Work Package 5: New Technical Developments Overview

Work Package Lead: UCAM
Task Leaders: UCAM/IFT
Partners: UCAM, IFT, (DLR), FZJ, UMAN, BA

Principal Objectives:

- **Small instrument package for O_3, H_2O, and aerosol/cloud**
  - **flight characterisation of the BCP (D5.1)**
  - **CDR for integrated package (D5.2)**

- **Conversion of CARIBIC to operational system**
  - **modification and re-certification (D5.3)**

Inputs from WPs 7, 8 and 9

Work Package 5: New Technical Developments
Timing of work packages and their components

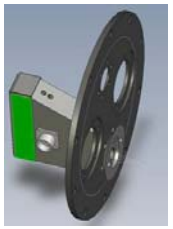
WP 5	New Technical Developments	Work Package Leader: UCAM, Task Leaders: UCAM/IFT, Partners: UCAM, IFT, DLR, FZJ, UMAN																		
Activity	Milestone/deliverable	Start	End	Year 1				Year 2				Year 3				Year 4				
				1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
Construction of a very compact instrument package																				
Flight testing of BCP	D 5.1	1	24																	
Preliminary Design Review (PDR) of small package	M 5.1.1	8	24																	
Development of in-flight data acquisition system (DAS)	M 5.1.2	8	24																	
Construction of prototype integrated instrument package	M 5.1.3	18	36																	
Critical Design Review (CDR) of small package	D 5.2	30	48																	
Transfer of CARIBIC into a routine operational system																				
Modification of the CARIBIC container	M 5.2.2	1	33																	
Re-certification of the CARIBIC container	D 5.3	24	36																	

Work Package 5: New Technical Developments

Partners	FZJ	**UCAM**	UMAN	BA	IFT
mmonths	11	**12**	11	1	18

Task 5.1: Small instrument package for O_3, H_2O, and aerosol/cloud

(UCAM, FZJ, UMAN)

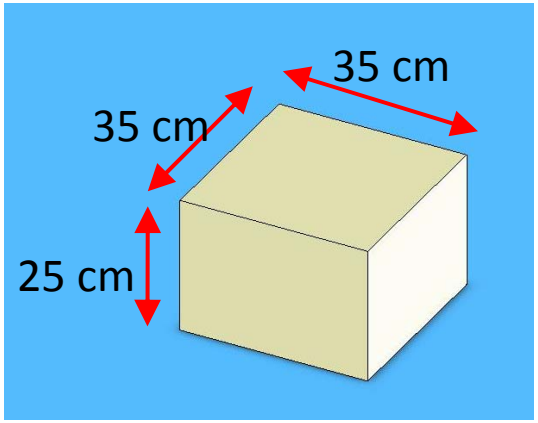




Task 5.2: Conversion of CARIBIC to operational system

(IFT, DLR)

Work Package 5: New Technical Developments
Task 5.1

- Small, ultra light (< 20kg)
- H_2O, O_3, Clouds (BCP), aerosol



Instrument	Weight (kg)	Conting-ency	Total
Water vapour	1	1	2
Cloud Probe	2	0	2
Internal aerosol	2	-	2
Ozone	3	1	4
DAS	5	-	5
Packaging	2	2	4
Pump? Pitot inlet?	?	?	?
Total	15	4	19

Preparation for certification

Work Package 5: New Technical Developments
Task 5.1

Components:

- Flight testing of backscatter cloud probe (BCP) **UMAN**
- Development of prototype data acquisition system **FZJ**
- Preliminary design review of small package
- Construction of prototype instrument package and inlet **UCAM**
- Preparation of documentation for critical design review

Additional input

WP 8: Testing of water vapour sensors (EUFAR)

WP 9: Testing of IAGOS equipment on research aircraft (NERC)

no	Internal Milestones	Partner
M5.1.1-B	Provision of instruments (O3, H2O, BCP, (Aerosol)) and DAS-components	FZJ, UCAM, UMAN

1. Provision of miniature cloud-coarse aerosol/dust instrumentation
   - Back-scatter Cloud Probe, Technology transfer from IAGOS-DS
   - BCP currently being certified for Airbus A-320

2. Calibration and flight validation of cloud BCP instrumentation
   - Flight validation data using NCAS-FAAM BAe 146 platform
   - Laboratory calibration of BCP to cloud/ice using MICC

1. Flight validation will be achieved through collaboration with NCAS-FAAM & EU science projects using the BAe 146 platform.

2. Technical assessment of BCP will continue as part of collaborative projects with the UK Met Office, University of Hertfordshire & Manchester using the Manchester Ice Cloud Chamber (MICC) facility. Test and intercomparison programmes are coordinated by the FAAM Cloud Instrument Users Group.

M5.1 Manchester Ice Cloud Chamber Facility - MICC

Information on MICC Facility can be found at http://130.88.15.75/microwiki/

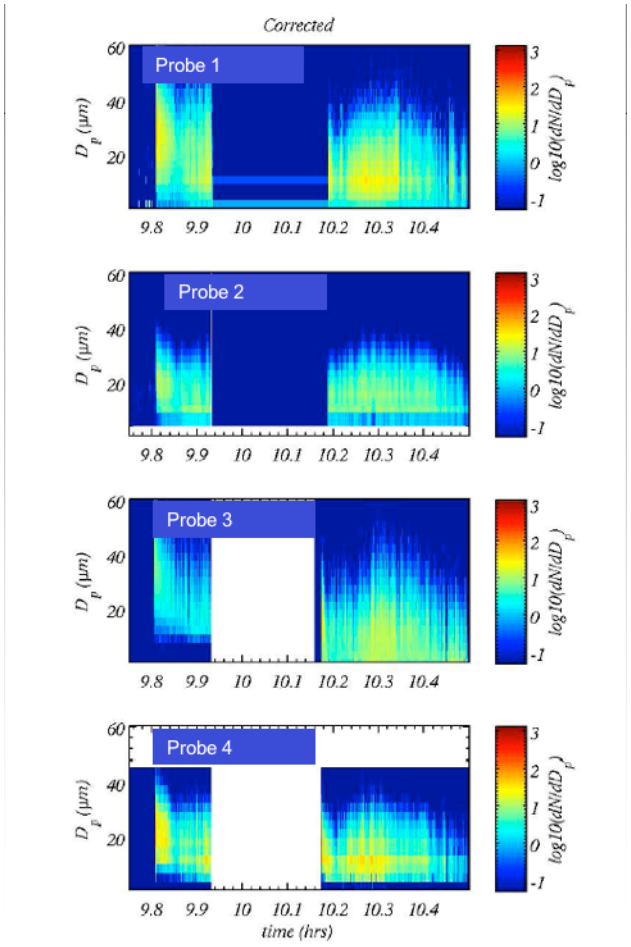
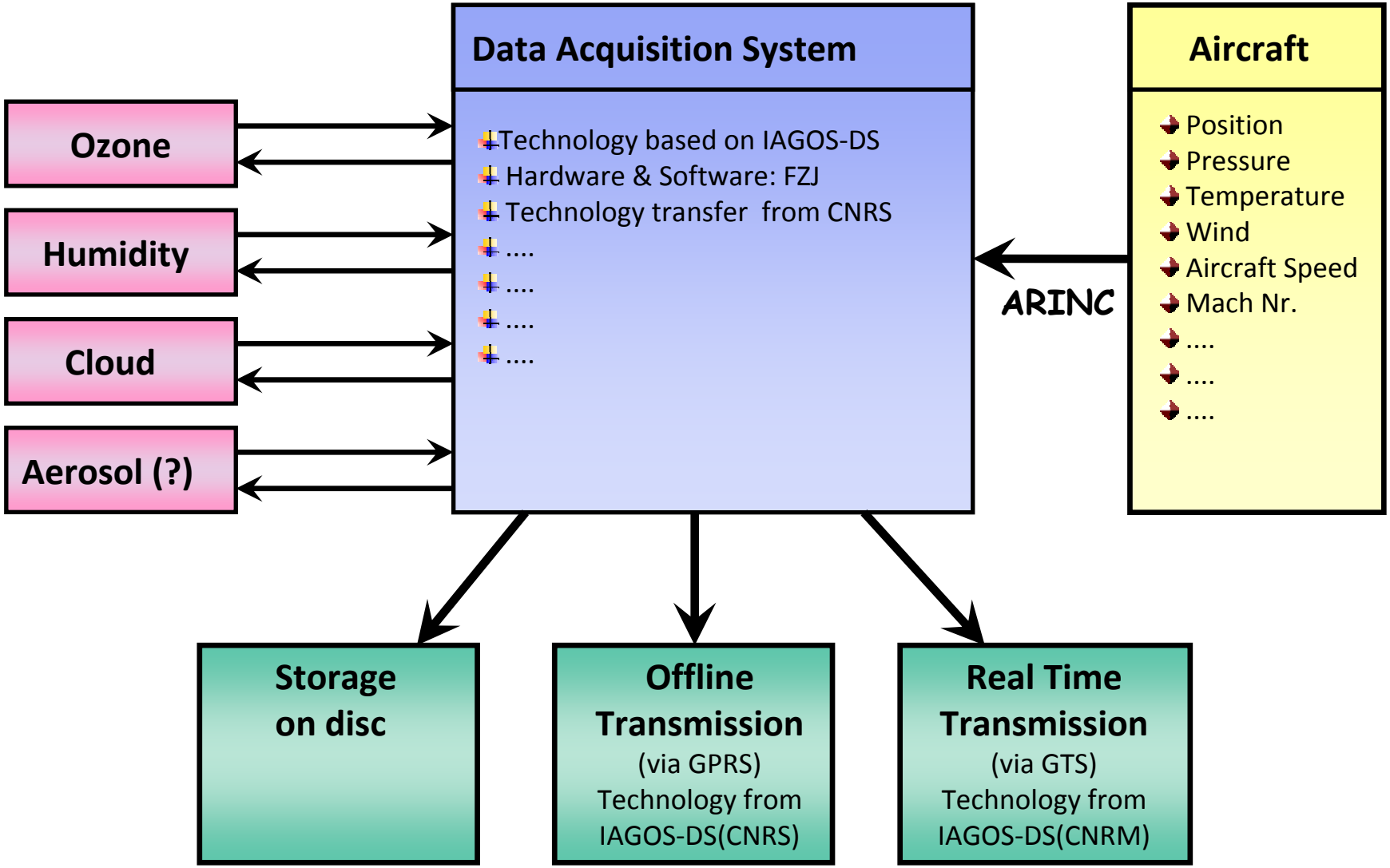


Figure shows preliminary comparisons of Met Office/Manchester/Hertfordshire cloud instrumentation. using MICC. 10 m tall ice cloud chamber capable of being cooled to -55°C and generating long duration clouds for probe intercomparisons.

WP5-Task 5.1-C (Lead FZJ):
Development of Prototype of Data Acquisition System

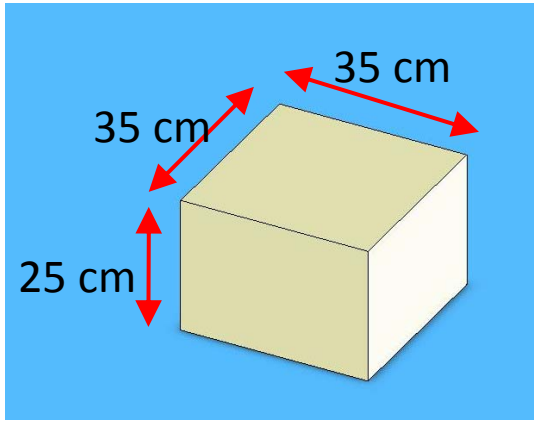


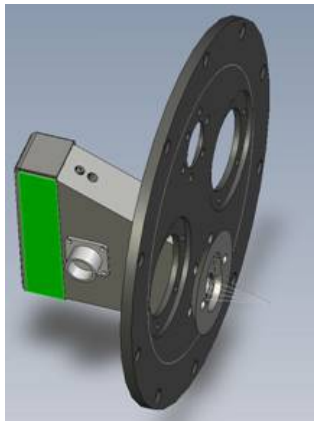
WP5-Task 5.1-C (Lead FZJ) : Development of Prototype of Data Acquisition System

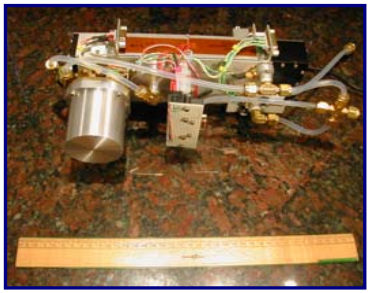
no	Milestones	Partner	start	due	del
M5.1.2	Prototype Data Acquisition system (DAS) will be provided for the integration into small flight package	FZJ	1	24	P&R

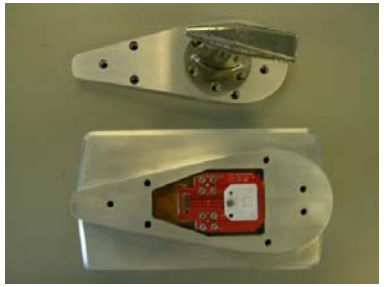
no	Internal Milestones (Informal)	Partner	start	due	del
M5.1.2-A	Definition of instruments, signals, and operational conditions	FZJ	1	6	R
M5.1.2-B	Provision of instruments (O3, H2O, BCP, (Aerosol)) and DAS-components	FZJ, UCAM, UMAN		12	P
M5.1.2-C	Design of prototype of DAS	FZJ	6	18	R

Work Package 5: New Technical Developments
Task 5.1









Key Issues:

- Selection of H_2O sensor (from DS)
- Inlet system (from DS)
- Inclusion of aerosol sensor (inlet issues)

Instrument	Weight (kg)	Conting-ency	Total
Water vapour	1	1	2
Cloud Probe	2	0	2
Internal aerosol	2	-	2
Ozone	3	1	4
DAS	5	-	5
Packaging	2	2	4
Pump? Pitot inlet?	?	?	?
Total	15	4	19

WP5-Tasks 5.1 b, d, e (Lead UCAM)
Partners: FZJ, UMAN

no	Deliverables/Milestones	Partner	start	due	del
M 5.1.1	Preliminary Design Review (PDR) of small package	UCAM	8	24	R
M 5.1.3	Construction of prototype small package and inlet	UCAM	18	36	P
D5.2	Critical design review (CDR) of small package	UCAM	30	48	R

no	Internal Milestones	Partner	start	due	del
M 5.1.1 A	Definition of inlet design	DS	-	6	R
M 5.1.1 B	Conceptual package design	DS	-	6	R

CARIBIC Container

18 measurement instruments

1.5 t

1.6 m

M. Hermann, WP-5

CARIBIC Instruments

	Trace Constituent	Equipment/Analyser
1	O_3 very fast	Chemiluminescence on an organic dye
2	O_3 very precise and accurate	UV absorption
3	CO	VUV fluorescence
4	H_2O gaseous	Diode laser photo acoustic detector
5	H_2O total	Laser photo acoustic and chilled mirror detectors
6	NO	Chemiluminescence with O_3
7	NOy	Chemiluminescence after conversion to NO
8	Hg	Enrichment and atomic fluorescence
9	CO_2	Non-Dispersive Infrared Absorption (NDIR)
10	O_2 ultra high precision	Electrochemical Cells
11	Methanol, acetone, acetaldehyde, acetonitrile	Proton transfer mass spectrometer (PTR-MS)
12	Aerosol particles with diameter >4, 12, 18 nm	Condensation particle counters (CPC)
13	Aerosol size distribution 150 - 5000 nm	Optical particle counter (OPC)
14	Aerosol elemental composition	Impactor, analysis by PIXE and PESA S, H, C, N, O etc
15	Particle morphology	Impactor, analysis by TEM, EFTEM, and AFM
16	Samples for VOC	Enrichment and analysis by GC-MS
17	Hydrocarbons, halocarbons, GHGs, isotopes	Whole air sampler and analysis by GC
18	BrO, HCHO, OClO, NO_2, O_4	Differential optical absorption spectroscopy (DOAS)
19	Clouds	Video Camera

M. Hermann, WP-5

Technical Integration of CARIBIC in IAGOS

- The operational level of IAGOS is expected to be comparable to that of aircraft operation. Building on the experience with MOZAIC new, small, certified equipment is developed and will be deployed long-term.
- CARIBIC has started as a scientific experiment and reached by the implementation with LUFTHANSA a high level of professional operation.

Technical Integration of CARIBIC in IAGOS

- As part of IAGOS, CARIBIC requires a range of improvements for long-term, steady operation. The complex container system is deployed monthly for about 40 hours. To have a high figure of merit requires several system improvements of technical nature.

- The operational frequency of CARIBIC is presently limited by engineering. Based on experience one could conduct twice a set of four flights monthly. The main requirement is: **Improved reliability of the systems**.

Task for CARIBIC within WP-5

- **„Modified and re-certificated CARIBIC-container system for routine operation”**
- An **engineer** will be employed for three years (50% IAGOS-ERI, 50% CARIBIC consortium)
- **Spare inlet system**
  To rule out the existing risk of a down period of more than 2 months a second inlet is manufactured.
- **Power consumption and temperature control**
  Reducing the power consumption is desirable for AC operation. Furthermore, temperature fluctuations can be better compensated.

Task for CARIBIC within WP-5

- **Central pumping/vacuum system**
  The present system is partly from the old CARIBIC system and needs replacement by a lighter energy saving reliable system
- **Intranet system**
  The communication between the master computer and the instruments needs to be made 100% reliable by data redundancy protocols and hardware changes.
- **Certification and documentation**
  After modification the documentation will have to be updated and the container must be recertified (incl. EMI test).
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