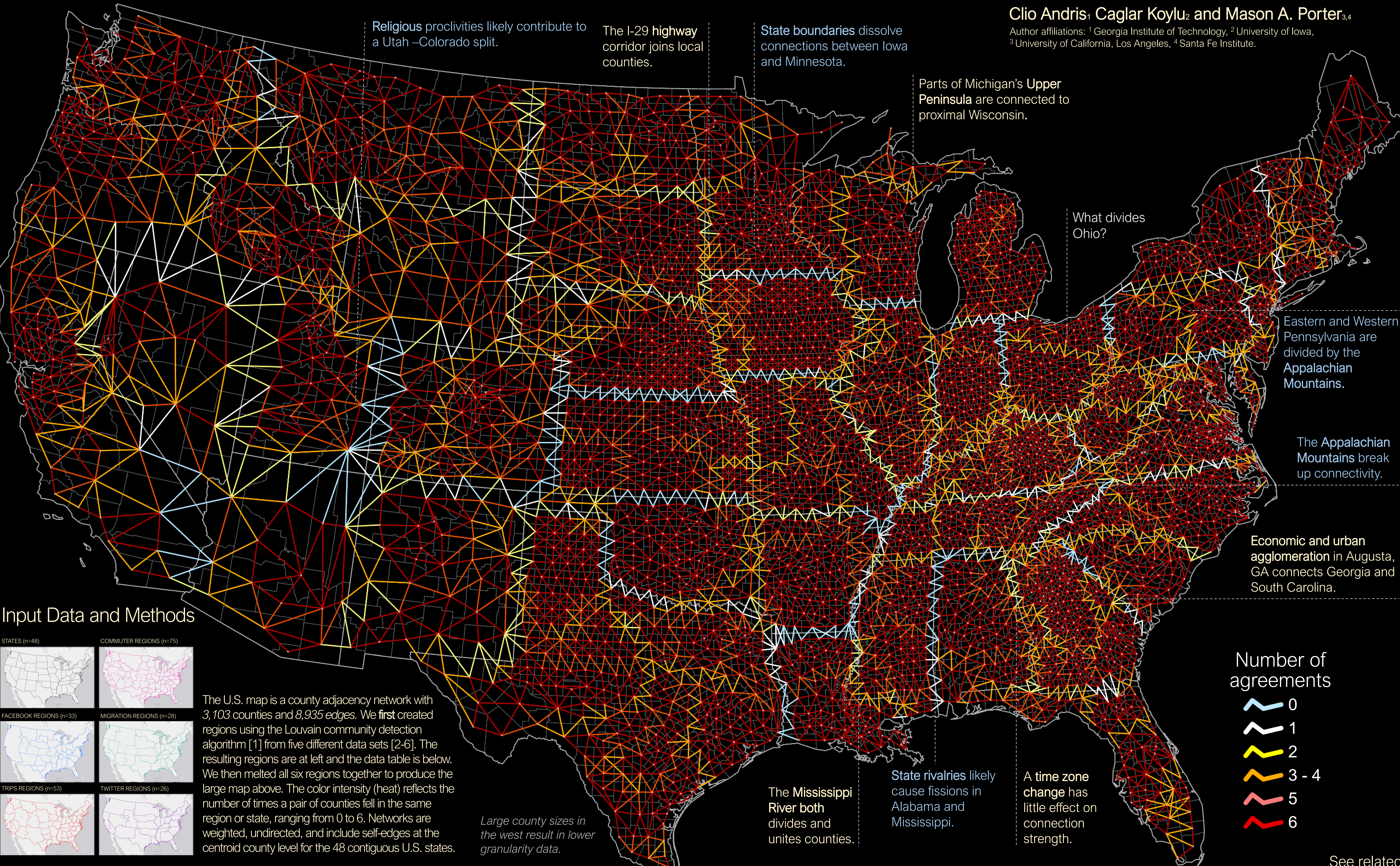


# Visualizing Large Multiplex Geographic Network Data using a Regionalization Approach

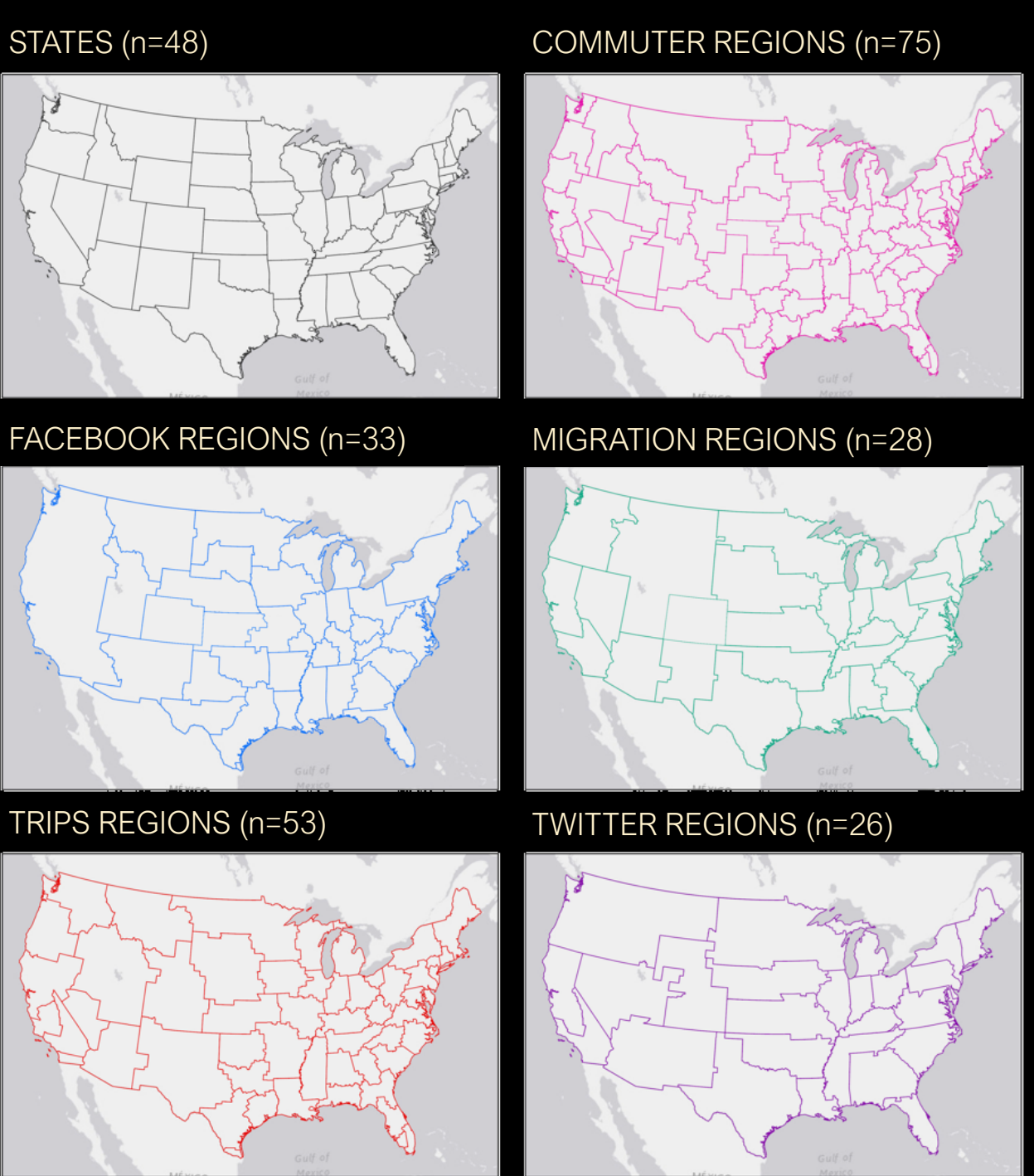
A geovisual analytic method for distilling billions of connections using network modularity and a network of 19,673,740,000 county-to-county weights.

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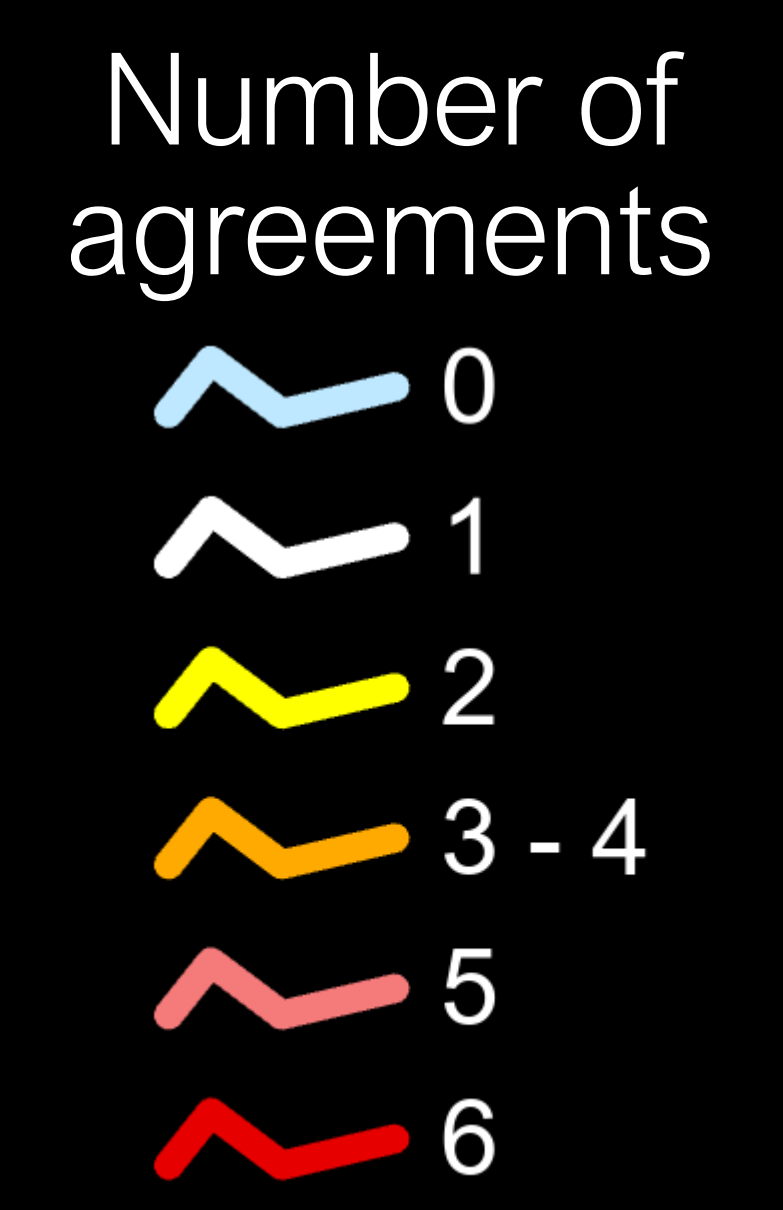


## Input Data and Methods



The U.S. map is a county adjacency network with 3,103 counties and 8,935 edges. We first created regions using the Louvain community detection algorithm [1] from five different data sets [2-6]. The resulting regions are at left and the data table is below. We then melted all six regions together to produce the large map above. The color intensity (heat) reflects the number of times a pair of counties fell in the same region or state, ranging from 0 to 6. Networks are weighted, undirected, and include self-edges at the centroid county level for the 48 contiguous U.S. states.

Large county sizes in the west result in lower granularity data.



Network Connections	Time period	Edges (e)	Total Edge Weights
Commutes (U.S. Census, LEHD-LODES)	2015	105,702	142,470,000
Facebook Friends (Social Connectivity Index (SCI))	Undisclosed	4,812,753	16,812,800,000
Migrants (U.S. Census, American Community Survey)	2013-2017	213,059	43,880,000
GPS-based Trips (SafeGraph, Inc.)	Jan + Feb 2020	2,126,578	2,669,200,000
Twitter Ties (Co-mentions from the Twitter API)	2014-2015	267,712	5,390,000
Same State (U.S. Census)	2018	9,120	N/A

### REFERENCES

- [1] Blondel, V. D., Guillaume, J. L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *J Statistical Mechanics: Theory and Experiment*, 2008(10), P10008.a.
- [2] M. Bailey, R. Cao, T. Kuchler, J. Stroebel, and A. Wong. Social connectedness: Measurement, determinants, and effects. *J Economic Perspectives*, 32(3):259-280, 2018.
- [3] SafeGraph. COVID-19 Data Consortium, 2020. Available at <https://www.safegraph.com/academics>. Two months: Jan-Feb 2020.
- [4] U.S. Census Bureau. 2013-2017 American Community Survey Migration/Geographic Mobility Data, 2020.
- [5] Twitter, Inc. Twitter Streaming API, 2021. Available at <https://developer.twitter.com/en/products/twitter-api>.
- [6] U.S. Census Bureau. Longitudinal Household Employer Dynamics LEHD-LODES Residence-Workplace Characteristics, 2020.
- [7] Shapefiles come from ESRI and the U.S. Census. All analysis was conducted in R Studio and Esri ArcMap.

Related paper: Andris, C., Koylu, C., and Porter, M.A. (2023). Human-network regions as effective geographic units for disease mitigation. *EPJ Data Science*, 12(1). MAP acknowledges support from the National Science Foundation (grant DMS-2027438) through the RAPID program. CA acknowledges support from the National Science Foundation (grant SBE-2045271).

See related paper here.

