

Topographic Map Downloader

Topo-Map

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1 Description

TopoMap is a tool to download topographical maps in the scale 1 : 25 000 or 1 : 50 000 of Switzerland , France and Spain. The topographical maps are downloaded from map servers provided by the public Geographic Institutes “Swisstopo”, “Institut Géographique National de France (IGN)” and “Instituto Geografico Militare de España (IGM)”.

2 Introduction

2.1 Public Map Servers

Downloading detailed topographic maps in the scale of 1 : 25 000 or 1 : 50 000 of France, Switzerland and Spain, is it really possible? Of course we don't talk about street maps from Google or Open Street Maps. We talk about professional topographic maps with contour lines, hill shades, forest limits and detailed hiking paths and streets.

Since the public Geographic Institutes of some European Countries started publishing their map products on the Internet, it is possible to view the maps. In the following list you find some popular links:

France:

<http://www.geoportail.fr>

Spain:

<http://www.ign.es/iberpix/visoriberpix/visorign.html>

Switzerland:

<http://www.mapplus.ch>

Germany:

<http://www.outdooractive.com/de/touren/>

Austria:

<http://www.bergfex.at>

Portugal:

<http://mapas.igeo.pt/igp/igp.phtml>

Unfortunately these links offer only a very limited range of features. The map window is small and it is not possible to visualize own vector data (like GPS waypoints). First and foremost its not possible to download those maps.

Wouldn't it be nice to download the maps? You could view the maps off-line, visualize bigger ranges of the maps, print the maps, copy the maps to your smartphone or process the maps with other tools like Geographical Information Systems (GIS) or Graphic Programs. Unfortunately the sites don't offer a direct download, but TopoMap is able to download them.

Keep in mind, TopoMap doesn't provide the maps. The maps (respectively the map tiles) are on the Internet. Click on the following link, play around with the numbers i and j and understand, that for instance entire spain is available:

http://ts4.iberpix.ign.es/tileserver/n=mapa_mtn25;z=30;r=2000;i=1412;j=9149.jpg

So TopoMap doesn't provide the maps, TopoMap only downloads the tiles, merges them to images (jpg) of a definable size and georeferences them. Therefore TopoMap doesn't harm copy rights. It's a tool that helps you saving a lot of time. Imagine you would manually click you through 4 000 000 tiles and merge them with a Graphic Program.

2.2 Mobile Atlas Creator

There are other similar tools, that allow downloading maps from tile servers. A very popular tool is “Mobile Atlas Creator”:

<http://mobac.dnsalias.org/>

The Mobile Atlas Creator allows downloading maps from a long list of public map tile servers. Unfortunately its limited to a specific type of map tile servers: Map tile servers compliant to the Google Map Coordinate System.

TopoMap is a tool similar to Mobile Atlas Creator, but it **focusses on other map tile servers**, even though google map tile servers are supported as well. Its important to understand, that TopoMap is complimentary to Mobile Atlas Creator. Map sources, that are already supported by Mobile Atlas Creator are not a priority target of TopoMap.

An other difference is related to the type of content. TopoMap wants to focus on topographic maps. Satellite images or street maps are not a focus of TopoMap.

3 Usage of the tool

3.1 Installation

Preconditions:

1. You need a Windows Operating System (Win XP, Win Vista, Win 7). The tool works on 32 and 64 bit systems.
2. You need an Internet connection.
3. You need a 50 GBytes free hard disk space for the resulting maps. Keep in mind, that maps leave a big footprint on your hard disk.

Installation:

1. Download the zip file TopoMap_Release_Executables_X.X.X.X.zip from Source Forge:
<http://sourceforge.net/projects/topo-map/>
2. Unzip all contained files to a new folder. No further installation is needed.
3. Make sure, you have the installed “Microsoft .NET Framework 3.5 SP1”. You can check that in “Add Or Remove Programs” in the “Control Panel”. If .NET Framework is not installed, update your Windows XP, Windows Vista or Windows 7 system.
4. Start the executable TopoMap.exe.

The screenshot shows the TopoMap application window with the following configuration:

- Web Proxy:** ☐
- Selected topological map:**
- Storage location:**
- Resolution and Pixel Size Options:**
 - ☒ 0: 1 : 25 000, 2m/Pixel
 - ☐ 1: 1 : 25 000, 4m/Pixel
 - ☐ 2: 1 : 50 000, 8m/Pixel
 - ☐ 3: 1 : 100 000, 16m/Pixel
 - ☐ 4: 1 : 200 000, 32m/Pixel
 - ☐ 5: 1 : 200 000, 64m/Pixel
 - ☐ 6: 1 : 400 000, 128m/Pixel
 - ☐ 7: 1 : 400 000, 256m/Pixel
 - ☐ 8: 1 : 800 000, 512m/Pixel
- Selected Map Area in degree (°) and in WGS 84:**
 -
 - Latitude Up (°):**
 - Longitude Left (°):** **Longitude Right (°)**
 - Latitude Down (°):**
- Merging Size in Pixel:** (x: West-Oest) (y: South-North)
- Progress Table (0: 1 : 25 000, 2m/Pixel):**

	Activate	Time left (h)	Done (%)	Success	Failed	Total	Done
1. Download	☒	1.5	98.0 %	3751842	0044016	3874152	☐
2. Merge	☐	0.0	0.0 %	0000000	0000000	0000000	☐
3. Georeference	☐	0.0	0.0 %	0000000	0000000	0000000	☐
-

3.2 Usage

Before you start the the tool, you should define the following properties:

1. Web Proxy

If you are connected through a Web Proxy to the Internet, specify the Web Proxy Server. Have a look in the browser settings to figure out the Web Proxy Address.

2. Selected topographic map:

The map, that you want to download (France, Spain, Switzerland).

1. Storage location:

The path, where you want the output to be written to. TopoMap automatically suggests a location.

2. Zoom levels:

The zoom levels you are interested in. You can enable more than one zoom level.

3. Map area:

The map area, that you want to create. A convenient tool to get the map area coordinates is Google Earth. Before you copy coordinates, change the way Google Earth displays coordinates: In Tools\Options you can switch to "decimal degree" display. Find the map area, that you are interested in and copy the left, right, lower and upper margin. Make sure, you don't mix longitude and latitude!

The bigger the map area, the more time and the more disk space you will need to download the maps. Downloading all France maps easily can need one week and 50 GBytes of disk space. So better start with a smaller map area.

4. Merging Size:

You can enter the image size (in pixel) of the resulting maps. The upper limit of the two values depend on the available amount of RAM. On a 2 GByte RAM machine it will be possible to merge images up to a limit to 16'000 * 16'000 pixel.

Furthermore you can enable/disable the following processing steps:

1. Download of the tiles:

Be aware, that for a country like France, Switzerland or Spain, millions of tiles must be downloaded. The download needs some time (up to several days) and a lot of hard disk space (up to 50 GBytes).

2. Merging of the tiles to big maps:

One tile corresponds some 100 meters. To create maps, the tiles have to be stitched (merged) together. In the tool a merging size (in pixels) can be defined. Depending on your memory size, there is an upper limit for the maximal map image size.

3. Georeferencing the maps:

In the last step the tool creates a World File and an Info File for each map. These files contain the georeference information of the map. Basically the files contain the information about the geographic location of the map. A Geographical Information System (GIS) is able to read this information and place the map on the world globe.

All mentioned steps can be interrupted at any time without any loss of information. After a new start, the tool continues the work, where it last was stopped.

Required resources:

	Disk Space for download	Disk space for merged maps	Time to download
France Mainland	39.9 GBytes	20.6 GBytes	Ca. 1 weeks
France Corsica	0.8 GBytes	0.4 GBytes	Ca. 0.5 days
Central Spain	35.3 GBytes	20.3 GBytes	Ca. 1 weeks
Canaries	1.1 GBytes	0.8 GBytes	Ca. 0.5 days
Switzerland	5.4 GBytes	3.3 GBytes	Ca. 2 days

Be aware, that TopoMap downloads a map always in a rectangle. As countries France, Spain or Switzerland have an irregular form, the first hours eventually only empty tiles are downloaded. These tiles may fail.

3.3 Output

On the main panel you can define a “Storage Location on the Disk”. The resulting download tiles and the merged images are located under this Storage Location Folder.

Under this folder you find a level directory structure that follows the following sequence logic:

1. Name of the map
2. Zoom level
3. Tile or map size in pixels per pixels
4. The name of the Row

In the row you find the tiles or maps. The file name applies a x-y coordinate scheme expressed in pixels.. Rectangle_0000004864_0000079872.jpg for example means the Rectangle (map or tile) at i=0000004864 and j=0000079872 in pixels. If you want to calculate the x-y coordinate in meters, you have to multiply the values with the pixel size, as displayed in the zoom level section.

x/y-Coordinate in meters

- $x = i * \text{PixelSize}$
- $y = j * \text{PixelSize}$

where

- Pixel size: (size in meters of one pixel)

If you want to know where exactly the tile is located on the globe, have a look into the World-File (*.jgw), the Ozi-Explorer-Calibration-File (*.map) or the info file (*.txt).

If you want to learn about World-Files see:

http://en.wikipedia.org/wiki/World_file

If you want to learn more about the Ozi-Explorer-Calibration-File see:

http://www.rus-roads.ru/gps/help_ozimap_file_format.html

3.4 Settings

In the directory, where TopoMap.exe is located you find a file, named TopoMap.exe.config. In this file you can change some setting that changes the behavior of TopoMap:

Parameter Name	Default values	Description of Parameter
webProxies	examples	Here you can store up to three different Web Proxy names
forceDownloadCheck	False	If true, checks for each tile, if it is present. Slows down downloading, if some or all tiles are already downloaded
rootDir	""	You can specify a root directory. Each time a new file Maps.xml is created, the rootDir will be applied for the storage path. After having changed the rootDir, delete the Maps.xml and start TopoMap.exe again.
createDefaultConfig	False	If true, TopoMap overwrites the map description file (Maps.xml) on each start and creates a default map description file.
toMaxArea	False	If true, TopoMap start up with maximal area values.
downloadRepetitions	2	Number of downloading cycles. Default is 2, what means, that the download is performed twice to make sure, that failed tiles can be fetched in the second cycle.
jpgCompression	50	The compression value for the jpg creation

Be careful with changing other then the mentioned parameters. Restart TopoMap after having changed the parameters.

3.5 Integrating other Map Resources

Its possible to integrate other map resources by simple configuration of an xml file. The first time, you start TopoMap, a file named Maps.xml is created. The file contains so called Map-Descriptions. Each Map-Descriptor describes one specific map. The last Map-Descriptor is named AnyMap, it can be used to configure any other map resource.

If you want to add more then one new Map-Descriptor, you can double the AnyMap section. Be careful, that the file keeps compliant to xml.

Lets have a look into the AnyMap sections of Maps.xml. You see parameter names with specific values.

```
<_storagePath id="ref-39">E:\TopoMap1.2\AnyMap</_storagePath>
<_mapDisplayName id="ref-40">Any Map: Please configure in the file Maps.xml</_mapDisplayName>
<_mapType>GOOGLE</_mapType>
<_mapDatum>WGS84</_mapDatum>
<_coordinateSystem>SPHERIC_MERCATOR</_coordinateSystem>
<_zone>0</_zone>
<_uriTemplate id="ref-41">http://anyMapServer/zoom{0}/xTile{1}/yTile{2}.jpg</_uriTemplate>
<_xPixelIn>256</_xPixelIn>
<_yPixelIn>256</_yPixelIn>
<_xPixelOut>4864</_xPixelOut>
<_yPixelOut>3328</_yPixelOut>
<_lonUpperLeft>5.9</_lonUpperLeft>
<_latUpperLeft>47.9</_latUpperLeft>
<_lonLowerRight>10.6</_lonLowerRight>
<_latLowerRight>45.7</_latLowerRight>
<_lonUpperLeftExtreme>5.9</_lonUpperLeftExtreme>
<_latUpperLeftExtreme>47.9</_latUpperLeftExtreme>
<_lonLowerRightExtreme>10.6</_lonLowerRightExtreme>
<_latLowerRightExtreme>45.7</_latLowerRightExtreme>
<_zoomLevels href="#ref-42"/>
<_step1Download>true</_step1Download>
<_step2Merge>true</_step2Merge>
<_step3Georeference>true</_step3Georeference>
</a1:MapDescriptor>

<SOAP-ENC:Array id="ref-42" SOAP-ENC:arrayType="a1:ZoomLevel[8]"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dne
utral%2C%20PublicKeyToken%3Dnull">
<item href="#ref-109"/>
<item href="#ref-110"/>
<item href="#ref-111"/>
<item href="#ref-112"/>
<item href="#ref-113"/>
<item href="#ref-114"/>
<item href="#ref-115"/>
<item href="#ref-116"/>
</SOAP-ENC:Array>

<a1:ZoomLevel id="ref-109"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dne
utral%2C%20PublicKeyToken%3Dnull">
<_level>0</_level>
<_displayName id="ref-183">0: 1 : 25 000?</_displayName>
<_pixelSize>2.3886571339117579</_pixelSize>
<_resolution>25000</_resolution>
<_enable>false</_enable>
</a1:ZoomLevel>
<a1:ZoomLevel id="ref-110"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dne
utral%2C%20PublicKeyToken%3Dnull">
<_level>1</_level>
<_displayName id="ref-184">1: 1 : 25 000?</_displayName>
<_pixelSize>4.7773142678235159</_pixelSize>
<_resolution>25000</_resolution>
<_enable>false</_enable>
</a1:ZoomLevel>
```

```
<a1:ZoomLevel id="ref-111"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dneutral%2C%20PublicKeyToken%3Dnull">
  <_level>2</_level>
  <_displayName id="ref-185">2: 1 : 50 000?</_displayName>
  <_pixelSize>9.5546285356470317</_pixelSize>
  <_resolution>50000</_resolution>
  <_enable>>false</_enable>
</a1:ZoomLevel>
<a1:ZoomLevel id="ref-112"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dneutral%2C%20PublicKeyToken%3Dnull">
  <_level>3</_level>
  <_displayName id="ref-186">3: 1 : 100 000?</_displayName>
  <_pixelSize>19.109257071294063</_pixelSize>
  <_resolution>100000</_resolution>
  <_enable>>false</_enable>
</a1:ZoomLevel>
<a1:ZoomLevel id="ref-113"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dneutral%2C%20PublicKeyToken%3Dnull">
  <_level>4</_level>
  <_displayName id="ref-187">4: 1 : 200 000?</_displayName>
  <_pixelSize>38.218514142588127</_pixelSize>
  <_resolution>200000</_resolution>
  <_enable>>false</_enable>
</a1:ZoomLevel>
<a1:ZoomLevel id="ref-114"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dneutral%2C%20PublicKeyToken%3Dnull">
  <_level>5</_level>
  <_displayName id="ref-188">5: 1 : 400 000?</_displayName>
  <_pixelSize>76.437028285176254</_pixelSize>
  <_resolution>400000</_resolution>
  <_enable>>false</_enable>
</a1:ZoomLevel>
<a1:ZoomLevel id="ref-115"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dneutral%2C%20PublicKeyToken%3Dnull">
  <_level>6</_level>
  <_displayName id="ref-189">6: 1 : 400 000?</_displayName>
  <_pixelSize>152.87405657035251</_pixelSize>
  <_resolution>400000</_resolution>
  <_enable>>false</_enable>
</a1:ZoomLevel>
<a1:ZoomLevel id="ref-116"
xmlns:a1="http://schemas.microsoft.com/clr/nsassem/TopoMap/TopoMap%2C%20Version%3D1.2.0.2%2C%20Culture%3Dneutral%2C%20PublicKeyToken%3Dnull">
  <_level>7</_level>
  <_displayName id="ref-190">7: 1 : 800 000?</_displayName>
  <_pixelSize>305.748113140705</_pixelSize>
  <_resolution>800000</_resolution>
  <_enable>true</_enable>
</a1:ZoomLevel>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

You easily can recognize, that the values contained in the section fully describe a map. Whenever a link is found ([href="#ref-42"](#)), search the link definition in the file and check the parameters there.

Now we will go step by step all parameters and explain what they are good for:

Parameter	Value (example)	Description of Parameter
storagePath	E:\TopoMap1.2\AnyMap	The path, where the map will be stored
mapDisplayName	Any Map: Please configure in the file Maps.xml	The name of the map, that will be displayed in the “Selected topographic Map” selector.
mapType	GOOGLE	Map Tile Sever Type: GOOGLE, GEOPORTAIL or IBERPIX. May be later other types of servers will be supported.
mapDatum	WGS84	The Map Datum of the Map
coordinateSystem	SPHERIC_MERCATOR	The coordinate system of the Map
zone	0	The UTM zone, if coordinate system supports zones.
uriTemplate	http://anyMapServer/zoom{0}/xTile{1}/yTile{2}.jpg	The link to the tiles. Wireshark is a good tool to find out the direct link to the tiles. The numbers in parenthesis will be replaced by: {0}: Google Map Zoom Level {1}: Tile Sequence number in x direction {2}: Tile sequence number in y direction
xPixelIn	256	Number of pixels in x-direction of the tiles
yPixelIn	256	Number of pixels in y-direction of the tiles
xPixelOut	4864	Number of pixels in x-direction of the resulting merged maps.
yPixelOut	3328	Number of pixels in y-direction of the resulting merged maps.
lonUpperLeft	5.9	Map area in decimal degree (WGS84)
latUpperLeft	47.9	Map area in decimal degree (WGS84)
lonLowerRight	10.6	Map area in decimal degree (WGS84)
latLowerRight	45.7	Map area in decimal degree (WGS84)
lonUpperLeftExtreme	5.9	Maximal allowed map area in decimal degree (WGS84)
latUpperLeftExtreme	47.9	Maximal allowed map area in decimal degree (WGS84)
lonLowerRightExtreme	10.6	Maximal allowed map area in decimal degree (WGS84)
latLowerRightExtreme	45.7	Maximal allowed map area in decimal degree (WGS84)
zoomLevels		Zoom levels (see next table)
step1Download	true	Wished processing step
step2Merge	true	Wished processing step
step3Georeference	true	Wished processing step

For each zoom level the following parameters are defined:

Parameter	Value (example)	Description of Parameter
level	7	The zoom level
displayName	7: 1 : 800 000?	The zoom name displayed on the panel
pixelSize	305.75	The size of one pixel in meters
resolution	800000	The printing scale of the original map
ebnable	true	If included in process true, else false

Right now Maps.xml is not particular flexible. Its planned to enhance the possibility of uriTemplate by adding more placeholder {n}.

4 Technical details

How does it work? If you analyse the IP traffic with Wireshark during the navigation on the map web sites, you immediately understand that the Java-Scripts get the maps by requesting small tiles of 256 * 256 pixels (for example in case of France). Well, that's all. You only have to understand the logic behind the HTTP requests, download the tiles sequentially for the whole country, merge them to maps and georeference them. Sounds easy, but depending of the country there is quite a lot of coding work to be done, like session maintaining and map projection calculations.

4.1 Switzerland

4.1.1 Downloading

TopoMap uses the site <http://www.mapplus.ch> to download the topographic map of Switzerland. Mapplus stores the tiles in a so called "Google Projection". Different zoom levels are available. The highest zoom level (16) shows the Swisstopo 1 : 25 000 topographic map.

The URL to a specific tile has the following format. The tile size is 611.5 m * 611.5 m respectively 256 * 256 Pixel.

<http://mpa1.mapplus.ch/swisstopo/zoom/X/Y.jpg>

Where:

- zoom: That's the zoom level. 16 is the highest zoom level
- X: Google tile sequence number in x-direction
- Y: Google tile sequence number in y-direction



4.1.2 Georeferencing

From the Google tile sequence numbers and the zoom level it is possible to calculate the geographic location of the upper left corner of the tile:

$$\text{Longitude(radians)} = \text{PI} * (2 * (X / 2^{\text{zoom}}) - 1)$$
$$\text{Latitude (radians)} = \text{atan}(\sinh(- \text{PI} * (2 * Y / (2^{\text{zoom}}) - 1)))$$

Furthermore it is possible to calculate the coordinates (in meters) of the upper left corner of the tile:

$$x = + r * \text{PI} * (2 * (X / 2^{\text{zoom}}) - 1)$$
$$y = - r * \text{PI} * (2 * (Y / 2^{\text{zoom}}) - 1)$$

Where:

- $r = 6\,378\,137$ m (Radius of the earth)
- x : x-Coordinate (in meters)
- y : y-Coordinate (in meters)

Note, that the Google Projection is based on the WGS84 Ellipsoid. Common GIS use a so called PROJ4 definition to describe the Google Projection. In technical terms it's a "Spherical Mercator Projection":

```
" +proj=merc +a=6378137 +b=6378137 +lat_ts=0.0 +lon_0=0.0 +x_0=0.0 +y_0=0 +k=1.0 +units=m  
+nadgrids=@null +no_defs"
```

4.2 France

4.2.1 Downloading

TopoMap uses the site www.geoportail.fr to download the topographic map of France. The site offers a set of different layers. TopoMap focuses on the map layer “cartes” and on the zoom levels 1 : 8'000 to 1 : 8'192'000. The zoom level 1 : 8'000 corresponds to the best resolution of the IGN 1 : 25 000 topographic map.

The following link will download a specific tile of France Mainland. The tile size is 512 * 512 m respectively 256 * 256 Pixel.

<http://visu-2d.geoportail.fr/geoweb/maps8u6T23uqPyC.jpg>

The name of the jpg looks quite much encoded and indeed it is. It contains the following information:

- The set of chosen layers
- The zoom level
- x and y coordinates of the tile in a specific projection



Some reverse engineering of the Java-Scripts helps us understanding the format of the jpg names:

8u6Z(X)XXxPYy.jpg

where:

- 8u6: The selected combination of map layers (8u6 is for the best resolution of the IGN 1 : 25 000 map)
- Z: A letter, that indicates the zoom level
- (X)XXx: Code of the x-coordinate. Details will follow.
- Yy: Code of the y-coordinate. Details will follow.

In the next table you see all the code formats for all different zoom levels:

Zoom	Geopotrail-Scale	Map-Scale	Code Template	Length	Pixel-Size (m)
11	8 000	25 000	8u6T (X)XXx Yy	10 or 11	2
10	16 000	25 000	8u6Q (X)XXx Yy	10 or 11	4
9	32 000	50 000	8u6m (X)XXx Yy	9 or 10	8
8	64 000	100 000	8u6Y (X)XXx Yy	9 or 10	16
7	128 000	200 000	8u6I (X)XXx Yy	9 or 10	32
6	256 000		8u6c (X)XXx Yy	9 or 10	64
5	512 000		8u6j (X)XXx Yy	9 or 10	128
4	1 024 000		8u6K (X)XXx Yy	9 or 10	256
3	2 048 000		8u6M (X)XXx y	8 or 9	512
2	4 096 000		8u67 (X)XXx y	8 or 9	1024
1	8 192 000		8u6W (X)XXx y	8 or 9	2028

Lets now have a closer look at the codes: The codes contain the following 62 characters: 0-9, a-z, A-Z. Some reverse engineering of the Java-Script code of the site is required to understand the order of these characters:

Codes: XuP4NGZ8ngIc jKM7WQTb2qC1ehOotLH9zsmawJSYlAifUvyrkEDx365Fp0VRdB
Nr 10: 0000000000111111111222222222233333333334444444444555555555566
Nr 1: 01234567890123456789012345678901234567890123456789012345678901

Unfortunately there are some nasty irregularities close to Greenwich 0 and close to the equator. First let's analyze 9 tiles somewhere placed east of Greenwich and north of the equator:

	Direction West to East		
Direction North to South	8u6T 23uq P y9	8u6T 23uC P y9	8u6T 23u1 P y9
	8u6T 23uq P yz	8u6T 23uC P yz	8u6T 23u1 P yz
	8u6T 23uq P ys	8u6T 23uC P ys	8u6T 23u1 P ys

(X)XX and Y design a block of 62 * 62 tiles. x and y designs the tile within the block.

Now let's have a look at a first irregularity: The code sequence. The sequence depends on the direction we are talking about. Horizontal (west to east) or vertical (north to south). And it depends where on the globe we are.

	West of Greenwich 0		East of Greenwich 0	
	Horizontal	Vertical	Horizontal	Vertical
North of equator	B...X	X...B	X...B	X...B
East of equator	B...X	B...X	X...B	B...X

Te sequence applies to the block codes (blue) and to the tile sequence within the block (red).

There are more irregularities in the horizontal direction in areas close to Greenwich 0:

- The first block east of Greenwich 0 has a block code with only two digits: 2G. The block has 62 tiles.
- The first block west of Greenwich 0 has a block code with only two digits: 9G. The block has one tile less then other blocks, 61 tiles. They start from B to u (not X). There is a simple reason for this irregularity: Mathematically it exists only one zero, there is not such thing like positive zero and a negative zero.
- All other blocks are regular, have three digits and 62 tiles.

	Horizontal direction (west to east)					
Block Codes	93P	93u	9G	2G	23u	23P
Tile codes	B...X	B...X	B...u	X...B	X...B	X...B
Number of tiles in block	62	62	61	62	62	62

May be close to the equator there are other irregularities, but they are not relevant in the case of France.

4.2.2 Calculating Codes

Let us calculate now an example. We have the coordinates of the lower left corner of a specific tile (zoom 1 : 8'000) in the Equirectangular Projection (about the Equirectangular Projection see the next chapter) and we search the download code for the tile.

x=3584 m

y=4974080 m

These coordinates are in meters (m). The zero point is where the Equator and the Greenwich meet each other. From the table in chapter we know, that the pixel size for the zoom level 1 : 8'000 is 2 m per pixel. All tiles of Geoportail always have 256 * 256 pixel. Therefore the size in meters of our tile is 512 * 512 m.

If we divide the coordinates by 512 m, the result is a tile count value in x- and y-direction:

TileCountX = 3584 m / 512 m = 7

TileCountY = 4974080 m / 512 m = 9715

So our tile is the 7th tile east of Greenwich and the 9715th tile north of the equator. Now we only have to figure out how to count with the letter codes.

Positive Tile Counting Numbers			Negative Tile Counting Numbers		
Nr	Greenwich to East	Equator to North	Nr	Greenwich to West	Equator to South
0	2GX	X	-	-	-
1	2Gu	u	-1	9Gu	?
2	2GP	P	-2	9GP	?
...			...		
7	2G8	8	-8	9G8	?
...			...		
61	2GB	B	-61	9GB	?
62	23uX	XX	-62	93uX	?
63	23uu	Xu	-63	93uu	?
64	23uP	XP	-64	93uP	?
...			...		
123	23PB	XB	-123	93uB	?
124	23PX	uX	-124	93PX	?
125	23Pu	uu	-125	93Pu	?
...			...		
9715	?	Pzf ¹	-9715	?	?
...			...		

The resulting tile code would be: 8u6T 2G8 Pzf. The corresponding download link would be:
<http://visu-2d.geoportail.fr/geoweb/maps8u6T2G8Pzf.jpg>

¹ 2*62*62 + 32 * 62 + 43 = 9715, 2=P, 32=z, 43=f

4.2.3 Georeferencing

Geoportail uses a Coordinate Reference System (CRS) called “Equirectangular Projection”. The 0-Point is where the Greenwich 0 and the equator meet each other. If each tile is 512 * 512 m, we can imagine a coordinate system over the whole world. The x and y coordinate can be directly derived from the (X)XxPYy code.

In the next step it's possible to calculate the geographic location of any specific x/y coordinate expressed in the “Equirectangular Projection”.

Latitude(degree) = $y * 180 / \text{PI} / r$

Longitude(degree) = $x * 180 / \text{PI} / r / \text{COS}(46.5)$

Where:

- $r = 6378137$ m (Radius of the Earth)
- x : x-Coordinate (in meters)
- y : y-Coordinate (in meters)

The “Equirectangular Projection” makes sure, distances are correct at a specific latitude. In the case of Mainland France, that's at a latitude of 46.5 degrees, more or less in the center of France.

Note, that the Geoportail.fr is based on the WGS84 Ellipsoid. Common GIS use a so called PROJ definition to describe the Equirectangular Projection:

```
"title=Geoportail - France metropolitaine +proj=eqc +nadgrids=null +towgs84=0.0000,0.0000,0.0000
+a=6378137.0000 +rf=298.2572221010000 +lat_0=0.000000000 +lon_0=0.000000000
+lat_ts=46.500000000 +x_0=0.000 +y_0=0.000 +units=m +no_defs"
```

4.3 Spain

4.3.1 Downloading

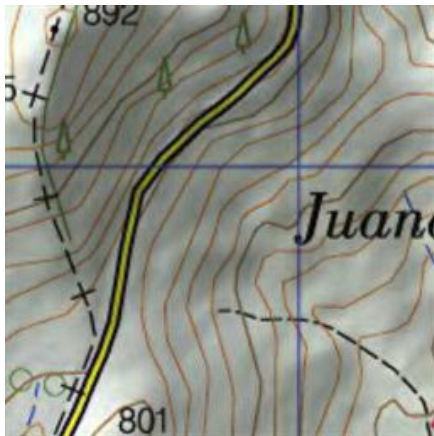
TopoMap uses the site <http://www.ign.es/iberpix/visoriberpix/visorign.html> to download the topographic map of Spain. Iberpix provides the tiles in UTM projection. The highest zoom level shows the IGM 1 : 25 000 topographic map of Spain.

The following link will download a specific tile of Spain. The tile size is 512 * 512 m respectively 256 * 256 Pixel.

http://ts4.iberpix.ign.es/tileserver/n=mapa_mtn25;z=30;r=2000;i=1212;j=9206.jpg

where

- mtn: The scale of the map (25 means 1 : 25 000)
- z: A UTM zone
- r: A pixel size (2000 means one pixel is 2000 mm in size)
- i, j: The coordinate of the tile in a coordinate system



4.3.2 Georeferencing

Georeferencing is easy as the tile coordinate (i, j) reflects indirectly the UTM coordinate:

$$x = i * 256 \text{ Pixel} * r / 1000$$

$$y = j * 256 \text{ Pixel} * r / 1000$$

Where:

- r: A pixel size (2000 means one pixel is 2000 mm in size)
- i, j: The coordinate of the tile in a coordinate system
- x: x-Coordinate (in meters)
- y: y-Coordinate (in meters)

Note, that Iberpix maps are based on the WGS84 Ellipsoid. Common GIS use a so called PRO4 definition to describe the UTM projection:

"`+proj=utm +zone=30 +ellps=WGS84 +datum=WGS84 +units=m +no_defs`"

Depending on the map you want to import in your GIS you have to adapt the **zone**.