BOG Report

BOG 4 – F-gases

IPCC TFI Expert Meeting on Use of Atmospheric Observation Data in Emission Inventories

5-7 September 2022
WMO HQ, Geneva - Switzerland

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Discussion Question #1

- ✓ *Assess and critique recent estimation techniques that utilise atmospheric observations as well as operational systems, platforms, instruments/sensors and methods/models for their potential to be used for the verification of national inventory sectoral emission estimates, consistent with the guidance provided in the 2019 Refinement*

Discussion Question #1

- Both atmospheric scientists and inventory compilers should be aware of the uncertainties in the emissions derived from atmospheric observations.
- For the most commonly used inverse modeling approach, these uncertainties may result from any of the components of the modelling system, including gas abundance measurements, priors, weather prediction models, transport models, inverse systems, and concentrations upwind of the region of interest.
- One way to better understand these uncertainties is to calculate results based on multiple versions of these components.

Discussion Question #1

- Priors are supplied as inputs to inversions, and priors with a range of detail (from uninformed to extensively informed) supply different but useful emissions estimates (an entirely independent estimate vs. a refinement of the inventory estimate) to the inventory community for the purpose of verification (as defined in the 2019 Refinement) of national emission estimates.
- Recognize that inverse analysis systems are not yet standardized; therefore, there is room for additional progress and refinement of emission estimates and uncertainties. As a result, identifying robust signals and robust differences between an inverse and inventory result requires expert judicious review and assessment of results. Robust signals are best identified or confirmed through consideration of multiple configurations of models and observations.

Discussion Question #2

- ✓ *Assess and evaluate successful examples of:*
  - *comparisons between atmospheric observations and national inventories that are consistent with good practice provided in the 2019 Refinement that have led to implemented or planned improvements in national inventories;*
  - *available examples where emission factors derived from atmospheric observations have been incorporated into a bottom-up inventory framework*

Discussion Question #2

- Atmosphere-derived emission estimates for F-gases are included in NIRs for four different countries.
- These successful examples all include ongoing respectful communication between both atmospheric and inventory-focused communities to better understand emission estimates, trends, and their uncertainties. The best examples include those where there was a dedication to continuous and long-term engagement in this collaborative process.

Discussion Question #2

- Useful outcomes have resulted from:
  - A sustained and consistent back-and-forth process.
  - Establishing a regular, predictable schedule for updated comparisons (e.g., annually). This builds long-term relationships and avoids having to reassemble the relevant expertise and data on an ad-hoc basis.
  - Bringing in additional expertise, e.g., from emitting industry.

Discussion Question #2

- Insight into what is driving emissions has been gained by combining on-the-ground knowledge of sources (from the inventory agency) with analysis of
  - temporal and spatial patterns in emissions (e.g., seasonality in emissions) and
  - emissions of different F-GHGs that may be emitted separately or together in characteristic ratios.
- Given that useful comparisons take time, successful programs have prioritized gases/sources.

Discussion Question #3

- ✓ *Assess the possibility that emerging datasets from atmospheric observations could be used to test and verify particular IPCC default values (emission factors) and associated uncertainties*

Discussion Question #3

- It is difficult to use atmosphere-based estimates to gain insights into specific default factors because current inverse systems provide total emissions from the sum of all emissive processes.

Discussion Question #3

- In addition, emissions for many F-gas source categories depend on multiple parameters (in addition to activity data), making it challenging to determine which of these parameters should be adjusted.
  - Nevertheless, in some cases, country-specific parameters have been informed by atmosphere-derived emissions among other datasets. In the long term, these country-specific factors could inform IPCC default values.
- Targeted pilot atmospheric measurement projects can provide insights into specific processes (e.g., associated with fluorochemical production).

Discussion Question #4

- ✓ *Discuss the use of gridding (spatial and temporal) of NGHGIs to allow comparison with atmospheric observation data*

Discussion Question #4

- Geographically or temporally disaggregating National GHGI information can facilitate more accurate comparisons with atmosphere-based emission estimates when the latter aren't representative of the entire country or year.
- Furthermore, the disaggregated inventory can be used to extrapolate atmosphere-based results representative of a limited portion of a country or time period to the entire country or year.
- Finally, disaggregated National GHGI information can help identify regions of a country where atmospheric observations should be best situated in order to capture emissions from the most emissive regions.

Discussion Question #5

- ✓ *Discuss terminology and classifications of sources/sinks and associated natural and anthropogenic GHG fluxes to find a common understanding of consistency and differences in atmospheric observation data and GHG inventory estimates*

Discussion Question #5

- Important for both inventory compilers and atmospheric science community to use consistent GWPs in aggregations across GHGs when comparisons are made. (Inventory compilers are likely to prefer the current UNFCCC-adopted GWP values.)

Discussion Question #5

- We propose including a glossary for the following terms:
  - Gas abundance measurements,
  - priors
    - uninformed (flat) vs. informed
  - weather prediction models,
  - transport models,
  - inverse systems,
  - "background concentrations" or concentrations upwind of the region of interest

Additional Observations

- Atmospheric measurements are currently informing refinements to existing industrial GHG reporting programs (e.g., updated emission factors used by facilities for reporting).
- May be useful to establish a forum for the regular exchange of ideas among inventory compilers regarding verification using atmosphere-based estimates.

Thank you

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