**Introduction**

Resuspension and transport of fine-grained volcanic ash from the Katmai National Park and Preserve region of Alaska has been observed and documented over the past several decades and has likely been occurring ever since the 1912 Novarupta-Katmai eruption. This eruption produced approximately 4 mi³ (17 km³) of ash deposits and 2.6 mi² (11 km²) of pyroclastic material that filled nearby valleys, creating what is today known as the Valley of Ten Thousand Smokes (VTTS). Ash in this valley is up to 660 ft (200 m) thick and the valley remains almost entirely free of vegetation.

During the spring and fall, or whenever strong northwesterly winds blow over the snow-free landscape, the ash can be reworked into dust clouds. The ash is especially susceptible to reworking when the ground is very dry. These dust clouds have been observed visually by individuals downwind and also in satellite imagery. These dust clouds have been seen in Katmai Pass area from MODIS Aqua 1 km true color satellite image showing resuspended volcanic ash from the Katmai National Park and Preserve region of Alaska has been resuspended and transported.

**1912 Novatupta-Katmai Eruption**

- 20th centuries largest eruption -globally
- 5th largest in historical times
- 3-day explosive eruption - 60 hr
- 100,000 ft (30 km) plume
- Created Katmai caldera - 2 mi
  - (3.2 km across)
- 6.5 mi³ (28 km³) of ash (fallout & flowage)
- 600 ft (183 m) thick - ash deposits creating the "Valley of Ten Thousand Smokes" (VTTS)
- Covered Kodiak in up to 2 ft (0.6 m) of ash

**Event Characteristics**

- Occur in late Spring and Fall - Snow-free & dry
- 1 to 5 events per year
- Winds speeds >20 kt (10.3 m/s)
- Clouds aloft 4,000 – 11,000 feet (1 – 3.5 km) above sea level
- Duration hours to days
- Enhanced by local terrain effects
- Extend up to about 250 km into Gulf of Alaska
- 2013+ trigger NOAA-NESDIS ash alert system
- Trace amounts of ashfall reported (<1 mm or 1/32nd inch)
- Samples look pristine – as if from erupting volcano

**Detecting/Tracking Resuspended Ash**

Events are small and often hard to detect in satellite imagery. Forecasts of strong NW winds tip us to look closely at satellite imagery.

**Summarize of events per year**

- 2003 - 1 event (Sept 23)
- 2004 - 2 events (Mar 30, Aug 21)
- 2005 - continuous plume Nov 3-11
- 2006-2009 - none
- 2008 - 2 events (Mar 30, Aug 21)
- 2011 - 2 events (Jan 15, May 11)
- 2012 - 1 event (Oct 30)
- 2013 - 3 events (May, Sep, Oct)
- 2014 - 2 events (Mar 12, Aug 20-21, Sept 21, 23)

**Health**

Volcanic ash is known to be hazardous to aviation and flight cancellations from Kodiak (including both commuter and jet aircraft) are common during resuspension events from the Katmai region. Cloud heights are low (up to 1,000 ft (3.5 km)) so ingesting ash is not impacted by these events. Little is known about the amount or sizes of ash particles in these resuspended clouds and thus studying their fallout (see below) may help to characterize the hazard to aviation. For example, quantifying the volume percentage of volcanic glass versus other material in these clouds may be useful.

**Particulate monitor deployment to Kodiak island**

Clouds of resuspended volcanic ash have not been well studied and little is currently known about the amount or sizes of ash particles in the clouds. Unlike many other wind-related erosion events in Alaska composed of non-volcanic sand and silt, these clouds are composed of volcanic ash (primarily volcanic glass) and are similar to ash clouds from a volcanic eruption. Thus, dilute clouds may pose hazards to human health and aircraft operation. AVO has deployed particulate monitors to Kodiak Island during the fall of 2015 to:

1) Measuring the concentration of particulate matter 10 microns and smaller (PM10, the particle size known to be respirable), 2) Verify if and how much ash is falling during times when resuspended ash is identified in satellite imagery, by pilot reports or other observers, and 3) Characterizing physical samples of particulate fallout to determine the percentage of volcanic ash compared to other material as well as the shape and size distribution.

AVO is coordinating with the National Weather Service (NWS) who has the responsibility to issue forecasts and statements of resuspended volcanic ash and Alaska Division of Conservation, Division of Air Quality, who has the responsibility for issuing air quality hazards and guidance.

**2015 Ash Resuspension Study**

AVO staff training on site community site operators to watch over the particulate monitor during its recent deployment. See operators are trained to sample bulk ash and ship the sample to AVO for analysis particle size distribution. The AVO particulate monitor only samples particles 10 microns and smaller to assess human air quality.

**AVO weekly update for 1912 Novatupta-Katmai Eruption**

- Sept 21, 2003 event
  - Clouds extend up to 155 miles (250 kilometers) over Shelikof Strait, parts of Kodiak Island, and clouds are concentrated between 4,000 and 11,000 ft (1-3.4 km) above sea level and can be observed visually by individuals downwind and also in satellite imagery. These dust clouds have been observed visually by individuals downwind and also in satellite imagery. These dust clouds have been resuspended.

**Hazes & Impacts of Resuspended Ash**

Ash deposits inside the jet engine that encountered the ash cloud from Katmai Volcano 1989. Right: Dark gray deposits of melted volcanic ash on leading edge of high-pressure turbine nozzle guide vanes. Left: Accumulation of unmelted volcanic ash on the high-pressure turbine rotor.

**Resuspended Ash from VTTS**

Pyroclastic deposits that fill the valley remain nearly vegetation-free more than 100 years after the eruption. Resuspended ash from VTTS seen in Katmai Pass area from KAVW webcam.

**Kodiak**

City of Kodiak, 100 mi (162 km) east of the Novarupta vent on the day after the eruption. Kodiak was blanketed in 2 feet (0.6 m) of ashfall (photo right).