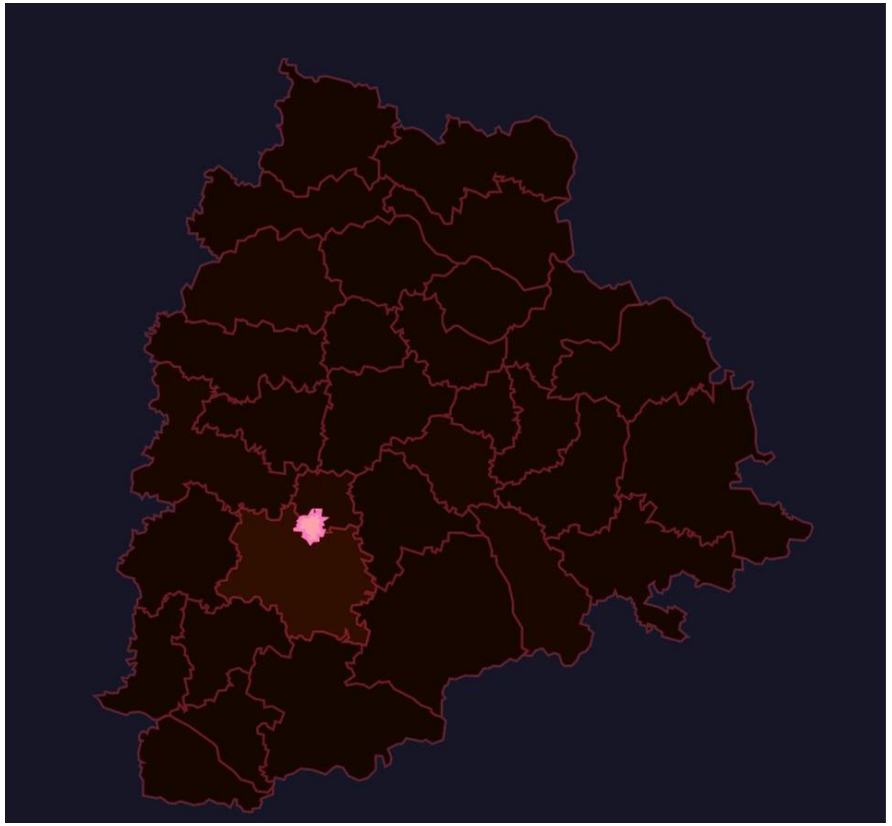


The Hotspotters

INDIA

Hari Dilip Kumar
Shailaja Sampat
Dr. Ashutosh Simha
Sachin Gattu

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)

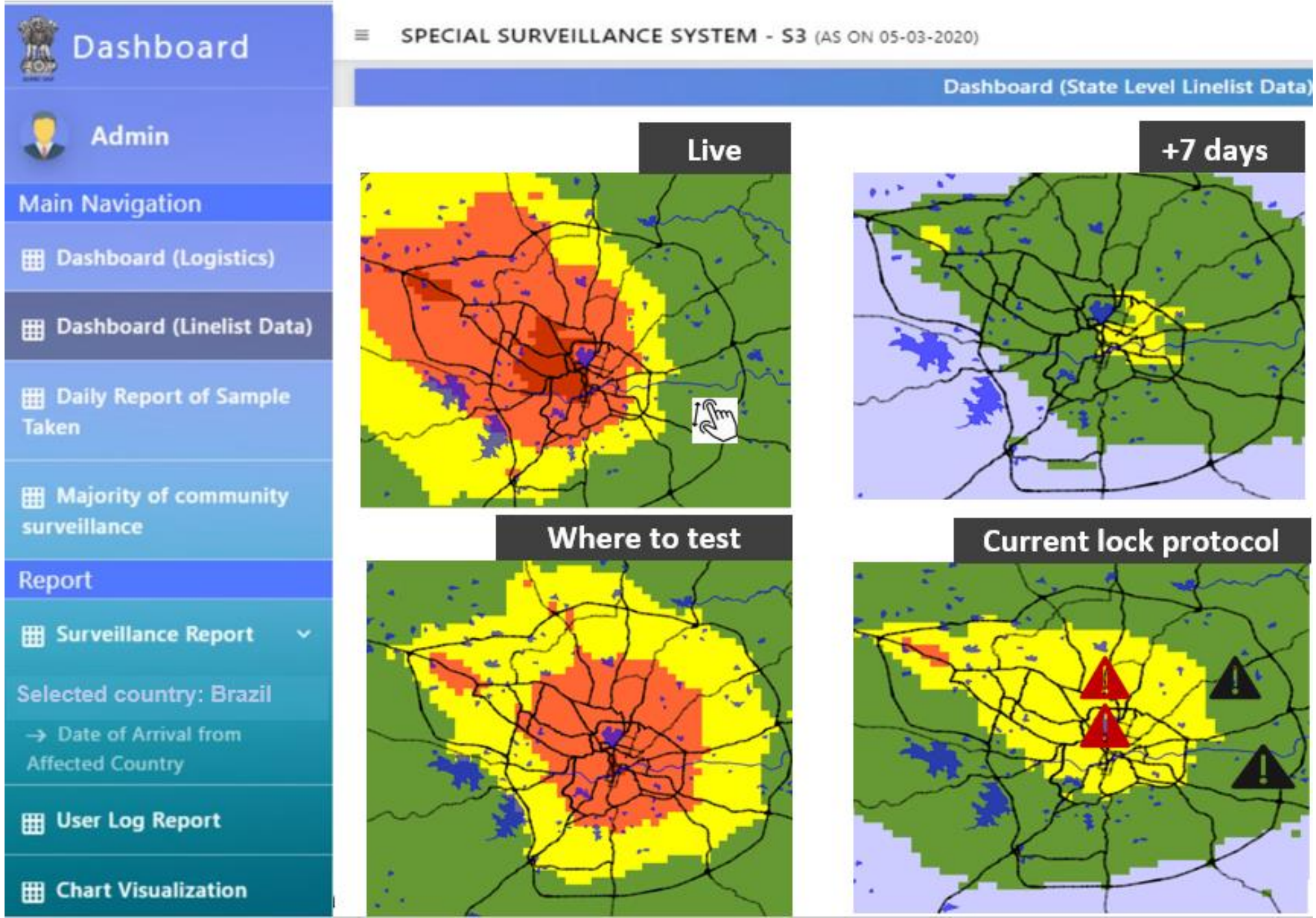
Use Case Owner

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,

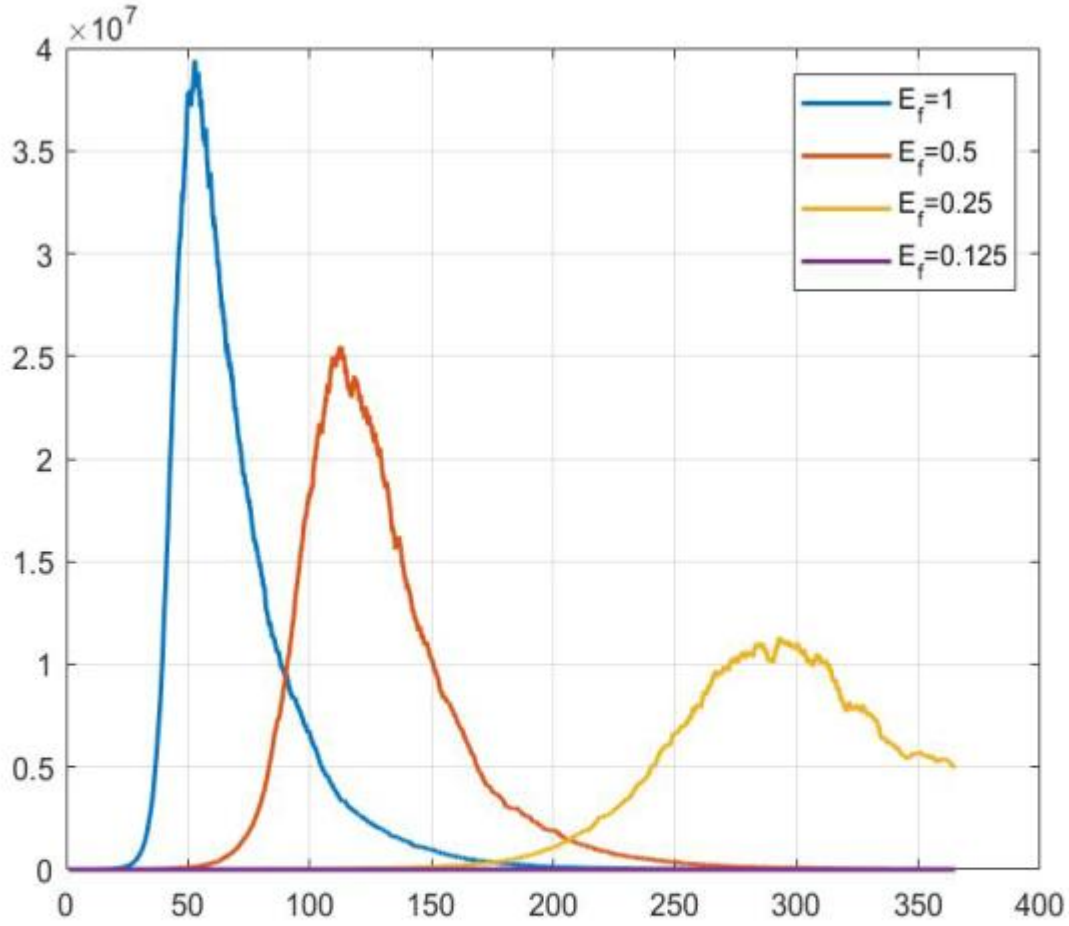
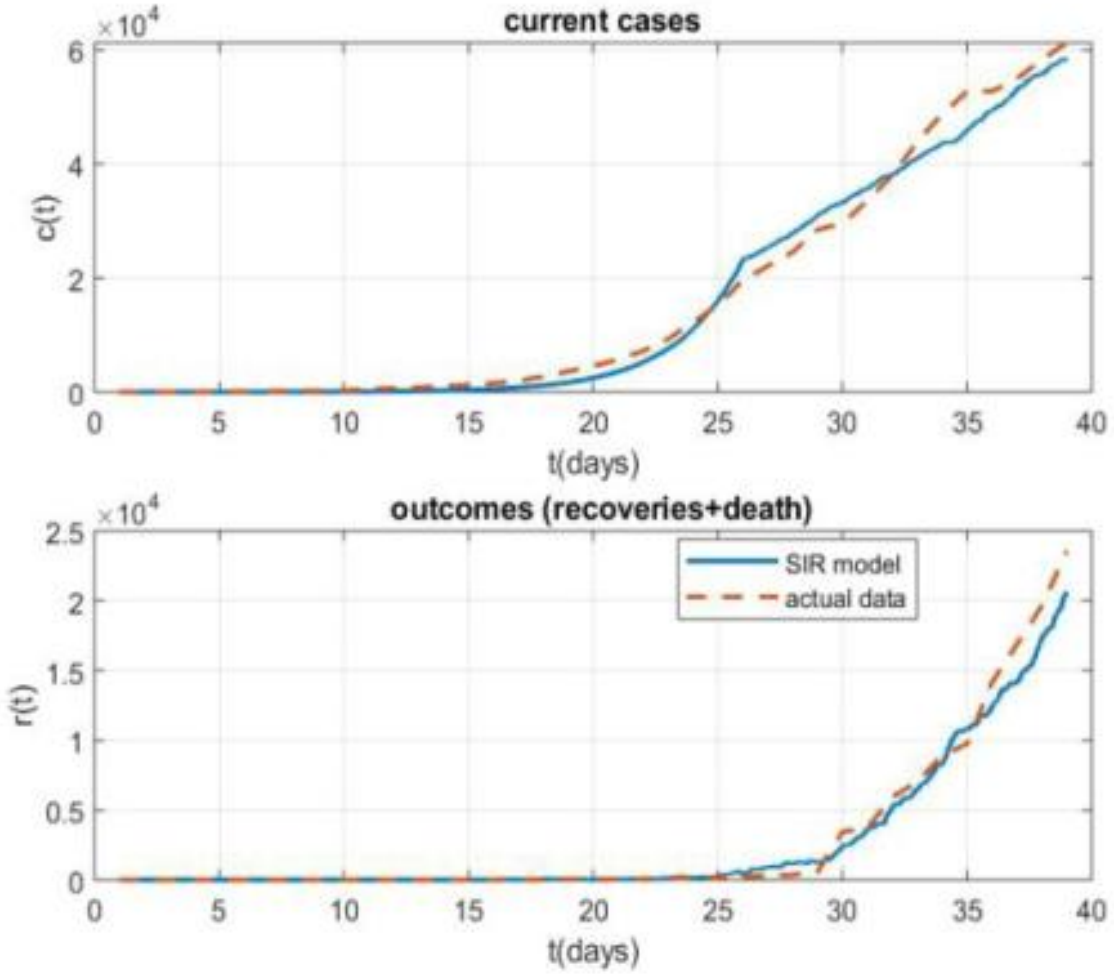


Fig. 9: Projections for Karnataka for 365 days with varying interventions using European average parameters.

Start with: Single Node SIR Model



S = Susceptible; I = Infected; R = Removed

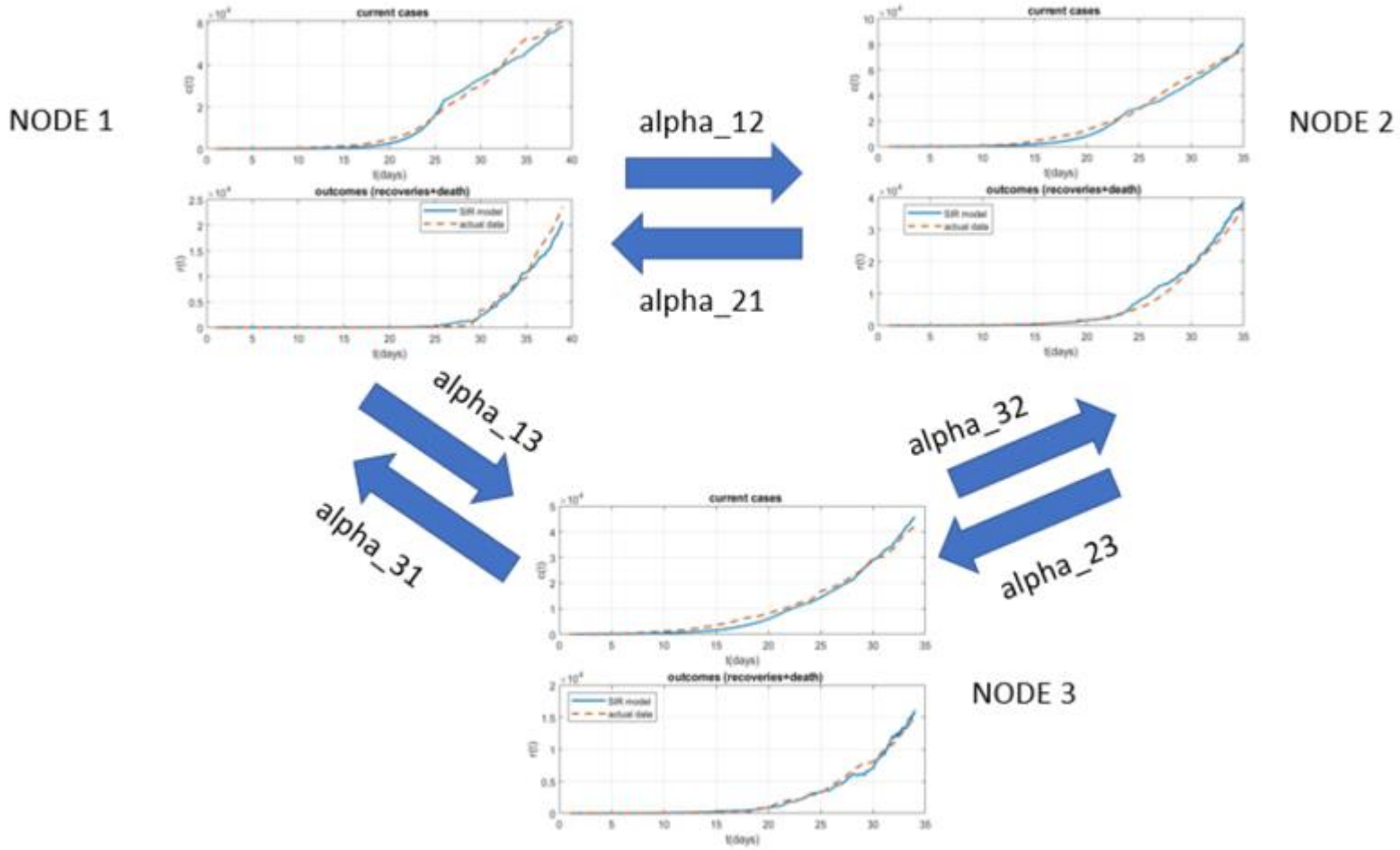
Governed by certain equations

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

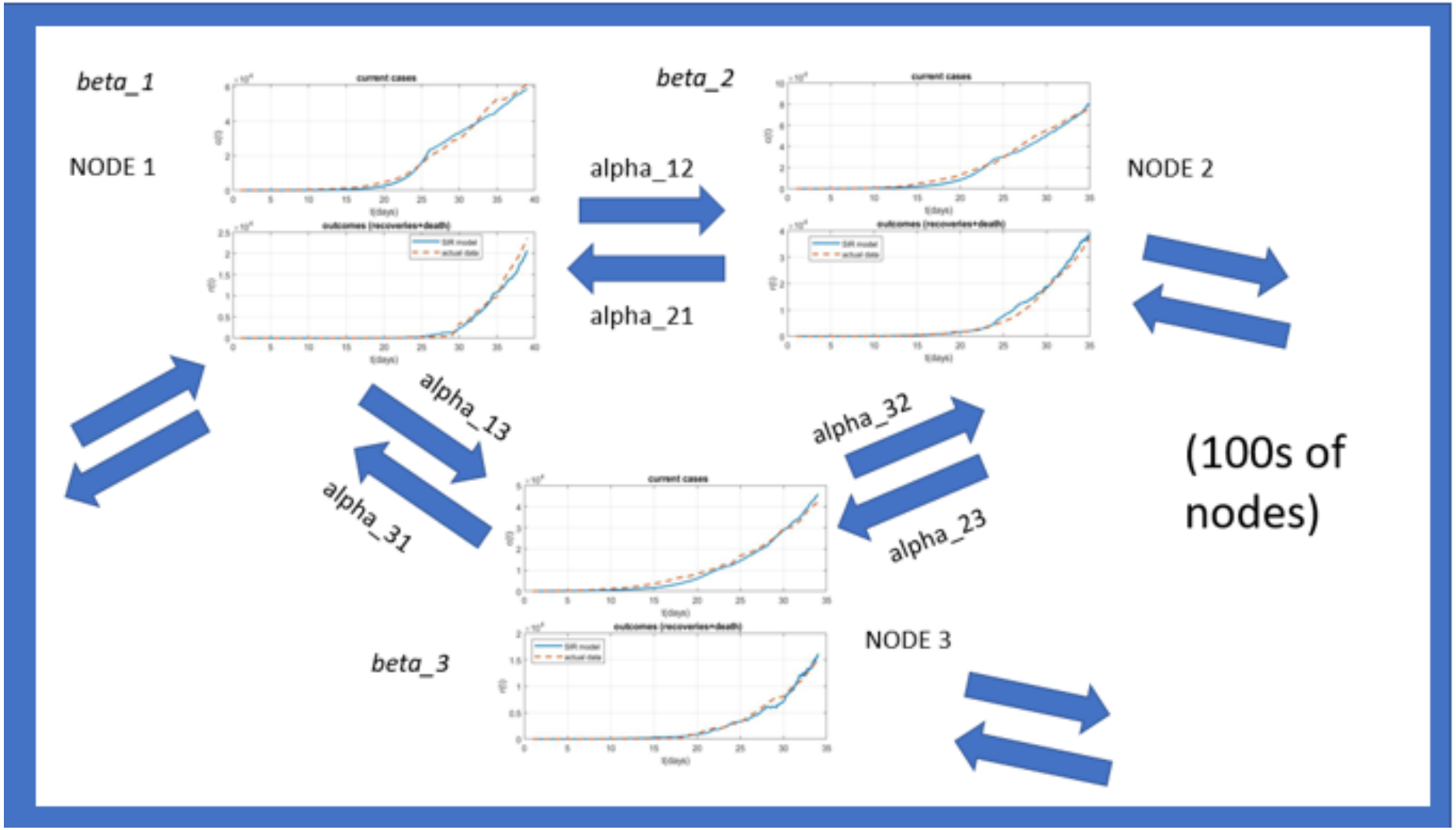
$$
\begin{aligned}
C(0) &= C_0, \; S(0) = S_0 \\
S(0) &= P_{total} - R(0) - C(0). \qquad (2)
\end{aligned}
$$

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..

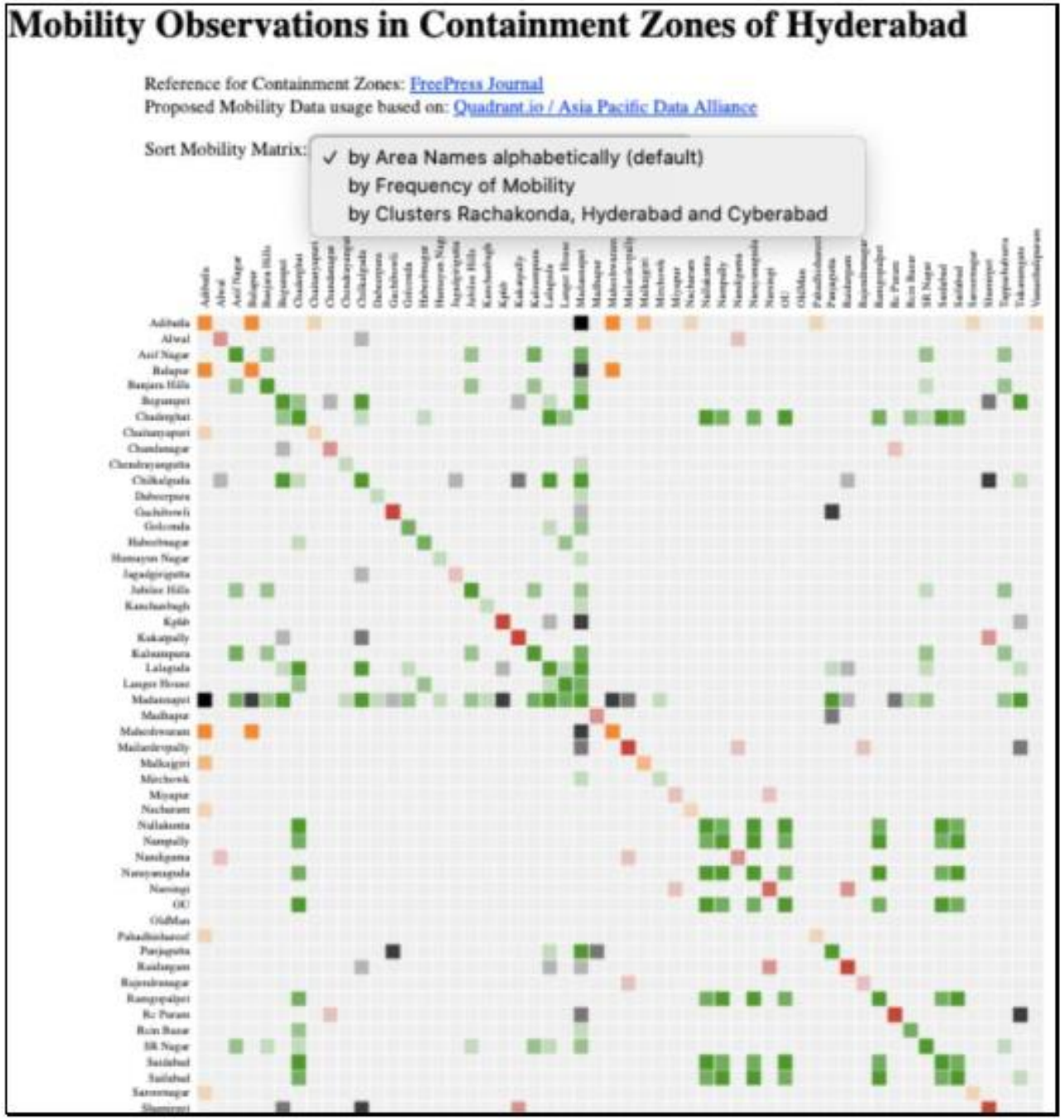


1 or more nodes for each ward;

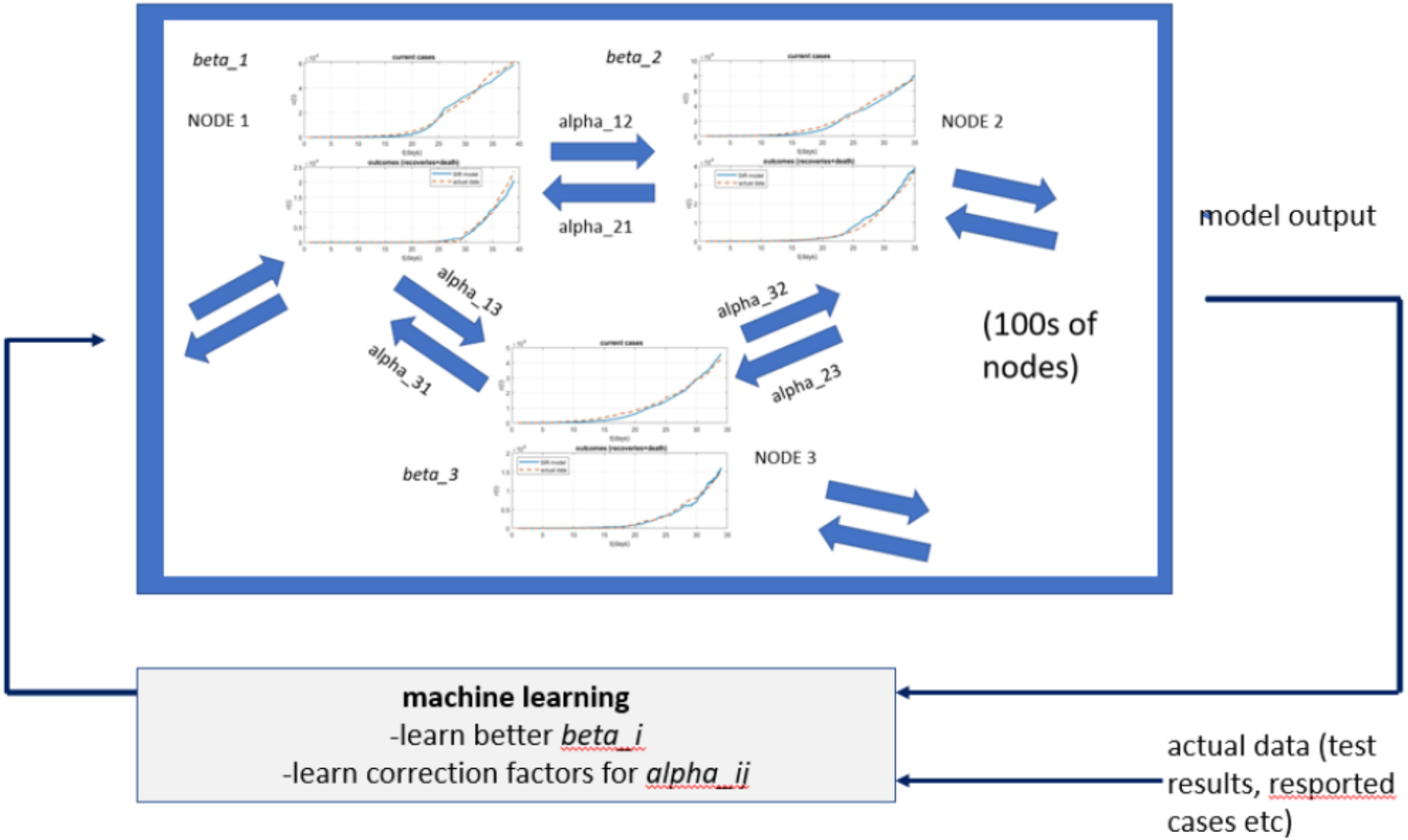
Nodes for migratory areas;

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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