

## **Can the Total Ozone Monitoring Spectrometer (TOMS) Measure Ozone Depletion in Rocket Plumes**

### Abstract:

The question whether the total ozone mapping spectrometer (TOMS) is capable of measuring ozone levels in a rocket plume is examined. Simulated measurements were computed for four plume scenarios corresponding to 20 and 30 km altitude and  $10^3$  and  $10^4$  s elapsed time. For each scenario, we considered plume constituents consisting of the chemical species calculated by Brady and Martin, and three different particle size distributions. For comparison, we also made simulated measurements of ozone total in the absence of particles and in the absence of particles and plume species. Plume measurements by TOMS suffer from two main problems: the detection field of view is typically larger than the column area for ozone loss, and the plume constituents distort the ozone measurement. Another issue limiting sensitivity is that TOMS measures attenuation of solar radiation transmitted through and then backscattered out of the atmosphere; however, only one of these two paths is likely to cross with the plume, unless TOMS is exactly aligned with the plume and the sun. Our simulated TOMS measurements indicate that large errors are caused by interfering absorptions by plume constituents; however, the error decreases to acceptable levels at  $10^4$  s. Though the large field of view is unfavorable for quantitative measurements, TOMS may be able to obtain evidence of ozone loss in plumes under the following conditions: (1) at times just before the ozone hole recovers when the plume and hole width are greatest, (2) at viewing angles similar to the plume track angle (i.e., maximize viewing pathlength through plume), and (3) at a higher altitude part of the plume (kinetic models indicate that the ozone hole is broader at 30 km than at 20 km).