Description of the DSCOVR/EPIC volcanic SO_2 Level 2 algorithm

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The DSCOVR/EPIC volcanic SO_2 algorithm is a modified version of the heritage NASA Total Ozone Mapping Spectrometer (TOMS) 4-band algorithm, adapted to the EPIC wavelengths. The algorithm uses four EPIC UV channels (centered at 317nm, 325nm, 340 nm, 388nm) to iteratively retrieve vertical column amounts of sulfur dioxide (SO_2), total ozone (O_3), the Lambertian equivalent scene reflectivity at 388 nm (R), and its spectral dependence, $dR/d\lambda$. The algorithm relies on spectral differences in SO_2 and O_3 absorption cross sections to separate the two gases. The sensitivities (Jacobians) associated with linear perturbations in SO_2, O_3 and R are pre-computed for each UV spectral band and stored in look-up tables, which are numerically interpolated for EPIC viewing geometry and state vector values at each iteration. The algorithm appears to have adequate sensitivity to detect moderate to large volcanic eruptions, when SO_2 amount exceeds about 15 Dobson Units (1 DU = 2.68 10^{16} molecules/cm^2). To increase sensitivity to small eruptions, a Step 2 of the algorithm uses the 317 and 388 nm EPIC channels along with a spatially smoothed field of total ozone.

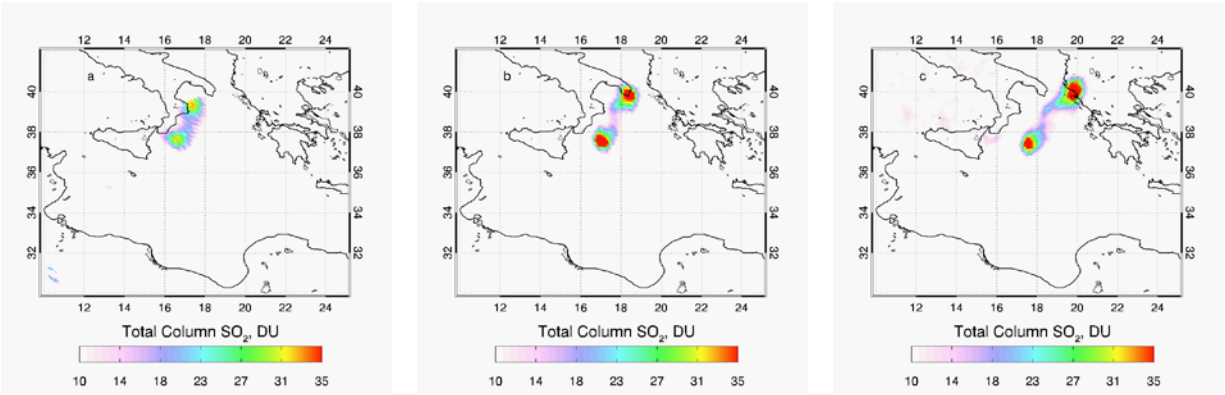

Figure. EPIC SO_2 maps for the December 3 2015 eruption of Etna volcano (Sicily, Italy; triangle). SO_2 in the Etna volcanic cloud was detected in three consecutive EPIC exposures at (a) 08:16UTC; (b) 10:04 UTC; (c) 11:52 UTC showing cloud movement eastward toward Greece.