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Objective comparison between a 3D-PSC-CTM and simultaneous observations by different satellite instruments

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BASCOE, a 4D-VAR assimilation system developed for analysis and forecast of the stratospheric chemistry, is built around a 3D model of chemistry, transport and microphysical processes related to Polar Stratospheric Clouds. Assimilation performs objective comparison between the model state and observed values, by means of observation operators which calculate model values in the observation space. Here we use these observation operators to assess the accuracy of the unconstrained 3D model. We choose as test case the vortex split event of the Southern Hemisphere in 2002.

When the observations are number densities of long-lived constituents, the observation operator simply interpolates in space the model values to the location of the measurement. We apply this simple technique to observations of O_3, HNO_3 and H_2O by GOME, POAM3, HALOE and MIPAS. GOME measurements can also be inverted into slant column densities of the short-lived radicals BrO and OClO, which have great scientific interest but are difficult to compare with model results. We have developed a "GOME observation operator" which takes into account fast chemical processes and the slant column geometry of these observations. This technique provides the first comparison (to the best of our knowledge) between a 3D-CTM and global-scale measurements of OClO.

After improvement of several features of the model, excellent agreement is found between satellite and simulated observations, all year long and for all observed species. The discussion focuses on key dynamical and chemical aspects identified during the study and therefore contributes to a better understanding of polar stratospheric chemistry.