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Temporal Variation of Middle Stratospheric Ozone Observed at the Southern Tip of South America during Austral Spring

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During austral spring, polar vortex often passes over the Patagonia area (south parts of Argentina and Chili). In addition, during austral late spring when the polar vortex breaks down, air mass with low ozone (O_3) concentration occasionally stays around the Patagonia area (de Laat et al., 2010), which results in an exposure of harmful ultraviolet (UV) radiation for a relatively long time. In order to monitor variations of the UV radiation and O_3 amounts with a time scale of a few hours, we have performed synthetic observations at the Patagonia area with several UV radiometers, a millimeter-wave spectroscopic radiometer (MWR), a differential absorption lidar (DIAL), and an ozonesonde. The MWR, which was installed at Río Gallegos (51.6°S, 69.3°W), Argentina, has recorded an emission spectrum around 110 GHz owing to rotational transition of the atmospheric O_3 molecules. The O_3 profiles that have sensitivity between 20 and 70 km are retrieved from the spectra with an integration time of 1 h by the optimal estimation scheme (Ohyama et al., 2016). In October and November 2014 and during October-December 2015, we performed coincident observations with the three instruments that measure O_3 profiles (MWR, DIAL, and sonde), and intercompared the O_3 profiles derived from our instruments and from the Microwave Limb Sounder. We found that the O_3 profiles were in agreement within 10-20% for one another. The continuous MWR measurements could observe drastic decreases of O_3 mixing ratios in the stratosphere during the periods when polar vortex passed over the Río Gallegos. The temporal variations of O_3 mixing ratios between 20 and 30 km were then compared with those of potential temperature (PT) and scaled-potential vorticity (sPV) that were calculated from the Modern Era-Retrospective Analysis for Research and Applications data (Rienecker et al., 2011). The PT and sPV were considered to be proxies for vertical displacement and horizontal advection, respectively. From regression analysis, we found that the temporal variations of O_3 above 27 km were mainly attributed to the horizontal advection and those below 23 km resulted from the horizontal advection and vertical displacement with a comparable rate. We will discuss in detail the O_3 variations at each altitude.