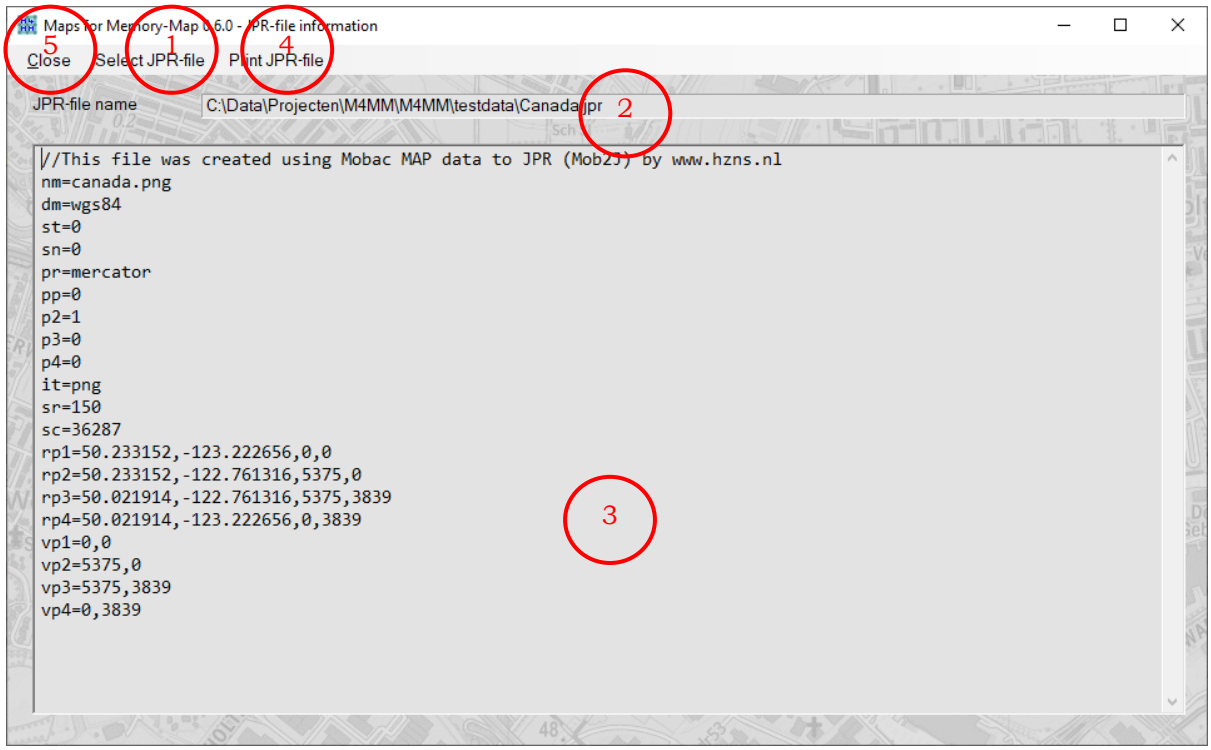
You can close this procedure using menu option *Close*(5).

Remarks:

- When no file was selected, you will see a warning message, no data will be shown and an and an image which tell you so(4).
- When a file was selected, but the size is too large, you will see a warning message, the file size will become red and an image which tell you so(4).
- If the color depth(6) isn't supported by Memory-Map you will see a warning message and the value will become red (only `Format8bppIndexed`, `Format4bppIndexed` and `Format1bppIndexed` are supported).

2.6 JPR-file

With this menu option you can read the content of Memory Map JPR-file which contains the Memory-Map calibration data.



By selecting the menu option *Information* > *JPR-file* in the main window a file selection dialog will launched to select a JPR-file. When a file is selected the *JPR-file Information* window will open. To select another JPR-file use the menu option *Select JPR-file* (1) in the *JPR-file Information* window.

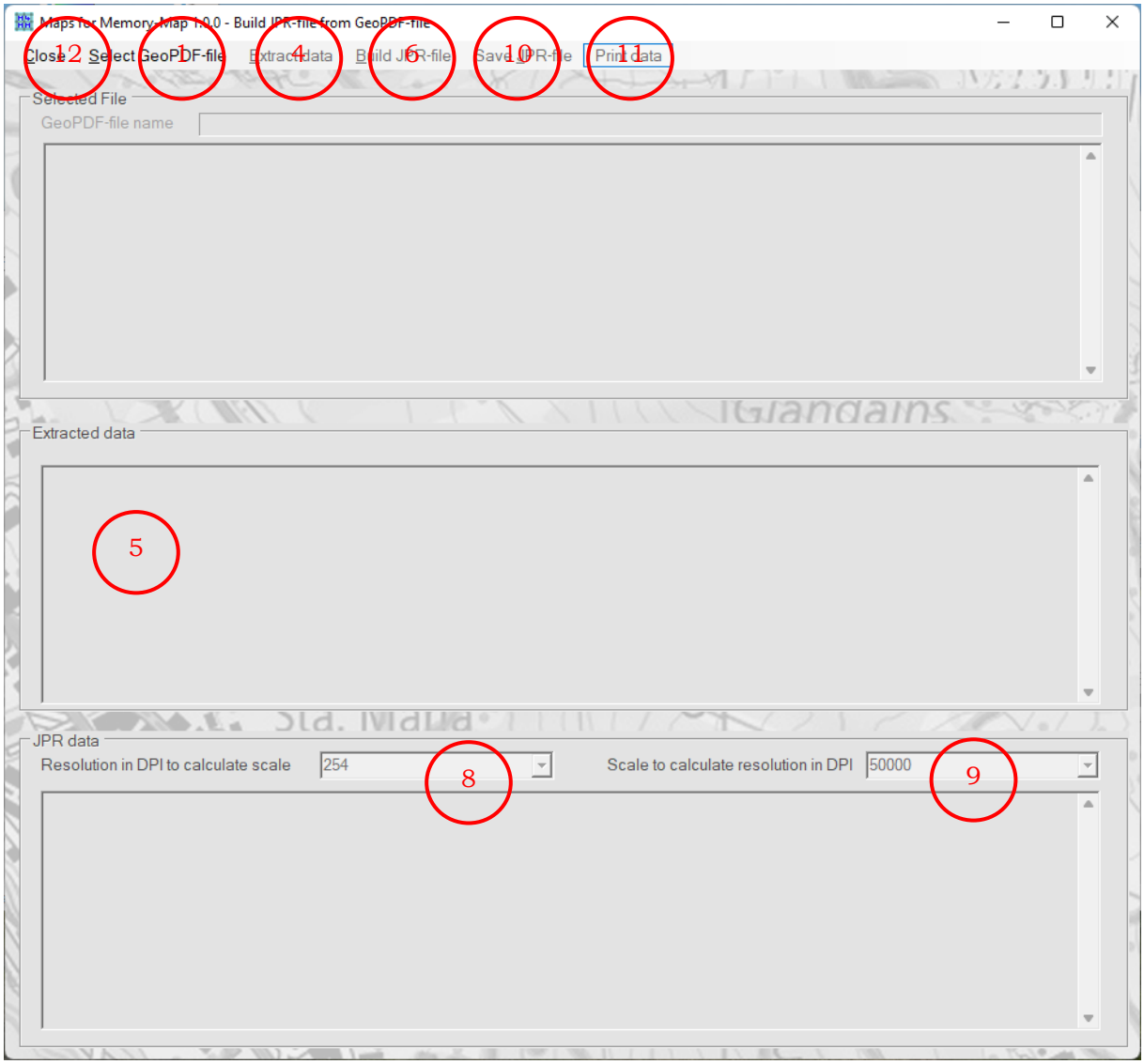
The file name with full path will be presented(2) as well the content(3). To print the Content of the JPR-file use the menu option *Print*(4) , in landscape or portrait format. You can close this procedure using menu option *Close*(5).

3.0 Build JPR-file

In this menu group you will find the options to create JPR-files. Although all the procedures looks (and works) the same, under the “bonnet” they are different. The main idea in the windows is: use the menu options from left to right and the information will appear from top to bottom.

3.1 From a GeoPDF-File

This menu option helps you to create a JPR-file based on the information in a GeoPDF-file.



By selecting the menu option *Build JPR-file* > *From GeoPDF-files* in the main window a file selection dialog will be launched to select a GeoPDF-file. When a file is selected the *Build JPR-file from GeoPDF-file* window will open. To select another GeoPDF-file use the menu option *Select GeoPDF-file*(1) in the *Build JPR-file from GeoPDF-file* window.

Remark:
the character “)” may not be included in the full filename with path and extension. In this case the WKT data cannot be retrieved.

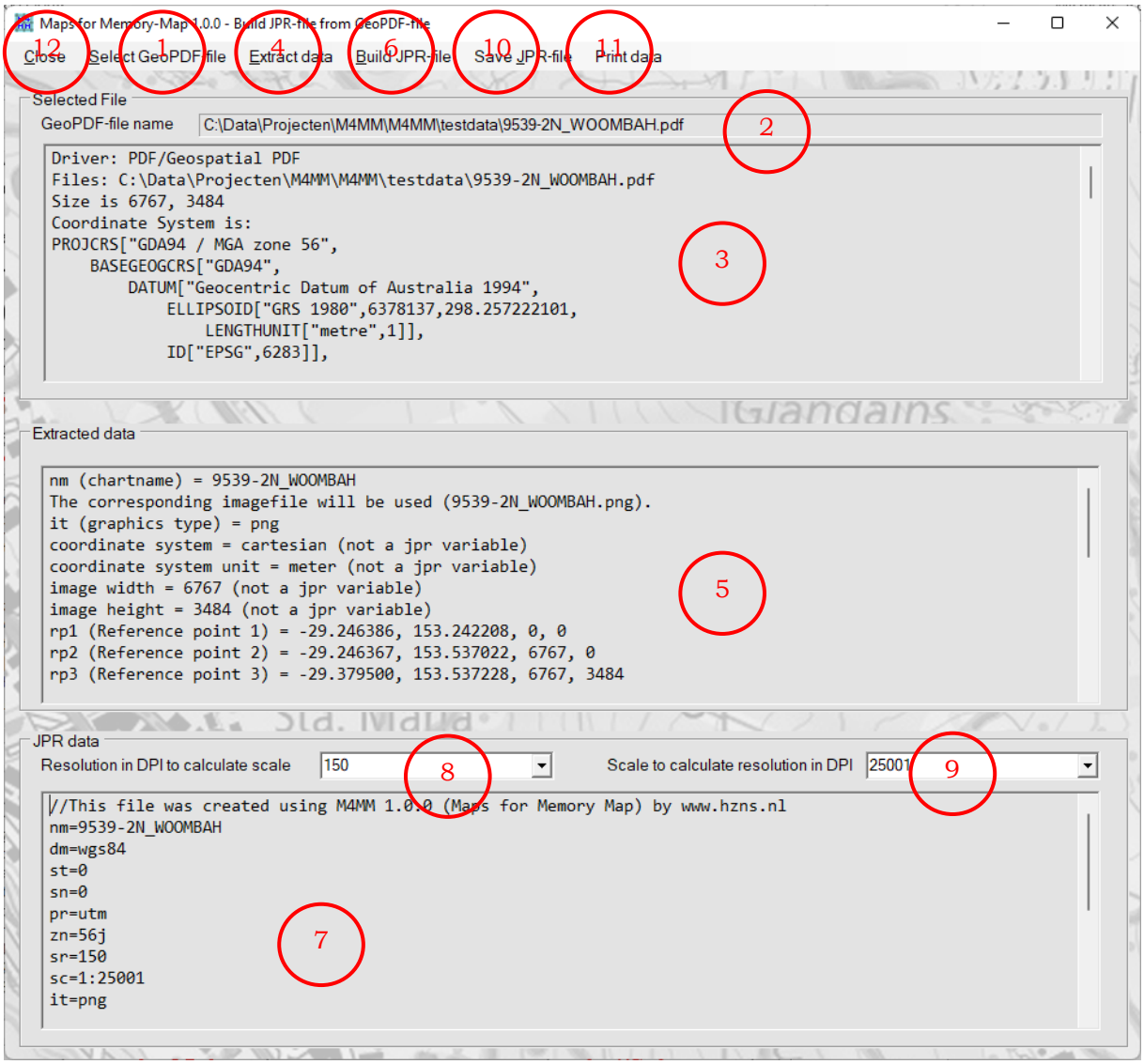
The file name with full path(2) and the WKT(3) (version 2.0) will be presented. When a selected file contains georeferenced data the next step (*Extract data*) will be enabled(4). If no georeferenced data are available, you will see a warning message. In the next step you will

see in the frame *Extracted data*(5) a mix of extracted data and messages (with information about the actual extraction. During the data extraction you maybe see some (warning) messages and/or questions.

- If a matching image file (PNG) is found you will be asked if the image data (size and type of image-file) may be used or these data from the GeoPDF-file.
- Related to the boundary (`vp=...`) you will be asked if the map has a collar. If so you may get a question about the use of the `NEATRLINE`-data (if available).

In all cases the corners of the image will be used as boundary points, except if you opt for the `NEATRLINE`-data.

Be aware: The (WKT) definition for the `NEATLINE` is "Area of interest". The definition for the boundary is the "Border of map area". Although both definitions aren't the same, a lot maps uses the NEATLINE to define the boundary. This means: check the result!



The following step is building the content for the JPR-file(6). In the frame *JPR data*(7) you will see the content. If the physical size of a pixel(dot) could be retrieved (one pixel = ? meter in reality), the scale(`sc=`) and the resolution (`sr=`) of the map can be set. You can change the scale (`sc=`) by changing the resolution (`sr=`) in DPI (9) or change the resolution (`sr=`) by changing the scale (`sc=`) (8). Initially the resolution will be set to 254 DPI. During the

building of the JPR-data this value will be changed if the WKT contains consistent resolution data. Be aware: resolution (`sr=`) and scale (`sc=`) are estimated values.

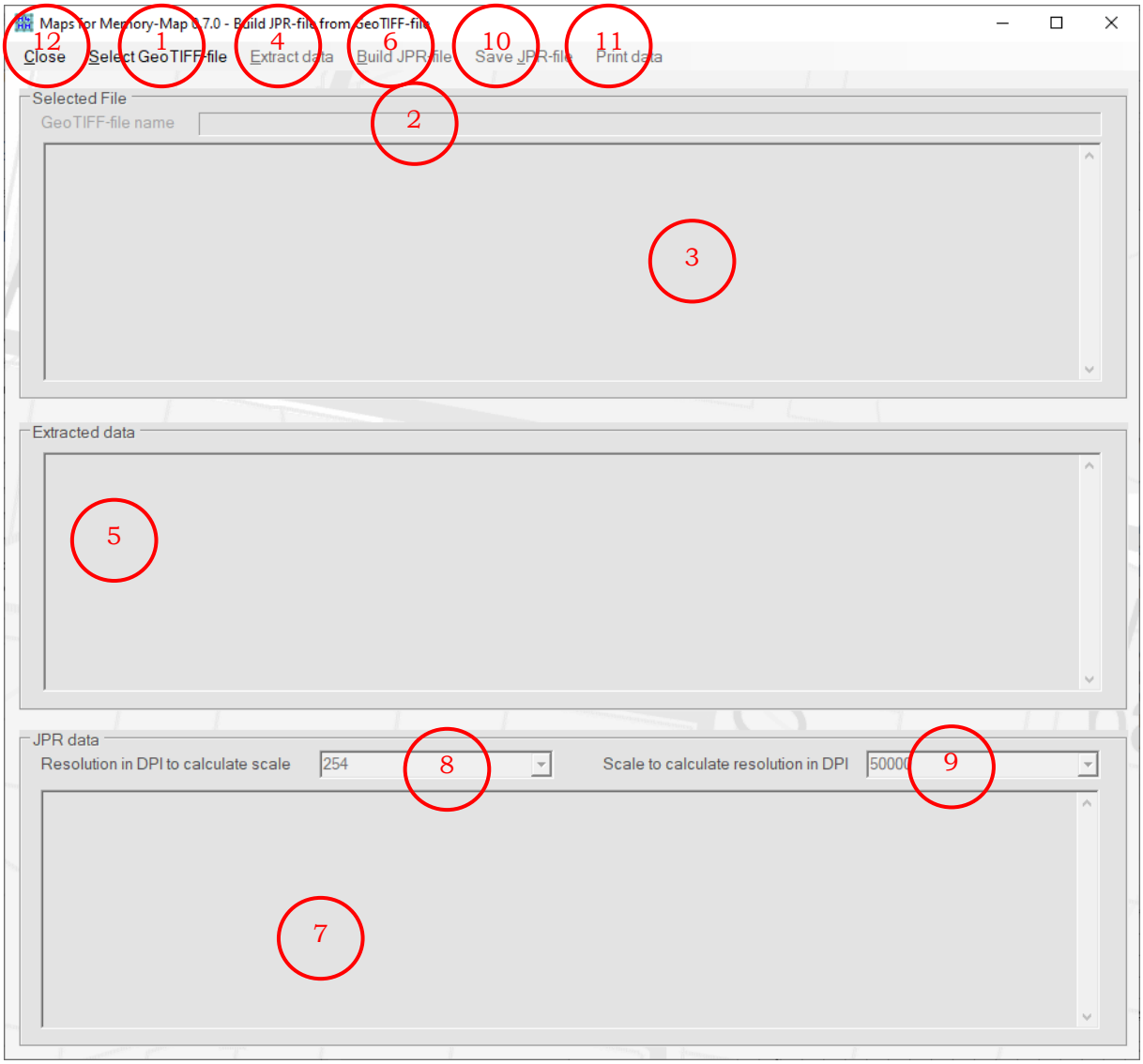
The last step is saving the JPR-data in a JPR-file(10). If this file already exists, you will be asked to overwrite or not.

To print data use the menu option *Print data*(11). You can select to print the WKT with or without the color data, the extracted data or the JPR-data, in landscape or portrait format.

You can close this procedure using menu option *Close*(12).

3.2 From a GeoTIFF-File

This menu option helps you to create a JPR-file based on the information in a GeoTIFF-file.



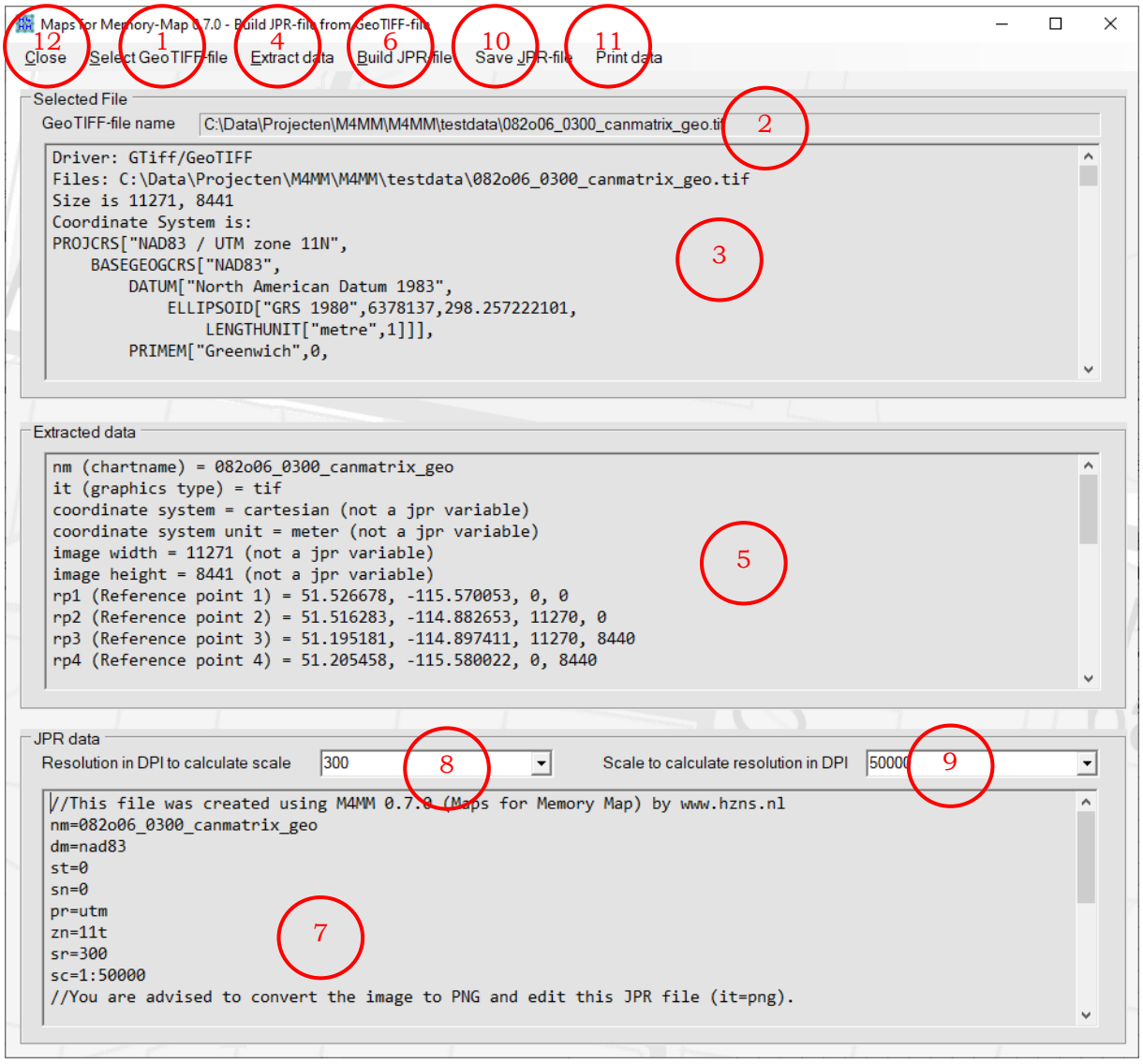
By selecting the menu option *Build JPR-file* > *From GeoTIFF-files* in the main window a file selection dialog will be launched to select a GeoTIFF-file. When a file is selected the *Build JPR-file from GeoTIFF-file* window will open. To select another GeoTIFF-file use the menu option *Select GeoTIFF-file*(1) in the *Build JPR-file from GeoTIFF-file* window.

Remark:
the character ")" may not be included in the full filename with path and extension. In this case the WKT data cannot be retrieved.

The file name with full path(2) and the WKT(3) will be presented. When a selected file contains georeferenced data the next step (*Extract data*) will be enabled(4). If no georeferenced data are available, you will see a warning message. In the next step you will see in the frame *Extracted data*(5) a mix of extracted data and messages (with information about the actual extraction. During the data extraction you maybe see some (warning) messages and/or questions.

Related to the boundary (`vp=...`) you will be asked if the map has a collar. If so you may get a question about the use of the `NEATRLINE`-data (if available). In all cases the corners of the image will be used as boundary points, except if you opt for the `NEATRLINE`-data.

Be aware: The (WKT) definition for the NEATLINE is “Area of interest”. The definition for the boundary is the “Border of map area”. Although both definitions aren’t the same, a lot of maps uses the NEATLINE to define the boundary. This means: check the result!



The following step is building the content for the JPR-file(6). In the frame *JPR data*(7) you will see the content. If the physical size of a pixel(dot) could be retrieved (one pixel = ? meter in reality), the scale(sc=) and the resolution (sr=) of the map can be set. You can change the scale (sc=) by changing the resolution (sr=) in DPI (8) or change the resolution (sr=) by changing the scale (sc=) (9). Initially the resolution will be set to 254 DPI. During the building of the JPR-data this value will be changed if the WKT contains consistent resolution data. Be aware: resolution (sr=) and scale (sc=) are estimated values.

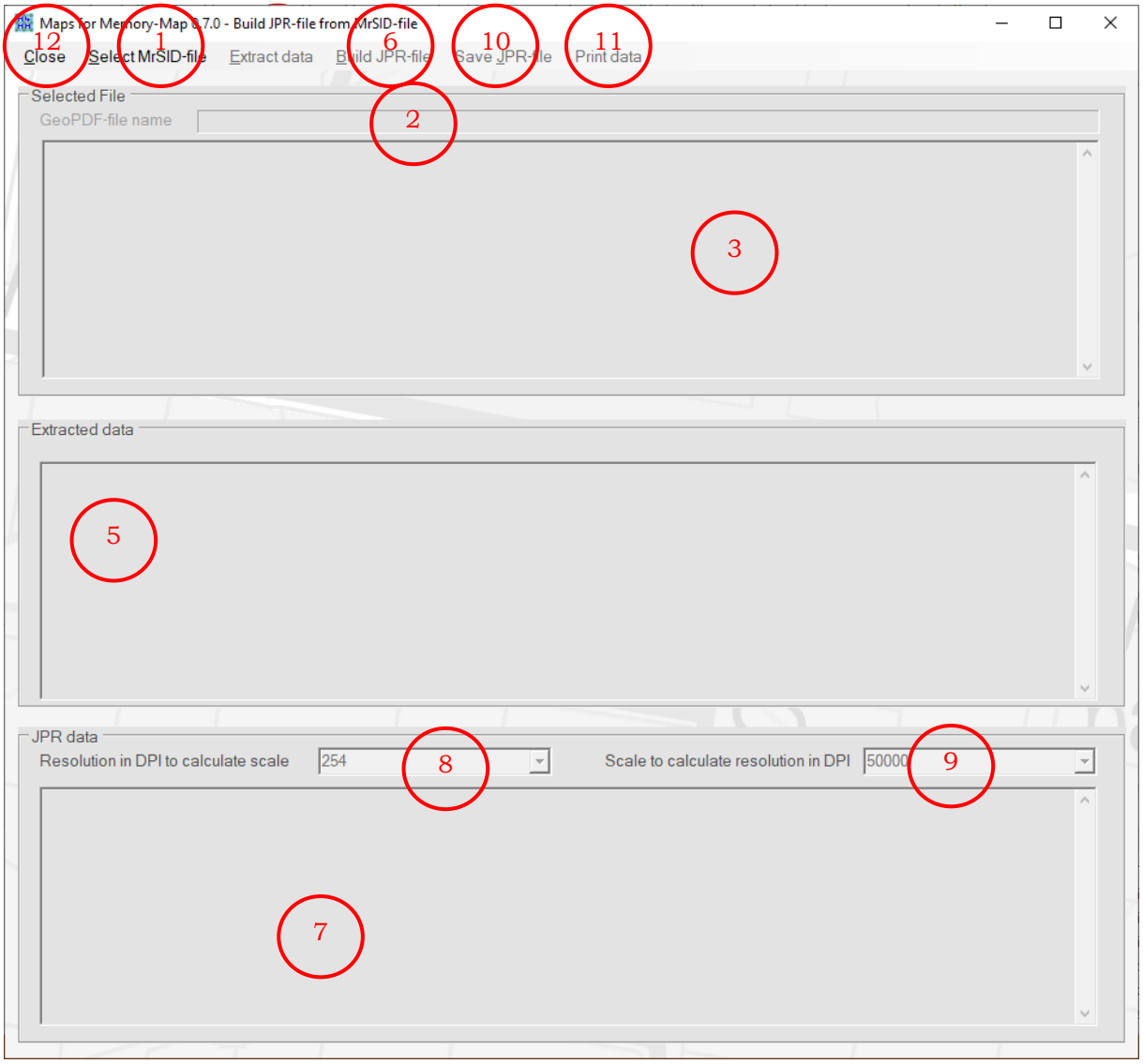
The last step is saving the JPR-data in a JPR-file(10). If this file already exists, you will be asked to overwrite or not.

To print data use the menu option *Print data*(11). You can select to print the WKT with or without the color data, the extracted data or the JPR-data, in landscape or portrait format.

You can close this procedure using menu option *Close*(12).

3.3 From a MrSID-File

This menu option helps you to create a JPR-file based on the information in a MrSID-file.

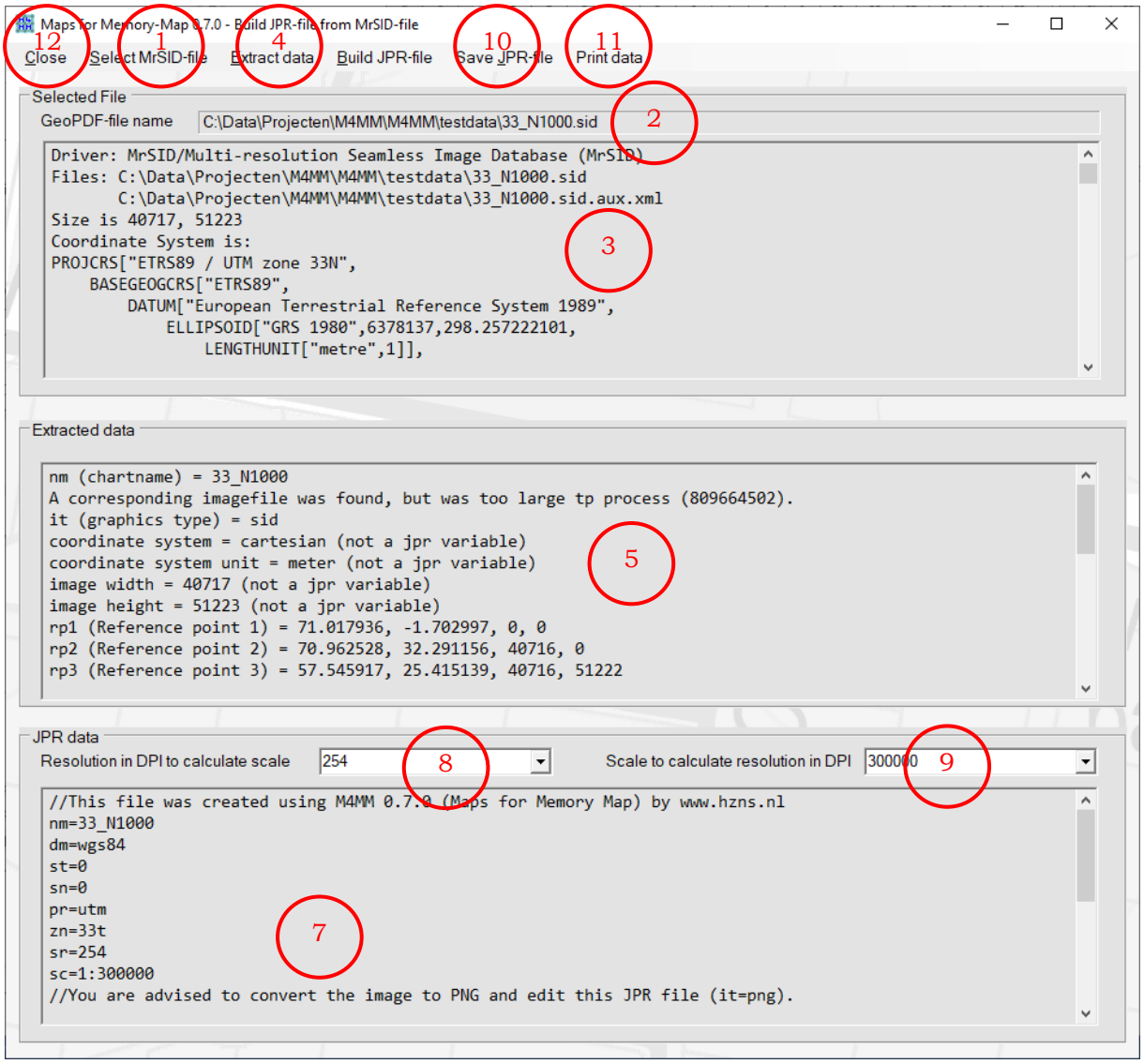


By selecting the menu option *Build JPR-file* > *From MrSID-files* in the main window a file selection dialog will be launched be launched to select a MrSID-file. When a file is selected the *Build JPR-file from MrSID-file* window will open. To select another MrSID-file use the menu option *Select MrSID-file*(1) in the *Build JPR-file from MrSID-file* window.

Remark:
the character ")" may not be included in the full filename with path and extension. In this case the WKT data cannot be retrieved.

The file name with full path(2) and the WKT(3) will be presented. When a selected file contains georeferenced data the next step (*Extract data*) will be enabled(4). If no georeferenced data available you will see a warning message. In the frame *Extracted data*(5) you will see a mix of extracted data and messages (with information about the actual extraction. During the data extraction you maybe see some (warning) messages and/or questions.

If a matching image file (PNG) is found you will be asked if the image data (size and type of image-file) may be used or these data from the MrSID-file.



The following step is building the content for the JPR-file(6). In the frame *JPR data*(7) you will see the content. If the physical size of a pixel(dot) could be retrieved (one pixel = ? meter in reality), the scale(`sc=`) and the resolution (`sr=`) of the map can be set. You can change the scale (`sc=`) by changing the resolution (`sr=`) in DPI (8) or change the resolution (`sr=`) by changing the scale (`sc=`) (9). Initially the resolution will be set to 254 DPI. During the building of the JPR-data this value will be changed if the WKT contains consistent resolution data. Be aware: resolution (`sr=`) and scale (`sc=`) are estimated values.

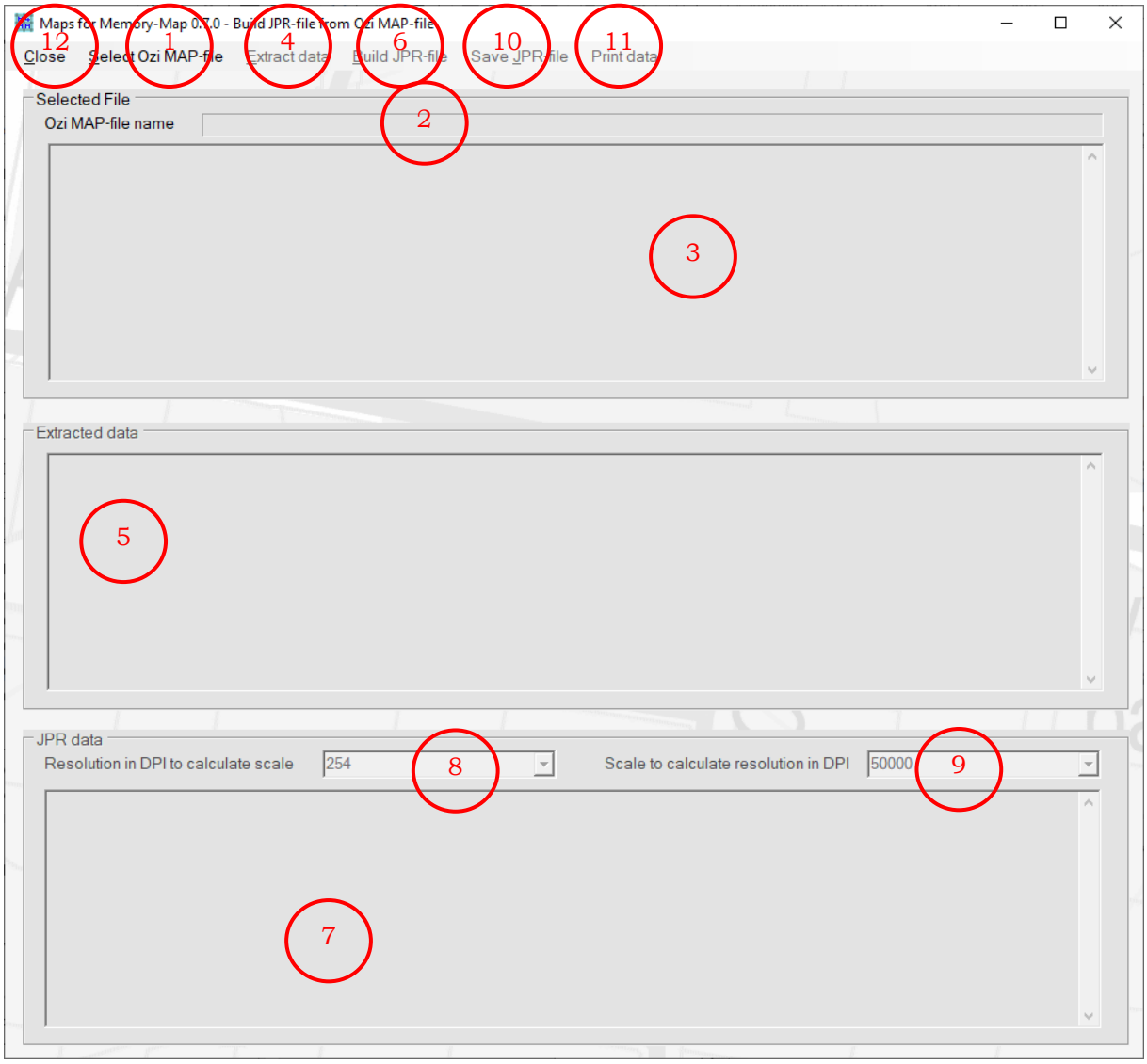
The last step is saving the JPR-data in a JPR-file(10). If this file already exists, you will be asked to overwrite or not.

To print data use the menu option *Print data*(11). You can select to print the WKT with or without the color data, the extracted data or the JPR-data, in landscape or portrait format.

You can close this procedure using menu option *Close*(12).

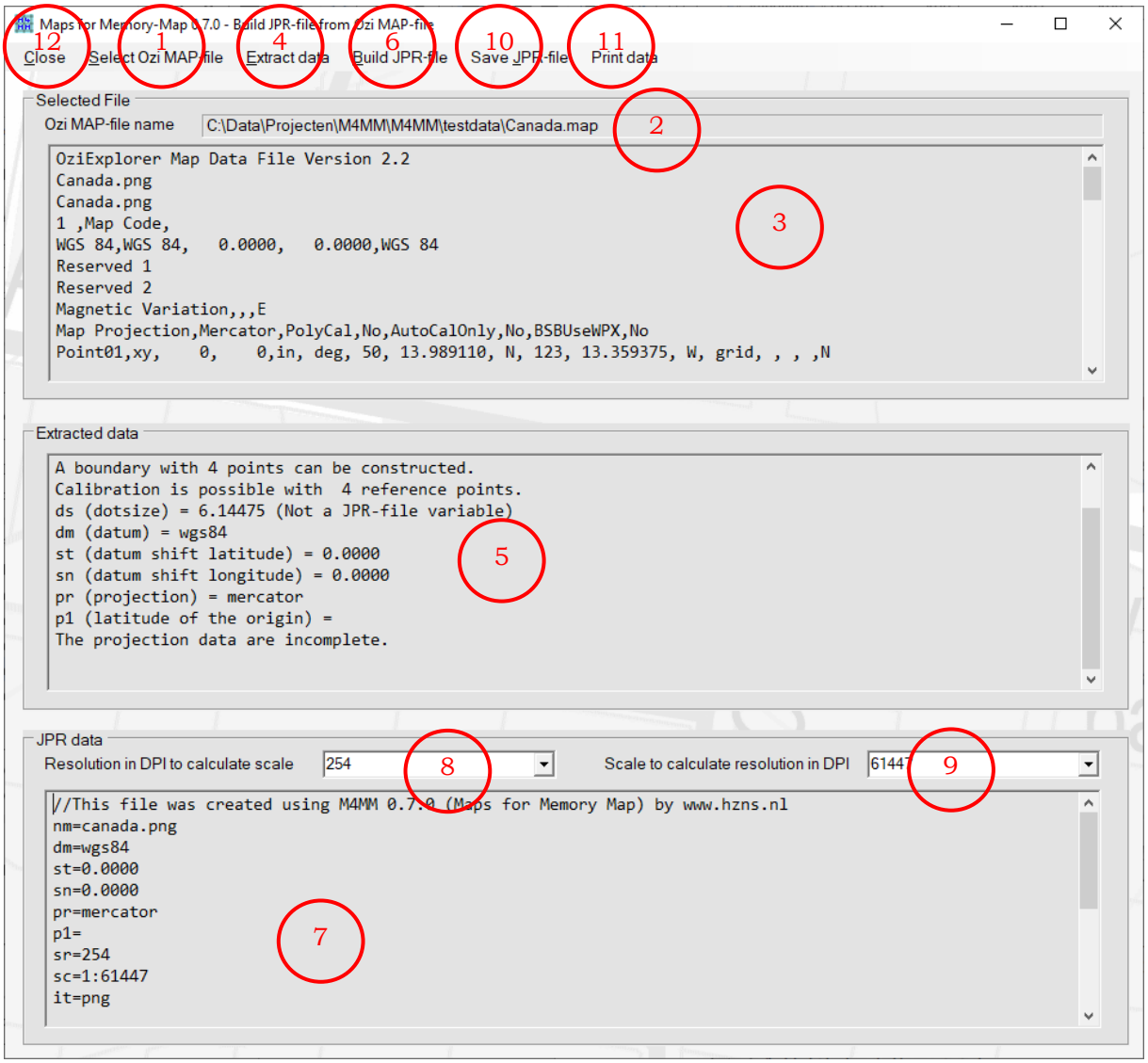
3.4 From a Ozi MAP-File

This menu option helps you to create a JPR-file based on the information in a Ozi MAP-file.



By selecting the menu option *Build JPR-file* > *From Ozi MAP-files* in the main window a file selection dialog will be launched be launched to select a MAP-file. When a file is selected the *Build JPR-file from Ozi MAP-file* window will open. To select another Ozi MAP-file use the menu option *Select Ozi MAP-file*(1) in the *Build JPR-file from Ozi MAP-file* window.

The file name with full path(2) and the content(3) will be presented. The next step (*Extract data*) will be enabled(4). In the frame *Extracted data*(5) you will see a mix of extracted data and messages (with information about the actual extraction. During the data extraction you maybe see some (warning) messages and/or questions. If a matching image file (PNG) is found you will be asked if these data (size and type of image-file) may be used or the same data from the Ozi MAP-file.



The following step is building the content for the JPR-file(6). In the frame *JPR data*(7) you will see the content. You can change the scale (`sc=`) by changing the resolution (`sr=`) in DPI (8) or change the resolution (`sr=`) by changing the scale (`sc=`) (9). Be aware: resolution (`sr=`) and scale (`sc=`) are estimated values.

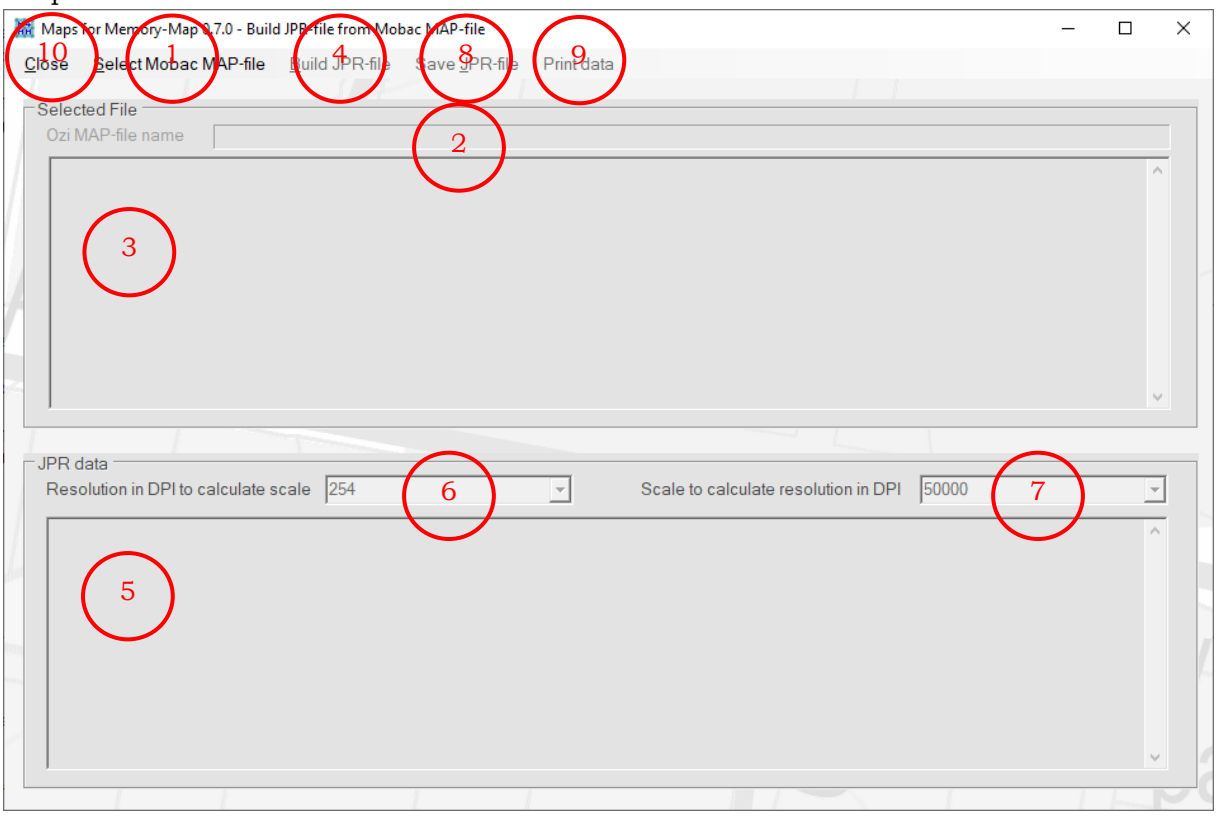
The last step is saving the JPR-data in a JPR-file(10). If this file already exists, you will be asked to overwrite or not.

To print data use the menu option *Print data*(11). You can select to print the MAP-data, the extracted data or the JPR-data, in landscape or portrait format.

You can close this procedure using menu option *Close*(12).

3.5 From a Mobac MAP-File

This menu option helps you to create a JPR-file based on the information in a Mobac MAP-file. Although you can use the option *From a Ozi MAP-file* the Mobac option is dedicated and simpler to use.



By selecting the menu option *Build JPR-file* > *From Mobac MAP-files* in the main window a file selection dialog will be launched to select a MAP-file. When a file is selected the *Build JPR-file from Mobac MAP-file* window will open. To select another Mobac MAP-file use the menu option *Select Mobac MAP-file*(1) in the *Build JPR-file from Mobac MAP-file* window.

The file name with full path(2) and the content(3) will be presented. The next step (Build JPR-file) will be enabled(4). In the frame *JPR data*(5) you will see content for the JPR-file. You can change the scale (`sc=`) by changing the resolution (`sr=`) in DPI (6) or change the resolution (`sr=`) by changing the scale (`sc=`) (7). Be aware: resolution (`sr=`) and scale (`sc=`) are estimated values.

The last step is saving the JPR-data in a JPR-file(8). If this file already exists, you will be asked to overwrite or not.

To print data use the menu option *Print data*(9). You can select to print the MAP-data or the JPR-data, in landscape or portrait format.

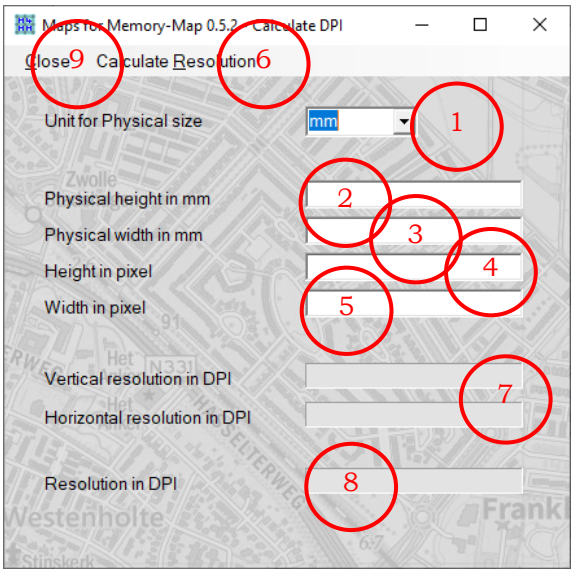
You can close this procedure using menu option *Close*(10).

4.0 Tools

In this menu group you will find some useful tools. The main idea in the windows is: use the menu options from left to right and the information will appear from top to bottom.

4.1 Calculate DPI

Handling GeoPDF-files it may necessary to know the graphical resolution in Dots per Inch (DPI). This tool does the trick.



First select the *unit for the physical size*(1). It may mm, cm or inch. The second step is to substitute al the measurements (2 to 5). The physical size can be retrieved with a PDF(-reader) application. The height and width in pixel can be retrieve with menu option "Information > Image-file". When all the values are in place, you can calculate the resolution(6).

Three different resolutions will be presented. The vertical and horizontal(7) and the average(8). In general these values are nearly the same. Small differences are most likely the result of rounding the numbers.

You can close this procedure using menu option *Close*(9).

4.2 Convert OZF2/OZFX3-files

Using GDAL it is possible to convert OZF2- and OZFX3-maps (OziExplorer) in to a graphics-format; in the application M4MM it will be the PNG-format (a format with no geographical information).

By selecting the menu option *Tools* > *Convert OZF2/OZFX3-files* in the main window a file selection dialog will be launched to select a Ozi/Explorer MAP-file. When a file is selected the *Convert Ozi -file* window will open. To select another MAP-file use the menu option *Select Ozi MAP-file*(1) in the *Convert Ozi-file* window.

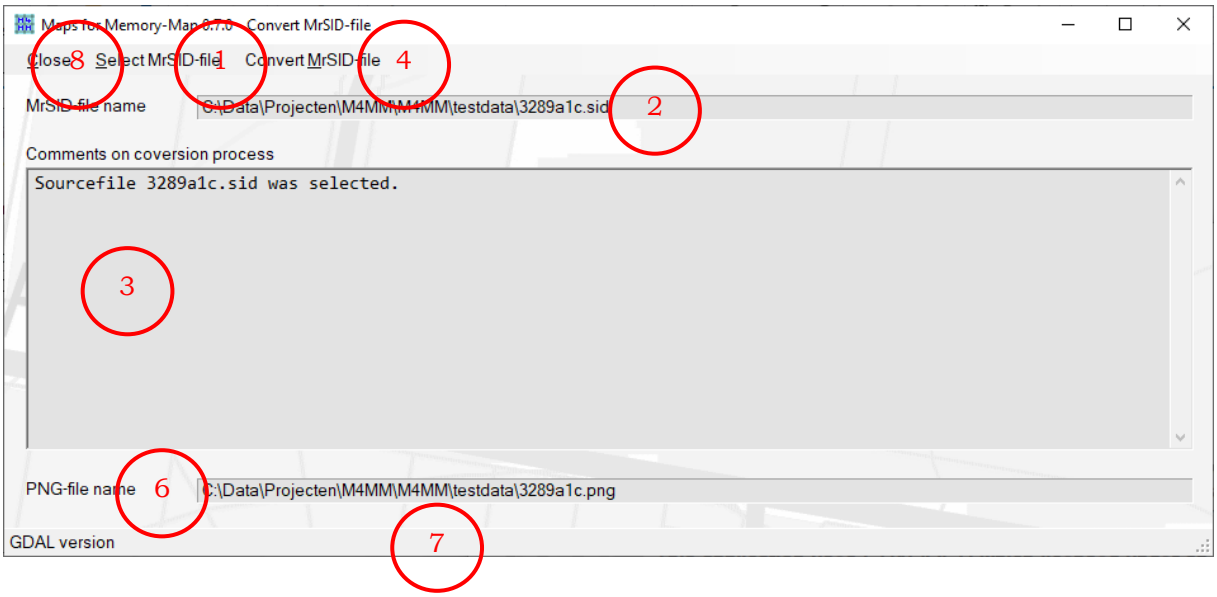
The name of the selected file will be presented(2) as well as the result of the search for the corresponding OZF2/OZFX3-file(3).

To convert the OZF2/OZFX3-file use the menu option *Convert Ozi-file*(4). The progress of the process will be presented(3) as well the created file with full path in the *PNG-file name* field(5). At the bottom of the window the used GDAL version is presented(6).

You can close this procedure using menu option Close(7).

4.3 Convert MrSID-files

Using GDAL it is possible to convert MrSID-maps in to a graphics-format; in the application M4MM it will be the PNG-format (a format with no geographical information)



By selecting the menu option *Tools* > *Convert MrSID-files* in the main window a file selection dialog will be launched to select a MrSID-file. When a file is selected the *Convert MrSID-file* window will open. To select another MrSID-file use the menu option *Select MrSID-file*(1) in the *Convert MrSID-file* window.

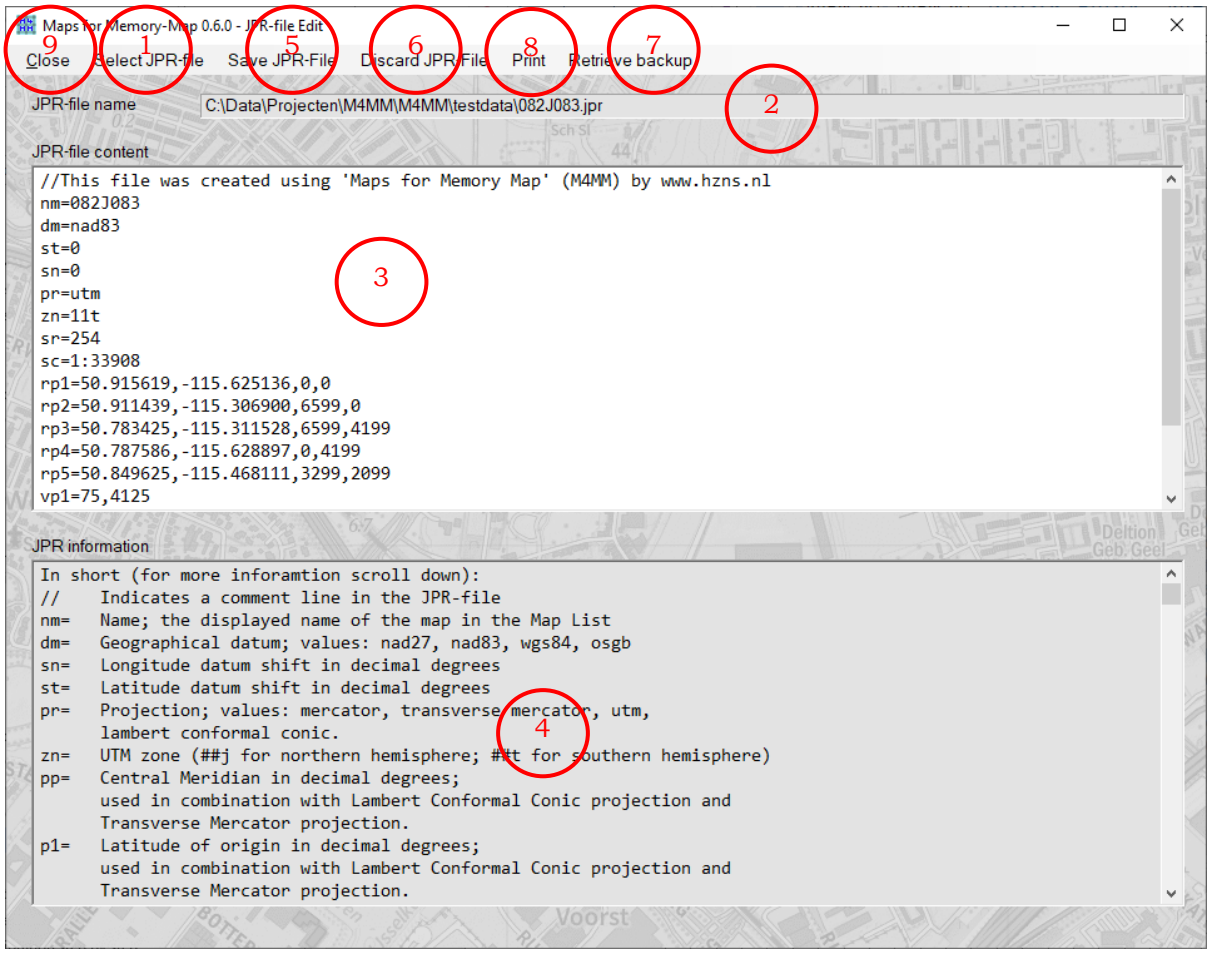
The name of the selected file will be presented(2) as well as the result of the search for the MrSID-file(3).

To convert the MrSID-file use the menu option *Convert MrSID-file*(4). The progress of the process will be presented(5) as well the created file with full path in the *PNG-file name* field(6). At the bottom of the window the used GDAL version is presented(7).

You can close this procedure using menu option *Close*(8).

4.4 Edit JPR-files

With this menu option you can Edit a JPR-files. It isn't a full featured editor, but it suits the purpose.



By selecting the menu option *Tools* > *Edit JPR-file* in the main window a file selection dialog will be launched to select a JPR-file. When a file is selected the *Convert MRTSID-file* window will open. To select another JPR-file use the menu option *Select JPR-file*(1) in the *Convert MrSID-file* window.

The name of the selected file will be presented(2) as well as the content(3).

This content can be edited. In the frame JPR information you will see a comprehensive explanation of the variables in a JPR-file(4) (please scroll).

To save the changes in the JPR-content select *Save JPR-File*(5). By saving a JPR-file M4MM creates in the background a backup from the original JPR-file (`example.jpr` > `example.bak`). To retrieve this file use the menu option Retrieve backup(7). To discard the changes in the JPR-file select *Discard JPR-File*(6).

To print the JPR-content as shown use the menu option *Print*(8), in landscape or portrait format.

To close the window *JPR-file edit* select menu option *Close*(9). If the JPR-data were changed but not saved, you will asked to save.

Memory-Map explained

In this part of 'The cookbook' you will find descriptions of procedures in Memory-Map related to the project M4MM, mainly calibration. It is therefore no replacement for the original Memory-Map Manual.

Installing Memory-Map

The installation of Memory-Map is strait forward. Download the actual version from the Memory-Map website and open the installation file (like `Memory-Map_6.4.3.1278.msi`) and follow the instructions.

Parallel installation version 5 and version 6

Because there is a bug in Memory-Map version 6 it may be needed to install a version 5 too. A parallel installation is possible. Install first the older one followed by the newer one. A parallel installation of Memory-Map for All(MMfA) is possible, be read the information in the help file.

Deleting Memory-Map

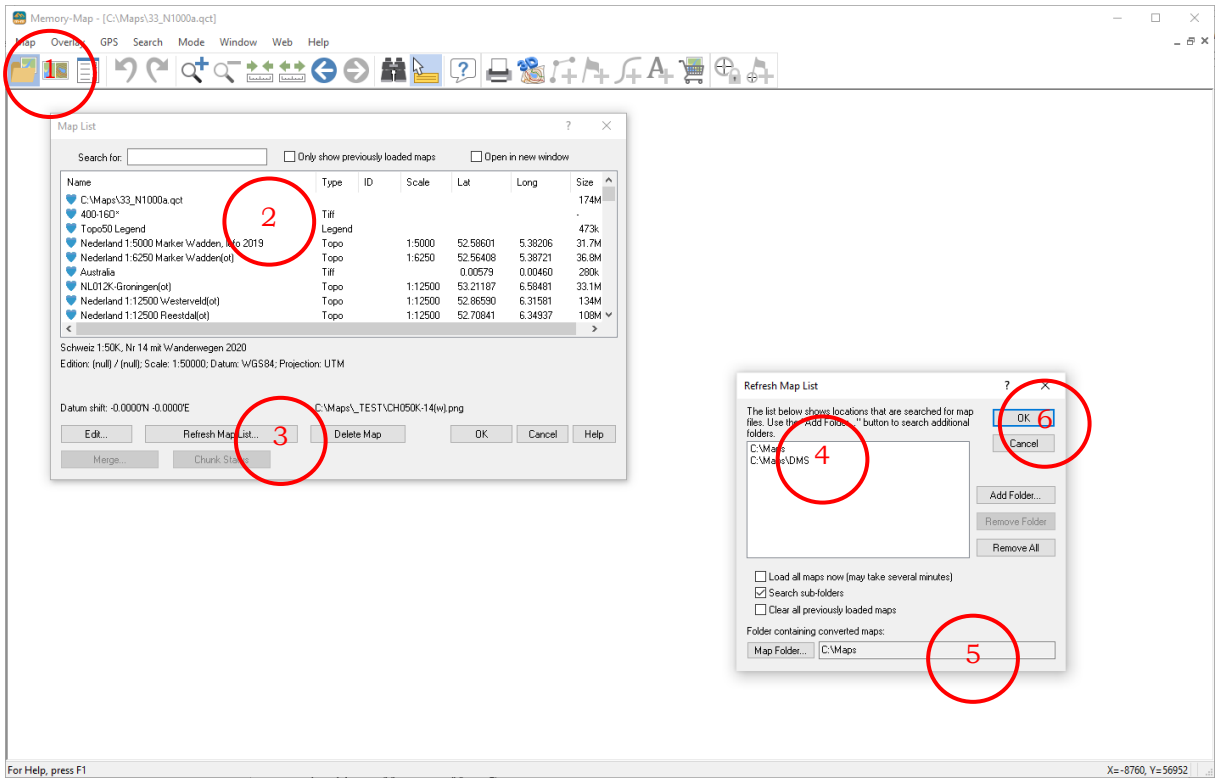
When deleting Memory-Map the 'Windows'-way the essential data about the licences will stay on your hard drive. After reinstalling Memory-Map will function properly.

Importing maps

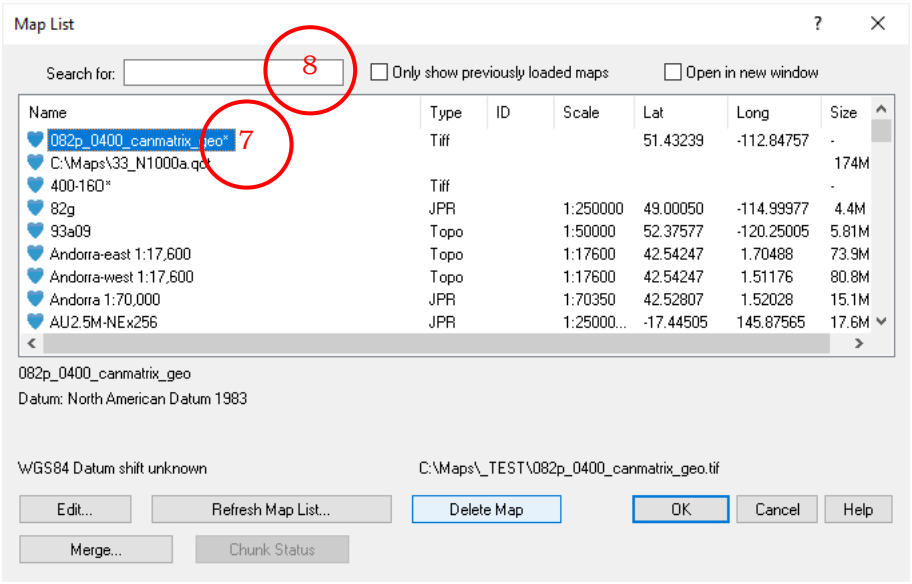
The main purpose of the project M4MM is to create maps which can be used with Memory-map. To import maps you need a full Memory-Map Navigator licence. There are more or less four option to import a map: a QCT-file, a qualified GeoTIFF-file, a qualified PNG-file with a related JPR-file and a qualified PNG-file without a related JPR-file. In the last case you must calibrate the map using Memory-Map. A qualified GeoTIFF-file means the color depth must be 256 colors or less and the used calibration data must be based on WGS 84, NAD 27, NAD 83 or OSGB. A qualified PNG-file means the color depth must be 256 colors or less.

First you must copy your QCT-file, GeoTIFF-file or the PNG- with/without the related JPR-file to a folder where Memory-Map can find them (will be explained later on in the paragraph).

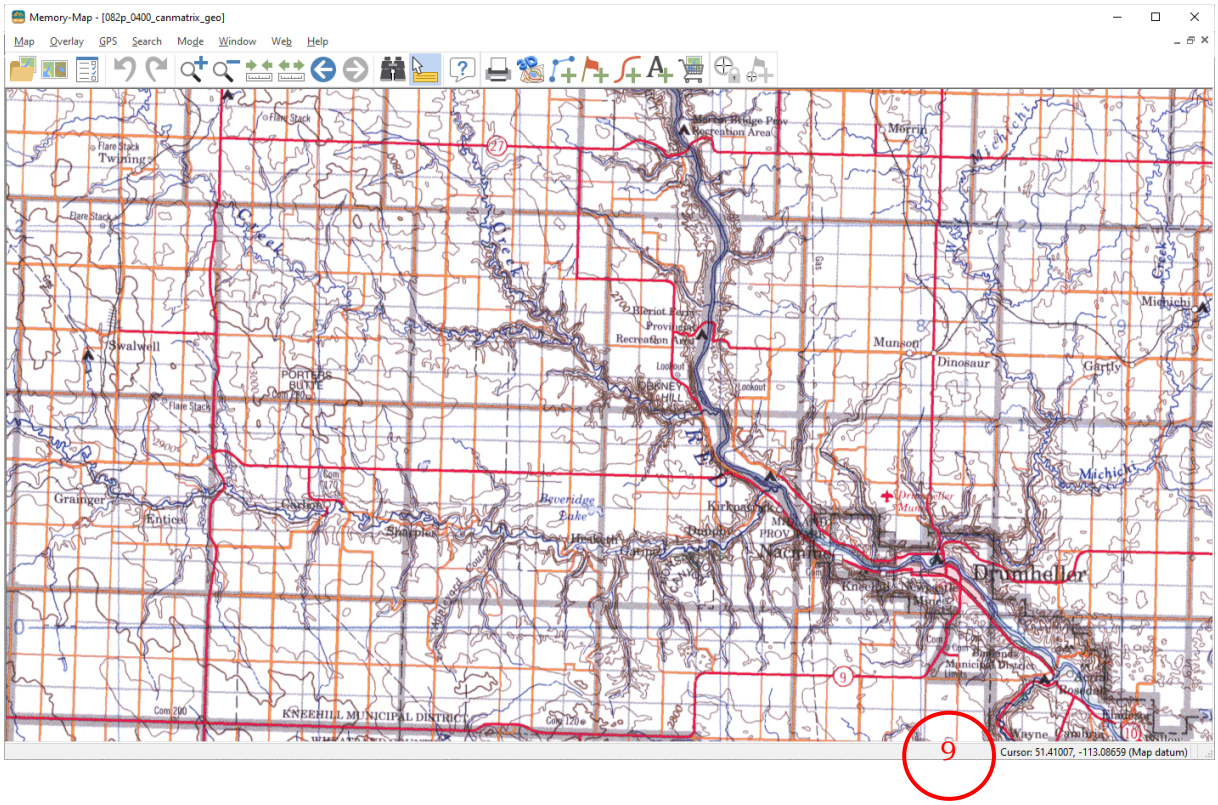
Open Memory-Map and open the Map list by using the keyboard combination *CTRL + M* or by clicking on the *Map List* icon(1). The *Map List* window will open(2). Click on the button



Refresh Map List ....(3). The upper textbox(4) must contain the name of the folder of your QCT-file, GeoTIFF-file or PNG-file (with or without the JPR-file). If not, add the folder. At the bottom of the window is a textbox *Folder containing converted maps:*(5). This is the folder where you will find the QCT-file of the map (after creation). all the folders in both textboxes (4)/(5) must exists. Otherwise Memory-Map does not work properly (and can even stall). When everything is ready click on the *OK* button(6).



The *Refresh Map List* window will close and the *Map List* Window will become active again. You will see the name(7) of your new map (with a little star(only PNG- or GeoTIFF-file)). Maybe you must scroll to find the file. You may narrow the search by using a filter (*Search for:*(8)). Select this map by double clicking on the name(7). The *Map List* Window will close and the map will be loaded in the main window of Memory-Map.



The first sign the map is calibrated you will see in bottom right corner (9) of the main window. A geographical coordinate has appeared instead of a pixel coordinate (in case the map isn't calibrated).

If the map was already calibrated now is the moment to check the calibration.

If the calibration is correct you can delete or move you GeoTIFF- or PNG/JPR-file. From this moment Memory-Map uses only the QCT-file. You will find this map in the *Folder containing converted maps:*(5) field. You may move this QCT-file to a place where Memory-Map can find it (one of the folders in the *Refresh Map List Window*(4)).

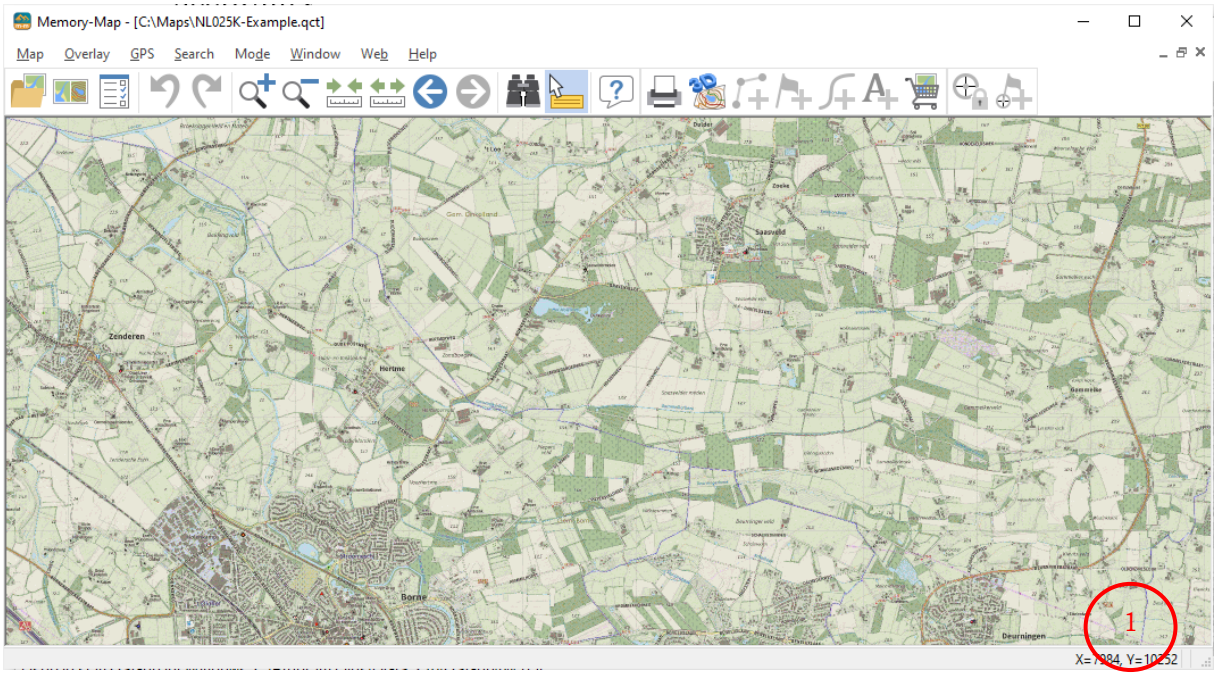
Calibrating maps

The presumption to start calibrating a map is an image of that map in PNG-file format with a color depth of 8 bit (255 colors) and a source for the geographical coordinates.

Warning: Memory-Map Navigator version 6 contains a bug in the calibration functionality. It will be explained in the paragraph First option. If you have or can find a version 5.4.4. use that version to calibrate your map. The versions 6 and 5 can be installed parallel.

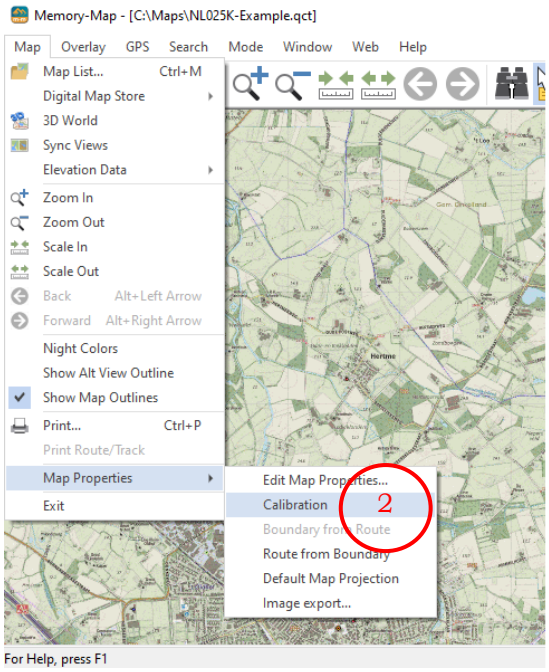
Calibration step by step

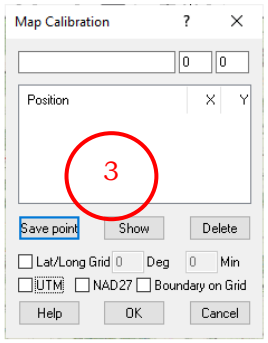
The first step is to import this map as described above without a JPR file. At the bottom right corner you will see pixel coordinates(1). In the background a QCT file will be created



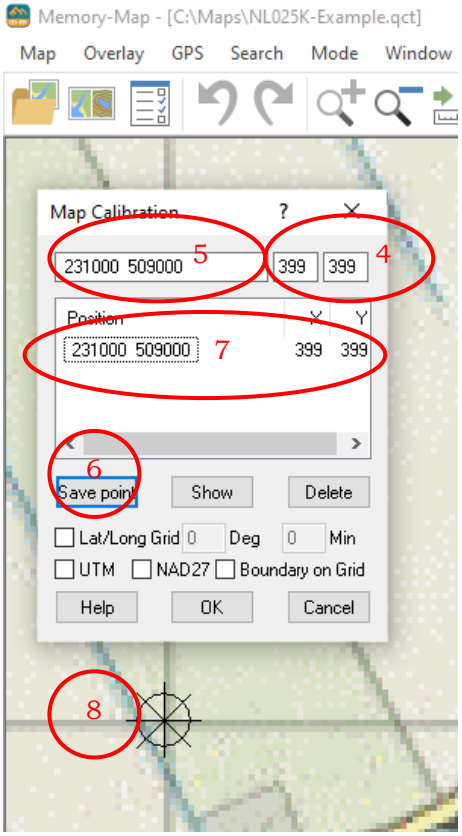
which points to the PNG-file. After calibration the image and the calibration data of the map will be added.

The second step is to select the coordinate or grid system. If possible select the option *Lat, Long > Degrees (+/-)*. This is the format Memory-Map uses to save the coordinates. In the example in the following paragraphs (a Dutch map), we go one level deeper to select the Dutch grid (RijksDriehoekstelsel).





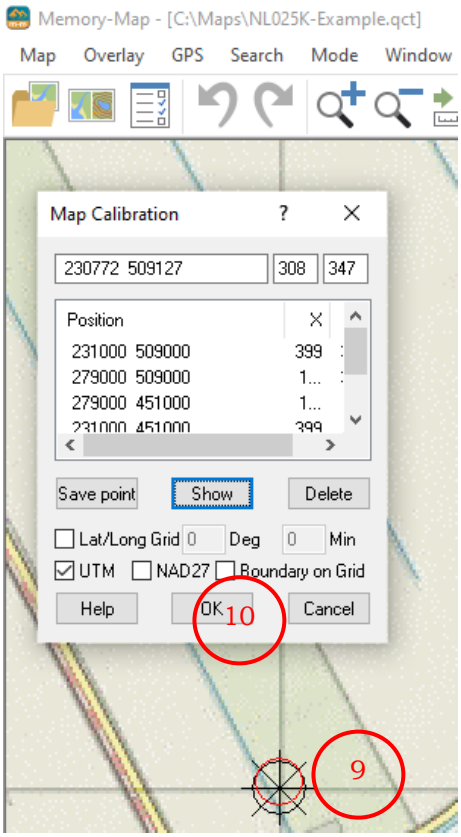
The third step is opening the calibration window. To do so select *Map* > *Map Properties* > *Calibration*(2). In Memory-Map 5.4.4 you must select *Map* > *Calibration*. The *Map Calibration* window (3) will open and the cursor shape will change into a double crosshair.



The fourth step is adding reference points. This can be done in two ways.

<u>The first option:</u> Select a reference point, zoom maximal in on that point and center the (double line) crosshair pointer over the point, Than click on the left mouse button. The pixel coordinates will appear in the *Map Calibration* window(4). Insert the geographical coordinates (5) and click on the *Save Point* button (6). The data will be copied into the middle box(7) and pixel coordinate will be marked with a (single line) crosshair(8). Now a second reference point can be added.
<u>Bug</u>: If you use Memory-Map version 6 the pixel coordinate is 2 pixel too far to the left and 2 pixel too far to the top when saving the point(6). You must correct this by adding 2 pixel both values(4). To do so select the point in the middle box(7) and edit the pixel coordinates(4).

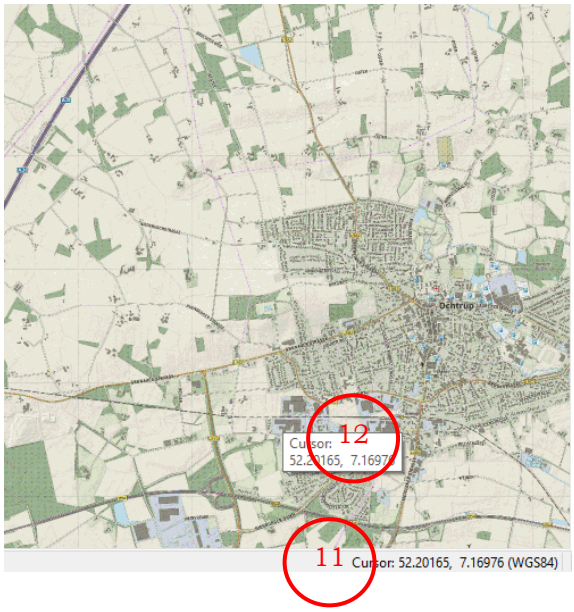
<u>The second option:</u> Insert the geographical coordinates(5) as well as the pixel coordinates(4) in the *Map Calibration* window "by hand" and click on the *Save Point* button(6). The data will be copied into the middle box(7) and pixel coordinate will be marked with a (single line) crosshair(8). Now a second reference point can be added.



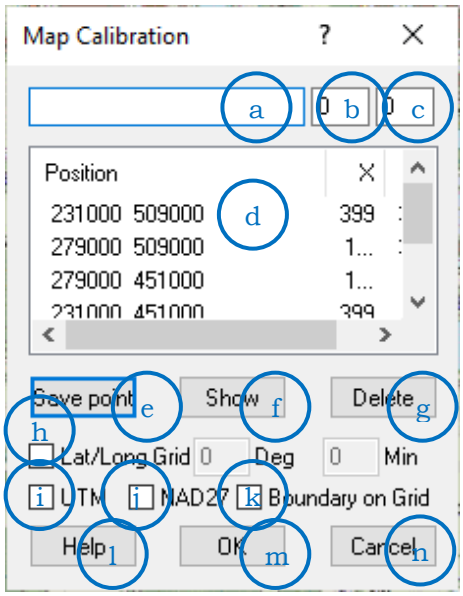
From the third reference point on a red circle(9) will appear near the crosshair. The center of this circle represents the geographical coordinate. The better the red circle matches the black crosshair, the better calibration will be. To calibrate a map you need at least three reference points; the more, the better. In most cases five points (near the corners and the center of the map) will do the job. Every time you add or edit a (new) reference point the location of the red circle will be recalculated.

Fifth and last step is saving the calibration data. Just click on the *OK* button(10). In the background two things happens: the QCT-file will be modified (image and calibration data) and a JPR-file will be generated.

When the calibration is done You will see map coordinates in the bottom right corner of the main window(11) and at the location of the cursor on the map(12).



The calibration windows explained



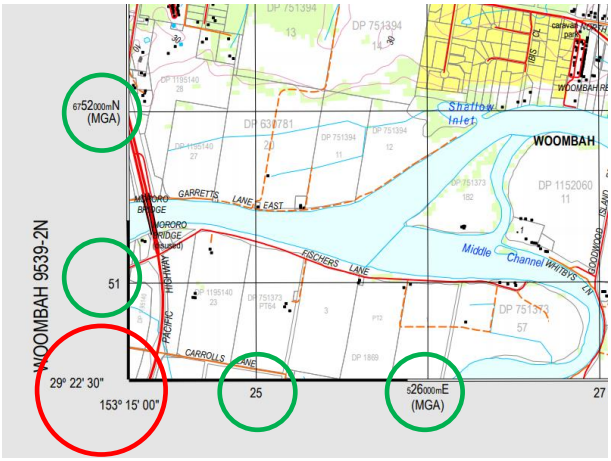
a: The field for the geographical coordinate.
b: The field for the pixel X coordinate.
c: The field for the pixel Y coordinate.
d: The list of already calibrated reference points.
e: The *Save point* button. To save a reference point. The data from fields a, b, and c will be moved to list d.
f: The *Show* button. After selecting a reference point in d and clicking on this button the cursor on the map will move to the selected reference point and the data of that point will be copied to fields a, b, and c.
g: The *Delete* button. After selecting a reference point in d and clicking on thos button the point will be removed from list d.
h: The option *Lat/Long Grid*. This option helps to calibrate a map based on Latitude and longitude. More details in the Memory-Map manual.
i: The option *UTM*. A non-documented option. It seems the map will be treated as map with Universal Transverse Mercator (UTM) projection. Use this option when handling a map with this projection. You may use this option for maps of small areas with a Mercator projection unless the map “crosses” an UTM zone.
j: The option *NAD27*. A non-documented option. To be used when calibrating using NAD27 coordinates.
k: The option *Boundary on Grid*. A non-documented option. Do not use this option, it destroys the boundary data.
l: The *Help* button. To open the calibration related help page.
m: The *OK* button. To save calibrated reference points (in list d).
n: The *Cancel* button. To cancel the calibration process. All data in fields a, b, and c and list d will be deleted.

Sources for the geographical coordinates

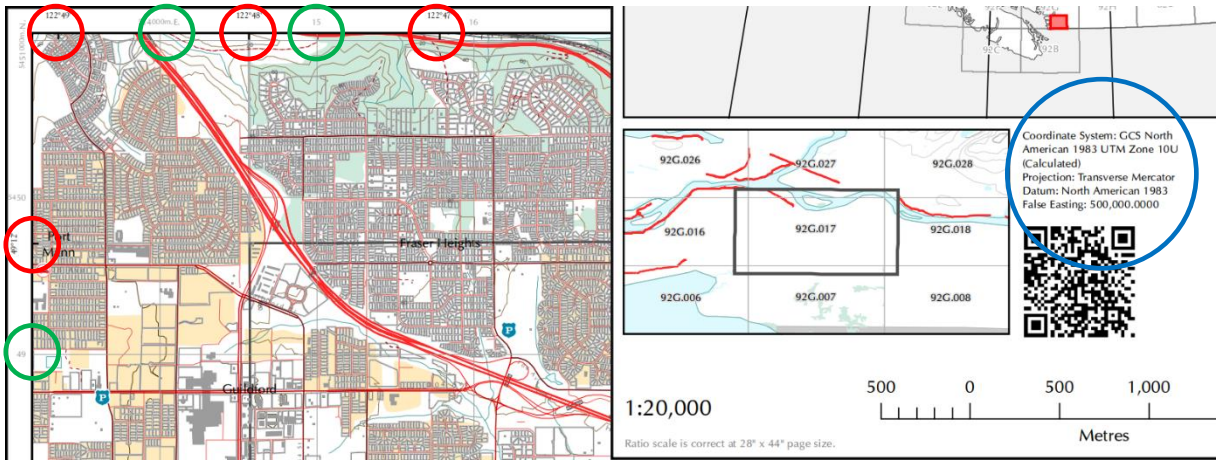
To calibrate a map you need to pinpoint the geographical coordinates to specific pixel. There are more or less three sources: the map (paper or electronic) itself, an other paper map and an online map.

The map (sheet) it self

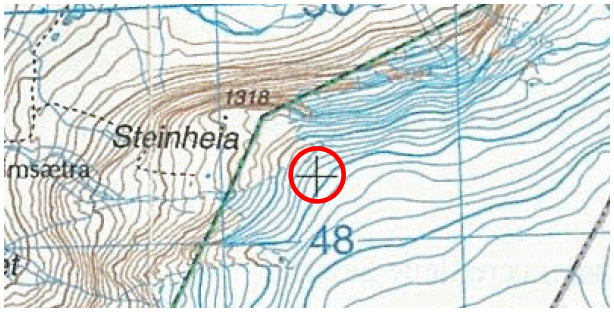
If you have scanned a (part of a) map sheet or you downloaded a full sheet, that sheet is you first source of information about coordinates. In a lot of cases these sheets have a collar, on which you can find information about the used coordinate system and the coordinates them self. To the right an example (Woombah/Australia). In the red circle you see the exact latitude/longitude coordinates of the bottom left corner (as in the other corners). In the green circles you see UTM coordinates based on the Australian grid (MGA). With this information you are able to calibrate you map, either with the latitude/longitude or with the MGA UTM coordinates (MGA is more or less the same as WGS84).



Below another example (Near Vancouver/British Columbia/Canada). At the collar you may find information about the coordinates. In the example you see latitude/longitude (red circle) and UTM coordinates (green circle). Based on the crosslines you can establish the coordinates of a certain pixel. Somewhere else on the collar there is additional information about these coordinate systems (blue circle). In the example the projection is Transverse Mercator, the coordinate system is UTM zone 10U and the datum is North American 1983 (NAD83).



A last example (to the left) from a scanned Norwegian map. The markers for the latitude/longitude coordinates were just crosshairs (red circle) every fifteen geographical seconds.



The coordinates on the map (collar) aren't always usable for Memory-Map. In these cases you must use a tool to convert the coordinate to WGS 84 latitude/longitude. Such a tool can be found on internet. Some examples Free online coordinates converter

(tool-online.com), https://twcc.fr/, and Transform coordinates - GPS online convertor (epsg.io).

Another paper map

Theoretical it is possible to calibrate a map with another paper map. You must find the exact same spot on both maps and must determine very accurate the coordinates of that spot. This is a challenging job which I can't recommend. A well trained map reader may do this within two or three meter on a map with a scale 1:25,000 and that is nearly enough. And the challenge will become even greater if the maps aren't from the same publisher. Using an online map from the internet is much easier.

An online map

The first step in this case is finding an online map with the possibility determine the location of a certain spot. Some examples of usable online maps which I have used in the past: The World Coordinate Converter (twcc.fr), ArcGIS (select *Measurements* > *Location*) and GISsurfer (use crosshair in middle of window). Use the same grid in Memory-Map and the online map.

The second step is to create your workspace. To do the job in a comfortable way you need to have two applications opened; Memory-Map and your online map. If possible use two monitors. The second best is a split screen: One application on the left side an one on the right side.

The last step is calibrating. Find on you map in Memory-Map a suitable spot, find the same spot on your online map and copy the coordinates of the online map to Memory-Map (preferable using the Windows 'copy and paste' function to prevent errors).

Selecting reference points.

The challenge is to find the exact same spot on your to calibrate map and you online map. In most cases a crossing of roads is the best option. An example based on the OpensStreet map in and an aerial photo in ArcGIS (red circle/white dot is the reference point). Use always the crossing of the center lines of the roads. On most maps the representation of a road is wider as in reality.

The center line is always spot-on on map with a smaller scale (1:100,000 or less). Other options are triangulation points or fixed points like the dots or triangles. An example of a Swiss map to the left (blue circle/dot to the left of 615). Don't use 'fluid' elements on a map (like shores, rivers or glaciers). They will change during time.

Calibration considerations

Decimal degrees and WGS 84.

The native way Memory-Map saves information is based on WGS 84 and in decimal degrees. Transformations of coordinates between coordinate systems are complicated calculations, sometimes in three or four stages. In every stage values will be rounded and so less accurate. To prevent these inaccuracies it is preferable to use WGS 84 as geodetic datum and decimal degrees as unit.

The amount of reference points

The bare minimum is three, but four of five are preferable for maps about 10,000 by 10,000 pixel. Larger map needs more points. For a map of 20,000 by 30,000 pixel you may need about eight to ten points (based on experience). Checking the calibration and adding reference points can be an iterative process by comparing the black crosshair and the red circle.

Accuracy of a reference point.

For this subject There are tree approaches. The first one is the way Memory-Map saves the reference points. Looking at a JPR-file latitude/longitude coordinates are used with decimal degrees. These coordinates have 6 digits behind the dot, which means (after some calculating) an approximate accuracy of less the 0.1 meter.

The second approach is based on the accuracy of a map. A high definition raster map with a scale1: 25.000 and a resolution of 660 DPI (like the British OSGB Explorer map) has an accuracy of approximate 1 meter (the size of a pixel in reality). Most maps have a lower accuracy.

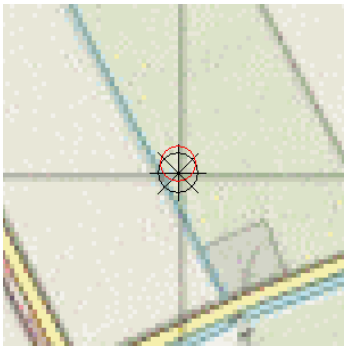
The last approach are the GPS chips used by mobile devices. Using latitude/longitude coordinates the representation in decimal degrees will have five decimals behind the dot (approximate 1 meter accuracy).

The conclusion which can be drawn: five digits is good, six digits is better, more digits is useless.

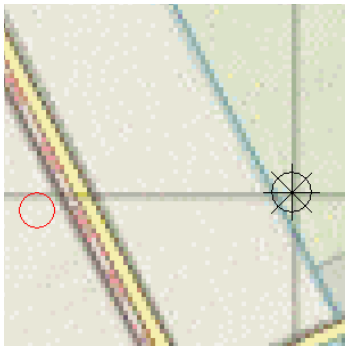
Checking calibration

The calibration can be checked in four different ways. The first one is checking the calibration in te terrain. In most cases is unfortunately impossible. The Second one is looking on the calibration itself, the third is testing it against another map source and the fourth using GPX-route/tracks.

Checking with Memory-Map



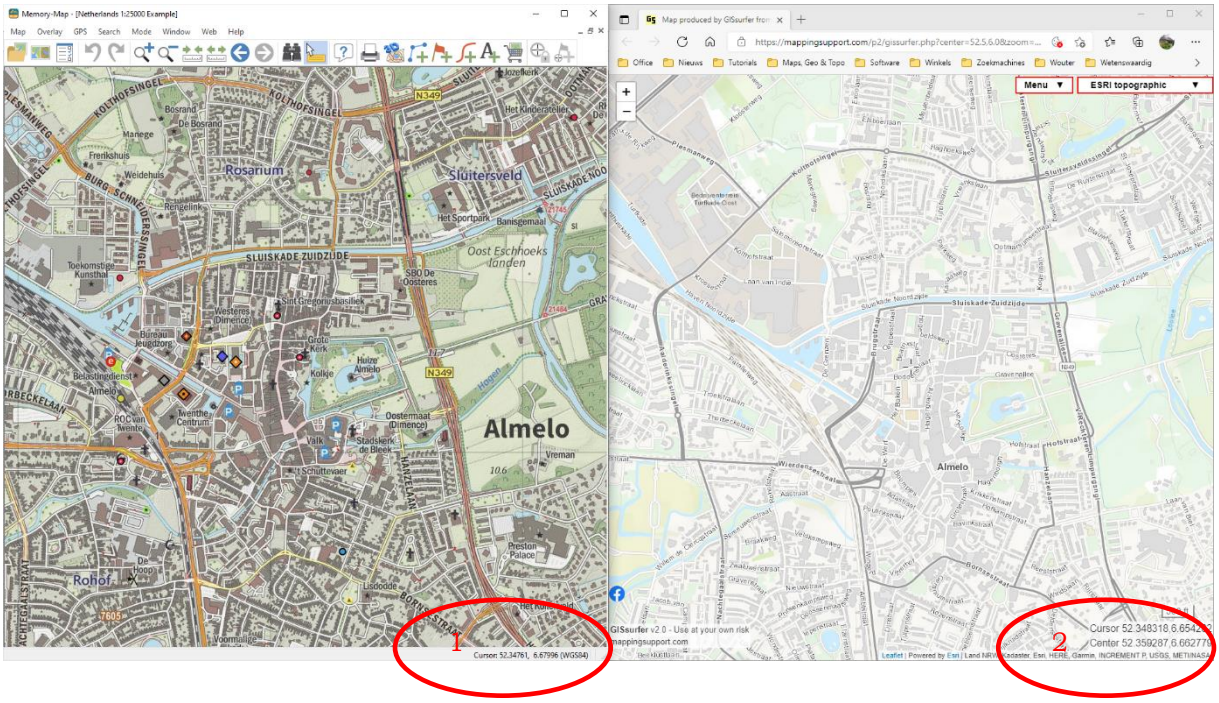
This method can only be used with a PNG-image and the related JPR-file.
To check the calibration open the Map Calibration window (*Map* > *Map Properties* > *Calibration*), select a reference point, click on the *Show* button and zoom in. You will see a black crosshair with a circle (the pixel coordinate) and a red circle (the geographical coordinate). When



for every reference point the red circle fit in the black circle the calibration is optimal. In the left example the calibration is three pixel of grid (one or two pixels are acceptable/red circle touches black circle). In most cases this mismatch can be correct by adding reference points. In cases like the right example means doing the calibration again.

Testing it against another map source

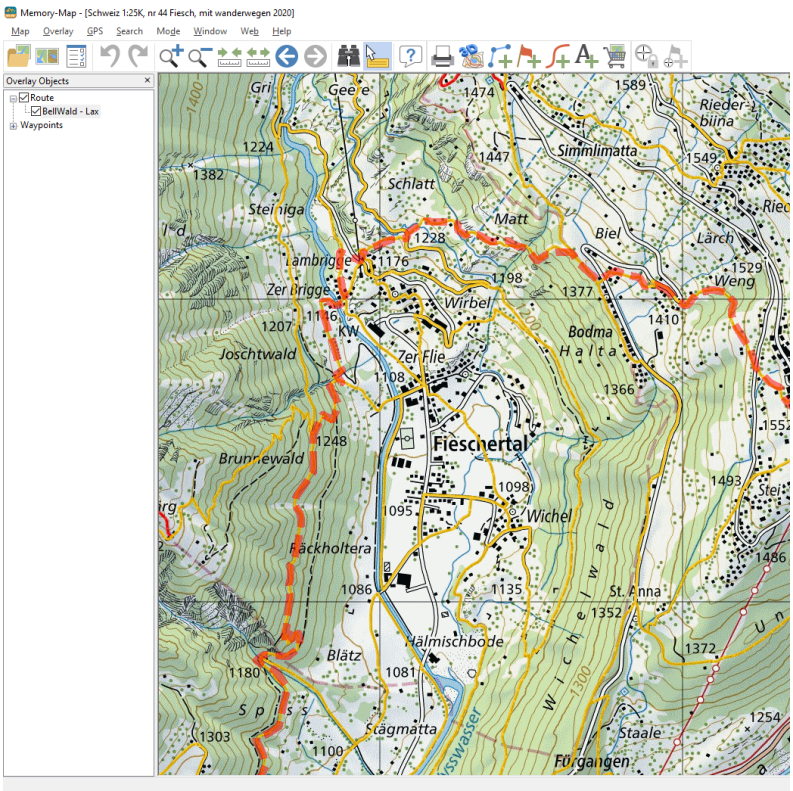
To do so create your work space as described in Sources for geographical coordinates/An online map. Select on your online map a 'check'-point, find the same point in Memory-Map and compare the coordinates. Repeat this procedure at least four or five times, for example in each corner and in the center of you Memory-Map map.



In the example above the webpage of GISserver is used, The World Coordinate Converter (twcc.fr) and ArcGIS are good alternatives.

Testing using a GPX-route/track

This is actually a "quick and dirty" method, but in practice it works well . Find in the internet to a hike or mountain bike site. Search there for one or more tracks or routes, which fits on your calibrated map. Downloads them as GPX-file and load them in Memory-Map. If everything is correct, the track or route fits neatly on the trails and roads. A helpful website with a lot of tracks (partly verified) is traildino.com.



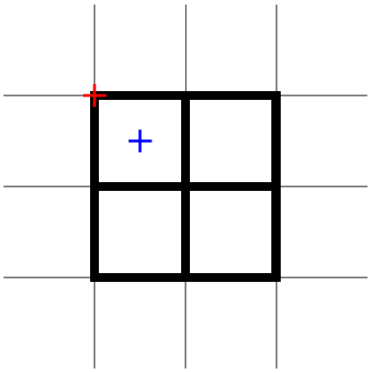
An example of a Swiss map with a route to the left.

Some remarks: It may helpful to change appearance of the track. In the example the transparency was set to 50 % and the line style to dashed. In this way it is easier to check the fitting.

From experience it is necessary to check the

calibration in at least two opposing corners.

Pixel coordinates

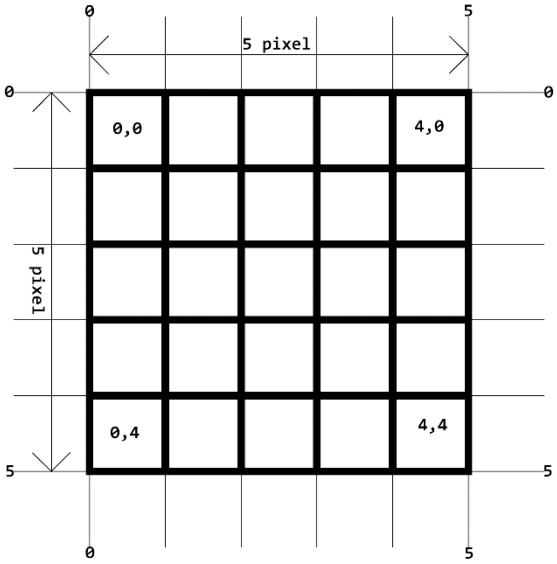


There are more or less two ways to identify the location of a pixel in an image.

The first one is by using a mathematical Cartesian coordinate of the top left corner of the pixel (red crosshair in the example to the right). The second one is the location of a pixel in a two dimensional array. The pixels center represents it (blue crosshair).

Memory-Map uses Cartesian coordinates. Some other program like OziExplorer uses array coordinates.

From array to Cartesian



In most cases all the pixels in an image are square and do have all the same length and height. There for the array coordinates can be used as Cartesian coordinates. They are just half a pixel of grid.

In the example to the left the outline of the image in Cartesian coordinates is (0,0) – (5,0) – (5,5) – (0,5) – (0,0). In array coordinates it is (0,0) – (4,0) – (4,4) – (0,4) – (0,0).

GeoPDF-, GeoTIFF- and MrSID-files use in most cases Cartesian coordinates. The application M4MM assume so.

OziExplorer uses the pixel coordinates. M4MM doesn't convert the OziExplorer coordinates to Cartesian.

Building a JPR-file using from MOBAC map using the MOBAC option the coordinates will be converted.

Remark: Although the difference between both coordinates may be small, it can effects a map merge (losing a column/row of pixels or a column/row with blank pixels).

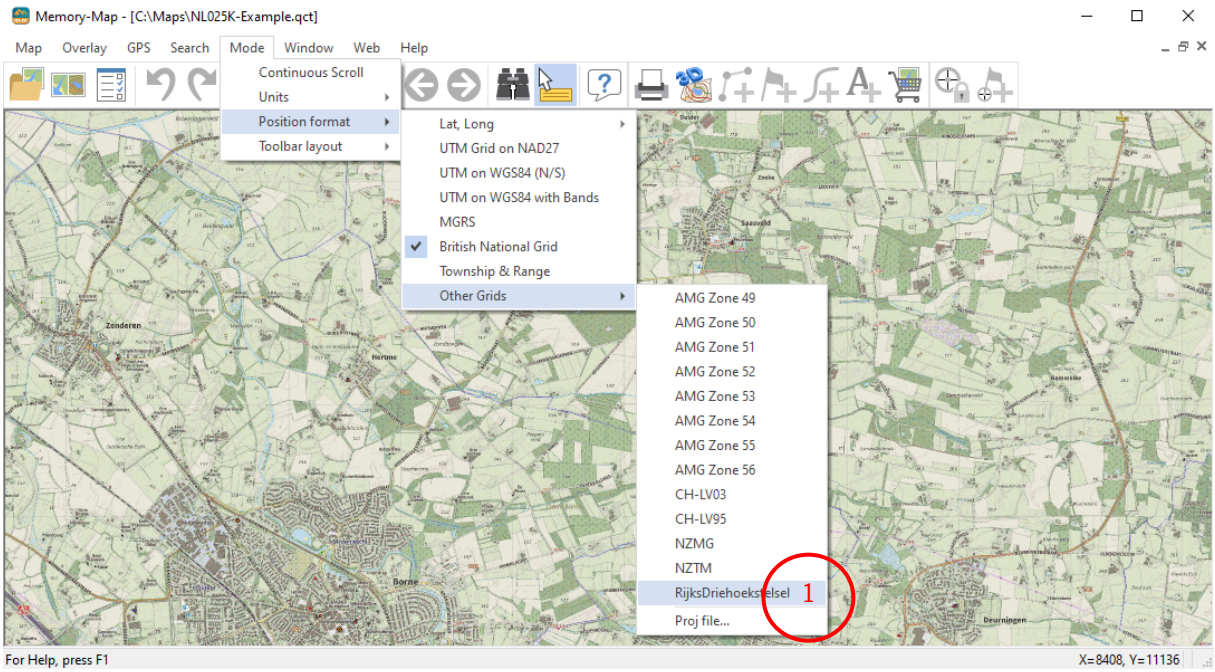
Selecting and adding Grids

Memory-Map has a number of native grids (coordinate reference systems): Latitude/Longitude, UTM based on WGS 84, UTM based on NAD 27, MGRS (Military Grid Reference System) and OSGB 36 (Ordnance Survey Groot-Britain 1936). A non-described but useful is the option to add grid systems. Memory-Map itself used this option to add the Australian, the New Zealand and the Dutch grids. The author added the Swiss grids. The grids can be used to pinpoint a location or to calibrate a map.

Warning: Although is possible to add grids to the PC version of Memory-Map, it isn't possible to the to the Apps for IOS/Android and Memory-Map for All.

Selecting a Grid

When selection the option *Mode* > *Position Format* you can select a native grid. To select an



added grid go to *Other Grids*. In the example the Dutch grid “RijksDriehoekstelsel” was selected(1).

Adding a Grid

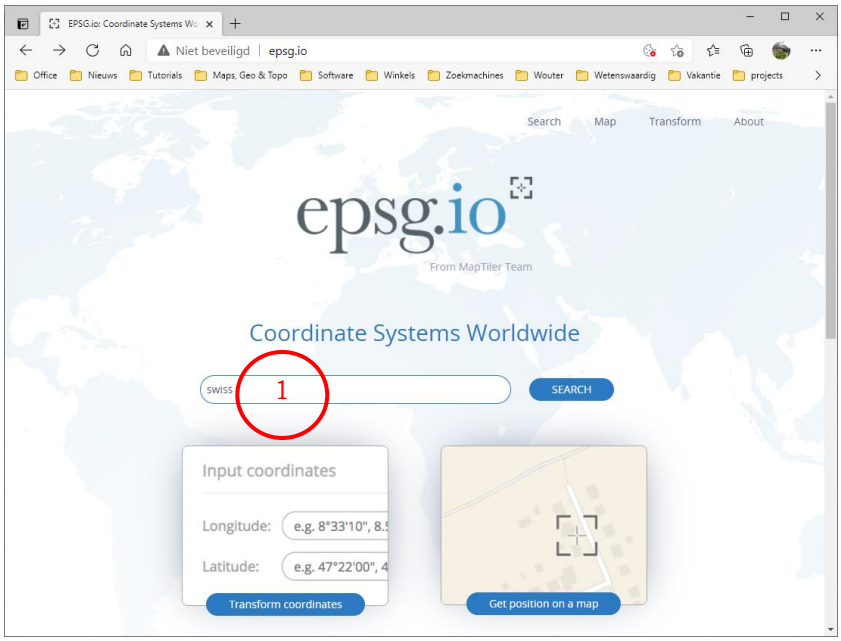
The data for an additional grid are stored in specific Grid-file. Each Grid has its own file with the file extension `.dat`. You will find these files in the “Grids” folder of Memory-Map (Navigator 6: `C:\Program Files (x86)\Memory-Map\Navigator-6\Grids`, Navigator 5: `C:\Program Files (x86)\Memory-Map\Navigator\Grids`). By adding a Grid-file to this folder the Grid will appear in the list *Other Grids*.

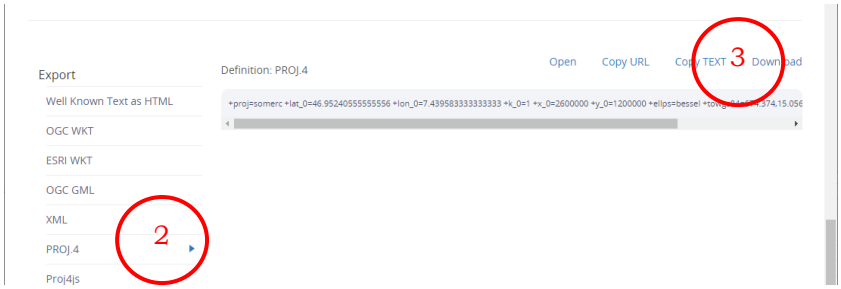
Creating a Grid

By studying the content of the Gird-files provided by Memory-Map the conclusion can be drawn that the content corresponds with the `PROJ.4` definition of that specific grid. By copying the definition in to a text-file (like `example.dat`) you can create a Grid-file.

Where to find **PROJ.4** definitions

Two sources can be recommended. The first one is the website http://www.epsg.io. After opening the website insert your keyword(1) and start the search. In the example the search is about Swiss girds. After the search operation the found grids will be displayed. By selecting one of them all details of that grid will be displayed. Scroll down to the *export* part of the page. Select the option *PROJ.4*. and the PROJ.4(2) definition will be displayed. Click on *Copy TEXT* and the definition will be copied to the clipboard. Save this information in a text-file. Give this file an "appealing" and clarifying name with the file extension DAT. In the example the file name CH-LV95.DAT would be a good option. The file name (without the extension) will be, when located in Memory-Maps "Grids" file folder, displayed in *Other Grids*.



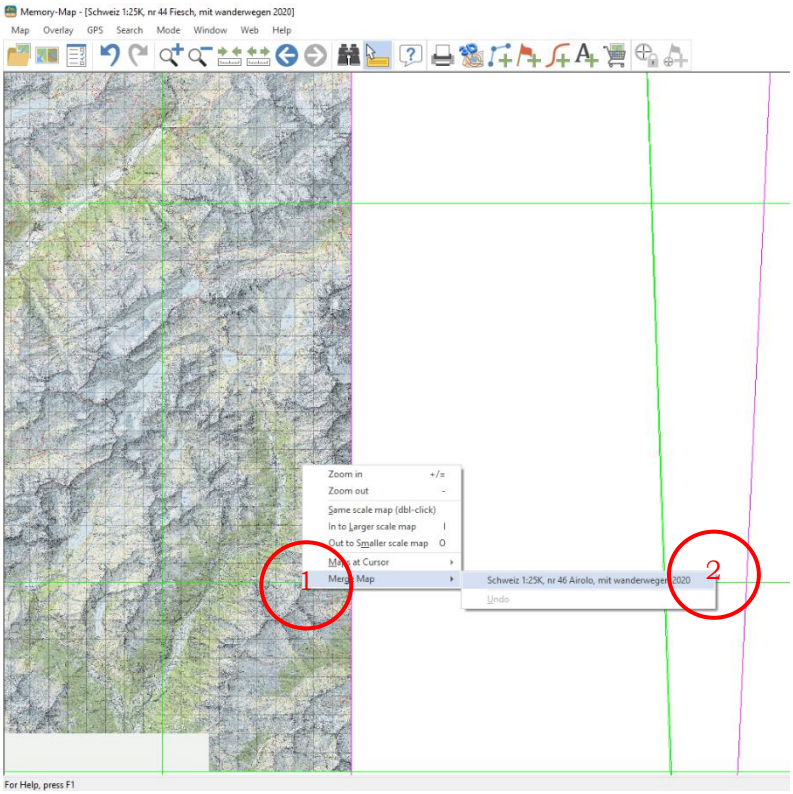


The second source is the application QGIS. This will be described separately.

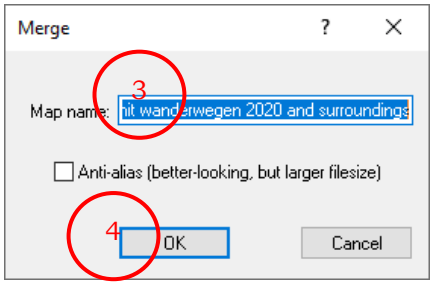
Which **PROJ.4** definition to use.

To find the correct definition is often a great challenge. When looking for a grid definition both EPSG.IO and QGIS give mostly multiple options. To select the right one you need some clues. If your source is a paper or an electronic map sheet have a look on this sheet (more information). If you didn't find any clues or you used an online map (grab, cut, past) you may find some information on the website of the publisher. Sometimes it is a case of trial and error. Although I'm not a wizard, I may help you if you send me a mail (info@hzns.nl).

Merging maps



Instead of creating one big map to calibrate you can also create some smaller maps, calibrate them and merge them together. Especially when using scanned paper maps. The first step is to calibrate all “sub” maps and check their calibration. The second step is the merging. Open you first map. Then move your cursor the location of the map to be merged (in the example right to the right-side of the first map) and click on the right mouse button. In the menu which appears select the option *Merge Map*(1) and select the map to be merged (2). After selection the *Merge* window will appear(3). You may change the name(4). After clicking on the OK button the merging starts. Repeat this procedure for each “sub” map. When ready you can find the merged map in the *Folder containing converted maps*.(as described in Importing map (5)). You may change the name of this QCT-file (get rid of the numbers). You may also chance the properties of the map in the window *Edit Map Data* (describe in the paragraph below/first image).



Structure of a Memory-Map JPR-file

One of the options to import a map into Memory-Map is using a PNG-image of that map with the related JPR-file with all the georeferenced data. In the paragraph Importing maps in Memory-Map is the "How to" described. In this paragraph the structure of the JPR-file will be explained, as far as possible.

Acknowledgement: All the information to write this paragraph was collected from open sources and from observation of the behaviour of Memory-Map with the trial and error method. The code of Memory-Map was never reverse-engineered, decompiled or disassembled. Said so this means the information isn't complete and may be not fully accurate. It was, it is and it will never be my intention to violate any copyright.

As Memory-Map uses more or less the same file structure as Fugawi. I used the their document "JPR file format Version 1.18" as information base.

An example

```
//Example - Dutch region of Twente
//be aware: not all the information is correct
nm= Netherlands 1:25000 Example
dm=WGS84
st=0.00001
sn=0.00002
pr=UTM
zn=32t
sc=25000
sr=254
it=png
cu=meters
du=meters
ed=10
et=01-2021
dt=01-02-2021
cr=copyright CC-BY 4.0
rp1=52.572433,6.493538,0,0
rp2=52.563272,7.230799,20000,0
rp3=52.024235,7.208567,20000,24000
rp4=52.033253,6.480191,0,24000
vp1=0,0
vp2=20000,0
vp3=20000,24000
vp4=0,24000
```

The structure

Some Notes in advance:

- In case a line contains more than one value, a comma is used as separator (`vp3=20000,24000`).
- A dot is used as decimal separator (`p5=34.00`).
- If there is no collar on the map, the bounding polygon is not required. It is advised to define the corners of the image as a boundary.
- Latitude and longitude are always in decimal degrees with negative sign for the southern and western hemispheres.
- In general the letters are not case sensitive. If a text is pasted to Memory-Map (like map name (`nm`) or copyright (`cr`) the case does matter.
- Pixel coordinates are measured from the top left corner of the image, starting at 0,0 as positive numbers.

Every line contains an indicator and a one or more values, except for lines beginning with //. These lines contains comments and can removed without damage.

Indicator: nm
Description: name of the map
Type: text
Values: free text, case sensitive
Remarks: If omitted Memory-map uses the name of the QCT-file with full path as nm.

Indicator: dm
Description: geodetic datum
Type: text
Values: confirmed values WGS84, NAD83, NAD27 and OSGB.
Remarks: a geodetic datum which is more or less the same as WGS84 may be used (subject of exploration).

Indicator: st
Description: latitude datum shift
Type: numeric in decimal degrees
Values: Mostly between (-)1.0 and (-)0.000005
Remarks: shift of (-)0.000005 is less than a meter.

Indicator: sn
Description: longitude datum shift
Type: numeric in decimal degrees
Values: Mostly between (-)1.0 and (-)0.000005
Remarks: shift of (-)0.000005 is less than a meter.

Indicator: pr
Description: map projection
Type: text
Values: confirmed values: mercator, transverse mercator; UTM and lambert conformal conic.
Remarks: none

Indicator: zn
Description: UTM zone
Type: text
Values: 01j to 60j (northern hemisphere) and 01t to 60t (southern hemisphere)
Remarks: only used in combination with projection UTM.

Indicator: pp
Description: Central Meridian
Type: numeric in decimal degrees
Values: -180 to 0 to 180
Remarks: used in combination with lambert conformal conic projection and transverse mercator projection.

Indicator: p1
Description: Latitude of origin
Type: numeric in decimal degrees
Values: -180 to 0 to 180
Remarks: used in combination with lambert conformal conic projection, transverse mercator projection and mercator projection (mid- latitude).

Indicator: p2
Description: scale factor
Type: numeric

Values: more or less `1.0`
Remarks: used in combination with `transverse mercator` projection.

Indicator: `p3`
Description: false northing
Type: numeric
Values: depending on coordinate system
Remarks: used in combination with `transverse mercator` projection.

Indicator: `p4`
Description: false easting
Type: numeric
Values: depending on coordinate system
Remarks: used in combination with `transverse mercator` projection.

Indicator: `p5`
Description: Standard Parallel 1
Type: numeric in decimal degrees
Values: `-90` to `0` to `90`
Remarks: used in combination with `lambert conformal conic` projection.

Indicator: `p6`
Description: Standard Parallel 2
Type: numeric in decimal degrees
Values: `-90` to `0` to `90`
Remarks: used in combination with `lambert conformal conic` projection.

Indicator: `sc`
Description: Scale
Type: numeric
Value: positive value
Remarks:
- Use the number behind `1:` as value.
- The value is an estimate (and will be rounded).

Indicator: `sr`
Description: resolution
Type: numeric
Value: positive value
Remarks:
- Resolution in dots per inch (DPI).
- The value is an estimate (and will be rounded).

Indicator: `it`
Description: Image type
Type: text
Value: `png` (only value)
Remarks: only PNG-images can be imported using a JPR-file.

Indicator: `cu`
Description: altitude contour line unit
Type: text
Value: `meters` and `feet`
Remarks:

Indicator: `du`
Description: depth contour line unit

Type: text
Value: `meters`, `feet` and `fathoms`
Remarks:

Indicator: `ed`
Description: edition name
Type: text
Values: free text, case sensitive
Remarks: If the map has a collar the edition indication may printed somewhere on that collar.

Indicator: `et`
Description: edition date
Type: text
Value: date
Remarks: use – as day/month/year separator (dd-mm-yyyy). If the map has a collar the edition date may printed somewhere on that collar.

Indicator: `dt`
Description: last revision date
Type: text
Value: date
Remarks: use – as day/month/year separator (dd-mm-yyyy). If the map has a collar the last revision date may printed somewhere on that collar.

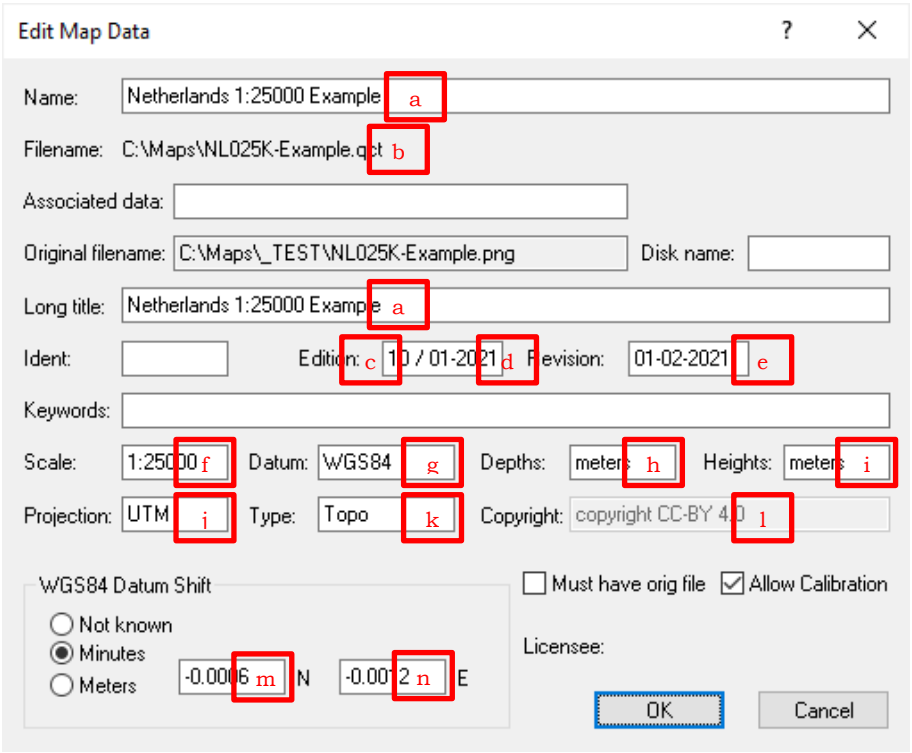
Indicator: `cr`
Description: copyright statement
Type: text
Value:
Remarks:
- be polite to the makers of maps and put their copyright statement on this place.
- do not use the word 'copyright' and the character '©' in the statement.

Indicator: `rp1 … rpN`
Description: reference point 1 to N
Type: decimal degree, decimal degree, numeric, numeric
Value: latitude, longitude, x coordinate of the pixel, y coordinate of the pixel
Remarks:
- latitude and longitude on the geodetic datum (`dm=…`).
- at least 3 reference points needed for calibration; the more the better.

Indicator: `vp1 … vpN`
Description: points 1 to N of the boundary (boundary of the map area of the image.
Type: numeric, numeric
Value: x coordinate of the pixel, y coordinate of the pixel
Remarks:
- At least 3 points are needed to create a boundary; mostly four points.
- The point must be in clockwise or anti clockwise around the map area.
- If the map hasn't a collar you can use the corners of the image.
- The boundary is necessary for some functionality of Memory-Map (*Map at Cursor*).
- `vp` stands for Vertex polygon Point.

In the following images of the windows *Edit Map Data* and *Map List* you will see where most of the JPR-data surfaces. The copyright-statement will appear on the print out of a map.

Edit Map Data window



a: name of map (`nm`)
b: location opened QCT-map
c: edition name (`ed`)
d: edition date (`et`)
e: last revision (`dt`)
f: scale (`sc`)
g: geodetic datum (`dm`)
h: unit of depth (`du`)
j: unit of height (`cu`)
i: projection (`pr`)
k: map type
l: copyright (`cr`)
m: latitude datum shift (`st`)
n: longitude datum shift (`sn`)

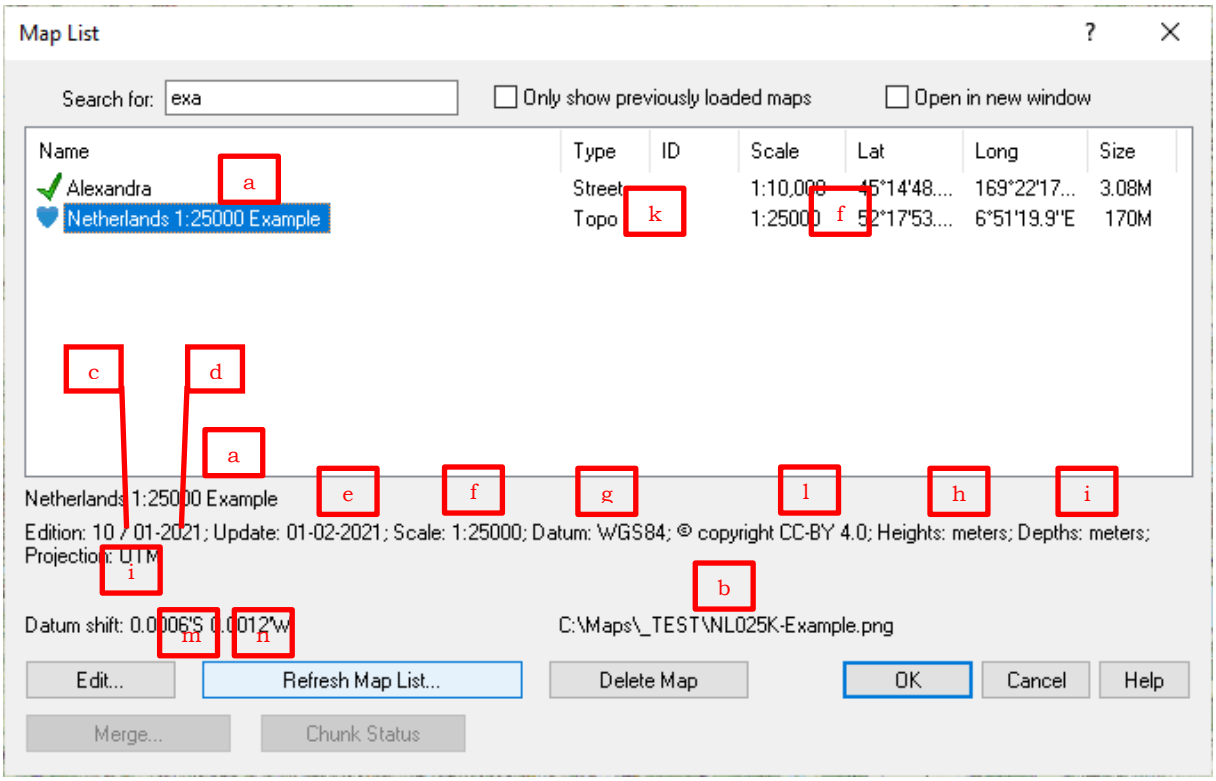
Remarks:

In a JPR-file is the datum shift in defined in decimal degrees; in *Map List* and *Edit Map Data* windows the shift is defined in decimal minutes (degrees * 60).

Using a JPR-file the map type will become `JPR` when scale is above 1:50,000. Map type with a smaller scale will become `Topo`.

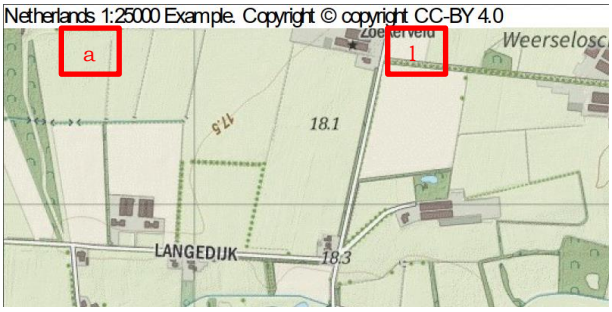
Map List Window

The letters in the image below refer to the same data as in the paragraph Edit Map Data window.



Printout of a map

The letters in the image below refer to the same data as in the paragraph Edit Map Data window.



Some third party software explained

Although I like to integrate functionality in M4MM as much as possible, I will use another application if it does the job better. The use of GDAL more or less essential, it is partly integrated. All other applications are optional.

In this part of 'The cookbook' you will find all the information you need to know to use the applications, as far as it is related to M4MM. You will find some words about the installation and the use.

GDAL

The Geospatial Data Abstraction Library (GDAL) is a translator library for raster and vector geospatial data formats that is released by the Open Source Geospatial Foundation. M4MM uses the GDAL functions `GDALINFO` and `GDAL_TRANSLATE`. The first one to extract the geographical data in WKT 2.0 format and the second to convert OziExplorer OZF2- and OZFX3-files and MrSID-files into graphical-files in PNG-format.

The M4MM relies on WKT 2.0. This means you must install an GDAL-environment version 3.0.4 or higher. M4MM Version 1.0.0 was tested using GDAL version 3.1.4 (64 bit) and 3.4.3. (64 bit).

Installing GDAL

The GDAL environment can be installed in two ways. The first one is as a standalone installation and the second is as a part of QGIS (a geographical information system). For both options you need to download the installation files from the website of QGIS (Download QGIS) and follow the instructions (more information about QGIS).

Use of GDAL

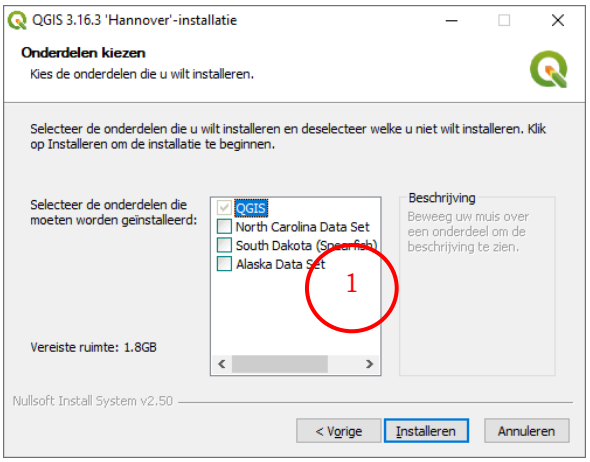
M4MM calls the GDAL functions by using a `SHELL` command. There for M4MM needs to know the location of the file `OSgeo4W.bat`. You will find this file in the "root"-directory of QGIS ("`c:\Program Files\QGIS x.x`" where `x.x` stand for the QGIS version) or GDAL ("`c:\OSGeo4W64`" or "`c:\OSGeo4W`"). M4MM will store this information in the file `m4mm.ini` in your (users) document directory.

QGIS

QGIS is a powerful open source geographic information system. It is party based on GDAL. This is the reason you can install QGIS is stead of GDAL. QGIS isn't only a replacement for GDAL but com with a lot of functionally, for example reducing the color depth of a GeoTIFF file without destroying the georeferenced data. In this paragraph of the M4MM manual some of these functions will be described as far as they are useful for the project M4MM

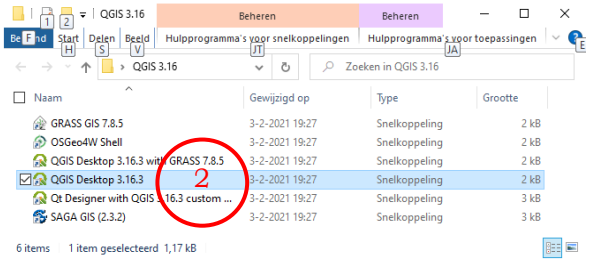
Installing QGIS

There are two important versions of QGIS. The first one is the long term release repository (LTR) version. This is the best option if like to use QGIS only as an "extension" of M4MM. If you are more adventurous and like to explore all the possibilities of QGIS try the latest version. The functionality of M4MM is based on the latest LTR version. The application M4MM (version 1.0.0) and 'The cookbook' were tested with versions 3.22.7 (LTR) and 3.24.3



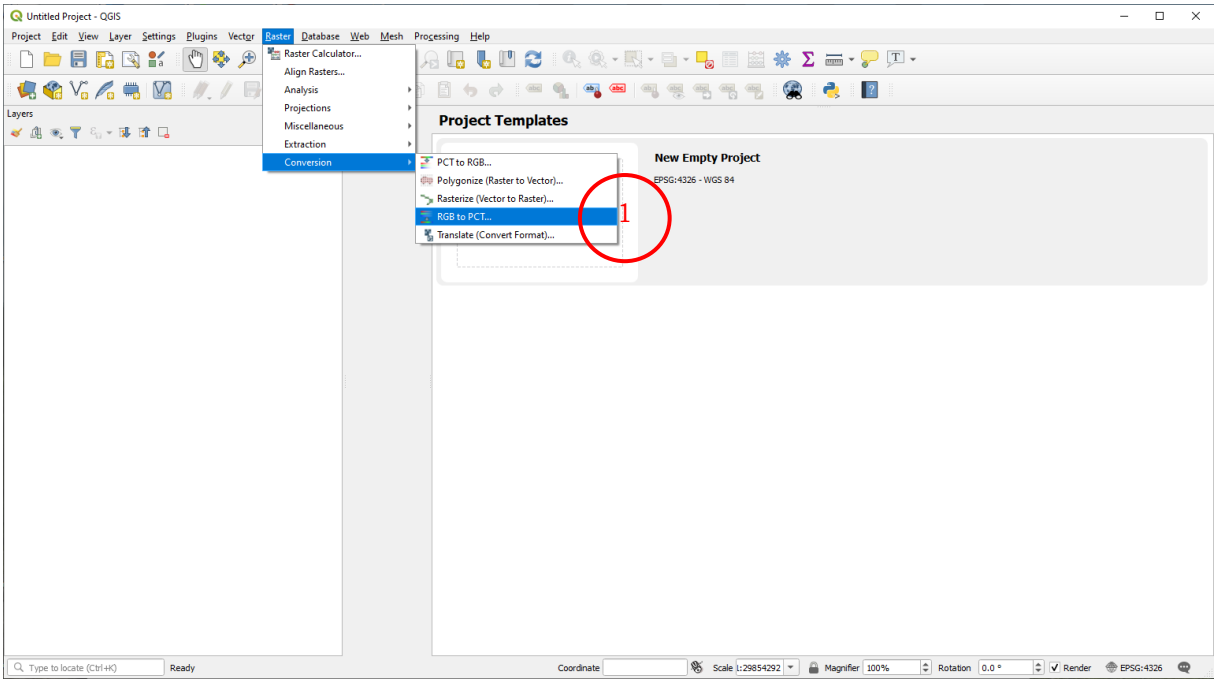
To install QGIS download the installation file from the website of QGIS (Download QGIS) and follow the instructions. If you only use GDAL don't install the data sets(1).

When the installation is completed you will find a map on your windows desktop called QGIS X.X.X (where x.x.x is the version). In this map several links. The link QGIS Desktop x.x.x is the right link to start QGIS.



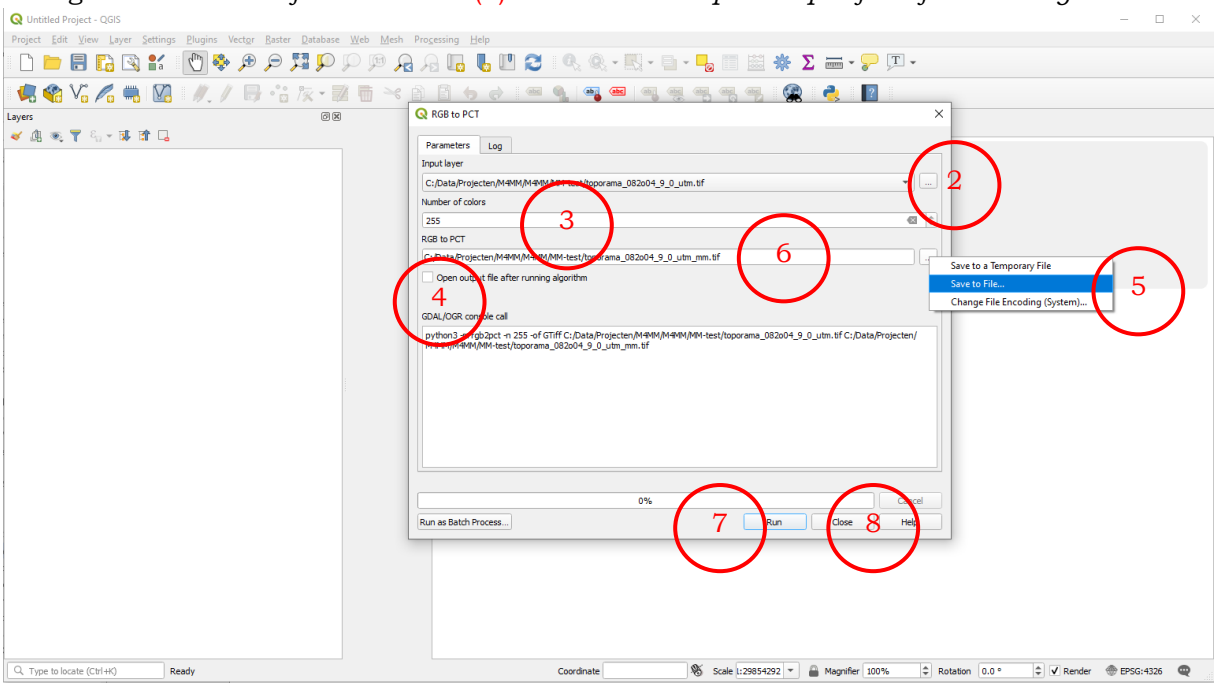
Converting GeoTIFF-file to 8 bit color depth

One of the QGIS functions is to convert georeferenced files (like GeoTIFF or MrSID) from 24 bit color depth (Red Green Blue) to 8 bit color depth (Paletted Color Table). GeoTIFF-files with a color depth of 8 bit, a metric Cartesian coordinate system and coordinates in WGS 84, NAD 83, GDA 94, ETRS 89 or OSGB may imported in Memory-Map without any changes. Other coordinates systems may not result in a correct calibration.



To do so open QGIS and select the menu option *Raster* > *Conversion* > *RGB to PCT*...(1). The window *RGB to PCT* opens.

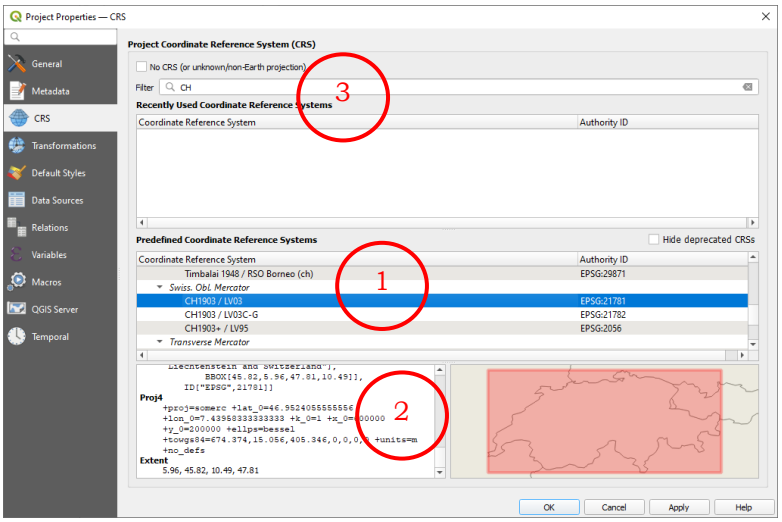
Go to the button … behind the *Input layer* input box(2) and select your GeoTFF-file (24 bit), change the *Numbers of colors* to `255`(3) and uncheck *Open output file after running*



algorithm(4) option. To set the output file name click on the button … behind the *RGB to PCT* input box and select the option *Save to file …* (5). The file extension must be `.tif`, do not use the same name as your input GeoTIFF-file and do not use spaces in your output file (in the example `_mm` was added to the file name(6). To execute the conversion click on the button *Run*(7). The `Log` tab will open and will see the progress. When ready, click on the *Close* button(8).

Finding **PROJ.4** definitions

In Memory-Map additional grids can be imported. The QGIS is one of the sources where the data can be found for these additional grids (PROJ.4 data).



In QGIS you can find the definitions in the *Project Properties - CRS* window (*Project* > *Properties* and select *CRS* tab). In the listbox *Predefined Coordinate Reference Systems*(1) you can select a grid system. The definitions for that grid will be presented in the bottom left textbox(2). By scrolling through this text you will find the Proj4 definition. By setting a filter(3) you can narrow the search for the right grid. Try the name of the country or area, the countries adjective or the country code. In the example the country code for Switzerland (CH) was used as filter. To save the Proj4 definition copy it to the clipboard and save it in a text file (with the file extension `.dat`).

PDF Exchange Editor

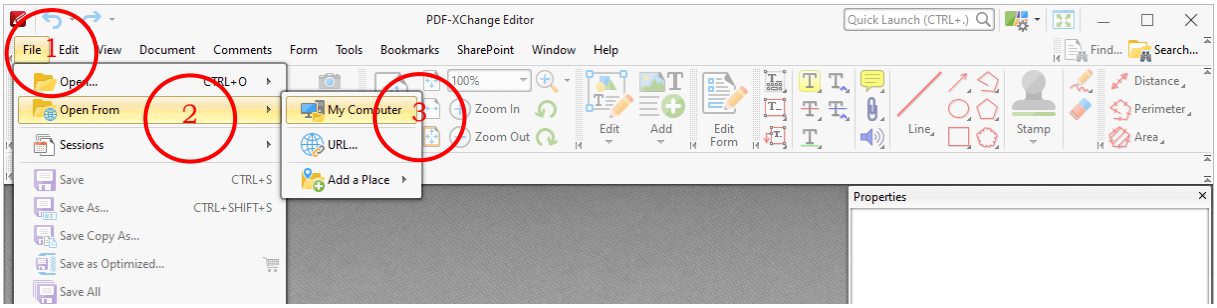
To Convert a GeoPDF-file to an image-file, you need an external application. PDF Exchange Editor is such an application. It is small, fast and has all the necessary functionality. All the tricks you need to convert are included in the free version.

Install PDF Exchange Editor

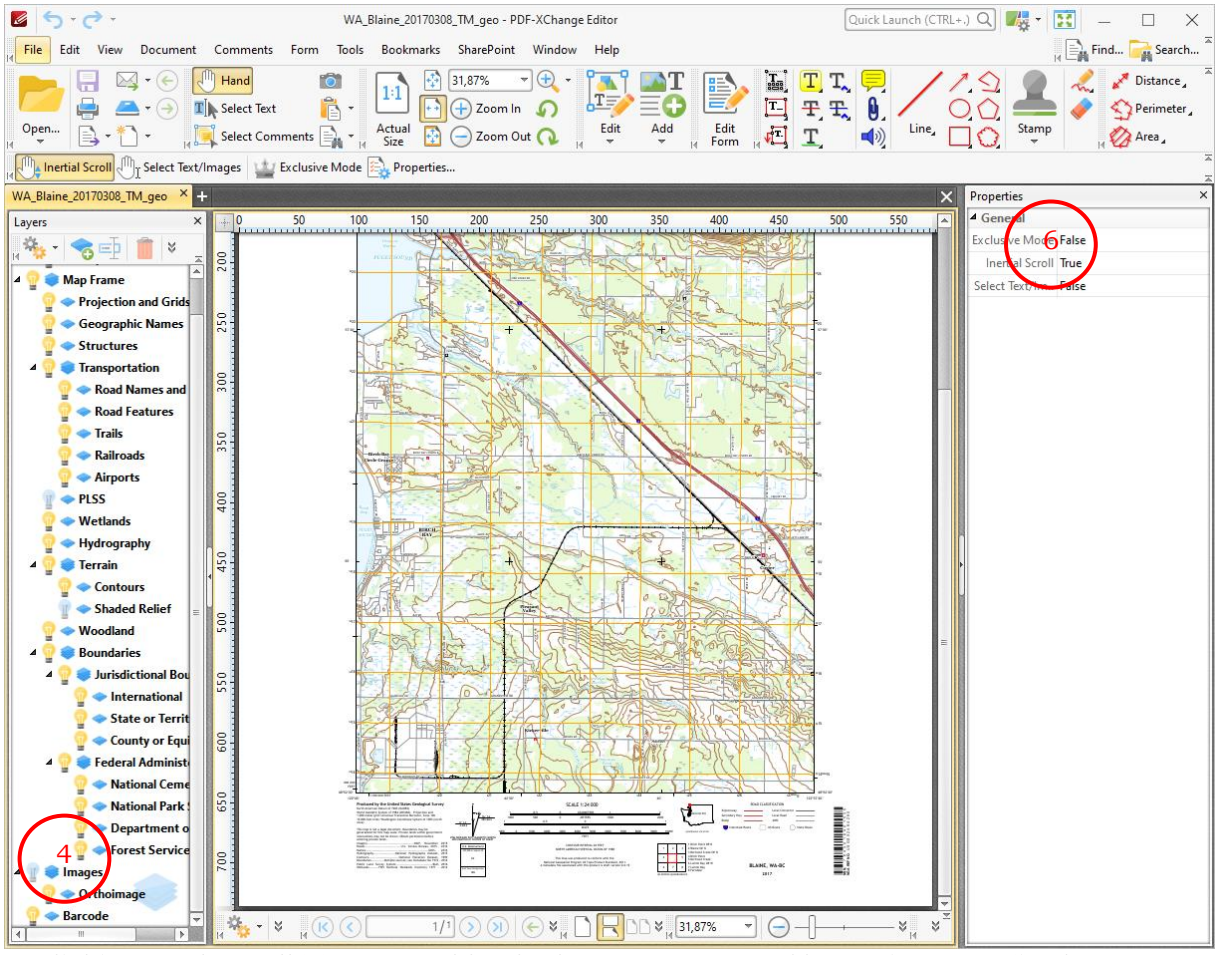
Go to the webpage of PDF Exchange Editor and download the free version (Most people like the 32 or 64 bit installer version). The next step is just installing.

Open and survey a GeoPDF-file.

To open a GeoPDF-file click on *File*(1) and select the option *Open from*(2) followed by *My*

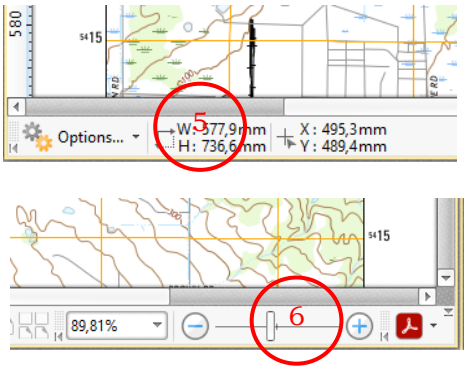


Computer(3). A standard file selection window will open. Select your file and it will open. To establish if the GeoPDF-file contains layer, you must activate the option *Layers*. Just use the key-combination *Ctrl + L* to open and close the *Layers pane*. If there are any layers you will see them.



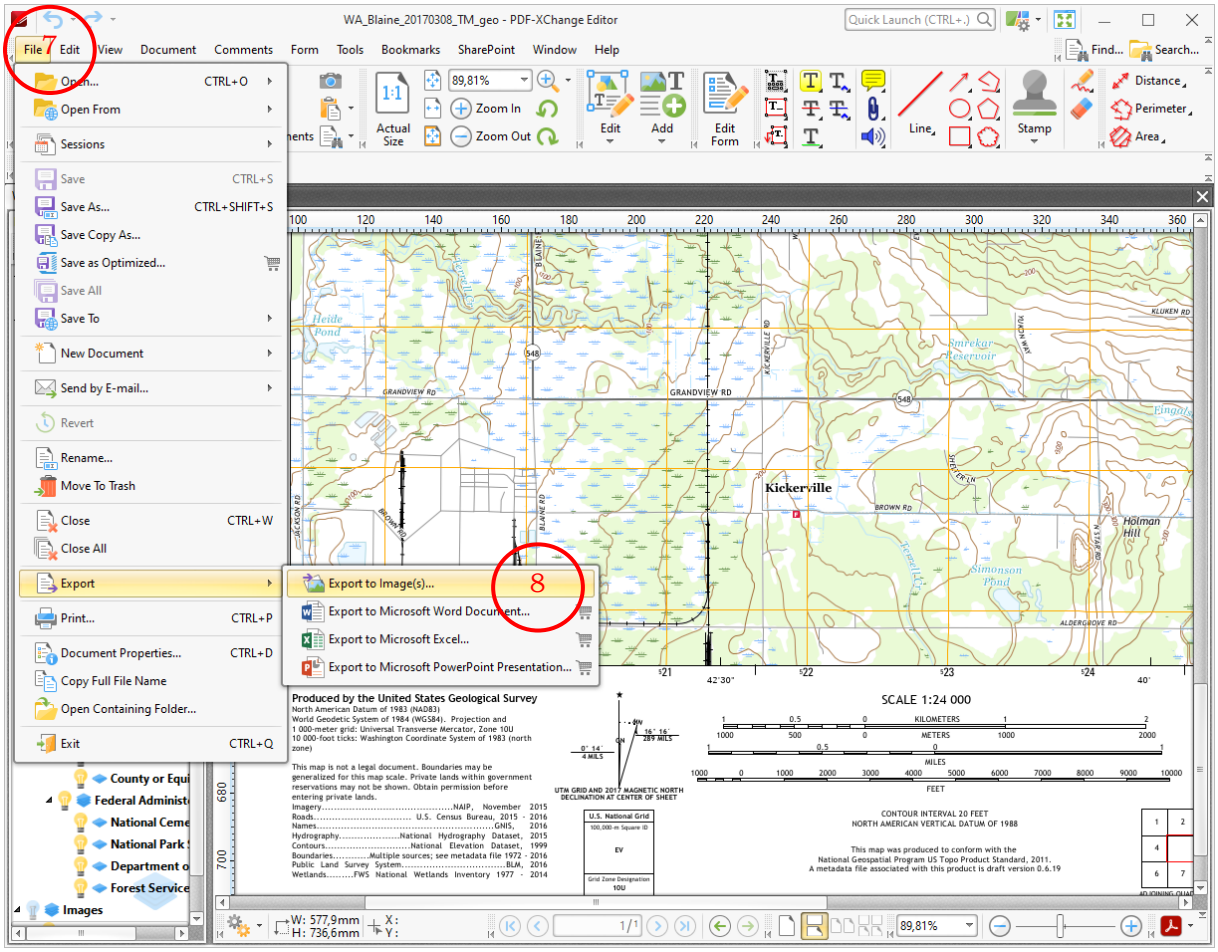
By clicking on the *Bulb*(4) you can blend a layer or a group of layers in or out (in the example the image group of layers is blended out).

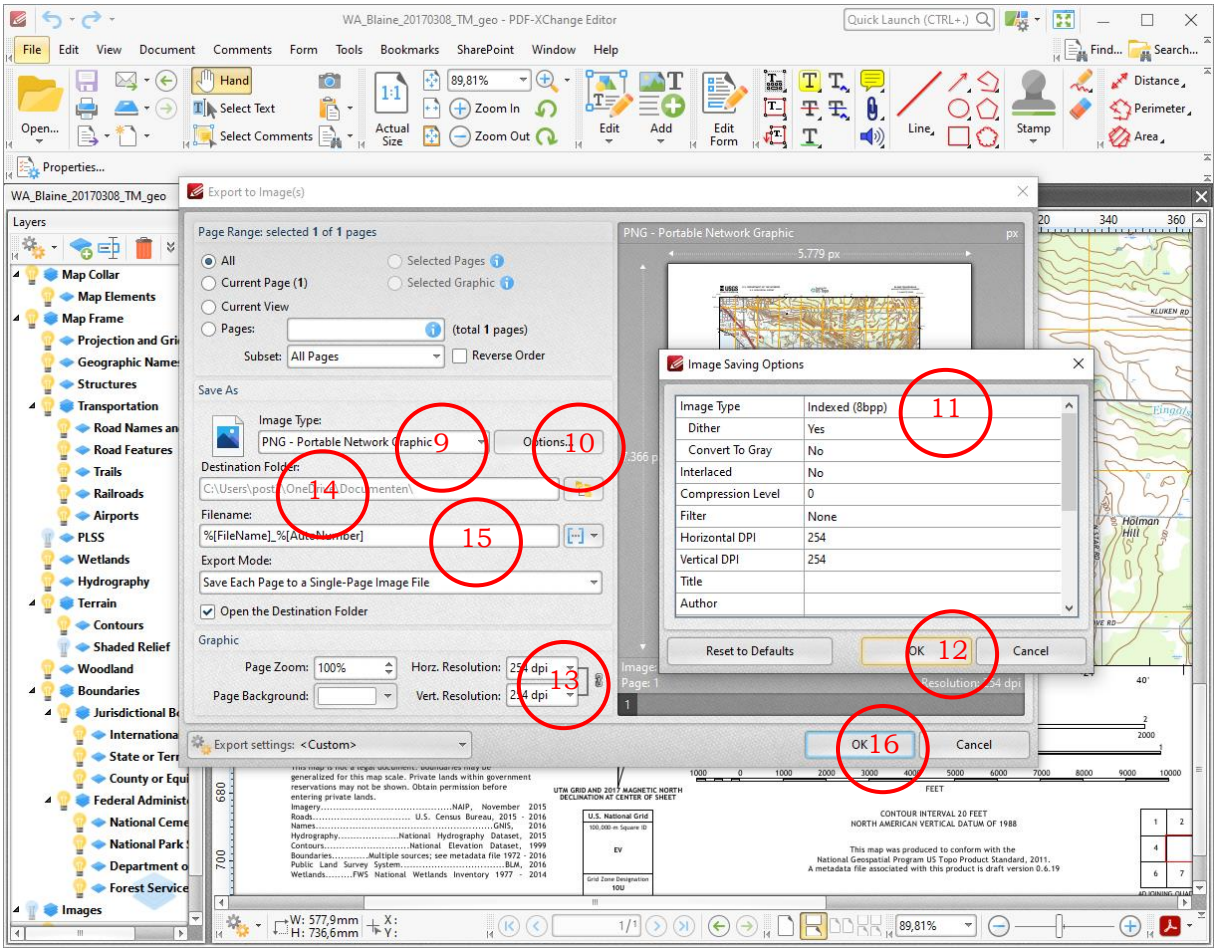
If you set the application to full screen you will see in the left bottom corner the physical size(5) of the GeoPDF-document (the map).At the bottom right corner you will see the option to zoom(6) the image in or out.



Convert a GeoPDF-file.

To convert a GeoPDF-file: Open the *File*-menu(7) and select the option *Export* > *Export to image* (8). The *Export to images*-window will open.





First you must change the *Image Type*(9) to “PNG - Portable Network Graphic.

The second step is changing the color depth. Click on the button *Options*....(10). The *Image Saving Options* window will appear. Select *Image Type* “Indexed (8bpp)” (11). If done click on the *OK* button(12) in the *Image Saving Options* window. The changes will be saved and the window will close.

The third step is changing the image resolution(13). If the GeoPDF-file is mainly vector orientated, try 254 dpi (= 100 pixel per cm).

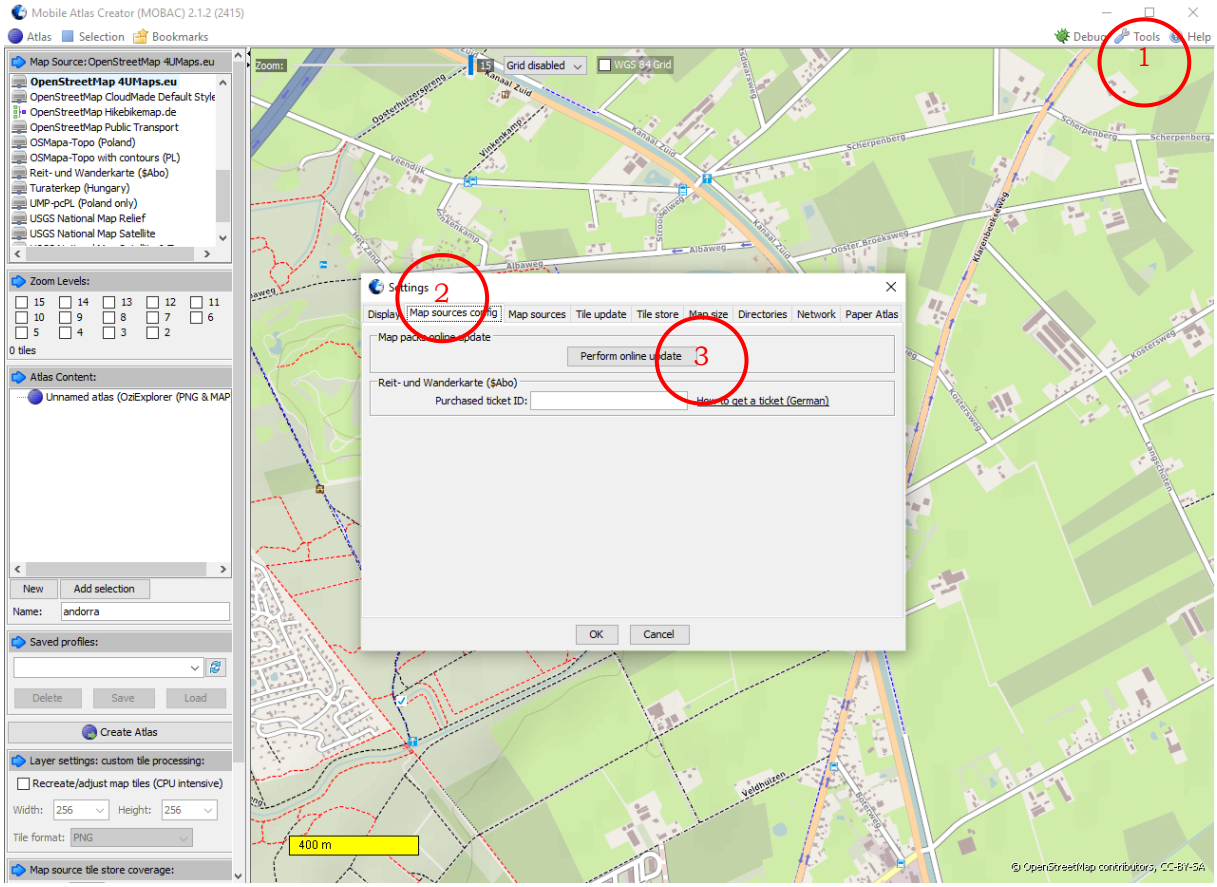
The last step saving the image. You may change the *Destination Folder:*(14). The best option is the same directory (or map) as your PDF file. To be sure your image will have the same name as your PDF-file you must change the *Filename:*(15) to: %[FileName]. Finally click on the *OK* button(16) in the window *Export to Image(s)*. The image will be created and the window will closed.

Mobile Atlas Creator (MOBAC)

With MOBAC you can create map in the PNG-format with a corresponding MAP-file with calibration data. This MAP-file can be converted to a JPR-file. Be aware MOBAC needs an internet connection to download the map data.

Install MOBAC

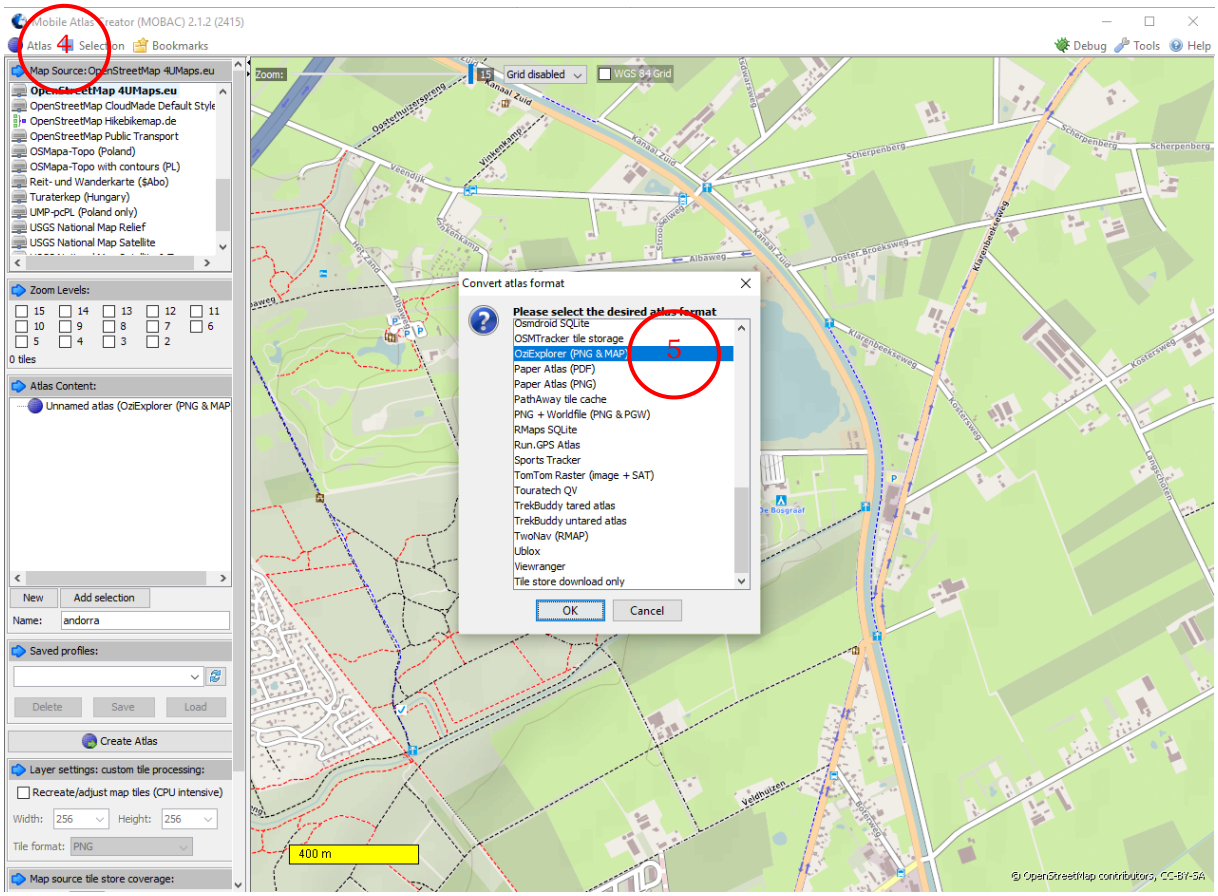
Go to the website [Mobile Atlas Creator (MOBAC) (sourceforge.io)] and download the latest version of MOBAC. Unzip the files and Copy or move the unzipped files to a folder where you would like to have Mobile Atlas Creator installed. Do not install MOBAC into `Program Files sub-directory`! A good option is the user directory. The application is started by executing the `Mobile Atlas Creator.exe` . During the first start all necessary files and folders are automatically created by the application.



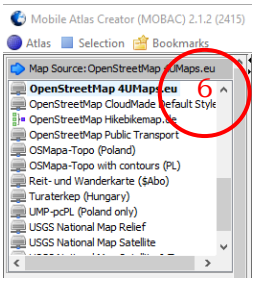
If you didn't used MOBAC for a longer time, it is useful to perform an update of the map resources. (open MOBAC, select *Tools*(1) > *Settings*. In the window *Settings* select tab *Map sources config*(2) and click on the button *Perform online update*(3).

Create a map

Although this manual tells you to create a map in MOBAC, it isn't a replacement for the [Mobac Quick Start Manual](#).

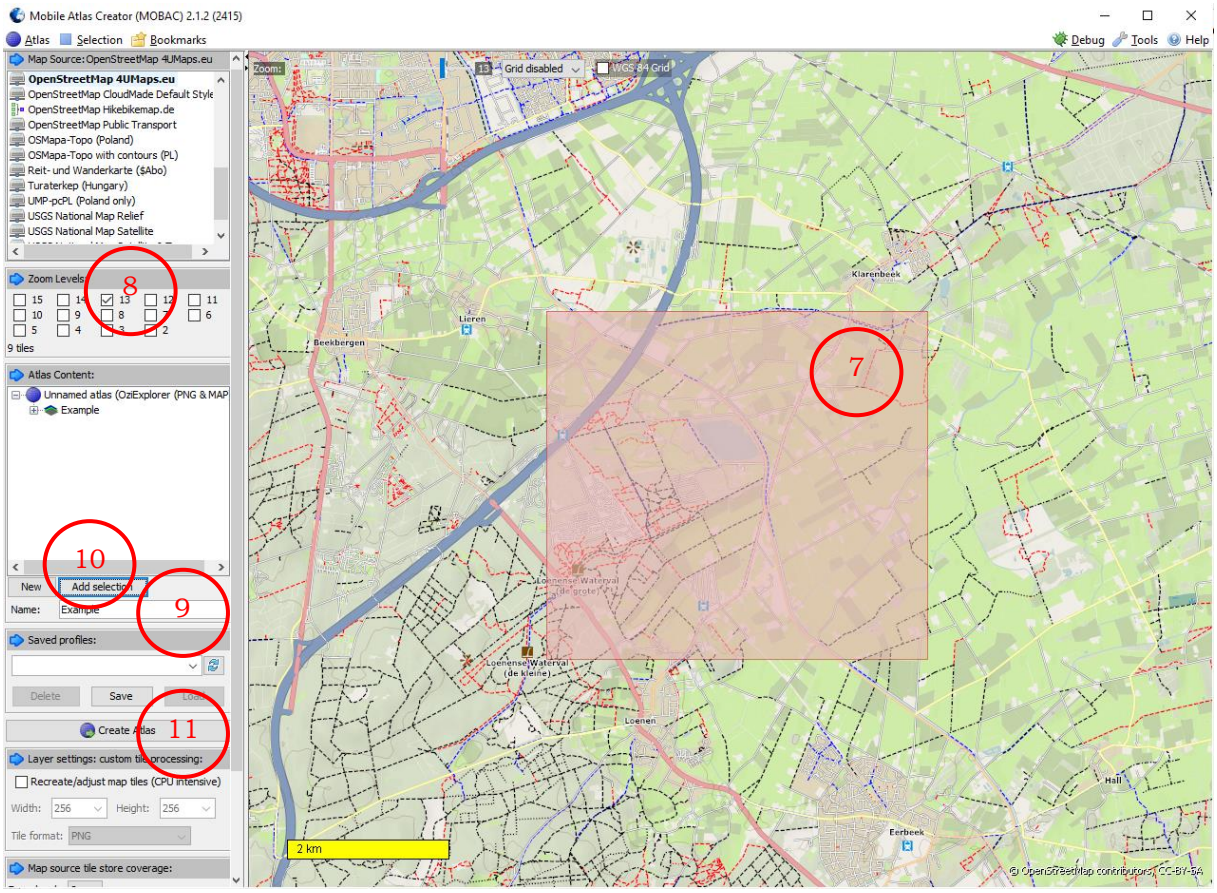


The first step is setting the output format for MOBAC. Open MOBAC. Select the option *Atlas*(4) > *Convert Atlas Format*. In the window *Convert atlas format* select the option *OziExplorer (PNG & MAP)*(5).



Next step is selecting an online map(6). The most useful maps are *OpenStreetMap 4UMaps.eu* and *OpenStreetMap Public Transport*. For special purposes or a specific country other options may be useful.

The third step is selecting an area. Navigate to the area you need by using the mouse-wheel (zooming) and the right mouse button (moving the map).

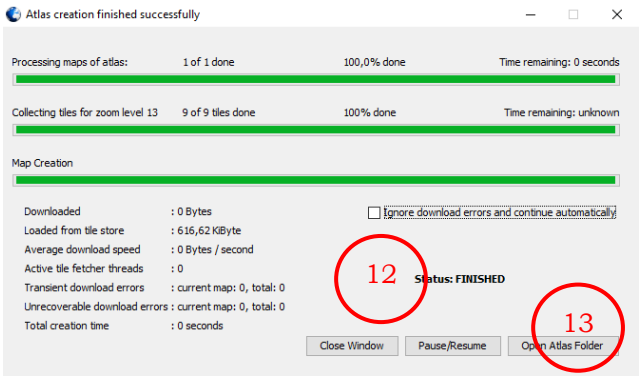


Select the area(7) you need using the left mouse button (push the button and draw a square) .

The forth step is selecting one of more *zoom levels*(8). for every zoom level there will be a separated set of files (a PNG- and a MAP-file).

The fifth step is naming your maps. Create a name for your maps in the field *Name:*(9) and click on the button *Add Selection*(10).

The sixth step is the “magic” one; creating the map. Click on the button *Create Atlas*(11). When in the Window *Atlas creation finished successfully* the status is *FINISHED,*(12) go to the *Atlas* folder by clicking on the button *Open Atlas Folder*(13). In the most recent folder you will find the result.



The seventh step is reducing the color depth. MOBAC creates PNG-files with a color 24 bit. Be aware of the maximum image size your Graphic application can handle (image size in pixel or size of file in bytes).

The last step is coping these files to a place your convenience (not moving, keep the original files as a backup).

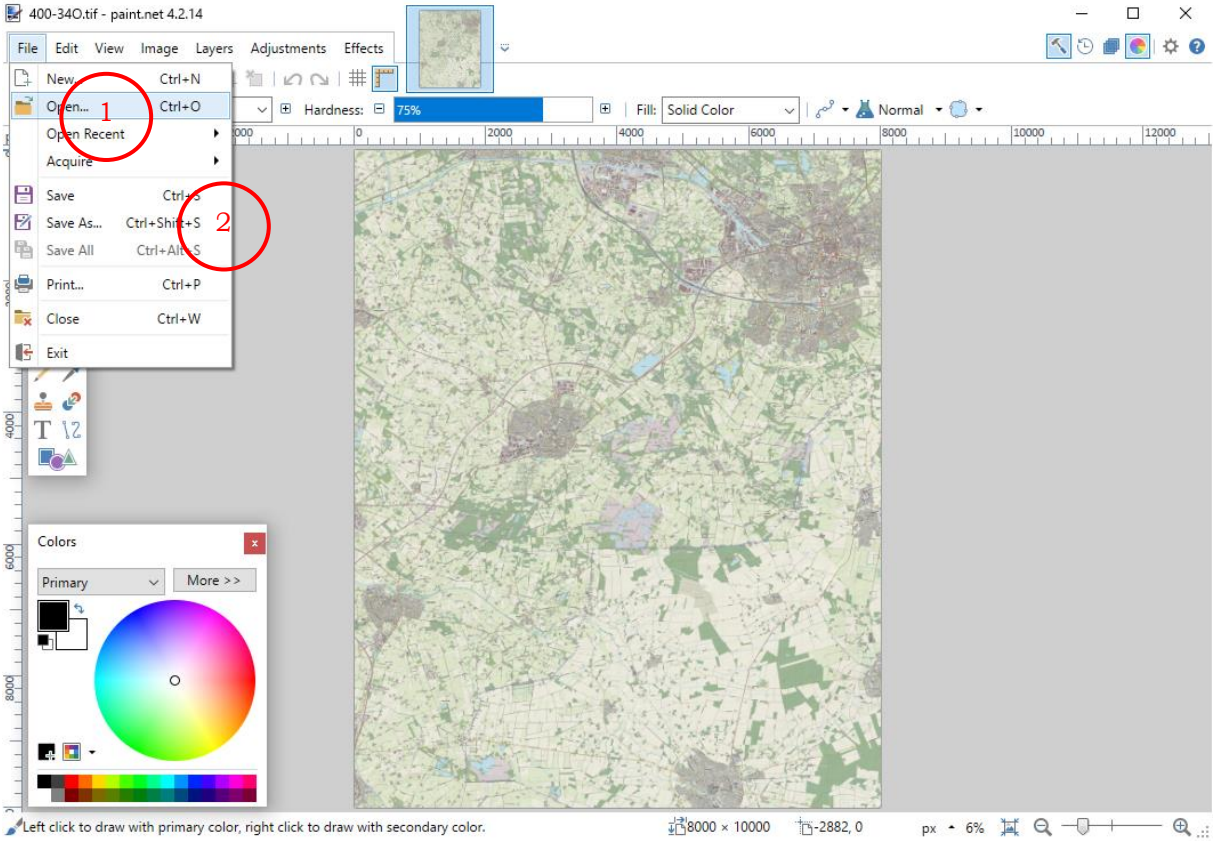
Paint.NET

Install Paint.NET

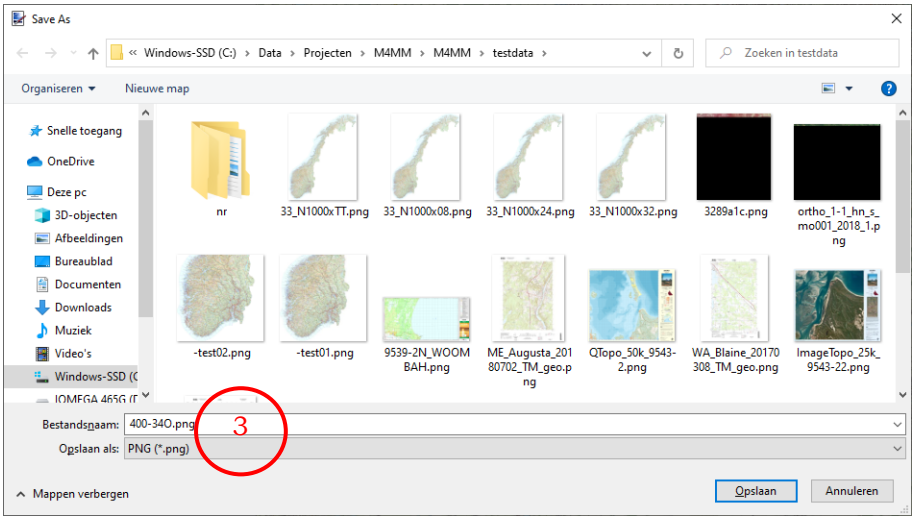
To install Paint.net is a strait forward process. Just go to the website Paint.NET and download the application (located somewhere in the top right corner). Unzip the installation file and execute `paint.net.X.Y.Z.install.exe` (where `X.Y.Z` stands for the version).

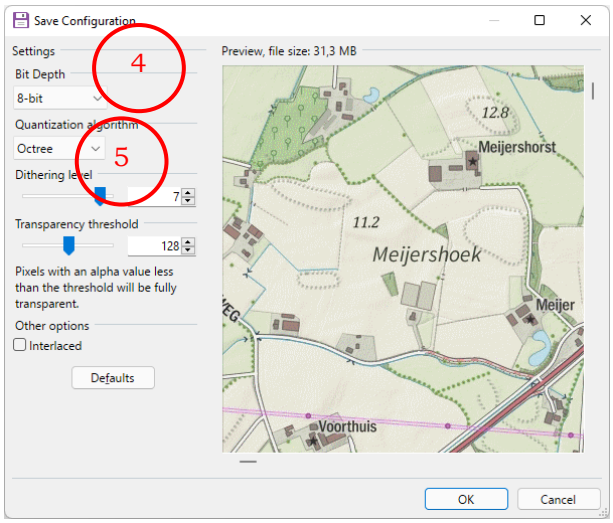
Reduce the color depth to 8 bit (256 colors)

Start Paint.NET. Select and open your graphics file with the image of the map (*File* > *Open…*(1)).



To reduce the color depth and, if necessary, the graphics file type, select *File* > *Save as* ….(2). Select in *Save As* window for *Save as* `PNG(*.png)` (3). After clicking in the *Save* button the Save Configuration will appear.





Select in this window *Bit Depth* `8-bit`(4) , and *Quantization algorithm* `Octree`(5) and click on the *OK* button. This starts the process of converting the image to a PNG-image with a color depth of 256 colors. An image may have a 32 bit color depth (an image which originates of a MrSID-file). Most likely the image has a transparency layer. If the 8-bit version is loaded into Memory-Map the background of the image may be black. This can be avoided by using a two stage conversion: first convert to 24-bit color depth and later reduce the color depth 8-bit.

In most cases the *Quantization algorithm* `Octree` gives the best results. If you aren't satisfied you may select the option *Median Cut*.

GIMP

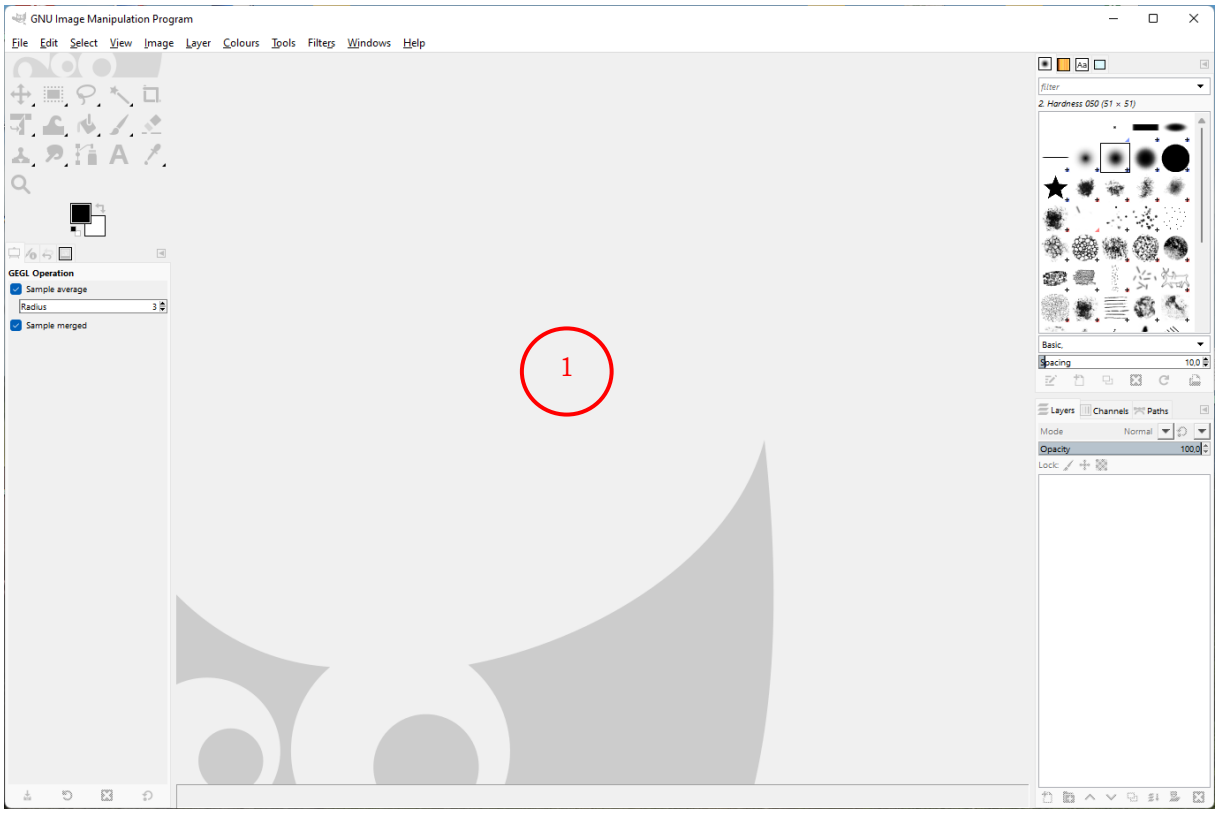
GIMP (GNU Image Manipulation Program) is a graphics application which has some options to manipulate the image of your map. The first one is to reduce the color depth of your image and second is saving a GeoTIFF-image including the GeoTIFF-data. The author of M4MM isn't a frequent user of GIMP. This means you will get only some basic instructions to fulfil these jobs.

Install GIMP

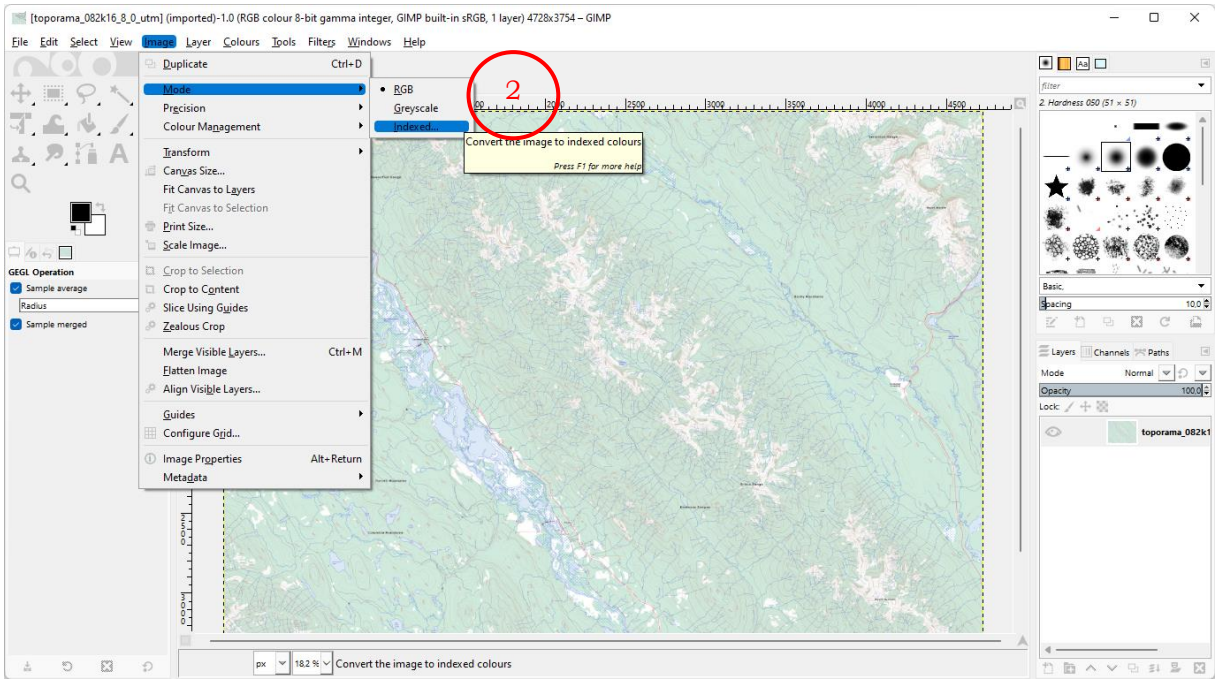
To install GIMP is a strait forward process. Just go to the website GIMP - Downloads and download the application. When the download is finish just start the installation by clicking on the executable.

Reduce the color depth to 8 bit (256 colors)

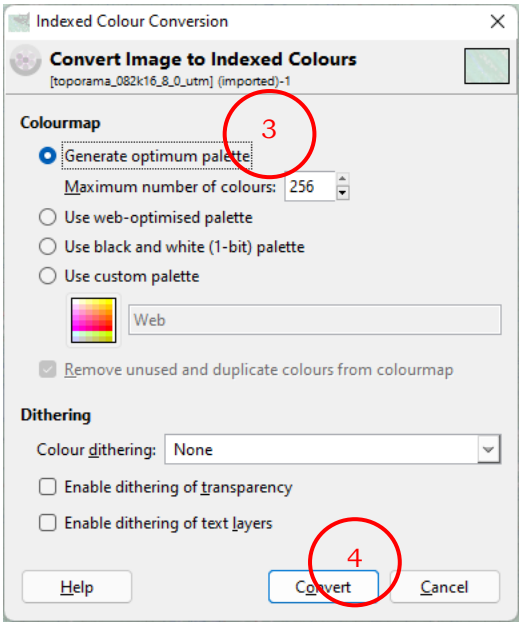
Start GIMP. Drag your image file in to the workspace of GIMP(1).



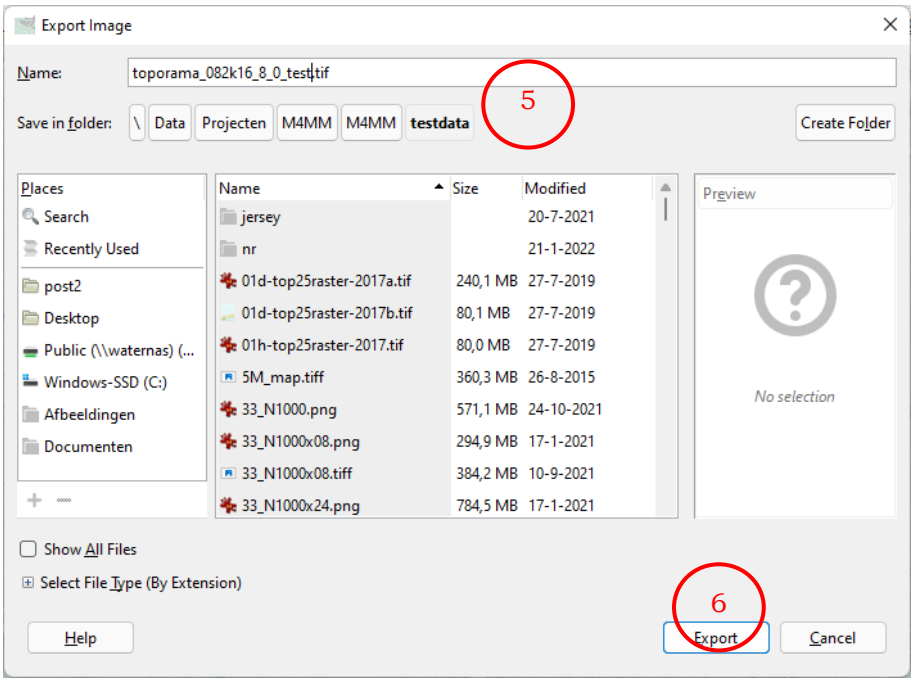
The next step is reducing the color depth. Select the option *Image* > *Mode* > *Indexed*(2).



The *Indexed Colour Conversion* window will open. Select the option *Generate optimum palette*(3), click on the button *Convert*(4) and the conversion will start. Be patient. After a while the conversion will be ready.



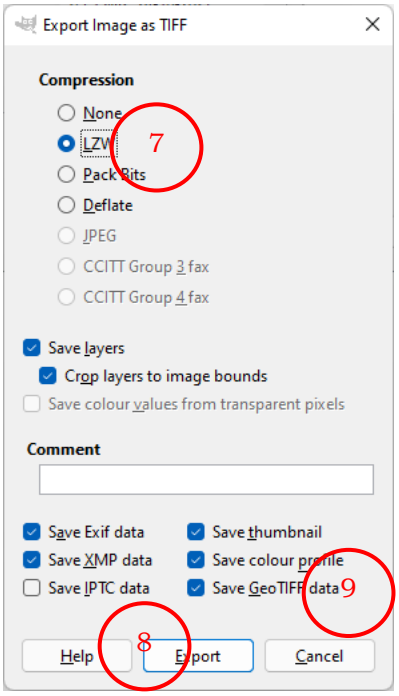
The last step is to export the result Use the menu option File > Export As … . The *Export Image* Window will open. Set your filename and file path(5) and click on the *Export* button(6). The *Export image as …* will open.



Select in this window the option *LZW*(7) and click on the *Export* button(8) and the image will be exported.

Be sure the checkbox *Save GeoTIFF data is checked*(9) if you want to keep these data.

GIMP overs a lot more options (like using a specific palette). With some experiments you can find your optimal procedure.



Background information

In this last part of 'The cookbook' you will find some subjects related to the project but without a direct relation to one of the applications mentioned in this document or related to more the one.

'Surveying' maps

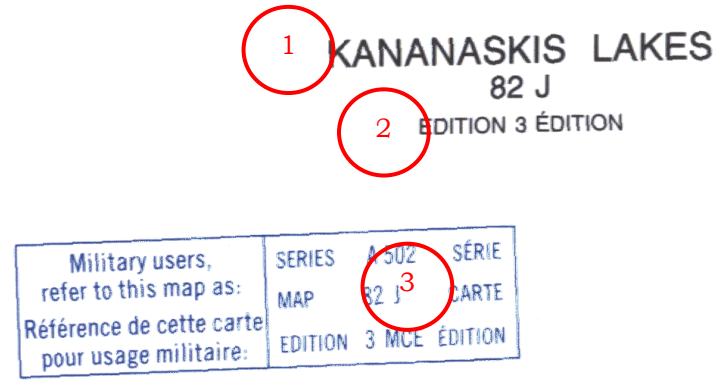
In several procedures you need information about the map(s) you are going use/calibrate. Although every map is different I will provide you with some clues and guidelines to find your way around. There are two main sources of information. The first is the map itself (especially if it is a paper map or an electronic copy of it) and second the website of the publisher (most likely when you created you map by grabbing, cutting and pasted pieces of an online map). In paragraphs below hints and clues will be given to retrieve essential data.

General information

A Canadian map was used as example. All the information was found on the collar of the map.

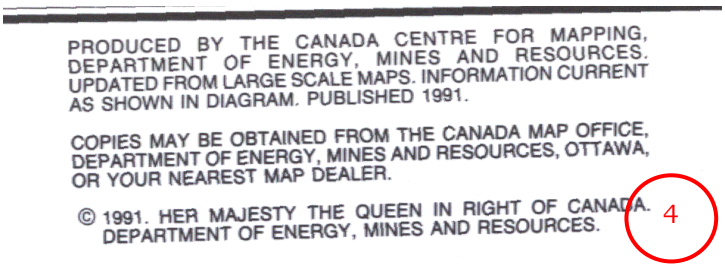
Name of the map

Maybe it sounds a little bit simple, but this information may needed to name a map(1). It may be also necessary to retrieve information from the internet. Mostly you find this name on the collar or the cover of the map. If you have an electronic map issued official authority the file-name may also useful. Some map names includes an indication for its coordinate system, projection or scale.



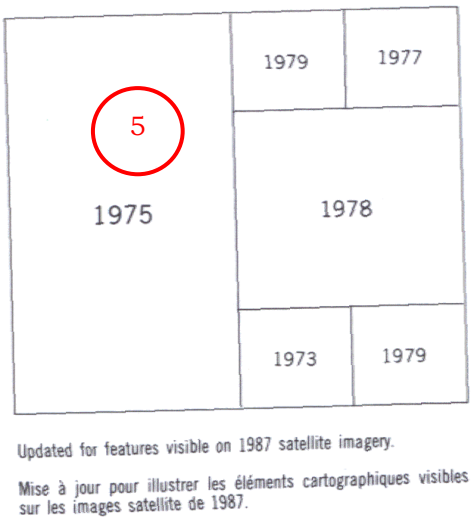
Publisher of the map

This information (4) may be necessary to retrieve additional information on the internet, such as legal and geographical information. Mostly you find this name on the collar or the cover of the map.



Legal information

This information(4) tells you wat you may or may not with the map, under which conditions. If no information is provided on the map sheet try the publishers website.



Date of publishing

The date of publishing(4) may tell you something about the actuality of the map. It may also help by selecting the correct Datum of the map (Datum must be older then the publishing date).

Edition, revision and series of the map

A edition(2) may identify your map further. It may also is an indicator for a special edition like a specific purpose. The revision (date) is indication for actuality. Military maps belongs to mostly to as set of map(3) (series). As series indication means often UTM coordinates.

Additional data

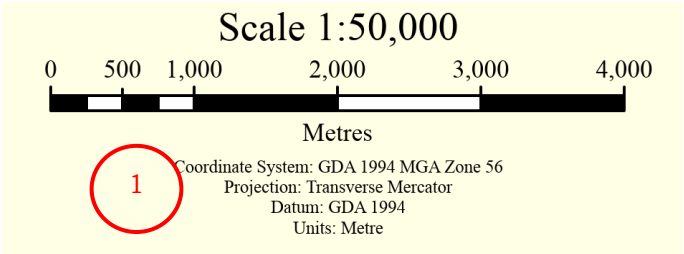
On some maps you will find additional information like actuality(5) or geographical location.

Geographical of geodetic information

An Australian map (QTOPO Amity 9543-2) was used as example. All the information was found on the collar of the map.

Projection, Map Datum, Grid system and UTM zone

Projection, Map Datum and Grid system (if necessary with UTM zone) (1) are essential data to pinpoint a location ort to calibrate a map. On most governmental maps these data can be found. If a map has a grid you may find some (additional) information in one of the corners. If no information is provided have a look on the website of the publisher.

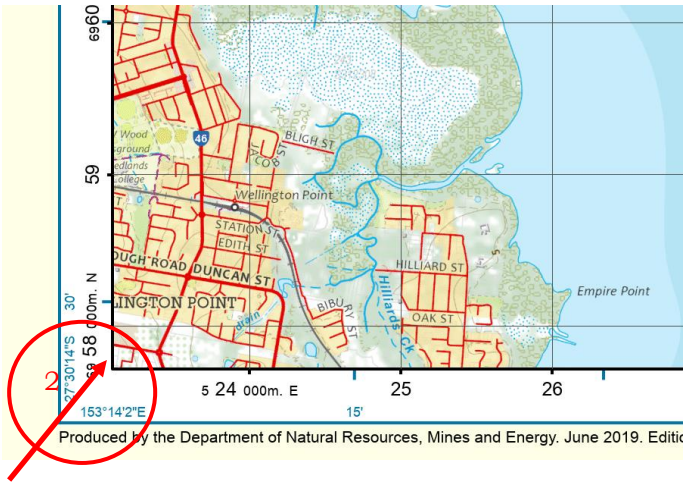


Scale

Although the scale isn't needed to pinpoint a location on a map, Memory-Map uses the scale as an sort option in the *Map List* window. On nearly all maps (with an Cartesian coordinate system) you will find this information.

Coordinates

In the example to the right you see two types of coordinates, the UTM gird coordinates based on MGA in black and the Latitude/Longitude coordinates in blue. Sometimes, like in the example, in every corner you may find the exact coordinate of that cormer(2) (153°14'2" East, 27°30'14" South). These coordinates can be used to calibrate the map with Memory-Map.

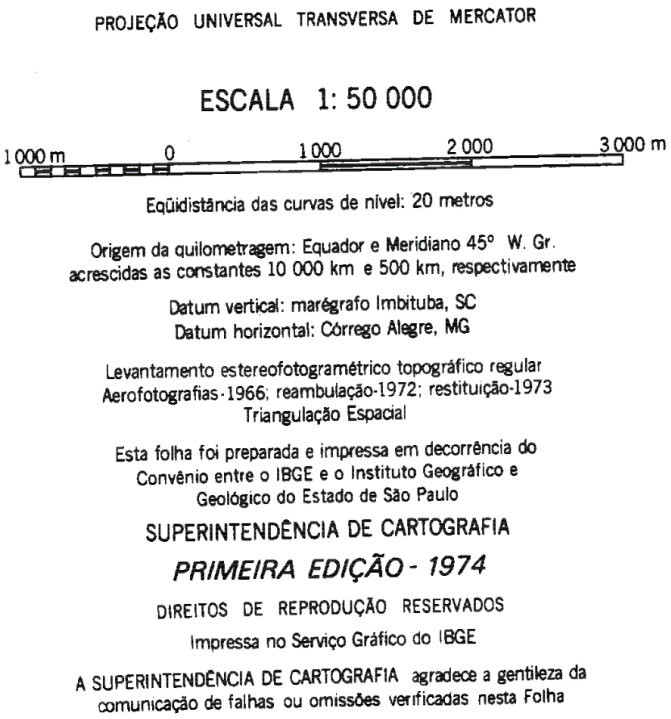


More examples

Brazil

Sometimes it becomes more challenging. From the Portuguese text to the right we can extract the following information:

- Publisher is IBGE.
- Edition is 1, issued in 1974.
- Projection is UTM.
- UTM zone is 23 south. On the map there is the indication central meridian is 45° West.
- Datum is most likely Corrego Alegre 1961 / UTM zone 23S. On the map you find the horizontal datum “Córrego Alegre, MG” in relation with the date issued 1974.
- Scale is 1:50,000

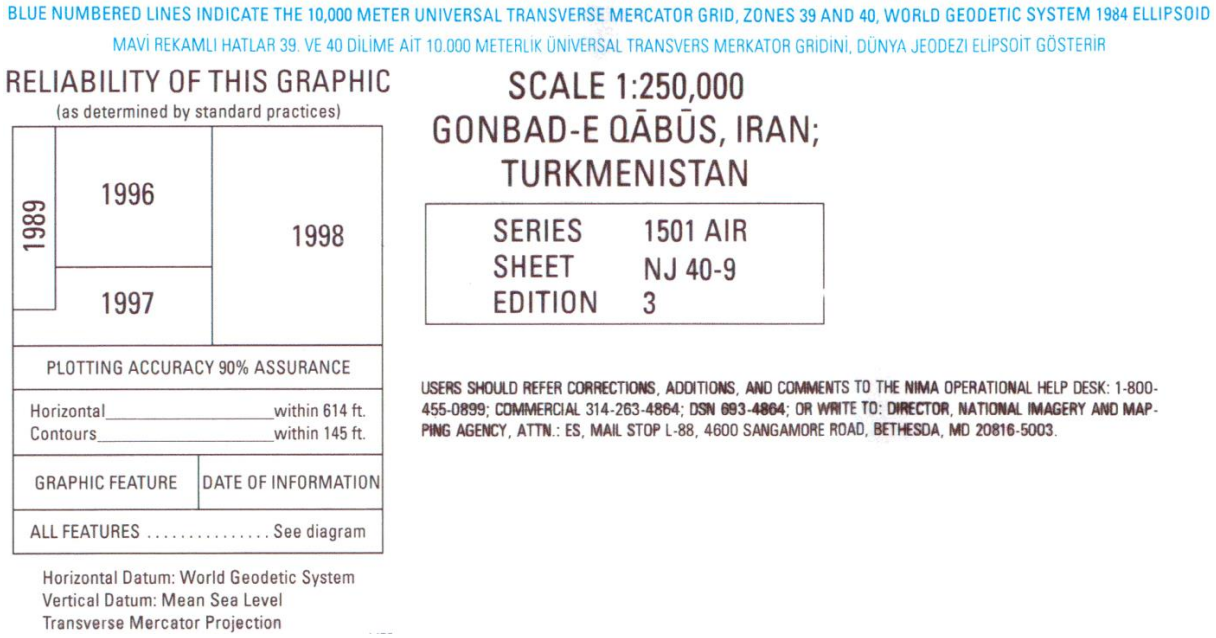


Canada

In this case a map with Lambert Conformal Conic (LCC) projection. Special attention to the standard parallels 49° N and 77° N.

Iran/Turkmenistan

Below an extract of the information on a Joint Operation Graphic (Air). The map was downloaded from the website [Perry-Castañeda Library Map Collection - UT Library Online (utexas.edu)](). You will find all the necessary data on the collar of the map.


BLUE NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONES 39 AND 40, WORLD GEODETIC SYSTEM 1984 ELLIPSOID

MAVİ REKAMLI HATLAR 39. VE 40 DİLİME AİT 10.000 METERLİK ÜNİVERSAL TRANSVERS MERKATOR GRİDİNİ, DÜNYA JEODEZİ ELİPSOİT GÖSTERİR

RELIABILITY OF THIS GRAPHIC

(as determined by standard practices)

1989	1996	1998
	1997	

PLOTTING ACCURACY 90% ASSURANCE

Horizontal _____ within 614 ft.
Contours _____ within 145 ft.

GRAPHIC FEATURE	DATE OF INFORMATION
ALL FEATURES ..... See diagram	

Horizontal Datum: World Geodetic System
Vertical Datum: Mean Sea Level
Transverse Mercator Projection

SCALE 1:250,000

GONBAD-E QĀBŪS, IRAN; TURKMENISTAN

SERIES	1501 AIR
SHEET	NJ 40-9
EDITION	3

USERS SHOULD REFER CORRECTIONS, ADDITIONS, AND COMMENTS TO THE NIMA OPERATIONAL HELP DESK: 1-800-455-0899; COMMERCIAL 314-263-4864; DSN 693-4864; OR WRITE TO: DIRECTOR, NATIONAL IMAGERY AND MAPPING AGENCY, ATTN.: ES, MAIL STOP L-88, 4600 SANGAMORE ROAD, BETHESDA, MD 20816-5003.

Recreational maps

On recreational maps (tourist,- walking-, hiking- or biking) the information may less accurate. Often interpretation is needed. 'GPS ready' means mostly the map is based on WGS 84 or equivalent (like NAD 83, ETRS 89 or GDA 94) but not always. When a UTM grid is used it doesn't mean this grid is based on WGS 84 datum. I have seen quit resent maps with NAD 27 datum.

If the information on the map is missing or is inconclusive try to find website of the publisher of the map or try to lookup your map in online book or map shops.

Datum, Pixprojection and grids

In 'The cookbook' frequently the concepts of datum, projection and grid are used. In the following paragraphs these concepts will be addressed, not in a scientific way, but hopefully understandable.

Datum, Geodetic datum, Horizontal datum

To pinpoint a location on the earth you need a reference framework. The (Geodetic) Datum is such a framework. It is more or less a description of the earth in a mathematical way. Is also the "Anchor" for coordinate systems (grids).

We think the earth is a sphere, but in reality it has its bumps and buts. The datum is a mathematical approximation, it is a model. During time the description became more and more accurate, thanks to sophisticated technics like measurements with satellites. Most datum describes the earth as an ellipsoid. Each ellipsoid has is unique name.

The positons of the continents on our earth aren't stable. These tectonic movements are small but in time significant . This means different continents may have a different datum.

For more information have a look on the Wikipedia Geodetic datum.

When in 'The cookbook' the word Datum is used it refers always to the horizontal datum (2D).

World Geodetic System 84 (WGS 84)

Today the most common used datum is WGS 84. This is also the "base" datum for Memory-Map. WGS was based on the ellipsoid GRS80 with some slide differences.

For more information have a look on Wikipedia World Geodetic System.

North American Datum 27 and 83 (NAD 27 and NAD 83)

NAD 27 and NAD 83 are the more or less standard datum for the North American Continent. NAD 27 is the old one, the newer NAD 83 is related to WGS 84. For recreational purpose you may assume that NAD 83 = WGS 84. NAD 83 is based on the ellipsoid GRS80.

For more information have a look on Wikipedia North American Datum.

European Terrestrial Reference System 1989 (ETRS 89)

Now a days the ETRS 89 is more or less the standard datum for Europe and supported by the European Union. New coordinate systems (grids) created by European countries are based on this datum. For recreational purpose you may assume that ETRS 89 = WGS 84. ETRS 89 is based on the ellipsoid GRS80.

For more information have a look on Wikipedia European Terrestrial Reference System 1989.

Geocentric Datum of Australia 1994 (GDA 94)

Most of the modern Australian maps are based on the GDA 94. GDA 94 was based on the ellipsoid GRS80. In 1994 was GDA 94 = WGS 84. Since that moment GDA 94 moved away from WGS 84 because of the tectonic movement of Australia. In 2020 the difference is about 1.8 meter north east. In the future GDA 94 will be replaced by GDA 2020.

For more information have a look on Wikipedia Geocentric Datum of Australia 1994.

Ordnance Survey Great Britain 1936 (OSGB 36)

This is the standard datum for Great Britain. This datum isn't compatible with WGS 84.

For more information have a look on Wikipedia Ordnance Survey National Grid.

Projection

If you try to stick a sheet of paper on a sphere it will wrinkle. That is, in short, the problem of every map maker. Since centuries a lot of solutions were developed. Although a globe is the best solution, it is very impractical. No wrinkles, no distortion.

There is no general solution. The purpose of the map dictates more or less the projection to use. Related to the project M4MM there are four projections relevant because Memory-Maps accepts these projections (by experience):

- Mercator
- Transverse Mercator
- Universal Transverse Mercator
- Lambert Conformal Conic

For more information have a look on Wikipedia Map projections or Directory of Map Projections (mapthematics.com).

Mercator

This cylindrical projection is often used for large areas. The world base maps of Memory-Map are good examples. Many major online street mapping services like Bing Maps, Google Maps, and OpenStreetMap use a variant of the Mercator projection for their map images called Web Mercator or Google Web Mercator. The origin of this projection is always 0 degrees North 0 degrees East.

For more information have a look on Wikipedia Mercator projection.

Transverse Mercator

The Transverse Mercator projection is an adaptation of the Mercator projection. The origin of the projection can be chosen. A lot of national and international maps uses this projection. It give a good accuracy for smaller areas some degrees north, west, east and south of the origin.

For more information have a look on Wikipedia Transverse Mercator projection.

Universal Transverse Mercator

The Universal Transverse Mercator projection is “special kind” of Transverse Mercator. It divides the earth into 60 zones of six degrees and with each its own origin (always 0 degrees north and (3 + N * 6) degrees east or west. This projection supports many military maps.

For more information have a look on Wikipedia Universal Transverse Mercator coordinate system.

Lambert Conformal Conic

Mercator projections are cylindrical, the Lambert Conformal Conic projection has a conical approach. The main parameters are two (standard) parallels and a central meridian. The Projections is often be used form map for a larger area like aeronautical charts.

For more information have a look on Wikipedia Lambert Conformal Conic.

Geographic coordinate systems

By trying keep is simple there are four kinds of coordinate systems:

- Ellipsoidal/Spherical coordinate system using latitude, longitude and elevation
- Cartesian coordinates based grid with a chosen origin
- Earth-centred, earth-fixed Cartesian coordinates
- Earth-centred pole coordinates

Only the first two types are relevant for the project M4MM. Memory maps saves geographic position based on latitude and longitude and many maps have a geographical coordinate system based on either latitude/longitude or grid coordinates or both.

Elevation/height will be ignored in the project M4MM. Memory-Map doesn't use is to calibrate maps.

For more information have a look on Wikipedia Geographic coordinate system.

Latitude/Longitude

To establish a geographical position using latitude/longitude you must now the geodetic datum and the origin. In nearly all the cases the longitude 0 degrees (Prime Meridian) is bound to Greenwich. The latitude 0 degrees (Equator) depends in the center to the earthen so depending on the datum.

There are two different ways of notation for degrees; in decimal degrees and in degrees, minutes, and seconds (DMS). Decimal degrees is preferable.

For more information have a look on Wikipedia Latitude and Longitude.

Cartesian coordinates based grid

A Cartesian coordinate system is based on two axes which are square to each other. Mostly the axis West (-) to East(+) is called the X-axis or Easting and the axis North(+) to South(-) is called Y-axis or Northing. Modern maps with a Cartesian coordinate system use Meter as unit of measurement. Some older maps may have Foot or Yard as unit of measurement.

In a description of a Cartesian coordinate system always the datum and the true origin of the system. This true origin is always located somewhere in the center of area where the system is design for. To prevent negative numbers the center (coordinate 0,0) of the system is often moved to the West and/or South of area where the system is design for. This called the false origin.

For more information have a look on Wikipedia Grid Coordinates.

Universal Transverse Mercator grid (UTM grid)

UTM is not only a projection, it is also a coordinate system. In fact it is a special kind of a Cartesian grid. Each zone has its own grid definition and each its own origin. Each zone has also his false origin. In the northern hemisphere 500,000 meter to the west and in the southern hemisphere 500,000 meter to the west and 10,000,000 meter to the south. To zones in the northern hemisphere the character j is added and in the southern hemisphere the character t.

Today maps which use a UTM grid are mostly based on WGS 84. Older maps may use older datum like NAD 27 and ED 50 (European Datum).

For more information have a look on Wikipedia Universal Transverse Mercator coordinate system.