U.S. Onroad Transportation CO_2 Emissions Analysis Comparing Highly-Resolved CO_2 Emissions and a National Average Approach: Mitigation Options and Uncertainty Reductions

Daniel Mendoza
Purdue University, University of South Florida
Kevin Gurney, Igor Razlivanov
Arizona State University
Sarath Geethakumar, Vandhana Chandrasekaran
CERIAS, Purdue University
Yuyu Zhou
Pacific Northwest Laboratory

EPA 2012 International Emission Inventory Conference

Motivation

- Transportation sector is the second largest CO_2 emitting U.S. economic sector ~ 32.3%
- CO_2 emissions for use in top-down/bottom-up carbon budget
- Local ordinances independent of national policymaking

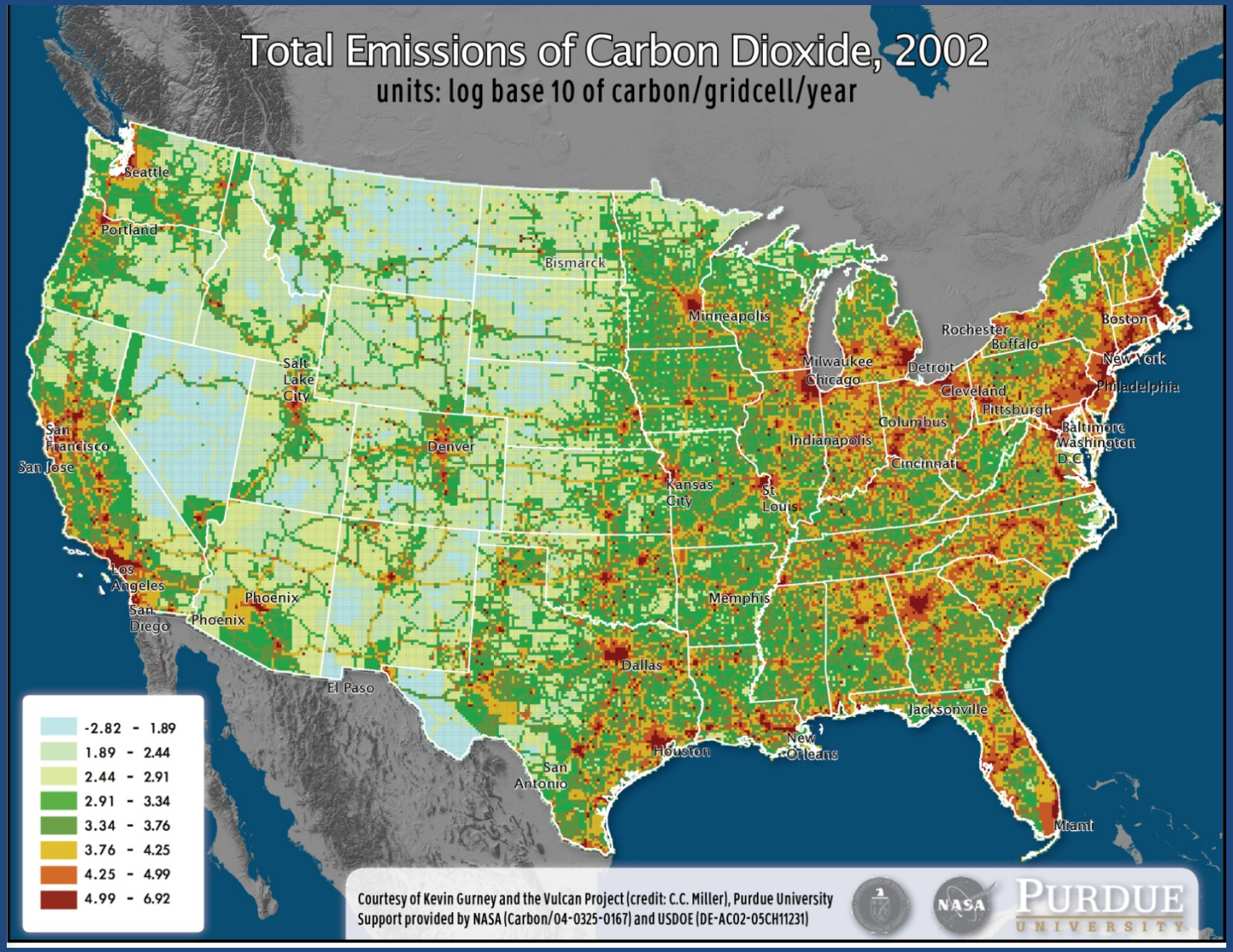
Vulcan Project

- High-resolution CO_2 emissions from fossil fuels
- Native and gridded resolution
- Point of emission (not sale, population)
- Most developed 2002
- Multi-year recently released

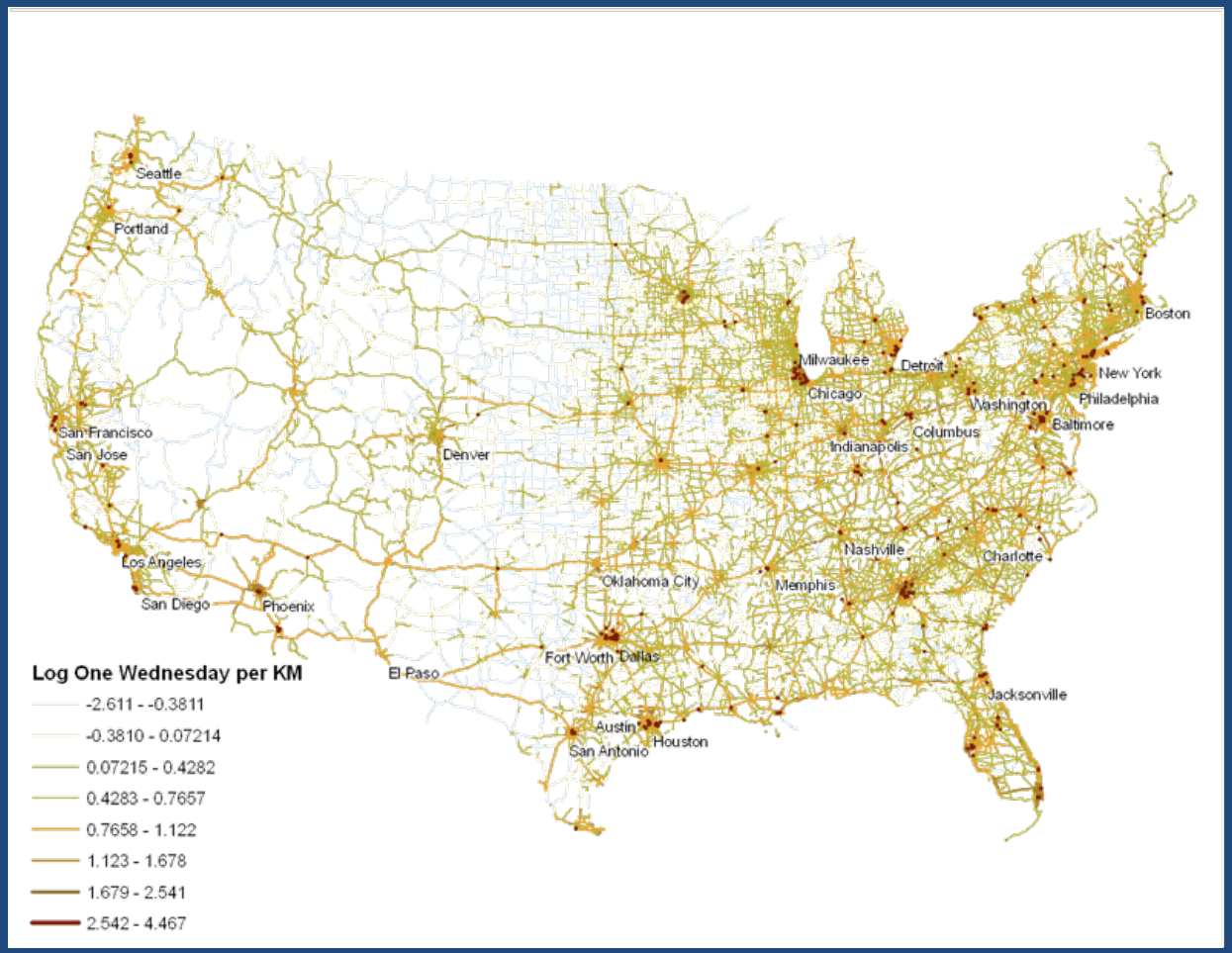
Previous work on spatial bias

- Previous studies; national, small area, proxy
- National level VMT, five vehicle classes and twelve road classes
- VMT and CO_2 emissions for large metropolitan areas
- Regional studies performed

Vulcan Project Results

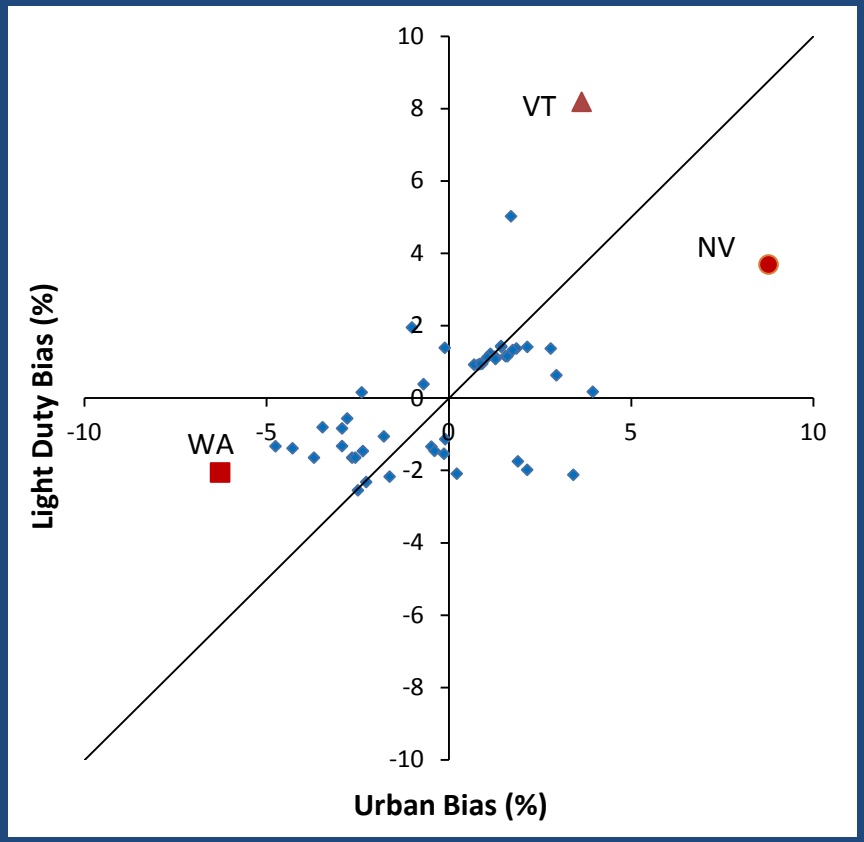


Static Map of Road Layer Output

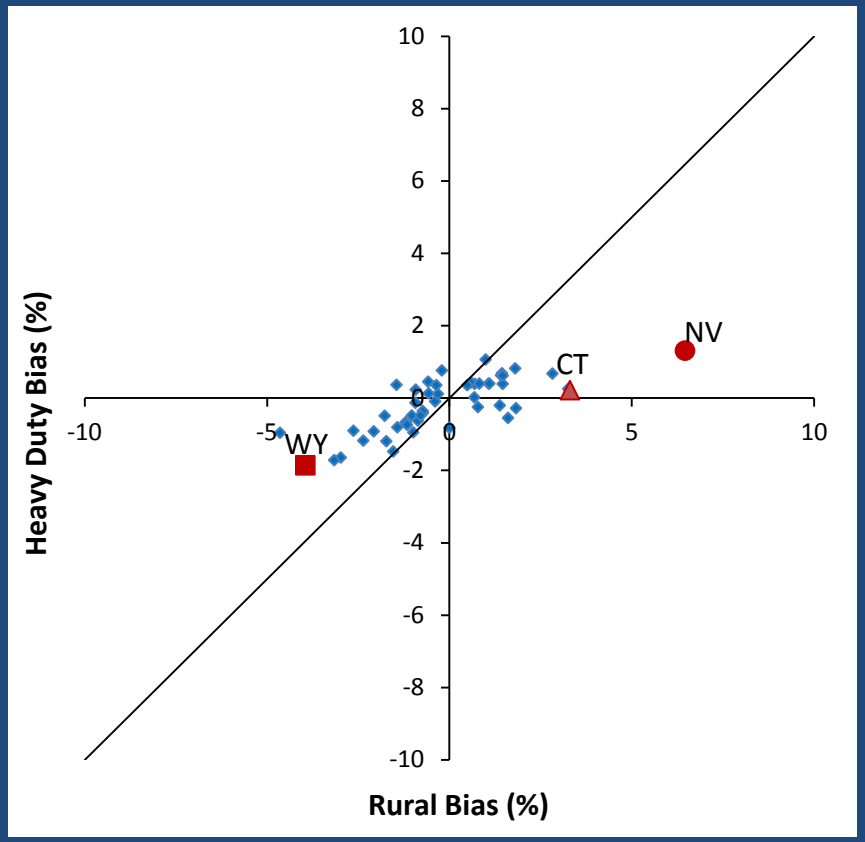


State specific biases

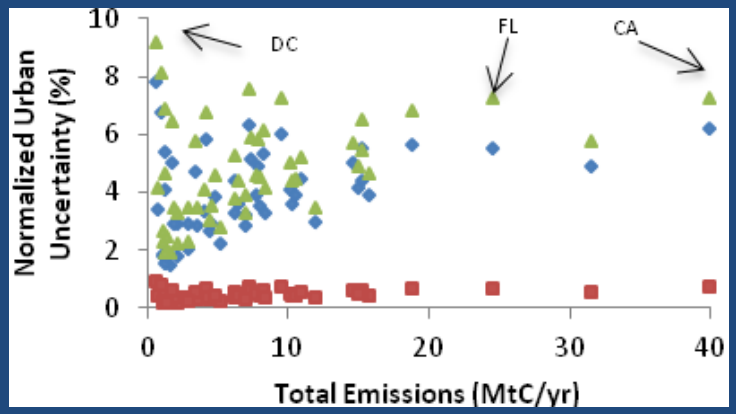
Light-duty vs. Urban

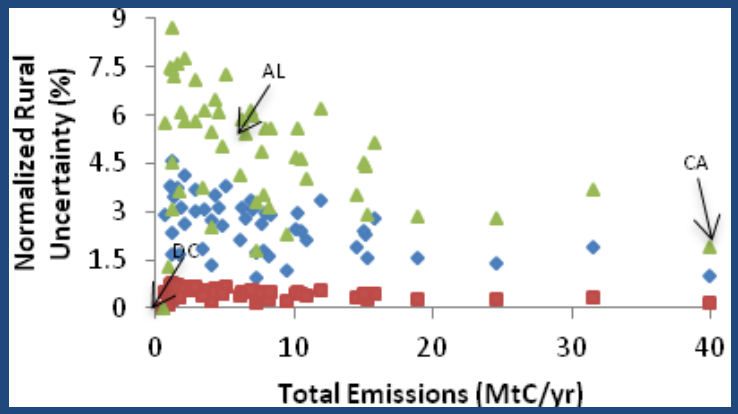


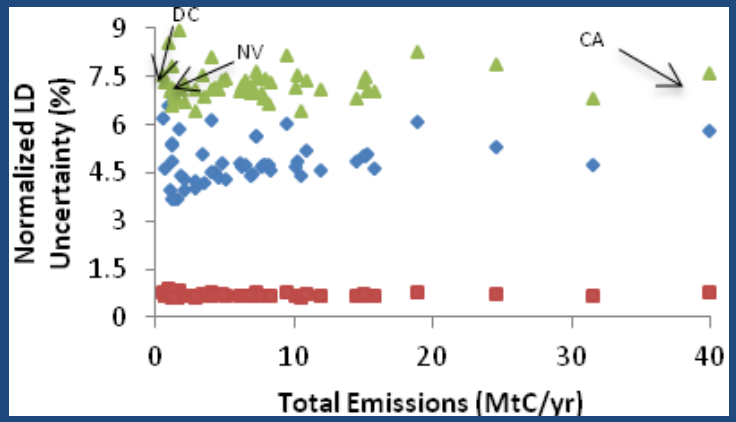
Heavy-duty vs. Rural

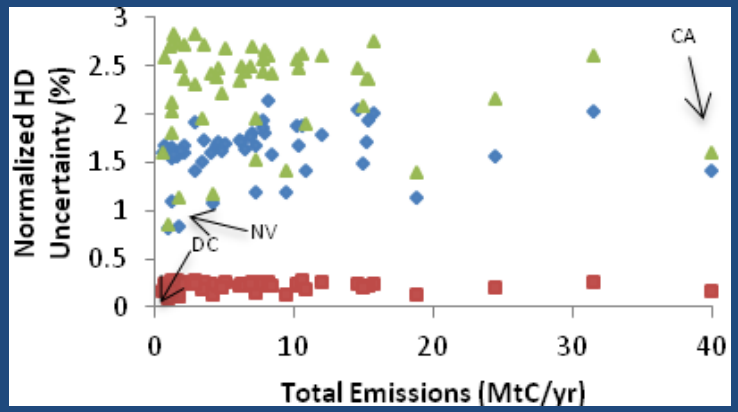


State-specific Emissions Uncertainties









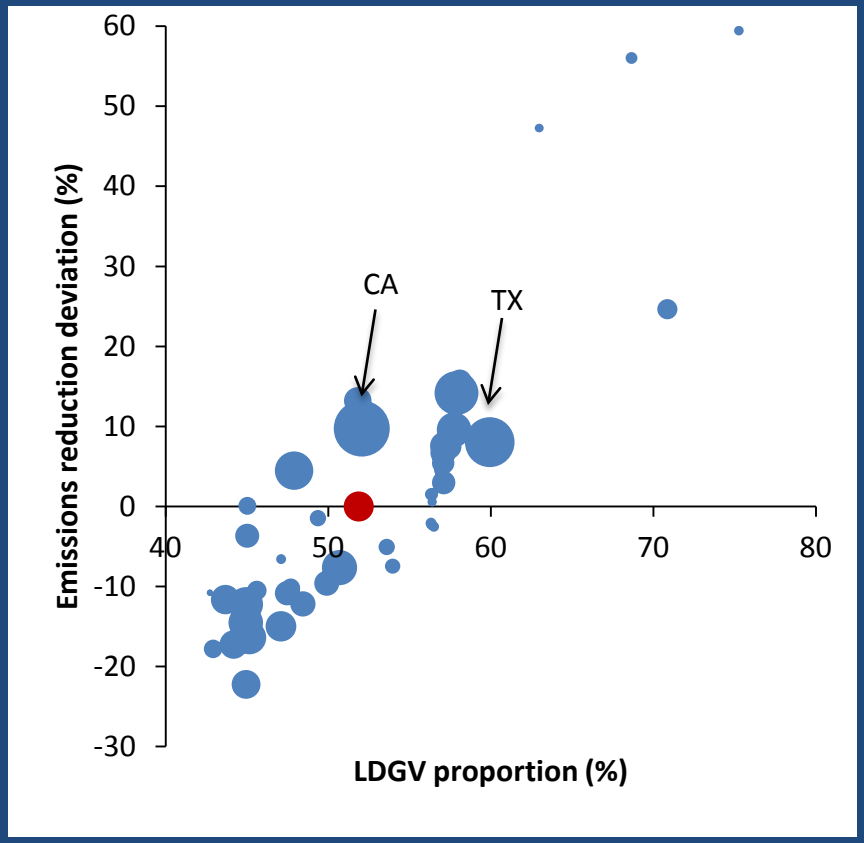
Fuel Efficiency (green triangles); VMT (blue diamonds); Fleet Age (red squares)

Uncertainty Improvements

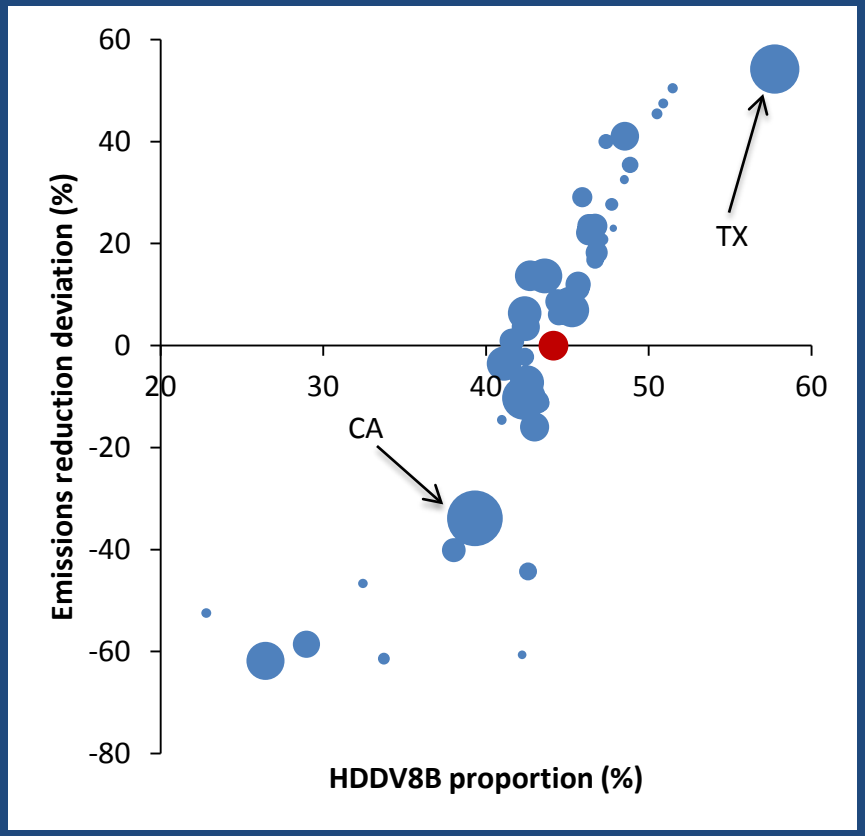
- VMT
  - Review of variables
  - Sparse coverage
- Age distribution uncertainty
  - Registration information
  - State-specific annual vehicle sales by class
- Fuel efficiency
  - New regulations for HD
  - Revised CAFE standards LD
  - Age distribution accuracy improvement
  - 5-cycle testing
- Kyoto Protocol (7%) and California Senate (8-15%)

State and vehicle-specific emissions reductions

Light duty gas vehicle (LDGV) 10% reduction



Heavy duty diesel vehicle (HDDV8B) 10% reduction



Implication of Spatial Biases

- Montgomery County, Maryland carbon tax: $5 per ton of CO_2
- A 10% emissions reduction using national averages would cause California to be undercharged by nearly $800,000 due to its smaller fraction of HDDV8B vehicles
- Conversely, Texas would overpay by $500,000 due to its larger fraction of LDGV vehicles

Conclusions

- Vulcan provides a point of emissions approach
- Web 2.0
- LD and HD behave differently
- Spatial biases range from 2-15%
- Uncertainty is approximately 5 times bias
- Estimates necessary: formulation/accountability
- Other pollutants

Acknowledgements

- Vulcan Group
  - Yang Song, Chris Miller, Salvi Asefi-Najafabady, Jianhua Huang, Alexandra Garden
- Past Vulcan Group Members
  - Mithun Vaidhyanathan, Broc Seib, William Ansley, Sullivan Peraino, Advait Godbole, Jaymee Binion, Warren Eckels
- Paul Svercl, FHWA
- Supported by NASA grant NNG05GG12G
- Department of Energy
- PCCRC
- Rosen Center for Advanced Computing

Thank you!