A 5 year programme on weather, climate, and air pollution in West Africa

DACCIWA Newsletter

DACCIWA

Spring 2015
1st Edition

COORDINATOR'S EDITORIAL

Dear Reader,

Welcome to the first biannual newsletter of the DACCIWA Project! We are a consortium of 16 academic, research and weather prediction institutions from across Europe and West Africa. The project is principally supported by the EU's 7th Framework Program. It brings together experts in atmospheric dynamics and chemistry, cloud physics and radiation with experts in air pollution and public health to investigate the pressing issue of the impacts of the rapidly increasing anthropogenic emissions from the densely populated Guinea Coast in West Africa on the local and regional air quality, weather and climate as well as impacts on human and ecosystem health. The current population of around 340 million is predicted to reach 800 million by 2050. Air quality, climate change and food security will be crucial issues for this growing population with local emissions expected to triple between 2000 and 2030.
DACCIWA is structured in seven workpackages focusing on specific scientific areas such as boundary-layer dynamics, cloud-aerosol interactions, radiation or precipitation with many cross-over activities in field observations, data analysis and modelling to foster synergy. This newsletter is part of a strong dissemination effort that also includes a dialogue with policymakers about this issue. DACCIWA will run until November 2018.

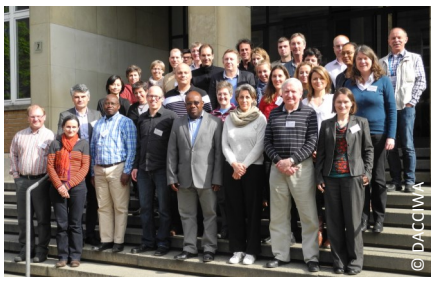
We thank all those working on and associated with DACCIWA and look forward to an exciting and productive collaboration!

Peter Knippertz, coordinator of DACCIWA

TOPICS IN THIS ISSUE

DACCIWA KICK-OFF

On 8-9 April 2014, the main project kick-off meeting was successfully held in Karlsruhe with about 40 participants. This gave ample opportunity for the project members to get to know each other and to establish collaborations. Break-outs were organized to refine the research strategy and plan upcoming tasks. Members of almost all project beneficiaries participated at the kick-off meeting. Additionally Peter Lamb (Chair Advisory Board, see box on Page 4) and some representatives of organisations interested in the work of and in a collaboration with DACCIWA (DWD: German Weather Service, Lapa / Université Felix Houphouet-Boigny (Ivory Coast), Technical University Darmstadt (Germany), Université d'Abomey-Calavi (Benin), University of Cologne (Germany)) were present.



Participants of the DACCIWA Kick-Off meeting

DACCIWA NEWS

- DACCIWA website launched: The DACCIWA website was launched in November 2014 and features a description of the project, contact information, a description of each of the work packages, news, and links to online resources / blogs (visit www.dacciwa.eu).
- Stay informed: If you want to receive this newsletter regularly, you can subscribe online on www.dacciwa.eu

DACCIWA news

Postponement of the main field campaign due to Ebola epidemic

A central element of DACCIWA is a major international intense observing period involving three instrumented ground supersites, an enhancement of radiosonde launches across West Africa and three large research aircrafts based at Lomé International Airport. The purpose of this field campaign is to provide observational data of sufficient resolution, breadth and quality to advance our physical and chemical understanding of the processes that determine the atmospheric composition and dynamics in southern West Africa. The obtained data will also be crucial for the evaluation and further development of satellite data and numerical models used for air quality, weather and climate simulations and predictions.

The field campaign was originally planned for June and July 2015. However, in November 2014 the DACCIWA partners decided to delay this activity by a year to the same time in 2016 due to the incalculable risks posed by the devastating Ebola epidemic in Sierra Leone, Guinea and Liberia. The complex logistics and preparations of such a large campaign made this early decision necessary. Fortunately, the situation has much improved since then and there is now growing confidence that the disease can be brought under control. So we are waiting with growing excitement for summer 2016 to arrive!

„We are waiting with growing excitement for summer 2016 to arrive!“ (Peter Knippertz, KIT, Scientific coordinator of DACCIWA project)

Figure 1

News from the Field

Report on Air Pollution and Health Measurements in Abidjan, Ivory Coast and Cotonou, Benin

The big issue of DACCIWA WP2 is to estimate spatial and temporal distributions of health impacts due to air pollution for major anthropogenic sources representative of South West Africa. The cross-analysis of joint physicochemical measurement and health proxies will be carried on to study the links between air pollution and health, and more particular determination of dose response functions for respiratory inflammatory risk and morbidity.

Where? Four experimental sites have been selected respectively close to domestic fires, traffic and waste burning. Three sites are located in Ivory Coast. The first one is located in Yopougon, which is the most crowded and the larger district of the city with high practices of domestic fires. Our site is installed within a courtyard (figure 1) surrounded by many houses using domestic fires for cooking. Moreover, this is a place where more than twenty women use woodfires for fish smoking. The second site is in Adjamé area, which is a place of Abidjan with many trades (big markets) and many traffic jam. Our site is located on the roof of a pharmacy, above a large street and close to a huge crossroad (figure 2). The third site is located in Akouedo in the Cocody district. It is located on the roof of a building built on the biggest waste burning hill of the country, in activity since 1965 (figure 3). The fourth site is located in Benin, in Cotonou. Located in Dantokpa area in front of the biggest market of Benin, this site is set on the balcony of a building nearby crossing roads with a high traffic density (figure 4). This is an interesting site because the vehicle park of Cotonou includes both four- and two- wheels using a gasoline fuel compared to Abidjan using mainly diesel four-wheels vehicles.

Figure 2

When? All the sites are fully equipped since February 2015 thanks to our African partners. Such installation was a bit delayed due to Ebola-related problems. They will be running until March 2017.

News from the Field

Report on Air Quality Measurements (cont.)

Figure 3

What to do? Long-term program includes PM2.5 aerosol weekly sampling (e.g. figure 5) to determine particulate mass, organic carbon, black carbon and aerosol pro-oxidant capacity and bimonthly measurements of gases concentrations using passive samplers for NO2, O3, HNO3, NH3, SO2. In parallel, census of hospital admission for respiratory diseases and morbidity are performed at the hospital or health center close to our four experimental sites. This census will be cross-linked with particle and gas concentrations to statistically estimate dose-response functions for morbidity.

Impactor measurements will be added to this instrumentation during the dry and wet seasons of 2015 and 2016, to determine aerosol chemical composition and pro-oxidant capacity by size as well as inflammatory biomarkers. Comparisons between these two dataset will produce dose-response functions for respiratory inflammatory risk.

Sunphotometer measurements of aerosol optical depths (AOD) are/will be deployed during the dry season 2015 and 2016 to study the links between AOD and ground measured PM2.5 mass, to validate satellite estimates, and to set a regional picture of aerosol pollution above SWA cities and help numerical modeling validation.

Figure 4

Who?

- Physicochemical tasks: UPS: C. Liousse, C. Galy-Lacaux, J.-F. Léon, L. Roblou, E. Gardrat, C. Chiron. Univ. Abidjan: V. Yoboué, E. Assamoi , A. Konaré, M. Bedou, J. Bahino (Ivory Coast phD student), S. Keita (Ivory Coast phD student), E. Touré (Ivory Coast phD student). Univ. Cotonou: A. Akpo, J. Djossou (Benin phD student), M. Bodjendu (Benin Master student).
- Epidemiology: I. Annesi-Maesano (UPMC), K. Kouamé (Institut Pasteur, Abidjan) and B. Fayomi (Univ. Cotonou).
- Biology: A. Baeza (UPD).

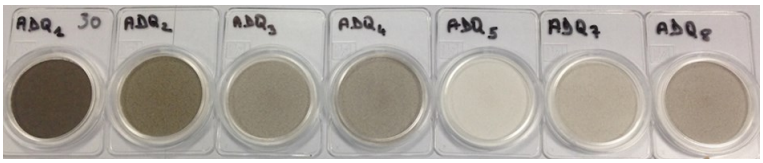


Figure 5: 7 weeks aerosol sampling at Akouedo waste burning site in Abidjan

Contact: Cathy Liousse (Cathy.Liousse@aero.obs-mip.fr)

DACCIWA publications

Satellite-based climatology of low-level continental clouds in southern West Africa during the summermonsoon season

In van der Linden et al. 2015, eye observations from synoptic stations and various products from satellite platforms were used to determine mean spatiotemporal characteristics of the low level stratus for June-September 2006-2011. Two Meteosat Seviri products were objective validated against cloud observations from SYNOP reports. It turned out that the SAFNWC cloud classification product underestimates low clouds at night and thus preference was given to an adapted RGB night microphysical scheme. Despite anticipated problems with low cloud detection due to mid- and upper-level clouds, a clear climatological picture emerged: During the night the cloud deck spreads northward and reaches is largest extent of approximately 800,000 km2 not until about 10 UTC. This late maximum was not expected and solicits explanation.

Both Meteosat products have difficulties in low cloud detection at dusk and dawn where about two hours are missing in the climatology. This and shielding by higher clouds make the subjective cloud observations from SYNOP stations invaluable. The SYNOP data from the study were included in a recently established surface observational data base at KIT. Data are already enhanced over GTS availability for 2006 in Ghana and Benin and in 2010 for Kumasi only. Currently, data digitization efforts are commencing in Ghana to get hourly data for 2006 and 2014 for some stations and further initiatives will be launched in due time. Data request can be directed towards Andreas Fink.

van der Linden, R., A. H. Fink, and R. Redl (2015), Satellite-based climatology of low-level continental clouds in southern West Africa during the summermonsoon season, J. Geophys. Res.

Symposium in memoriam of Peter Lamb

Peter J. Lamb was the first Chair of the Advisory Board of DACCIWA. He provided invaluable help, support and advice to the project during the proposal writing stage and at the kick-off meeting in Karlsruhe in April 2014. His sudden passing in May 2014 was a shock to everyone in DACCIWA and an enormous loss to the project and the whole research community working on African climate. The overview article on DACCIWA that recently appeared in BAMS (see page 5 of this Newsletter) was dedicated to him. In order to honour Peter Lamb's distinguished contributions to African climate and weather research for economic development the American Meteorological Society Board on Societal Impacts is currently organizing an event entitled **"Peter J. Lamb Symposium—Helping Africa to Help Itself"** to take place in New Orleans from 10-14 January 2016. Abstracts for this symposium are due by 3 August 2015. More information can be found on the website at

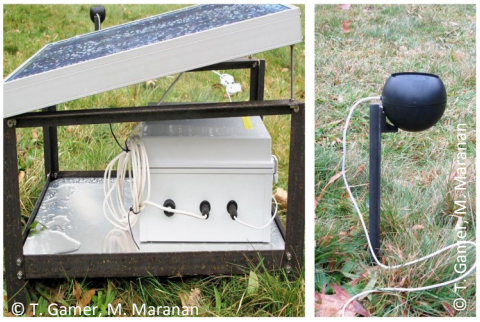
http://annual.ametsoc.org/2016/index.cfm/programs-and-events/conferences-and-symposia/peter-j-lamb-symposium-helping-africa-to-help-itself/

News from the Field

Efficient raingauges tested

The West African Monsoon (WAM) and the associated rainfall are widely regarded as the socio-economical key element of many at the Guinea Coast. However, reliable rainfall forecasts in this region have been hindered by the lack of a spatio-temporally high-resolved rain gauge network – important for better understandings in the dynamics of the WAM as well as the validation of spaceborne observations. To overcome the data sparseness about 15 cost-efficient rain gauge systems, provided by the partner University of Leeds, will be deployed at sites around Kumasi, mostly on school grounds. The rain gauge operates on an optical basis where drops of a known diameter, formed out of collected rainwater at the end of a funnel, are identified and counted by an infrared sensor and logger, respectively. A minute-by-minute recording is employed with a maximum intensity of 300 mm/hr and a resolution of 0.01 mm. While being tested at KIT and in Leeds a first batch of nine rain gauges was shipped to Kumasi in early April. Together with two KIT scientists the installation and activation will be executed by KNUST in the coming month. The rainfall monitoring network is planned to run fully operational by the end of 2015.

Contact: Andreas Fink (Andreas.Fink@kit.edu)



(Left) Solar panel and logger box; (Right) Mounted rain gauge

News from the Field

Site report from Ile-Ife, Nigeria

In January 2014, the Teaching and Research Farm at Obafemi Awolowo University (OAU) was selected as a convenient, secure and undisturbed location for setting up of a world-class meteorological research facility, OAU-Met Station, in tandem with execution of the project: "Dynamics aerosol-chemistry-cloud interactions in West Africa – DACCIWA". The farm site originally was chosen in February/March, 2004 for conduct of Nigeria Micrometeorological Experiment (NIMEX), a multi-institutional collaborative research project investigating surface energy balance in the tropical wet and dry climate. Over several months efforts were made to deploy assortment of meteorological instrumentation to the DACCIWA site for routine and research-grade measurements of atmospheric and soil parameters.

At the experimental site an area of 350 m^2 was cordoned by open wire nettings and dedicated for the surface measurements. In the middle, a 15-m open-frame mast was erected for profile measurements of atmospheric surface layer (SL) parameters. Three shorter masts; 2.0 m, 2.5 m and 6.0 m were put in position for solar/atmospheric radiation instrumentation, Eddy Covariance (EC) system and automatic weather station (AWS), respectively (see Fig. 1). The following meteorological parameters are recorded (on a routine basis) at the OAU/DACCIWA project station: 2-min. averages of the wind speed and direction, air temperature and relative humidity, pressure, soil temperature, soil heat flux, soil moisture, PAR, global radiation and net radiation, from June 2014 to date. Also measured is the wind profile (in the lowest 800 m above the land surface) using an acoustic sounder (Fig. 2) and the turbulent fluxes of sensible and latent heat and mass (CO_2) by ultrasonic anemometer/infrared gas analyser (Fig. 3).

Figure 1: DACCIWA Project Site at OAU, Ile-Ife

News from the Field

Site report from Ile-Ife, Nigeria (cont.)

Figure 2: METEK PCS 2000 Sodar system at OAU, Ile-Ife

For retrieval of data, a network of programmable dataloggers (3 nos. of Campbell Scientific model CR1000) are used to collect the data acquired from all meteorological sensors.

Two dataloggers are linked by direct cable connections and a third via a GSM modem for remote data acquisition (AWS data collection platform) and stored onto desktop computers. Continuous electrical power supply to the site is ensured by a 6.5 kW gasoline-powered generator and uniterruptible power supply (UPS) as backups.

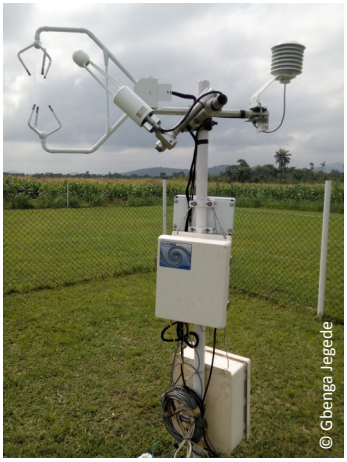


Figure 3: Open Path Eddy Covariance (OPEC) System (CSAT3 and LI-7500) at DACCIWA Project Site, Ile-Ife

The present field measurements are integrated within on-going research projects for the postgraduate students at OAU and designed to meeting the goals of DACCIWA (WP1). The OAU research group actively participated in the "dry runs" in June 2014 organized as preliminary before the intensive observation period (IOP) of DACCIWA project (2015) with main research interest in existence of nocturnal low-level jets.

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„Modelling data will be shared across the consortium to maximise usage and impact." *(J. Marsham, coordinator of DACCIWA modelling)*

Modelling activities

The DACCIWA modelling strategy

DACCIWA includes modelling across scales and as 'seamless' approach as possible will ensure synergies between process studies at high-resolution and coarser weather and climate style runs. As proposed, models will be run at the institutions where the expertise resides, but data will be shared across the consortium to maximise usage and impact.

The first DACCIWA modelling telecom discussed methods to achieve these aims, particularly common model domains and time periods. It was agreed that ahead of the 2016 field campaign short duration simulations should focus on either the 2006 or 2014 monsoon seasons, as these between have them the best data, from either the AMMA field campaign or recent satellite-borne instruments.

Shared model domains were discussed (Figure 1 below). The yellow small domains are not yet well defined and depend on supersite locations. They will probably be ~50 km boxes depending on people's computing power, centred just upstream (southwest) of supersites. The red boundary is positioned far east of the DACCIWA field campaign domain to avoid having the boundary over the Ethiopian highlands. It was agreed that groups should coordinate with John Marsham when they start using domains.

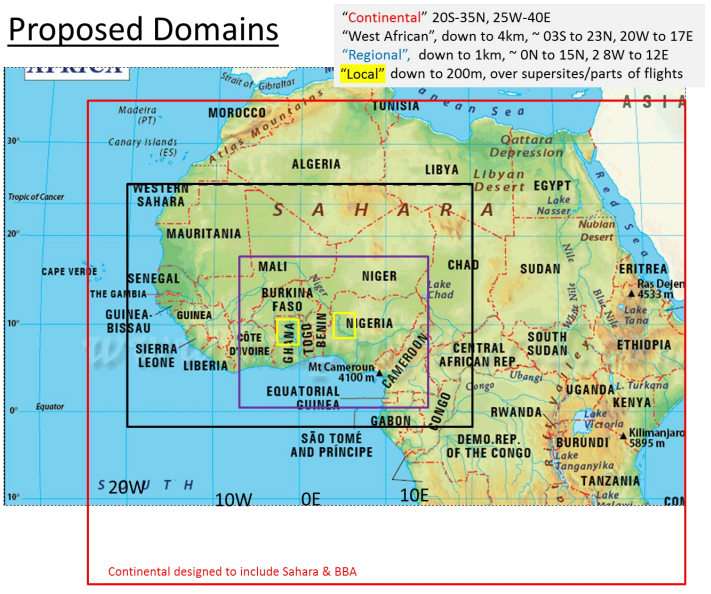

Figure 1: Proposed modelling domains

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Acknowledgments

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DACCIWA publications

The DACCIWA project: Dynamics-aerosol-chemistry-cloud interactions in West Africa

Abstract

Massive economic and population growth, and urbanization are expected to lead to a tripling of anthropogenic emissions in southern West Africa (SWA) between 2000 and 2030. However, the impacts of this on human health, ecosystems, food security, and the regional climate are largely unknown. An integrated assessment is challenging due to (a) a superposition of regional effects with global climate change, (b) a strong dependence on the variable West African monsoon, (c) incomplete scientific understanding of interactions between emissions, clouds, radiation, precipitation, and regional circulations, and (d) a lack of observations.

This article provides an overview of the DACCIWA (Dynamics-Aerosol-Chemistry-Cloud Interactions in West Africa) project. DACCIWA will conduct extensive fieldwork in SWA to collect high-quality observations, spanning the entire process chain from surface-based natural and anthropogenic emissions to impacts on health, ecosystems, and climate. Combining the resulting benchmark dataset with a wide range of modelling activities will allow (a) assessment of relevant physical, chemical, and biological processes, (b) improvement of the monitoring of climate and atmospheric composition from space, and (c) development of the next generation of weather and climate models capable of representing coupled cloud-aerosol interactions. The latter will ultimately contribute to reduce uncertainties in climate predictions. DACCIWA collaborates closely with operational centers, international programs, policy-makers, and users to actively guide sustainable future planning for West Africa. It is hoped that some of DACCIWA's scientific findings and technical developments will be applicable to other monsoon regions.

Knippertz, P., H. Coe, J. Chiu, M. Evans, A. Fink, N. Kalthoff, C. Liousse, C. Mari, R. Allan, B. Brooks, S. Danour, C. Flamant, O. Jegede, F. Lohou, and J. Marsham, 2015: AMERICAN METEOROLOGICAL SOCIETY interactions in West Africa. Bull. Amer. Meteor. Soc. doi:10.1175/BAMS-D-14-00108.1, in press

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