Aerosols at Mauna Loa Observatory (MLO) – Spring 2001 Versus Spring 2011

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The rapid development of Chinese industry has raised concerns about aerosol impacts and climate in the Pacific basin. This concern was addressed in the massive ACE-Asia international aerosol study of March – May, 2001. As part of a diverse multi-national program, we operated 22 aerosol sampling sites from middle China to the Arctic, the Western coast of the USA, and MLO, including a ship. The MLO site was typical of 8 other sites, where aerosols were sampled by DRUM impactors in 3 hr increments, in 8 size modes, from late March through April. Samples were analyzed for 32 elements, sodium to lead, by Synchrotron-induced X-Ray Fluorescence to picogram/m^3 sensitivity. We have duplicated the sampling and analysis of ACE-Asia at MLO in Spring 2011, and added to it new types of analysis for mass and optical properties, including a surrogate for soot. These techniques have also been applied to the 2001 samples. Transport models such as the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model, satellite data, and composites of wind and sea level pressure data have been used to identify transport paths to MLO. One of the early results is the realization that Asian dust aerosols generally arrive at MLO from the East, circulating clockwise around the Pacific subtropical high, while sulfates can also meander slowly across the Pacific, especially from mid-latitudes in China. Wind circulation patterns over the Pacific Ocean were more active in the 2011 compared with 2001, with a more active jet stream. The increased wind circulation patterns in 2011 can increase the amount of dust and anthropogenic aerosols transported across the Pacific and from there to Hawaii around the Pacific subtropical high. This can help explain the increased amounts of aerosols in 2011 compared with 2001 as characterized by the optics data and for 2001, dust aerosol data. Nevertheless, there are several key dates in both 2011 and 2001 that contain very similar meteorological patterns. Comparison of aerosol data for the above dates in both 2001 and 2011 will prove useful in identifying trends in sulfate and other potential anthropogenic signatures in aerosols reaching Mauna Loa from China due to potential changes in industrial outputs between 2001 and 2011. The data will be compared to our identical site at Greenland Summit, operating since 2003.

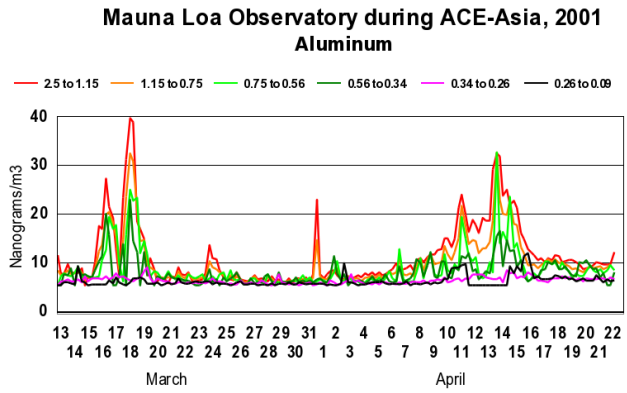

Figure 1. Fine soil aerosols transported to MLO during ACE-Asia, Spring 2001.

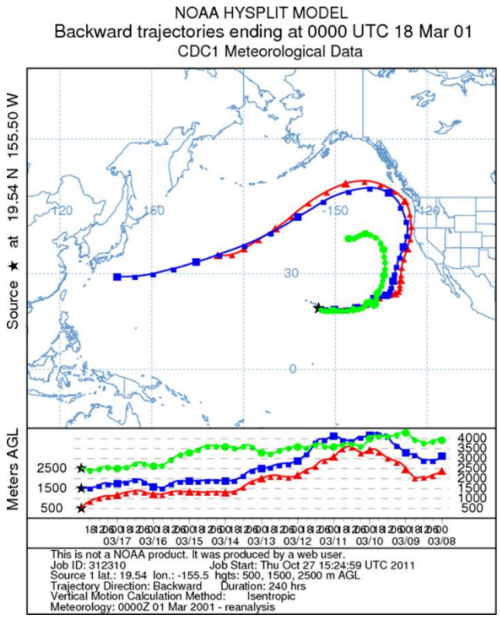

Figure 2. HYSPLIT trajectories from Asia during the March 18 episode.