



## Workshop on the Provision of Information on Volcanic Eruptions and Ash Clouds, Yaoundé, Cameroon, 16–20 June 2025

### Case Studies of Recent Volcanic Eruptions and Their Impacts on Aviation



PPT-2.1B – RVA DR Congo



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## 1. Introduction – Volcano Hazards in the DR Congo

- The DR Congo is located within the Albertine Rift, an area of significant seismic and volcanic activity
- Main active volcanoes: Nyiragongo and Nyamulagira
- Volcanic ash poses major risks (aviation, health, agriculture, infrastructure)
- Disaster management is complicated by ongoing conflict, limiting access, hindering aid, and affecting public trust
- Highlights the need for integrated strategies that account for the conflict context when managing disasters



## 2. Active Volcanoes and Ash Sources

### 2.1. Mount Nyiragongo

- Stratovolcano (3,470 m), famous for its active lava lake and extremely fast lava flows
- Located ~12 km north of Goma, considered one of the most dangerous volcanoes in the world
- Major eruptions:
  - 1977 → sudden lava lake drainage, flows at 60 km/h, ~50 deaths
  - 2002 → destroyed ~15% of Goma, thousands of homes, massive displacement
  - 2021 → unexpected lava flows, gas and ash emissions, new damages and evacuations
- Continuous activity, satellite monitoring, high risk for Goma's growing population (over 1 million)



## 2. Active Volcanoes and Ash Sources

### 2.2. Mount Nyamulagira

- Shield volcano (3,058 m), Africa's most active volcano
- Large summit caldera, many flank vents, frequent eruptions since the late 19th century
- Notable eruptions:
  - 2004, 2006 → SO<sub>2</sub> and ash plumes visible from satellites
  - 2014 → significant ash fallout, atmospheric pollution, between January 4 and 13, 2014, reddish ash plumes, significant atmospheric pollution, degrading air quality in the surrounding regions.
  - 2024 → aviation red code, major ash emissions, a weak ash emission, with a plume reaching an estimated altitude of 4,000 meters (13,000 feet) above sea level
- Significant impacts on aviation, agriculture, and public health over a broad area



## 2. Active Volcanoes and Ash Sources

### 2.3. Other Potentially Active Volcanoes

- Bisoke, Tshibinda, May-Ya-Moto: less active but still monitored
- Nyiragongo and Nyamulagira remain the main concerns due to frequent ash emissions



## 2. Active Volcanoes and Ash Sources

### 2.4. Other volcanic activities : Tremors

- Movements of local tectonic faults
- Volcanic activity from Nyiragongo and Nyamulagira (magma injection, opening of fissures)

#### Recent examples:

- May 2021: After the Nyiragongo eruption, over 100 seismic tremors recorded within 24 hours, causing building collapses
- May 2025: Magnitude 4.5 earthquake felt in Goma and surrounding areas, with no major damage

#### Main impacts:

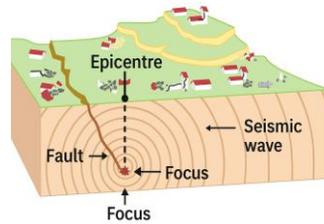
- Safety risks for buildings, roads, runways, hospitals, etc
- Fear and displacement of populations, overloading humanitarian structures
- Potential to trigger or worsen a volcanic eruption

#### Action

Runway inspections required after tremors.



## SEISMIC TREMORS



## 2. Active Volcanoes and Ash Sources

### 2.4. False alerts

- Between 2020 and 2024, several false volcanic eruption alerts in Goma caused panic and confusion, notably in October 2020 (article in *Science*), May 2021 (government false alert about Murara), and September 2024 (social media rumors).
- The key lessons: the rapid spread of rumors, the importance of clear official communication, and the need to strengthen technical monitoring capacities to prevent false alarms.





### 3. Regional Risk Considerations

- **Volcanic Eruption Parameters to consider in GOMA :**
- **🌋 Eruption Altitude** → Determines affected flight levels; key for aviation risk and rerouting
- **🌐 Border Impact** → Tracks ash crossing national borders; essential for international FIR coordination
- **👉 Wind Speed & Direction** → Controls ash drift and spread; crucial for forecasting and issuing alerts (SIGMETs, VAAs)
- **✈️ Routes Network** → Identifies major air traffic routes and airports; important for defining no-fly zones and alternate routes



### 4. Volcanic Hazards in Goma

- ✓ **Human impact**
  - Loss of life from lava flows, toxic gases, building collapses, or evacuation-related accidents
  - Massive displacement of populations (hundreds of thousands forced to flee)
  - Respiratory and health problems due to ash and gas inhalation
- ✓ **Infrastructure damage**
  - Destruction of homes, schools, hospitals, roads, and utility networks
  - Damage or partial closure of Goma International Airport (lava crossing the runway, reducing its length)
  - Disruption of communication and power supplies
- ✓ **Aviation hazards**
  - Volcanic ash clouds posing major risks to aircraft engines and avionics
  - Airspace closures, flight cancellations, and rerouted air traffic



## Volcanic Hazards in Goma



### 4.1 Aviation Related Risks in Goma

- High altitude, wide horizontal spread, long duration
- SO<sub>2</sub> content → formation of H<sub>2</sub>SO<sub>4</sub>, risk of damaging or blocking engines
- Presence of radioactive materials and acid rain, harmful to humans
- Risk of blockage of the Pitot tube (affects wind speed, temperature, pressure readings)
- Cockpit window opacity
- Reduced tire adhesion, risk of runway excursion



## 4.2 Nyiragongo Eruption management

(May 2021)

From eruption onward, full compliance with ICAO recommendations:

- Authorities informed
- Crisis committee established
- Regional preparation ensured
- VONA (OVG) & VAA/VAG (VAAC Toulouse) messages issued
- SIGMET VA (WMO/N'Djili) & ASHTAM (NOF) messages issued
- Coordination with neighboring FIRs
- Dangerous area defined (60 NM around Nyiragongo)
- ATS routes adapted, traffic rerouted
- Collaborative decision making mechanism established



## 5. Main Milestones

- ✓ **Memorandum of Understanding (MoU) 2024**
  - Signed between RVA (Régie des Voies Aériennes) and OVG (Observatoire Volcanologique de Goma)
- ✓ **Volcanic Ash Contingency Plan (VA) 2024**
  - Jointly signed and endorsed by RVA and OVG
- ✓ **Air Traffic Management (ATM) Contingency Plan**
  - Updated and aligned with international standards
- ✓ **Airspace Simulation Exercise (VOLCEX) 2023**
  - Organized by ICAO to test aviation and airspace responses to volcanic ash scenarios
- ✓ **Ground Simulation Exercise 2017**
  - Conducted by the Government in collaboration with international organizations



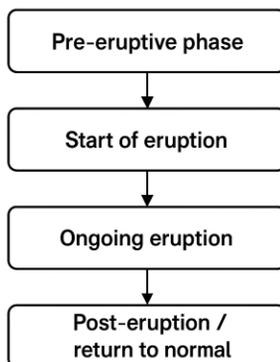
## 5.2 MOU RVA OVG

- ✓ Collaboration between RVA and OVG for air safety regarding volcanic activities
- ✓ OVG: volcanic monitoring, sending VONA messages, updates every 6 hours, participation in VOLCEX exercises
- ✓ RVA: transmitting information to aviation actors, issuing NOTAM/ASHTAM, SIGMET VA, coordination with ACC and MWO/N'djili
- ✓ Information dissemination: via AMHS networks, phone, internet, with written confirmation of communications
- ✓ Coordination meetings every 6 months (or as needed) between RVA, OVG, ATS, and meteorology services
- ✓ Agreement effective upon signature, with possible amendments by written agreement, signed in 2024



## 5.2 VACP PHASES

The VACP (Volcanic Ash Contingency Plan) covers 4 phases:



### Sources of Volcanic Activity Alerts:



Aircraft observation  
(Special AIREP message)



OVG observation  
(VONA message)



Satellite observations  
(satellite imagery data)



Meteorological observations



## 5.3 VA Contingency plan

- The ATM Contingency Plan for the Kinshasa FIR outlines actions to manage any air traffic crisis, including volcanic ash clouds, in three phases:
  1. Crisis within the country
  2. Crisis affecting neighboring FIRs
  3. Return to normal operations
- Key actions (for phases 1 and 2) include:
  - Contacting relevant authorities and key stakeholders
  - Establishing a coordination committee
  - Issuing a NOTAM (by NOF)
  - Informing neighboring FIRs
  - Strict use of predefined ATS routes
  - Making decisions through collaboration



## 6. Conclusion

- Vigilance and collaboration between local and global actors are essential.
- Invest in real-time monitoring, early warning, and cross-border coordination.
- Transform lessons learned into strong, tested contingency plans.
- Focus on resilience to protect lives and aviation operations in a high-risk region.



# THANK YOU

Together, by uniting operational, technical, and institutional efforts, **we can make the AFI region a model of volcanic risk preparedness and aviation safety.**



**Thank you for your attention**

# Q&A