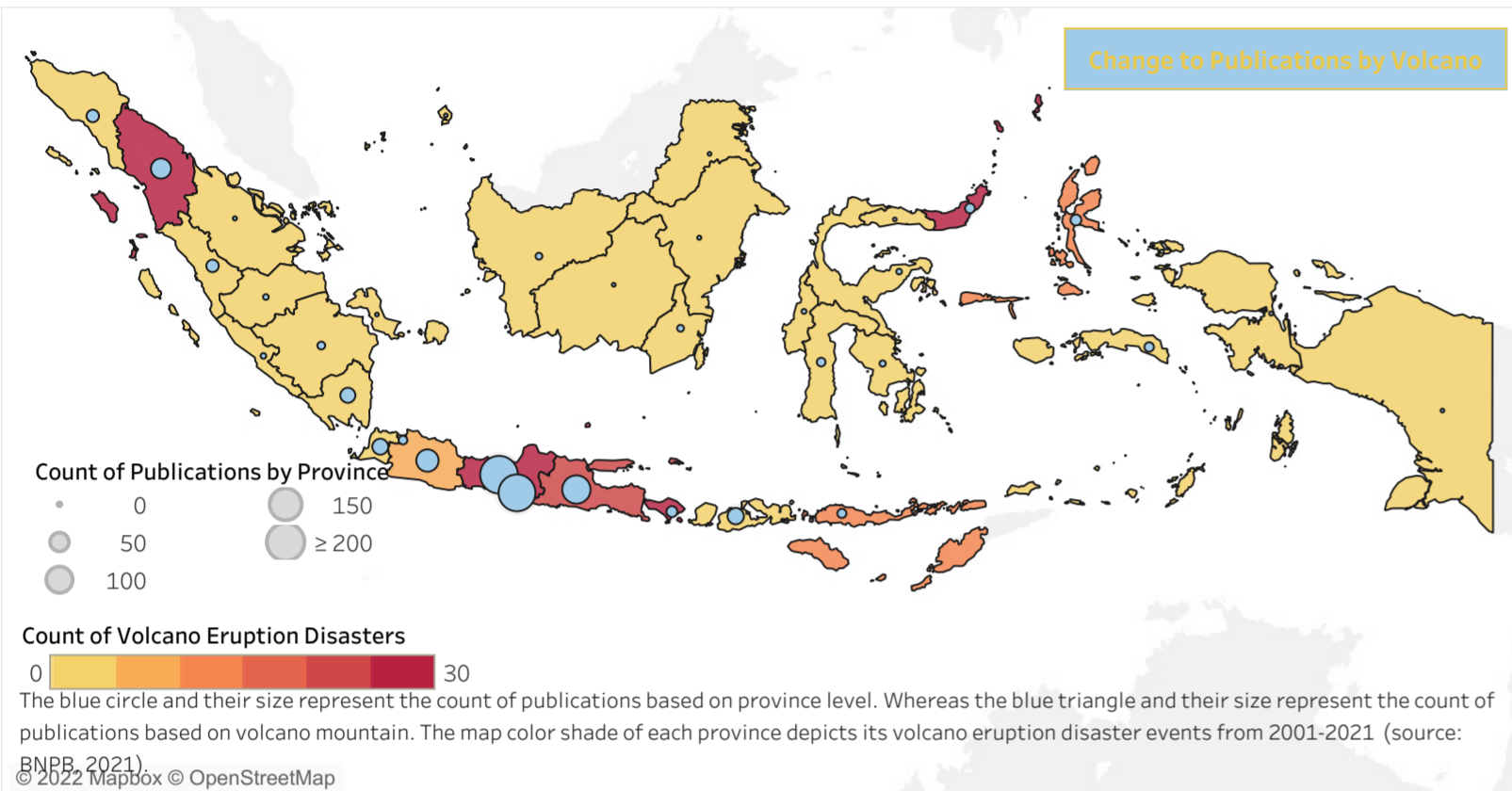


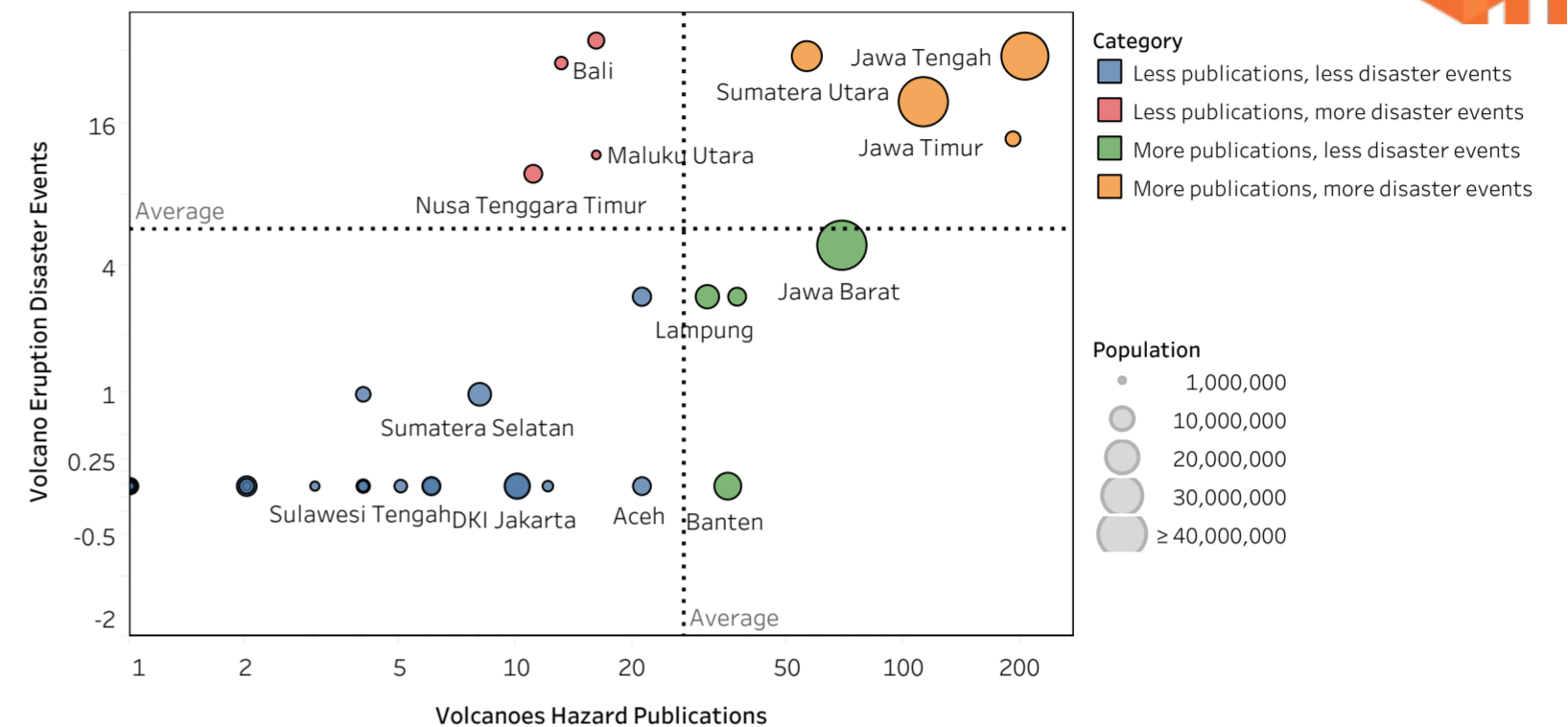
# Indonesia Disaster Knowledge Update - December 2021



## Research publications about Volcanoes Hazards in Indonesia



### Volcanoes Hazard Publications VS Volcano Eruption Disaster Events



### Level of Research Scope

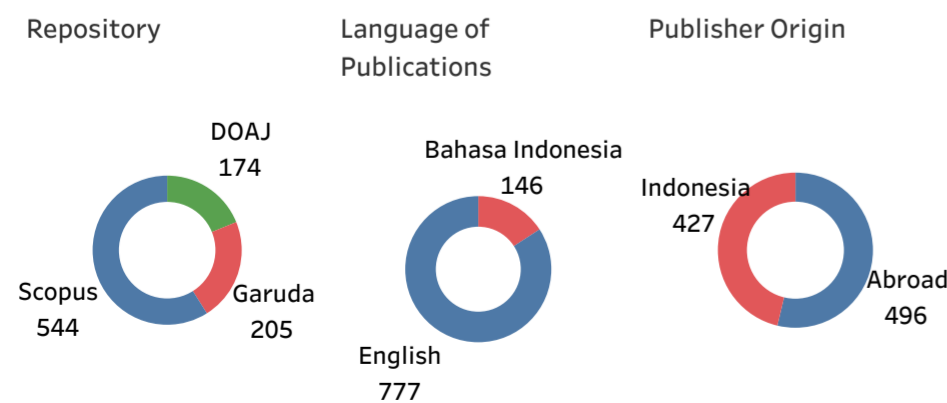


The map shows Indonesia's research distribution on volcano hazards by province and volcano mountain (source: CARI! repository-of-repositories, 2021). From 923 collected publications about topics with relevance to Indonesia, 470 were researched at the city/district level, 221 at the provincial level, 137 at the national level, and 95 publications at the global level in attribution to Indonesia. The research distribution strongly corresponds with the existing volcano mountain presence in the province and the recent major volcano disaster such as the eruption of Mt. Merapi, Mt. Anak Krakatoa, and Mt. Sinabung. There are 3 distinctive hotspot locations on volcano research in Indonesia; Sumatera Utara province (56 publications), provinces in Java Island to Nusa Tenggara (686 publications), and Sulawesi Utara & Maluku Utara provinces (29 publications). The least researched region of volcano hazards is all provinces in Kalimantan Island combined (15 publications), archipelago provinces in Sumatra (0 publications), Papua Barat province (2 publications), and Papua province (1 publication).

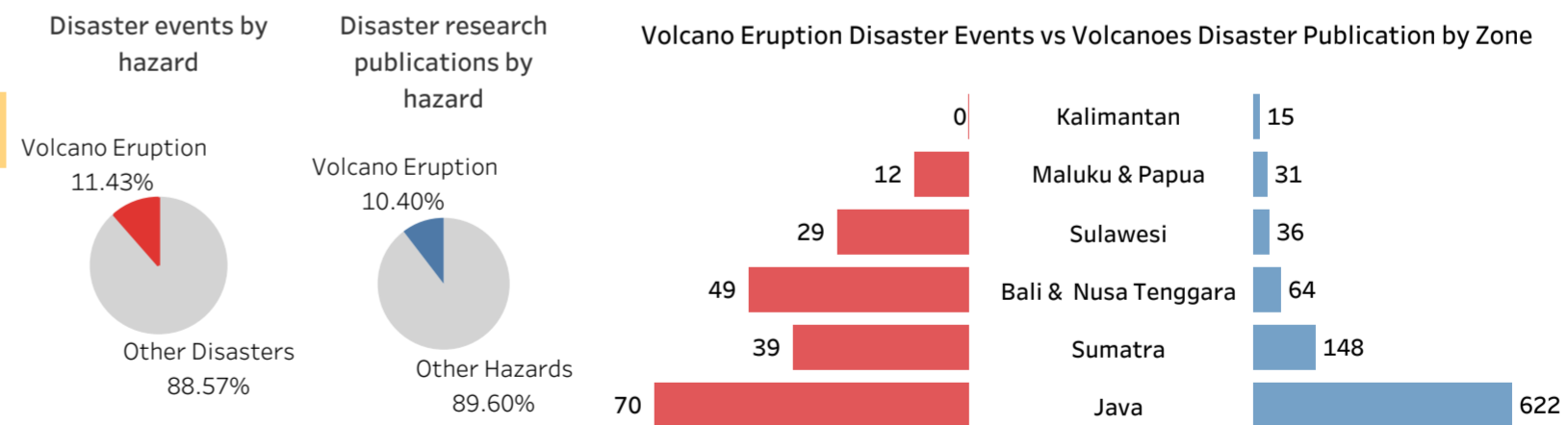
The quadrant plot shows the provinces category (represented by the different colors) based on the number of publications on volcano hazards and eruption disaster events (source: BNPB, 2021). The dot size depicts its province's total population (BPS, 2020). There are 8 provinces that have more publications on volcano hazards than the national average publications (<27 publications), all of them are all provinces in Java Island, and the rest is North Sumatera, Lampung, and Nusa Tenggara Barat province. Where Central Java, East Java, DI Yogyakarta, and North Sumatera had disaster events related to volcanoes. Even though these areas faced many volcanic eruptions, the less researched provinces are Bali, North Sulawesi, North Maluku, and Nusa Tenggara Timur provinces. The other 22 provinces in Indonesia are in the blue category, with fewer publications and fewer disaster events. The overall trends between the number of publications on volcano hazards and the number of volcano eruption events are linearly correlated.

## Publication Statistics

923 Publications | 489 Publishers | 858 Authors



We only selected research publications on disasters related to volcanoes; thereby, we excluded volcano publications that focused only on volcanoes' physical or chemistry aspects and also mud volcanoes. The charts show the number of research publications about volcano hazards in Indonesia published between 1992 and December 2021. These publications are compiled in CARI! repositories. 554 publications were extracted from Scopus, 174 publications from the DOAJ directory, and 205 publications from Portal Garuda. 777 publications were written in English and 146 publications were written in Bahasa Indonesia. A total of 427 publication titles are published by Indonesian publis..

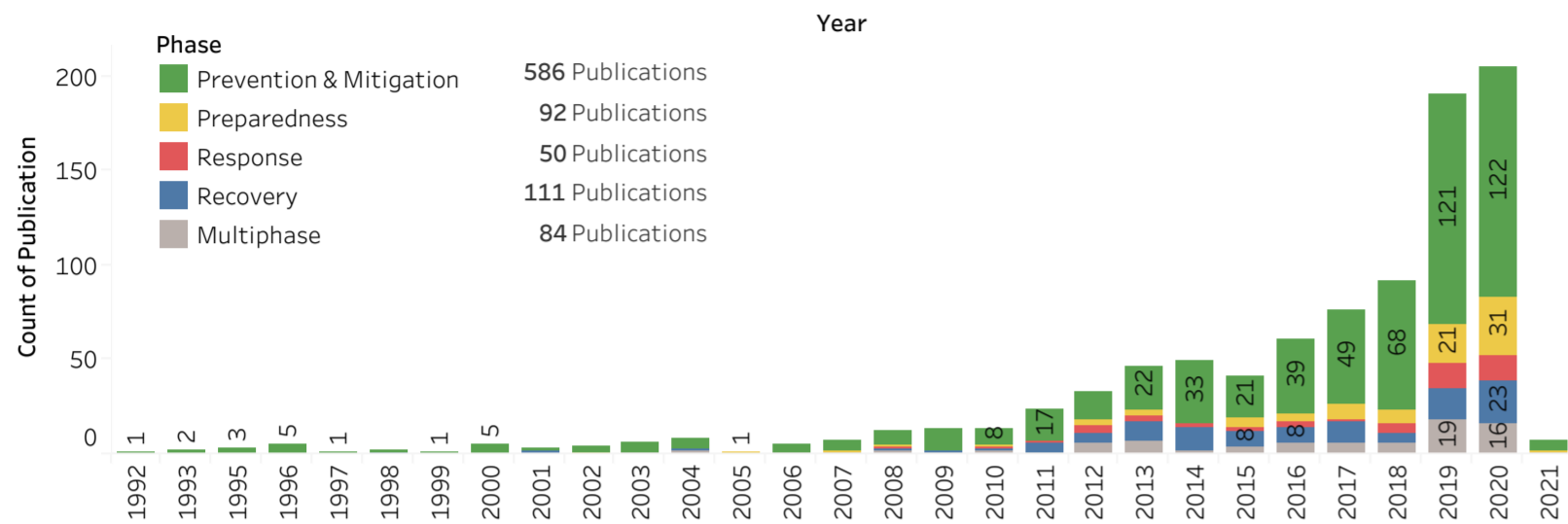


Volcanic eruption is contributed to 11,43% of all disaster events in Indonesia (2001-2021) (BNPB, 2021) and also makes up 10,4% of all research publications on nature-induced hazards (CARI!, 2021). The areas with frequent volcano disaster events also have higher publications on volcano hazards, except Bali & Nusa Tenggara area which have many frequent disaster events but the publication number is lower than Sumatra area. Another interesting issue is a far gap between Java and the other areas in publications number. This issue encourages volcano hazard researchers to expand the study in Sumatra, Bali and Nusa Tenggara, Sulawesi, and Maluku and Papua areas.

# Indonesia Disaster Knowledge Update - December 2021



Research Publication Trends of Volcanoes Hazard and Its Disaster Management Phase



The bar chart above indicates the research publication trends on volcano hazards from 1992 to 2021; the color code has attributed to the disaster management phase. The publications slowly grew to 285 publications from 1992 to 2015; in 2016, there was a vast rise (adding 61 publications compared to 2015) in this type of publication. Meanwhile, in 2019, 190 publications were added up compared to 2018, the trend was rising exponentially. In general, the post-eruption of Mt. Merapi in 2010 and newly active Mt. Sinabung triggered only a small number of published research. On the other hand, Mt. Krakatau eruption with the tsunami in 2018 gave a significant rise in publications number. Since the beginning, disaster management's prevention and mitigation phase has been the majority theme for publication, followed by the recovery, preparedness, multiphase, and response phase. Recent eruptions may increase the number of publications in the upcoming year.

## Top Publications based on Scopus directory

Historical eruptions of Merapi Volcano, Central Java, Indonesia, 1768-1998

Voight B. | Journal of Volcanology and Geothermal Research  
Published on 2000-01-01 | Cited by 190 articles

10,000 Years of explosive eruptions of Merapi Volcano, Central Java: Archaeological and modern implications

Newhall C.G. | Journal of Volcanology and Geothermal Research  
Published on 2000-01-01 | Cited by 114 articles

Lahars at Merapi volcano, Central Java: An overview

Lavigne F. | Journal of Volcanology and Geothermal Research  
Published on 2000-01-01 | Cited by 109 articles

Sediment transportation and deposition by rain-triggered lahars at Merapi Volcano, Central Java, Indonesia

Lavigne F. | Geomorphology  
Published on 2003-01-01 | Cited by 100 articles

Toward a revised hazard assessment at Merapi volcano, Central Java

Thouret J.C. | Journal of Volcanology and Geothermal Research  
Published on 2000-01-01 | Cited by 79 articles

The list above is the top-five publications on volcano hazards in Indonesia, ranking by the number of citations from 1992 to 2021 sourced from the Scopus directory. The same publisher publishes the top 4 publications and the same author wrote the top 2 publications. The eruption of Merapi Volcano attracted many researchers around the globe to study. All of these top-ranked publications are authored by foreign researchers.

## Top Investigated Cities



## Top Investigated Provinces



## Top Investigated Topics

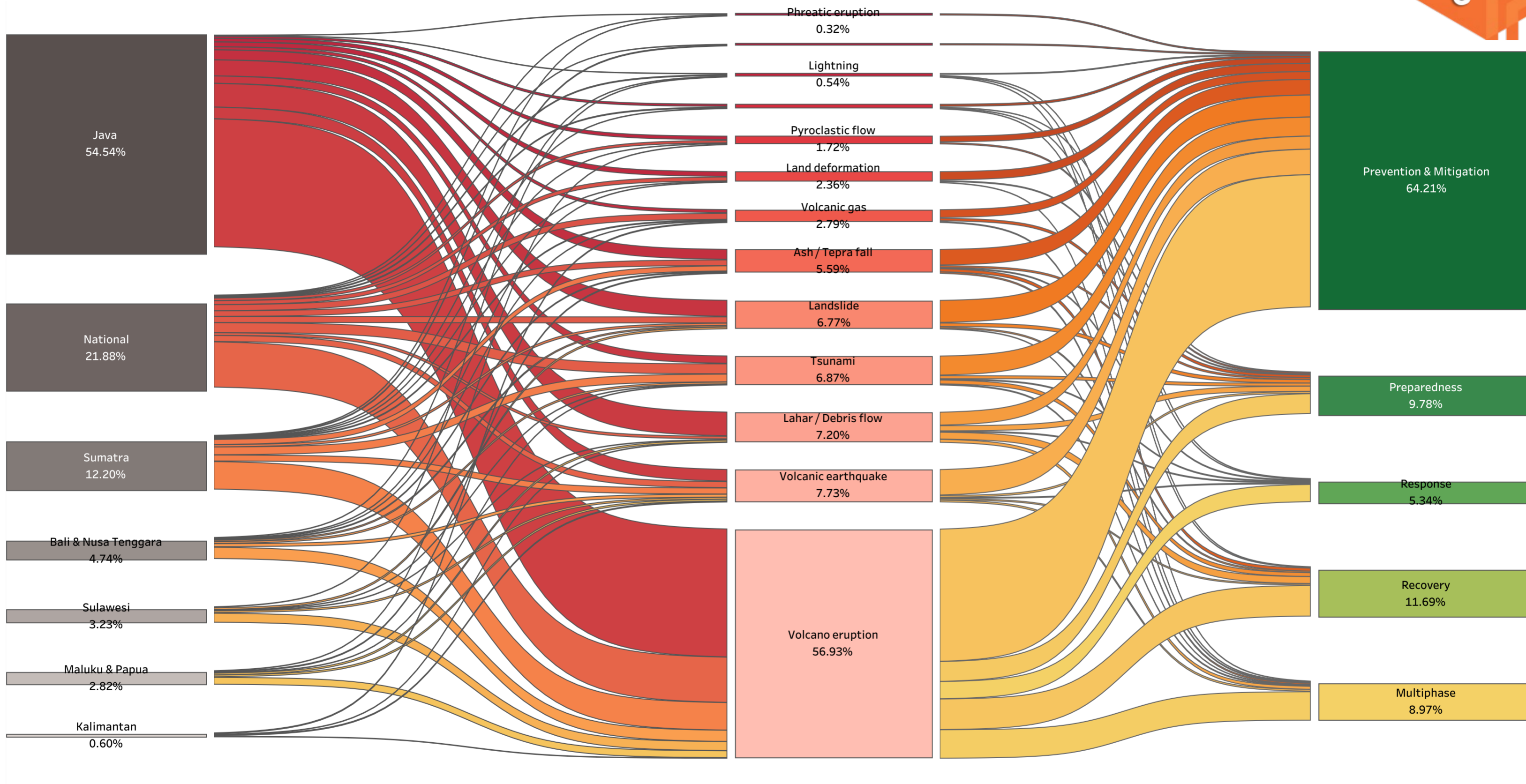


## Top Investigated Volcano



Research on volcano hazards concentrated in Mt. Merapi with 256 publications, followed by Mt. Anak Krakatau, Mt. Sinabung, Mt. Kelud, and other large volcanoes. Some extinct volcanoes, e.g., Mt. Toba & Mt. Samalas, and dormant volcanoes, also have research publications. The most investigated cities are Kota Yogyakarta (76 publications), Sleman (45 publications), and Magelang (26 publications) because of the hazard from Mt. Merapi. Furthermore, other cities with publications are Karo regency (22 publications), Bima regency (16 publications), and Ternate (11 publications). Jawa Tengah province (205 publications), Yogyakarta province (191 publications), and Jawa Timur province (112 publications) are the top three investigated provinces. Finally, if we classify it by the disaster management phases, topics that have frequently been conducted are hazard assessment (613 publications), risk assessment (182 publications), vulnerability assessment (200 publications), and impact assessment (180 publications).

Sankey Diagram of Volcanoes hazards publications: Location to Volcanoes hazards type to DRM Phase



This Sankey diagram is calculated based on the number of publications. The box and the thickness of the flows show the number of publications related to the topics. The sub-volcano hazards are adopted from UNDRR Hazard Definition & Classification (2020). Research on volcano hazards is widely dominated in the Java Island zone, contributing to more than half (54%) of all publications related to volcanoes. From publications found in Java, 61% of the publications generally studied volcano eruption hazards, while the others studied hazards on lahar/debris flow (11%). 21,8% of volcano hazard publications are conducted at the national level, which studied volcano eruption in general (50%) and less on tsunami hazard induced by volcanoes (11%). The other zones followed the same pattern. Volcano hazard publication sorted by sub-volcano hazard type shows that 57% of publications don't specifically study sub-hazard. Volcanic earthquakes are the most studied sub-hazard (7,7%), followed by lahar/debris flow hazard (7,2%) as Indonesia's primary sub-volcano hazard type. Next in line on types of sub-volcano hazard type are tsunamis, landslides, and ash/tephra fall. On the other hand, the topic on prevention and mitigation phase on volcano disaster research has the highest number of publications in the disaster management phase (64%), followed by the recovery phase (11,7%), preparedness (9,8%), multiphase (8,9%), and response (5,3%).

# Indonesia Disaster Knowledge Update - December 2021

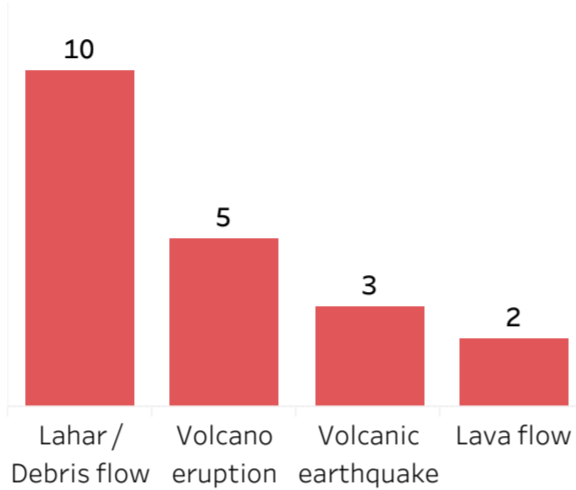


## Volcano Hazard Research Publications about Mt. Semeru

Publications by DRM Phase

Phase	Topic	Count
Prevention & Mitigation	Hazard assessment	12
	Improve Infrastructure	2
	Risk assessment	2
	Mitigation	1
Preparedness	Preparedness	1
Recovery	Innovation & technology	1
Response	Saving life	1

Publications by sub volcano hazard



## Publications of Recovery Phase Research Post-Eruption

Research Topics of Recovery Phase Publications

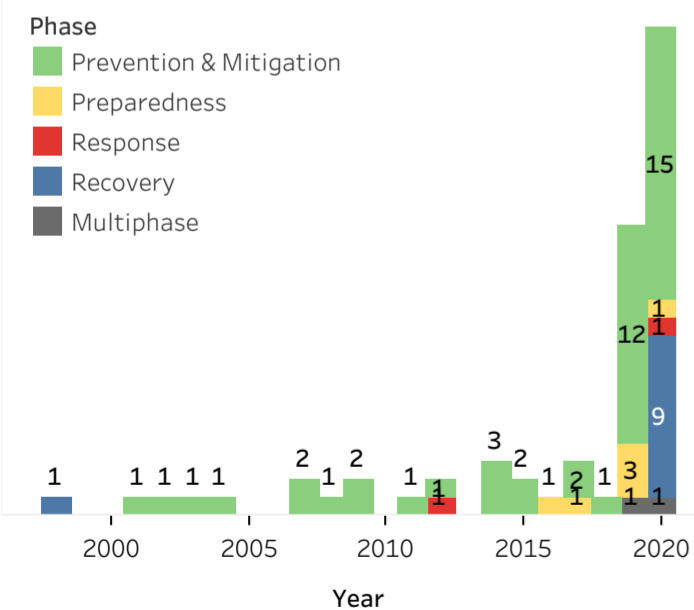


The recent Mt. Semeru eruption on 2nd December 2021 has raised many questions about how such an actively monitored hazard still led to many victims and severe impacts. Mt. Semeru has 20 research publications on volcano hazards from 1997 to 2020 (CARI!, 2021). The bar chart above shows the distribution of academic research about Mt. Semeru with heavily focused on hazard assessment and prevention and mitigation phases, but lack of knowledge on other disaster management phases. Among the hazard assessment topics, 4 of the research found recommended a spatial change program for settlement and agriculture areas around the volcano. The sub-volcano hazard of Mt. Semeru studied is lahar/debris flow (the primary hazard of the latest eruption event), volcano eruption in general, volcanic earthquake, and lava flow.

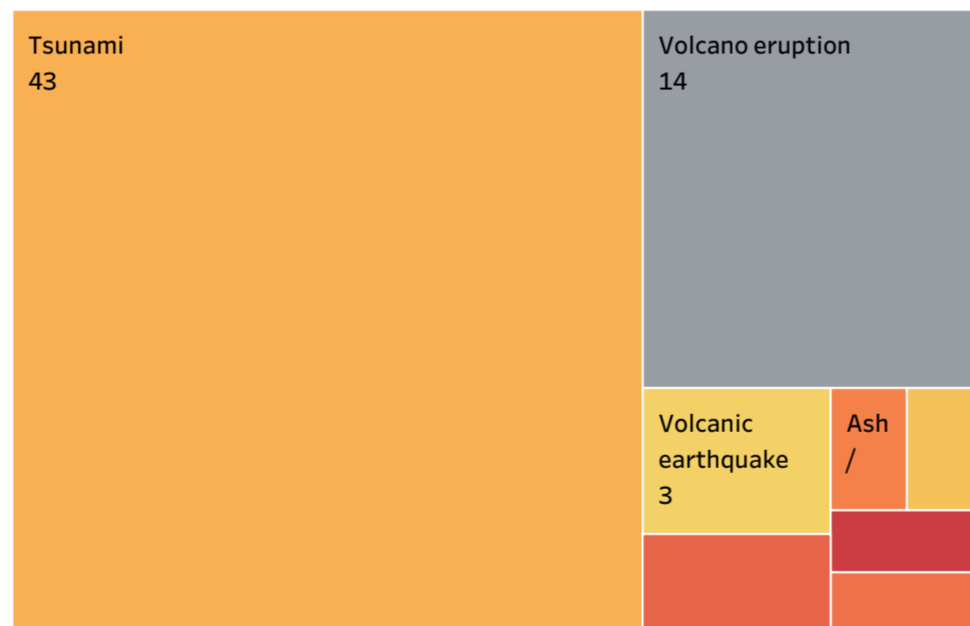
## Volcano Hazard Research Publications about Mt. Anak Krakatau

Publications by volcanoes in recovery research

Volcano hazard publications trend



Publications by sub volcano hazard type



We examine 11 sub-recovery phases research themes in publications of eruption based on the International Recovery Platform (2019). Researches on the recovery phase for eruption is dominated by the study of impact assessment (32 publications), followed by livelihood recovery (15 publications), shelter/housing of IDPs (12 publications), and so on. More recovery phase-related studies have been done in Mt. Merapi (54 publications) than other eruption activities in Mt. Kelud, Mt. Krakatau, and Mt. Sinabung.

The topics found for impact assessment in Mt. Merapi vary from environmental, physical, spatial, economic, and livelihood. The impact assessment studies in Mt. Krakatau focus on its relation to the tsunami in 2018. Moreover, the topics on livelihood and shelter/housing are also dominated by researches on Mt. Merapi. The studies in Mt. Merapi are also inclusive and have already included gender issues in its discussion. On the contrary in Mt. Sinabung, even though there have been repetitive eruptions in the past 10 years, it is found that there is only 1 publication studying livelihood and 1 publication examining shelter/housing.

66 research publications on volcano hazards from 1998 to 2020 studied Mt. Anak Krakatau (Krakatau). The devastating tsunami generated by the flank collapse of Mt. Anak Krakatau in 2018 triggered many kinds of research that can be seen on the bar chart above. However, if divided per management cycle, there is not much research on activities post-disaster events, including the response and recovery phases. The recovery (9 publications) and response (1 publication) publications are found from 2020. An interesting type of publication on sub-volcano hazards found that tsunami-related publications have high number than volcano eruptions in general, at the same time, volcanic earthquakes and land deformation about volcanic activity in Mt. Krakatau.

In conclusion, the studies on post eruptions in Indonesia are dominated in Java Island, specifically Mt. Merapi. However, other areas still require further assessment to increase their capacity. For example, the studies in Mt. Kelud are also various; however, the number of publications in this area is still low compared to Mt. Merapi. Therefore, many studies require in order to increase the capacity of volcanic areas in Indonesia.