

Evaluation of MIROC4-ACTM reanalysis of GHGs concentrations using aircraft

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Using the “Atmospheric Chemistry Transport Model” being part of the “Model for Interdisciplinary Research On Climate Earth System Model, version 4” (MIROC4-ACTM), simulations of several important greenhouse gases, such as CH₄, CO₂, SF₆, and N₂O, have been conducted using optimized emissions by inverse modelling of surface measurements for the period 1996-2016 (referred to as “reanalysis data”). Aircraft observations, conducted on board passenger aircraft (projects: CARIBIC and CONTRAIL) over diverse latitude and longitude regions offer independent constraints for evaluating the quality of reanalysis data. MIROC4-ACTM captures the variations in CO₂ and SF₆ observed by CARIBIC and CONTRAIL very well, with a correlation coefficient of above 0.96 and a slope of 0.92 at all atmospheric conditions. However, for CH₄ and N₂O the agreement was worse, with correlation coefficients (slopes) between CONTRAIL observations and model simulations of 0.80(0.49)-0.87(0.66) and 0.74(0.55)-0.77(0.75), respectively, at 0-140°E and poleward of 40°N. Further south, that is between 30° S-40°N latitude (for the Tokyo-Australia flights), the correlation coefficients (slopes) was 0.76(0.83)-0.88(0.89) and 0.92(0.87)-0.98(1.05), respectively. Similarly, the agreement with the CARIBIC observations was moderate for CH₄ and N₂O, with correlation coefficients (slopes) of 0.81(0.55) and 0.88(0.65), respectively.

Keywords: MIROC4-ACTM, CONTRAIL, CARIBIC