The evolution of Nazi concentration camps

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1 Abstract

The genocide of 6 million Jews at the hands of the German state during World War Two is one of the more tragic and horrific events of the 20th century. One of its most perplexing aspects is how one of the most civilized countries in Europe decided and was able to commit that atrocity. It is perplexing that educated, sophisticated people would develop such a skewed worldview and belief system that a significant minority among them would be supportive of such a crime and help commit it. It raises the question of whether even modern societies can accept the mistreatment of innocent people in ways that we currently consider unfathomable. What happened during the Holocaust is well known in its broad outlines. What is less known is the size of the operation needed to transport millions of people to thousands of concentration camps throughout Europe. I believe that showing that in a memorable way will make the point that the Holocaust was not the work of a handful of fanatics but required the concerted effort of millions of people in the armed forces, government, industry and the acquiescence of a substantial fraction of the German society. That in turn makes the point that a modern, civil society can be co-opted to do something horrific. That message has become more important in recent years when social discourse is becoming progressively more untethered from objective truth and hate speech is on the rise. The goal of this project is to demonstrate some of these points through a visualization of the evolution of Nazi concentration camps.

2 Introduction

2.1 Motivation

The Holocaust was the largest genocide in human history [6]. Anywhere between 4.2 and 7 million people, around 2/3 of the Jewish population in Europe, were systematically murdered by the German state from 1941 to 1945 in an attempt to eliminate all Jews from Europe [7]. Most of these deaths happened in concentration camps either in gas chambers, immediately upon arrival, or, usually, over a few months of forced labor because of malnutrition, disease, exposure to the elements or because of punishment. Others, especially in Poland and occupied Soviet union were killed by paramilitary death squads (Einsatzgruppen) [8] by shooting. In addition to the murder of Jews, 3.3-3.5 million Soviet prisoners of war and 1.8-3 million Polish civilians were murdered by mistreatment and starvation around the same period.

State sponsored antisemitic propaganda in Germany in the 1930s desensitized ordinary Germans to the injustice and mistreatment suffered by the Jews to the point that more drastic measures like seizure of property, physical attacks, deportations and internment in concentration camps were tolerated by a large number of Germans ([7], ch. 1-7). The same climate that made antisemitism

tolerable among the average person, also radicalized extremists in that society to the point that they were willing to assist in committing mass murder. Parallels can be drawn between anti-semitic propaganda in Germany in the 1930s and the spread of fake news int he modern world [13]. Combine that with the rise in antisemitism [11] and hate speech in general [12] one can be rightfully concerned about whether US society is on path of being desensitized to the mistreatment of minorities. That is one reason that the story of the Holocaust is more relevant today and should be told in a way that is impactfull.

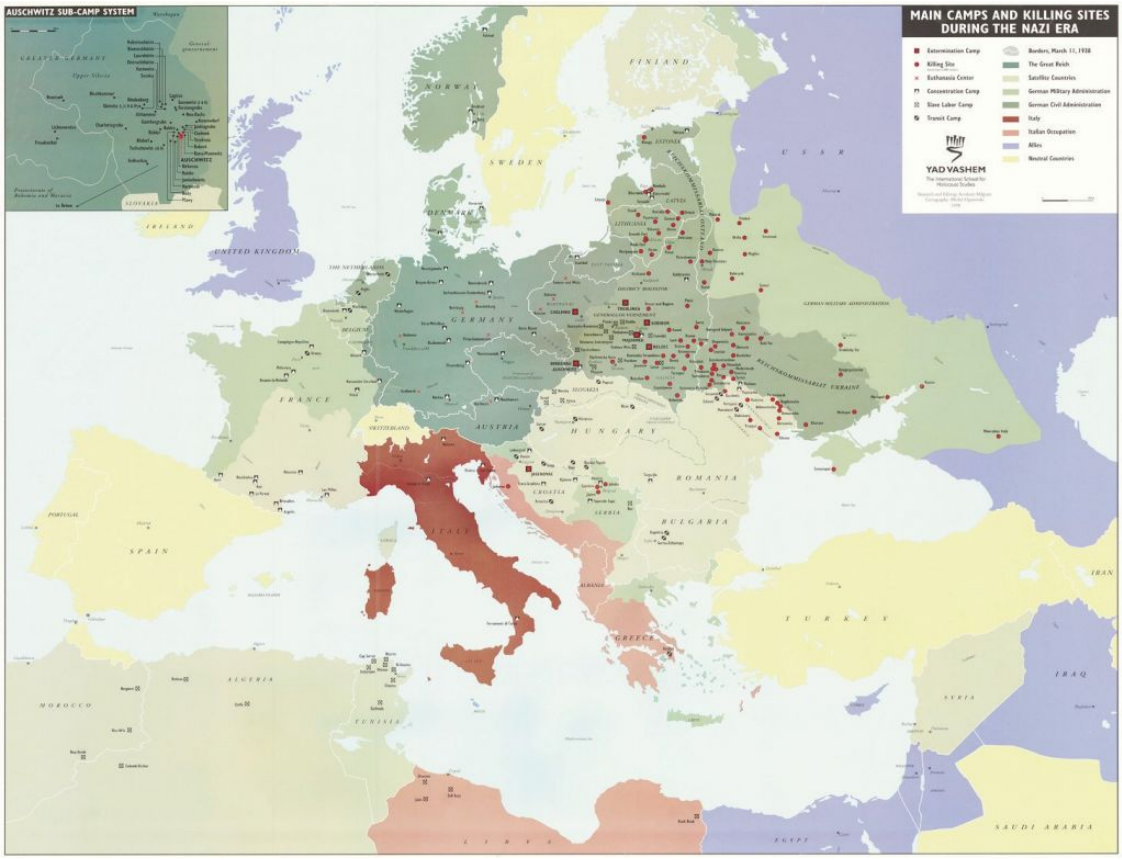
Even though the size of the atrocity is well known, knowing that number does not necessarily equate with an understanding of the scale involved. Specifically the German state used its significant resources to establish and maintain thousands of concentration camps throughout Europe [14]. The first of these camps were established in the 1930s as the Nazis came to power and were greatly expanded after the war started. Visualizations of the geographic extent of the camps, the population of the people incarcerated there and how it changed over time, their places of origin, and the types of forced labor they performed will make clear the enormity of the operation and the fact that it was centrally organized. I believe that this type of visualization, especially if done in a way that grabs and holds the attention, despite the information overload that most of us deal with, can sensitize people to the effect attitudes toward discrimination can have on a society.

2.2 Background

There is an extensive literature on the Holocaust (see Bibliography in [15]) as well as oral histories, documentaries, photographic evidence and movies. However, visualizations, especially the kind that succinctly display its enormity are harder to come by. A list of maps that show concentration camps in Europe along with some secondary information such a number of Jews deported by country, Einsatzgruppen massacres, etc. can be found in [5]. However these do not provide much information about the size of the camps or their temporal evolution. A similar map from [3] is shown below. As can be seen the map is hard to read and does not show size and time information.

[2]:
```
from IPython.display import Image
Image("media/camps_3.jpg")
```

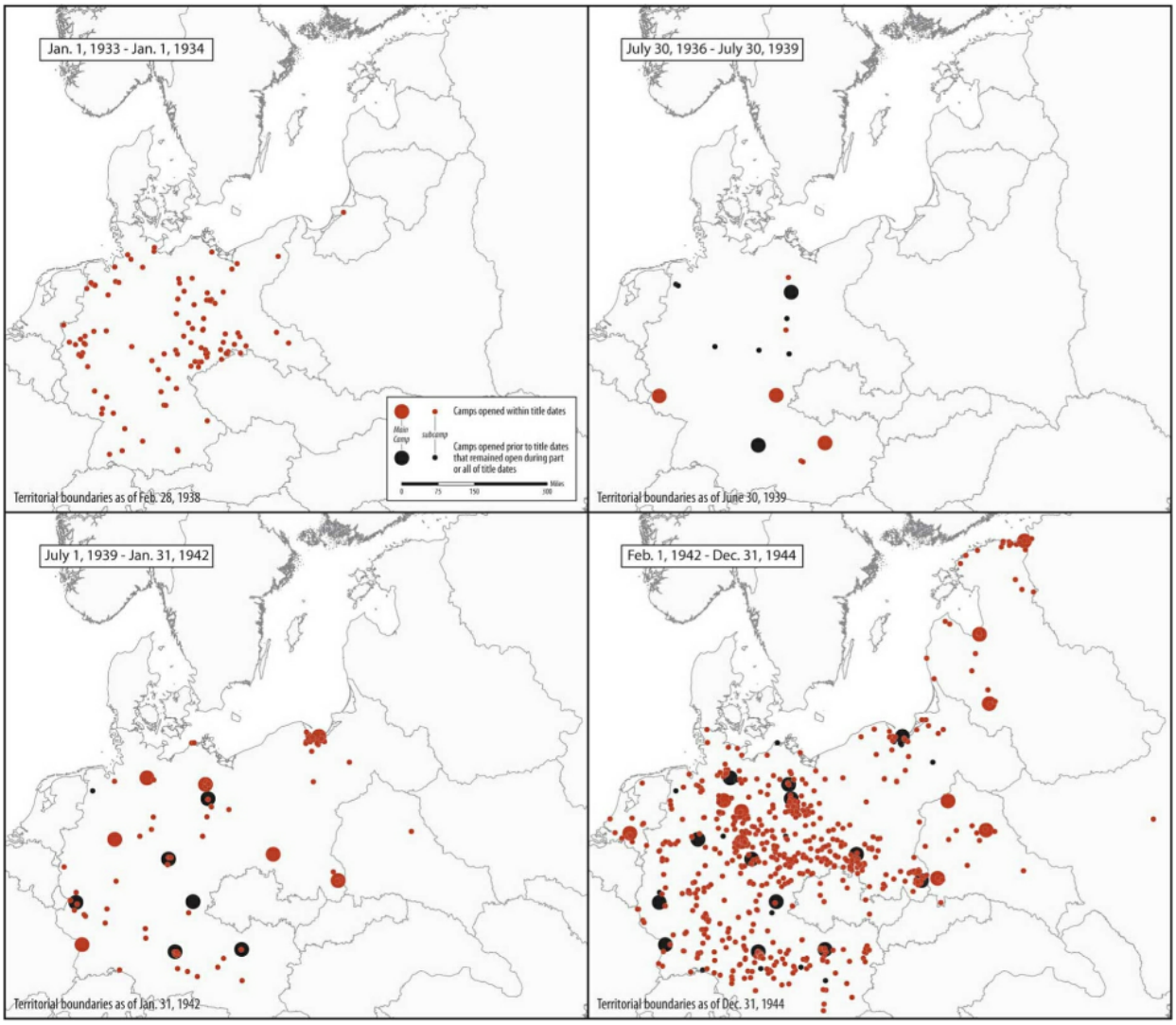
[2]:



Geographic and temporal visualizations are provided in [14]. The image below shows four snapshots of main and satellite camps in operation from 1933 to 1944. Note that camps change over time with older ones closing and new ones being established. Also, the rate at which that happens seems to vary in time. An animation would have conveyed the time dependence better. Such an animation was given by the book author in a presentation ([16], at 17:30 into the video) but could not be found in a standalone form online.

[13]:
```
Image("media/geoographies_pg46.png")
```

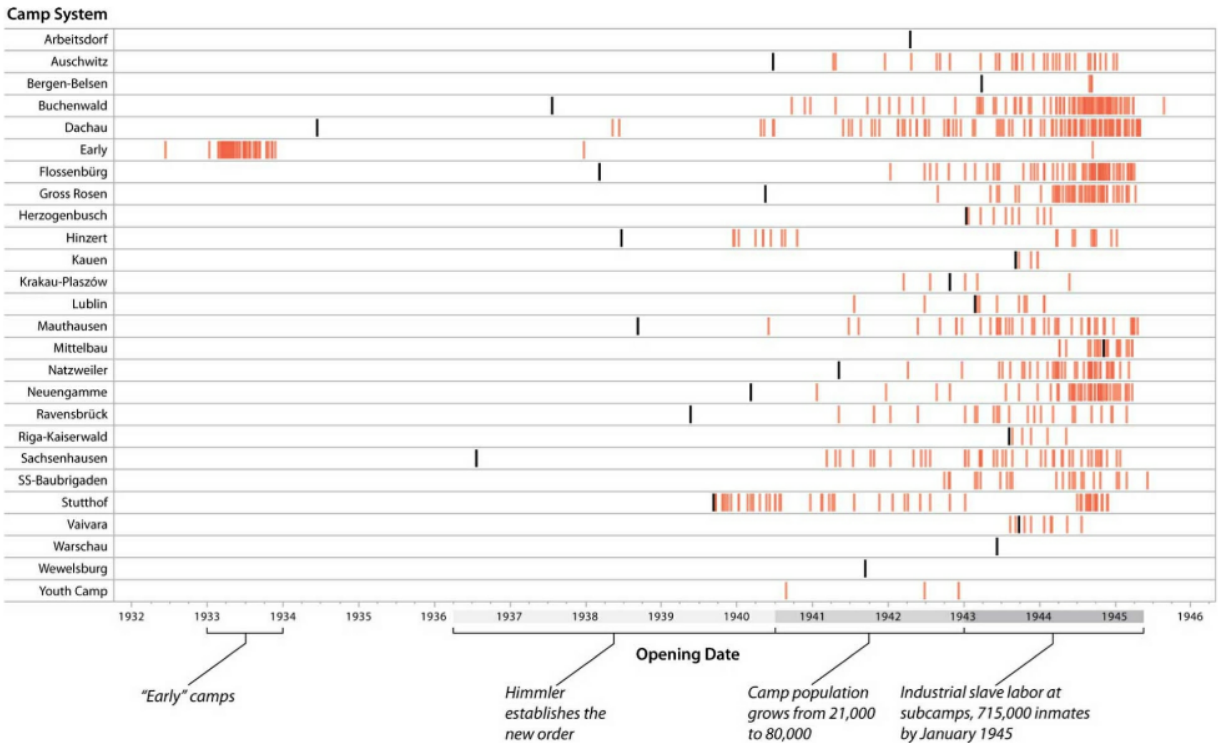
[13]:



The same reference [14] contains other visualizations of the evolution of the Holocaust such as the ones shown below indicating the relationship between main camps and subcamps, the type of production supported by labor in various camps, etc. These visualizations taken together provided a thorough view of the extent of the Holocaust but there is not a single one that accomplishes that on its own. Also, these are not available online making them less widely accessible.

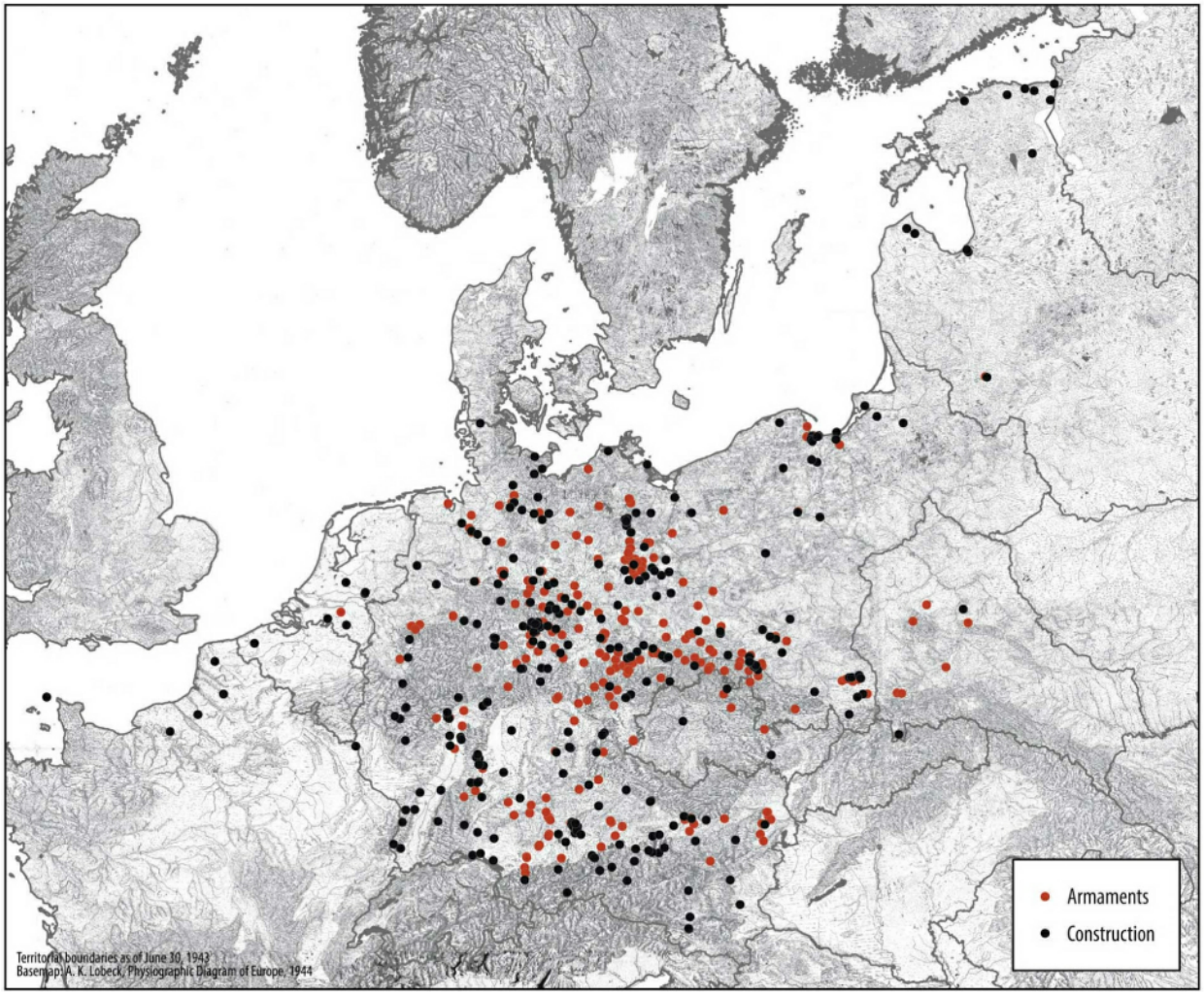
[15]:
```
Image("media/geoographies_pg52.png")
```

[15]:



[16]:
```
Image("media/geoographies_pg65.png")
```

[16]:



An animation of the time evolution of the killing rate at Treblinka, Sobibor and Belzec death camps can be found in [17] (see below). The video does a good job showing how from where people were sent to the death camps and how that number changed over time. The progressively increasing curve showing total number of deaths is particularly impactfull. However the animation only relates to those three death camps, that although significant, were only a small part of the total constellation of concentration camps implicated in the Holocaust.

[20]:
```
from IPython.display import HTML
HTML('<iframe width="1280" height="720" src="https://www.youtube.com/embed/
 ↪WvqTgRWXaDY" title="Operation Reinhard visualization" frameborder="0"␣
 ↪allow="accelerometer; autoplay; clipboard-write; encrypted-media; gyroscope;␣
 ↪picture-in-picture" allowfullscreen></iframe>')
```

[20]:
```
<IPython.core.display.HTML object>
```

2.3 Objectives

Even though multiple visualization relating to Holocaust concentration camps exist, there isn't a single one that displays the magnitude of the operation and how it evolved over time during the war. I believe that such a visualization will be much more impactful in conveying the magnitude of the Holocaust, and the deep involvement of the government in its organization and execution. Specifically, the objective of this project is to produce an animation of the evolution of Nazi concentration camps across time and space, while simultaneously providing information about their size, further details about the prisoner population, the type of work performed there, etc. The passage of time and total number murdered will also be shown for impact. Multiple variants of the animation will be produced that emphasize different aspects of the story. Finally some other static plots may added that show other aspects of the data that are add to the story.

3 Dataset

The Nazi camp dataset to be used in this work was developed by Prof. Anne Knowles and her students at Middlebury College (see [18] for the dataset itself, [16] for a description of how the dataset was curated and [14] for a publication that uses the dataset). It relied on multiple, publicly available sources of information and incorporates a number of corrections for missing or incorrect information. It is provided as a set of ArcGIS files that are can be read in Python using the pyshp module.

The database contains 1111 records, each record corresponding to a camp. A caveat of the dataset is that it only includes a subset of the 60,000 labor camps that Nazi Germany operated before and during the war [16]. However this is the most inclusive dataset on the subject that could be located. Each record has 31 fields that contain the following information (with some duplications): 1. Camp name and the name of the main camp it belonged to if it was a subcamp 2. Latitude and longitude of the camp location. 2. When the camp opened and closed. 3. The peak camp population with information about prisoner gender, ethnicity, area of origin. 4. Type of work the prisoners were engaged with both as a text description and encoded; the commercial firms that benefited from their labor, when that information is available. 5. Metadata about how the record was curated and edited.

An example record is shown below.

[36]:
```
import shapefile
sf = shapefile.Reader("SSCampDataset/SS_Camps_Definitive.dbf", encoding="latin1")
for r, f in zip(list(rec), sf.fields[1:]):
    print('{:10} = {}'.format(f[0],r))
```

```
ID         = 16-0134-0
MHG_ID     = 1304.0
SUBCAMP    = Bremen-Blumenthal [aka Bremen Deschimag, Bahrsplate]
MAIN       = Neuengamme
WOMEN      = 0.0
MEN        = 0.0
GENDER     = 0.0
FIRMS      = Krupp Company, Deschimag AG, Oberbaurat Meiners, Bremen
Wollkammerei
```

```
YYYY_OPEN  = 44
MM_OPEN    = 08
DD_OPEN    =
OPEN_TXT   = "August/September 1944"
YYYY_CLOSE = 45
MM_CLOSE   = 04
DD_CLOSE   = 09
CLOSE_TXT  = "April 9, 1945"
PRISONERS  = Some Jewish
DATE_OPEN  = 1944-08-15
DATE_CLOSE = 1945-04-09
PEAK_POP   = 929.0
FUNC_1     = 4.0
FUNC_2     = 0.0
HOW_FOUND  =
SHARE_LOC  = 1
LAT        = 53.0833
LONG       = 8.8
NATIONS    = Belgian, Polish, Russian, Ukranian, a few German
ENCY_REF   = Encylopedia of Camps and Ghettos p. 1091
LABOR      = Deployed at various work sites; some worked in Deschimag AG
shipyard
EDIT_NOTES =
FIRMABBREV = Krupp
```

Additional data that will supplement this dataset:

1. European borders at the start of World War II [19]
2. European borders during WWII, at monthly intervals [20]

4 Implementation

4.1 The decision to use Bokeh

At the start of this project the intent was to generate an animation to display the locations of concentration camps in central Europe over time, from the start of the war till its end. The goal was to display the camps as a scatter plot overlaid on a map of Europe with the points sized and colored to display some camp attributes of interest. It quickly became apparent that the data set was rich with information and even its most important elements could not easily be displayed in a single animation without making it too busy. Also, some information that would be important to engage the viewer and illustrate the cruelty of the system was captured in textual form and was not easy to display. All these elements pointed to the need for a more interactive visualization. That would have the additional benefit of engaging the user more because now she would in a sense "operate" the display as opposed to being a passive viewer. The decision was made therefore to create the visualization in Bokeh [21]. Bokeh is a Python framework that allows the creation of interactive visualizations in a browser.

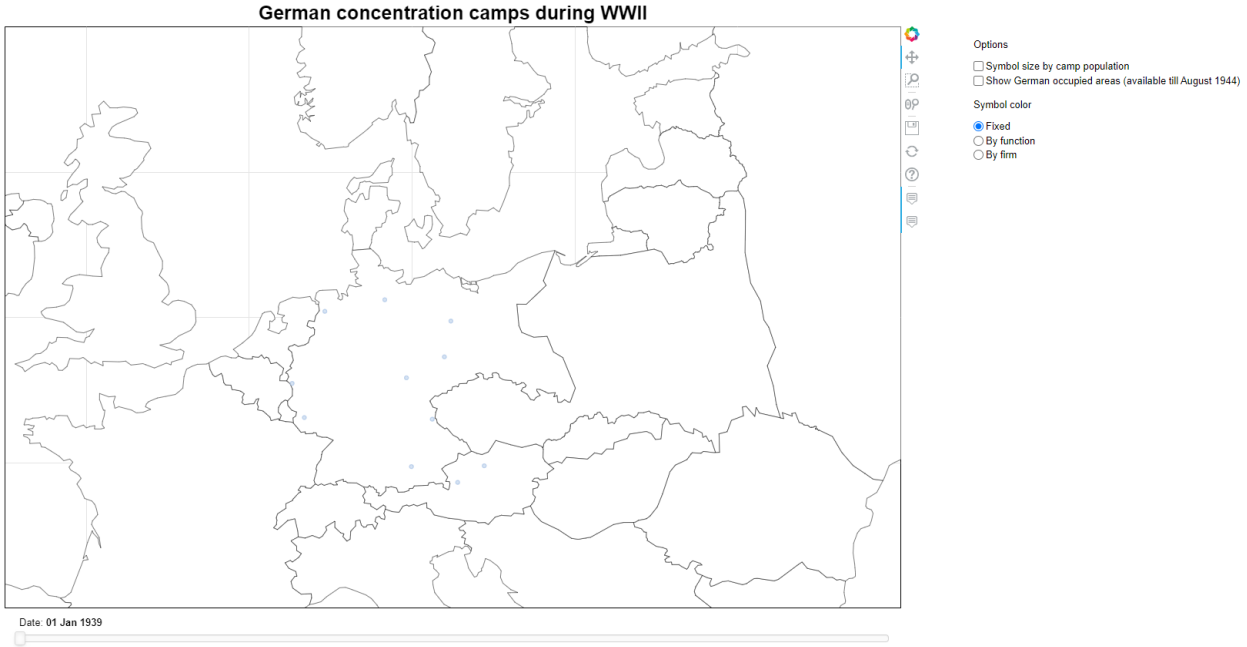
4.2 The visualization

The German concentration camp visualization is shown in the image below. This what the user would see when the visualization first loads. It shows a map of central Europe with countries boundaries as they were in 1938 [19]. The map is using two point equidistant projection [22] with the two points being $N48^oE2^o$ and $N48^oE21^o$ which is are in France just south of Paris and modern day Hungary east of Budapest. This projection was selected because the map distances from these two locations are proportional to the true distances, i.e. they minimize the length distortion of the map. The two locations were selected because they spanned the area in Europe where the concentration camps were located. Overall it appeared that this projection minimized distortions in the area of interest.

The concentration camps are shown as circles on the map. The slider below the chart sets the date and only camps that were functioning at that date are shown. Out of the 1111 camps in the database, 968 had both their date opened and closed fields populated so that is the subset from which the displayed camps are selected.

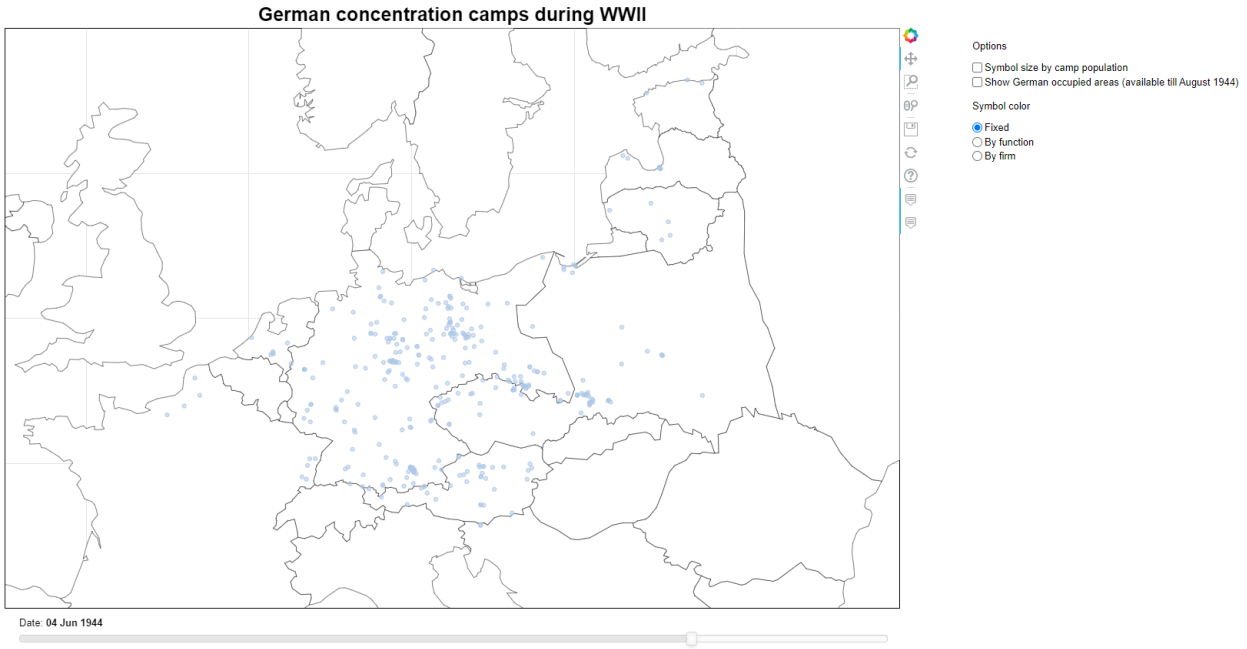
[15]:
```
Image("media/vis-start-screen.png", width=1800)
```

[15]:



Dragging the slider updates the map as can be seen in the image below which displays concentration camps later in the war. The updates are throttled so the screen refreshes on mouse up. That was necessary to prevent excessive lag since the camp database has to be queried to regenerate the view. As the viewer moves the slider to the right it becomes apparent that the number of camps increases drastically as the war progresses and continues to increase to the very end, even though Germany is losing the war. That illustrates the fact that the camps were inextricably linked with the war.

[5]:
```
Image('media/vis-basic-later.png')
```
[5]:

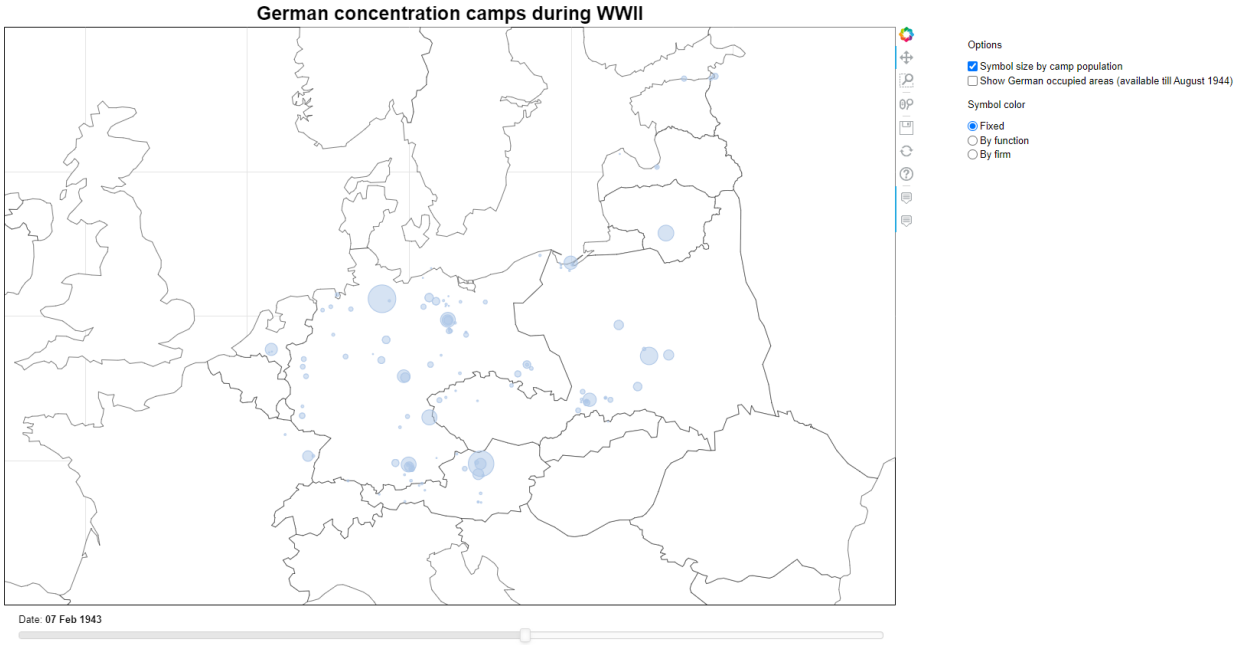


4.2.1 Options

A set of controls are available to the right of the chart that can be used to change the plot appearance and information displayed. These are described in more detail below

Camp size Selecting the "Symbol size by camp population" option sets the size of the circles proportional to the peak population of the camp. The way the camp populations changed with time is not available in the database so regardless of date slider location the peak camp size is shown. The circle radius is set to $0.15(\sqrt{P}+10)$ where P is the peak camp population. That size is in pixels. This was a compromise between making the circle area proportional to the camp population and keeping the smaller camps visible. It was not possible to find a way in Bokeh to show a legend for the circle size so the size information is displayed in a qualitative manner. However the actual size of a particular camps can be seen by hovering the mouse over them, see relevant section below.

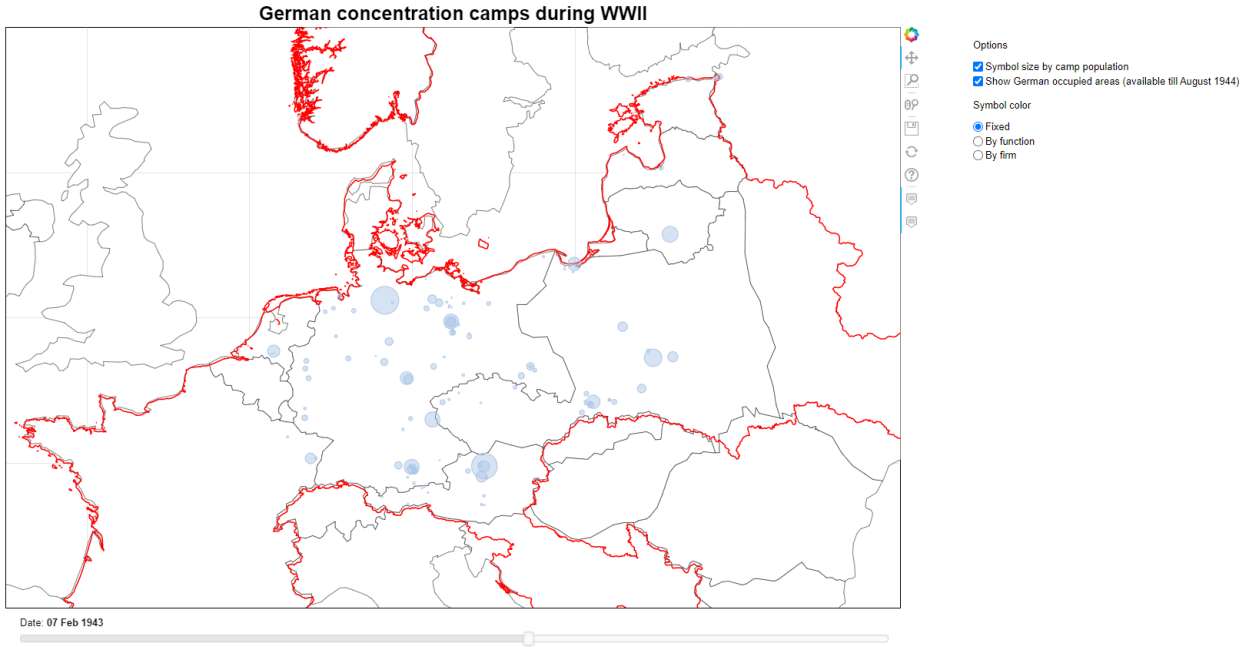
[6]:
```
Image('media/vis-show-size.png')
```
[6]:



German occupied territories An option exists to display the borders between European territory occupied by Germany at different times in the war. This was generated by combining the maps for the German mainland and countries occupied by Germany as provided in [20]. Note that even though both the 1938 maps from [19] and those in [20] where projected the same way a small misalignment exists between them that varies with location (less in the North sea coastline, more further south). The reason for the misalignment is unknown. The intent was to show that many camps were setup in the occupied territories in the East and, more dramatically, that most camps at the end of the war were closed only as the front lines reached them and they were liberated by the Allies. Unfortunately the border data in [20] after about August 1944 are not updated and even though the database ostensibly contains data till April 1945 they all appear to be duplicates of the August 1944 data. Therefore the German occupied territories are not shown after August 1944 as indicated on the plot.

[7]:
```
Image('media/vis-borders.png')
```

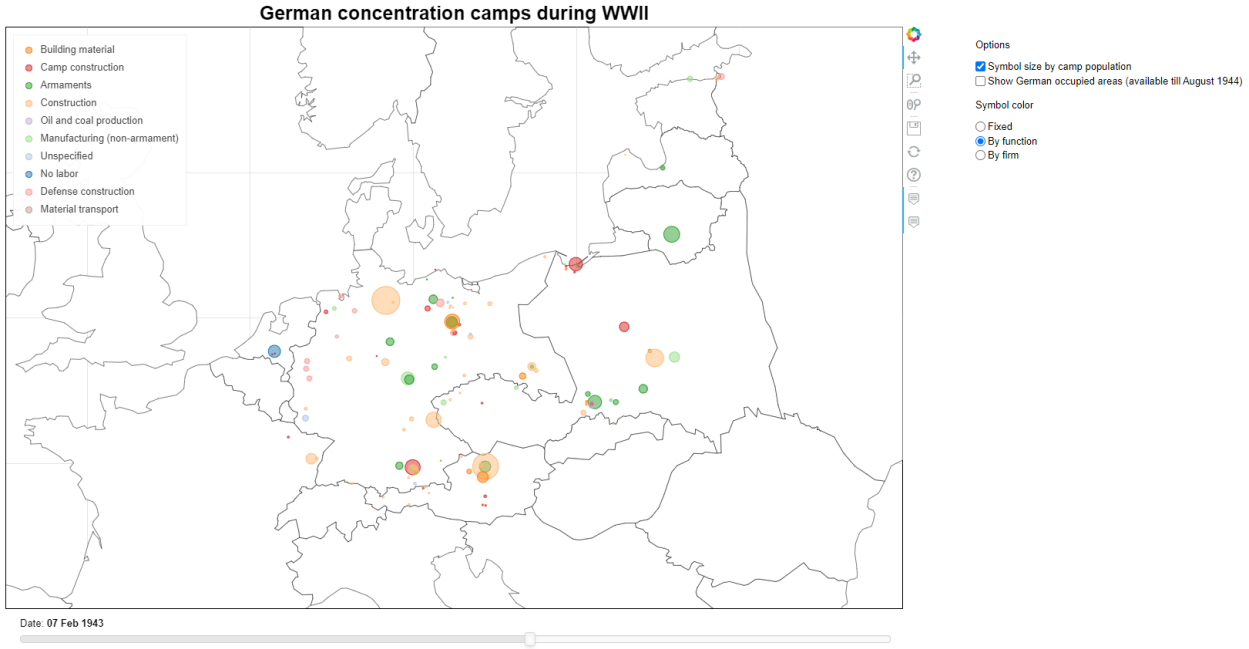
[7]:



Camp function Selecting the symbol color option "By function" colors the camps by the type of work that was done there. That illustrates that the camps essentially operated as pools of slave labor. It is striking that only a very small number of camps actually did not have a forced labor component. That also explains to the viewer why so many camps continued to operate till the very end of the war.

[8]:
```
Image('media/vis-show-function.png')
```

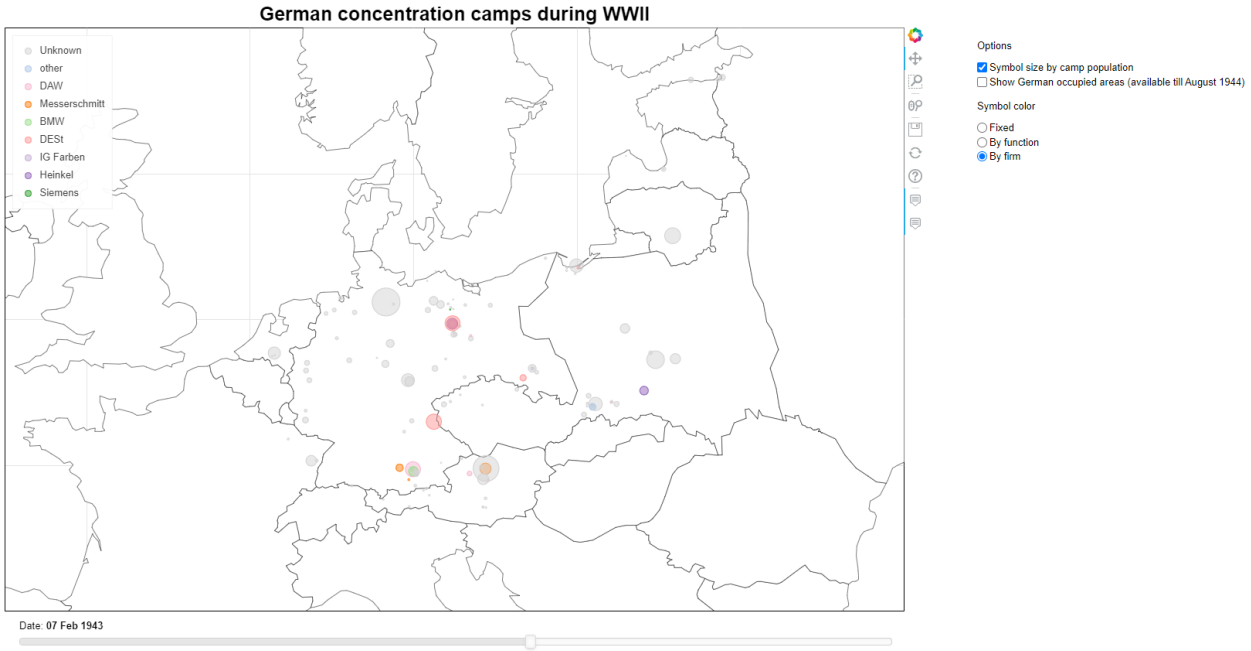
[8]:



Firms benefiting from slave labor Selecting the symbol color option "By firm" colors the camps by the industrial firms that used camp slave labor in their plants. For the majority of the camps this information is not known. However even from the small number of them for which it is know, it becomes apparent to the viewer that many, well known German firms were complicit in the Holocaust and benefited financially from the mistreatment and death of millions.

[9]:
```
Image('media/vis-show-firm.png')
```

[9]:



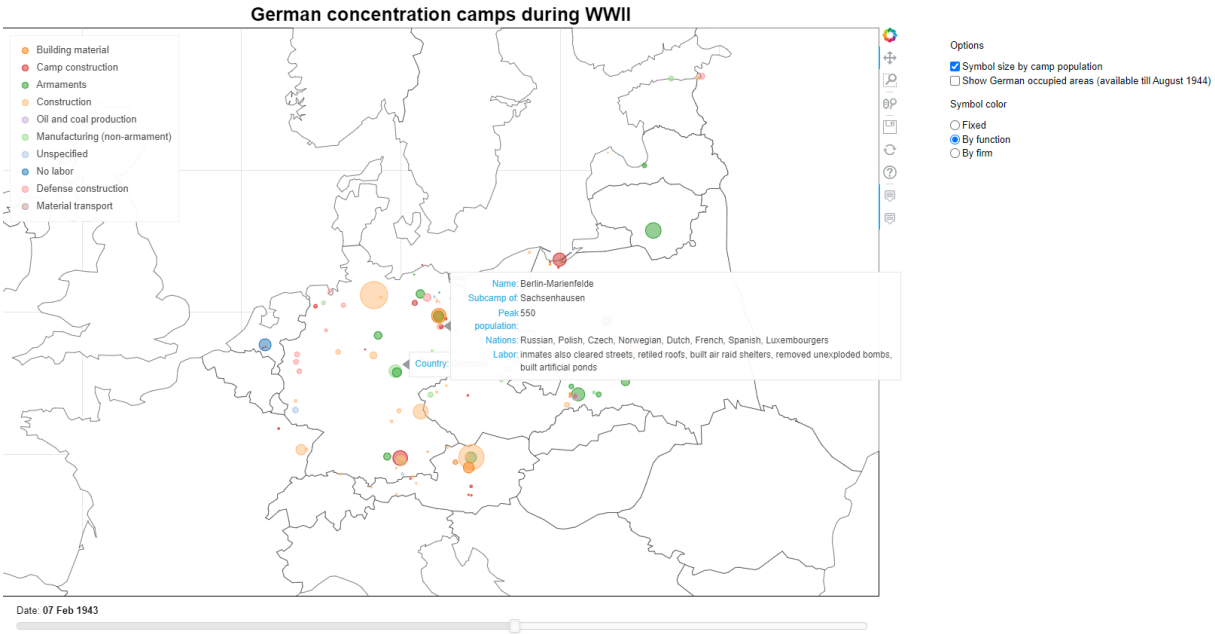
Hover information Hovering the cursor over the position of a camp opens a tooltip window that provides some additional information:

- Camp name
- The main camp to which it was a subcamp
- Peak population
- The nations from which the prisoners came
- The type of labor performed in some detail

The information is important because it makes it clear the many camps formed large complexes of subcamps requiring significant organizational skills to operate. The nationalities of the prisoners indicate that they were often transported significant distances which also points to the extensive organization needed to implement such a system. Finally the labor description provides some indications of how difficult the conditions were in the camps and the diverse set of tasks that the prisoners performed.

[10]:
```
Image('media/vis-hover.png')
```

[10]:



4.3 Discussion

An interactive visualization was put together of the Nazi concentration camp evolution during the second world war. The visualization provides the geographic location of the camps as a function of time and camp attributes such as size and, type of labor performed and what industrial entities benefited from it. The type of information and how it was shown were selected in such a way as to elucidate the magnitude of the endeavor. Bokeh proved an efficient framework with which to generate this. The complete application, excluding code that prepared the datasets for use, comprises of 230 lines of Python code. Aspects of the Bokeh framework that could have been improved:

- It does not appear possible to generate legends for scatter plots using symbol size to encode a quantity.
- In this case we have scatter plots that change with a time variable. Not all categories appear on all times. Bokeh generates a legend with only the categories showing in that instance. That has the undesirable effect of the legend entries changing as the time slider moves. It would have been useful to be able to declare the legend categories in advance and keep them unchanged. Even though it is possible to create custom legends this specific capability is not available.
- The GeoJSON data source in Bokeh is somewhat slow when the boundaries are complex, causing updates to lag significantly. That was seen here with the German border boundaries.
- The learning curve is somewhat steep and Bokeh would benefit from more extensive tutorials.

Overall however the Bokeh library allowed the creation of a fairly complex interactive visualization with a small amount of effort.

5 References

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