

The Standardisation of Volcano Alert Level Systems (VALS):

A local and global perspective

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1. CAN THERE BE ONE VOLCANO ALERT LEVEL SYSTEM (VALS)?

The purpose of a VALS is to provide:

- 'Bridge' between the physical and social sciences
- Simple shorthand to say 'PAY ATTENTION' for decision makers
- Coordinate hazard communication, management and decision making

Historically there have been discussions reviewing whether it is possible to develop one worldwide standardised VALS. These discussions focused on the physical hazards of VALS including:

- How to define a specific alert level
- Expressing different volcanic activity and hazards
- What information to provide and when

There was a lack in consensus for developing a global standardised VALS, due to the vast number of complexities involved. In practice VALS are not simple to use, this is because in addition to the wide variety of complex *physical dynamics*, there are *societal issues* that affect the ability for a VALS to fulfil its purpose. These are shown below:

Complex Physical Dynamics	Societal Focused Issues
Wide variety of volcano hazards i.e. lava, pyroclastic flows, ash, lahars, blasts, landslides, tsunamis, earthquakes etc.	Communication, decision making and management between the volcanologists, decision makers and users involved
Limited scientific understanding and modelling	Political, economic, and cultural issues
Provide timely alerts to both local and global users (i.e. local towns and aviation)	The structure and communication at an observatory
Incorporate varying abilities and capabilities to forecast activity which depends on: <ul style="list-style-type: none"> ▪ Monitoring capabilities ▪ Resources available to interpret data ▪ Extent of scientific knowledge on volcano's history, and data interpretation (uncertainty) 	Design of alert: <ul style="list-style-type: none"> ▪ The style: Colours / Numbering / Letters ▪ Information provided: Description / Instructions / Advice ▪ Communication tool: Single / Dual system for different users

What we know: a social science approach

This research approaches the problem of whether there can be one globalised VALS from a social science perspective using interviews and historical documents. The recent standardisation of the United States Geological Survey (USGS) VALS provides a lens to understand:

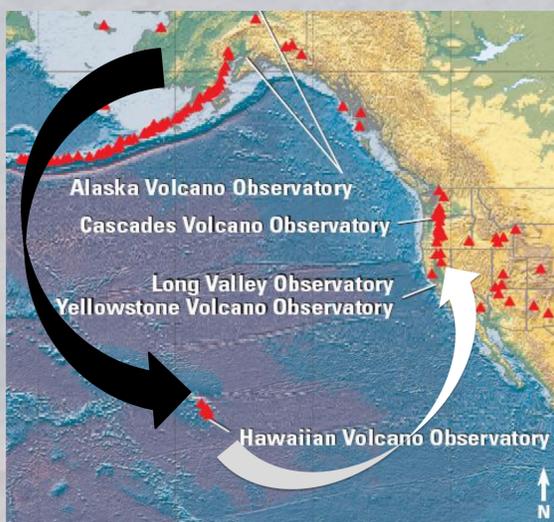
- The complexities involved in standardisation
- How this affects the local and global users of the system
- The impact of a standardised VALS on the USGS observatories
- The impact on the USGS's ability to provide an effective warning to different user groups

3. THE LOCAL VS. THE STANDARDISED NATIONAL:

The USGS case study provides a lens to compare the local VALS versus the standardised national VALS. Using a scenario for two users, one from aviation and one from the ground hazard perspective, some interesting insights can be observed.

Troublesome USA travels:

Everywhere the two visitors go has a volcano alert level of Watch / Orange.



1) Pilots Trip (Orange Alert)

Based on a story told to me during my research interviews about an experienced commercial Alaskan pilot flying from Alaska to Hawaii.

Alaska: Interprets that volcano is exhibiting unrest with increased potential for eruption. He makes a diversion.

Hawaii: When pilot arrives at Hawaii, he expects a diversion, however there is none as volcano has only a small ash plume that prohibits low level flying near to the volcano.

2) Lucky Tourists Trip (Watch Alert)

A Hawaiian resident who wants to brush up on some skiing and travels to California to visit Mammoth Mountain ski resort.

Hawaii: Eruption underway, but no effect on her unless she visits sites near eruptive activity.

Long Valley: When the tourist arrives, an eruption is expected imminently (hours to days). She would be experiencing severe seismic activity, and is likely to be evacuated.

- These examples highlight that although the alert level terms are standardised throughout the USA, they mean different things to users, and in different locations.

2. OPENING THE BLACK BOX USING STANDARDISATION

To date little has been published about VALS making them a black box (i.e. a system in which only its externally visible behaviour is considered and not its implementation or inner workings). The process of standardisation can provide a lens into the black box to highlight the complexities involved for the local and global decision makers and users of VALS.

Case study: the USGS

The USGS provides an excellent case study to review any differences for the VALS users in using a local versus a nationally standardised system. This is because the USGS had three different locally developed VALS prior to adoption of the standardised VALS at five of their observatories in 2006.

The USGS makes an interesting case study due to:

- Diverse range volcanic activity (from shield volcanoes to large calderas)
- Experience abroad with Volcano Disaster Assistance Program (VDAP), providing insights from crises all around the world
- Excellent resources and capabilities for volcano monitoring and observatory operation

The rationale behind the standardisation was:

- To provide greater staff flexibility in 'crises' and speak with 'one voice' using standard terms
- Less confusing for users i.e. different U.S. Federal agencies and mobile emergency practitioners
 - All about the bigger picture!

The recently standardised USGS VALS:

Term	Description
NORMAL	Volcano is in typical background, noneruptive state or, after a change from a higher level, volcanic activity has ceased and volcano has returned to noneruptive background state.
ADVISORY	Volcano is exhibiting signs of elevated unrest above known background level or, after a change from a higher level, volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
WATCH	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, OR eruption is underway but poses limited hazards.
WARNING	Hazardous eruption is imminent, underway, or suspected.

Color	Description
GREEN	Volcano is in typical background, noneruptive state or, after a change from a higher level, volcanic activity has ceased and volcano has returned to noneruptive background state.
YELLOW	Volcano is exhibiting signs of elevated unrest above known background level or, after a change from a higher level, volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
ORANGE	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, OR eruption is underway with no or minor volcanic-ash emissions (ash-plume height specified, if possible).
RED	Eruption is imminent with significant emission of volcanic ash into the atmosphere a likely OR eruption is underway or suspected with significant emission of volcanic ash into the atmosphere (ash-plume height specified, if possible).

4. WHERE DOES THIS LEAD US?

This table presents some of the issues raised from the case study, showing the pros and cons of a localised system versus a standardised national one, identifying four key issues:

Issues	Local (individual USGS Observatories)	National (new standardised system)
Users needs	Provides flexibility to local community but global users may be confused	Limits flexibility possible, but two systems specific for their users
Communication Methods	Local interpretation likely to be more effective	Common terminology and understanding, but must be known
Decision Making	Gear decision on local needs, circumstances and knowledge	Descriptions provide guidelines / criteria, but implications may vary
Management	Local stakeholders develop close relationships	Streamlines communication within federal agencies reducing confusion

This study indicates it is difficult for a VALS to be standardised and still maintain the benefits of a local system, in addition to being understood by users both local and global such as aviators.

What can we learn from this case study?

- Accommodating both the local and global remains a complex dilemma for VALS
- There is a need to learn more about VALS, in particular the related societal issues
- And review what works / doesn't work AND under what conditions

So can there be one worldwide standardised system?

1. The USGS case study highlights the complexities involved in just standardising nationally
2. Worldwide standardisation would have even greater differences in societal issues
3. Global standardisation is emplaced for aviation:
 - However implementation of it globally remains unclear, as currently only used in the USA
4. Standardisation for ground hazards is difficult as depends on the local scenario:
 - Populations and most infrastructure are fixed
 - Many volcano observatories already have a VALS in place

It may be useful and practical to establish some best practice VALS guidelines!

- Guidelines would need to review developing countries scenarios