Toward identifying the critical mass in spatial two-sided markets

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Outline

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Problem

Something like Uber: Is a platform: needs to recruit drivers to provide supply

However, Uber, other than e.g. Youtube, operates in geographical space.

Consequences of that.

Outline

- Conceptual model
- Simulations with stylized model
- Simulations on a realistic substrate

Conceptual

Conventional market (a)

Top left

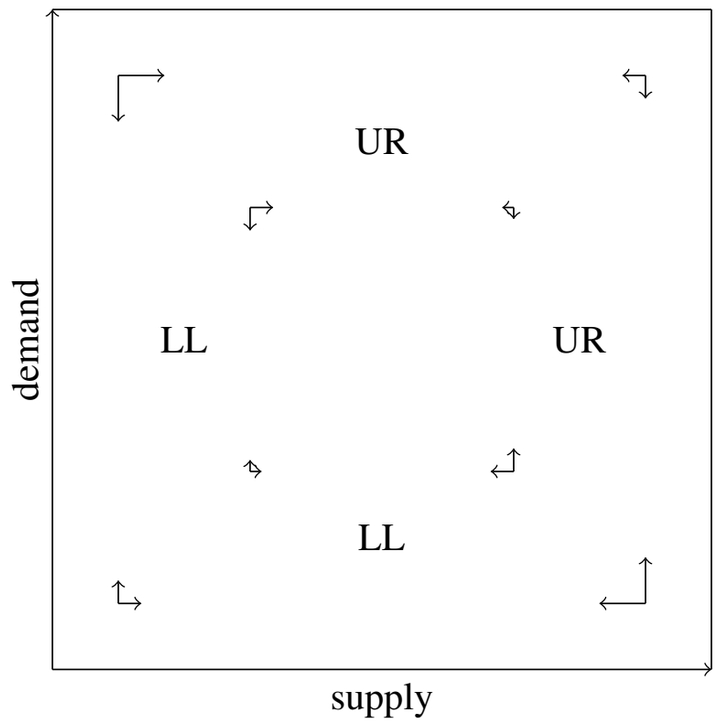
high demand, low supply → prices high
→ demand ↘ & supply ↗

Top right

high demand, high supply → prices somewhat high
→ demand ↘ & supply ↘

Etc.

demand & supply meet around (0.5,0.5), @ medium price



(a)

Market with network effects & economies of scale (b)

(network effects: more customers = more attractive for customers; economies of scale: more supply = lower average costs. E.g. telephone system.)

Top left

demand high, supply low → prices high
→ demand ↘, supply ↗ (same as before).

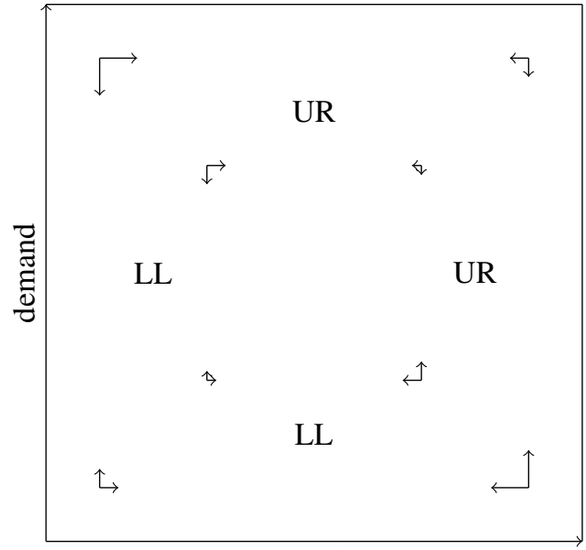
Top right

demand high, supply high → prices low
→ demand ↗, supply ↗ (total opposite).

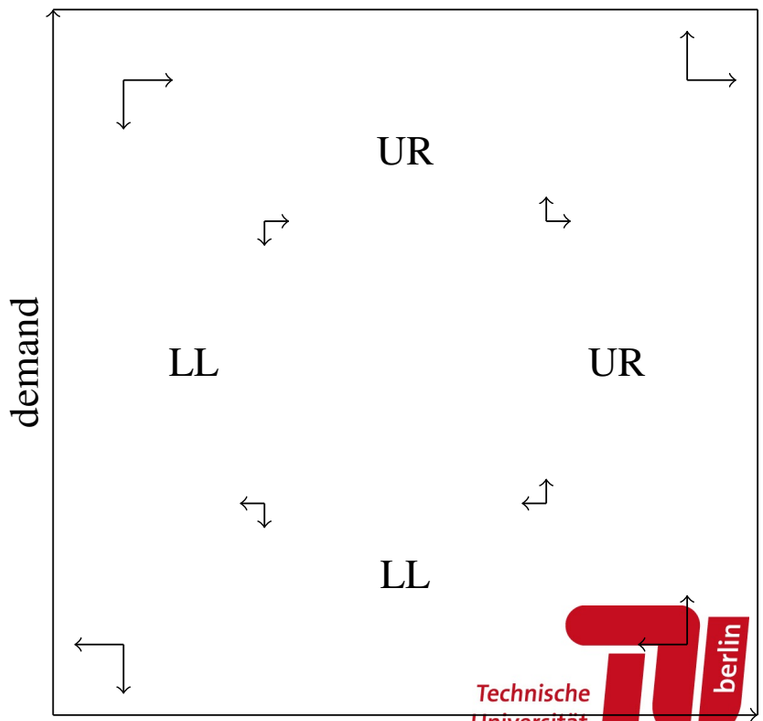
Overall

Dynamics has ***two*** attractive fixed points: (0,0) & (1,1).

Supply owner needs to predict demand.



(a)



(b)

Platform markets (c)

Same as (b) except:

Platform owner does not own supply!

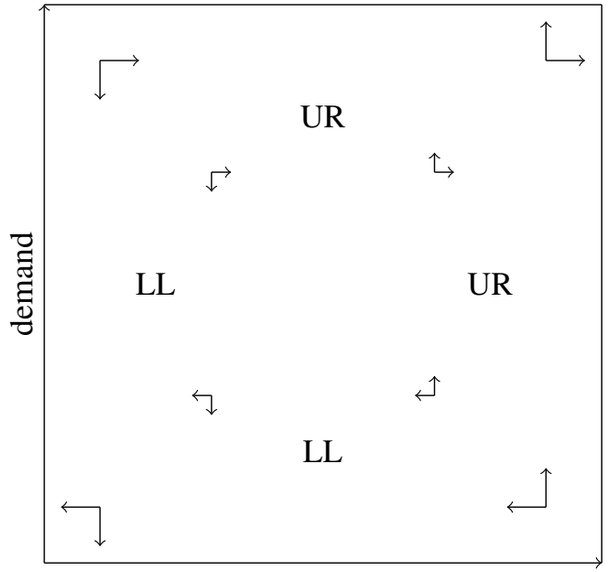
E.g. UBER ≠ uber DRIVERS

→ Platform owner needs to predict max possible demand and supply (e.g. dotted rectangle).

Potentially viable only if rectangle reaches into UR.

Only potentially viable system can become *super-critical*.

Even a potentially viable system can remain *sub-critical*.



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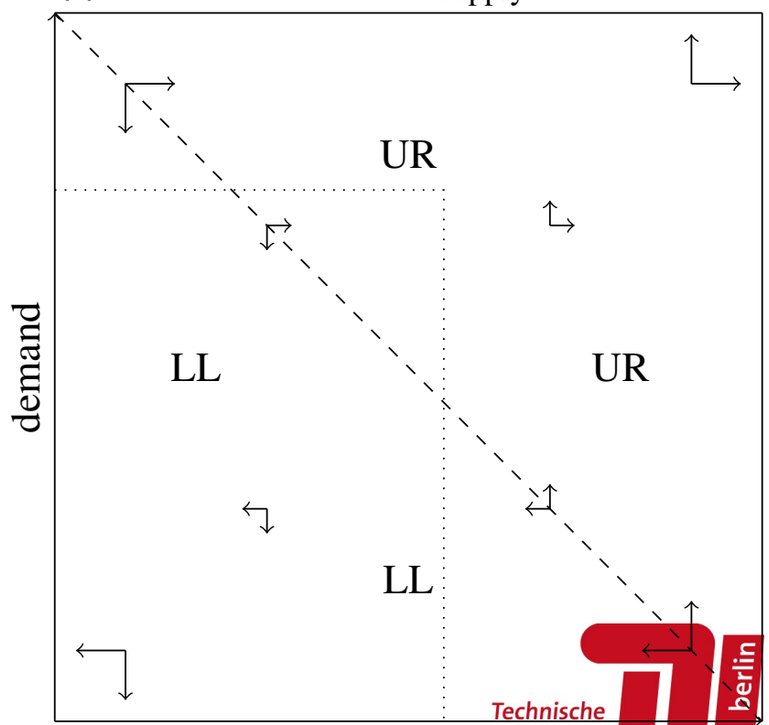


(c)

From homogeneous to spatial markets

(Approximately) non-spatial markets

E.g. youtube:

- Viewers (=demand)/uploaders (=supply) sitting everywhere.

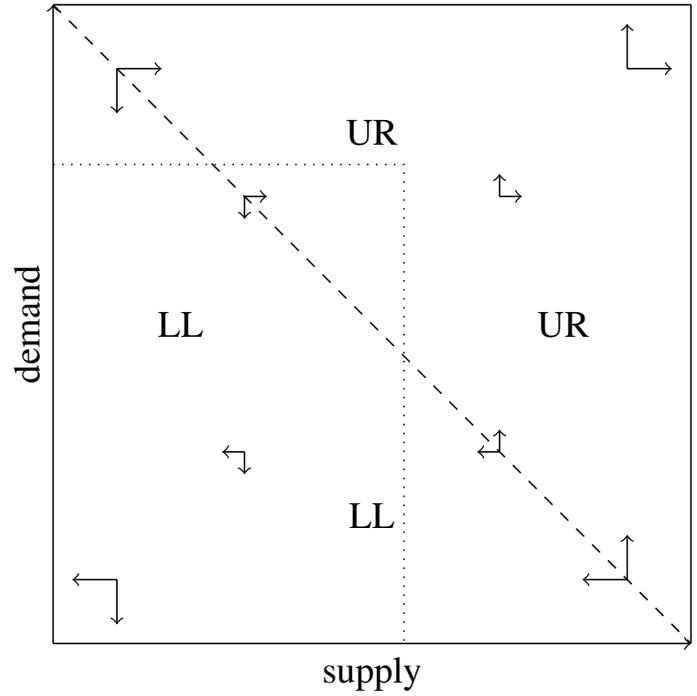
→ One global diagram (c) to describe system.

Spatial markets

E.g. UBER:

- Users at locations → density
- Drivers at locations → density

→ Many local diagrams (c) to describe system.



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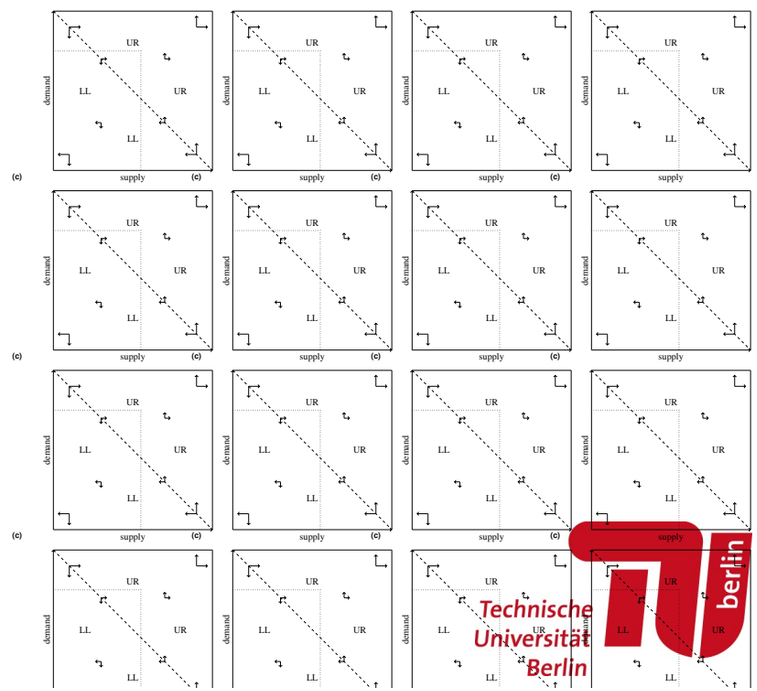

Some predictions

Determine max demand and max supply in each region (dotted rectangle).

- Completely in LL → platform not viable in area.
- Reaches into UR (upper right) → platform potentially viable.
- Farther in UR → more viable → higher proba that it will become super-critical.

- *Super-critical areas can affect their neighbors (if potentially viable at all).*
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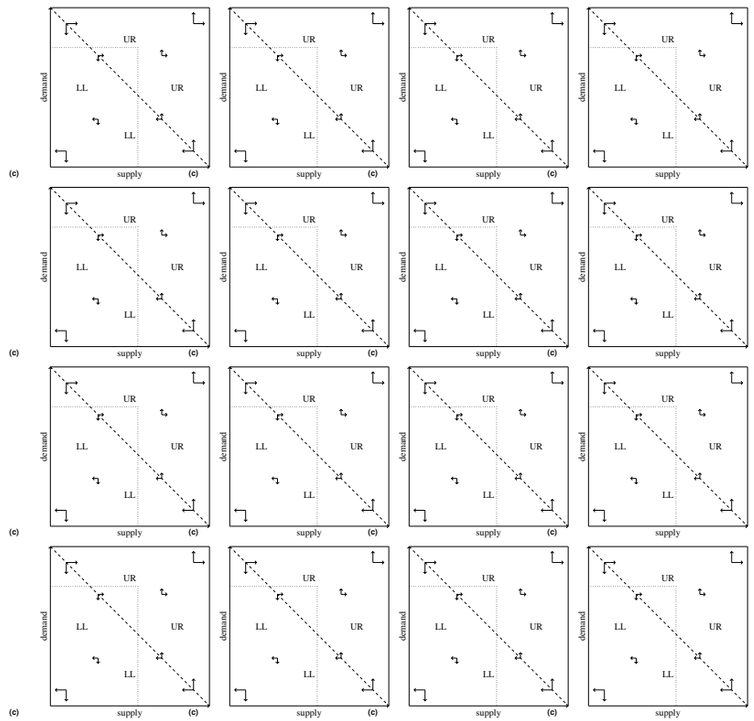

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Stylized simulations

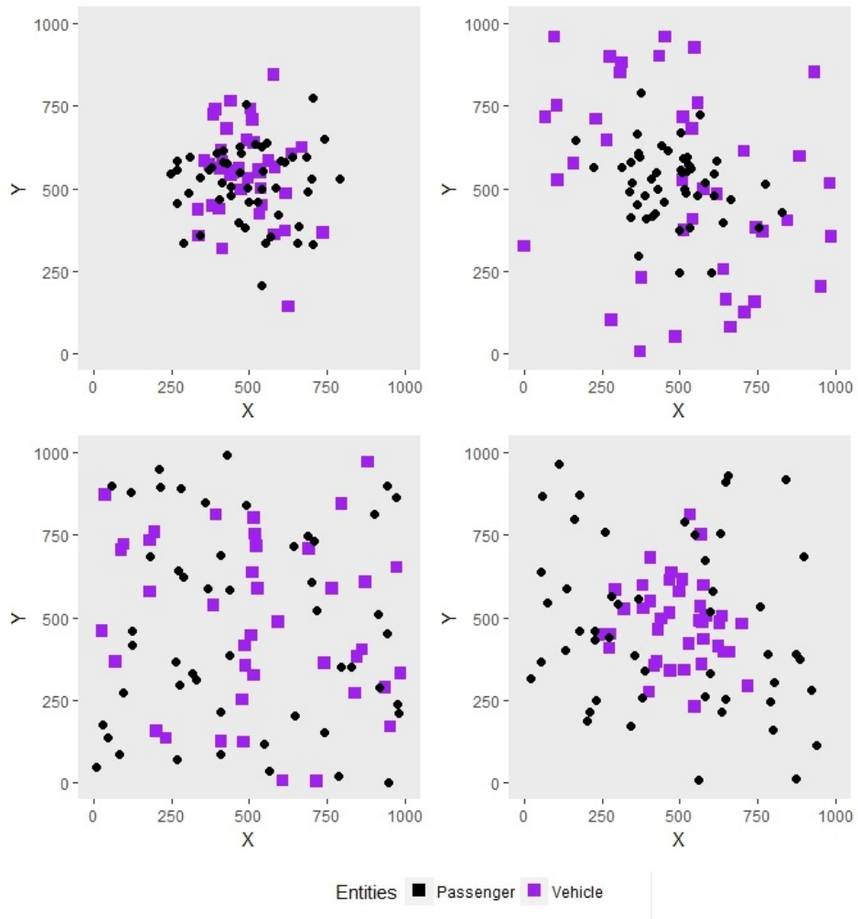
Stylized world

Stylized world

- Square world of size 1x1, 3x3, 5x5 (km x km)
- Potential users **U**niformly | **N**ormally arranged.

Simulation. Per time step:

- Vehicles “rain” into system (U or N).
- Users “interested” if > 5 vehs within 0.1km
- Go through interested users and match with closest vehicle; remove vehicle from pool.
- Remove vehicles where pickup distance was > 500m.
- The “vehicles rain” is reduced over time.
- Some addt’l technical details which are, I hope, irrelevant.



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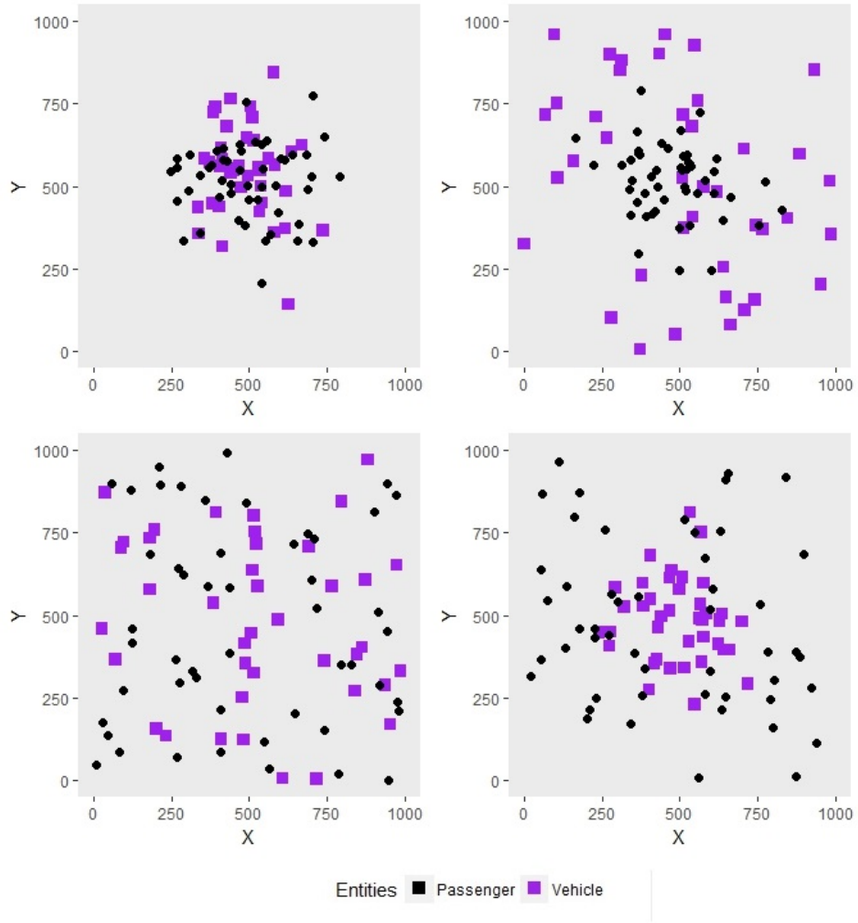
Expectations

- Taxis either become super-critical, or die out.
- More “vehicle rain” → higher proba to become super-critical.
- More population → higher proba ...

- The smaller the system, the fuzzier the boundary. (“Finite size effect” in “theory of phase transitions”.)



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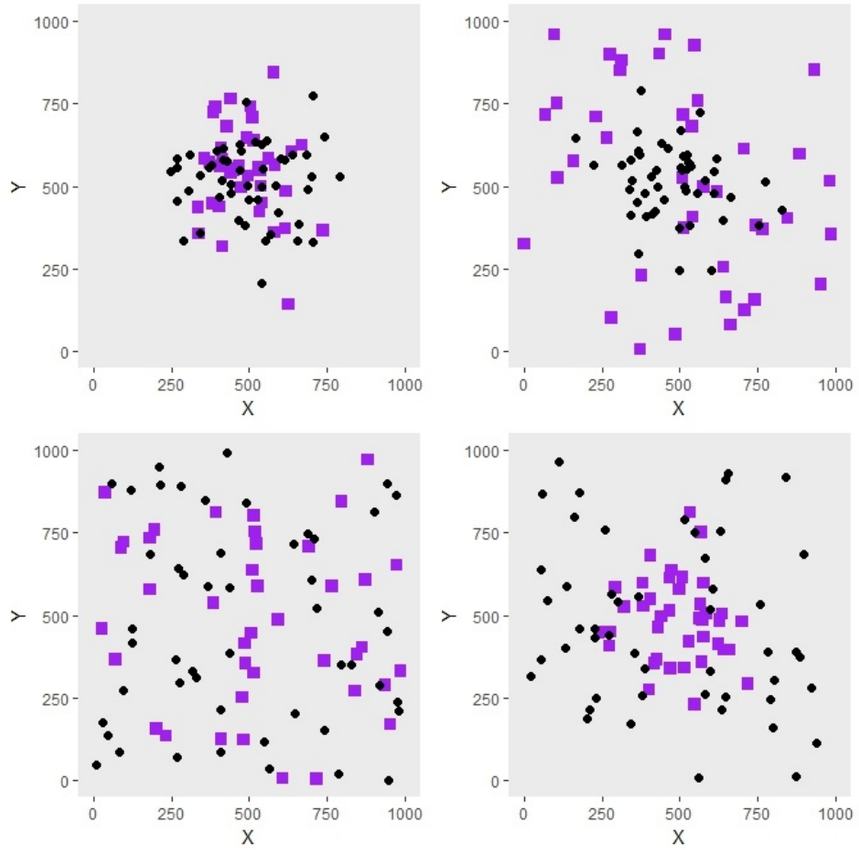
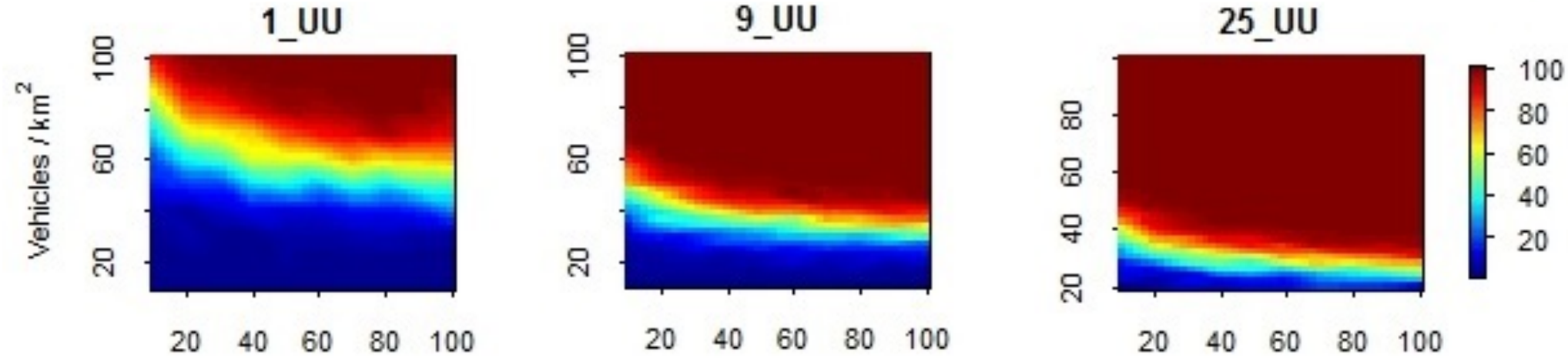


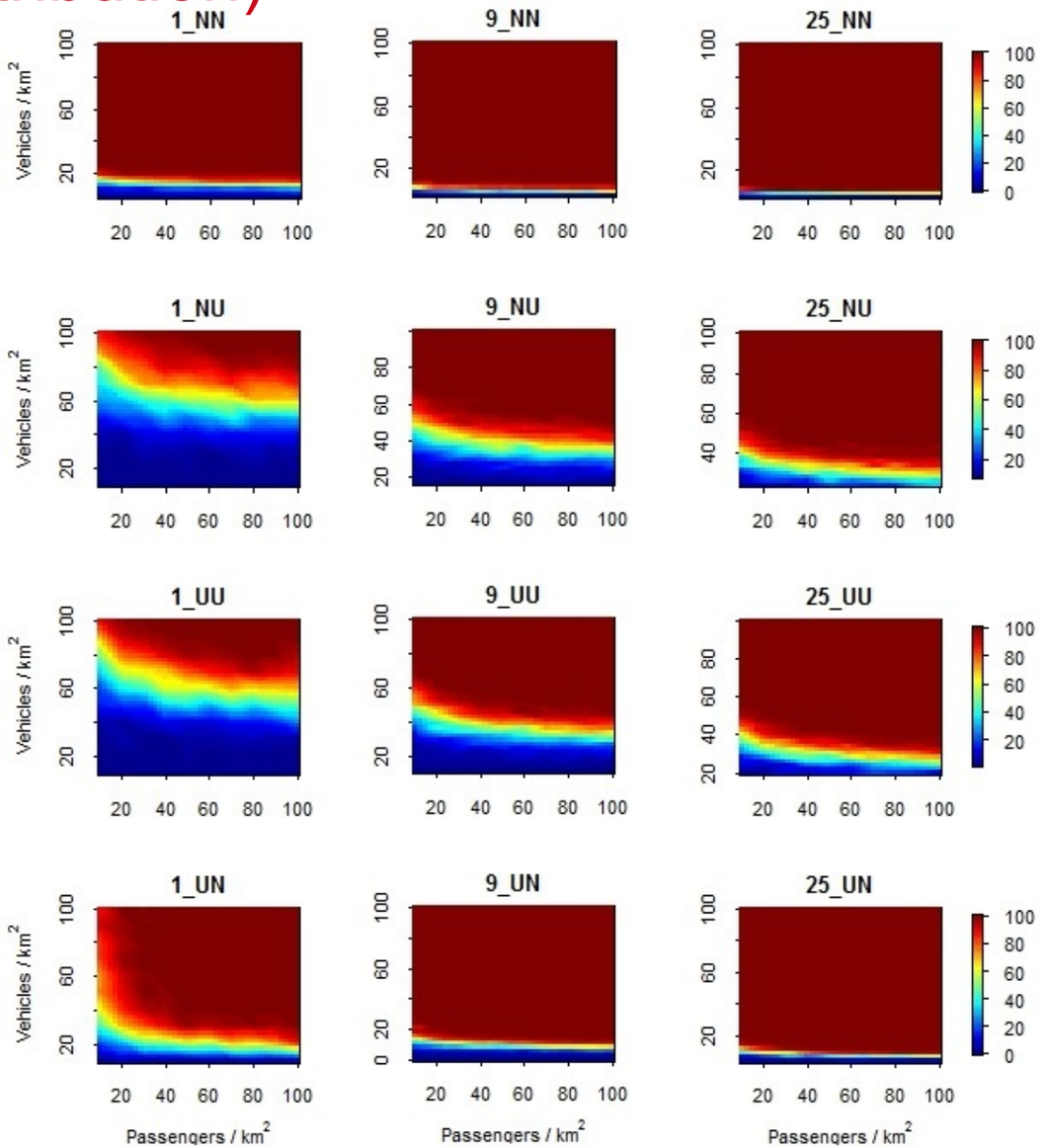


Now all NU cases (population/vehicles distribution)

Normally distributed “vehicles rain” (*N cases) higher proba than uniformly distributed (*U cases).

Population distribution much less important.

→ *Initially rather concentrate your vehicles into smaller areas!*



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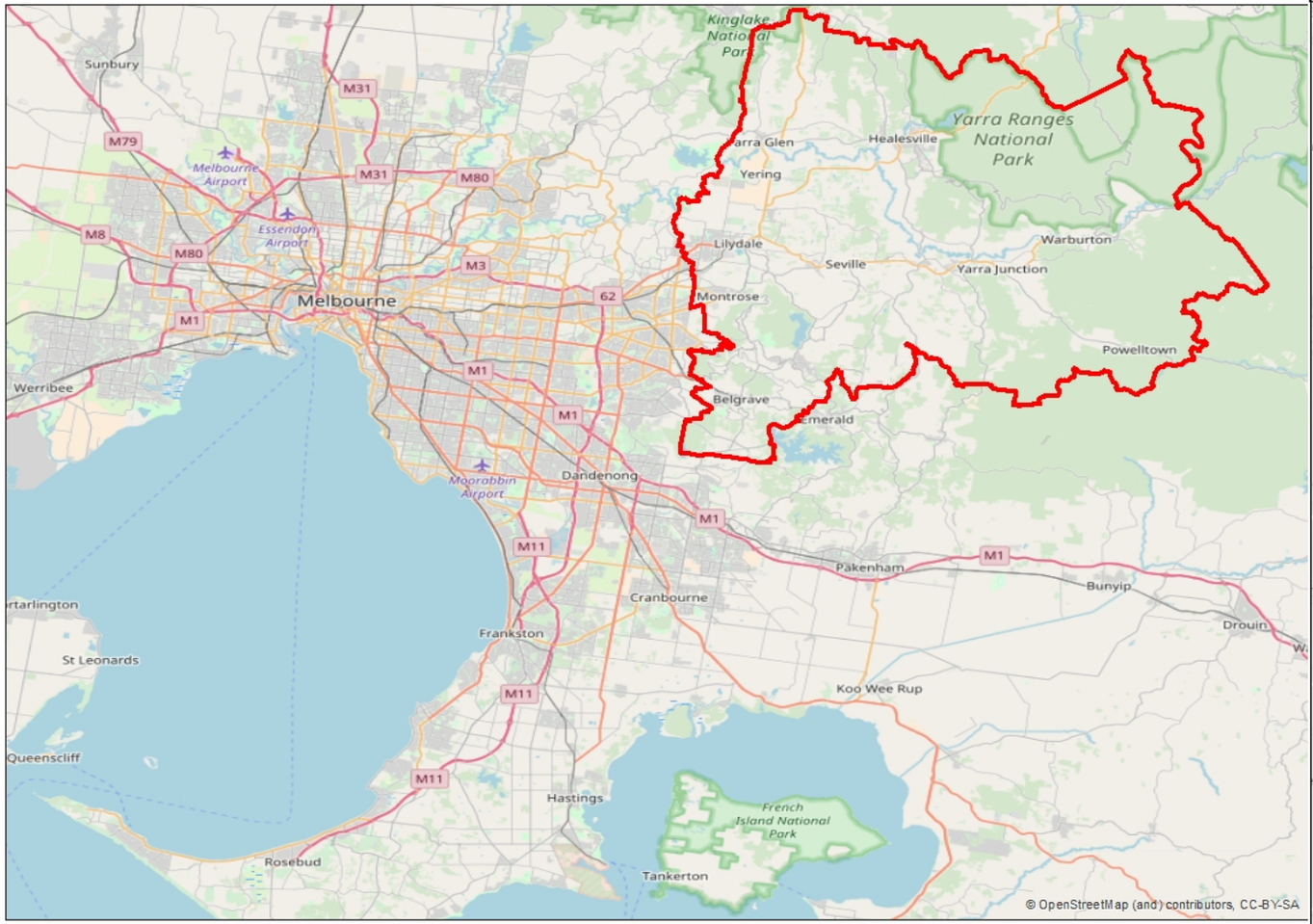
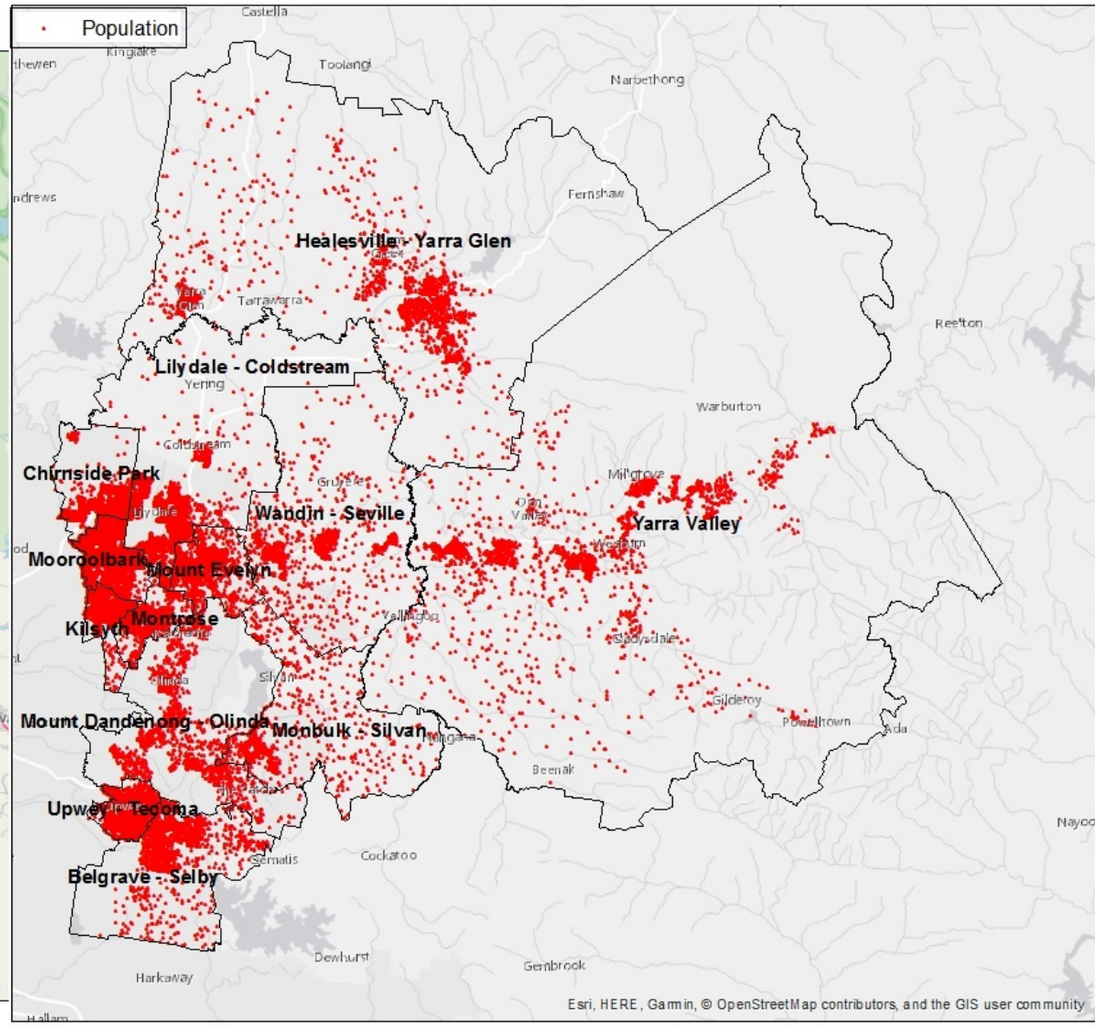
Simulations with real world substrate

Yarra Ranges area





Same simulation.

Only difference (I hope): “vehicles rain” uniform per “suburb”.

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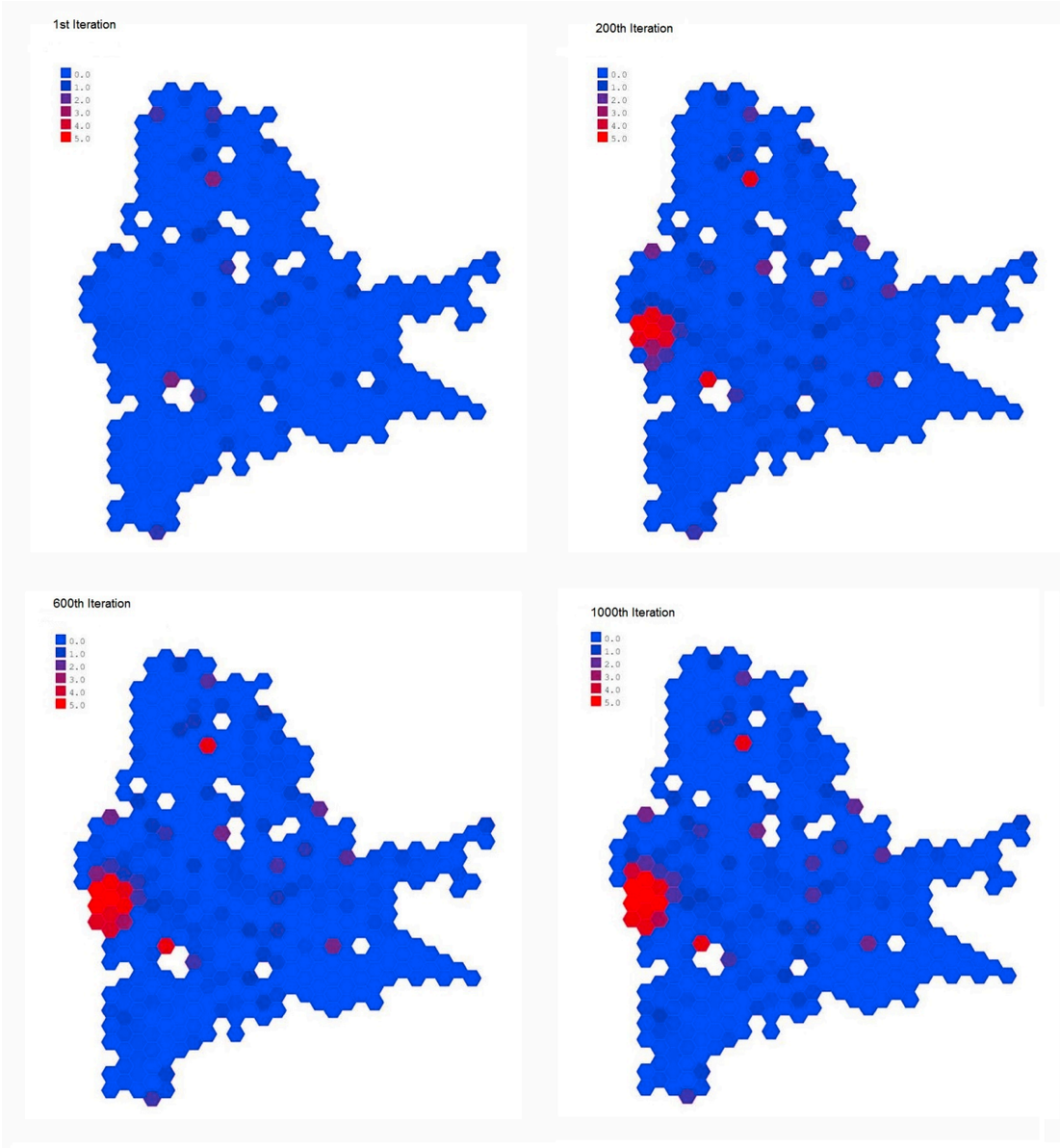
Over time ...

- Some areas become and remain super-critical.
- Infect all reachable neighbors.

- Run again → get different outcome



Conclusion

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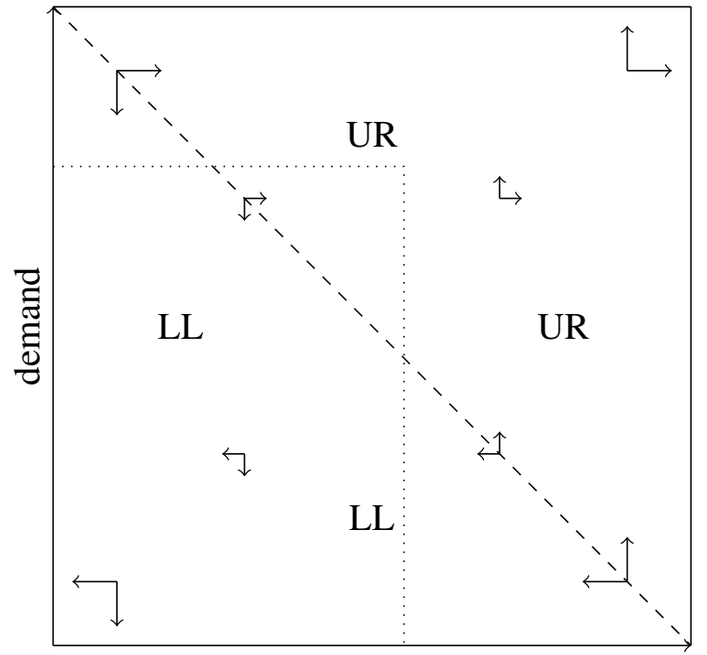
- Take platform market model from **non-spatial to spatial**.
- Have criticality **dynamics separately in each "cell"**.
- Cells where demand/supply reach into UR ***can*** **become super-critical**.
- Super-critical cells **infect neighbors**.

→ Start such platforms in urban cores; concentrate initial subsidies there & remove once super-critical.

→ Will spread by itself to all "reachable" areas.

→ Move subsidies to smaller and smaller cities; keep there until super-critical.

"Driverless vehicles owned by Uber" very different system from current platform system.



(c)