

# Introduction to EUFAR

EUropean Fleet for Airborne Research

[www.eufar.net](http://www.eufar.net)

## EUFAR: European Fleet for Airborne Research

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### Networking

- ESF-SAC
- Future of the Fleet
- Expert Groups
- Education & training
- E-Communication

### TA

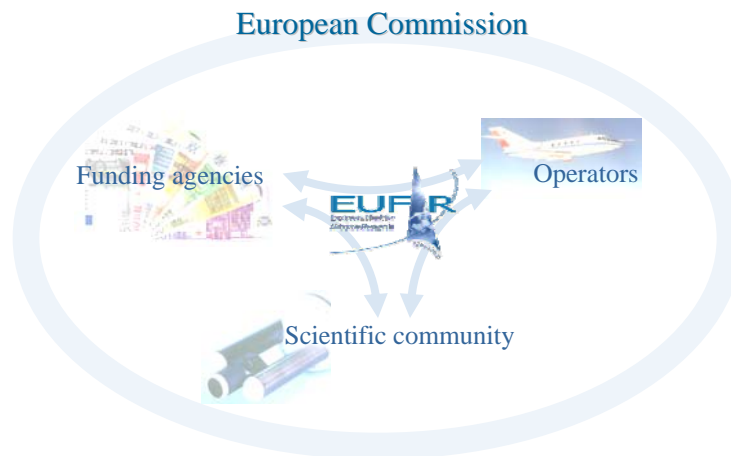
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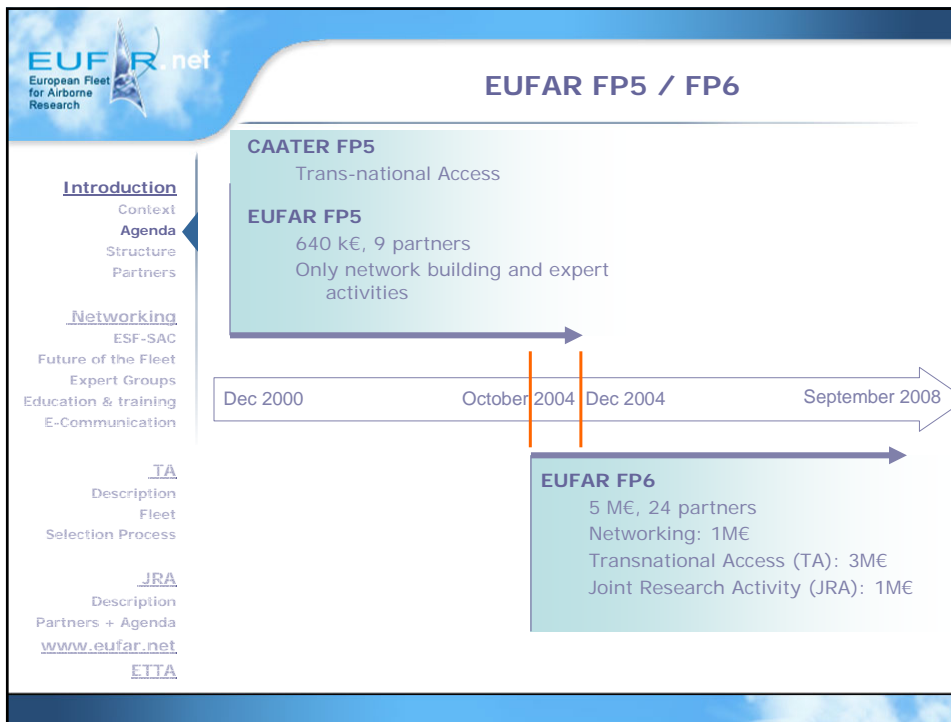
### JRA

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### ETTA





**EUFAR FP6 Activities**

EUFAR is an Integrated Infrastructure Initiative (I3) of the European Commission.  
 EUFAR aims at coordinating the operations of the European fleet of instrumented aircraft in the field of environmental research in the atmospheric, marine, terrestrial and Earth sciences.

**•Networking Activities**

- N1. ESF Scientific Advisory Committee (NIESF-SAC)
- N2. Transnational Access Coordination (N2TAC)
- N3. Future of the Fleet (N3FF)
- N4. Expert Working Groups (N4EWG)
- N5. Education and Training (N5ET)
- N6. E-Communication (N6EC)

**•Transnational Activities (TA)**

**•Joint Research Activities (JRA)**  
 AARP. Airborne Aerosol Reference Pod

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## 24 partners from 12 countries:

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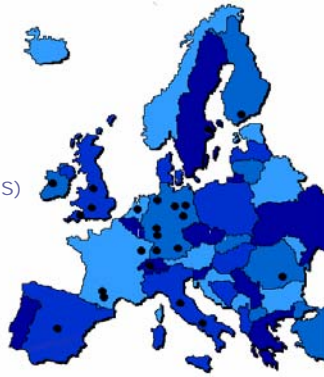
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[ETTA](#)

- ▲ Météo-France
- ▲ ESF
- ▲ DLR
- ▲ NLR
- ▲ Enviscope
- ▲ INSU - CNRS
- ▲ MetOffice
- ▲ NERC (ARSF/BGS)
- ▲ INTA
- ▲ TAU
- ▲ GTK
- ▲ TU-BS
- ▲ FUB



- ▲ METAIR
- ▲ CNR-ISA FoM
- ▲ FZK
- ▲ MISU
- ▲ MPI-C
- ▲ NUIG
- ▲ UNIMAN
- ▲ IFT
- ▲ ANM
- ▲ AWI
- ▲ Geophysica
- ▲ EEIG

## Networking activities: : N1ESF-SAC (Scientific Advisory Committee)

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#### ▲ **Tasks:**

- ❖ to assess the scientific demand in term of airborne infrastructures and services,
- ❖ to evaluate the activities of the EUFAR I3 with regard to the demand,
- ❖ to provide National Research Funding Institutions with guidance for establishing multi-lateral agreements on TA, instrumental developments and the long term evolution of the fleet.

#### ▲ **Deliverables:**

- ❖ Survey questionnaire to the scientific community on user needs,
- ❖ Organisation of a forum on ETTA between research funding institutions, scientific users and aircraft operators

#### ▲ **Coordinator:**

- ❖ European Science Foundation

## Networking activities: N3FF (Future of the Fleet)

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#### Tasks:

- ❖ Identify obstacles and find technical solutions to a unified management of Transnational Access (Transnational Access at Equal Terms through national funding)
- ❖ Evaluate existing fleet capabilities
- ❖ Elaborate on possible enhancements of the fleet following user's needs (Large Scale Facility...)

#### Deliverables:

- ❖ Report on past activities of the fleet
- ❖ Report on technical obstacles to Trans-national Access, and solutions to facilitate ETTA
- ❖ **(new)** Report on the scientific impact of airborne research
- ❖ Operators views on gaps in the European fleet
- ❖ Proposal to ESFRI for the construction of a new pan-European infrastructure.

#### Coordinator:

- ❖ Météo-France

## Networking activities: N4EWG (Expert Working-Groups)

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
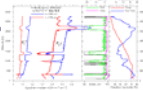
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#### Objective: Improve cost/effectiveness of airborne research by:

- ❖ Reducing duplication of new developments 
- ❖ Sharing expertise
- ❖ Harmonizing procedures for instrument calibration, airborne measurements and data processing 

#### Deliverables:

- ❖ Expert workshops 
- ❖ Reports with advices to Researchers, Operators, Funding agencies
- ❖ Instrumentation and calibration database

#### Coordinator

- ❖ MetOffice, UK

## Networking activities: N4EWG Achieved/Planned on March 2007 (Month 30/48)

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### ETTA

- ↳ **Certification and Operations**
  - ↳ **Aerosols**
  - ↳ **Gaz phase chemistry**
  - ↳ **Imaging remote sensing**
  - ↳ **Microphysics**
  - ↳ **Radiation**
  - ↳ **Thermodynamics**
  - ↳ **Turbulence**
- 
- ↳ **Data processing**
  - ↳ **Active remote sensing**
  - ↳ **Solid-Earth Geophysics**
  - ↳ **(new) Instrumentation design and integration**

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## Networking activities: N5ET (Education and training)

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### ETTA

- ↳ **Objectives**
  - ❖ Promotion of airborne research in European academic community, especially dedicated to young scientists
- ↳ **Deliverables:**
  - ❖ Two opportunities are offered to students through EUFAR Education&Training:
    1. Get 100% funding for flight hours, including scientific and engineering support for integration of instruments, data analysis, etc
    2. Join researchers in existing field campaigns (benefit of training by the host research group and participation to research flights and data analysis).
  - ❖ **(new)** Organisation of two summer schools on airborne measurements:
- ↳ **Coordinator:**
  - ❖ National Administration of Meteorology (ANM), Romania

## Networking activities: N5ET Achieved on March 2007 (Month 30/48)

E&T : Join a field experiment

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ETTA

Application status	On March 12, 2007
Received	15
Not Eligible	0
Selected by UGSP	14
Rejected by UGSP	0
In Evaluation	1
Achieved	13

## Networking activities: N6EC (E-Communication)

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ETTA

↳ **Tasks:**

- ❖ Upgrades / maintenance of the EUFAR website
- ❖ Online Transnational Access and Education&Training projects selection procedures
- ❖ Database: aircraft, instrumentation, publications
- ❖ EUFAR fleet planning
- ❖ Expert Working Groups mailing-lists

↳ **Coordinator:**

- ❖ Meteo-France

## Transnational Access Activity Description

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ETTA

- Access is offered through EUFAR TA activity to 24 instrumented aircraft, ranging from low and slow flying small single engine aircraft to 4 engine turbo-jet aircraft carrying several tons of instrumentation payload
- Priority to new inexperienced users and researchers from countries which do not operate similar infrastructures
- Fast and effective online selection procedure. Applications to be submitted at [www.eufar.net](http://www.eufar.net)

**Figures:**

- ❖ 3M€ available for experiments
- ❖ 44 research projects to be funded (450 flight hours)
- ❖ 24 aircraft

**Coordinator:**

- ❖ MetOffice, UK

## Transnational Access Activity Aircraft of the Fleet

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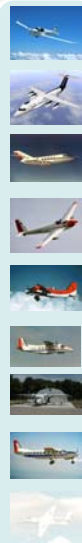
**Description**

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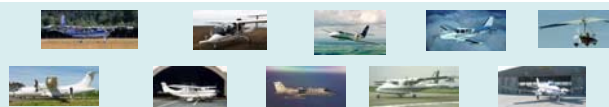
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OPERATORS	CATEGORIES				
	1. Strato. jet	2. Jets	3. Large A/C	4. Medium A/C	5. Small A/C
Geophysica EEIG	Geophysica				
DLR		F-20		Cessna 208B	
NLR		Citation			
ENVISCOPE		Learjet			Partenavia
SAFIRE		F-20	ATR-42		Piper-Aztec
MetOffice			BAe-146		
NERC				Do-228	
INTA				2 CASA-212	
TAU				King-Air 200	
GTK				Twin-Otter Caravan	
TU-BS				Do-128	
FUB					Cessna 207 TMG-ASK-16
METAIR					TMG Dimona
ISAFoM					3 Sky-Arrow
FZK					Microflight
<b>TOTAL AIRCRAFT : 24</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>8</b>	<b>9</b>



## Transnational Access Activity User Group Selection Process

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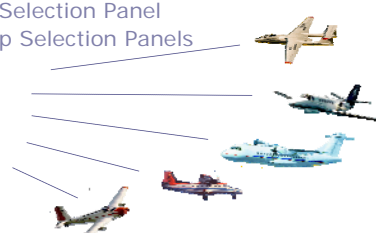
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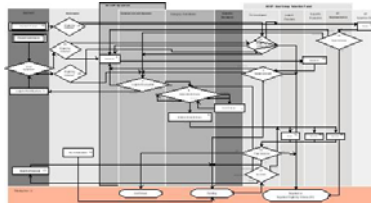
ETTA

**Organization:**

- 1 Overall User Group Selection Panel
- 5 Category User Group Selection Panels
  - Stratospheric aircraft
  - High Level Jets
  - Large Aircraft
  - Medium Size Aircraft
  - Low Level Aircraft



**Online selection procedure:**



## Transnational Access Activity Achieved/Planned on March 2007 (Month 30/48)

44 research projects to be funded (450 flight hours)  
24 aircraft

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ETTA

Application status	On March 12, 2007
Received	47 (of which 5 E&T)
Not Eligible	5 (of which 1 E&T)
Selected by UGSP	20 (of which 1 E&T)
Rejected by UGSP	5
In Evaluation	17 (of which 3 E&T) 39 %
Achieved	14 projects, 115 Fl hours, 10 aircraft 32 % , 26 % , 42 %



## Joint Research Activity: Description

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ETTA

↳ **Design of an Aerosol Reference Pod (under-wing container)**

- ❖ Fits on more than 50% of EUFAR aircraft
- ❖ Used for inter-calibrations

↳ **Suite of instruments:**

- ❖ Concentration (condensation particle counters - CPCs)
- ❖ Ambient size distributions (X-probe)
- ❖ Dry size distributions (differential mobility analysers + CPCs, optical particle counter)
- ❖ Optical properties (nephelometer, soot photometer)
- ❖ Thermal volatility (heated/unheated ADENA CPC)
- ❖ Chemical composition (cascade impactor, filters)

↳ **Coordinator:**

- ❖ UNIMAN, UK



Example of Underwing Pod (METAIR)

## Joint Research Activity: Partners + Agenda

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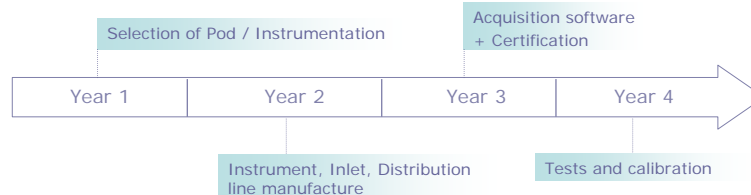
[www.eufar.net](http://www.eufar.net)

ETTA

↳ **6 partners:**

Name of institution	Task
UNIMAN, UK	Coordinator Aerosol optical properties
Enviscope, Germany	Pod survey Inlet manufacturing
Météo-France	X-Probe (aerosol sizing) Data-acquisition Calibration
NUIG, Ireland	Dry aerosol sizing
IFT, Germany	Flow/Particle modeling Distribution line design
MPIC, Germany	Aerosol Concentration/thermal volatility module

↳ **Agenda:**



## Trans-national Access at Equal Terms

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**ETTA**

- ⚡ Most airborne facilities (all the big ones) are subsidized;
- ⚡ Airborne operation (real) costs are high (~6 to 12000 € / hour
- ⚡ Much higher than what is provisioned in National thematic funding programs
- ⚡ (subsidized) access to a national facility is easy
- ⚡ (real cost) access to a foreign aircraft is impossible, except as part of a European project, or as invited scientist

**It follows that**

- ⚡ In each country, science is driven by availability of the infrastructures
- ⚡ Field experiments not always performed with the most suited aircraft (when the one available at the national level is "almost" suited)
- ⚡ Airborne research is not developed in countries which are not operating aircraft

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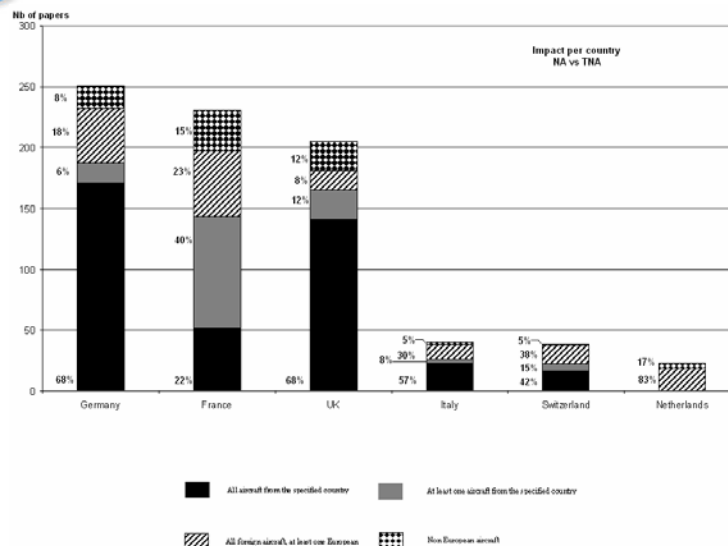
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**ETTA**



## Support to Existing Infrastructures in FP7 Integrating Activities

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[ETTA](#)

The Community actions should also stimulate the coordinated development and networking of these infrastructures, and foster the emergence of new research infrastructures of pan-European interest within a medium to long term vision.

**Integrating Activities:** to ensure that European researchers may have **access to the best research infrastructures** to conduct their research by supporting the **integrated provision of infrastructure related services** to the research community at a European level and at international level when appropriate. Integrating activities should also aim at **structuring better**, on a European scale, **the way research infrastructures operate**, and at **fostering their joint development in terms of capacity and performance**. Emphasis should be given to the efficient and coordinated implementation of trans-national access and service activities.

**EUFAR net** [www.eufar.net](http://www.eufar.net) : list of expert working groups

European Fleet for Airborne Research

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### EUFAR Expert Working Groups

The Expert Working Groups address technical and scientific issues specific to airborne measurements, through specialized workshops, with a view to exchanging knowledge and promoting best practice and investments in airborne research. The main objectives of the EUFAR Expert Working Groups are:

- to improve expertise among the scientists in the field of airborne measurements and to ensure its continuity at aircraft operating centres,
- to facilitate the transfer of expert knowledge to users and vice versa,
- to avoid unnecessary duplication in instrumentation developments.

Participants are experts in airborne measurements that are recognised internationally in their field. Their activities are conducted within Expert Groups. Twelve working-groups have been established in the below fields of expertise:

• **Support to airborne measurements:**

Working groups designation	Coordinator
Certification and Operations	Marc Portaval
Data issues	Bruno Doucet
Instrument, Design & Install.	Phil Brown

• **Specific measurement fields:**

Working groups designation	Coordinator
Active remote sensing	Jacques Pekos
Aerosols	Paola Fornerli
Gas phase chemistry	Jim McVey
Infrared remote sensing	Alex-José-Gómez-Sánchez
Microphysics	Marcel Hendrickx
Radiation	Jonathan Taylor
Solid Earth Geophysics	Michael Lee
Thermodynamics	Martin Zwart
Turbulence	Gyöngyi Malinová

**EUFAR expert working groups**

- All
- Active remote sensing
- Aerosols
- Certification and Operat.
- Data issues
- Gas phase chemistry
- Infrared remote sensing
- Instrument, Design & Install.
- Microphysics
- Radiation
- Solid Earth Geophysics
- Thermodynamics
- Turbulence



**EUFAR net** www.eufar.net: aircraft details

European Fleet for Airborne Research

Large Tropospheric Aircraft / FAAM - BAe146

Specifications Instruments Planning

FAAM - BAe146 - G-LUXE

Operated by: Facility for Airborne Atmospheric Measurements

The information displayed on this website is subject to change. Its nature is only indicative, and confirmation will only be provided by the operator of the facility.

**Technical Specification:**

**General Description:**

- Dimensions:
  - Length: 31.00m
  - Height: 8.58m
  - Wingspan: 26.00m
- Cabin:
  - Length: 19 m; Width: 3.45 m; Height: 2.13 m
  - Apertures: Main door: Width: 0.89 m; Height: 1.91 m
  - Engines: 4 LF507-1;
- Flying performance:
  - Max. take-off weight: 42000 kg
  - Max. payload: 4000 kg
  - Max. cruising speed: 796 km/h
  - Ceiling: 35000 ft
  - Max. range: 3700 km
  - Max. endurance: 6 h
  - Conditions for max. range: at 25000 ft
- Cabin pressurization: equl 8000 ft
- AVNRC: y95

**Information for scientific users:**

**Specialized Informations:**

- Scientific payload in normal operation: 4000 kg

**Basic Measurements:**

Instrument type	Instrument name	Operator
Cloudscope	INMIST	FAAM
Neutronov	Sky Tech Research, Inc. NS-2a	FAAM
ROSMOUNT	Environmental Data Systems (EDS)	FAAM
Lymex-alpha	UNMET TMC	FAAM
Laser NJ	Horvath-HM33	FAAM
JV-LWC	UNMET Johnson-Holm	FAAM
Video Camera	Photron L1C-0800	FAAM
Hemox	Environ 4000-af	FAAM
BR	BR-LSU-as	FAAM
BR	Cooney FSP-3.3um	FAAM
BR	Cooney FSP-3.3um	FAAM
PSAP	ESAP-FAAM	FAAM
FSP	Fast FSP	FAAM
OAP	30-20	FAAM
PCASP	BMG-ECASP	FAAM

**Planning of FAAM 4 2008**

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	Mon	Tue	Wed	Thu	Fri	Sat	Sun
DATEY							
ESCAP_FSP00-1							
FSP							
PSAP							
PCASP							
ESCAP_FSP-1							
ESCAP_FSP-2							
YPMAP							
SAFREC							
BR-OFAP							
LAND-MS-1							
BR-MS-0001							
ESCAP_FSP00-2							
EU-AMMA-if-0001							

**E I I A**

**EUFAR net** www.eufar.net: instruments

European Fleet for Airborne Research

About EUFAR Search & Instruments EUFAR Activities Search Members

Area of Instruments Calibration Facilities Members Research Projects Funding Institutions

Instruments

The information displayed on this website is subject to change. Its nature is only indicative, and confirmation will only be provided by the operator of the facility.

**Search by measurement:** Select measurement

**Search by alphabetical order:** A-Z

**Search by measurement:** Aerosols

**Search by alphabetical order:** A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Instrument type	Instrument name	Operator
WIND		
Rad All		
Hygrometer		
OAP		
OZONE		
OAP		
GAP		
Accelerometers		
Rad probe		
ACT_gnc		
Smoke Probe		
Smoke Probe		
LI 7500		
LCAR		
Accelerometers		
Hygrometer		
Hygrometer		
BEFA		

**Instruments**

The information displayed on this website is subject to change. Its nature is only indicative, and confirmation will only be provided by the operator of the facility.

**Search by measurement:** Aerosols

**Search by alphabetical order:** A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Instrument type	Instrument name	Operator
AETHALD	AE-52	BM-FU
AMS	AMS	FAAM
FSP	Fast FSP	Enviscope
FSP	Fast FSP	FAAM
FSP	Fast FSP	Météo-France / CNRM
Fiber Sampler	Fiber Sampler	INTA
Fiber Sampling	EBios	FAAM
FSP	ESSP-100	BM-FU
FSP	ESSP-100	INTA
FSP	ESSP-100	TAU
FSP	ESSP-100	SAFRE
FSP	ESSP-100	Enviscope
FSP	ESSP-300	Geophysica-OEE
FSP	ESSP100	SAFRE
Fiber Sampling	ESU-1.4	Enviscope
GR 1108	GR1108-1108	BM-FU
GR 1108	GR1108-DEC-0.3-20	METAR
MetOne	700-10-105	METAR

Operated by: Instituto Nacional de Técnica Aeroespacial

Operated onboard: INTA-CASA 212 AR (INTA, Spain) [\[Details\]](#)

The information displayed on this website is subject to change. Its nature is only indicative, and confirmation will only be provided by the operator of the facility.

**General info:**

- Name: Forward Scattering Spectrometer Probe
- Acronym: FSP

**Instrument type:**

- Backscattered parameter: Cloud water droplets size
- Operating principle:
  - Optical probe: Cloud droplets pass through sample volume, where they scatter a laser beam (scattering can be derived).
- Alternative techniques:
  - Other optical: cloud microphysics probes, in-situ or in-lab.
- Measurement(s):
  - Cloudwater profiling
  - Cloud microphysics: Particle sizing
  - Cloud microphysics: Cloud microphysics
  - Cloud microphysics: Liquid Water Content
  - Aerosol mass loading

**ESPP-100:**

- Manufacturer: PMS
- Deployment year: 2007

**E I I A**

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1. Local System + Link to the EUFAR server
2. EUFAR central server + terminals



**EUFAR Management Structure**

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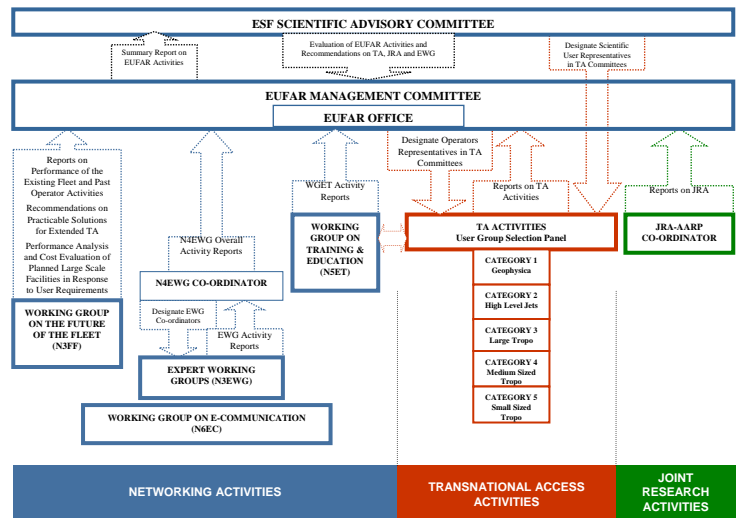
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**EUFAR net**  
European Fleet for Airborne Research

**EUFAR INITIATIVE FOR THE CONSTRUCTION OF  
A LONG ENDURANCE / HEAVY PAYLOAD TURBOPROP  
FOR TROPOSPHERIC RESEARCH**

**The EUFAR initiative has been submitted to ESFRI via the french delegate and it is presented to EMEG by Meteo-France, EUFAR co-ordinator, on behalf of the EUFAR I3.**

**This initiative shall therefore not be regarded as a french proposal, but as the proposal of a European Consortium**

ESFRI HEARING      EMEG MEETING      23 March 2006      BRUSSELS

**EUFAR net**  
European Fleet for Airborne Research

**Scientific Research Fields supported by Airborne Research**

**The following statistics summarize the activities of the whole EUFAR fleet over the period 1997-2005 per scientific field**

Scientific Field	Percentage
Biological and Ecological Research	21%
Polar Research	16%
Chemical Processes, Aerosols, and Air Quality	13%
Satellite Calibration And Validations	3%
Ocean-Atmosphere Interactions	5%
Atmospheric Dynamics	4%
Cloud Systems / Precipitation Physics	3%
Radiation	2%
Solid Earth Geophysics	3%
Other	30%

**A total of 26598 hours flown over the period 1997-2005**  
**An annual average of 2955 flight hours**

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## Consequences of the national fragmentation in the construction of airborne infrastructures

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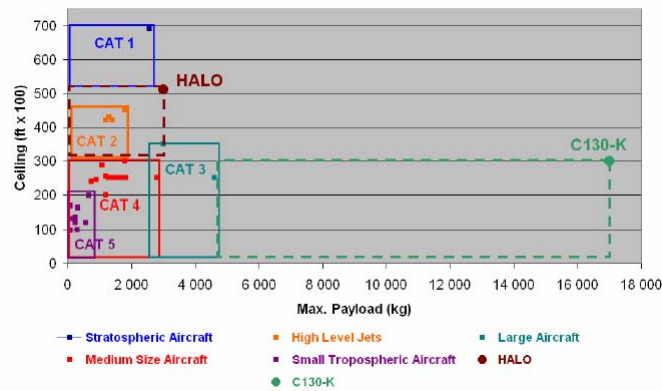
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The M55, for stratospheric research (CAT1), belongs to a Russian company and it is operated for research in Europe by the Geophysica EEIG. The long term sustainability of this aircraft however is not presently secured.



## Consequences of the national fragmentation in the construction of airborne infrastructures

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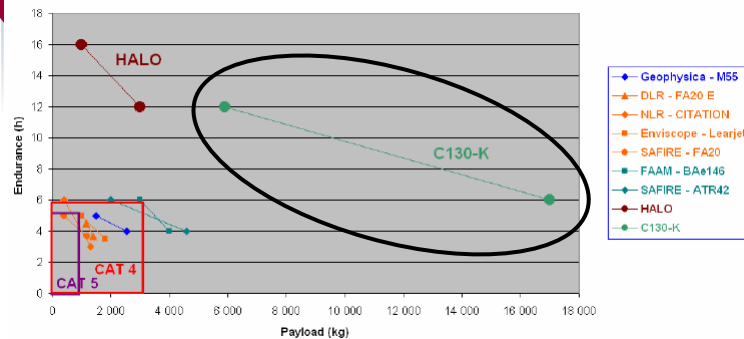
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Germany has recently succeeded to purchase and equip a heavy-payload and long-endurance (12-16 h) jet, « HALO ». This aircraft, a Gulfstream 550, is the most performing aircraft available today on the CAT2 market. It will be equipped and become operational for research in 2009.

**For tropospheric research, there is presently no heavy-payload and long-endurance aircraft in the European fleet.**





## Consequences of fragmentation on access to remote areas

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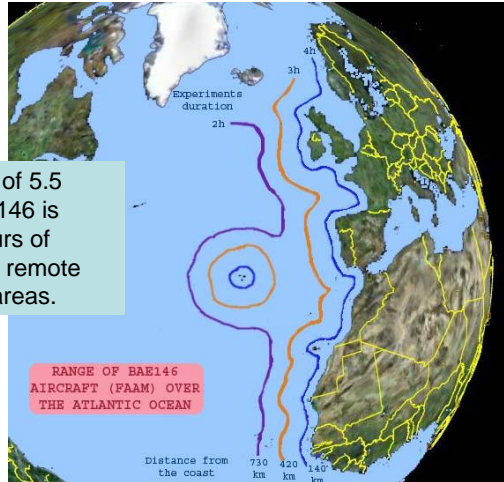
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With its endurance of 5.5 hours, the UK BAe146 is limited to a few hours of scientific work over remote (oceanic or polar) areas.



## The concept of flying laboratory

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This concept has been developed since many years by the **National Center for Atmospheric Research of the US-NSF (NCAR)**.

More than 20 scientists, from USA and Europe, have been collecting data together on board the NCAR C130 during the RICO campaign



## Scientific Impact Study

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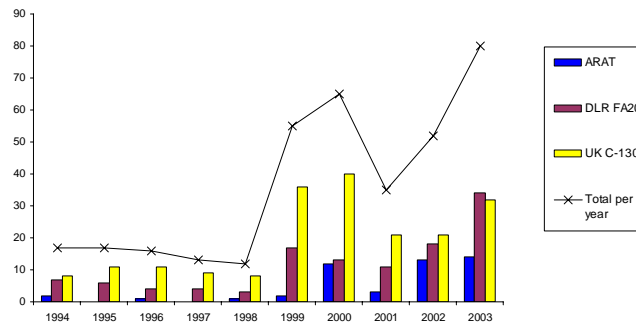
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This graph shows the evolution, from 1994 to 2003, of the number of publications in refereed journals for the three aircraft separately, as well as the total number of articles per year.

The smaller publication rates from 1994 to 1998 may reflect a bias due to the internet reference search engine because some data bases are not yet completed for these years. This bias will be corrected in the final report, after confirmation and additions by the authors.



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The following statistics measure the scientific impact in term of annual publication rate, citation rate per article, # of published paper per flight hour and per euro spent.

From 1994 to 2003	ARAT-F27	DLR-F20	UK-C130
<b>Total number of papers</b>	<b>48</b>	<b>117</b>	<b>197</b>
Total number of citations/ # of articles documented*	370/46	871/71	2379/152
<b>Citation rate/article</b>	<b>8.0</b>	<b>12.3</b>	<b>15.7</b>
Average flight hours / year	157	307	307
<b># papers / FH * 100</b>	<b>31</b>	<b>38</b>	<b>64</b>
Flight hour cost (CAATER)	7440	10238	12860
<b>Annual k€ spent</b>	<b>1168</b>	<b>3143</b>	<b>3948</b>
<b># papers / € spent * 10<sup>6</sup></b>	<b>4.1</b>	<b>3.7</b>	<b>5.0</b>

\* All published papers have not yet been documented in terms of citations

## Technical solutions

Three aircraft models have already been identified that fulfil EUFAR requirements

Designation	Lockeed C130	CASA C295	AIRBUS 400M
Aircraft cost	10 M€	23 M€	70+ M€
New avionics	10 M€	included	included
Modif. for Res.	10 M€	Not quoted	Not quoted
Payload at 10h	10 T	3.5 T	10 T
Produced A/C	~ 1000	<40	Launched 2009
Past exp.	UKMO, NASA, NCAR	none	none
Ann. op. costs	<1 M€	<1 M€	<1 M€
++	Best perf/cost ratio	Modern A/C	Modern A/C
	Large exp. on struct. modif.	Eur. A/C	Eur. A/C
--	old A/C (30 y)	Only 2 props Lim. security	No exp. on struct. modif.
<b>Total cost</b>	<b>40-60 M€</b>	<b>40-65 M€</b>	<b>90-110 M€</b>

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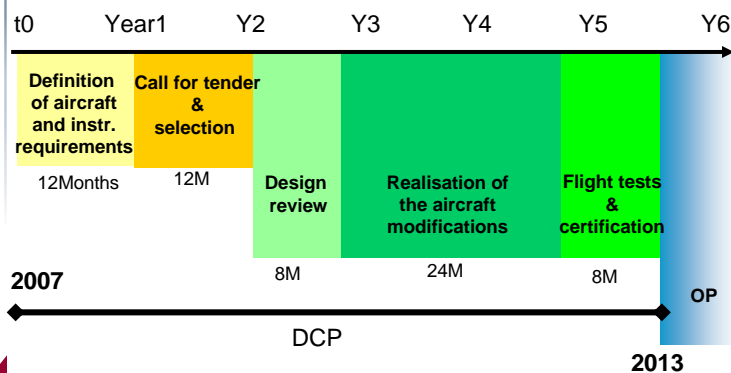
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## Design & Construction : Agenda

From Year 0, the project will progress according to the following agenda



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## DCP-OP Personnel Costs

The activities of the OP Group during the 6 years of the DCP amount to :

**Personnel : 2.6 M€**

**Functioning : 1 M€**

**i.e. an average of 0.6 M€ annually**

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	Level	Cost per year [k€]	Total Man-Month	Total cost
<b>Project leader</b>	Senior engineer	80	64	427
<b>Secretary</b>	Bilingual secretary	29	64	155
<b>Administrative and legal</b>	Engineer	50	15	62
<b>Engineer for scientific modification</b>	Senior engineer	73	64	389
<b>Engineer for scientific electric power</b>	Engineer	65	46	249
<b>Aeronautical engineer: certification</b>	Engineer	65	26	141
<b>Engineer for Data acquisition</b>	Engineer	65	35	189
<b>Designer</b>	Technician	43	38	136
<b>Aircraft mechanics engineer</b>	Engineer	65	46	249
<b>Pilot</b>	Senior engineer	73	13	80
<b>Scientific instruments technician 1</b>	Technician	43	40	143
<b>Scientific instruments technician 2</b>	Technician	44	40	147
<b>Technician: Documentation quality</b>	Technician	45	40	150
<b>Engineer for numerical simulation</b>	Senior engineer	73	10	61
			<b>Total</b>	<b>2577</b>



*Thank you*

*for your attention*