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UTC Spotlight

University Transportation Centers Program

This month: The Mid-Atlantic Transportation Sustainability UTC | September 2016 No. 102

Developing Research Solutions to Address Complex Environmental Challenges

The Mid-Atlantic Transportation Sustainability University Transportation Center (MATS UTC) is a regional center that focuses on research and education--where faculty, students, and transportation professionals from diverse backgrounds come together to solve some of society's most challenging transportation sustainability problems. The Mid-Atlantic region faces significant environmental challenges resulting from the densely populated, heavily traveled I-95 corridor, hundreds of miles of coastline, mountainous regions reliant on connectivity for economic opportunities, and a complex mix of public agencies.

The University of Virginia (UVA), located in Charlottesville, is the lead university of MATS UTC, which also includes Marshall University (MU), Morgan State University (MSU), Old Dominion University (ODU), the University of Delaware (UD), and Virginia Tech (VT). They are tackling these challenges head on. Their emphasis on collaboration encourages the innovation that is necessary to significantly improve transportation environmental sustainability.

"I am pleased that in two short years, our MATS partners have come together to provide a significant resource to this region and the nation, "stated Brian Smith, PhD, and the director of MATS UTC. "Already we're demonstrating improved abilities to provide transportation services in a sustainable manner."

By developing tools, processes, and services for transportation professionals, MATS UTC researchers are advancing basic and applied research to address some of the most critical environmental impacts attributed to transportation infrastructure and systems. Focused primarily on the highway, transit, railway, and waterway systems of the Mid-Atlantic region, they are making important strides in areas that garner public attention and government scrutiny. Projects related to fuel use, emission reductions, air pollution, and stormwater control are stellar examples of research ideas being translated into actionable solutions. Examples of these projects include the following:

Removal of Nitrogen from Stormwater by Zero Valent Iron (ZVI) and Biochar in Bioretention Cells: A team of researchers from UD and UVA joined forces to explore a stormwater management system that reused waste materials to remove nutrient runoff, such as nitrogen and phosphorus, from soil and surface water. They designed a novel treatment medium that includes biochar and scrap iron particles (ZVI). Tested in the lab and verified in the field, the biochar/iron medium removed nitrogen (as nitrate) two to four times more than conventional media.

The researchers hope that this environmentally friendly and cost-effective approach will result in requiring significantly less land to meet regulatory stormwater standards. Researcher, Paul Imhoff, presented a poster on the topic to congressional staff at the Chesapeake Bay Day on Capitol Hill, March 2016, and gave an oral presentation in July to the US EPA Region 3 in Philadelphia.

LiDAR for Air Quality: A research team from ODU and VT took an innovative approach to repurposing a NASA Light Detection and Ranging (LiDAR) system that was used to measure aerosols in the atmosphere from flying aircraft. They modified and enhanced the LiDAR system to measure the depolarization ratio of particulate matters (PM) over a wide area with a range of 12 km at a high spatial resolution. The PM in the atmosphere, one of the factors for air pollution caused by vehicle emissions, can be measured in the atmosphere at a long range, an approach that is not commercially available today.

Why is this important? Current methodologies for measuring PM specifically from "hot-spot" congestion (e.g., at tunnel entrances or in high truck traffic areas) rely on hand-held vehicle emission measurement technologies. These methods do not provide aerial measurements, so recommendations about health and environmental risks in relation to traffic or flow patterns are currently difficult to make.

Design of a Decision Support Tool for Nutrient Credit Exchange: Researchers at UVA teamed up with the Virginia Transportation Research Council to develop a web-based decision support tool for streamlining stormwater management in light of new regulations that allow for nutrient credit exchange. This research tests the feasibility of creating a web-based environmental decision support system that automatically aggregates data from different Federal web services to support stormwater calculations and decision making. Data gathering and analysis can be highly time consuming and tedious, but Federal data providers are increasingly creating open web services that could address these challenges.

Results of this research have shown that service requests, such as soil data access, river network tracing, and watershed delineation, typically take under 10 seconds using already available Federal web services. This shows that building a distributed environmental decision support system is feasible. Next steps are to formalize the software to create a stormwater decision support system that directly leverages Federal web services, greatly reducing the need for time consuming and tedious data gathering and preparation steps.

Network-Wide Impacts of Eco-Routing Applications: Real-time transportation data is critical for creating information on which "green" transportation choices can be facilitated. Researchers from VT, ODU, and UVA explored how applications, such as eco-routing and eco-lanes utilizing connected vehicle technology, could potentially reduce urban congestion, fuel consumption levels, and greenhouse gas emissions.

Results showed that the systems could realize 4 to 9 percent reductions in fuel consumption. Additional reductions in the range of 2 to 6 percent were achieved using advanced optimization techniques. Furthermore, the proposed eco-routing produced reductions in the total network travel time in the range of 3 to 14 percent. The long-term environmental and economic impact of eco-routing operations could be significant, especially when applied to bus fleets, trucking, and highly congested areas.

"These projects provide just a few examples of the scope and impact of our UTC's efforts," said Holly Rybinski, Principal with Rybinski Engineering and a MATS UTC Advisory Board member. "The researchers are filling industry voids and demonstrating the value of their ideas."

Sharing the results of MATS UTC collaborative research ensures that transportation professionals have the tools they need to implement sustainable transportation plans while achieving environmental benefits.

About This Project

The Mid-Atlantic Transportation Sustainability UTC (MATS UTC), a regional consortium of six universities lead by the University of Virginia, Charlottesville, serves the region through applied research, education, workforce development, and technology transfer focused on environmental sustainability. Visit www.matsutc.org for information about the Center's graduate class in transportation sustainability, webinars, and the undergraduate summer research program. Contact: Emily Parkany, Ph.D., MATS UTC Managing Director, at emilyparkany@virginia.edu.