NASA Volcanic Cloud Data for Aviation Hazard Mitigation

A. Krueger, N. Krotkov, and K. Yang
JCET & GEST/UMBC

G. Vicente and E. Hughes
NOAA/ NESDIS

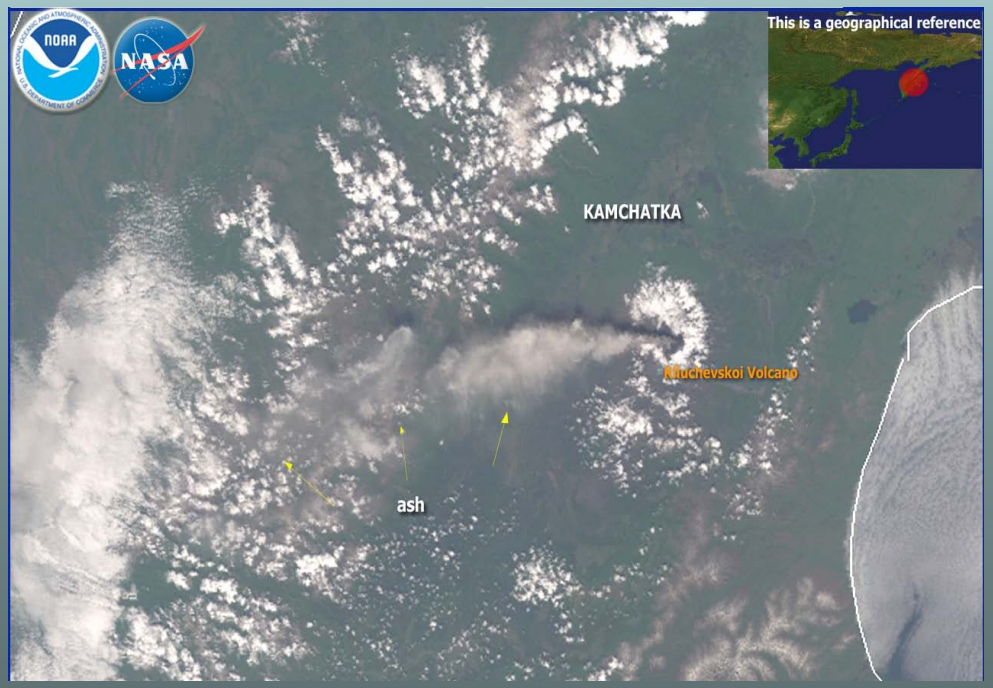
How can we detect volcanic ash clouds more reliably?

- Operational systems often fail to detect fresh ash clouds
- Test Aura/OMI UV technology
  - Use SO_2 as proxy
  - Use Aerosol Index
- Many eruptions since 2006 for evaluation

Comparison of OMI & MODIS data under good detection conditions

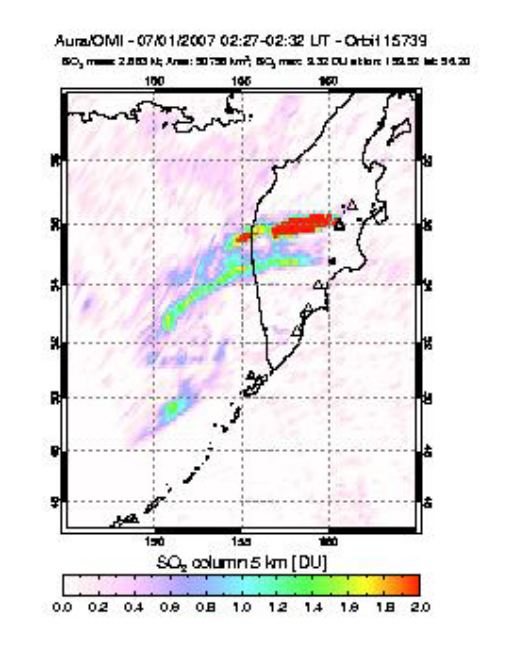
Klyuchevskoy July 1, 2007

MODIS Ch 1,4,3 00:25 UT



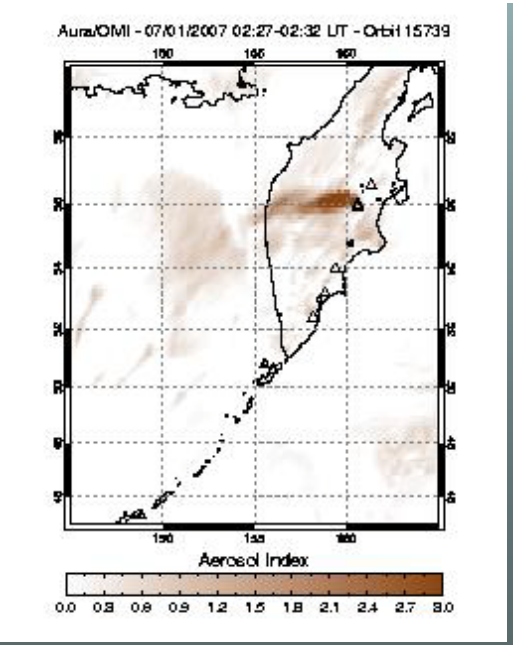
OMI SO_2

02:31 UT



OMI ash

02:31 UT



IR and UV Detection of Volcanic Ash

- IR ash detection:
  - Plume must be transparent
  - Water hides ash
  - Plume temperature contrast with underlying surface
- Fresh ash clouds are:
  - Dense, must wait until sheared to thin layer
  - Full of water, ice

- UV ash (AI) detection:
  - Scattering by ash differs from Rayleigh scattering
  - Sunlight necessary
- Fresh ash clouds are:
  - Detected upon eruption
  - Independent of water content
  - Not detectable at night

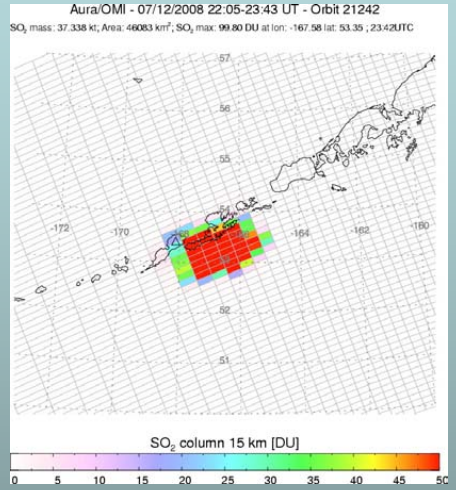
SO_2 and Ash detection in very fresh (< 2 hrs) eruption clouds from OMI

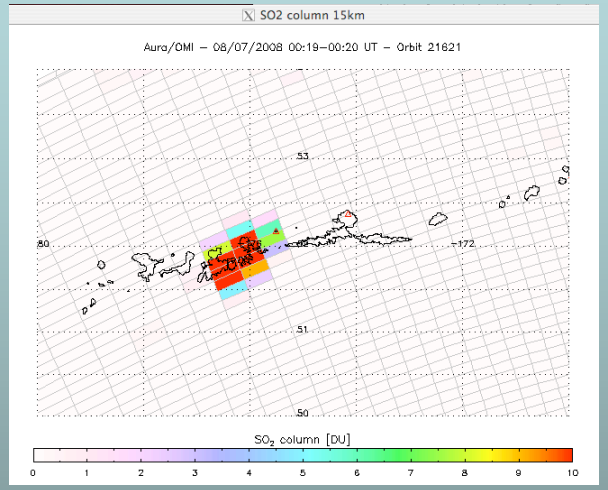
Okmok; 7/12/2008

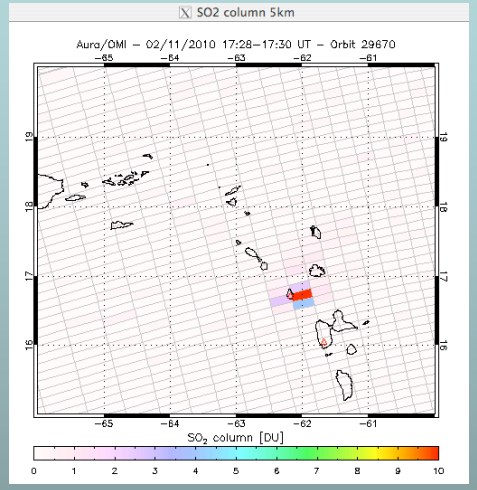
Kasatochi; 8/8/2008

Montserrat; 2/11/2010

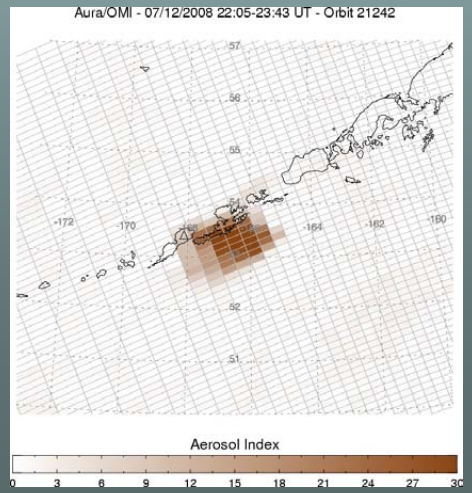
SO_2

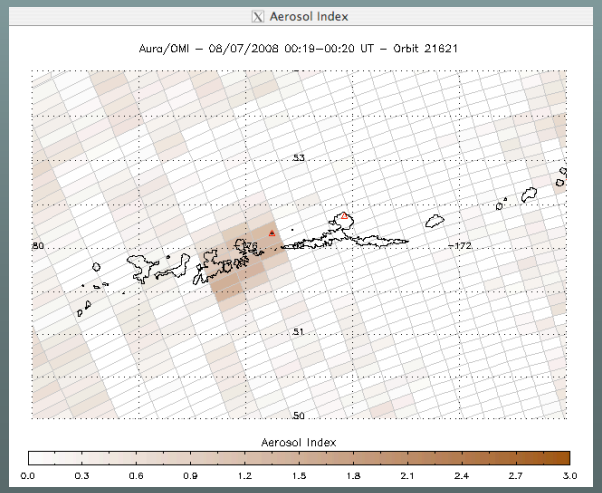


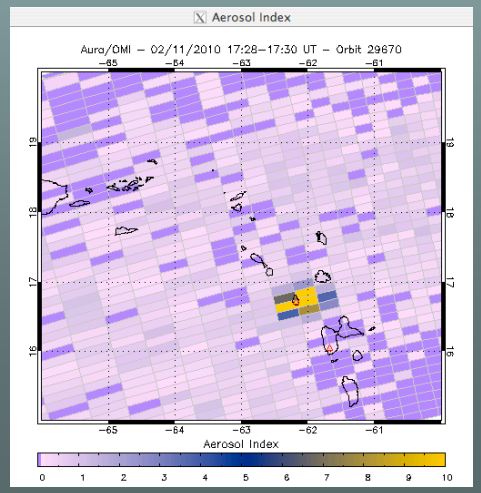




Ash





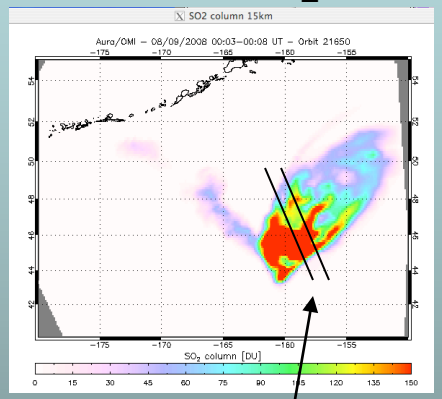


Research Results

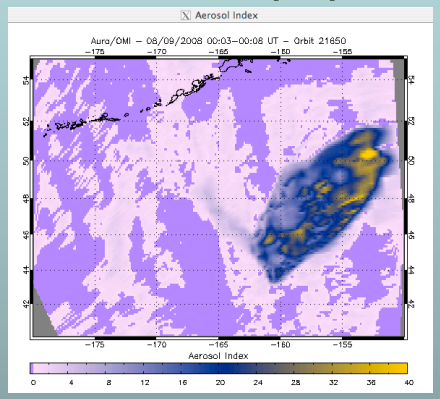
- Products developed
  - SO_2 column content
    - Volcanic degassing; PBL
    - Effusive eruptions; Troposphere
    - Explosive eruptions, Stratosphere
  - Ash (AI); explosive eruptions
  - Plume height
- NRT Data production
  - Aura/OMI data (GSFC)
  - MetOp/GOME-2 data (NESDIS)
  - NOAA web sites for DSS's
- Analysis of plume and air traffic behavior
  - > 20 eruptions in 3 years
  - 3 eruptions N Pac and N Atlantic
- Monitor pre-eruptive activity
  - Global volcanoes monitored daily
  - Emission tonnage provided
- SO_2 data validation
  - Okmok plume over Pullman, WA

Kasatochi cloud; Gulf of Alaska

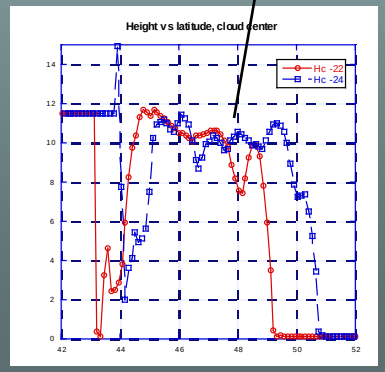
OMI SO_2



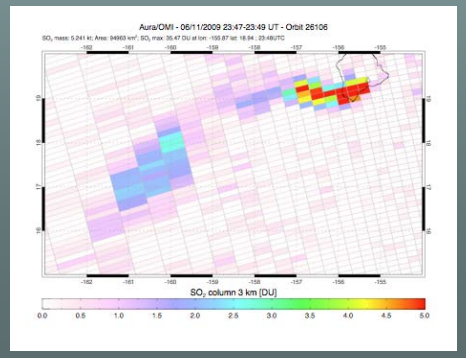
OMI Ash (AI)



Plume height

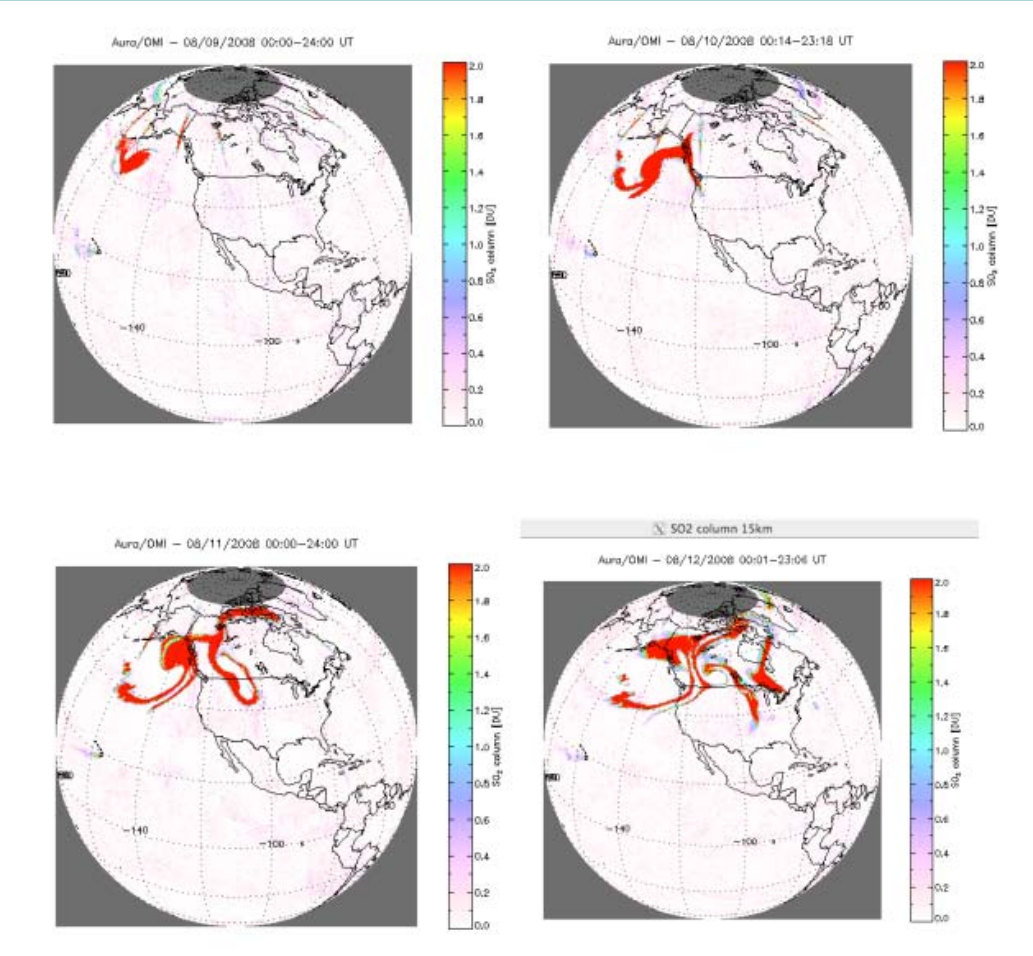
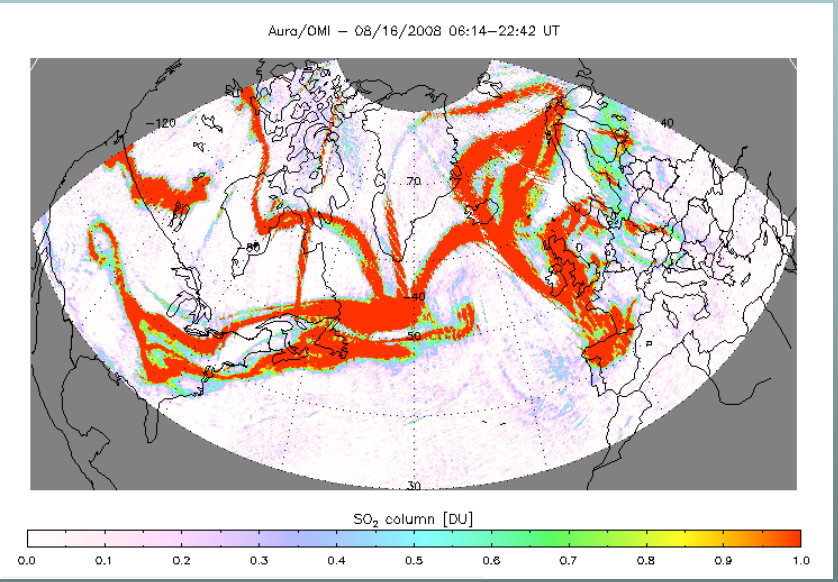


SO_2 degassing; Kilauea



Primary Findings

- Volcanic plume behavior
  - Explosive magmatic eruptions contain both ash and SO_2
  - SO_2 is easier to detect than ash (proxy)
  - Dense ash falls out in 2 - 4 days
  - SO_2 lasts for weeks
- Value of UV data
  - Potential for early detection of ash and SO_2
  - Plume height
  - Monitor volcanic unrest
- Future
  - GOME-2 in production
  - NPP/OMPS coverage in future

Global span of volcanic SO_2 clouds:

Kasatochi August 7, 2008