Moving Toward MRV
Structures Enhancing International Recognition
of
Advanced Greenhouse Gas Measurement Capabilities

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Outline

• Quality in Greenhouse Gas Quantification
• Future GHG Quantification Needs and Measurement Challenges
• Future Observing Capabilities
• International Testbeds
  – Facilitation Opportunities via the Metré Convention
  – A Framework Proposal
  – Efforts to Move Toward a Testbed Framework
Recognition of Measurement Results
Desired Quality of Greenhouse Gas Inventory Data

• Quantification Supporting Market / Regulatory Functions
  – Best Case: Material quantities & their variation are known and agreed
    & not a point of contention

• International Trade as Paradigm
  – Quantification technologies commonly used & accepted in trade are well established
    & routinely unquestioned
  – Mass and Volume measurement have been a staple in trade for millennia
  – Confidence in the material quantities in commercial transactions is foundational to harmony in commerce
    and equity in regulation

Desired GHG Quantification to Implement
Trade or Regulation Approaches

\[ \text{CO}_2 \text{e ton Emitted} \approx \text{CO}_2 \text{e ton Removed} \]
\[ \text{CO}_2 \text{e ton (urban)} \approx \text{CO}_2 \text{e ton (biogenic)} \]
Future Greenhouse Gas Measurements
Accuracy Needs

U.S. Reduction Targets
• Inventory data are performance metrics for national and international reduction efforts
• Pres. Obama’s Climate Action Plan: 17 % relative to 2005 by 2020
• EPA carbon rule (Electrical Gen.): ~30 % relative to 2012 by 2030

Gauging Progress / Target Achievement
• Accuracy requirements at the 1% - 5% Level
• Based on internationally-recognized measurement methodologies

Greenhouse Gas Inventory Data Needs Assessment
• Confidence reduction target achievement and progress monitoring is enhanced by increased quantification reliability and accuracy
• Advances in a range of measurement capabilities are needed to assess progress toward and attainment of reduction targets
  • Both bottom-up and top-down

Actionable Information
• Attribution (Identity) of emitter/absorbers support both regulatory and market needs
• Requires measurement capabilities at relatively small geospatial scales
Future Observing & Measurement Capabilities
OCO 3 - International Space Station

Broadly Mapping of a City's CO₂ Footprint

• A space-based instrument designed to investigate important questions about CO₂ distribution on Earth applicable to growing urban populations and changing patterns of fossil fuel use
• Future deployment on the International Space Station (launch status: TBD).
• Continue the OCO-2 CO₂ data record for carbon cycle science with an additional capability enabled by a more flexible pointing system: Regular sampling of more world cities and power plants (over 80% of fossil-fuel CO₂ emission sources monthly) than available with OCO-2.
• ~4,000 – 1 x 3 km footprints per sampling pass

Video Credit: Graphics courtesy: Henry Kline, Sha Feng, Zhijin Li, Annmarie Eldering, and John Howard (JPL).
International GHG Measurements Framework
Engaging the Metrology & Climate Communities

Concept:

• An International Greenhouse Gas Measurements Test Bed Framework that:

  – Enables joint development of advanced measurement capabilities for urban and regional GHG domes and their dynamics,
  – Establishes scientific validity and performance capabilities of advanced measurement methodologies and instruments,
  – Provides a focus for multi-organization efforts with locations and organization on all continents but Antarctica,
  – Facilitates open, internationally-recognized measurement methodology development and evaluation with open data exchange and utilization across national borders, and
  – Strengthens methods to correlate and calibrate satellite instrument observations on-orbit with those made on the surface as a means to advance accuracy and establish SI traceability
International GHG Measurements Framework
Engaging the Metrology & Climate Communities

Approach:

• Focus on Megacities as test bed sites
  – Cover 6 of the 7 continents
• Engage with nations / regions having:
  – Suitably located megacities
  – The scientific and technological capabilities needed, and
  – The necessary national interest and will to commit the required resources
• Use existing structures available within the Mètre Convention
  – Operational, internationally-recognized treaty organization with well-demonstrated working relationships and organizational structures
  – Facilitates communication & dialog
  – Broaden international linkages – WMO, international climate change/science communities

Status:

• Projects underway Paris and the U.S.; Planned in Brazil
Developing Tools & Test Beds for Diagnosing Inventory Accuracy for U. S. Urban GHG Domes


The Indianapolis Flux Experiment (INFLUX)
- A Top-Down/Bottom-Up Greenhouse Gas Quantification Experiment in the City of Indianapolis, Indiana

The LA Megacity Carbon Project
- Estimating the Emissions Trends in a Megacity Having Complex Topography & Meteorology

The Northeast Corridor Project
- The Largest U.S. Megacity
- A Test Bed Having Moderately Complex Topography & Meteorology
- Initiation of The Effort Began in Mid-FY 14.

International Recognition of Measurement Results
Enhancing Quality of GHG Inventory Data

• Quantification Supporting Market / Regulatory Functions
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• A Measurements Framework Supporting Economic Systems
  The Metré Convention (1875)
  – Governance Orgs.: General Conference on Weights and Measures & International Committee on Weights and Measures (CIPM)
  – Implementing Org.: International Bureau of Weights and Measures
  – Activity Focus: Ensure comparability and recognition of national measurement standards, hence measurement results across borders & time
  – Framework: The CIPM Mutual Recognition Arrangement
    (http://www.bipm.org/en/cipm-mra/)
  – Member State Rep: National Metrology Institutions

• NIST: U.S. National Metrology Institute
  Responsibilities for accurate quantification & quality measures and their supporting methods & standards
Within and Between Community Agreements and Outreach

Metré Convention & CIPM Mutual Recognition Arrangement

- 53 member states & 41 States Associated with the CGPM
- International Organizations

Joint Meetings / Workshops

- WMO-BIPM Workshop on Measurement Challenges for Global Observation Systems for Climate Change Monitoring: Traceability, Stability and Uncertainty – April 2010
- Workshop Series in the Americas
- U.S.-China Bilateral workshops on Metrology Challenges in Climate Science – 2011 thru 2014
THANK YOU FOR YOUR ATTENTION