Forecast-driven Evidence of Human Mobility Impacting the Spread of COVID-19

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Goal

- Does controlling mobility control the spread of an epidemic?
- Simplification: Does the foresight of mobility help us better predict the spread of an epidemic?

Data Sources

- SafeGraph Inc. point of interest (POI) visitor patterns data
- Google Mobility Report LA County
- 2010 census block group data
- LA Times confirmed cases
- LA County Public Health cumulative infection

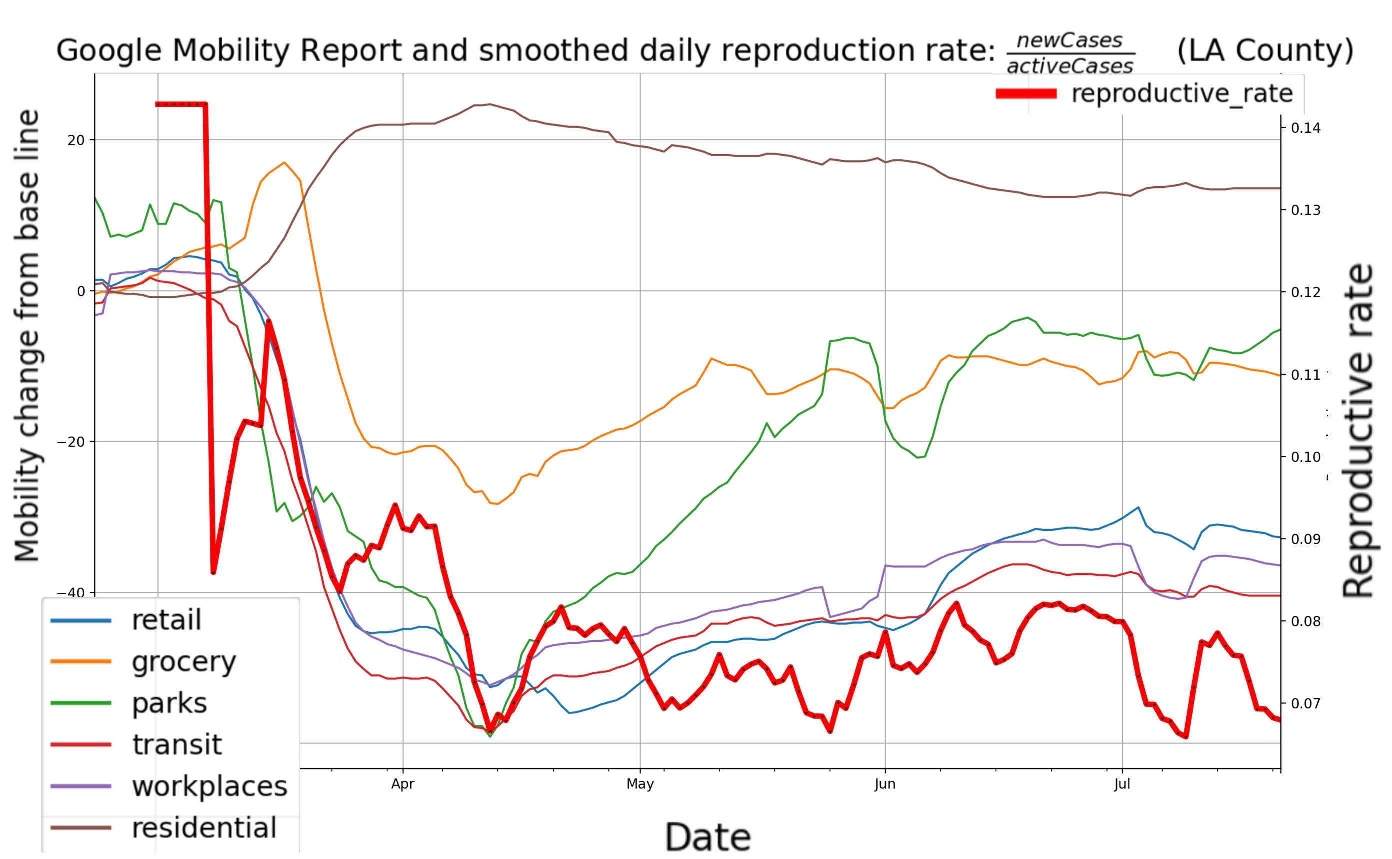

Figure 1: Google Mobility Report LA County data and COVID-19 reproduction rate.

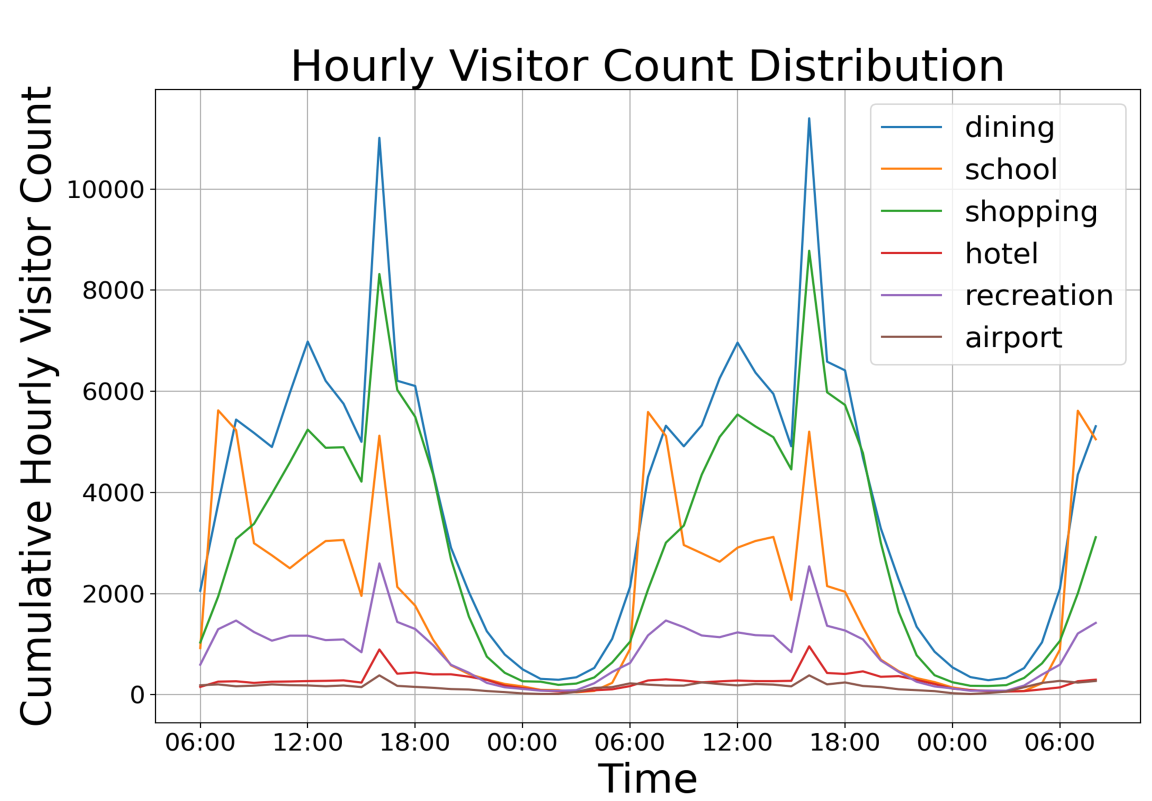

Figure 2: A snapshot of hourly visitor patterns in SafeGraph data

Methodology

Two branches of variations of the SIKJα model that incorporate

- Inter-region Mobility (original SIKJα formula)
- Visitor-pattern Mobility. (extended formula, see equation 1)

$$\Delta I_d = \sum_{i=0}^{M-1}\left(\sum_{j=0}^{k_i-1}\beta_{ij}\cdot \mathrm{sus}\left(start_{d,i,j}\right)\cdot \Delta I\left(start_{d,i,j}, end_{d,i,j}\right)\cdot \mathrm{mobavg}_i\left(start_{d,i,j}, end_{d,i,j}\right)\right) \quad (1)$$

- **M:** number of mobility features
- **sus(d):** susceptible population on date d
- $\mathbf{\Delta I(s,t)}$**:** increase in infection from date s to date t.
- $\mathbf{mobavg_i(s,t)}$**:** date s to t's average mobility score for i^{th} mobility feature
- $\boldsymbol{start_{d,i,j}}$ **and** $\mathbf{end_{d,i,j}}$ **:** starting and ending date of j^{th} time window for i^{th} mobility feature.

We also performed manual and agglomerative hierarchical clustering on the SafeGraph visitor patterns data to build distinct mobility features based on the nature of POI locations.

Results

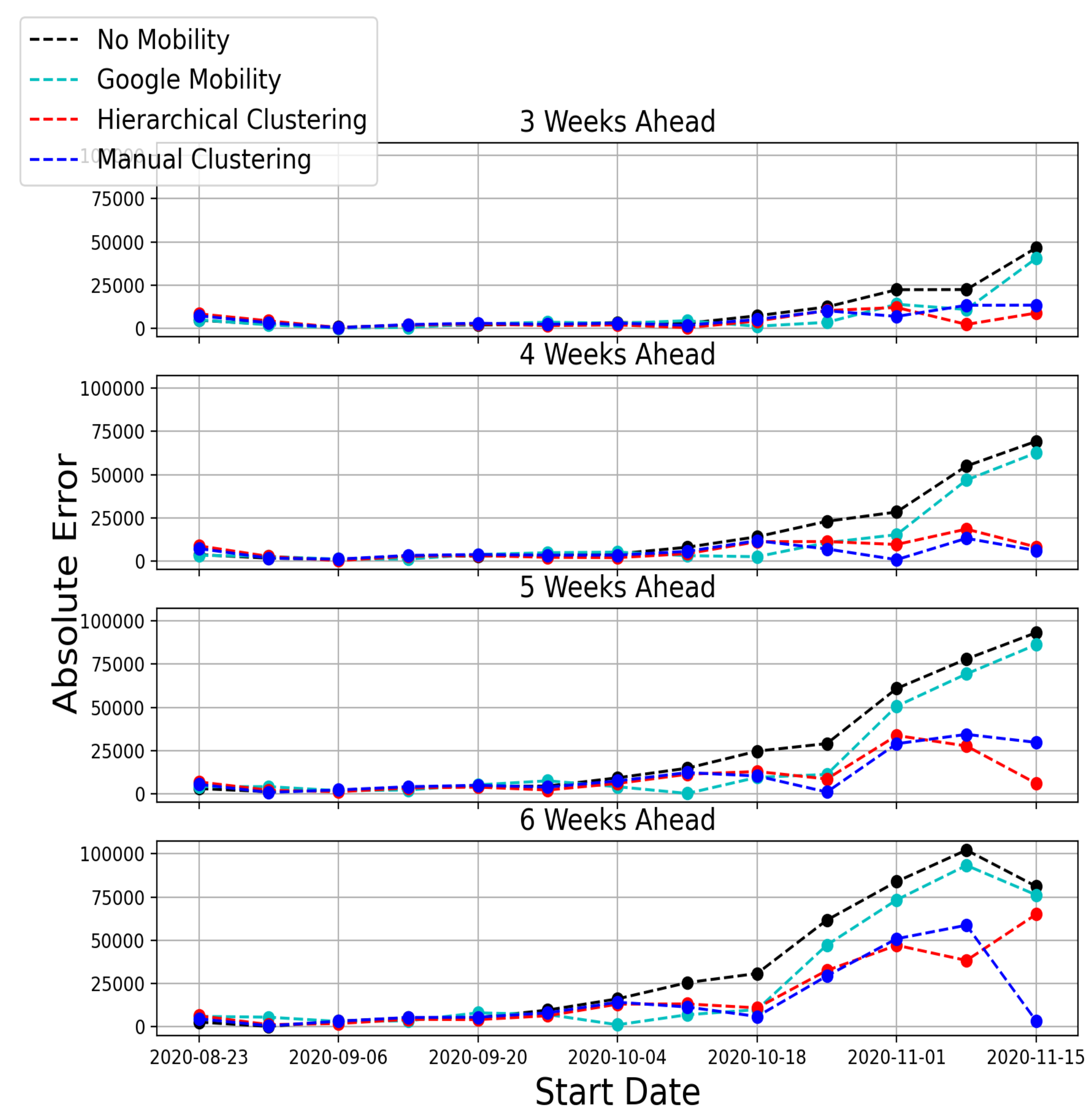

Figure 3: Absolute error of all the visitor pattern mobility models

- Inclusion of mobility features consistently produce lower errors
- Micro-level mobility features outperform macro-level ones.
- The underlying pattern need not be explicitly identified by location types

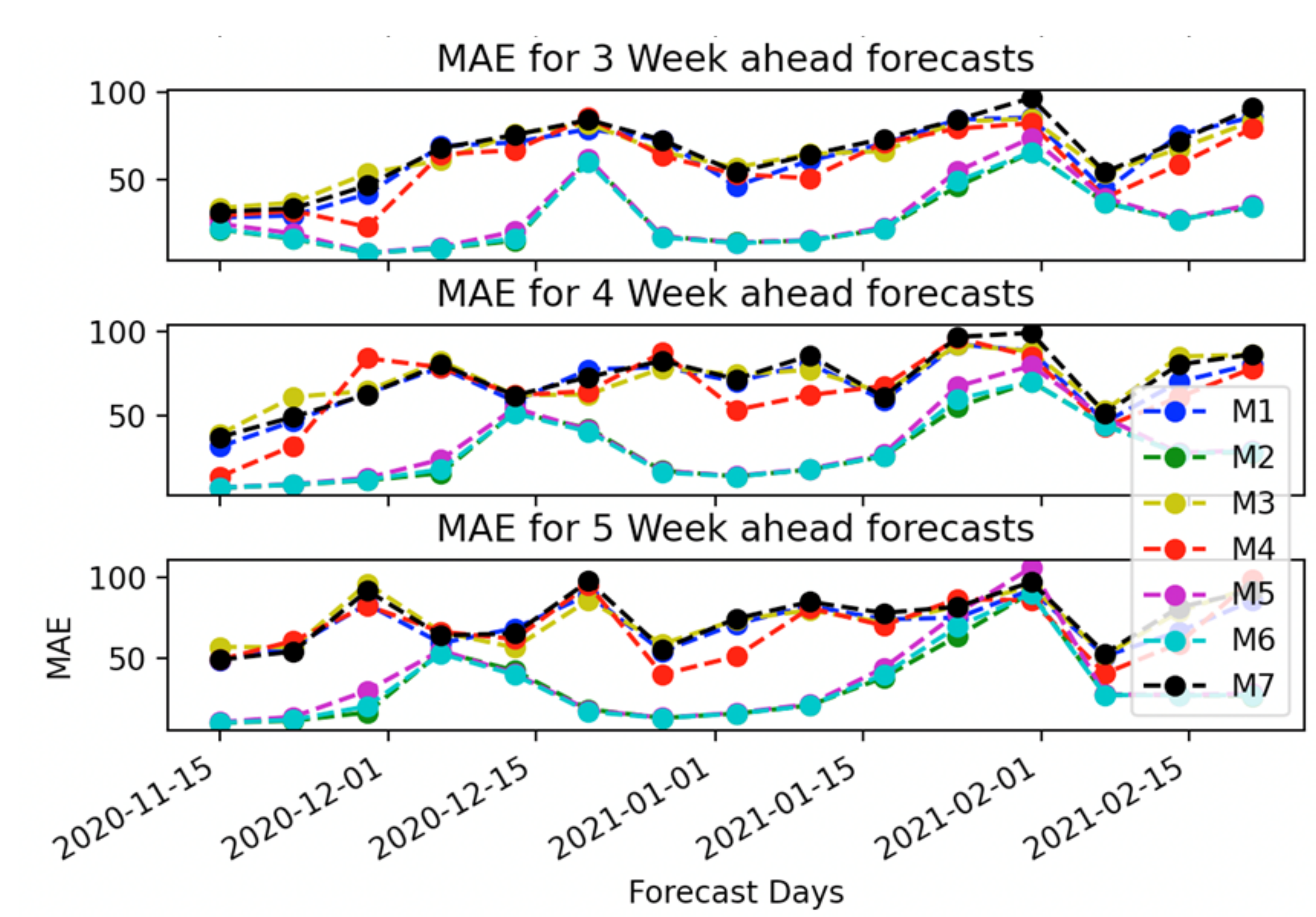

Figure 4: MAE of all the inter-regional mobility models