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Deep convective injection of boundary layer air into the lowermost stratosphere at midlatitudes

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Abstract. On 22 August 2001 a measurement flight was performed with the German research aircraft FALCON from Sardinia to Crete as part of the Mediterranean Oxidant Study (MINOS). Cruising at 8.2 km, the aircraft was forced to climb to 11.2 km over the southern tip of Italy to stay clear of the anvil of a large cumulonimbus tower. During ascent into the lowermost stratosphere in-situ measurements onboard the FALCON indicated several sharp increases in the concentrations of tropospheric trace gases, e.g. CO, acetone, methanol, benzene and acetonitrile, above the anvil. During one particular event deep in the stratosphere, at O₃ concentrations exceeding 200 ppv, CO increased from about 60 to 90 ppv, while the concentration of acetone and methanol increased by more than a factor of 2 (0.7 to 1.8 ppv for acetone; 0.4 to 1.4 ppv for methanol). Enhancements for the short lived species benzene are even higher, increasing from 20 pptv in the stratosphere to approx. 130 pptv. The concentrations during the event were higher than background concentrations in the upper troposphere, indicating that polluted boundary layer air was directly mixed into the lowermost stratosphere.

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