Daily monitoring of Ecuadorian volcanic degassing from space

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Abstract

We present daily measurements of sulfur dioxide (SO_2) emissions from active volcanoes in Ecuador and southern Colombia between September 2004 and September 2006, derived from the Ozone Monitoring Instrument (OMI) on NASA's EOS/Aura satellite. OMI is an ultraviolet/visible spectrometer with an unprecedented combination of spatial and spectral resolution, and global coverage, that permits daily measurements of passive volcanic degassing from space. We use non-interactive processing methods to automatically extract daily SO_2burdens and information on SO_2 sources from the OMI datastream. Maps of monthly average SO_2 vertical columns retrieved by OMI over Ecuador and S. Colombia are also used to illustrate variations in regional SO_2 loading and to pinpoint sources. The dense concentration of active volcanoes in Ecuador provides a stringent test of OMI's ability to distinguish SO_2 from multiple emitting sources. Our analysis reveals that Tungurahua, Reventador and Galeras were responsible for the bulk of the SO_2 emissions in the region in the timeframe of our study, with no significant SO_2 discharge detected from Sangay. At Galeras and Reventador, we conclude that OMI can detect variations in SO_2 release related to cycles of conduit sealing and degassing, which are a critical factor in hazard assessment. The OMI SO_2 data for Reventador are the most extensive sequence of degassing measurements available for this remote volcano, which dominated regional SO_2 production in June–August 2005. At Tungurahua, the OMI measurements span the waning stage of one eruptive cycle and the beginning of another, and we observe increasing SO_2 burdens in the months prior to explosive eruptions of the volcano in July and August 2006. Cumulative SO_2loadings measured by OMI yield a total of ~ 1.16 Tg SO_2 emitted by volcanoes on mainland Ecuador/S. Colombia between September 2004 and September 2006; as much as 95% of this SO_2 may originate from non-eruptive degassing. Approximate apportionment of the total SO_2loading indicates that ~ 40% originated from Tungurahua, with ~ 30% supplied by both Reventador and Galeras. These measurements of volcanic SO_2 degassing in Ecuador confirm OMI's potential as an effective, economical and risk-free tool for daily monitoring of SO_2emissions from hazardous volcanoes.

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