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

T. Sugita<sup>1</sup>, H. Akiyoshi<sup>1</sup>, M. Kadowaki<sup>2</sup>, H. Nakamura<sup>3</sup>, I. Ikeuchi<sup>3</sup>, E. Wolfram<sup>4</sup>, J. Salvador<sup>4</sup>, and A. Mizuno<sup>5</sup>

1. National Institute for Environmental Studies (NIES), Tsukuba, Japan

2. Japan Atomic Energy Agency, Tokai, Japan 3. Fujitsu FIP Corporation, Tokyo, Japan

4. Laser Application Research Center (CEILAP)-UNIDEF, Villa Martelli

Argentina 5. Institute for Space-Earth Environment (ISEE), Nagoya University, Nagoya, Japan

## Introduction/background

The ozone hole in the S.H. is still large in some distinct years, hence UV risks should be cared in some longitudes in the high latitudes (>50°S). In the 2009 spring, a prolonged ozone decrease was observed over the southern tip of South America (de Laat et al., GRL, 2010; Wolfram et al., Ann. Geophys., 2012).



In this study, we assess the performance of chemical transport model simulation (see below) over Río Gallegos (RGG), Argentina (51.6°S, 69.3°W) from a view of ozone vertical profiles near the boundary of polar vortex. The left panel shows potential vorticity (PV) maps for November 13 and 23, 2009 at the 475K and 675K levels. On 23 Nov., the location of RGG against the polar vortex was inside at 475K(\*18km) and outside at 675K(\*24km).

#### Data

- DIfferential Absorption Lidar (DIAL) at RGG (Wolfram et al.)

- MIROC3.2-CTM nudged toward ERA-Interim (Akiyoshi et al.,

JGR, 2016). The nearest grid-point for RGG is used. - Microwave Limb Sounder (MLS; http://mls.jpl.nasa.gov/) within 500km to RGG etc.

 Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES; http://smiles.tksc.jaxa.jp) within 500km to RGG, but for only Nov. 23 and 24.

- The derived meterological products (DMP) are used for both MLS (Manney et al., JGR, 2007) and SMILES (Kreyling et al., JGR, 2013) to examine PV values.

#### Method

First, we focus on dates of Nov. 23 and 24, 2009, when DIAL measurements were made, and both MLS and SMILES were operated (**A**). Then, time-series of O<sub>3</sub> from DIAL, CTM, and MLS were examined over RGG at 18 km and 24 km in the course of spring (from Sept. to Nov.) (**B**). In addition, those of N<sub>2</sub>O from CTM and MLS were also checked to see transport processes (**B**). Since RGG was located outside the vortex for most days before 10 Nov., we further looked at two other locations: One is 20 degrees south of RGG (71°S, 68°W), located inside the vortex for most days (**C**), and the other is near the south pole (82°S, 0°W), located inside the vortex in the course of period for reference (**D**).

### **Results/Remarks**

For  $O_3$  comparisons between DIAL and MLS or SMILES (**A**), good agreement is found for altitudes from 16 km to 35 km for both days, except for altitudes below 18 km on 24 Nov. between DIAL and MLS. On the other hand, the CTM profiles are larger than DIAL below 18 km on 23 Nov. and below 23 km on 24 Nov (**A**). The CTM profiles agree rather with those of MLS and SMILES in some cases, although the CTM  $O_3$  values are larger than those of SMILES below 18 km on 23 Nov.

Because the boundary region of the vortex has still existed in that period over RGG, inhomogeneities of O<sub>3</sub> values both in space and time are expected as seen from the satellite data. Nonetheless, the O<sub>3</sub> profiles from CTM reveal less appreciable latitude difference than those from satellite instruments. Looking at the time-series of O<sub>3</sub>, N<sub>2</sub>O, and PV (**B**), the PV values from CTM are higher in the latter half of Nov., but the corresponding O<sub>3</sub> and N<sub>2</sub>O values are not so small compared to those of MLS.

We further examined  $N_2O$  profiles from CTM in the course of this spring (from Sept. to Nov.) inside the vortex (C and c.f., D). These profiles are compared with  $N_2O$  profiles from MLS. The resulting time-series shows that the CTM values at 18km are somewhat larger than those of MLS in the period from Sept. to early Oct., 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 also overestimated in the model. This is a possible cause of the larger  $O_3$  values below "20km in the model.

Acknowledgements: This project is supported by Japan Science and Technology Agency (JST) and Japan International Cooperation Agency (JICA) under SATREPS program in collaboration with CEILAP in Argentina and Magellan University in Chile. The DMP data was provided by Dr. G. Manney through the Aura/MLS website. The PV values from MERRA2 for Río Gallegos were extracted by Dr. H. Ohyama.

Date in 2009



Date in 2009

Date in 2009