Profilling the SO2 Plume from Volcan Turrialba: Ticosonde Balloon Measurements Compared with OMI and OMPS Retrievals

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MOTIVATION and APPROACH
Unlike many other atmospheric trace species, the large-scale distribution of SO2 is affected by episodic, spatially inhomogeneous and occasionally large-magnitude emissions events. Both of these represent a challenge for remote sensing of SO2 from space, and it is thus important to take advantage of every opportunity to obtain ground truth measurements of SO2.

We have been using indirect and more recently a direct dual ozone sondes techniques to estimate volcanic SO2 over San José, Costa Rica. We compare these two in situ approaches and then compare these to SO2 column observations obtained from two satellite instruments: the Ozone Monitoring Instrument (OMI) on Aura and the Ozone Mapping and Profiler Suite (OMPS) on Suomi-NPP.

A UNIQUE VALIDATION OPPORTUNITY
Turrialba [10.0°N, 83.8°W, elev. 3440 m] is a large stratovolcano located ~35 km east of the San José, Costa Rica. Activity re-commenced in 1996 and has led up to a series of five eruptions, four of them explosive, in the last five years. These have occurred during an extended period of fumarolic activity and emission of SO2.

The NASA Ticosonde program began making ozone sondes measurements in the San José metropolitan area in 2005. The following year, we began to see notches in the ozone profiles that were consistent with interference from SO2 in the ECC ozone sondes. We determined that the most likely source of the SO2 was fumarolic emissions from the summit craters of Turrialba.

In February 2012 we showed that a dual-ozone sonde technique could successfully detect the Turrialba plume at San Jose. In July 2013, we began flying dual ozonesondes on a regular basis, and we now have a data base of 24 dual sondes launches along with over 80 regular ozone sondes with notched profiles in the lower troposphere.

SUMMARY AND FUTURE WORK
With over two dozen dual sonde launches to date and a growing record regular ozone sondes showing evidence of volcanic SO2 plumes, we have assembled a unique data set to validate both past and forthcoming retrievals of column SO2 from both OMI and OMPS as well as future instruments such as TROPOMI. This initial effort demonstrates the advantages and the challenges inherent in validating satellite measurements of small-scale and intrinsically dynamic feature in the atmosphere. Further progress will require consideration of plume trajectories as well as a better understanding of the near-field evolution of the plume.

Acknowledgements: This work has been supported in by the NASA Aura Science, Upper Atmosphere Compostion Observations and MEaSUREs programs.