Multi-century reconstruction of atmospheric Hg(0) trends using tree-rings from Northern Canada

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An improved quantitative understanding of the atmospheric Hg(0) pool and historical anthropogenic emissions is key to be able to predict how regulatory action (i.e., the Minamata Convention on Mercury) will affect Hg concentrations in various environmental compartments, and thus exposure risk in human populations. We propose tree-rings as an archive that can be used to infer temporal trends in Hg(0) and which offers numerous advantages as well as important methodological considerations, which will be discussed. We present a tree-ring Hg record from the Klondike Goldfields to demonstrate that Hg concentrations in white spruce tree rings are consistent with the history of local mining activity and Hg use. We then use this approach to reconstruct temporal trends in atmospheric Hg(0) spanning from 1600 AD to present-day, from various regions in northern Canada, including continental sites and coastal sites. Regional differences exist in the timing of the onset of rising Hg concentrations (and max. concentrations) attributed to anthropogenic emissions. Furthermore, the enrichment factor in modern Hg(0) relative to pre-industrial Hg(0) estimated from tree rings appears to be somewhat lower compared to values obtained using sediment and peat cores. Overall, tree-rings show tremendous promise for various applications such as validating emission inventories and refining atmospheric Hg models.