

# The Hotspotters

INDIA

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*for*  
Hack4Resilience

The challenge...

## Forecasting new hotspots and rate of transmission in the relaxed zones using mobility data or other proxies

Can we nowcast new hotspots of disease spread based on data from sources other than only confirmed cases within a zone? Can proxy datasets be identified which can help monitor the rate of transmission and probability of new hotspots before the cases are confirmed by tests.

### Data Needed

- Mobility data from mobile network providers
- Mobility data from sources such as Facebook Mobility datasets
- Identifying trends in rural-urban migration to aid in redefinition of zones within the state
- Data on confirmed, quarantined and suspected cases at a granular level (Aarogya Setu App)

## Use Case Owner

Emerging Technologies Wing, Government of Telangana

As the stringency in lockdown is relaxed in India in stages, where some zones have relaxed rules in comparison to others, it is important to nowcast the probability of developing new hotspots. This can help the Government intervene before the number of cases rises uncontrollably.

## Partners



The solution...





# Dashboard



Admin

## Main Navigation

Dashboard (Logistics)

Dashboard (Linelist Data)

Daily Report of Sample Taken

Majority of community surveillance

## Report

Surveillance Report

Selected country: Brazil

→ Date of Arrival from Affected Country

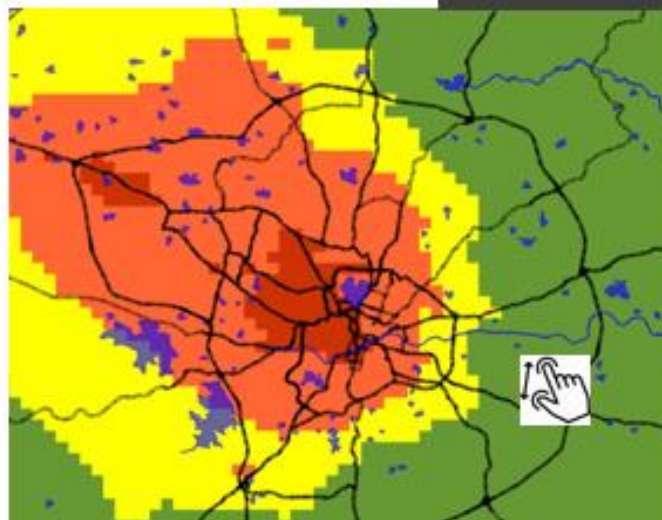
User Log Report

Chart Visualization

SPECIAL SURVEILLANCE SYSTEM - S3 (AS ON 05-03-2020)

Dashboard (State Level Linelist Data)

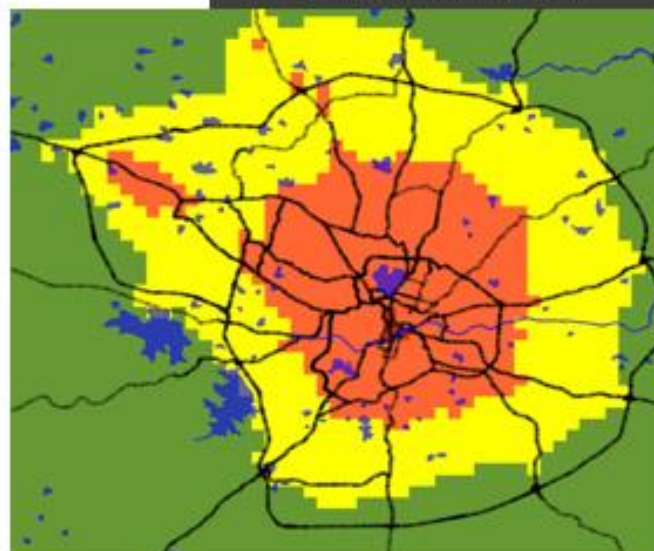
Live



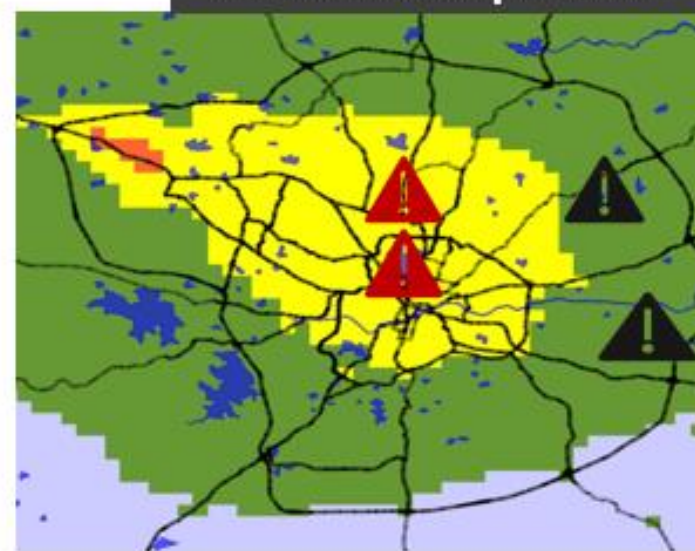
+7 days



Where to test



Current lock protocol



# How it works...

Based on Simha, Ashutosh, R. Venkatesha Prasad, and Sujay Narayana.

"A simple stochastic SIR model for covid 19 infection dynamics for karnataka: Learning from Europe."

arXiv preprint:2003.11920 (2020). Available [online](#),

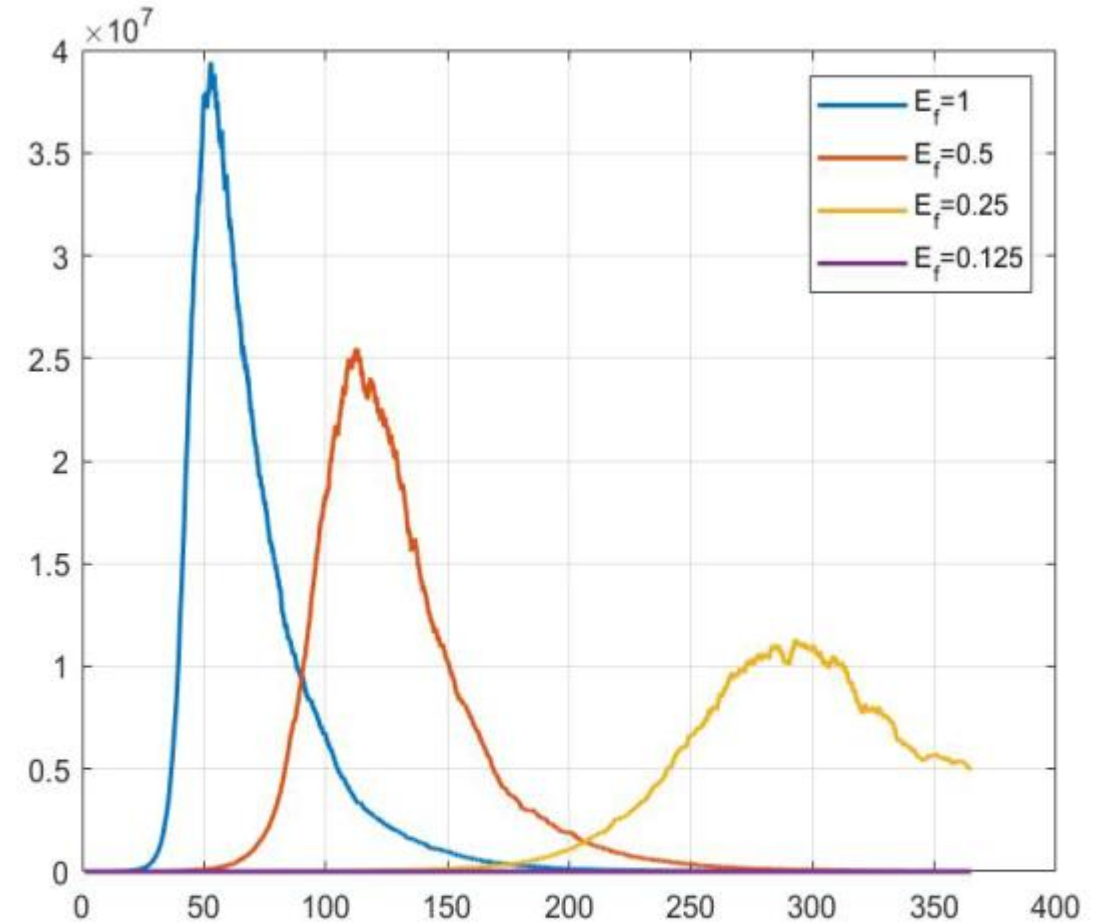
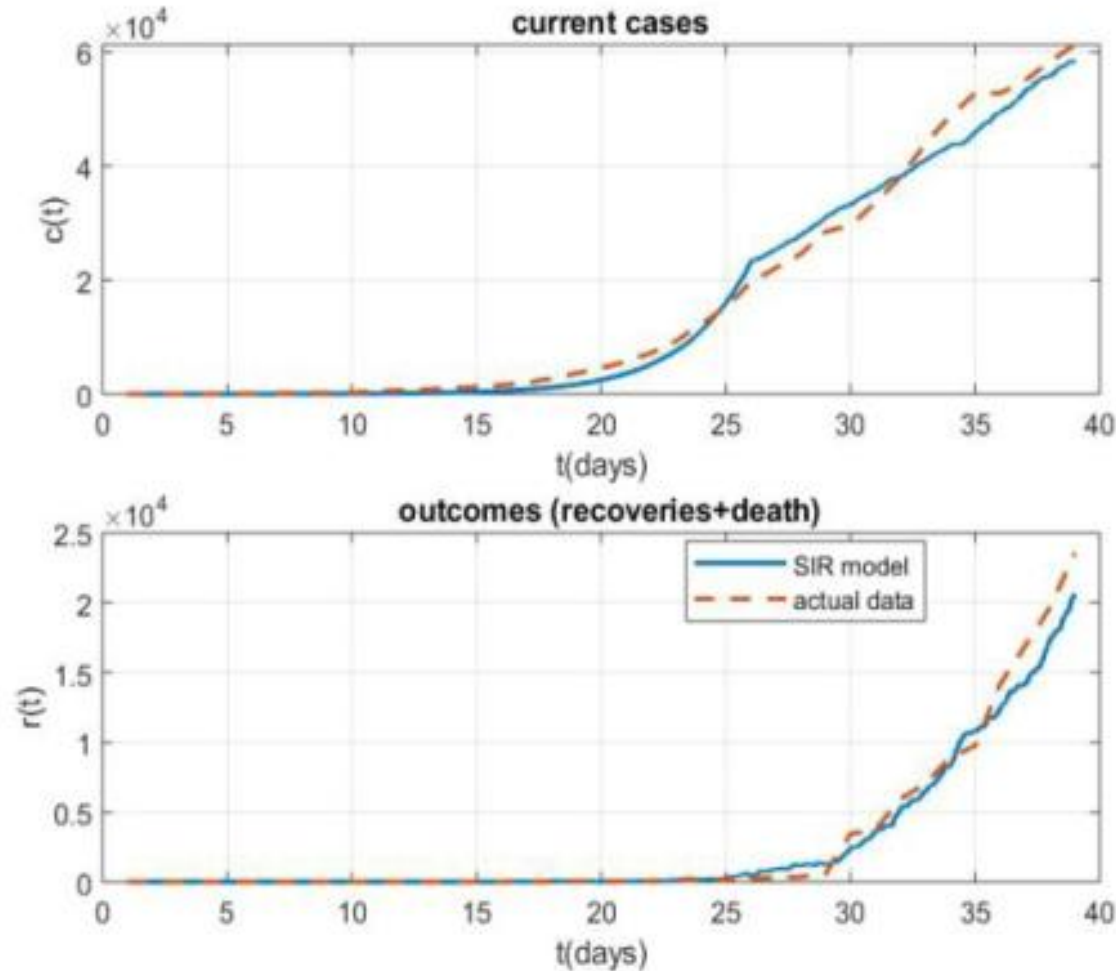


Fig. 9: Projections for Karnataka for 365 days with varying interventions using European average parameters.

# Start with: Single Node SIR Model



S = Susceptible; I = Infected; R = Removed

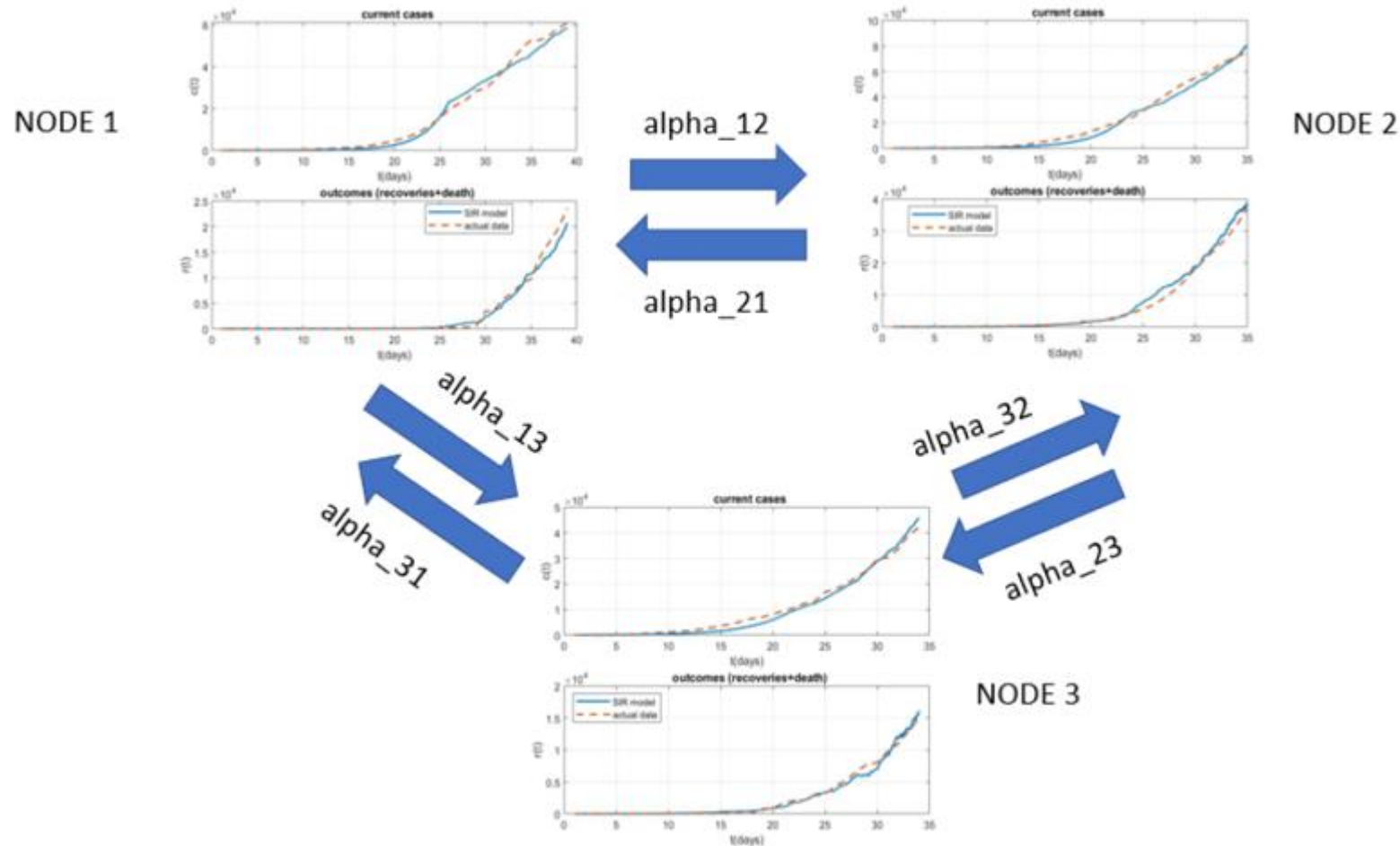
Governed by certain equations

$$\begin{aligned}dS(t) &= -E_f \beta S(t) C(t) dt \\dC(t) &= (E_f \beta S(t) C(t) - \gamma C(t)) dt + \sigma C(t) dW_t \\dR(t) &= \gamma C(t) dt - \sigma C(t) dW_t,\end{aligned}\tag{1}$$

$$\begin{aligned}C(0) &= C_0, \quad S(0) = S_0 \\S(0) &= P_{total} - R(0) - C(0).\end{aligned}\tag{2}$$

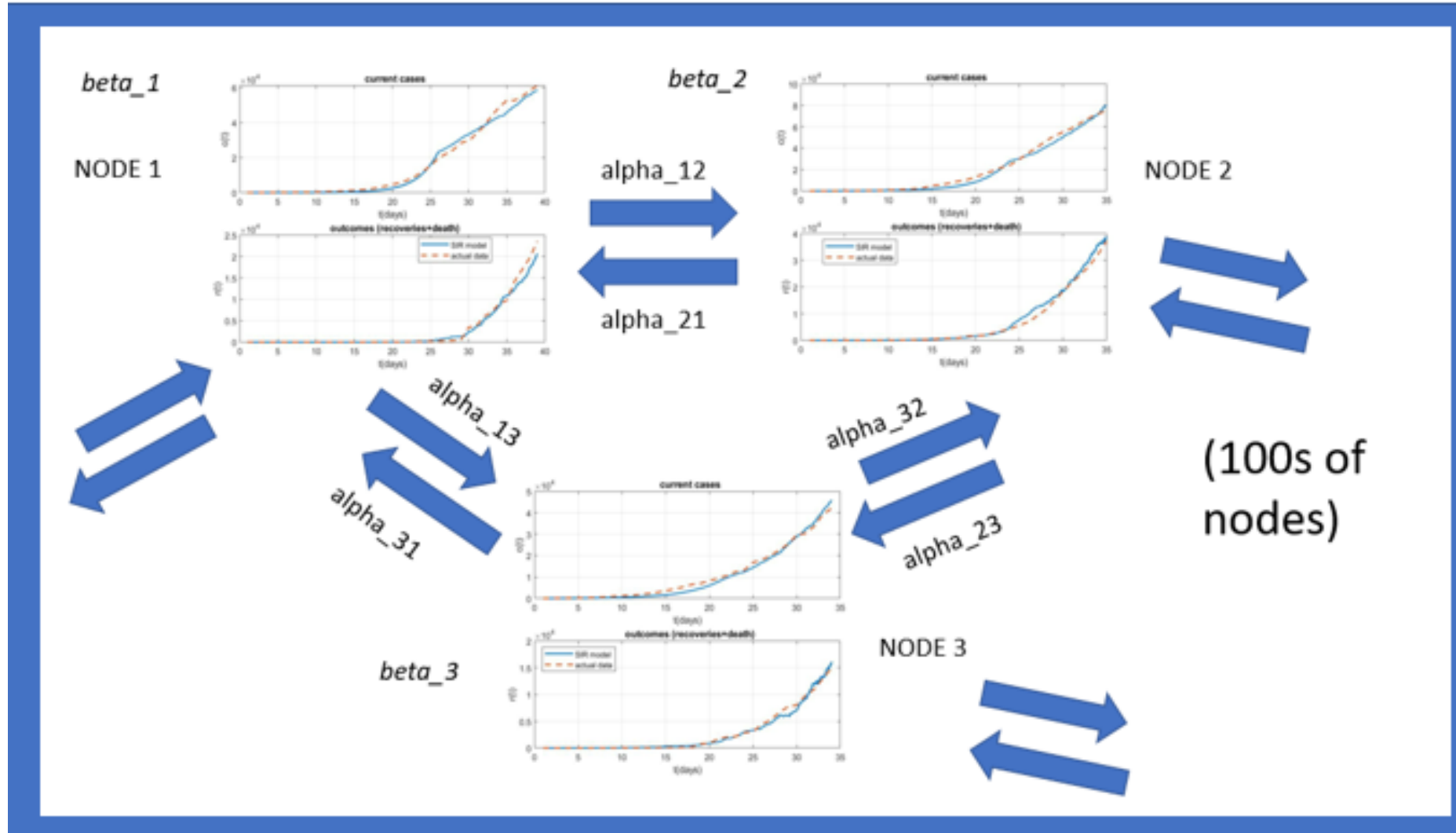
**NOTE** C = Infected population in the equations above

*Link* the SIR nodes to form a network representing the city





# The full model for Hyderabad would have **many** linked SIR nodes..

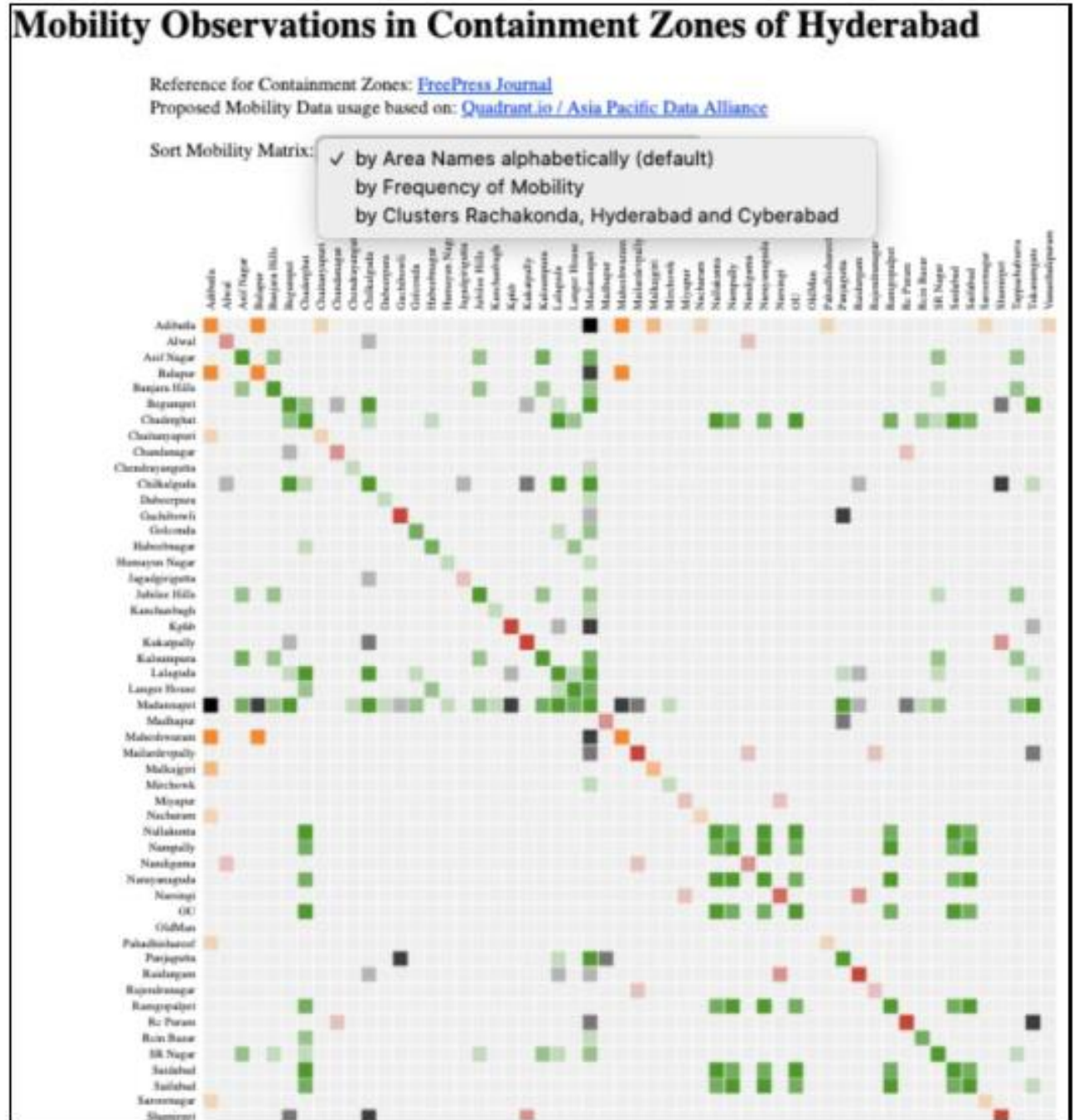


1 or more nodes  
for each ward;

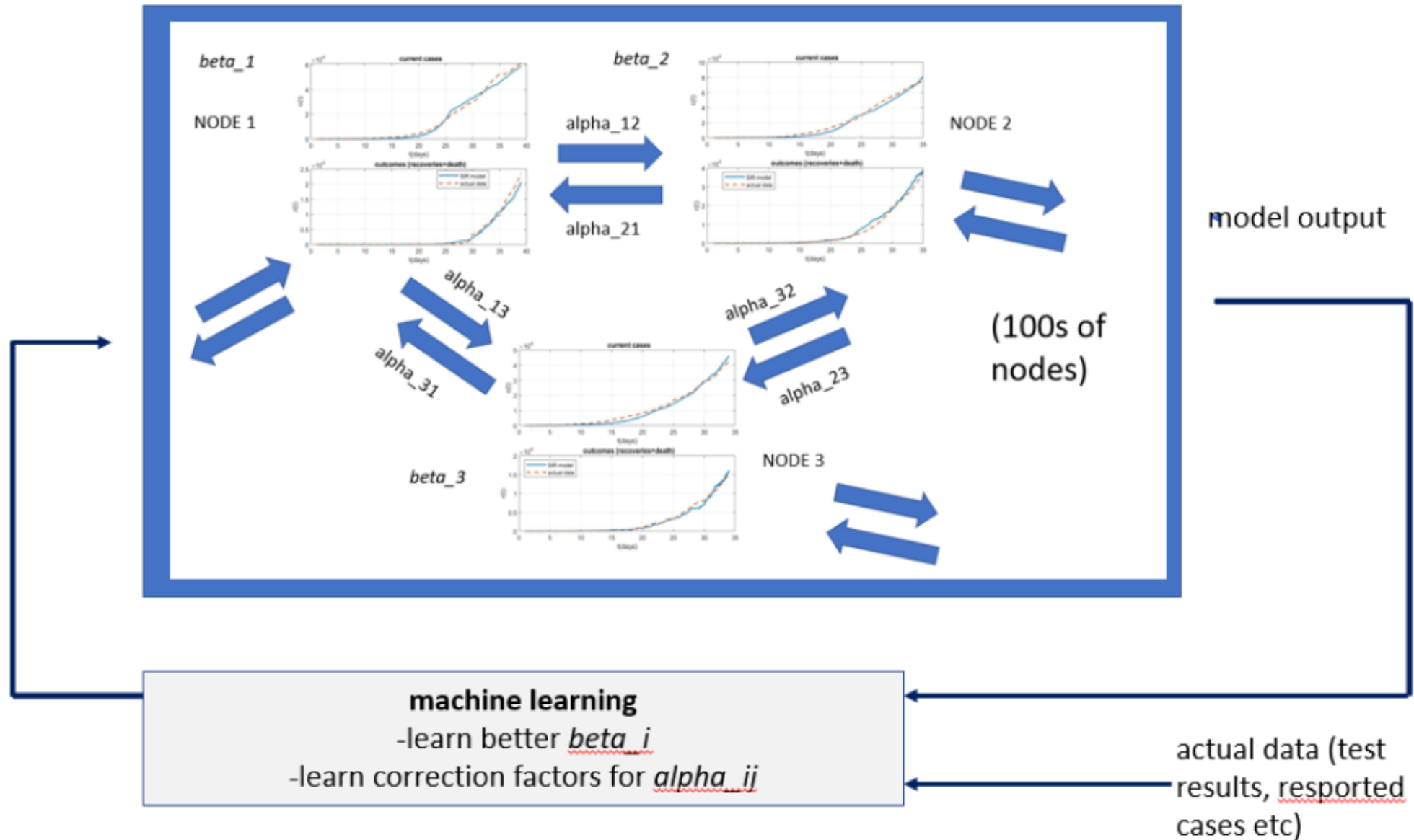
Nodes for  
migratory areas;

etc

Connectivity  
between nodes  
is inferred in  
real-time from  
high resolution  
**mobility** data.



# Machine-learning for accurate tracking and model updation



NOTE: Parameter learning has already been demonstrated for single node SIR in the referenced paper.

# From proof-of-concept...

- Current prototype
  - **Testbed model** of 32 nodes with simulated cluster parameters
  - Trivial **machine-learning** loop  
(Learning has been demonstrated elsewhere for single-node problem)
  - **Simulated data** for adjacency matrix  
(due to lack of high resolution mobility data)
  - Heatmap renderings run in browser on **test** data

# From proof-of-concept to full scaleup...

- Current prototype

- **Testbed model** of 32 nodes with simulated cluster parameters
- Trivial **machine-learning** loop (Learning has been demonstrated elsewhere for single-node problem)
- **Simulated data** for adjacency matrix (due to lack of high resolution mobility data)
- Heatmap renderings run in browser on **test** data

- Scaled-up version

**Full model** of 100s of nodes based on real ward or sub-ward level demographic and case data (with timestamps).

Full **machine-learning** loop with learning across all clusters. Disaggregated case data from March 15 – June 15 required.

**High resolution mobility datasets** required for intra-city connectivity to be derived.

**Real-time dashboards** will be available on web and mobile to authorized users.



# Thank you!

## The Hotspotters



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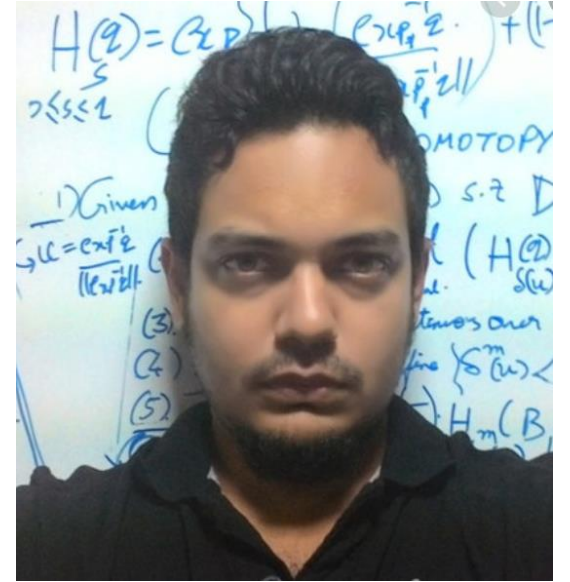
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