High Throughput Computing in Your Backyard: Urban Hydrology Applications

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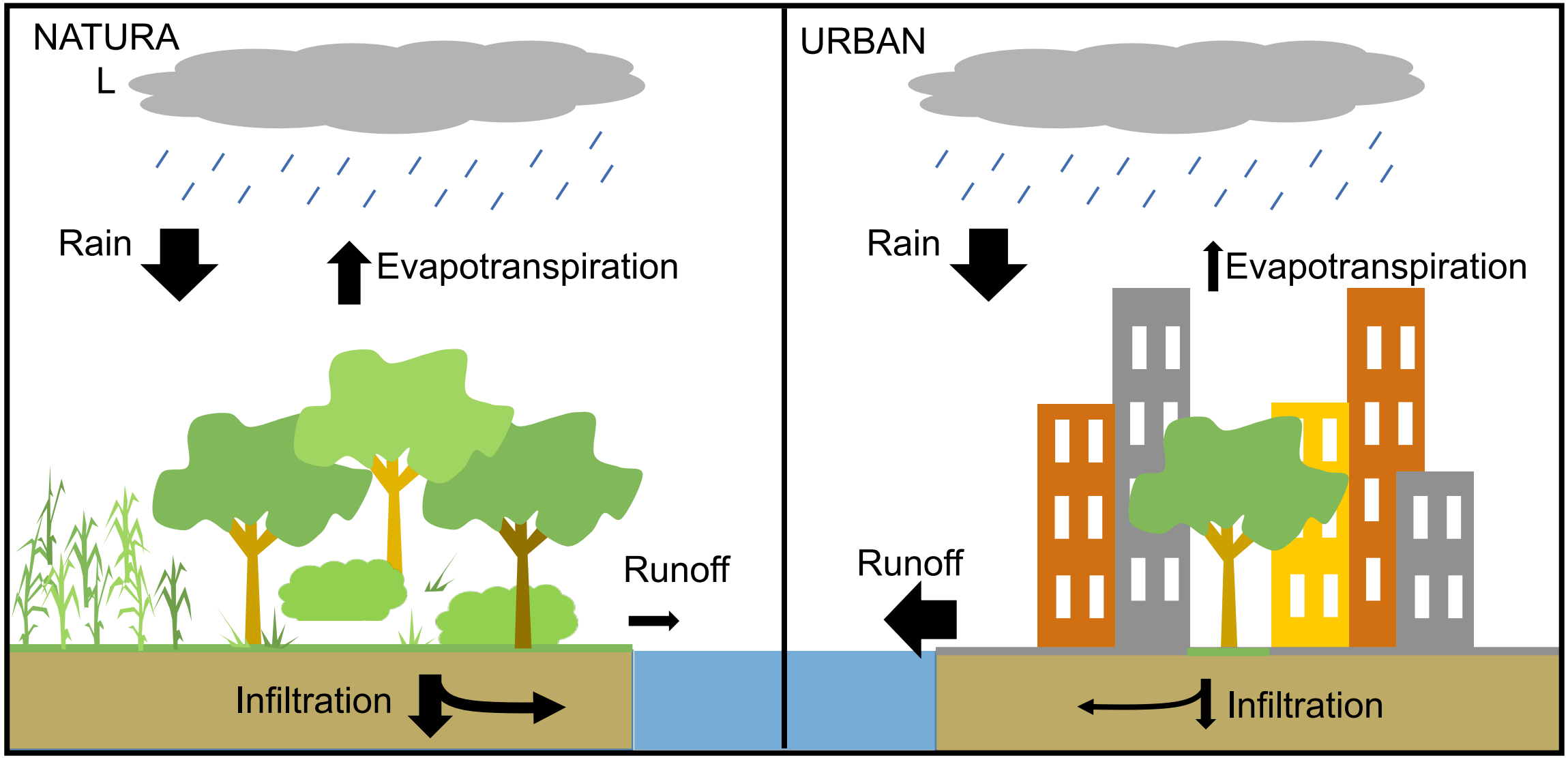
Urbanization messes with how water flows

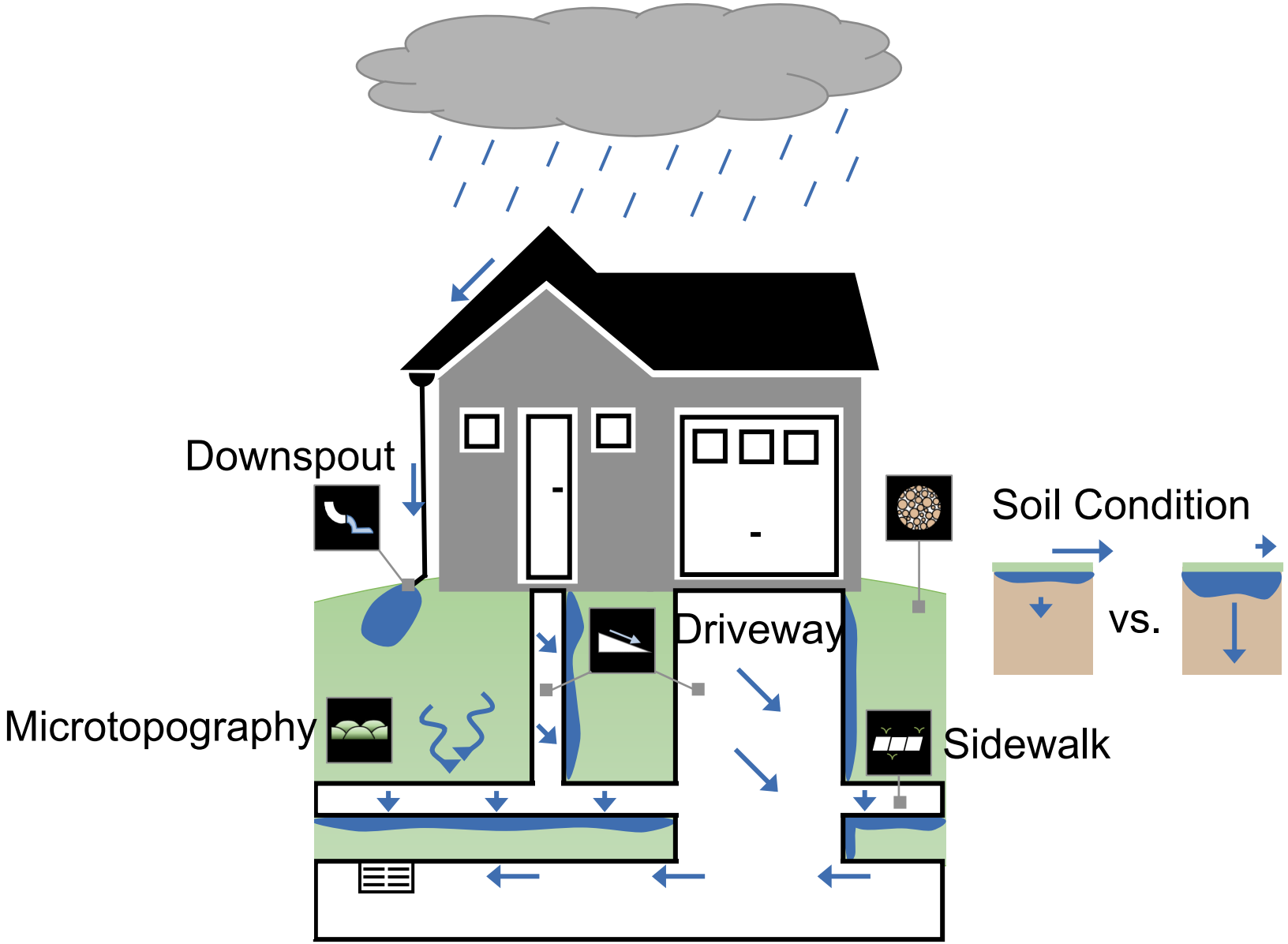


Urbanization messes with how water flows

Last Millennium's Approach

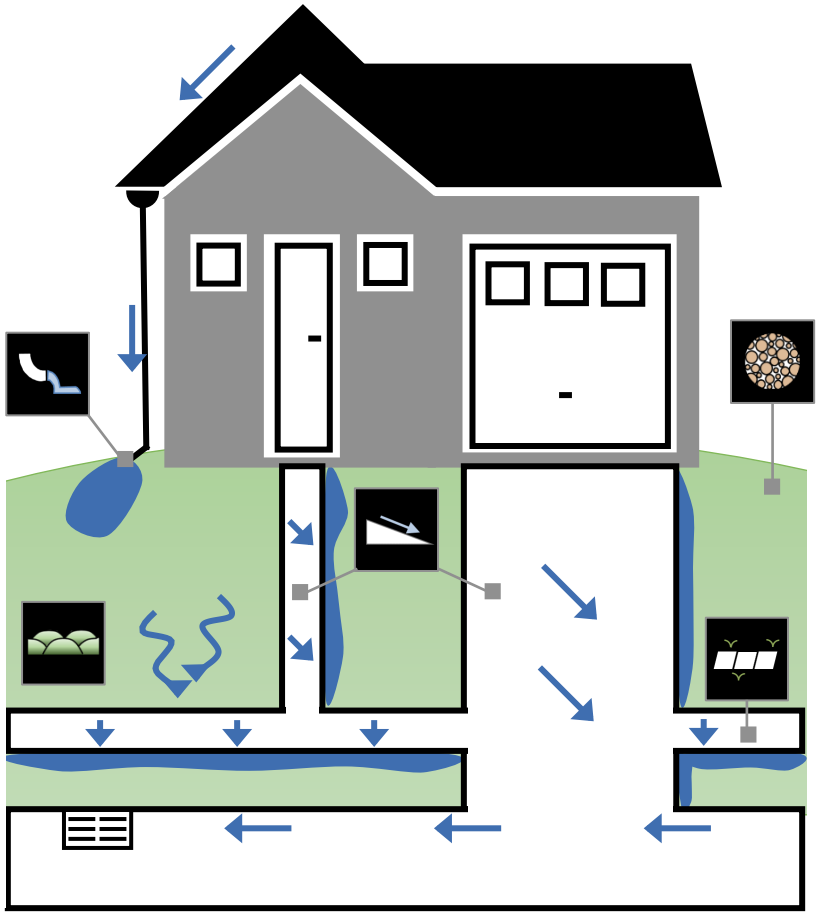
Today's Approach

Homeowner decisions affect urban hydrology



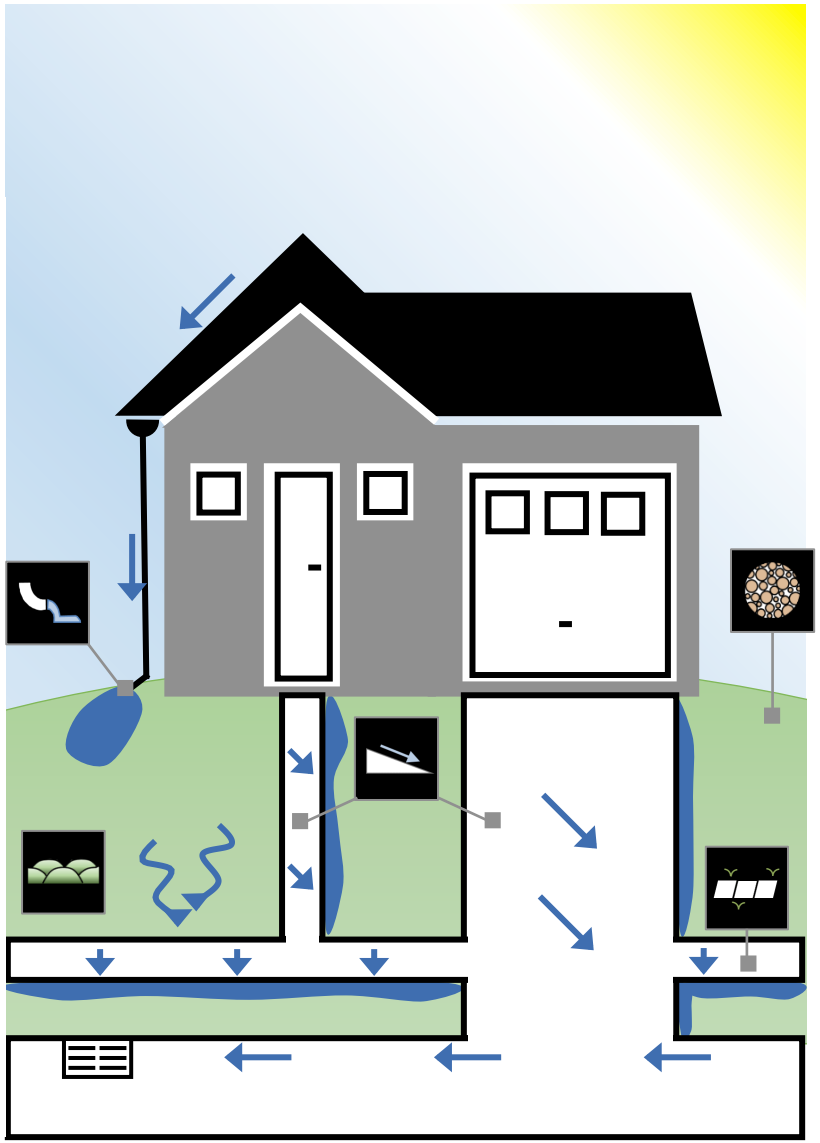
Homeowner decisions affect urban hydrology

How do these practices interact with one another?



Homeowner decisions affect urban hydrology

How do these practices interact with climate?



Homeowner decisions affect urban hydrology

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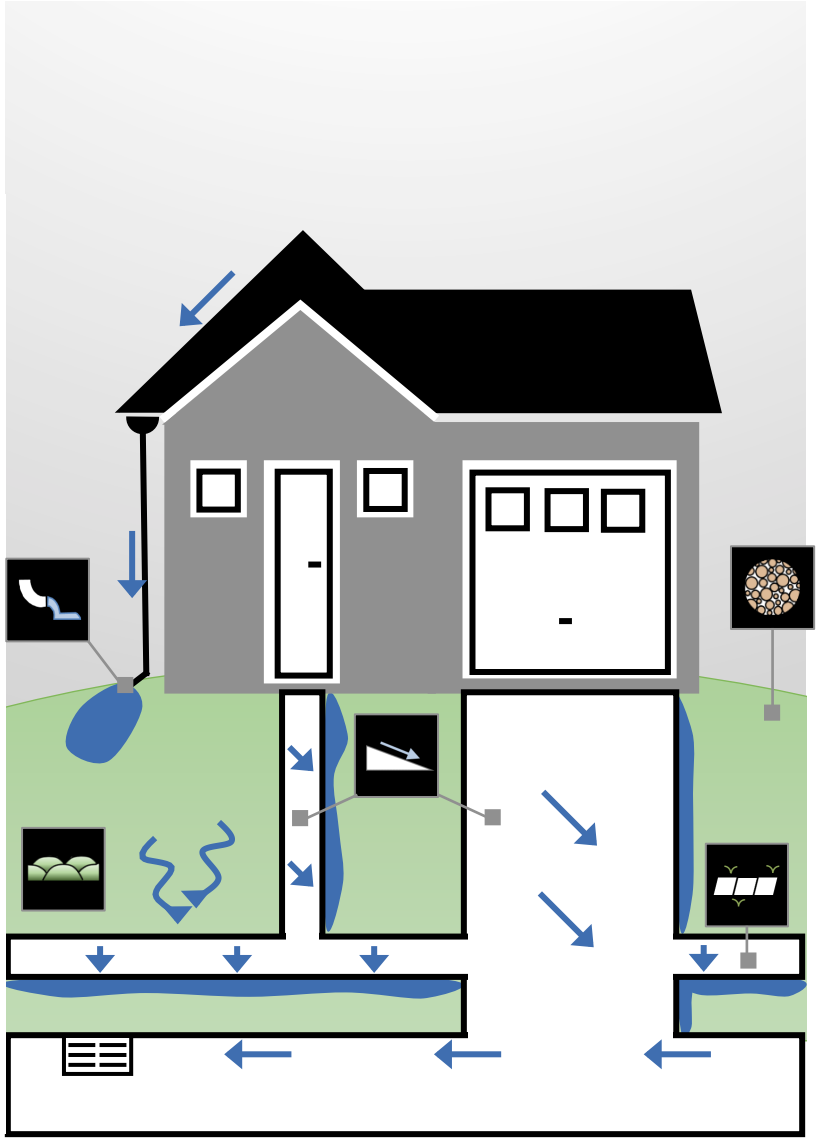
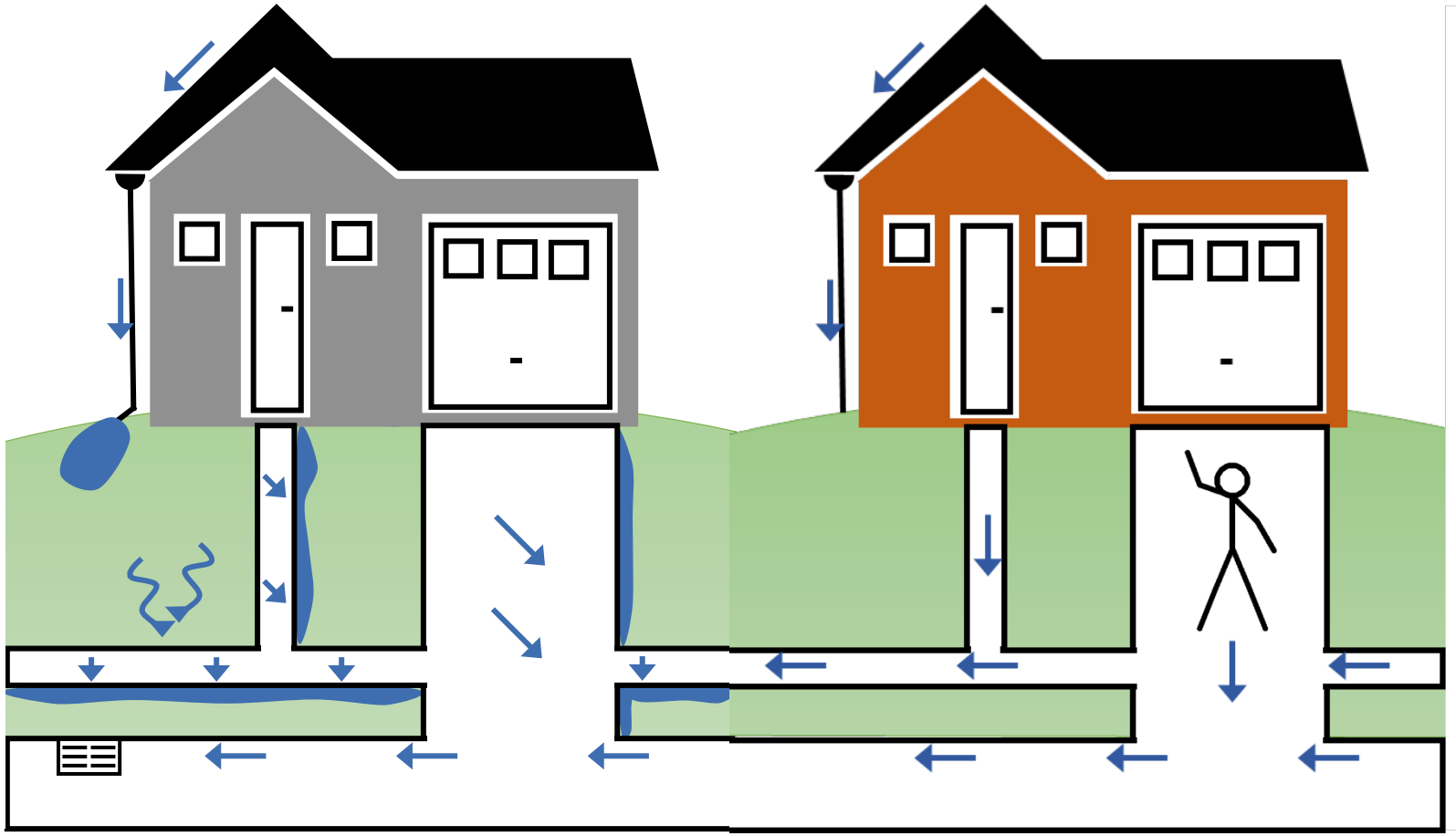


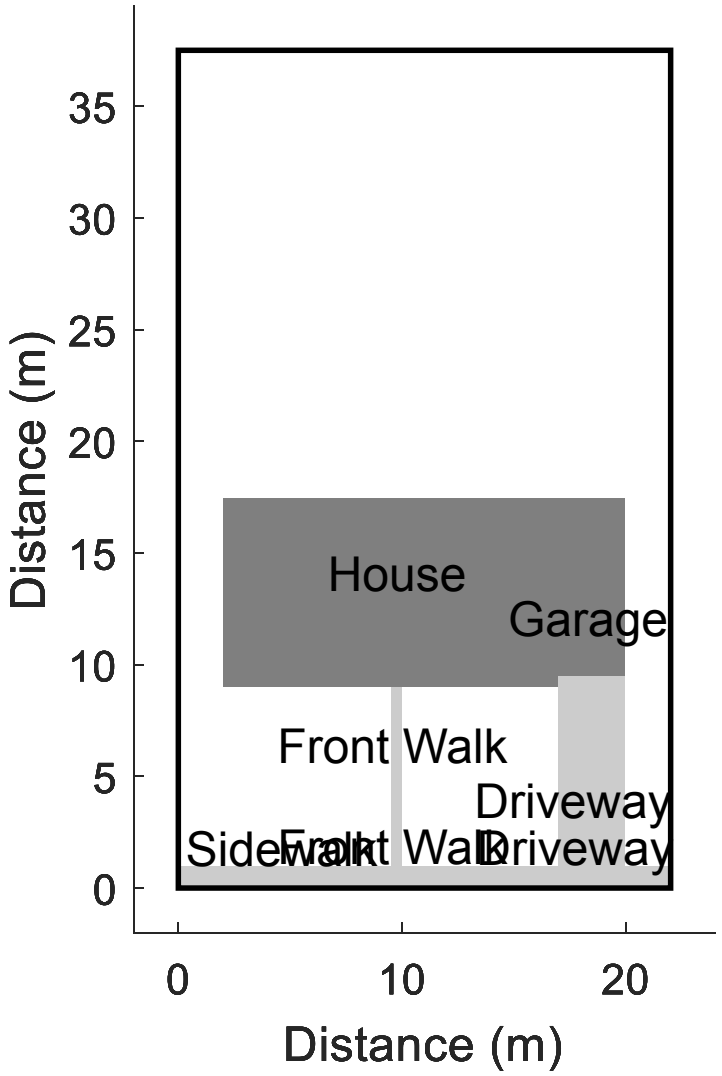
Homeowner decisions affect urban hydrology

How do your actions combine with your neighbors' actions to impact larger scale hydrology?



Basic Lot Layout

▪ = 0.5m x 0.5m grid cell
(to scale)



Why these models take forever*

*To me

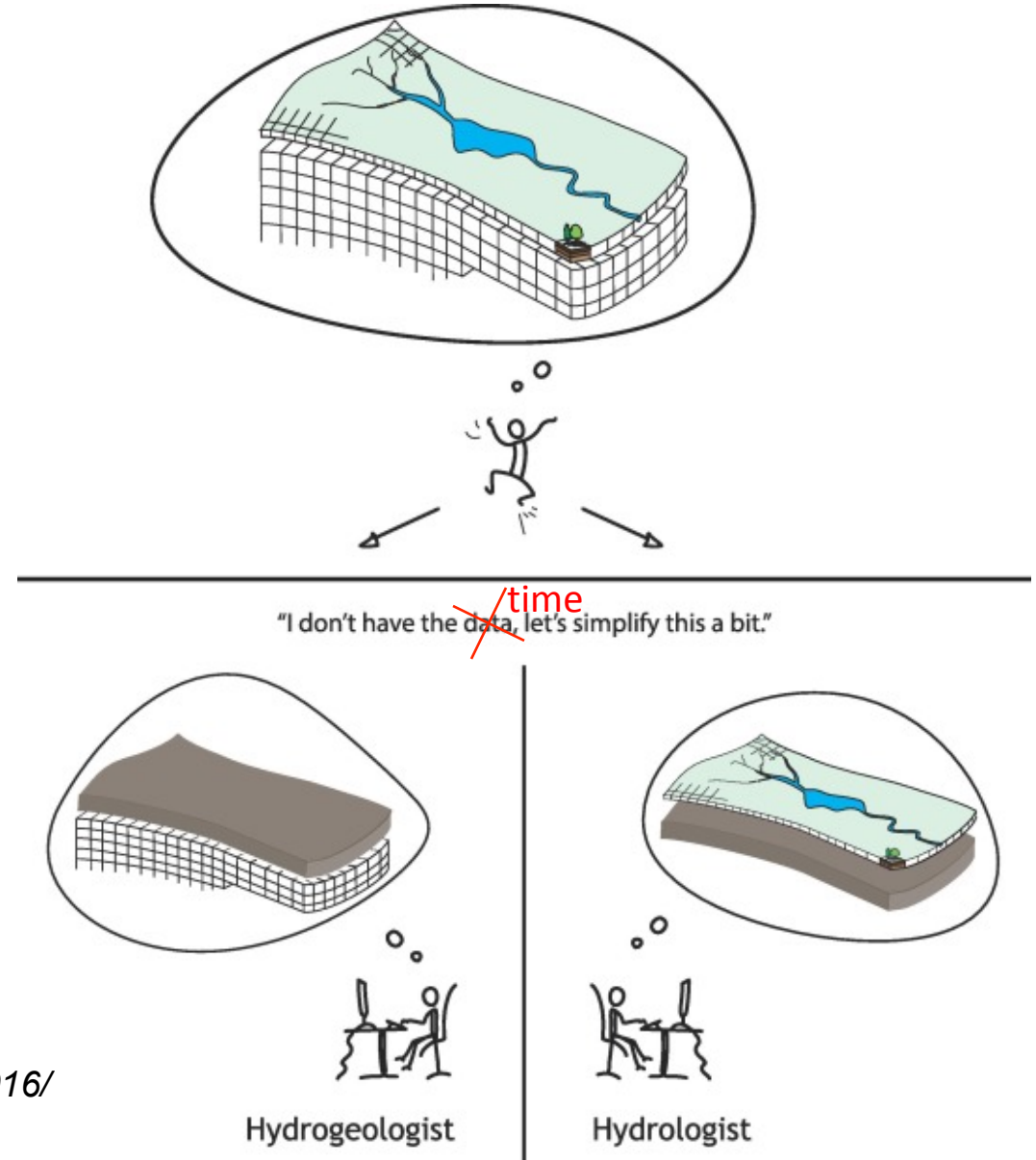


Image:
Staudinger et al., 2019 https://doi.org/10.1016/j.jhydrol.2019.01.058

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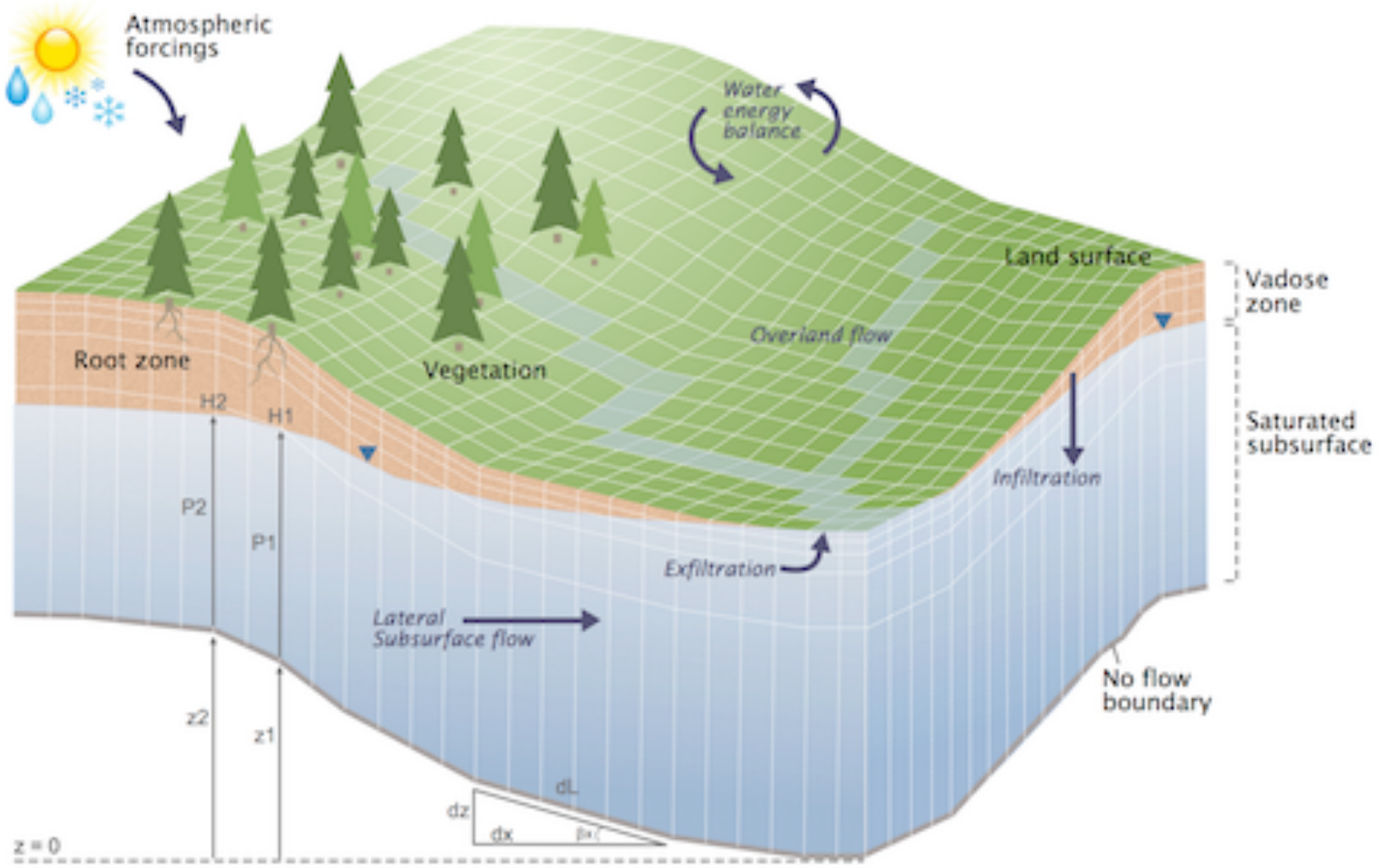
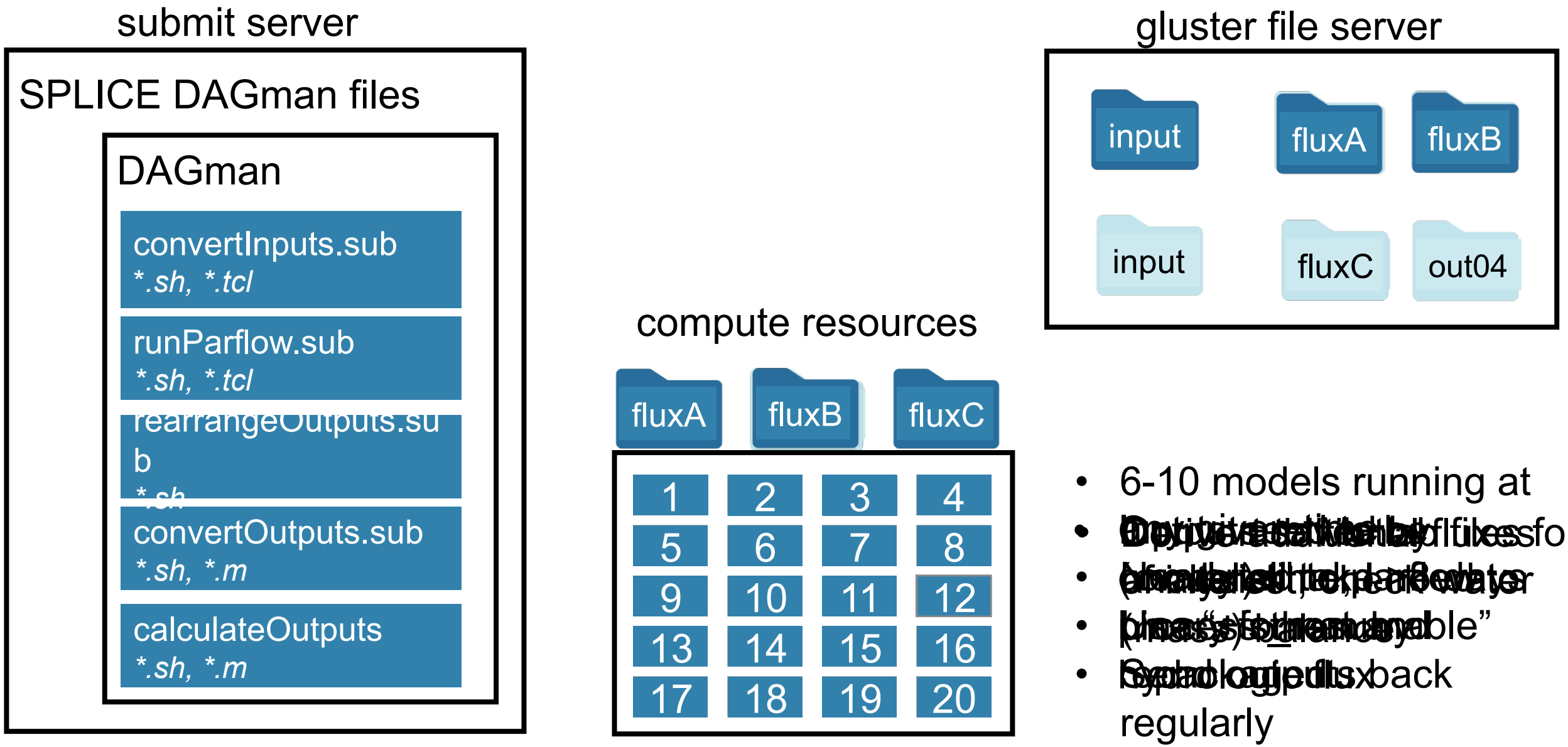


Image: parflow.org

Why I started on HTC

1. Model too big for desktop → HPC
2. Postprocessing too small for HPC → Postprocess on HTC
3. Do everything on HTC!

HTCondor Workflow



- 6-10 models running at
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible] back regularly

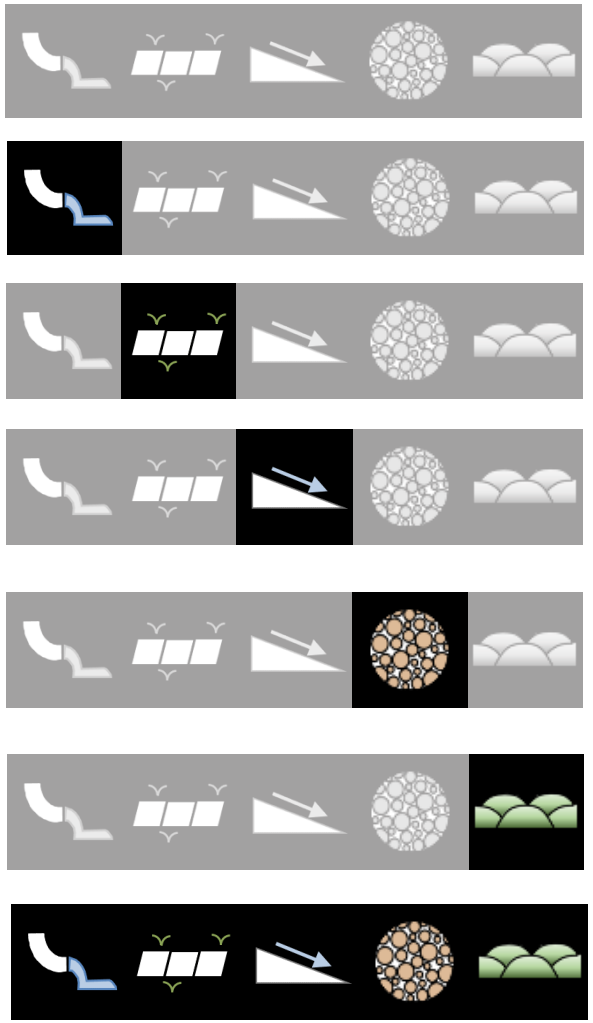
Key wins along the way

1. Figuring out what “compiling” means
2. Using DAG and ultimately DAG splice
3. Sending back output regularly, but not too frequently
4. Custom script to extract current status of all models

Current Pinch Points

1. Limited to Gluster machines
2. So much data, no (cheap) place for it to go
3. As my models get bigger, back to hybrid HPC/HTC workflow

Urban Hydrology Applications

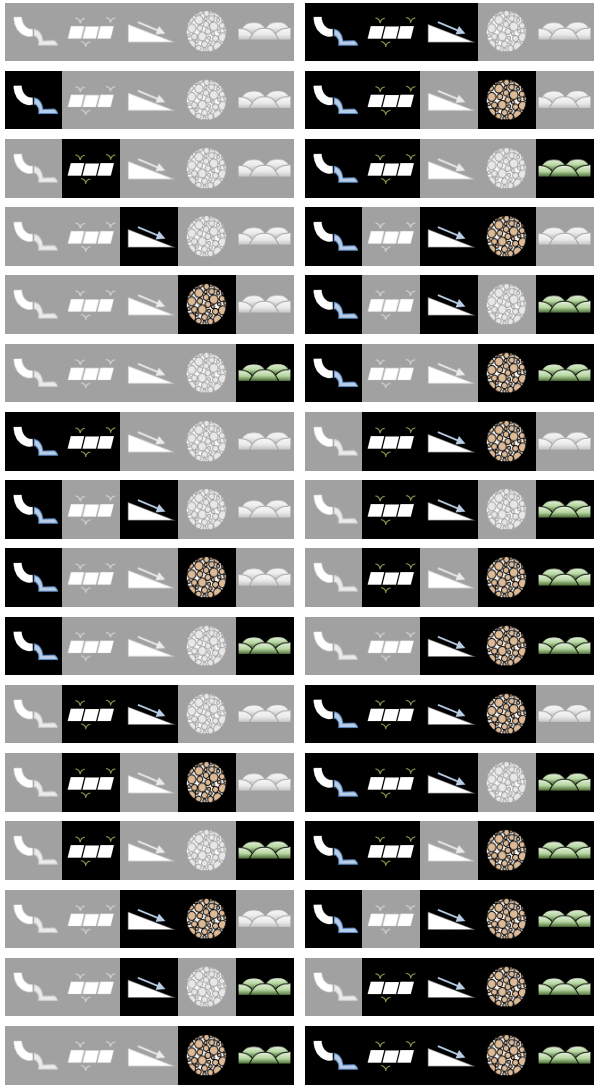


7 scenarios
x 20 processors each
x 5-ish days each

More resources + time than I ever imagined spending on hydrologic modeling

Urban Hydrology Applications

Baseline



Baseline Compaction = ?

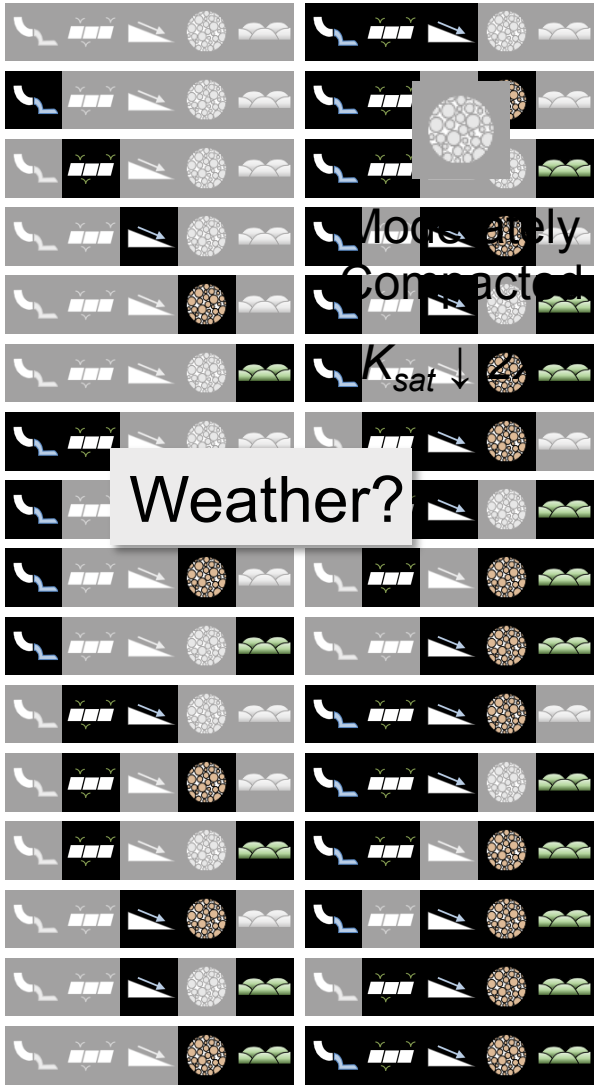
Lowest-Impact

Urban Hydrology Applications

Highly Compacted

K_{sat} ↓ *10x*

Baseline



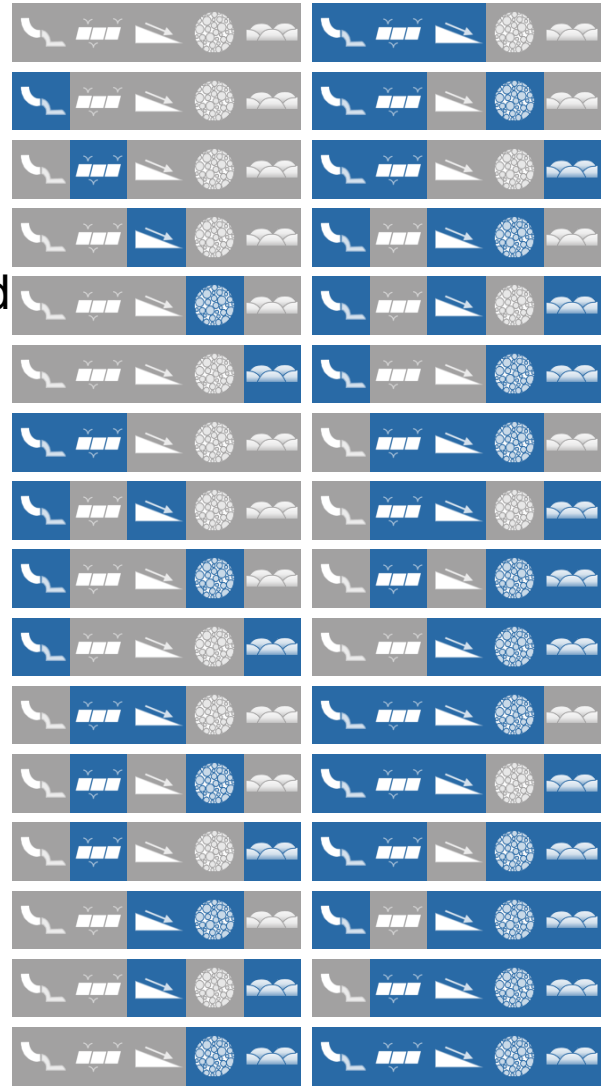
Lowest-Impact

Urban Hydrology Applications

Baseline

Highly Compacted

K_{sat} ↓ 10x



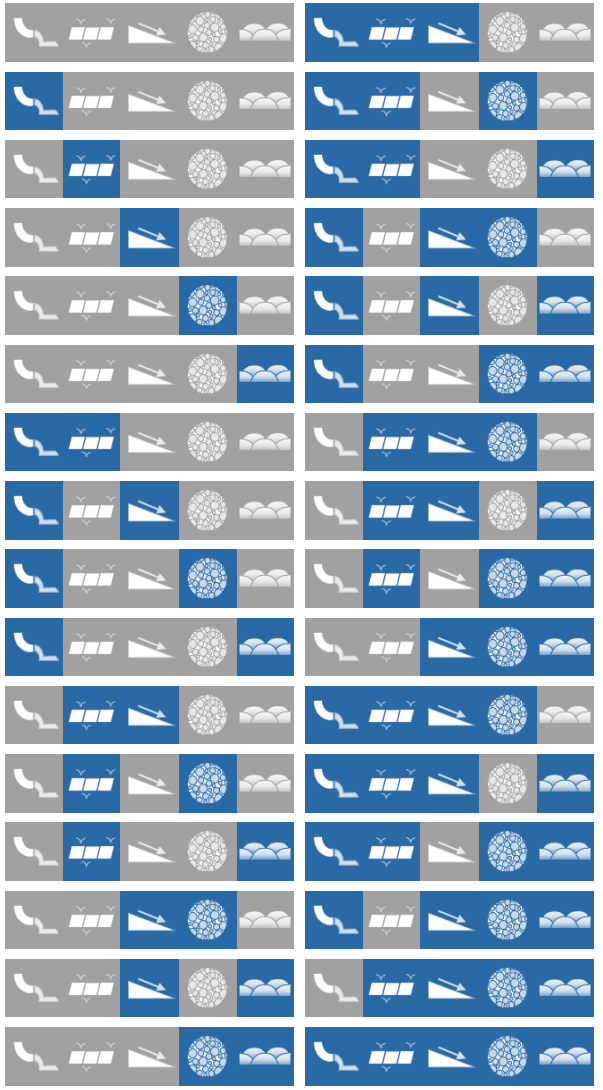
Lowest-Impact

Average

Baseline

Moderately Compacted

K_{sat} ↓ 2x



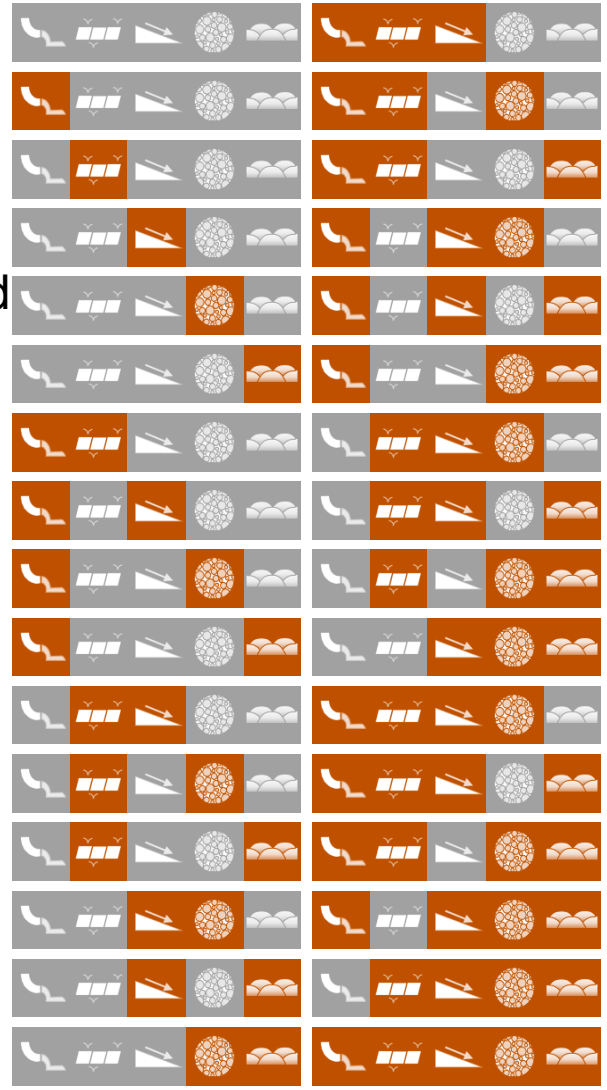
Lowest-Impact

Urban Hydrology Applications

Baseline

Highly Compacted

K_{sat} ↓ 10x



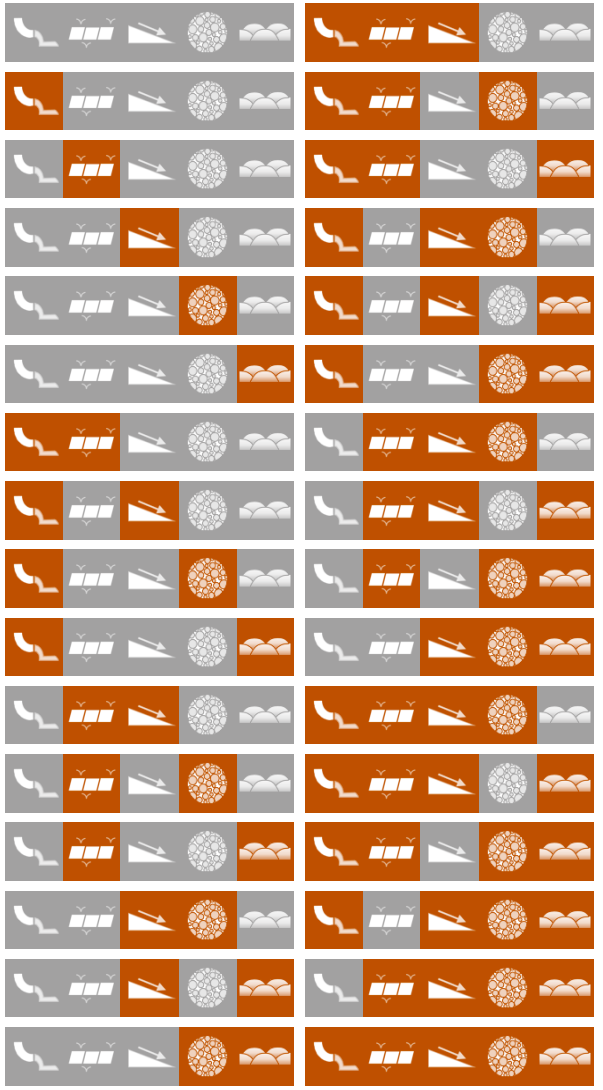
Lowest-Impact

Dry

Baseline

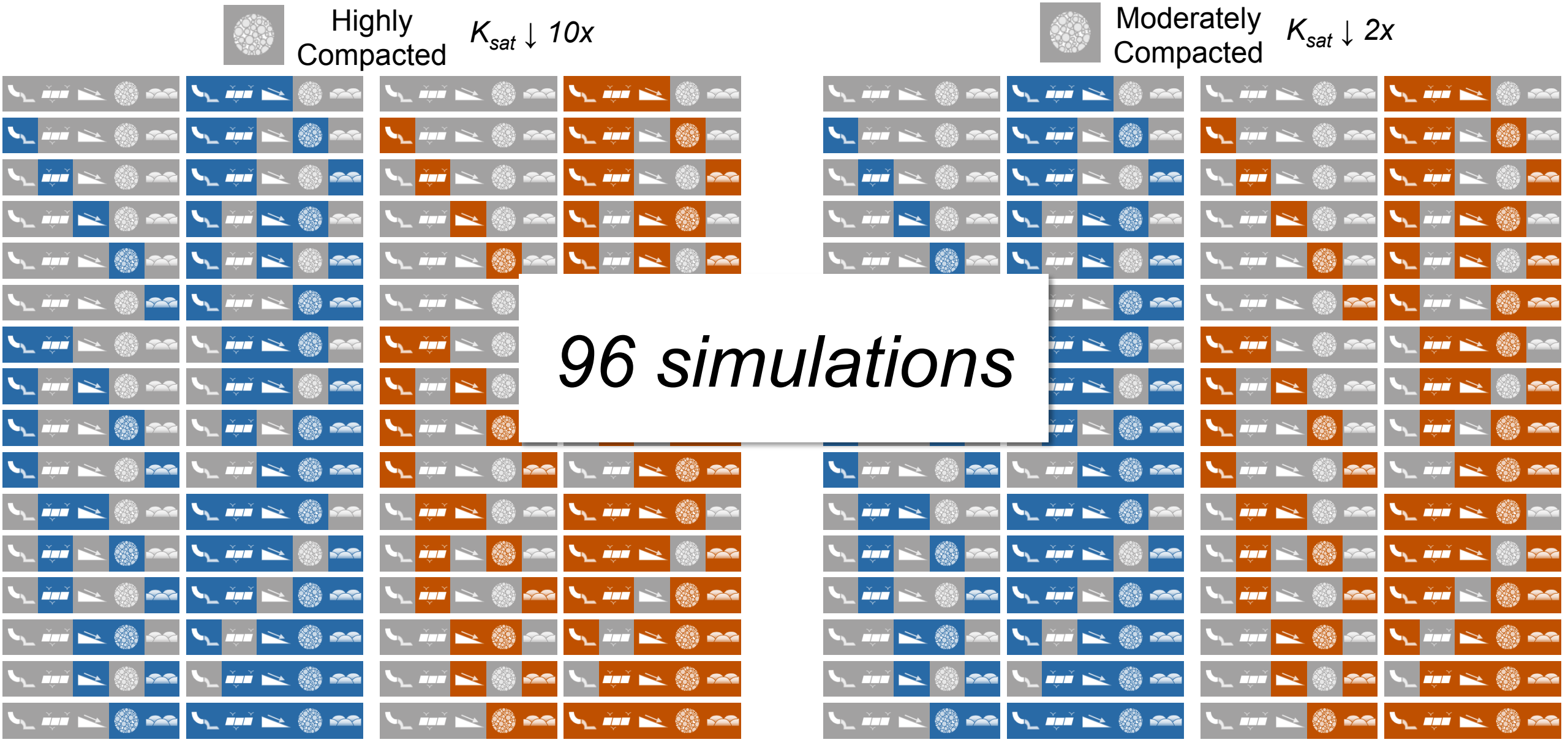
Moderately Compacted

K_{sat} ↓ 2x



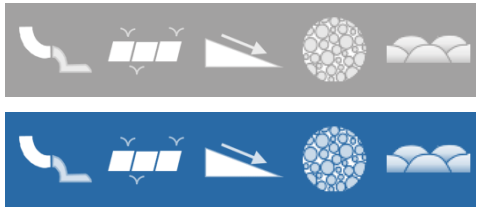
Lowest-Impact

Urban Hydrology Applications

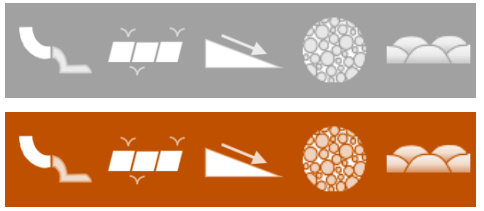


Urban Hydrology Applications

WET



DRY



Urban Hydrology Applications

2 Lot Types

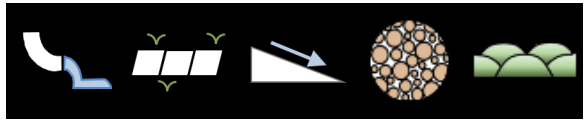
X

50 Largest U.S. Cities (plus Madison)

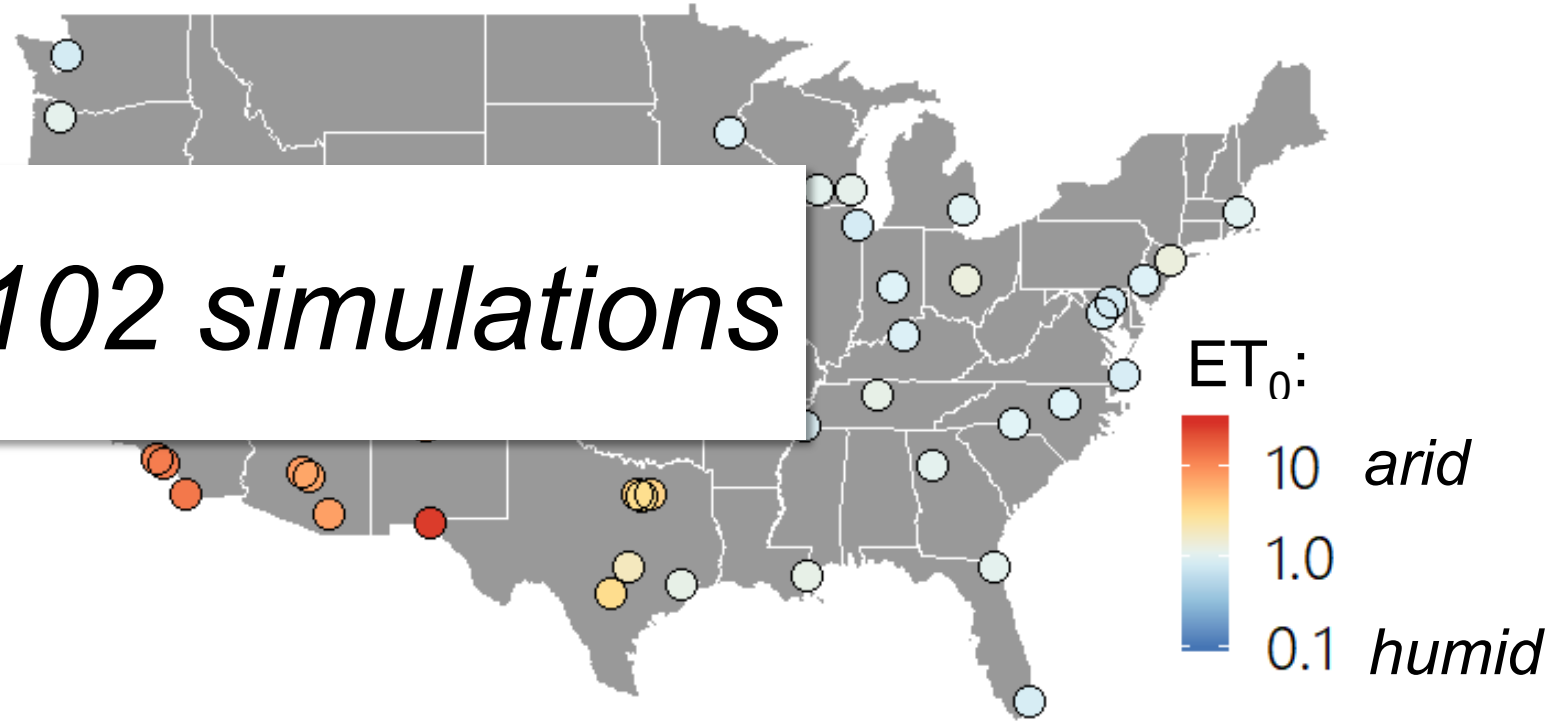
Hourly weather data WY2014

Baseline

Low-Impact

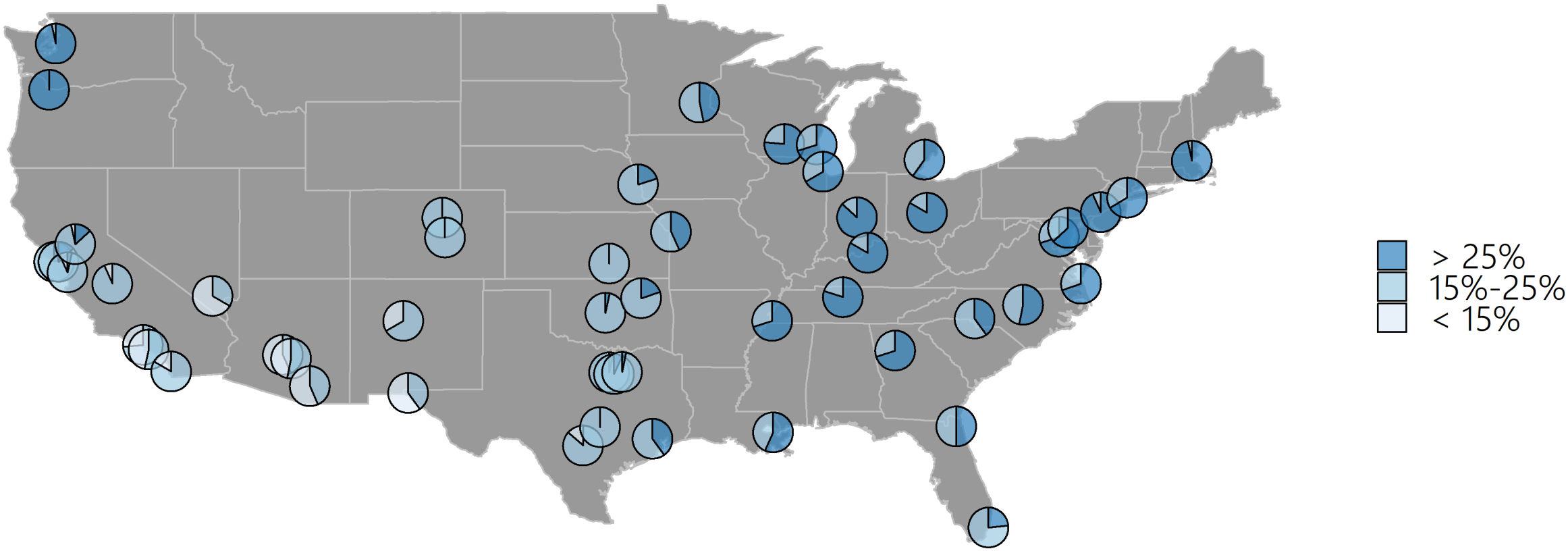


102 simulations

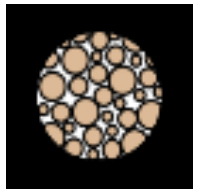


Urban Hydrology Applications

Reduction in runoff
Estimates for WY1981 – WY2010

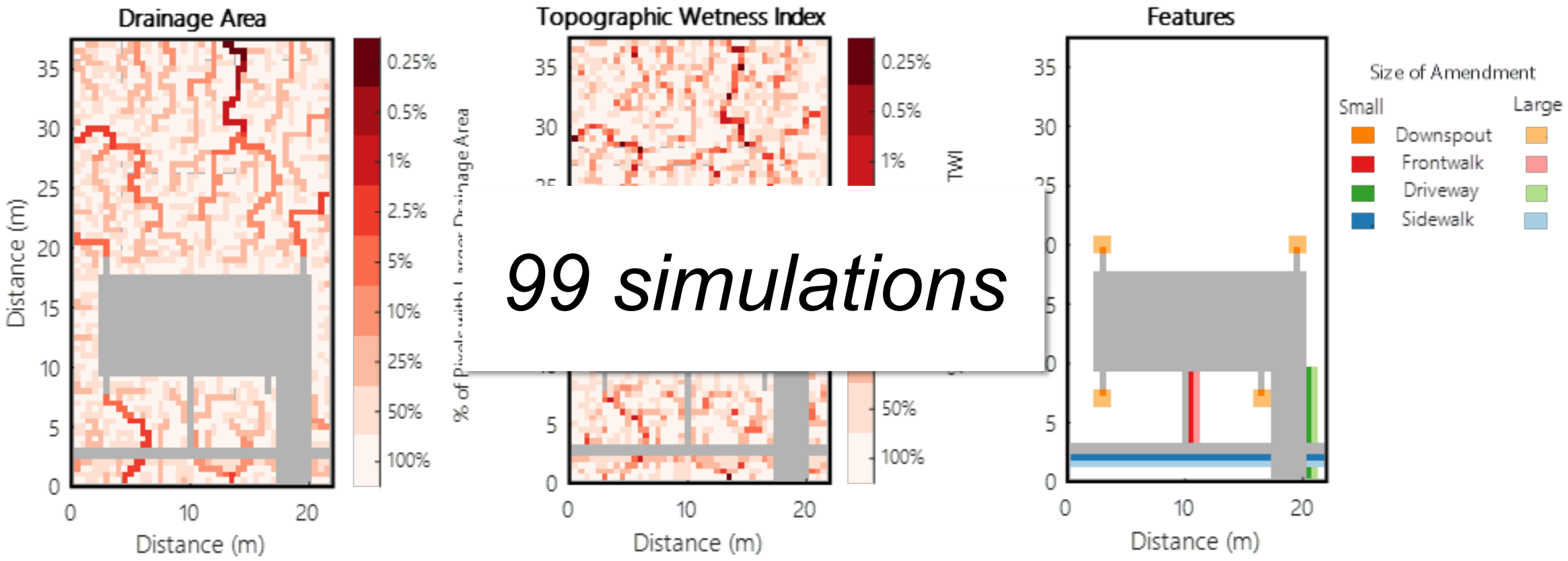


Urban Hydrology Applications



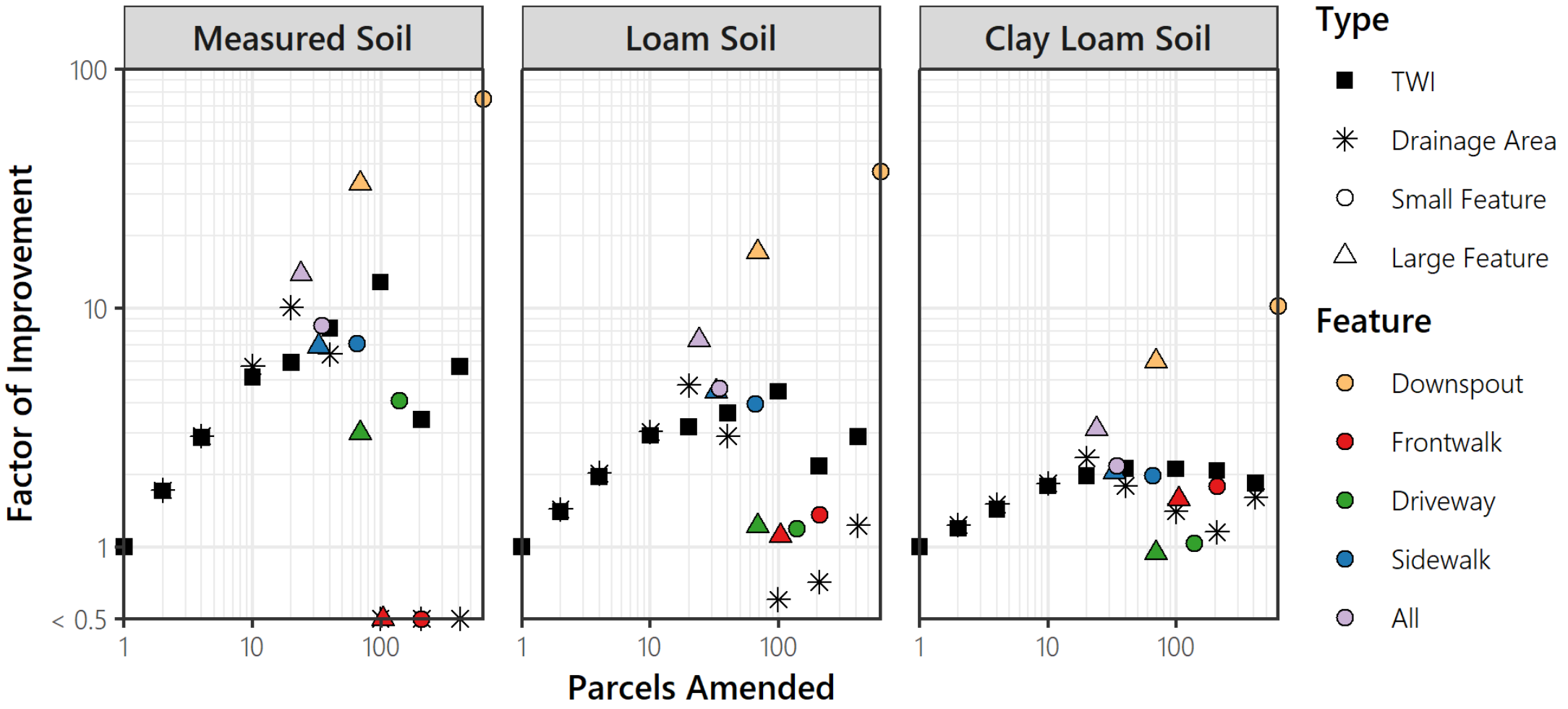
Compaction ?

Urban Hydrology Applications



99 simulations

Urban Hydrology Applications



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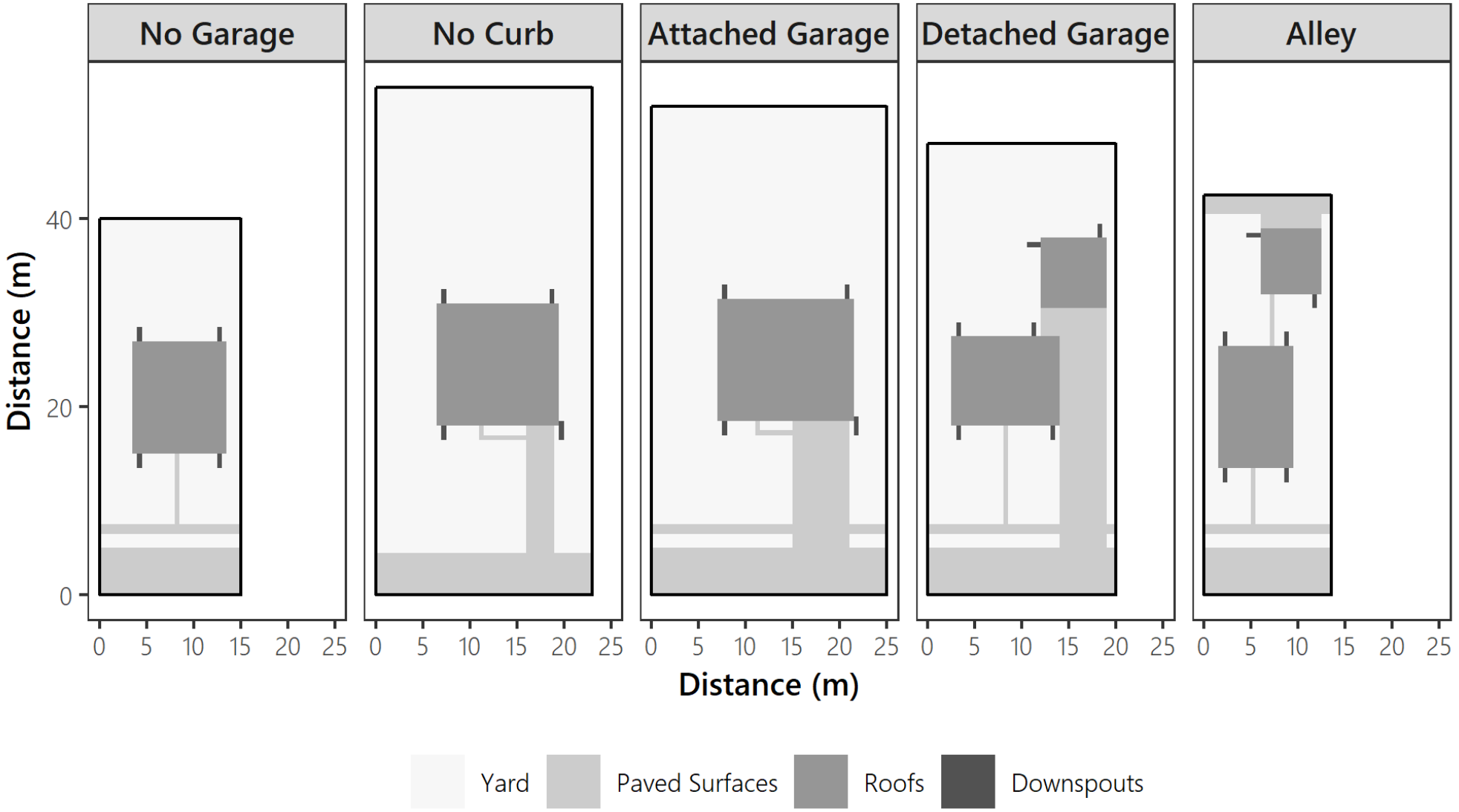

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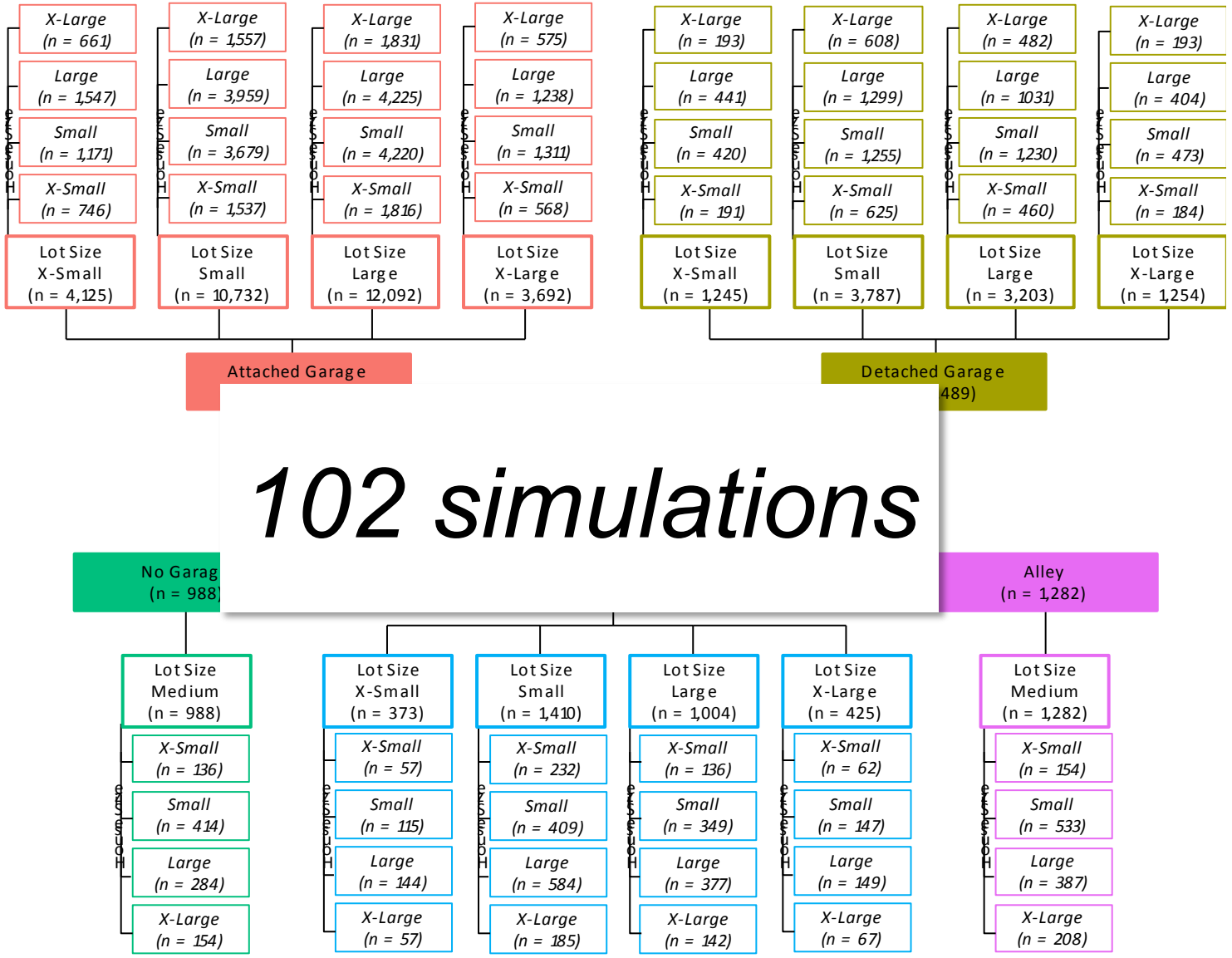

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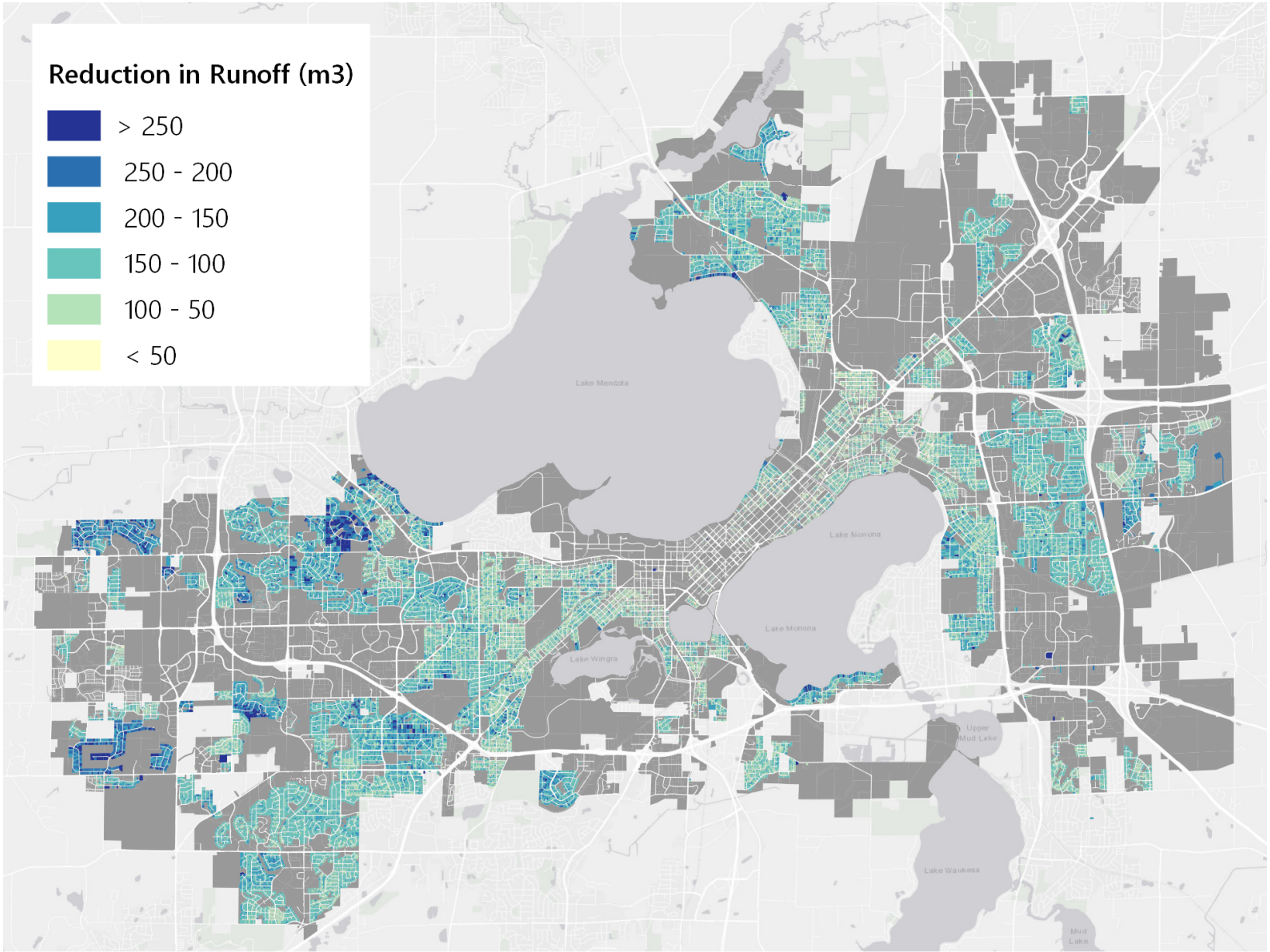

Thank You!

Questions?

Funding

UW Water Resources Institute, WR12R002
UW Sea Grant Institute, RCE-05
LTER-NTL

Others

Hydroecology Lab
UW Center for High Throughput Computing

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