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Surface and boundary layer exchanges of volatile organic compounds, nitrogen oxides and ozone during the GABRIEL campaign

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Abstract. We present an evaluation of sources, sinks and turbulent transport of nitrogen oxides, ozone and volatile organic compounds (VOC) in the boundary layer over French Guyana and Suriname during the October 2005 GABRIEL campaign by simulating observations with a single-column chemistry and climate model (SCM) along a zonal transect. Simulated concentrations of O_3 and NO as well as NO_2 photolysis rates over the forest agree well with observations when a small soil-biogenic NO emission flux was applied. This suggests that the photochemical conditions observed during GABRIEL reflect a pristine tropical low-NO_x regime. The SCM uses a compensation point approach to simulate nocturnal deposition and daytime emissions of acetone and methanol and produces daytime boundary layer mixing ratios in reasonable agreement with observations. The area average isoprene emission flux, inferred from the observed isoprene mixing ratios and boundary layer height, is about half the flux simulated with commonly applied emission algorithms. The SCM nevertheless simulates too high isoprene mixing ratios, whereas hydroxyl concentrations are strongly underestimated compared to observations, which can at least partly explain the discrepancy. Furthermore, the model substantially overestimates the isoprene oxidation products methlyl vinyl ketone (MVK) and methacrolein (MACR) partly due to a simulated nocturnal increase due to isoprene oxidation. This increase is most prominent in the residual layer whereas in the nocturnal inversion layer we simulate a decrease in MVK and MACR mixing ratios, assuming efficient removal of MVK and MACR. Entrainment of residual layer air masses, which are enhanced in MVK and MACR and other isoprene oxidation products, into the growing