NOVAC Scanning Instruments at Latin-American Volcanoes: Installation and First Results

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abstract

Volcanic emissions monitoring during volcanic unrest, especially at eruptive and intense passive degassing stages can give good indication of the pattern of activity of a volcano. The Network for Observation of Volcanic and Atmospheric Change (NOVAC) project encompasses a global network of stations to monitor volcanic gas emissions using Scanning Dual-beam miniature – Differential Optical Absorption Spectrometer (Mini-DOAS) instruments. This poster describes the installation and first results of Scanning-DOAS instruments at some Latin-American volcanoes, as part of the NOVAC project.

masaya (nicaragua)

In April 2007, two Scanning-DOAS instruments were installed inside Masaya's caldera to the west of the summit, with the goal of monitoring SO_2 emissions from the volcano (Figures 1 and 2). The stations consist of a 3-m-high glass fibre tower with a solar panel as roof, providing energy to the instruments through a regulator and gel battery. Data from the instruments is sent to INETER in Managua using spread spectrum wireless data transceivers.

Figure 1 (left): Caracol SO_2 monitoring station. Figure 2 (above): Nancital SO_2 monitoring station.

Figure 3 shows values of Masaya SO_2 flux recorded by the two described monitoring stations during 23 April 2007.

Masaya shows an emissions behaviour similar to San Cristóbal, showing strong fluctuation of SO_2 emission during short periods of time over the day. During the studied day a complete plume was quantified at Caracol station, however Nancital only measured half of the plume. The difference on quantified flux by both stations can be seen in Figure 3.

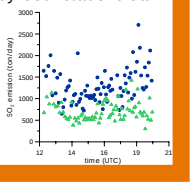

Figure 3: Masaya SO_2 flux for 23 April 2007. Data recorded by the two stations where blue circles show data from Caracol and green triangles from Nancital station. Meteorological information was obtained from the Air Resources Laboratory website of the National Oceanic & Atmospheric Administration (NOAA).

popocatepetl (mexico)

In July 2005, a prototype scanning mini-DOAS system was installed at Popocatépetl volcano (Figure 1) at Tlamacas station, located ~4 km north of the crater of the volcano (Figures 2 and 3). The instrument scans a plane perpendicular to the predominant direction of the plume. It has been intermittently running for more than two years.

During March-June 2007 additional instruments were installed at Popocatepetl at two other stations: Chipiquixtle (Figure 4) and Colibri (Figure 5).

The scanning mini-DOAS system collects scattered UV light, scanning different directions in a conical shape around the volcano. The slant column of every scanned position is combined with plume height, wind direction and wind speed information, yielding total SO_2 emission. Data is transferred to the National Center for Disasters Prevention (CENAPRED) in Mexico City using spread spectrum wireless data transceivers.

Figure 2: Map of monitoring stations at Popocatépetl volcano. NOVAC instruments have been installed at Tlamacas (PPM), Colibri (PPC) and Chipiquixtle (PPX) stations (source: Alicia Martinez).

A direct radio link to CENAPRED in Mexico City is achieved from two of the stations (Tlamacas and Colibri), the third station (Chipiquixtle) needs two repeater sites due to geography descriptions. A desktop computer runs a custom-built-program (NovacProgram), downloading data from the instruments and evaluating the data in real-time. For every downloaded scan, the emission of SO_2 is calculated.

Figure 3 (left): Tlamacas (PPM) station. Figure 4 (middle): Chipiquixtle (PPX) station, Figure 5 (right): Colibri (PPC) station.

Figure 5 shows some of the SO_2 emission data recorded by one of the scanning mini-DOAS instruments. Meteorological information necessary for SO_2 emission calculation was obtained from the Air Resources Laboratory website of the National Oceanic & Atmospheric Administration (NOAA).

Plume height used for flux calculation was assumed to be constant for every day (plume rise approximately 500 m from the crater of the volcano) based on daily visual observations routinely performed at CENAPRED, using a high-resolution colour camera.

Popocatépetl's daily average SO_2 emission is highly variable as observed from Figure 5. Large standard deviation values can attest for instability of the system. Both SO_2 daily average and standard deviation give information about degassing as well as stability of the volcanic system.

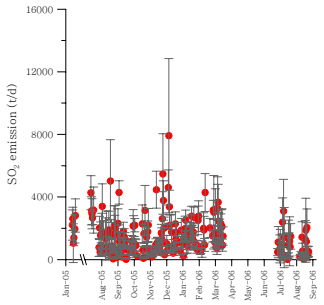

Figure 5: Popocatépetl SO_2 emission daily average (red dots) and standard deviation (grey bars).

san cristobal (nicaragua)

In November 2006, three Scanning-DOAS instruments were installed at San Cristóbal volcano with the purpose of monitoring SO_2 emissions from the volcano. Figure 1 shows a 3D view of the volcano and the installation sites: Seismic Station Hill (Figure 2), Suiza (Figure 3) and Pedro Marin (Figure 4); as well as Chonco (Figure 5), a repeater site for Pedro Marin station. The instrument collects scattered UV light, scanning different directions in a plane perpendicular to the predominant direction of the plume. The total column of every scanned position is combined with plume height, wind direction and wind speed information, yielding total SO_2 emission.

Figure 1: 3D view of San Cristóbal and the installation sites (Google Earth).

Figure 2 (left): Seismic Station Hill monitoring station; Figure 3 (middle up): Suiza monitoring station;Figure 4 (middle down): Pedro Marin monitoring station;; Figure 5 (right): Chonco repeater station.

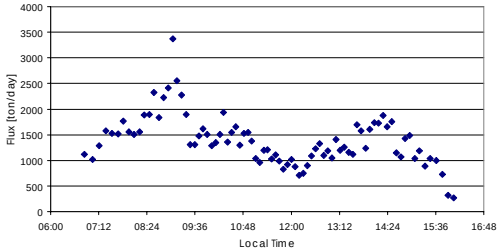

Figure 6: San Cristóbal SO_2 flux for 21 November 2006. Data recorded by the instrument installed at the Seismic Station. Meteorological information was obtained from the Air Resources Laboratory website of the National Oceanic & Atmospheric Administration (NOAA).

Figure 6 shows results of San Cristóbal SO_2 flux recorded by the instrument installed at the Seismic Station for 21 November 2006. San Cristóbal shows an interesting behaviour, showing strong fluctuation of SO_2 emission during short periods of time over the day.

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