Scientific missions of INTA from unmanned research aerial platforms

INTA-CAB

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**MICRAS Project**  
*(Scientific missions in manned and unmanned aircrafts)*

*INTA is developing sophisticated unmanned flying platforms with high potential in the study of the atmosphere. MICRAS represents a huge advantage in the study of atmospheric microbial ecology and its relationship with the atmospheric physicochemical parameters and the different microbial environments which can be found.*
OBJECTIVES:

- Collect bioaerosol samples using ALO (Lightweight Observation Air Vehicle).
- To improve the methodology of sampling from ALO we starting with land experiments.
- To analyze the sampling efficiency DNA extraction
CIAR
(Airborne Research Center of Rozas)

CIAR is an initiative of INTA, together with the regional government of Galicia and the Ministry of Economy and Competitiveness (MINECO) of Spain, through FEDER funds of Technology.

CIAR offers a privileged location, taking into account that the RPAs can fly only in restricted areas because most of them are still under development and a new regulation is needed.

This center to allow RPAs to fly in segregated airspace, for scientific research and the development of new equipment and technological instrumentation, necessary to expand these flight campaigns to provide the necessary infrastructure for the users.
ALO
(Lightweight Observation Air Vehicle)

ALO is a flexible system, provides close range, real time reconnaissance and target acquisition information by means of Light Air Vehicles equipped with small, or both, stereable sensors (TV or FLIRSystems). ALO have been selected to improve aerobiology studies and a specific mechanisms for collecting microorganisms from atmosphere for this test.
## Scientific missions of INTA from unmanned research aerial platforms

<table>
<thead>
<tr>
<th>ALO</th>
<th>SIVA</th>
<th>MILANO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
<td>2.33 m</td>
<td>4.03 m</td>
</tr>
<tr>
<td><strong>Wing Span</strong></td>
<td>3.48 m</td>
<td>5.81 m</td>
</tr>
<tr>
<td><strong>Height</strong></td>
<td>0.98 m</td>
<td>1.03 m</td>
</tr>
<tr>
<td><strong>MTOW</strong></td>
<td>60 kg</td>
<td>300 kg</td>
</tr>
<tr>
<td><strong>MPL</strong></td>
<td>6 kg</td>
<td>50 kg</td>
</tr>
<tr>
<td><strong>Vmax</strong></td>
<td>180 kg/h</td>
<td>190 kg/h</td>
</tr>
<tr>
<td><strong>Vcruise</strong></td>
<td>115 kg/h</td>
<td>115 kg/h</td>
</tr>
<tr>
<td><strong>Autonomy</strong></td>
<td>5 h</td>
<td>7 h</td>
</tr>
<tr>
<td><strong>Scope (Data Link)</strong></td>
<td>100 km</td>
<td>150 km</td>
</tr>
<tr>
<td><strong>Flight Roof</strong></td>
<td>4270 m</td>
<td>4270 m</td>
</tr>
</tbody>
</table>
Experimental procedure:

AIR → Pump Suction
Filtration ≠ Molecular Methods

DNA → IDENTIFICATION
Bioaerosol samples collected (20):

Land samples (8):

- Two meteorological conditions: no rain (15/04/2016) and rain (12/04/2016)
- Collected by filtration during 4 hours
Land samples

- Two meteorological conditions:
  - rain (12/04/2016) and no rain (15/04/2016)

http://ready.arl.noaa.gov
Bioaerosol samples collected:

Flight samples (6):

- 15/03/2016
- Collected by filtration
- Duration flight: 1h 45m
- Height (agl): 925 m

http://ready.arl.noaa.gov
Efficiency test: 6 samples were collected from ALO on ground during 4 hours.

DNA extraction. Fast DNA Spin kit for soil (Q-Bio Gene Inc., CA, USA) was used according to the manufacturer’s instructions.
### DNA extraction results:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Site</th>
<th>Sampler</th>
<th>Comments</th>
<th>DNA (ng/μl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land</td>
<td>Pall 1</td>
<td>It was raining</td>
<td>4.1</td>
</tr>
<tr>
<td>2</td>
<td>Land</td>
<td>Pall 2</td>
<td>It was raining</td>
<td>4.2</td>
</tr>
<tr>
<td>3</td>
<td>Land</td>
<td>Pall 3</td>
<td>It was raining</td>
<td>3.9</td>
</tr>
<tr>
<td>4</td>
<td>Land</td>
<td>Monitor</td>
<td>It was raining</td>
<td>5.3</td>
</tr>
<tr>
<td>5</td>
<td>Land</td>
<td>Pall 1</td>
<td>Dry weather</td>
<td>6.4</td>
</tr>
<tr>
<td>6</td>
<td>Land</td>
<td>Pall 2</td>
<td>Dry weather</td>
<td>6.7</td>
</tr>
<tr>
<td>7</td>
<td>Land</td>
<td>Pall 3</td>
<td>Dry weather</td>
<td>6.4</td>
</tr>
<tr>
<td>8</td>
<td>Land</td>
<td>Monitor</td>
<td>Dry weather</td>
<td>3.0</td>
</tr>
<tr>
<td>9</td>
<td>ALO</td>
<td>Monitor</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>10</td>
<td>ALO</td>
<td>Monitor</td>
<td>DNA of these three samples was extracted together</td>
<td>12</td>
</tr>
<tr>
<td>11</td>
<td>ALO</td>
<td>Monitor</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>ALO</td>
<td>Monitor</td>
<td>DNA of these three samples was extracted together</td>
<td>15</td>
</tr>
<tr>
<td>13</td>
<td>ALO</td>
<td>Monitor</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>14</td>
<td>ALO</td>
<td>Monitor</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>15</td>
<td>ALO</td>
<td>Monitor</td>
<td>Flying</td>
<td>1.5</td>
</tr>
<tr>
<td>16</td>
<td>ALO</td>
<td>Monitor</td>
<td>Flying</td>
<td>2.0</td>
</tr>
<tr>
<td>17</td>
<td>ALO</td>
<td>Monitor</td>
<td>Flying</td>
<td>1.4</td>
</tr>
<tr>
<td>18</td>
<td>ALO</td>
<td>Monitor</td>
<td>Flying</td>
<td>1.0</td>
</tr>
<tr>
<td>19</td>
<td>ALO</td>
<td>Monitor</td>
<td>Flying</td>
<td>2.1</td>
</tr>
<tr>
<td>20</td>
<td>ALO</td>
<td>Monitor</td>
<td>Flying</td>
<td>0.9</td>
</tr>
</tbody>
</table>
**DNA extraction results:**

**DRY conditions:** *Pinus (mitochondria), Actinobacteria, Pseudomonas*

**RAIN conditions:** *Cellulomonas, Actinobacteria, Chloroflexi, Bacterioplacton.*
Conclusions:

Collect bioaerosol from ALO was possible.

- **Flight results:**
  
  DNA concentration: 0.9 to 2.1 ng/µl.
  
  This amount is not enough for a direct molecular ecology study but a DNA amplification will be performed to finish the diversity study.

- **Land results:**
  
  DNA concentration: 3.9 to 15 ng/µl.
  
  It could be enough efficiency for a molecular study diversity, especially when identical samples were analyzed together.

- Efficiency was better with dry weather.
MICRAS

Introduction

Objectives

Center Test

RPA Test

Materials and methods

Results

Conclusions

Future Research

Future Research:

- DNA amplification from ALO samples.

- DNA concentration of land samples, 16S rRNA gene amplification, cloning and sequencing.

- New flight increasing time (5 hours).

- Aerodynamical Studies (pump suction/analysis monitors)

- Chemical analysis in the same atmospheric conditions
Thank you

Merci

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