



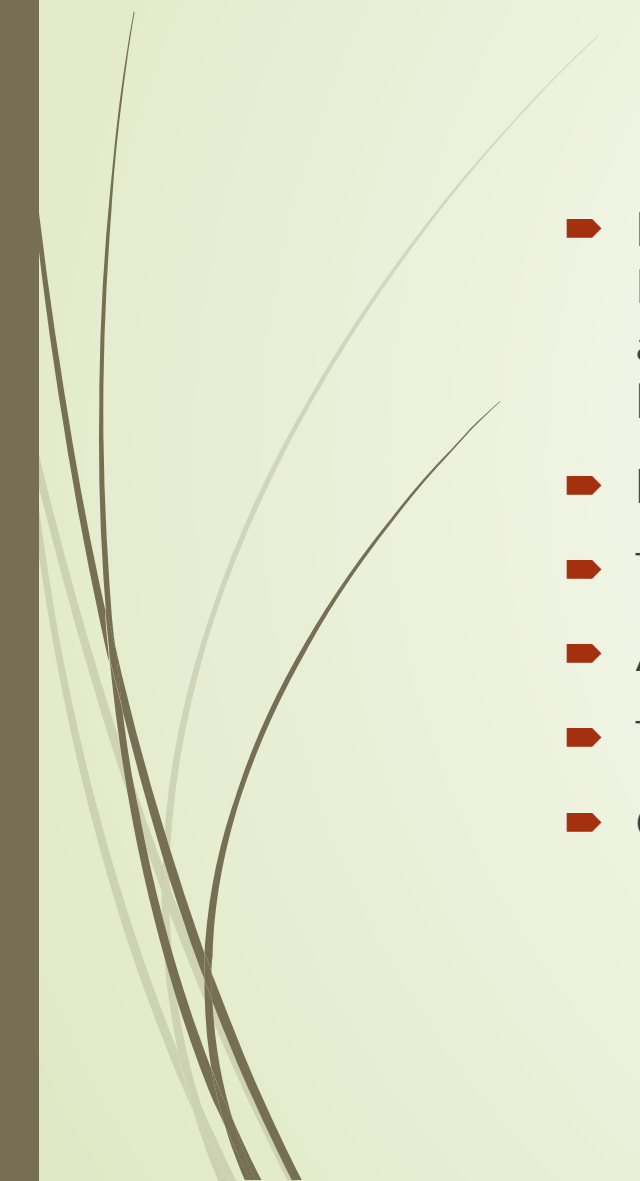
DRC experience on ATM management of Mount Nyiragongo volcanic eruption

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Air Navigation, RVA





Background Nyiragongo Volcano

- ▶ Nyiragongo is a stratovolcano of the Great Rift Valley located in the Democratic Republic of Congo. It is located in the Virunga Mountains about 20 km north of the city of Goma and Lake Kivu and west of the border with Rwanda.
 - ▶ Recent eruption: 2021
 - ▶ Two previous eruptions: 1977 and 2002
 - ▶ Altitude : 3 470 m
 - ▶ Type : Rift volcano
 - ▶ Coordinates : 1° 31' 07" south, 29° 15' 14" east
- 




The phase before the eruption

- Nyiragongo erupted unexpectedly without any alert being raised; hence the pre-eruption phase is omitted.
- Emphasis in this phase could have been placed on raising awareness of the potential hazard and to protect aircraft in flight.
- The actions would be based on well-prepared, well-exercised contingency plans and standard operating procedures.
- However, the Eruption occurs after attending a virtual workshop on volcanic ash exercises



Start of eruption phase

- The initial response, “raising the alert”, commences when a volcanic eruption is expected. It should be noted that sometimes volcanoes erupt unexpectedly without any alert being raised; hence the pre-eruption phase may be omitted.
- Emphasis in this phase is placed on raising awareness of the potential hazard and to protect aircraft in flight. The actions shall be based on well-prepared, well-exercised contingency plans and standard operating procedures.
- Initial awareness of the event may be provided by means of a Special AIREP, VONA, satellite data, as well as other remote sensors. This information may lead to the production of the initial SIGMET, VAA/VAG, NOTAM as per the On-Going Eruption Phase.
- States should ensure that alerting information is distributed expeditiously by the most appropriate means to allow for the early warning of aircraft in flight.



Day 1: Start of eruption

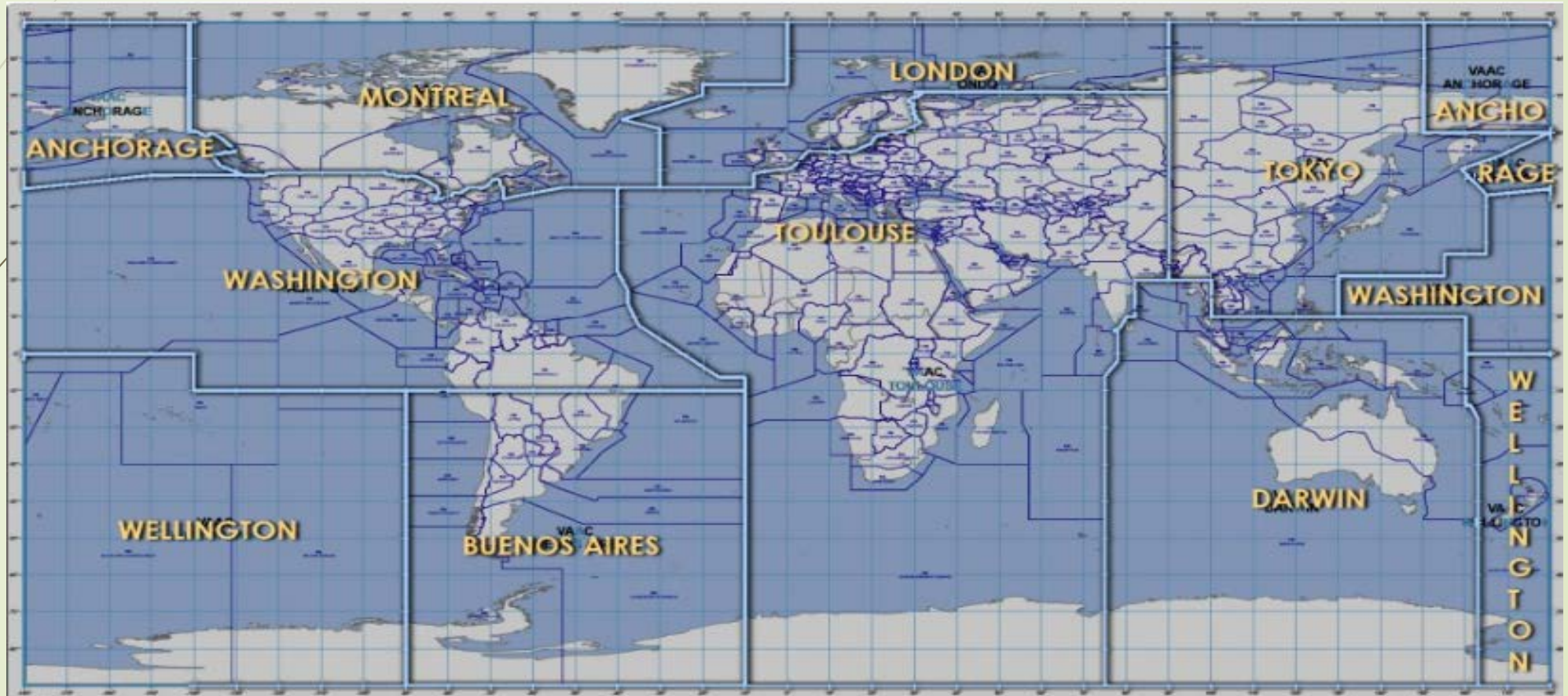
Saturday, May 22, 2021

- ▶ start of eruption 18:00 UTC, announced by ATC Goma by phone,
- ▶ RO ATM ICAO WACAF informed in the media requests confirmation and goes into action for the necessary support
- ▶ First NOTAM on volcanic eruption around 21h00Z, Discussions on the need to activate the contingency plan
- ▶ Reception VAAC Toulouse 21h00Z through RO ATM ICAO WACAF
- ▶ Need to create a national crisis committee
- ▶ On the standby 24 hours, stayed awaked until morning to respond to calls and requests such as from IATA, etc.
- ▶ Challenges on the first day. Contact list with neighboring FIRs needed to be updated
- ▶ A very close collaboration between ANSP(RVA), CAA and the Ministry of Transport and Communication since the first night of the eruption

Phase of Eruption in progress

- ▶ Volcanic ash may affect any combination of airspace; therefore, it is not possible to prescribe measures to be taken for all situations. The following guidance therefore may prove useful during the on-going eruption phase, but should not be considered mandatory or exhaustive:
- ▶ The ACC/FIC will continue to act in accordance with the ATS Contingency Procedures contained in PANS-ATM (Doc 4444) Chapter 15.8;
- ▶ ACCs/FICs affected by the movement of the volcanic ash shall ensure that appropriate AIS messages are originated in accordance with Annex 15 [*Aeronautical Information Services*]. ACCs/FICs concerned and the appropriate ATFM unit should continue to publish details on measures taken to ensure dissemination to all concerned;
- ▶ the ACC/FIC should solicit special air-reports on volcanic activity if so requested by the appropriate VAAC;
- ▶ ACCs/FICs and ATFM units should be aware that for the purposes of flight planning and execution, operators could treat the horizontal and vertical extent of the volcanic ash contaminated area to be over-flown as if it were mountainous terrain; and
- ▶ any reported differences between published information and observations (pilot reports, airborne measurements, etc.) should be forwarded as soon as possible to the appropriate authorities to ensure revision of any incorrect information and its dissemination to all concerned.

The nine VAACs (Volcanic Ash Advisory Centres)



First VAAC message received via ICAO

NYIRAGONGO - 2021-05-22 22:17 utc

VA ADVISORY

DTG: 20210522/2217Z

VAAC: TOULOUSE

VOLCANO: NYIRAGONGO 223030

PSN: S0131 E02915

AREA: AFRICA (CENTRAL)

SUMMIT ELEV: 3470M

ADVISORY NR: 2021/2

INFO SOURCE: SAT IMAGERY, TWITTER

AVIATION COLOUR CODE: RED

ERUPTION DETAILS:ERUPTION AT 20210522/1800Z ONGOING ERUPTION

OBS VA DTG: 22/2230Z

OBS VA CLD: SFC/FL450 S0133 E02918 - S0218 E02836 - S0142 E02721 - S0112 E02857 - S0133 E02918 MOV SW 15KT

FCST VA CLD +6 HR: 23/0430Z SFC/FL450 S0130 E02921 - S0300 E02751 - S0224 E02612 - S0151 E02633 - S0054 E02906 - S0130 E02921

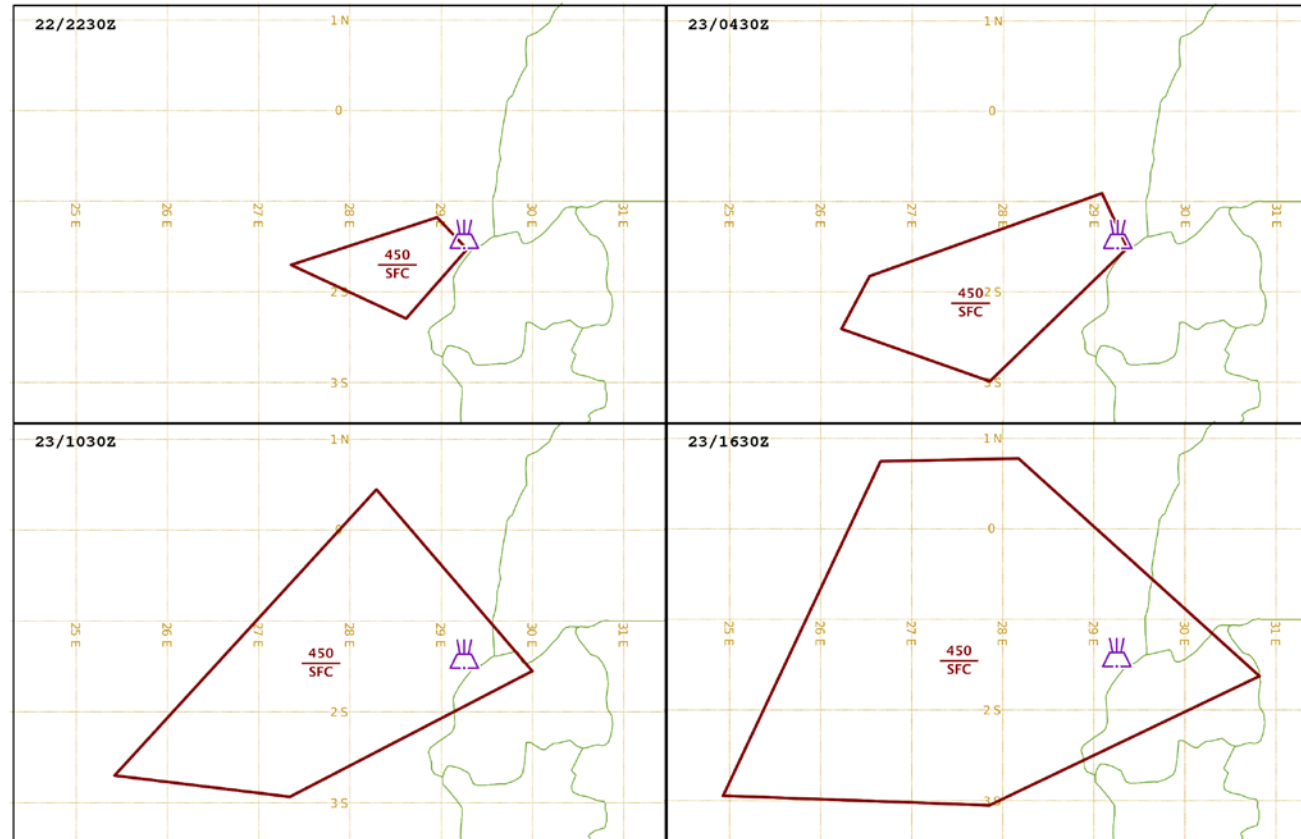
FCST VA CLD +12 HR: 23/1030Z SFC/FL450 S0133 E03000 - S0257 E02721 - S0242 E02524 - N0027 E02818 - S0133 E03000

FCST VA CLD +18 HR: 23/1630Z SFC/FL450 S0139 E03048 - S0303 E02751 - S0257 E02457 - N0045 E02639 - N0048 E02809 - S0139 E03048

RMK: ASH CLOUD ESTIMATED UNDER FL450

NXT ADVISORY: NO LATER THAN 20210523/0430Z=

Map



VOLCANIC ASH ADVISORY

DTG:20210522/2217Z

VAAC:TOULOUSE

VOLCANO: NYIRAGONGO 223030

AREA: AFRICA (CENTRAL)

SUMMIT ELEV: 3470M



ADVISORY NR: 2021/2

INFO SOURCE:SAT IMAGERY, TWITTER

AVIATION COLOUR CODE:RED

ERUPTION DETAILS: ERUPTION AT 20210522/1800Z ONGOING ERUPTION

RMK: ASH CLOUD ESTIMATED UNDER FL450


NXT ADVISORY:NO LATER THAN 20210523/0430Z.



Day 2: Eruption in progress

Sunday, May 23, 2021

- ▶ Formal creation of the national crisis committee including the CAA, the Ministry of Transport, Communication Roads and Opening-up, the ANSP (RVA).
- ▶ Among the Ministry's experts, a seasoned pilot closely analyzes the situation for advice and guidance
- ▶ Creation of an ad hoc subcommittee of the RVA including the General Manager, the Director of Operations, the ATC, AIS, MET, ACC/FIC and ATS/GOMA managers with internal coordination of guidance and actions between the General Management, CCR Ndjili and Goma Continued collaboration with the RO ATM ICAO WACAF,
- ▶ creation of the WhatsApp group Nyiragongo VACP CCT which served as a communication platform.
- ▶ The Goma Volcanological Observatory (OVG Goma) provides regular volcanological information taken into account by VAAC/Toulouse and for the benefit of the community.



Day 2: Eruption in progress

Sunday, May 23, 2021 continued

- ▶ NOTAM activation of contingency plan upon authorization from CAA
- ▶ First ASHTAM by AIS
- ▶ First SIGMET and first VONA by MET
- ▶ Continuous reception of VAACs from the Toulouse Center contributing to the elaboration of VONAs, NOTAMs, ASHTAMs, SIGMETS, etc.
- ▶ Closure of Goma and Bukavu on order and after evaluation of SMS security by the national crisis management committee

Decrease from FL450 to FL300

NYIRAGONGO - 2021-05-23 04:23 utc

VA ADVISORY

DTG: 20210523/0423Z

VAAC: TOULOUSE

VOLCANO: NYIRAGONGO 223030

PSN: S0131 E02915

AREA: AFRICA (CENTRAL)

SUMMIT ELEV: 3470M

ADVISORY NR: 2021/3

INFO SOURCE: SAT IMAGERY, TWITTER

AVIATION COLOUR CODE: RED

ERUPTION DETAILS:ERUPTION AT 20210522/1800Z ONGOING ERUPTION

OBS VA DTG: 23/0300Z

OBS VA CLD: SFC/FL300 S0157 E02642 - N0006 E02921 - S0112 E02951 - S0224 E02930 - S0342

E02730 - S0157 E02642 MOV SW 10KT

FCST VA CLD +6 HR: 23/0900Z SFC/FL300 S0145 E02545 - N0027 E02909 - S0042 E02948 - S0224

E02930 - S0400 E02648 - S0145 E02545

FCST VA CLD +12 HR: 23/1500Z SFC/FL300 S0148 E02403 - N0057 E02854 - S0042 E02948 -

S0224 E02930 - S0357 E02548 - S0148 E02403

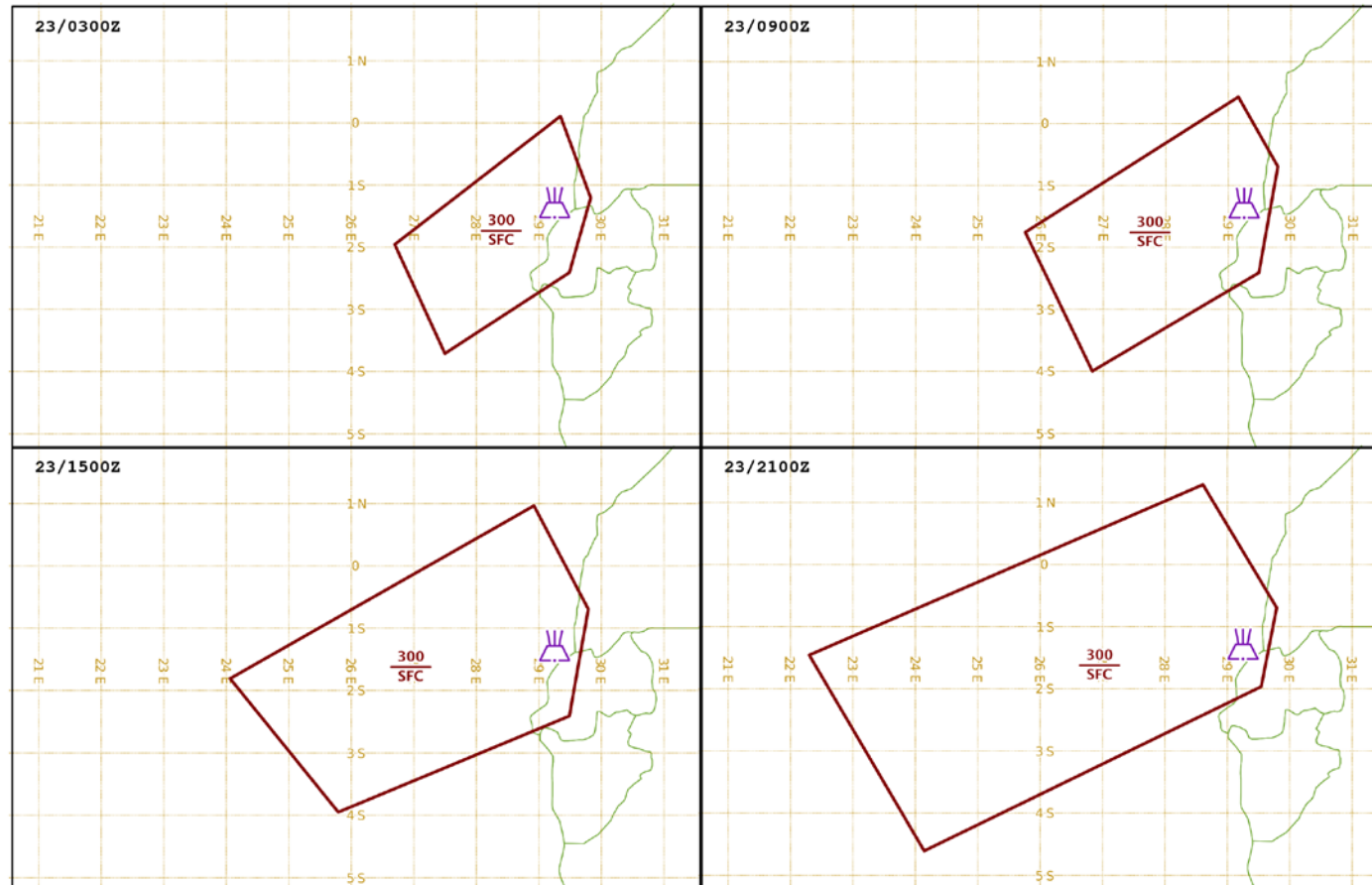
FCST VA CLD +18 HR: 23/2100Z SFC/FL300 S0127 E02218 - N0118 E02836 - S0042 E02948 -

S0157 E02933 - S0436 E02409 - S0127 E02218

RMK: ASH CLOUD ESTIMATED UNDER FL300

NXT ADVISORY: NO LATER THAN 20210523/1030Z=

Map



VOLCANIC ASH ADVISORY

DTG:20210523/0423Z

VAAC:TOULOUSE

VOLCANO: NYIRAGONGO 223030

AREA: AFRICA (CENTRAL)

SUMMIT ELEV: 3470M



ADVISORY NR: 2021/3

INFO SOURCE: SAT IMAGERY, TWITTER

AVIATION COLOUR CODE: RED

ERUPTION DETAILS: ERUPTION AT 20210522/1800Z ONGOING ERUPTION

RMK: ASH CLOUD ESTIMATED UNDER FL300

NXT ADVISORY: NO LATER THAN 20210523/1030Z.

Decrease from FL300 to FL200

NYIRAGONGO - 2021-05-23 10:08 utc

VA ADVISORY

DTG: 20210523/1008Z

VAAC: TOULOUSE

VOLCANO: NYIRAGONGO 223030

PSN: S0131 E02915

AREA: AFRICA (CENTRAL)

SUMMIT ELEV: 3470M

ADVISORY NR: 2021/4

INFO SOURCE: SATELLITE DATA, OVG GOMA

AVIATION COLOUR CODE: UNKNOWN

ERUPTION DETAILS:ERUPTION AT 20210522/1800Z NO SIGNIFICANT ERUPTION DETECTED

OBS VA DTG: 23/1000Z

OBS VA CLD: SFC/FL200 S0127 E02924 - S0151 E02915 - S0142 E02845 - S0106 E02900 - S0127 E02924 MOV E 5KT

FCST VA CLD +6 HR: 23/1600Z NO VA EXP

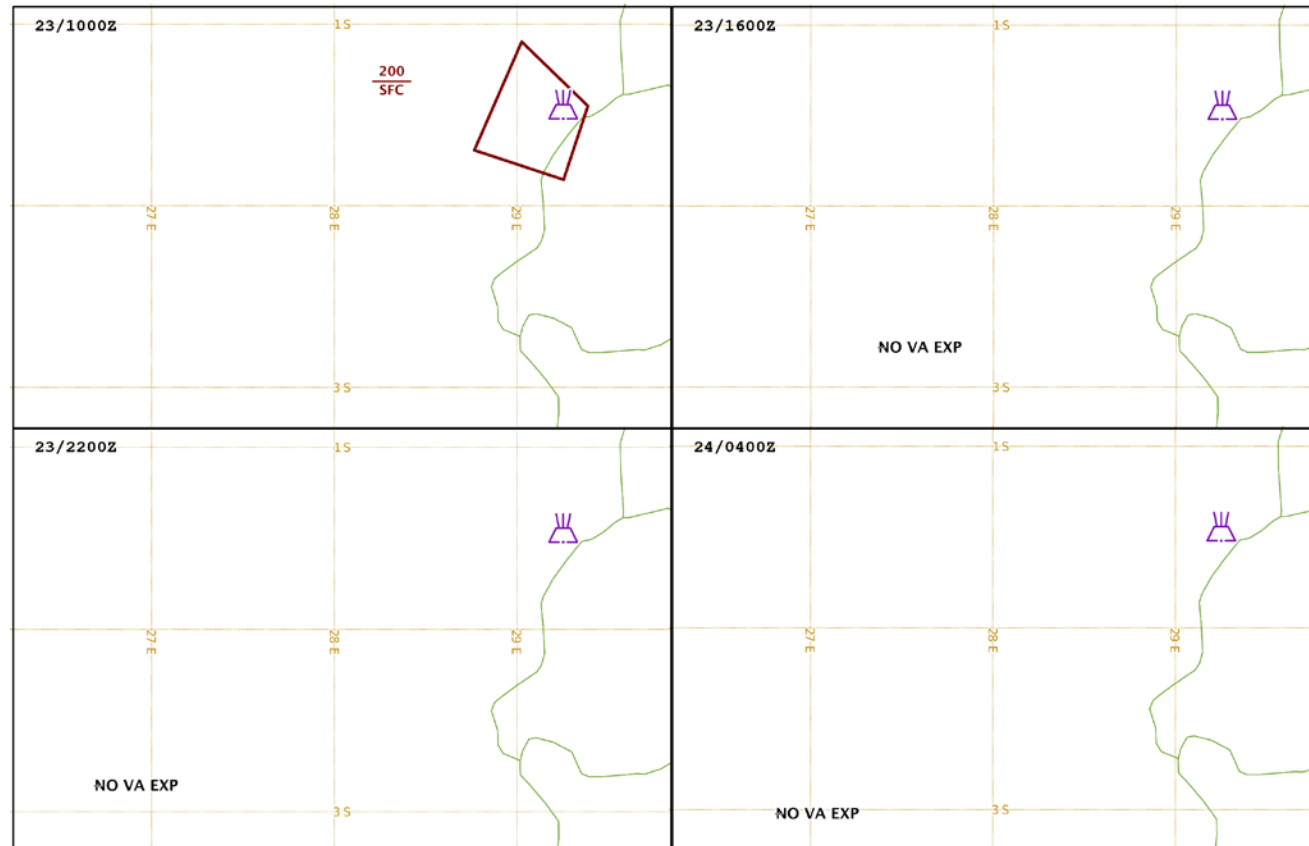
FCST VA CLD +12 HR: 23/2200Z NO VA EXP

FCST VA CLD +18 HR: 24/0400Z NO VA EXP

RMK: LAVA FLOW STILL ONGOING AROUND CRATER. FEW ASH CLOUD AND SO2 POSSIBLE NEAR SUMMIT

NXT ADVISORY: NO LATER THAN 20210523/1500Z=

Map



VOLCANIC ASH ADVISORY
DTG: 20210523/1008Z
VAAC: TOULOUSE
VOLCANO: NYIRAGONGO 223030
AREA: AFRICA (CENTRAL)
SUMMIT ELEV: 3470M



ADVISORY NR: 2021/4
INFO SOURCE: SATELLITE DATA, OVG GOMA
AVIATION COLOUR CODE: UNKNOWN
ERUPTION DETAILS: ERUPTION AT 20210522/1800Z NO SIGNIFICANT ERUPTION DETECTED
RMK: LAVA FLOW STILL ONGOING AROUND CRATER. FEW ASH CLOUD AND SO2 POSSIBLE
NEAR SUMMIT
NXT ADVISORY: NO LATER THAN 20210523/1500Z.



Day 3: Eruption in progress

Monday, May 24, 2021

- ▶ Seismic movements have been observed almost every five minutes since 05:00 UT according to ATM officials in Goma
- ▶ Reopening of the Bukavu airport on order and after evaluation of the SMS by the national committee of crisis management



Day 3: Eruption in progress

Monday, 25th May 24, 2021


- ▶ 06:00 TU, Beginning of volcanic ash fall on the runway of Goma, in the city, on cars, houses, etc.
- ▶ Continued seismic movements
- ▶ Cracks in some buildings, houses, roads, etc.
- ▶ After SMS safety assessment by the national crisis management committee, Bukavu airport is closed again



Day 4: Eruption in progress

Tuesday, May 26, 2021

- ▶ Issuance of a NOTAM on the closure of a portion of the airspace within a radius of 100Nm centered on the GOM VOR, from ground to FL350
- ▶ Reactions from IATA followed by ICAO WACAF advising to leave the final decision to the crews, according to their SMS evaluations, to fly over or divert the airspace affected by the volcanic ash
- ▶ The National Crisis Management Committee accepts IATA's request, which is in accordance with ICAO recommendations, and replaces the NOTAM closing a portion of the airspace with another non-binding NOTAM.




Day 5: Eruption in progress Wednesday, May 27, 2021

- Continued seismic movements
- More cracks in buildings, houses, etc.
- Volcanic ash continues to fall on the city of Goma
- Evacuation of the population from the city by Fears of a new eruption through cracks in the earth or in the lake
- ATS Services remained in Goma and continues to assist the crisis management team



Day 6: Eruption in progress Thursday, May 28, 2021

- ▶ Seismic activity decreases significantly and lull gradually returns
- ▶ Exemption granted to humanitarian helicopter flights for GOMA and BUKAVU



Day 7 and beyond: Eruption in progress

- ▶ VAAC, ASHTAMS, SIGMETS, NOTAMS, continued to be issued
- ▶ Tuesday June 1, 2021, BUKAVU airport is again closed by NOTAM, taking into account the evolution of the volcanic ash.

Eruption start decreasing

NYIRAGONGO - 2021-06-01 14:45 utc

VA ADVISORY

DTG: 20210601/1445Z

VAAC: TOULOUSE

VOLCANO: NYIRAGONGO 223030

PSN: S0131 E02915

AREA: AFRICA (CENTRAL)

SUMMIT ELEV: 3470M

ADVISORY NR: 2021/43

INFO SOURCE: OVG, VONA AND SAT IMAGERY

AVIATION COLOUR CODE: ORANGE

ERUPTION DETAILS:ERUPTION AT 20210522/1630Z ERUPTION IS DECREASED

OBS VA DTG: 01/1500Z

OBS VA CLD: SFC/FL180 S0112 E02906 - S0136 E02930 - S0157 E02915 - S0145 E02845 - S0112

E02906 MOV SW 10KT

FCST VA CLD +6 HR: 01/2100Z SFC/FL180 S0054 E02857 - S0142 E02942 - S0251 E02909 - S0215

E02806 - S0054 E02857

FCST VA CLD +12 HR: 02/0300Z SFC/FL180 S0054 E02857 - S0142 E02942 - S0251 E02909 -

S0215 E02806 - S0054 E02857

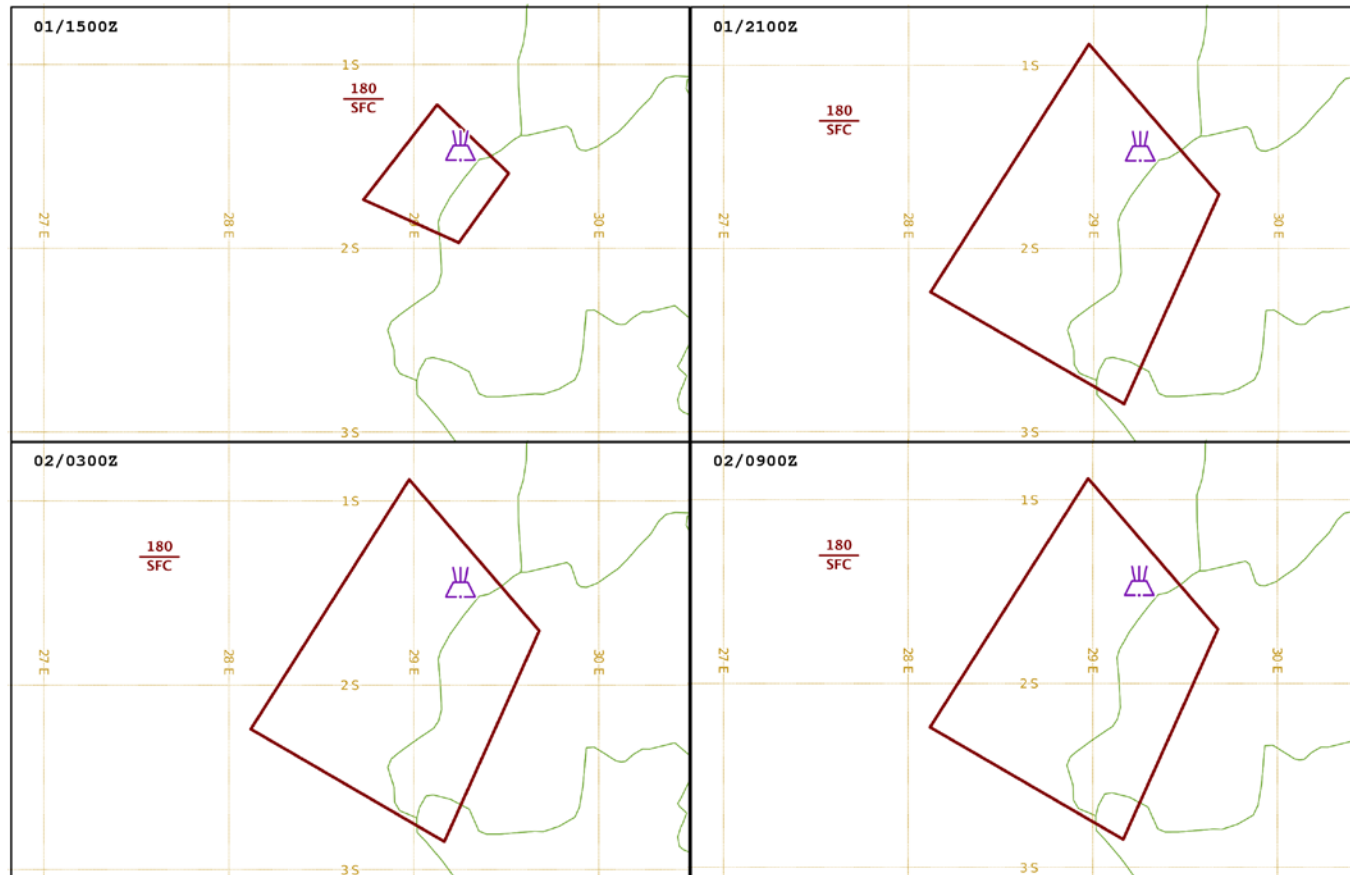
FCST VA CLD +18 HR: 02/0900Z SFC/FL180 S0054 E02857 - S0142 E02942 - S0251 E02909 -

S0215 E02806 - S0054 E02857

RMK: NIL

NXT ADVISORY: NO LATER THAN 20210601/2100Z=

Map



VOLCANIC ASH ADVISORY
DTG:20210601/1445Z
VAAC:Toulouse
VOLCANO: NYIRAGONGO 223030
AREA: AFRICA (CENTRAL)
SUMMIT ELEV: 3470M



ADVISORY NR: 2021/43
INFO SOURCE:OVG, VONA AND SAT IMAGERY
AVIATION COLOUR CODE:ORANGE
ERUPTION DETAILS: ERUPTION AT 20210522/1630Z ERUPTION IS DECREASED
RMK: NIL
NXT ADVISORY:NO LATER THAN 20210601/2100Z.



ATC Operational management

- ▶ Attention elements in VAACs, NOTAMs, ASHTAMs, SIGMETs includes : FL, color code, affected area or routes
- ▶ Creation of temporary charts in ATC, TSA, DTA, etc. in the TOPSKY ATC X automated system
- ▶ Information to crews and neighboring FIRs
- ▶ Deviation of several flight trajectories, especially on days 2, 3 and 4 in application of the contingency plan
- ▶ Cancelled flights from or to the affected area
- ▶ Route deviation at the pilot's initiative after safety assessment



Key role players

- RDC (RVA, CAA, Mini Transcoms,)
- Internally RVA (DG, DE, DNA, CA, ACC, AIS, MET, GOM APT)
- OACI (WACAF)
- FIRs voisines
- IATA
- Airspace users

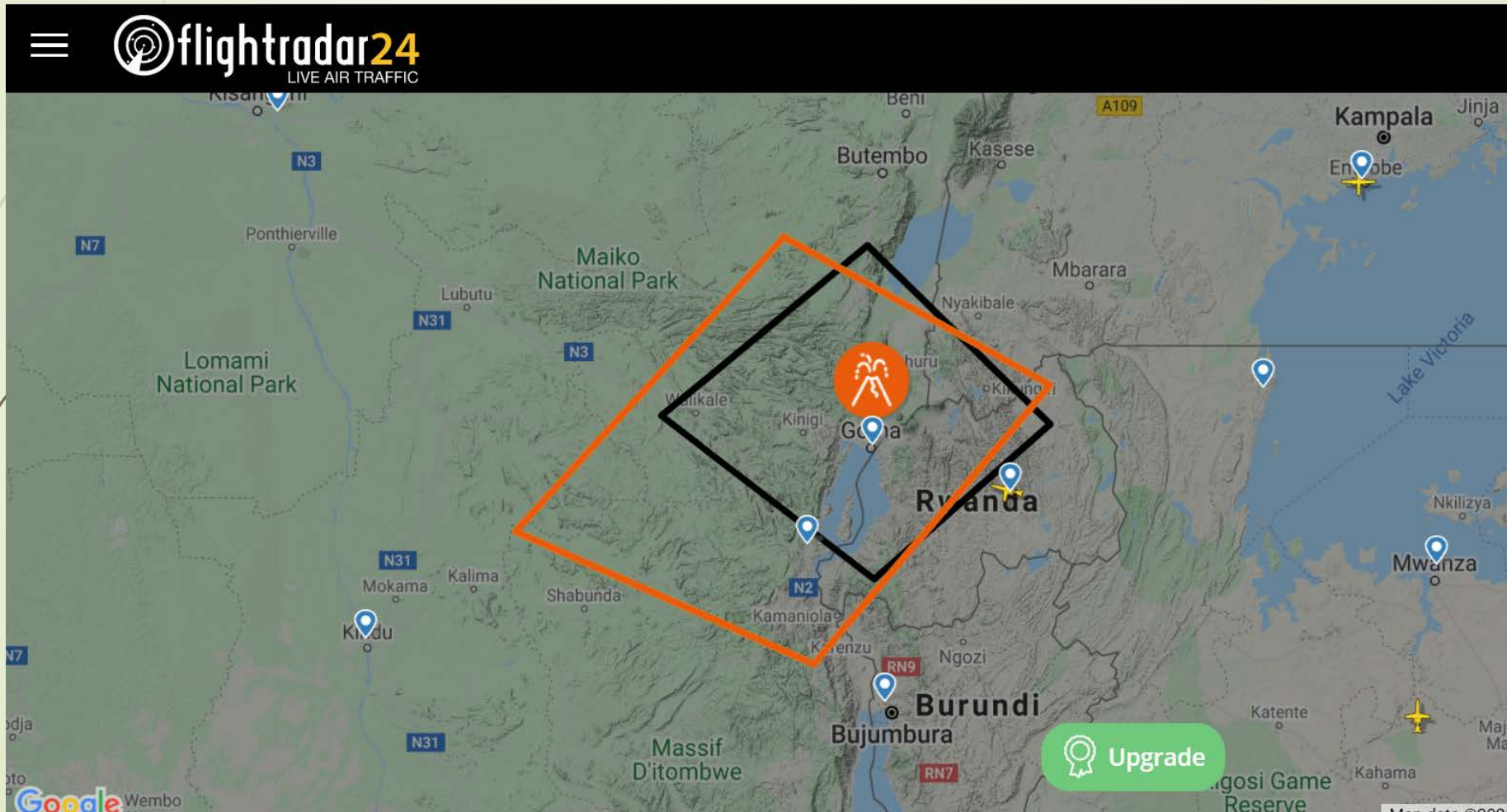
Social Impact

- Some casualties according to official sources,
- Some villages affected by the lava
- Displaced populations etc.

Smoke and volcanic ash



Affected area on June 2nd , 2021 at 03:00UTC



Post eruption phase

- In preparation
- Preparing for post eruption actions





Challenges and way forward

Challenges

- Lack of advance warning
- Coordination and decision making at the onset of the eruption
- Training on volcanic contingency management

Way forward

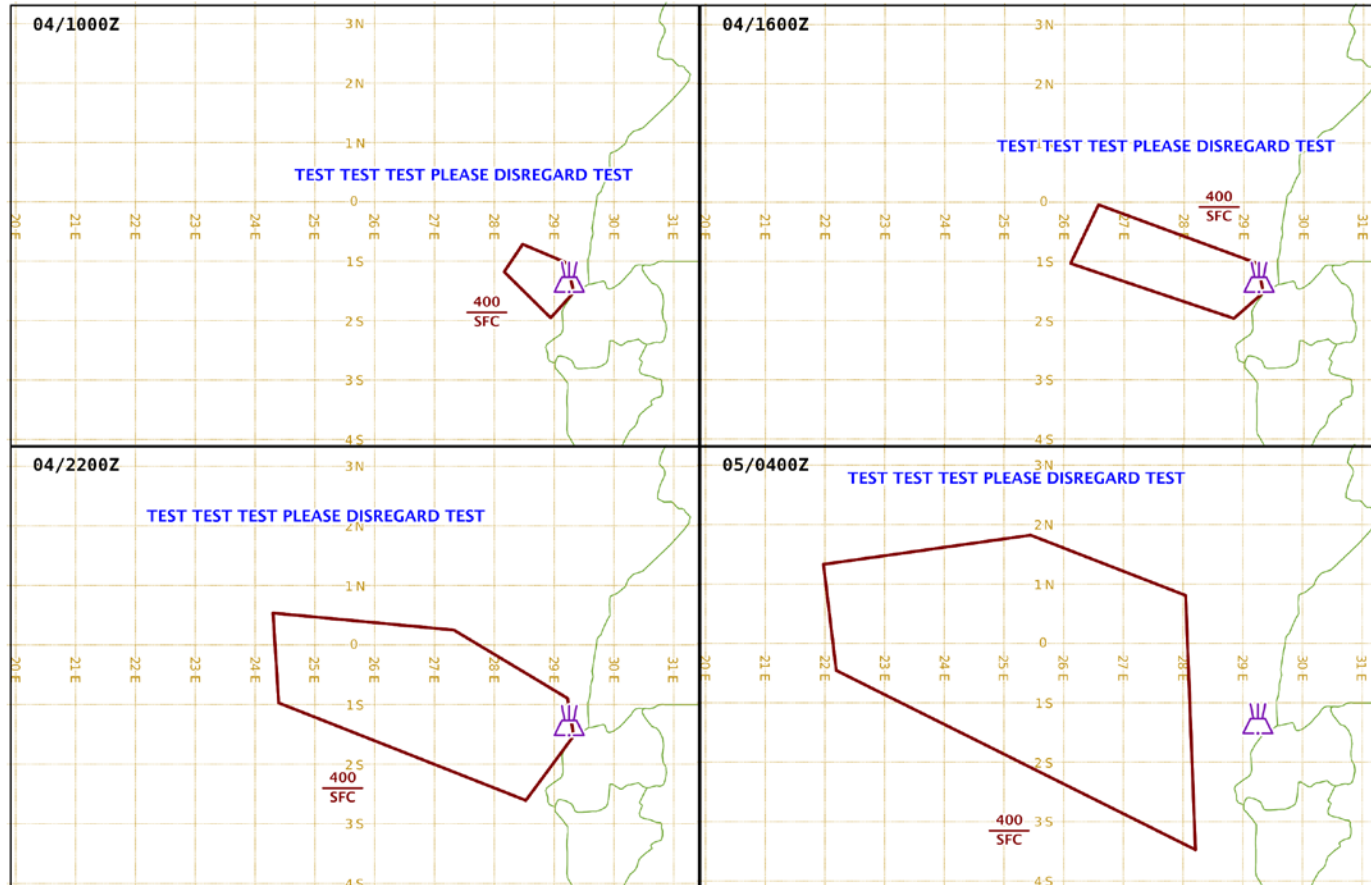
- Bi-annual volcanic ash exercise
- Inclusion of volcanic contingency in ATC simulator training and exercises
- Revision of the contingency plan
- Update contact list

VAAC Test Message

NYIRAGONGO - 2020-02-04 10:01 utc

VA ADVISORY
STATUS: TEST
DTG: 20200204/1001Z
VAAC: TOULOUSE
VOLCANO: NYIRAGONGO 223030
PSN: S0131 E02915
AREA: AFRICA (CENTRAL)
SUMMIT ELEV: 3470M
ADVISORY NR: 2020/2
INFO SOURCE: TEST TEST TEST
AVIATION COLOUR CODE: NIL
ERUPTION DETAILS:ERUPTION AT 20200204/0800Z TEST TEST TEST
OBS VA DTG: 04/1000Z
OBS VA CLD: SFC/FL400 S0130 E02915 - S0200 E02900 - S0115 E02815 - S0045 E02830 - S0100
E02915 - S0130 E02915 MOV NW 15KT
FCST VA CLD +6 HR: 04/1600Z SFC/FL400 S0130 E02915 - S0200 E02845 - S0100 E02600 - N0000
E02630 - S0100 E02915 - S0130 E02915
FCST VA CLD +12 HR: 04/2200Z SFC/FL400 S0130 E02915 - S0230 E02830 - S0100 E02430 -
N0030 E02415 - N0015 E02715 - S0100 E02915 - S0130 E02915
FCST VA CLD +18 HR: 05/0400Z SFC/FL400 S0330 E02815 - S0030 E02215 - N0115 E02200 -
N0145 E02530 - N0045 E02800 - S0330 E02815
RMK: TEST TEST TEST PLEASE DISREGARD TEST
NXT ADVISORY: NO FURTHER ADVISORIES=

VAAC Test



VOLCANIC ASH ADVISORY
DTG: 20200204/1001Z
VAAC: TOULOUSE
VOLCANO: NYIRAGONGO 223030
AREA: AFRICA (CENTRAL)
SUMMIT ELEV: 3470M



ADVISORY NR: 2020/2
INFO SOURCE: TEST TEST TEST
AVIATION COLOUR CODE: NIL
ERUPTION DETAILS: ERUPTION AT 20200204/0800Z TEST TEST TEST
RMK: TEST TEST TEST PLEASE DISREGARD TEST
NXT ADVISORY: NO FURTHER ADVISORIES.



**Thank you for your attention
Questions or comments?**

**Eldonny MBUYI NYEMBUE
Deputy Director of Operations,
Air Navigation, RVA**

