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Air quality modelling for Pacific Island countries: Insights from the Solomon Islands and Fiji

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Abstract: Air quality in Pacific Island countries remains a critically under-researched area. The prevailing perception is that these islands enjoy consistently clean air, yet the limited monitoring studies available reveal a different picture, with elevated concentrations of pollutants from biomass burning, road traffic, waste burning, and other local sources. The absence of systematic measurements creates major gaps in understanding population exposure and health risks. Robust evidence is urgently needed to characterise air pollution in these environments and to inform policy actions that protect public health.

In this study, we present high-resolution air quality modelling for two representative Pacific Island nations: the Solomon Islands and Fiji. The modelling framework couples the Weather Research and Forecasting (WRF) model with the EMEP MSC-W chemical transport model to simulate atmospheric composition for the year 2019. Meteorological fields were generated using WRF driven by ERA5 reanalysis, while anthropogenic emissions were taken from the HTAPv3 global dataset for 2018 at 0.1° × 0.1° resolution. Natural sources such as sea salt and biogenic emissions were also included through standard EMEP parameterisations. The model was configured at a horizontal resolution of 3 km × 3 km, with hourly output to capture diurnal variation, and covered the main populated islands of both countries. The analysis focused on three priority pollutants of public health concern—fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), and ozone (O_3).

To capture intra-urban variability of pollutant concentrations more accurately, we applied the uEMEP model to downscale emissions from road traffic to high-resolution subgrids (50 m × 50 m resolution) in the capital cities of Honiara (Solomon Islands) and Suva (Fiji) using local road network data as a proxy. The downscaling method involves calculating concentrations at the subgrid level with a Gaussian dispersion model which are then added to only the non-local contributions calculated by the regional model, thereby avoiding double counting of emissions. This combination of regional chemical transport modelling and local-scale dispersion modelling provides the first spatially and temporally resolved assessment of air quality across these islands.

Preliminary analysis suggests that Pacific Island urban centres are not exempt from air pollution challenges: pollutant levels exceed WHO air quality guideline values, driven by both local and regional sources. These findings emphasise the urgent need for systematic air quality monitoring and targeted policy interventions in Pacific Island countries.

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