Deposition and ecosystem processing of atmospheric mercury in the Lake Champlain basin
- 1995 -

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ABSTRACT

Deposition and ecosystem processing of atmospheric mercury (Hg) in the Lake Champlain basin have been studied in cooperation with the University of Michigan Air Quality Laboratory since December, 1992 at the VMC Air Quality Monitoring site in Underhill Center, VT (400 m elevation). Daily wet-only precipitation, weekly 24 hr vapor and particulate air samples, stream water and snowmelt have been analyzed for total Hg by cold vapor atomic fluorescence spectrometry (CVAFS). Further details of methods and objectives can be found in previous reports. Reported here is a brief update on findings through the end of 1995.

Between December 1992 and December 1995, total Hg concentration in precipitation ranged from 1.2 to 59 ng/L, with a mean of 9.5 ng/L, and with the highest concentrations generally occurring during the summer months (Fig. 1). Total annual Hg deposition in precipitation averaged 8.3 $\mu g/m^2$ (83 mg/ha) during this period (Fig. 2). Combined wet and dry deposition of Hg, using vapor phase estimated dry deposition, was 14.9 $\mu g/m^2$ for 1993, 13.6 $\mu g/m^2$ for 1994, and 14.3 $\mu g/m^2$ for 1995, with the greatest deposition rates in the summer months (Fig. 3). Vapor phase Hg ranged from 0.5 to 6.9 ng/m^3, with a mean of 1.74 ng/m^3, and without much seasonal variation (Fig. 4). We have not yet independently confirmed the accuracy of the one extreme measurement (6.9 ng/m^3 on 14 July 1995). Particulate phase Hg ranged from 1 to 43 pg/m^3, with a mean of 10 pg/m^3, and with the highest concentrations occurring in the winter months (Fig. 5).

During 1995, total Hg concentrations in stream-water continued to be monitored in Nettle Brook, a small stream draining an 11 ha mixed hardwood gauged catchment in the Stevensville Brook area. Hg concentrations were 1 to 3 ng/L during base flow conditions, and reached 79 ng/L at peak flow during spring snowmelt in 1994. Stream flow and Hg concentration during spring snowmelt in 1995, however, were much lower than 1994, resulting in substantially smaller stream export of Hg (Fig. 6). The relationship between Hg input in atmospheric deposition and stream Hg export in Nettle Brook is shown in Table 1. A large proportion of the Hg deposition input appears to be retained by the catchment, with only 10-24% being exported in stream water. The fate of this retained Hg (accumulation or volatilization) is unknown at this time.

ACKNOWLEDGMENTS

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COOPERATORS

University of Vermont: Joanne Cummings, Carl Waite, Rinda Gordon
Proctor Maple Research Center: Melvin Tyree, Sumner Williams
University of Michigan: Jerry Keeler, Anne Rea
NOAA Air Resources Laboratory: Richard Artz
VT ANR DEC Air Pollution Control Program: Rich Poirot

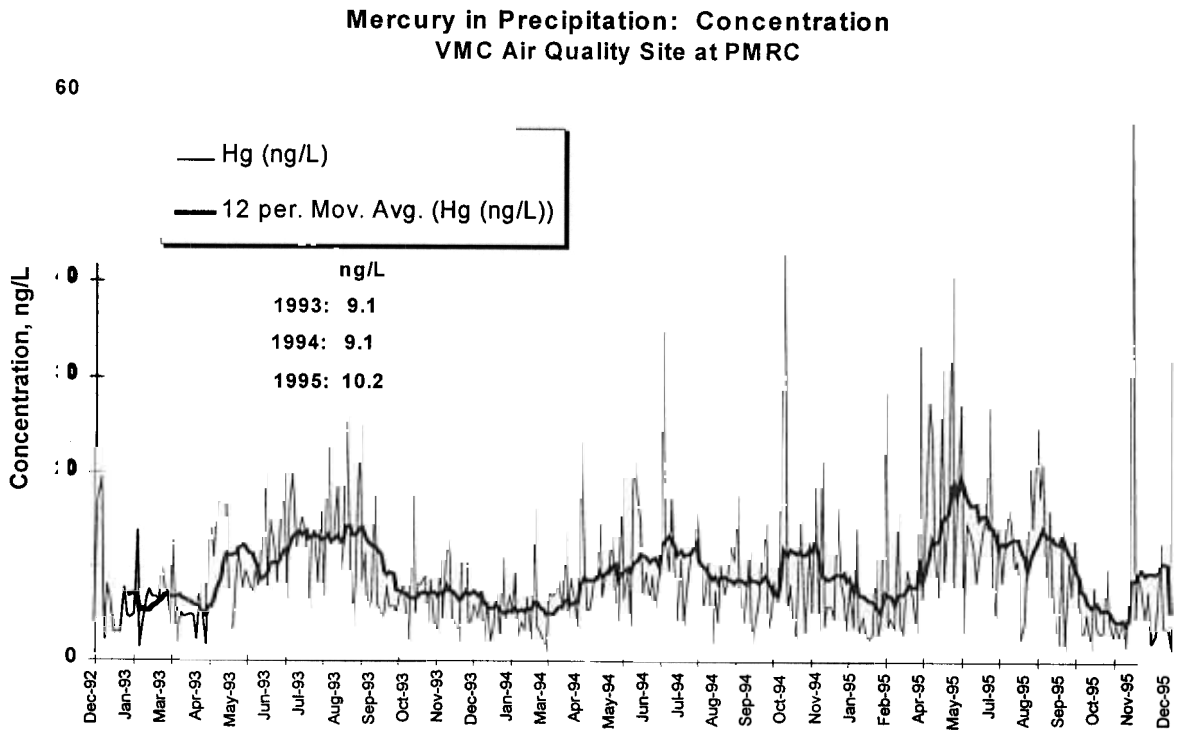

Figure 1. Event precipitation Hg concentrations and running mean, 1992 - 1995

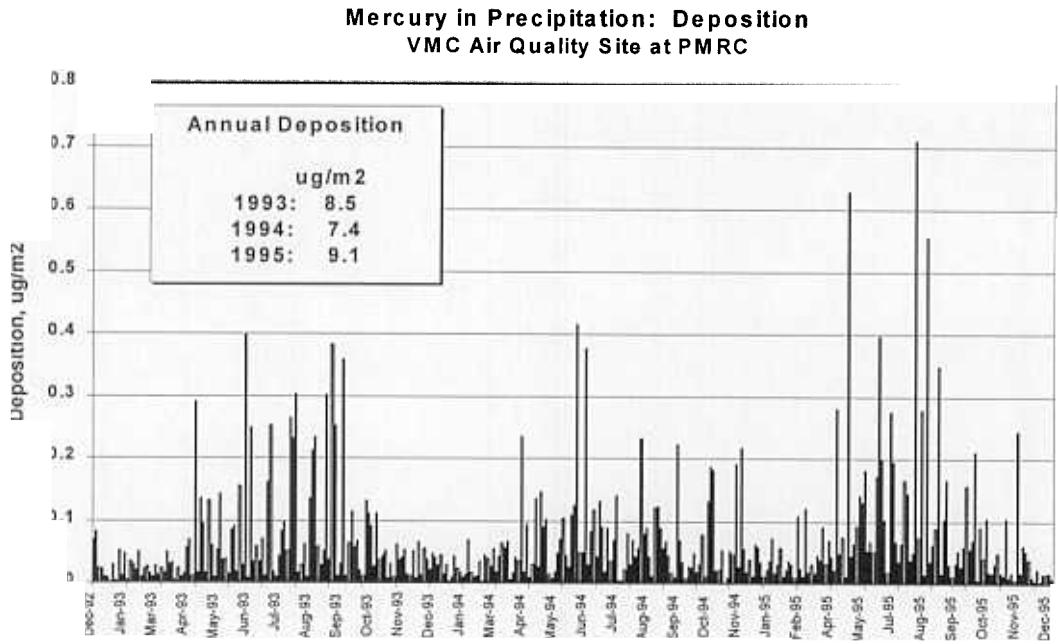

Figure 2. Event precipitation Hg deposition, 1992 -1995.

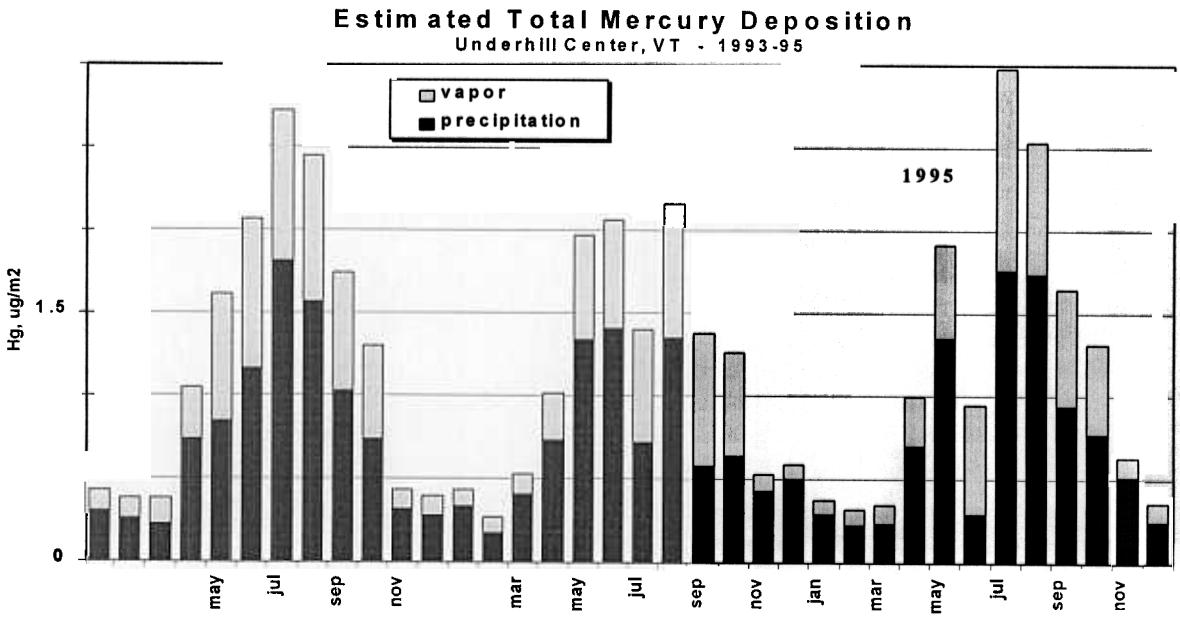

Figure 3. Monthly total wet and estimated dry (vapor) deposition, 992 - 1995.

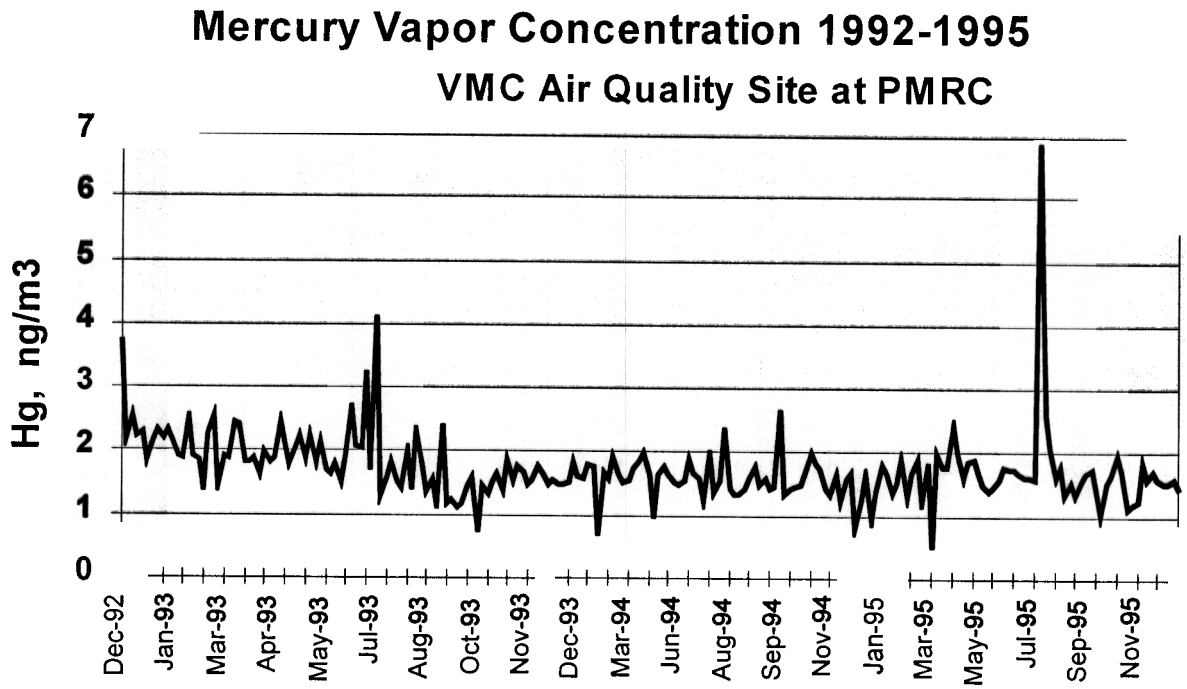

Figure 4. Weekly vapor Hg concentrations, 1992 - 1995.

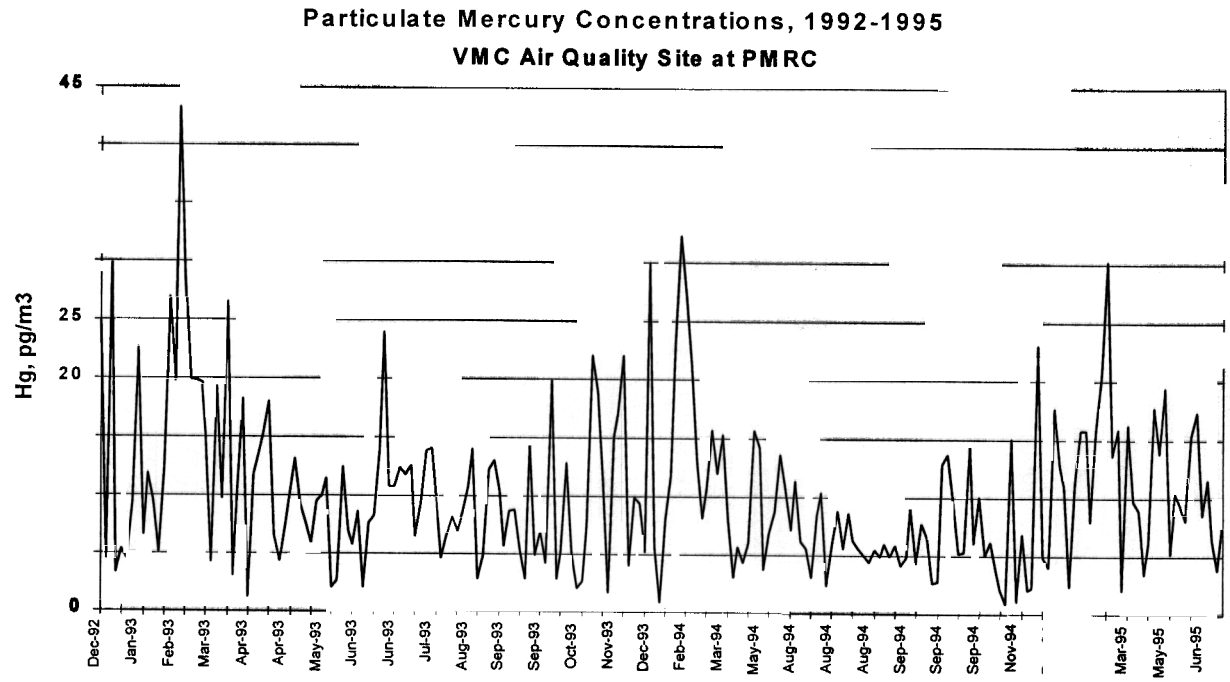

Figure 5. Weekly particulate Hg concentrations, 1992 - 1995.

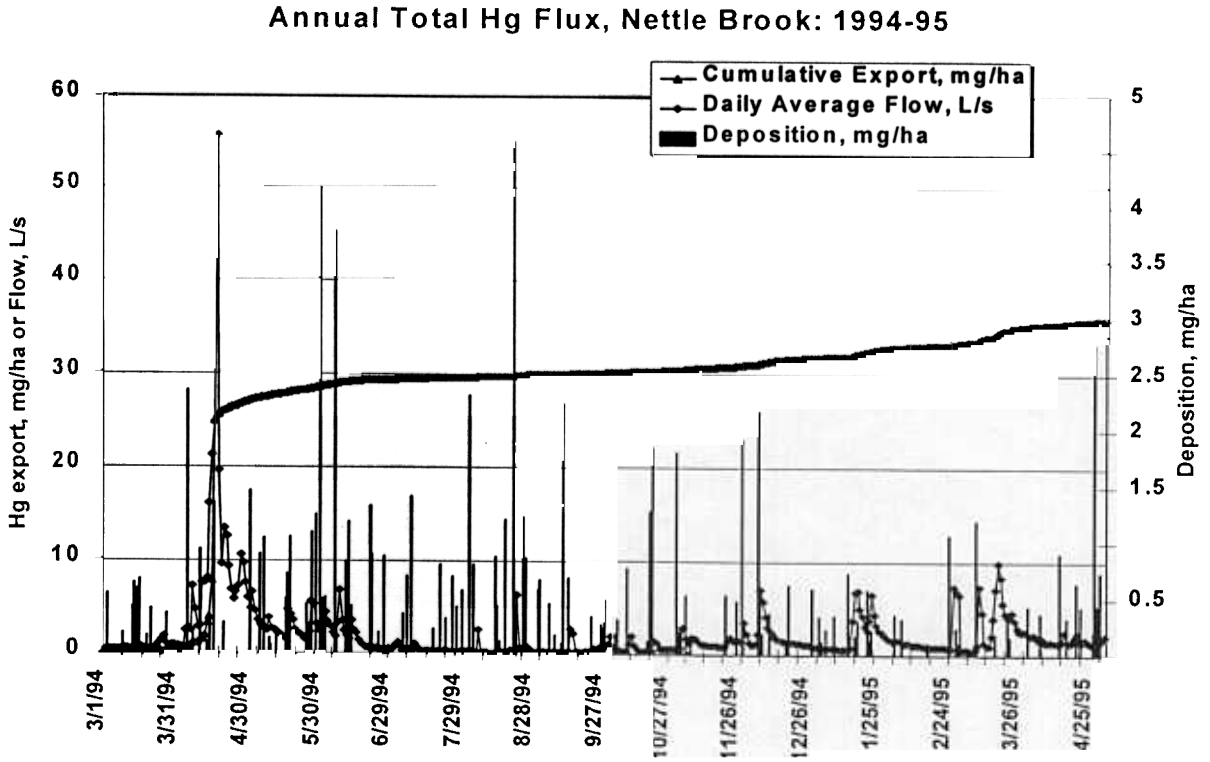

Figure 6. Cumulative stream export of Hg from Nettle Brook catchment, stream flow and precipitation Hg deposition, 1994 - 1995.

Table 1. Nettle Brook Hg Input / Output

Wet & Dry Deposition Inputs, 1994-95:	**280 mg/ha**		
1994:	*134*		
1995:	*146*		
Stream Export, ... 1994-95:	**44 mg/ha**		
1994:	*30*		
1995:	*14*		
Net Retention in Catchment, 1994-95:	**236 mg/ha**	**(84%)**	
1994:	*104*		*(76%)*
1995:	*132*		*(91%)*

MEASUREMENT OF ENVIRONMENTAL AND POLLUTANT GRADIENTS

IN THE FOREST CANOPY

1995

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ABSTRACT

From January to December 1995 meteorology and ozone (O_3) data were continuously collected at five elevations (0.5, 7.5, 12, 16, and 24 m above the ground) from the VMC research tower at the Proctor Maple Research Center in Underhill, VT. In 1995, we did few new analyses of meteorological data and have no new results to report. We hope to examine these data more thoroughly in 1996 and report new results at that time. Examination of O_3 data for 1995 revealed a similar pattern to that observed in 1992-94. As in previous years, O_3 concentrations generally increase with height in the canopy, but the largest and only significant difference occurred between 0.5 m (just above the forest floor) and all other elevations, with O_3 levels being lowest at 0.5 m. On average, over the entire sampling season (mid April-mid September), O_3 concentrations were 26% lower at 0.5 than at 24 m, compared to 23% and 21% lower in 1994 and 1993, respectively. This reduction in O_3 concentration just above the forest floor may result from inadequate mixing of air due to a boundary layer effect and lower air velocities at this level or the physical or chemical destruction of O_3. Number of hours of O_3 exposure at threshold concentrations of $\geq$60, $\geq$70, $\geq$80, $\geq$90, and $\geq$100 ppb during June, July, and August were tabulated for 1995, as previously done in 1993 and 1994. As in 1994, it was found that the total number of hours of exposure at the two lower concentrations ($\geq$60, and $\geq$70 ppb) continued to decrease from the previous year, averaging a 24% reduction in number of hours of exposure at the four upper elevations (7.5, 12, 16, and 24 m). The number of hours of exposure at $\geq$80 ppb increased by an average of 12 hours at the four upper elevations in 1995 from 1994, but remained 55% lower than 1993 numbers. When averaged over the entire season, O_3 concentrations in 1995 were similar to those in 1993 at all elevations. However, 1994 concentrations were 10% lower than than those in 1993 and 1995, and this reduction was consistent across all canopy heights. Examination of average seasonal diurnal patterns for 1995 revealed that O_3 concentrations reached a daily low in early morning (around 7:00 AM) and maximum levels from midday to early afternoon and again shortly before midnight.