

Study of fundamental physical and chemical parameters of atmospheric aerosols from aerial platforms research, manned and unmanned

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Water based aerosols are ubiquitous in the actual troposphere. On Earth, the natural water cycle goes through the aerosol phase and the liquid bulk phase on a regular basis. Atmospheric aerosols are therefore essential to carry both biological and chemical agents. The study of fundamental physical and chemical parameters of the atmospheric aerosol from different platforms is the main goal of this project. INTA (Spanish National Aerospace Agency) presents MICRAS as an interdisciplinary project for the study of atmospheric aerosols and airborne microorganisms using aerial research platforms, both manned and unmanned.

The confluence of disciplines such as chemistry, physics and microbiology, with the clear support of engineering and information technology, will enable us to cover the complete study and innovative way of aerosols. The chemical composition of aerosols, its spatial and temporal distribution, its optical characteristics and microphysical parameters are essential to build a model of the microbial ecology of the atmosphere¹. All this information requires continuous monitoring with accurate instrumentation. The different INTA's platforms are able to obtain information in situ on the characteristics of aerosol and can obtain depending on the trajectory of the plane, vertical profiles of aerosols from the surface to about 7000 m. The platform aircraft with instrumentation to measure atmospheric microphysics parameters, aerosols and thermodynamic parameters are essential to carry out this work.

INTA is a public research agency that develops new airborne platforms for research and has the needed infrastructure for RPAS R&D. INTA is developing sophisticated unmanned flying platforms with high potential for the study of the atmosphere. Among them, the Lightweight Observation Air Vehicle (ALO, according to its initials in Spanish) operates in automatic flight, and gets eight hours endurance and 100 Km range. ALO is a flexible system, provides close range, real time reconnaissance and target acquisition information, equipped with stereable sensors (TV or FLIR). It represents a huge advantage in the study of the atmospheric physicochemical parameters and its relationship with the different microbial environments² that we could find. Different experiments were done on

land and on flight and a total of 15 bioaerosols samples were collected.

Chemical Parameters

These samples were analyzed by spectroscopy and chromatography techniques to study the chemical composition and the formation of Secondary Organic Aerosols (SOA) found in water droplets. We also analyzed tracers of gases for chemical analysis of different compounds of high interest: NO₂ / NO_x, SO₂, CO. These data are useful in the study of climate change, volcanic emissions, detection of polluted areas, etc². The study of the SOAs is the basic methodology of organic material removal filters and analysis by chromatographic analytical techniques (GC-MS). The organic composition is indicative of the various contributions of: forests, large bodies of water (rivers, lakes, seas, ..), human contamination and it is very different in rural and urban areas.

Physical Parameters

Throughout the flight in situ, data will be obtained with the probes available on the aircraft: number of particles per cm³, relative humidity, atmospheric pressure, or amount of size distribution of aerosols are some of the data that we collect. The aircraft's instrumentation also provides altitude data, flight speed, location, attitude of the aircraft (FTI, Flight Test Instrumentation), etc.

The manned platform (C-212 s/n 301) provides: Atmospheric instrumentation (an optical particle counter (OPC)), Aerosol microphysics (PCASP-100X, CPAS, that allows the study of atmospheric particles by mass spectrometry (particles from 0 to 0.3 and from 0.5 to 50 microns), Clouds microphysics (CAPS, drops from 15 to 915 microns, LWC (Liquid Water Content), ED (Effective Diameter), etc.), ...

Similarly, we can get models of microbial ecology to be related to the cycles of nitrogen, sulfur and carbon compounds. Also, DNA extraction from samples were done and the use of molecular ecology tools will allow to identify and quantify the presence of microorganisms of the atmosphere.

1. Griffin DW (2001) *Dust in the Wind. Global Public and Ecosystem Health.* 2:20-33.
2. Vallero D (2014) *Methods for Measuring Air Pollutants, In Fundamentals of Air Pollution (5th),* 579-626.