

Air Quality Modeling of Kuwait to Understand Impact on the Environment

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Abstract:

Kuwait faces atmospheric pollution because of its arid environment and multiple sources, including petroleum extraction, refinery operations, power generation, urbanization, and dust storms. Pollution has even been compounded due to the historic environmental damage of the 1990 Iraq invasion that has led to long-standing terrestrial and marine ecosystem degradation. Pollutants are mainly SO_x/SO_2 , $\text{NO}/\text{NO}_2/\text{NO}_x$, O_3 , CO , CO_2 , CH_4 , HCT, NMHC, THC, H_2S , (VOCs), and particulate matter ($\text{PM}_{2.5}$ and PM_{10}). The study has two main components: one is the dispersion, spatial distribution, and environmental consequences of different pollutants, which is carried out through atmospheric dispersion modeling using AERMOD and real-time air quality assessments; the other aspect is exploring the relationships of these pollutants with greenhouse gas emissions, carbon footprints, climate change, and environmental sustainability. Pollution hotspots, meteorological factors, regular (routine), accidental, emergency, and warfare-related pollution scenarios are all studied. The study cross-checks model predictions against applicable Kuwaiti national air quality standards. This study considers Kuwaiti emission reduction, renewable energy integration, ecosystem restoration, and low-carbon industrial practices. This work aims to provide decision-makers with evidence to formulate pollution control strategies, emergency response plans, climate change mitigation measures, and sustainable environmental management policies. In the presentation part, the following items will be discussed: Landscape and sources of emission, main environmentally sensitive receptor, dust storms, sustainability of energy transition, war and pollution, and role of environmental factors in dispersion.

Keywords: Environmental Risk Assessment, Emission Inventories, Emergency Response Planning, Ecosystem Resilience