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Mercury Emissions and Cycling Under Alternative Societal Development Pathways

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Future releases of primary anthropogenic emissions of mercury are uncertain and will be affected by global and regional growth and economic development. This work projects anthropogenic Hg emissions under four shared socioeconomic pathway (SSP) narratives (2010 – 2300) using methods consistent with existing historical inventories. We find that projected future emissions are comparable to all-time historical anthropogenic emissions, with a greater than two-fold difference between the lower (SSP 1-2.6) and upper bound (SSP 5-8.5) scenarios. We use these emissions to estimate potential impacts on the global mercury cycle using a suite of modeling tools. Asia is projected to continue being the largest regional source of anthropogenic mercury emissions. Under SSP 5-8.5, growth occurs in emissions from Africa and the Middle East, prolonging anthropogenic impacts on the global Hg cycle. Global box modeling suggests legacy Hg emissions will begin to decline soon after primary emissions peak between 2020 to 2080 across scenarios. In contrast with emissions, the total magnitude of Hg stored in the deep ocean and mineral-stabilized soils will continue growing for over a century. Finally, we used a source-receptor attribution framework to analyze drivers of regional atmospheric deposition. While future deposition in Asia and Europe is projected to be primarily driven by changes in domestic emissions, other regions are strongly affected by changes in global legacy emissions and/or primary emissions internationally. Results of this work elucidate potential future trajectories of Hg emissions and reservoirs in the biosphere that drive biological exposures.