

# Development of an International Forum which Coordinates Airborne Science Platform Capabilities

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## Commission I, WG I/1 Standardization of Airborne Platform Interface

**KEY WORDS:** EUFAR, ICCAGRA, Research Aircraft, Airborne Science, Geoscience Aircraft,

### ABSTRACT:

There are two major science airborne platform organizations, European Facility for Airborne Research (EUFAR) and Interagency Coordinating Committee for Airborne Geoscience Research and Applications (ICCAGRA), which combined, operate about 80 aircraft for science missions. EUFAR operates primarily aircraft based in the European Union to support its remote sensing and in-situ experiments or sensor developments. The EUFAR works with multiple agencies from its member countries to support its airborne platform requirements. ICCAGRA is a US Government organization that primarily coordinates activities between the member agencies in support of scientific research by airborne platforms. In addition, China, Canada, Australia, Brazil, Costa Rica, and others, all have smaller internal programs using airborne platforms for their scientific in-situ and remote sensing studies. As a result of little coordination between these varied international organizations, there are many lost opportunities to the science community thus hampering the potential data acquisition yields from the missions that are flown. These barriers are physical, regulatory, availability, procedural, etc. There is a need for an international forum to address these issues and develop ways to counter the barriers so the platforms can maximize their scientific contributions through building awareness, education, developing physical methodologies to interface equipment, engaging regulatory authorities, developing joint processes between governments and science agencies for utilizing excess capacity, etc. These issues need to be discussed in an international venue where we as a science community can improve our collaboration and develop ways to maximize the science effectiveness from these expensive facilities.

### INTRODUCTION

The primary mission of the new ISPRS Working Group I/1 seeks to promote the standardization of instrument interfaces, data formats, and aircraft accommodations, to facilitate more efficient, flexible, and cost-effective international science flight operations. The increased portability of instrumentation between aircraft increases the opportunities for cooperative research and can reduce the operating costs by leveraging flight opportunities. This is being accomplished through the establishment of 11 Terms of Reference groups called TORs.

#### The 11 TORs are:

TOR #1: Coordinate a forum for discussion between the international airborne science communities.

TOR #2: Develop airborne sensor interface format standards in coordination with other working groups to promote maximum sensor portability between aircraft increasing science yield from the sensors.

TOR #3: Develop airborne satellite data relay systems use for

science research programs between aircraft and ground in coordination with other working groups

TOR #4: Develop an airborne science literature search to identify peer reviewed published papers and citations and make an available in a data base.

TOR #5: Support the regulatory agencies in supporting airborne science sensor certification and approval requirements for Lidar, Dropsonde and electromagnetic spectrum emissions.

TOR #6: Maintain an inventory of the international airborne science capabilities and report annually.

TOR #7: Develop a forum to discuss transnational access system(s) for airborne users.

TOR #8: Support the use of Unmanned Aerial System (UAS) vehicle activity for science observations in civil and restricted airspace on an international basis and engage the International Civil Aviation Organization (ICAO).

TOR #9: Promote the education and outreach on an international basis of airborne based science activity.

TOR #10: Develop a forum to coordinate expert workshops in airborne science sensor categories.

**TOR #11:** Develop airborne data processing standards to facilitate instrument inter-calibration and normalize international data exchange.

We will give a short description of each of the TORs in this paper; many of the TORs will have separate papers.

### **TOR OBJECTIVE**

**TOR#1:** Coordinate a forum for discussion between the international airborne science communities.

This group is promoting opportunities for senior managers in the science aircraft programs to share their experiences and activities. The process has already brought the European Union (EU) and United States (US) programs closer together, allowing for improved cooperation on international programs. An example is the quite extensive US participation in the EU science aircraft demonstration activity this October at the Toulouse airport. Additionally, there is now a focus to increase cooperation with Chinese and Canadian science aircraft programs as a way to expand the participation internationally for developing common systems for science aircraft interfaces.

**TOR#2:** Develop airborne sensor interface format standards in coordination with other working groups to promote maximum sensor portability between aircraft increasing science yield from the sensors.

The goal here is to develop and promote standards to facilitate international portability of instrumentation between airborne platforms. This will allow science to be leveraged with limited research funding giving maximum data value. Instruments can be then easily integrated into a suite of sensors. New instrument can be matured by joining an experiment that is already scheduled. An additional goal is to enable tools that can communicate between sensors and aircraft.

**TOR #3:** Airborne satellite data relay systems use for science research programs between aircraft and ground in coordination with other working groups.

It is valuable for programs to enable situational awareness and process optimization. Network two-way is key - gives more data to decision makers. There's currently a big demand for more bandwidth, however, there are several obstacles to overcome - technical (physics), signal-to-noise & bandwidth capacity, big manned platforms and small vehicles, air/ground/space ops. Additionally, we are constrained by usage considerations (i.e., air-to-air communication, etc). However, emerging technology is very promising, including new satellites under development, new infrastructure, new frequency allocations (harmonized telemetry), software radios, frequency allocations, satellite infrastructure and globally harmonized telemetry. Implementation of these systems is challenging, since science programs are on limited budgets.

**TOR #4:** Develop an airborne science literature search to identify peer reviewed published papers and citations and make an available in a database.

The development of a database of publications regarding airborne science is the goal of this TOR. Both EUFAR and U.S. have limited databases. The TOR is finding a way to merge these two databases and develop an airborne science literature search of identifying peer-reviewed, published papers. Fields are recorded because of relevance (e.g., productive campaigns) not because of availability. Initially will be bringing a group together to define suitable key words and identify search software.

**TOR#5:** Support the regulatory agencies in supporting airborne science sensor certification and approval requirements for Lidar, Dropsonde and electromagnetic spectrum emissions.

This group will be establishing the arenas in which aircraft based science programs intersect with the regulatory agencies on an international basis. By building an organization which can speak for the science community there is an opportunity to affect the aviation based policies being developed which could be moved in a favorable direction towards the science community needs.

**TOR #6:** Maintain an inventory of the international airborne science capabilities and report annually.

The objective is to maintain an inventory of the international airborne science capabilities and report it annually. It is a straightforward issue, which seems easy at the outset but when the details start to be delved into it increases in complexity. EUFAR, European Union's airborne science organization, has done this very well, not so for the US based organizations, where there is little standardization. The details in our database are the first direction this group will proceed down such as: determine what information, how to maintain it, where to obtain it, national verses international databases, personnel to contact, etc. Finally, what format: website database like Excel, etc. The difficulty level of defining characteristics significantly increases as we move from fairly well defined manned aircraft to the more undefined micro Unmanned Aerial Systems.

**TOR #7:** Develop a forum to discuss transnational access system(s) for airborne users.

This is mainly a European issue where there are no common terms among countries. Project funding is for total costs of each country individually. Interest is being expanded to the US based flight assets and the science sensors with their access to other countries. The problem is that a scientist with good proposal based on scientific merit, doesn't know the process for funding and opportunities available in other countries. Young scientists should get access to aircraft and their parent institutions should cover costs and direction on gaining access to the appropriate flight assets, which may or may not be available in their countries.

**TOR #8:** Support the use of UAS vehicle activity for science observations in civil and restricted airspace on an international basis and engage the ICAO.

Here the issues are to understand and document current methods of access across the world and inventory of UAS relevant activities. The US has a number of working groups for developing science opportunities on UAS systems. There's significant overlap between these working groups. First this ISPRS group needs a sense of basics to identify priority missions, develop con-ops for discussion with Civil Aviation Authority (CAA) ("How can we work with you"). The group also should be a respected voice speaking for science, in general to educate CAAs, scientists and general public on the realities of how UASs support science (through lectures, presentations, demonstrations, etc.). Take some of the work the militaries have achieved in this field and bring it to the science community for the benefit of the global community.

**TOR #9:** Promote the education and outreach on an international basis of airborne based science activity.

The mission of this group is to "Promote Airborne Science" in order to attract more students and researchers to airborne research.

Four identified goals with objectives:

**GOAL 1: Education Based Activities**

- Inventory education programs (identify and list programs)
- Create inventory of training programs (identify training courses and links to education materials)
- Identify gaps within Airborne Science Education
- Identify educators in Airborne Science

**GOAL 2: Communication**

- Coordination with other TORs
- Coordination with other groups (e.g. ISPRS Technical Commission VI Education and Outreach, ASPRS Education and Professional Development Committee)
- Objective 3: Development of outreach materials (brochures, fact sheets)

**GOAL 3: Promote International Outreach**

- Develop sessions (e.g. session/forum/side event on ISRSE34, Sydney 2011)

**GOAL 4: Strategic Plan**

- Development of a strategic plan

The expected benefits of coordination are expertise and information exchange, improved access to education material, exchange of best practices, and awareness of use and implementation of Airborne Science materials for the scientists and decision-makers of today and to prepare the future work force.

**TOR #10:** Develop a forum to coordinate expert workshops in airborne science sensor categories.

The purpose of the group is to develop a forum to coordinate expert international workshops regarding airborne science sensors for remote sensing and in situ systems. What will need to be done is to make the scientist of flight programs aware of international activities of joint interests and allow them to combine efforts for maximizing the data yield per flight hour.

**TOR #11:** Develop airborne data processing standards to facilitate instrument inter-calibration and normalize international data exchange.

This group will to develop data processing standards using common and accepted algorithms to aid in intercomparison of data, troubleshooting instrument or processor issues. In addition, a standard for data and metadata input and output will be defined. A software toolbox will be developed to give users easy access to the processing algorithms. This toolbox will be non-proprietary, use commonly available libraries and be easily portable across multiple platforms. These standards and software components will aid small institutions in doing data processing, in addition to enabling aircraft data to be easily shared and compared on an international basis.

## CONCLUSION

These eleven Terms of Reference groups in Working Group 1 of ISPRS Technical Commission 1 have a strong sense of the requirement to build international consensus for coordinating our international airborne science requirements. The satellite and terrestrial systems to a greater extent have developed standards on a global scale - it is time for the airborne platforms to join with common systems allowing our science communities to communicate and share the data acquisition. The overall result of this Working Group will be to improve the data yield per flight hour while lowering the cost and increasing the access. This should apply to both the experienced and young scientist research programs which utilize aircraft science platforms.

## REFERENCES

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