

HOW TO – CREATING A BASEMAP WITH MAPBOX AND USING IT AS A VISUAL FOR POWER BI

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This “How to” proposal responds to:

- A requirement to visualize data with a geographical dimension in an interactive Power BI dashboard/report. As the default basemaps (such as OSM and Bing) are not aligned with the official UNHCR endorsement on global administrative boundaries, custom basemaps are required to ensure a full adherence with the UNHCR standards.
- As of the date of this document, the features of the “ArcGIS Maps for Power BI” are insufficient to support the data visualization and web sharing needs. For example, this tool does not provide an option to connect to the private feature layers (see the information box below for more detailed information). This problem can be evaded with stand-alone Power BI application.

The Mapbox Visual was chosen as visual support as it fully meets the needs for cartographic visualization as well as the publication issue. The Mapbox Visual can be imported and accessed as a visualization plugin inside Power BI.

This “How-to” will walk you through getting started with the Mapbox Visual, and how to create a basemap visualization in Mapbox and how to make it available in Microsoft Power BI. To accomplish this, you will need access to both a Mapbox and a Microsoft Power BI account.

Quick overview - ArcGIS Maps for Power BI

It is possible to access and call up the content on ArcGIS Online to create a map visual in Power BI through an ArcGIS Online organization account (see this [Tutorial, October 19, 2019](#)).

ArcGIS Online supports hosted feature layers for use as reference layers only. Webmaps are not currently supported. Level 1 and 2 users can connect to ArcGIS Maps for Power BI maps and use the secure content available in the organization (content published by ArcGIS Enterprise for example). This includes the UNCS basemaps currently available in the UNHCR ArcGIS Online map library. (See this [Announcement, May 8, 2018](#)).

So, why not using it?

The customization is quite limited unless feature layers are handled through ArcGIS Online platform. Moreover, the web publication of a Power BI dashboard/report embedding an ArcGIS Maps visual is a complicated process. A new release has been announced for Q1 2020, which will provide the possibility of web publishing (See [Microsoft User documentation](#)).

Data visualization tools like Mapbox and Power BI are evolving fast as new versions with updated features are released several times a year. The information in this report is based on the features available in the releases of early 2020. Readers are strongly advised to verify the features and functions of newer releases when interested in using either of the tools.

I. Getting started

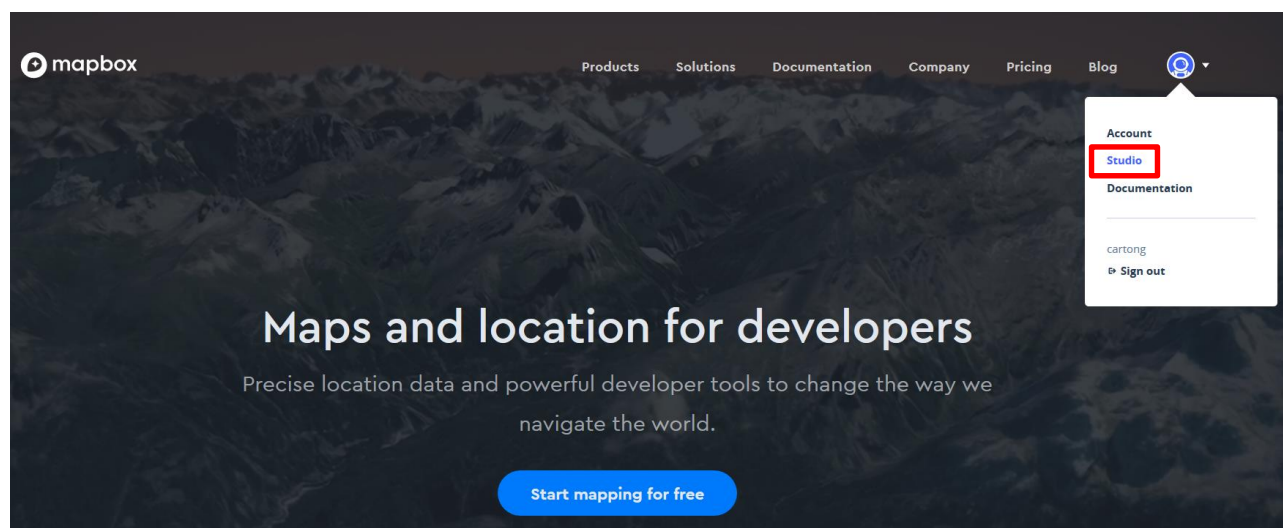
A few resources before you get started:

- **Mapbox account** – You will need a Mapbox access token to add **the Mapbox Visual in Power BI**. Sign up for a free account on Mapbox or use the one provided by your organization.
- **Power BI account** – Sign into your Power BI account or create a new one.
- **Mapbox Visual for Microsoft Power BI** - You can either add the Mapbox Visual using the Power BI Marketplace, or you can download the [latest Mapbox Visual](#) from the open-source Power BI GitHub repository.
- **Dataset for Power BI** – Load and set your dashboard or your Power BI report. This document doesn't explain how to create it.
- **Geospatial data** (MBTile, KML, GPX, GeoJSON, Shapefile (zipped), CSV) – Here you will upload *country boundaries data recognized by UN* in geojson format into your Mapbox custom basemap.

II. Create a basemap using Mapbox Studio

Mapbox Studio is an online tool that allows you to create custom maps from *vector tiles*. This website allows you to generate vector tiles from datasets or tilesets, host them freely on the Mapbox server (within the limits of the conditions set by the site, i.e. **50,000 views per month**) and stylize them.

Once authenticated on the [Mapbox website](#), go to the **Studio**:



Or visit: <https://studio.mapbox.com/>

The user usually works in two or three steps:

1. **Creating vector data or importing vector data for edition** (*optional*) through:
 - ⇒ The "**Dataset Editor**"; it allows you to create or to import your own data into GeoJSON (JSON or CSV) and edit it. You can't work directly from a database. Once saved, your dataset must be exported to tilesets to convert it as vector tiles in order to be styled in the "Style Editor".

See [Mapbox glossary: dataset](#)

2. Creating vector tiles through:

- The "**Tileset** Editor"; it allows you to import a collection of raster or vector data (that you could have created previously as datasets) in order to be aggregated and then divided into an uniform grid of square tiles at 22 preset zoom levels.

See [Mapbox glossary: tileset](#)


 **mapbox** | Studio

Styles **Tilesets** Datasets 

3. Stylization of vector tiles via:

- The "**Style** Editor", which allows you to style your vector tiles according to your needs adding custom fonts, icons or layers, or to apply one of the predefined styles of Mapbox Studio (Mapbox: Vector Tiles, 2019), or again to mix them by refining the built-in template map styles (Figure 1).

 **mapbox** | Studio

Styles Tilesets Datasets 

See [Mapbox glossary: style](#)

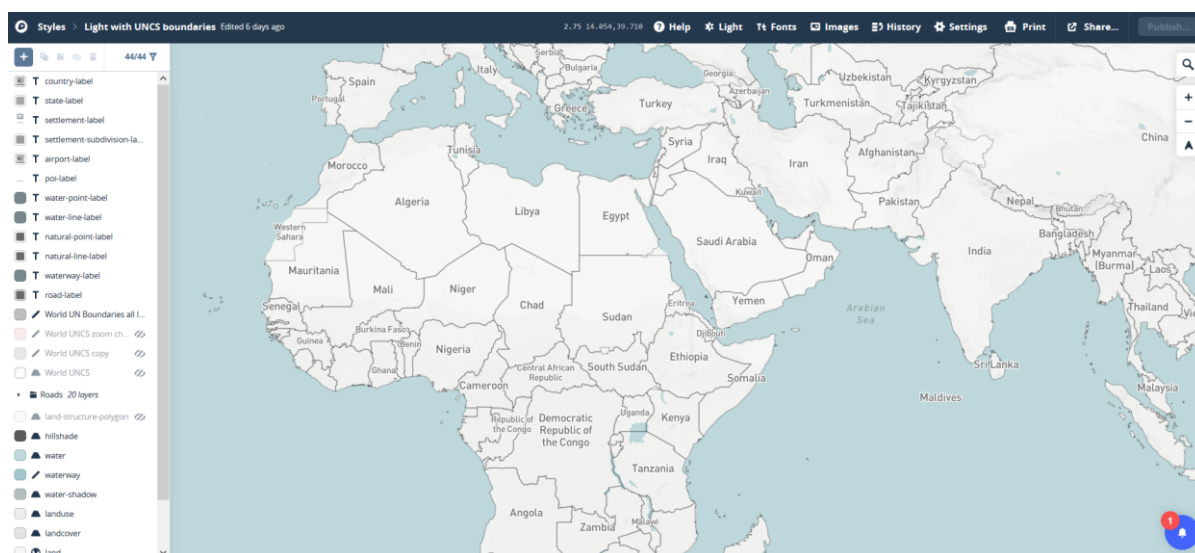


Figure 1 – "Light" built-in basemap from Mapbox Studio templates library updated with UN recognized boundaries

II.1. Mapbox vector tiles: workflow

Mapbox Studio is a relatively simple tool that allows you to quickly create vector tiles with default settings that however cannot be edited. **The stylization of the data is therefore relatively limited.**

The default setting for the tile creation will lead to generating tiles only for zoom levels above 2. This results in the disappearance of borders on a global scale of less than 2. In addition, there is no adaptation of the data display according to the zoom level: the appearance of the tiles at zoom level 2 and zoom level 20 is exactly the same, regardless of the amount of information displayed (which is not a problem in our case given that we only display borders; however, this could become problematic if a lot of data needs to be represented).

To overcome this problem and be able to edit the display of the data according to their zoom level, Mapbox has developed another vector tile creation tool, **Tippecanoe**, which provides many customization options.

Then, the file once edited and generated in MBTiles via Tippecanoe can be imported into Mapbox Studio to be displayed and stylized before being called into Business Analytics tools, heavy clients such as SIG software or light clients like web applications (Figure 2).

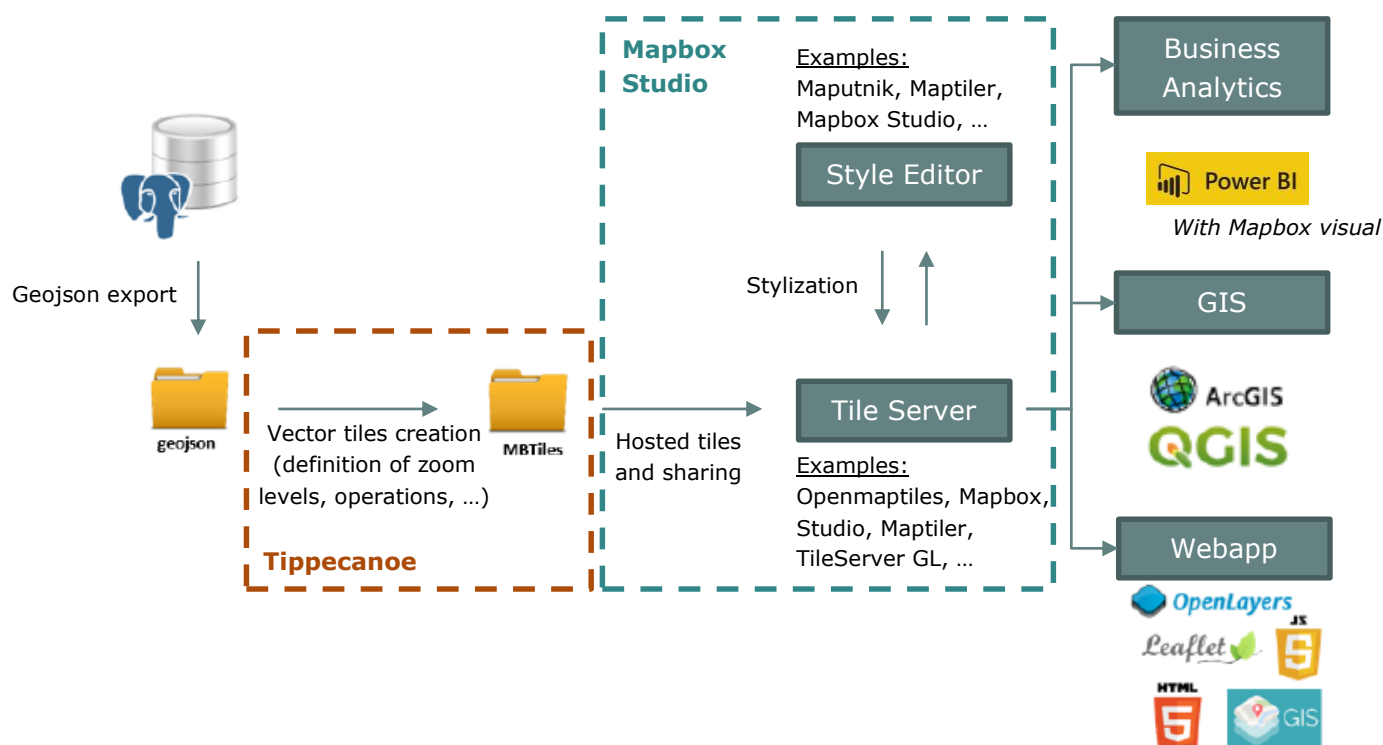


Figure 2 – General vector tiles workflow (inspired by C. Guyénot, 2019). In this case, Mapbox Studio is the vector tiles host and the style editor chosen in this "How to", among other options described.

II.2. Upload and prepare your geospatial data to Tippecanoe

Tippecanoe is a tool used to create **MBTiles vector tiles** from GeoJSON data. This is a Mapbox service for cases where the data exceeds the size limits supported by Mapbox Studio. Tippecanoe offers more advanced options including the adaptation of the display of the data according to the zoom level.

Tippecanoe also includes many options to customize the appearance of your vector tiles ([GitHub: Tippecanoe, 2019](#)).


The easiest way to perform your editions and to create custom vector tiles from your geojson file is to use a Linux virtual machine or the Linux subsystem available in Windows 10. We recommend using the latter - a more direct method.

Install the Linux subsystem with windows 10

1. **Enable developer mode:** **Start > Settings > Update & Security**. On the left panel, click on **"For Developers"** then select **"Developer Mode"** then **Yes**.
2. **Restart**
3. **Install the Linux subsystem on Windows:** **Start > Settings > Apps**. In the right column, click on **"Programs and Features"** in the **"Related settings"** section. In the left column, click on **"Turn Windows features on or off"**. Check the option **"Windows Subsystem for Linux"** and click on the **OK** button
4. **Restart**
5. **Install the Ubuntu 18.04 distribution:** go to the Microsoft Play Store, search for Ubuntu 18.04, Install and Launch. Be careful as a minimum of available disk space is

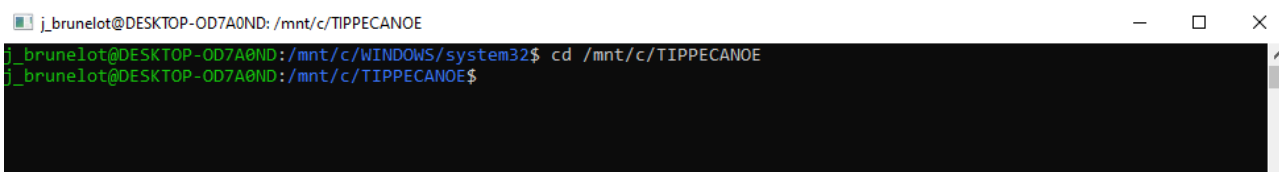
required. Choose your login and password. Please note that these identifiers will be reused later.

6. **Launch the Linux subsystem: Type "bash" in the windows search bar** close to the start menu. A window of this type should open, the Linux subsystem is launched:



```
j_brunelot@DESKTOP-OD7A0ND: /mnt/c/WINDOWS/system32
j_brunelot@DESKTOP-OD7A0ND: /mnt/c/WINDOWS/system32$
```

It is recommendable to change your work directory. The best is to work at the root C:/. Type this command ("TIPPECANOE" being the name of the folder created at the root C:/):



```
j_brunelot@DESKTOP-OD7A0ND: /mnt/c/TIPPECANOE
j_brunelot@DESKTOP-OD7A0ND: /mnt/c/TIPPECANOE$ cd /mnt/c/TIPPECANOE
j_brunelot@DESKTOP-OD7A0ND: /mnt/c/TIPPECANOE$
```



"cd" for "change directory". Take care:

- in the sense of the separators: "/" and not "\"
- the main directory is written: "c/" and not "c:\"
- use "sudo" command to work as administrator if necessary. This command allows you to update the list of available packages if required.

Indeed, the installation of Tippecanoe requires prior updates and installations. Once done, the Tippecanoe project can be cloned from GitHub and installed. Everything you need is summarized here:

<https://github.com/mapbox/tippecanoe>

Or type:

```
git clone https://github.com/mapbox/tippecanoe.git
cd tippecanoe
make -j
make install
```

Line-delimited GeoJSON

The Mapbox Tilesets API requires that tileset sources be formatted as line-delimited GeoJSON (uncompressed line-delimited sequences of GeoJSON features).

All information in this section is extracted from [Troubleshooting/tilesets-sources](#) document.



Validate line-delimited GeoJSON

You can use the Tilesets CLI to validate a tileset source file by using the command:

```
$ tilesets validate-source path/to/your/data.json
```



Convert GeoJSON to line-delimited GeoJSON

To convert a GeoJSON file to line-delimited GeoJSON, you can use the Tippecanoe `tippecanoe-json-tool` command:

```
$ tippecanoe-json-tool in.geojson > out.geojson.ld
```

💡 Convert other data formats to line-delimited GeoJSON

If your source data is in a vector format other than GeoJSON, such as a Shapefile or KML, you need to convert it to line-delimited GeoJSON before using it to create a tileset source. The [Fiona CLI tool](#) outputs line-delimited GeoJSON by default and is thus a good option for converting files. You will probably need to install the *click* package first.

Here is an example converting a Shapefile into a line-delimited sequence of GeoJSON features:

```
$ fio cat ~/data/countries.shp > countries.geojson.ld
```

💡 The `ogr2ogr` utility from GDAL (version 2.4) can also convert many data formats to line-delimited GeoJSON

```
$ ogr2ogr -f GeoJSONSeq countries.geojson.ld ~/data/countries.shp
```

Use Tippecanoe to edit zoom levels

The main command line that you will use for this “How to” is:

```
tippecanoe -zg -o <mbtiles_name>.mbtiles <geojson_name>.geojson
```

The `-zg` option will make Tippecanoe choose a maximum zoom level that should be high enough to reflect the precision of the original data (if it turns out still not to be as detailed as you want, use `-z` manually with a higher number as `-z0` for instance; `-Z` to precise the minimum zoom if needed)

| zoom level | precision (ft) | precision (m) | map scale |
|------------|----------------|---------------|---------------|
| -z0 | 32000 ft | 10000 m | 1:320,000,000 |
| -z1 | 16000 ft | 5000 m | 1:160,000,000 |
| -z2 | 8000 ft | 2500 m | 1:80,000,000 |
| -z3 | 4000 ft | 1250 m | 1:40,000,000 |
| -z4 | 2000 ft | 600 m | 1:20,000,000 |
| ... | ... | ... | ... |
| -z19 | 0,8 in | 2 cm | 1:600 |
| -z20 | 0.4 in | 1 cm | 1:300 |
| -z21 | 0.2 in | 0.5 cm | 1:150 |
| -z22 | 0.1 in | 0.25 cm | 1:75 |

[GitHub: Tippecanoe, 2019](#)

With the `-zg` parameter, you can add those complementary ones:

`--drop-densest-as-needed`: If the tiles are too big at low or medium zoom levels, drop the least-visible features to allow tiles to be created with those features that remain

`--extend-zooms-if-still-dropping`: If the tiles are too large even at high zoom levels, keep adding zoom levels until reaching one that can represent all the features

[GitHub: Tippecanoe, 2019](#)

Example:

```
tippecanoe -zg -o UN_boundaries.mbtiles --drop-densest-as-needed --extend-zooms-if-still-dropping World.geojson
```


With optional parameters in italics.

Use Tippecanoe to edit resolution, projection, create filters, simplify geometries and other useful parameters

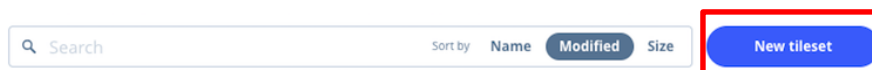
Refer to [GitHub: Tippecanoe, 2019](#)

II.3. Upload your custom MBTiles data to Mapbox

First, you need to **upload the MBTiles** file previously created from your geojson to Mapbox **as a tileset**. If you have not gone through the Tippecanoe step, the data must be in one of the following formats: KML, GPX, Shapefile (zipped), CSV or your GeoJSON source file.

1. Navigate to the [Tilesets page](#) in Mapbox Studio
2. Click on the **New tileset** button

Tilesets



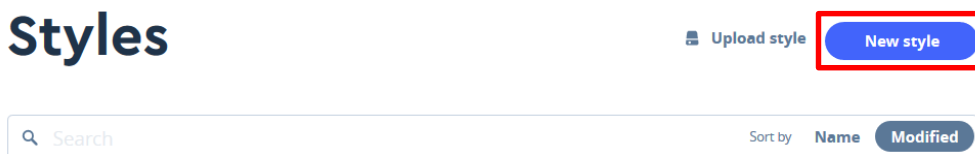
3. In the **New tileset** window, you can either click the **Select a file** button and choose the file, or you can drag and drop the file directly into the window
4. When you are prompted to do so, click **Confirm**
5. After the file uploads, you will see a confirmation success message. Click on the link in the confirmation message to open your new tileset's information page. The tileset's information page includes the **tileset ID**, the layer's **name**, and the layer's **properties**, **all which you will need to reference in Power BI**.


II.4. Update the style of your tileset

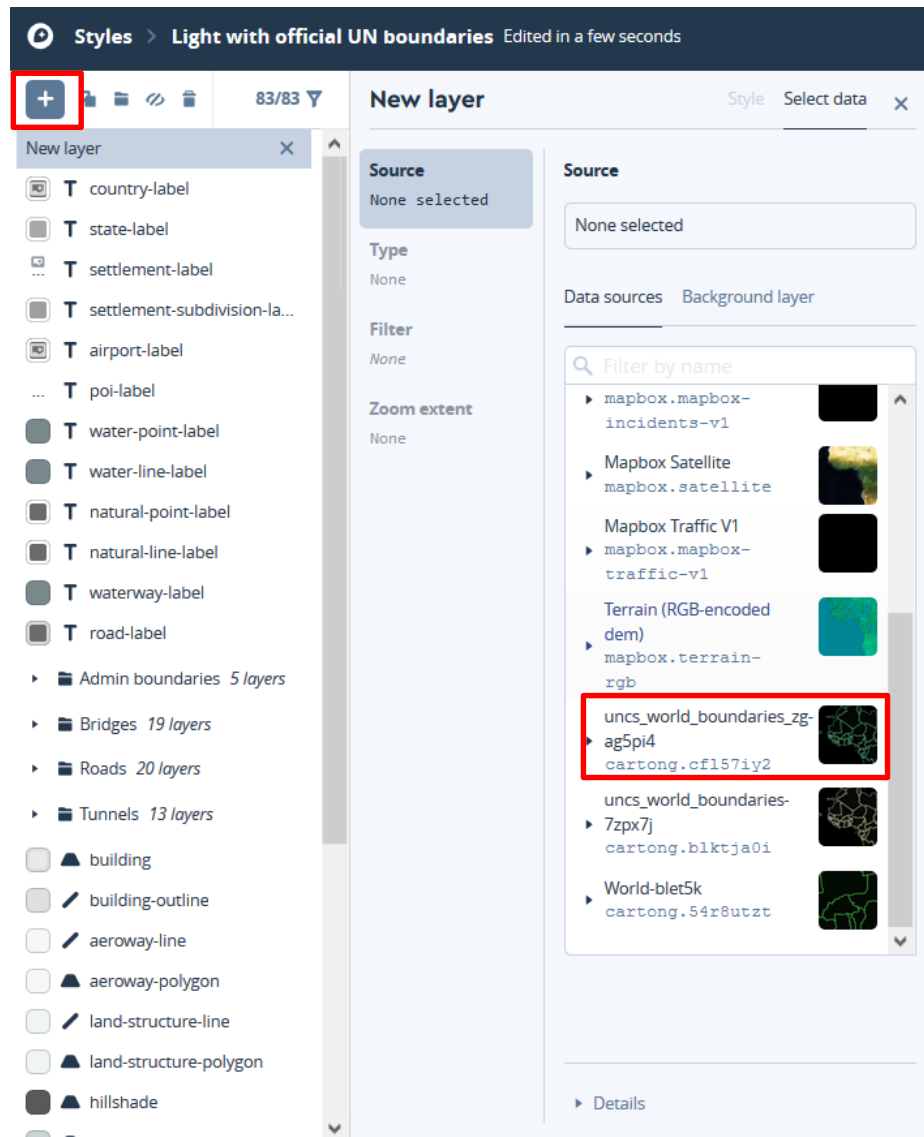
Secondly, you need to create a style. Here you can start from scratch ("Blank" template), update an existing one among the available templates or call an existing json style (as the UNHCR official basemap).

1. Navigate to the [Style page](#) in Mapbox Studio
2. Click on the **New style** button (or **Upload style** in case where you would upload an existing json style)

Styles



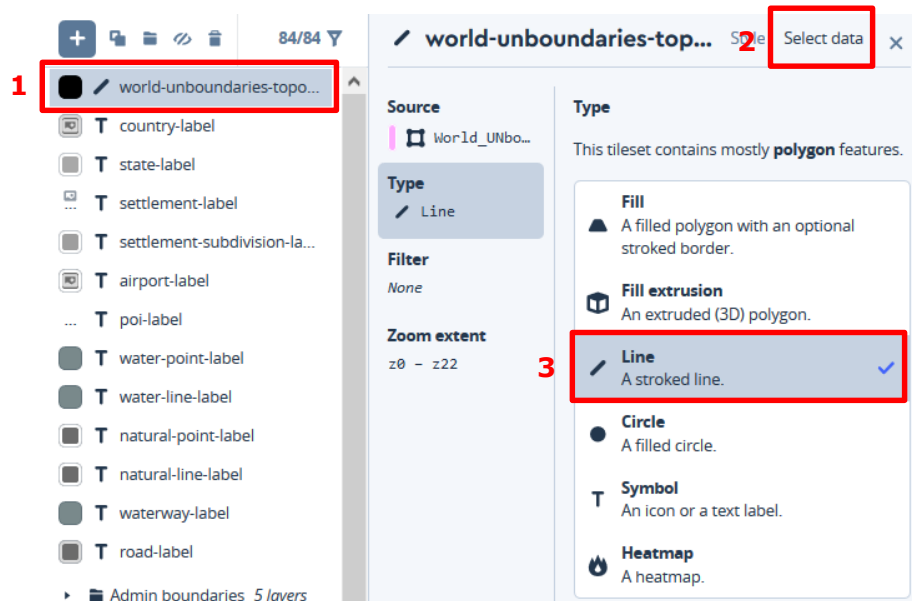
3. In the opening window, choose your template (for example "Light")
4. Rename the style so that you can find it later. Click into the title field in the upper left side of the screen to change the title from Light to Light with official UN boundaries for example.
5. **Add your tileset as a new layer**, by clicking first on  and then choose the tileset that you previously uploaded



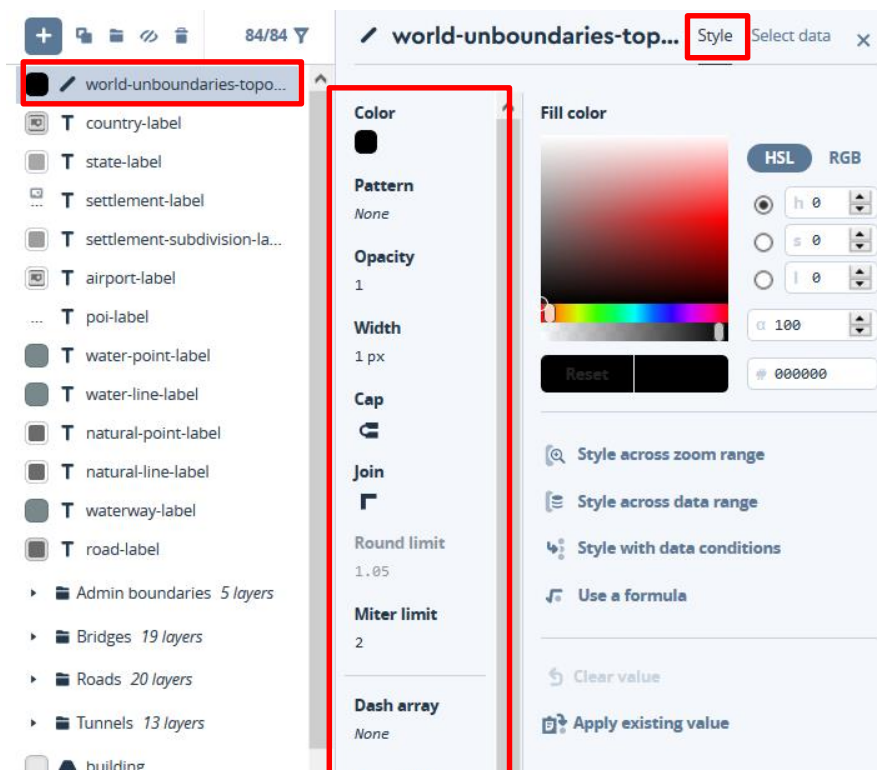
The editor is now showing your map in an x-ray mode. X-ray mode shows all the data in the sources added to the style, regardless of whether there is a layer to style it.

6. Edit your layer

- Its type:** allows you to select the type of layer to create either fill, fill extrusion, line, circle, symbol, heatmap, or raster data types. Click on the layer **(1)** > "Select data" **(2)** > Select **Line (3)** (selecting **Fill** doesn't allow you to change the thickness or color of the contour / outline). During this step, your layer will be highlighted on the x-ray map.



- b. **Its color and other properties:** each layer can be styled individually by clicking on the name of the layer in the Layer list. Alternatively, click on the **Style** tab and the map will switch back to the style mode displaying your new layer. You can pick values individually, based on a data attribute, zoom level, or the value of another property.



- Its position in the Layer list, by simply pressing down on the layer and reorder it to the desired position, like shown in the labels above
- Its name
- The view by scrolling back to the
- And explore the other properties

7. Publish your style to save your modifications



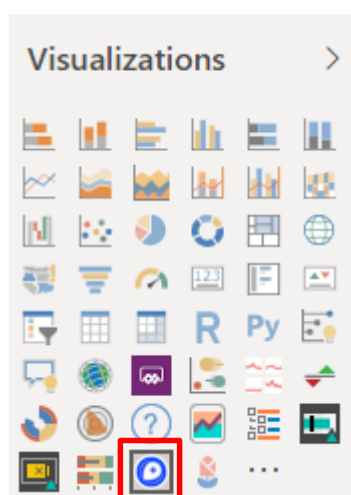
III. Call up your Mapbox style into the Mapbox for Power BI visual

III.1. Add Mapbox visual to your Power BI report

1. In the *Visualizations* pane, click the **Import a custom visual** option,
2. Select **Import from marketplace**,
3. Enter "Mapbox" in the search menu and press enter,
4. Click the **Add** button next to the *Mapbox visual* option to add it to your Power BI report. It will appear as a blue Mapbox logo on the *Visualizations* toolbar.

Alternatively, you can download the latest "Mapbox Visual for Power BI" from Mapbox's [open-source GitHub repository](#):

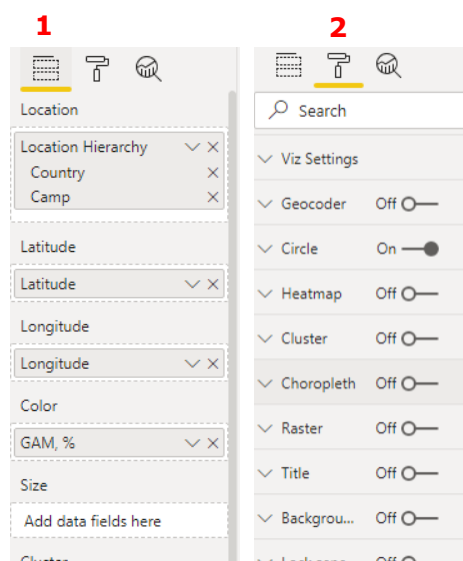
1. Click the Import a custom visual icon (three dots) and select Import from file,
2. Upload the latest Mapbox Visual,
3. A new blue Mapbox logo will appear in the Visualizations pane.



III.2. Create Mapbox visualization

Click on the Mapbox icon in the Visualizations panel to add a new visualization on your report. While customizing your visualization, you'll work in both the **Fields** and **Format** panels:

- The **Fields panel (1)** is where you will specify which data fields to associate with different types of Mapbox layers (for example map styles, heatmaps, circle maps, and cluster aggregation for points; choropleth map for polygons). Depending on the data field filled in ([Latitude] and [Longitude] for points, [Location] and [Color] for polygons), the Mapbox visualization container will populate with instructions on how to create your visual.
- The **Format panel (2)** is where you will specify the visualization style for each layer, such as color and radius – depending on the type of Mapbox layers you work with.



For this “How to”, let’s take an example with a Circle map, where your data must include XY coordinates to drag to [Latitude] and [Longitude] fields. Make sure that the *Do not summarize* option is checked for both fields.

III.3. Set-up your visualization

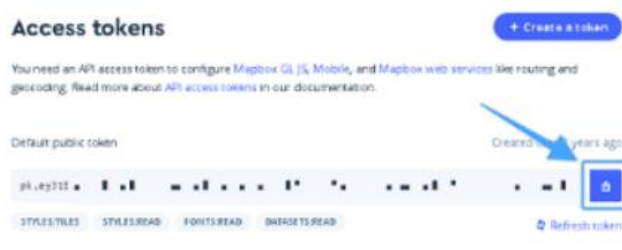
Connect your Mapbox account using your access token:

1. Click on the link “**Click here to get a free Mapbox access token**” (1), in the visualization container. Accept the external link request if prompted. You will be forwarded either to the Mapbox sign up page or your Mapbox account page.

Start building with Mapbox in 3 steps:

1 [Click here to get a free Mapbox access token](#)

1. Copy your Mapbox access token from the link above.



2. Paste your Mapbox access token into the PowerBI Viz format panel.

2. Sign up with your account or organization account
3. Copy (2) your Mapbox Access token from your account page

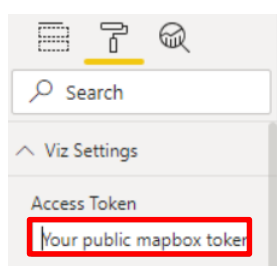
Access tokens

[+ Create a token](#)

You need an API access token to configure [Mapbox GL JS](#), [Mobile](#), and [Mapbox web services](#) like routing and geocoding. Read more about [API access tokens](#) in our documentation.


| Name | Token | Last modified | URLs |
|----------------------|--------------------------|---------------|-----------------------------|
| Default public token | Your public mapbox token | 18 days ago | N/A Refresh |

4. Back in Power BI, go to the **Format** panel and find the **Viz Settings** option. Paste your access token in the **Access token** field.

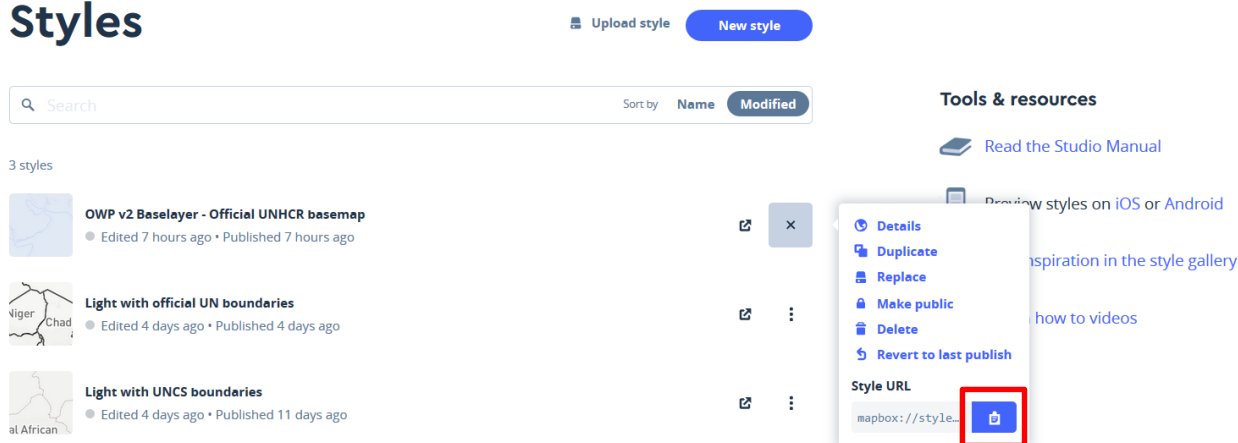


III.4. Change the map style

With the Mapbox Visual for Power BI, you can change the map style used in your visualizations. You can use any Mapbox default style (as *Light*, *Black*, *Streets*, *Satellite*, etc.) or use a custom map style that you previously created with Mapbox Studio. To update the map style:

1. In the Format panel, select **Viz Settings > Map Style**,
2. Select **Custom... style**,
3. You are prompted to enter a **style URL**. Among your styles, click on  and copy your Style URL as shown below for the "OWP v2 Baselayer – Official UNHCR basemap":

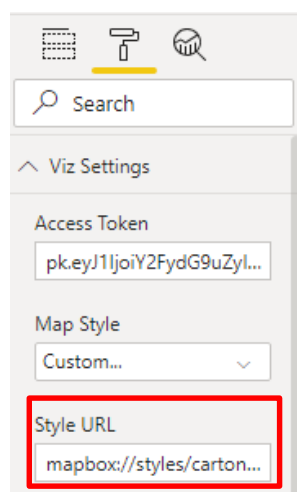
Styles



 A complete style URL, like **mapbox://styles/cartong/style_ID**, is comprised of three components:

- **mapbox://styles**: points to the Mapbox Styles API
- **/cartong**: your Mapbox username
- **/style_ID**: your style's unique ID

4. Paste it in the **Style URL** box



5. Your custom visual on Mapbox should now appear in the background.
6. You are able to further customize your map by choosing the appropriate visualization for your data (such as circle, heatmap, cluster, **choropleth**). Other customization options include widgets including a legend and map title; further instructions can be found at <https://docs.mapbox.com/help/tutorials/power-bi/>.