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The Intra-Craterial Eruption (Vent) of February 2016 and its Influence on Temperatures in the Fractures on the South Flash of the Nyiragongo Volcano and in the City of Goma.

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ABSTRACT

The Nyiragongo volcano is one of the active volcanoes of the Virunga volcanic chain. It is part of the group of volcanoes of the western branch of the East African Rift. It represents a threat to the populations of Goma and its surroundings.

Since its first exploration at the end of the 19th century, the Nyiragongo volcano has erupted three times (January 10, 1977, January 17, 2002 and May 22, 2021) and its three eruptions have all been fissural.

Due to its high activity, a new vent opened inside its main crater on February 29, 2016. The appearance of this vent pushed us to enter the data in order to analyze the evolution of the temperature in the fractures on the southern flank of the Nyiragongo volcano and in the city of Goma.

The analysis of temperature data at the different measurement sites informed us about the influence of this new wind on the temperatures in the fractures located on the southern flank of the volcano and in the city of Goma. All the measurement sites were sensitive to this new appearance, but it was that of the summit of the Nyiragongo volcano which showed the most considerable variation.

Keywords: Vent, Fracture, Eruption, intra-craterial, Nyiragongo.

I. INTRODUCTION

The Nyiragongo volcano is one of the active volcanoes of the Virunga volcanic chain. It is geographically located at 1.52°S, 29.25°E and its summit is 3470 m above sea level. It is part of the group of volcanoes of the western branch of the East African Rift (Platz et al. 2004).

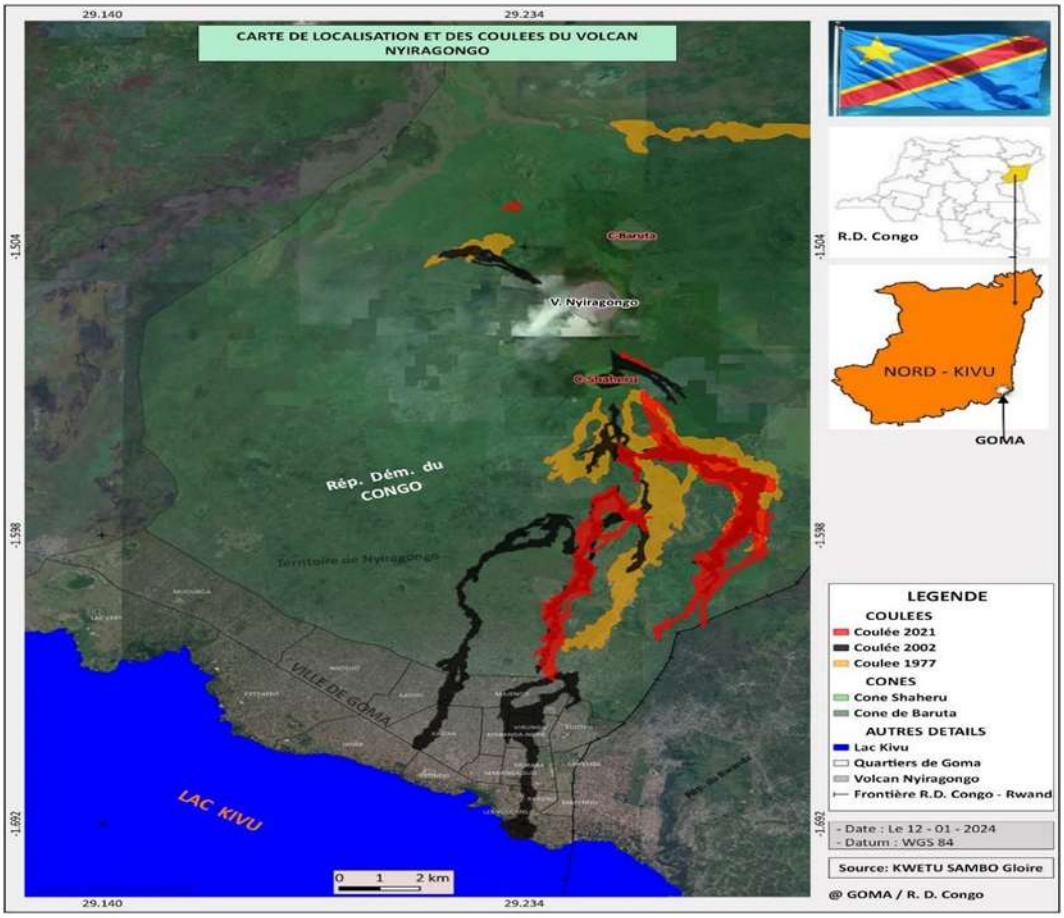


Figure 1: Geographical location of the Nyiragongo volcano.

- Nyiragongo is a stratovolcano containing a permanent lava lake inside its main crater.

- Nyiragongo (3470m) and Nyamulagira (3058m altitude) are currently active volcanoes in a group of eight major structures forming the Virunga volcanic chain.

- Since its first exploration at the end of the 19th century, the Nyiragongo volcano has erupted three times (January 10, 1977, January 17, 2002 and May 22, 2021) and its three eruptions have all been fissures. The first two eruptions took place when the volcano held a closed lava lake, that is to say a lake with a solidified surface (Tazieff 1977; Pottier 1978; Ueki 1983; Durieux 2004a, b; Komorowski et al. 2004; Tedesco et al. 2007).

- Several volcanic cones are found on the flanks of the volcano, which testifies to its high activity. The Nyiragongo eruptions of 1977, 2002 and 2021 were all fissural, fed by dykes triggered by rift movement which caused the opening of a system of NS-oriented fractures and which led to the drainage of the lava lake (Tazieff 1977; Durieux 2004a; Komorowski et al. 2004; Tedesco et al. 2007; Wauthier et al. 2012).

- During the 2002 eruption, this network of fractures extended south through Goma and Gisenyi and even below Lake Kivu.

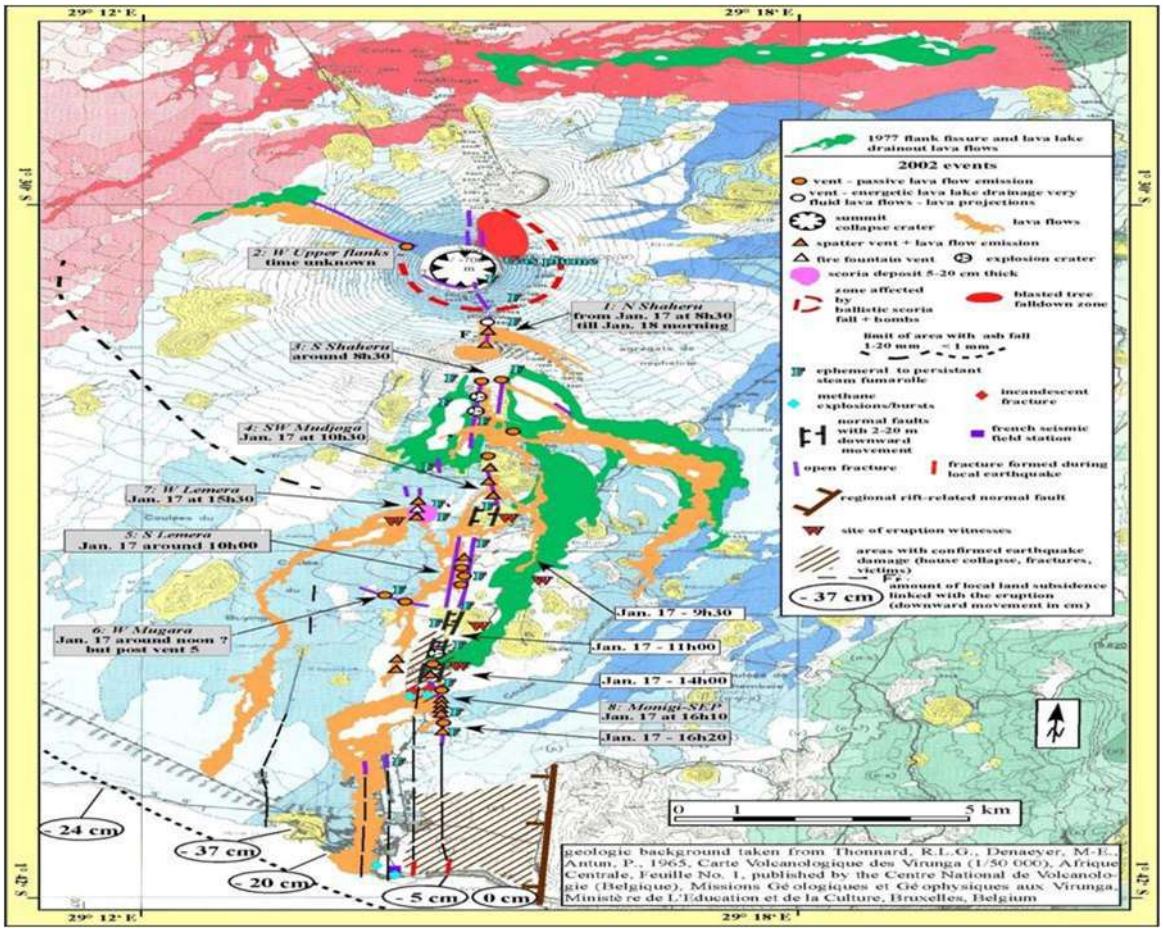


Figure 2: The network of fractures of the Nyiragongo volcano. (Komorowki and all. 2003)

- On February 29, 2016 at 3:00 a.m. local time, there was a sudden opening of a new vent inside the main Nyiragongo crater, near the main well (lava lake). This new vent opened in an area where the morphology of the lower part of the crater had changed significantly since the 2002 eruption. (Charles B. et al. 2016).

- It is located in the eastern part of the crater, on the third platform. It is also located a few hundred meters from the major SW-NE oriented fracture which extends between the main crater of Nyiragongo and the adventitious crater of Baruta.

Figure 3: Location of the new February 2016 vent.

- The study carried out was to find out if the opening of this new vent had an impact on the temperatures at the level of the fractures at different sites already listed on the southern flank of the Nyiragongo volcano and in the city of Goma.

II. METHODOLOGY

A. Measuring instrument

The instruments used are data loggers or recording thermometers or TINYTAG Plus PT 100 thermal sensors with download cable and which are equipped with probes buried approximately 1 meter deep in the ground. These thermal sensors record temperature data continuously with a recording interval set to every 10 minutes.

Fig.4. ***A****. The Tinytag Pt100 sensor* ***B****. The PT 100 probe* ***C****. The USB download cable*

The PT100 probe is a high temperature probe with a 1.5m cable that monitors temperatures from -50°C to +600°C. The PT100 probe measures the change in resistivity of a platinum filament wrapped around a glass rod. Typically, PT100 probes have a resistivity value of 100 ohms at 0°C. The resistivity variation is approximately 0.4 ohms/°, with an accuracy of +/- 0.3. The data logger uses a PT100 -50 probe to + 300/600 °C the TGP-4104 to measure very high temperatures.

B. Data used

- The ground temperature was measured at the sites of Chemchem High School, Heal Africa, the fiftieth anniversary school, the Governor's residence, Bugarura, Shaheru and the summit of the Nyiragongo volcano.

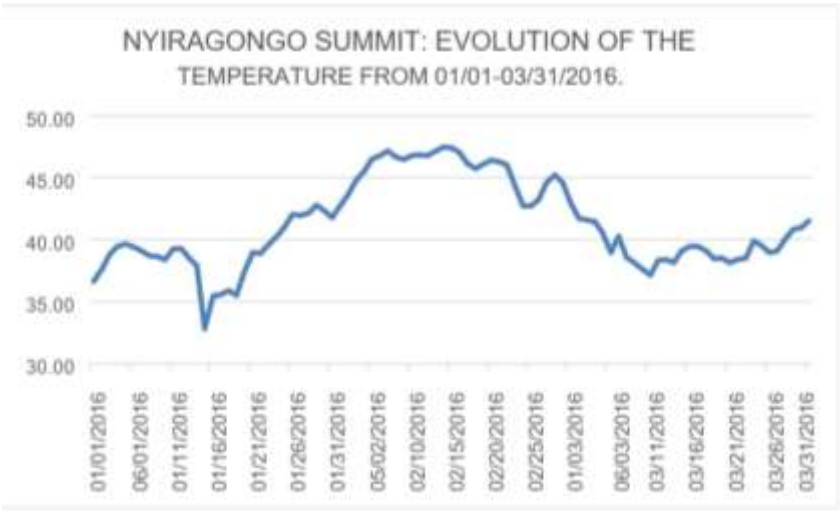
- The data used was recorded by the Tinytag TGP-4104 probes and downloaded by the Tinytag Explorer software. A correction of the data is carried out before their validation using the data from the calibration of the probes carried out every two years by the thermostat

III. PRESENTATION OF DATA AND RESULTS INTERPRETATION

- We used temperature data from January 1st to March 31, 2016 for each site.

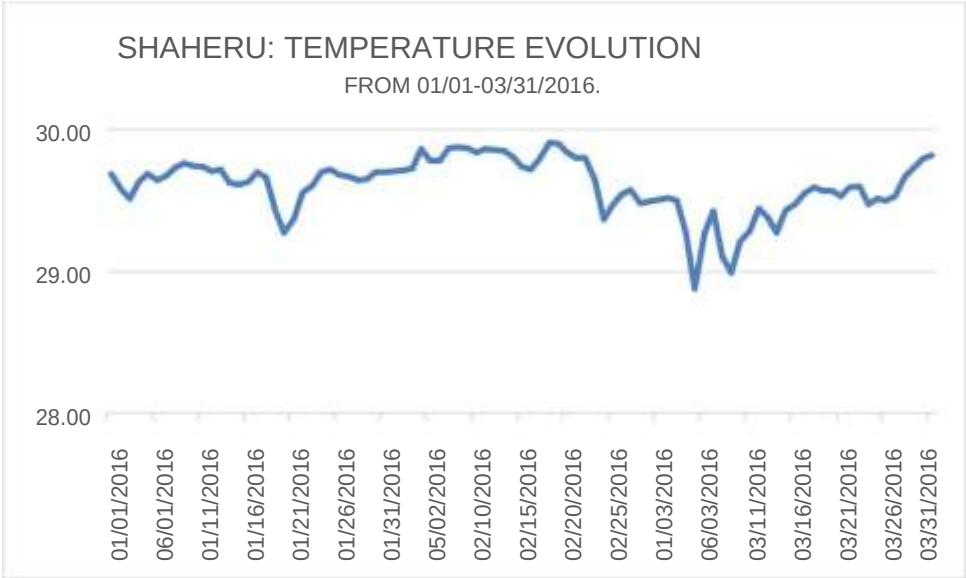
- Based on observations made on our different study sites, we found the following:

1. NYIRAGONGO SUMMIT SITE:



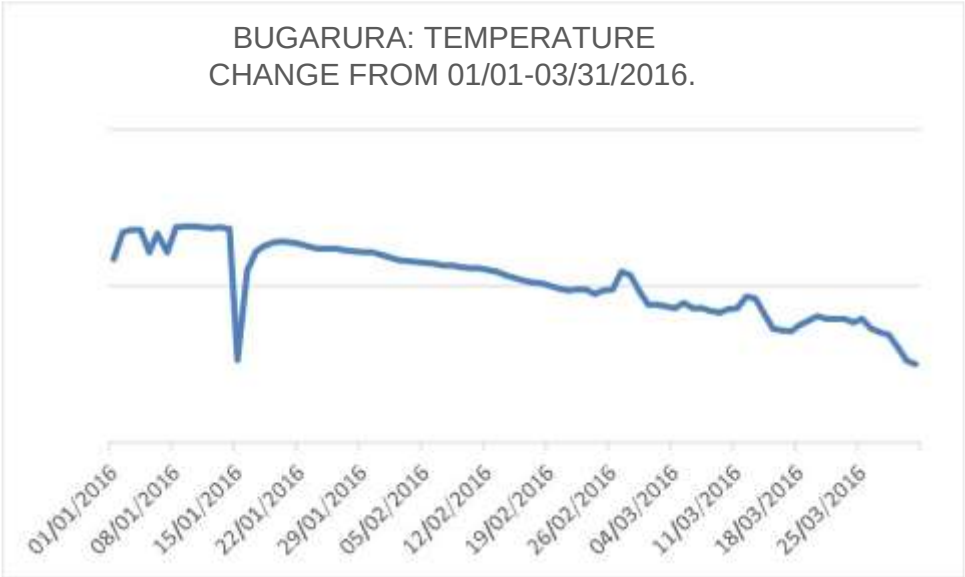
An increase in temperature of 14.66°C is observed since January 15, 2016 when the temperature was 32.81°C until February 14, 2016 when it rose to 47.47°C. After this date, the temperature stabilized a little until it began to gradually drop until it returned to normal.

2. SHAHERU SITE:



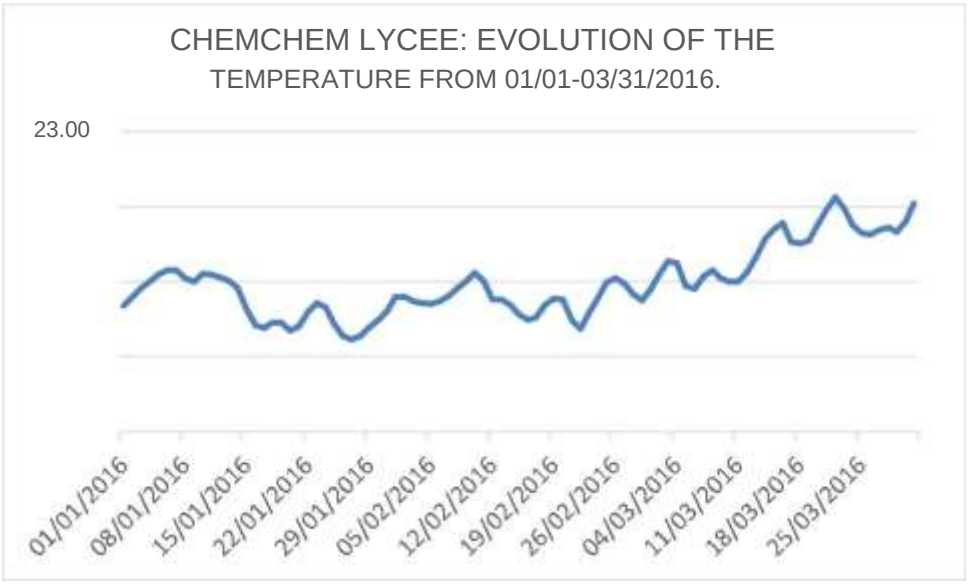
There is a slight increase in temperature of 0.63°C from January 20 to February 18, 2016.

3. BUGARURA SITE:



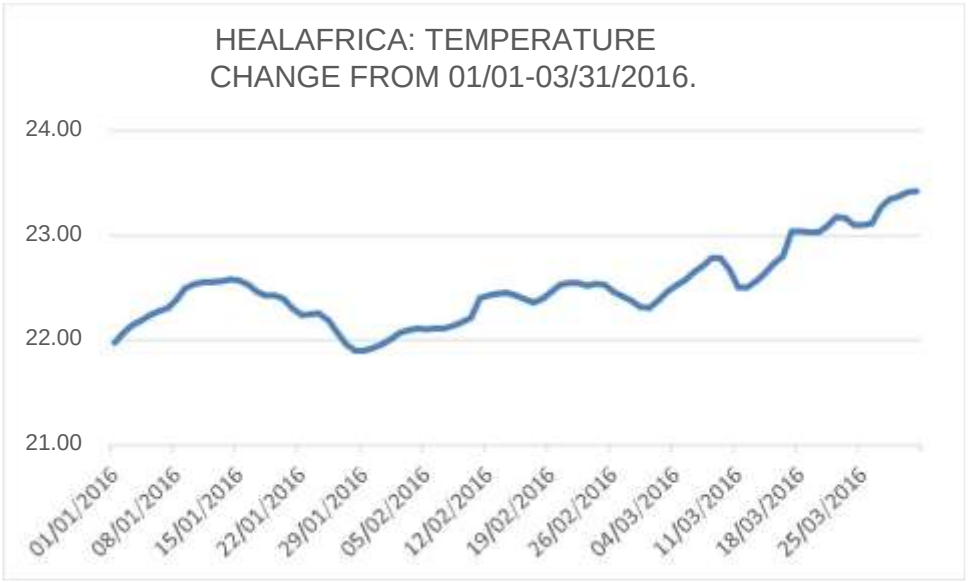
The temperature at this site did not really vary, but there was a slight temperature agitation of 0.56°C from 01/15 until 02/27/2016. After this date, the temperature evolves normally.

4. CHEMCHEM LYCEE SITE:



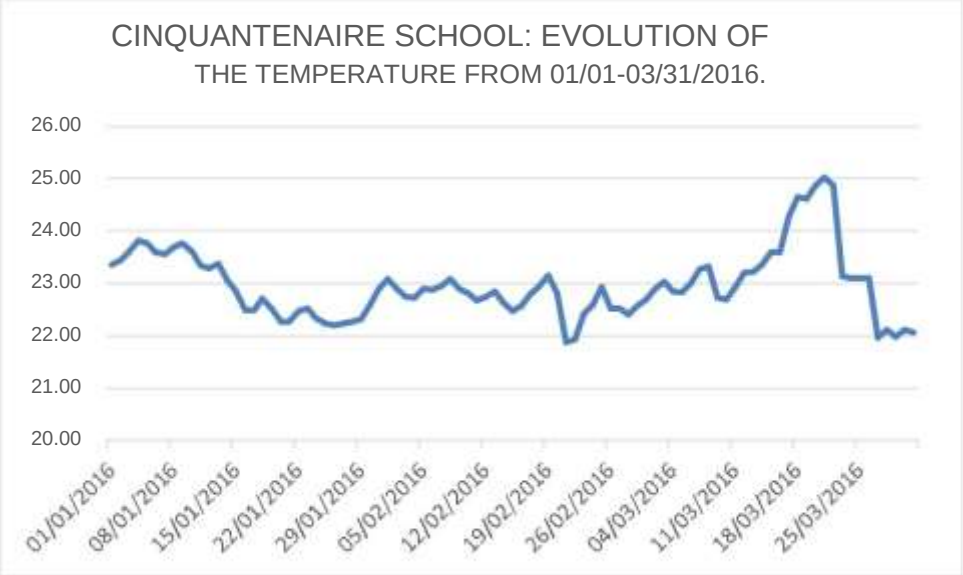
We observed a temperature variation since February 22, 2016 where the temperature increased from 20.37°C to 22.13°C on March 22, 2016, an increase of 1.76°C.

5. THE HEAL AFRICA SITE:



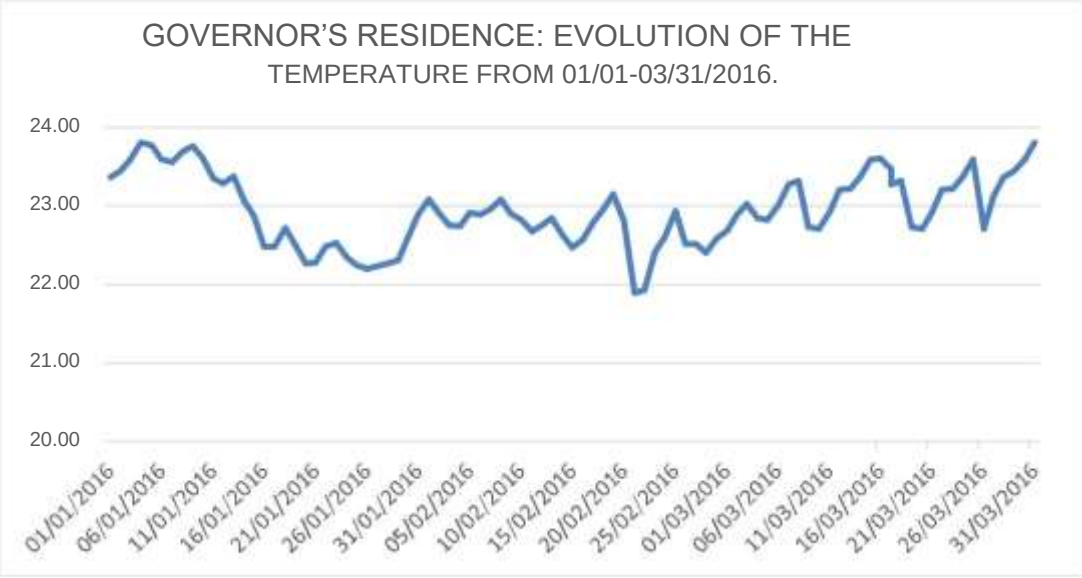
At this site, we noted a slight increase in temperature of 1.52° from January 29 when the temperature was 21.90°C to 23.42°C on March 31.

6. SITE OF THE CINQUANTENAIRE SCHOOL:



We observed a temperature increase of 3.13°C since February 21, 2016 where the temperature increased from 21.89°C to 25.02°C on March 21, 2016. After this date, the temperature proceeded to increase.decreases until it returns to its normal course.

7. THE GOVERNOR'S RESIDENCE SITE:



We observed a temperature increase of 1.92°C at this site since February 21, 2016 where the temperature increased from 21.89°C to 23.81°C on March 31, 2016.

IV. CONCLUSION

This study allowed us to know the reaction of different sites to the opening of the new vent in February 2016. After analyzing the data collected on the ground, we note that:

- The Summit and Shaheru sites were the first to respond well before the opening day of this vent. This leads us to say that these two sites suffered the intrusion of magma before the other sites.

- Sites located in the city of Goma presented their reactions just a few days before the opening of the vent.
- The Bugarura site remained almost indifferent to this appearance of the new vent.
- Only the summit site had presented a remarkable increase in temperature during this period of activity.
- The opening of this vent influenced the temperature variation at our sites, but this variation was felt more at the summit than at the other sites.

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