

The health risks of the dust and potentially toxic metals around an industrial hub

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The port area around Saldanha Bay, South Africa, is an industrial hub that processes large quantities of mining materials such as iron ore and manganese ore. Furthermore, metal and steel are being produced in the area. These activities have led to the visible emission and deposition of dust and led to concerns about its impact on human health. This region can therefore be used to understand the pollution of such industrial hubs and the possible risks to human health.

Our study addresses the spatial and temporal variation of dust in the area and the potential health risks associated with this dust. The focus is on the PM_{2.5} concentration, the total dust quantity, and the presence of potentially toxic metals in the dust. For this purpose, the monitoring data was used to evaluate the PM_{2.5} concentration, the Fe, Mn, Cu, Pb, and Zn content in the dust, and the dust deposition flux from 2016 to 2023. In addition, an extended PM_{2.5} monitoring and dust sampling effort in 2024 and 2025 allowed us to determine the Al, As, Ba, Cd, Co, Cr, Hg, Mo, Ni, Sb, Se, Sn, Sr, and V content in the dust particles. Furthermore, the metal content of the deposited dust and soils is determined to give a broad overview of the spatial distribution of potentially toxic metals. To address the health risk, the PM_{2.5} concentration was compared to national health standards and standards from the World Health Organisation. The potential risk of the metals was determined using the health risk assessment model from the United States Environmental Protection Agency. The results showed that in general, the metal fluxes have increased over time. Also, certain regions in the study area are at higher risk which is determined by proximity to the port area, geography, and wind patterns. Whereas the PM_{2.5} concentration shows low health risks, the Mn and Pb content of the dust crosses health risk thresholds. Future work could investigate the precise origin of each metal in order to develop appropriate mitigation plans and protect the public health in such industrial areas.