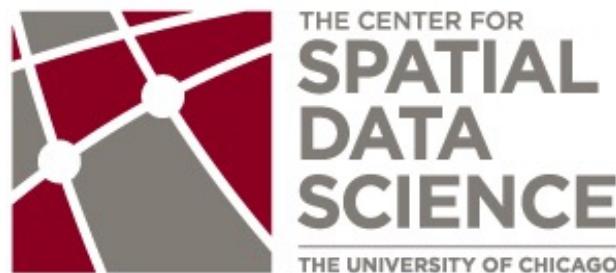


Origin-Destination Flows

Luc Anselin



<http://spatial.uchicago.edu>

concepts and examples

visualization

exploration



Concepts and Examples



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- Flow Data

- origin-destination flow matrix

- $n \times n$ or $n \times m$ table

- origin and destination points

- aggregate to zonal totals (origin, destination, flow)

- trajectories



- **Flow Characteristics**

- characteristics of origins and destinations

- push and pull factors as cross-sectional data

- characteristics of flows = $n \times m$ table

- distance decay

- possibility of intra-region flows



<i>i/j</i>	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	RM	
I	184217	4640	1404	2078	3552	487	568	1680	420	528	79	122	8904	208679
II	5460	229630	3258	5081	2770	529	571	1604	387	513	75	143	8229	258250
III	1301	3703	123291	5078	1626	351	217	379	126	179	42	43	3408	139744
IV	2788	6337	5995	282952	4055	586	372	601	226	391	74	96	7947	312420
V	3919	2726	2342	3423	797336	2591	1663	5878	1134	2580	378	2887	28439	855296
VI	494	616	543	765	3318	403591	3169	2182	800	927	103	617	19727	436852
VII	616	528	439	492	2546	4205	491351	5383	1489	1223	129	1264	25704	535369
VIII	1705	1490	786	834	7294	3611	4598	1032149	7988	4171	694	2182	40074	1107576
IX	521	449	318	297	1596	2447	1410	7289	435078	5742	349	367	23703	479566
X	679	544	358	468	2912	1321	1441	4134	6992	548567	2223	3177	21043	593859
XI	90	52	45	89	319	128	213	574	620	1984	40939	252	1535	46840
XII	263	220	81	147	3270	395	435	2040	755	2504	174	76945	4455	91684
RM	10302	7392	4180	7480	27011	14209	12588	19064	12028	13877	1763	3096	3079528	3212518
	212355	258327	143040	309184	857605	434451	518596	1082957	468043	583186	47022	91191	3272696	8278653

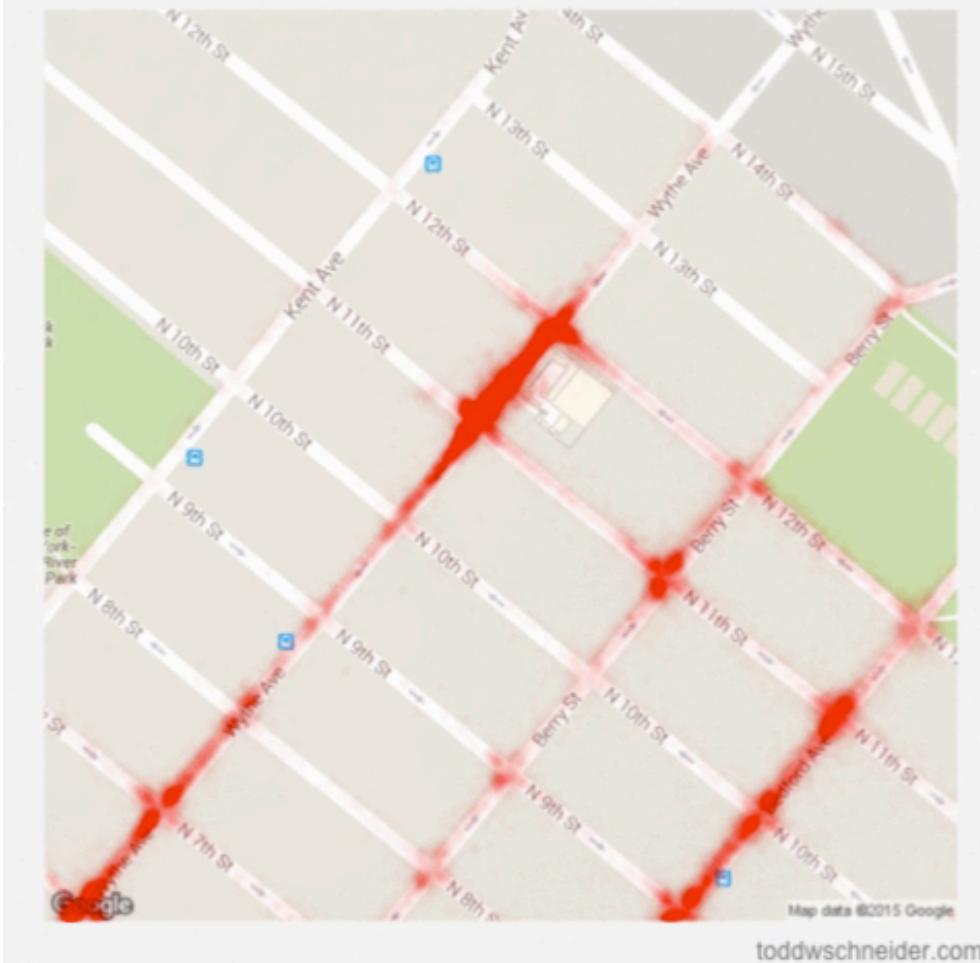
migration flow table



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1st Half 2013

Taxi pickups in Northside Williamsburg



origin points



New York City Taxi Pickups

2009–2015



toddwschneider.com

New York City Taxi Drop Offs

2009–2015

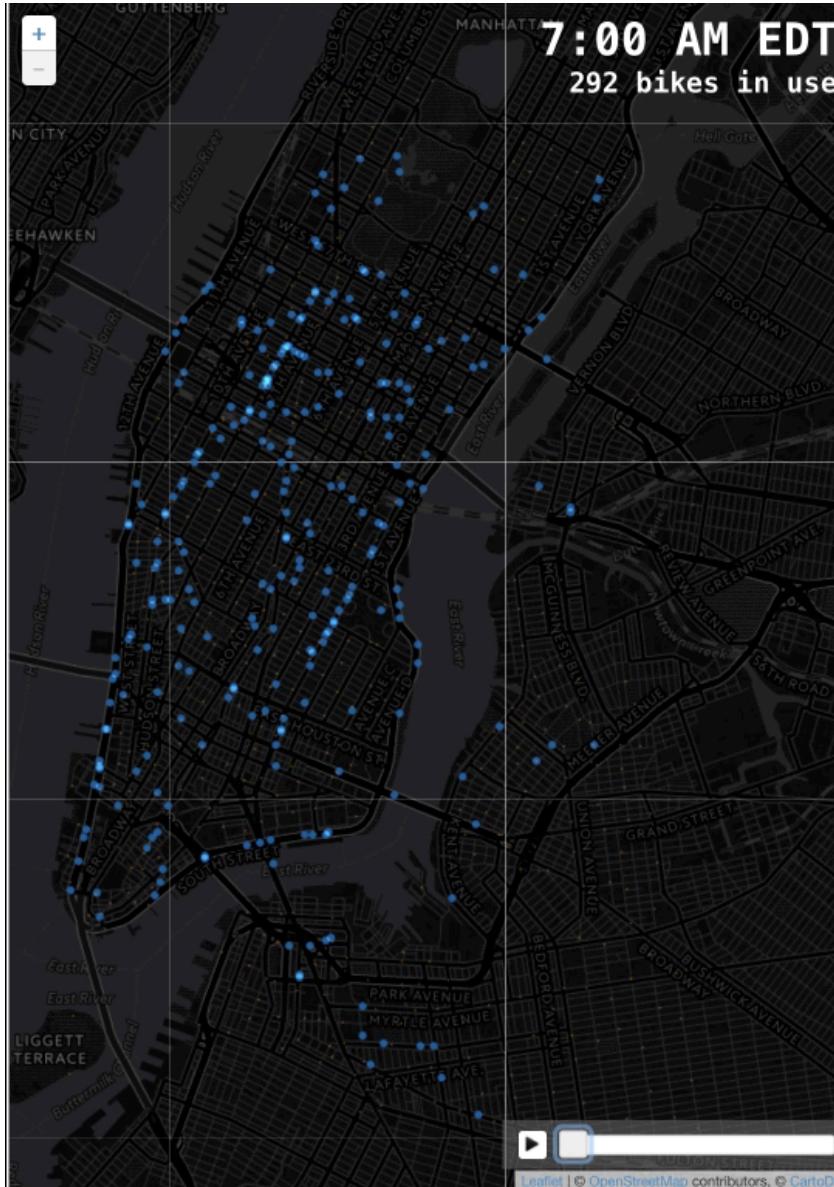


toddwschneider.com

origin and destination totals



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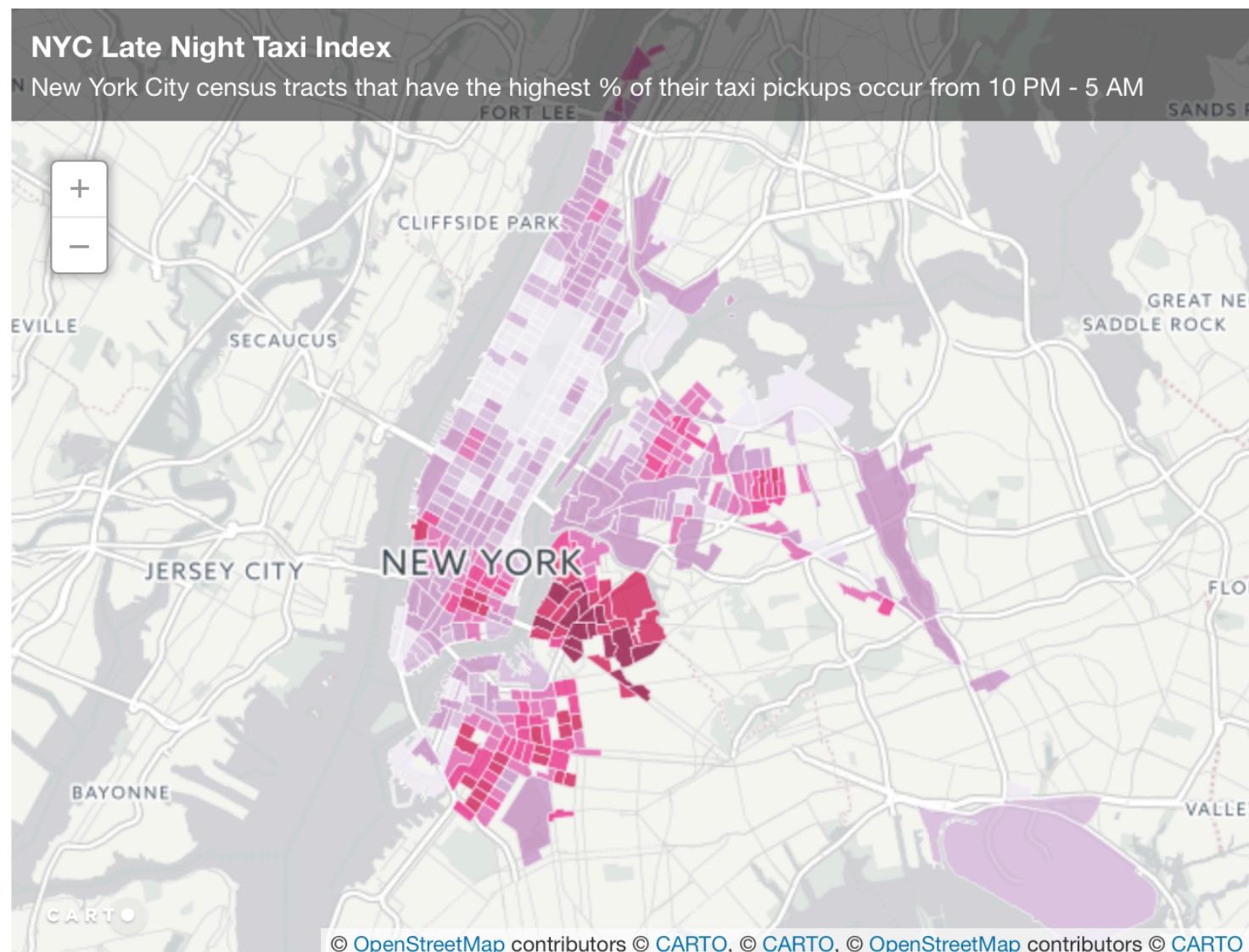


origin to destination flows (trajectories)



NYC Late Night Taxi Index

New York City census tracts that have the highest % of their taxi pickups occur from 10 PM - 5 AM



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Map created by  [toddwschneider](#)



flows by origin totals



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- Exploring Flow Data

- detection of dominant flows

- detection of zero flows

- detection of similar flows



- Characteristics of Flows

O-D characteristics and flows
distance and flows



Visualization



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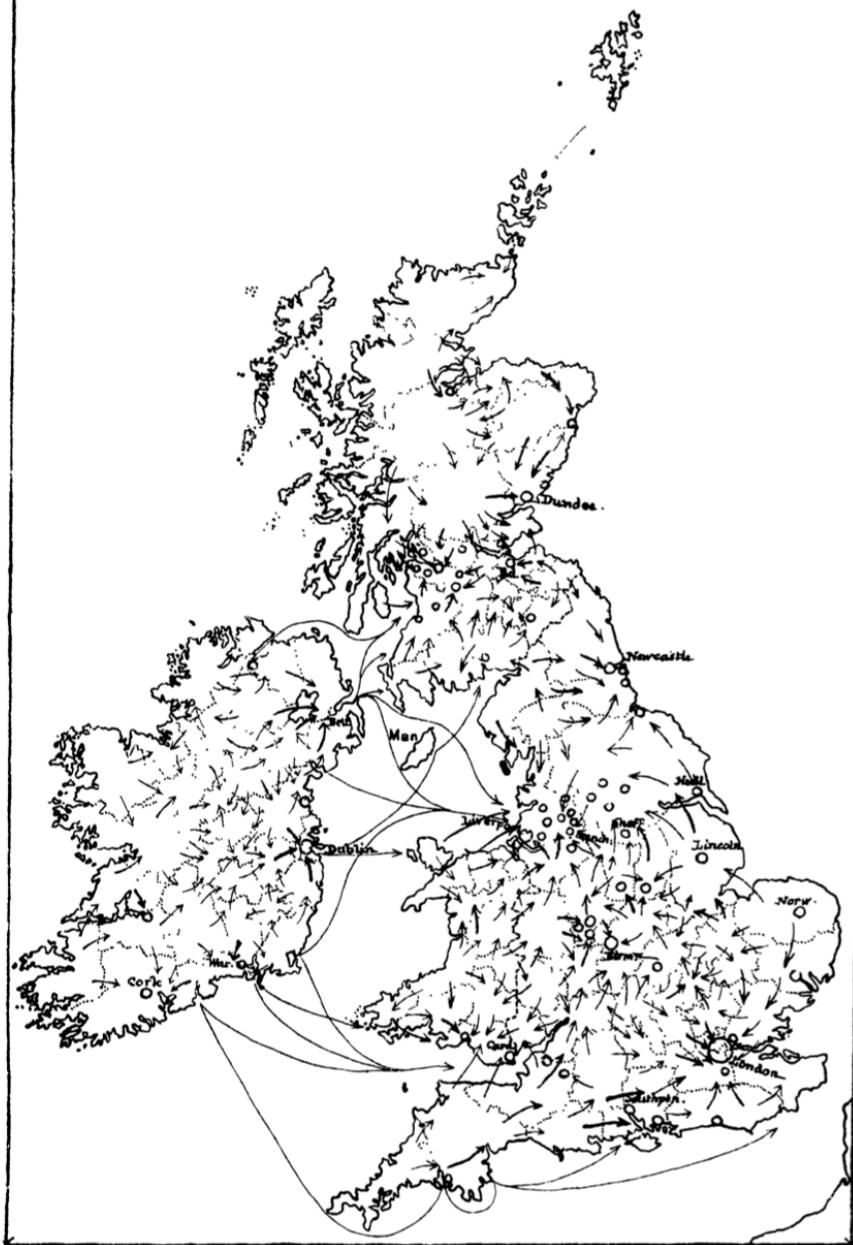
Antecedents



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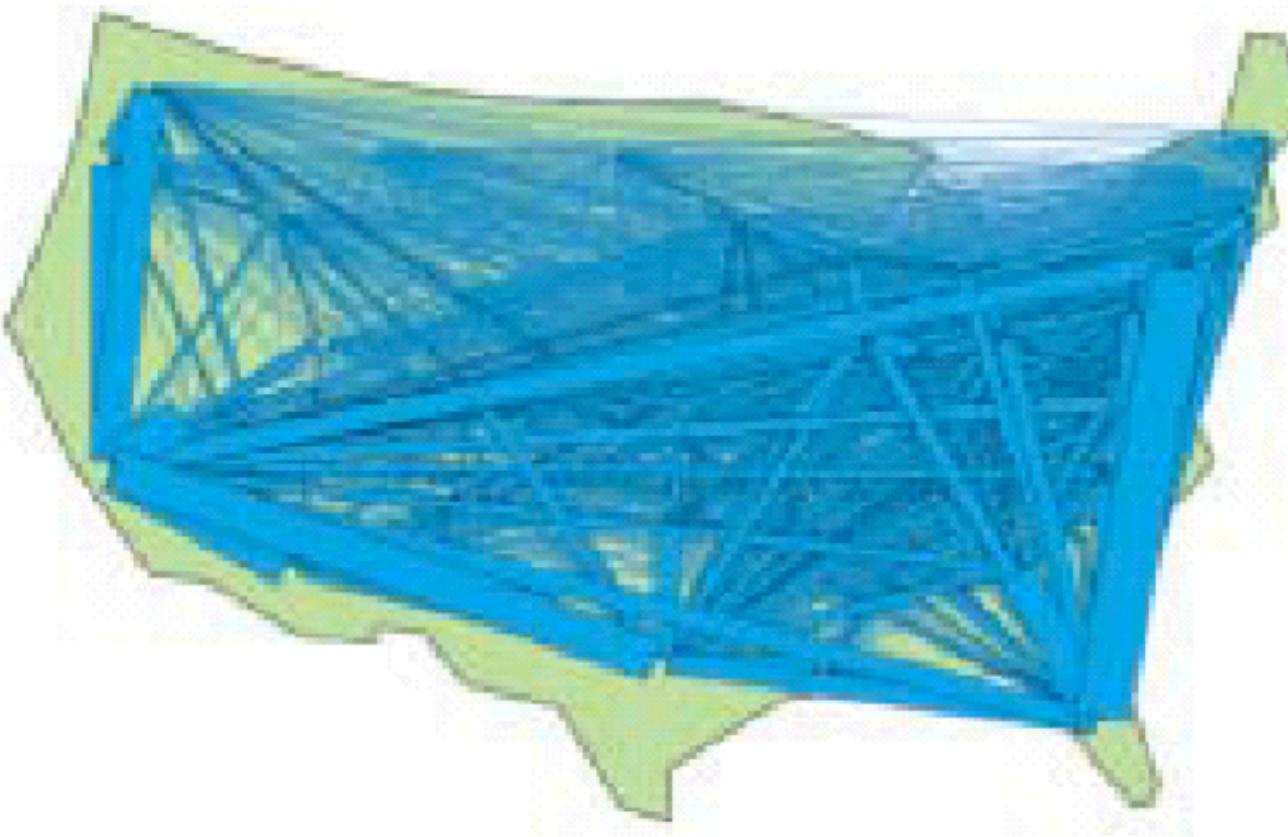


CURRENTS OF MIGRATION.



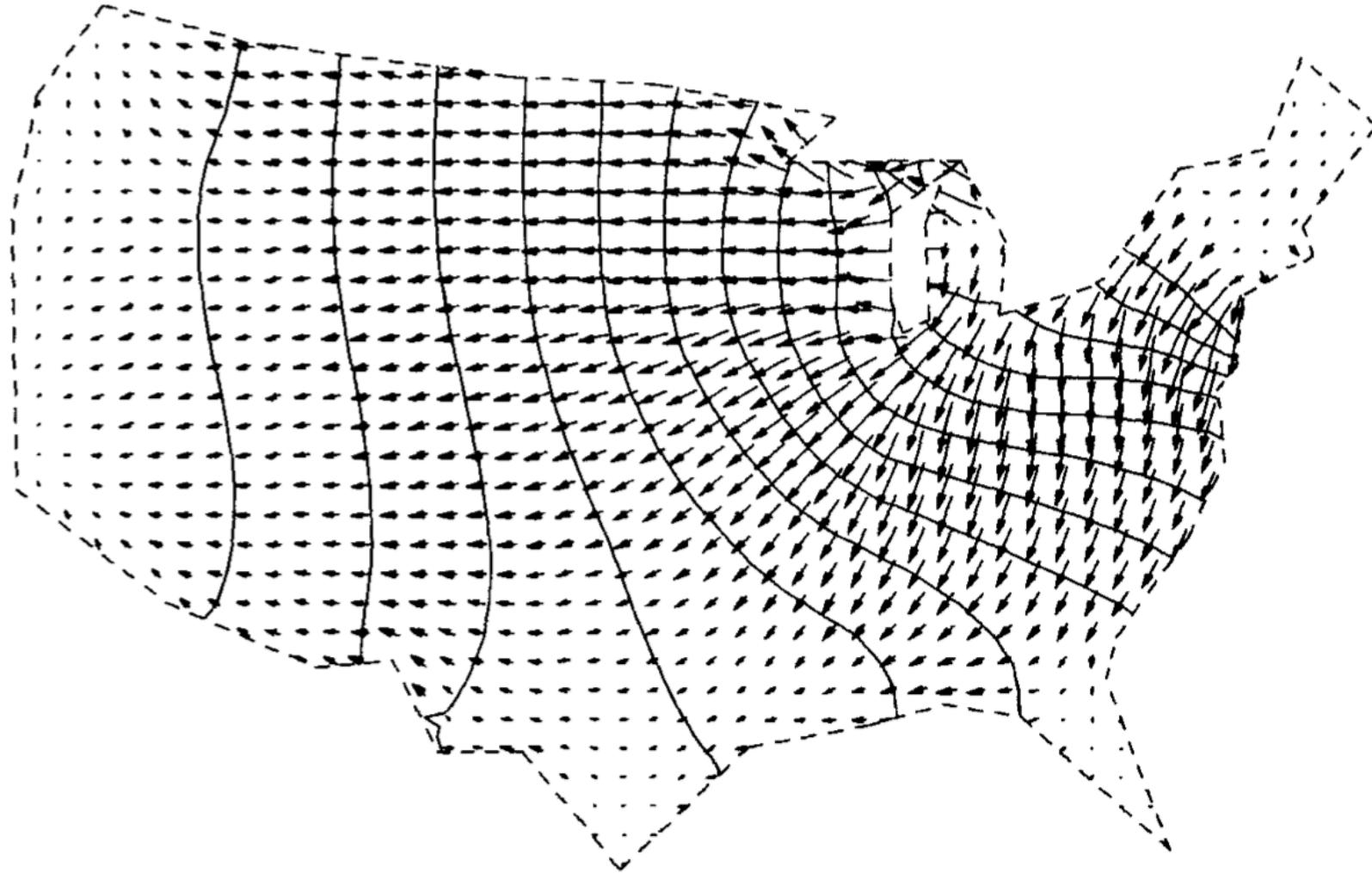
Ravenstein (1885)
currents of migration





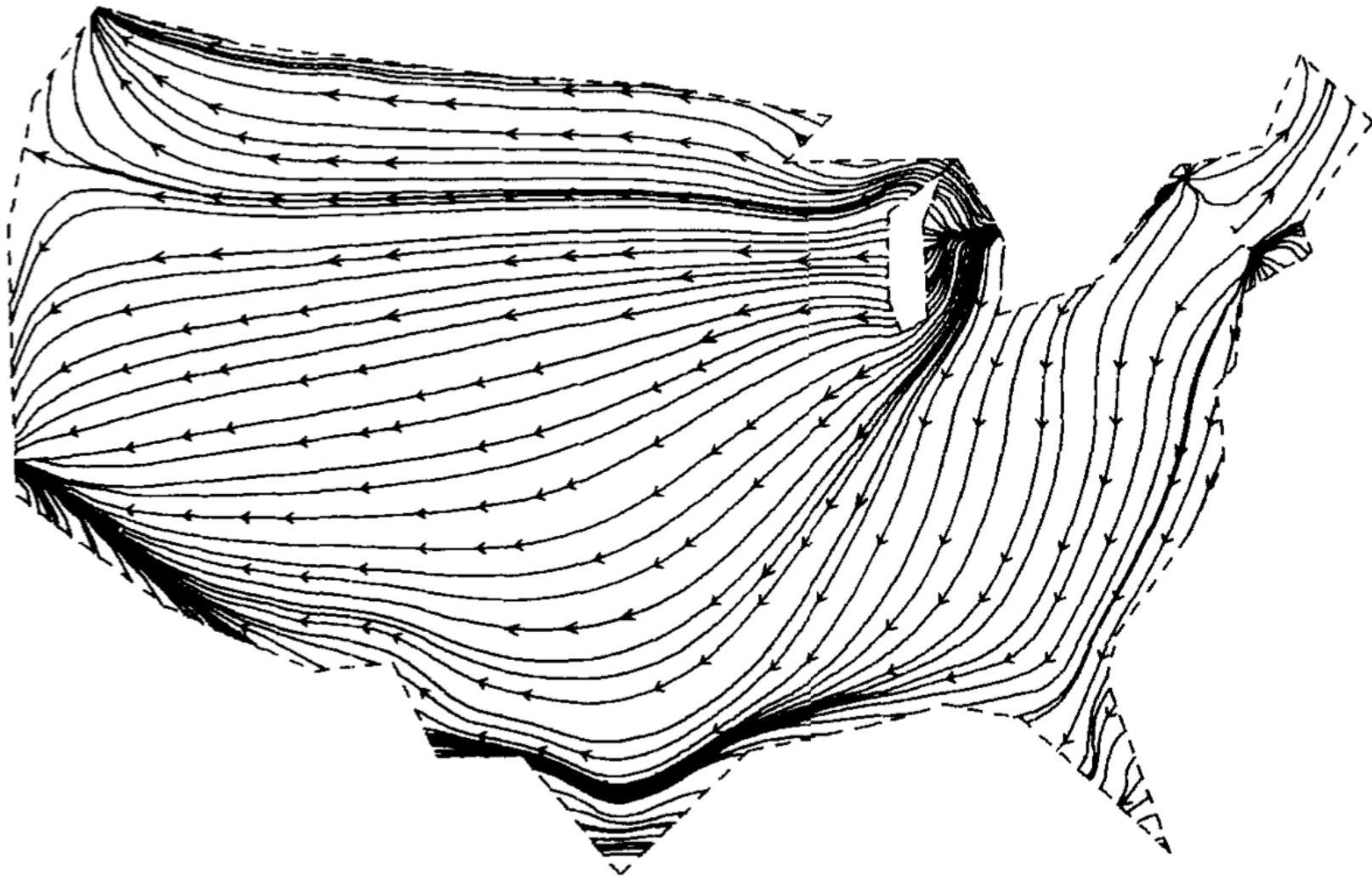
Tobler (2001)
two-way migration flows





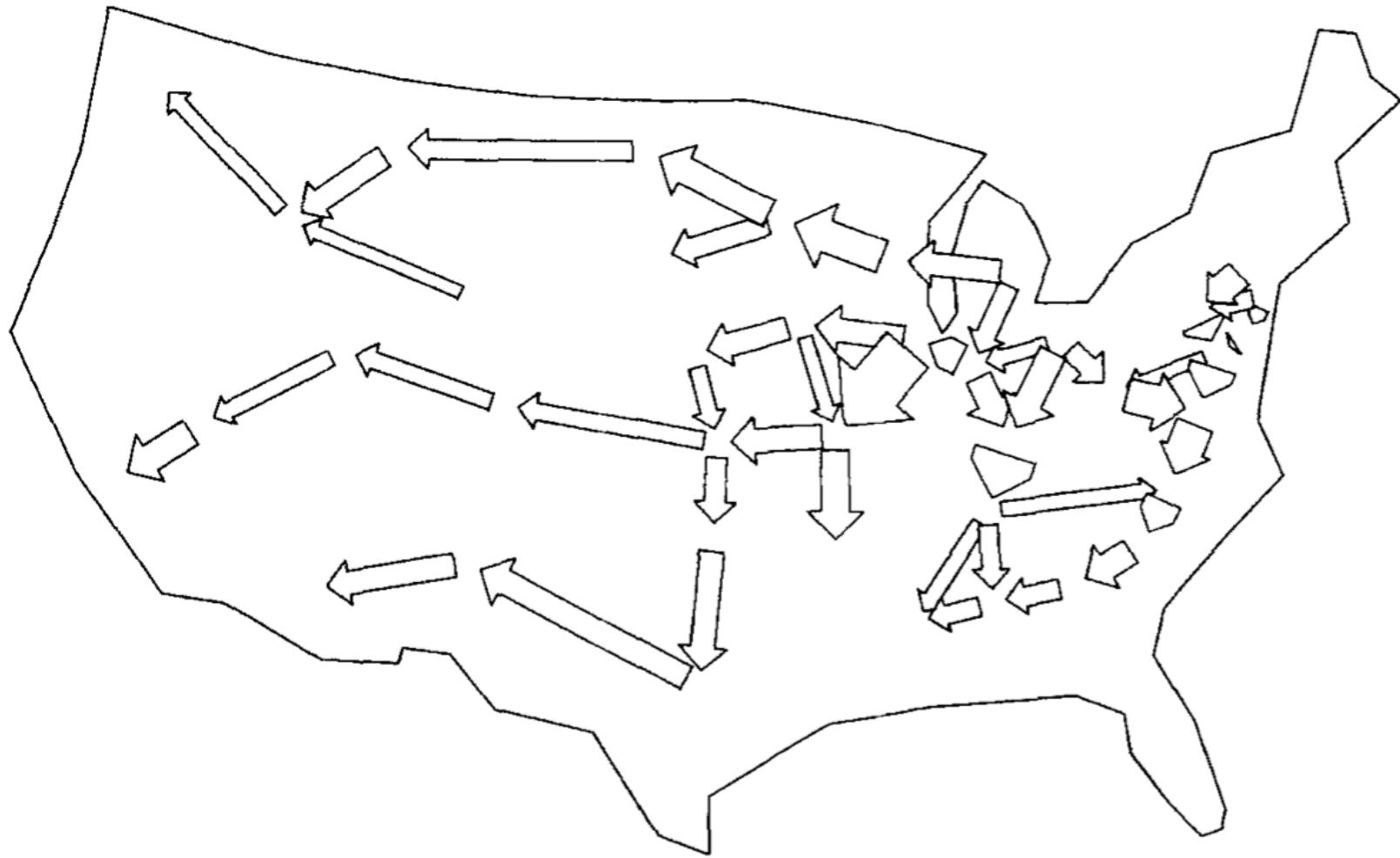
Tobler (1981) flow vector gradient field





Tobler (1981)
fiscal transfer trajectories





Tobler (1981)
net federal fiscal transfer flow map

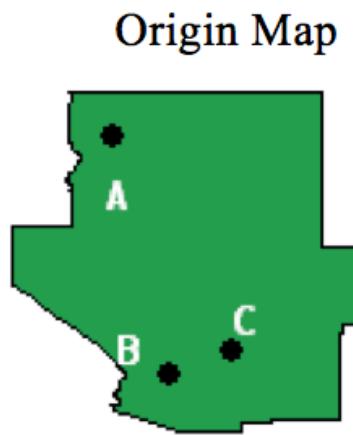


Flow Maps

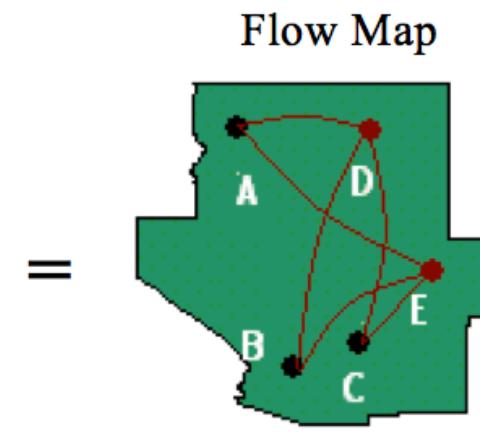
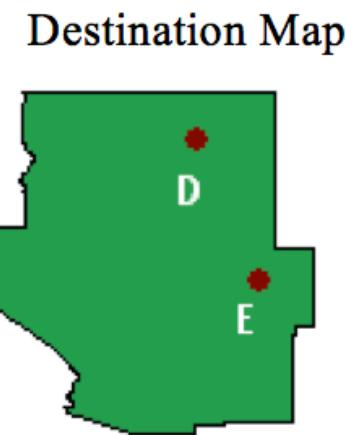


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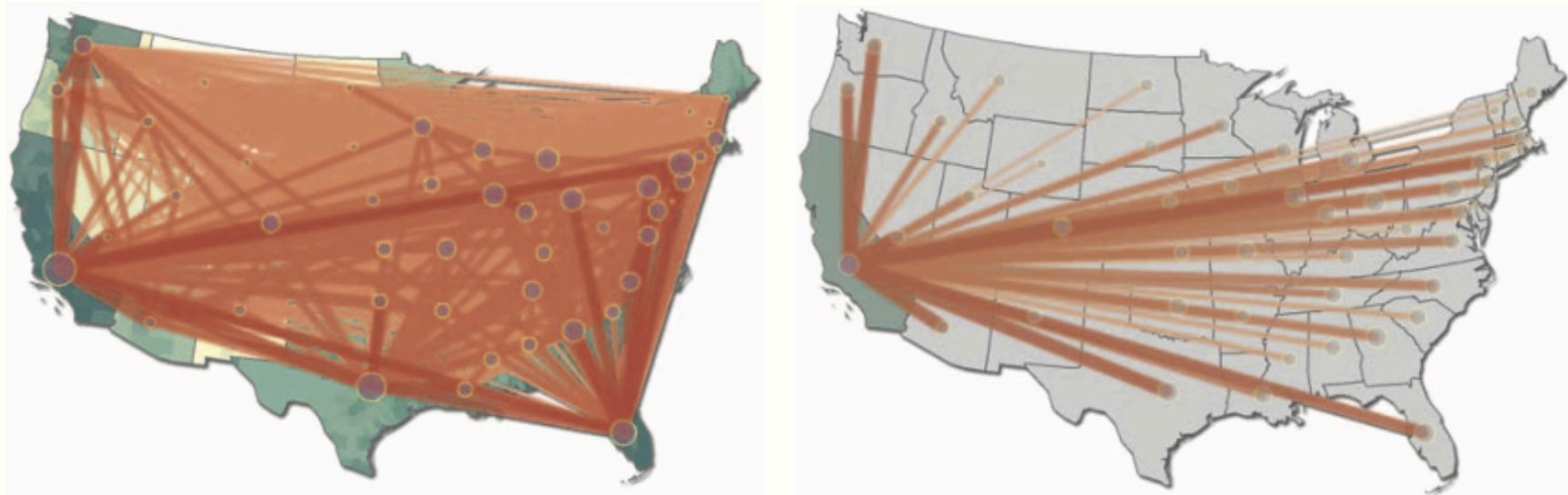


+



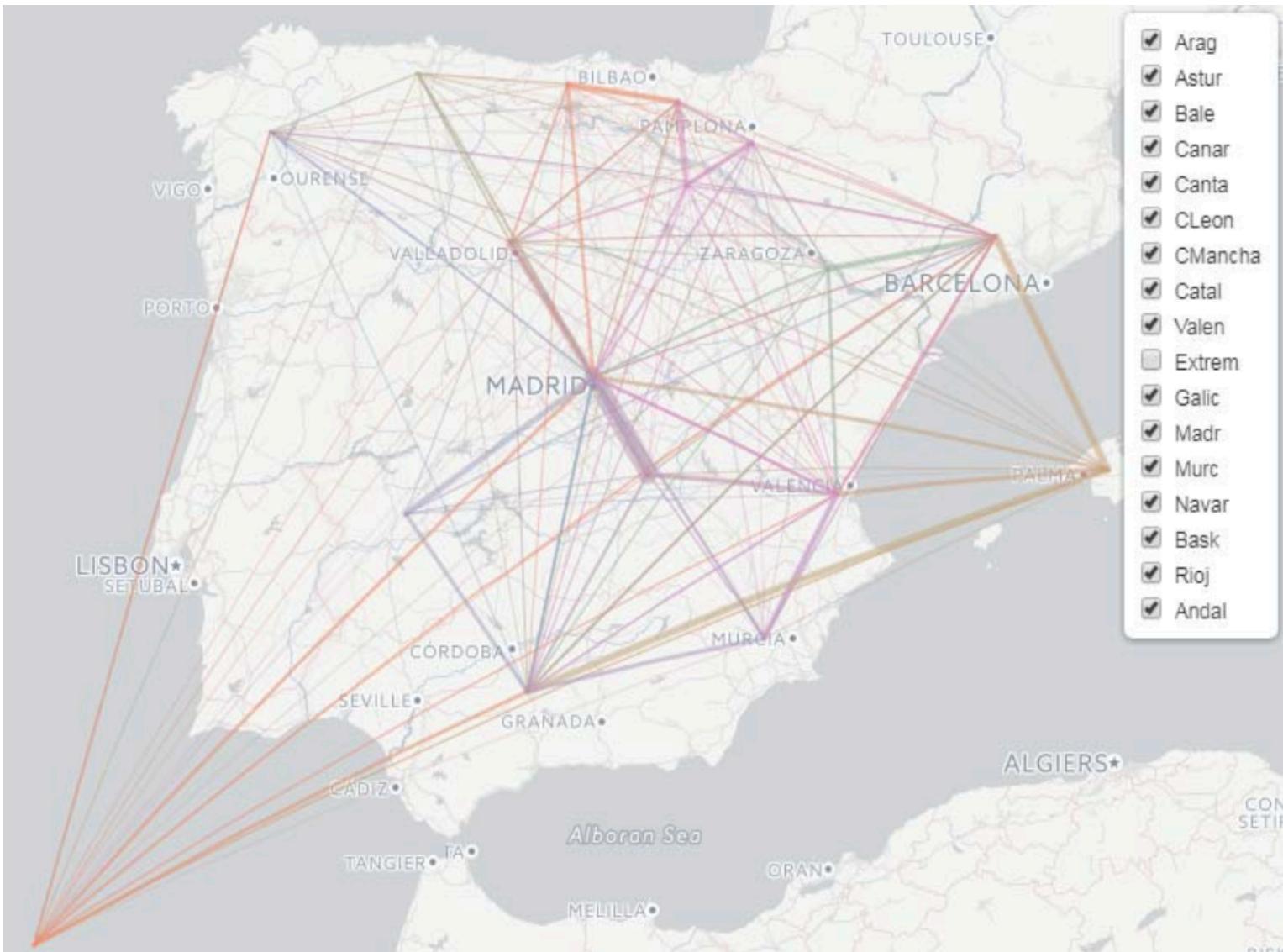
flow map entities





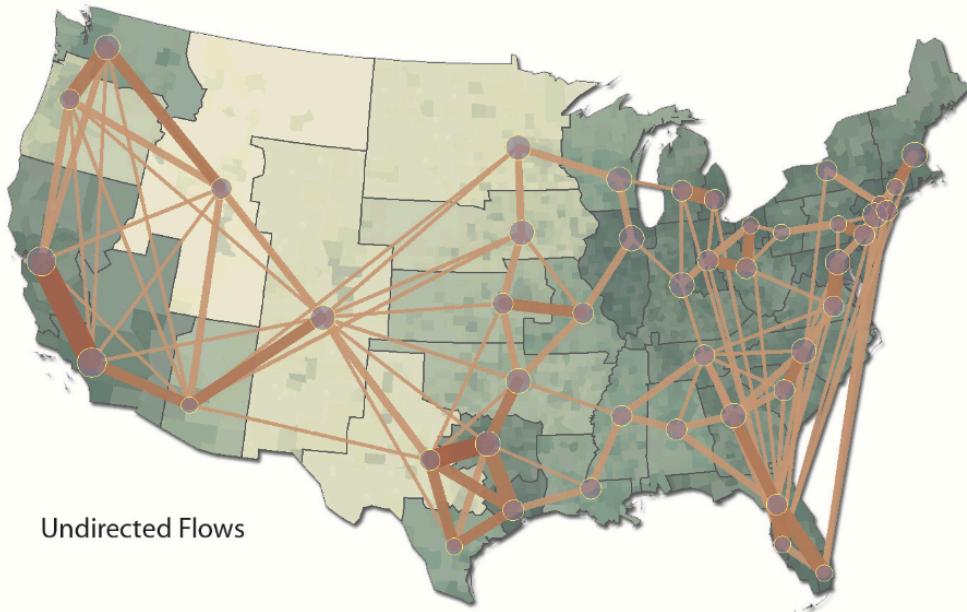
traditional flow map
Source: Guo (2009)



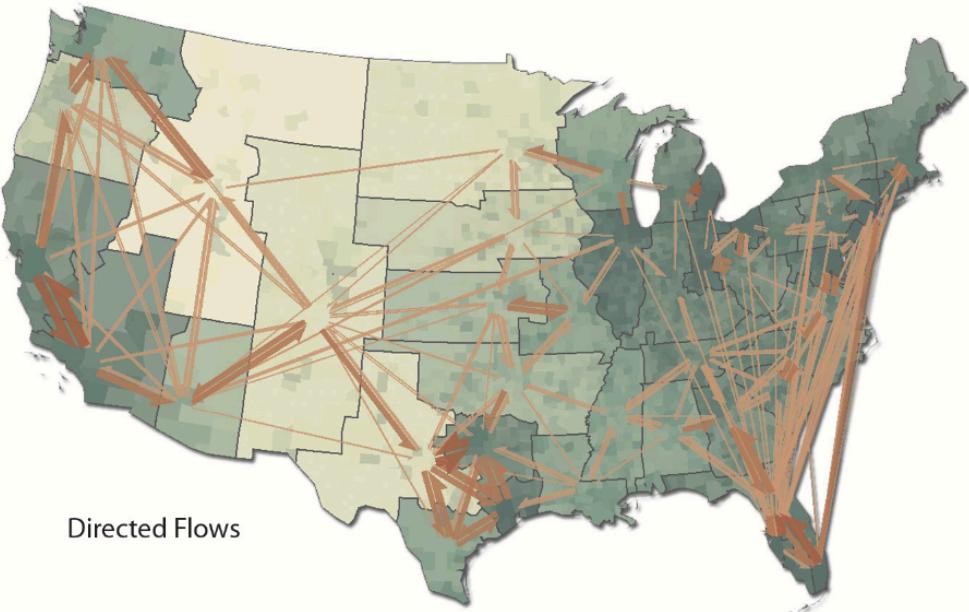


flow network graph





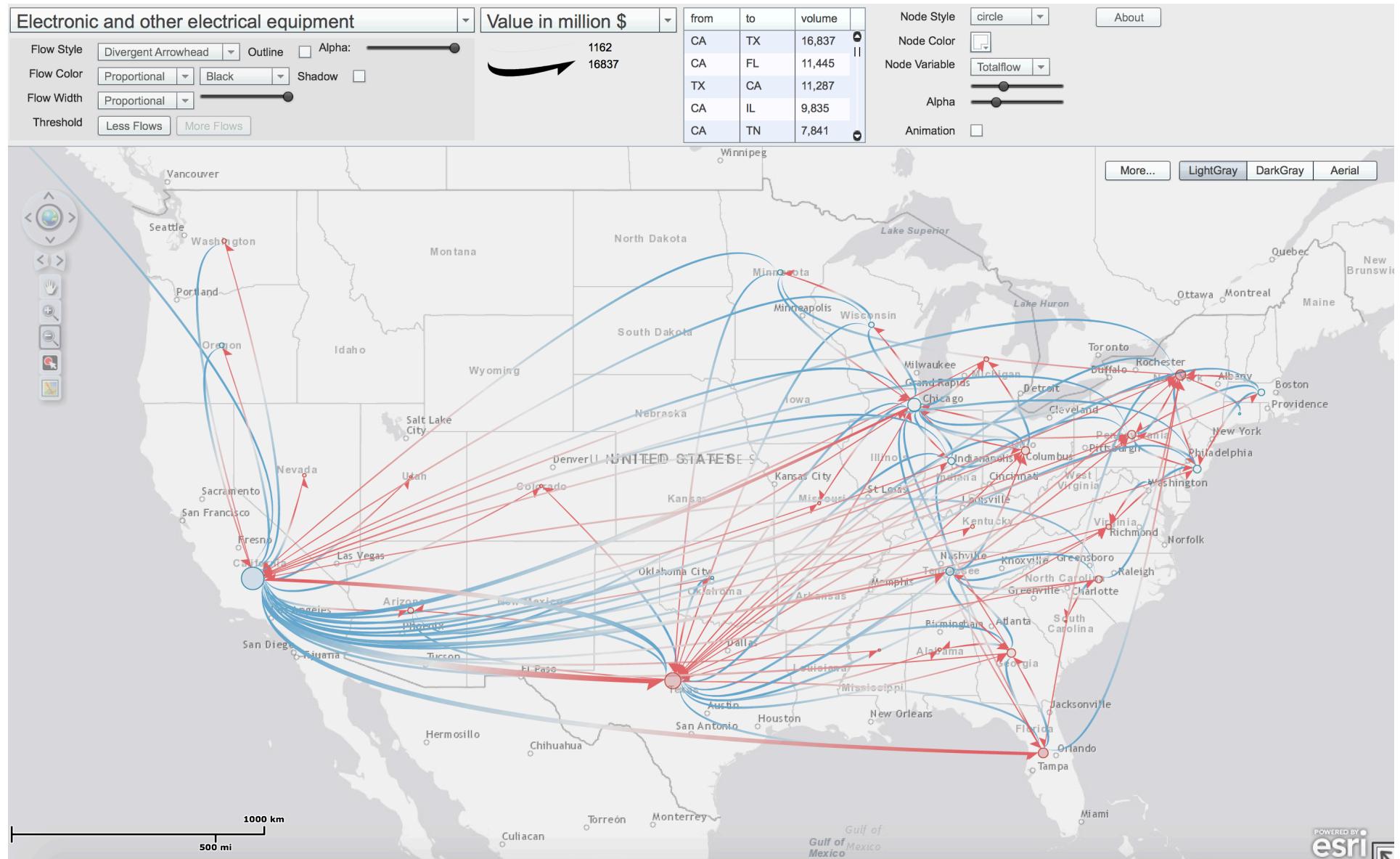
Undirected Flows



Directed Flows

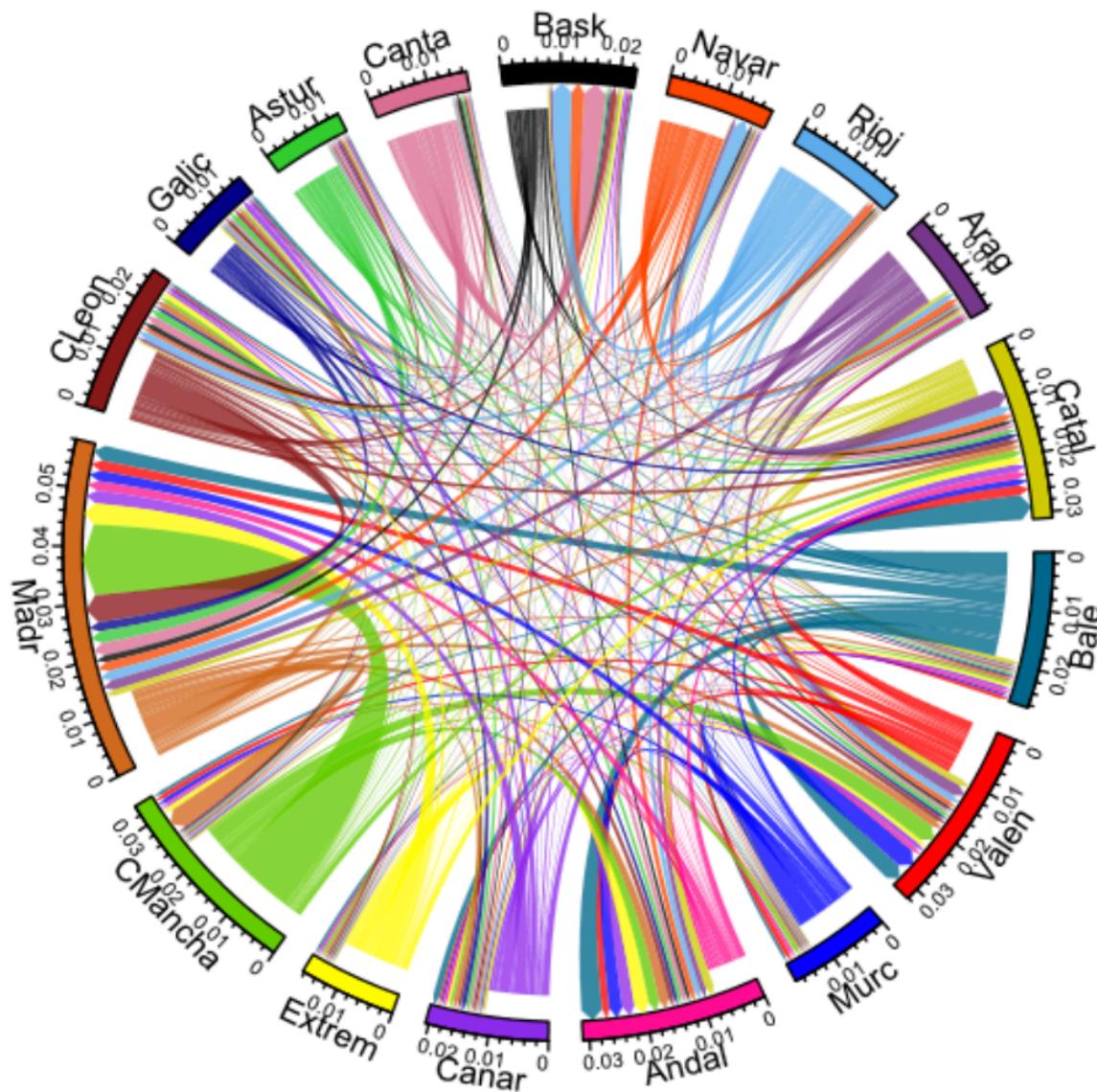
regional aggregation
Source: Guo (2009)





interactive commodity flow map
Source: Koylu and Guo (2017)
<http://tinyurl.com/commodityflows>

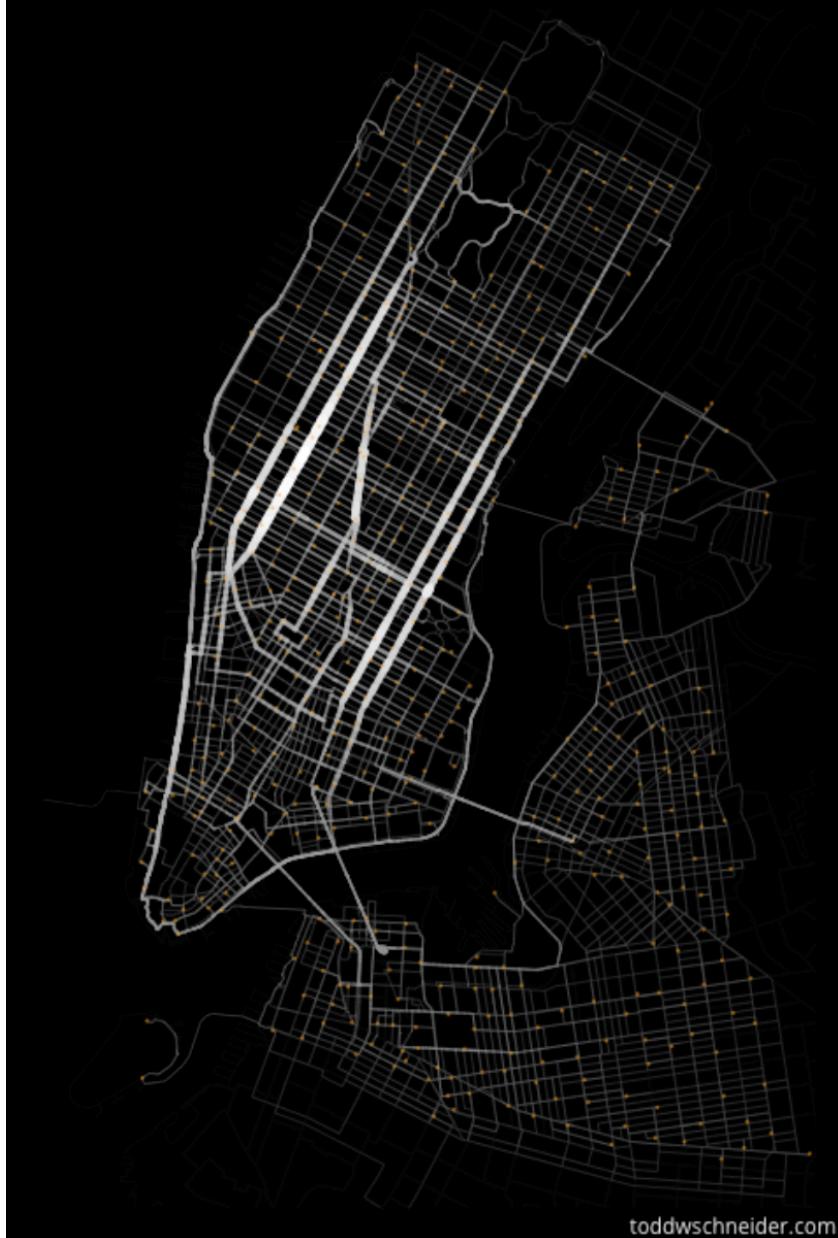




circular plot

NYC Citi Bike Most Popular Roads

Sep–Nov 2015



trajectories



Exploration



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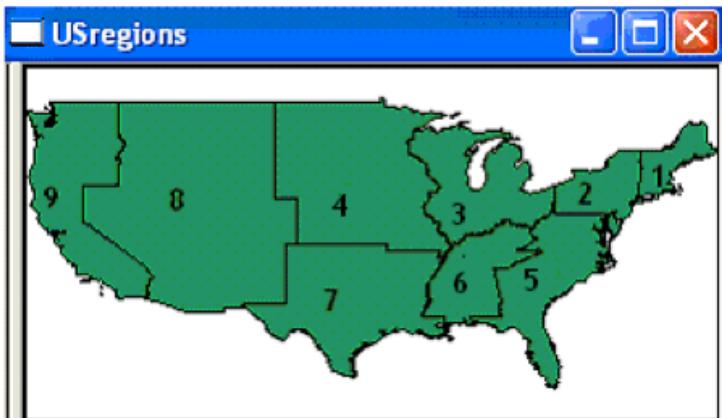


Patterns and Outliers



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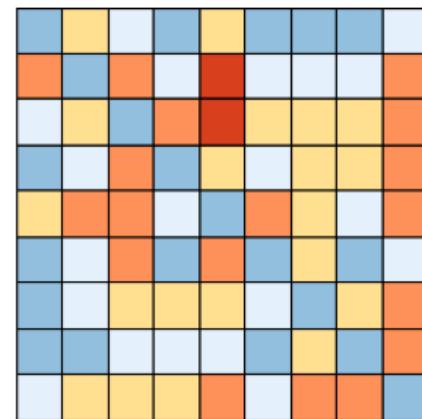




(a)

Regions	1	2	3	4	5	6	7	8	9
1	0	180	79	27	198	38	45	27	67
2	283	0	300	67	719	55	93	88	268
3	87	237	0	282	551	231	179	173	394
4	30	61	287	0	144	50	186	182	275
5	131	383	346	92	0	252	192	89	280
6	21	54	287	50	317	0	142	27	88
7	30	65	162	145	199	121	0	134	290
8	21	44	98	114	90	26	158	0	437
9	72	133	230	165	266	66	252	343	0

(b)



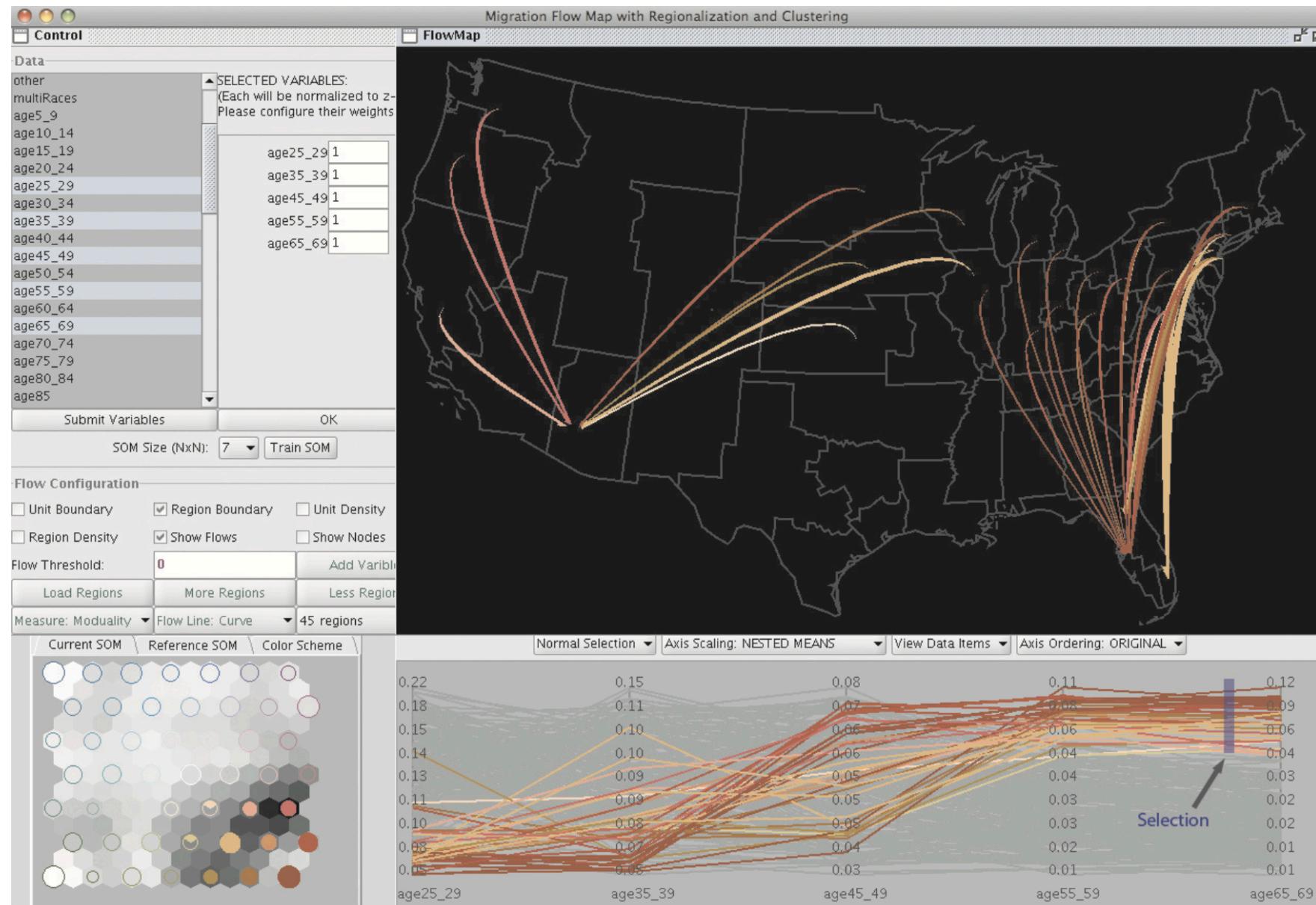
(c)

BoxMap (Hinge=1.5) : MIGRATION

- Lower outlier (0)
- < 25% (21)
- 25% - 50% (20)
- 50% - 75% (20)
- > 75% (18)
- Upper outlier (2)

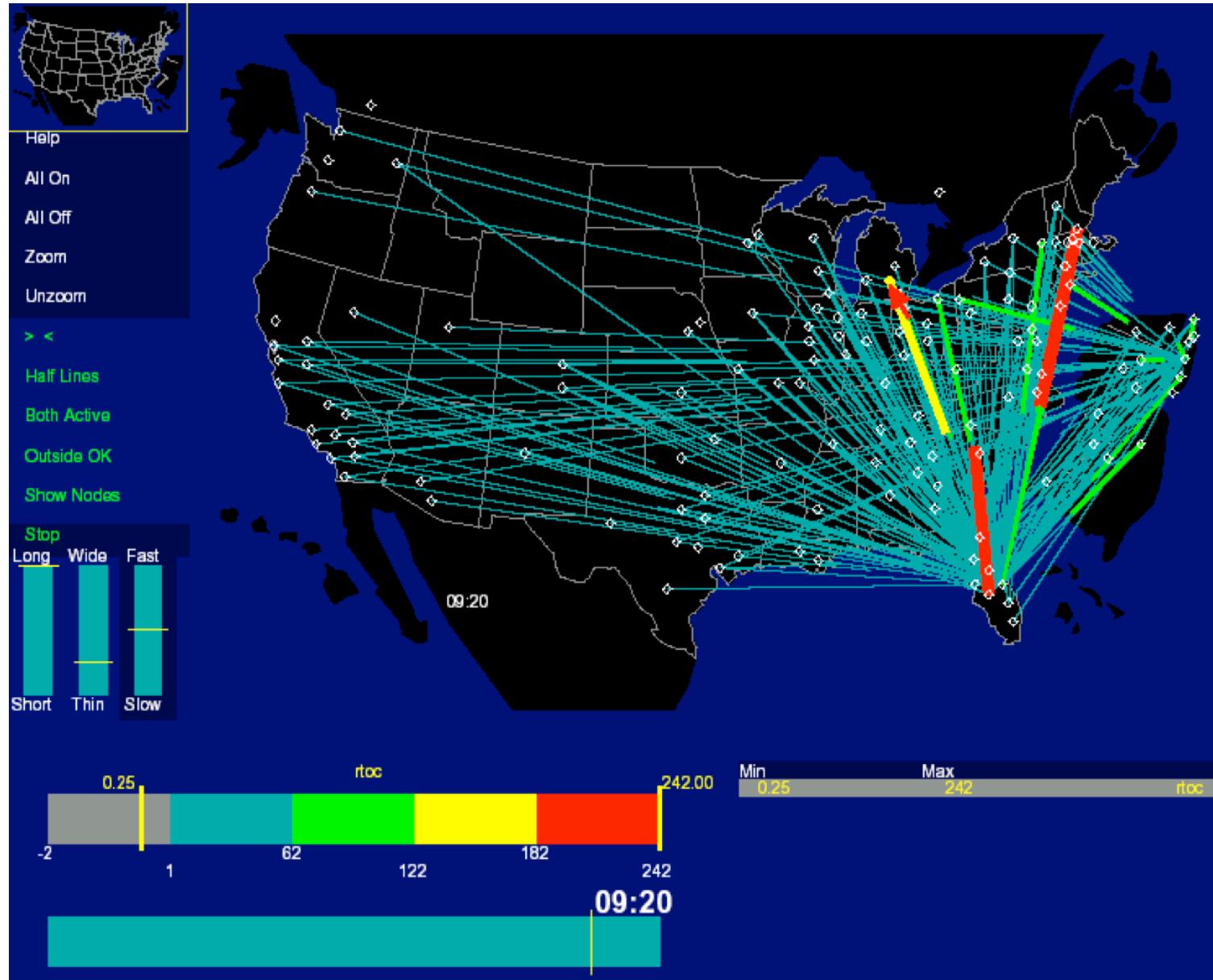
exploring the O-D matrix flow pixelmap





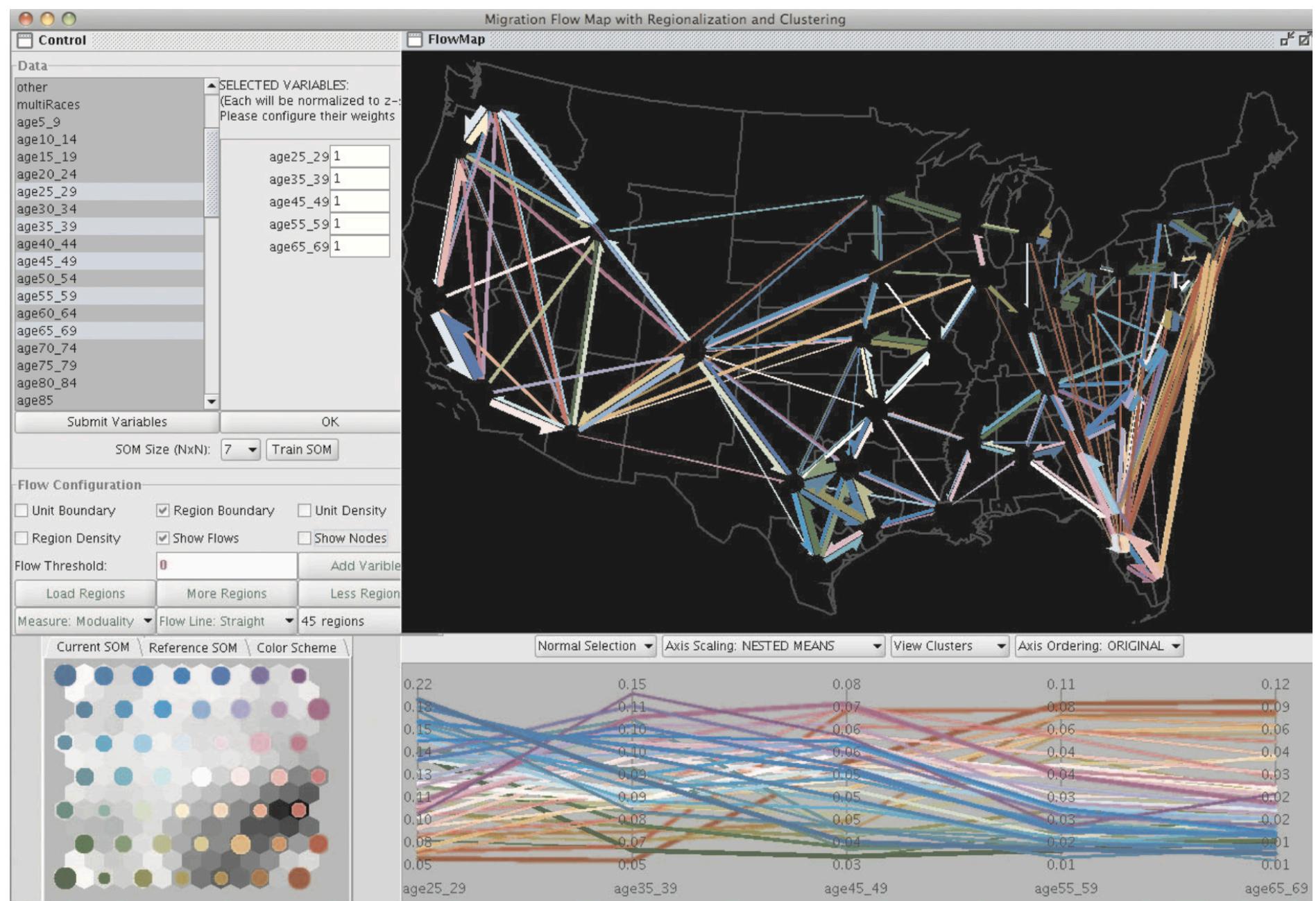
selection
 Source: Guo (2009)





detecting outliers





multivariate exploration
Source: Guo (2009)



Linking and Brushing



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linking and brushing



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brushing the flow map



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brushing flow plots



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brushing O-D plots



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Spatial Patterns



distance decay plots



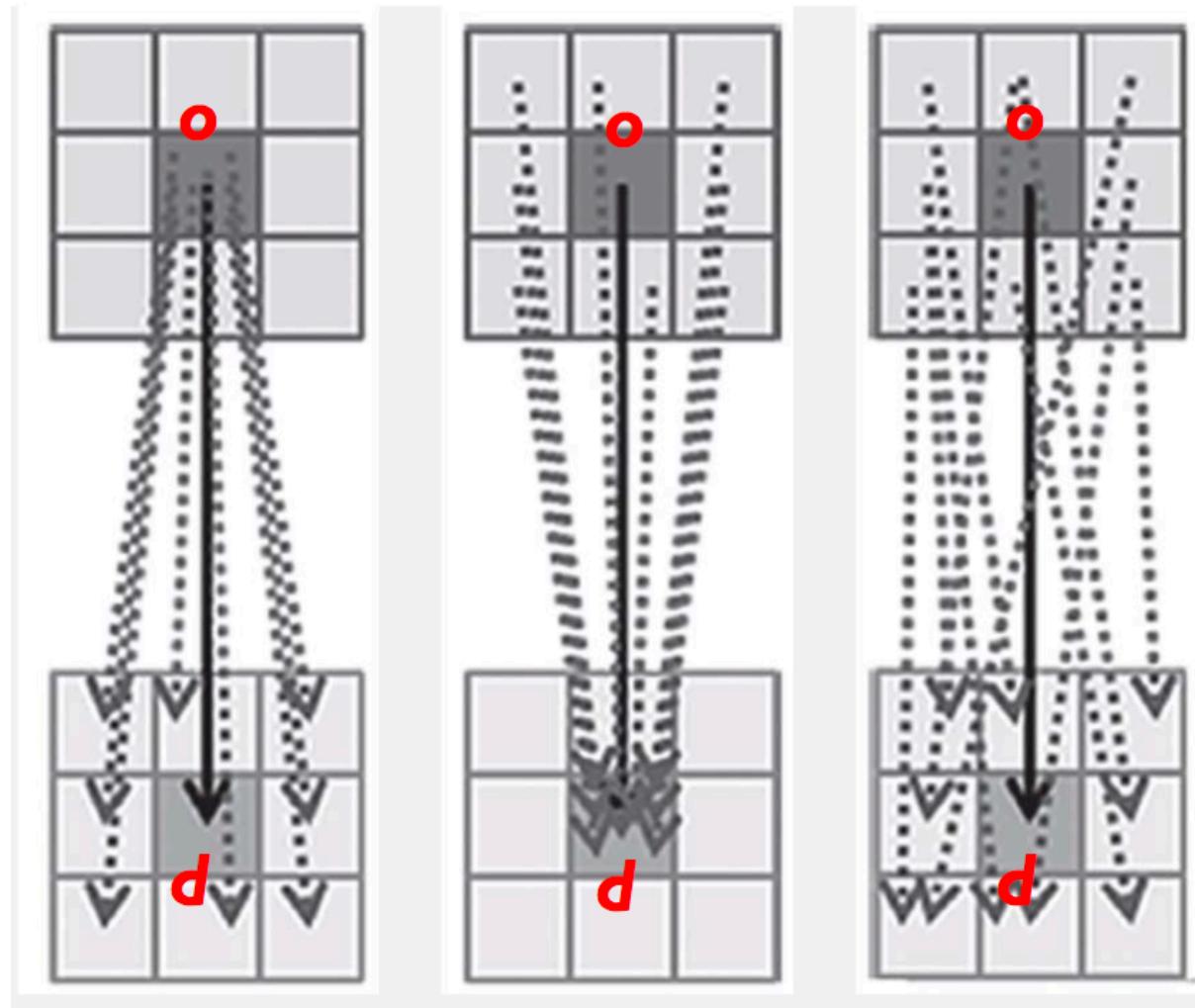
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distance-decay bins



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spatial dependence
origin, destination, flows

