

# Global Partnership for Mercury Air Transport and Fate Research

- Advancing the Objectives of the 23<sup>rd</sup> UNEP Governing Council -

---

## 1. Background

In February 2005 the Governing Council of the United Nations Environment Programme (UNEP), at its 23<sup>rd</sup> meeting urged, (in Decision 23/9 IV, mercury programme), governments, inter-governmental and non-governmental organizations and the private sector to develop and implement partnerships as one approach to reducing the risks to human health and the environment from the release of mercury and its compounds. The Decision also requests that partnerships identify elements including goals, process and timelines, roles and responsibilities of, partners and a mechanism to implement effective monitoring and evaluation procedures to assess and report on progress.

In addition, Decision 23/9 IV requests UNEP to facilitate work to improve global understanding of international mercury emission sources, fate and transport.

In this context, a discussion paper entitled “Global Partnership for Mercury Air Transport and Fate Research”, was prepared by the U.S. Environmental Protection Agency (USEPA) and posted on the UNEP web site in October, 2005. The discussion paper lists some proposed goals, objectives and initial action for a partnership. At the beginning of 2006, Italy offered to lead a fate and transport research partnership in close cooperation with the U.S., Canada, Japan and other interested partners.

### Current Status

The current document presents initiatives, both ongoing and proposed, for the 2005-2008 period that contributing partners have individually identified as having potential relevance to the emerging partnership. The initiatives include such activities as research, training, transfer of knowledge and capacity building, sharing of sound scientific information on mercury fate and transport on regional, hemispheric and global scales, providing technical assistance and training on different aspects of mercury monitoring and analysis, modeling and environmental assessment.

In some cases, the initiatives are existing or proposed bilateral or multi-partner projects. In other cases, the initiatives are domestic activities that may result in findings or products that may be applicable and useful in other countries.

In the framework of the 8<sup>th</sup> Intern. Conf. on Mercury as a Global Pollutant, held in Madison, Wisconsin, USA, the CNR-IIA set up a half-day meeting on August 9<sup>th</sup> at 14.00 for exchange of information among interested countries/partners. More details on this meeting are reported in a companion document Report from the UNEP-MFTP\_August 2006 Meeting.doc made available on the UNEP web site as well as on the MFTP website ([www.cs.iaa.cnr.it/UNEP-MFTP](http://www.cs.iaa.cnr.it/UNEP-MFTP));

## **Next Steps**

1. Italy to submit the final version of the current report to UNEP in September 2006.
2. A business meeting will take place within the next six months and before the GC meeting of February 2006.
3. Italy, in co-ordination with other partners, to lead the organization of a partnership business meeting that would address partnership goals, objectives, roles, etc. within the next six months, i.e. before the February 2007 Governing Council meeting.
4. Potential partners wishing to provide information and comment on any aspects of the Partnership can contact Italy at any time.
5. Italy will establish a website by the end of September 2006 that can be used as a “bulletin board” for sharing of partnership-related information. The site will feed into the UNEP web site.
6. Italy plans to organize a workshop to be held during 2008 to discuss the status of partnership activities looking towards the 2009 UNEP Governing Council meeting.

## **2. Specific Contributions**

### **2.1 Contribution from Italy**

The Italian Ministry of Environment through the technical assistance of the Institute for Atmospheric Pollution of the CNR has promoted a 3-year pilot project (2006-2009) for assessing spatial distributions of ambient concentrations and deposition fluxes of mercury and its compounds in the City of Suzhou, which is located 80 miles west of Shanghai. This is part of its broad activity undertaken in China since 2001 on different aspects related to air quality monitoring and assessment, in cooperation with several Chinese institutions, including SEPA, EPBs, universities and research centers. The City of Suzhou is an important historical town of medium size, nearly 3 million inhabitants, with an important industrial setting, which includes coal power plants, incinerators of solid and industrial wastes, iron-steel manufacturing facilities, and other small and medium industrial plants. The research activity will involve the following tasks:

- training of Chinese personnel on mercury monitoring in the laboratory and in the field;
- development of an emission inventory at urban-regional scale, use of GIS systems for data retrieval and management, and pre-processing of emission data as input to air quality regional scale models;
- Field measurements at one-two sites in the City of Suzhou will be carried out in October/November 2006 with the aim to perform a preliminary assessment of ambient concentrations and deposition fluxes of elemental (GEM), reactive (RGM) and particulate (Hg(p)) mercury with changing meteorological conditions. These measurements will be coupled with other air quality measurements for assessing the emission source profiles through receptor modeling;
- Regional scale atmospheric modeling of GEM, RGM and Hg(p) aimed to assess the spatial distributions of mercury species on urban/regional scale;

In addition to the activity in China, Italy will contribute also through its on-going MEDOCEANOR ([www.cs.iaa.cnr.it/research\\_projects](http://www.cs.iaa.cnr.it/research_projects)) programme and the MERCYMS

project funded by the European Commission both aimed to assess the cycle of mercury in the Mediterranean Sea region and the relative contribution from North African and Middle East Countries to the global regional budget ([www.cs.iiia.cnr.it/MERCYMS/project.htm](http://www.cs.iiia.cnr.it/MERCYMS/project.htm)).

Italy is also acting as Chair of the Working Group on Mercury in the framework of the UNECE-Hemispheric Transport on Air Pollutants. The aim of this WG is primarily focused on (a) hemispheric / global scale modeling of mercury transport and deposition; (b) assessing the import/export of mercury at continental scale; and (c) source-receptor relationships. As Chair of this task force, Italy will assure a prompt transfer of major outcomes of the UNECE-HTAP Task Force on Mercury to the UNEP-MFTP which will represent an important added value to the overall goal of the UNEP-MFTP.

Italy will establish a website by the end of September 2006 that can be used as a “bulletin board” for sharing of information by partners. The site will feed into the UNEP web site and discussions will take place as to its expansion of its scope. In this way, the information developed under the Partnership, e.g., workshop presentations, reports, inventories, etc., could then serve as an educational and capacity-building tool for interested countries and stakeholders who may have not had the opportunity to participate in that particular partnership activity. The website would directly link with the UNEP mercury small grants information.

## 2.2 Contribution from USA

The U.S. Environmental Protection Agency (USEPA) will cooperate with the Italian Institute for Atmospheric Pollution of the CNR as well as the Chinese Environmental Protection Administration (SEPA) and others in conducting training of Chinese scientists on ambient mercury and particulate matter monitoring equipment. This could include a two-day workshop/conference to exchange information related to harmonize modern monitoring methods and instrumentation to characterize the form of mercury emissions from anthropogenic sources of mercury and mechanisms of transport.

The USEPA will continue measurement of ambient atmospheric mercury, gas and particulate phase anions, particulate matter inorganic trace elements, and criteria gases at the U.S. National Oceanic and Atmospheric Administration’s high altitude station at Mauna Loa, Hawaii to better understand transformation and fate of globally cycling mercury. The specific objectives are to provide support to accumulate a long-term record of ambient elemental gaseous mercury, divalent or reactive gaseous mercury (RGM), particulate mercury and associated species to:

- Support atmospheric mercury chemistry research
- Investigate reaction mechanisms for the oxidation of elemental mercury to RGM in the marine free troposphere.
- Evaluate formation mechanisms of particulate mercury
- Establish a global baseline mercury measurement station

The USEPA will share these data, at intervals deemed appropriate, posting a notice of data availability on the UNEP web site.

The USEPA will participate in additional monitoring, receptor modeling and training activities as circumstances and resources permit. In addition, the USEPA will participate in

various meetings and teleconferences among Global Partnership partners that would be facilitated by Italy as the lead country and contribute to various reports to UNEP developed by the Partnership. At Italy's request, the USEPA will arrange teleconferences among the Global Partners.

*The US Geological Survey (USGS).* The USGS will make available its World Coal Quality Inventory (WoCQI), a database consisting of about 2,800 samples of mercury (and other contaminant) concentrations from more than 80 country collaborators, as well as an additional 7,500 samples of US coals ([http://energy.er.usgs.gov/coal\\_quality/wocqi/collaborators.html](http://energy.er.usgs.gov/coal_quality/wocqi/collaborators.html)). These data have various applications of interest to the Partnership, e.g., a 305-sample subset of WoCQI, collected in 2001, representing mines throughout China, was recently used to estimate process-input mercury resulting from coal use in China (Streets et al., 2005). Also, these data may be especially useful in combination with the International Energy Agency (IEA) Clean Coal Center's Coal Power 5 database (<http://www.iea-coal.org.uk/content/default.asp>). In addition, the USGS offers analytical and interpretative capabilities to target specific coals for additional sampling, under the sponsorship of individual countries, or by the Partnership.

*The U.S. National Oceanic and Atmospheric Administration (NOAA).* NOAA will establish three new long-term atmospheric mercury monitoring stations in the continental United States: (1) at the Grand Bay National Estuarine Research Reserve, Mississippi; (2) at Beltsville, Maryland, in collaboration with USEPA's Office of Air and Radiation; and, (3) at Canaan Valley Institute (CVI) in West Virginia, in collaboration with CVI. Each of these sites will measure ambient concentrations of elemental, divalent, and particulate mercury and traces gases (e.g., SO<sub>2</sub>, O<sub>3</sub>, CO, NO, NO<sub>y</sub>), as well as wet-only deposition of mercury and major ions.

Objectives for the sites include:

- Develop robust measurement and data-management methodologies, to inform the design of an anticipated multi-agency network of speciated ambient mercury concentrations;
- Establish a long-term, high-quality, publicly available measurement record, at a site that provides regional background information but is also impacted periodically by point and non-point emission sources;
- Create a database of measurements that will be used to evaluate and improve atmospheric mercury models, to help answer critical questions regarding atmospheric fate and transport of mercury;
- Use of the measurements at the site and associated models to assess the impact of emissions changes within and outside the region.

Data from these sites will be shared; a link to the data will be placed on the web page for this Partnership.

NOAA will continue to provide the READY web-based atmospheric information system (<http://www.arl.noaa.gov/ready.html>) that provides worldwide meteorological data and the HYSPLIT model for computing atmospheric trajectories and dispersion.

NOAA will participate in additional monitoring, atmospheric modeling and training activities, including technical support and advice to other countries on developing a mercury monitoring

strategy (including atmospheric and ecosystem modeling, and training activities), as circumstances and resources permit.

### **2.3 Contribution from Japan**

The Ministry of the Environment and National Institute of Environmental Studies will start a research project in 2006 on the modelling of global mercury cycling, monitoring and the establishment of emission inventory, with a focus in East Asian region. This will include the following:

- ❑ Establishment of a background monitoring station for mercury and other heavy metals in a remote area, based on the pilot measurement conducted in FY 2005.
- ❑ Establishment of a transport model for heavy metals in East Asia
- ❑ Study on missing emission factors and improvement in the emission inventory
- ❑ Participation in and contribution to the on-going international activities on monitoring and emission inventory, including the project in China mentioned by Italy, with the agreement of other parties.

### **2.4 Contribution from Canada**

Several sites across Canada have been measuring total gaseous mercury (TGM) using the Tekran 2537A continuous measurement instrument since 1997 (Canadian atmospheric mercury measurement network CAMNet). This ongoing network aims to establish atmospheric mercury levels across Canada in rural and semi-urban areas and to describe changes in those levels. The data are publicly available in Environment Canada's NATChem database. The standard operating procedures (SOP) developed for this network have been used throughout Canada, the US and in Europe and are available upon request. In addition, Environment Canada has also developed a QC procedure and a QC software package for measurements using this instrumentation. Atmospheric speciation measurements are being made with the Tekran 1130/1135 speciation system at several sites within CAMNet. While this type of measurement system is currently under assessment for full use in the network, a SOP has been developed including a QC protocol and software package. The SOPs and data analysis methods are available upon request.

To investigate the levels of mercury in precipitation, Canada collects information at several sites as part of the continent-wide Mercury Deposition Network (MDN). This information is publicly available on the MDN website.

Canada has the longest record for continuous measurements of atmospheric mercury, snow samples and mercury speciation research in the Arctic. We are collaborating with other Arctic countries (Norway, Denmark, Russia and USA) to develop a circumpolar network of TGM measurements to establish the behavior of mercury in this unique environment.

Canada has participated in several international field research campaigns between 2000 and 2004 to share knowledge, technology and data on the behavior of mercury in Polar Regions. Canada will contribute to and be a co-author on the next Arctic Monitoring and Assessment Programme (AMAP) assessment to report on the advances in knowledge made since 2002 on Mercury Depletion Events and their contribution to elevated levels of mercury in the Arctic Environment.

Canada hosted the International Interdisciplinary Workshop for Mercury in Polar Regions in August 2005 where 60 scientists from 6 different Arctic countries gathered to discuss the state of scientific research on mercury from the atmosphere through the ecosystem to humans. The report of this workshop contains recommendations as to the future direction of interdisciplinary research and is available upon request. Canada has proposed to be actively involved in research that (pending funding) investigates the transport, cycling and deposition of mercury to the polar environment (using an interdisciplinary approach) for the 2007-2008 International Polar Year. See the Canadian IPY website ([www.api-ipy.gc.ca](http://www.api-ipy.gc.ca)) for the proposals submitted. Canada is participating with and contributing to several international ongoing research programs during the IPY including: “Ocean-Atmosphere-Sea Ice-Snow pack” (OASIS) and Atmospheric Monitoring network for anthropogenic pollution in Polar Regions (ATMOPOL). As well, Canada has submitted a proposal through the IPY to collaborate with Chinese, Vietnamese and Japanese researchers on the transpacific transport of mercury from Asia. This will include training researchers on the instrumentation and the protocols currently used for CAMNet as well as the loan of instrumentation.

Canada is collaborating with GKSS in Germany to make speciation measurements of atmospheric mercury in the southern hemisphere on the Polarstern from August to October 2006 through sharing of technology, instrumentation and procedures.

Canada has initiated measurements in British Columbia and the Yukon to assess the transfer of atmospheric mercury from transpacific sources.

Canada has developed the global/regional atmospheric heavy metals model (GRAHM) for the distribution of atmospheric mercury. Using this model, source-receptor relationships were developed to estimate the intercontinental transport of mercury to various regions. The impact and contribution of global mercury emissions on the Arctic were estimated. In collaboration with Canadian universities, halogen chemical mechanism and the deposition processes during the Arctic springtime depletion events were developed. Springtime Arctic mercury cycling was introduced in GRAHM and extent of its impact on the mercury accumulation in the Arctic, sub-Arctic and globally were estimated. Canada participated in the EMEP model intercomparison study which was recommended by CLRTAP and led by MSC-E. Canada has also participated in a North American model intercomparison study led by US-EPA as one of the three global models to provide the boundary fluxes for regional modeling. Canada is actively participating in developing the work plan of the use of multi-model approach in support of the UN-ECE LRTAP task force on hemispheric transport of pollutant. Canada will be contributing to the interim report due mid 2007 and the final assessment report of the evidence for intercontinental transport due 2009. GRAHM will be participating in the model evaluation and intercomparison study for mercury as part of this study.

Canada is collaborating with Denmark on the Galathea III project to investigate the global distribution of mercury in the troposphere. This project involves a world wide Danish cruise from the North Atlantic to the South Pacific to study global ocean processes. This project aims to determine the dynamics of mercury around the world's oceans in the atmosphere and their dependency on geographical location, type of air mass and presence of possible sources and sinks. Canada will be participating by sharing technology, instrumentation and procedures.

Through the Commission for Environmental Cooperation, Canada worked with Mexican researchers to make measurements of TGM from 2002 to 2003 in Mexico. Canada provided the expertise, instrumentation and standard operating procedures. In addition, Canada aided the implementation of 2 mercury wet deposition (MDN) sites in Mexico. Canada continues with work with Mexican researchers by currently providing instrumentation that is used in field research studies and assisting Mexico to seek funding to continue these programs. Canada will provide expertise and operating procedures for atmospheric mercury speciation measurements in the future.

Environment Canada closely works with Indian and Northern Affairs Canada on the development of a training and capacity building program for northerners on atmospheric trend measurements. Once completed, this program will be applicable to training and capacity building for developing nations.

## **2.5 Contribution from South Africa**

### Establishing a SAMA Programme

Mercury pollution and its consequences on ecosystems and human health are not very well understood in South Africa. In this regard, a 2-day forum to initiate a South African Mercury Assessment (SAMA) Programme ([www.waternet.co.za/sam Mercury](http://www.waternet.co.za/sam Mercury)) was held during 7-8 March 2006. Participants included the Council for Scientific and Industrial Research, ESKOM, SASOL, Department of Environmental Affairs and Tourism, Department of Water Affairs and Forestry, the Basel Convention Regional Centre Pretoria, and Universities of Stellenbosch and Witwatersrand. Prof. Robert Mason (University of Connecticut, USA) provided guidance and advice on developing a SAMA Programme, which would include an Hg monitoring network similar to the one proposed for the USA. The aims of the forum were to (i) discuss the need to establish a SAMA Programme; (ii) develop a framework for Hg research in the SAMA Programme; and (iii) discuss a way forward that would improve national awareness of the SAMA Programme.

A clear need for a SAMA Programme was recognised, with the following key objectives being identified for the Programme: to co-ordinate and facilitate high-quality research relating to Hg pollution in South Africa; to develop and execute a co-ordinated plan to achieve this, based on partnerships; and to provide opportunities for collaboration and training for young scientists. In addition, the SAMA Programme will ensure that research results are evaluated scientifically; disseminated in an appropriate manner to stakeholders; contribute to advisories and mitigation controls; and contribute to the effective management of natural resources.

The research of the Programme focuses on measuring Hg emissions and mapping the fate and consequences of Hg pollution in South Africa. The research undertaken forms part of the following focus areas that were developed for the research framework: (i) a regulatory framework (policy, communication); (ii) analytical methods; (iii) fate, transport, speciation and source; and (iv) impact (ecosystem and human health risk assessment).

An Executive Co-ordination Committee will be identified during September 2006 to be held at the CSIR. A Secretariat and Technical Steering Committee will be established by December 2006. These committees will focus on the way forward for the SAMA Programme.

### Collection of Hg data in the SAMA Programme

An initial assessment of Hg levels in selected Western Cape rivers (Eerste/Kuils, Salt (Liesbeek and Black), and Silvermine) and Gauteng (Steenkoolspruit) was undertaken as a follow-up to the workshop in March 2006. Rivers were selected because they are either heavily impacted by treated effluent discharged from wastewater treatment works or from industry; receive runoff from urbanised areas, or are impacted by coal waste sites. All samples were analysed at the University of Connecticut in the USA, with medium-term plans to establish the Hg analytical techniques at the CSIR. This assessment is the first of its kind to provide important data on MeHg levels in these rivers. The results of this pilot study were presented at the 8<sup>th</sup> Conference on Mercury as a Global Pollutant held in Wisconsin, USA during August 2006, and will be submitted a peer-reviewed journal. A similar assessment is planned for September 2006, on the Vaal River system in Gauteng, to compare the Hg levels in water, sediment and biota in this system with that of the rivers sampled in March 2006. This work is a collaborative effort between scientists from the SAMA Programme and Prof. Robert Mason of the University of Connecticut.

### Summary of key tasks undertaken as part of the SAMA Programme

- ❑ Conducted a literature review on Hg-based studies undertaken in South Africa, which included a review of national and international policies / legislation relating to Hg pollution;
- ❑ Convened a workshop with Government and national and international scientists to discuss the initiation of a SAMA Programme, and developed a framework for Hg research;
- ❑ Formally launched the SAMA Programme, which was highlighted at an international conference;
- ❑ Undertook preliminary research on the transport, fate and consequences of Hg in selected rivers in South Africa;
- ❑ Developed / developing partnerships with international scientists in the USA and Europe;
- ❑ Investigated ways to include the SAMA Programme's activities in UNEP's larger Global Mercury Programme.

We envisage that in ten years from now, a completed baseline study will provide South Africa with a comprehensive view of the Hg situation in the country, which could lead to a health advisory. Baseline data will be updated continuously and disseminated throughout the proposed Hg monitoring network, which will be set up in close collaboration with Government and civil society.

### Key tasks to be undertaken beyond 2006

- ❑ National Survey of Hg pollution and impacts in South Africa;
- ❑ Develop a Hg inventory for South Africa and develop scenarios on Hg emissions;
- ❑ Map information obtained in National Survey, using large-scale multidisciplinary mapping;
- ❑ Develop and/or identify appropriate mitigation processes or actions for ameliorating the Hg pollution that has been identified; and
- ❑ Submit large-integrated project proposals, with collaborators both nationally and internationally.

### 3. Partnership

<b>ITALY (Chair)</b>	
<p>Dr. Nicola Pirrone Head of Division CNR-Institute for Atmospheric Pollution 87036 Rende Italy Tel: +39-0984 493239; Fax: +39-0984 493215 E-mail: <a href="mailto:n.pirrone@cs.iaa.cnr.it">n.pirrone@cs.iaa.cnr.it</a></p>	
<b>USA</b>	
<p>Dr. Joel D. Scheraga (Lead) National Program Director Global Change Research Program/Mercury Program ORD-US Environmental Protection Agency Washington, D.C. 20460 USA Tel: (202) 564-3385 E-mail: <a href="mailto:scheraga.joel@epa.gov">scheraga.joel@epa.gov</a></p>	<p>Stanley B. Durkee (Alternate) Office of Science Policy ORD-US Environmental Protection Agency Washington, D.C. 20460 USA Phone: (202) 564-6784 E-mail: <a href="mailto:durkee.stan@epa.gov">durkee.stan@epa.gov</a></p>
<b>JAPAN</b>	
<p>Dr. Eisaku Toda Deputy Director Environmental Health and Safety Division Ministry of the Environment 1-2-2 Kasumigaseki Chiyoda Tokyo 100-8975 Japan Phone +81-3 5521 8260 Fax: +81-3 3580 3596 e-mail <a href="mailto:eisaku_toda@env.go.jp">eisaku_toda@env.go.jp</a></p>	<p>Dr. Noriyuki Suzuki (scientific lead) National Institute for Environmental Studies (NIES) Onogawa, Tsukuba Ibaraki 305-8506, Japan Tel: +81-29 850 2331 Fax: +81-29 850 2880 e-mail: <a href="mailto:nsuzuki@nies.go.jp">nsuzuki@nies.go.jp</a></p>
<b>CANADA</b>	
<p>Dr. Keith Puckett Director Air Quality Research Environment Canada Tel : (416) 739-4836 E-mail: <a href="mailto:Keith.Puckett@ec.gc.ca">Keith.Puckett@ec.gc.ca</a></p>	<p>Dr. Cheryl Heathwood Chief Hazardous Air Pollutants Environment Canada Tel : (819) 953 7157 ; Fax: (819) 953 8963 E-mail: <a href="mailto:Cheryl.Heathwood@ec.gc.ca">Cheryl.Heathwood@ec.gc.ca</a></p>
<b>SOUTH AFRICA</b>	
<p>Dr Joy Leaner Research Group Leader: Water Ecosystems Council for Scientific and Industrial Research 1 Jan Cillier Street / P.O.Box 320 Stellenbosch 7590, South Africa E-mail: <a href="mailto:jleaner@csir.co.za">jleaner@csir.co.za</a> voice: +27 21 888 2553; fax: +27 21 888 2682 cell: +27 84 409 6909</p>	