



Building Shared Metropolitan Data, Modeling and Planning Frameworks



UrbanSim

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Land Use
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Challenges

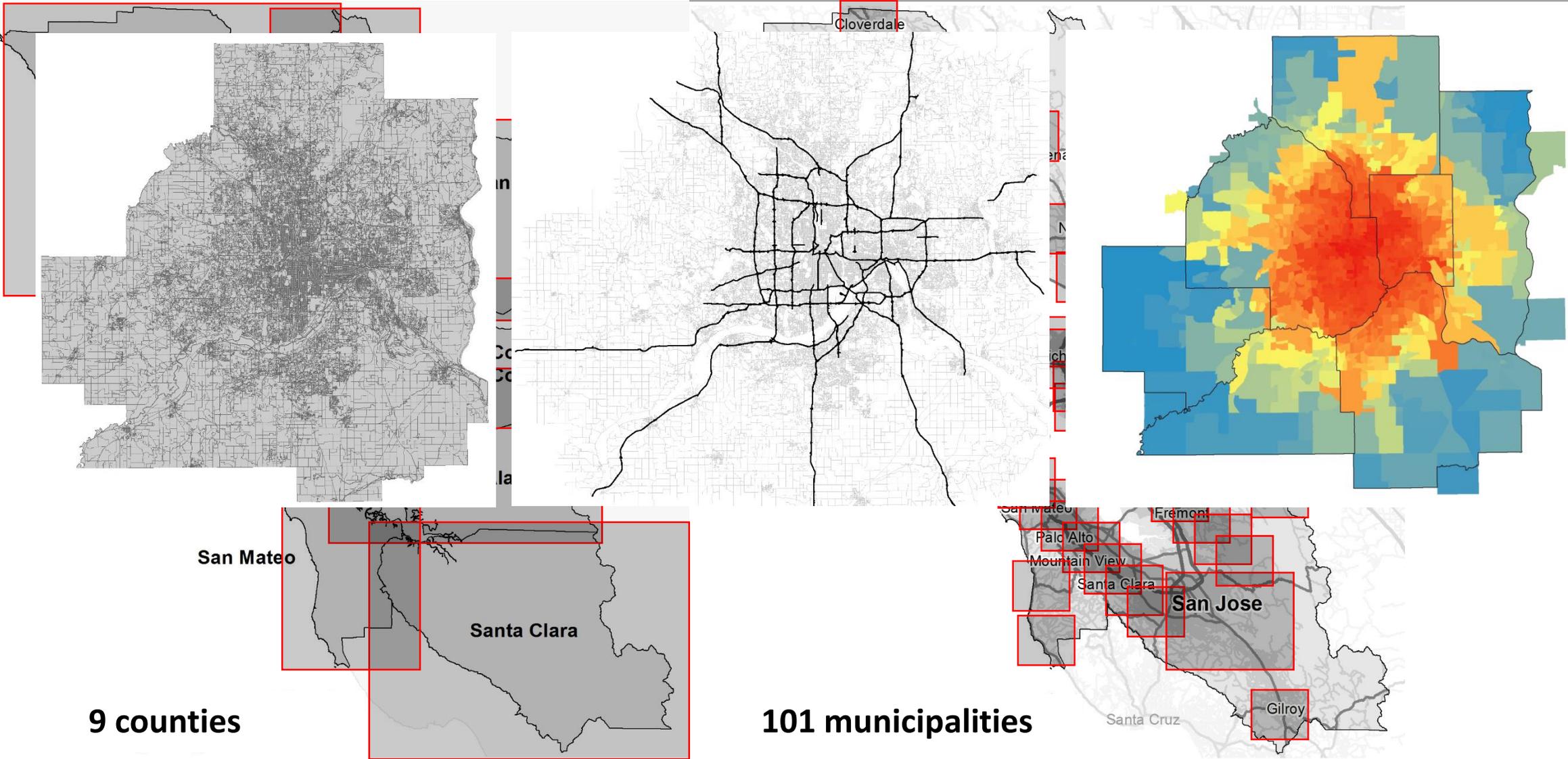
Regional Transportation Plans (RTPs):

- Are multi-year efforts that often involve the collection of a massive amount of data on current and planned land uses from many local governments
- Are reliant on coordination with local jurisdictions that control land use decisions
- Land use forecasting and modeling efforts that inform the RTP are often started from scratch as each new RTP process begins
- The start-up process to collect local data and harmonize it within the region can be cumbersome and costly



Source: Plan Bay Area 2040, MTC & ABAG 2017

Challenges



Challenges

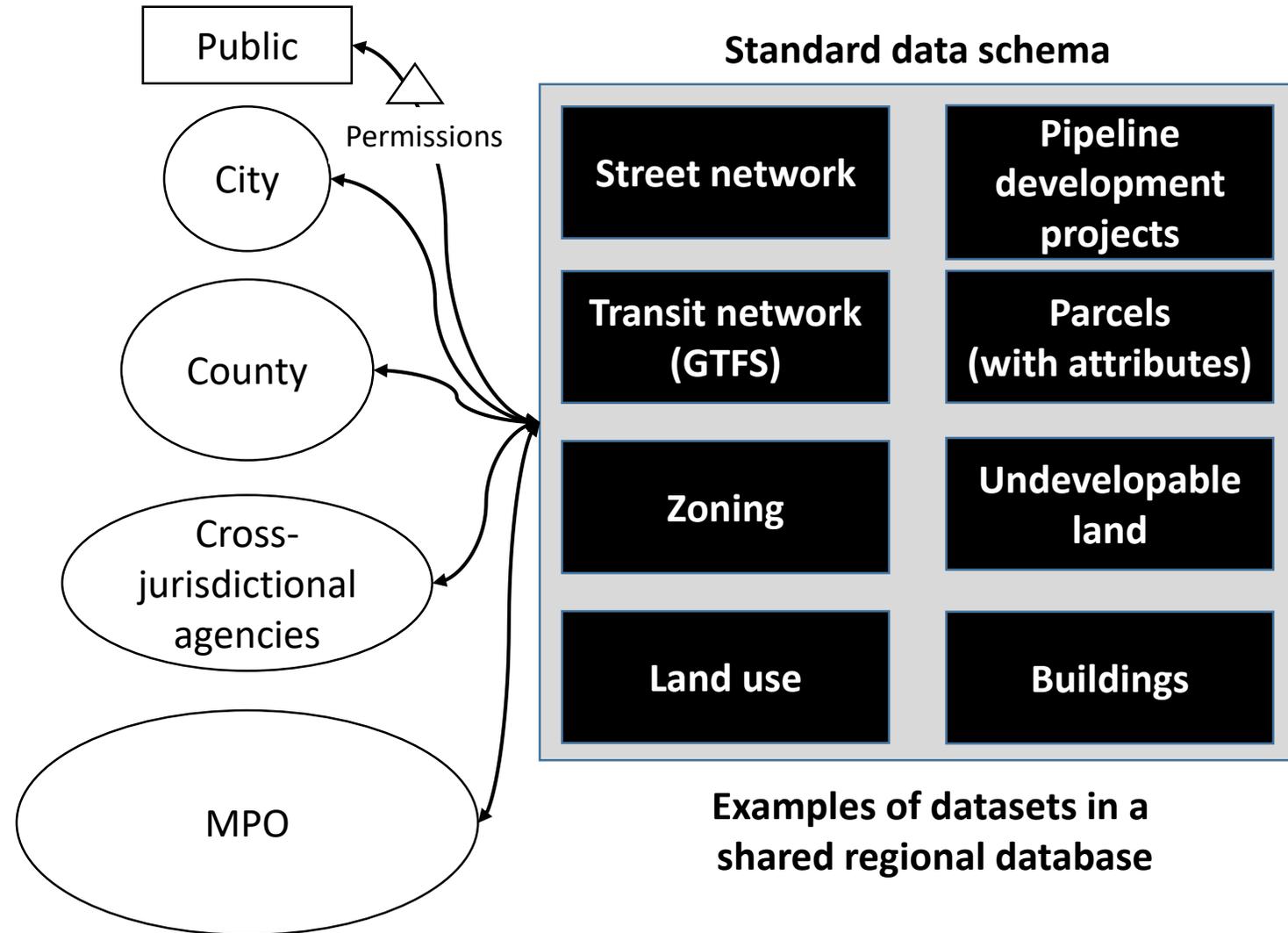
There is no persistent, collaboratively maintained repository for data on the built and planned environment



OpenStreetMap



Examples of crowdsourced initiatives of centralized open datasets

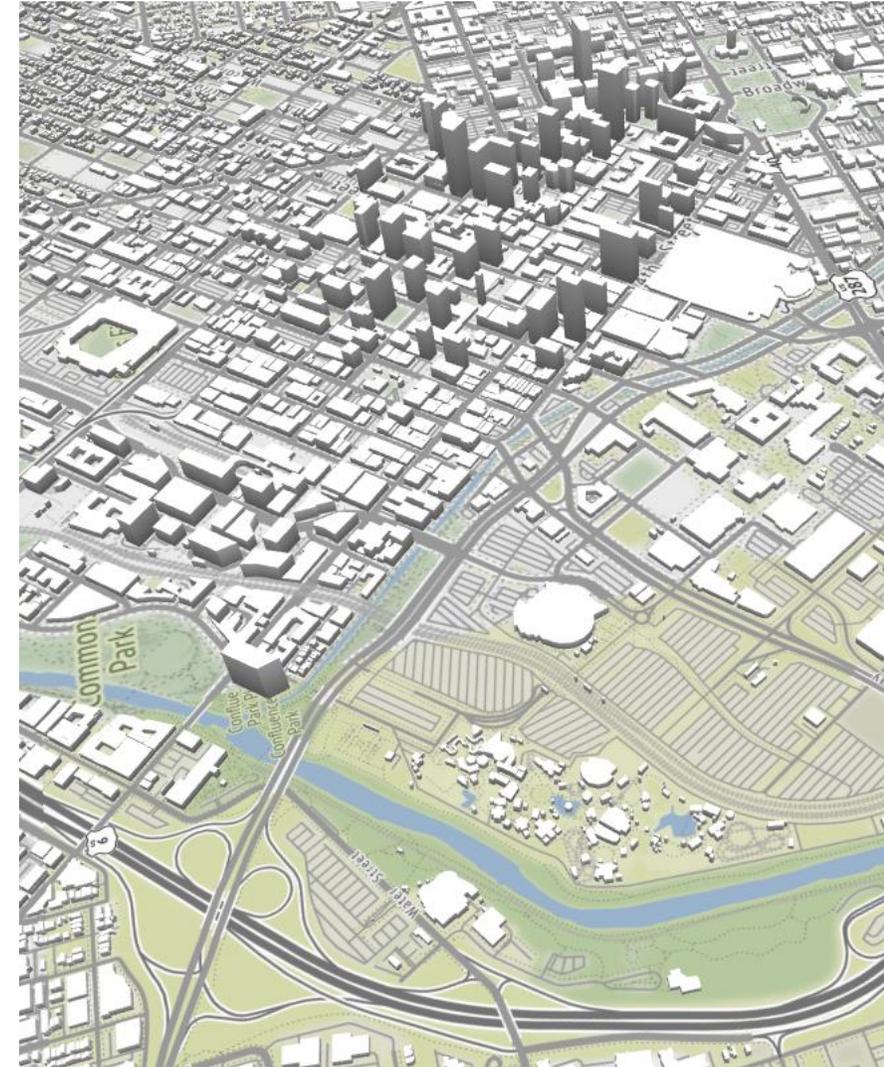


Allocation of future development & land use:

- Political negotiation with local jurisdictions or committee of experts
- In-house spreadsheet models and custom software
- Sketch planning and visioning tools
- Behavioral models

The UrbanSim land use model:

- Substantial data requirements
- Requires significant staff resources for training and knowledge of computer programming
- Most practical for MPOs with large budgets, computing resources, and staff



UrbanSim: UrbanCanvas

What is UrbanSim?

UrbanSim is:

- A microsimulation land use model
- Designed to support the need of MPOs, cities and other organizations for analyzing the potential effects of land use policies and infrastructure investments on the development and character of cities and regions
- Developed as a Open Source model system initially funded by 6 NSF grants
- Based upon research led by Paul Waddell at the University of California, Berkeley
- Actively used by MPOs in: Albuquerque, Austin, Denver, Detroit, Honolulu, Phoenix, Salt Lake City, San Diego, San Francisco, and Seattle, among others

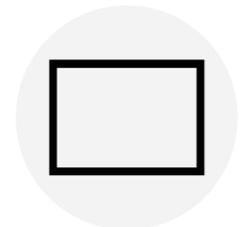
Geographic levels of analysis:



Parcels



Census Block

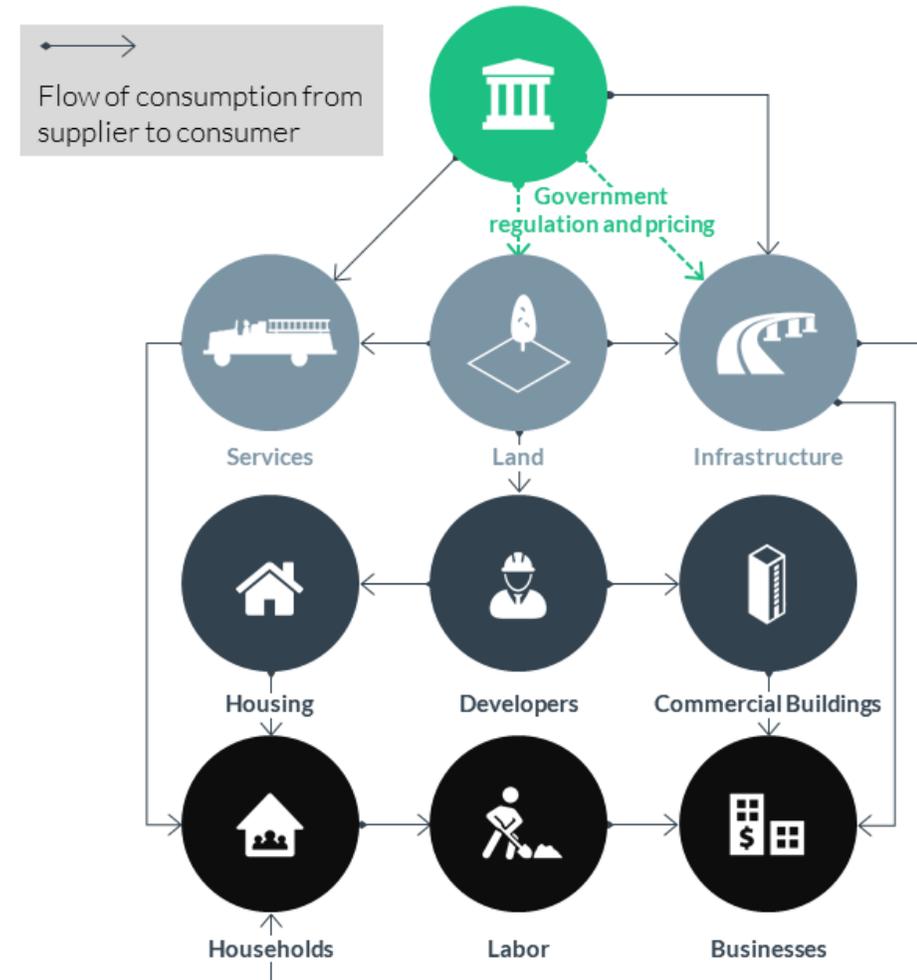


Arbitrary Zone

How does UrbanSim work?

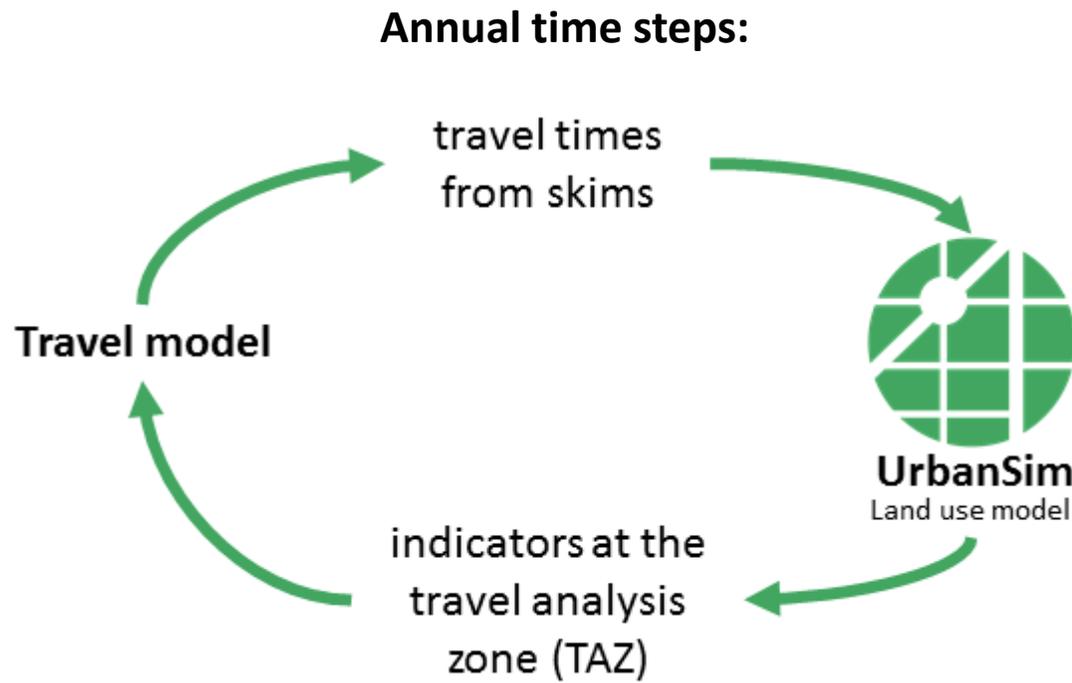
UrbanSim:

- Simulates the behavior of decision-making agents that participate in the real estate market (e.g. households, employers, and real estate developers)
- Simulates urban development as a dynamic process over time and space
- Simulates the land market as the interaction of demand and supply, with prices and rents adjusting to clear the market
- Housing markets are separated by tenure and building type
- Explicitly incorporates governmental policy assumptions and evaluates policy impacts by modeling market responses
- Is based on random utility theory and uses logit models for the implementation of demand components

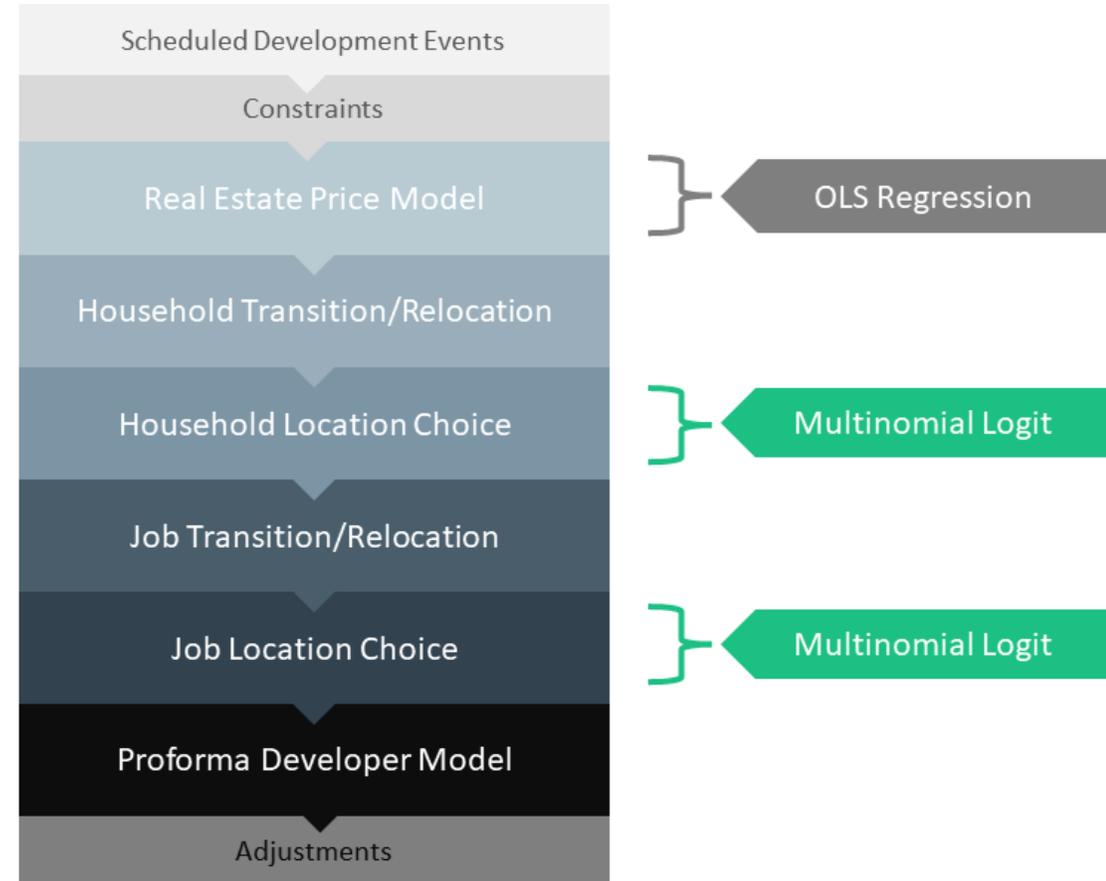


UrbanSim simulates agents interacting within real estate markets

How does UrbanSim work?



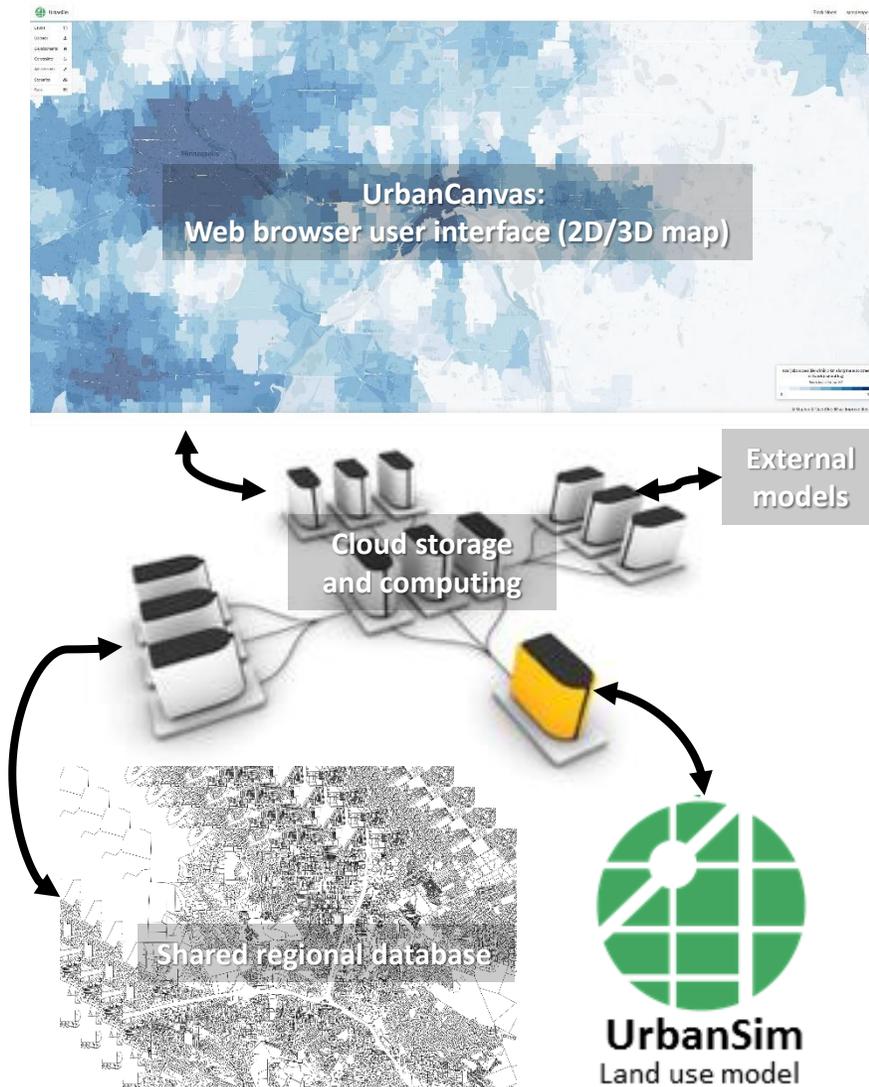
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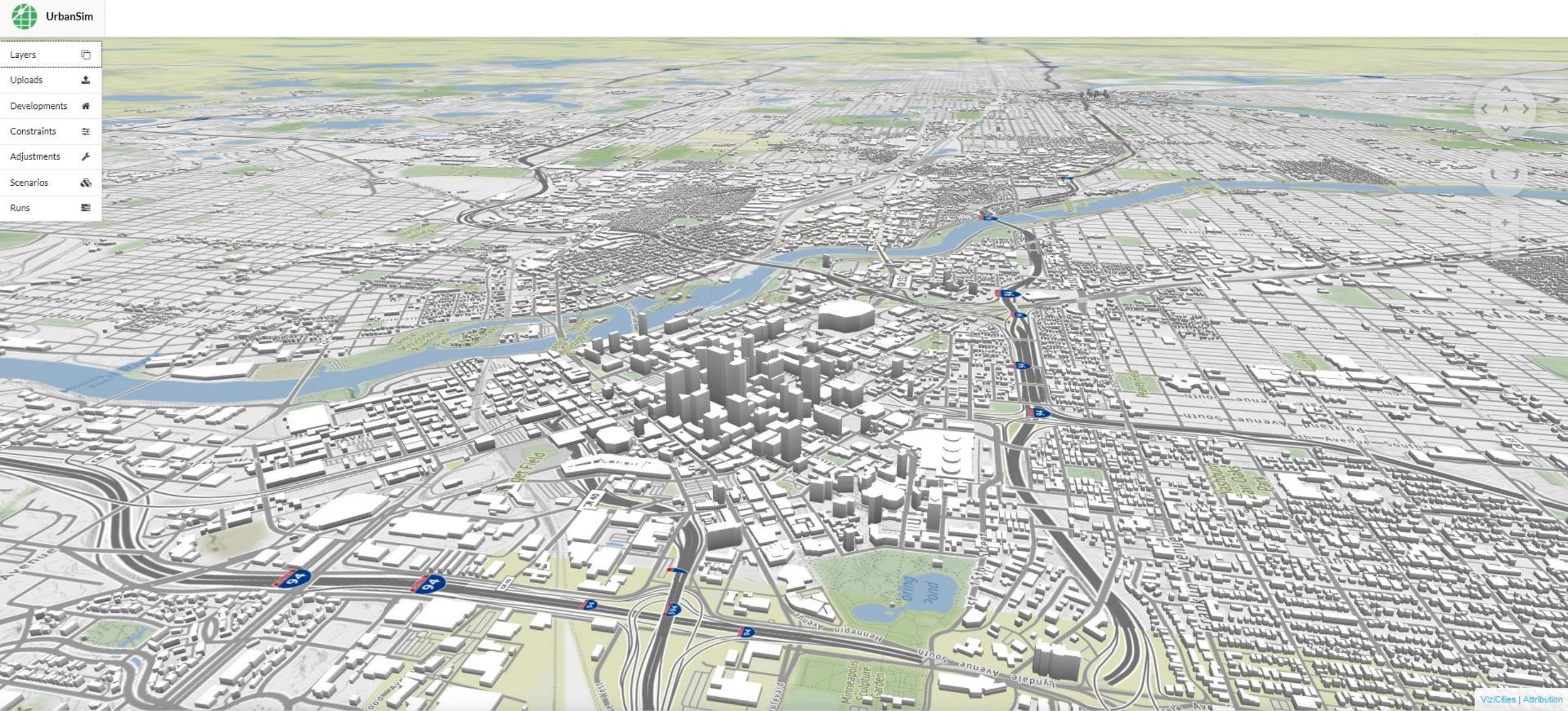
A platform to support regional planning & land use forecasting:

UrbanSim Cloud Platform:

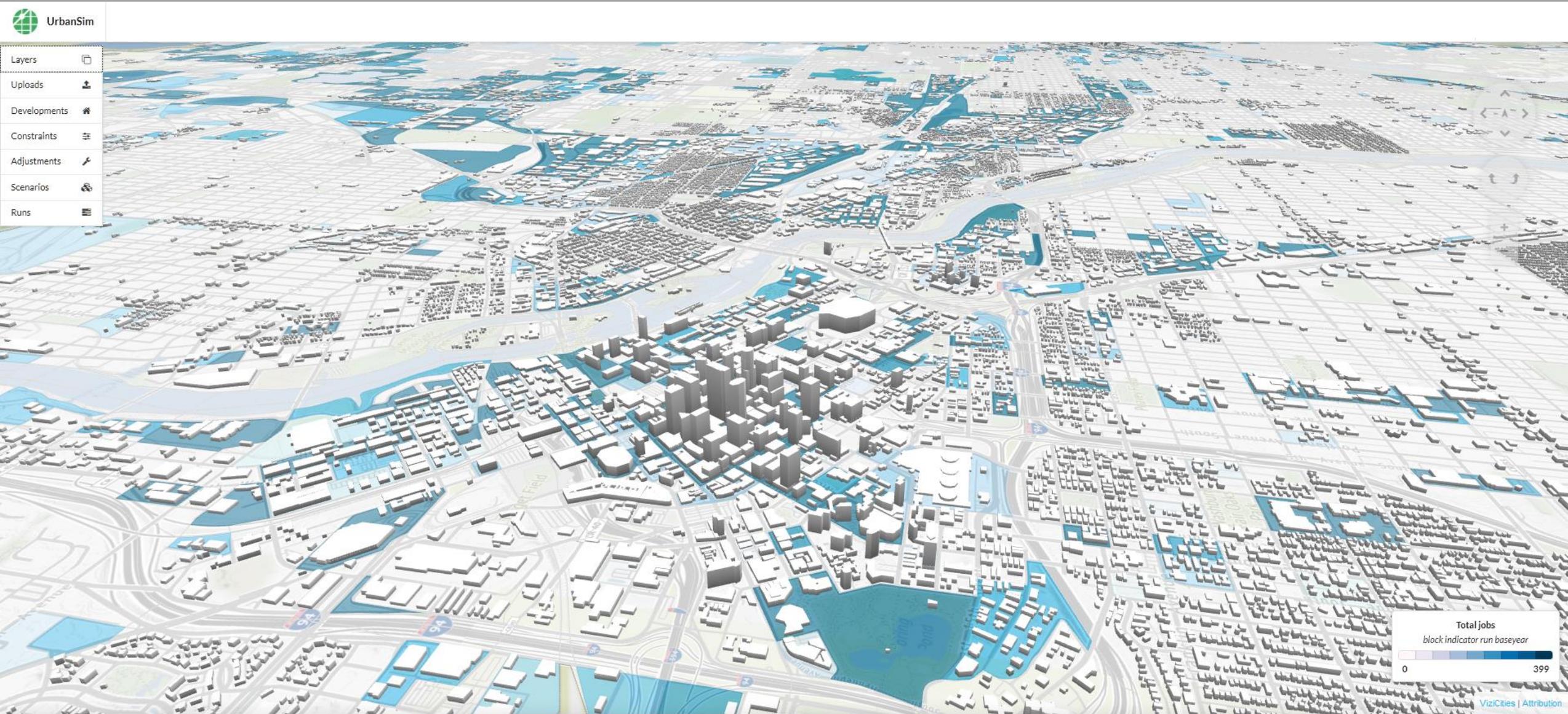
- Wraps the UrbanSim land use model within cloud infrastructure:
 - scalable cloud computing on demand
 - run as many simulations as needed without the need for local computing resources
- 2D/3D mapping web user interface to manage data inputs and visualize simulated results with integrated analytics
- Shared regional data repository enabling collaboration among cities, counties, transportation agencies and the MPO
- Rapid prototyping and management of scenarios
- Flexible geographic aggregation from the parcel level to arbitrary zonal geographies



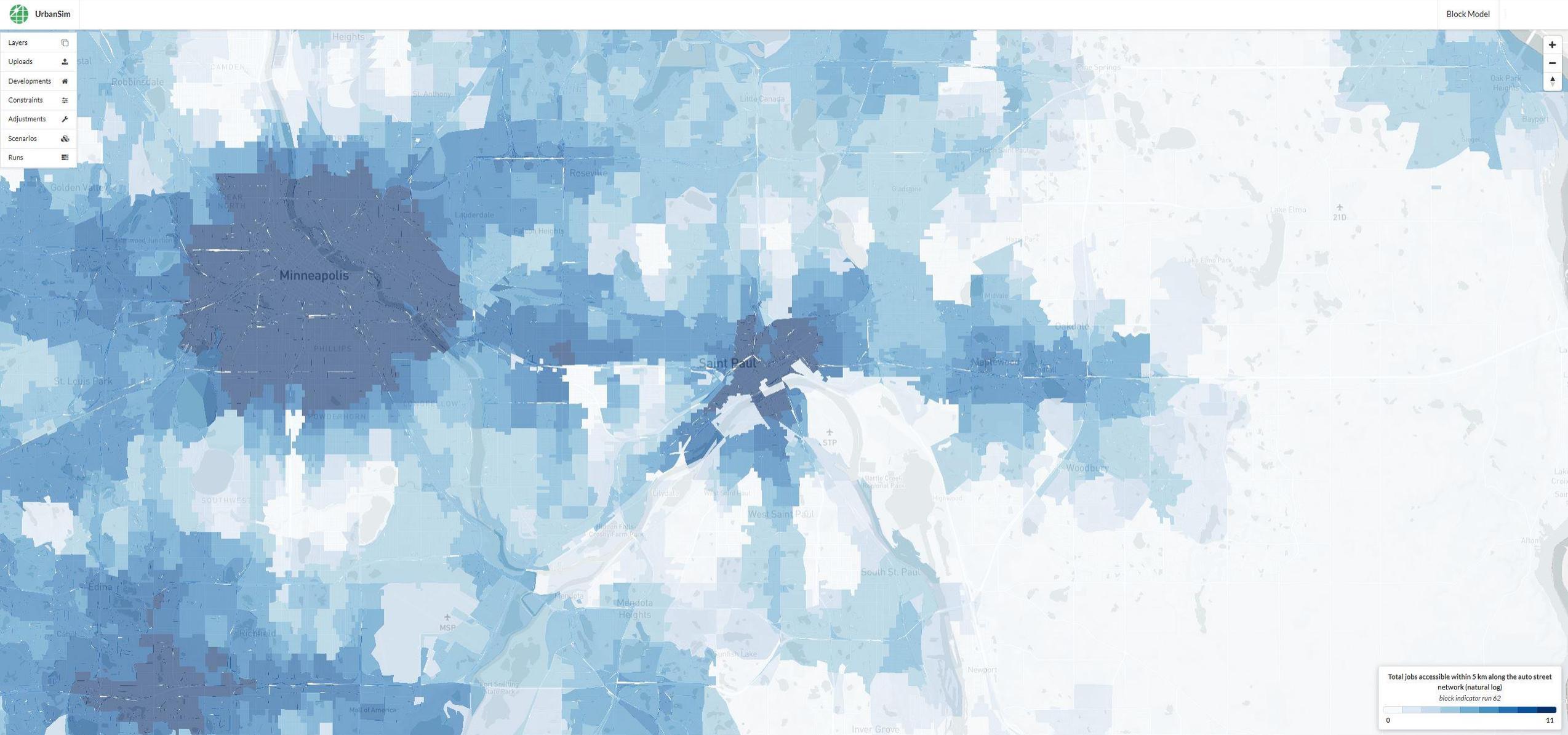
UrbanSim Cloud Platform: UrbanCanvas



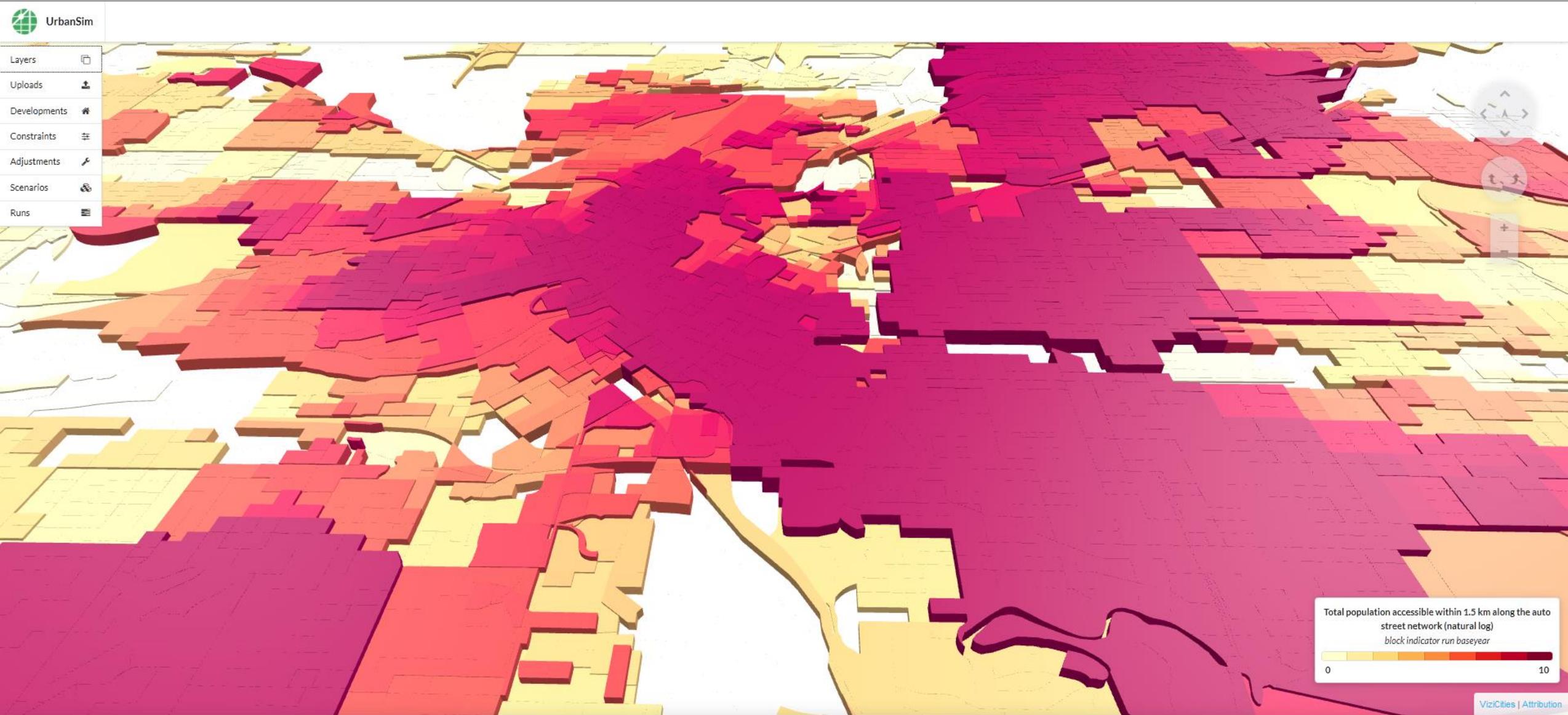
UrbanSim Cloud Platform: UrbanCanvas



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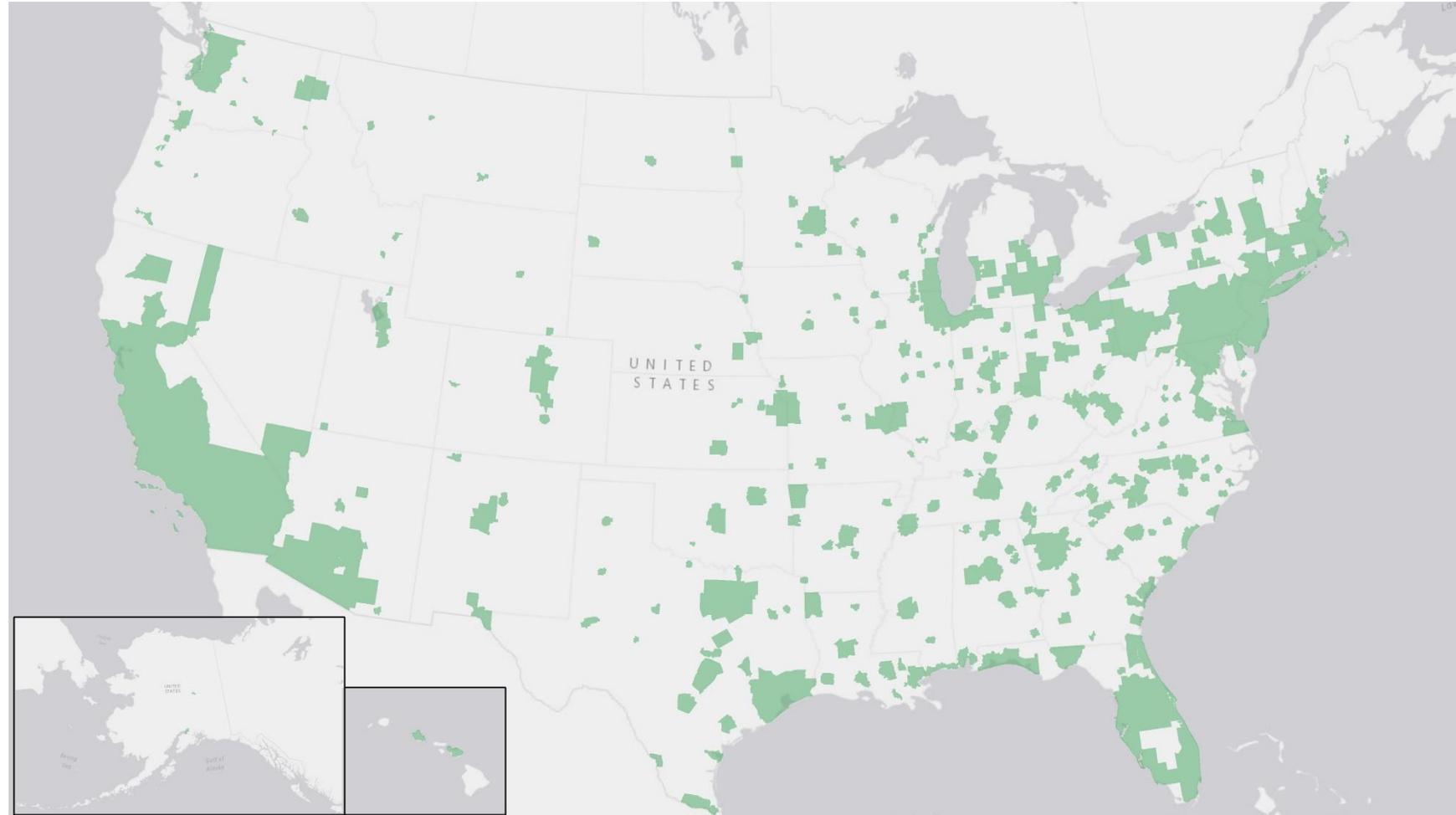


UrbanSim Cloud Platform: UrbanCanvas



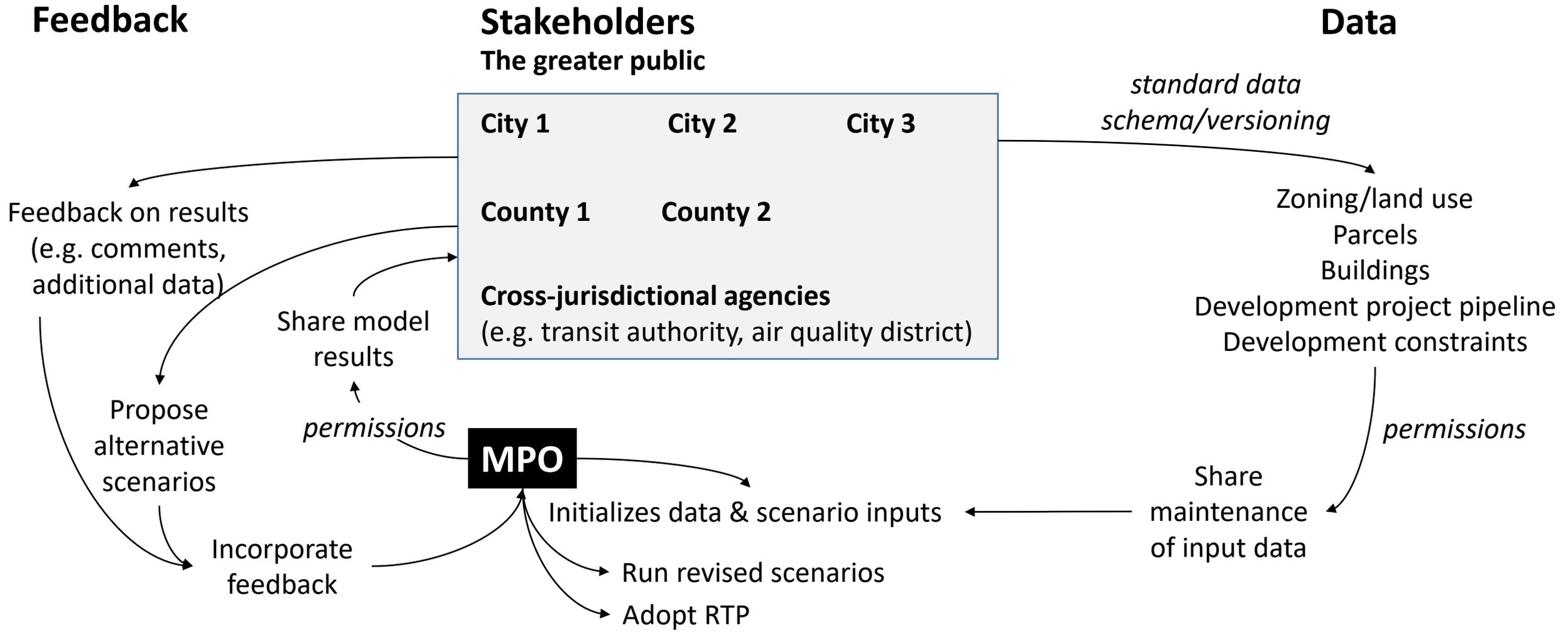
UrbanSim Cloud Platform: UrbanSim Census Block Model

- **350+ metropolitan areas:**
 - Synthetic population at census block level
 - Pre-built block level UrbanSim models
- **Lower barrier of entry to begin using UrbanSim:**
 - Meanwhile can build parcel level data needed to run more detailed parcel level model
- Leverage national data and modeling infrastructure for model specification and calibration



MPO jurisdictions with pre-built census block level UrbanSim models

UrbanSim Cloud Platform: Shared regional database



Open Source tools for regional planning

Urban Data Science Toolkit:

- **UrbanSim**
A platform for simulating urban real estate markets and their interaction with transportation.
- **ORCA**
A generalized framework for data processing and orchestration to support UrbanSim, ActivitySim, and other types of modeling.
- **ActivitySim**
A platform for simulating Activity-Based Travel.
- **Pandana**
A fast network accessibility engine for computing accessibility metrics.
- **Spandex**
Spatial Analysis and Data Extraction.
- **Synthpop**
A Population Synthesizer.
- **ChoiceModels**
A library of flexible discrete choice models, including Multinomial Logit, Nested Logit, Mixed Logit, and Latent Class Models.
- **UrbanAccess**
A library to obtain, clean, merge and analyze GTFS Transit Networks and OSM networks for pedestrian and transit accessibility.

The screenshot shows the GitHub repository page for the Urban Data Science Toolkit. The repository is located in Berkeley, CA, and has a website at <http://www.urbansim.com> and an email at udst@urbansim.com. The repository has 51 people, 17 teams, and 0 projects. The page displays a search bar, filters for repository type and language, and a list of repositories. The repositories listed are:

- urbanaccess**: A tool for GTFS transit and OSM pedestrian network accessibility analysis. It has 4 stars, 3 forks, and was updated 3 minutes ago. It includes tags for graph, network, openstreetmap, gtfs, network-analysis, accessibility-analysis, and transit-networks.
- pandana**: Pandas Network Analysis - dataframes of network queries, quickly. It has 59 stars, 25 forks, and was updated 3 days ago. It includes a tag for C++.
- osmnet**: Tools for the extraction of OpenStreetMap street network data. It has 1 star and was updated 3 days ago. It includes tags for graph, network, openstreetmap, overpass-api, and street-networks.
- orca**: Pipeline orchestration tool with Pandas support. It has 21 stars, 8 forks, and was updated 4 days ago. It includes a tag for Python.

On the right side of the page, there are sections for 'Top languages' (Python, JavaScript, Jupyter Notebook, C++, Batchfile), 'Most used topics' (graph, network, openstreetmap), and 'People' (51 members).

Open Source tools for regional planning

Vizicities

A framework for 3D geospatial visualization in the browser.

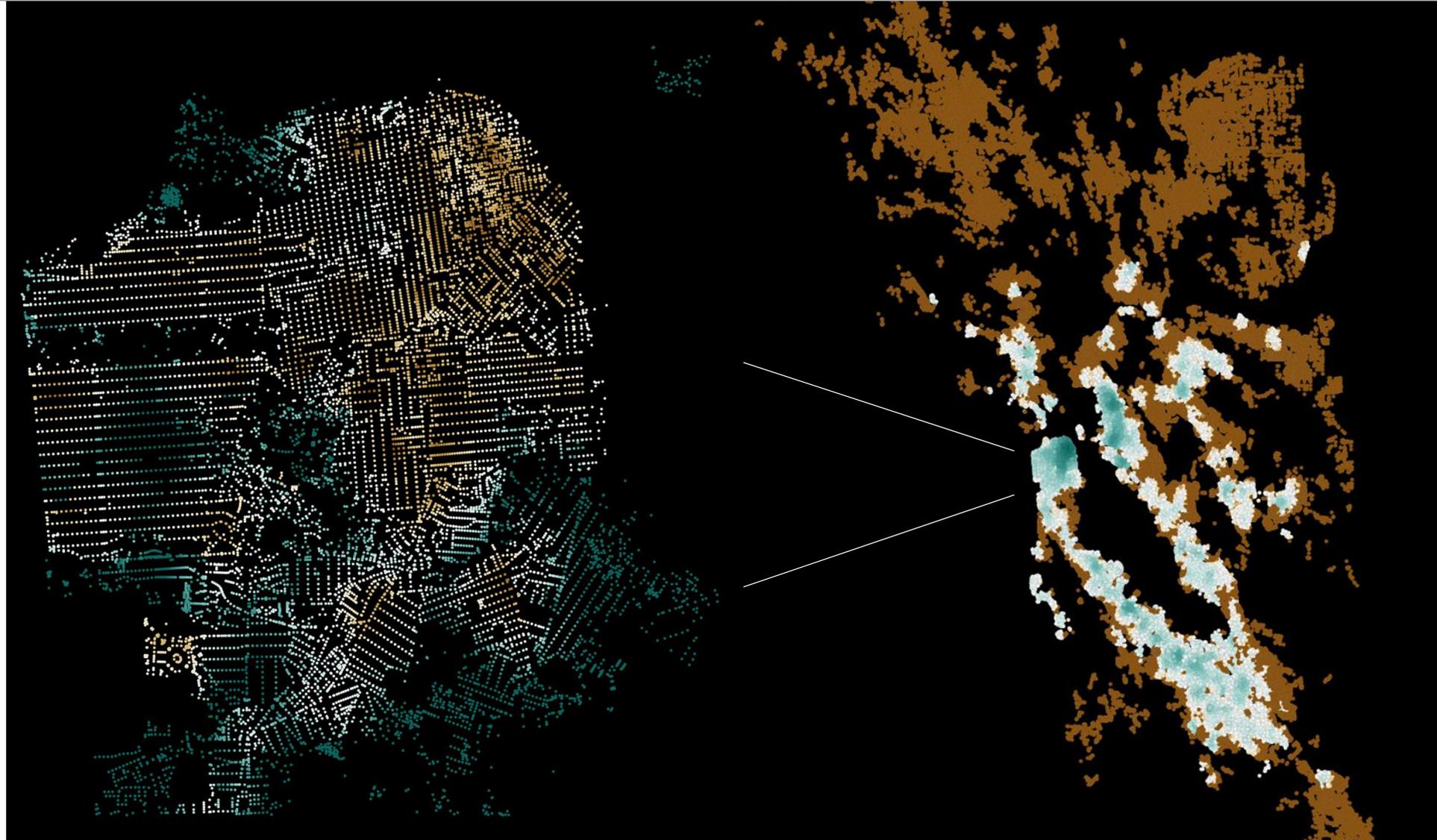


Example: Buildings in New York City categorized by height

Open Source tools for regional planning

Pandana

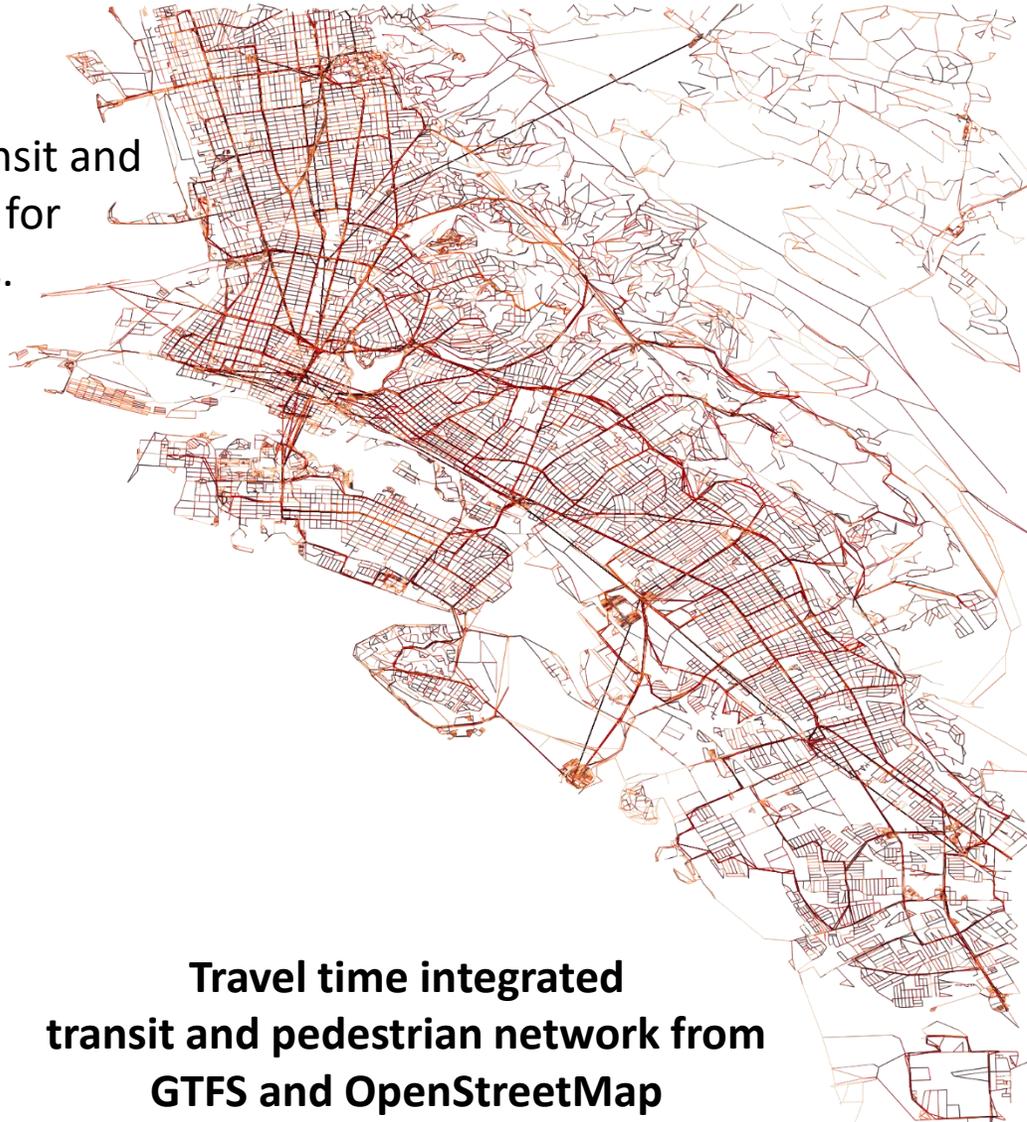
A fast network accessibility engine for computing accessibility metrics.



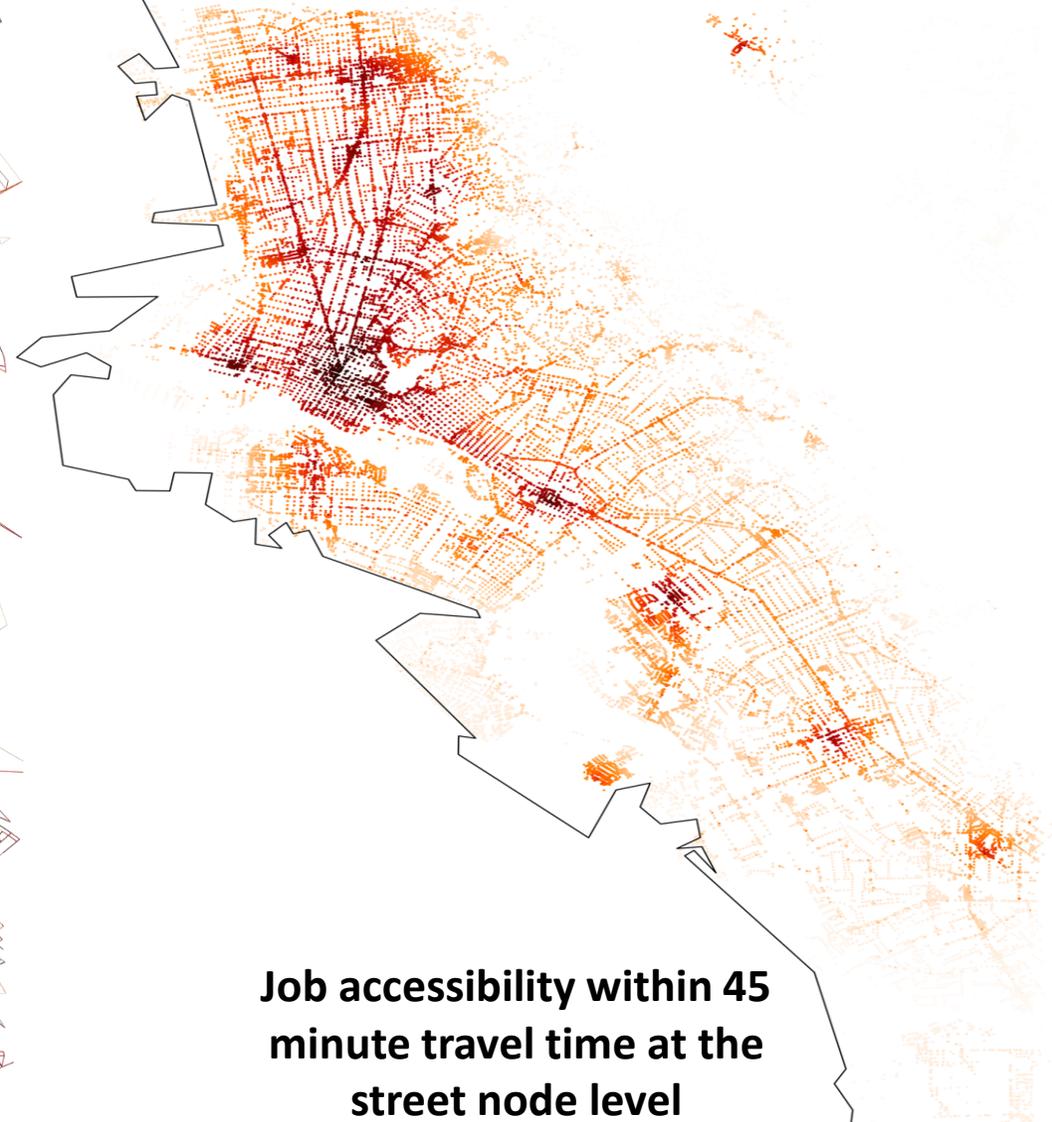
Open Source tools for regional planning

UrbanAccess

Quickly compute transit and pedestrian networks for accessibility analyses.



Travel time integrated transit and pedestrian network from GTFS and OpenStreetMap



Job accessibility within 45 minute travel time at the street node level

UrbanSim Cloud Platform use cases:



Represents 13 municipalities and parts of two counties in Colorado's North Front Range

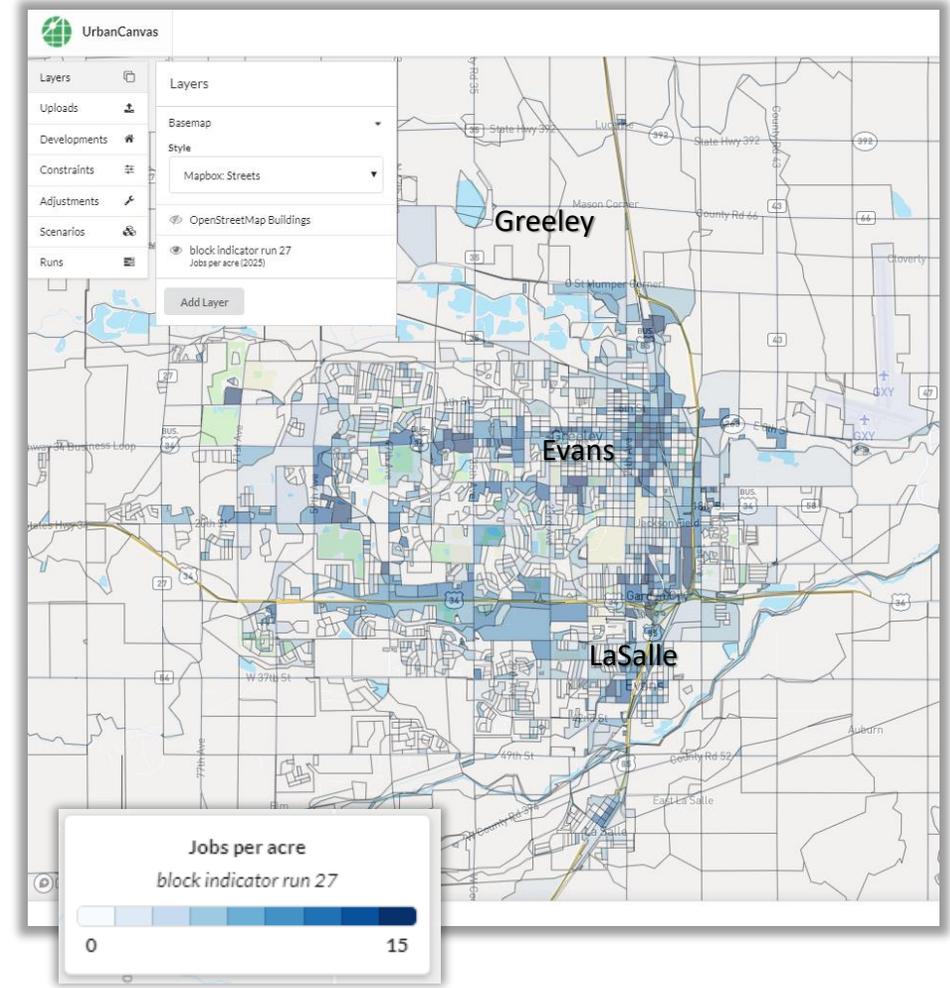
Land Use and Travel Demand Modeling Efforts:

Now – December 2017:

- Gathering zoning and future land use data from 35 communities and two counties
- Adjusting TAZ boundaries for use in UrbanCanvas with staff from 16 communities, two counties, and the National Park Service

2018 and Beyond:

- Compose and run scenarios that integrate growth, land use, and water demand trends to aid the NFRMPO long-range planning process
- Integrate UrbanCanvas outputs into NFRMPO's 2045 Regional Travel Demand Model



NFRMPO UrbanSim simulation results in UrbanCanvas



UrbanSim

Thank you!

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UrbanSim can be used to:

- Predict land use information (e.g. real estate development and prices, and the location and types of households and businesses) for input to a travel model
- Predict the effects on land use patterns from alternative investments in transportation infrastructure, or in alternative levels of service or pricing.
- Predict the effects of changes in land use regulations on land use, including the effects of policies to relax or increase regulatory constraints on development of different types.
- Predict the effects of changes in the macroeconomic structure or growth rates on land use.
- Predict the possible effects of changes in demographic structure and composition of cities on land use, and on the spatial patterns of clustering of residents.
- Examine the potential impacts on land use and transportation of major development projects, whether actual or hypothetical.