Research brief
Dust and Radon Levels on the West Coast of Namibia – what did we learn?

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Windblown dust from natural mineral sources is estimated to account for up to 89% of the global aerosol load, with anthropogenic sources accounting for 8%. Within the southern African region, Namibia is the main source of mineral dust where episodic dust storms associated with strong easterly winds give rise to mineral dust emissions from both natural as well as anthropogenic sources. High concentrations of particulates in the air pose a risk to human health and welfare, with no safe threshold for exposure to PM_{10} and $PM_{2.5}$ according to the World Health Organisation (WHO, 2000).

A study conducted in the Erongo Region of Namibia in 2010, indicated PM_{10} concentrations to be elevated in the towns of Swakopmund and Walvis Bay, with windblown dust from natural and anthropogenic activities as the main contributors. Exposure to ionising radiation associated with the inhalation of windblown dust, as well as from radon progeny, were identified as potentially harmful to human health. Between 2016 and 2019, this study was updated and extended, with an ambient monitoring network established to measure particulate matter and radon concentrations at three locations (i.e. Walvis Bay, Swakopmund and close to the town of Arandis). In addition, the emissions inventory and dispersion model were updated, and the results validated against the ambient monitoring data.

Elevated PM_{10} concentrations were recorded at all stations, except at Henties Bay. $PM_{2.5}$ concentrations, only measured at Swakopmund and Walvis Bay, reflected similar temporal variation as the daily PM_{10} concentration trends, but at levels well below the WHO guideline. The highest PM_{10} concentrations were found to occur during east-wind conditions, with higher concentrations recorded at the coast than at inland locations. At Walvis Bay and Swakopmund, high PM_{10} concentrations were also recorded during westerly and south-westerly wind conditions, when marine biogenic aerosols and sea salts are emitted due to wind friction on the sea surface. The contribution from sea salt was confirmed through chemical analyses, where the average sodium content in the PM_{10} was 6.1% at Swakopmund and 4.5% at Walvis Bay.

Modelled results only accounted for anthropogenic sources, as windblown emissions from natural sources could not be modelled with any degree of certainty. Vehicle entrainment from roads (i.e. paved, unpaved and salt/treated surfaces), followed by mining and quarry operations, were found to be the main anthropogenic sources contributing to PM_{10} and $PM_{2.5}$ emissions. Modelled results from these sources were low, especially at the coastal receptors, indicating natural sources to be a significant contributor to particulate matter (PM) concentrations.

The measured and modelled results were used to recommend PM guidelines for the Erongo Region, where the South African National Ambient Air Quality Standard for PM_{10} and the WHO Interim Target 3 for $PM_{2.5}$, were recommended, but with more allowable exceedance days due to east-wind conditions and the presence of sea salt.

The radiation-related public exposure doses due to the inhalation of radon, radon progeny and radioactive dust were quantified using real-time empirical results for ambient atmospheric radon concentrations, and radionuclide concentrations from select PM_{10} samples. The contributions of both radon and ambient radioactive dust to the public exposure dose in the Erongo Region were found to be well-below the world-wide average doses suggested by UNSCEAR and other international bodies.

Reference

Liebenberg-Enslin, H, von Oertzen, D, and Mwananawa, N. Dust and radon levels on the west coast of Namibia – What did we learn? Atmospheric Pollution Research, 2020.