About urban emission

Cities and metropolitan regions, home to a significant portion of the global population, are responsible for about 70% of greenhouse gas emissions. To address this challenge, researchers are advancing techniques in urban emissions measurement and modeling, enabling detailed assessments down to the building and street level. This precise local data empowers urban decision-makers to establish accurate emissions baselines, track trends, and evaluate the effectiveness of carbon mitigation efforts. By harnessing innovative measurement and analysis systems, researchers are creating reliable frameworks for identifying emissions sources, ultimately paving the way for effective climate solutions in cities across the U.S. Explore below to learn more about these groundbreaking developments.

Urban Emission Solution

- **1. Sustainable Transportation**
- **Public Transit Improvement:** Expand and enhance public transportation options to reduce reliance on personal vehicles.
- **Active Transport Infrastructure:** Invest in bike lanes, pedestrian pathways, and safe crossings to promote walking and cycling.
- **Electric Vehicles (EVs):** Encourage the adoption of electric vehicles through incentives, charging infrastructure, and low-emission zones.
- **2. Energy Efficiency in Buildings**
- **Retrofitting:** Upgrade existing buildings with energy-efficient technologies like insulation, LED lighting, and energy-efficient appliances.
- **Green Building Codes:** Implement and enforce building codes that require sustainable practices and materials in new construction.
- **3. Renewable Energy Integration**
- **Solar Energy:** Promote rooftop solar installations and community solar projects to harness renewable energy.
- **District Heating and Cooling:** Develop systems that utilize renewable sources for heating and cooling, reducing emissions from traditional energy sources.

Carbon Dioxide Emissions Estimates Available at Neighborhood scale

- Decision makers can now access annual estimates of carbon dioxide emissions from fossil fuel burning at a neighborhood scale across the contiguous United States through the U.S. Greenhouse Gas Center (US GHG Center) portal. This federal multi-agency resource makes greenhouse gas data readily available, enabling insights into energy usage patterns across the country. While the U.S. government has historically tracked emissions at national and state levels, tools like the Vulcan Project allow for detailed analysis down to individual neighborhoods. By providing emissions data at a one-square-kilometer resolution, users can pinpoint sources of emissions and explore strategies for reducing fossil fuel consumption. Kevin Gurney, director of the Vulcan Project, emphasizes that this localized data enables researchers to understand how industrial activities have shifted and how population density affects emissions efficiency. With the launch of Vulcan 4.0, local decision makers can leverage this information to tailor emissions reduction strategies for their communities.

National dataset connects greenhouse gases and air quality

Doubling the Benefit of Climate Solutions

- Reducing greenhouse gases (GHGs) can yield significant co-benefits, particularly in improving air quality while addressing climate change. For instance, nitrogen oxides (NOx) and carbon dioxide (CO_2) are critical indicators of air quality and GHGs, respectively, both primarily resulting from fossil fuel combustion in transportation, electricity generation, and industrial processes. Brian McDonald, a physical scientist at NOAA's Chemical Sciences Laboratory, highlights the potential of the GRA^{2}PES model, which predicts that electrifying transportation in New York City could lead to a 43% reduction in CO_2 emissions and a 62% decrease in nitrogen oxides. This dual benefit illustrates how targeted strategies can enhance air quality while also mitigating climate impacts.

A More Complete Picture of Atmospheric Conditions

- Since the U.S. Clean Air Act was established in 1970, significant progress has been made in tackling air pollution by targeting both point sources, like smokestacks, and non-point sources, such as emissions from the transportation sector. Since the early 1990s, national targets for reducing greenhouse gas (GHG) emissions have been set to address climate change, supported by various policies at federal, state, and local levels that aim to mitigate pollution from both industrial and vehicular sources.

Innovative urban testbeds to advance emissions estimates

Bottom-up and top-down methods

The NIST testbed system is a vital resource for enhancing the accuracy of greenhouse gas (GHG) emissions estimates by integrating both bottom-up and top-down approaches.

- **Bottom-up estimates** rely on specific activity data—like traffic volumes, energy usage, and agricultural outputs—paired with emission intensity factors that can differ based on sector, technology, and location. This method allows for detailed, activity-specific assessments of emissions, providing a granular view of sources.

- **Top-down approaches**, on the other hand, involve direct atmospheric measurements of GHG concentrations. By analyzing changes in these concentrations over time and in relation to factors like weather and seasonal variations, researchers can infer the total emissions from various sources. This method captures the overall impact of emissions more directly but can sometimes overlook specific local activities.

- By comparing these two methods, researchers can identify discrepancies and refine their estimates. The NIST testbed facilitates this comparison by providing a controlled environment for data collection and analysis, helping to align the two approaches. This integration enhances the reliability of GHG emissions estimates, which is crucial for effective climate policy and management.

- Ultimately, the collaboration of these methodologies can lead to better monitoring, reporting, and verification of emissions, aiding efforts to mitigate climate change effectively.

An Inter-Agency Prototype For Greenhouse Gas Monitoring

- The NIST testbed system is essential for improving the accuracy of greenhouse gas (GHG) emissions estimates by effectively integrating both bottom-up and top-down approaches.

- **Bottom-up estimates** depend on detailed activity data—such as traffic volumes, energy consumption, and agricultural practices—coupled with emission intensity factors that vary by sector, technology, and geographic region. This approach provides a nuanced understanding of emissions at a granular level.

- In contrast, **top-down approaches** utilize direct atmospheric measurements of GHG concentrations. By examining variations in these concentrations over time and in relation to factors like weather and seasonal changes, researchers can derive estimates of total emissions from various sources. This method offers a broader perspective on emissions but may miss specific localized activities.

- By comparing and contrasting these two methodologies, researchers can pinpoint discrepancies and improve their estimates. The NIST testbed provides a controlled setting for data collection and analysis, facilitating the alignment of the two approaches. This integration significantly enhances the reliability of GHG emissions assessments, which is vital for developing effective climate policies.

- Ultimately, the synergy between these methodologies leads to improved monitoring, reporting, and verification of emissions, thereby supporting more effective climate change mitigation efforts.

THANK YOU