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Past and future simulations of NO_2 from a coupled chemistry-climate model in comparison with observations

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Abstract. Trends in derived from a 45 year integration of a chemistry-climate model (CCM) run have been compared with ground-based measurements at Lauder (45° S) and Arrival Heights (78° S). Observed trends in at both sites exceed the modelled trends in N_2O, the primary source gas for stratospheric NO_2. This suggests that the processes driving the trend are not solely dictated by changes in but are coupled to global atmospheric change, either chemically or dynamically or both. If CCMs are to accurately estimate future changes in ozone, it is important that they comprehensively include all processes affecting NO_x ($NO+NO_2$) because NO_x concentrations are an important factor affecting ozone concentrations. Comparison of measured and modelled NO_2 trends is a sensitive test of the degree to which these processes are incorporated in the CCM used here. At Lauder the 1980-2000 CCM NO_2 trends (4.2% per decade at sunrise, 3.8% per decade at sunset) are lower than the observed trends (6.5% per decade at sunrise, 6.0% per decade at sunset) but not significantly different at the 2σ level. Large variability in both the model and measurement data from Arrival Heights makes trend analysis of the data difficult. CCM predictions (2001-2019) of NO_2 at Lauder and Arrival Heights show significant reductions in the rate of increase of NO_2 compared with the previous 20 years (1980-2000). The model results indicate that the partitioning of oxides of nitrogen changes with time and is influenced by both chemical forcing and circulation changes.

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