Supplementary Material

# S1a Table of Repeat or recurring evacuations in the period 1986-2015

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| EruptionYear | Warning trigger(a) | No. (peakb) | Activity(VEImaxc) | Duration  | Destruction(d) | Relocation | Compliance(e) | Pull | Push | Notes |
|  |  **Kelut, Indonesia (DAC Classification =LMI, World Risk Index = HIGH)(f)** |
| *1990(g)* | Monitor (seismic) | 60,000(1) | XP(4) | ~ 4 weeks | 500(1) |  | n/r |  |  |  |  |  |
|  |  |  |  |
| 2007 | Monitor(seismic) | 38,170(2) | Dome(2) | 3 weeks | - | - | Low, 50% not at all, 75% early return (2) |  |  |  |  | Insanitary conditions and looting interpreted as rumoured(2) |
|  |  |  |  |
| 2014 | Monitor (seismic)(3)/surface(4) | 166,000(3) | XP(4) | 8 days | 11,093(4) | - | Good during emergency(3)but, farmers stay put & daytime return(4) |  |  |  |  | Rapid evacuation but strong pull to return from resource, tourism(5)by day 4 evacuees reduced by 17,000(4) |
|  |  |  |  |
|  | **Merapi, Indonesia (LMI, HIGH)** |
| 1994 | Surface | 6,026(6) | Dome/pf(x)  | ~5-6 weeks |  | 2700(7) | Low, 50% return within 1 month(8) |  |  |  | Largely self-evacuation(8), continuation enforced(7,8) |
|  |  |
| 2006 | Monitor/surfaces | 26,870(9) | Dome/pf | 1 month |  |  | Variable, 20-86% daily return after 1 week(7,10) |  |  |  | Strong ownership of risk culture(7,10), complicated by regional earthquake |
|  |  |
| *2010* | Monitor/ surface | 399,403(11) | XP/pf(4) | Majority 11 days;some 5 weeks | (13) | 2200(13) | High initial conformity (81%) but 50% return at some point(12) |  |  |  |  | Boredom and family separation(14) as well as protecting livelihoods(12,14) |
|  |  |  |  |
|  | **Sinabung, Indonesia (LMI, High)** |
| 2010 | Surface | 26,137(15) | XP(2) | 1 month |  |  | Varied with activity(15) | uk |  |  | Poor preparedness affected coping(3) |
|  |  |
|  | **Mayon, Philippines (LMI, VERY HIGH)** |
| *1993* | None | 57,000(16) | *XP*(2) | 2-4 months | 500(18) | 500 (17) | Enforced compliance |  |  |  |  |  Daytime entry for farming permitted(17) |
|  |  |  |
| 2000 | Surface | 29440-68596 | XP(3) | ~6 weeks |  | 1480  |  |  |  |  |  |  Daytime entry for farming permitted(17) |
|  |  |  |
| 2006 | Surface | 95926(17) | XP(1)/lahars | 6 weeks |  | 1160(17) |  |  |  |  |  | 3000 families still in centres 1 year later, system overwhelmed by volcano+ typhoon(17). Daytime entry for farming permitted(17) |
|  |  |  |  |
| 2009 | Surface | 47766(17) | XP |  |  | 2004 |  |  |  |  |  | Daytime entry for farming permitted(17) |
|  |  |  |  |
| 2014 | Surface/gas | 51625(18) | Dome(0) | 6weeks (70%)-3 months (30%) |  |  | Initially daily return to secure water etc(18) |  |  |  |  | Mandatory evacuation orders used, strategic change to preserve resource and pre-empt unofficial return |
|  |  |  |  |
|  | **Karthala, Comoros (LDC,HIGH)** |
| 2005 | Surface | 10000 | XP(3)/lahars | 3days-1 week | (30) |  | Voluntary evacuation(19) |  |  |  | No shelter, water and food security. Water supply issues across island. Lahars destroyed buildings(20) |
| 2006 | Surface | 2000 | Lava lake(0) | 2 weeks |  |  | Voluntary evacuation |  |  |  | Concerns triggered by 2005 activity, felt EQ |
|  |  |
| 2007 | Surface | - | Lava  |  | 1 |  | Voluntary evacuation |  |  |  | Concerns from felt EQ |
|  |  |
|  | **Fogo, Cabo Verde (LMI, HIGH)** |
| 1995 | Surface  | 1498(21) | Lava/XP(2) | ~6 months | (village) |  | Some returning, 12.5% waited ‘until last minute’ (paroxysm)22 |  |  |  |  | Re-settlement unsuccessful(22) |
|  |  |  |  |
| 2014-5 | Surface | 1076(21) | Lava/XP(2) | ~ 6 months | 260 |  | Daily return/rebuilding |  |  |  |  | Some re-occupation immediately after eruption re-building within one year (22,23) |
|  |  |  |  |
|  | **Cerro Negro, Nicaragua (LMI, VERY HIGH)** |
| 1992 | Surface | 9282 | XP(3) | 1 week |  | 450 | 75% compliance |  |  |  |  |  |
|  |  |  |  |
| 1995 | Surface | 6000 | XP(2)/lava | 2 weeks  |  |  | 50% compliance |  |  |  |  |  |
|  |  |  |  |
| 1999 | Surface | 6,195 | XP(2) | nr |  |  | nr |  |  |  |  |  |
|  |  |  |  |
|  | **Popocatepetl, Mexico (UMI,MEDIUM)** |
| 1994 | Surface | 25,000(24) | XP | ~ 1week |  |  | e.g. 38% in 1 town never evacuate(25) |  |  |  |  | Perceptions of shelter conditions important as well as livelihoods. |
|  |  |  |  |
| 1999 | monitored | 50,000 | XP | 4 days |  |  | e.g. 38%-50% in 1 town never evacuate(25) |  |  |  |  |  |
|  |  |  |  |

1. Warning trigger relates to the dominant signal that initiated decision to call an evacuation. Surface indicates evacuation did not occur until activity was observable at surface. Monitor, evacuation caused by a change in some type of subsurface monitored data.
2. No of evacuees. Numbers are from Smithsonian GVP unless indicated otherwise
3. Dominant activity. Where a sequence was recorded they are named sequentially. VEImax refers to the maxmimum explosivity recorded for that eruptive episode by SI GVP. XP: explosive activity; Dome: dome building: pf: activity generating pyroclastic density currents other than explosions; lahars: significant lahar activity.
4. Filled box indicates there was permanent infrastructure destruction, where number is quoted (as buildings or homes) this is also shown . Similarly relocation indicates the number of households relocation in geographically distinct setting post eruption.
5. Filled box square are based on our push-pull characters as follows Top Left: crops and livestock, Top Right: place, Bottom left: tourism or other resource (mining) Bottom right: protecting assets. Pull Top left: disease/crowding Top Right: mental health and boredom Bottom left: hostilities Bottom right: lack of food, water.
6. World Risk Index refers to the rank assigned risk as a function of exposure to natural hazrds, susceptibiilty, coping capacity and adaptive capacity (Welle et al., 2015). DAC refers to the classification given by the OECD to the country based on Gross National Income per capita.: LDC is Least Developed Countries, LMI Lower Middle Income Countries and Territories, UMI Upper Middle Income Countries and Territories and H High Income Countries and Territories
7. Italicised eruptions also feature in the fatalities in Table 2.

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# S1b One off or continuous recurring evacuations in the period 1986-2015(a)

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| **Volcano/ Year(s)** | **Activity style** | **Evacuation patterns** | **No. and trigger (peak)** | **Compliance** | **Pull** | **Push** | **Notes** |
| **Sinabung, Indonesia, ( DAC Classification = LMI, World Risk Index = HIGH)** |
| *2013-2015* | XP | Staged, long term then relocation | 22000 (3) (surface) | Initially good, becoming less good with daily drift after few weeks |  |  |  |  | Early self evacuation, issues with long term use of shelters meant for other purpose encourages driftback (18). Issues with finance release and legislative ‘disaster’ affected long term solutions (18) |
|  |  |  |  |
| **Pinatubo, Philippines (LMI, HIGH)** |
| *1991-1993* | Dome/XP | Staged evacuations until the eruption peak, from circular zones centred on the volcano. Permanent destruction of many settlements. Long term evacuation and resettlement post-eruption, due to lahars. | > 60.000 by June 15, 1991. (surface) | In early stages of activity, 80% of a sample of those ordered to evacuate took precautionary measures; 46% evacuated immediately26Later on, pattern of living in new settlements but working lands on volcano flanks |  |  |  |  | Indigenous Aeta were most affected pre-eruption, and permanently excluded from settlements within 10 km of the volcano27. Following eruption, there were considerable displacements for over a decade, due to the long-term hazards from lahars(28).  |
|  |  |  |  |
| **Unzen, Japan,(HIGH, VERY HIGH)** |
| *1991-1995* | Dome/XP | Staged evacuations, following first debris flow/lahar (May 15), first pyroclastic flow (May 24) and continued escalation in activity. | Ca. 11,000 by early June 1991(29). Surface.  |  |  |  |  |  | In late May 1991, there were multiple returns to the evacuated zone both by farmers, but also by journalists and mass media, eager to capture images of the growing dome. The fatal eruption of June 3rd, 1991, led to multiple deaths inside the evacuated zone(30). |
|  |  |  |  |
| **Manam, Papua New Guinea (LMI, VERY HIGH)** |
| *2004-2015(b)* | XP | ‘Permanent and total’ | 9000(31) (surface) | Initially good, but now 2,500 are back on island with daily movement(31) |  |  |  |  | Many evacuees spent more than a decade in ‘care centres’ on mainland, creating profound issues with wellbeing, livelihoods and local hostility (31,32). Some now relocated. Better use of local knowledge would have improved situation (31,32,33) |
|  |  |  |  |
| **Rabaul, Papua New Guinea (LMI, VERY HIGH)** |
| 1994-95*(c)* | XP(4) | 4-6 months, destruction of villages | 70000 (felt/monitored seismicity34,35) | Some self evacuation, 15,000 homes lost(35) |  |  |  |  | Geographically distinct responses to eruption, due to difference in felt EQ(35). Militarised control of destroyed zone (looting(36).) Rebuilding on top of some destroyed areas, others re-settled. |
|  |  |  |  |
| **Mt Cameroon, Cameroon (LDC, VERY HIGH)** |
| 1999 | Lava/XP(2) | 6 weeks | ~600-1000(37) (surface activity) | 86% compliance in most affected village(37) |  |  |  |  | Younger males tended to return in daytime, and not evacuate (farming). Theft of livestock reported but not verified. Poor conditions in camp. (38) |
|  |  |  |  |
| **Nyiragongo, Democratic Republic of the Congo (LDC, not determined)** |
| *2002* | Lava | Few days  | 500,000 (surface activity39) | Village self-evacuation on flanks and in Goma. Rapid re-occupation but many homes destroyed |  |  |  |  | Crisis involved cross-border evacuation, prompting some re-occupation within two days (before lava cooled(40). Issues of food supply for 15,000 remaining in camps after 4-5 days. |
|  |  |  |  |
| **Tungurahua, Ecuador (UMI, HIGH)** |
| 1999-2014 | XP | Enforced total (3 months) then periodic short evacuation (days), staged to activity. | 26,000 (surface activity42) | Variable through eruption, improved by ‘vigias’(41) |  |  |  |  | Initially forced evacuation prompted conflict and re-occupation. Some re-settlement sites built, variably occupied. Collaborative monitoring network(42,43) |
|  |  |  |  |
| **SHV, Montserrat (UMI, not determined)** |
| 1995-2010 | Dome/XP | Staged | 7,500 (surface) | Poor shelter conditions drove return in 1997(44) |  |  |  |  | Significant migration in response to eruption (>50%) population. Some (most vulnerable, (45)) remained in temporary shelters for years. Poor conditions in shelters, loss of infrastructure significant in driving zoning decision. |
|  |  |  |  |
| **Chaiten, Chile (HIGH, VERY HIGH)** |
| 2008 | XP(4) | Total, return spatially determined relative to river (lahars) | 8119 | Drift back to ‘permanent exclusion zone’ by some(46) |  |  |  |  | Re-settlement site abandoned. Legislative issues around long term solutions. Some early return to retrieve belongings were unofficial |
|  |  |  |
| **Eyjafjallajökull,Iceland (HIGH,VERY HIGH)** |
| 2010 | Lava/XP(3) | Initial 24 hours then 4-5 days | 700 | Large compliance but some daily return and non-evac(47) |  |  |  |  | First evacuation, compliance affected by warning time. Daily return driven by livestock concerns (48). |
|  |  |  |  |

1. Main notes and annotations as for Table S1a
2. There were discrete events in our timeframe in 1992 and 1996, In 1996 around 2,500 from one side of the island were temporarily but this established land and access ties utilised in 2004 (Connel and Lutkehaus, 2015).
3. Further eruptions and evacuations in 2006 and 2014 but these have not been documented in peer-reviewed literature as yet.

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