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The Effects of the Quasi-Biannual Oscillation on Tephra Distribution from a Plinian Eruption

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The quasi-biannual oscillation (QBO) dominates the equatorial zonal wind in the tropical stratosphere. Alternating easterly and westerly wind regimes form in the upper stratosphere and propagate downwards to the tropopause with a mean period of approximately 28 months. The westerly phase of the QBO is characterized by faster and more regular downward propagation, while the easterly phase has higher intensity (up to double the wind speed) and longer duration. Long-term lower stratospheric wind records indicate prevailing easterly winds (~60 % of the time) for the tropical regions. However, during westerly phases of the QBO, the wind is exclusively blowing towards the east. This leads to different but well predictable tephra distributions during the two phases. The QBO is effectively controlling the variations of the lower stratospheric wind regimes between 15° N and 15° S. Therefore, the effects of the QBO on spatial tephra distribution impact all tropical volcanic regions, including Central America, SE-Asia, the Andean Northern Volcanic Zone and the African Rift. We use the Tephra2 model in a case study from Tandikat volcano in West Sumatra to analyse the different QBO phases' effects on tephra distribution from Plinian eruptions. Incorporating the QBO in probabilistic hazard assessments for Plinian eruptions improves the accuracy of the hazard assessments. Understanding the effects of the QBO on the spatial tephra distribution will also help re-evaluate distal tephra records.