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A new tropospheric and stratospheric Chemistry and Transport Model MOCAGE-Climat for multi-year studies: evaluation of the present-day climatology and sensitivity to surface processes

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Abstract. We present the configuration of the Météo-France Chemistry and Transport Model (CTM) MOCAGE-Climat that will be dedicated to the study of chemistry and climate interactions. MOCAGE-Climat is a state-of-the-art CTM that simulates the global distribution of ozone and its precursors (82 chemical species) both in the troposphere and the stratosphere, up to the mid-mesosphere (~70 km). Surface processes (emissions, dry deposition), convection, and scavenging are explicitly described in the model that has been driven by the ECMWF operational analyses of the period 2000–2005, on T21 and T42 horizontal grids and 60 hybrid vertical levels, with and without a procedure that reduces calculations in the boundary layer, and with on-line or climatological deposition velocities. Model outputs have been compared to available observations, both from satellites (TOMS, HALOE, SMR, SCIAMACHY, MOPITT) and in-situ instrument measurements (ozone sondes, MOZAIC and aircraft campaigns) at climatological timescales. The distribution of long-lived species is in fair agreement with observations in the stratosphere putting aside the shortcomings associated with the large-scale circulation. The variability of the ozone column, both spatially and temporarily, is satisfactory. However, because the Brewer-Dobson circulation is too fast, too much ozone is accumulated in the lower to mid-stratosphere at the end of winter. Ozone in the UTLS region does not show any systematic bias. In the troposphere better agreement with ozone sonde measurements is obtained at mid and high latitudes than in the tropics and differences with observations are the lowest in summer. Simulations using a simplified boundary layer lead to larger ozone differences between the model and the observations up to the mid-troposphere. NO_x in the lowest troposphere is in general overestimated, especially in the winter months over the Northern Hemisphere, which may result from a positive bias in OH. Dry deposition fluxes of O_3 and nitrogen species are within the range of values reported by recent inter-comparison model exercises. The use of climatological

deposition velocities versus deposition velocities calculated on-line had greatest impact on HNO_3 and NO_2 in the troposphere.

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