INVENTORY ENGAGEMENT: DARTE, ACES, AND STAKEHOLDER COLLABORATIONS IN NEW ENGLAND

Conor Gately

CO_2 Urban Synthesis and Analysis ("CO2-USA") Workshop

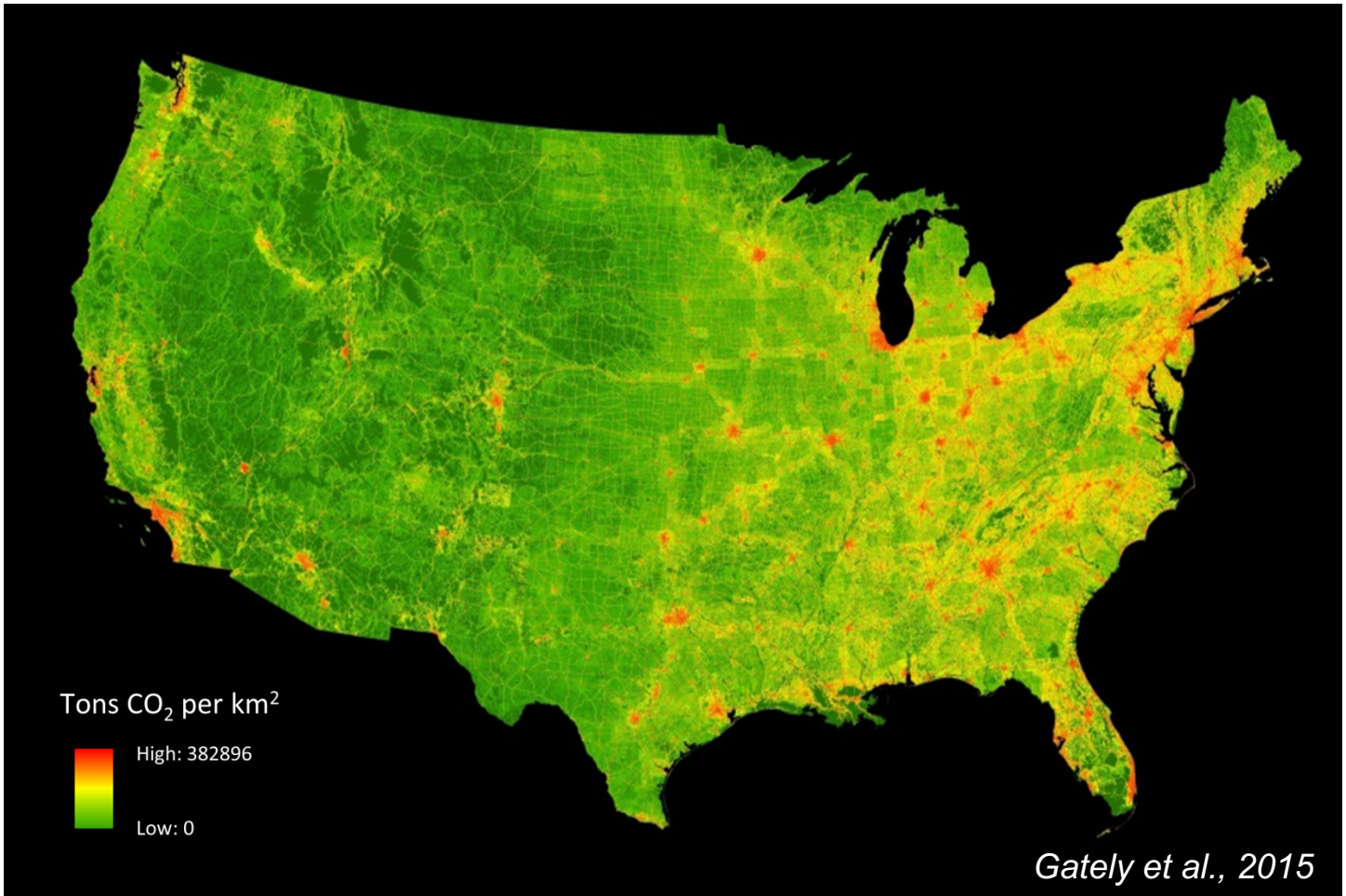
National Institute of Standards and Technology, Gaithersburg, MD

November 6th, 2017

1. **Overview of bottom-up inventories**
2. **Inventory utilization by municipal governments and other stakeholders**
3. **Convergence in methods for inventory construction**

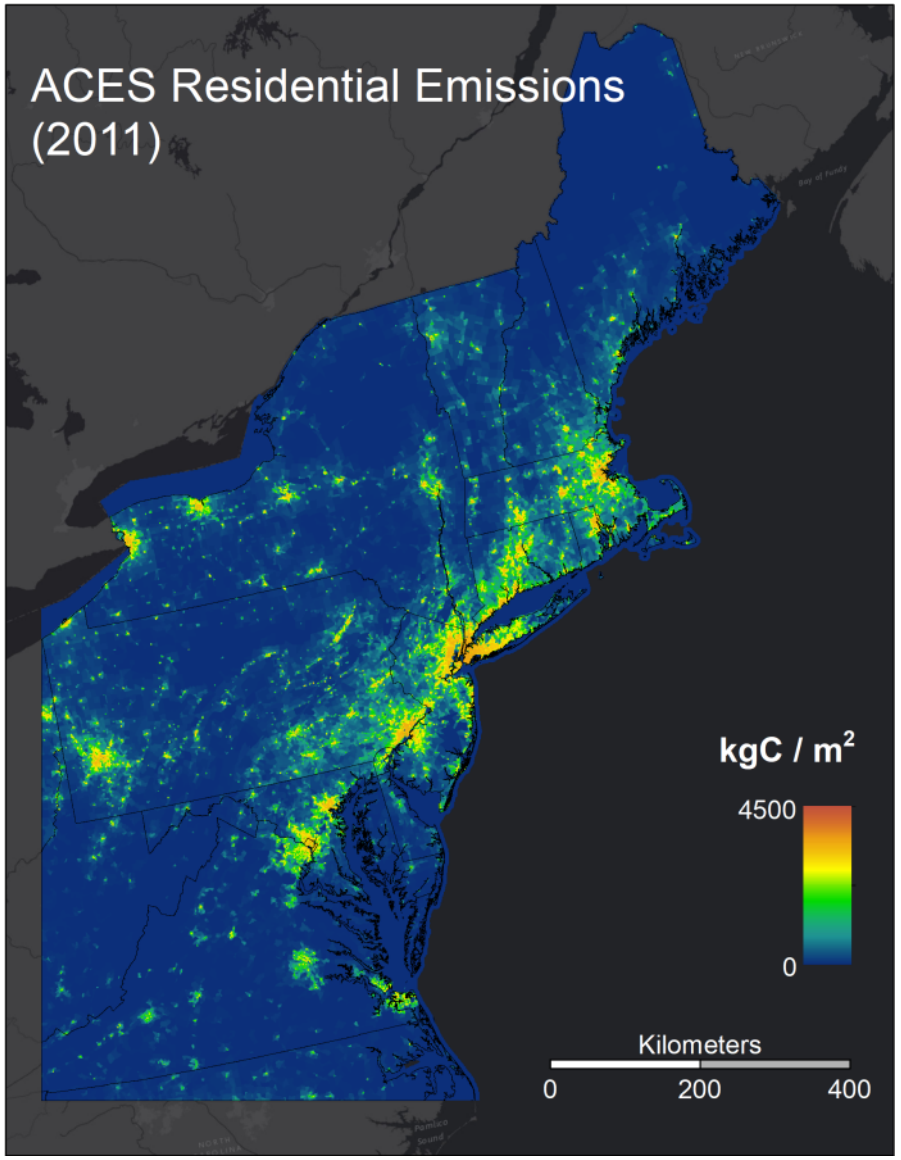
Database of Road Transportation Emissions (DARTE)

- **Bottom-up national inventory of on-road CO_2 emissions**
- **33-year time series at 1 km^2 resolution**



Anthropogenic Carbon Emission System (ACES)

Sector	Data Source	Space (native)	Time (assigned)
Residential	NEI	County	HDD model
Commercial	NEI	County	HDD model
Industrial	NEI GHGRP	County / Point	EPA – AMPD
Electricity	NEI GHGRP	Point	EPA – AMPD
Airports	NEI	Point	FAA – ATADS
On-road	DARTE	Line	State DOTs – ATRs
Off-road	NEI	County	Uniform
Oil & Gas	EPA	County / Point	Uniform
Marine	NEI	Area	Uniform
Railroad	NEI	Line	Uniform



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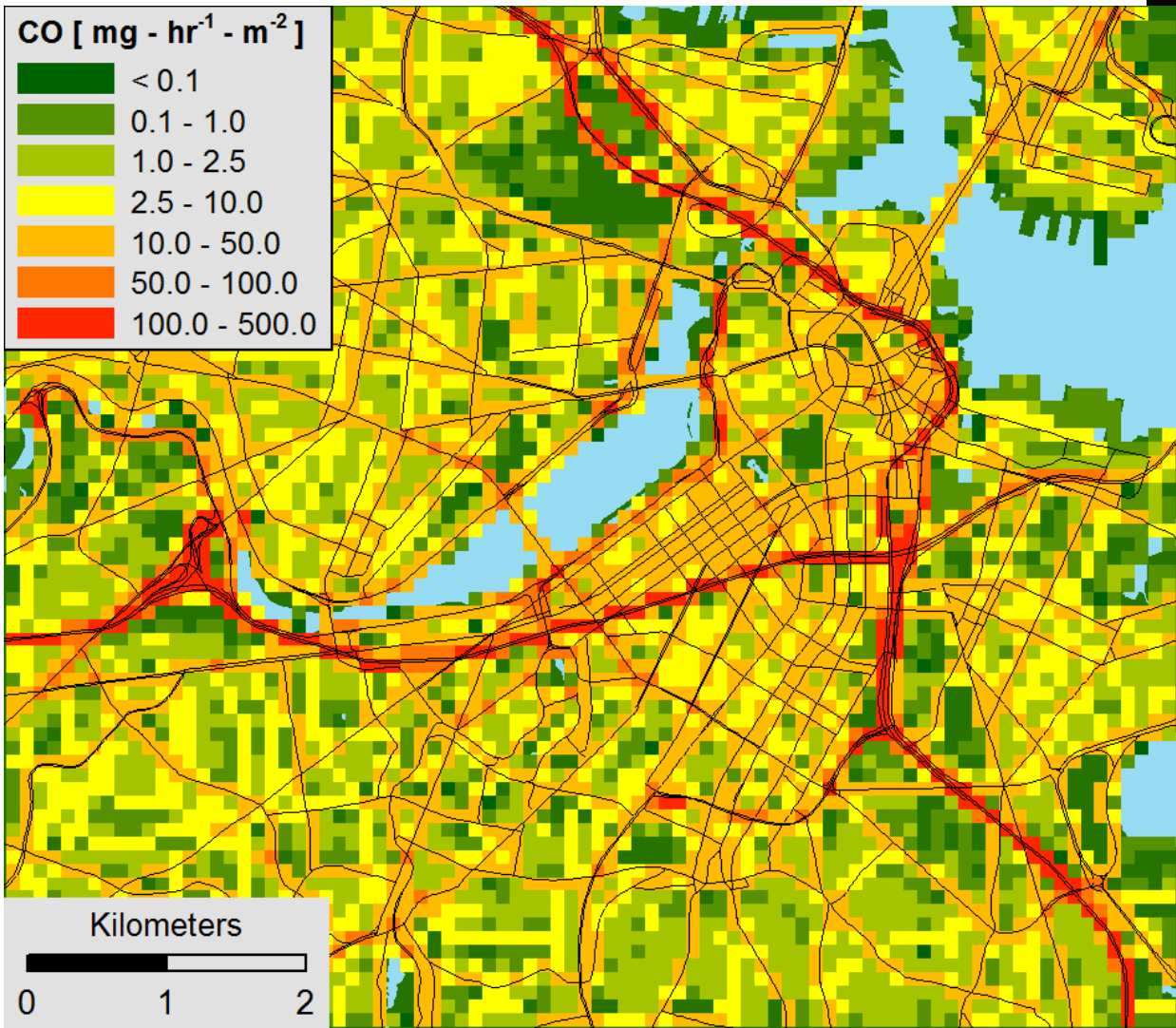
GPS-BASED VEHICLE EMISSIONS INVENTORY

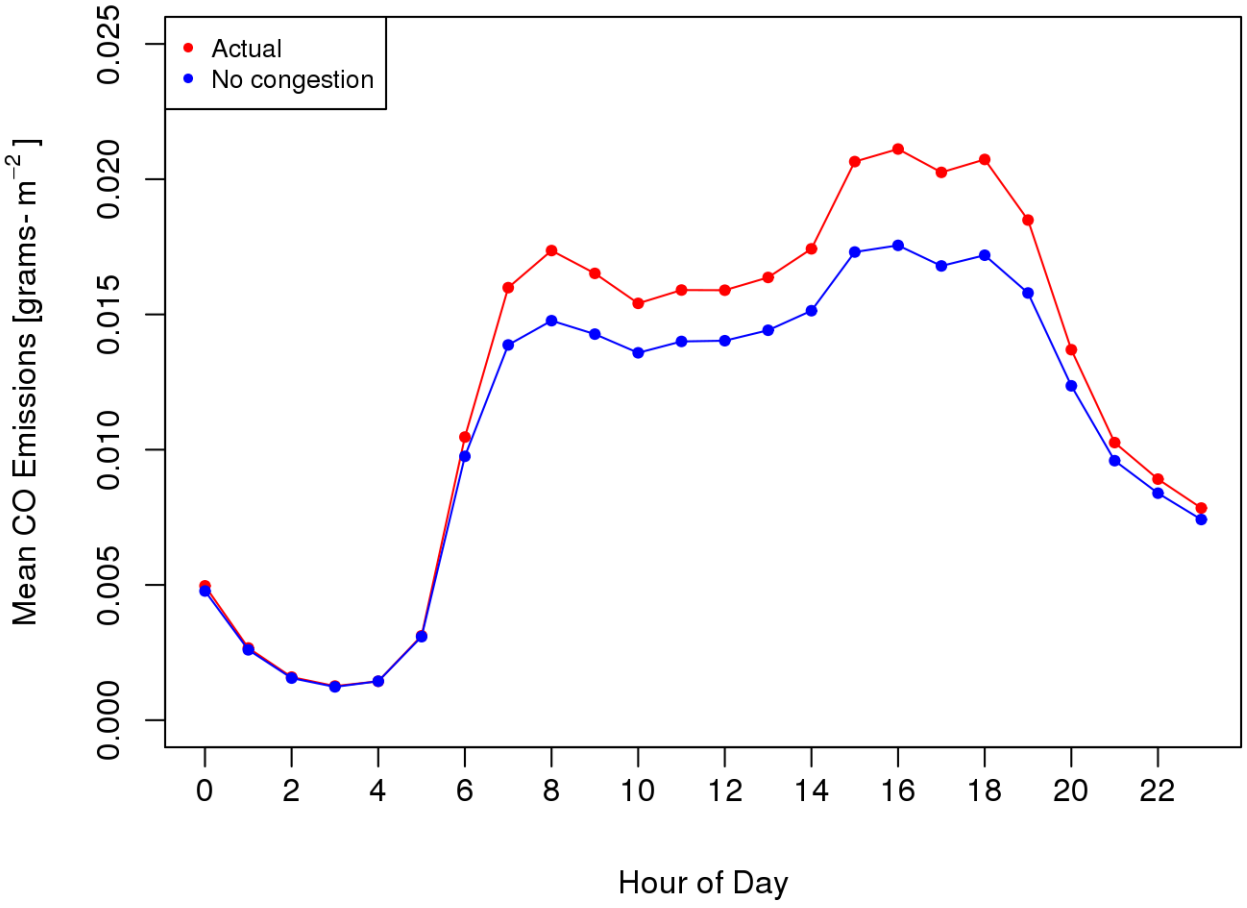
Gately et al. (2017)

- **Extensive local data sharing with partner agencies (Boston MPO, City of Boston)**
- **GPS data on vehicle speeds at 5 minute intervals**
- **Hourly emissions from vehicles at 100m^2**
- **CO_2 as well as CO, NO_x, $PM_{2.5}$, SO_2**



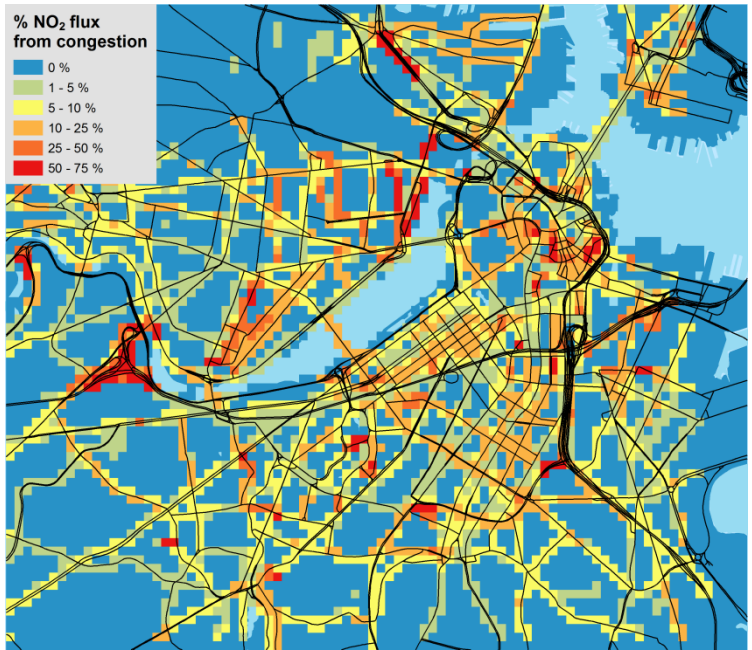
STAKEHOLDERS USE INVENTORIES DIFFERENTLY THAN RESEARCHERS

- Different needs w.r.t. spatial and temporal resolutions
- Different standards for uncertainty
- Often want activity data as much as emissions data
- Use cases can inform research pathways



CITY OF BOSTON, MA

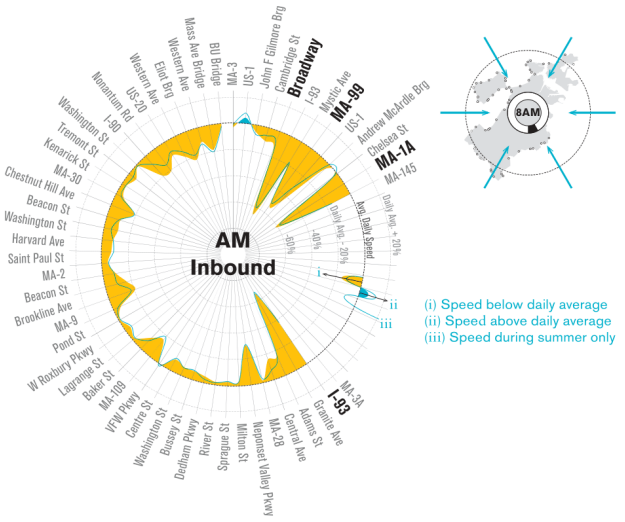
- GoBoston2030 plan
- Targets need benchmarks
- Mitigation policies need spatially explicit data

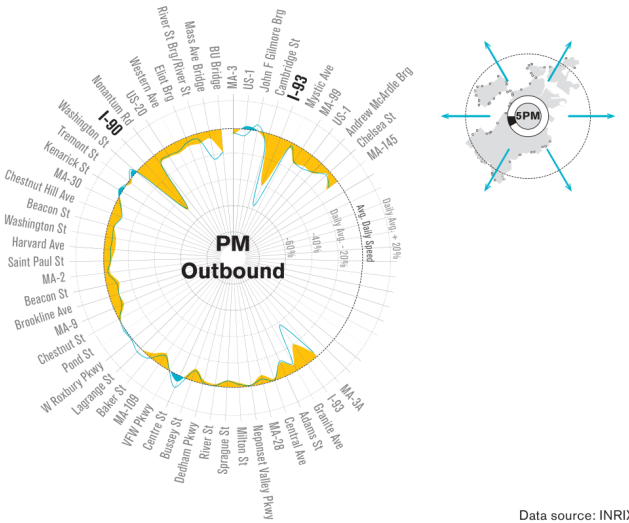


Roadway Traffic Flow

While the amount of driving per Bostonian has declined, peak hour congestion continues to cause delays. This is most noticeable on major State and Federal highways where regional vehicular traffic is concentrated. Some major highways lose 40 – 60% of their average speed during rush hour. Some key arterials connecting neighborhoods outside of downtown are also congested to lesser degrees, but most local streets have noticeably less congestion, largely due to Boston's driving rates.

Peak vs. Average Roadway Travel Speed at Select Road Crossings into Boston



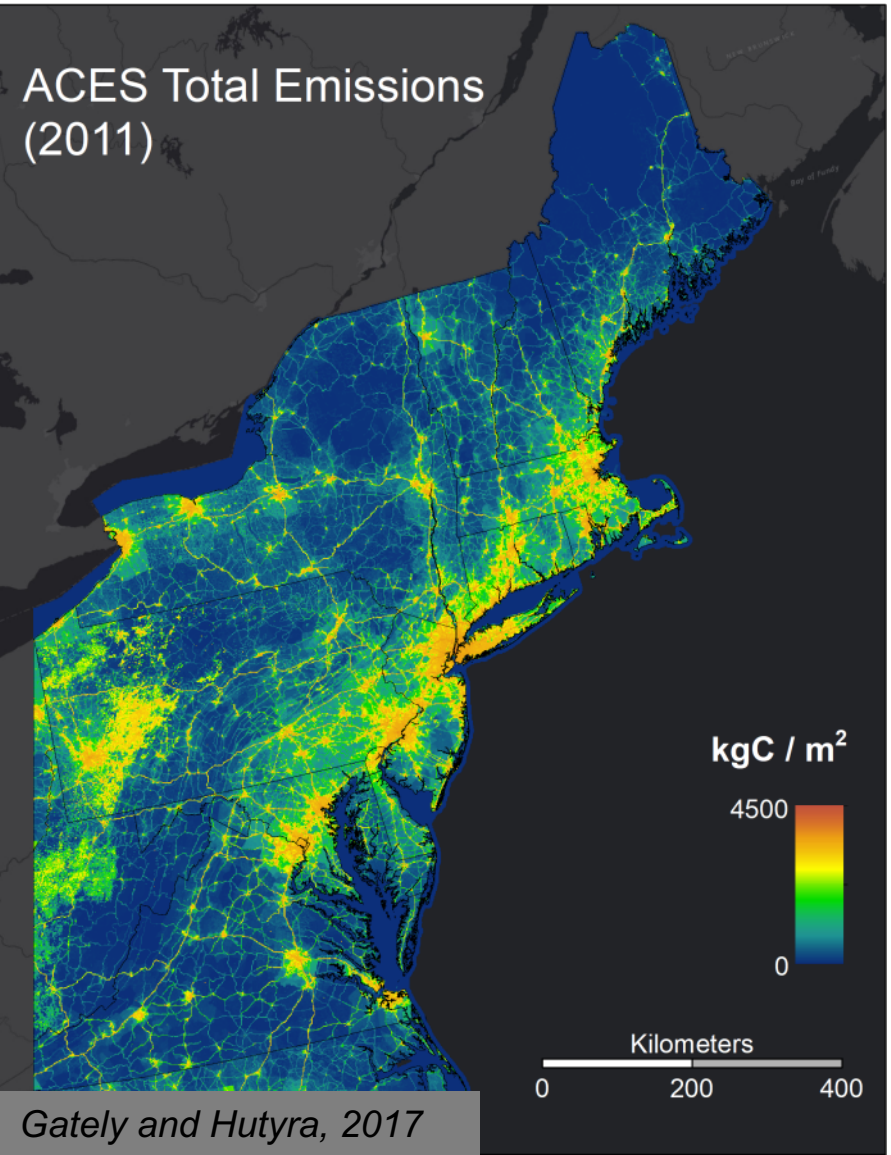


Traffic slows by 15% on average during peak periods

On highways such as I-93 and Route 1, traffic speeds slow by as much as 60% during the morning commute. Despite modest declines in the proportion of driving trips among all trips since 2005, congestion has remained a persistent challenge since the number of total trips has increased.

Data source: INRIX

ACES and City of Providence, RI



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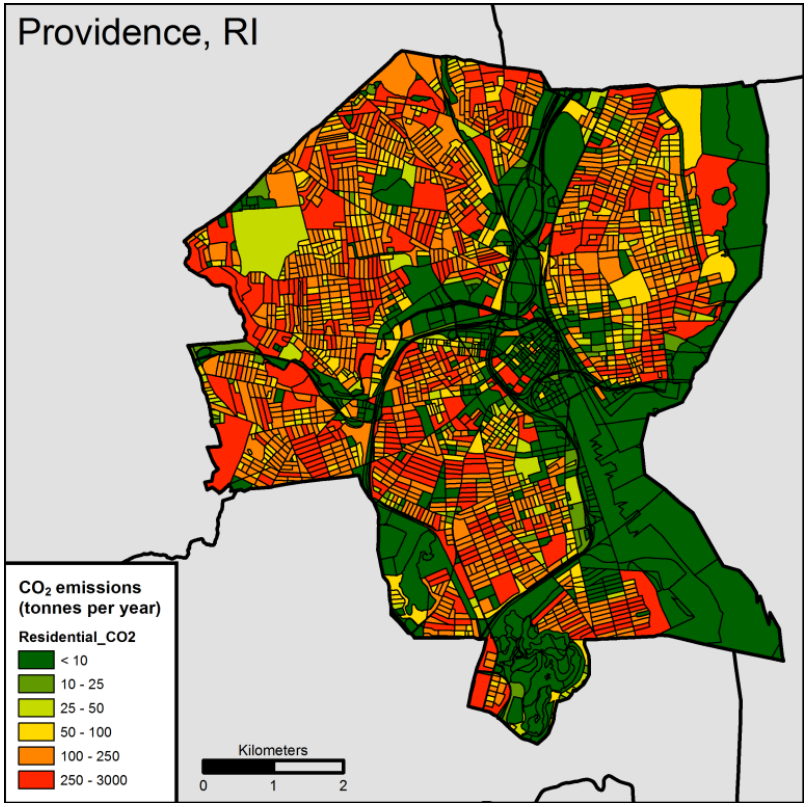
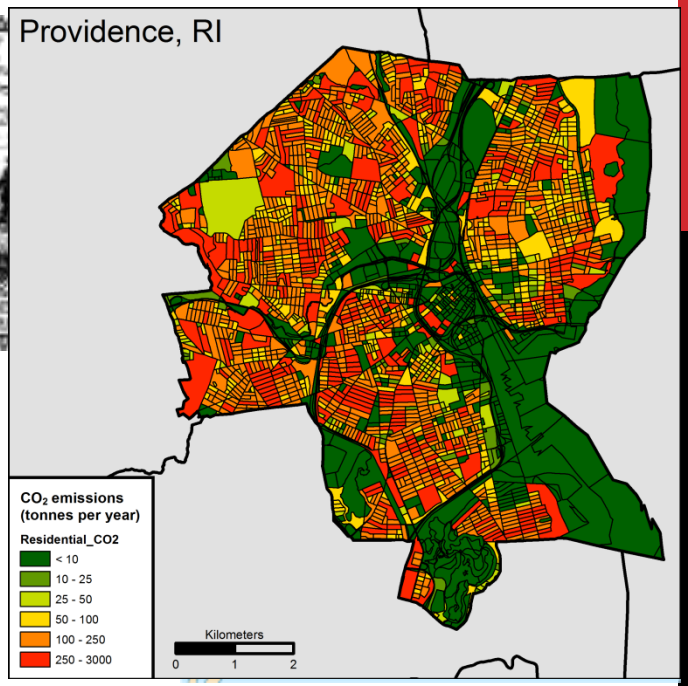
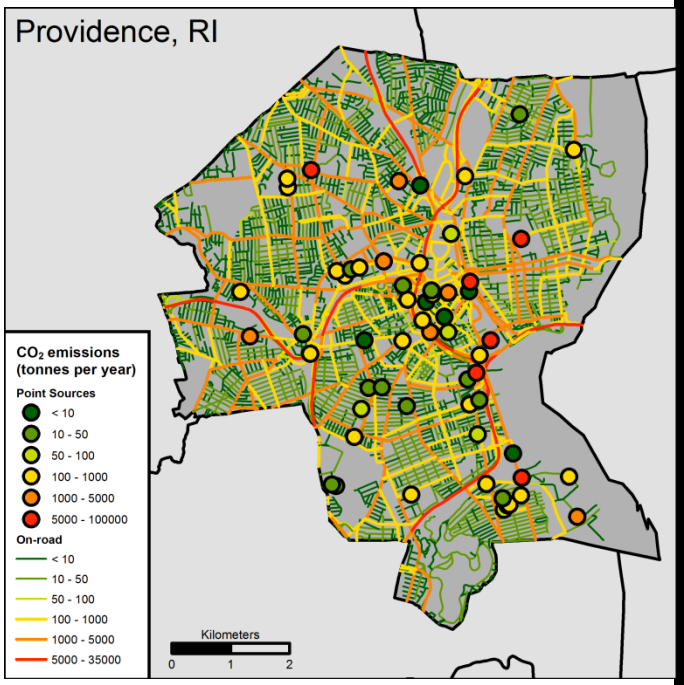


CITY OF PROVIDENCE, RI

- **Joined Compact of Mayors in 2015**
- **Executive Order 2016-3:**
  - *"Achieve city-wide carbon neutrality by 2050"*
  - *"Consider climate impacts and greenhouse gas emissions in all planning and decision making processes, including… neighborhood and comprehensive planning[.]"*
- **Needed to develop first GHG inventory**
- **ICLEI ClearPath tool**
- **Leveraged additional ACES data**
  - Validate ClearPath inventory
  - Support future efforts to target neighborhood-scale policies

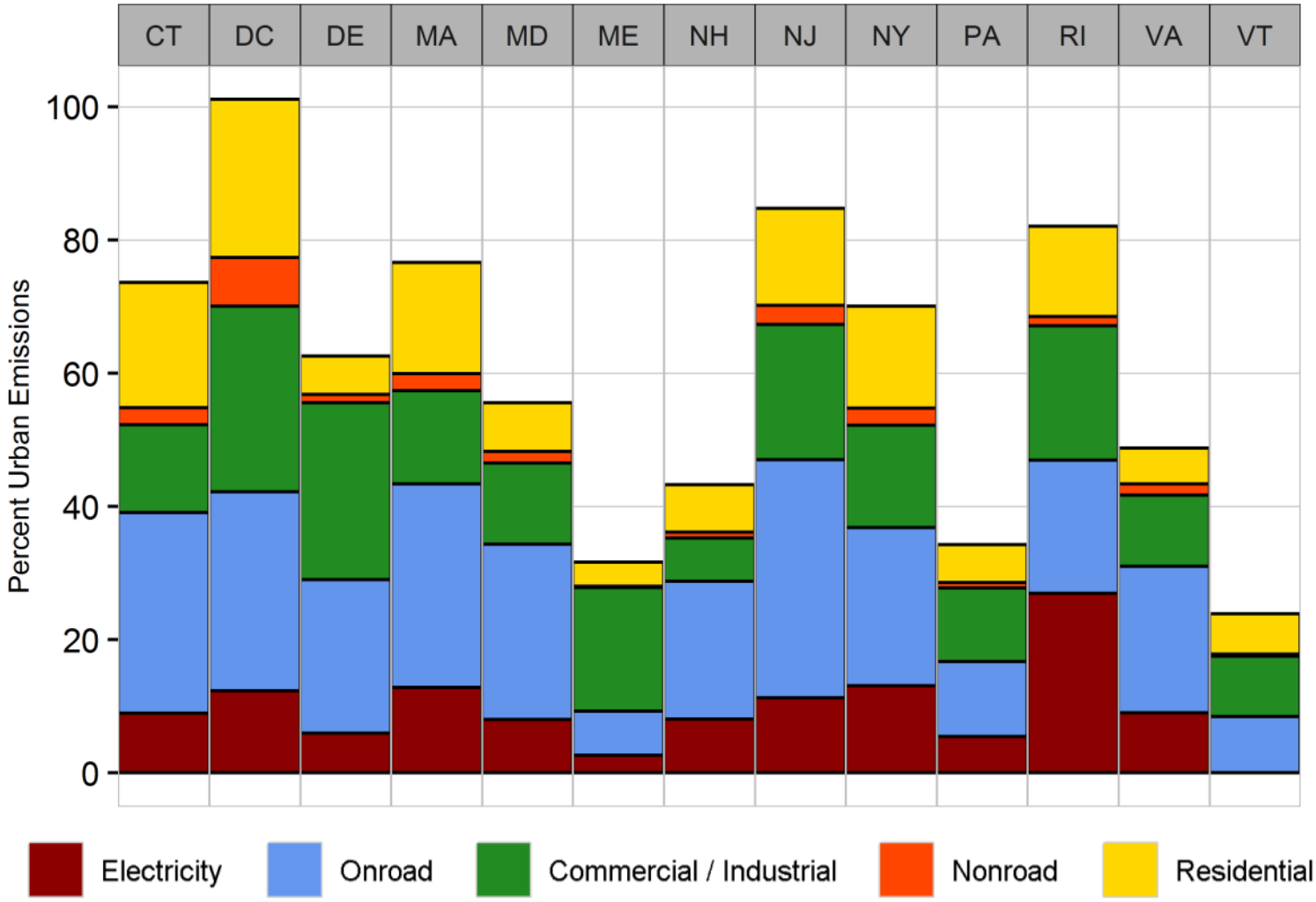




LESSONS LEARNED

- **Resources, Objectives, and Scope**
  - Research inventories supported by NOAA, NASA for purposes of basic science: Focus on advancing understanding of the carbon cycle, space-time variations in emissions, priors for top-down models
- **Projects of Opportunity**
  - Extracurricular PhD research – embedding and interning within stakeholder organizations
  - Summer Fellowships and external funding
- **Persistence and Iteration**
  - We reached out to build relationships and share our data and results
  - Cities and agencies responded – but their objectives and scope don't necessarily align with those of our research grants
  - Iterative discussions help develop and define goals on both sides
  - Challenges in institutionalizing these collaborations of opportunity

ONE-SIZE-FITS-SOME?



Gately and Hutyra (2017)

TOWARDS OPERATIONAL GHG INVENTORIES

Point sources

- Established databases (GHGRP, NEI, eGRID)
- Directly reported CO_2 emissons
- How to include non-GHGRP facilities? Facility ID harmonization?

Nonpoint sources

- Residential Buildings
    - Census household fuel use (ACES)
    - Building energy use models (Hestia)
- Commercial Buildings
    - Data on commercial building square footage and energy use is confidential or hard to obtain at national scale
- Industrial facilities
    - Best way to spatially allocate “non-point” facility emissions?

TOWARDS OPERATIONAL GHG INVENTORIES

- **Oil and Gas**
  - EPA tool is available to estimate county-scale CO_2 emissions
  - Wellhead locations are often proprietary
  - Generate “anonymized” spatial proxies for wellhead locations and production levels

- **On-road**
  - MOVES model
    - + developed at EPA, well documented
    - - sensitive to default input data, outdated emissions factors
  - ACES-style model based on road-level HPMS / FHWA data
    - + constructed at sub-grid scales to improve accuracy
    - - more time-consuming to update

INVENTORY PUBLICATION FORMATS

Gridded

- Research-oriented
- Flexible and adaptable to analysis at different scales
- Standard data formats (NetCDF, GeoTiff, HDF5)

Administrative Boundary

- More relevant to stakeholders
- Standard shapefiles are available (Census TIGER/Line)
- Clarifies spatial resolution of constituent data sources in inventory

ACES >> Expansion to CONUS will include release of emissions at 'raw' scales – points/lines/areas and municipal boundaries.

THANK YOU!
ANY QUESTIONS?