

水銀の大気輸送と運命に関する研究分野  
UNEP グローバルパートナーシップ・ビジネス会合報告

## 1 . 目的と背景

水銀の大気輸送と運命に関する研究分野の UNEP グローバルパートナーシップ ( UNEP-MFTP: UNEP Global Partnership for Mercury Air Transport and Fate Research ) は、イタリアを議長国として、日本、米国、カナダなどのパートナー国の協力を得て、2006年に発足した。

第 1 回 UNEP-MFTP 会議は、2006 年 8 月 9 日米国ウィスコンシン州マディソンで開催され、パートナーシップへの貢献に関する各国の提案について討議し、作業計画 ( Work Plan ) 案が作成された。

各国の作業計画は、既存、新規の 2 国間 ( 他国間 ) 協定に基づくプロジェクトや、他国で適用可能な知見等を提供する国内活動などに関するイニシアチブが寄せられ、2006 年 9 月 UNEP ケミカルに提出された。

第 2 回 UNEP-MFTP 会議は、2007 年 1 月 9-10 日、カナダのケベック州ガティノーで開催され、各国のパートナーシップ活動の現況、今後の活動を促進する方策などについて討議された。日本からは鈴木規之 委員長 ( 国立環境研究所 ) が出席した。

## 2 . 会議概要

日 時 : 2007 年 1 月 9-10 日

場 所 : カナダ・ガティノー Environment Canada オフィスビル

出席者 : イタリア、日本、米国、カナダ、UNEP ケミカルズ

議事概要 :

### 1 . パートナーシップ活動の進捗状況について

パートナー各国から、既存、進行中、計画中の活動が報告された。パートナー各国の活動状況については、別添 1 に概略を添付する。

- ・ 日本からは、バックグラウンド地域における大気中有害金属類の監視計画と、環境中長距離輸送モデルの検討計画について報告し、パートナー活動として合意された。
- ・ 日本が協力を検討しているイタリアのパートナーシップ活動の一つ、中国蘇州市パイロットモニタリング事業は遅延し機材搬入が止まっている状況である。

### 2 . パートナーシップに対してのパートナーの要望について

カナダ、米国、日本等から、パートナーシップ活動について意見が寄せられ、会議参加国の要望が合意事項として取りまとめられた。

- ・ 各国の独自のパートナーシップ貢献活動をより価値あるものとするよう、パートナー国同士が連携し取り組み、相乗効果の促進に努める。
- ・ 本パートナーシップでは、水銀の大気中への排出、その輸送と形態変化、及び

沈着についてのモニタリングとモデリングに関する研究を、当面の優先活動スコープとする。また、パートナーは、排出インベントリーや長期監視データの比較やその方法、互換性についても検討する。

- ・ 日本のパートナーシップ活動の一つである大気と他の媒体間の輸送に関するモデル開発に関しては、上記のパートナーシップの優先的活動範囲を踏まえた上で、自発的な研究を予備的に行い、将来、本パートナーシップの範囲が広がった際に役立てる。
- ・ 本パートナーシップは、既に国際的に取り組まれている活動や、地域的な調査研究に関する協力活動等も含む。
- ・ 地球規模の水銀循環に関して、健全な科学情報の整備に努め、科学者のみならず、政策立案者との情報共有を促進する。
- ・ 本パートナーシップの発展のために重要と考えられる事項については、UNEP 管理理事会決議の中に盛り込むべき事項として草案し、パートナー各国でレビューする。

### 3 . 組織的課題について

パートナーシップの組織的課題（目標、実施スケジュール、会議予定、パートナーの役割、進捗評価、資金等）について討議された。パートナーシップの発展ステップとスケジュールは以下のとおりである。

- ・ パートナー初期メンバーの活動計画の収集
- ・ 2006 年 インフォメーションミーティング（米国マディソン）
- ・ パートナー参加国の勧誘
- ・ MFTP パートナーシップのウェブサイト作成
- ・ 2007 年 ビジネスミーティング（カナダ・ガティノー）
- ・ 他の UNEP 水銀グローバルパートナーシップとの連携と統括的リード
- ・ UNEP 水銀排出インベントリー作成ツールキットのテスト参加国への勧誘
- ・ 2007 年 必要に応じて電話会議
- ・ 2007 年 次回 MFTP 会議
- ・ 2008 年 公開ワークショップ：4-6 月の 3 日間（ローマで開催予定）
  - UNEP 世界水銀アセスメントのアップデートを行う。
  - 2004 年にイタリアで開催されたワークショップの成果を踏まえる。
  - 2009 年の管理理事会に成果を報告する。
- ・ 2009 年 世界水銀会議（中国貴陽市）においてセッション検討

### 4 . 会議報告

- ・ 本 MFTP 会議の議事録（別添 2）は、情報として UNEP 管理理事会に送る。
- ・ 本 MFTP パートナーシップに関する各国貢献活動の更新については、第 24 回 UNEP 管理理事会において、各国政府から報告すること。

## 各国のパートナーシップ貢献活動状況【概要】

水銀の大気輸送と運命に関する研究分野の UNEP グローバルパートナーシップは、イタリアを議長国として、カナダ、日本、米国、UNEP が連携し、2006 年に発足した。作業計画 (Work Plan) や活動状況は、パートナーシップのウェブサイト に 詳細な報告がある (<http://www.cs.iiia.cnr.it/UNEP/index.htm>)。

## ● イタリア

イタリアは、2006 年から 2008 年まで、地中海地域、欧州、中国、北極において、以下の活動を計画している。

## ➤ MED-OCEANOR プログラム

イタリア科学審議会と欧州委員会 (MERCYMS project) の支援により、フランス、スロベニア、ギリシャ、スペイン、エジプト、イスラエル等の地中海諸国が参加し 2000 年にスタート。水銀化学種の循環に影響を与える大気と海洋間の交換プロセスや、媒体中の化学形態変化に関する調査研究を実施する。

## ➤ ESPREME プロジェクト

欧州委員会の資金で、水銀を含む大気中有害金属類の汚染に関し、他大陸から長距離輸送される水銀と欧州諸国起源の寄与との相対的な評価を行う。

## ➤ AMSUCY プロジェクト

イタリア環境省及び国立大気汚染研究所 (CNR-IIA) とは中国国家環境保護総局と共同で、中国蘇州市において 3 年間 (2006 ~ 2009 年) の水銀監視パイロットプロジェクトを計画している。蘇州市内の 1-2 ヶ所の測定地点で、形態別水銀を実測し、大気中濃度の予備的評価を行うとともに、技術トレーニングを実施する。

## ➤ UNECE-HTAP Task Force 水銀ワーキンググループ

長距離越境大気汚染条約・半球移動タスクフォースの水銀ワーキンググループは、イタリアが議長国としてリードする。WG は、水銀の半球・全球規模で、水銀排出に占める自然源および人為起源の寄与について、また、排出削減対策の効果の評価について、モデルの相互比較を行うことを目的としている。

## ➤ 極地研究プログラム

2008 年、国際極観測年の活動の一環として、スバルバール諸島ニーオルセンのイタリア観測所において調査活動を行う。プログラムは、極地における大気から雪氷面への水銀輸送と沈着に関する機構について調査研究を行う。

## ● 日本

## ➤ バックグラウンド地域における大気中有害金属類のモニタリング計画

環境省では、アジア太平洋地域における有害金属類の長距離輸送の実態解明

を進めるとともに、国際的な環境監視システムの早期構築に向け、監視手法、監視項目等について検討するため、沖縄県辺戸岬にある国立環境研究所辺戸岬大気・エアロゾル観測ステーション等で、2007年2月より試行調査を開始する。

➤ 環境中長距離輸送モデルの検討計画

国立環境研究所では、水銀の化学形態変化を的確に考慮し、大気と水、地表面など環境媒体間の動態や輸送を、包括的に取り扱う多媒体モデルの構築に取り組む。多媒体輸送モデルでは、大気中では Hg (0)、Hg<sup>2+</sup>、Hg (p) の 3 種、他の媒体中では Hg (0)、Hg<sup>2+</sup>、MeHg の 3 種の動態に注目し、G-CIEMS をベースに用いてモデル評価を行う。

● 南アフリカ

➤ 南アフリカ水銀アセスメント (SAMA) プログラム

水銀の排出源、運命と輸送に関する研究プログラムは、産官学が連携するパートナーシップの一環として、2006年より10年間実施され、南アフリカにおける水銀観測の包括的な展望を与えるものとなる。

- ・ 科学産業研究審議会 (CISR) は産業界と協力して、石炭燃焼と利用に伴う水銀放出について解明する研究に着手する。
- ・ 水・森林省は、国家監視計画を通じて、水資源の水銀モニタリングを継続する。
- ・ CISR は水銀インベントリー開発に焦点をあて、水銀汚染とその影響に関する調査研究に着手する。
- ・ ステレンボッシュ大学では、水銀の化学形態分析方法の開発を進めている。
- ・ CSIR は米国コネチカット大学と、河川における水銀排出源及び運命と輸送プロセスに関する調査研究について、パートナーシップ活動を継続する。

● 米国

米国では、環境保護庁 (USEPA) が中心となり、海洋大気庁 (NOAA)、エネルギー省 (DOE)、地質調査所 (USGS)、電力研究所 (EPRI) がパートナーとして連携している。

- USEPA は、中国蘇州市でのイタリア CNR-IIA が実施するプロジェクトと連携し、中国側技術者の研修や技術トレーニングを担当する。
- USEPA は、ハワイ島マウナロアの NOAA 高地観測所において、大気中の形態別水銀の観測を継続して実施する。
- 米国政府機関はパートナー間で以下の情報共有化を図っていく。
  - ・ USGS は世界石炭成分質インベントリーを共有化する。データベースでは、80カ国以上の2,800試料の水銀データや、米国の7,500の石炭試料のデータを利用できる。

- ・ NOAA は、米国内で3カ所の新たな長期水銀観測所における形態別水銀の大気中濃度や沈積量について、データの共有化を図る。
  - ・ NOAA は、READY ウェブ情報システムを通じ、気象データ、大気中の軌跡や拡散を計算する様々なモデルを提供する。
  - ・ エネルギー省(DOE)の国立環境技術研究所(NETL)は、大気観測データ、及びサンプリングとモニタリング方法に関する情報を共有化する。
  - ・ DOE/NETL は、中国科学技術部と浙江大学とのパートナーシップを維持していく。この活動には、石炭火力発電所の排出係数の整備が含まれている。また、イタリアが主導する蘇州モニタリングプロジェクトにも関与する。
- EPRI は、大気中水銀の越境輸送を解明するための観測プログラムを拡張する。この計画には、オレゴン州バチラー山における継続的な高地監視と、航空機による側深調査による、海洋と大陸環境での雲中の水銀化学プロセスに関する研究が含まれている。EPRI は、また、全球及び地域規模のモデル研究を継続するとともに、バックグラウンドへの寄与を解明するため、山火事、火山など自然排出源からの水銀フラックスを調査する。さらに、データ解析や情報管理において、水銀沈着観測ネットワーク(MDN)を支援していく。

## ● カナダ

- カナダは、大気や降水中の形態別水銀の観測を継続して行い、北アメリカにおける水銀観測ネットワークの整備に関し、引き続き米国やメキシコと連携していく。
- カナダと米国は、降水中の水銀レベルを推定する水銀沈着観測ネットワーク(MDN)の連携に加え、乾性沈着に関しても観測ネットワークの整備について協力を継続する。
  - カナダは、北極圏のノルウェイ、デンマーク、ロシア、米国といった諸国と、北極圏水銀観測ネットワークの整備で連携していく。これは、カナダの北極における長年の大気中水銀の連続観測データを基礎とし、発展させるものである。
  - カナダは、水銀の大気中越境輸送を推定し、排出 - 受容関係を明らかにする全球及び地域規模モデル(GRAHM)を開発した。GRAHM は、国連欧州経済委員会の長距離越境大気汚染条約(UNECE-LRTAP)の半球移動タスクフォース(TF-HTAP)などにおいて、相互モデル比較に参加している。
  - カナダは、2007-2008年の国際極観測年の活動として、水銀の輸送と運命に関する調査研究で、中国、ベトナム、日本の研究者との連携を計画している。

Global Partnership for Mercury Air Transport and Fate Research  
Business meeting January 9, 10 2007  
Gatineau, Canada

---

## **Background**

At its 23<sup>rd</sup> session, in February 2005, the Governing Council of the United Nations Environment Programme (UNEP) adopted decision 23/9 IV on mercury, in which it urged governments, intergovernmental and non-governmental organizations and the private sector to develop and implement partnerships, in a clear, transparent and accountable manner, as one approach to reducing the risks to human health and the environment from the release of mercury and its compounds to the environment. The Decision also requested 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 requested UNEP to facilitate work to improve global understanding of international mercury emissions sources, fate and transport.

The Global Partnership for Mercury Air Transport and Fate Research (“the Partnership”, for the purposes of this report) is one of several partnerships established in response to decision 23/9 IV. From January 9-10, 2007 a meeting of the Partnership was held in Gatineau, Canada with the main objective of discussing and defining, for the Partnership, the elements included in decision 23/9 IV.

The purposes of the meeting were to talk about the Partnership business elements, to review and discuss activities proposed by each partner, to develop and promote better understanding of the Partnership, to develop a work program for 2007-08 and to prepare an update report on the progress of the Partnership for UNEP.

The meeting was chaired by Nicola Pirrone (Italy) with participation from UNEP, Environment Canada, US-EPA, the Electric Power Research Institute (EPRI), the Japanese National Institute for Environmental Studies and IDEA Consultants Inc (Japan).

The agenda (attached) was followed, with the exception that item 8 (review and progress report of partner activities) was moved up to become item 5.

### **1. Introductory Remarks**

Environment Canada welcomed the participants and expressed the hope that the participants would work through and define business elements of the Partnership and also that the meeting would be considered as a model for other partnerships to emulate. The participants' attention was drawn to the Canadian proposals for the business elements as well as for the scope of the Partnership that had been drafted for the meeting.

### **2. Purposes of the meeting**

The Chair presented his thoughts on the purposes of the meeting. Participants agreed to use the Chair's presentation (attached as Appendix 1) as an outline for discussion that would result in the preparation of a work program for 2007-08.

### **3. Brief Overview of goals and progress of the other partnerships**

John Whitelaw (UNEP) reviewed the background of the UNEP global mercury programme up to and including the current activities such as partnerships and the small grants programme. Five areas have been defined for partnerships:

- Chlor-alkali sector,
- Coal combustion,
- Mercury-containing products,
- Small scale and artisanal gold mining and
- Mercury air transport and fate research (the Partnership).

The partnerships are progressing at different rates, with the Air Transport and Fate Research Partnership being the furthest advanced in terms of structure of the partnership. UNEP allowed that some potential partners seemed to not be keen to participate, possibly because they viewed partnerships as being a less than ideal process to address mercury issues.

### **4. Review of Partnership development to date**

Drawing on the Canadian proposal for a process and timeline for Partnership development and implementation, the Chair reviewed work to date as well as future and projected coordinating activities for the Partnership.

The Chair confirmed that, so far, no additional partners have formally requested to join the Partnership, though preliminary contacts were ongoing with several countries.

### **5. Review and progress report of partner activities**

The status of the partner activities proposed as contributions to the Partnership was presented and is attached in Appendix 2. Although South Africa was not able to attend the meeting their input is also included in Appendix 2.

### **6. Roundtable: partner aspirations for the Partnership**

Partners described their individual aspirations for the Partnership and, after discussion, the following aspirations were agreed upon.

1. As a group, partners should strive to facilitate and encourage synergies among different partners, countries, groups and institutions in order to increase the value of individual partner contributions.
2. Partners present at the current meeting would develop elements key to the future of the Partnership and provide these elements to their respective national authorities for comment and any appropriate approvals before submission for consideration at Governing Council. A set of elements regarding the facilitation of the transfer of knowledge and information to receiver countries was developed.
3. At least initially, the scope of the Partnership's research activities would be constrained to mercury in the atmosphere from the point of emission to the point up to and including deposition and that research on biogeochemical cycling and effects of mercury in aquatic or terrestrial systems be deferred at this time.
4. Within the agreed scope, research on mercury in the atmosphere can be organized into the following sub-components:
  - emissions (spatial/temporal resolution, natural/anthropogenic, speciation, re-emission), including emission inventory work;
  - transport (ambient concentration, meteorology);

- transformation (speciation, phase transformation, in-cloud and free atmosphere processes, near-source environments and processes, interactions with atmospheric micro-environments);
  - deposition (wet/dry deposition, removal processes, air-surface exchange processes, bidirectional processes), and
  - modeling (source apportionment).
5. Activities within the sub-components could be grouped as follows :
- Emission inventories: Development of high quality emission inventories with suitable spatial and temporal resolution for important mercury species to facilitate the ability to model mercury at global, continental, regional and local scales. Partners may focus on developing methods and technologies to ensure data comparability and compatibility and means to share these data. Both anthropogenic and background emissions should be considered: within background emissions, both natural emissions of new (native) mercury, re-emissions of earlier deposited mercury, fluxes from human-altered environments and uptake of mercury by natural and human environments from the atmosphere could be included.
- Continuous measurements of speciated mercury in atmospheric compartments: Continuous measurements and high-frequency monitoring critical to understanding the global spatial and temporal distribution of mercury concentration and wet/dry deposition and for establishing trends in mercury in relation to the efficacy of management measures, including emissions controls. Partners can focus on measurement methods and technologies to ensure data comparability and compatibility, means to share these data and identify data gaps.
- Processes research studies: Collaboration and integration of process research studies to increase the understanding of mercury in the atmosphere. Partners can focus on identifying knowledge gaps and facilitating interaction among research groups in partner countries.
- Modeling of atmospheric mercury: Development and application of models for understanding global transport, global chemical transformations, processes throughout the atmosphere and including at extreme latitudes, source apportionment, deposition to receiving systems as well as in the development of effective emission reduction strategies. Partners can collaborate on evaluation of science and policy questions using mercury models.
6. Understanding the high priority of emission inventories and atmospheric measurement, processes and transport, voluntary contribution of research on intermedia transport involving the atmospheric boundary layer could be explored, to expand the knowledge of air-surface exchange processes and serve as the initial contribution to a program of much broader scope in the future.
7. Individually and together, the partners should strive to facilitate the development of sound scientific information on global mercury cycling and its patterns (e.g., air concentrations and deposition rates, mechanisms of air transport/transformation, air-water exchange, chemistry in the MBL) and enhance sharing of such information among scientists and with policymakers with the understanding that scientific results must be translated into language clear and comprehensible to policy makers and the public.
8. Where possible, the partners should strive to provide technical assistance and training to support the development of critical information.
9. Recognize that the Partners, working together, may establish regional collaborative research programs within the scope of the Partnership. These programs will be invited to post summaries (written in clear language) addressing research questions, training

arrangements, identification of participants, progress reports and descriptions of results on the Partnership website.

10. Agreed to build on work already underway internationally, e.g. task force on hemispheric transport, collective measurement campaigns, key scientific priorities as identified by international groups such as the Arctic Monitoring and Assessment Programme.

### **7 & 8. Organizational Issues**

Participants referred to the partnership business elements listed in the agenda (taken from Decision 23/9 IV paragraphs 28b and 29) :

- Partnership goals
- Process and timeline for partnership development and implementation
- Expectations for meetings/teleconferences for the overall partnership
- Roles and responsibilities of partners
- Mechanism to implement effective monitoring and evaluation procedures for partnership progress
- Resource Considerations
- Other

#### Partnership Goal

Participants agreed that the Partnership goal as proposed by Environment Canada and taken from Decision 23/9 IV paragraph 32a is to “Improve global understanding of international mercury emissions sources, fate and transport”.

#### Process and timeline for Partnership development and implementation

Again the proposal from Environment Canada was drawn on to result in the following agreed steps:

- collect suggested contributions from initial set of partners (done)
- information meeting in Madison (done)
- additional partners invited to step forward (none have so far stepped forward)
- establishment of Partnership website (done)
- business meeting (January 9-10, 2007)
- set initial scope of Partnership and select initial focus activities to 2008
- invite the leads of the other UNEP mercury partnerships to join the Air Transport and Fate Research Partnership. This reflects the partners’ agreement that the mercury Air Transport and Fate Research Partnership can play an integrative role with the other more source-specific partnerships. A key aspect of this role lies in the development of source or sector-based monitoring and emissions inventories.
- invite countries that are piloting the UNEP emissions inventory toolkit to join the Air Transport and Fate Research Partnership
- during 2007 : teleconferences as needed
- partners’ meeting during 2007 to monitor progress of activities; share any results
- status report to UNEP in 2007
- hold a three-day public workshop in Italy in April-June 2008.

#### Expectations for meetings/teleconferences for the overall partnership

Included in “process and timeline” above.

It was agreed that the agenda of the 2007 partners meeting could include:

- Further definition of the process for monitoring progress of the Partnership towards its goal.

- Discussions of a Partnership training plan, which could include making grey literature available to non-expert receptor countries.
- Preparation of a status report to UNEP.
- Planning for the public workshop in 2008.

Partners agreed that the 2008 workshop should aim to:

- prepare a report updating the relevant gaps identified in Chapter 10 (Data and Information Gaps) of the 2002 UNEP Global Mercury Assessment. This will also allow evaluation of progress towards the Partnership goal.
- build on the book produced as a result of the workshop that was held in Italy in 2004: *Pirrone, N. and K. Mahaffey (2005) Dynamics of Mercury Pollution on Regional and Global Scales. Springer Publishers, New York, NY, USA. ISBN: 0387244948, pp.744.*
- produce a document summarizing the achievements and future directions of the Partnership
- provide these reports as input to the 2009 UNEP Governing Council.

#### Roles and responsibilities of partners

Participants agreed that these included the following roles:

- partners to track their individual activities and alert other partners to any setbacks
- confer with other partners in project groups as needed
- report data and results in a timely manner, aiming to meet Partnership timelines
- overview the data or results of individual activities in order to gain an overall perspective on progress and meet Partnership goal
- co-ordination and preparation of Partnership status reports and workshop documentation
- being pro-active, both individually and as a Partnership, in identifying additional activities and strategies that would contribute to advancing the Partnership goal

These roles were not specifically assigned to individual partners during the meeting.

#### Mechanisms to implement effective monitoring and evaluation procedures for the partnership

It was agreed that this was an important element and participants discussed a range of evaluation issues and possible mechanisms. It was agreed that the timeline and milestones identified would assist in monitoring progress, and that the 2008 workshop would be an important opportunity to evaluate the success of the Partnership in meeting its goal.

#### Resource considerations

Partners discussed a range of issues including:

- the relationship of the Partnership to the UNEP global mercury programme small grants programme,
- possible ways to engage international donor agencies and make them aware of Partnership activities and needs and
- ways to improve funding allocation to the UNEP global mercury programme, including partnerships.

In terms of the small grants programme, a role was seen for the Partnership in assisting the development of proposals that would advance the goal and aspirations of the Partnership. It was agreed that UNEP could consult with the Partnership for expert advice aimed at assisting

the development of proposals.

In terms of engaging international donors, a possible role was seen for the Partnership in:

- informing other countries of opportunities to pursue possible financial support from different agencies such as the Asian Development Bank, World Bank, other regional funding institutions, and that it is desirable that these agencies be involved in the beginning of the process, and
- considering ways to market the significance of mercury studies to major funding organizations so that the study of mercury pollution is included in their selection criteria as an issue with significant socio-economic implications.

However, it was also recognized that any proposals needed to be country-driven.

#### Other

No other elements were identified by participants.

#### **10. Assessment of fit and synergies of activities into the proposed goals, etc.**

Environment Canada pointed out that the partner activities described during agenda item 5 could be grouped into “completed”, “ongoing” and “possible future” activities. The partners agreed that reports and information from completed activities should be made available on the Partnership website. Environment Canada offered to organize the ongoing activities into a timeline so that any existing synergies (in reporting cycles, etc) could be identified by partners.

#### **11. Next Steps**

Partners agreed that the minutes from the January 9-10, 2007 meeting should be finalized and provided by UNEP as information to the January 18, 2007 meeting of the Committee of Permanent Representatives in Nairobi.

Specific follow-up actions identified for the partners are given in Appendix 3.

## Appendix 1 : Chair's suggestions for Partnership objectives

- ✓ Accelerate the development of sound scientific information on global mercury cycling and its patterns (e.g., air concentrations and deposition rates, mechanisms of air transport/transformation, air-water exchange, chemistry in the MBL);
- ✓ Enhance sharing of such information among scientists and between them and policymakers;
- ✓ Provide technical assistance and training, where possible, to support the development of critical information.
- ✓ Establish regional air transport and fate collaborative research programs. Each regional program would be invited to post non-technical summary reports of their research plans, progress, and published results to the UNEP website. This would serve as a vehicle for information exchange and coordination between scientists and policymakers as well as facilitate communication among scientists themselves;
- ✓ Coordinate and conduct critical research on national/ regional/global scales that could contribute to a better understanding of the atmospheric transport and environmental fate of mercury emissions;
- ✓ Develop related data sets and tools,
- ✓ Coordinate with various organizations and programmes (I.e., GEOSS, IGBP-IGAC, IGBP-SOLAS, WHO, UNECE-HTAP);
- ✓ Coordinate and train among international organizations and individual countries to achieve:
  - ✓ methods/modeling harmonization;
  - ✓ development of model intercomparison studies, sensitivity analyses and research strategies (national, regional, global) for addressing global cycling and transport; and
  - ✓ increased awareness and information transfer of global cycling in risk management decision-making.

## Appendix 2 : Status of partner activities

### Contribution from Italy

Italy is leading the Global Partnership for Mercury Air Transport and Fate Research in cooperation with Canada, Japan, US and UNEP. The work plan of the Partnership along with a description of the progress made in 2006, the specific contributions of the partners and products of the Partnership are reported in detail on the Partnership's web site at: <http://www.cs.iiia.cnr.it/UNEP/index.htm>. Italy will continue to maintain and update the web site.

The Italian contribution to the Partnership is related to different aspects of atmospheric mercury emissions, transport and transformations on regional and global scales. Activities are carried out in the Mediterranean region, in China and in Polar regions as well. The specific projects and programs led by Italy in 2006 and planned for the following two years are briefly reported below.

*MED-OCEANOR Programme:* It is supported by Italian National Research Council and co-funded by European Commission. It is aimed to investigate the air-water exchange processes and MBL chemistry that influence the cycling of mercury species in the region. The programme was started in 2000 and is projected to continue in the future. It involved several Mediterranean countries i.e., France, Slovenia, Greece, Spain, Morocco, Egypt, Israel. Intensive atmospheric, surface and deep sea measurements were performed and training activities were provided to several participants on different state-of-the-art techniques and methods for assessing the mercury levels in air and water samples. More information can be found at: [http://www.cs.iiia.cnr.it/research\\_project.htm](http://www.cs.iiia.cnr.it/research_project.htm).

*MERCYMS project:* It was funded by the European Commission as part of the FP5 and was aimed to investigate on mercury cycling in the Mediterranean region. The projects ended in 2006 and now is continuing the distribution of its products to major national and international policy makers and stakeholders in EU and abroad. More information can be found at: <http://www.cs.iiia.cnr.it/MERCYMS/project.htm>.

*ESPREME project:* It is funded by the European Commission as part of the FP6 and is aimed to develop an assessment of atmospheric trace metals pollution, including mercury, in Europe and possibly to assess the relative contributions of EU countries compared to the long range transport contribution originated in other continents. More information can be found at: <http://www.cs.iiia.cnr.it/espreme.htm>.

*AMSUCY project:* It is a three-year project funded by the Italian Ministry of Environment and it is a joint project with SEPA in Beijing and other Chinese institutions at province level. It is aimed to assess spatial and temporal distributions of atmospheric mercury in the City of Suzhou, China and possibly the source-receptor relationships. The project includes tasks on measurements and modeling. Training activities will be carried out to interested parties. More information can be found at: <http://www.cs.iiia.cnr.it/AMSUCY/index.htm>.

*UNECE-HTAP Task Force, WG on Hg:* Italy is Leading the Working Group on Mercury. The major goals of this WG is to perform a modeling intercomparison for assessing the effectiveness of emission reduction measures and assessing the relative contribution of natural vs. anthropogenic sources on hemispheric and global scales. Preliminary tests of the models

involved was carried in 2006. The final results will be part of the 2009 UNECE-HTAP report.

*Polar research program:* As part of the IPY in 2008, Italy will perform an intensive campaign in Ny-Alesund on the Svalbard Islands at the Italian research site. The aim of this project is to investigate on mercury depletion mechanisms that affect the transfer of mercury from the atmosphere to surface snow. More information can be found at: <http://www.htap.org>, <http://aqm.jrc.it/HTAP>.

### **Contribution from Japan**

*Monitoring Project for Ambient Atmospheric Mercury and Other Heavy Metals in Remote Background Areas:*

The Ministry of the Environment plans to start the background air monitoring of mercury and other heavy metals to contribute to the understanding of their atmospheric long-range transport. For this purpose, Japan will start a pilot project at remote background areas in February 2007.

The objectives of the pilot project are to:

- ❑ Monitor current levels of toxic trace elements, including mercury, in air, particles, and precipitation;
- ❑ Obtain useful information on the long-range transportation of trace elements in Asia-Pacific region;
- ❑ Develop monitoring methodologies and measurement items;
- ❑ Contribute to the international efforts in ambient atmospheric monitoring.

Pilot project sites: Pilot monitoring will be conducted at the sites where the data for the assessment of background levels of toxic trace elements across Japan, including the contribution from the Asian continent and other sources, are most likely to be obtained. One of the proposed project site is at the Cape Hedo Atmosphere and Aerosol Monitoring Station, Okinawa. The other proposed site will be selected from one of the National Acid Rain Monitoring Stations on remote islands in the Japan Sea.

### **Methods of sampling and analysis:**

- Mercury in atmosphere and particulate matters  
Mercury speciation such as gaseous elemental mercury (Hg(0)), divalent reactive gaseous mercury (RGM), and total particulate mercury (TPM) are continuously measured with Tekran mercury speciation system at the Cape Hedo Atmosphere and Aerosol Monitoring Station.
- Toxic trace elements in particulate matters  
Airborne particles are collected on a polytetrafluoroethylene filter using a low-volume sampler. Toxic trace elements including Pb, Cd, Cu, Zn, As, Cr, V, Ni, and Hg, in particles are analyzed with the inductively-coupled plasma mass spectrometer (ICP/MS) once a week.
- Toxic trace elements in precipitation  
Precipitation samples are collected using an automatic wet-only sampler, and toxic trace elements are measured once a month. Toxic trace elements and their analytical methods are the same as those of particulates.

*Modelling fate of mercury species in multimedia environment:*

Long-range transport of mercury species has been simulated by a number of atmospheric

transport and chemistry modeling frameworks. Although atmospheric transport and resultant deposition are believed to be the major source of entry into surface environment, inter-media processes between air and surface media including water, soil and others may not necessarily be described in existing modeling frameworks sufficiently. We are going to develop a multimedia-modeling framework to assess the inter-media transport of mercury species through media-boundaries based on the multimedia-modeling framework for organic chemicals, which mainly focuses on the inter-media transport of media boundaries explicitly. By combining existing chemical/transport atmospheric modeling experiences to the inter-media transport simulation, more comprehensive fate modeling including both air and terrestrial/aquatic environment would be possible for more integrated assessment purposes.

The objectives of the pilot project are to:

- ❑ Develop inter-media transport scheme and process descriptions for mercury species by expanding the multimedia modeling frameworks.
- ❑ Results of the existing and our atmospheric monitoring information are to be used in the process description and validation of simulation results.
- ❑ After box-model study of multimedia processes, integration to the atmospheric chemistry and transport scheme will be explored for the final goal of the project.

#### Methods:

Multimedia fate model G-CIEMS will be used as the basis of the study, which is now under POP model inter-comparison study by MSC-E/EMEP. Hg(0), RGM (Hg<sup>2+</sup>), Particulate and MeHg will be the first set of target chemicals for the study.

#### Contribution from South Africa

A South African Mercury Assessment Programme (SAMA) was established during 2006 to serve as the principal programme through which mercury research in South Africa is co-ordinated. Its are: 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. More information can be obtained at: [www.waternet.co.za/sama](http://www.waternet.co.za/sama).

To date, partners of the SAMA Programme focused on different aspects of mercury research. As mercury acts differently in different systems, emphasis was placed on all systems (water, air, terrestrial environment, and human health). The projects undertaken in 2006 and planned, by the partners for the next two years, are as follows:

**CSIR:** A few pilot studies, funded by the CSIR and National Research Foundation, were undertaken. The studies form part of a larger project that focuses on:

- A mercury inventory for South Africa, and developing scenarios on its emissions;
- A national survey of mercury pollution and impacts in South Africa to determine the sources, fate and transport of Hg in South Africa, in air and water resources;
- Mapping information obtained in national survey, using large-scale multidisciplinary mapping;
- Evaluating the impacts of artisanal gold mining on human health and environmental health; and
- Developing and/or identifying appropriate mitigation processes or actions for ameliorating the Hg pollution that has been identified.

*A mercury inventory on coal combustion* (its sources and emissions to the environment) was established during 2006, and information will be published in the peer reviewed literature during 2007. In order to complete the inventory and to provide updated information to UNEP, this study will be extended during 2007 to include other mercury sources (household appliances, landfill sites, cement factories, waste incinerators, etc).

*A pilot study on the fate and transport of mercury* in selected South African rivers in the Western Cape (Liesbeek, Black, Eerste/Kuils, Silvermine) and Gauteng (Steenskoolspuit, Vaal River) was undertaken in 2006. Total mercury and methylmercury analyses were made of all air, water, sediment and biota samples collected, in collaboration with the University of Connecticut, USA. The information will be published during 2007. Detailed studies will be undertaken in collaboration with University of Connecticut, USA, and as part of MERSA, Norway, during 2007.

*A historical analysis of mercury in sediment* of selected water resources was undertaken during 2006, and will be continued during 2007.

*A pilot study on mercury emissions from artisanal gold mining* in South Africa is planned for 2007. The study will focus on the Limpopo/Mpumalanga Provinces.

*Department of Water Affairs and Forestry:* Funded by the Department, total mercury in water resources has been measured since 1975, as part of South Africa's National Monitoring Programme. Monitoring of water resources will continue during 2007.

*SASOL:* Funded internally by SASOL, research has focused on understanding mercury released from coal during the Fischer-Tropsch process; and also focuses on the safe disposal of the elemental mercury that is recovered. Research will continue during 2007.

*University of Stellenbosch:* This group focuses on analytical method development for mercury speciation, with new methods for detecting elemental and inorganic mercury at low levels, being successfully developed. The method has been tested at the Cape Point Global Atmospheric Watch station, as a pilot study. The group is currently developing this method for other mercury species. Capacity is also being developed on a new technique to study the impact of humic acids on mercury and methylmercury bioavailability.

*ESKOM:* Funded internally by ESKOM, studies focus on the different mercury species emitted during coal combustion processes in electricity generation, since it is likely that species other than oxidized and particulate mercury is released during coal combustion.

The SAMA Programme envisages that in ten years from now, a completed baseline study will provide South Africa with a comprehensive view of mercury measurements in the country. Baseline data will be updated continuously and disseminated throughout a proposed mercury monitoring network.

### **Contribution from USA**

U.S. Partners (to date): U.S. Environmental Protection Agency (USEPA) (Facilitator), U.S.

National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Energy (DOE), U.S. Geological Survey (USGS), Electric Power Research Institute (EPRI)

USEPA will provide training and consultation to Chinese scientists on mercury and particulate monitoring equipment. This will be conducted through an Italian-led 3-year collaborative mercury monitoring/modeling project in Suzhou. A non-technical summary of the project plan is expected to be placed on the UNEP web site as a model collaborative research program.

USEPA will continue taking speciated measurements of atmospheric mercury (together with particulate matter and other criteria pollutants) at the U.S. National Oceanic and Atmospheric Administration's high altitude station at Mauna Loa, Hawaii. Data obtained are to be shared, at intervals deemed appropriate with notice of availability to be posted on the UNEP web site.

USEPA will participate in additional monitoring, source receptor modeling and training activities as circumstances and resources permit, participate in various meetings among Global Partnership partners that would be facilitated by Italy (the lead country) and contribute to various reports under the Partnership. At Italy's request, USEPA will arrange teleconferences among Global Partners.

NOAA will 1/share its monitoring data, through a web link to be placed on the Partnership website, for three new long-term mercury monitoring stations within the U.S. that will measure ambient concentrations of mercury species as well as other pollutants, e.g., SO<sub>x</sub> and PM, as well as mercury deposition 2/ continue to provide worldwide meteorological data through the READY web-based information system and various models for computing atmospheric trajectories and dispersion, including HYSPLIT and 3/ participate in additional monitoring, modeling and training activities, including technical advice to other countries on developing a mercury monitoring strategy.

USDOE's National Energy Technology Laboratory (NETL) will 1/ share atmospheric monitoring data it has collected within the U.S. and information about sampling and monitoring methodologies. 2/ continue its mercury work in China, developing and, after consultation with Chinese collaborators, sharing project information as deemed appropriate. As part of the latter project, NETL will maintain its ongoing partnership with the Chinese Ministry of Science and Technology (MOST) and Zhejiang University, which includes developing mercury emission factors for estimating emissions from coal-fired plants. To this end, speciated measurements have been taken at a sample of Chinese plants having different technologies. The dialogue with the Italian-led Suzhou project will be continued.

The USGS will share its World Coal Quality Inventory, a database of 2,800 samples of mercury (and other) contaminant concentrations from more than 80 country collaborators as well as 7,500 samples of US coals (<http://energy.er.usgs.gov/coal/quality/wocqi/collaborators.html>). These data were recently used to develop DOE's mercury emissions inventory in China (Streets et al, 2005). These data may be useful in combination with the International Energy Agency (IEA) Clean Coal Center's Coal Power 5 database (<http://www.iea-caol.org.uk/content/default.asp>).

EPRI will expand its atmospheric mercury measurement program to better understand transboundary transport through continued support of high altitude ground-based monitoring (Mt Bachelor, Oregon) and aircraft soundings, including an investigation of in-cloud

processing of mercury in marine and continental environments. EPRI will continue its mercury global and regional modeling, using the “one atmosphere” models as well as studies on mechanisms. EPRI will also continue work on background mercury fluxes, including work at various impacted and natural sites and undertaking aircraft measurements to elucidate natural sources of emissions, e.g., volcanoes and wildfires. Finally, EPRI will continue its support for the Mercury Deposition Network (MDN) data analysis, data quality, data interpretation and data measurement programs and will investigate further initiation of a background site in California. Results will be shared with the Partnership by posting reports at [www.epri.com](http://www.epri.com).

### **Contribution from Canada**

Canada maintains a domestic mercury emission database under the National Pollutant Release Inventory (NPRI) program.

Several sites across Canada have been measuring total gaseous mercury using the Tekran 2537A continuous measurement instrument since 1997. The data are publicly available in Environment Canada’s NAtChem database. The standard operating procedure (SOP) is available upon request and has been used throughout Canada, the US and in Europe. A quality control (QC) procedure and a QC software package for measurements within this Network have been developed and can be shared.

Atmospheric speciation measurements are being made with the Tekran 1130/1135 speciation system in research mode at several sites. A SOP, QC protocol and QC software package have been developed and can be available on request. This measurement system will be assessed for operational use in the network. Canada and the United States have initiated discussions leading toward the development of a mercury dry deposition network.

The level of mercury in precipitation is determined at sites across Canada as part of the Mercury Deposition Network (MDN). The data are publicly available on the MDN website.

Canada conducts mercury processes research aimed at understanding environmental pathways by which mercury is cycled.

Canada works internationally through agreements such as the NAFTA CEC North American Regional Action Plan (NARAP) on mercury, New England Governors/Eastern Canadian Premiers (NEG/ECP) action plan on mercury, Great Lakes Binational Toxics Strategy and the Arctic Council Action Plan on Mercury and contributes to the Arctic Monitoring and Assessment Program and the United Nations Environment Program.

Canada is collaborating with other Arctic countries (Norway, Denmark, Russia and USA) to develop a circumpolar network of TGM measurements. Canada will be a co-author on the next Arctic Monitoring and Assessment Programme (AMAP) assessment. This document will 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.

During the 2007-2008 International Polar Year (IPY) Canada has proposed to investigate the transport, cycling and deposition of mercury to the polar environment (using an interdisciplinary approach) and to collaborate with Chinese, Vietnamese and Japanese

researchers on the transpacific transport of mercury from Asia.

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. Canada participated in two model intercomparison studies (one EMEP study led by MSC-E and one North American study led by US-EPA). Canada is participating in developing the work plan of the use of the multi-model approach in support of the UN-ECE LRTAP task force on hemispheric transport of pollutants. Canada will be contributing to the interim report (mid 2007) and the final assessment report of the evidence for intercontinental transport (2009). GRAHM will be participating in the model evaluation and intercomparison study for mercury.

Through the Commission for Environmental Co-operation, Canada provided instrumentation and training to measure GEM concentrations at various sites in Mexico, aided the implementation of 2 MDN sites in Mexico and is assisting Mexico to seek funding to continue and expand these programs (with USA).

### **Appendix 3 : Specific follow-up actions identified for the partners**

To build membership in the Partnership, UNEP will invite the five countries in its Asia region who are participating in a test of the mercury emission toolkit to participate in the Partnership. The invitation will be issued within the next 4 months. Canada/USA will approach Mexico through the Commission for Environmental Cooperation within 4 months. USA/Canada will provide information on the Partnership to the next meeting of the Steering Group to the Arctic Council Action Plan mercury project.

To further knowledge on emissions, Italy/USA will consult within 2 months with the teams working on greenhouse gas emissions (current and future as applied to the energy sector) in selected countries with a view to improving mercury emission estimates. Italy will approach colleagues to harmonize emission inventories.

Possible Partnership activities to further the understanding of mercury in the atmosphere through processes studies are currently in the formative stage and include a measurement program at K2, a UNEP proposal on emissions (both led by Italy) and joint studies for the International Polar Year.

Italy will investigate a special session on Partnership activities during the 2009 International Conference on Mercury as a Global Pollutant to be held in China.

US will co-ordinate teleconferences as needed during 2007 and will explore hosting a face-to-face meeting in US in early to mid-November, 2007.