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US-EU SUSTAINABILITY WORKING GROUP EMISSIONS VISUALIZATION DEMONSTRATION



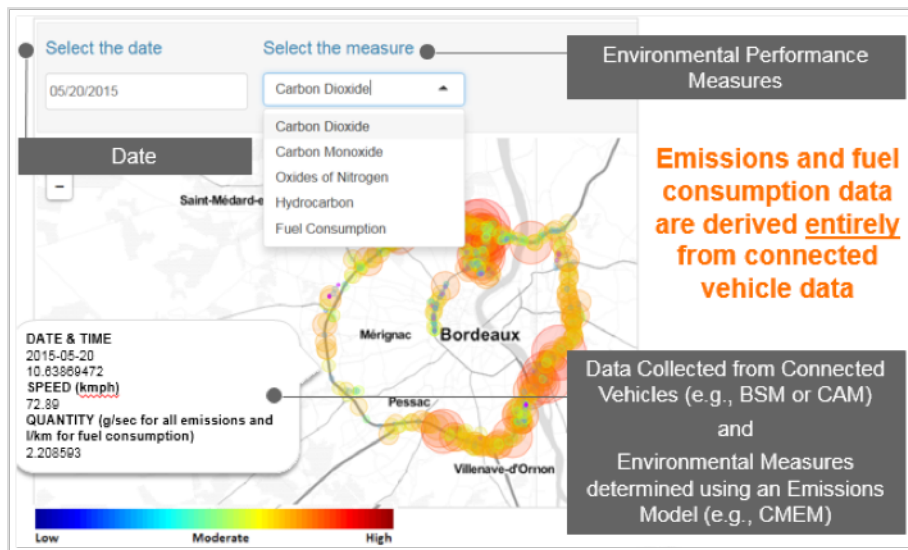
Background

The United States (US) and European Union (EU) Sustainability Working Group (SWG) was formed in 2010 with a vision to cross-leverage research and insights from studies in both the United States and Europe for mutual benefit. The US and EU both have robust research programs investigating the potential for connected vehicle applications to reduce vehicle emissions and fuel consumption. As such, the working group was established to identify, research, quantify, and evaluate the environmental benefits that can be achieved from deploying intelligent transportation systems (ITS) and connected vehicle applications.

For the 2015 ITS World Congress, the US-EU SWG developed an emissions visualization tool that demonstrated the potential to use connected vehicle data to visualize emissions data. Working together, the EU and the US developed a tool that:

- Leveraged EU Compass4D connected vehicle data (e.g., archived cooperative awareness messages, or CAM, data) and infrastructure
- Used US algorithms to calculate environmental performance measures based on vehicle trajectory data
- Produced vehicle emissions and fuel consumption heat maps derived entirely from connected vehicle data.

For the demonstration, visualizations were created to depict vehicle fuel consumption and emissions derived from connected vehicle data for a geo-fenced roadway segment in Bordeaux, France. The visualizations show emissions and fuel consumption hotspots where vehicles emitted.



Visualizing Emissions and Fuel Consumption Data

Emissions visualizations allow transportation planners and system operators to gain valuable insights into the environmental performance of the transportation system, helping them:

- Visualize and monitor transportation-related vehicle emissions over time
- Prioritize transportation solutions—both conventional and ITS solutions—that have the potential to reduce vehicle emissions
- Perform before and after impact assessments to determine and track the effectiveness of newly deployed transportation solutions
- Support real-time operational decisions to help reduce emissions, including:
 - + Updates to traffic signal timings (at hotspots) in real-time on arterials
 - + Implementation of speed harmonization strategies—optimized for the environment—on freeways.



Compass4D Data

The EU's Compass4D project provided vehicle data from 23 vehicles. Data was collected for a geo-fenced area—the ring road—around Bordeaux, France, during the month of July 2015. Archived data was used to minimize interference with the Compass4D operations. Vehicle data was similar to CAM messages and included:

- Instantaneous speeds
- Instantaneous accelerations
- Vehicle location
- Vehicle characteristics (e.g., vehicle type and engine type).

The US Emissions Model

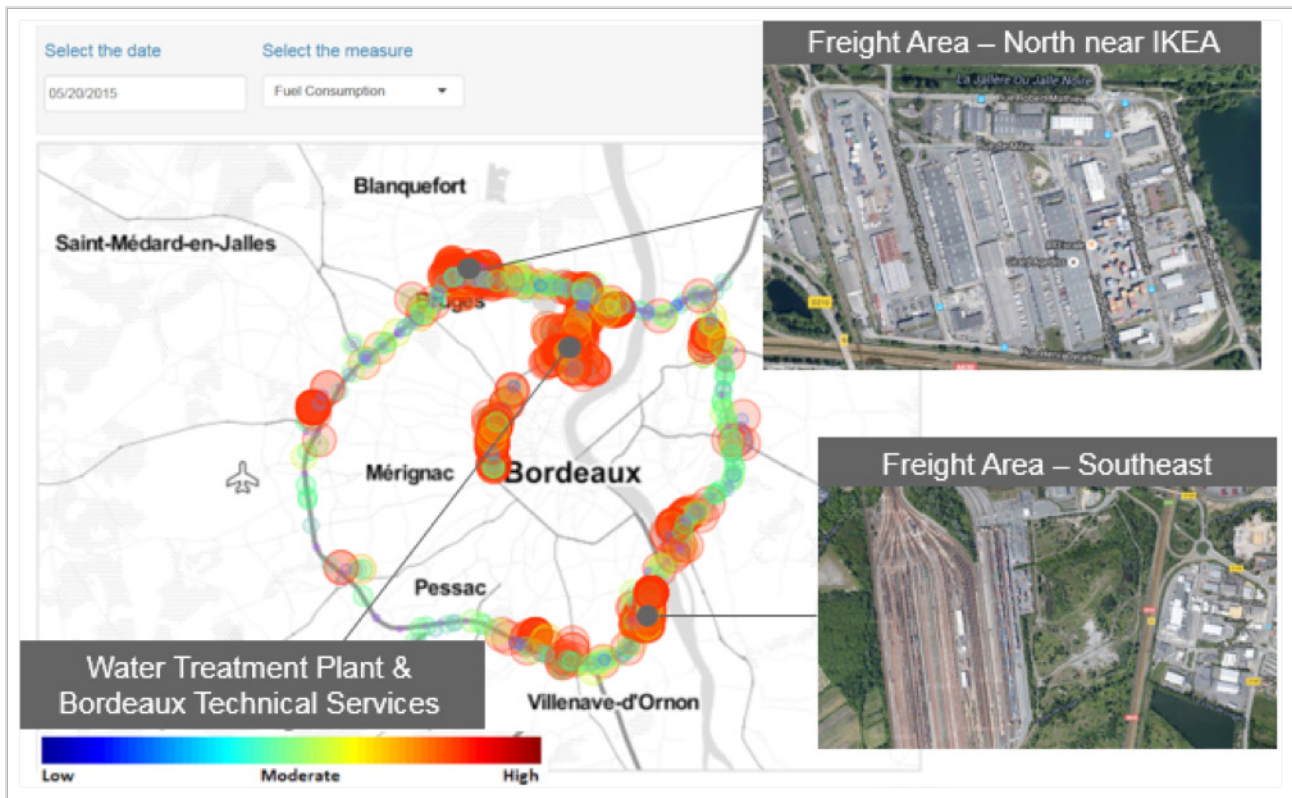
Compass4D data served as input to the US Comprehensive Modal Emissions Model (CMEM). CMEM is an emissions estimation modeling tool developed by the University of California, Riverside. The tool is a foundational pre-cursor to the US Environmental Protection Agency's Motor Vehicle Emission Simulator (MOVES) model that estimates emissions based on vehicle trajectory data.

The US-EU SWG emissions visualization tool was developed using R studio—an open source software. Outputs from CMEM served as inputs to the tool, which generated interactive map-based visualizations. The tool allows users to visualize emissions and fuel consumption for a single day (over a 24-hour period) or by hour. Users are able to visualize carbon dioxide (CO²), carbon monoxide (CO), oxides of nitrogen (NO_x), hydrocarbons, and fuel consumption along roadway segments in Bordeaux, France. Emissions data and fuel consumption data are based entirely of data collected from connected vehicles.

Observations from the Demonstration

Using the emissions visualization demonstration tool, researchers were able to observe fuel consumption and emissions hotspots in Bordeaux including freight delivery areas in the north and southeast and a water treatment plant near Bordeaux.

To learn more about the Applications for the Environment: Real-Time Information Synthesis (AERIS) research program and the Emissions Visualization Demonstration, visit: <http://www.its.dot.gov/aeris/>.



Fuel consumption hotspots in Bordeaux observed using the emissions visualization tool

For more information about this initiative, please contact:

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