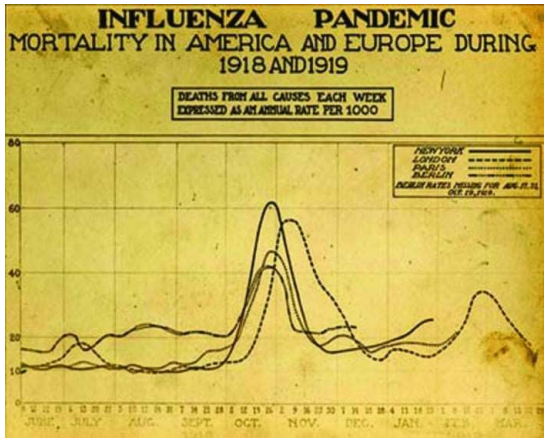
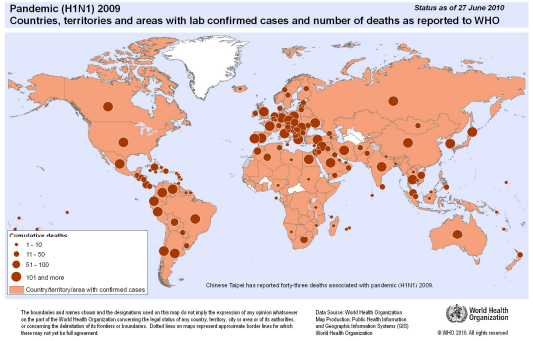
Spatial and Space-Time Data on COVID-19: COVID-19 Data Forum

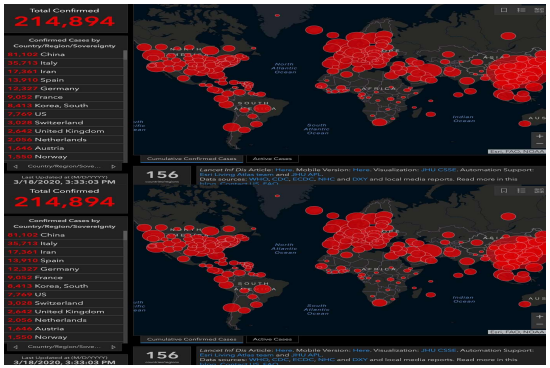
Orhun Aydin, PhD

Environmental Systems Research Institute

University of Southern California







Evolution in Communicating Pandemics

Steps for Spatial Analysis of COVID-19 Data

Map the Cases

- Data gathering
- Data cleaning
- Curation

Map the Spread

- EPI models
- Spread timelines
- Future of spread

Map Vulnerable Populations

- Where are they?
- Movement patterns

Map Available Resources

- Hospital
- Equipment
- Groceries

Communicate

- Reasons behind interventions

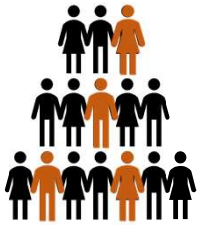
Challenges Pertaining to COVID-19 Data

Data Uncertainty	Uncertainty pertaining to data. Interplay of spatio-temporal scale of data and uncertainty
Varying Scales of Data Sources	County-level, hospital-level, agent-level
Spatial, spatio-temporal representation	Spatial and temporal aggregation/representation of data. Conforming to
Impacts many dimensions of our lives	Different data sources & types require a wide type of data representation
Data is dynamic	Serving, consuming & curating live data is challenging

Data Requirements of Epi Models

Epidemiological Models (IHME/CHIME/SEIR/Covid19Surge/…)

- Population
- Demographics



- Attack Rate
- Infection Rate
- Incubation Period
- Infectious Period
- Convalescence Period

- Hospitalizations Rate
- Death Rate
- Hospital Stay

- Intervention Types
- Social Distancing
- Effectiveness

Data Requirements for Resource Allocation

Beds/ICU Beds/Ventilators

Total Resources & Availability

Shortages need to be avoided

- Case Mortality Increases
- Nearby care-providers experience peaks

Personal Protection Equipment (PPE)

Masks, gloves, gowns, …

Used by clinicians to protect from infection

Can be prohibitive for effective staff

Resources for Geospatial COVID-19 Data

- ESRI Disaster Response Hub
  - https://coronavirus-disasterresponse.hub.arcgis.com/
- Contains data that is:
  - Live
  - Curated
- Serves data through a RESTful API
  - Simple data interaction through R and Python

Facebook for Good: Mobility Data (Latest...

Measure of relative travel and how much people stayed home provided by Facebook Data for Good. Data...

View data

BlueDot County Social Distancing Metrics

BlueDot (Toronto, Canada) analyzes anonymized, near-real-time, mobile device-location data (from Verase...

View data

SafeGraph Weekly Patterns Data

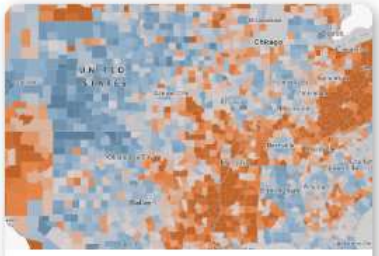
High accuracy points-of-interest (POI) business listing data for all places in the USA with visitor cou...

View data

Health, Racial & Economic Equity Data Group

A collection of Esri maps, data, and tools that can help guide decisions around health, racial, and econo...

View data



Bureau of Labor Statistics Monthly Unemploymen...

This layer shows Bureau of Labor Statistics (BLS) unemployment figures for the most current availa...

View data

JHU Centers for Civic Impact Covid-19 Count...

The current situation for the coronavirus COVID-19 in the US per county.

View data

Chmura CVI Counties April 2020

April 2020 Release of the Chmura COVID-19 Economic Vulnerability Index - County Level Data. An Ind...

View data

Coronavirus COVID-19 Cases

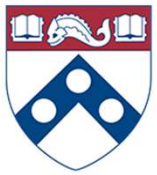
This feature layer contains the most up-to-date COVID-19 cases and the latest trend plot. It covers the U...

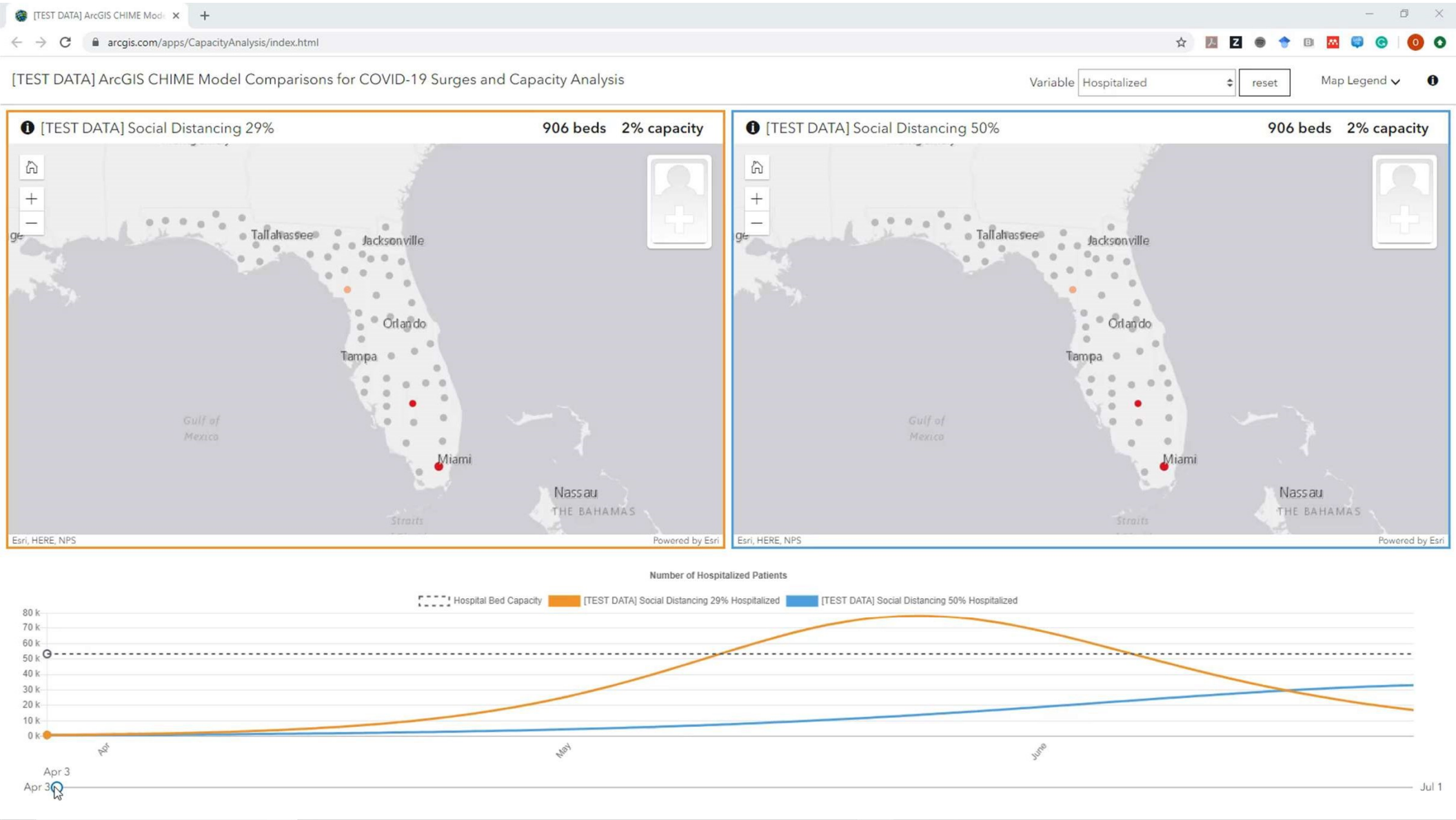
View data

Sharing & Communicating Analysis

Communicating Analysis

- Large number of open-source modeling projects
  - CHIME – Community-driven, originally from U. Penn
    - SIR Model
    - Deterministic and Bayesian models exist
  - IHME – Institute for Health Metrics and Evaluation
    - Developed by IHME Group
    - Bayesian Curve Fitting
  - Covid19Surge – Developed by CDC
    - SIICR Model
    - Planning tool
- How to make these communicable?




[TEST DATA] ArcGIS CHIME Mod
arcgis.com/apps/CapacityAnalysis/index.html
[TEST DATA] ArcGIS CHIME Model Comparisons for COVID-19 Surges and Capacity Analysis
Variable
Hospitalized
reset
Map Legend
[TEST DATA] Social Distancing 29%
906 beds
2% capacity
[TEST DATA] Social Distancing 50%
906 beds
2% capacity
Tallahassee
Jacksonville
Orlando
Tampa
Miami
Nassau
THE BAHAMAS
Gulf of Mexico
Straits
Esri, HERE, NPS
Powered by Esri
Number of Hospitalized Patients
Hospital Bed Capacity
[TEST DATA] Social Distancing 29% Hospitalized
[TEST DATA] Social Distancing 50% Hospitalized
80 k
70 k
60 k
50 k
40 k
30 k
20 k
10 k
0 k
Apr
May
June
Apr 3
Apr 3
Jul 1

Spatial Data APIs and R

- GeoJSON, Feature Services and Image Services
  - *geoJSONR* package
  - Brings in geoJSON description as R dataFrame

- *arcgisbinding* (R-Bridge) allows seamless interaction to ESRI Feature services that are publicly availably
  - Works seamlessly with ESRI's REST API
  - Data I/O as R Dataframe
  - https://r-arcgis.github.io/

Data Related Analysis Challenges

- Resolving different scales
  - Data comes in a multitude of scales
    - Spatial
    - Temporal
- Representing uncertainty in data and models
- Community-driven data curation
  - Enable high-fidelity in data when possible
  - Challenging for live data