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Picture 1. Photograph of a pyroclastic flow from Merapi, at a local museum (March 2016, taken by E. Schwartz-Marin).

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ABSTRACT

Gunung Merapi (Mountain of Fire) is the guardian of a cosmogonic-sacred landscape, and one of the most dangerous volcanoes in the world. Its eruptions are well studied, however, the relationships among ritual, science, protection and grassroots disaster management arising after the 2006 and 2010 eruptions are mostly overlooked. This paper fills this gap in the literature, through qualitative research that explores local perceptions and places respiratory protection in a larger ecology of protective practices during, and after, volcanic crises. In a previous study, 99% of respondents in Yogyakarta used masks to protect from inhaling volcanic ash. In order to understand the respiratory protective practices developed, in the last decade, to cope with Merapi's eruptions, we need to engage with the emergence of the local volunteer-led grassroots monitoring systems. Although these networks were formalised by agencies, they were originally set-up in a bottom-up fashion to respond to pyroclastic flows and other life-threatening volcanic hazards. Our research found that they play a key role in the distribution of masks and respiratory health narratives, thus influencing the wide adoption of certain types of respiratory protection. Disaster management agencies, village heads, ritual experts and volunteers participating in these monitoring networks share spiritual signals (dreams) and scientific ones (seismic data, health narratives) and masks as part of their response to volcanic crises. Our findings about these Merapi networks challenge dominant assumptions in the Disaster Risk Reduction literature that tend to equate building resilience with the substitution of problematic 'cultural beliefs' for 'scientific facts'.

Introduction

Gunung Merapi's (Mountain of Fire) most recent large eruption occurred in October 2010. At its deadliest moment, a pyroclastic surge (a cloud of super-heated gas and ash) swept rapidly (150–300 km per hour) over the hamlets and villages established near the volcano, in Central Java, Indonesia (Surono et al. 2012). Survivors described the event as an 'avalanche' (*guguran*,[1] in Bahasa Indonesia) of burning ash (interview Mas Vivi 2016). In its wake, the surge took the life of animals and of about 350 villagers, including the spiritual and ritual icon Mbah Maridjan – the *Juru Kunci* (literally, Key Master) – who, in a defying act,[2] refused to leave his house (now a memorial place) located approximately five kilometres from Merapi's crater. Some of the villagers living in other hamlets narrowly escaped the pyroclastic cloud.[3] The 2010 eruption brought havoc and destruction, but also new forms of protection and social organization. Amongst the forms of protection available, the wide use of masks to avoid ash inhalation has emerged as the norm: 99% of inhabitants surveyed in a different part of this study, in 2016, reported using – mostly surgical – masks during recent ash exposures (Covey et al. 2019). This prevalence is of great interest for the Health Interventions in Volcanic Eruptions (henceforth HIVE) consortium (of which this study is part), since the principal aim of our comparative research has been to examine how and why people protect from inhaling ash, and what influences the use of respiratory protection in three distinct volcanic settings: Popocatépetl in Mexico (Schwartz-Marin et al. n.d.), Sakurajima in Japan, and Merapi in Indonesia.

This article explores why, in the Special Region of Yogyakarta, people adopted the use of masks to avoid inhaling ash, in such large numbers and how the adoption of masks sits in relation to a complex, larger ecology of protection. A simple explanation would be that we have witnessed a large cultural shift provoked by a loss of faith in 'traditional religious beliefs' and ritual experts, with the rise of new local leaders that endorse science as a better way to deal with volcanic hazards. Literature exploring vulnerability and culture already provides this suggestion, in the context of disaster risk reduction (DRR) at Merapi (Donovan 2010a; Donovan et al. 2012; MacLean 2014), but we consider it to only partially assess the local reality. Via our qualitative study, we propose different theoretical approaches to culture, which is not to be considered a symbolic envelope to immutable laws of nature, but a co-constitutive element of the local ecology.

Existing works on culture, protection and DRR in the vicinity of Merapi endorse a functionalist approach to explain how local culture and 'traditional beliefs' shape economic activities and risk reduction strategies, resulting in vulnerability or resilience. In this literature, the function of myths and local knowledge is portrayed as a way to 'domesticate' the uncanny or create coping strategies to deal with disaster by placing the blame elsewhere or, in a more 'positive' light, to help local villagers resist the imposition of top-down State policies of relocation (Dove 2008; Schlehe 1996). While there is a wealth of literature exploring Merapi and its rituals (for example Dove 2008, 2010; Schlehe 2010), the social construction of hazards and volcanological expertise (Donovan 2010a, 2010b; Donovan et al. 2012; Donovan and Surhyanto 2011) as well as the relocation practices after volcanic eruptions in Indonesia (Wildenauer 2015),[4] the intersection of spirituality, science and protective practices has still to receive scholarly attention. Recent work focuses on emergent forms of social media monitoring on Merapi's slopes which are used to distribute information, labour and resources (Saputro 2016; Tazic and Amir 2016), seeing timely and decentralized grass-roots exchange as key to building more resilient communities. Recent literature moves away from simple mechanical explanations, showing how religious networks and beliefs can contribute positively to protective practices (instead of being simply an obstacle), articulating fatalist accounts of 'God's will' and very active rebuilding and protection initiatives (Joakim and White 2015).

Social sciences scholarship has produced two strands of research on Merapi, mostly following disciplinary boundaries: one attends to social and political dimensions of rituals and spirituality around Merapi (Dove 2008; Schlehe 1996, 2010; Joakim and White 2015); the other looks at the informational infrastructures, grassroots monitoring and volunteerism during disasters (Saputro 2016; Tazic and Amir 2016). In our own research, we found spirituality, social media monitoring, and scientific logics to be intimately intertwined.[5] We advance the idea that new protective practices do not emerge from the distinction between ritual and science, or the substitution of incorrect knowledge with enlightened evidence. Rather, there is a distinctive form of incorporating different types of monitoring signals into a unified monitoring system that informs decision-making and is communicated via a dissemination network. Such co-existence allows for the production of knowledge and protective practices that might, at first, appear incommensurable, or even conflicting, to cross-fertilize in order to take care of health, patrimony, and family/village.

After a brief discussion of methods, background, and theory, the paper revisits cultural theories of risk[6] dealing with Merapi. This section is followed by a description of how our

interviewees engage with the surrounding landscape and manage connected networks. We then describe the scientific and spiritual grassroots monitoring practices, and forms of volunteerism, devised to avoid the potentially deadly consequences of exposure to volcanic emissions. The last section explains how mask use and other forms of respiratory protection have thrived along with the connected-villages and grassroots monitoring practices. We then show how the abovementioned forms of protection and social organization have engendered communal practices and infrastructures of care that make the wide distribution of masks possible. We conclude with an analysis of people's different versions of volcanic ash, narratives about its adverse health effects and dangerous properties, at variance with factual information and physical processes. We aim to inform the anthropology of disasters, health, spirituality, and science in ways that will take us beyond the dominant cultural theory of risk.

Methods

Fieldwork took place from March to August 2016. We conducted 65 interviews of approximately one hour in Yogyakarta and Central Java provinces around Merapi volcano and in Yogyakarta City (see Table 1 and Figure 1, below, for specific locations and administrative status). We chose to compare rural and urban areas, since the relationship with the landscape and the volcano is starkly different depending on whether people live on Merapi's slopes or not (Schlehe 1996; Dove 2010). We privileged a person-centered ethnography, grounding theories in 'the lived experience of real people', so that we could investigate how members of a community are constituted by sociocultural and material contexts (Levy and Hollan 2015, 313).

Our methods resonate with the plea to provide more space to 'reception studies' within the anthropological discipline and, specifically, in the study of climate change. Therefore, we take into consideration how local societies 'receive, interpret, understand, adopt, reject and utilize' scientific discourse (cf. Rudiak-Gould 2011, 9 for climate change anthropology), in our case on volcanic ash risk. Paying attention to the framing of scientific discourse is especially relevant in critiquing top-down paradigms of vulnerability. Thus, we focus on local agency and how people, themselves, assess their vulnerability (Lazrus 2009). In our approach, the 'local' includes the scientific framework rather than considering it external. In his review of the current debate, Rudiak-Gould analyses how several anthropological works would intentionally dismiss addressing the role of scientific discourse in local communities (2011, 10–11); instead we take it as central to understanding Javanese practices dealing with volcanic ash around Merapi.

Table 1. Location series number, location name and number of research participants.[7]

Location	Name, number of participants	Location	Name, number of participants	Location	Name, number of participants
1	Babadan, 3	**8**	Kinahrejo, 6	**15**	Sleman District Office, 3
2	Srumbung, 2	**9**	Kali tengah, 2	**16**	Jl kaliurang, 3
3	Klaten (Deles, Balerante), 3	**10**	Manggong, 3	**17**	UGM, 1
4	Paras, 1	**11**	Jambu, 3	**18**	Kelurahan Wirobrajan, 1
5	Tunggul Arum, 1	**12**	Petung, 2	**19**	Balaikota, 3
6	Turi, 2	**13**	Huntap Dongkelsari, 2	**20**	Jetisharjo, 7
7	Turgo, 4	**14**	Pakembinangun, 4	**21**	Kelurahan Keraton, 9
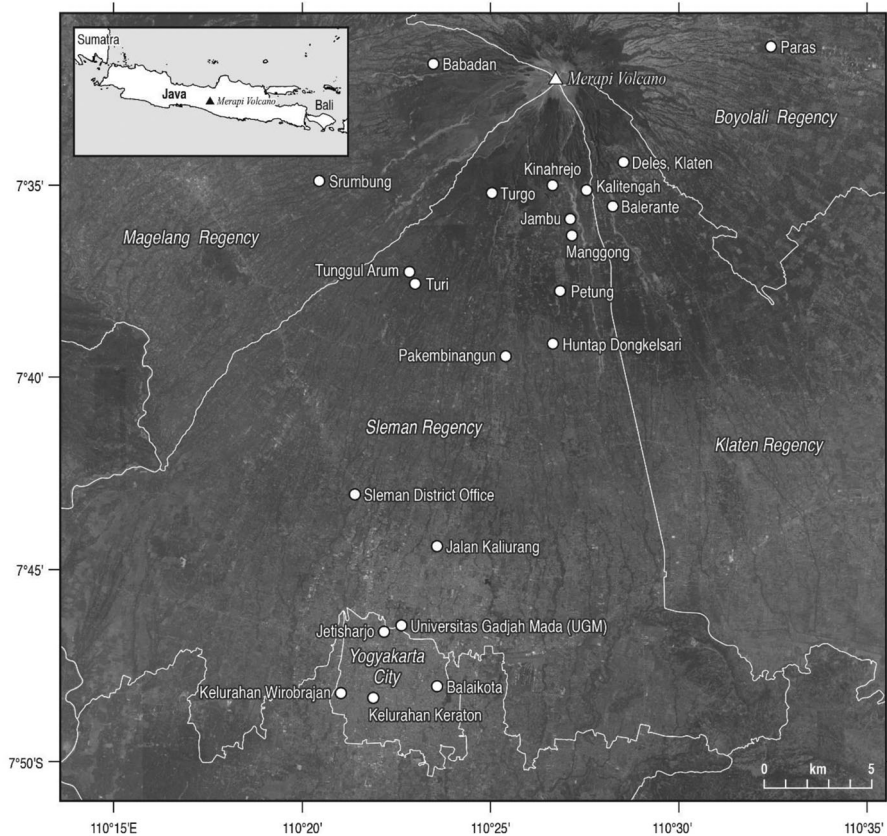
Figure 1. Map of Merapi, Yogyakarta province and Central Java showing locations of the interviews. Map data: Google, Digital Globe 2019.

Interviewees were recruited through snowballing, integrated with an inductive sampling approach to include 'groups and types of cases not originally specified or conceived of in the original study design' (Guest 2015, 222). Sampling methods considered local knowledge and expertise, specifically focusing on the relationship that the local villagers have with Merapi, their participation in information-communication-technology (ICT), their role in mask distribution and in organizing activities for DRR. The largest group of interviewees included rural and urban workers, comprising those involved in touristic activities such as 'Lava Tours', and others working in sand mining (clearing volcanic debris from the region's river valleys). We also interviewed village and hamlet leaders, many of whom act as information brokers on risk, health hazards and relocation, as organizers of volunteers and NGOs. Other respected figures included traditional healers and ritual experts (the current *Juru Kunci*), as well as government officers in Sleman and Kotamadya districts, particularly those involved in the disaster management agency (BPBD), and the district/municipality health section. Interviews were conducted with the head of the Institute for Research and Development of Geological Disaster Technology – Center for Volcanology and Geological Hazard Mitigation (BPPTKG-PVMBG)[8] responsible for volcano monitoring in Indonesia, and at the branch monitoring office in Desa Babadan in Central Java.[9]

The theoretical and thematic guidelines for the qualitative research were developed by (Merli), and all interviews were conducted by (Rachmawati), except for five that were conducted by (Nugroho). Interviews were logged and translated from Javanese and Indonesian into English by the interviewers and shared with the research team. Pilot interviews were conducted at the beginning of fieldwork together with (Schwartz-Marin) in Yogyakarta, an activity that helped develop a situational map (Clarke 2005) to (re)present the networks and include emerging topics of interest for our interviewees. All participants' names used in this article are pseudonyms. Analysis of the interview data was conducted by (Schwartz-Marin & Merli).

Pluralism, care and multiplicity in the historical context of Javanism and Islamic modernity

Annemarie Mol's *The Body Multiple* (2002) offers a ground-breaking analysis of the non-univocal ways in which atherosclerosis is enacted in a Dutch hospital, within the apparently coherent field of biomedicine, opening up a rich conversation at the interface of Anthropology, Science and Technology Studies (STS), and Philosophy (De La Cadena 2010; De La Cadena et al. 2015). Mol's analysis allows us to think about objects as specific, practical achievements in which 'there are no invariable variables. There is interdependence, and where two or three modes of ordering, two or three ways of enacting an object meet, there is interference, too' (Mol 2002, 121). Different from Mol's Dutch field site, where 'there might be tensions inside medicine, but clashes between fully fledged paradigms are rare' (Mol 2002, 178), at Merapi, fully fledged paradigms do find each other, yet instead of clashing, they co-exist without the need for one hegemonic ontology, approach or ruling logic to tame their radical difference. This is why, we are not talking about syncretism – which implies a blending of two distinct traditions (Stewart 1999) – but rather of multiplicity.

Merapi is the photograph of a pyroclastic flow in the local museums; the dream/voice/roar that warns attentive and gifted locals about its unrest; the sounds and graphs produced by a seismometer and shared via Facebook or walkie talkies; a sticker placed on one's window indicating the owner's status as an authority to be consulted in case of emergency; a mystical landscape full of spirits forming the backdrop to the lives of Yogyakarta Province's inhabitants, and its capital city which is just 30 km south of the volcano. The people we interviewed openly talked about the different natures of Merapi, but also about the need for their synchronization (*sinkronisasi*). The spiritual and geological natures of Merapi are brought together thanks to the sense of communal duty-sharing that characterizes the volunteering and grassroots monitoring networks in Yogyakarta (which also distribute health advice and masks for respiratory protection). These networks perform an incessant work of care, understood as: 'everything that we do to maintain, continue and repair "our world" so that we can live in it as well as possible' (Tronto 1993, 103). A key aspect of 'situated care' (Puig de la Bellacasa 2017) at Merapi is instantiated by the efforts to synchronize spiritual warnings revealed through dreams, with the sounds of a seismograph. Many times, such efforts are unsuccessful; nonetheless the very act of trying to align disparate knowledge registers transforms a plurality of realities, into multiple versions of a geophysical and living entity.

Engaging with disparate knowledge registers seems implausible, if not frankly impossible, from a modern worldview, hardwired as we are to notions of scientific objectivity and risk mitigation. However, the ability to find resonances (Wikan 1992) across knowledge registers by non-Western and non-Modern cultures (Law et al. 2013) is not new and has been part of the anthropological literature, and even legal ethos of Indonesia, for some time now. For instance, regulations published in 2010 for disaster management establish, and reiterate via nine different articles, that 'it is necessary to improve the administration of disaster management in the pre-disaster, emergency response, and post-disaster by accommodating the values of local wisdom' (PRSRY 2010, 1). This local provision aims to enable local policy makers to 'protect communities from the distribution of aid that threatens, destroys and/or eliminates local cultural values and wisdom' (PRSRY 2010, 51). The envisioned protection appears thus to extend beyond the volcanic hazard and into the preservation of a moral landscape.

In reviewing Mary Douglas and Aaron Wildavski's Risk and culture (1982), Caplan (2000) and Skinner (2000) highlight how the mainstay theoretical point of cultural theory of risk could be formulated in terms of social groups choosing their 'terrors and nightmares, selecting some and ignoring others, and such choice is culturally informed' (Skinner 2000, 161; cf. Caplan 2000, 10). Cultural theory of risk has been critiqued for focusing exclusively on a narrow tripartite (at times quadripartite) typology of social organization (grid-group theory), without really paying attention to either the individual (despite Douglas' proposal of a 'methodological individualism') or the temporal aspects of risk perception (Caplan 2000, 9, 11–12; Skinner 2000, 162–163). Time is, instead, central in the elaboration by two leading theorists of risk, sociologists Ulrich Beck and Anthony Giddens, who analyse how the future shapes the present, via the modern concept of risk (Caplan 2000, 5). In the present research, we aimed to assess how risk perception is modulated through time in people's experience of Merapi, and encountered how dreams (rather than nightmares) are differentially selected or ignored by specific individuals and groups.

Merapi's local epistemology (or wisdom) is not homogeneous and presents tensions between two main approaches to practices: on the one hand *kejawan* (Javanism), characterized by the use of Javanese language and rituals, and on the other hand Islamic modernity, characterized by the use of Arabic, literalist interpretations and an aversion to syncretic forms of ritual practice, coupled with an agenda for modernization. Historical and ethnographic analysis of the relationship between Javanism and Islam characterize the development of religious schools (*pesantren*) and political parties seeking alternatives to political Islam, as sources of tensions that stirred political and violent confrontation in the nineteenth and early twentieth centuries in Indonesia (Hefner 1987). This field of contention is historically established and is well researched in the classic anthropological literature on Indonesia (Geertz 1960; Jay 1963; Bowen 1984); neither is it limited to Indonesia and is observed in specific modalities in other regions of Southeast Asia where Islam is practiced with differences existing between traditionalist and modernist groups (see Roff 1985 for broader Southeast Asia; Nagata 1982; Aziz and Shamsul 2004 for Malaysia; Scupin 1987 and Merli 2012 for southern Thailand). From Hefner's historical point of view (1987) the transition from the Old Order (1945–1966) to the New Order (1967–1998), and its enthusiastic promotion of Islamic education, was leading to the Islamization of Java. For other historical anthropologists, Javanese rituals like *Slametan* have always

been akin to Islamic mystic traditions such as Sufism (Woodward 1988), therefore we should understand Islamic Javanism as another form of local Islam (rather than something opposed to it). This is also in line with scholarly work that conceptualizes *Slametan* as 'communal space for the local Javanese, either the Abangan or the Santri, to greet and pray for peace and happiness among themselves' (Ali 2007).[10]

Hefner and Woodward conceded that, historically, Central Java, with its high court Javanism linked with the Sultan and Hindu-Buddhist traditions, has always been inclusive of other religions. This difference was made clear by one of our key research participants who spontaneously said: 'you see, here [Yogyakarta], we are not fanatics. That is why we take care of all our Buddhist and Hindu temples' (Schwartz-Marin Field notes, 2016). In our research, members of grassroots monitoring networks around Merapi, who are also practitioners of *kejawen* and Islam, like Pak Tanro, have experienced a growing opposition to ritual offerings such as *wiwitan* (a ceremony performed before planting rice in fields, by making food offerings to 'Mbok Sri' [mother or goddess of rice]).[11] On the occasion of communal feasts (*kenduren* or *slematan*) organized at prescribed intervals following a funeral, some members of the community were reported to hold the opinion that 'those ceremonies are not really in accordance [*sesuai*] with religion [Islamic teachings]' (interview) (cf. Bowen 1984 for a thorough analysis of a similar epistemological clash in the Aceh region). The gap between the traditionalist 'old group' (*Kaum Tua*) and the modernist 'young group' (*Kaum Muda*) on Merapi's slopes became evident during our fieldwork when our gatekeepers tried to dissuade us from interviewing members of the network that were too linked to 'the old ways' (that is *kejawen*), or even their fathers who would not stop talking about the spiritual warnings given by Merapi.

Given this antagonistic history, it is all the more relevant that protective practices related to 'hot' clouds (*awan panas* in Bahasa, *wedus gembel* in Javanese; pyroclastic density currents or flows in scientific terms) and the aftermath of eruptions have generated a conglomerate of volunteer groups that include scientists, villagers, ritual experts and active members of governmental organizations that defend the role of local wisdom in recovery and disaster management implementation. In 2010, under the coordination of Yogyakarta's Regional Disaster Management Agency (Badan Penanggulangan Bencana Daerah, BPBD) at the district level, each village established *desa siaga bencana* (disaster preparedness and resilient villages programme) to prepare a contingency plan in case of emergency, including a standard operating procedure at hamlet level. We could read this shift towards empowering hamlets as an instance of *reformasi*, which entailed a devolution of 'governing powers and services from central to local governments' (Diprose et al. 2019). *Reformasi* occurred after Suharto's rule ended in 1998–1999 and, while it is appealing to think of the grassroots monitoring networks as a direct product of a wider governmental push on *reformasi*, its origins lie in forms of communal solidarity that have shaped life and civic-ritual duty in Yogyakarta for centuries, and are locally widely acknowledged: 'for us, it is almost a sin not to share what we know and [not] to care for each other' (interview Mas Yuyi 2016).

The work of JALIN Merapi (Jaringan Informasi Lingkar Merapi, or the Information Network Around Merapi Volcano) illustrates the importance of grassroots organizations and volunteers' response in the aftermath of the 2010 eruption. The network operates via eight community radio stations[12] and played a pivotal role during and after disasters: 'Jalin Merapi recruited and assigned approximately 700 volunteers to gather

information about the refugees' needs, to operate a media centre and to help distribute the relief aid' (Saputro 2016, 67). This active monitoring and aid network (and others) continue to exist, shaping protective practices to deal with ash (*abu* or *awu,* otherwise unspecified, are used to indicate 'normal ash', that is 'cold' ash related to ash falling from an airborne plume rather than 'hot' ash directly from pyroclastic flows), since the constant preoccupation with the deadly aspects of Merapi is also the source of a continuous communal exchange and transmission of information of possible dangers, including those related to the inhalation of ash. Thus, thanks to the existing monitoring networks such as JALIN Merapi and DREAM (Disaster Research Education and Management),[13] both established before 2010, or via Whatsapp and Facebook groups, villagers and urban dwellers were able to share protective strategies, including mask use to avoid ash inhalation, as well as to communicate that there are 'toxic elements' hidden in the ash.

It was only after the 2010 eruption – the district-level disaster management agency (BPBD Sleman) established the Forum (Forum Relawan Merapi), an organization developed to coordinate volunteers in the aftermath of the eruption – that the official disaster governance structures took an interest in existing monitoring and volunteering networks.

> In Sleman, we have the most active and the largest numbers of volunteers, I think, in all of Indonesia, because we have many disasters related to Merapi. We began activities around the time of the 2006 eruption and earthquake. People in Sleman want to help others, which raises the numbers of volunteers, and we have received prizes and awards for it, but what we need now is to increase their capacity and competence. That is why we are part of the Forum. (interview Rego-IK 2016)

In an effort to standardize the volunteers' set of skills, BPBD Sleman has recently tried to formalize the Forum, starting with the registration of volunteers, followed by training programmes. Lively peer-to-peer networks of care allow government officials to tap into free labour of volunteers, existing governance mechanisms and recognized local authorities and providing, in return, infrastructure and access to seismic data.

The grassroots monitoring and aid networks have also eased the long and arduous work of getting governmental funds and donations into the hands of volunteers, circumventing corruption practices that see the amount of monetary support 'diminishing' as it moves from the top agencies to the local level (paraphrasis from interview, Schwartz-Marin, fieldnotes 2016). Grassroots participation has helped locals to distribute goods, such as masks, to their community directly, and to access training to update their skills and their legitimacy as peer-experts in the response to hazards. Probably, the most impressive achievement of the network is its capacity to nurture protective practices that transgress the alleged distinction between fact and fiction, thus bypassing the tensions between Javanism and Islamic modernity.

The coexistence of seemingly incommensurable knowledge registers in the Javanese region has not gone unnoticed by anthropologists of spirituality and religion. Schlehe (2015) describes the negotiations between modern universalism and local knowledge as 'spiritual cosmopolitanism', a concept that reinforces the distinction between 'eastern spirituality' and 'Western rationality' in Java. Others analyse the political economy of disasters and religious practices near Merapi (Dove 2010, 2008) and the role of information technologies and spirituality in the construction of resilience (Joakim and White 2015;

Saputro 2016; Tazic and Amir 2016). The anthropology of science has developed its own 'Cosmopolitics' which, instead of tackling the tensions among local and universal religious narratives, ritual offerings, and forms of spiritual communion (as in Schlehe 2015), examines the ontological politics on which the universalism of 'Science' rests (Haraway 1988; Latour 1993).

Regardless of their specific interests in the negotiations enacted in the region, scholars have thus far overlooked instances of vulnerability and protection that blur the distinction between 'belief' and 'stubborn matter of fact'. Villagers and, to a lesser extent, urban dwellers near Merapi switch between the realm of spirits and that of seismic data circulated via Facebook and volunteers' walkie talkies (cf. section on spiritual and seismic surveillance) and executed through networks of solidarity and mutual care in their everyday activities. In response, we propose to move away from functionalist-oriented cultural theories of risk, since our research participants are not only open minded or tolerant about various forms of practice, but bring them together without synthesizing, or subsuming, them under one ruling logic, as is the case in many non-modern settings (Law et al. 2013).

Connecting with Gunung Merapi

Volcanic disasters bring devastation but also new opportunities for business and social organization (Schlehe 1996; Lavigne and Gunnell 2006; Dove 2008). Different groups of people enter the narrative flows that issue forth from the Merapi area and contribute their own narratives, linking their lives to its spiritual, economic and political abundance:

> Merapi brings his own blessings. In my opinion, and the opinion of others, the breath and blood of the people that live around Merapi flow from its ground, because the food that we eat was produced by it. No wonder, after the eruption, people want to come back to their places because of this bond. (Interview Mas Piran, villager)

Volcanic eruptions have brought hardship and damaged existing infrastructure, thus limiting economic opportunities, yet this scarcity also became the inspiration to redefine villagers' economic activities and identity. Given the constant adaptation of political and economic activities to the volcano's eruptive cycles, and the opportunistic way in which people create businesses in the aftermath of volcanic eruptions, some authors have typified Merapi as a culture of disaster (Dove 2008).

> [T]o those who are patient, God gives them a blessing. Thus, thanks to the eruption we can have a jeep-lava-tour that brings income, trails for tourists and improved economy. Although, back then, we were shocked, it's just natural. Besides that, actually the location after the eruption has flourished, since there are more and bigger trees. (Interview Ibu Ati, female shop owner, 2016)

Research conducted by Salipi and Nugroho (2017) shows that Merapi's eruptions have brought economic opportunities for local people, who can run new forms of business (for example lava tours), rent out accommodation, and operate restaurants. On the other hand, since 1994, Merapi's eruptions left lasting effects on the environment that have threatened surface water supplies,[14] changed farming practices and the job prospects of those that live nearby the volcano. The burnt motorcycles exhibited in various local museums established after the 2010 eruption bear witness to the devastation that

engulfed the area, but also to the inventiveness and adaptation of its inhabitants. Images of this momentous memory are displayed in grassroots and individual volunteer-led museums, which bring income to the hamlets while simultaneously disseminating information about disaster preparedness. The place where *Mbah* Maridjan lost his life to the pyroclastic flow has been repurposed to be a memorial museum. Tourist and market stalls where one can purchase pictures and booklets depicting the 2010 eruption, as well as food and souvenirs, line the nearby street. If visitors are lucky, they can also meet the new *Juru Kunci* (Pak Asih) here during communal exchanges and chats. Visitors can also find publications informing about the work of the Red Cross, other NGOs, and the government agencies dealing with evacuation of people at risk.

Due to the flexibility and polyvalence of the adaptation to volcanic eruptions near Merapi, debates and paradigms in the anthropology of disaster such as continuity and change, resilience and cultural syncretism are exemplified and challenged on this volcano's slopes. Most of the scholars researching the political ecology at Merapi, ranging from local spiritual connections, to relocation practices, and production of knowledge (excluding 'scientific practice' from their analyses), tend to examine it in terms of its function to either mitigate risk or increase exposure to volcanic threats; for example 'causing evacuation failure and therefore increasing the local population's vulnerability' (Donovan 2010a, 3).

Social anthropologists analysing Merapi's 1994 eruption and its aftermath, such as Schlehe (1996, 404) sustain that the belief in spirits increases people's sense of security, making people resist the government's resettlement policy. Similarly, Dove (2008) characterizes the anthropomorphisms in the narratives and rituals organized around Merapi as a form of domestication, 'by reducing "the awesome and incomprehensible to something prosaic and simplistic"' (Bankoff 2004, 96–97 cit. in Dove 2008, 332). Merapi's local myths are seen as psychological coping mechanisms to deal with dangers that impact negatively on people's understanding of what preparedness amounts to (Donovan and Surhyanto 2011).

Other analysts are less prescriptive about the role of 'culture' and are aware of the difficulty in supporting mechanistic hypotheses that directly link 'beliefs' with (non-)protective action (Joakim and White 2015). What scholars like Katherine Donovan may have overlooked is that changes in the spiritual-physical landscape are also modifications in the relationship between eruptive dangers and protective practices. For instance, whereas immediately after the eruption of 1994, changes in the spiritual-volcanic landscape were explained by local inhabitants as a response to a lack of religious discipline, misgivings of political leaders and the response of the ancient spirits to the sinful activities of inhabitants (Schlehe 1996), in the medium and long term so-called 'cultures of vulnerability' also adapt to accommodate new protective practices. Dove (2008) proposes that domestication allows Turgo (a hamlet on the slopes of Merapi) inhabitants to better tend to crops and thrive in their environment. For example, changes in the landscape and the consequent relation between local people and these events also bring new dispositions towards what was possible and not possible in regard to volcanic crisis and appropriate responses.

Historically, Turgo hamlet was considered to be placed in a protected position because of a hill located between the hamlet and the crater. However, the 1994 eruption took an unprecedented direction southward and this hill proved not to be protective any longer,

which 'changed everything … that is why, when people tell me we don't need to evacuate, I just remind them about the mountain' (interview Pak Gunawan 2016).[15] Some people were still using a cosmological perspective related to 'the old Merapi' whereas what they were dealing with was 'a new Merapi'. This interpretation of the relationship with the volcano in terms of two different Merapis resembles the divide between traditionalist (the old way) and modernist (the new way) Islamic practices, appeasing the environment or rejecting a ritual interpellation of it with old ritual practices. The intimate relationship between sacred landscape, spirituality, and protection is in perpetual flux; as the eruptive events constantly transform the landscape and the spiritual landmarks, so do the dispositions towards evacuation: 'before we were reluctant to leave, today we take out the umbrella before it rains' (interview Babani 2016).

Given the plasticity and intertwined-ness of landscapes, forms of protections and spirituality, we shift our perspective from culture as a process of domestication, a subjective sense of security, or the stubborn manifestation of deep-seated cultural beliefs, to understanding these conceptions as practical achievements, that cannot be 'culturalised', or subordinated to the logics of one master narrative of reality or one coherent worldview. After all, '[a]nthropology is that Western intellectual endeavour dedicated to taking seriously that which Western intellectuals cannot … take seriously' (Viveiros de Castro 2011, 133).

Spiritual and seismic surveillance

Gunung Merapi's eruptive activity and hazards have been carefully recorded and studied (for example Surono et al. 2012; Damby et al. 2013). Our study participants pointed out Merapi's exceptional status; a government disaster manager reminded us that 'Merapi is an exception. Its dramatic qualities draw lots of attention, but the type of monitoring and social organisation that characterise the people in Yogya are absent in many of the other volcanic sites I continually visit' (Schwartz-Marin, field notes, 2016). To state that the volcano is a celebrity is no poetic license: Merapi is central to Javanese cosmology. Its eruptions are associated with political transformations, the volcano is monitored via several forms of surveillance, a panopticist gaze producing political inferences of the volcanic events, as noted by Dove (2010).

The organization of the grassroots monitoring networks partially owes its success to the governmental investment in information technologies and the adaptation of the *Cyber Kampung* (Jones 2016), model to their own needs. In 2006, due to the drastically diminished business opportunities in the aftermath of volcanic disaster, groups of neighbours pooled their resources together to connect to the internet and brand their local shops, services, and talents. The first *Cyber Kampung* served as the initial platform not only for businesses, but also for other hamlets and villages to experiment with ICTs and Facebook. An example of this is the hamlet of Balerante, where they set up their own monitoring post and internet antenna, linking their existing walkie-talkie communication network, to CCTV cameras, Whatsapp and social media (mainly Facebook), to keep an eye on their volcanic *Simbah* (grandparent) and tap into seismic data produced by local scientists.

Before the 2006 eruption, local communities used two musical instruments – *kentongan* (a wooden slit-drum) and *bende* (a brass large disk, a kind of gong) – to communicate about emergencies with nearby hamlets and villages, with the *bende* being used when the maximum level of alert was reached (as in major eruptions, lahars or ash falls).

Changes in temperature and animal behaviour have historically provided signs of volcanic unrest:

> we were the first to experience the heat wave, it was unbearable, it shouldn't be that hot … tigers are usually afraid of humans, but during eruptions, they will escape to the villages because they can't stand the heat. That's a fact that can't be denied. (interview Bikanga 2016)

For many generations, observations and warning techniques have included spiritual signals, unusual but repetitive events (such as people disappearing on Merapi's slopes), feelings, and visions. One such vision is vividly described in this interview's excerpt:

> Back then [my parents' and grandparents' generation], there would be a procession with lights invisible [to most people] and the light would be very bright with spirits from Merapi volcano heading to the sea because [these spirits] were linked to the South Sea. Some people were able to see it – that's how I got the story but I've never seen it myself although my parents did. But back then, if people saw the procession, there will be a flood [mudflow, *lahar*] the next day. (interview Banak, F 2016)

Spiritual forms of surveillance are still common in the vicinity of Merapi, where fasting and contemplation are ways to communicate with the *penunggu* (volcano's tutelary spirit) that has warned locals

> to move to the West [of the volcano] to avoid the harm that can be produced by its eruptions. So, we believe the ones who understand it [the intuitions or signs], are the ones who practice '*laku prihatin*' [self-discipline, usually in the form of fasting]. Signs are also related to 'feelings'. (interview Pak Gunawan 2016)[16]

Spiritual communication comes in the forms of dreams, and oneiric revelations. Pak Dusmi, a very active grassroots monitor, talks about two natures: 'The nature like this [referring to his physical surroundings] and the supra-natural that we have to believe in' (interview). Others like Pak Tarno (volunteer and *kejawen* practitioner), have received dreams in the form of verbal warnings: 'if asked to run, just run – if asked to leave, just leave' or in the form of a silent female spirit that comes to him while practising self-discipline; despite being 12 kilometres away, his bond with nature is maintained by offering flowers and food: 'we pray to connect with nature … but also feed them, using flowers that symbolise different things such as loyalty, birth, trust' (interview). Usually, ritual burials and offerings are a way to protect from these warnings. Mas Sephirot, another active volunteer, narrated how his father had received a vivid dream in 2006, in which 'poultry was melted in its cages, by hot clouds' (interview), to which he responded by burying two chickens alive.[17] However, sharing and interpretation of dreams and feelings are not always limited to a private circle; spiritual revelations can become part of a wider grassroots monitoring system, since the *kesepuhan* (elders that receive signs) are recruited as volunteers by the disaster management agency. The following quote by Pak Gunawan, a 40-year-old grassroots monitoring volunteer[18] – also a liaison connecting elders and volunteers – briefly illustrates what is described by many other villagers as synchronization (*sinkronisasi*) practices:

> This kind of knowledge can go through feelings or dreams, probably they are in contact with the guardian tutelary spirit of Merapi [*penunggu Merapi*]. I don't really understand this, though. We [I and the '*kesepuhan*', elders] like to chat and discuss, but sometimes their intuitions and dreams cannot be linked to specific actions, but we still like to understand each other … it is

part of our warning system. In our group of volunteers [friends and colleagues] we accept each other, so we share. (interview Pak Gunawan 2016)

The auto-didactic and inclusive nature of the interpretation of both the seismic data shared via Facebook and dreams shared in informal conversations, is possible thanks to the vibrant network of sign givers and sign takers. Volunteers feed the network with information [sometimes on a daily basis] and are in charge of verifying the source of information and communicating with volcanologists and seismologists. The use of the disaster agency seismic radio frequency is illegal, but the members of the official monitoring agencies allow the volunteer-led network to tap into their frequency, and even provide them with explanations and demonstrations of how their equipment works. All these practices attend to the changes of Yogyakarta's ancestral patterns of guardianship:

Our seismic monitoring network allows us to identify different sounds. For instance, we can know if it is raining or not, so it could be raining at the summit, but downhill there is no rain. So, based on these sounds we gauge if there is the possibility of a flood [mudflow]. (interview Mas Tikal 2016)

Although volunteer networks are forms of monitoring and protection, operating by established surveillance of the volcano's activity (ash emissions, lahars, explosions etc.), they also allow for dissemination of advice on health protection (including mask use).

Ash 'toxicity' and mask distribution

The monitoring and memorialization of Merapi has been overtly, and rightly, centred on deadly 'hot clouds' (pyroclastic flows). Nonetheless, the protective practices regarding ash inhalation have entered ubiquitously into the daily practices of villagers via peer-to-peer health advice. For instance, in Turgo, located just four kilometres from the summit of Merapi, Mas Yuyi (a local volunteer) told us that 'ash has hidden elements inside it that need to be taken care of such as sharp and poisonous silica'. Then, he explained how he demonstrated the presence of silica in the ash by performing a public explanation/demonstration of its 'sharpness' (*ketajaman*, Bahasa) and dangerous nature to his neighbours, by rubbing ash into his own motorcycle's surface and showing them how paint immediately fell off the motorbike.

If we squeeze the sand [ash] in our hand we can feel it is coarse. But we have to be thankful that, even though we use a variety of masks [including cloths covers], those who received permanent damage [because of ashfall] were not many.

Yet, volcanic ash particles, small enough to enter the lung, are not 'abrasive' within the respiratory system and do not cut the lungs. Crystalline silica is not always present in volcanic ash, and various laboratory tests need to be performed in order to ascertain its presence (Horwell and Baxter 2006). Damby et al. (2013) found that ash from the 2010 Merapi eruption contained between 2 and 10 wt. % crystalline silica and Nattrass et al. (2017) and Horwell et al. (2012) have shown that there are geochemical reasons why volcanic silica may not be particularly toxic. However, the World Health Organization now considers any fine particulate to be capable of causing increased illness and death at a population level (WHO 2013) and a review of medical studies at volcanoes concluded that ash can sometimes exacerbate existing respiratory disease (like asthma and bronchitis) but that

there is still insufficient evidence to say whether ash poses a risk of chronic disease development (Horwell and Baxter 2006). In the interview reported above, however, our research participant assumed silica to be a constant and dangerous feature of volcanic ash. It is not clear where these narratives (that silica would scratch the lungs, for example) originated – a governmental agency or medic or some other source – but inaccurate information has spread. This shows that health advice is not simply a reproduction of scientific information, but rather a performance designed to convince others around Merapi of the need to use a mask.

However, ash was not, in general, considered to be deadly, but a perception of it as potentially dangerous, and possibly a cause for [mild] disease, was widely shared. Ibu Varela, urban dweller and mother of two, told her children about the 'iron in the ash'. Another woman voiced her concerns about the 'poisonous sulphuric gases' that are avoided by wearing masks (despite the fact that surgical masks, which are most often used around Merapi (Covey et al. 2019; Horwell et al. 2019) will not prevent the inhalation of gases), and some interviewees told us that they rub grinded coffee on the external side of their masks to avoid the smells and the shortness of breath. Even one of the most eminent scientists and monitoring authorities in the area stated that 'there are crystals in ash, not in common ash … if we look at it under the microscope it is very dreadful … and if it goes inside the lungs it will wound you. As I said before, particularly babies are vulnerable' (interview Pak Midas 2016). While the potentially-toxic elements described in ash might vary with eruption (that is silica, iron and sulphur) the idea that ash is inherently dangerous or 'toxic' is locally widespread: 'volcanic ash is dangerous because of the silica elements, which is why, after eruptions, there's always respiratory and lung tests' (Ibu Iaketa 2016).

Nowadays, masks are widely used as a barrier against a range of potentially-toxic airborne contaminants, including urban air pollution, but the situation was different just a few decades ago. To understand how the adverse health effects of ash were conceptualized and communicated (regardless of the scientific accuracy of these claims), and respiratory protective measures adopted, we need to examine the organization of networks of care that emerged via the distribution of masks.

> In 2010, we were aided by our network of communication, such as our walkie-talkies; communicating through the radio, so the process was rather fast. The information consisted of how and where to access masks. The [district] health section also directly distributed some boxes of masks for people in each *kelurahan*. Some volunteers helped us with mask distribution at the road junctions. (interview Pak Aristy 2016)

While the grassroots monitoring networks are vital for public mask distribution, within households, women were often the ones ensuring that children and elders were wearing masks, and using them properly (that is, by covering both their nose and mouth). Pak Numikut, a volunteer and farmer, along with many others including the new *Juru Kunci*, noticed an incremental change in the use of masks:

> people started wearing masks in 1994, but still in limited numbers. Now, if there is an eruption, even a small one, people already have or receive masks very quickly. If we went outside, for example to search for grass to feed cows, we would wear masks.

Before masks became ubiquitous, people used other protective fabrics 'clothes like *gandum bagor* [cloth made from the bags to carry flour] or *jarik* [traditional cloth for women]'[19] (interview Pak Aristy 2016).

The availability of masks, to be purchased or free of charge, is no doubt an important element in the adoption of respiratory protection measures. Volunteers, and heads of villages and hamlets, consistently reported that they had a stock of masks to distribute to their neighbours, prioritizing those deemed to be more vulnerable.

> We always have a stock, at least for the people in this *kampung* [about 400–500 inhabitants]. One person, one mask. But the problem is that the masks need to be replaced on a daily basis. In 2012–2013 we experienced a phreatic eruption. It was a good opportunity for us to do a drill [*simulasi*] . …. I called my team and told them 'get the masks and stand on the street, distribute the masks for students in elementary school and kindergarten', they are more vulnerable than us. (Pak Gunawan 2016)

Nonetheless, the free distribution of masks depends on the characteristics of the volcanic event and the time communities have to prepare to face an eruption. Pak Gunawan recognized a sharp difference between the eruption in 2010, when they had time to prepare, and the ashfall from Kelud volcano (located ~300 km away) in 2014, that took people by surprise.

A study which documented the use of facemasks in Yogyakarta during the Kelud eruption in 2014 (Horwell et al. 2019) established that most of the masks used were bought by householders in local shops and pharmacies (41%), and street stalls (15%). While many other masks also came from NGO donations (over 1.5 million masks were available for Yogyakarta in the 2014 eruption), and were distributed by NGOs volunteers, only 11% of the respondents got their masks via this channel. This example shows that respiratory protection is not exclusively a question of free mask availability: if masks are available, locals are prepared to buy them. This situation is especially interesting because people do not consider certain types of masks to be particularly effective against ash: 'in my opinion, my mask wasn't effective and comfortable, and I could still feel the ash' (interview Ibu Laketa 2016; see also Horwell et al. 2019). Similarly, a local volunteer and office worker mentioned: 'I think the masks we got are not safe enough, both types: surgical masks with straps or those with ear loops, and the ones that had to be tied were difficult to wear' (interview Mas Rothi 2016).

A close analysis of the use of respiratory protection exemplifies how to engage differently with the notion of 'protection' during and after disasters, since many still used masks despite perceiving them as not being particularly effective. Concerning the efficacy of masks, informants lamented the lack of *socialisasi* (community engagement and sharing of ideas and practices): 'actually, people don't know whether the masks are good or not. There was no *socialisasi* about the best masks to use back then, because it was an emergency situation' (interview Ibu Ita 2016). Since this research was undertaken, as a result of the findings of the HIVE consortium (Mueller et al. 2018; Steinle et al. 2018), such information is now readily available, in Bahasa, at www.ivhhn.org, as videos and pamphlets.

The caring authorities that take on a protective role are sometimes peers such as the volunteers who are part of the grassroots monitoring networks (DREAM and Jalin Merapi), who have been key in distributing both masks and health narratives about ash.

The spread of community knowledge which labels volcanic ash as a dangerous element, encourages protection via the precautionary principle (McDonald et al. 2020), but is not necessarily scientifically justified. Despite the wide use of respiratory protection, our research participants' experiences of the health impacts of ash were at odds with the idea of toxicity and possible severe consequences:

> People did not get serious problems with their eyes and cough. For instance, after the eruption it was dry season, ash was flying everywhere particularly after cars passed by, but in the end people were fine! They were not sick even though they just closed their eyes and covered their mouth and nose with their hands. (interview Mas Simali 2016)

Similarly, the new Juru Kunci states that 'the impact of hot clouds [*awan panas*] is huge [because it is deadly] but ash [*abu*] just produces cough and eye irritation'. Deaths around the time of eruption (not related to hot clouds) were attributed to pre-existing illnesses: 'one or two elders died, because they were already sick before the eruption. I do not have exact data because at that time I was not head of village' (interview Mas Simali 2016). Other heads of villages and locals attribute serious illnesses after the eruption to stress resulting from loss of property, malnourishment, and anxiety caused by the eruption (for example for pregnant women), but none attributed illnesses to ash.[20] Nonetheless, some interviewees such as Ibu Varela, housewife and volunteer, have internalized the mask-wearing norm so deeply that they state:

> The rule says that it [mask] has to be worn continuously. The important thing is to protect your nose. Because, otherwise, the ash will get into your lungs. Those who don't wear masks probably think they're uncomfortable. Well … these are ignorant people, but I should not judge them, I don't know their reasons. I wore a mask and hijab on the days the ash was around. The hijab was for head protection. (interview Ibu Sali 2016)

Mask wearing has also become the norm in a tourist attraction known as the Lava Tour, with visits to the hamlets and areas near Merapi damaged by the 2010 eruption. The jeeps travel on unsealed roads and through the valleys which are being 'sand' mined (industrial removal of volcanic deposits), mobilizing dust in the process, so the visitors are given masks to wear. Nowadays, people wear masks during outdoor activities, such as on scooters and in everyday use; masks are, without a doubt, the dominant mode of respiratory protection in Yogyakarta.

Conclusions

In order to answer the question about why widespread mask use has taken root on the slopes of Merapi, we need to understand the infrastructure of care that allows for constant monitoring and public demonstrations of knowledge to travel. Volunteering networks, initially devised to manage *wedus gembel* (pyroclastic flow) hazard and eruption emergencies, grew stronger during the 2006 and 2010 eruptions, becoming a platform to share masks, guidelines and information about the possible health effects of inhaling ash.

For our research participants, many of whom belong to these volunteer networks, *socialisasi* (sharing of knowledge and good practice) and *sinkronisasi* (synchronization, or bringing together different natures and knowledges about Merapi) are central activities to shape, share and sustain protective practices. Efforts to synchronize the revelations of

sounds and feelings experienced through dreams, with seismic data shared via social media, could not be disentangled from the success of surgical masks as a device to protect from ash, as both are enactments of care made possible by the same set of people and infrastructures. The collaboration of governmental agencies, international sponsors-donors and NGOs has engendered health initiatives to freely give masks; but people are also ready to buy masks, as it has become a form to care for themselves and others. The role of care becomes more salient when we consider that many research participants did not consider ash to be dangerous in their experience, yet they deem it to be poisonous in general. Some did not deem their masks particularly efficient, yet they are widely used. Based on our findings, we suggest to question two related assumptions that are often fielded in DRR: the first is that there is a causal relationship between beliefs/perceptions and vulnerability/protection; the second is that programmes would need to effect change in the (allegedly coherent) belief system in order to obtain a change in behaviour. In Yogyakarta, disaster managers, village heads, families, volunteers and those living near Merapi, fully engage with plurality, transforming this plurality into multiplicity (that is non-univocal and interdependent ways of enacting) (Mol 2002) and bringing together different natures of Merapi for *sinkronisasi*. Incommensurability is not a problem, in our case study's communities, since the question is not how to evaluate the knowledge of others and our own, or even what are the parameters that identify acceptable and truthful information. The crux is how to engage with these different knowledge registers that might be beyond our comprehension and experience – made possible by a deep commitment to care for other forms of knowledge and revelation of dangers.[21] Spiritual sustenance, respiratory protection, and promotional material not only co-exist with each other in the commercial and memorial spaces but also in the everyday protective practices of villagers living around Merapi.

What makes Merapi multiple is not that its different versions exist within one coherent paradigm but that, through *care*, different – sometimes undecipherable and unknown – enacted natures can be brought together via a loosely-knit community of protective practices that do not need to fight for coherence or purity. The new Merapi is produced via a synchronization of traditionalist and modernist views of the volcano as a novel, ritual-rich way forward.

Notes

1. The root of the term, *gugur* means to fall, to come off, died, while *guguran* is an avalanche. Other related terms are *berguguran* (to fall off, accidental falling) and *keguguran* (miscarriage).
2. Some local people interpret his refusal as a defying act against scientific authorities' advice, to demonstrate his special spiritual connection with the volcano and reassert the role of the Juru Kunci in the mythology of Yogyakarta (he refused leaving also during the 2006 eruption). The Juru Kunci was also disobeying the direct orders of the 10th Sultan of the Kraton in Yogyakarta, reminding that he was appointed by the 9th Sultan, and therefore he was not obliged to follow the former's orders.
3. The majority of locals had first evacuated to a temporary shelter, then to relocation sites. Nowadays those that used to live in the most affected villages, have turned their previous homes into places of remembrance, commerce, paying respect and ritual offerings.
4. Wildenauer's visual work (2015) deserves special mention as it explores relocation practices through an analytical lens that blurs the distinction between subjectivity and nature.

5. Most of the social organization we are describing and analysing emerged just before 2006, and would probably go unnoticed if scholars were looking for science and ritual in segregated and isolated spaces and under the expected guise.

6. Krüger et al. (2015) provides several examples of the cultural theory of risk, such as the almost factorial model discussed by Schipper (2015, 148–149) in which beliefs determine attitudes, perceptions, and behaviours.

7. Here is a detailed description of the administrative divisions in Indonesia and corresponding localities surveyed (bold font). Propinsi (Province); Kabupaten (District) or Kota (Municipality); Kecamatan (sub district); **Kelurahan (village)**, in urban area: Keraton, Wirobrajan (Yogyakarta); **Desa (village)**, in rural area: Pakembinangun, Bangunkerto-Turi (Yogyakarta); Srumbung (Magelang), Paras (Boyolali); **Kampung (hamlet)** usually in urban area (even though the term extends to some rural areas of Indonesia): Jetisharjo (Yogyakarta); **Dusun (hamlet)**, in rural areas: Tunggul Arum, Turgo, Kinahrejo, Kali Tengah, Manggong, Jambu, Petung, Dongkel-sari-Gungan (Yogyakarta); Balerante, Deles (Klaten); Babadan (Magelang); **RW-RT** (Rukun Warga – Rukun Tetangga) (for urban and rural areas) neighbourhood; **Organizations visited**: BPBD Kota Yogyakarta, BPBD Kabupaten Sleman, Dinas Kesehatan Kabupaten Sleman, Centre for Health Policy and Management – Universitas Gadjah Mada, BPPTKG-PVMBG, Kantor Pemkab Sleman, and around Jalan Kaliurang.

8. Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi – Pusat Vulkanologi dan Mitigasi Bencana Geologi.

9. A volcano observation post (Pos Pengamatan Gunung Berapi) which is located in Babadan hamlet, Krinjing village, Kecamatan (sub district) Dukun, Kabupaten (district) Magelang.

10. When discussing about Javanese religion, culture and society, these categories should not be viewed as static due to the complexity of Muslim society (Ali 2007) and the influence of globalization and fundamentalism in Indonesia, including Java.

11. The relationship between Javanism, agricultural rituals, feast and Dewi Sri or Mbok Sri is fleshed out in detail by Heringa (1997).

12. A complete list of names and frequencies is given via the JALIN website (http://jalinmerapi.net) and a Facebook page.

13. DREAM works under PSMB (Pusat Studi Manajemen Bencana- Disaster Management research Centre) in UPN Yogyakarta. https://www.facebook.com/pg/Disaster-Research-Education-Management-DREAM-611337385604338/about/?entry_point=page_nav_about_item&ref=page_internal

14. People were forced to drill wells to reach fresh water.

15. Dove (2008) and Schlehe (2010) describe how the loss of the Turgo mountain, considered the ancestor of Merapi, and thus protected from its 'coughing', became an absence that reminded the locals that the volcano's behaviour had permanently changed.

16. Self-discipline is related to fasting, contemplation of nature, and long periods of meditation and prayer.

17. Mas Vivu, an elderly man who described how the burning cloud of ash (Wedus Gembel, lit. 'woolly sheep') scarred his body, also told us that he preferred not to share the dreams he had prior to the eruption, in order to avoid attracting attention and being identified as a spiritual healer (interview 2016). Similar narratives of various interviewees suggest that there is a wide spiritual practice that remains unpublicized, and decoupled from the grassroot monitoring networks.

18. Pak Gunawan, comes from a village (Glahargo) that refused to evacuate in 2010, and whose dwellers are still living in their original location.

19. Still today some women manufacture their home-made masks to protect from ash.

20. These opinions somewhat conflict with the results of a questionnaire survey conducted as part of the HIVE project which found that 79% of 600 respondents in the Yogyakarta region perceived that their masks (for ash protection) were very effective. Additionally, 73% of respondents thought that inhaling volcanic ash might be very harmful to their health and 66% were very worried about inhaling ash (Covey et al. 2019).

21. Some of us might be tempted to describe such care as tolerance. However, in line with the Kantian critique, we avoid the notion of tolerance, which implies we tolerate that which we do not like, share or believe. What is happening at Merapi's slopes in terms of *sinchronisasi* goes well beyond tolerance understood in this sense.

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References

Ali, Muhammad. 2007. "Categorizing Muslims in Postcolonial Indonesia." *Moussons, Social Science Research on South East Asia* 11: 33–62.

Aziz, Azmi, and Amri Baharuddin Shamsul. 2004. "The Religious, the Plural, the Secular and the Modern: A Brief Critical Survey on Islam in Malaysia." *Inter-Asia Cultural Studies* 5 (3): 341–356.

Bowen, John R. 1984. "Death and the History of Islam in Highland Aceh." *Indonesia* 38: 21–38.

Caplan, Pat. 2000. "Introduction: Risk Revisited." In *Risk Revisited*, edited by Pat Caplan, 1–28. London: Pluto Press.

Clarke, Adele. 2005. *Situational Analysis: Grounded Theory After the Postmodern Turn*. Thousand Oaks, CA: Sage.

Covey, Judith, Claire J. Horwell, Laksmi Rachmawati, Rioga Ogawa, Ana Lilian Martin-del Pozzo, Maria Aurora Armienta, Fentiny Nugroho, and Lena Dominelli. 2019. "Factors Motivating the Use of Respiratory Protection Against Volcanic Ashfall: A Comparative Analysis of Communities in Japan, Indonesia and Mexico." *International Journal of Disaster Risk Reduction* 35. doi:10.1016/j.ijdrr.2019.101066.

Damby, David E., Claire J. Horwell, Peter J. Baxter, Pierre Delmelle, Ken Donaldson, Christina A. Dunster, B. Fubini, et al. 2013. "The Respiratory Health Hazard of Tephra from the 2010 Centennial Eruption of Merapi With Implications for Occupational Mining of Deposits." *Journal of Volcanology and Geothermal Research* 261: 376–387.

De La Cadena, Marisol. 2010. "Indigenous Cosmopolitics in the Andes: Conceptual Reflections Beyond "Politics"." *Cultural Anthropology* 25 (2): 334–370.

De La Cadena, Marisol, Marianne E. Lien, Mario Blaser, Casper Bruun Jensen, Tess Lea, Atsuro Morita, Heather Swanson, Gro B. Ween, Paige West, and Margaret Wiener. 2015. "Anthropology and STS: Generative Interfaces, Multiple Locations." *HAU: Journal of Ethnographic Theory* 5 (1): 437–475. doi:10.14318/hau5.1.020.

Diprose, Rachael, Dave McRae, and Vedi R. Hadiz. 2019. "Two Decades of *Reformasi* in Indonesia: Its Illiberal Turn." *Journal of Contemporary Asia* 1–22. doi:10.1080/00472336.2019.1637922.

Donovan, Katherine. 2010a. "Cultural Responses to Volcanic Hazards on Mt. Merapi, Indonesia." Doctoral Thesis., School of Geography, Earth and Environmental Sciences: University of Plymouth.

Donovan, Katherine. 2010b. "Doing Social Volcanology: Exploring Volcanic Culture in Indonesia." *Area* 42 (1): 117–126.

Donovan, Katherine, and Aris Surhyanto. 2011. "The Creatures Will Protect Us." *Geoscientist* 21 (1): 12–17. Accessed April 24, 2017. https://www.geolsoc.org.uk/Geoscientist/Archive/February-2011/The-creatures-will-protect-us.

Donovan, Katherine, Aris Surhyanto, and Pungky Utami. 2012. "Mapping Cultural Vulnerability in Volcanic Regions: The Practical Application of Social Volcanology at Mt Merapi, Indonesia." *Environmental Hazards* 11 (4): 303–323.

Douglas, Mary, and Aaron Wildavsky. 1982. *Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers*. Berkeley: University of California Press.

Dove, Michael R. 2008. "Perception of Volcanic Eruption as Agent of Change on Merapi Volcano, Central Java." *Journal of Volcanology and Geothermal Research* 172 (3–4): 329–337.

Dove, Michael R. 2010. "The Panoptic Gaze in a Non-Western Setting: Self-Surveillance on Merapi Volcano, Central Java." *Religion* 40 (2): 121–127.

Geertz, Clifford. 1960. *The Religion of Java*. Chicago: The University of Chicago Press.

Guest, Greg. 2015. "Sampling and Selecting Participants in Field Research." In *Handbook of Methods in Cultural Anthropology*, edited by H. Russell Bernard and Clarence Gravlee, 215–249. Lanham, MD: Rowman & Littlefield.

Haraway, Donna. 1988. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." *Feminist Studies* 14 (3): 575. doi:10.2307/3178066.

Hefner, Robert. 1987. "Islamizing Java? Religion and Politics in Rural East Java." *The Journal of Asian Studies* 46 (3): 533–554.

Heringa, Rens. 1997. "Dewi Sri in Village Garb: Fertility, Myth, and Ritual in Northeast Java." *Asian Folklore Studies* 56: 355–377.

Horwell, Claire J., and Peter J. Baxter. 2006. "The Respiratory Health Hazards of Volcanic Ash: A Review for Volcanic Risk Mitigation." *Bulletin of Volcanology* 69 (1): 1–24. doi:10.1007/s00445-006-0052-y.

Horwell, Claire J., Djoni Ferdiwijaya, Tri P. Wahyudi, and Lena Dominelli. 2019. "Use of Respiratory Protection in Yogyakarta During the 2014 Eruption of Kelud, Indonesia: Community and Agency Perspectives." *Journal of Volcanology and Geothermal Research* 382: 92–102.

Horwell, Claire J., Benedict J. Williamson, Ken Donaldson, Jennifer S. Le Blond, David E. Damby, and Leon Bowen. 2012. "The Structure of Volcanic Cristobalite in Relation to Its Toxicity; Relevance for the Variable Crystalline Silica Hazard." *Particle and Fibre Toxicology* 9: 44.

Jay, Robert R. 1963. *Religion and Politics in Rural Central Java*. New Haven: Yale University Press, Southeast Asia Studies.

Joakim, Erin, and Robert White. 2015. "Exploring the Impact of Religious Beliefs, Leadership and Networks on Response and Recovery of Disaster Affected Populations: A Case Study form Indonesia." *Journal of Contemporary Religion* 30 (2): 193–212.

Jones, Nicola. 2016. The Birth of Indonesia's Cyber Village. A Small Neighbourhood in the Developing World Built Fame and Fortune Through Their Connection to the Internet. Can the Lessons It Offers Help Wire The World? Accessed March 6, 2018. https://www.sapiens.org/technology/indonesia-cyber-village/.

Krüger, Fred, Greg Bankoff, Terry Cannon, Benedikt Orlowski, and E. Lisa F. Schipper, eds. 2015. *Cultures and Disasters: Understanding Cultural Framings in Disaster Risk Reduction*. London: Routledge.

Latour, Bruno. 1993. *We Have Never Been Modern*. Cambridge, MA: Harvard University Press.

Lavigne, F., and Yanni Gunnell. 2006. "Land Cover Change and Abrupt Environmental Impacts on Javanese Volcanoes, Indonesia: A Long-Term Perspective on Recent Events." *Regional Environmental Change* 6 (1–2): 86–100.

Law, John, Geir Afdal, Kristin Asdal, Wen-yuan Lin, Ingunn Moser, and Vicky Singleton. 2013. "Modes of Syncretism: Notes on Noncoherence." *Common Knowledge* 20 (1): 172–192. doi:10.1215/0961754X-2374817.

Lazrus, Heather. 2009. "The Governance of Vulnerability: Climate Change and Agency in Tuvalu, South Pacific." In *Anthropology and Climate Change: From Encounters to Actions*, edited by Susan A. Crate and Mark Nuttall, 240–249. Milton Park: Routledge.

Levy, Robert I., and Douglas W. Hollan. 2015. "Person-Centered Interviewing and Observation." In *Handbook of Methods in Cultural Anthropology*, edited by Russell Bernard and Clarence Gravlee, 333–364. Lanham, MD: Rowman & Littlefield.

MacLean, Dana. 2014. *Reducing the Volcano Risk in Indonesia*. Jakarta: IRIN Association. Accessed December 13, 2017. http://www.irinnews.org/report/100019/reducing-volcano-risk-indonesia.

McDonald, Fiona, Claire J. Horwell, Richard Wecker, Lena Dominelli, Miranda Loh, Robie Kamanyire, and Ciro Ugarte. 2020. "Facemask Use for Community Protection from Air Pollution Disasters: An Ethical Overview and Framework to Guide Agency Decision Making." *International Journal of Disaster Risk Reduction* 43: 101376. doi:10.1016/j.ijdrr.2019.101376.

Merli, Claudia. 2012. "Negotiating Female Genital Cutting (Sunat) in Southern Thailand." In *Self-Determination and Women's Rights in Muslim Societies*, edited by Chitra Raghavan and James Levine, 169–187. Waltham, MA: Brandeis University Press.

Mol, Annemarie. 2002. *The Body Multiple. Ontology in Medical Practice*. Durham, NC: Duke University Press.

Mueller, W., C. J. Horwell, A. Apsley, S. Steinle, S. McPherson, J. W. Cherrie, and K. S. Galea. 2018. "The Effectiveness of Respiratory Protection Worn by Communities to Protect from Volcanic Ash Inhalation; Part I: Filtration Efficiency Tests." *International Journal of Hygiene and Environmental Health* 221 (6): 967–976.

Nagata, Judith. 1982. "Islamic Revival and the Problem of Legitimacy Among Rural Religious Elites in Malaysia." *Man* 17 (1): 42–57.

Nattrass, C., C.J. Horwell, D.E. Damby, D. Brown, and V. Stone. 2017. "The Effect of Aluminium and Sodium Impurities on the In Vitro Toxicity and Pro-Inflammatory Potential of Cristobalite." *Environmental Research* 159: 164–175. doi:10.1016/j.envres.2017.07.054.

PRSRY (Provincial Regulation of special region of Yogyakarta No 8). 2010. On Disaster Management. [Peraturan Daerah Provinsi Daerah Istimewa Yogyakarta No 8 tahun 2010 tentang Penanggulangan Bencana].

Puig de la Bellacasa, Maria. 2017. *Matters of Care: Speculative Ethics in More Than Human Worlds*. Minneapolis: University of Minnesota Press.

Roff, William R. 1985. "Kaum Muda-Kaum Tua: Innovation and Reaction Amongst Malays, 1900–41." In *Readings on Islam in Southeast Asia*, edited by Sharon Siddique, Ahmad Ibrahim, and Yasmin Hussain, 123–132. Singapore: Institute of Southeast Asian Studies.

Rudiak-Gould, Peter. 2011. "Climate Change and Anthropology: The Importance of Reception Studies." *Anthropology Today* 27 (2): 9–12.

Salipi, Citra Fathimah, and Fentiny Nugroho. 2017. "Independent Entrepreneurship of Tourism Sector in Disaster-Prone Area of Mount Merapi." ICAS Conference in Makassar. https://download.atlantis-press.com/article/25886451.pdf.

Saputro, Kurniawan Adi. 2016. "Information Volunteers' Strategies in Crisis Communication: The Case of Mt Merapi Eruption in Indonesia 2010." *International Journal of Disaster Resilience in the Built Environment* 7 (1): 63–72.

Schipper, E. L. F. 2015. "Religion and Belief Systems." In *Cultures and Disasters: Understanding Cultural Framings in Disaster Risk Reduction*, edited by F. Krueger, G. Bankoff, T. Cannon, E. L. F. Schipper, and B. Orlowski. Routledge: London.

Schlehe, Judith. 1996. "Reinterpretations of Mystical Traditions: Explanations of a Volcanic Eruption in Java." *Anthropos* 91 (4–6): 391–409.

Schlehe, Judith. 2010. "Anthropology of Religion: Disasters and the Representations of Tradition and Modernity." *Religion* 40 (2): 112–120. doi:10.1016/j.religion.2009.12.004.

Schlehe, Judith. 2015. Cosmopolitanism in the Modern Mystical World of Java. Occasional Paper Series (24): Southeast Asian Studies at the University of Freiburg.

Schwartz-Marin, Ernesto, Merli Claudia, and Horwell Claire. n.d. "The Revelations of Popocatépetl's Ash: Authority and Protection at the Crossroads of Science, Ritual and Health in Mexico." Manuscript.

Scupin, Raymond. 1987. "Interpreting Islamic Movements in Thailand." *Crossroads: An Interdisciplinary Journal of Southeast Asian Studies* 3 (2/3): 78–93.

Skinner, Jonathan. 2000. "The Eruption of Chances Peak, Montserrat, and the Narrative Containment of Risk." In *Risk Revisited*, edited by Pat Caplan, 156–183. London: Pluto Press.

Steinle, S., A. Sleeuwenhoek, W. Mueller, C. J. Horwell, A. Apsley, A. Davies, J. W. Cherrie, and K. S. Galea. 2018. "The Effectiveness of Respiratory Protection Worn by Communities to Protect from Volcanic Ash Inhalation; Part II: Total Inward Leakage Tests." *International Journal of Hygiene and Environmental Health* 221 (6): 977–984.

Stewart, Charles. 1999. "Syncretism and Its Synonyms: Reflections on Cultural Mixture." *Diacritics* 29 (3): 40–62.

Surono, Jousset, Philippe, Pallister John, Boichu Marie, M. Fabrizia Buongiorno, Budisantoso Agus, Costa Fidel, et al. 2012. "The 2010 Explosive Eruption of Java's Merapi Volcano—A '100-Year' Event." *Journal of Volcanology and Geothermal Research* 241-242 (S): 121–135. doi:10.1016/j.jvolgeores.2012.06.018.

Tazic, Justyna, and Sulfikar Amir. 2016. "Informational Capital and Disaster Resilience: The Case of Jalin Merapi." *Disaster Prevention and Management: An International Journal* 25 (3): 395–411. doi:10.1108/DPM-07-2015-0163.

Tronto, Joan. 1993. *Moral Boundaries: A Political Argument for an Ethic of Care*. New York: Routledge.

Viveiros de Castro, Eduardo. 2011. "Zeno and the Art of Anthropology: Of Lies, Beliefs, Paradoxes and Other Truths." *Common Knowledge* 17 (11): 128–145.

Wikan, Unni. 1992. "Beyond the Words: The Power of Resonance." *American Ethnologist* 19 (3): 460–482.

Wildenauer, Nora. 2015. Fighting for Nothing to Happen. Film.

Woodward, Mark. 1988. "The "Slametan": Textual Knowledge and Ritual Performance in Central Javanese Islam." *History of Religions* 28 (1): 54–89.