Monitoring of Atmospheric Gases

Total Gaseous Mercury (TGM)

1. Description

Total gaseous mercury (TGM) concentrations have been measured in Canada by the Canadian Air and Precipitation Monitoring Network (CAPMoN) and other Environment Canada projects.

At all locations the TGM measurements were made using automatic Tekran ® 2537 mercury vapour analyzers (described in detail in Poissant, 1997). The air is typically sampled at flow rates between 1.0 and 1.5 L/min (depending on location) and is passed through a Teflon filter (47 mm diameter; 0.45 µm) at the sample line inlet to remove particulate matter. Inside the analyzer, the mercury in the sample air is pre-concentrated before analysis by amalgamation on gold cartridges (5-30 minute concentration time). Mercury is removed from the gold cartridges by thermal desorption and is detected using Cold Vapour Atomic Fluorescence Spectrophotometry (CVAFS). The analyzer has two gold cartridges which allow alternating accumulation and desorption to occur simultaneously resulting in the continuous measurement of mercury in the air stream at 5-30 minute intervals. The instruments are calibrated daily using an internal mercury source and verified during routine site audits by manual injections of mercury from an external source. The data are quality controlled using the Environment Canada RDMQ (Research Data Management and Quality Control) system.

Limited studies suggest that atmospheric TGM measurements consists of gaseous elemental mercury (GEM) and reactive gaseous mercury (RGM) (Temme et al 2003; Slemr et al, 2008); however, it is possible that, under certain environmental conditions and sample inlet configurations, some RGM is removed (Gustin and Jaffe, 2010). Because TGM concentrations in the lower atmosphere typically comprise >95% GEM and <5% RGM, the measured TGM concentrations largely represent GEM concentrations.

Total gaseous mercury measurements are made to understand the spatial and temporal trends of atmospheric mercury concentrations across Canada. Individual sampling locations may have additional site-specific objectives associated with their monitoring activities. The resulting datasets provide consistent measurements of atmospheric mercury concentrations throughout Canada and can be used to identify spatial and temporal trends.

2. Site Information

Environment Canada measurement sites for which data can be downloaded represent a diversity of regional conditions across the country including areas near urban/industrial activity as well as in remote regions. A table of Environment and Climate Change Canada site locations and years of activity are available from the file: *Networks_Studies-Réseaux_études-TGM-SiteListing-ListeDesSites_EN-FR.csv.*

3. Data Sets

Hourly average TGM concentration data from Environment and Climate Change Canada locations can be downloaded from either the NAtChem web page or this Open Data Portal

4. References

Results from the TGM measurements in Canada have been published in the following Journal articles:

Gustin, M., Jaffe, D. Reducing the uncertainty in measurement and understanding of mercury in the atmosphere. 2010. Environmental Science and Technology, 44 (7), pp. 2222-2227.

Slemr, F., Ebinghaus, R., M. Brenninkmeijer, C.A., Hermann, M., Kock, H.H., Martinsson, B.G., Schuck, T., Sprung, D., Van Velthoven, P., Zahn, A., Ziereis, H. Gaseous mercury distribution in the upper troposphere and lower stratosphere observed onboard the CARIBIC passenger aircraft. 2008. Atmospheric Chemistry and Physics Discussions, 8 (5), pp. 18651-18688.

Temme, C., Einax, J.W., Ebinghaus, R., Schroeder, W.H. Measurements of atmospheric mercury species at a coastal site in the antarctic and over the south atlantic ocean during polar summer. 2003. Environmental Science and Technology, 37 (1), pp. 22-31.

Results from the air mercury measurements in Canada have been published in the following journal articles:

Banic, C.M., Beauchamp, S.T., Tordon, R.J., Schroeder, W.H., Steffen, A., Anlauf, K.A., Wong, H.K.T. Vertical distribution of gaseous elemental mercury in Canada. 2003. Journal of Geophysical Research D: Atmospheres, 108 (9), pp. ACH 6-1 ACH 6-14.

Blanchard, P., Froude, F.A., Martin, J.B., Dryfhout-Clark, H., Woods, J.T. Four years of continuous total gaseous mercury (TGM) measurements at sites in Ontario, Canada. 2002. Atmospheric Environment, 36 (23), pp. 3735-3743.

Dastoor, A.P., Davignon, D., Theys, N., Van Roozendael, M., Steffen, A., Ariya, P.A. Modeling dynamic exchange of gaseous elemental mercury at polar sunrise. 2008. Environmental Science and Technology, 42 (14), pp. 5183-5188.

Dommergue, A., Ferrari, C.P., Poissant, L., Gauchard, P.-A., Boutron, C.F. Diurnal cycles of gaseous mercury within the snowpack at Kuujjuarapik/Whapmagoostui, Québec, Canada. 2003. Environmental Science and Technology, 37 (15), pp. 3289-3297.

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Gbor, P.K., Wen, D., Meng, F., Yang, F., Sloan, J.J. Modeling of mercury emission, transport and deposition in North America. 2007. Atmospheric Environment, 41 (6), pp. 1135-1149.

Kim, K.-H., Ebinghaus, R., Schroeder, W.H., Blanchard, P., Kock, H.H., Steffen, A., Froude, F.A., Kim, M.-Y., Hong, S., Kim, J.-H. Atmospheric mercury concentrations from several

observatory sites in the Northern Hemisphere. 2005. Journal of Atmospheric Chemistry, 50 (1), pp. 1-24.

Lim, C.-J., Cheng, M.-D., Schroeder, W.H. Transport patterns and potential sources of total gaseous mercury measured in Canadian high Arctic in 1995. 2001. Atmospheric Environment, 35 (6), pp. 1141-1154.

Mazur, M., Mintz, R., Lapalme, M., Wiens, B. Ambient air total gaseous mercury concentrations in the vicinity of coal-fired power plants in Alberta, Canada. 2009. Science of the Total Environment, 408 (2), pp. 373-381.

Poissant, L. Total gaseous mercury in Quebec (Canada) in 1998. 2000. Science of the Total Environment, 259 (1-3), pp. 191-201.

Poissant, L., Amyot, M., Pilote, M., Lean, D. Mercury water - Air exchange over the upper St. Lawrence River and Lake Ontario. 2000. Environmental Science and Technology, 34 (15), pp. 3069-3078.

Poissant, L. Potential sources of atmospheric total gaseous mercury in the St. Lawrence River Valley. 1999. Atmospheric Environment, 33 (16), pp. 2537-2547.

Poissant, L. Field observations of total gaseous mercury behaviour: Interactions with ozone concentration and water vapour mixing ratio in air at a rural site. 1997. Water, Air, and Soil Pollution, 97 (3-4), pp. 341-353.

Steffen, A., Douglas, T., Amyot, M., Ariya, P., Aspmo, K., Berg, T., Bottenheim, J., Brooks, S., Cobbett, F., Dastoor, A., Dommergue, A., Ebinghaus, R., Ferrari, C., Gardfeldt, K., Goodsite, M.E., Lean, D., Poulain, A.J., Scherz, C., Skov, H., Sommar, J., Temme, C. A synthesis of atmospheric mercury depletion event chemistry in the atmosphere and snow. 2008. Atmospheric Chemistry and Physics, 8 (6), pp. 1445-1482.

Steffen, A., Schroeder, W., Macdonald, R., Poissant, L., Konoplev, A.Mercury in the Arctic atmosphere: An analysis of eight years of measurements of GEM at Alert (Canada) and a comparison with observations at Amderma (Russia) and Kuujjuarapik (Canada). 2005. Science of the Total Environment, 342 (1-3), pp. 185-198.

Steffen, A., Schroeder, W., Bottenheim, J., Narayan, J., Fuentes, J.D.Atmospheric mercury concentrations: Measurements and profiles near snow and ice surfaces in the Canadian Arctic during Alert 2000. 2002. Atmospheric Environment, 36 (15-16), pp. 2653-2661.

Temme, C., Blanchard, P., Steffen, A., Banic, C., Beauchamp, S., Poissant, L., Tordon, R., Wiens, B. Trend, seasonal and multivariate analysis study of total gaseous mercury data from the Canadian atmospheric mercury measurement network (CAMNet). 2007. Atmospheric Environment, 41 (26), pp. 5423-5441.

Wen, D., Lin, J.C., Meng, F., Gbor, P.K., He, Z., Sloan, J.J. Quantitative assessment of upstream source influences on total gaseous mercury observations in Ontario, Canada. 2010. Atmospheric Chemistry and Physics Discussions, 10 (11), pp. 28755-28786.

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Surveillance des gaz atmosphériques

Mercure gazeux total

1. Description

Les concentrations de mercure gazeux total (MGT) ont été mesurées au Canada par le Réseau canadien d'échantillonnage des précipitations et de l'air (RCEPA) et dans le cadre d'autres projets d'Environnement Canada.

Dans tous les sites, les mesures du mercure gazeux total sont effectuées par un analyseur automatique de vapeur de mercure Tekran® modèle 2537 (décrit en détail par Poissant, 1997). L'air est habituellement échantillonné à des débits entre 1 et 1,5 L/min (selon le site) et, pour éliminer les matières particulaires, traverse un filtre de téflon (diamètre de 47 mm; pores de 0,45 µm) à l'entrée de la conduite de prélèvement des échantillons. Dans l'analyseur, le mercure dans l'air échantillonné est préconcentré avant l'analyse, par amalgamation sur des cartouches en or (durée de concentration de 5 à 30 min.). Le mercure est retiré des cartouches en or par désorption thermique et est détecté par spectroscopie à fluorescence atomique à vapeur froide. L'analyseur possède deux cartouches en or, ainsi les opérations simultanées de recharge et de désorption permettent la mesure continue du mercure dans le flux d'air, avec un cycle de 5 à 30 minutes. Les instruments sont étalonnés chaque jour par rapport à une source de mercure interne et ils sont vérifiés lors des contrôles de routine des sites par des injections manuelles de mercure à partir d'une source externe. Les données sont soumises au contrôle de qualité du Système de gestion et de contrôle de la qualité des données de recherche (RDMQ) d'Environnement Canada.

Des études limitées laissent entendre que les mesures du mercure gazeux total dans l'atmosphère comprennent du mercure élémentaire gazeux et du mercure gazeux réactif (Temme *et al.*, 2003; Slemr *et al.*, 2008); toutefois, il est possible que, dans certaines conditions environnementales et configurations de conduite de prélèvement des échantillons, du mercure gazeux réactif soit éliminé (Gustin et Jaffe, 2010). Étant donné que les concentrations de mercure gazeux total dans la basse atmosphère comportent généralement plus de 95 % de mercure élémentaire gazeux et moins de 5 % de mercure gazeux réactif, les concentrations mesurées du mercure gazeux total représentent en grande partie les concentrations du mercure élémentaire gazeux.

Les mesures du mercure gazeux total sont prises pour comprendre les tendances spatiales et temporelles des concentrations atmosphériques de mercure à l'échelle du Canada. Des sites d'échantillonnage individuels peuvent avoir d'autres objectifs qui leurs sont propres associés à leurs activités de surveillance. Les ensembles de données qui en découlent fournissent des mesures uniformes des concentrations atmosphériques de mercure partout au Canada, et ils peuvent servir à déterminer les tendances spatiales et temporelles.

2. Information relative aux sites

Les sites de mesure d'Environnement Canada pour lesquels les données peuvent être téléchargées représentent la diversité des conditions régionales dans tout le pays, y compris les zones près des activités urbaines ou industrielles, ainsi que les régions éloignées**.** Le tableau des sites d'Environnement Canada et des années d'activité : *Networks_Studies-Réseaux_études-TGM-SiteListing-ListeDesSites_EN-FR.csv.*

3. Ensembles de données

Les données sur la concentration moyenne horaire de mercure gazeux total recueillies aux sites d'Environnement et changements climatiques Canada peuvent être téléchargées à partir de la page d'accès aux données en ligne de la Base de données nationales sur la chimie atmosphérique (NAtChem) ou le portail des données ouvertes**.**

4. Références

Résultats à partir des mesures du mercure gazeux total au Canada ont été publiés dans le Journal des articles suivants:

Gustin, M., Jaffe, D. Reducing the uncertainty in measurement and understanding of mercury in the atmosphere. 2010. Environmental Science and Technology, 44 (7), pp. 2222-2227.

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