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Moving for safety: a qualitative analysis of affected communities' evacuation response during the 2014 Mayon Volcano eruption

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Abstract

This study looks at the 2014 Mayon Volcano eruption to identify possible factors that contribute to the actions that people (local authorities/officials, community leaders, and residents) take during an eruptive period. We used qualitative analysis to examine interviews of people who experienced the August–December 2014 Mayon Volcano unrest, to determine the nature of people's understanding of hazards and risks, their decision-making, and response process. The thematic analysis shows that residents reacted to the information given to them in several ways- they evacuated when ordered (mandatory), chose not to evacuate for various reasons (e.g. they did not believe they are in danger citing experiences, inconvenience in evacuation sites, etc.), and evacuated even when not ordered to (voluntary). The local officials and community leaders were asked about their views on the possible reasons or motivations as to why residents would evacuate, and common themes that emerged were fear emanating from the experience of past eruptions, obeying the order to evacuate because it is the law, and order from provincial authorities (setting aside personal opinion on the state of the volcano based on experiential knowledge), and the potential to receive relief goods for those who are economically in need. This paper also looks at the challenges to local officials when an eruptive episode occurs- but the event falls short of the expected typical explosive behavior from the volcano. This study argues for people's experiential knowledge as an important factor in shaping views about hazards and risks that leads to the decision-making of individuals and its importance in risk communication strategies.

Keywords: Volcano alert levels, Narrative analysis, Evacuation response, Qualitative analysis, Experiential knowledge

Introduction

This work focuses on understanding how the people (local authorities/officials, community leaders, and residents) around Mayon Volcano use their knowledge from past eruption experience in shaping their understanding of the volcano's hazards and risks and in developing their views of ongoing activity. Their constructed views based on experience contribute to how they decide and

act when Mayon is declared with unrest. However, other factors come into play (e.g. considerations of affected livelihood, disruption of the way of life, a culture of obedience or trust and belief in leadership, etc). The timeliness of information received, the decisions, and actions on the information are crucial, as is the appropriateness of their responses. This paper explores how people interpret and attach meanings to hazards that influence their views of risks, from three (3) different perspectives: from local officials who work within organizations of authority (e.g. local Disaster Risk Reduction and Management Office or DRRM), community leaders, and from the residents at risk on the ground who live side by side with the

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source of hazards. This study also looks at the challenges in responding to a volcanic crisis, when major explosive eruptions do not ensue as expected.

It is not only the available information that determines how or even when people will act to manage the risks from different natural hazards. It also matters how people interpret the information, especially how they think it is meaningful to them. People interpret information in the context of their experiences, beliefs, and expectations (Bird et al. 2009). A positive response during the occurrence of a major hazardous volcano eruption not only depends on the public's knowledge of the evacuation plan but also their knowledge and perception of the possible hazards and risks (Paton et al. 2008). Eiser et al. (2012) recognized that people's interpretation of hazards and risks is shaped by their own experience, personal feelings, values, and cultural beliefs which are made complex by interpersonal and societal dynamics. Issues that can affect the interpretation of hazards are the timing of assessment and the nature of personal experience (Paton et al. 2001). Other factors that contribute to interpretation are access to information, capacity for self-protection, and trust (Eiser et al. 2012). Haynes et al. (2008a) recognized that for local officials, it is crucial to have an understanding of how people perceive risks and how they interpret a specific situation concerning hazards and potential responses during a crisis (Paton et al. 2008). In frequently erupting volcanoes, experiential knowledge of volcano behavior is recognized as a contributor to evacuation decisions (Barclay et al. 2019; Naismith et al. 2020; Mei et al. 2013). This work looks at how these theories and observations based on studies of behaviors of people and collective action as a community around active volcanoes in other parts of the world are manifested and observed locally in the Philippines.

In this study, we interviewed the people affected by the 2014 Mayon Volcano unrest and explored their narrative stories to identify the various reasons that may have contributed to their decision to evacuate or to remain, using qualitative methods, specifically narrative inquiry and thematic analysis. Narrative inquiry is the study of human experience involving the retelling of stories (Clandinin and Huber 2014) using interviews as a data collection tool (Connelly and Clandinin 1990; Clandinin and Connelly 2000). Narratives are stories people tell about their lives (Gray et al. 2005), and in this case, events related to Mayon Volcano eruptions as experienced by the interviewees. We note the importance of the "point of view" that distinguishes narratives from other stories (Frid et al. 2000). These narratives are important because they are situated within a broader cultural and social context and thus reveal social structures and processes. A particular strength of the narrative approach is that it

enables us to analyze how people typically understand and represent their own lives. Our narrative analysis draws from the philosophical traditions of phenomenology. Phenomenology is the nature of meaning that people construct in their lives that guide their actions, and in this construction of meaning, individual's beliefs are implicated (McPhail 1995). As a qualitative research methodology, phenomenology focuses on the study of an individual's lived experiences (Lester 1999; Pietkiewicz and Smith 2012; Van Manen and Van Manen 2014; Neubauer et al. 2019). In this method, we describe the meaning of experience, not only what was experienced but more of how it was experienced by these people. As science and risk communicators we need to know how to learn from the experiences of others for us to truly appreciate their views and decisions.

Evacuation behaviors

During volcano unrest, the goal is to save lives and immediate evacuation from the hazard zone is still the most effective means to ensure this (Tomsen et al. 2014). Evacuation is the removal of people from impact areas as a response to an imminent threat of disaster (Lindell and Perry 1993). It is moving people and assets temporarily to safer places before, during, or after the occurrence of a hazardous event to protect them (UNISDR 2009). The term *evacuation* is used to describe the withdrawal actions of persons from a specific area of a real or anticipated threat or hazard, and may last for any amount of time and may occur more than once. In Sorensen and Sorensen (2007), *shadow evacuation* is defined as the action when people evacuate from outside the official evacuation zone while *early or spontaneous* evacuation is defined as when people evacuate before an official warning is issued. In the Mayon Volcano local context, both are considered as *voluntary evacuation*. As used in this paper, *voluntary evacuation* is a type of evacuation when people move and leave without advisory, most often, their area is already outside the hazard zone. In a *mandatory evacuation*, an advisory is issued and people are ordered to move to safer locations or identified evacuation centers. The term *forced evacuation* as used for Albay Province in its released advisories, implies that when evacuation order is issued for certain areas, people are expected to follow. Once advisory for evacuation is issued, assisted evacuation procedure is coordinated, which includes dispatch of transportation support to pick up and ferry people. Government officials direct and compel all persons in identified hazardous areas to leave and move to safer locations for their safety. People may not be willing to leave but transportation provided by the government will arrive to ensure the movement of residents. *Pre-emptive evacuation* is another term used in

Albay. The term was popularized during Typhoon Reming of 2006. As the word implies, it is “taken as a measure against something possible, anticipatory or feared”. Here, it is evacuating people 24h in advance before the expected arrival of the tropical cyclone in the area. For the volcano unrest situation, this could mean expanding the pre-determined kilometer-radius zone.

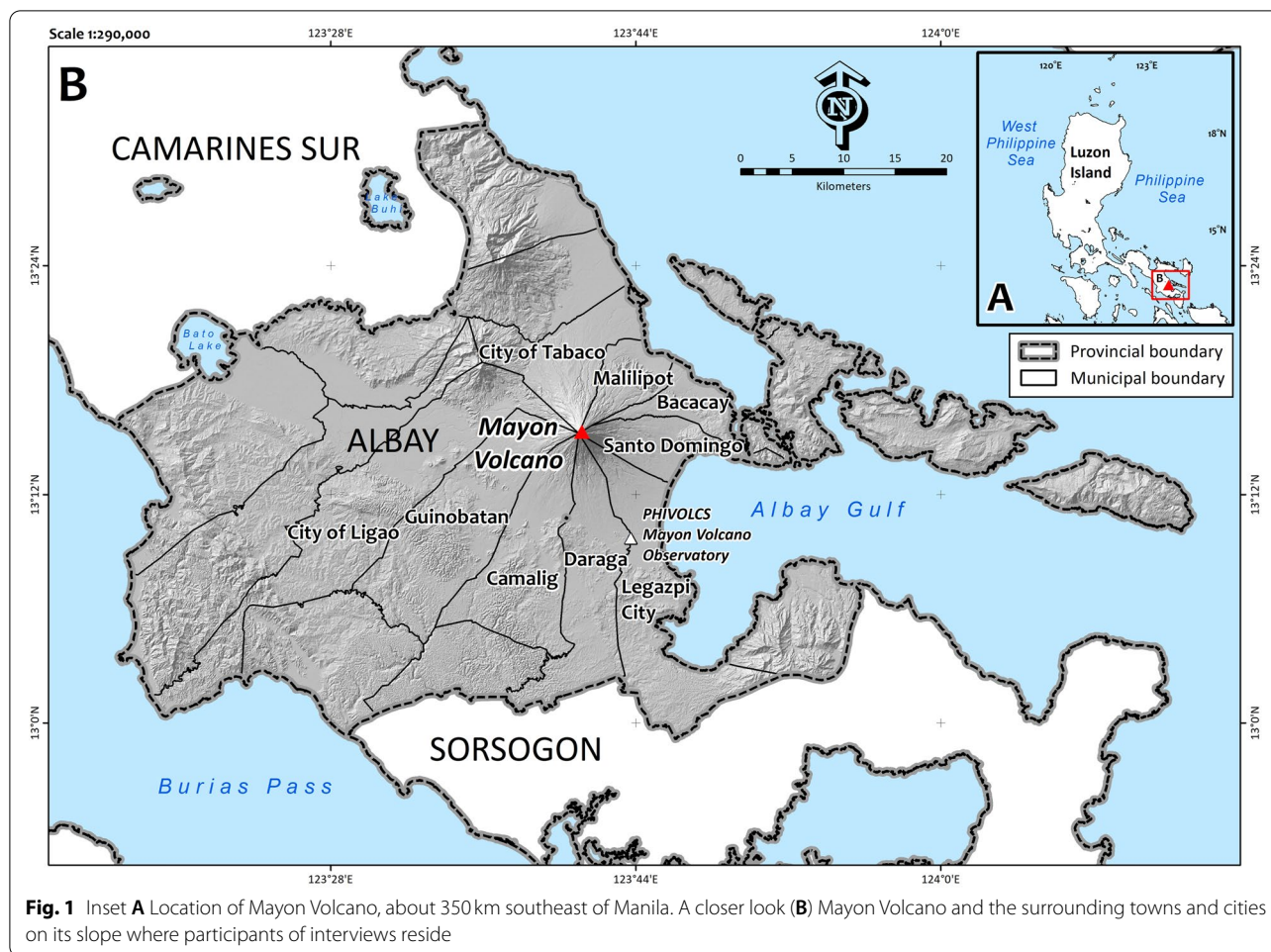
There are a good number of case studies of volcano eruptions and evacuations that looked at relationships of preparedness and response of authorities, and community actions such as Karthala Volcano in Comoros (Morin and Lavigne 2009), the 1994 and 2006 eruptions of Merapi Volcano, Indonesia (Mei and Lavigne 2012), 2010 Merapi Volcano (Mei et al. 2013), the 2007 Kelut, Indonesia (De Belizal et al. 2012), the 2010 Sinabung Volcano and 2014 Kelut (Andreastuti et al. 2019). All these are documented events with lessons learned in risk communication because of both successes and issues and problems encountered.

Many previous works also discuss risk communication, warnings, and evacuation behaviors during a volcanic crisis. Specific for volcano evacuation, Haynes et al. (2008b) highlighted that for local officials, it is important to understand how people perceive risks to improve risk communication. Qualitative and quantitative methods were used to analyze underlying attitudes and judgments during an ongoing volcanic crisis. Misunderstandings and misinterpretation of information and roles result from differing perceptions of risks. Acceptance or defiance to risks is not determined by knowledge (or lack of it) according to Rohrmann (2008). Paton et al. (2008) further reiterated the same idea that knowledge is not enough, and noted that positive response during volcanic crisis not only depends on the public’s knowledge of evacuation plan but also their perception of possible hazards. Similar to Haynes et al. (2008b), Paton et al. (2008) also recognized the importance for officials to understand how the public interprets the situation in relation to volcanic hazards. Paton et al. (2001) identified that issues that affect people’s interpretation are the timing of assessment and the nature of personal experience. Hazards can be experienced directly or vicariously (e.g. where individuals are aware of hazard activity in other parts of the country or world but are not themselves directly affected). Vicarious experience can also influence risk perception. This is again recognized by Bird et al. (2009), that it is not just the information that determines whether people will act to manage their risk, as decisions to act are determined by how people interpret the information (how meaningful it is to them), and people interpret information in the context of their experiences, beliefs, and expectations. This recognition of the importance of experiential knowledge of people living in

frequently erupting volcanoes is highlighted by Barclay et al. (2019), Mei and Lavigne (2012), Mei et al. (2013), Naismith et al. (2020), and Bankoff et al. (2021).

The local government structure and Management of Mayon Volcano Crisis

Mayon Volcano (13° 15.4', 123° 41.1') is located in Albay Province, southeastern Luzon approximately 350 km from Manila (Fig. 1). Its edifice is shared by three (3) cities (Ligao, Legazpi, and Tabaco) and the five municipalities (towns of Guinobatan, Camalig, Daraga, Sto Domingo, Malilipot, and Bacacay). In the Philippines, governance is structured into three (3) levels- provinces, cities or municipalities, and barangays. The general administrative and political term for these units is Local Government Units (LGUs). LGUs oversee local governance- from providing basic services to the people and ensuring peace and order. The smallest unit – a village is locally known as a *barangay*, which is headed by a village chief or *kapitan*. Several *barangays* make up a city or municipality, which in turn is headed by a mayor, while the province is headed by the governor. All are elected LGU officials with a 3-year term. In some areas, *barangays* are made up of smaller sub-units known as *purok* (less than 50 families) and for remote areas, these are usually isolated clusters of houses within the *barangay*. Under the Philippine Disaster Law of 2010 or Republic Act (RA) 10121, all LGUs are required to establish their Disaster Risk Reduction and Management Offices (DRRMOs) with 24/7 Emergency Operations Center (EOC), and these offices are to prepare their Disaster Risk Reduction and Management Plan (DRRMP). The DRRM Office in Albay Province is formally known as Albay Public Safety and Emergency Management Office (APSEMO, established in 1994). Coordination during a crisis is thru the Province-City/Municipal-Barangay level DRRM Councils (P/C/M or B-DRRMC) headed by the Governor for the Province level, the Mayor in the city or municipal level, and the *kapitan* in the *barangay* level. There exists at the national level a council known as the National Disaster Risk Reduction and Management Council (NDRRMC) whose members are representatives of the various national government departments (department secretary-level or heads), mostly for coordination purposes and national-level DRRM plans. There is a regional level- Regional Disaster Risk Reduction and Management Council (RDRRMC), and the local office that works with Albay Province is the Office of Civil Defense Region 5 (OCD Region 5) which is tasked to coordinate for provinces especially if an event affects multiple provinces. But, local governments under the constitution have local autonomy.



Monitoring and assessment of the volcano using its multi-parameter network is the mandate of PHIVOLCS. Volcano bulletins and advisories on the status of the volcano, and warnings by declaring increases in Alert Levels come from PHIVOLCS. The planning, preparations, and implementation of evacuation procedures are by the LGUs thru their DRRMOs. The PHIVOLCS and Albay Province have a well-established relationship when it comes to Mayon Volcano owing to the many experiences out of the repeated eruptive activities, which date back as early as 1984. After 1984, the PHIVOLCS drafted Operation Mayon (PHIVOLCS 1990), the first-ever of its kind, which was the original basis of the LGU Response Plan even before the existence of APSEMO.

Mayon volcano: geologic setting and a brief history

Mayon Volcano has 51 recorded eruptions since 1616. The 1814 eruption is characterized as Plinian while the more recent ones such as 1968, 1978, 1984, 1993, 2000, 2006, 2009 have been observed to have eruption styles that varied from Vulcanian or Strombolian or a

combination of these styles in one eruptive period. What people have witnessed through time was the generation of pyroclastic density currents (PDCs or pyroclastic flows), lava fountaining, and quiet effusion of basalt to basaltic andesite lava flows (Moore and Melson 1969; Corpuz 1985; Arboleda and Martinez 1999; Catane and Mirabueno 2001; Arpa et al. 2006; and Maeda et al. 2015). In February 1993, what initially started as a small but fatal phreatic event progressed to the slow but sustained intrusion of the lava dome on the crater floor that resulted in intermittent collapses due to oversteepening of the growing dome, generating PDCs (Catane and Mirabueno 2001). In the 2000 eruptive episode, quiet dome growth on the floor of the crater summit was followed by lava fountaining and tall eruption columns, generating PDCs (Arpa et al. 2006). Phreatic explosions that are difficult to detect occurred multiple times throughout Mayon's history. These events, although small are dangerous because of their sudden nature, and examples in recent times include the 2 February 1993 event that killed 77 people (mostly farmers), and the 7 May 2013 event that resulted

in the deaths of five (5) climbers. It is also the recognition of occurrences of phreatic events that necessitated the identification of the 6-km radius Permanent Danger Zone (PDZ) as early as in the 1990s (PHIVOLCS 1990).

Mayon volcano PDC Hazard map and alert levels

The Mayon Volcano Hazard Map for Pyroclastic Density Currents (PDCs) was generated by PHIVOLCS (PHIVOLCS 1990) (Fig. 2) to help guide the LGUs in their response planning. The huge gully (referred to as Bonga Gully) at the southeast sector starting from the crater lip was carved after the series of PDCs of the 23–24 September 1984 eruption. This feature served as a main topographic control for the direction towards which the PDCs of succeeding eruptive events (1993, 2000–2001, 2006, 2009 eruptions) would flow. Based on this configuration- where the crater lip is lower and open to the

southeast, PHIVOLCS delineated a sector in the southeast that is identified as of higher susceptibility compared to the other sectors around Mayon. The Bonga Gully also became the natural canal towards which the lava flows of 1993, 2000–2001, 2006, and 2009 eruptions flowed. It is expected that at some point, the gully will be filled by the succession of lava flows and pyroclastic deposits and this will affect the direction of future PDCs. Reassessments after each eruptive period were therefore done to determine any morphological changes (crater and channel configuration, especially depth) that could affect the direction of future PDCs. The version of the map used during the 2014 event shows the distance to where the maximum extent that PDCs can reach based on data from historical medium-scale eruptions.

There are five (5) main features on the PDC Hazard Map: (1) the area showing the maximum extent that

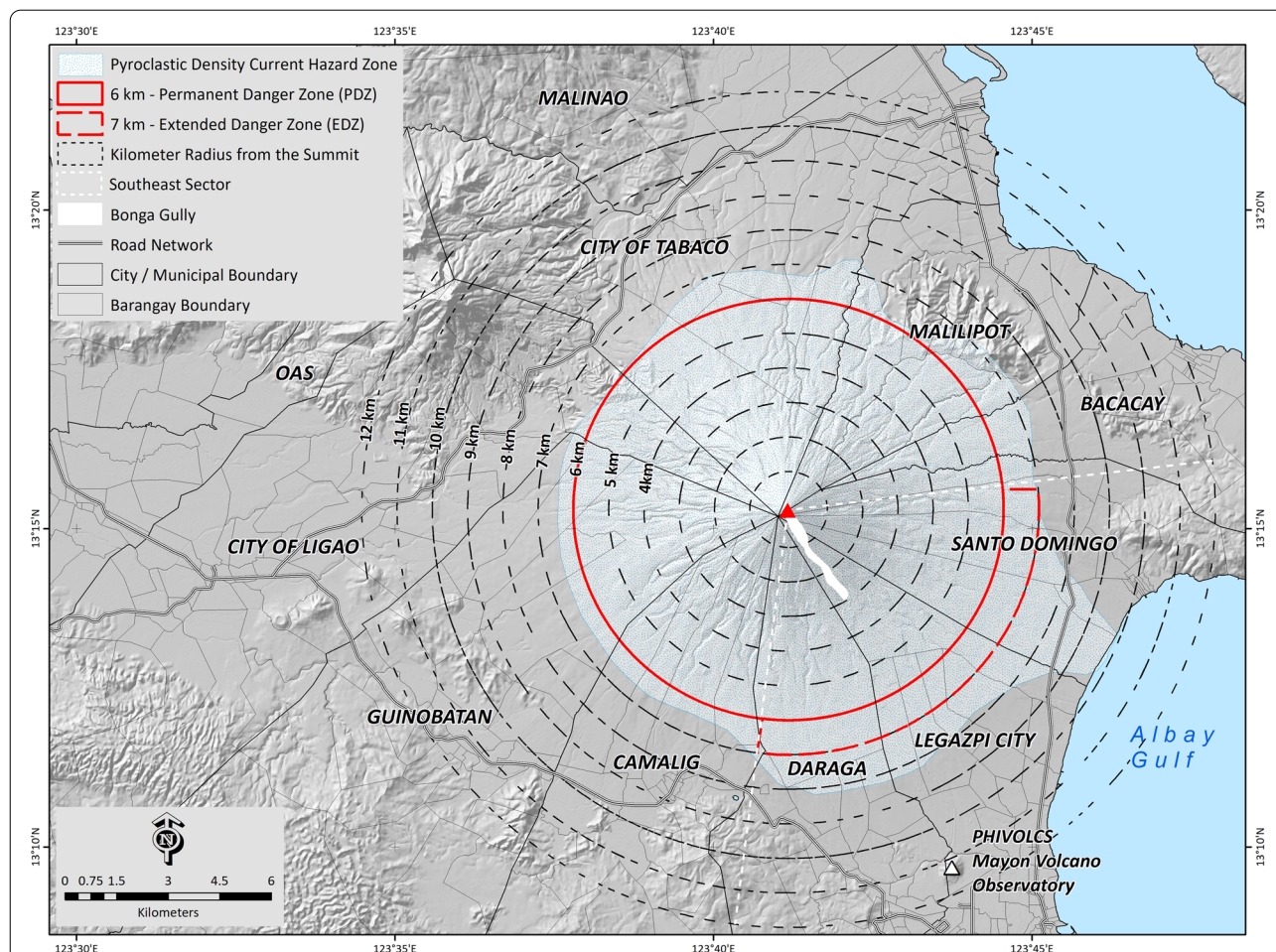


Fig. 2 Mayon Volcano Pyroclastic Density Current Hazard Map with kilometer radius (broken lines) from Mayon Volcano summit and location of *barangays* (villages). The 6-km radius Permanent Danger Zone (PDZ) is indicated in the red solid line. Note the Bonga Gully, which was formed after the 1984 eruption in the southeast, and the delineated area identified as High-Risk Zone (HRZ) enclosed in white broken lines in the southeast quadrant. Data sources: Danger Zones from PHIVOLCS, 2000; the Base map is an Interferometric Synthetic Aperture Radar - Digital Terrain Model (IFSAR-DTM) from NAMRIA, 2013; Administrative boundaries are adopted from PhilGIS, 2011

PDCs reached historically; (2) the area identified as most susceptible in the southeast sector due to the presence of the Bonga Gully (defined by broken line boundaries); (3) the identified 6-km radius Permanent Danger Zone (PDZ); (4) the 7-km Extended Danger Zone (EDZ) for the defined southeast sector; and (5) kilometer-radius distance from the summit that is used by the DRRMOs as reference for their operations. The area identified within the 6-km PDZ means that there are hazards (explosions, rockfalls, and landslides) that may suddenly occur within this area that any access and approach is dangerous, and could lead to serious injuries and death, as such, no permanent settlement is allowed.

For years, several barangays within the 6-km have been resettled but, full implementation has not been carried out. With its rich soil, farmers utilize the land within this zone during the period of quiescence of the volcano, with an understanding that at any time that an advisory such as an increase in Alert Level from PHIVOLCS, PDZ implementation should be heeded and the various LGUs are in charge of ensuring adherence to this.

The status of the Mayon Volcano is described using the PHIVOLCS Mayon Volcano Alert Levels with 0 (No Alert) to 5 (Hazardous Eruption) (Table 1). Each of the Alert Levels is guided by a set of monitoring parameters (Supplementary Table S1). Descriptions and implications of each Alert Level are also provided and this becomes the basis of Albay Province and all LGUs within the province to implement their required action. The last column in Table 1 presents a summary of these actions (Albay Public Safety and Emergency Management Office (APSEMO) 2014). In the same way as the PDC Hazard Map, this Alert Level scheme has also evolved, having gone through regular review and revised as necessary based on assessments especially after each major event.

Both the PDC Hazard Map and Mayon Volcano Alert Levels which were shared by PHIVOLCS with the LGUs were used as the basis for their contingency plans. So, even before the enactment of the RA 10121 of 2010, Albay Province already has an existing response/contingency plan, wherein *barangays* are listed according to distance in kilometer radius from the summit, and this is the basis of actions taken depending on the Alert Status of the volcano.

The most recent version of Hazard Map and Alert Levels by PHIVOLCS are integrated into the APSEMO Plan which includes specific action to be taken for each of the alert levels (Table 1). With the perfectly conical shape of Mayon Volcano, defining zones for evacuation is based on distance from the volcano summit. When advisories by PDRRMO are released, the directive for the evacuation of *barangays* is given according to distance in kilometer radius, for a more systematic evacuation process.

Each LGU has a prepared list of areas that are within a specific distance in a kilometer radius for ease of activation to operationalize their plan. Issuances of bulletins and advisories by PHIVOLCS especially increasing or lowering of an alert level are always done in coordination with the PDRRMC (Table 1). The City/Municipal Mayors have complete control and jurisdiction but all are members of the Provincial-level Disaster RRMC. During a volcanic crisis, the Province of Albay provides augmentation in the form of logistical support (e.g. transportation) as well as supplies (e.g. relief goods) to the various cities and municipalities.

The 2014 Mayon volcano eruptive activity and management of the volcano crisis

The 2014 Mayon Volcano eruptive unrest started on 12 August when visual observation of the summit crater revealed the growth of a new lava dome (PHIVOLCS 2014a). By 15 August, PHIVOLCS raised the Alert Level from 1 to Alert Level 2 and emphasized restriction of access to the six (6) kilometer-radius Permanent Danger Zone (PDZ). After 4 weeks, on 15 September the level was raised to Alert Level 3 following an observed noticeable escalation of unrest evidenced by an increase in recorded rock fall events, occurrences of low-frequency volcanic earthquakes, and observed crater glow. PHIVOLCS recommended the enforcement of the 7-km Extended Danger Zone (EDZ) on the southeastern slope (PHIVOLCS 2014b) (Fig. 2). There have been instances in the past of growth of lava domes in other volcanoes e.g. Merapi, in Indonesia (Lavigne et al. 2018), Unzen Volcano, Japan in 1991 (Nakada et al. 1999), and Hibok-Hibok in the Philippines in 1951 (MacDonald and Alcaraz 1956) and Merapi (Mei et al. 2013) which resulted to collapses when the domes became huge and unstable. These had fatal outcomes when ash clouds of the PDCs from collapsed lava dome engulfed people on the slope of the volcano. Similar collapse-type PDC-generating activities have been observed during Mayon's earlier eruptions (e.g. 1993 and 2000). The distinction in the different types of PDC-generation or mechanisms has been recognized by volcanologists. But, the subtle differences in an ongoing event may not be as visually obvious and certainly not as easily recognizable to non-scientists. An example of the case of Mayon is the apparent lack of huge, prominent domes as observed in Hibok-Hibok and Unzen volcanoes.

Materials and methods

This study covered the LGUs and their *barangays* around Mayon Volcano, specifically those within 6 to 8 km from the volcano summit (Fig. 2). The two main sources of data analyzed in this work were interviews conducted

Table 1 Mayon Volcano Alert Levels and Province Required Action

PHIVOLCS		APSEMO	
ALERT LEVEL	Description	Interpretation and Recommendations	APSEMO Required Actions ^a (2014)
0 No Alert	Quiet	No eruption in foreseeable future. Entry in the 6-km radius Permanent Danger Zone (PDZ) is not advised because phreatic explosions and ash puffs may occur without precursors	Normal Stage
1 Abnormal	Low level unrest	No eruption imminent. No entry in the 6-km radius PDZ	Alert Stage
2 Increasing Unrest	Moderate unrest	Unrest probably of magmatic origin; could eventually lead to eruption 6-km radius PDZ may be extended to 7 km in the sector where the crater rim is low	Monitoring Stage
3 Increased Tendency Towards Eruption	Relatively high unrest	Magma is close or at the crater. If trend is one of increasing unrest, eruption is possible within weeks Extension of Danger Zone in the sector where the crater rim is low will be considered	Evacuation Status (6-km PDZ), but preparedness stage in the Extended High Risk Zone (HRZ) in the Southeast Quadrant
4 Hazardous Eruption Imminent	Intense unrest	Hazardous eruption is possible within days. Extension of Danger Zone to 8 km or more in the sector where the crater rim is low will be recommended	Evacuation Stage. Evacuation of the population in the areas declared within the extended HRZ
5 Hazardous Eruption	Hazardous eruption ongoing	Occurrence of pyroclastic flows, tall eruption columns and extensive ashfall.	Emergency Response Stage. Full implementation of PDCC Emergency Response Plan. Complete evacuation of residents of barangays covered by the extended danger zones around Mayon Volcano

^a Minimum required actions. As what happened in 2014, APSEMO decided to advance evacuation termed as "pre-emptive evacuation." Areas evacuated (in kilometer radius) expanded and went beyond areas originally identified in the plan

as well as documentation such as advisories issued and records of evacuation shared by the LGUs.

Qualitative interviews

To gather data used for this work, we conducted interviews during the three (3) week-long fieldwork between June to November 2015. The purpose of the study is to document experiences and explore the narrative stories of people during the 2014 volcanic crisis. We focused on finding people that experienced specifically the 2014 event and were able to describe in detail their experiences. We also focused on the residents of communities within 6, 7, and 8 km-radius from the volcano summit as these were the areas affected by the evacuation orders issued by APSEMO/PDRRMC. Figure 4 shows the *barangays* indicated by letters where the people we interviewed were residents. The complete list of *barangay* names and corresponding codes as presented in Fig. 4 is in Supplementary Table S3.

To capture the different stories of experiences, we interviewed two (2) officials from national agencies, 7 from provincial-, municipal-, or city-disaster risk reduction management offices (P-C/M-DRRMO), 11 *barangay kapitan* and 37 residents (interviewees). Permission to be interviewed willingly was initially sought verbally from the interviewees, and this was formalized by obtaining written consent so that the data from the interviews can be used for this research. The interviewees are to remain anonymous to retain privacy (as required by the Philippine Law RA 10173/ Data Privacy Act of 2012) and are therefore presented here in their coded names. All field interviews were video-recorded then transcribed. Qualitative method- specifically thematic analysis of the transcribed interviews was used to pick out the “whys” of “how” people reacted, decided, and took action the way they did. The selected excerpts were categorized into similar topics and organized in tabulated form. For purposes of presentation in this paper, transcriptions originally in the local language (most we interviewed spoke Filipino) were translated to English. For this paper, we directly cite several quotes from the interviewees.

Documents and evacuation data from the LGUs

As the purpose of the study is to relate views about personal experiences and evacuation decisions, we also collected data on evacuation to present an overall picture of the community response. Data on the list of locations of pre-identified evacuation centers including the number of evacuees were provided by the APSEMO (Supplementary Table S3). In addition, other sources of data include the official documents collected from PHIVOLCS, APSEMO, and the LGUs which describe actions taken during the emergency period between August–December

2014. A review of the PHIVOLCS issuances of information via volcano bulletins and advisories, and how these were used by the APSEMO in their issued advisories and the cities and municipalities as a basis for decision-making, directives, and actions were undertaken. The location of schools used as evacuation centers were based on the Department of Education data of 2015.

Data and results

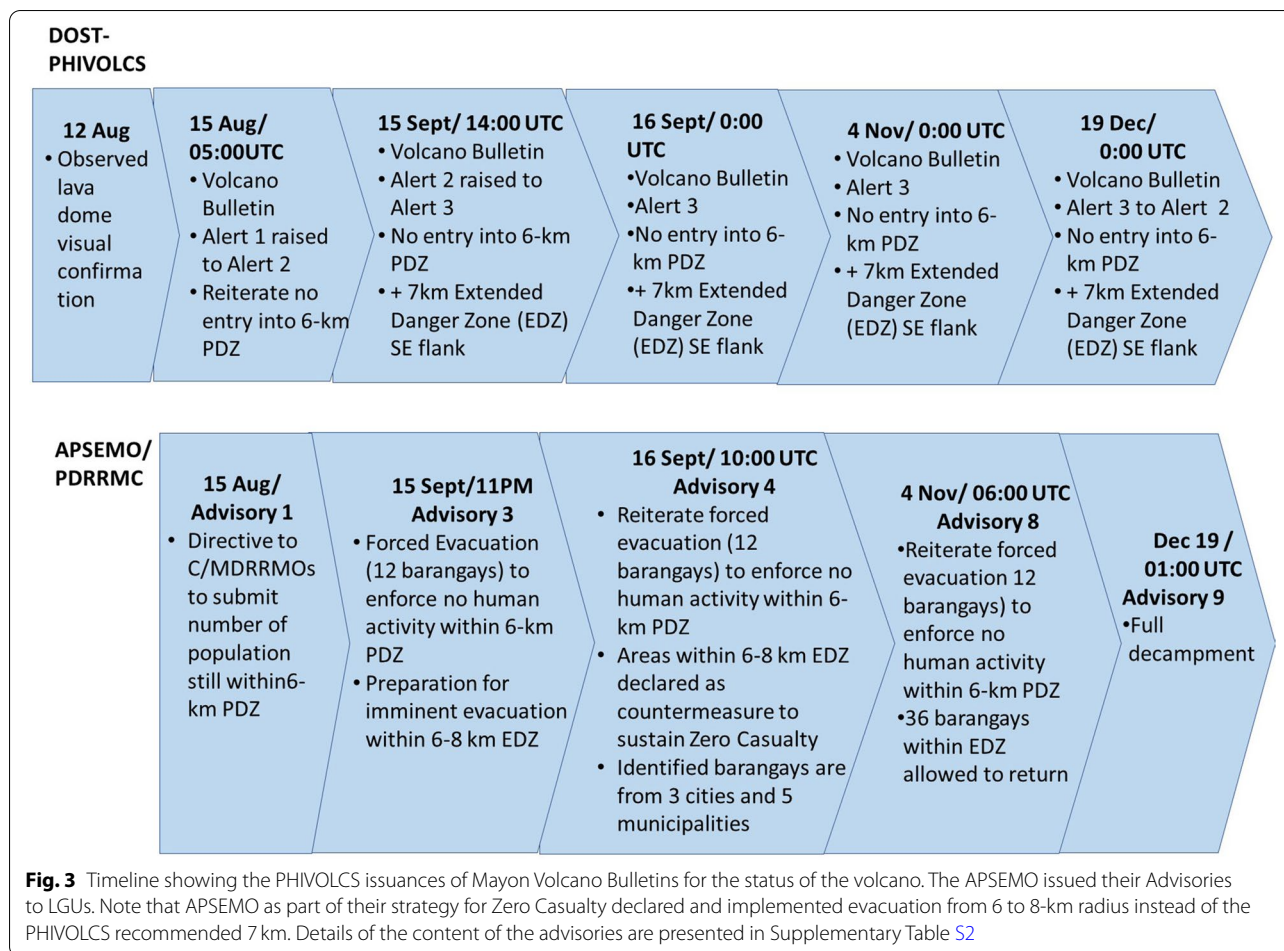
The 2014 Mayon Volcano evacuation process was organized based on a system tested by past experiences. The evacuation centers had been pre-identified and listed in the response plan and were made readily available for occupancy by the social work unit of each LGU. Transportation for residents was immediately dispatched with logistical support coming from the Philippine Army.

Moving people to safety in a volcano crisis is one of the most difficult undertakings, and managing the evacuated populace distributed in various sites eventually presents its challenges when prolonged. For 2014, one of the challenges was the strain on the resources of the local government and psychology of individuals who were affected. The situation was further compounded by various expectations and views and behaviors of the affected populace. First, we examined the spatial distribution of evacuees, then focused on the details of individual thoughts on the eruption and actions taken.

Mayon volcano 2014 evacuation data: spatial distribution

Albay Province prides itself to be prompt and organized when it comes to volcano eruption response owing to all the lessons learned from the experiences with many previous eruptions (e.g. 1968, 1978, 1984, 1993, 2000–2001, 2006, and 2009), and long-established APSEMO. The APSEMO and the cities and municipalities within the Albay Province are well-coordinated and use available information from PHIVOLCS (e.g. PDC Hazard Map, Alert Levels). The province-level DRR Plan and emergency response plan have a list of *barangays* within each kilometer radius and corresponding pre-identified evacuation sites. In the plan, most of these evacuation sites are buildings in government-run schools although additional government-owned facilities most often but not necessarily public school sites were identified. The system is activated during the increase in alert level.

The information on the observed increase in Mayon activities in August 2014 as released by PHIVOLCS prompted the APSEMO thru the PDRRMC of Albay Province to issue corresponding advisories and evacuation orders on identified *barangays*. First to evacuate were those residents in *barangays* within the 6-km PDZ on 15 August (Albay PDRRMC 2014a). Next to evacuate were those within the 6–8-km radius of EDZ on 16 September

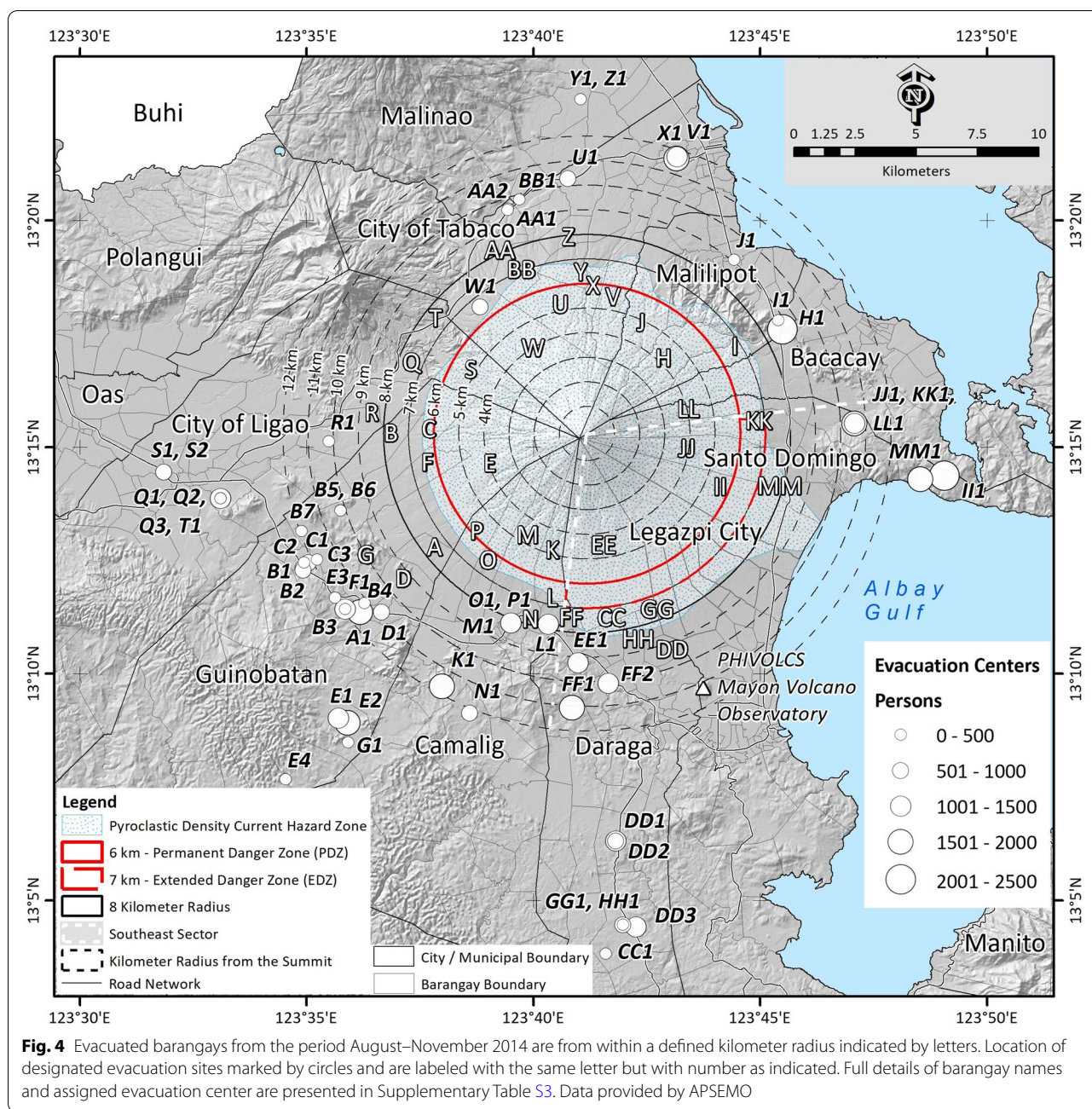


2014 (APSEMO 2014b,c; Albay PDRRMC 2014b,c). Note, that as part of the goal to reduce deaths and achieve a “Zero Casualty”, APSEMO extended to 8 km the areas to be evacuated in the SE sector – wider than the 7-km recommendation in the DOST-PHIVOLCS Bulletin (Fig. 3). Many, of the local populace, expected a display of typical explosive eruptions when the Alert Level was raised from 2 to 3. However, days passed and the days became weeks, and Mayon Volcano remained in its non-explosive lava dome build-up until it gradually ceased activity. By 4 November 2014, several of the identified *barangays* were issued clearance to decamp by APSEMO (Albay PDRRMC 2014d). By 19 December 2014, PHIVOLCS lowered the Alert Level to 2, reiterating that “the public is still reminded to avoid entry into the 6-km PDZ (PHIVOLCS 2014c).” The PDRRMC issued a full decampment order which was immediately implemented (Albay PDRRMC 2014e).

At its peak (Supplementary Table S3), the number of people in the 43 pre-identified evacuation centers (public school buildings) reached 40,000 with 9600 more in other

government facilities (not schools) and around 1600 people who opted to take refuge in private houses (mostly relatives in another town, etc). Most evacuation centers were located within areas just outside the 8-km to 21-km radius from the volcano’s summit (indicated by italicized letters in Fig. 4). For ease of operations and management, evacuation centers were confined within the jurisdiction of the LGU to which the *barangay* belongs. On record, the numbers indicated the total families and individuals that evacuated. More interesting to note were the details of narratives we found out in interviews. As the evacuation procedure was the responsibility of each LGUs to implement, variations among LGUs in implementation comes as a prerogative of the leaders and officials.

The experiences of the residents and *barangays* officials during the period from August to December 2014 were documented by interviews. The narratives captured the experiences covering expressed thoughts, their views, and insights about the hazards and risks from Mayon Volcano and evacuation. By reviewing the narratives, we were able to capture descriptions of information



dissemination, how information was used, and people’s decision-making. Issues on the evacuation process, evacuation center conditions especially the prolonged evacuation, and the awaited explosive eruption that did not happen as was expected surfaced.

Interviews about experiences: narratives on eruptions, decisions, and actions

In the analysis of narratives, five (5) themes were identified as follows: (a) comparison of Mayon eruption characteristics thru the years; (b) communication of volcano status at different levels; (c) information on Mayon Volcano Status and the decision- and action-making of officials; (d) implementation of the evacuation procedures; and (e) *barangay* officials’ insights on the residents’

reasons to evacuate or stay. Some significant statements related to these were selected as examples.

Comparison of Mayon volcano eruption characteristics through the years

How do residents of Mayon Volcano view eruptions? To appreciate the residents' experiential understanding of what to them is an eruption, there is a need to look back through their shared stories. We can only discern the residents' meaning of eruption hazards and risk, through understanding their experiences and interpretations. Some examples of stories are presented below, the location of the *barangay* where the resident belongs is indicated by the labels presented in Fig. 4 and Supplementary Table S3. Quotes from the DRR Officers are presented as coded letters and numbered DRR-# to maintain anonymity to which LGUs they belong.

"1984, it erupted in the early morning. I remember it was 24 September. We were asleep, then were awakened by the shaking. It was an explosion. Really very strong. Strong- Booom! The fire going this way (hand gesture upwards). The ash, smoking, billowing up like a cauliflower. There was smoke, then the leaves of the coconut trees drooped, like hit by a typhoon. So much ash. This 2014, there was no display of glow. There was none in 2014. I would try to listen at night when it was quiet because at night you can hear if there was.. that it's like breathing. None. I could not hear anything. Yes, in the previous ones, you can really hear it. It was like rumbling, you can hear like it is breathing...huum, hum, hum.. like that. Then, later on, the ash... hum, hum...hum...We were included in the list of those who were asked to evacuate, e. I did not want to. I know the situation of Mayon. It will not erupt, In my opinion, it will not erupt." -#21MB, Tambo, Ligao (Q)

"1968 only, ten years (referring to 1978), then 1984 there was also an eruption. I don't know what years after. Now, this eruption (2014), we did not see fire. Yes, before, we can see there was a fire in the crater. Now, this eruption, we saw nothing. Yes, this 2014. In 2008 (author's correction- should be 2009), we can still see fire, but for this one, we did not see. Because I think the crater lip is lower in the Legaspi and Camalig side. On this side, it is high. In'78, we can see the fire. Yes, it was like a fountain. And there was a sound like- ..hung! yes, we could hear it clearly at times that we could not sleep. Like it is tired, and you hear hung.hung! only. Like a fountain. It erupted like the ash went up." - #8LC, Tambo, Ligao (Q)

"1968 Mayon Volcano eruption. 1978, 1984, 1993 right? And then these succeeding eruptions, the small, bits, and pieces. If you will recall, the strongest eruption to my experience is 1993. The latest one (the 2014?), no maám. It was only a phreatic explosion last year.... Small.. getting smaller and smaller. It was small. It was small, right? I did not see.. we did not experience lava fountaining..none.. we did not see that." - DRR-9

In the narratives, most referred to experiences from past eruptions and cited specific years especially when they gave their views and described their thoughts about the 2014 event. Based on the narratives, one or several of these events were cited by the residents and *barangay* officials: 1968, 1978, 1984, and 1993. The eruptions of 2001, 2006, and 2009 were sometimes mentioned but did not have an immediate memory recall – some even referred to these events as “minor”. Most of the residents' descriptions of past eruptions had either complete display or combinations of rumblings, explosions, ground shaking, the fireworks-like spewing of rocks and ash showers. From the narratives, the 1984 event was by the far the one that residents felt their lives were in danger that necessitated self-evacuation. Many recalled the tall ash column, lava fountaining, ashfall, felt shaking of the ground, a sound which was either explosion or breathing-like or rumbling from the volcano. The 2014 event by comparison was thought of as mild to none at all by the residents and *barangay* officials, yet many evacuated as they followed orders to do so.

Communication of Mayon volcano status in 2014

As pre-arranged, APSEMO directly received information from PHIVOLCS. As soon as information was received, APSEMO convened the PDRRMC for information dissemination and consultation, and decision-making. Daily meetings for updates jointly convened by PDRRMC with the OCD-Region 5 and PHIVOLCS were held during the 2014 unrest. Which channels were used further down the line to disseminate information about the volcano's status? When asked to describe how information was received, the *barangay* officials and residents we interviewed identified the use of mobile phones, access to the official website of Albay Province, official social media, meetings, and the traditional but still utilized passing on of information by the *barangay* officials themselves doing the rounds in their area (word of mouth). In most situations, the C/MDRRMC is the primary source of official information for the *barangay* leaders (BDRRMC). However, the APSEMO has engaged in a multi-level approach using SMS/mobile phones. In the past, (pre-cellular phone, pre-SMS years) the original setup was that

APSEMO would pass information to the municipal level. This has drastically changed with time.

“At present, it is emplaced and works. It is fast considering it’s from the Governor’s social media now it is so easy and then Governor to Mayor and MDRRMC. Everything is easier now because all are on call 24/7. The MDRRMC, even us, in the middle of the night we receive and send text messages....For the evacuation order, even before it was called, there have been some discussions about who to evacuate on the first day. It was eleven o’clock in the evening when they announced forced evacuation. This was even before the MDRRMC officer sent their text messages, I already knew, and everything I received from the governor. I forward to all the barangay councilors. For the alert, what happened is that the first evacuations happened at 11 o’clock, but immediately after, the following day, the people went down already.” -#28PN, Cabangsan, Camalig (L)

“Sent text messages, then they called, then sometimes they would come here because the MDRRMC they wait for the go signal from PDRRMC. Yes, then the PDRRMC sent to MDRRMC, then to BDRRMC in the barangay.” - #45RM, Tumpa, Camalig (P)

“We were called by the mayor to hold an emergency meeting. Then the Governor offered forced evacuation. So that night, at 6 o’clock the people needed to go down. Yes, it was automatic. Because I was also scared that I will not be able to fulfill my duties with the people if something happens, it will be difficult, right? So we need to abide by the will of the government. Those who were stubborn, I asked them to sign.” -#69 MB, Comon, Tabaco (V)

“Over the radio. On TV, and the government is active. For example, if there is a problem with Mayon, all the kapitan will be called for a conference. Then when kapitan comes back, he will hold a session, an emergency session, and will tell us what was discussed in their conference.” - #66FB, Oson, Tabaco (Y)

Information on Mayon volcano status and the decision-making and actions

From the review of documents during the eruption, APSEMO through the Albay PDRRMC released Advisories to all concerned local chief executives (LCEs- collective term for mayors). At least 9 PDRRMC Advisories were issued starting 15 August when the Alert Level 2 was raised by PHIVOLCS. Figure 3 is the summary of

retrieved Advisories put in a timeline to compare these with PHIVOLCS releases of Mayon Volcano Bulletins. Details of the content of the advisories are also presented in Supplementary Table S2.

The PHIVOLCS Mayon Volcano Bulletin dated 15 September 2014 when the Alert Level was raised from 2 to 3 recommended: “no entry into the 6-km radius PDZ and the 7-km Extended Danger Zone on the southeastern flank be enforced.” The recommendation only covers the 7-km Extended Danger Zone (EDZ). However, with its “Zero Casualty” goal of the province, the 15 September Albay PDRRMC Advisory 4 states “evacuation of the 10,000 families in the 6-8 km EDZ buffer zone.” In this pre-emptive evacuation scheme, the province opted to be a step ahead. This declared area is defined in APSEMO Mayon Volcano Preparedness and Response (2009 Action Plan). In the plan, it is stated that during Alert 1 “the 6 km radius is in effect,” on Alert 2 “the zone is extended to 7 km in the southeast” and on Alert 3, “the zone is extended to 8 km southeast.” Here, the anticipatory nature of APSEMO was reflected- to take actions for the safety of the people- by having phase by phase orderly evacuation and planning to have support for the evacuees for an extended period. However, this kind of action required sufficient support that can be given to the evacuees and the local government needed many resources to sustain this work. With time, as the event unfolded, it was not only the required support. The local government also needed to deal with the increased restlessness of people in the evacuation areas when there is uncertainty felt, regarding the activity or perceived inactivity of the volcano. The following were insights from the DRRM Officers about the implementation of the evacuation order.

“Yes. It is the provincial that communicates to us. I think the governor is always nervous, so, really, this is over the record, we lose funds even if there is no eruption yet.. just being on the safe side always.”- DRR-5

“Aah, it depended on what the province will say. Until we reached the 8-kilometer danger zone to be evacuated. Last year, we asked them to evacuate. Aah those within 6 km, together with those within 8-km, because there were barangays with a portion of purok in xxxx which was within 8 km, so they were brought down.” -DRR-4

“During the time, last year we had what we call “forced evacuation” within the 6-km then the 7 to 8 extended danger zone. Yes, extended danger zone, that’s how PDRRMC referred to it. So we evacuated up to 8 kilometers. Then after November 16, we had

a strategic decampment. Those families within the 6-7 only they were left behind. We had full decampment on December 16....Aahhmm for the evacuation- forced evacuation- they follow, but for several days..then the heads of the families they would go back. Their number one reason was to monitor their properties, then they said it was not convenient to stay in the evacuation center, since imagine they have stayed for almost 3 months in the evacuation centers.” - DDR-6

“The difference with 1993, there were more people who evacuated (in 2014)..they were very cooperative, and the Mayon activity was very visible then (in 1993) (what do you remember of 2014?) None, they just said, there was an ongoing activity at Mayon... But I am just an ordinary person, I did not see that Mayon was active, that needed to evacuate people. (if there was no order?) we will not evacuate people, no. No, not even the 6 km. If there was no order from APSEMO.” – DRR-9

One LGU stood firm and did not enforce evacuation that covered areas within the extended 8km, reasoning they had very few families within 7km and that the majority of clusters of the households are located outside the 8km radius. Still, they opted to do selected evacuation of these identified “few families”.

“Because the order of governor that those within 6 km extended to 7 km danger zone, those should be evacuated. But xx is not within the area, well there were a few families that you can count with the fingers of your hands, so we did localized evacuation. The people were moved to the barangay hall and to their relatives who lived far, for example in xxxxx. So we let them stay in the barangay hall, which is 10 km away. ...Local, then, because we are under the province, we should follow...but we did not have residents living up there, well...if there were (within 7 km), it will just be few families, so what we did is localized evacuation, so in the vicinity but people are ready.”- DRR-2

Evacuation experiences: evacuation procedures; experiential knowledge and views about 2014

Lay people’s views on evacuation Based on the narratives there were two major actions taken by the residents: did not evacuate and evacuated. There were various reasons identified by residents who opted to evacuate. Some evacuated, upon issuance of advisory, citing better to be on the safe side, or readiness to abide by the mandatory

nature of the order. Some of those who evacuated waited for the order and pick-up transportation. Some unwillingly evacuated or were forced to evacuate when the military personnel came. The following presents some thoughts from people as to why they evacuated.

“..evacuated willingly because nobody here is left behind because what we want is there will be no casualty. That is how it should be as we can never tell if something suddenly happens at night, so we should ask people to leave.”- #33JS, Sua, Camalig (O)

“Yes, the truck picked us up there. (if you were not picked up?) We will go down. We are ready, the others took the tricycle.” -#27 ML, Anoling, Camalig (K)

“Here, the Mayor does not neglect us, we are always picked up.” - #34 RM, Tumpa, Camalig

“...we were afraid of the military.” - #16 CB, Baligang, Ligao (S)

“Yes, there was an order, e. Because there was an order from the governor for a zero casualty. I became a barangay official in 2013, so we need to do this as our responsibility compared to when I was not yet an official. Of course, we follow because we also would like to avoid..” -#50HR, Muladbud Grande, Guinobatan (B)

“We evacuated. When the government says so. There was nothing else. Of course, when the government says you should evacuate, then you follow.” -#70 CM, Matnog, Daraga (GG)

The majority of the residents evacuated based on the summary report of evacuees presented in Fig. 4. In the narratives, some expressed concerns about staying in the evacuation centers and would have preferred to stay in their homes. This was well-expressed:

“The 1968 event was prolonged because we stayed too long in the evacuation. We were asked to leave this place. Of course, we were scared. Also, the trucks came to pick us up. (if no transportation is provided?), we will just stay, we cannot go too far, as there will be nothing to eat out there..because if you evacuate if not asked to, there will be no supplies for you. But if they pick you up, the government will provide relief. In 1968, it was already erupting for 2 weeks. Two weeks before the government took us. But now (2014), it is better, it has not even erupted yet, they pick you up and get you. I do not know, why?

Maybe they are far better at getting support. As it is going to erupt, alert, alert status and they are getting us out of here. I hope, we do not want Mayon erupting, because even if they give us food provision, yes there is food there, our source of livelihood suffers, and besides there will be no people here, we might lose our stuff, our livestock..so it is difficult when it is erupting. If it were only us, if we are to decide, ay we do not want to leave. It's our livelihood that is affected. And it is difficult in the evacuation site. People can get sick there. But we have to follow the orders of the government. If something happens to us, where to put the blame but on us." -#17CV, Amtic, Ligao (T)

"You know this government. When they say 6 kilometers danger zone, they will evacuate. When they say the 7 km or 8 kilometers are included, people will evacuate, but they are picked up here. For example, Mayor xxx says evacuate. For this now, (2014), we evacuated with this Alert only, it is not even erupting yet. Because even if we do not want to, we were forced to leave. They said-" If Mayon erupts and something happens to you, do not blame us." So, if you do not obey, and something happens, so what happens to you? Of course, our lives are more important. We get our food from here. We will not depend on them. It's only with the animals. In the evacuation center, you can not just wait to be provided with supplies. You should bring your own money. They will not provide you with everything. Soap, etc. they will give you a kilo of rice, canned sardines. So, if we can have a choice to decide, we will not evacuate. The space is cramped and unsanitary. So people can get sick in the evacuation. But the mayor will get angry if you do not evacuate. Even the kapitan of barangay, the mayor asked them to evacuate the barangay, so the barangay officials went around – house to house, asking people to leave. If you do not obey, the mayor will be angered. The governor ordered this. Their reason is to ensure our safety, of the people. Yes, it is good if people are safe. They ensure our safety. But in the evacuation center? Difficult. Then the volcano did not erupt. There was just some minor shaking, you can feel sometimes. But there was no strong ash emission. There was no explosion." -#17CV Amtic, Ligao (T)

Residents who evacuated but would return Some also admitted that they evacuated but would now and then go back to quickly check on their farms and livestock. Sneaking in is potentially more dangerous and

problematic to the local authorities, so informing authorities for more coordinated moves would have been preferred. More coordinated and orderly visits were done in Merapi 2010 (Mei et al. 2013). In Kelut, residents were ferried by truck provided by the government for various purposes – visit livestock, check houses, (De Belizal et al., 2012). This move needs to be done with caution as a similar practice of occasionally returning to high-risk zones by day for crops to be harvested has been reported to have fatal outcomes in Monserrat (Barclay et al. 2019).

"E, we are scared, but we have our farm here. Yes, we go back during the daytime. We are used to it, madam. Of course, I evacuated my family. I, I am certain, I can run, and hide in dens." - #51 JF, Muladbucad Grande, Guinobatan (B)

"We would go there then come back again because they do not check, that's why we go back and forth. We also have animals. For the others, it was difficult there to cook food then it was difficult to take a bath. So we go back quickly then leave again." - #52 PM, Miisi, Daraga (EE)

Reasons why residents did not evacuate Those who were within the hazard zone (outside 6, between 7 to 8 km) but refused to evacuate believed they were not in danger citing that they have many experiences in the past and they would know if they were in danger considering that they have not observed any of the usual signs. The nature of personal experience plays significantly on how the residents reacted, with some saying that "we know when" it will erupt, and "I think it will not erupt". Residents as well as some *barangay* officials believed that they did not think the 2014 Mayon activity was strong enough to merit an evacuation.

"No. We are a force here, not that we are a hard-headed lot. We know the extent of the area that will be affected by what Mayon Volcano spews out. There were more deaths at the evacuation center than here." -#5MM, Bonga, Legaspi (QQ)

"I was left behind here. Eh I did not want to. I told them they go ahead. No, I stayed here. Ay, I felt bad for the animals. If I abandon them, my carabao will be pitiful if there is nothing to feed him." -# 15-AQ, Baligang, Ligao (S)

"Those who were evacuated, within 8 kilometers. We were included but we did not evacuate. I did

not want to. I know Mayon's situation, it will not erupt. E I practically grew up here, like a rooster this is where I have grown my white hair. You can feel if Mayon is decided to erupt. Even if you hear those on the radio that it's supposed to erupt, see on tv that there are indications that in the coming days that it was supposed to erupt because of the magma. We did not evacuate before, but we monitor. We are ready with our truck. We do not go to the evacuation center because you can get sick. You can get sick there. Yes, it is true they have this and that there, as some say, there is meat. But if for 3 days I do not get to eat vegetables, I will get weak I want vegetables. E there, it was all canned goods, noodles of all sorts. I don't like that, I need vegetables. Here the vegetables are fresh. You just get from here." -#21MB, Tambo, Ligao (Q)

"Well, we did not evacuate. No, we stayed here. It was not strong (the eruption). Yes, but that others evacuated. My children who were here, I asked them to evacuate. My wife and I guarded this house. My wife and I are already old. I am 62. I am not afraid. No, and we already know what that (the eruption) is." -#54 RM, Matnog, Daraga (GG)

"It's always been like that, when Mayon erupts people are asked to evacuate, even if it is not serious.. even when it is not a strong eruption." -#65 MB, Magapo, Tabaco (U)

For residents of active volcanoes such as Mayon where eruptions have been experienced so many times in the past, visual and auditory evidence can significantly influence hazard perception and can bring out a better response to warnings (Martinez-Villegas 2017; Lindell and Perry 1993). This reliance of residents on experiential knowledge of volcanic behaviors was recognized by Barclay et al. (2019) and reiterates what Bankoff (2002) has referred to as *culture of disaster*. Aside from the seeming lack of obvious visual and auditory signs that some residents have been used to, others cited inconvenience in the evacuation centers and so opted to stay behind. Conditions in the evacuation center and concerns of getting sick there were also expressed.

Barangay officials' insights on residents' reasons to evacuate or stay

From the narratives, we found responses from the *barangay* officials, especially their views as to why their constituents would opt to evacuate or not. Three motivations emerged: fear, abiding orders from an authority, and potential support that will be received.

Fear- as a reason to evacuate Fear is an unpleasant emotion caused by the belief that someone or something is dangerous, likely to cause pain or a threat. Several responses expressed this *fear* of what the Mayon eruption can do based on their experience. One even mentioned that they will not wait to be evacuated if they see the need to do so, based on what the volcano will display. The concern was personal safety and for the family's well-being as reasons for evacuating. The feeling of personal safety seemed to be based on knowledge from personal experience as to what the volcano can do. For the 2014 Mayon Volcano case, the effects of PDCs and lahars in the past (e.g. 1993) were embedded in the people's memories and influenced their perception of the possible hazard (Paton et al. 2008) thus the fear, and so there were some reports of people that voluntarily evacuated. Voluntary evacuation as defined earlier refers to people moving out on their own even without advisory to do so as they are actually outside the identified hazard zone or defined kilometer radius for a particular Alert Level.

"It's the fear, the others, it is fear that prevails in them because of their experience." -#56-CB, Fidel Surtida, Sto Domingo (JJ)

"People can see the need to evacuate because even if you do not tell them when you see it is an eruption and seems to be escalating, even if you do not tell them to, they will leave... Because the majority especially those with children, the children get scared easily, so they need to be evacuated. When an alert is raised to 3 or 4 or higher, then we have to evacuate." -#4EP, Buyuan, Legaspi City (PP)

"Alert 3.. we evacuated residents living within the 6-km permanent danger zone. But those in XXXX, even if it is not within. It is outside.. the location is a bit uncertain, so they evacuate. But if you will notice, based on our records, they (XXXXX) were not listed as within 6 km, but they are affected – like the schooling of their children. So we recognize this (but not in writing). But because there is their argument, with my long service/ experience here. Can you take on the fear for us, if we stay there? Right?" -DRR-9

Obedience: follow order or abide by authorities as a reason to evacuate One commonality in the responses was that local officials abide by the order of the high authority, for this case the Provincial level, citing the "Zero Casualty" as adapted by the Province. Evacuation orders by the local government were mandatory.

In the statements, it is not easy to quickly discern whether “abiding” the advisory emanates from full recognition of the Province as the authority. There certainly was some buy-in to the idea, a great belief, and trust in the local authority especially in the campaign for “Zero Casualty” that many *barangay* leaders constantly cited during the interview. On this aspect, there is a need to reassess the goal of attaining “Zero Casualty” as it is important to recognize how and in what ways we can help people in minimizing risks.

But there was also a “fear” factor for possible repercussions in case of non-compliance. One local leader said that the choice for them was to be on the safe side so, “better to follow the order,” “for our safety.” *Barangay* officials felt responsible for the safety of “their” residents. Another said the “military” was there knocking at your door- so there must have been some feeling of being intimidated as well, that they were compelled to follow. Applying “forced evacuation” by the local government with help of police or the military can overcome difficulty in evacuation to save lives, but may also have some negative implications later on (Tobin and Whiteford 2002).

“We were called by the Mayor for an emergency meeting. Then the Governor offered forced evacuation. So that night, at 6 o'clock the people needed to go down. Yes, it is automatic. Because I was also scared that I will not be able to fulfill my role with people if something happens, it will be difficult, right? So We need to abide by the will of the government. Those who are stubborn, I ask them to sign.” -#69 MB, Comon, Tabaco (V)

“Ay, there is no problem, ay we go down because that is what the mayor wants. Uuhm, that is- to evacuate... E what they are thinking of is for “zero casualty”, according to the governor.” -#16-JB, Bali-gang, Ligao (S)

“There was an order for us, the mayor ordered us to evacuate.. for our safety, so we followed.. yes when there was advise to evacuate, we evacuate (p5).. aahh, when there was an order from the municipal especially now that I have a position, it was automatic, I inform my co-officials, and they also go around..there are those who hesitate, ask “why do we need to leave, it is not strong yet, we were not affected yet..” to us, we tell them, it is better to follow the order of the higher officials/ authority.” -#6 EL, Alcala, Daraga (DD)

“There are those who are willing, others are forced to join, because they are concerned about the difference in their comfort inside an evacuation center, compared to when staying in one’s home. And the others are stubborn, they say they have lived here for so long and have experienced eruption, but nothing happened to them.” -#28-PN, Cabangan, Camalig (L)

“To me, it is okay of course, when you equate preparedness against resources. The resources available to be used, at least it was being provided to the people. At the same time, we were able to test the capacity of local officials dealing with more than 3 months of evacuation and camp management...To me, to see that the people are safe and that we can provide to them their basic needs. Their needs despite and despite limited resources, but because of coordination, the provincial government, and other NGOs are helping each other.” -DRR- 6

Relief goods– potential support that will be received as a reason to evacuate Some local officials mentioned that there were people who followed the advisory and evacuated because of the potential support that will be received. This confirms what has been mentioned in passing by some during the interviews. Some local officials dealt with this situation strictly while others chose to accommodate.

“There were others, because of what one can say, they were really after the relief goods being given... Because of their need. They are the ones who get angry. We have a list of those who should evacuate, only those within 6 km danger zone., so this was accounted family and they were the priority to be evacuated, but that does not happen always.” -#56-CB, Fidel Surtida, Sto Domingo (JJ)

“Purok 1 and 2 were also farther downslope, there were those, that if the mayor says these certain groups were not included, then they were sent back home..those who evacuated on their own, when they reached the site, we told them we do not force them to go back. We tell them they are not included in the 1,2 because the order is for them to return.. maybe because some of them, because of dire need..E they learned that every time there is evacuation, those will have relief.. at least it would help them..” -#25EG, Quirangay, Camalig (M)

“Even the students have been displaced, because

we have schools within 7 km, so they were displaced.. they also had to go to the evacuation center, they said it's a burden to them, economically as they had to have fare for transport to go to school, there were those who did not go to school because it was not easy...that's what they said... then those within 9 km buffer zone, they want to evacuate – because they are unemployed, those are the ones that we turn down... we have monitoring cards with names...those even outside 8 would like to go. Maybe it was after a month, because of the assistance, because the governor declared an open city, it was open so many assistance poured in for the evacuees, because in a day, there will be 3 to 4 NGOs, and the regular supplies/ration that we give was not included yet, so those without work within the 9 km would volunteer to evacuate... especially ma'am those relocatees, those who have been permanently relocated where they are safe... they want to go to the evacuation center just to enjoy the benefits... but no, they are not given anymore because we have a card. We are strict on this.” -DRR- 6

The plight of relocated residents with farms upslope within the hazard zones

Despite the recurring volcanic hazards, the existence of settlements around the Mayon Volcano came long before the PDZ declaration which was only after the 1984 eruption (PHIVOLCS 1990). There is an ongoing program for resettlement and some in the past years have been implemented. Resettlement is a slow process as it needs

consultation with affected residents within the PDZ- it is the source of their livelihood. The PDZ in principle is the area declared as no permanent residence, but during quiet times of the volcano, the people utilized areas within 6km for farmlands and other livelihoods. This gives truth to the suggestion of Bachri et al. (2015) that people choose to live with volcanic hazards because of the benefits and opportunities, for this case livelihood. This use of farm land during Mayon’s quiet period was practiced, with the understanding that once the Alert level is increased, implementation of No Entry takes effect, so this leaves the farmers in economic difficulty when Mayon erupts.

Based on the APSEMO June 2014 list- certain barangays have been resettled. These relocatees still maintained their temporary house upslope on Mayon during quiet times. This was mainly for a place to stay as they tended to their farms and livestock. Technically, they were not entitled to stay at the evacuation centers nor to receive government support. But there was a need to consider their plight, as they depended on the land on the slopes of Mayon for their livelihood.

“We did not evacuate as we have been relocated. So we were at the relocation site. But, our livelihood is here, there is no work at the relocation site. When there is eruption they go back to the relocation site.” -#53 SM, Budiao, Daraga (CC)

“Yes, all. Very strict. Very strict..and we have our place. At the relocation, We already have. So we do not go to the evacuation. We go to each of our own houses. We have a house here. We have a house

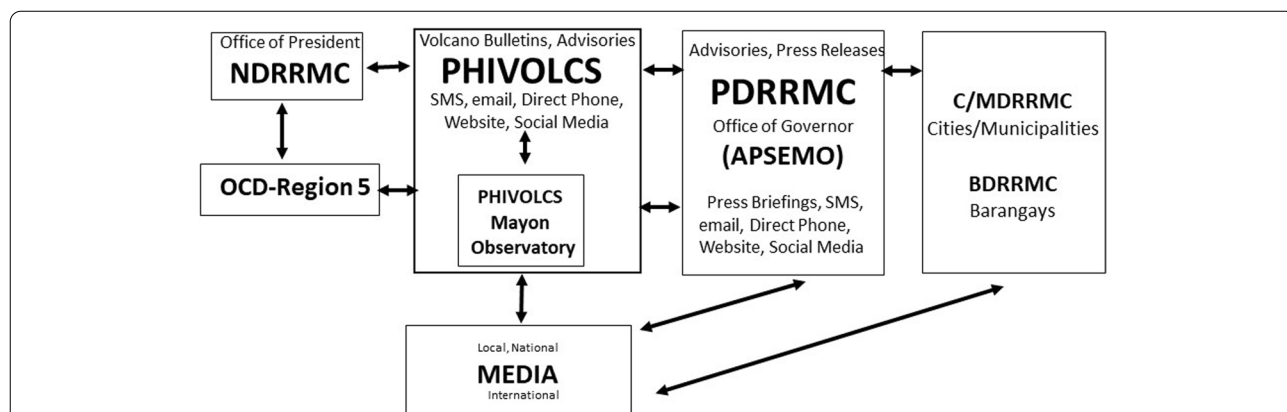


Fig. 5 Current information flow on the status of Mayon and how this is relayed simultaneously to various groups using multiple channels with PHIVOLCS as the main source. PHIVOLCS as warning agency issues Volcano Alert Levels for specific volcano status thru its Volcano Bulletins or Advisories simultaneously to the Albay Province, Regional (OCD-Region 5) and national-level (National Disaster Risk Reduction Management Council, NDRRMC), based on interpretation of data coming from its network of monitoring instrument maintained and operated by the Mayon Observatory at Lignon Hill in Legaspi City. The local, national and international media has access to this information. Issuances from PHIVOLCS are directly received by the provincial-level disaster office (APSEMO) which in turn still communicates the information officially to the Albay constituents via various local media channels

there. Yes, there was advice to evacuate. Ha? Yes, we follow, why not. O, it was the order of the municipality, so we follow. That is the advice of the government.” -#71 EM, Banadero, Daraga (HH)

Relocation or resettlement which a risk avoidance solution is effective at reducing physical vulnerability (Bowman and Henquinet 2015) but this effort fails if it does not incorporate an alternative source of livelihood, as for this Mayon case, the volcano will still pull people back to the hazard zone within 6-km PDZ as their farmlands are located there.

Discussion

Communicating hazards and risks: alert levels during a crisis and the challenges of quiet lava dome growth

Sorensen and Sorensen (2007) recognized the changing technological and social context of warnings. In Albay Province, short message service (SMS) or commonly known as “text messages,” the internet and social media have been extensively used and have modified existing protocols and processes well-established in the past (e.g. pre-2000 events, more linear information flow). Instead of the traditional hierarchy of top to bottom communication flow (pre-2000), Albay Province now has direct communication with community leaders via different information channels (Fig. 5). Community leaders can easily access vital information. Also, information from PHIVOLCS is more directly accessed by the general public via its official website and social media, not only in the traditional channels or various forms of communication platforms (radio, television, and print). What is documented and validated is that direct, multi-channel information flow at all levels and multi-direction has significantly replaced the linear model of risk communication which prevailed more than 20 years ago.

The warning that gets to the residents is “official” and people at risk are expected to respond to these official warnings. Important assumptions have taken place in this case, first, that before the establishment of action per alert level scheme being followed by the province in their standard operating procedures (SOP) or protocol, there have been discussions among the province disaster officers together with the municipal level and lay people who will eventually follow the procedures. Second, that the alert level scheme with agreed actions has been disseminated long before the actual event, as part of the information education communication programs of the municipal-level DRRM offices. The third assumption is that the lay people are asked and expected to follow the province-level directives- which still assumes a top-down flow of official warning information to the public. This

approach of communication still sees risk as determined by experts before communication and the idea of effective risk communication is the result of either transferring information to a public that understands and accepts it or in some formulations, persuading the public to accept a given risk (Grabill and Simmons 1998; Sorensen and Sorensen 2007).

Tobin and Whiteford (2002) recognized in their work that, during the 1999 unrest of Tungurahua Volcano, in Ecuador the enforcement of evacuation was difficult and problems were further aggravated, when after all the pronouncements of alerts, no major eruptions occurred as anticipated. The consequences (e.g. confusion, a restlessness of the public) of occurrences of volcanic activities that deviate from what is expected such as the case of Kelut, Indonesia in 2007 again highlights the importance of appropriate communication when possibly dealing with adjusting to new scenarios than that previously understood (De Belizal et al. 2012). Also, prolonged periods of evacuation have accompanying consequences- loss of livelihoods, social disruption, exposure to communicable diseases, pressure to return to identified hazardous areas, among others (Tobin and Whiteford 2002).

This kind of challenge posed by volcanic unrest was also recognized in Popocatepetl, Mexico. For this case, there was a prolonged, low-level volcanic crisis of variable intensity that lasted for more than 20 years without showing any signs of ending (De la Cruz-Reyna et al. 2017). This crisis resulted in two opposite developments: (1) during periods of little visible activity, people dwelling near the volcano become somewhat apathetic; but (2) during times of easily observed visible activity, awareness of changes at the volcano – and their hazardous implication – is rapidly and greatly enhanced by the common use of social media by people.

What was not taken into account was that for residents with long years of experience with Mayon Volcano eruptions, these people need to validate their beliefs about eruptions by visual and auditory evidence as Tobin and Whiteford (2002) have emphasized. There is strong experiential knowledge among Mayon residents acquired through frequent eruptions through the years. This must be considered in designing strategies of risk communication before and during volcanic activities (Bankoff et al. 2021).

During the 2014 Mayon Volcano event, many expected a display of explosive eruptions, when the Alert Level was raised from 2 to 3. But as days passed, the volcano remained in its non-explosive lava dome build-up and then ceased after several weeks. Due to the quiet nature of the activity (growth of lava dome in the summit area that did not lead to PDC-generation), the prolonged evacuation started to take its toll on the residents in

evacuation sites, just like in most cases of prolonged volcanic unrest. The event not only took its toll on the residents who were on the evacuation sites but as well on the LGUs concerned (Sales and Ducuis 2014). As mentioned, a similar situation occurred in Kelut in the year 2007 (De Belizal et al. 2012). In the Kelut event, it was the inability to give a simple explanation about the ongoing event that was the issue as their existing communication protocol did not cover anything specific for quiet-type of eruption and there was a need to adjust. For Mayon, after several consultation meetings, a PDRRMC Advisory 8 dated 4 November 2014, identified barangays to decamp (those between 6 and 8 km EDZ) and retained in the evacuation centers only those within the 6 km radius PDZ. The lowering of Alert by PHIVOLCS on 19 December 2014 was immediately followed by full decampment order for the remaining barangays thru the PDRRMC Advisory 9 issued on the same day. As an effect, it was acknowledged that there is a need to review and incorporate descriptions pertaining to the “non-explosive” type of eruptions in the current Alert Level scheme, which as of 2014 was more focused on an explosive type of eruptions.

There needs to be more engagement and discussions with the LCEs (governor, mayors) on the whys of the volcanic unrest as well as an understanding of the volcano processes and quantified risks and uncertainties as to the basis for their decisions. For PHIVOLCS, there is a need to review, assess, and reflect on how we can further improve and develop our strategies for risk communication. This review should consider incorporating and highlighting the range of activities the volcano is capable of and the various activities- describing scenarios that are easily understood by the people, those that are relatable based on experiential knowledge.

Views of eruption that define evacuation action

In this study, the resident's and official's points of view were drawn from their lived experiences. Eruptive events experienced in the past provided imageries of what transpired before 2014. In these stories shared by the residents, three dimensions of their views of their Mayon Volcano eruption experience are considered- as seen, as heard and as felt.

The narratives represented what the residents experienced. Understanding the residents' views of volcanic eruptions brings us closer to understanding their construction of what to them is a risk. This gives better perspectives of connecting “risk” with “eruptions”. Understanding the people's construction of risk will lead to an understanding of their particular actions (evacuation and non-evacuation) (Martinez-Villegas 2017).

What we observed is the residents' shared structured meanings through time. Describing in the local language, visually, they related eruption to *fire at the summit, explosion*, relating the *presence of ash especially lots of it with gradations from few to so much or a lot, to thick*. In terms of were or were not heard- *did not hear anything to like it was breathing to a loud explosion*, and *felt weak shaking to strong shaking*. We have to relate to their differentiation between *mild* from *strong* as how the interviewees described their experience, among others. These are the common thoughts they have expressed as to what to them is eruption (Martinez-Villegas 2017). The 2014 experience falls short of expectations of the “eruption/ eruptive event” that the residents have been used to experiencing since 1968 onwards.

There is a need to understand the residents' meanings of eruption through their own experiences. The meanings of many of these words and phrases are contextually dependent. *Shared meaning* means that the words we use mean the same to each of us or that we understand how each of us uses words differently and take that into account in our conversations or risk communication. At a deeper level, it means that we understand the different values, beliefs, and emotions that we each give to and associate with words (Gurteen 2017). The residents have developed a shared meaning structure as to what to them is an eruption, and this includes common language for making sense of their lived experiences, having gone through the occurrence of eruptions and with them having experienced these phenomena have fostered the development of these shared meanings (Bjorn and Ngwenyama 2008).

Experiential knowledge, communicating risks before and during a crisis

Unlike in some cases of volcano unrest with an unprepared response of authorities and communities for example, in Karthala Volcano, Comoros (Morin and Lavigne 2009), there is a well-established structure for disaster response for Mayon Volcano in Albay Province. However, we also recognize that there is a continued need to better understand the communities affected during eruptions. There is a need for reassessment on how to communicate the varying risks given the range of possible behaviors of Mayon volcano during the unrest. This awareness of residents' local knowledge should be well-integrated into evacuation planning and is critical in the implementation of authorities during an ongoing event. Emphasis and consideration should be given to the residents' knowledge, views, and attitudes about the risk from the volcano which is shaped by their experiences. Their experiential knowledge is an important factor in their decisions to evacuate or not. The local authorities must have an

understanding of the different possible hazard scenarios and how these can be further integrated and surfaced into the action planning of authorities. More critical is the added extra room to be considered for flexibility to adjust and fill in emerging gaps within the existing plans as recognized during an ongoing event such as in 2014.

There are recent case studies of volcano eruptions and evacuations. For the case of Merapi 1994 and 2006 eruptions where there were existing plans and structure of authority for implementation, problems that arose from gaps in responses of institutions and communities during the management of emergency were recognized and highlighted (Mei and Lavigne 2012). During the Merapi 2010 eruption, the existing structure, pre-existing hazard map, and evacuation plan were already based on scenarios taking into account recent twentieth-century eruptions, that turned out to be smaller magnitude (Mei et al. 2013). As the eruption progressed, there was an increase in magnitude that danger zones were expanded- which was beyond the original emergency plan. This meant higher requirements from the increased number of evacuees, that went over and beyond the capacity of the plan, putting stress, and overwhelming the existing response system.

The Albay Province and the implementation of evacuation during a Mayon Volcano event is a good example of an efficient, and well-practiced process due to many previous experiences of implementing an existing Emergency Management Plan (not only volcano-related but including tropical cycle-related). But unlike in a tropical cyclone situation that people can return and rebuild a few days after the typhoon has passed, the prolonged nature of a volcanic event, adding to that the eventually non-explosive nature of eruption that took place, took a toll on the people and there began restlessness of the evacuees as they do not see any explosive event that they have been used to. In retrospect, some would ask if the province's decision for more conservative pre-emptive evacuation (and extending to 8 instead of 7 km) in the name of protecting lives thru its Zero Casualty agenda outweighs the potential negative impacts of prolonged evacuation to the affected populace. As identified by Tobin and Whiteford (2002) some effects associated with prolonged evacuation practices include social disruption, economic losses, effects on mental and physical health among many.

In the study by Lavigne et al. (2018) communicating risks from PDCs presents the most challenge of ensuring that people are kept out of the PDC's way. Despite a well-studied volcano-geology, there are still uncertainties in terms of defined hazardous zones from PDCs based on mapped out extent due to the nature of the volcano, with the possibility of underestimating or overestimating

hazard zones. How is this to be communicated (for the case of Mayon 2014- extending to another kilometer the area of hazard zone), to avoid the need to do the last-minute evacuation, a pre-emptive evacuation was done. Also, there was the reluctance of people to evacuate if traditional warning signs (visual, auditory, somatosensory) they are familiar with are lacking. For the case of Mayon Volcano 2014, explaining that small lava dome build-up.

Relatively effective warning and responses of communities were documented and studied for the cases of Sinabung eruption in 2010 and Kelut in 2014. For improved or close coordination and collaboration between the government and community during a volcano crisis, the government needs to have a better grasp and understanding of the community dynamics- where cultural understanding is essential for effective crisis management and risk communication (Andreastuti et al. 2019). Mayon 2014 parallels with the Kelut event of 2007 (De Belizal et al. 2012) – 3 months of unrest and instead of explosive event, quiet dome building occurred.

Evacuation: response to warnings, pre-emptive evacuation

In previous major events around Mayon, especially for typhoon-related, the Albay PDRRC rallying for “Zero Casualty” adapted a practice coined as *pre-emptive evacuation*. Originally used starting the 2006 Typhoon Reming (International name- Durian), people are evacuated early on or in advance following a weather forecast. This worked well for the Province of Albay. In pre-emptive evacuation during times of volcanic unrest, an additional area or an extended zone (usually 1-km additional) was included on top of what was identified and recommended. Operationally during volcanic unrest, the term *mandatory evacuation* was used for evacuating those identified within certain zones according to the approved evacuation plan following warning criteria (e.g. the 6-km PDZ for Alert Level 3). Somehow, because of identified extended zones up to 8 -km in 2014 documents, the terms were interchangeably used. From the analysis of how the terms have been applied operationally, all evacuations whether pre-emptive or mandatory involved time and anticipation. It seemed like “pre-emptive” refers to more cautious approaches i.e. lower risk tolerance (by daring to extend the radius zone to be evacuated beyond what was in the existing plan). For the case of volcanic unrest, extending the area of coverage in earlier identified zones to be evacuated is the decision of the local government. Barclay et al. (2019) has a different view on the “Zero Casualty” as a central goal and suggests that instead of aiming and focusing only on the risk to life, (zero casualty or loss of lives), the focus should be best

possible life outcomes which consider livelihoods, well-being and security.

Based on the interviews of the *barangay* officials, at least 3 main reasons appear as the “whys” or motivations for people’s various decisions to evacuate: (a) fear emanating from the experience of people on past eruptions of Mayon (b) following order to evacuate because it is the law so people obey and (c) relief goods or what the government can provide the evacuees. Fear-based experience leads people to evacuate on their own, by choice, or to readily follow orders. Others who moved out following orders evacuated by compromise. This choice of many to evacuate appeared to be so influenced by the nature of residents to obey the authorities which suggested high trust in the local government. The third “motivation” - relief goods or what the government can provide the evacuees - is something that emerged from this interview. This seems to be unique to the site and culturally embedded.

For the evacuation that took place, some would argue, was deciding for an extended area and therefore more people to evacuate an aggressive, conservative, or proactive move? Was the local government too eager? Too cautious? Was this necessary? Isn’t this prone to abuse? Some would argue, if the local government can afford and they were willing to take care of evacuees and were concerned for the comfort of people, then in the long term, the decision to extend evacuation to 8-km was justifiable? These questions are difficult to address within the scope of this work.

Other issues

On the issue of supplies and relief goods, the LGUs have become more responsive to the needs of the evacuees and this was started as early as 1993 by one LGU if only was sustained, and given much thought of as part of the planning.

“During the 1993 event, if the pigs were marketable, the MDCC bought them. So, these were distributed to the evacuees. That’s the first time it happened... Ramos time. Because that time, during the Presidency of Pre Ramos, it was during his time that what was given was adequate to me, ha. The right/appropriate funds for the evacuees..30 pesos per head, per evacuee. The mayor distributes. So at that time, we were the first to give fresh meat. It was not always canned goods...noodles... the other municipalities followed suit. But, the succeeding presidents, especially the current, sorry mam, no...It was only Ramos, not that we are bragging, since 1993. It’s just who is quicker...”-DRR-9

Two (2) other LGUs have implemented almost similar schemes by 2014, and have become more responsive and sensitive to the needs of evacuees.

“Aahhmm for the evacuation- forced evacuation- they follow, but for several days..then the heads of the families they would go back. Their number one reason was to monitor their properties, then they said it was not convenient to stay in the evacuation center, since imagine they have stayed for almost 3 months in the evacuation centers. Then they said, when they evacuate, all we can think of for three months were sardines, rice..so, as part of our initiative, we provided fish, fresh fish. Yes in xxxxx also distributed at least fresh supplies not just sardines.. then also, the others distributed fresh vegetables.” – DRR-7

“Actually what happened last year, they were here too long, they stayed for 3 months, they evacuated. But there was a food-for-work scheme. Then some people raised vegetables in one of our evacuation centers, the one with the housing project where we housed them...they raised vegetables because the land was big enough that they can plant. They raised their fresh produce there.”– DRR-4

Other related issues also emerged. First, those living outside the identified 8-km radius were not asked to evacuate. But if they also have farms upslope, they will not have access or will have restricted access to their livelihood. They were not physically threatened (residence outside the zone) but economically affected (source of livelihood within the restricted zone) by the Mayon Volcano. Because they were not on the list of people to be evacuated, they were not entitled to relief goods or support from the government. This was one situation not accounted for when APSEMO identified those barangays that should be supported because the basis is the distance of the residences from the summit crater, not of the farms.

Another important issue that emerged involved areas outside the 8-km radius, on the lower slopes. Some expressed fears of possible lahars on the lower slopes, both syn- and post-eruption. Many remember the lahars of Typhoon Reming in 2006. They were not part of the evacuation advisory (for the PDCs), but some voluntarily evacuated. Some LGUs have addressed this in various ways- either by accepting the voluntary evacuees for a certain period or being firm and informing the voluntary evacuees that they could not stay in the evacuation area at all especially if there was no reason to fear for lahars if there is no forecast for a typhoon. It would be a different case if there was a forecast for incoming typhoons as

the action plan would have an advisory for this. Both can have implications- the first, accepting voluntary evacuees could be prone to attracting more voluntary evacuees that were not necessary. This scenario would put more pressure on the LGUs to provide support, which they may not be capable of doing for a prolonged period. Turning away “voluntary” evacuees may not reflect well on the local leaders and could have negative implications on the future political hold in the area. Neither action solves the issue of the farmers not having direct access to their livelihood located on the slope of Mayon during 2014.

Concluding remarks

How do residents and officials understand the risks from Mayon Volcano? Based on this study, understanding of hazards and risks from Mayon varied but most draw much from the experience of past eruptions. Some interviewees recalled previous experiences as their comparison as to what to them is “strong” and “mild” to non-eruption. There is high value in recognizing and using everyday language to describe what they have seen, heard, and felt. Based on relating eruptive activities to experience, there are commonly used words that describe PDCs, tall ash columns, and lava fountaining. With a long history of experience from previous eruptions- and the range of eruption types they witnessed, residents look out for behaviors of Mayon they are familiar with as what to them is “dangerous” during a time of crisis.

The decision to evacuate and leave one’s home is complex. Many responded out of obedience to the order of recognized, trusted authorities. Many chose to evacuate, never mind the inconvenience, as obedience to authority is the decision, although to some, in their mind, would prefer to stay. The choice to evacuate appeared to be so influenced by the nature of people to obey the authorities which suggested high trust and belief in the leadership in the local government. Yet some DRRM officers recognized the impact of this prolonged evacuation and aim for “Zero Casualty” to the local funds, and how this leads to an inward reflection of balancing between timing and scope of pre-emptive evacuation and the cost to the local economy.

Most often residents evacuated out of fear of what Mayon eruptions can do. Some have stood firm on choosing not to evacuate for understandable reasons- livelihood, livestock, home security, belief that Mayon will erupt based on experience. There were also those who, because of fear of lahar would like to leave even if they were not within 7 or 8 km.

In retrospect, the 2014 Mayon Volcano eruption posed little hazard. Dealing with the uncertainty, fear, and political factors were more difficult. The open,

constant consultation of APSEMO with PHIVOLCS played a vital role in the ability to quick decision-making on evacuation and eventual decampment. Residents generally followed, although there were some questions in their minds as the eruption turned out as unusually quiet from their perspective, basing on what to them is an eruption. Although the activity died down, there were lingering questions in the minds of the people. In this aspect, there is a need to improve communication of the range of behaviors Mayon Volcano can do to explain the phenomena. There is a need to review the Alert Level scheme to address quiet dome growth which means, the need to improve the existing Alert Levels to include the missing necessary words to address this case. In addition, based on the interviews, there is strong experiential knowledge on Mayon Volcano’s eruption behaviors that should be considered as a foundation, in risk communication efforts before and during the unrest.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13617-021-00109-4>.

Additional file 1: Supplementary Table S1. Mayon Volcano Alert Levels and Province Required Action.

Additional file 2: Supplementary Table S2. Timelines MAYON VOLCANO 2014 UNREST. Actual text content. Significant statements highlighted.

Additional file 3: Supplementary Table S3. Details of Evacuation (Based on Report as 31 October 2014, Source: APSEMO).

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Authors’ contributions

MMV is the main project researcher and gathered data from the field. She undertook most of data reduction: reviewed video recordings, analyzed transcriptions, made annotations, interpreted data, and wrote the manuscript. RUS gave inputs on the ideas, main points on interpretations and data discussion. JAS is dissertation adviser, gave inputs during discussions on methods of data collection and data treatment of full transcriptions specifically on phenomenology and thematic analysis. RCL assisted in field data gathering as main videographer, search and selection of respondents, transcriptions and discussions of insights on the respondents. ACP processed the evacuation data we collated as available from the LGUs, generated map figures used in the spatial analysis of evacuation and contributed in the writing of the section on evacuation data for this paper. The author(s) read and approved the final manuscript.

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Availability of data and materials

Data supporting this work, specifically full transcriptions of the interviews are available at DOST-PHIVOLCS upon request and subject to agreements. Full names of all respondents are tabulated and are kept by the main author in DOST-PHIVOLCS. However, the respondents/ resource persons are “coded” and full names will not be available to any third party due to the Philippine Law Republic Act 10173 of 2012 also known as Data Privacy Act. The law protects individuals from unauthorized processing of personal information.

Declaration

Competing interests

The authors declare that they have no competing interests

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References

- Albay PDRRMC (2014a). Advisory 1, 15 August 2014 <http://albay.gov.ph/pdr-rrmc-advisory-1-on-mayon-volcano/>
- Albay PDRRMC (2014b). Advisory 3, 15 September 2014
- Albay PDRRMC (2014c). Advisory 4, 16 September 2014
- Albay PDRRMC (2014d). Advisory 8, 4 November 2014
- Albay PDRRMC (2014e). Advisory 9, 19 December 2014
- Albay Public Safety and Emergency Management Office (APSEMO) (2014). Population at Risk inside the 6-km radius Permanent Danger Zone (June 2014) <http://albay.gov.ph/category/apsemo/page/3/>
- Andreastuti S, Paripurno ET, Gunawan H, Budianto A, Syahbana D, Pallister J (2019) Character of community response to volcanic crises at Sinabung and Kelud volcanoes. *J Volcanol Geotherm Res* 382:298–310. <https://doi.org/10.1016/j.jvolgeores.2017.01.022>
- APSEMO (2014b). Population at risk in 6.5–8 km extended high danger zone (SW, N and NE sectors) <http://albay.gov.ph/mayon-volcano-danger-zones-population-at-risk/>
- APSEMO (2014c). Barangays and population at risk to pyroclastic flows extended 8–10 km SE
- Arboleda RA, Martinez MML (1999) Chronology of the 1993 Eruption of Mayon Volcano, Philippines. The Mayon Volcano 1993 Eruption. Volcanological and Seismological Monograph, PHIVOLCS 1–14
- Arpa MCB, Bornas MAV, Abigania MIT, Solidum RU, Listanco EL, Ozawa A, Tagami T (2006) Characterization of lava flow and Pyroclasts from the February–march 2000 eruption of Mayon volcano. *Jrnl Geol Soc Phil* 61(1):1–19
- Bachri S, Stötter J, Monreal M, Sartohadi J (2015) The calamity of eruptions, or an eruption of benefits? Mt. Bromo. *Nat Hazards Earth Syst Sci* 15:277–290
- Bankoff G (2002) Cultures of disaster: society and natural Hazard in the Philippines. Taylor and Francis, Milton Park. <https://doi.org/10.4324/9780203221891> <https://www.taylorfrancis.com/books/mono/10.4324/9780203221891/cultures-disaster-greg-bankoff>
- Bankoff, G, Newhall CG, Schrieken A (2021) The Charmed Circle: Mobility, Identity, and Memory around Mount Mayon (Philippine) and Gunung Awu (Indonesia) Volcanoes Human Ecology. <https://link.springer.com/article/10.1007/s10745-021-00225-0>, doi: <https://doi.org/10.1007/s10745-021-00225-0>
- Barclay J, Few R, Armijos MT, Phillips JC, Pyle DM, Hicks A, Brown SK, Robertson REA (2019) Livelihoods, Wellbeing and the Risk to Life During Volcanic Eruptions. *Front. Earth Sci* 7:205. <https://doi.org/10.3389/feart.2019.00205>
- Bird DK, Gisladdottir G, Dominey-Howes S (2009) Resident perception of volcanic hazards and evacuation procedures. *Nat Hazards Earth Syst Sci* 9:251–266 <https://nhess.copernicus.org/articles/9/251/2009/nhess-9-251-2009.pdf>
- Bjorn P, Ngwenyama O (2008) Virtual team collaboration: building shared meaning, resolving breakdowns and creating translucence. *Info Syst J* 19:227–253. <https://doi.org/10.1111/j.1365-2575.2007.00281.x>
- Bowman LJ, Henquinet KB (2015) Disaster risk reduction and resettlement efforts at San Vicente (Chichontepec) Volcano, El Salvador: toward understanding social and geophysical vulnerability. *J Appl Volcanol* 4(14):18. <https://doi.org/10.1186/s13617-015-0031-0>
- Catane SG, Mirabueno MHT (2001) Characteristics and origin of the pyroclastic flows and surges of the 1993 Mayon volcano eruption. *J Geolo Soc Philipp* 56(3–4):125–143
- Clandinin DJ, Connelly FM (2000) Narrative inquiry: experience and story in qualitative research. Jossey-Bass, Inc., San Francisco, p 211
- Clandinin DJ, Huber J (2014) Narrative inquiry, In B McGraw, E Baker, and P Peterson, (Eds), International encyclopedia of education, 3rd, New York: Elsevier doi: <https://doi.org/10.1016/B978-0-08-044894-7.01387-7>
- Connelly MF, Clandinin DJ (1990) Stories of experience and narrative inquiry. *Educ Res* 19(5):2–14
- Corpus EG (1985) Chronology of the September–October 1984 eruption of Mayon volcano Philippines. *Philipp J Volcanol* 2(1–2):36–51
- De Belizal E, Lavigne F, Gaillard JC, Grancher D, Pratomo I, Komorowski JC (2012) The 2007 eruption of Kelut volcano (East Java, Indonesia): phenomenology, crisis management and social response. *Geomorphology* 136:165–175
- De la Cruz-Reyna S, Tilling RI, Valdés-González C (2017) Challenges in Responding to a Sustained, Continuing Volcanic Crisis: The Case of Popocatepetl Volcano, Mexico, 1994–Present. In: Fearnley CJ, Bird DK, Haynes K, McGuire WJ, Jolly G (eds) Observing the Volcano World. Advances in Volcanology (An Official Book Series of the International Association of Volcanology and Chemistry of the Earth’s Interior – IAVCEI, Barcelona, Spain). Springer, Cham. https://doi.org/10.1007/11157_2016_37
- Eiser JR, Bostrom A, Burton I, Johnston DM, McClure J, Paton D, van der Pligt J, White MP (2012) Risk interpretation and action: a conceptual framework for responses to natural hazards. *Int J Disaster Risk Reduc* 1:5–16
- Frid I, Ohlén J, Bergbom I (2000) On the use of narratives in nursing research. *J Adv Nurs* 32(3):695–703
- Grabill JT, Simmons WM (1998) Toward a critical rhetoric of risk communication: producing citizens and the role of technical communicators. *Tech Commun Q Fall* 7(4):415–441
- Gray RE, Fergus KD, Fitch MI (2005) Two black men with prostate cancer: a narrative approach. *Br J Health Psychol* 10(Pt 1):71–84
- Gurteen D (2017) Conversational Leadership. <http://conversational-leadership.net/shared-meaning/>. downloaded 10 Aug 2017
- Haynes K, Barclay J, Pidgeon N (2008a) The issue of trust and its influence on risk communication during a volcanic crisis. *Bull Volcanol* 70:605–621
- Haynes K, Barclay J, Pidgeon N (2008b) Whose reality counts? Factor affecting the perception of volcanic risk. *J Volcanol Geotherm Res* 172:259–272
- Lavigne F, Morin J, Mei ETW, Calder ES, Usamah M, Nugroho U (2018) Mapping Hazard zones, Rapid Warning Communication and Understanding Communities: Primary Ways to Mitigate Pyroclastic Flow Hazard in Fearnley. In: CJ BDK, Haynes K, WJ MG, Jolly G (eds) Advances in Volcanology: Observing the Volcano World, Volcano Crisis Communication, pp 107–119. https://doi.org/10.1007/11157_2016_34
- Lester, Stan. (1999). An introduction to phenomenological research. <https://www.rgs.org/NR/rdonlyres/F50603E0-41AF-4B15-9C84-BA7E4DE8CB4F/0/Seaweedphenomenologyresearch.pdf> retrieved Dec 2016
- Lindell MK, Perry RW (1993) Risk area residents’ changing perceptions of volcano hazard at Mt. St. Helens, HRRC publication 169A. *Predict Percept Nat Hazard*:159–166. https://doi.org/10.1007/978-94-015-8190-5_19
- MacDonald G, Alcaraz A (1956) Nuees Ardentes of the 1948–1953 eruption of Hibok-hibok volcano. *Bull Volcanol* 18:169–178
- Maeda Y, Kumagai H, Lacson R, Figueroa MS III, Yamashina T, Ohkura T, Balolou AV (2015) A phreatic explosion model inferred from a very long period seismic event at Mayon volcano, Philippines. *J Geophys Res Solid Earth* 12(226–242):226–241 <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014JB011440>
- Martinez-Villegas ML (2017) Mayon volcano residents’ construction of eruptions: a phenomenological study of risk communication (2017)- doctor

- of communication dissertation. University of the Philippines–Open University, Los Banos, p 90
- McPhail JC (1995) Phenomenology as philosophy and Mmethod: applications to ways of doing special education. *Remedial Spec Educ* 16(3):159–165 177. <https://deepblue.lib.umich.edu/handle/2027.42/68638>
- Mei ETW, Lavigne F (2012) Influence of the institutional and socio-economic context for responding to disaster: case study of the 1994 and 2006 eruptions of the Merapi volcano, Indonesia. In: Terry JP, Goff J (eds) *Natural hazards in the Asia-Pacific region: recent advances and emerging concepts*, vol 361. *Geol Soc Lond, Spec Publ*, pp 171–186. <https://doi.org/10.1144/SP361.14>
- Mei ETW, Lavigne F, Picquout A, de Belizal E, Brunstein D, Grancher D, Sartohadi J, Cholik N, Vidal C (2013) Lessons learned from the 2010 evacuation at Merapi volcano. *J Volcanol Geotherm Res* 261:348–365
- Moore JG, Melson WG (1969) Nuees Ardentés of the 1968 eruption of Mayon volcano. *Philipp Bull Volcanol* 33:600–620
- Morin J, Lavigne F (2009) Institutional and social responses to hazards related to Karthala volcano, Comoros. *Shima. Int J Res Island Cult* 2(1):54–71 <https://www.shimajournal.org/issues/v3n1/f.-Morin-et-al.-Shima-v3n1-33-53.pdf>
- Naismith AK, Aemijos MT, Escobar EAB, Chigna C, Watson IM (2020) Fireside tales: understanding experiences of previous eruptions among other factors that influence the decision to evacuate from eruptive activity of Volcan de Fuego. *Volcanica* 3(2):205–226. <https://doi.org/10.30909/vol.03.02.205226>
- Nakada S, Shimizu H, Ohta K (1999) Overview of the 1990–1995 eruption at Unzen volcano. *J Volcanol Geotherm Res* 89:1–22
- Neubauer BE, Witkop CT, Varpio L (2019) How phenomenology can help us learn from the experiences of others. *Perspect Med Educ* 8:90–97
- Paton D, Johnston D, Bebbington M, Lai C, Houghton B (2001) Direct and vicarious experience of volcanic hazards: implications for risk perception and adjustment adoption. *Austr J Emerg Manage Summer* 2001:58–63 <https://ajem.infoservices.com.au/downloads/AJEM-15-04-11>
- Paton D, Smith L, Daly M, Johnston D (2008) Risk perception and volcanic hazard mitigation: individual and social perspectives. *J Volcanol Geotherm Res* 172:179–188
- PHIVOLCS (1990) Operation Mayon, p 38
- PHIVOLCS (2014a). Mayon volcano bulletin 15 August 2014
- PHIVOLCS (2014b). Mayon volcano bulletin 15 September 2014
- PHIVOLCS (2014c). Mayon volcano bulletin 22 December 2014
- Pietkiewicz I, Smith J (2012) A practical guide to using interpretative phenomenological analysis in qualitative research psychology. *Czasopismo Psychol* 18(2):361–369 <https://www.researchgate.net/file.PostFileLoader.html?id=53c8b90acf57d7ce4b8b45a2&assetKey=AS%3A273565755084817%401442234566451>
- Rohrmann B (2008) Risk Perception, Risk Attitudes, Risk Communication, Risk Management: A conceptual Appraisal, 15th International Emergency Management Society <http://www.rohrmannresearch.net/pdfs/rohmann-rrr.pdf>, <https://www.scribd.com/document/139458850/TIEMS-2008-Bernd-Rohrmann-Keynote>
- Sales S, Ducuis A (2014) Long wait for Mayon eruption depletes Albay gov't fund. *People's Journal*, October 01, 2014
- Sorensen JH, Sorensen VS (2007) Chapter 11. Community processes: warning and evacuation. In: Rodriguez H, Quarantelli E, Dynes R (eds) *Handbook of disaster research*. Springer. https://doi.org/10.1007/978-0-387-32353-4_11
- Tobin GA, Whiteford LM (2002) Community resilience and volcano Hazard: the eruption of Tungurahua and evacuation of the Faldas in Ecuador. *Disasters* 26(1):28–48
- Tomsen E, Lindsay JM, Gahegan M, Wilson TM, Blake DM (2014) Evacuation planning in the Aukland volcanic field, New Zealand: a spatio-temporal approach for emergency management and transportation network decisions. *J Appl volcanol* 3(6):22 <https://appliedvolc.biomedcentral.com/articles/10.1186/2191-5040-3-6>
- UNISDR Terminology on disaster risk reduction (2009). <https://www.undrr.org/publication/2009-unisdr-terminology-disaster-risk-reduction>
- van Manen M, van Manen M (2014) Phenomenology. In D. Phillips (Ed.), *Encyclopedia of educational theory and philosophy* (Vol. 1, pp. 611–616). SAGE Publications, Inc., <https://www.doi.org/10.4135/9781483346229.n253>

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