

The Local Map of Europe: Municipal Boundary Changes, 2014-2024

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Motivation and research gap. Subnational research in Europe increasingly relies on municipalities as the unit of analysis in studies of public finance, political representation, service provision, electoral behavior, and policy performance. Yet municipal units are not temporally stable: their number, territorial configuration, and legal identifiers (names and registry codes) change, sometimes frequently and sometimes in ways that are subtle but analytically consequential. When researchers ignore these dynamics, they risk comparing non-comparable units across time, inducing measurement error in outcomes and covariates, and biasing longitudinal inference. Despite well-known waves of amalgamation and other territorial reforms, cross-national evidence remains fragmentary. The existing literature has tended to focus on single-country reforms, to emphasize one change type (especially mergers), or to treat boundary and identifier changes separately. As a result, there is limited systematic knowledge about (i) what kinds of municipal changes occur in Europe, (ii) how frequent they are across countries and years, and (iii) how to build practical tools that allow researchers and practitioners to track local units consistently over time.

Objective. This study provides a comprehensive account of municipal boundary changes across 35 European countries between 2014 and 2024 (EU and EFTA members and the constituent units of the UK). We pursue three goals. First, we conceptualize municipalities as the lowest tier of local government where self-rule is institutionally exercised: units with a clearly delineated territory, a governing apparatus, authority to make binding decisions for local residents, and some autonomy in managing local affairs. Second, building on systematic analysis of official geospatial boundary data and extensive legal verification, we develop the LoQoG typology of municipal boundary changes, distinguishing between changes to territorial boundaries and changes to legal identifiers. Third, we introduce and document the LoQoG dataset, which records all legally confirmed changes in European municipalities during the study period and provides an infrastructure for longitudinal, cross-national, and spatially explicit research designs.

Data sources and coverage. For each country and each pair of consecutive years (t and $t+1$), we collect official municipal boundary files (e.g., Shapefile, GeoJSON, GML) published by national mapping/statistical agencies or Eurostat. All files are converted into a harmonized GeoPackage format, reprojected to a common coordinate reference system (EPSG:3035, ETRS89/LAEA Europe), and uniformly encoded (UTF-8) to ensure comparability across sources and years. The resulting spatial archive provides annual snapshots of municipal boundaries that, in most countries, represent the configuration as of January 1 of each year. Because boundary changes may enter into force mid-year (e.g., Latvia's 2021 reform, some French mergers effective outside January 1), we treat temporal alignment explicitly and record cases where effective dates do not coincide with annual spatial vintages.

Methodological approach: geo-detection plus legal verification. We implement a geo-based pipeline that detects potential municipal changes from spatial data and then confirms and classifies each case using official legislative sources. The workflow consists of five building blocks. (1) Acquisition of official municipal boundary files for each year. (2) Code-based change detection: polygon comparison across t and $t+1$ identifies three signals—extinction (a polygon ceases to exist), emergence (a new polygon appears), and reconfiguration (polygons persist but their boundaries change through intersection patterns). The detection stage relies on intersection analysis, topological adjacency checks, and minimum-area thresholds to filter spurious differences and technical noise. (3) Legal verification: for every detected potential change, we identify an official legal document (laws, decrees, gazette notices) confirming the change; verify that the number of affected units and their names match both spatial files and legislative sources; and record the effective date and any staged implementation. For ambiguous cases, clarification requests can be directed to competent authorities (e.g., INSEE or public data platforms in France). (4) Historical database construction: we compile a master table that records the annual status of each municipality (unchanged, extinct, newly created, reconfigured) and assigns an internal LoQoG identifier to track territorial configurations over time. (5) GIS integration: each polygon is tagged with internal identifiers, enabling direct use in GIS and reproducible linkage to municipal-level statistics.

The LoQoG typology of municipal boundary changes. A central contribution is a typology that provides standardized concepts and operational definitions for municipal change events. Following prior work distinguishing geographic from non-geographic changes, we classify changes by the relational mapping between municipal units at t and their transformed state at $t+1$, and by whether municipalities are created and/or ceased to exist. We identify ten principal categories of boundary change and sixteen subcategories.

Boundary changes fall into four outcome groups. (A) Both municipalities cease to exist and municipalities are created: **merger** (two or more municipalities unite into a new municipality), **split** (one municipality is divided into two or more new municipalities, none retaining the original legal identity), and **composite restructuring** (simultaneous dissolution, merger, and/or territorial transfers that reorganize a whole area, often in large-scale reforms). (B) Municipalities are created but none cease to exist: **de-merger** (re-establishment of municipalities previously absorbed in a merger, fully reversing its territorial effects), **separation/secession** (a new municipality is formed from part of an existing municipality that continues to exist), and **unincorporated area formation** (a new municipality is formed from territory previously outside municipal organization, such as military training areas). (C) Municipalities cease to exist but none are created: **dissolution** (a municipality ceases to exist and its territory is redistributed among existing municipalities). (D) Neither municipalities cease to exist nor are created: **unincorporated area integration** (non-municipal territory is incorporated into existing municipalities), **territorial transfer** (one-way transfer of territory between municipalities), and **territorial exchange** (mutual exchange of territory). For transfers and exchanges we additionally distinguish national versus international cases (across neighboring countries).

Identifier changes. The geo-based approach also detects cases where municipal boundaries remain constant but legal identifiers change. We classify three types: **name change**, **ID change**, and **simultaneous name and ID change**. These modifications matter because many statistical systems and research datasets key municipalities by names and/or registry codes that may change independently of territory. Conversely, a registry code may persist through a territorial transformation,

creating the appearance of continuity when the underlying unit has changed.

Boundary-identifier interactions and the measurement problem. The intersection of territorial and identifier changes is a primary source of longitudinal inconsistency. In newly formed municipalities (especially mergers), we observe recurring name/ID configurations: (a) new name with new ID; (b) new name with inherited ID; (c) inherited name with new ID; and (d) inherited name with inherited ID. These patterns shape how municipal-level statistics are reported and interpreted. When a newly formed unit inherits a pre-existing code, time-series data keyed on that code can conflate administrative restructuring with substantive change. We illustrate the issue with two examples. In France, the 2019 merger creating Les Hauts-Talican inherited the ID of one constituent commune (Beaumont-les-Nonains), causing election results and other municipal statistics keyed by the inherited code to refer to a different territorial entity in 2019 than in 2014 or 2024; when Beaumont-les-Nonains was later re-established, the same code again referred to the pre-merger unit. In Italy, population statistics show large apparent jumps (e.g., for San Michele all'Adige) driven by merger-driven territorial consolidation and code inheritance rather than demographic growth. These examples demonstrate why a boundary-aware identifier system is necessary for valid longitudinal inference.

Empirical overview of municipal change in Europe (2014-2024). The descriptive evidence indicates notable dynamism even within Europe's highly institutionalized administrative landscape. Across the 35 countries, the total number of municipalities decreased by approximately 4% over the study period. The distribution of change events is highly uneven. France accounts for the largest number of boundary change cases (hundreds of events, primarily mergers), followed by Austria and Germany. Several countries experienced no municipal boundary changes during the observation window (e.g., Croatia, Liechtenstein, Malta, Romania, Slovakia, and some UK constituent units), underscoring that stability is heterogeneous and should not be assumed. Across all countries, mergers are the most common change type, followed by territorial transfers and territorial exchanges. Complex and rare categories (e.g., de-mergers, unincorporated area formation) occur in only a small number of country contexts, but are nevertheless important for comprehensive tracking and for avoiding misclassification.

The LoQoG dataset and identifier infrastructure. The LoQoG dataset operationalizes the typology and verification results into a reusable research infrastructure. It provides (i) a boundary-aware internal identifier (LoQoG ID) that captures territorial configurations over time, (ii) a change-event identifier (Case ID) that groups all municipalities involved in a legally confirmed change and encodes country, change type, internal case number, and the pre/post years (e.g., "fr-m-34-2015-2016"), and (iii) harmonized geospatial layers that allow users to map and analyze municipal evolution in GIS. This design supports multiple use cases: validating whether a researcher's municipal panel is truly geographically consistent; reconstructing pre-merger entities from post-merger units; aligning electoral, fiscal, and socio-economic statistics to stable geographic frameworks; and enabling transparent documentation of discontinuities in time series.

Implications for research design and official statistics. The study highlights limitations of common ad hoc solutions: restricting samples to stable municipalities or choosing time windows without reforms can reduce external validity, induce selection bias (by excluding restructured areas), and foreclose studying reform effects. Instead, boundary-aware tracking enables analysts to (1) correctly interpret discontinuities, (2) perform robustness checks that account for administrative change, and

(3) construct harmonized panels where geographic units are explicitly stabilized. Beyond academia, the LoQoG approach can inform statistical agencies' dissemination practices by providing a complementary layer of boundary-sensitive identifiers or flags. Such additions would help users distinguish genuine socio-demographic change from administrative reorganization and improve interoperability across datasets.

Limitations and future extensions. The geo-first approach may miss legally relevant changes that do not produce detectable spatial differences in annual boundary files, and annual vintages may misrepresent mid-year changes. Spatial resolution differences across years may generate false positives, which we address via legal verification. The 2014-2024 period offers a decade-long window suitable for typology development but is subject to a one-year observation lag inherent in annual spatial snapshots; changes decided in 2024 may only appear in 2025 files and fall outside the current scope. Future work can extend the pipeline temporally (continuous updating), geographically (beyond Europe where official geospatial and legal sources are available), and vertically (tracking boundary changes at higher administrative tiers). Integrating LoQoG-style identifiers into broader statistical infrastructure could further improve the quality, transparency, and reproducibility of subnational research.

Conclusion. Municipal boundary and identifier changes are a pervasive but under-documented feature of European local governance with direct consequences for longitudinal analysis. By combining algorithmic geospatial detection with systematic legal verification, developing a comprehensive typology, and releasing an integrated dataset and GIS-ready layers, this study provides both conceptual clarity and practical infrastructure for tracking municipalities consistently over time. The LoQoG project offers a corrective lens for interpreting local statistics, reduces the risk of biased inference, and opens new opportunities for comparative research on the causes and consequences of territorial restructuring.