# MLS Scientific Publication

Scientific Themes: Atmospheric composition, Atmospheric dynamics, Biomass burning, Methyl Cyanide, Convection, Remote Sounding.

**Enhancements in lower stratospheric $CH_3CN$ observed by the Upper Atmosphere Research Satellite Microwave Limb Sounder following boreal forest fires.**

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## Summary

This paper describes the observation and interpretation of an unusual enhancement in lower stratospheric $CH_3CN$ (methyl cyanide, also known as acetonitrile) off the coast of Florida over the period 25–30 August 1992 made by the Microwave Limb Sounder (MLS) on the Upper Atmosphere Research Satellite (UARS). The enhancement appeared suddenly in the MLS data on 25 August, after which it was carried westward, consistent with trajectory calculations, and dispersed.

The paper discusses three theories for the possible origin of the event. The first two (a link to a failed rocket launch, and a link to the earlier eruption of Mount Spurr in Alaska) are ruled out. The strongest hypothesis for the origin of the enhancement relates it to a boreal forest fire near Boise Idaho. Biomass burning is known to be the dominant source of $CH_3CN$ in the atmosphere. During this period MLS made no observations north of 34°N, so the region of the fire was unobserved, and it is impossible to tell from the MLS data alone the true extent of the enhancement.

The Total Ozone Mapping Spectrometer (TOMS) aerosol observations for the days preceding the fire show a sudden significant enhancement, extending over much of the United States and Canada on 22 August. The paper suggests that this enhancement represents smoke and soot from the Boise fires. A study of the wind fields indicates that this aerosol enhancement must have been located in the lower stratosphere.

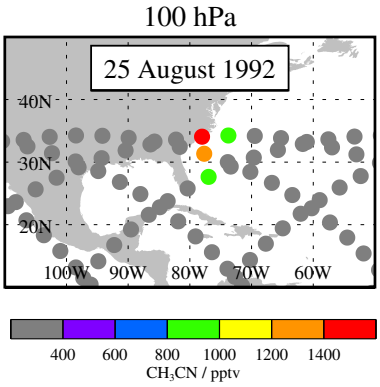


**Figure 2 (subset):** Observed enhancement in lower stratospheric $CH_3CN$ observed by MLS. Typical values at these altitudes are around 30 pptv.

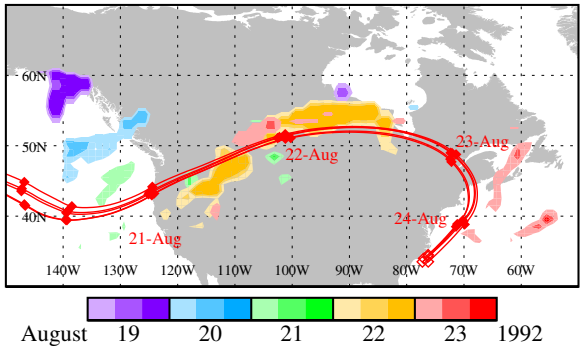


**Figure 8:** TOMS aerosol enhancements prior to the MLS $CH_3CN$ enhancement. The enhancement seen on 22 August is thought to be due to forest fires in Boise Idaho at the time (features over the Pacific on 19, 20 and 21 August are related to the Mount Spurr eruption on 18 August). The red lines indicate backward trajectories from the location and time first enhanced MLS $CH_3CN$ at 100 hPa shown above.

The paper proposes that polluted air in the region of the forest fire was transported to the lower stratosphere by convective activity associated with a strong series of thunderstorms in the region. Image data from the Advanced Very High Resolution Radiometer (AVHRR) show both the smoke associated with the fires and, later, clouds associated with strong thunderstorms whose tops are at the tropopause.

Observations of such enhancement events are not unprecedented, though so far only a handful or so of similar events have been documented in the literature. The understanding of the nature, frequency and importance of these events is still in its early stages. No other events of comparable magnitude are seen in the multi-year MLS data. However many tropopause penetration events may go unobserved by MLS as they are not associated with heavily polluted air.