



Effect of NO_x on formaldehyde production in the lower troposphere at Lauder, New Zealand

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Formaldehyde (HCHO) is a key intermediate in the photooxidation of methane by hydroxyl radicals. HCHO was measured by Fourier Transform InfraRed (FTIR) spectrometry from 1992 to 2005 at Lauder (45°S, 169°E), a rural site in Central Otago, New Zealand. These measurements, one of the longest time series for atmospheric HCHO measurements in the Southern Hemisphere, have shown significant seasonal HCHO cycles in the lower troposphere at Lauder. During this 13-year period, the maximum monthly mean HCHO was about 970 ppt, occurring in January, while the minimum was about 380 ppt, occurring in July-August.

We applied a chemical box model (based on a clean air subset of the Master Chemical Mechanism) to the photochemistry at Lauder in the months of January and July, capturing both HCHO maximum and minimum. NO_x is critical for the production of HCHO. In rural areas soil emissions represent a major contribution to the local NO_x budget, leading to highly variable NO_x concentrations. We show that the production of HCHO from methane increases with increasing NO_x concentrations, but that HCHO production from methane alone is insufficient to match the observed values. However, for NO_x values of about 200 ppt, the inclusion of isoprene mixing ratios of about 180 ppt in January and 35 ppt in July would be sufficient to give the observed HCHO mixing ratios. Analysis of air mass origin by calculating 5-day backwards trajectories shows that air arriving at Lauder frequently originates in Fiordland, a forest rich region of New Zealand, making the assumed isoprene mixing ratios plausible.