

(20-220414-C) Balloon-based SO₂ Measurements during the Hunga Tonga Eruption

P. Walter¹, J.H. Flynn², S.L. Alvarez², J. Brioude^{3,4}, S. Evan⁵, J. Metzger⁶, G.A. Morris¹, S. Yoon², A. Kotsakis^{7,8}, E. Klovenski², M.D. Spychala^{9,1}, E. Corrales¹⁰, A. Alan¹⁰, J.A. Diaz^{11,12}, and J. Harnetiaux¹³

¹St. Edward's University, Austin, TX 78704; 512-364-3158, E-mail: pauljw@stedwards.edu

²University of Houston, Houston, TX 77004

³Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309

⁴NOAA Chemical Sciences Laboratory (CSL), Boulder, CO 80305

⁵Laboratoire de l'Atmosphère et Cyclones LACy / UMR8105, Université de La Réunion, 97744 Saint-Denis Cedex 09, France

⁶Observatoire des Sciences de l'Univers OSU-Réunion / UMS3365, Université de La Réunion, CNRS, France

⁷ERT, Inc., Laurel, MD 20707

⁸Formerly University of Houston

⁹New Mexico State University, Las Cruces, NM 88003

¹⁰Universidad de Costa Rica, San Jose, Costa Rica

¹¹INFICON, East Syracuse, NY 13057

¹²Formerly Universidad de Costa Rica, San Jose, Costa Rica

¹³En-Sci, Westminster, CO 80234

A novel technique has been developed to measure sulfur dioxide (SO₂) using a modification of the existing electrochemical concentration cell (ECC) ozonesonde technology. The previous sonde-based method to measure SO₂ (i.e. the dual-sonde approach) has large uncertainties in the stratosphere that would limit its effectiveness in measuring SO₂ from an explosive volcanic eruption. Due to that and other limitations, several modifications were made to create a single-sonde system that would directly measure SO₂ (i.e. the SO₂ sonde). These modifications included (1) a positively biased ECC background current, (2) the addition of an O₃ removal filter, and (3) the addition of a sample dryer. The SO₂ sonde measures SO₂ as a reduction in the cell current. Field tests in 2018 included lower tropospheric measurements near Kilauea Volcano (before and during the 2018 eruption in the Lower East Rift Zone), Costa Rica's Turrialba Volcano, and anthropogenic plumes from the Athabasca Oil Sands region of Alberta, Canada. The SO₂ sonde was deployed to La Réunion as part of the Tonga volcano Rapid Response Experiment (TR²Ex). During 21-25 January 2022, the SO₂ sonde sampled SO₂ in the stratospheric Hunga Tonga volcanic plume during four free-release balloon flights. Two of those soundings also had ozonesondes, and notches in the ozone data were observed in the plume. The altitudes of those plumes ranged from 19 to 30 km. We will overview the SO₂ sonde measurements during the initial TR²Ex deployment and compare the SO₂ sonde and ozonesonde measurements.

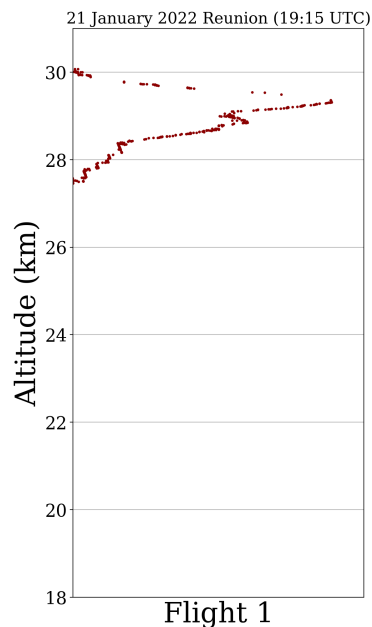


Figure 1. Vertical profile of SO₂ from a measurement taken using an SO₂ sonde on 21 January 2022 from the Maïdo Observatory in La Réunion.