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Evaluation of CAM-Chem VSL^{Br} model performance during SouthTRAC campaign

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In the framework of the SouthTRAC Campaign (Transport and Composition of the Southern Hemisphere Upper Troposphere and Lower Stratosphere) based on Rio Grande, Argentina, a local research group from CONICET (Argentine National Research Council) joined the German consortium maintaining the HALO research aircraft (High-Altitude and LOng-range aircraft) to help with the flight planning and evaluation of the chemical composition of the upper troposphere and lower stratosphere within the ozone hole periphery. The SouthTRAC aircraft campaign was carried out in two phases which took place in September and November 2019, respectively. With the purpose of providing additional information of the atmospheric composition of brominated Very Short-Lived (VSL^{Br}) species and compare with HALO observations during the transfer and campaign flights, a CAM-Chem (Community Atmosphere Model with Chemistry) global chemistry-climate simulation was conducted. The model setup used in the halogenated CAM-Chem simulation had a 1° x 1.25° lat-lon resolution, 56 hybrid vertical levels from the surface to the middle stratosphere and considered assimilated meteorology from MERRA, including an explicit treatment of VSL^{Br} sources and chemistry. Model output of VSL^{Br}, long-lived bromine and chlorine (LL^{Br} and LL^{Cl}) species and ozone mixing ratios, as well as the main inorganic halogen reactive and reservoir species and gas/heterogeneous phase reaction rates affecting lowermost stratospheric ozone were analyzed in horizontal domains and vertical cross-sections across each flightpath. The model performance with respect to the HALO observations has a general good agreement, presenting better results for mid latitudes (between 30º S and 50º S) than for southern latitudes (>50º S). In particular, CAM-Chem timeseries consistently reproduced the spatio-temporal variation of the main VSLBr species (CH_2Br_2 and $CHBr_3$), including the sharp variations observed across the tropopause. For both VSL^{Br} as well as for LL^{Cl} compounds such as CFC-12, the Pearson correlation coefficient r obtained during each of the flights ranged between 0.7 and 0.9, while the Normalized Mean Bias (NMB) was smaller than 8% for almost every flight. Regarding LL^{Br} CH_3Br, the correlation with the aircraft observations is high (r>0.9) but the inter-hemispheric variability during

transfer flights is not fully captured. For Ozone, the model presents mid to high correlation with respect to measures ($0.5<r<0.95$) with a variable overestimation ranging from 10% to at most 40% in some flights.