Associating the temperature difference model, used for AVHRR and GOES, to the MODIS image from February 19, 2001 of the eruption plume of Mt. Cleveland, Aleutian Islands, Alaska

Steve J. Smith, Jonathan Dehn, and Ken Dean

Abstract:

The estimation (from a mass retrieval technique) and detection (from a band temperature difference technique) of mass from airborne ash of volcanic eruption plumes is critical for hazard mitigation. These techniques are important to avoid encounters between ash and aircraft. There have been some cases where a plane has encountered ash even when it was hundreds to thousands of kilometers away from the source volcano. Because the North Pacific is the location of almost 100 potentially active explosive volcanoes, detection of ash is vital for the safety of aircraft that traverse this region every day. The mass retrieval technique of airborne volcanic ash, using the subtraction of two long wave thermal bands versus a single thermal band to detect the airborne ash, is analyzed using MODIS data from a 2310 UTC image of the Mt. Cleveland eruption plume. This mass retrieval technique is similar to that carried out in other studies on AVHRR satellite images for post-eruption analyses. The AVHRR model uses analyses of Band 4 (10.3 to 11.3 μm) minus Band 5 (11.5 to 12.5 μm) versus Band 4. This same technique is applied to the MODIS data using Band 31 (10.78 to 11.28 μm) minus Band 32 (11.77 to 12.27 μm) versus Band 31 (i.e. bands similar in wavelength to AVHRR and GOES Band 4 and Band 5 respectively). Results from the analysis of the MODIS data are compared to a similar mass retrieval from a GOES image recorded at 2316 UTC, February 19, 2001. In addition, the spectral signature of airborne volcanic ash is compared for all 36 MODIS bands to determine the optimum channel to apply the band temperature difference technique that will detect the maximum aerial coverage of the plume. Initially it was expected that the band temperature differencing technique using MODIS Band 31 minus Band 32 would provide very similar results as the same channels in GOES and AVHRR data over a similar spectral range. However, preliminary results reveal that MODIS Band 31 minus Band 32 may show better internal plume structure than the GOES temperature difference of Band 4 minus Band 5. Additionally, and possibly of more importance to aircraft safety, MODIS Band 29 minus Band 32 detect a larger aerial extent of the plume as compared to the GOES Band 4 minus Band 5.