Quantifying the volcanic ash hazard to aviation in Southeast Asia

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Southeast Asia (SEA) hosts a densely populated airspace and some of the most active volcanic arcs on the planet. This combination has resulted in dozens of aircraft-volcanic ash encounters in the past 50 years. Only ~80 of 346 potential ash-producing volcanoes in SEA have been mapped in detail. We approximate the hazard at the remaining 266 by comparing their morphologies to the well-documented 80, and use simplified profiles of the 80 as proxy histories for the 266. We assume that volcanoes with similar morphologies have similar eruptive behavior.

We define 5 classes of volcanoes, based on morphology but also considering degassing behavior. These are: (1) Laguna class volcanoes, fields of maars, cinder cones, spatter cones, and shields. The type example is the Laguna Volcanic Field, Philippines (13.204, 123.525). There are 35 Laguna class volcanoes in SEA (N_{Laguna}=35). (2) Mayon class volcanoes, open-vent, frequently active, steep sided stratocones. Most have small summit craters, spatter ramparts, small pyroclastic fans (typically <3 km but up to 5 km in radial length) and lava flows. The type example is Mayon Volcano, Philippines (13.257, 123.685). N_{Mayon}=41. (3) Kelut class are semi-plugged composite cones with dome complexes, pyroclastic fans, and commonly with debris avalanche deposits or collapse scars. The type example is Kelut Volcano, Indonesia (-7.933, 112.308). N_{Kelut}=176. (4) Pinatubo class are large plugged stratovolcanoes with extensive (tens of km) pyroclastic fans and large summit craters or calderas up to 5 km in diameter. The type example is Pinatubo Volcano, Philippines (15.133, 120.350). $N_{Pinatubo}$=22. (5) Tambora-Toba class are calderas with long axes >5 km and surrounded by extensive ignimbrite sheets. The type examples are Tambora Volcano, Indonesia (-08.25, 118.00) and Toba Caldera, Indonesia: (02.583, 098.833). Silicic domes that might produce large caldera-forming eruptions are also classified as Tambora-Toba class. $N_{T\text{-}T}$=19.

We estimate the probabilities of each VEI eruption from each morphologic class in the next decade, based on (Poisson) the eruptive history of the class. The probability is 1 (Pr =1) that $\geq$1 volcano in every class will produce $\geq$1 small (VEI 1-2) eruption, that a Mayon class volcano will produce a VEI 3 eruption, and that a Kelut class volcano will produce a VEI 4 eruption. A VEI 5 eruption has a Pr = 0.2 of occurring from a Kelut class and a 0.1 from a Pinatubo class volcano. The probability of a VEI $\geq$6 eruption is <0.01 from all classes combined. Ongoing work will address ash dispersion from these eruptions into heavily traversed air traffic corridors in SEA.