V-ADAPT: Implementation of a Global Volcano Remote Sensing Observation System

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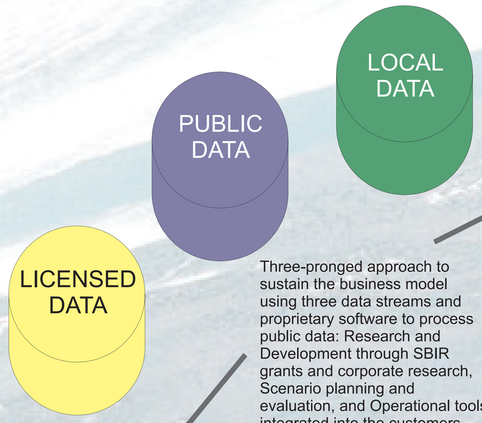
For over 25 years the volcano remote sensing group at the Geophysical Institute has built a system of tools and techniques to effectively mitigate hazards from volcanoes in the North Pacific. The start-up company, V-ADAPT (Volcanic-Ash Detection Avoidance and Preparedness for Transportation) was founded in 2013 apply these tools and techniques globally and provide these to customers world-wide.

Building on the base set of tools, a near-real time image browser with thermal and ash alerts as well as the Puff volcanic ash transport and dispersion model, a series of modules are designed to meet the needs of the transportation industry. The development pathway will be determined by the customers as the company grows.

Further modules range from near real-time ash mass determination and restarting of ash tracking models based on this data to long term probabilistic modeling for planning where volcanic ash is least likely to be present. Feedback from the volcanic monitoring community is needed to best design tools to meet the needs of a financially strained transportation system.

The company supports itself through three primary efforts, funded research projects to develop new monitoring techniques, scenario planning services based on a 20 year archive of volcanic activity detected from space, and third operational services that integrate into a customers decision support system.



Three-pronged approach to sustain the business model using three data streams and proprietary software to process public data: Research and Development through SBIR grants and corporate research, Scenario planning and evaluation, and Operational tools integrated into the customers decision making process.

OPERATIONAL SERVICES

PUFF PLUME TRACKING
Prototype:
puff.images.alaska.edu/

Automated runs of alert volcanoes globally
Custom runs by individual users
Forecasts using windfields > 1 day in advance
Location and relative concentration
Probabilistic forecasts using > 40 years of data

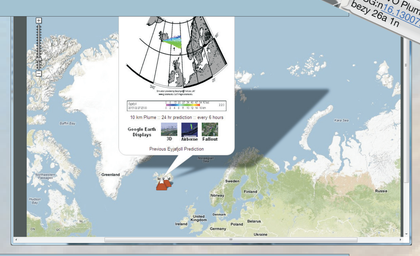
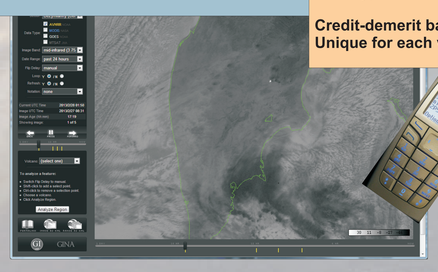


IMAGE BROWSER
Prototype:
v-adapt.images.alaska.edu/tools/ftp_browser.php

8 days of imagery
Standard products (VIS, MIT, TIR, split-window
Overlay of VO data sets
KML (Google Earth) portability



ASH ALERT
Prototype: running to SMS

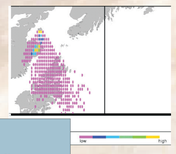
Split window based
Spatial statistics

HOTSPOT ALERT
Prototype: running to SMS

Credit-demerit based
Unique for each volcano

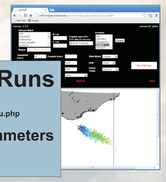
Ash Mass
Prototype: in testing

Split window retrieval
Modified by size distribution



Ash Fallout
Prototype: in testing

Thickness and size
Forecasts with time



Custom Puff Runs
Prototype:
puff.images.alaska.edu/cgi-bin/login_agu.php

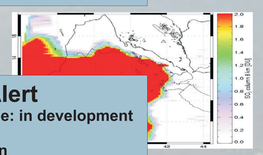
Volcano unique parameters

Ash Exposure
Prototype: in testing

Direct exposure to aircraft
Applicable to ground

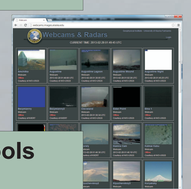
Hotspot Browser
Prototype:
v-adapt.images.alaska.edu/tools/auto_obs_viewer.php

Zoomed view
Precursor detection



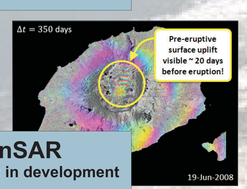
SO_2 Alert
Prototype: in development

Detection
Tracking



Webcam Tools
Prototype:
webcams.images.alaska.edu

Archive
Glow and ash detection



SAR / InSAR
Prototype: in development

Long term forecasts
Change detection

RESEARCH AND DEVELOPMENT

Support through grants and contracts, consultancy with stakeholders

Using expertise from within the group and the University of Alaska Fairbanks, sprogress can be made in research on environmental monitoring focusing on the forecasting, detection and mitigation of volcanic hazards. This includes opportunities in:

- Small business innovation research grants to develop new monitoring techniques
- Local testing and services for infrared and UV monitoring
- Industry sponsored research

Montoring Research
Prototype: in development
Interdisciplinary, instruments and software

Fuzzy Forecast
Prototype: in development

Interdisciplinary
Data integration

UAV Application
Prototype: in development

Ash sampling
Test flights

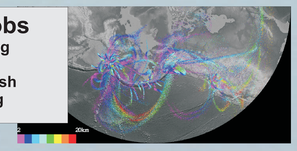
SCENARIO PLANNING

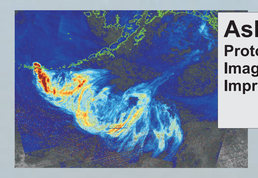
Based on the 20 year archive of volcanic activity in North Pacific, the 60 year archive of wind-field data, the historic records of volcanic eruptions and the public archive of satellite data, V-ADAPT has the ability to do detailed scenario planning and generate probabilities for areas (airports, cities) or aircraft to be impact by volcanic ash. Further, because this database is time dependent, V-ADAPT can forecast where how potential hazards will develop with time, permitting planning to be in place ahead of a crisis.

Already this database has yielded numbers that match well with the historic impacts of volcanic eruptions, not just on aviation, but other infrastructure and businesses as well.

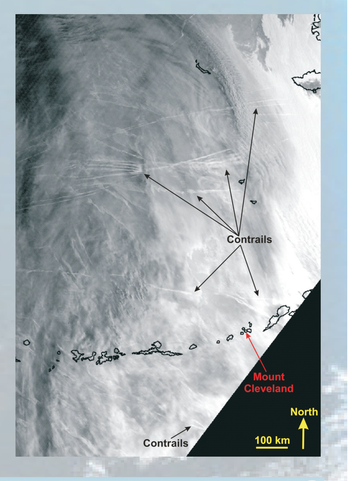
Puff 60yr probs
Prototype: in testing

Likely location of ash
Long term planning





Ash Composites
Prototype: in testing
Image stacking
Improve detection limits



ICAO estimated $250M per year losses to airlines from volcanic ash (pre 2010)
Redoubt 2009 cost Alaska ca. $450M, about $25M to airlines (300 flights)
Eyjafjallajökull 2010 cost airlines ca. $7.5B (5B Euros) over 5 days (100K flights)

2540 volcanoes worldwide, about 650 erupted in last 300 years
160 volcanoes in the North Pacific, 32 erupted in last 25 yr, (19 AK, 9 RFE, 4 KI)
Data from 1986 to present arranged for 111 quarters (JFM, AMJ, JAS, OND)
Activity in 90 of the 111 quarters (81% of the time) applicable globally

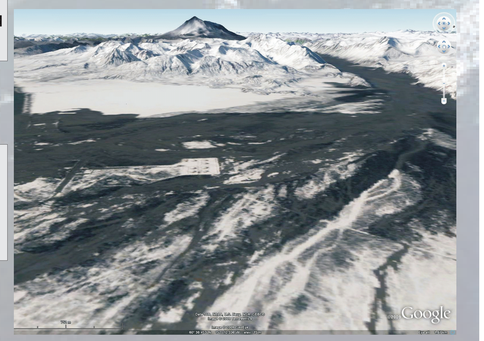
Events per year (NP/Global)	Size of the event	Total estimated yearly cost (NP/Global)
2.6 / 46.3	Lavas, threat of an ash eruption	$1.3M / $23.2M
1.9 / 34.2	Low-level ash plume with no lavas	$1.9M / $34.2M
3.7 / 66.3	Lavas and ash plumes	$7.4M / $132.6M
0.2 / 3.6	Unexpected ash plume	$0.5M / $8.9M
0.8 / 14.3	Full scale eruption- Many major ash plumes	$2.8M / $49.9M

Ash Impact
Prototype: in development

Effect on infrastructure and equipment

DEM flow models
Prototype: in development

Long term effects
Ground based mitigation



What is V-ADAPT ?
- UAF's first start-up company as part of its commercialization efforts
- Designed to support research and students at UAF with decreasing federal support
- Provides software and data to customers to help them in their decision making processes

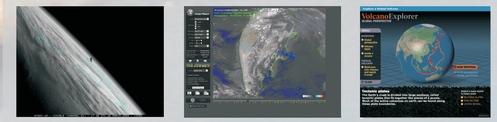
What V-ADAPT is not, does not do
- Does not perform monitoring
- Does not give official warnings about activity

Mission: Mitigation of volcanic hazards, by supporting decision making
- Forecasting, forewarned is forearmed, otherwise always behind the curve when a volcano erupts. (Scenario planning, Probabilistic forecasts, Puff runs for alert volcanoes)
- Eruption detection, within minutes when an eruption happens, location and size. (links from responsible organizations)
- Plume tracking, where is the ash, how much and where is it going a day in advance. (Puff and other VATD runs, by the customer for the customer)
- End of the eruption, when the ash and volcano no longer a hazard. Research and development into new monitoring techniques.

Much of this is value added information, collated and passed on from responsible agencies.

Image data formats fall into three categories:

Power Users	*General Web Users*	*Virtual Globes*
Federal Agencies	Public, Airlines, Portable	Airlines, Managers
net CDF, GRIB	PNG, GeoTIFF, simple text	KML, WMS



All of the data comes with sets of meta-data that may in iteself fulfill the needs of customers for research, planning and operations.

Volcanic-Ash Detection, Avoidance and Preparedness for Transportation