Project No: 603502

DACCIWA

"Dynamics-aerosol-chemistry-cloud interactions in West Africa"

Deliverable

D3.3 Campaign Data

Due date of deliverable:	31/05/2017		
Completion date of deliverable:	30/05/2017		
Start date of DACCIWA project:	1st December 2013	**Project duration:**	60 months
Version:	[V1.0]		
File name:	[D3.3_CampaignData_DACCIWA_v1.0.pdf]		
Work Package Number:	**3**		
Task Number:	**3**		
Responsible partner for deliverable:	**DLR**		
Contributing partners:	**UoY, UPS, UNIVMAN, UBP, CNRS**		
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Project coordinator organisation name:	Karlsruher Institut für Technologie		

The DACCIWA Project is funded by the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 603502.

Dissemination level		
PU	Public	**x**
PP	Restricted to other programme participants (including the Commission Services)	
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CO	Confidential, only for members of the consortium (including the Commission Services)	

Nature of Deliverable		
R	Report	
P	Prototype	
D	Demonstrator	
O	Other	**x**

DOCUMENT INFO

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Changes with respect to the DoW

Issue	Comments

Dissemination and uptake

Target group addressed	Project internal / external
Scientific community	Internal and external

Document Control

Document version #	Date	Changes Made/Comments
0.1	20.03.2017	Template
0.2	18.05.2017	First version for approval by the General Assembly
1.0	30.05.2017	Final version after approval

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1 Summary

High-quality gas-phase chemical measurements were successfully performed from all three research aircraft deployed during DACCIWA. The data completeness is very good considering the high frequency of missions and the high temperatures in the aircraft cabins during the flights. Most of the chemical data are already available on the DACCIWA data bank in accordance with the work plan.

Some delayed VOC data will be provided in three months. Here, quality-control is still ongoing. This is due to leak problems (TO) and the use of the novel adsorption tube sampling technique (F20). The ATR VOC data is already available.

2 Introduction

Observations with three European research aircraft constituted a major component of the DACCIWA field campaign. In total the three aircraft performed 50 flights between 27 June and 16 July 2016 covering cities and regions of interest in Togo, Benin, Ghana, and Ivory Coast. Measurement targets were large cities, power plants, ship routes, oil extraction facilities, biogenic emissions and biomass burning plumes. A detailed overview of the DACCIWA filed campaign is provided by Flamant et al. (2017).

The aircraft deployed during DACCIWA include the SAFIRE ATR 42 (ATR), the BAS Twin Otter (TO) and the DLR Falcon 20 (F20). The campaign base of all three aircraft was the military part of the airport in Lome, Togo. The rational and types of flights performed are described in Flamant et al. (2017). The total number of science flight hours amount to 155. Reports on individual missions are available on the DACCIWA website.

The aircraft were equipped with instruments to measure chemical species, aerosol and cloud properties as well as meteorological parameter. Here the availability of chemical data is described. The status of the aerosol, cloud and meteorological data is given in D4.3.

3 Aircraft chemistry instrumentation

The trace gas instrumentation of the three aircraft included ozone, key ozone precursor species (NO_x, VOC, CO, HCHO), aerosol precursor species (SO_2, secondary VOC), and long-lived greenhouse gases (CO_2, CH_4). In the following an overview of the chemistry instrumentation for the individual aircraft is given. All instruments have been deployed many times on the same and/or other research aircraft of the involved institutions and were operated according to best practise procedures.

The very hot temperatures in the cabin of the aircraft during the low level flight sections in West Africa occasionally downgraded the nominal precision and accuracies of the measurements. The measurement uncertainties of the individual instruments and flights are given in the header of the data files provided on the DACCIWA data bank.

Here we address the measurements of the gas-phase chemical compounds. Information on the chemical nature of the aerosol particles were also measured by the aircraft using aerosol mass spectrometers. These measurements and the corresponding data are described in D4.3.

3.1 ATR

In Table 1 the trace gas instrumentation of the ATR during DACCIWA is depicted including information on the measurement technique and the responsible institution.

Table 1: Gas-phase trace gas measurements on board the ATR

Parameters	**Instrument**	**Technique**	**Responsible institution**
Primary / secondary VOC	Ionikon	PTR-MS	LaMP / CNRS
O_3	TEI 49i	UV analyser	SAFIRE /
NO_x	TEI 42CTL	Ozone chemiluminescence+ NO_2 BLC converter	SAFIRE / LaMP /CNRS
SO_2	API T100U	Fluorescence	SAFIRE / LaMP /CNRS
HCHO (Formaldehyde)	Aerolaser 4021	Hantzsch reaction	LaMP / CNRS
CO_2, CH_4, CO	PICARRO	CRDS	SAFIRE
Upwelling and downwelling photolysis frequency J(NO2)	Meteo Consult	Photoelectric detectors	SAFIRE

The ATR payload included also filter radiometers for measurements of the photolysis frequencies of NO_2.

3.2 TO

The chemistry instrumentation of the TO is summarized in Table 2. Included is also information on the measurement techniques and responsible institution.

Table 2: Gas-phase trace gas measurements on board the TO

Parameter	**Instrument**	**Technique**	**Responsible institution**
O_3	TEI49i	UV absorption	UoY
NO, NO_2	Air Quality Design CL / BLC	Chemiluminescence / photolytic conversion	UoY
CO	Aerolaser AL5002	VUV fluorescence	UoY
SO_2	TEI43iTL	UV fluorescence	UoY
CH_4, CO_2, H_2O	Los Gatos Research UGGA	cavity enhanced absorption	UoY / BAS
VOC	Whole air samples	Glass tube samples – GC-FID	UoY

3.3 F20

The chemical measurements of the F20 are shown in Table 3. Originally the DACCIWA payload of the F20 included also a PICARRO instrument for on-line CH_4 and CO_2 measurements. However, the instrument broke-down during a test flight at DLR two days before the transfer to West Africa and could only be repaired at the company in the USA after the campaign.

Table 3: Gas-phase trace gas measurements on-board the F20

Parameter	**Instrument**	**Technique**	**Responsible institution**
O_3	TE 49c	UV absorption	DLR
NO_2	SPIRIT	QCL	CNRS
CO	SPIRIT	QCL	CNRS
VOC, PFC	PERTRAS	Tube samples, TD-GC-MS	DLR
CH_4 isotopes	Bag sampler	Tedlar samples, MS	DLR/ UoL
SO_2	TE 43 Trace level	Pulsed fluorescence	DLR
H_20 vapor	Ly-alpha, CR-2	Ly-alpha, DP mirror	DLR

The F20 payload included a novel adsoption tube sampler. Different types of tubes were used with this device depending on the measurement task (VOC or perfluorocarbon measurements).

4 Data availability

Most of the trace gas measurements of the DACCIWA flights have been uploaded already to the DACCIWA data base. The individual data files include a header with important information on the data including measurement uncertainties. In the following an overview is provided on the data availability of the chemical measurements for the DACCIWA aircraft.

For some measurements the quality-control of the data is still on-going. Information on the status of this data and the expected date of upload to the DACCIWA data base is provided.

4.1 ATR

An overview of the availability of chemical measurements from the ATR for the individual flights is given in Table 4. The overall data availability is very good. Only VOC and HCHO data for a few flights are missing

Table 4: Availability of ATR chemical data

	Flight	VOCs	HCHO	Ozone	NOx	SO_2	CO	CO_2, CH_4	JNO_2
29/06/2016	AS0017								
30/06/2016	AS0018								
01/07/2016	AS0019								
02/07/2016	AS0020								
02/07/2016	AS0021								
03/07/2016	AS0022								
05/07/2016	AS0023								
06/07/2016	AS0024								
06/07/2016	AS0025								
07/07/2016	AS0026								
08/07/2016	AS0027								
08/07/2016	AS0028								
10/07/2016	AS0029								
11/07/2016	AS0030								
11/07/2016	AS0031								
12/07/2016	AS0032								
13/07/2016	AS0033								
14/07/2016	AS0034								
15/07/2016	AS0035								
16/07/2016	AS0036								

Green : Quality controlled data available on Database (May 2017)
Red: Missing data due to instrument failure.

4.2 TO

An overview on the status of the TO chemistry measurements is given in Table 5. The overall data availability is good. Problems were only identified for the VOC measurements (see section 5).

Table 5: Availability of TO chemical data

Flight	O_3	NO, NO_2	CO	SO_2	CH_4, CO_2, H_2O	VOCs
01.07						
03.07						
04.07						
05.07am						
05.07pm						
06.07am						
06.07pm						
07.07						
08.07am						
08.07pm						
10.07am						
10.07pm						
11.07am						
11.07pm						
13.07						
14.07						
15.07am						
16.07pm						

Green: Quality controlled data on data bank (May 2017).
Yellow: Data analysed, quality control ongoing, expected upload to data bank August 2017.
Red: Data missing due to instrument failure.

4.3 F20

An overview on the availability of the F20 chemistry measurements is provided in Table 6. The overall data availability is very good. The quality-control for the VOC and PFC measurements is on-going (see section 5).

Table 6: Availability of F20 chemical data:

Flight	O_3	NO_2	CO	VOC, PFC	CH_4	SO_2	H_2O
29.05							
20.06							
01.07							
05.07o							
06.07							
07.07							
08.07							
10.07							
11.07							
12.07							
13.07							
14.07							

Green: Quality-controlled data on data bank (May 2017)
Yellow: Data analysed, quality-control on-going, upload of data on data bank in Aug. 2017

5 Information on delayed or missing data

5.1 ATR

Flight AS0020 and AS0029 were at high altitude, low pressure: PTRMS and Aerolaser were unable to control inlet flow.

Other flights: missing data due to instrument failure.

5.2 TO

Analysis and QC of the VOC data is taking longer than expected. Leaks identified on some of the whole air sample cases resulting in data being unreliable (indicated by the red boxes on many flights).

5.3 F20

All adsoption tube samples for VOC and PFC measurements have been already processed by TD-GC-MS. The quality-control is taken longer than expected. Data should be available with a three months delay (Aug. 2017). The preliminary data show that the special PFC tracer experiments for the Lome city pollution plume have worked.

6 Conclusion

An unique airborne data set have been sampled during DACCIWA of the chemical composition in West Africa impacted by a variety of anthropogenic and natural emissions. The data completeness for the three aircraft is very good. Most of the data have been uploaded on the DACCIWA data bank according to the work plan. Some delayed VOC data will be available in three months.

7 Reference

Flamant, C., et al., TheDaynamics-Aerosol-Chemisty-Cloud Interactions in West Africa field campaign: Overview and research highlights, submitted to Bull. Am. Met. Soc., 2017.