NASA Satellites Track Air Pollution from Sulfur Fires in Iraq

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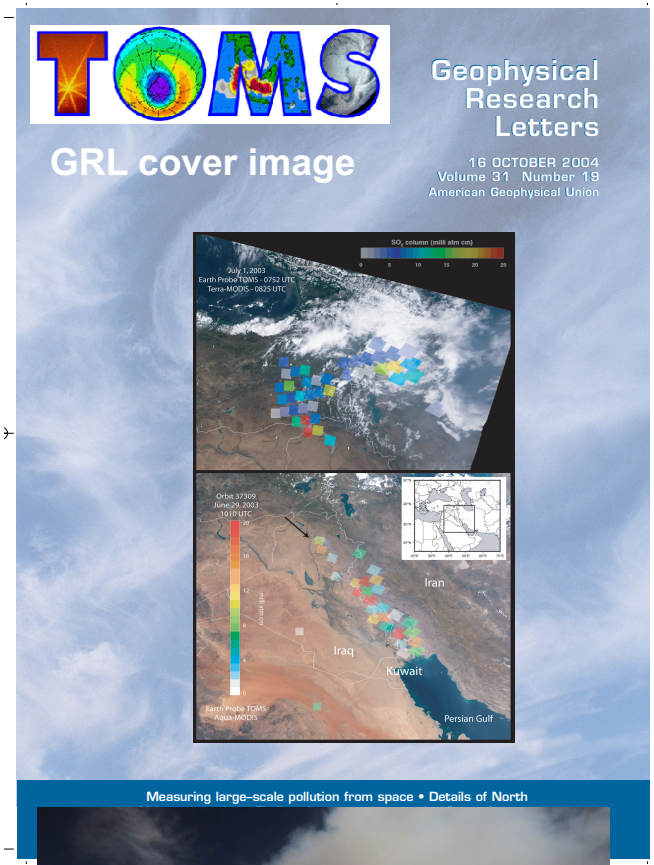
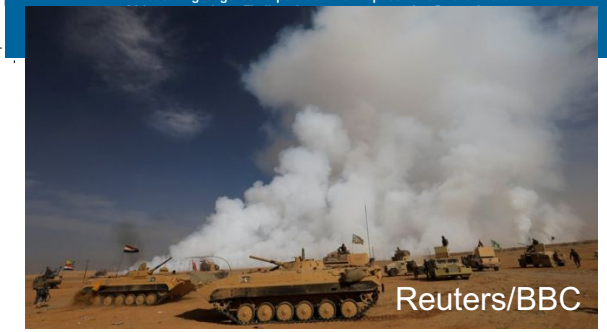
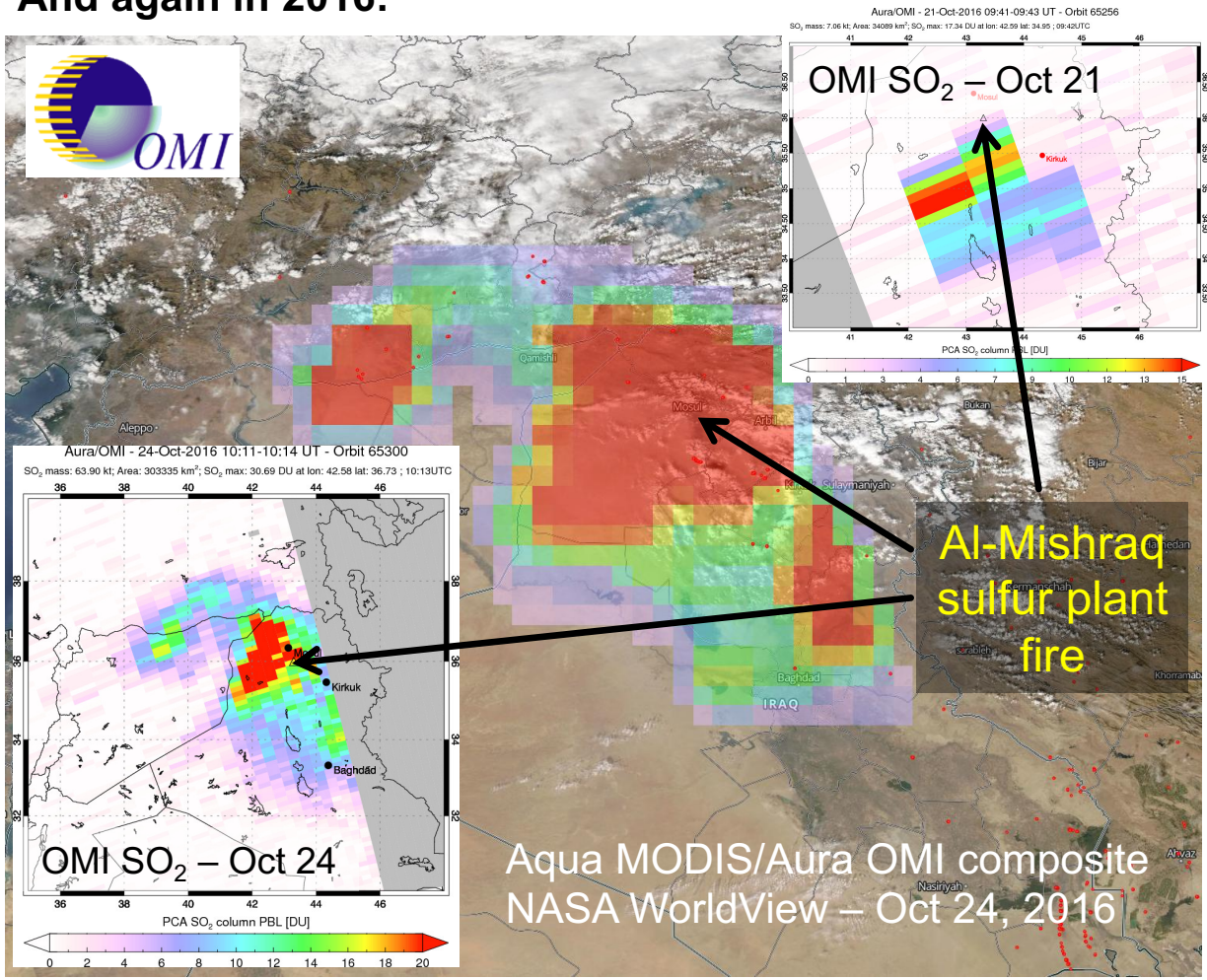
In 2003:



Measuring large-scale pollution from space • Details of North



And again in 2016:



During the Iraq War in 2003, a fire at a sulfur plant created a toxic SO_2 gas cloud detected by NASA's TOMS instrument. During the battle for Mosul in 2016, the same sulfur plant was set alight again, with SO_2 emissions tracked by OMI.

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References:

Total Ozone Mapping Spectrometer (TOMS) observations of the sulfur fire in Iraq in 2003 are described in the following paper:
Carn, S.A., A. J. Krueger, N. A. Krotkov, and M.A. Gray (2004). Fire at Iraqi sulfur plant emits SO_2 clouds detected by Earth Probe TOMS. *Geophysical Research Letters* 31(19), L19105, doi:10.1029/2004GL020719

The current (2016) sulfur fire in Iraq is ongoing at this time and we hope to write a paper on the event within the next few months.

Data Sources: Ozone Monitoring Instrument (OMI) observations of the 2016 Iraq sulfur fire use new operational OMI SO_2 products described in this paper:

Li, C., N.A. Krotkov, S.A. Carn, Y. Zhang, R.J.D. Spurr, and J. Joiner (2016), New-generation NASA Aura Ozone Monitoring Instrument volcanic SO_2 dataset: Algorithm description, initial results, and continuation with the Suomi-NPP Ozone Mapping and Profiler Suite, *Atmospheric Measurement Techniques Discuss*ions, doi:10.5194/amt-2016-221, in review.

These new SO_2 volcanic and pollution products, produced by the Goddard Ozone Monitoring Instrument (OMI) SO_2 team at code 614 (Can Li (614/ESSIC) and Nickolay A. Krotkov (PI- 614)), are currently ingested within three hours into NASA's Land, Atmosphere Near real-time Capability for EOS (LANCE) platform, which enables multi-product and multi-satellite near real-time (NRT) imagery generation using the public NASA Worldview web application (https://worldview.earthdata.nasa.gov/) used to produce some of the images on slide #1.

Technical Description of Figures:

Graphic 1 (left): This shows the cover of Geophysical Research Letters from 2004 featuring the first Iraq sulfur fire observed by Earth Probe TOMS
Graphic 2 (right): This shows OMI and MODIS observations of the 2016 Iraq sulfur fire. The background NASA Worldview figure shows that OMI detected high concentrations of SO_2 in the sulfur fire plume (purple to red) over northern Iraq on October 24, overlaid on an Aqua/MODIS RGB image from the same day. Other images show OMI SO_2 retrievals on October 21 and October 24. According to a Washington Post news article on October 23, the toxic SO_2 plume originated from a fire set by Islamic State militants at the Mishraq sulfur mine, about 25 miles southeast of Mosul. The fire was also reported by BBC News on October 22 (http://www.bbc.com/news/world-middle-east-37738667). Plumes of SO_2 from the fire were first detected on October 21 and have been observed every day since then (as of October 25).

Scientific significance, societal relevance, and relationships to future missions: The SO_2 emissions from the fire created serious air quality issues in Iraq, with several deaths attributed to the fumes. This is an example of air pollution being used as a weapon – the deliberate setting of a sulfur fire to create a toxic gas cloud. Satellite observations of such events are crucial to assess the geographic extent of the air pollution, estimate ground-level concentrations of SO_2, and forecast transport into other regions. Such sulfur fires also produce a relatively pure SO_2 cloud, which is rarely observed in the atmosphere (other anthropogenic and volcanic SO_2 emissions are mixed with a variety of other gases and particles), which could be used to improve understanding of atmospheric sulfur chemistry.