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Comparison of ozone profiles among DIAL, two satellite instruments, and chemical transport model simulations over Río Gallegos, Argentina on 23-24 November 2009

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We are conducting a project that develops an observation network for ozone and aerosols in South America under the SATREPS program supported by JST and JICA. The monitoring of ozone at the South Patagonian Atmospheric Observatory (OAPA, 51.6°S, 69.3°W) in Río Gallegos, Argentina is one of the essential part of this project. Whereas, a chemical transport model (CTM) has been developed in NIES to study chemical and dynamical processes in the stratosphere. The model incorporates a chemical module into the MIROC3.2-GCM using horizontal winds and temperature nudged toward ERA-Interim data (e.g., Akiyoshi et al., JGR, 2016). To examine a performance of the model simulation, the calculated ozone profiles around OAPA were compared with those observed by a DIfferential Absorption Lidar (DIAL) at OAPA between 16 km and 35 km. We focus on a period of 23-24 November 2009 when the DIAL measurements were conducted. A persistent ozone decrease for three weeks was found during the period. Such the long-lasting decrease over the southern tip in South America was unusual (e.g., de Laat et al., GRL, 2010). In addition, we obtained several coincidence measurements (within 500 km in distance from OAPA) by satellite-borne instruments: MLS and SMILES. For comparisons between DIAL and SMILES ozone profiles in the number density, good agreement is found for altitudes from 16 km to 35 km for both days. MLS ozone profiles also agree well with those of DIAL, except for altitudes below 18 km on 24th. On the other hand, the CTM ozone profiles are larger than DIAL below 18 km on Nov. 23 and below 23 km on Nov. 24. The CTM profiles agree rather with those of MLS and SMILES, although the CTM ozone values are larger than those of SMILES below 18 km on Nov. 23. Because the boundary region of the Antarctic polar vortex has still existed in that period over OAPA, inhomogeneities of ozone values both in space and time are expected as seen from the satellite data. Nonetheless, the ozone profiles from CTM reveal less appreciable latitude difference than those from satellite instruments. We further examined N_2O profiles from CTM during the course of this spring (from October to November 2009). These profiles are compared with N_2O profiles from MLS. The result shows that the CTM values below 23 km are somewhat larger than those of MLS in the early October, suggesting a weaker diabatic descent in the model. Then, the difference between the two extends towards November, suggesting that horizontal influx from outside of the vortex is overestimated in the model. This is a possible cause of the larger ozone values below $\sim$20km in the model.

SATREPS: Science and Technology Research Partnership for Sustainable Development

JST: the Japan Science and Technology Agency

JICA: the Japan International Cooperation Agency

MLS: the Aura Microwave Limb Sounder

SMILES: the Superconducting Submillimeter-Wave Limb-Emission Sounder