Estimating Daily NO_2 Concentrations using OMI NO_2 and Land Use Regression

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Epidemiological studies have shown that the exposure to ambient nitrogen dioxide (NO_2) is associated with adverse health effects. However, ground NO_2 monitoring networks are sparsely distributed, and using the NO_2 concentrations measured at ground monitoring sites as exposure estimates causes exposure errors.

For retrospective exposure assessment of daily ambient NO_2, we developed a mixed effects model using Ozone Monitoring Instrument (OMI) tropospheric NO_2 densities and land use regression (LUR) in the New England region, U.S., for the period 2005-2010. In the model, OMI NO_2 data explained spatial and temporal variability in ambient NO_2 concentrations. Also, LUR accounted for fine-scale spatial variability in NO_2, further enabling us to estimate NO_2 at point locations. The mixed effects model performed reasonably well, showing cross-validation R^2=0.79 and a good agreement between the measured and estimated NO_2 concentrations (slope=0.98 and intercept=0.15). The spatial pattern of estimated NO_2 concentrations exhibited high NO_2 concentrations in emission source areas such as high populated and traffic areas.

The mixed effects model in combination with satellite NO_2 data and LUR led us to generate spatially and temporally resolved NO_2 exposure estimates for health effect studies. While reducing exposure errors, the modeling approach is expected to contribute to revealing more reliable associations between the exposure to NO_2 and health outcomes.