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Using IASI and MIPAS in combination to characterise CO and other volatile organic compound emissions from fires

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Short-lived species emitted from wildfires, such as carbon monoxide (CO) and volatile organic compounds (VOCs), carry a lot of information on atmospheric processes relating to chemistry, convection and emission. These disruptive events are indirectly a climatological feature of the Earth's atmosphere and its climate response and occur at sufficient frequency to make studying and understanding biomass plume chemistry vital. Accurate measurement of trace gases from these events will also aid improvements in climate/chemistry models.

In this study, we utilise IASI, MIPAS and ACE data to derive wildfire emissions of VOCs, in the context of two periods; the early 2009 Black Saturday fires and the BORTAS campaign fires. Using the complementary viewing angles of IASI (nadir) and MIPAS/ACE (limb), results will be shown which illustrate observations of aged plume composition, chemistry, distribution and area along with information about vertical distribution.

The Black Saturday fires were a particularly severe event over South-Eastern Australia which burnt an area of 450,000 km^2, with up to 400 individual fires being identified on February 7^{th} 2009 alone. Driven by weeks of little or no rainfall and record-breaking temperatures, we show that the plumes from this event, contained enhanced VOC amounts and mixed within the lower stratosphere, reaching altitudes up to 18 km. Enhancement ratios, using CO as a reference, show potential secondary formation of HCOOH within the plume. We are able to track the evolution of the plume with IASI data for up to 20 days after the initial event.

The second case study is comparison to results from a recent aircraft campaign over North America in July/August 2011 (BORTAS). The NERC-funded campaign was dedicated to studying the impact of local pollution events over North America and aged plumes originated from Asia and Siberia. In the context of the campaign aims, we investigated CO, VOC chemistry and aerosol signatures in boreal biomass plumes. The most significant event was a series of fires over North-west Ontario which we show released a significant quantity of CO and formic acid. The validation of IASI formic acid from this event with in-situ data is particularly good. We also derive the time-evolution of a variety of VOCs (including PAN) within aged plumes, using comparisons of MIPAS and ACE data. These plumes originate from both the boreal forests of North America and Siberia, and show excellent agreement between these independent datasets. Particularly large enhancements of PAN were discovered from Siberian forest fires in late July 2011.