

Modeling the Effects of Temperature on Air Pollutant Concentration

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Abstract : Air dispersion (AD) models such as AERMOD are important tools for estimating the environmental impacts of air pollutant emissions into the atmosphere from anthropogenic sources. The outcome of these models is significantly linked to the climate condition like air temperature, which is expected to differ in the future due to the global warming phenomenon. With projections from scientific sources of impending changes to the future climate of Saudi Arabia, especially anticipated temperature rise, there is a potential direct impact on the dispersion patterns of air pollutants results from AD models. To our knowledge, no similar studies were carried out in Saudi Arabia to investigate such impact. Therefore, this research investigates the effects of climate temperature change on air quality in the Dammam Metropolitan area, Saudi Arabia, using AERMOD coupled with Station data using Sulphur dioxide (SO₂) - as a model air pollutant. The research uses AERMOD model to predict the SO₂ dispersion trends on the surrounding area. Emissions from five (5) industrial stacks, on twenty-eight (28) receptors in the study area were considered for the climate period (2010-2019) and future period of mid-century (2040-2060) under different scenarios of elevated temperature profiles (+1oC, + 3oC and + 5oC) across averaging time periods of 1hr, 4hr and 8hr. Results showed that levels of SO₂ at the receiving sites under current and simulated future climactic condition fall within the allowable limit of WHO and KSA air quality standards. Results also revealed that the projected rise in temperature would only have mild increment on the SO₂ concentration levels. The average increase of SO₂ levels were 0.04%, 0.14%, and 0.23% due to the temperature increase of 1, 3, and 5 degrees respectively. In conclusion, the outcome of this work elucidates the degree of the effects of global warming and climate changes phenomena on air quality and can help the policymakers in their decision-making, given the significant health challenges associated with ambient air pollution in Saudi Arabia.

Keywords : air quality, sulphur dioxide, global warming, air dispersion model

Conference Title : ICAQP 2022 : International Conference on Air Quality and Pollution

Conference Location : Sydney, Australia

Conference Dates : March 28-29, 2022