EU funded project

Regional quantification of emissions of substances controlled under the Montreal Protocol: A Pilot Project

Background

In 2018, a study published in Nature showed that global emissions of trichlorofluoromethane (CFC-11) had been increasing unexpectedly since 2012, after the consumption and production phase-out date for that substance established under the Montreal Protocol on Substances that Deplete the Ozone Layer. The parties to the Montreal Protocol mobilized themselves and their institutions as well as related entities to take action to identify and address the unexpected emissions. One of the actions was the convening of an international symposium[1] on the unexpected increase in emissions of CFC 11, held in Vienna in March 2019, among scientists and experts. In May 2019, another article was published on the possible regions of emissions. Both the Scientific Assessment Panel (SAP) and the Technology and Economic Assessment Panel (TEAP) have provided reports to the parties on the unexpected emissions and potential sources of emissions of CFC-11. During 2018 and 2019, parties discussed the matter extensively.

[1] The report of the symposium was published in the July 2019 newsletter of the "Stratosphere-troposphere Processes and Their Role in Climate" project and is available on the Ozone Secretariat website at: https://ozone.unep.org/system/files/documents/SPARC-report-on-unexpected-CFC-11-emissions.pdf

In November 2019, parties to the Montreal Protocol, at their Thirty-First Meeting, took decision XXXI/3, in which they decided: "To request the Scientific Assessment Panel to work with the Ozone Research Managers at their meeting in 2020 to identify gaps in global coverage of atmospheric monitoring of controlled substances and to provide options on ways to enhance such monitoring as well as exploring options for informing the parties of preliminary information indicating unexpected emissions of controlled substances for the consideration of the Thirty-Second Meeting of Parties and the Twelfth Conference of Parties, in 2020." (para. 8)

In accordance with the decision, the SAP in cooperation with experts in the atmospheric monitoring of substances controlled under the Montreal Protocol, prepared a white paper entitled "Closing the Gaps in Top-Down Regional Emissions Quantification: Needs and Action Plan" for discussion at the eleventh meeting of the Ozone Research Managers (ORM11), which had been scheduled to take place in April 2020. Owing to the coronavirus pandemic, the meeting has been rescheduled to be held in July 2021. However, as the paper had already been prepared, and to keep up the momentum, the co-chairs of ORM11 decided to convene an online meeting of the ORM11 on 7 and 8 October 2020 to discuss that paper in particular (see the report of the online meeting, UNEP/OzL/Conv.ResMagr/11(I)/2).

The second part of the ORM11, with a full agenda comprising all the issues that the ORM was to address, was held online from 19 to 23 July 2021. The ORM finalized their recommendations on the issue of gaps in atmospheric monitoring of controlled substances, as an additonal category to the usual set of recommendations. The report of ORM11 contains the recommendations which have also been posted as a separate document in the ORM meeting portal.

The recommendations are also reproduced as a meeting document (UNEP/OzL.Conv.12/7) for the combined Twelfth Meeting (part II) of the Conference of the Parties to the Vienna Convention and the Thirty-Third Meeting of the Parties to the Montreal Protocol, October 2021. The Meeting of the Parties to the Montreal Protocol is expected to discuss the issue of gaps in monitoring with a view to taking a decision on the way forward.

This pilot project has been developed based on the white paper prepared by the SAP in cooperation with atmospheric monitoring experts and discussed and endorsed by the ORM. (UNEP/OzL/Conv.ResMagr/11/4/Rev., 2).

Objectives

The overall objective is to begin the process of closing the gaps in global coverage of atmospheric monitoring of substances controlled under the Montreal Protocol on Substances that Deplete the Ozone Layer. This is important in order to identify unexpected emissions, and to quantify and attribute such emissions. Continued and expanded monitoring will help sustain the achieved phaseouts of these substances, and quickly identify unexpected emissive activities to assure that the healing of the ozone layer is not jeopardized.

There are three aims of this pilot project. First, it will identify suitable locations for new flask sampling and high-frequency in-situ stations. Second, the pilot project will enable initial flask sampling in a selected region where measurements can be effectively utilized. This initial, year-long, flask sampling will provide much needed information for the suitability of the site, i.e., ascertain that the site provides data on the region of interest, has no local "contamination sources," and the logistical support is adequate for a high frequency station. Third, the pilot project will lay the groundwork for the establishment of at least one high-frequency in-situ measurements and potentially a flask analysis laboratory in a developing country or countries. The pilot project will focus on the Northern Hemisphere where the uses and manufacture of Montreal Protocol gases are highest. The pilot project will also establish connections with currently working networks and research institutions.

The long-term aim is to establish flask sampling and high-frequency in-situ measurements in countries within the regions where observational coverage is largely absent to strengthen the regional identification and quantification of emissions of controlled substances. Currently, there is almost no observational coverage of eastern Europe, western, southern and central Asia, all of South America, portions of North America, large parts of Southeast Asia, Australia and New Zealand, and most of Africa.

Project Approach

The Ozone Secretariat is the pilot project manager. A pilot project steering committee will be formed consisting of 5 members, including a representatives of the Ozone Secretariat and the European Commisssion and experts to be nominated by the co-chairs of the Ozone Research Managers (ORM), the Scientific Assessment Panel (SAP) and the Advisory Committee of the Vienna Convention Trust Fund (VCTF) for research and monitoring. Through these experts, the following expertise will be brought to bear:

- expertise in the field of systematic obervation and research;
- perspectives of the "users" of the data and information acquired from monitoring stations and activities; and
- linkage to the activities of the VCTF that focuses significantly on capacity building in developing countries.

Phase 1: Identification of suitable locations and countries for the flask measurements and high-frequency in-situ stations

This phase will develop a list of candidate locations for flask sampling measurements and in-situ measurement stations for further exploration. Observing System Simulation Experiments (OSSE) analysis and calculations will be carried out to establish the locations' specific value for regional emission detection. Seasonal and interannual variabilities in patterns of atmospheric transport will also be analysed.

Within the regions that do not have observational coverage (see Fig. 1 below) specific locations will be identified for flask sampling measurements and potentially high-frequency in-situ measurements, also taking into account criteria such as population distribution, locations of potential emissive industries/activities, and regions of high economic activity or growth will be taken into consideration.

- The initial flask sampling locations do not require high-level technical expertise and support, but do require limited infrastructure and a long-term financial and work commitment.
- In-situ measurement station locations should have access to logistical support, including: 1) a building or enclosure for housing the measurement equipment that has sufficient environmental control, reliable electric power, data connectivity and access for personnel and supplies; 2) availability of qualified technical personnel to operate and maintain the instrumentation and station; and 3) a long-term commitment to the work and to providing financial support.

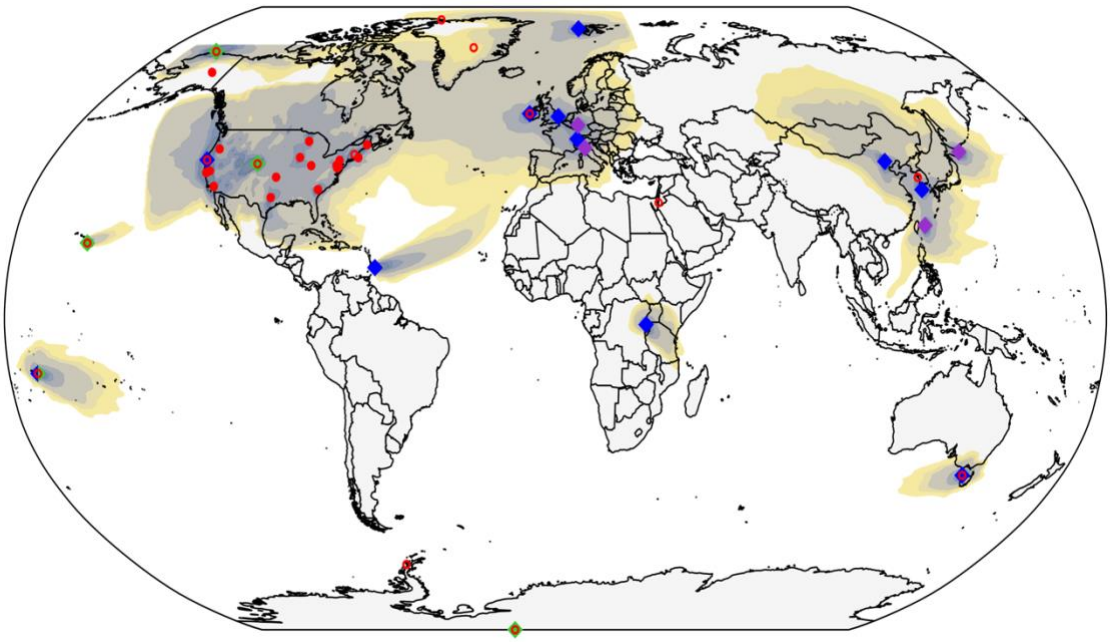

Figure 1. Map of Advanced Global Atmospheric Gases Experiment (AGAGE) high-frequency measurement stations (blue diamonds), AGAGE affiliated high-frequency measurement stations (purple diamonds), National Oceanic and Atmospheric Administration (NOAA) high-frequency measurement stations (green diamonds), NOAA daily flask-sampling locations (red filled circles) and NOAA weekly flask-sampling locations (red open circles) for monitoring atmospheric substances controlled by the Montreal Protocol. Modelled[2,4] annual "footprint" sensitivities are shown for the plotted high-frequency *in-situ* measurement and daily flask sampling locations (except for the South Pole, central Alaska, and parts of the Beaufort Sea north of Alaska). Sensitivity contours begin at the approximate limit where quantitative estimates of emissions can be made and increase exponentially toward the station locations.

Phase 2: Implementation of flask sampling measurement programmes in one or two developing countries.

This phase will establish an agreement with one or two developing countries to carry out a a daily flask sampling project, nominally for one year, and develop associated project document(s) for implementation and reporting by the countries in collaboration with an analysis facility.

The two developing countries will be selected for flask sampling measurements based on criteria such as availability of an air intake tower, protected space and electric power; ease of shipping the collected samples to a central laboratory (e.g., at NOAA or an AGAGE facility, to be determined) for subsequent analysis; and existing resources and personnel within the country that can be used.

The projects will be implemented in accordance with the agreements and the project documents and the collaborating laboratories responsible for the measurements.

Phase 3: Development and implementation of the collaboration plan for continuing observations, calibrations, data sharing and modelling.

International collaboration plan will be developed for sharing data and expertise, and laying the groundwork for the establishment of at least one high-frequency measurement site or flask measurement laboratory.

International collaboration and cross-border sharing of experimental expertise and data are key components of a successful regional controlled substance emissions quantification programme. The

steering committee will identify international programme and bodies to collaborate with to enhance the project activities, results, sustainability and replicability. The collaboration plan will be developed during 2022, mainly by the Steering Committee and the Ozone Secretariat. Some of the specific areas where collaboration is needed include:

- Quality control and curation of the data.
- Supporting and enhancing international open-access databases and models. These needs are currently met in part by existing data repositories, such as the World Data Centre for Greenhouse Gases operated by the Japan Meteorological Agency under the World Meteorological Organization, that archive a broad range of atmospheric trace gas measurements including substances controlled by the Montreal Protocol.
- Exchanging technical knowledge, operational expertise, calibration standards, and, most importantly, sharing of data and models. Collaboration and coordination among the international and national programmes can enhance the quality of the measurements and the credibility of their interpretations.
- Peer review of observational data and emissions modelling, especially when it involves using data from diverse sources.

Furthermore, an implementation plan will be developed for at least one new high-frequency measurement station at a location or locations supported by the OSSE and flask measurement programmes as chosen and vetted based on the results of Phases 1 and 2 of the project. A new flask measurement laboratory in a developing country would also be considered for establsihment within the collaboration plan.

The implementation of the collaboration plan would require further resources additional to the resources under the pilot project.

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