

Chapter 8

INTEGRATING TIME AND SPACE IN A DIGITAL-HISTORICAL ADMINISTRATIVE ATLAS

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How CAN *TIME* be integrated into digital maps? Especially in the last decade, many researchers have been trying to answer this question, but these have mostly been focusing on point mapping over time, such as the movement of individuals, transport, or other point-located objects, or they have used the *time slice method*: making a separate map for each time slice of interest, such as one separate map for each day or each year.¹ In contrast, this chapter focuses on the polygon-based mapping of countrywide administrative divisions over a long time period, with data not collected as time slices but, rather, with time and space integrated into one dataset with time as an attribute parameter. Each type of administrative units had to be both *space filling*, in the sense that every place had to be covered by one and only one of these units at a one time, but also *time filling*, in the sense that every unique place had to be covered by one and only one of these units at all times.² Furthermore the data model presented had to handle both date-precise changes as well as imprecise data, owing to the character of the historical source from, mainly, before around 1800.

The DigDag project, short for “Digital Atlas of the Danish Historical-Administrative Geography,” is by Danish standards a huge mapping project, for which the development of the method and the main data collection were completed between 2008 and 2012.³ The goal was to establish a historical database that could tie all Danish administrative districts together geographically and historically from around 1660 up till the present day. This has provided a historical-administrative geographical information system

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1 Perner, “Segregated behind the Walls”; Li et al., “The Spatial and Temporal Change of Cropland”; Doukas and Demoula, “Historical GIS (HGIS)”; Navickas, “Thirdspace?”; Lesger and van Leeuwen, “Residential Segregation from the Sixteenth to the Nineteenth Century.”

2 See www.digdag.dk (accessed January 23, 2021).

3 The following institutions participated in the DigDag project: Danish State Archives, Danish National Survey and Cadastre, Copenhagen University, the National Museum of Denmark, the University of Southern Denmark, the Royal Danish Library, and the Heritage Agency of Denmark.

platform for the digital humanities, allowing use of DigDag as an internet-based atlas,⁴ as a vector map resource for GIS, and as a search engine for use in the service functions of archives, collections, and libraries. This chapter is not primarily about the possible use cases of DigDag's data nor about the project's technical aspects, however. The overall focus lies on the methods used for registering, mapping, and publishing administrative information. How have the data been generated, and what have been the challenges, advantages, and disadvantages in doing so?

The Administrative Divisions of Denmark

The administrative divisions of any country are an extremely complex matter intrinsically, and especially when the goal is to systematically register and map not just all types of units but every single unit, its time span, its geographical changes, and its relations to other units, at a very detailed scale in both time and space over more than 350 years. This has included the mapping of some seventy types of administrative units, such as parishes, shires, counties, and municipalities, comprising in total around 25,000 administrative units, of which some existed for a short period while others have been in existence through the entire period. This large data collection and mapping project has been possible only as a result of several fortunate circumstances in Denmark's administrative structure and the presence of many highly useful sources in the country's archives.

First, written as well as cartographical historical sources concerning administrative divisions are often plentiful and concentrated in the archives in Copenhagen, rather than being scattered across regional archives. In 1660 the Kingdom of Denmark lay in ruins economically, politically, and militarily after years of warfare with Sweden. This resulted in the introduction of a strongly absolutist form of government, which was one of the most centralized in Europe at that time. In the short run, the absolutism gave the state administration—desperately in need of revenue—the power to collect land taxes from every farm and landowner, through a detailed land register, which has given us early, accurate, nationwide, and standardized knowledge on the local and regional administration. In the long run, the strong absolutism was also one of the reasons for a continuous stream of information about, and regulation of, every level of administration making its way into the national archives in Copenhagen.⁵ Centralized bureaucratic may be annoying for people, but it is worth its weight in gold for historians working on a project such as DigDag.

The second reason that DigDag was possible is the nature of “land units” or “village areas” in Denmark (Danish: *ejerlav*) and their relationship to the rest of the

⁴ Data can be used and downloaded freely at “Dataforsyningen,” SDFE (Danish Agency for Data Supply and Infrastructure), <https://dataforsyningen.dk/data>.

⁵ Løgstrup, *Enevælden og enhedsriget*.

administrative units. To understand how DigDag works it is essential to understand what land units are and how the project makes use of them. Before the land reforms that started around 1800, a land unit was the total area used for cultivation, grazing, and foresting more or less jointly for one village (an open-field system), although a land unit could also be the land under one manor farm, which typically had its own field system separate from the peasants. Single-located farms could have their own land units, or groups of single-located farms could form land units together. In all cases, land units before around 1800 constituted a geographical area that was either cultivated or used some other way more or less jointly by one or several settlements.⁵ After the land reforms and enclosure, primarily between 1785 and 1810, the land units became meaningless in an agricultural sense, since production turned from the jointly operated open-field system to one based on individual farms with completely individual plots. In an administrative sense, however, the land unit continued to exist, as the basis for the land register for taxation purposes and as the basis for the central administration of landownership. There were, and still are, around 8,000 to 9,000 land units at any given time in Denmark.⁷

The land units were, and are, with few exceptions—such as with *birk* units, described below—not demarcated by parish boundaries or by the borders of any of the other larger administrative units. Each land unit was, at any one time, with only rare exceptions, completely under one parish, under one shire, under one municipality, etc. This means that we have been able to use the land units as “building blocks” for all the other seventy or so types of units, such as parishes and municipalities. Instead of drawing the same border seventy times, we can draw it once in GIS, and afterwards define the administrative relation of the other seventy types of administrative unit in a relational database. The method is described below, but here I would like to point out that the nature of the Danish land units has allowed us to save working time, and it has made it possible to reconstruct other geographical units on the basis partly of written sources and partly of the mapping of land units.

Figure 8.1 shows an overview map from 1836 of two land units near Grenå in Jutland based on older enclosure maps, where the enclosure in Villersø village⁸ to the south took place in 1792 and in Dalstrup⁹ in 1805. With the exception of some smallholders, all the farms remained in the village core and none of the larger farms were pulled down and erected anew away from the old village, as was common practice in many villages as a result of the enclosure process in Denmark. Together, the two land units formed a parish, and neither the borders of the land units nor the borders of the parish have changed from 1660 till today. Such continuity is not unusual for the

6 Dam and Jakobsen, *Historisk Geografisk Atlas*, 54–55, 98–103.

7 Korsgaard, *Kort som kilde*, 78–87.

8 Danish Geodata Agency, “01 Villersø.”

9 Danish Geodata Agency, “Æ 09416.”

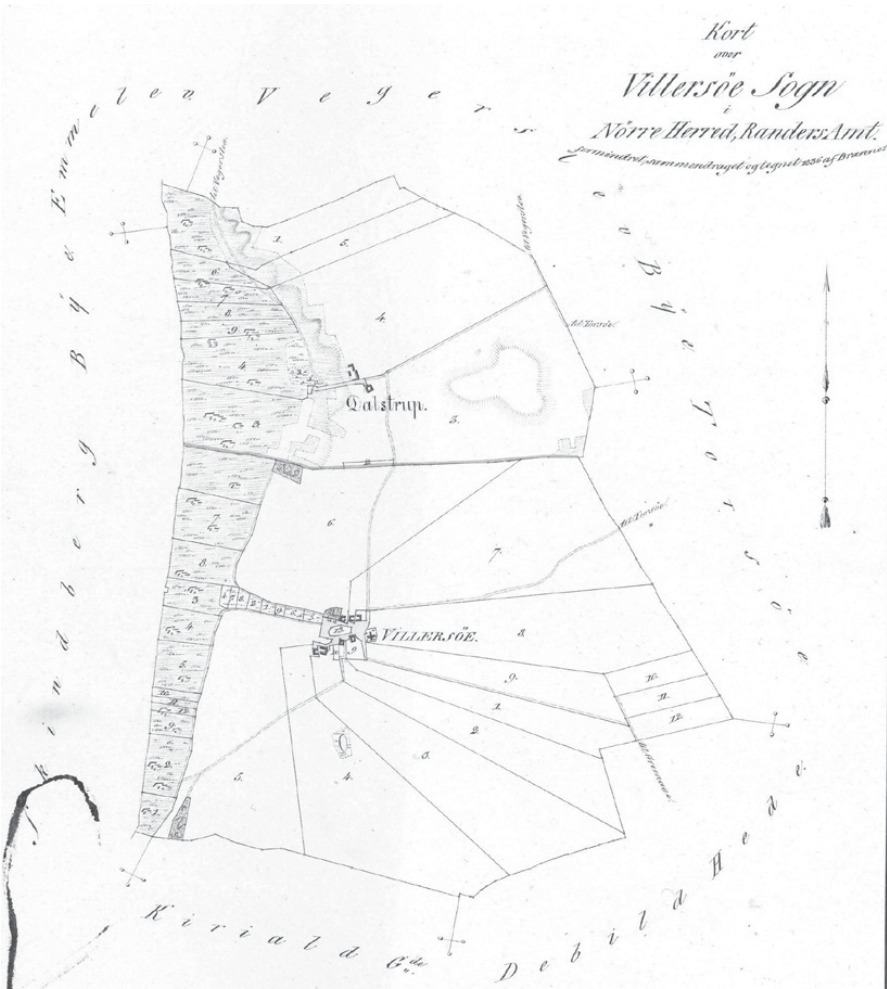


Figure 8.1. Overview map (1:20,000), 1836, based on enclosure maps and cadastral maps (1:4,000), ca. 1792–1816, showing each landowner's plot in the parish of Villerlø in eastern Jutland. The parish consisted of two land units: Dalstrup land unit in the northern part and Villerlø land unit in the south. A thick grey line shows the border between the land units. A parish in Denmark typically covered, and still covers, one to three land units.

Copyright: Danish Geodata Agency.

smaller units, especially for the land units, and this is the third circumstance behind the success of the DigDag project. Fewer than a tenth of the land units changed their geography more than three times, making the land unit a relatively stable unit type over the period since 1660, and thereby a relatively easy unit to map over time; see Figure 8.2. Some land units were more dynamic and a few have as many as thirteen different areas in the period mapped.

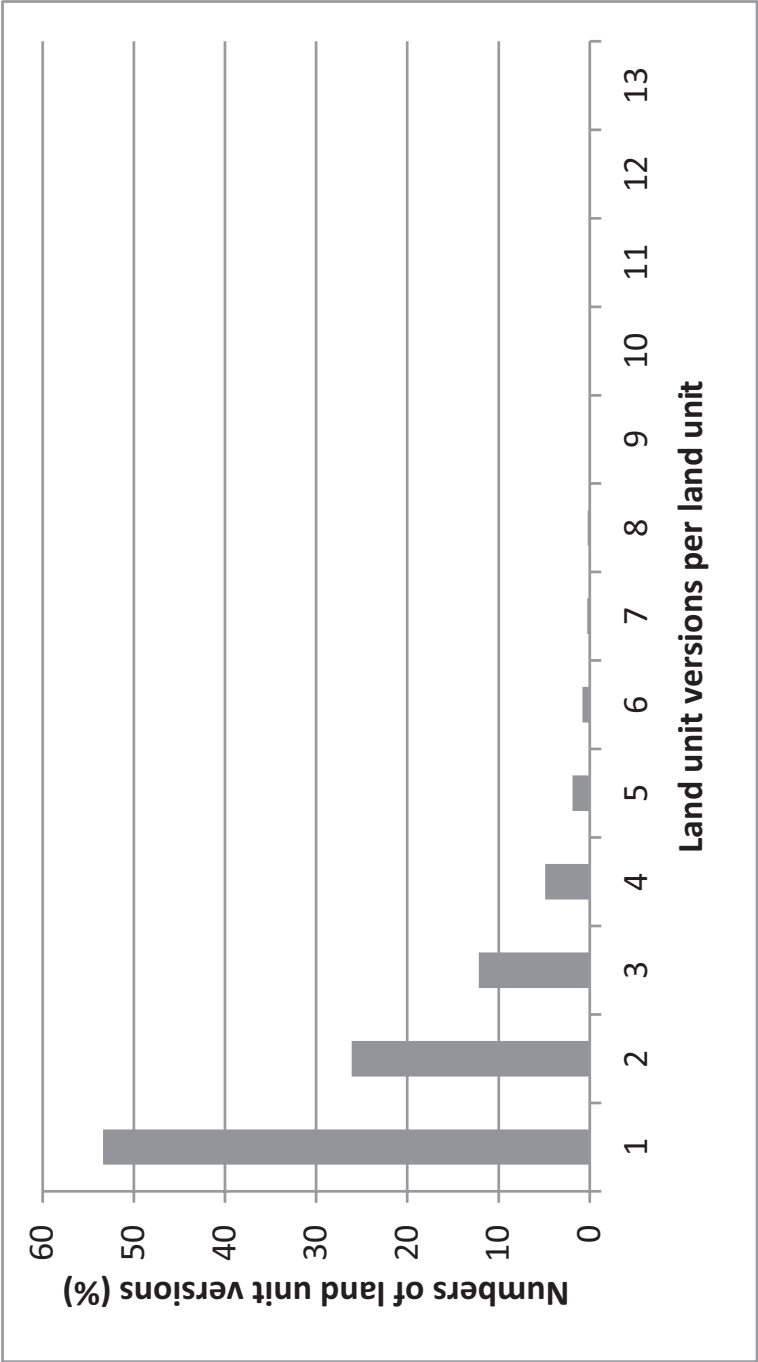


Figure 8.2. Land unit versions per land unit, 1660–2012. More than half the land units did not have any geographical changes at all, whereas the most dynamic land units covered thirteen different areas over the period. Image by Peder Dam.

Data Structure

In Figure 8.3, a generalized model of the relational GIS database is shown. Basically, the data are located in three domains. First, the “UNIT” domain can be seen as the core or the body of the database. This part of the relational database is where data concerning each administrative unit, its time span, its administrative classification, and similar information are stored. If the “UNIT” domain is the body of the database, the “GEO” domain must be seen as its legs that the “UNIT” rests on. Each administrative unit is, for a certain time span, defined geographically to cover a few or hundreds of land units. These land units are vector-mapped over time in the GIS part of the database. In a few cases, it has been necessary to use partial land units as well. Third, the “NAME” domain contains the names of administrative units and place-names in general.¹⁰

The dating of units, their geography, and their names constitute one of the most central pieces of information in DigDag. All the tabular data in the model in Figure 8.3 and all relations between them (illustrated with arrows) are dated. The dating methods of the data are described below.

This data structure and the overall method described above allow DigDag to reuse the borders of land unit (LU) polygons and thereby save working hours, enabling the project team to reconstruct administrative units on the basis of land unit mapping and written sources, as well as making it possible for users to retrieve information on geographical relations between different types of administrative unit (AU) at any given time, such as parishes and municipalities, since they are both defined geographically through land units. Hence, this data structure is exceptionally practical; furthermore, it enables the project team and the research community to make surveys not previously possible.

The first downside of the method, however, is its complexity. The description above is only a simplification of the data structure. The development process of the data model and its implementation and incorporation into the working routine have been time-consuming. The complexity also has a large impact on the visualization of the data; see “Viewing and Publishing the Data” section.

Second, there are cases when the land unit is not sufficient to map other administrative units. There are some exceptions to the general assumption that land units are not aligned with the borders of other units. In these exceptional cases, it is necessary to create extra polygons, called “partial land units.” This issue is primarily associated with larger cities, where the final map ended up being complicated, with, typically, five to ten land unit versions, and double the number—or more—of partial land unit versions in the same area.

The third and final challenge is, in principle, insoluble: how to map what is, in theory, impossible to map? Some areas were, until the enclosure, shared between different administrative units without defined borders that can be drawn on a map. This is, for example, the case with some “common areas” (Danish: *fælles overdrev*)—that is,

¹⁰ Primary: *Danmarks Stednavne, 1922–2006*, and SDFE, “SNSOR Database.”

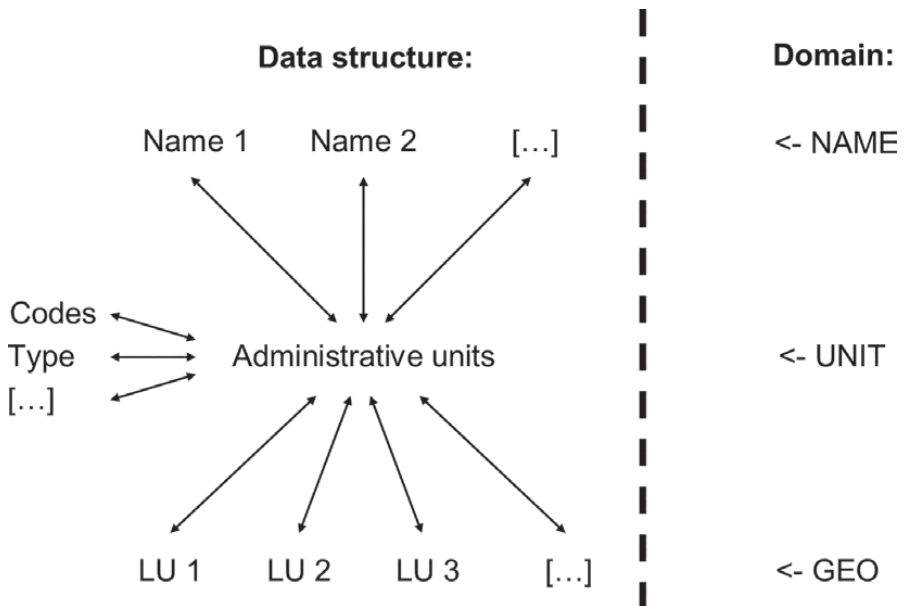


Figure 8.3. Simplified data model of the DigDag project. Text items such as “Administrative units” stand for tabular data. A range of information for these units, such as their types (parishes, municipalities, etc.) and codes, has been registered. Arrows stand for relations between tabular data. For instance, one administrative unit can have one or more name over time, and can be defined geographically over time by different land units, which are vector-mapped in the GIS database. Image by Peder Dam.

woodlands and grasslands where peasants from different parishes, or even different counties, had the right to let a number of their livestock graze, but without specifying in which part of the common area.¹¹ The common areas can with little difficulty be mapped as separate land units, but it is not possible to map the different parishes and counties without generalizing the situation. Luckily, there were very few such common areas split along parish, or other, lines in Denmark after 1660. A similar type of challenge is associated with the *birk* units, however. A *birk* is a juridical unit for tenants administered by their private or royal landowner.¹² In these cases, some farms in a village could belong to traditional juridical systems, whereas other farms in the same villages could belong to a privately administered juridical system. Before the enclosure, therefore, it is impossible to draw borders, since the land was mainly used jointly by all the farms, and the *birk* units covered a substantial part of the country in the seventeenth and eighteenth

¹¹ Fritzsbøger, *Det åbne lands kulturhistorie*, 64–67.

¹² Frandsen, *Atlas*, 2:91–98.

centuries—at times up to a quarter of the country.¹³ To put it simply, the common areas and the *birk* units were all mapped through different types of coarse generalizations, which then were commented on and described in textnotes in the database. Even so, it must be emphasized that these generalizations cover only a very small part of the database: mainly units before about 1800.

Dating of Units

The dating of units in DigDag follows database standards already partly developed by the Danish National Archives.¹⁴ For each unit there must be a “from-date,” which states when the unit first appears, and a “till-date,” stating when the unit ceases to exist. Similarly, each geographical version must have both a “from-date” and a “till-date” defining the time span for the unit having that extent.

There are three main dating types in the system. “Precise dating” is characterized by one exact date registered as “Day.Month.Year,” such as “07.04.2011.” For “interval dating,” an exact date is not known, but a “minimum”—that is, a time when it is certain the change has not happened—and a “maximum”—that is, a time when it is certain the change has happened—are known. If a unit is dated as “from = 1670–1710” and “until = 08.02.1870–23.03.1870,” the unit was founded some day between 1670 and 1710 (both years included) and ceased to exist some day between February 8 and March 23, 1870 (both dates included). Interval dating can thus consist of two years, two dates, two months, or any combination of these. In reality, a unit with a lifespan of one year represents itself an interval dating. If, according to historical sources, a unit is founded in 1660, the unit was imposed at some point between January 1, 1660, and December 31, 1660, both dates included.

Finally, “open-start” or “open-end dating” is a dating with an unknown starting date or an unknown ending date. In DigDag, this category includes units and unit versions that go back further than the mapping period, without exact knowledge of their date of establishment (typically “–1660” or “–1682”), or units and unit versions that existed 2012 and continue to exist (“2012–”). Dating of the type “from = –1660” and “until = 2012–” signifies a unit that has existed from 1660 or earlier and that still exists today. A unit characterized by “from = 1660” and “until = 2012” was founded some day in 1660 (precise date unknown) and ceased to exist some day in 2012 (precise date unknown). Examples of all three main dating types are shown in schematic form in Figure 8.4 and in tabular form in Figure 8.5.

Interval dating is the most problematic of the three methods, since it represents imprecise data for the project’s period of interest, and the project team have of course tried to minimize the use of it. But having imprecise data for some of the unit entries is unavoidable, partly because of a lack of precise historical sources, especially for

¹³ Frandsen, *Atlas*, 1:118–33.

¹⁴ Jensen, *Dateringer i DigDag*.

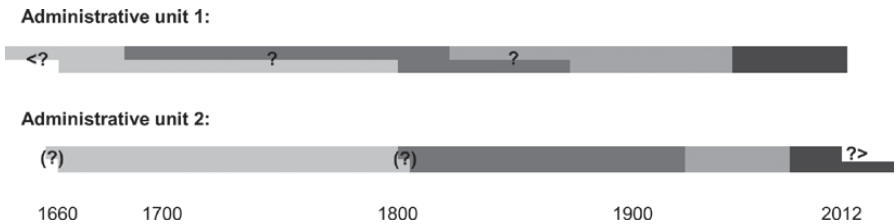


Figure 8.4. Graphical illustration of two administrative units and their four geographical versions, shown with different colours with both precise dating, interval dating (marked with two colour stripes and “?”), and “open-start”/“open-end” dating (marked with “<?” and “?>” respectively). Unit 2 is generally precisely dated; only the exact starting date in the year 1660 and the day in February 1800 when the geographical change between versions 1 and 2 occurred is unknown. Unit 1 is characterized by more imprecise dating. The starting date is known only to be before 1660, and the change between versions 1 and 2, as well as 2 and 3, is dated only as intervals (1688–1800 and 1820–July 27, 1870). See also [Figure 8.5](#). Image by Peder Dam.

Unitversion	From (text)	Until (text)
AU 1, version 1	–1660	1688–1800
AU 1, version 2	1688–1800	1820–27.07.1870
AU 1, version 3	1820–27.07.1870	01.01.1955
AU 1, version 4	01.01.1955	01.01.2012
AU 2, version 1	1660	02.1800
AU 2, version 2	02.1800	01.01.1930
AU 2, version 3	01.01.1930	25.08.1987
AU 2, version 4	25.08.1987	2012–

Figure 8.5. Dating of administrative units and their versions shown in [Figure 8.4](#). Precise dating has a white background, interval dating has a light grey background, and “open-start”/“open-end” dating has a dark grey background. Image by Peder Dam.

the oldest data, and partly because the project tried to avoid time-consuming work if that would result only in a relatively small data improvement. The latter reasoning is thereby a practical prioritization, and it is primarily accepted with land unit changes not involving other administrative units. Changes of the geographical extent of a land unit that do not involve changes in parishes or other larger units are often dated as an interval between two cadastre maps. The area affected by interval dating concerning parishes is below 0.5 percent before the enclosure, around 1800, and mostly below 0.05 percent after the enclosure; see [Figure 8.6](#).

The dating methods described allow DigDag to register data in a very flexible way, such that the database can handle precise dates as well as imprecise ones. This has been

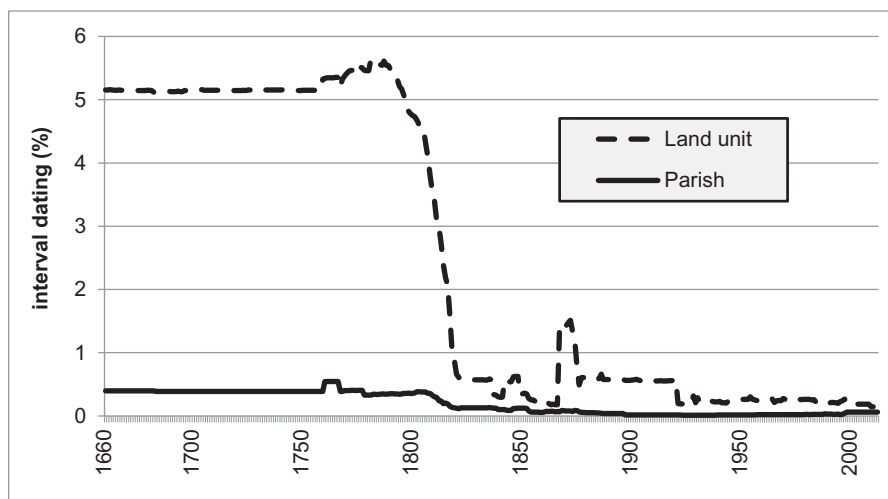


Figure 8.6. Percentages of areas affected by interval dating over time for land units (dashed line) and the parishes (solid line), 1660–2012. The graph shows the percentage of land where at a certain time it is unclear which unit the area belonged to. The use of interval dating for other unit types larger than a parish is, with a few exceptions, even more seldom than for parishes. Interval dating concerning coastal line changes, which often develop gradually and therefore are registered as intervals on the basis of the map material, are not included here.

Image by Peder Dam.

a fundamental necessity for the project, since it has, on the one hand, been a goal to register the data as accurately as possible, preferably down to exact dates, but, on the other hand, the historical sources in some cases provided only imprecise dates.

These dating methods require some training to be used properly, however. Additionally, the challenges associated with dating include considerations with respect to how imprecise dating should be best visualized online as well as exact delimitations of starting and ending dates of interval dating. Mapping datasets with imprecise dating is discussed below. As for the latter issue, the *minimum* date for a change is set at a time when it is certain the change has not occurred, and the *maximum* date is set at a time when it is certain the change has occurred. In reality, the sources and our historical knowledge often indicate that a shorter interval is the most plausible option; for the sake of firm certainty, though, it is necessary to use longer intervals. For instance, Danish land units before around 1800 dated through interval dating (see Figure 8.6) are associated with time periods of more than 100 years. There are good nationwide geographical sources from 1682, such as land registers and reconstructed maps by Karl-Erik Frandsen,¹⁵ and

¹⁵ Frandsen, *Atlas*, 1:6–47.

again from around 1800, such as enclosure maps and cadastral maps.¹⁶ In between these sources, however, there are very few cartographical or geographical data available. Many of the land unit changes can therefore be dated only to the period from around 1682 to around 1800. This long period is based on extant evidence, and thus the most certain; consequently, this is the information that has been registered in the database. It is my firm belief, however, that most of the interval-dated changes between 1682 and around 1800 happened as a result of Danish land reforms that began around 1770 but are mostly associated with the period from 1785 to 1810.¹⁷

Integration of Time into GIS Maps of Danish Land Units

Above it is clarified how dating was registered as the tabular data. In this section I focus on how this was implemented in GIS maps. In [Figure 8.7](#), seven land units and their geographical changes over time are schematically shown as different colour blocks with the time scale on the vertical, Y, axis.

The traditional way to map such units is also illustrated in [Figure 8.7](#). The mapper selects certain years, so called time slices, which are considered especially relevant for future studies, and/or certain years for which there are good and reliable historical sources to base a map on. This method was used in the latest paper atlas of Danish historical administrative divisions, published in 1984,¹⁸ in which the historical land units were mapped around 1820 based on the oldest nationwide cadastral map series, as well as being reconstructed for around 1682 on the basis of the same maps combined with detailed written sources, such as *Christian V's Land Register* (Danish: *Christian V's matrikel*) from 1682 to 1688.

There are a number of problems associated with time slices, however. First and foremost, it is not possible to determine the exact time of any geographical changes, only that it has taken place between map X and map Y. The user of such an atlas will run into problems if the person is interested in a year between the two maps or the two time slices where there are changes in their area of interest. A GIS user wishing to do a nationwide thematic map will run into numerous problems unless the user is so fortunate to be mapping the same year as the one of the time slices. Second, this method, especially if there is a need for many time slices, can be time-consuming and unpractical. Since most Danish land units have been so stable, a mapping project with many time slices would show many units with completely identical areas for different years. The traditional time slice method would therefore result in unnecessary doubling of the same data; moreover, data correction in the event of errors or data from new sources would be tedious to implement.

¹⁶ Korsgaard, *Kort som kilde*, 70–83.

¹⁷ Fritzbøger, *Det åbne lands kulturhistorie*, 108–18.

¹⁸ Frandsen, *Atlas*, vol. 1.

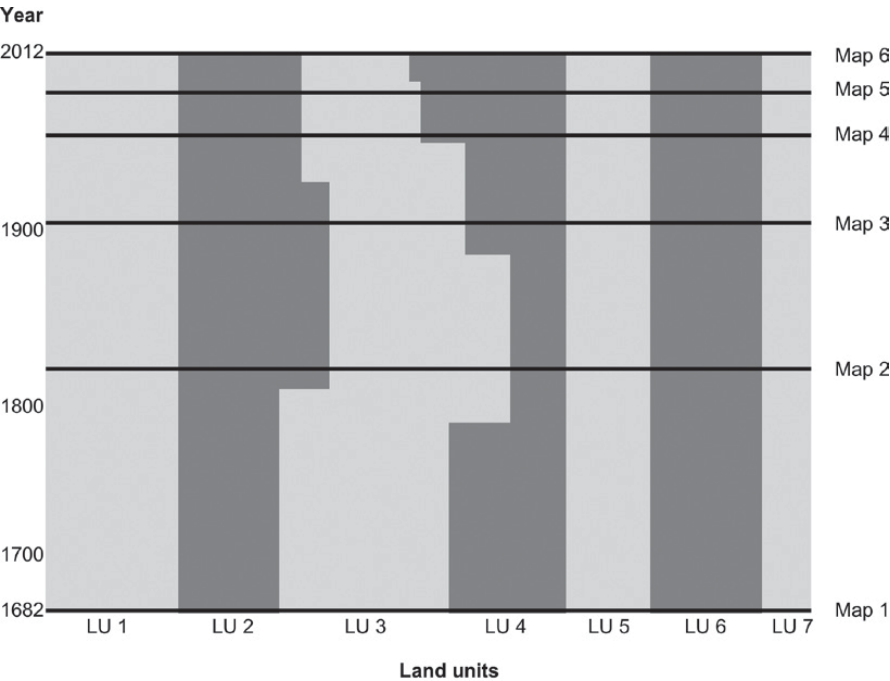


Figure 8.7. Schematic illustration of geographical changes in seven land units, 1682–2012. The figure should be read the following way: LU 1 does not change at all between 1682 and 2012; LU 2 has geographical changes in 1810 and 1930; LU 3 changes geography in 1800, 1810, 1890, 1930, 1960, and 2000; and LU 4 changes borders in 1800, 1890, 1960, and 2000. The last three land units (LUs 5 to 7) do not change during the period. The thick black lines illustrate six traditional mappings, so called time slices, in 1682, 1820, 1910, 1970, 1990, and 2012. Image by Peder Dam.

The method developed by DigDag seeks to register and map all changes, within the criteria stated, but without mapping the same unchanged area more than once. The method is based on multiple overlaying polygons with time span registration in the associated database; see Figure 8.8. If it can be found from the historical sources that land units such as LU 1, 5, 6, and 7 in the figure did not change in the period from 1682 till 2012, the modern-day polygons of the land units are simply classified as going “from = -1682” and “until = 2012-,” and the polygons themselves are not changed. For such areas there is only one polygon, and thus only one land unit version in the digital vector map. For areas where the land units changed once or more, an equally new number of polygons and land unit versions were generated, covering the historical areas and the time spans of all land unit versions registered in the database; see Figure 8.9. The result is a vector map in which some areas have one polygon and some have several.

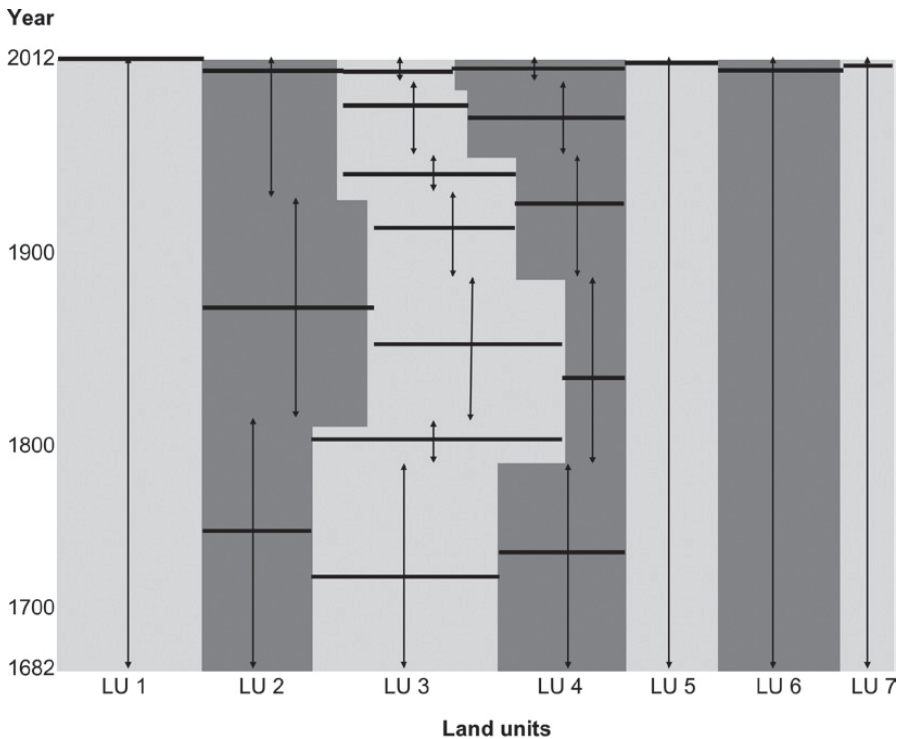


Figure 8.8. Schematic illustration of geographical changes in seven land units and the mapping method of the DigDag project, 1682–2012. One polygon (thick horizontal line) stands for each different version of each land unit with time span registration (thin vertical arrow) in the associated database. See also Figure 8.9. Image by Peder Dam.

In reality, the mapping process and the final data were all somewhat more complicated than illustrated here, but this is not of relevance for method development—with one exception. To get a more precise understanding of the method, however, it is necessary to discuss interval dating once again. Many land unit changes cannot be specified precisely. This is especially the case with changes before around 1800, when the oldest cadastral maps date from, and with border changes that involve only land units, but not parishes, municipalities, counties, or other larger administrative unit types. Changes that involved only land units are at times possible to get specified by archival studies at the National Survey and Cadastre, but it is very time-consuming and there are several thousand of such—typically minor—changes. Most of these changes are therefore only interval-dated and registered to be between two sets of historical maps.

Border changes that involve both land units and other administrative units are more relevant for a far greater number of future users. The changes are also much easier to get specified to an exact date, because of the richer and more easily accessible sources; most

Land unit	From	Till	Land unit	From	Till
LU 1, version 1	-1682	2012-	LU 4, version 1	-1682	1800
LU 2, version 1	-1682	1810	LU 4, version 2	1800	1890
LU 2, version 2	1810	1930	LU 4, version 3	1890	1960
LU 2, version 3	1930	2012-	LU 4, version 4	1960	2000
LU 3, version 1	-1682	1800	LU 4, version 5	2000	2012-
LU 3, version 2	1800	1810	LU 5, version 1	-1682	2012-
LU 3, version 3	1810	1890	LU 6, version 1	-1682	2012-
LU 3, version 4	1890	1930	LU 7, version 1	-1682	2012-
LU 3, version 5	1930	1960			
LU 3, version 6	1960	2000			
LU 3, version 7	2000	2012-			

Figure 8.9. Data underlying the DigDag mapping method in Figure 8.8, 1682–2012. Image by Peder Dam.

of these changes are therefore specified to an exact date, or at least a year. Even so, there are changes, especially in the seventeenth and the eighteenth centuries, for which it is impossible to find historical sources stating the precise date of the border change. For this reason, most types of administrative units have some instances of interval dating.

Interval dating is illustrated in Figures 8.10 and 8.11. The land unit versions are the same as in Figures 8.7 and 8.8, with one exception: the first border change between LU 3 and 4 cannot be specified more precisely than being sometime between 1700 and 1800. Although there is only one change that cannot be specified, this results in interval dating (1700–1800) in four land unit versions; the first and second versions of both LU 3 and 4.

The method described has allowed the project team to reach the goal and map every version of the land unit as far as the historical sources and present-day resources have made it possible; to map each version only once, thereby avoiding a doubling of data and the wasting of working time; and, finally, to integrate all the data into one database. The method has been proved to function successfully, at least for the described dataset.

The method is more complex than the traditional time slice method, however, with respect to both the mapping process and visualization. In some cases, sets of land units are interrelated in both space and time, which means that sets of interval dating and border changes become interrelated. If a land unit changes twice, whereby one of the changes is associated with another land unit to the west (dated 1800 to 1820) and the other with a third land unit to the east (dated 1810 to 1830), it is not possible to map their relationships unless the situation is generalized. This is due to the fact that it is not possible to establish whether the change to the west or to the east happened first or whether the changes happened at the same time. Both changes were therefore typically dated as 1800 to 1830.

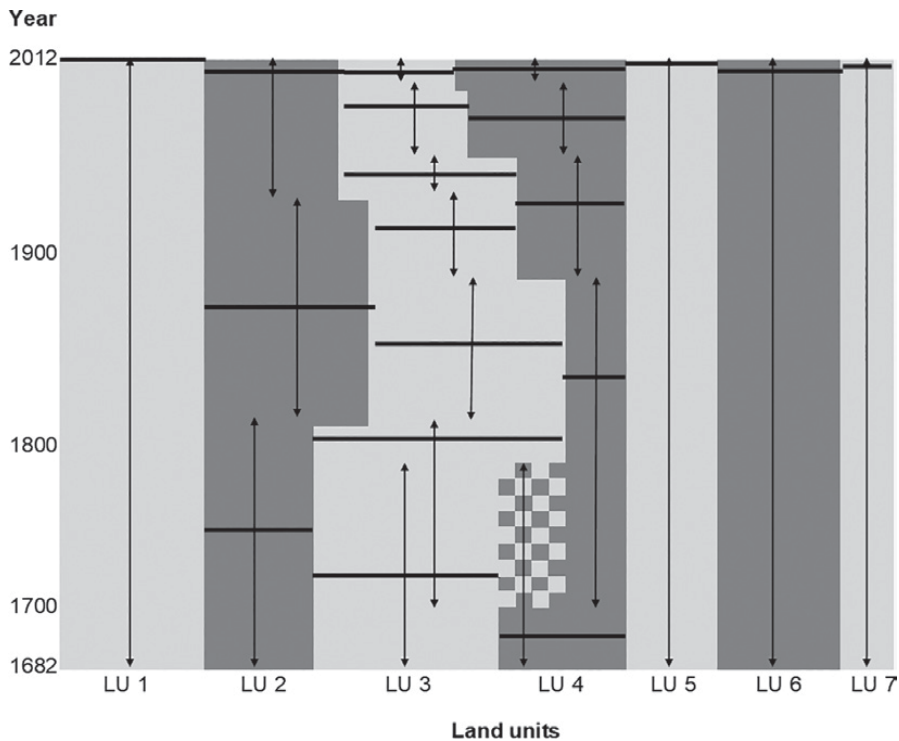


Figure 8.10. Schematic illustration of geographical changes in seven land units and the mapping method of the DigDag project, 1682–2012. One polygon (thick horizontal line) stands for each different version of each land unit and time span registration (thin vertical arrow) in the associated database. The dotted area between LUs 3 and 4 between 1700 and 1800 illustrates a change that occurred at some point in that period. See also [Figure 8.11](#). Image by Peder Dam.

Land unit	From	Till	Land unit	From	Till
LU 3, version 1	–1682	1700–1800	LU 4, version 1	–1682	1700–1800
LU 3, version 2	1700–1800	1810	LU 4, version 2	1700–1800	1890
LU 3, version 3	1810	1890	LU 4, version 3	1890	1960
LU 3, version 4	1890	1930	LU 4, version 4	1960	2000
LU 3, version 5	1930	1960	LU 4, version 5	2000	2012–
LU 3, version 6	1960	2000			
LU 3, version 7	2000	2012–			

Figure 8.11. Data underlying the DigDag mapping method in [Figure 8.10](#) for LUs 3 and 4. The other land units have the same dating as seen in [Figure 8.9](#). Image by Peder Dam.

Viewing and Publishing the Data

As described, the main priorities of data collection have been precision and quality—that is, to register the data as precisely as possible and to allow for an equally good registration of the impression in the form of interval dating. In the publishing phase, however, the priorities were set somewhat differently, since the focus lay on providing high-quality data as well as communicating complex data in a comprehensible way for a very diverse group of users of the project's website. Most users have never used geographic information system technologies, and almost none have heard of interval dating.

The data collected in the production database, as described above, are not affected by the publishing choices described below. The production database is converted into a separate database for the online platform with download functions. This customized publishing database allows the platform to function more rapidly and more effectively by means of pre-calculated polygons as well as making it possible for the project team to generalize some of the data to make them more comprehensible and easier to communicate.

The publishing database (see [Figures 8.12 to 8.14](#)) can be described as a huge mash-up of the land unit polygons and a series of relationship links between larger units and land units. Sets of polygon versions are generated for each of the some 25,000 units within the seventy or so unit types in DigDag. Some units, such as many parishes, ended

Almindeligt kort ↻

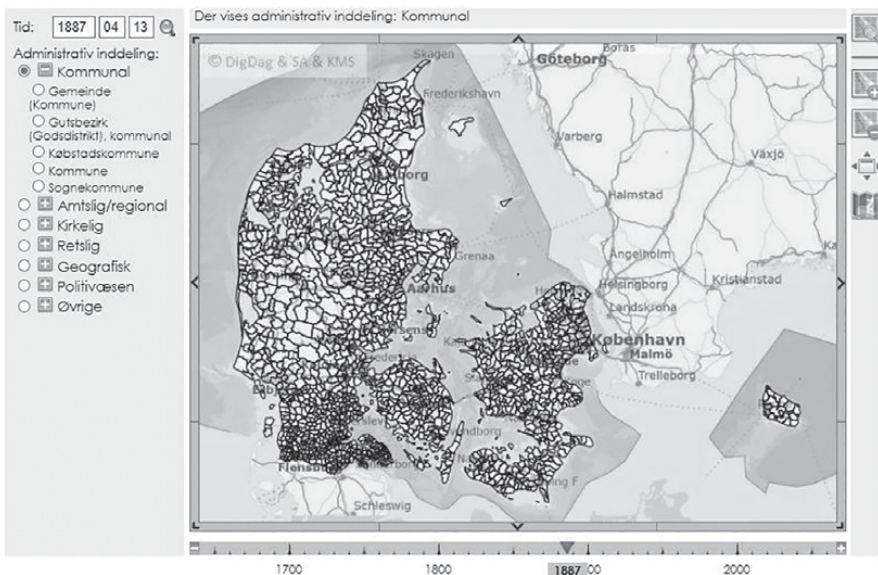


Figure 8.12. DigDag interface in which the municipalities (“Kommunal”) filter has been selected and the date April 13, 1887, chosen in the bar to the left. A year can also be chosen by using the time slider bar below the map. Image by Peder Dam.

Dobbelt kort ↻

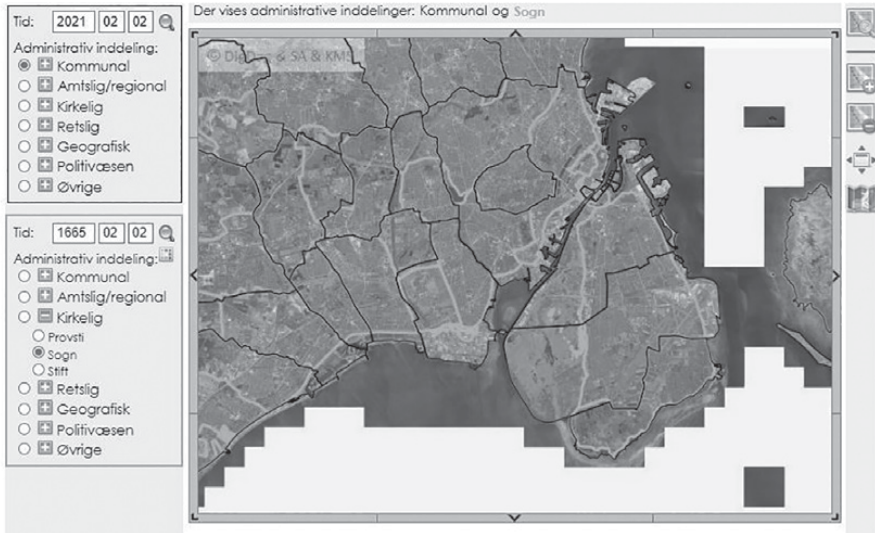


Figure 8.13. DigDag interface in which two types of administrative units in the Copenhagen area, the present-day municipalities (black lines) and the parishes, dated February 2, 1665 (dark grey lines), have been chosen. Note how many of the borders, often following smaller water streams, are identical in 1665 and 2021, whereas the coastlines have changed a lot in the period due to reclaimed land and the expanding city by the waterfront. Image by Peder Dam.

up with having only one polygon throughout the entire period from 1660 till today, whereas many of the more dynamic municipalities ended up with ten or more polygons, even though some have existed only for a couple of decades. In order to get one and only one polygon for each unit at a certain time, the publishing database operates with calculated average dates in the event of interval dating in the production database. A date of 1700–1800 in the production database is converted to “01.07.1750” in the publishing database and a date of 1850 is converted to “01.07.1850.” This enables users to choose one date and one unit type to get a map in which each area in Denmark is covered by one and only one unit. Furthermore, in case of multiple names for one unit, just one name is chosen. The publishing database is thereby a generalization of the inaccuracies and complexities of the underlying data, while the original and non-generalized data are still accessible in the production database. The publishing database is freely accessible, but the production database is an internal tool for DigDag.

Conclusion

The methods described above work. The DigDag project has succeeded in collecting large quantities of historical data despite many different types of sources and despite the complexities of administrative divisions, as well as in integrating time and space into

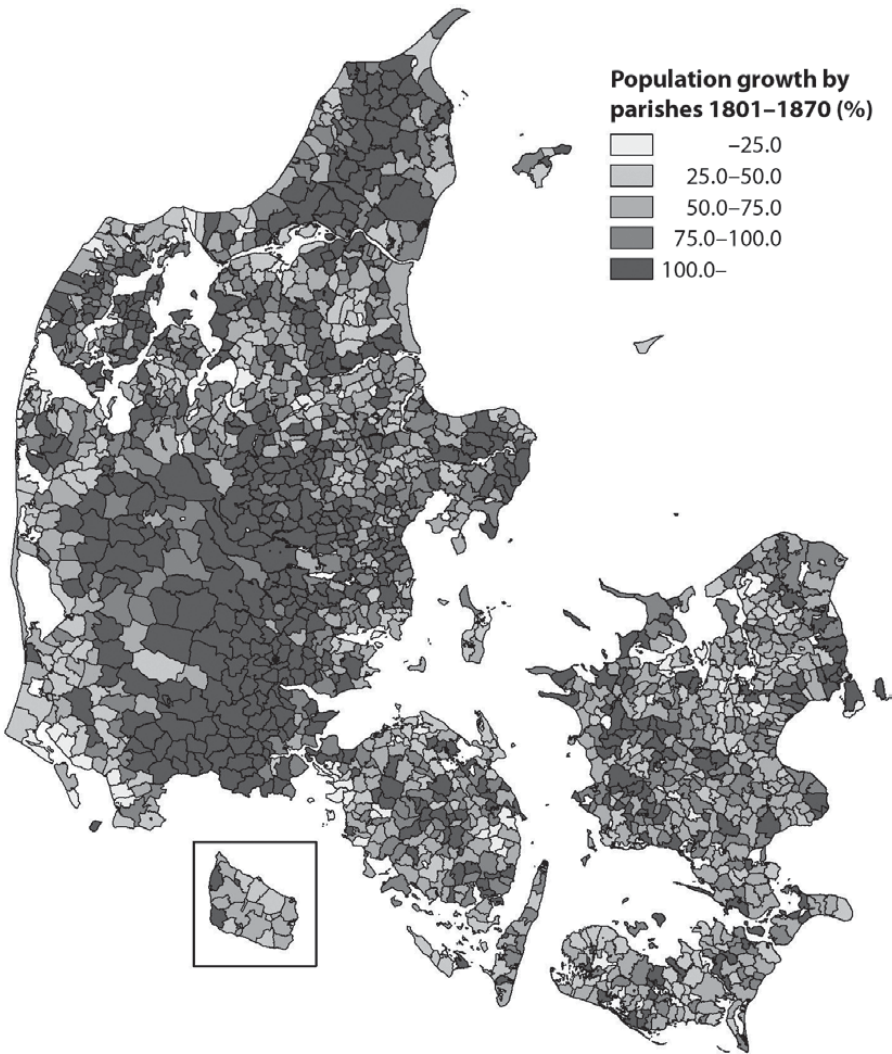


Figure 8.14. Map based on the combination of two parish maps from 1801 and 1870 showing population growth (%) per parish. DigDag data have many possibilities for the mapping of historical statistical data. Based on DigDag data and population data from Statistics Denmark. Image by Peder Dam.

one dataset. The database can handle precise and imprecise data alike, and the users of the online platform can easily access maps and datasets for both local inquiries for a given time and for countrywide mapping and analysis. The dataset has proved useful for historians, geographers, and a wide range of other scientists and administrators

working with historical administrative division. All of this would not have been possible had the methods described above not been used.

In my view, the largest disadvantage is the complexity of the methods. Since time, space, and relationships between administrative units are integrated into one dataset, one slip-up in the working process or one piece of incorrect information from historical sources can result in numerous errors in the final maps and make it difficult to locate the original error in the production database. Likewise, one error in one of the final maps can be a result of multiple inaccuracies in the original data, which then all have to be checked. This is further complicated by the diversity of source types incorporated in this project, including original cadastral maps, written sources from a 400-year period, and overview maps and registers of administrative divisions made by other historians. Each of these source types have their possible errors and problems. It has therefore been essential to have well-trained staff, and it has been necessary to run several quality controls, both visual and manual as well as automatic controls in GIS. Since time, space, and administrative relation are integrated and all data must fit in like a puzzle, there are several ways of finding errors automatically, after which these errors have to be interpreted and fixed manually.

Another challenge that the project team has worked on extensively is how much we, as researchers, should generalize complex data in order to be able to communicate the knowledge in as easily comprehensible a manner as possible to as large a group of users as possible. The distinction between the production database and the publishing database partly solved this problem. The complex production database allows research community to access both very accurate data and imprecise data, while the publishing database still allows the project team to communicate the data in a comprehensible way. Furthermore, this distinction allows for changes to and improvements of employed generalizations in the future. The original complex data have not been changed, only the use to which they are put.

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