

Characterization of ambient air quality: drones push the boundaries

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PRODUCTIVITÉ



COMPÉTITIVITÉ



EXPORTATION



ENVIRONNEMENT

Presentation overview

- Background and objectives
- Partners
- Prototype DronAIR
- Field tests
 - Common contaminants
 - Radioactivity
- Examples of applications and development prospects



Background

- UAV uses and applications are expanding
- Growing number of issues related to air quality
- Health impacts on the population and environmental disturbances
- Need to improve protections and conduct more environmental research
- Limitations of conventional methods for monitoring ambient air quality
- Need for innovative systems and equipment

Challenge

- Design, build, and test a comprehensive drone solution system for ambient air sampling and measurements.
- Find implicated partners



Partner overview : CRIQ

Québec government corporation reporting to the Minister of the Economy, and Innovation; CRIQ will celebrate its 50th anniversary in 2019



Make Québec industry more competitive and boost growth by supporting innovation, productivity, and exports.



200 EMPLOYEES



3,000 PROJECTS – 2,000 CLIENTS



> 97% OF CLIENTS SATISFIED



LOCATIONS IN QUÉBEC CITY (HEAD OFFICE) AND MONTRÉAL



ANNUAL BUDGET ~ \$ 30 MILLION
SELF-FINANCING RATIO: 53%



\$ 107 MILLION IN ECONOMIC BENEFITS (2012–2015)



Sophie D'Amours,
Chair of the Board of Directors
Rector of Université Laval

Centre d'expertise en analyse environnementale du Québec du MELCC (Ministère de l'Environnement et de la Lutte contre les changements climatiques)

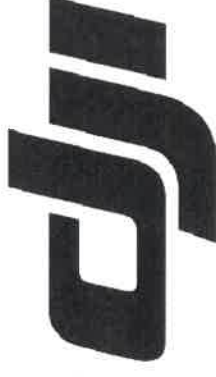
Mission: Ensure the availability, quality and continuity of expertise and analytical information for environmental protection and resource conservation.

More than 100 highly qualified scientists with broad expertise in quality systems and environmental analysis in areas such as biology, ecotoxicology, microbiology, and chemistry



DroneXperts

- DroneXperts founded in 2012
- Located in Québec City, Canada
- Design and operation of drones for gathering specific data
- 4 main divisions:
 - Distribution to companies
 - Management and training
 - Technology and expertise
 - Research & development



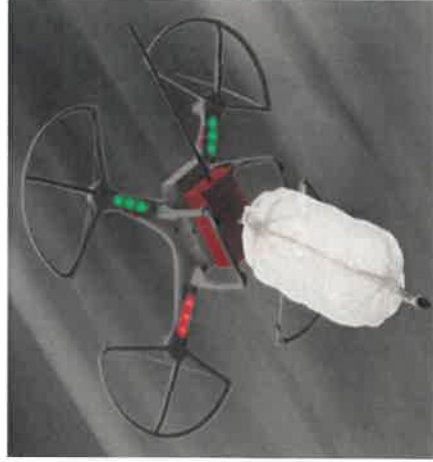
- Analyzed the patent literature: 19 relevant patents
- No Canadian patents conflict with the development of a comprehensive UAV Air Sampling System
- Meetings of experts: CRiQ, DroneXperts, and CEAEQ



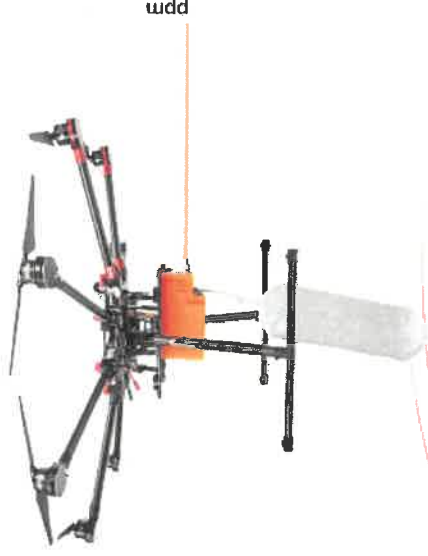
Using drones for ambient air sampling



Berkeley: Phantom 2 modified



Scentroid: Phantom 2 modified DR300



Scentroid: Spreading Wings S900 modified DR1000



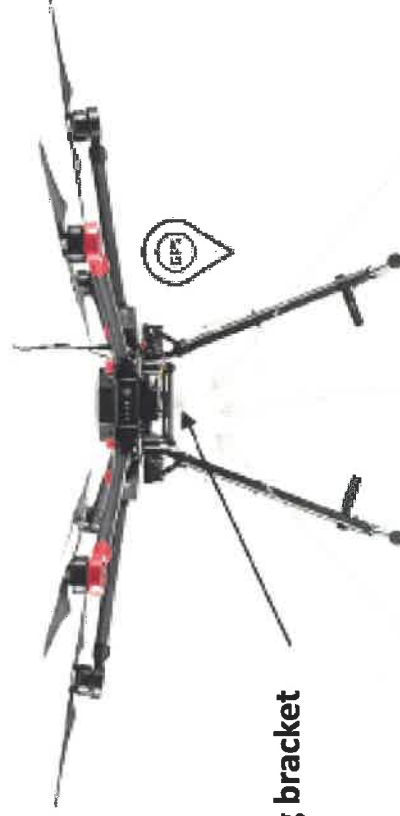
Chose the DJI M600 Pro

- Hexacopter
- Good Payload
- Flight autonomy
- Reliability
- Ease of operation
- Good price point
- Robust
- Other...

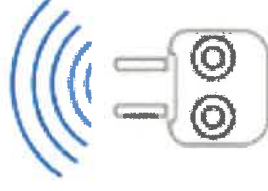


1st DronAIR concept

Multicopter UAV

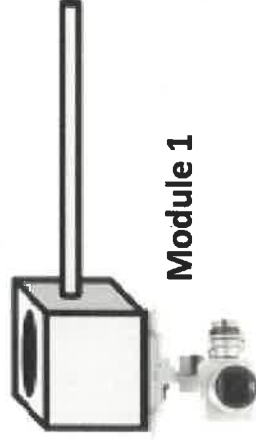


Mounting bracket

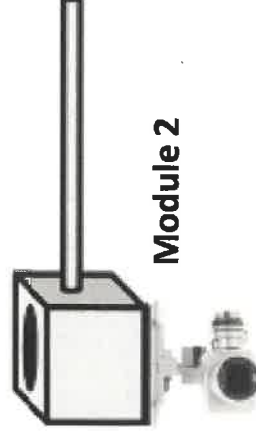


Remote control

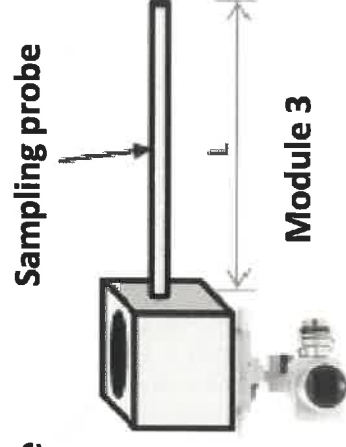
Interchangeable sampling and measurement module



Module 1



Module 2



Module 3

Camera

DronAIR Module

- Comprehensive sampling system: VOC, odours, GHG

Canister (TO-15)



Adsorbent Tube (TO-17)



Lung (EN13725)



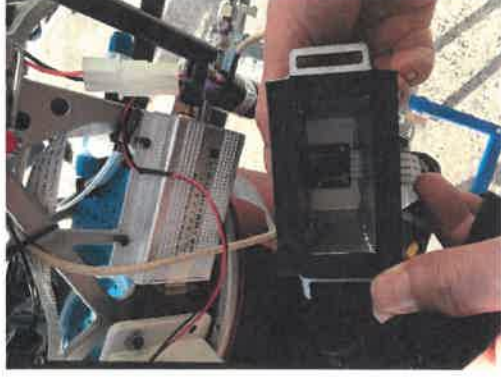
DronAIR Module

- Decision support system: portable CEM equipped with a camera

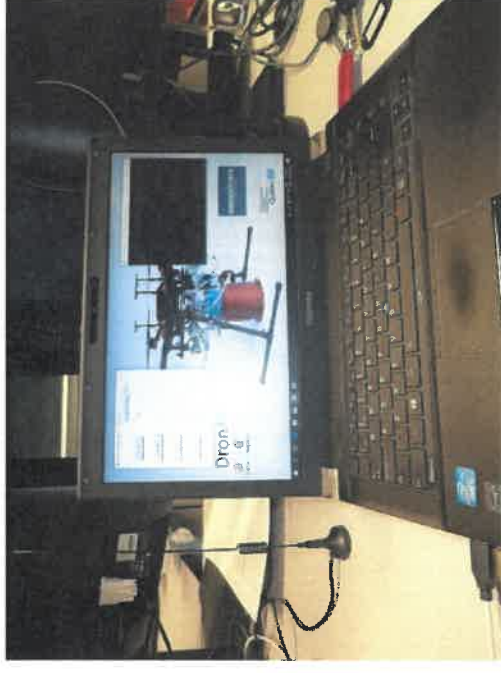
Portable CEM analyser



Embedded Camera



Remote Control Station (PC)

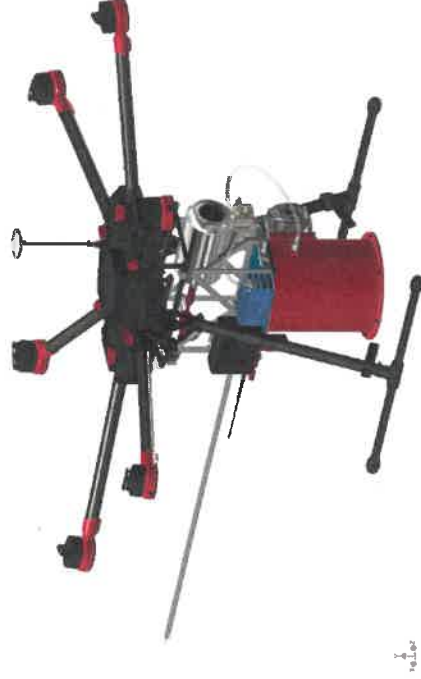


DronAIR Nacelle

- 3D metal printing (Aluminum)



EOS M 290

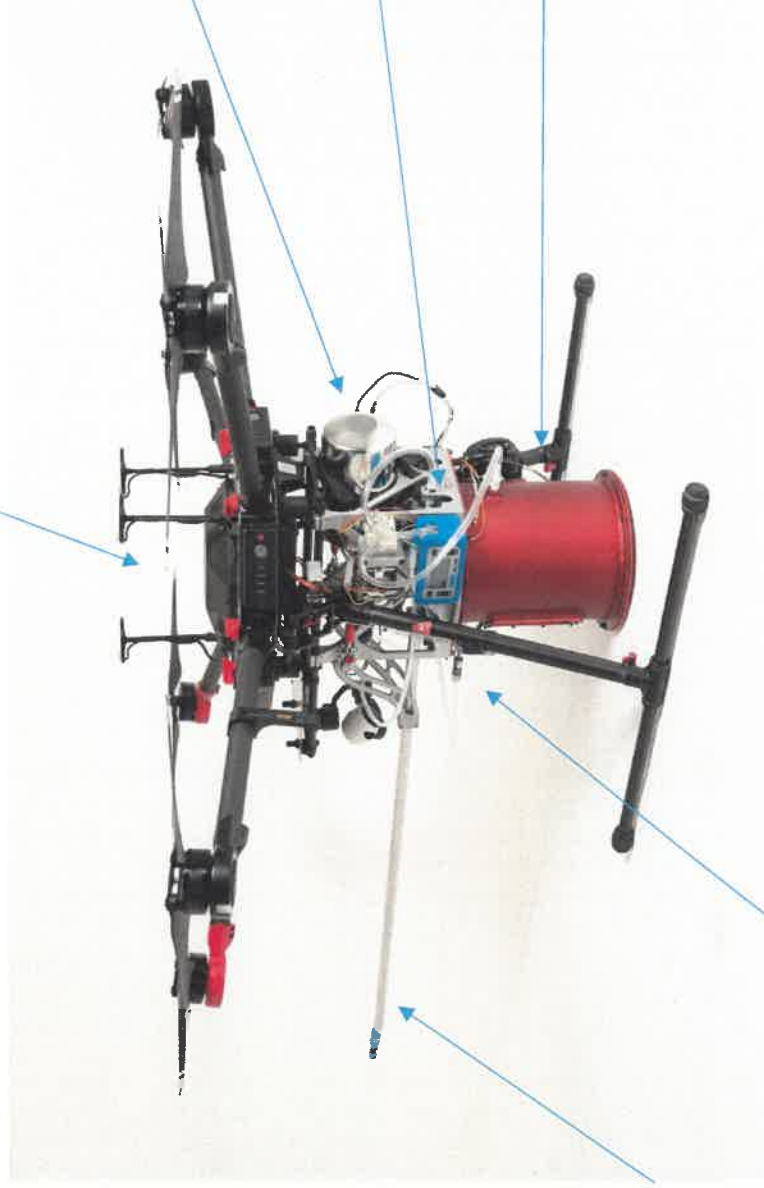


DronAIR prototype

Portable CEM Analyser +
Embedded Camera



DJI M600 Pro



1.4L Canister

Pump
Controller -Tube

5L Sampling
Lung

Sampling Probe

Aluminium Nacelle (3D printing)



Field tests

- Control conditions
- Real-time conditions

[vidéo DronAIR.mp4](#)



Chauveau Soccer Complex



MSW Incinerator in Québec City

Chauveau Soccer Complex (Québec City)



Waste pit (MSWI in Québec City)



Usefulness for Radioactivity Detection

Incidents involving radioactive substances may pose safety issues related to the exposition of first responders and other persons to ionizing radiation

Contexts

- Storage and management of material with higher NORM activity
- Transport of medical isotopes
- Industrial use of radioactive isotopes
- Nuclear waste storage
- CBRN / G7 Summit



Detector Models

Thermo

RadEye G20-ER10



- Geiger-Müller Counter
- No Identification
- Small and light (300 g)
- Backlight

icx Technologies - FLIR

IdentiFINDER-N



- Gamma Spectrometer
- Manual Isotope Identification
- 1,25 kg
- No Backlight

Mirion

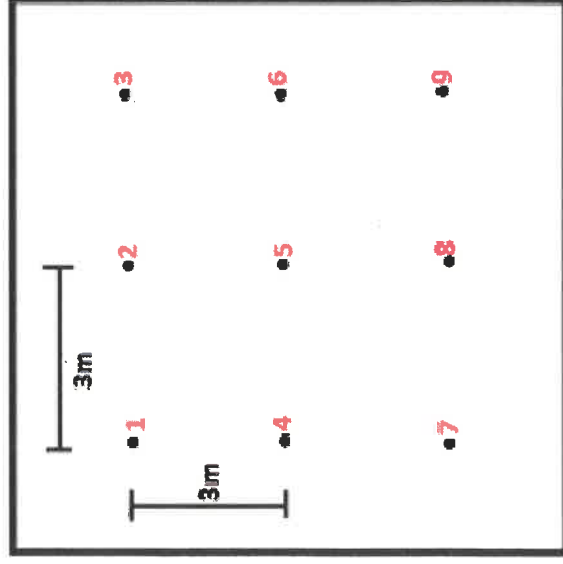
PDS-100 GN/ID



- Gamma Spectrometer
- Automatic Identification
- Light (300 g)
- Backlight

Field Tests

Test #1



- Sources hidden in a container
- Set-up of 9 containers

Test #2



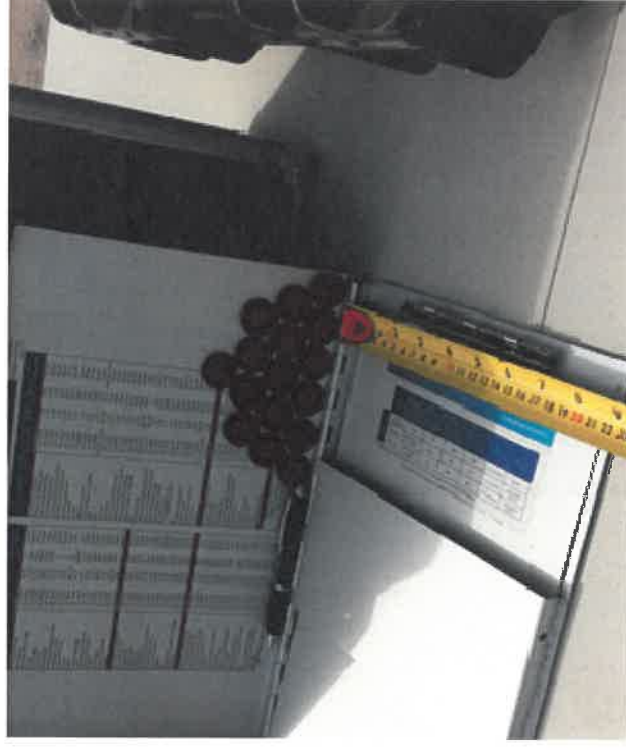
- Sources hidden in the grass
- 60 m² Vegetated Area
- Sources hidden on a large area
- 3 000 m² Platform

Test #3



The Radioactive Sources

- Isotope: Cs-137
- Activity: 132 kBq = 3,6 μ Ci
- Nb: 17
- Total Activity: 2,24 MBq = 61 μ Ci



Results for Radioactivity Field Tests

- All three instruments were useful to detect ionizing radiation while installed on the DronAIR nacelle
- All three instruments were useful to quickly find hidden sources
- Sources localized over a 3 000 m² area in less than 9 minutes



Next Steps

- Integrate a real time geolocation system
- Camera improvement
- Remote control of the detector
- Field tests for map distribution of ground radiation
- Drone contamination evaluation
- Evaluation of other detectors



A great example of an innovation project undertaken by a public-private partnership!

PASSEPORT INNOVATION

ENSEMBLE 
on fait avancer le Québec

Économie, Science
et Innovation
Québec 



Thank you!

Questions?