Integrating REMI with Additional Programs

Regional Economic Models, Inc.

what does REMI say?℠

Agenda

- Introduction
- REMI Command Line Interface
- Command Line Interface Example
- ArcGIS Integration in the REMI model
- Visualization in ArcGIS
- Conclusion

Command Line Interface

The PI+ command mode function allows for seamless integration with other applications by enabling policy simulations and data exports through a command line interface. It automates the process of loading simulations, importing policy variables, running forecasts, and exporting results without requiring user input.

- Supports automation by running forecasts and exporting results without user prompts.
- Capable of importing policy variables from files, running forecasts, and exporting data in various formats.
- Allows users to specify simulation details, such as forecast years and regional controls.
- Can be called from other applications via batch files, Visual Basic, or other Windows programming languages.
- Can be enabled for any of REMI's products

Command Line Interface – Features

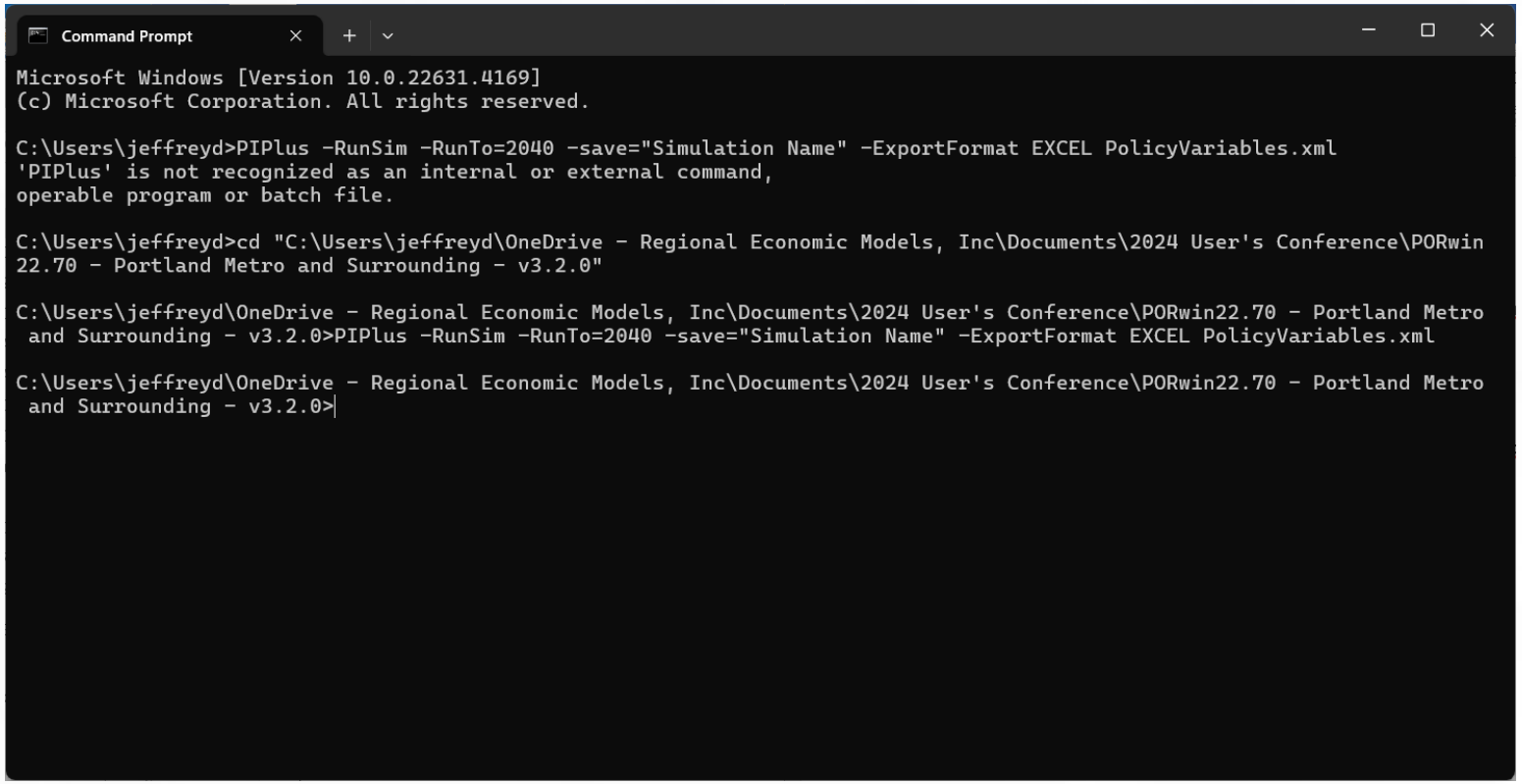
Various syntaxes available depending on what the user wants to run, including the following:

- –OpenOnly opens control or simulation, if one exists with given name.
- –CustomList=CustomListName names a Favorite to be exported "
- –ExportNames AltExportFileName Specifies the name and location of the export file
- -RunTo= specifies the year to which the forecast will run
- –Control specifies the control that will be used as the driving control. (if not selected and the simulation is saved, the first alternative control is the driving control.)
- –Save="Simulation Name" saves the new object to the file with the given name.
- -ExportFormat: Available formats are; Excel, CommaText (default), TabText, XML and HTML.

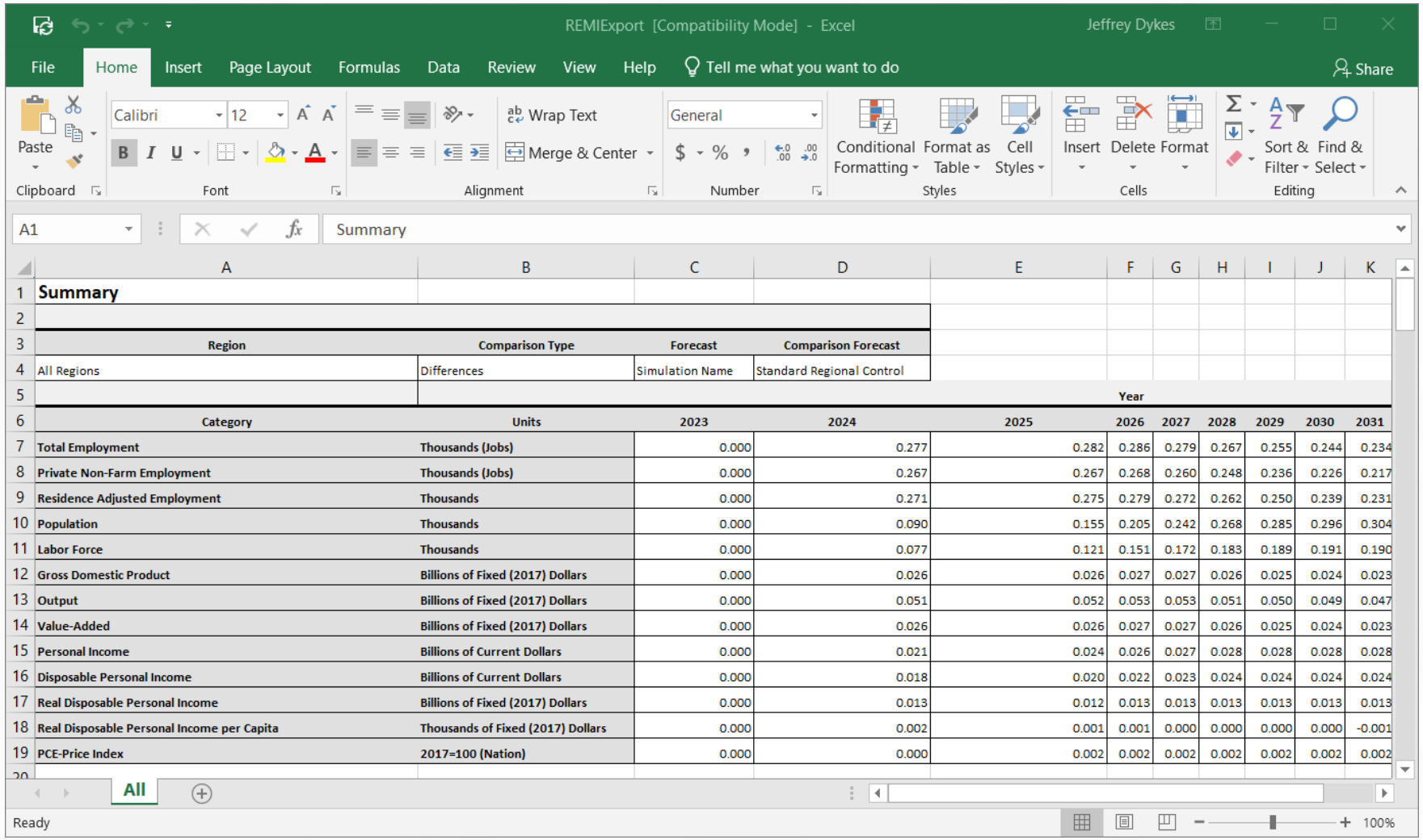
Command Line Interface – Example

Example: to open the "PolicyVariables.xml" PV export file, run it to 2040, save it as "Simulation Name", and export the file to Excel: *PIPlus -RunSim -RunTo=2040 -save="Simulation Name" -ExportFormat EXCEL PolicyVariables.xml*

- After entering this into the command prompt, it will open PI+, import the file, run the simulation, save the file, and then save the Excel export file within the "Exports" folder of the model directory.



Command Line Interface – Results



Summary

Region	Comparison Type	Forecast	Comparison Forecast
All Regions	Differences	Simulation Name	Standard Regional Control

		Year								
Category	Units	2023	2024	2025	2026	2027	2028	2029	2030	2031
Total Employment	Thousands (Jobs)	0.000	0.277	0.282	0.286	0.279	0.267	0.255	0.244	0.234
Private Non-Farm Employment	Thousands (Jobs)	0.000	0.267	0.267	0.268	0.260	0.248	0.236	0.226	0.217
Residence Adjusted Employment	Thousands	0.000	0.271	0.275	0.279	0.272	0.262	0.250	0.239	0.231
Population	Thousands	0.000	0.090	0.155	0.205	0.242	0.268	0.285	0.296	0.304
Labor Force	Thousands	0.000	0.077	0.121	0.151	0.172	0.183	0.189	0.191	0.190
Gross Domestic Product	Billions of Fixed (2017) Dollars	0.000	0.026	0.026	0.027	0.027	0.026	0.025	0.024	0.023
Output	Billions of Fixed (2017) Dollars	0.000	0.051	0.052	0.053	0.053	0.051	0.050	0.049	0.047
Value-Added	Billions of Fixed (2017) Dollars	0.000	0.026	0.026	0.027	0.027	0.026	0.025	0.024	0.023
Personal Income	Billions of Current Dollars	0.000	0.021	0.024	0.026	0.027	0.028	0.028	0.028	0.028
Disposable Personal Income	Billions of Current Dollars	0.000	0.018	0.020	0.022	0.023	0.024	0.024	0.024	0.024
Real Disposable Personal Income	Billions of Fixed (2017) Dollars	0.000	0.013	0.012	0.013	0.013	0.013	0.013	0.013	0.013
Real Disposable Personal Income per Capita	Thousands of Fixed (2017) Dollars	0.000	0.002	0.001	0.001	0.000	0.000	0.000	0.000	-0.001
PCE-Price Index	2017=100 (Nation)	0.000	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002

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REMI

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- **ArcGIS Integration in the REMI model**
- Visualization in ArcGIS
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ArcGIS Integration

GIS provides a framework for visualizing data.

This can be historical or descriptive data.

For forecasting and analysis, need a link between forecasting/analysis model or other tool.

This presentation shows the link between the REMI TranSight model and ArcGIS.

The Approach

TranSight has a comprehensive economic/demographic forecast.

GIS base year has population and other indicators at the parcel level.

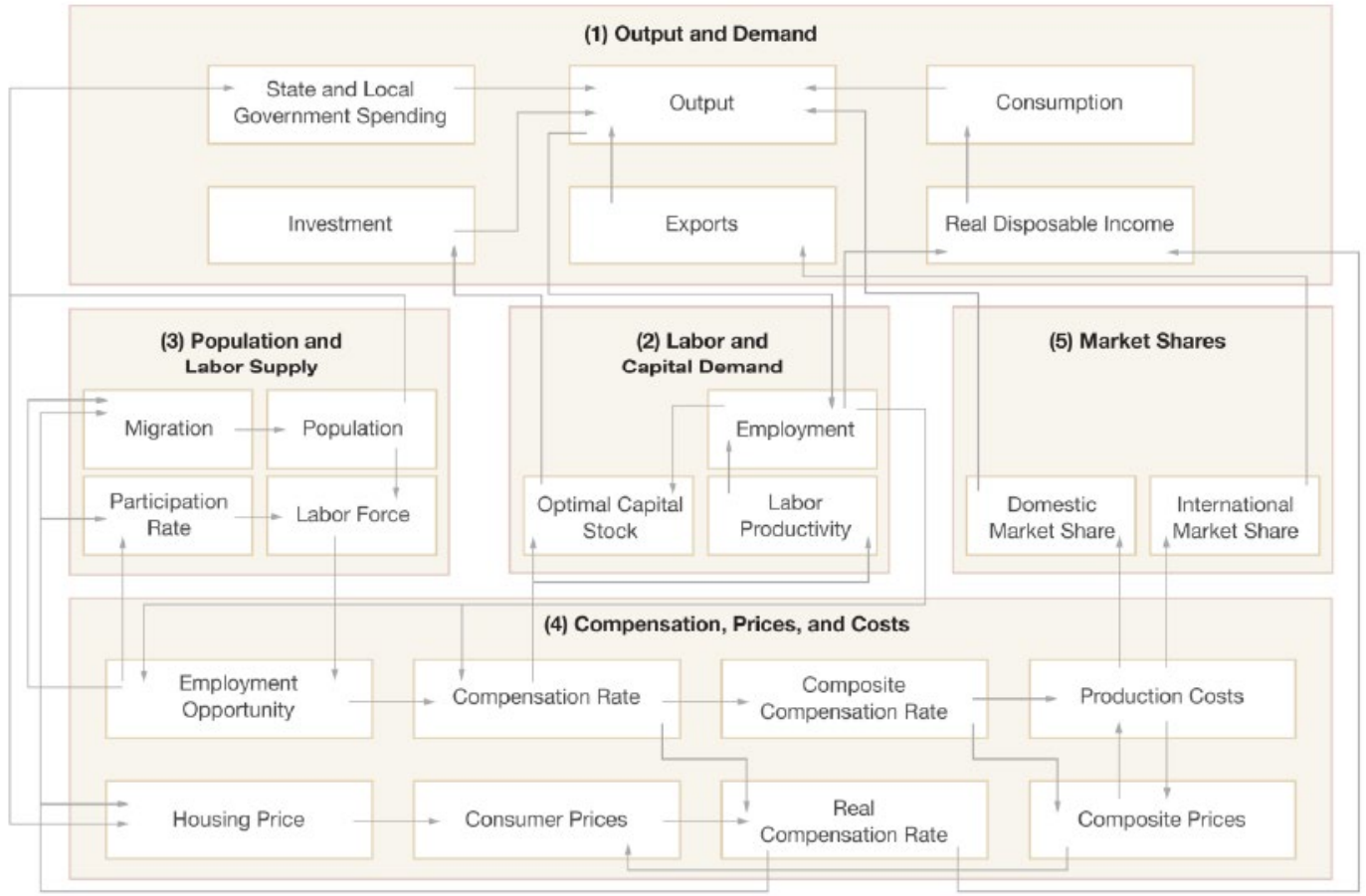
The TranSight forecast is used to “drive” changes in variables at the parcel level.

TranSight users can develop simulation forecasts based on long-range planning objectives and transportation/land use policy changes.

GIS visualizes potential paths for metropolitan development at the parcel level.

REMI TranSight

REMI Model Linkages (Excluding Economic Geography Linkages)



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REMI TranSight

General equilibrium model with employment and demographics determined in simultaneous equation system.

Demographics driven by economic conditions (employment opportunity and compensation rates); complete cohort-component model by age/gender/race, special populations (military, college students); retirement migration. Driven by retirement age population of the US.

Further, simulation capabilities to look at alternatives based on transportation network changes, land use policies, and other factors.

Components of Population Change

Region: All Regions | Comparison Type: Levels

Category	Race	Units	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Starting Population	White-NonHispanic	Thousands	197310.037	197253.465	197183.865	197101.314	196970.551	196821.407	196657.940	196475.811	196265.557	196017.391	195728.156	195399.594	195027.472	194611.963	194150.646	193643.506	193090.960	192493.662	191852.693
	Black-NonHispanic	Thousands	41147.535	41472.654	41799.911	42125.348	42440.641	42754.167	43068.232	43382.003	43694.009	44002.087	44305.238	44604.427	44898.349	45186.968	45469.534	45745.686	46015.087	46277.569	46533.016
	Other-NonHispanic	Thousands	29210.006	29796.270	30387.997	30996.757	31615.948	32248.055	32884.456	33521.501	34157.518	34792.091	35428.953	36063.235	36696.232	37329.529	37962.979	38596.886	39231.214	39865.890	40500.843
	Hispanic	Thousands	60572.284	61836.025	63062.589	64280.081	65510.272	66760.692	68017.926	69276.042	70539.841	71811.305	73091.106	74375.052	75662.749	76954.240	78247.950	79543.145	80838.633	82132.807	83424.262
Natural Growth	White-NonHispanic	Thousands	-323.759	-319.324	-322.988	-334.165	-352.380	-376.705	-405.809	-439.246	-476.580	-517.173	-559.448	-602.747	-646.711	-691.107	-734.543	-776.668	-817.300	-855.931	-892.353
	Black-NonHispanic	Thousands	198.016	197.340	195.719	193.174	189.680	185.667	181.113	176.019	170.281	163.851	156.945	149.626	142.144	134.422	126.644	118.876	111.071	103.258	95.485
	Other-NonHispanic	Thousands	268.646	275.294	281.094	286.302	290.864	294.778	298.114	300.809	302.869	304.472	305.655	306.345	306.893	306.874	306.550	305.974	304.997	303.763	302.084
	Hispanic	Thousands	783.476	793.489	802.656	811.919	821.209	830.624	839.919	848.645	856.514	863.322	869.017	873.601	876.692	878.378	878.684	877.606	874.914	870.655	864.662
Births	White-NonHispanic	Thousands	1885.379	1883.201	1878.318	1870.837	1860.563	1848.431	1834.994	1820.575	1805.332	1789.484	1773.647	1758.097	1742.916	1728.235	1714.138	1700.624	1687.460	1674.490	1661.567
	Black-NonHispanic	Thousands	522.680	525.018	526.598	527.471	527.662	527.549	527.223	526.623	525.636	524.290	522.691	520.968	519.259	517.677	516.235	514.962	513.814	512.715	511.598
	Other-NonHispanic	Thousands	410.363	418.922	427.123	435.072	442.750	450.166	457.298	464.128	470.734	477.125	483.395	489.498	495.537	501.511	507.348	513.026	518.476	523.610	528.358
	Hispanic	Thousands	999.432	1016.918	1033.781	1050.831	1068.158	1085.828	1103.569	1121.076	1138.047	1154.269	1169.806	1184.466	1197.995	1210.504	1221.995	1232.444	1241.703	1249.623	1256.141
Deaths	White-NonHispanic	Thousands	2209.138	2202.525	2201.306	2205.002	2212.943	2225.136	2240.803	2259.821	2281.912	2306.657	2333.095	2360.844	2389.627	2419.343	2448.682	2477.292	2504.761	2530.421	2553.921
	Black-NonHispanic	Thousands	324.665	327.678	330.880	334.297	337.982	341.882	346.111	350.604	355.355	360.439	365.746	371.342	377.115	383.255	389.591	396.085	402.743	409.457	416.113
	Other-NonHispanic	Thousands	141.717	143.629	146.029	148.770	151.886	155.388	159.184	163.319	167.865	172.653	177.740	183.154	188.644	194.637	200.798	207.052	213.479	219.846	226.274
	Hispanic	Thousands	215.956	223.429	231.126	238.912	246.948	255.204	263.650	272.432	281.532	290.947	300.789	310.864	321.303	332.127	343.311	354.837	366.789	378.968	391.480
Population Before Migrants	White-NonHispanic	Thousands	196986.278	196934.141	196860.876	196767.150	196618.171	196444.702	196252.131	196036.565	195788.977	195500.218	195168.708	194796.847	194380.761	193920.856	193416.103	192866.838	192273.660	191637.731	190960.340
	Black-NonHispanic	Thousands	41345.551	41669.995	41995.630	42318.522	42630.321	42939.834	43249.345	43558.022	43864.290	44165.938	44462.183	44754.053	45040.493	45321.390	45596.178	45864.562	46126.158	46380.828	46628.501
	Other-NonHispanic	Thousands	29478.652	30071.564	30669.091	31283.059	31906.812	32542.834	33182.570	33822.310	34460.387	35096.563	35734.608	36369.580	37003.125	37636.402	38269.529	38902.860	39536.211	40169.653	40802.927
	Hispanic	Thousands	61355.760	62629.514	63865.245	65092.000	66331.481	67591.317	68857.844	70124.687	71396.356	72674.627	73960.123	75248.653	76539.441	77832.618	79126.634	80420.751	81713.547	83003.462	84288.924
Total Migrants	White-NonHispanic	Thousands	267.187	249.723	240.438	203.402	203.236	213.238	223.680	228.992	228.414	227.938	230.886	230.625	231.202	229.791	227.403	224.123	220.002	214.962	208.785
	Black-NonHispanic	Thousands	127.104	129.917	129.718	122.120	123.845	128.398	132.658	135.987	137.797	139.300	142.244	144.296	146.475	148.143	149.508	150.525	151.411	152.188	152.560
	Other-NonHispanic	Thousands	317.618	316.433	327.666	332.889	341.243	341.622	338.931	335.208	331.704	332.390	328.627	326.652	326.403	326.576	327.357	328.354	329.678	331.190	333.356
	Hispanic	Thousands	480.265	433.075	414.837	418.272	429.211	426.609	418.198	415.154	414.950	416.479	414.929	414.095	414.800	415.332	416.510	417.882	419.260	420.800	423.236
Economic Migrants	White-NonHispanic	Thousands	18.902	39.914	40.713	25.362	12.164	14.255	22.057	26.369	27.341	24.840	27.524	27.874	26.387	24.358	21.206	17.669	13.545	9.130	3.419
	Black-NonHispanic	Thousands	-1.665	9.077	9.501	5.623	2.131	2.950	5.140	6.362	6.745	5.887	6.785	6.969	6.630	6.096	5.256	4.270	3.112	1.832	0.145
	Other-NonHispanic	Thousands	-27.606	-25.860	-14.518	-8.195	-2.589	-5.049	-9.491	-12.560	-15.136	-13.750	-16.686	-17.642	-17.145	-16.172	-14.613	-12.856	-10.722	-8.426	-5.453
	Hispanic	Thousands	10.369	-23.131	-35.696	-22.790	-11.706	-12.157	-17.706	-20.171	-18.950	-16.977	-17.623	-17.201	-15.872	-14.281	-11.848	-9.083	-5.936	-2.536	1.889
International Migrants	White-NonHispanic	Thousands	199.712	199.706	199.812	200.109	200.558	201.152	201.617	201.788	201.977	202.160	202.287	202.504	202.690	202.929	203.169	203.483	203.864	204.230	204.654
	Black-NonHispanic	Thousands	116.503	118.522	120.479	122.456	124.386	126.227	127.726	129.488	131.325	133.168	135.064	137.020	139.011	141.071	143.177	145.268	147.426	149.625	151.825
	Other-NonHispanic	Thousands	339.630	340.606	341.512	342.615	344.060	346.023	347.566	346.723	345.807	344.899	344.036	343.037	342.089	341.122	340.190	339.306	338.477	337.694	336.956
	Hispanic	Thousands	455.603	452.670	449.756	446.436	442.666	438.324	434.871	433.836	432.783	431.720	430.615	429.497	428.322	427.044	425.687	424.221	422.567	420.841	419.010
Retired Migrants	White-NonHispanic	Thousands	1.546	1.424	1.269	1.256	1.244	1.376	1.337	0.854	0.775	0.673	0.301	-0.152	-0.236	-0.301	-0.102	0.310	0.471	0.100	-0.105
	Black-NonHispanic	Thousands	0.031	0.060	0.090	0.109	0.120	0.143	0.137	0.142	0.164	0.176	0.194	0.202	0.220	0.247	0.261	0.295	0.321	0.340	0.378
	Other-NonHispanic	Thousands	0.713	0.786	0.813	0.891	0.886	1.017	0.994	1.047	1.207	1.214	1.197	1.216	1.214	1.335	1.455	1.628	1.703	1.766	1.767
	Hispanic	Thousands	1.059	1.093	1.158	1.190	1.270	1.440	1.407	1.494	1.589	1.661	1.719	1.687	1.685	1.779	1.791	1.995	2.031	2.073	2.107
Special Populations Migration	White-NonHispanic	Thousands	47.026	8.679	-1.356	-23.325	-10.730	-3.545	-1.330	-0.019	-1.679	0.265	0.775	0.400	2.360	2.805	3.129	2.661	2.122	1.503	0.817

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Linking of Land Use to NAICS Codes

- Export ArcGIS attribute table to Excel
- Create key between land use codes associated with the shape file and associated NAICS codes

LUCODE	DESCRIPTION	NAICS Code	NAICS Description	DEFINITION (of colum
1000	**Spaced Rural Residential**			Single family homes lo
1090	Spaced Rural Residential Without Units			Parcels of land that do
1100	**Single Family Residential**			
1110	Single Family Detached			A single-unit structure
1120	Single Family Multiple-Units			A single-unit attached
1190	Single Family Residential Without Units			Parcels of land that do
1200	**Multi-Family Residential**			Multiple dwelling units
1280	Single Room Occupancy			For Rent SROs provide
1290	Multi-Family Residential Without Units			Parcels of land that do
1300	**Mobile Home Park**			Includes mobile home
1400	**Group Quarters**			Group living accommoc
1401	Jail/Prison	N/A	State and Local Government	
1402	Dormitory	61	Educational services; private	School associated grou
1403	Military Barracks	N/A	Federal Military	Group living accommoc
1404	Monastery	813	Religious, grantmaking, civic, professional, and similar organ	
1409	Other Group Quarters Facility	N/A	State and Local Government	Convalescent or retiren
1500	**Hotel/Motel/Resort**			
1501	Hotel/Motel (Low-Rise)	721	Accommodation	Hotels, motels, and oth
1502	Hotel/Motel (High-Rise)	721	Accommodation	Hotels and motels that
1503	Resort	721	Accommodation	Resorts with hotel acco
2000	**Heavy Industry**			
2001	Heavy Industry	3364-3369	Manufacturing	Shipbuilding, airframe,
2100	**Light Industry**			
2101	Industrial Park	3364-3369	Manufacturing	Office/industrial uses c
2103	Light Industry - General	3364-3369	Manufacturing	All other industrial uses
2104	Warehousing	493		Usually large buildings
2105	Public Storage	493		Public self-storage buil
2200	**Extractive Industry**			
2201	Extractive Industry	212		Mining, sand and grave
2300	**Junkyards/Dumps/Landfills**			
2301	Junkyard/Dump/Landfill	562	Waste management and	The landscape should s
4100	**Airports**			
4101	Commercial Airport	481	Air transportation	Lindbergh Field only.
4102	Military Airport	481	Air transportation	Airports owned and op
4103	General Aviation Airport	481	Air transportation	All general aviation air
4104	Airstrip	481	Air transportation	

Join REMI Employment Data with Shape File

- Join the employment data by NAICS code to the shape file data using the NAICS-land use key
  - In the screenshot to the right, the third column represents the total employment change for that NAICS code, and the fourth column is the employment change for that specific parcel
- This can also be done for simulations to determine the employment change by parcel

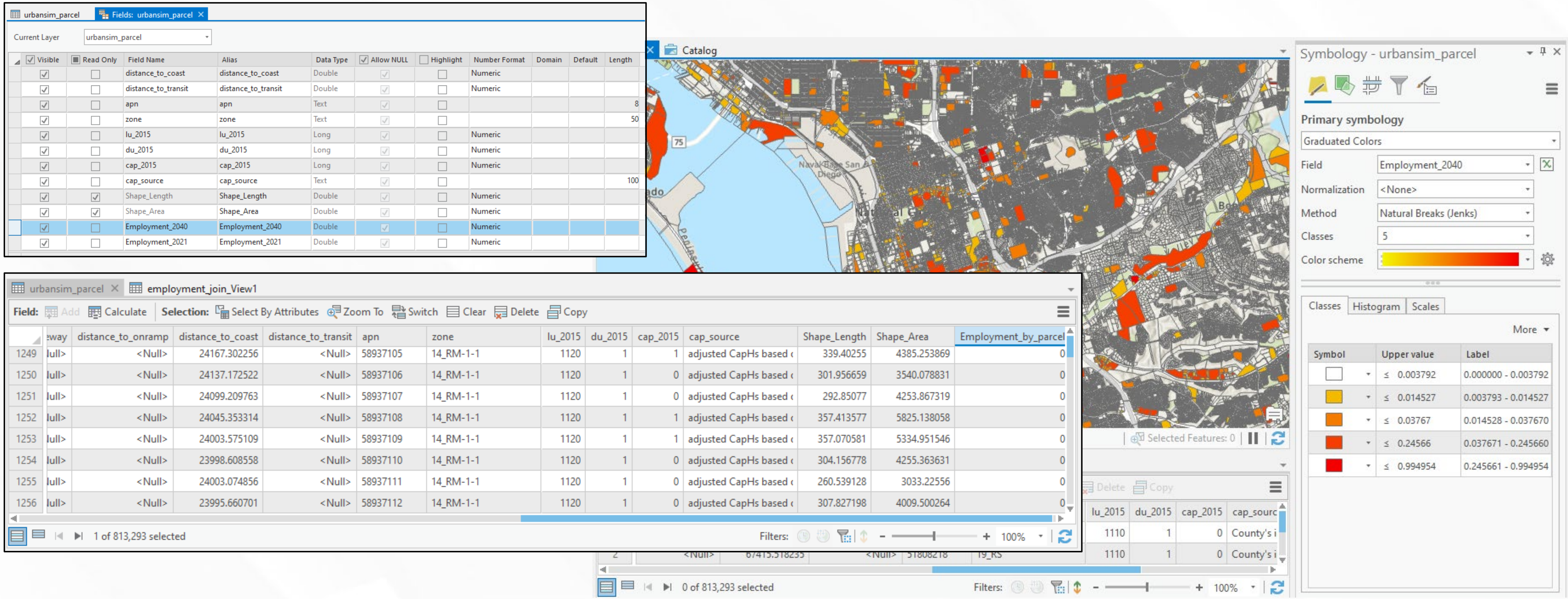
OID_	NAICS	Employment i	Employment_Value
336	813	23	0.000181321
1175	112	11	6.31E-06
1922	713	25	0.000111283
2536	813	23	0.000354852
2538	44	194	0.00552554
2539	44	194	0.004300316
2540	44	194	0.006256099
2541	493	3	4.22E-05
2647	44	194	0.004912187
2700	112	11	1.54E-05
2701	112	11	3.46E-05
2703	112	11	2.18E-05
2755	713	25	5.36E-05
3169	112	11	2.03E-05
3217	112	11	9.06E-05
3222	112	11	4.85E-05
3255	44	194	0.051207974
3388	493	3	1.46E-05
4081	112	11	8.66E-05
5107	713	25	7.21E-05
5124	713	25	5.12E-05
5223	61	51	0.001046969
5240	561	133	0.000707612

Weighting by Industry Parcel Square Footage

- Determine each parcel's square footage as a percentage of the total square footage of each industry
- Multiply this percentage by the total employment change for that particular industry
  - Example (baseline employment data):
    - Parcel 4408 NAICS code: 713 (Amusement, Gambling, and Recreation industry)
    - Shape area: 256,234 sq ft
    - Parcel square footage as % of total (which is 36,089,295 ft^2) for NAICS 713: 0.71%
    - NAICS 713 employment: 24,345 * 0.71% = **181 jobs in parcel 4408 from the Amusement, Gambling, and Recreation industry**

Weighting by Industry Parcel Square Footage

- Add a field of the shape file within ArcGIS for the employment by parcel
- Copy the employment by parcel calculations to the new field created in the shape file
- Use the “Symbology” feature within ArcGIS to create a color coded map showing the magnitude of employment impacts by parcel



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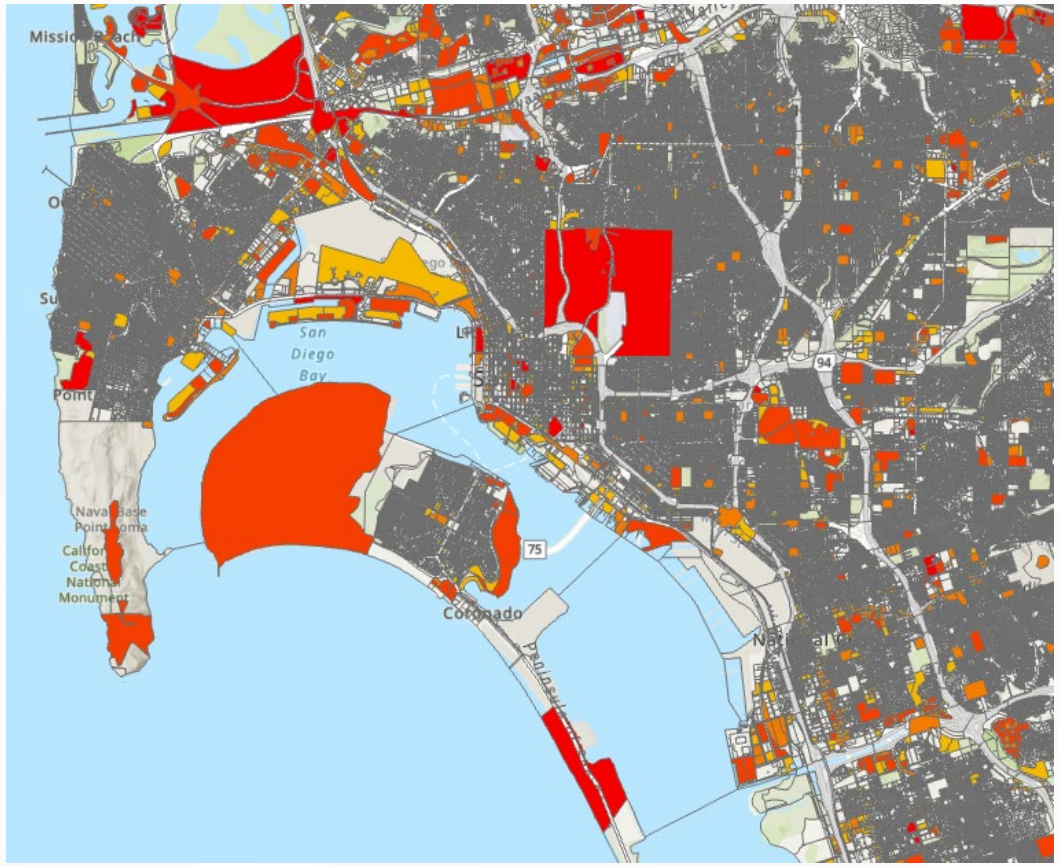
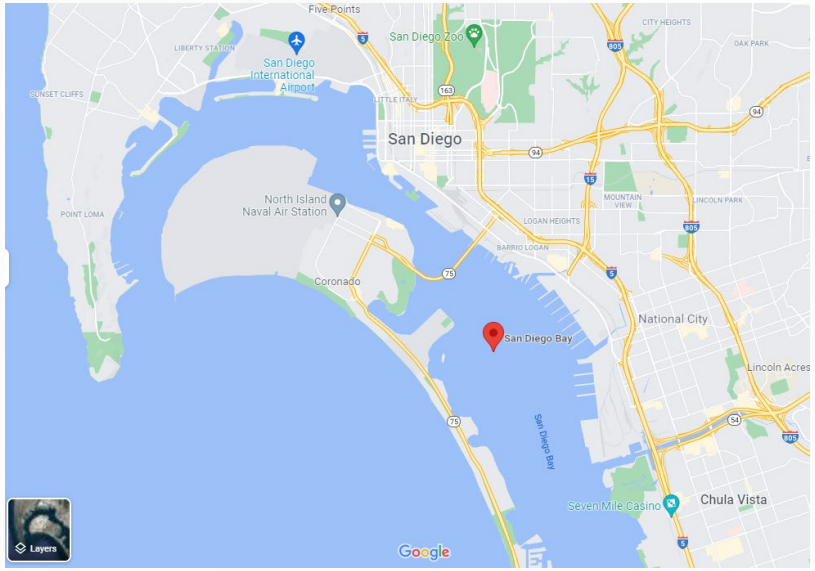
Visualizing REMI baseline employment for San Diego within ArcGIS



Baseline employment by parcel (2021)

Symbol	Upper value	Label
	≤ 0.003792	0.000000 - 0.003792
	≤ 0.014527	0.003793 - 0.014527
	≤ 0.03767	0.014528 - 0.037670
	≤ 0.24566	0.037671 - 0.245660
	≤ 0.994954	0.245661 - 0.994954

Key (thousands of jobs)



Google map of San Diego for reference

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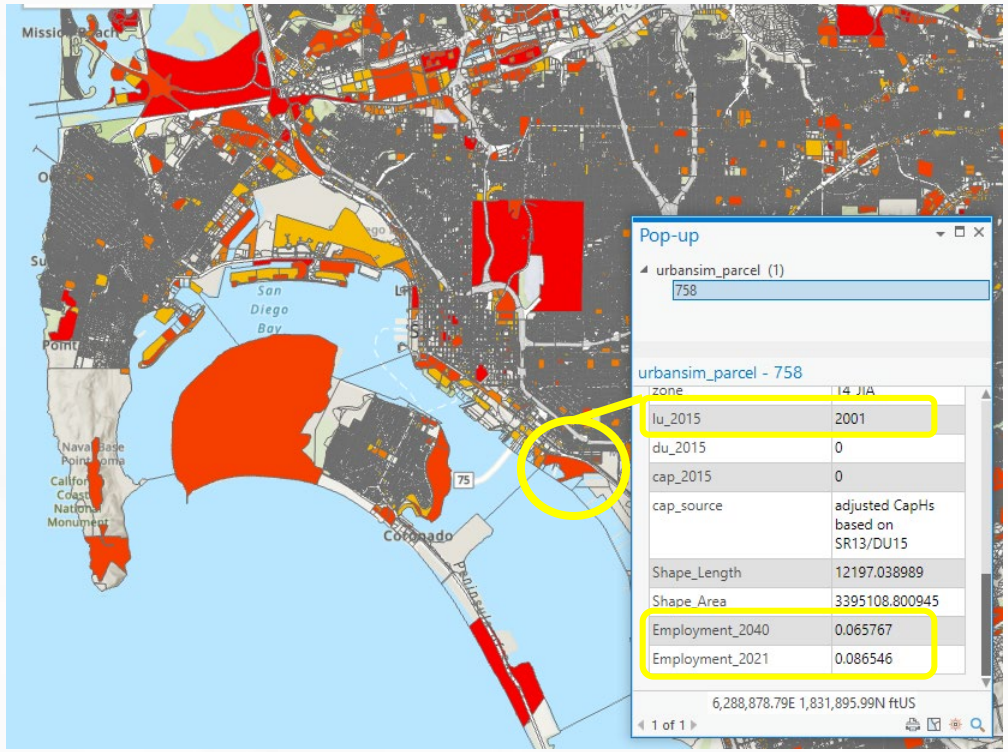
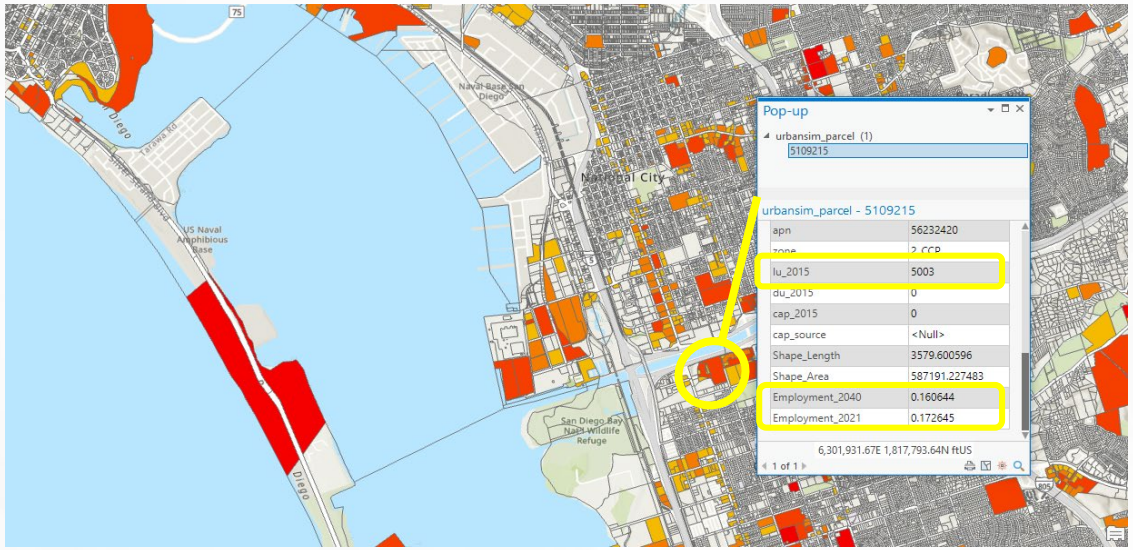
Obtaining employment data for specific parcels



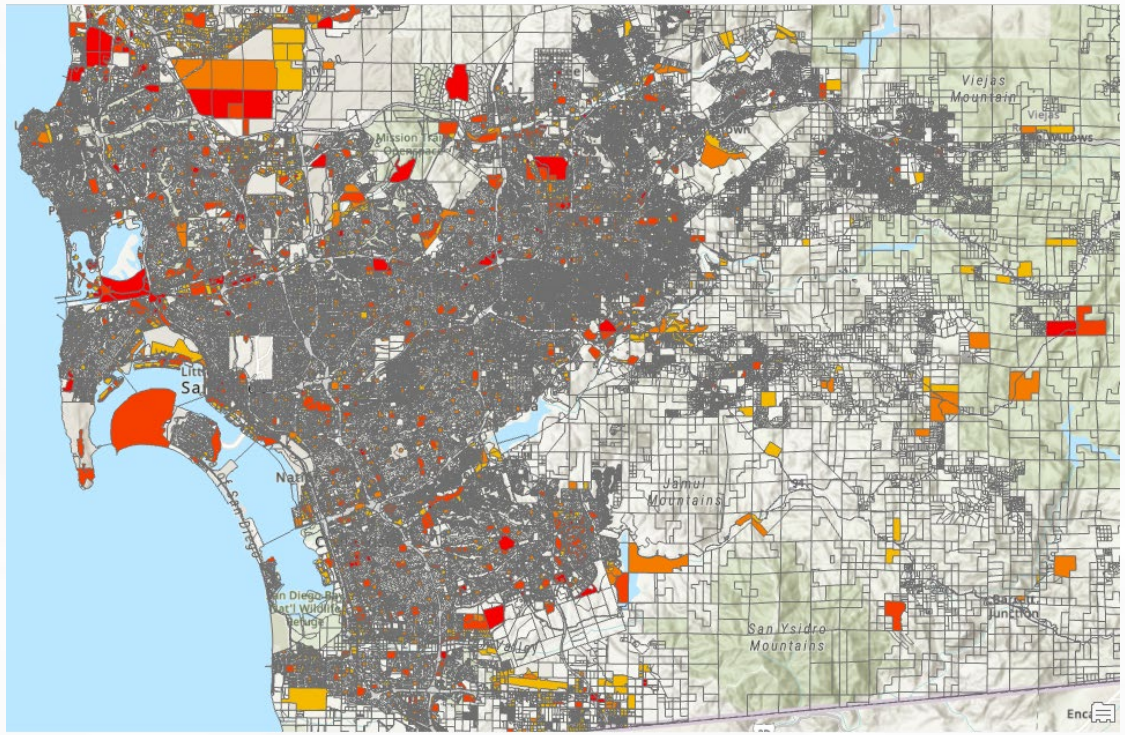
- Land use code of 2001 (Heavy Industry) corresponds to the NAICS code of 3364-3369 (Manufacturing) based on the land use to NAICS mapping
- 2021 employment: 86
- 2040 employment: 66
- This actual parcel in San Diego corresponds to NASSCO, a General Dynamics shipbuilding/ship repair yard

Obtaining employment data for specific parcels

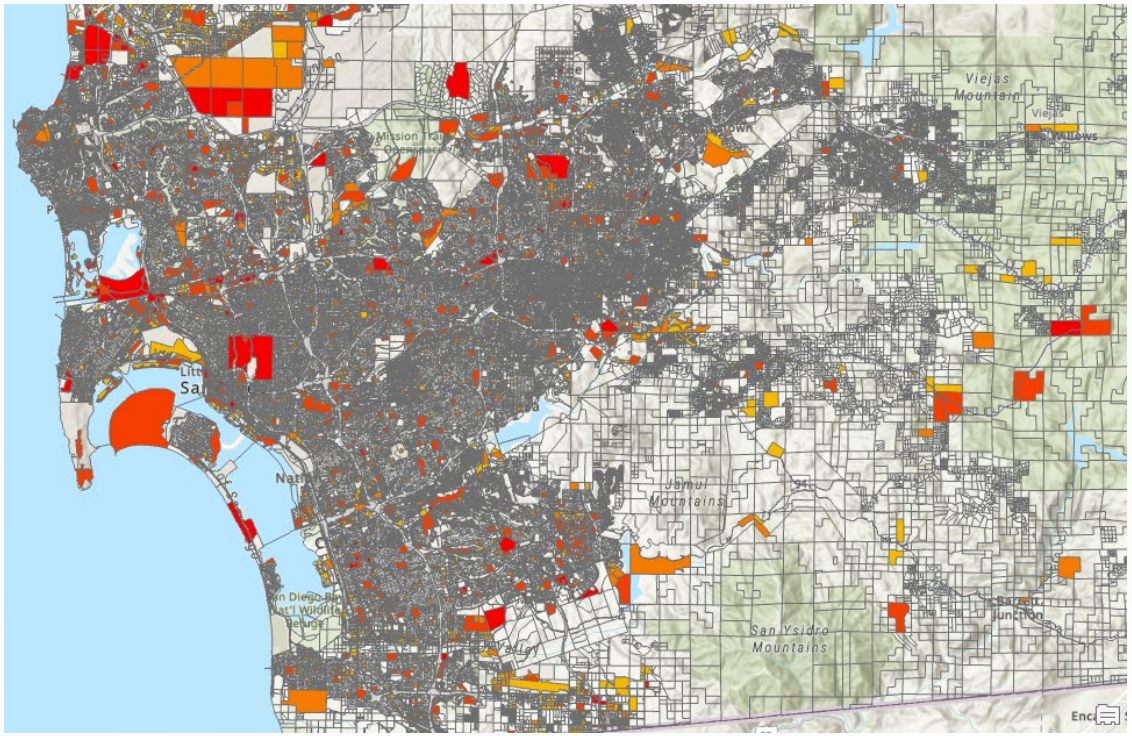


- Land use code of 5003 (Community Shopping Center) corresponds to the NAICS code of 44-45 (Retail Trade) based on the land use to NAICS mapping
- 2021 employment: 173
- 2040 employment: 161
- This actual parcel in San Diego corresponds to a shopping center including a Walmart and Best Buy

Visualizing REMI simulation results within ArcGIS – Incorporating REMI forecast years



2021



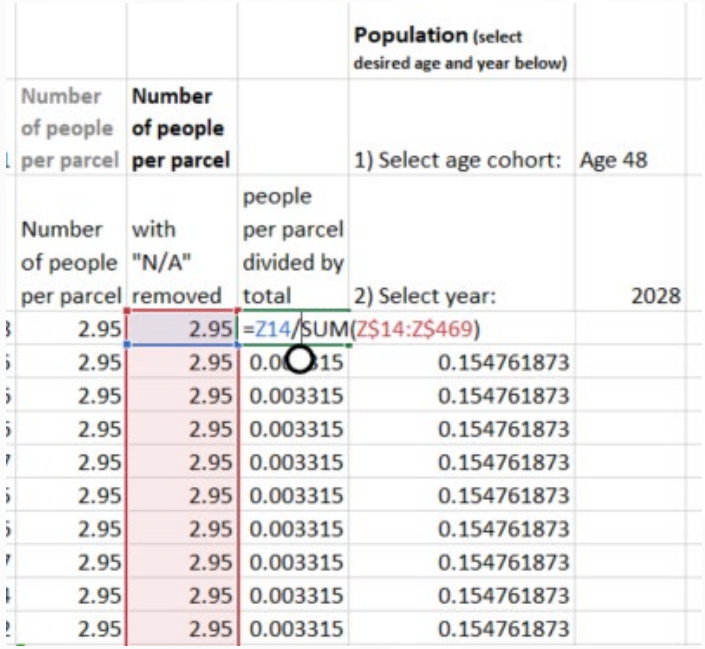
2040

- Importing different years of the REMI forecast allows for visualization of how employment changes over time

Additional REMI-ArcGIS Integration - Population

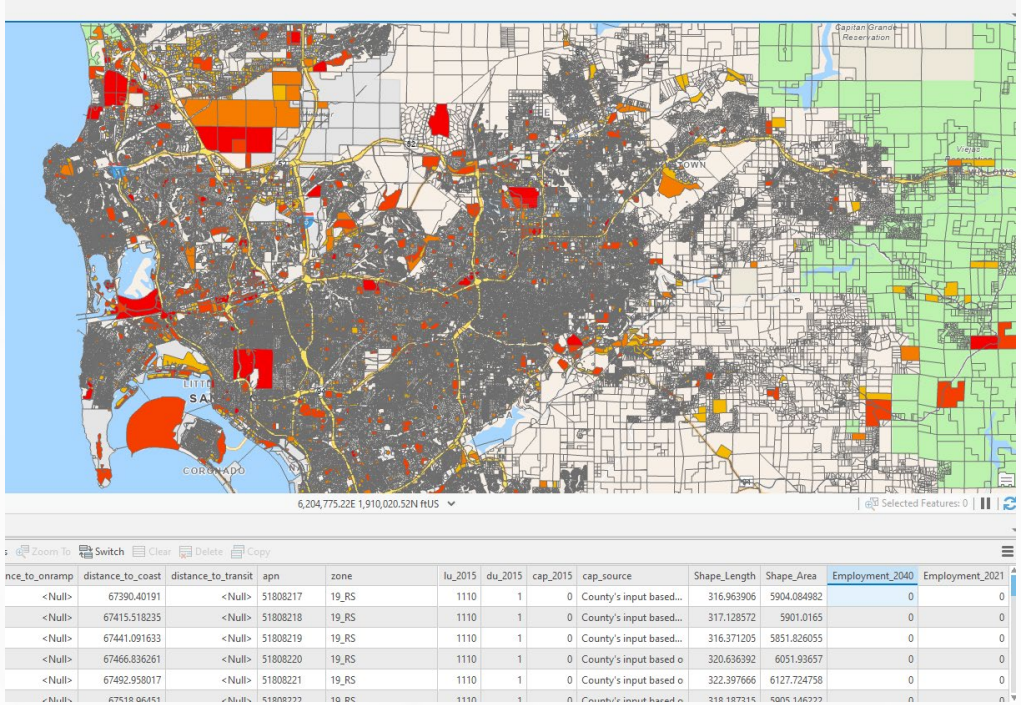
- In addition to visualizing employment data, other REMI variables can be integrated with ArcGIS, assuming data availability in the shape file, such as population by parcel
- Based on the residential land use type the average number of people per household can be assigned based on the number of units in that land use code, which is then used to determine a percentage that each parcel represents of the population
- The actual population value is then multiplied by these percentages to determine the number of people for each parcel

LUCODE	DESCRIPTION	Residential: Average Number of People per Household (source: Census Bureau)	Notes
1000	**Spaced Rural Residential**		
1090	Spaced Rural Residential Without Units	0	Does not cont
1100	**Single Family Residential**	**2.95**	
1110	Single Family Detached	2.95	
1120	Single Family Multiple-Units	2.95	
1190	Single Family Residential Without Units	0	Does not cont
1200	**Multi-Family Residential**	**35.73**	A rough estima
1280	Single Room Occupancy	2.95	
1290	Multi-Family Residential Without Units	0	Does not cont
1300	**Mobile Home Park**		

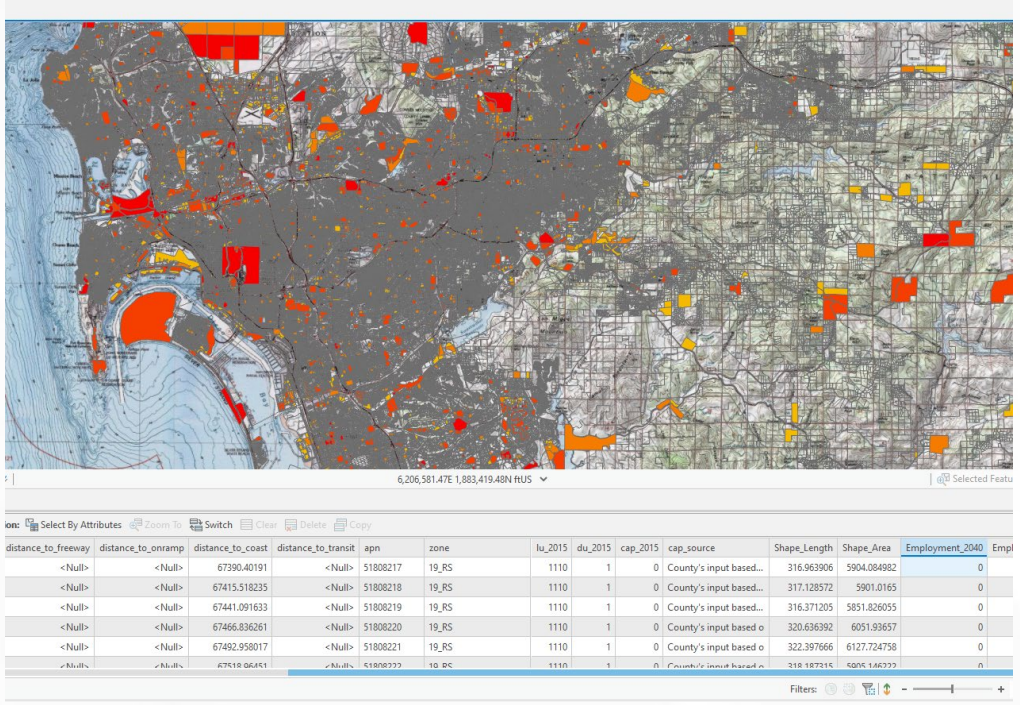


Other Applications

- Using other ArcGIS layers in conjunction with REMI results can help with utility and transportation planning
- Based on what components are available in the shape file, spreading of REMI results variables can be further customized



nce_to_onramp	distance_to_coast	distance_to_transit	apn	zone	lu_2015	du_2015	cap_2015	cap_source	Shape_Length	Shape_Area	Employment_2040	Employment_2021
<Null>	67390.40191	<Null>	51808217	19_RS	1110	1	0	County's input based...	316.963906	5904.084982	0	0
<Null>	67415.518235	<Null>	51808218	19_RS	1110	1	0	County's input based...	317.128572	5901.0165	0	0
<Null>	67441.091633	<Null>	51808219	19_RS	1110	1	0	County's input based...	316.371205	5851.826055	0	0
<Null>	67466.836261	<Null>	51808220	19_RS	1110	1	0	County's input based o	320.636392	6051.93657	0	0
<Null>	67492.958017	<Null>	51808221	19_RS	1110	1	0	County's input based o	322.397666	6127.724758	0	0



distance_to_freeway	distance_to_onramp	distance_to_coast	distance_to_transit	apn	zone	lu_2015	du_2015	cap_2015	cap_source	Shape_Length	Shape_Area	Employment_2040	Empl
<Null>	<Null>	67390.40191	<Null>	51808217	19_RS	1110	1	0	County's input based...	316.963906	5904.084982	0	
<Null>	<Null>	67415.518235	<Null>	51808218	19_RS	1110	1	0	County's input based...	317.128572	5901.0165	0	
<Null>	<Null>	67441.091633	<Null>	51808219	19_RS	1110	1	0	County's input based...	316.371205	5851.826055	0	
<Null>	<Null>	67466.836261	<Null>	51808220	19_RS	1110	1	0	County's input based o	320.636392	6051.93657	0	
<Null>	<Null>	67492.958017	<Null>	51808221	19_RS	1110	1	0	County's input based o	322.397666	6127.724758	0	

Conclusion

- The REMI model can be used in conjunction with other models in order to streamline and to enhance the analysis
- The Command Line Interface allows for automation of simulation runs and data exporting
- ArcGIS shape files can be linked to results within the REMI model in order to explore visualization tools and to allow for sub-county analysis
    - Visualization can be customized based on how detailed components are in the shape file (such as land use code detail, housing types, parcel square footage, etc.)
- Using other ArcGIS layers such as utility data along with forecast data can help planners forecast future needed utility expansion

Thank you for attending!

For more information, please contact
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