Urban Emission and Greenhouse Gas Monitoring: Multidisciplinary Technical and Organizational Considerations

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Anthropogenic climate change has a major impact on our lives and challenges us to develop fast, cheap, and sustainable solutions for mitigation actions. With growing urbanization, a majority of energy use and emissions is increasingly attributed to cities, which therefore need to be at the forefront of climate action.

Complementing approaches for cities to understand their emissions are top-down statistical emission inventories and bottom-up measurements within the city boundaries. However, traditional methods of building and maintaining municipal emission inventories alone are expensive, time-consuming, and of limited utility for mitigation decision and planning support processes. Since statistic emission inventories often only are built only yearly and with some delay, fast feedback loops on alternatives are not possible, and the influence of short-term temporal influences or small-scale changes within the geographic area of a city not well understood.

To address these issues, we have built an Internet-of-Things sensor network for urban emission and greenhouse gas monitoring. To address spatial and temporal granularity issues and to complement existing sparse high-quality measurement stations, we have decided to follow a low-cost approach to allow for a larger amount of sensors, thereby enabling a more fine-grained overview within the urban area. The Carbon Track and Trace (CTT) project is intended to provide cities with real-time greenhouse gas (GHG) measurement capability. It couples low-cost sensors to Big Data analytics that is expected to provide cities and regions with a unique capacity to measure impacts of their policy and planning decisions.

The issue was addressed with a mix of methodologies, ranging from technical implementation and integration issues to conceptual and governance contributions. We have demonstrated a prototype implementation and delivered deeper conceptual insight into integration into larger frameworks, such as whole city systems, city sustainability, GHG management and climate goals, governance and policy. Gap analyses of the current state to sensor-based systems have been performed as a roadmap from manual to automatic data gathering and emission monitoring and inventories. City integration and policy issues are important for this type of approach and can be achieved by engaging with pilot cities. This includes issues of how to work with cities, how to anchor such projects within city departments, ownership, permissions, integration with city ICT systems, and collaboration with urban, mobility, and environmental planning, to name a few. Further general governance issues are financial issues and bankability of climate actions that can be eased with better measurements.

This approach will give cities detailed insights into the emission footprint on an intra-level scale. It will help set up proper baselines and monitoring for mitigation actions and allow evidence-based prioritization of climate investments by doing a reality check on assumptions and test reduction policies' impact.

We want to specifically highlight the need of a multi-sectorial and multi-disciplinary approach that explores the issue from a multitude of angles. This approach ultimately provides a better understanding and deeper integration of different stakeholders' views as well as enabling us to conceptualize a more integrated solution.

More info: https://www.ntnu.edu/ad/ctt