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Tracking the environmental redistribution of arsenic (As) via the atmosphere: long l(As)ting & legacy effects

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Arsenic (As) is a trace element naturally present in the environment, with a distribution that has been greatly modified by human activity. Importantly, As carries a significant threat to human health, not only because of its toxicity but also because of its likelihood of exposure. A widely-recognized, but primarily localized exposure source is the use of groundwater contaminated with As. The atmosphere represents another, and more regional, exposure route. Arsenic emitted from both natural and anthropogenic sources can undergo long-range transport that leads to As deposition in susceptible environments where it can affect ecosystems and human health. However, atmospheric As emissions, transformations and redistribution of atmospheric As to surface environments remain largely unknown. While anthropogenic emission inventories have been consistently estimated, available estimates for natural emissions vary by over three orders of magnitude. Specifically, natural biogenic emissions of methylated and volatile As by organisms have been known for over one hundred years, but their global contribution has yet to be quantified. We close this important knowledge gap by constraining the large uncertainties in anthropogenic and natural emission sources to the atmosphere via the application of a global atmospheric model of As using the modeling framework ICOsahedral Nonhydrostatic model with Aerosols and Reactive Trace gases (ICON-ART). We determine and evaluate the magnitude of biogenic As emissions against temporal changes in anthropogenic emissions, by comparing model results against compiled As measurements using inversion methods and uncertainty analysis. Ultimately, we aim to determine the redistribution and legacy impacts of As in the environment between reservoirs, linking the hydrosphere, pedosphere, biosphere, and atmosphere in high exposure settings.