Notes from VMC Mercury Workshop March 18, 2002

Present: Mim Pendleton, Carl Waite, Gerry Livingston, Joe Petrucci and students (UVM); Chris Rimmer, VINS; Erik Titrud, VT A.G.; Sandy Wilmot, Judy Rosovsky, VT FPR; Ning Gao, St. Lawrence Univ.; Jamie Shanley, Ann Chalmers, USGS; Celia Chen, Eric Miller, Dartmouth; Paul Wishinski, Bart Sponsellor, Jeff Merrell, Neil Kamman, VTDEC.

Notetaker: Neil Kamman

Several participants spoke at the meeting, and these discussions are summarized below.

Erik Titrud provided a short discussion on VT's joint lawsuit with other northeastern states over acid-forming emissions from certain Midwestern power generating facilities. He noted that while mercury is not one of the stated causes for the lawsuit, at least one State (N.J.) has been able to include reductions in mercury emissions in addition to reductions in SO_x and NO_x as part of their settlement. Erik noted that the final decision in the important New Source Review case could have a large influence on the outcome of VT's current suit.

Ning Gao provided an overview of the mass balance mercury model she and others are constructing for Lake Champlain. The model is parameterized to include numerous (58?) tributaries feeding 13 lake segments, with both advective and convective flows between segments, methylation rates, direct atmospheric deposition and revolatilization, factored into the model to predict in-segment total and methylmercury concentrations. The model is being constructed in Stella ® and is leveraging chloride-based flow calibrations initially developed by Smeltzer et al, and adapted for dynamic simulation use by McIlroy. To complete development of the model, there is an outstanding need for Hg sedimentation data, methylation rates, and for overall validation data.

Jamie Shanley discussed USGS efforts towards characterizing Hg movement through watersheds, and in Lake Champlain surface waters (***Ann Chalmers*** contributes significantly to these activities). Several datasets were discussed, including mercury runoff data from forested and agricultural systems, and from the urbanized Englesby Brook. An overall finding is that 2/3rd of the annual export of Hg from a watershed is in particulate mercury form and this export is strongly related to flow. Extreme flow events have been shown to contribute over ½ the annual export from a watershed. The remaining 1/3rd of annual Hg export is as dissolved Hg, which is not flow-dependant, but rather constitutes a 'slow leak' from the watershed. Interestingly, Englesby shows the highest concentrations of Hg and methylHg of all VT watersheds USGS has evaluated. Upcoming USGS efforts include continuation of existing efforts, implementation of automated sampling in the Lamoille and Winooski Rivers, and Otter Creek, for mercury during storm events, and evaluation of methylmercury production at Arrowhead Mountain Lake. Jamie's discussion prompted a round-robin discussion on the various forms mercury assumed across environmental matrices. Luckily, between the bunch of us, we captured most of the important information (we think).

Celia Chen spoke about the Dartmouth University 'Trace Metal Project,' which is a multi-year project aimed at addressing environmental trace metal contamination in multiple environmental compartments. Celia's interest lies in the transfer of Hg within food webs. In their work, Celia and her colleagues have discovered that the lower-trophic level biota have a large influence on Hg in upper trophic-level consumers (predatory fishes etc), due not only to the bioaccumulative nature of Hg, but also to the capability of plankton to bioconcentrate or biodilute Hg, depending on their density. The story goes approximately as follows. All other factors being equal, waterbodies with greater planktonic biomass will deliver less Hg to fishes due to the mercury being more evenly distributed across the lower web. In waters where there is less biomass, the Hg is more easily concentrated to upper trophic levels. Celia pointed out that Dartmouth is now in possession of a

stable isotope MS capable of analyzing naturally occurring stable isotopes of mercury. This is extremely promising new technology which is presently being used in the METALLICUS project.

Chris Rimmer spoke about the measurements made to date of mercury in the threatened Bicknell's thrush, which is a neotopical migrant that feeds on montane forest dwelling, *non-aquatic* insects. The limited available data suggest that there exists geographic variation in the amount of Hg in individual bird populations which is not simply attributable to elevation. More importantly, the data indicate that older birds have greater mercury burdens than younger ones (as measured by feather Hg) indicating bioaccumulation in the forest system birds. Chris and his colleagues are beginning to look at bird behavior and at mercury in the prey base of the birds, to begin to determine the source of contamination.

Joe Petrucci spoke briefly about his efforts to develop an innovative new instrument capable of analyzing mercury and other elements/compounds on single particles. The rapid sampling rate, coupled with the very high analytic sensitivity, suggests that this instrument could produce data to support extremely detailed and innovative analyses related to mercury, such as characterizing eddy diffusion rates. The air modelers in the room were very excited about the possibility presented by this new technology.

During the open meeting earlier that day, Eric Miller spoke about his efforts to develop a seasonal spatial deposition map for both wet and dry Hg deposition. Eric's novel approach to developing the maps employs his existing 'big-leaf' model of forest canopy gas exchange (developed for acid forming compounds), to provide spatial deposition estimates which account for precipitation patterns, orography, and land cover. Eric's workis currently being supported by NESCAUM, and by the States of Mass and VT.

Neil Kamman spoke about the status of the REMAP studies in Vermont, and also about the work currently being undertaken by a USDA-Northeast Ecosystem Research Collaborative regional mercury workgroup. The REMAP studies are looking to develop Hg risk characterizations of lakes across VT (and NH), by incorporating information about Hg in waters, sediments, biota (plankton, fish, and piscivores), as well as deposition estimates being developed by Eric Miller. The NERC workgroup is working to accumulate all Hg datasets existing across NY, New England, and SE Canada, with the purpose of developing regional maps of Hg contamination presently as well as historically, and with the goal of developing Hg risk characterizations which are meaningful in a regional context. Information about the NERC effort is available online at www.briloon.org/NERC.

Current Status for Air Hg monitoring at PRMC:
A discussion followed where the future of the Hg monitoring efforts at Proctor was discussed. A fundamental issue with operation of the station lies in the lack of stable, long-term funding (although a $100K allocation is now in the process of being transferred from EPA-ORD to UVM). A fundamental question posed to the group was whether the level of data currently being collected at Proctor merits the expense, and whether an alternate, less costly mechanism (e.g. incorporation of PMRC into the Mercury Deposition Network) would be a viable option. While many participants could live with the simple wet deposition data provided under MDN, several individuals spoke convincingly of the need for the detailed data currently collected at Proctor. These data have been instrumental in Hg receptor and trajectory modeling, and are presently being used in the development of the spatial Hg maps. An alternate scenario was discussed, wherein PMRC may be instrumented with Tekran™ instruments such that all current analyses could be performed in-situ. In the near-term, this would require significant investment, but has the potential to be far less costly over the long-term. The group agreed that a follow up meeting was necessary to more fully explore this topic.

Additional Data Needs:
The group also discussed what was not being monitored in VT in regards to mercury, specific to the VMC mission. The group identified that only very limited work was being done towards developing a soil Hg inventory in VT. Such an inventory would be useful for evaluation of long-term changes in atmospheric Hg loadings. In addition, a terrestrial indicator organism would be useful to track changes in Hg accumulation to terrestrial biota over time.