The main field campaign June - July 2016

DACCIWA Newsletter

DACCIWA

COORDINATOR'S EDITORIAL

Dear Reader,

Welcome to the Fourth newsletter of the DACCIWA Project! This newsletter is part of our effort to communicate our research activities with the scientific community, the general public and policymakers. If you missed the first three newsletters, you can still access them on our webpage www.dacciwa.eu, together with a lot more information on the project and the involved parties in Europe and Africa.

The last issue was all about the planning activities for our big field campaign in June and July this year. Now we can – a little proudly – report that the field campaign was the success we had all hoped and worked for for such a long time. Not everything went perfectly smoothly, as one would expect for such a large coordinated effort, but overall we are more than satisfied with the unique and comprehensive dataset obtained. And more importantly, everybody returned home safe and sound from the field, and no equipment was damaged. Currently, the data are being quality controlled and uploaded to our database at http://baobab.sedoo.fr/DACCIWA. The final years of the project will be about the analysis of these observations, providing a solid foundation for an improved understanding, modelling and monitoring of the atmosphere over southern West Africa well beyond the project duration.

Thank you for your continued interest in DACCIWA!

Peter Knippertz, project coordinator

4th Edition
Autumn 2016

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DACCIWA IN LEEDS

On 2-4 November 2016, the second interim project meeting was successfully held in Leeds with more than 70 scientists. Unfortunately the participation of the African collaborators was quite low, because many encountered problems or delays with their visa applications for the UK.

Participants of the DACCIWA project meeting in Leeds November 2016

A list with foreseen publications was elaborated and collaborations between the different work packages – especially with regard to analysing the data from the main field campaign in summer 2016 – were coordinated and intensified.

News from the field

DACCIWA Ground campaign
Chasing the low-level clouds in West Africa

In June and July 2016 three supersites Savè (Benin), Kumasi (Ghana) and Ile-Ife (Nigeria) were installed to investigate the processes which determine the development and dissolution of the low-level clouds. These clouds cover a large area and exist for a large part of the night as well as during the morning in those months.

Trucks with measurement equipment arriving at the Savè supersite

Before the measurements could start, the equipment had to go on a long journey. After more than six weeks on trucks and ships and several days in customs, the containers finally reached their destinations (movie about instrumentation transport and installation at Savè site is available at: http://ulisse.cnrs.fr/). Installation and calibration of the different equipment as well as putting everything into operation took another 10 days – taking into account that for some of the supersites generators had to be installed.

The X-band radar was positioned on top of two containers allowing to do horizontal scans and detection of precipitation in a radius of about 100 km.

Team at the Savè supersite

During the two months of measurements, 15 intensive observation periods (IOPs) were performed: 3 before, 5 after and 7 during the aircraft campaign, which was scheduled in the middle of the ground campaign (12 June to 30 July 2016). In order to plan and coordinate an IOP at the three supersites, Skype conferences took place every day. A weather forecast and an overview of the performance of the instruments were prerequisites for the IOP decision making. On IOP days, normal radiosondes, as well as frequent radiosondes were launched and remotely piloted aircraft systems (RPAS) were additionally operated in intervals of 1.5-3 hours for 24 hour periods – hard work for all of the staff members. For collection of the frequent radiosondes, local personal was employed – also a difficult task taking into account that the environment was often characterized by impassable areas with bushes and trees. Nevertheless, the measurements proceeded without severe complications or difficulties, data lacks were small and the collected data set provides comprehensive information about the atmospheric conditions – even some unexpected phenomena (Instrument availability table: http://dacciwa.sedoo.fr/source/monitoring.php?current=20161116&nav=Monitoring).

After the successful measurement period it took another week of dismounting all the equipment, which was then transported back to France, Germany and Great Britain. The equipment arrived safely. The gathered data are currently quality controlled and can soon be analysed scientifically.

Contact: Norbert Kalthoff (Norbert.kalthoff@kit.edu)

News from the field

DACCIWA Ground campaign Supersite Instrumentation

Savè (Benin)

- Energy balance stations
- Radiosondes
- Frequent radiosondes
- Sodar
- Two lidars
- Wind profiler
- Microwave radiometer
- Ceilometer
- Cloud camera
- Cloud radar
- X-band rain radar
- Spectrometer and sun photometers

Ile-Ife (Nigeria)

- Energy balance station
- 15-m-tower
- Sodar
- Tethered radiosonde
- Hand-held infrared radiometer
- Rain gauge
- Sun photometer

Kumasi (Ghana)

- Energy balance station
- Flux station
- Automatic weather station
- Sodar
- Microwave radiometer
- Radiosondes
- Frequent radiosondes
- Ceilometer
- MRR
- Cloud camera
- Sun photometer (ARM)

DACCIWA in the Press

Press release on DACCIWA field campaign

On 30 August a coordinated press release on the main field campaign was published by the French, British and German DACCIWA partners. This resulted in a broad coverage including internet, print and radio.

Details on the DACCIWA webpage: http://www.dacciwa.eu/stay-informed/newsroom

Meet the DACCIWAs

Marlon Maranan

I'm a PhD student at the Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany, in the working group „Atmospheric Dynamics“ led by Peter Knippertz and Andreas Fink who are also my supervisors. Within the DACCIWA project my work is incorporated in WP6 where my focus lies on a climatological view of precipitation systems, their spatial distribution and their contribution to the annual rainfall in Southern West Africa. The investigation of case studies of different rainfall types during the period of the DACCIWA field campaign and their representation in the WRF model is also part of my PhD.

Weather in general has always been a strong interest of mine. I guess most of the people who start studying atmospheric science are fascinated by atmospheric phenomena that they experience on a daily basis – certainly in my case. I started studying meteorology at KIT and obtained both my Bachelor's and Master's degree there. For the latter I already got in touch with tropical dynamics by working on verification methods for tropical rainfall.

The DACCIWA project came right in time after I finished my Master's. The prospect of participating in a big field campaign (my first ever) and to travel to a region I've never been before made it quite easy for me to commit to the project. I was mainly involved in the installation of the raingauge network around Kumasi (Ghana) and the radiosonde campaign in Accra (Ghana) and Lamto (Ivory Coast). The instrumentation enables us to monitor the precipitation amount as well as the environmental conditions such as temperature and humidity more closely which is crucial for my study on rainfall systems. Due to the time-consuming work on setting up the raingauges the field campaign itself marked my third trip to West Africa - and it was, as always, an exciting experience.

During the trips I got a good impression about precipitation in general in the DACCIWA region. Rainfall out of warm clouds occur more often than expected. The nature of coastal convection can be at times more vigorous than mesoscale convective systems. Often, a mere look into satellite images doesn't give you that. Therefore, I hope that the DACCIWA project will eventually help to get a more profound understanding of precipitation processes in Southern West Africa.

Contact: marlon.maranan@kit.edu

News from the field

DACCIWA City campaign

From July 1st to July 14th, 2016, the WP2 team was engaged in its 3rd intensive campaign, after the ones of July 2015 and January 2016 and before the last one of January 2017. This new campaign follows the same objectives as the previous ones and focuses on the 4 sites representative of the main specific SWA combustion sources: traffic at Adjamé site in Abidjan (Côte d'Ivoire) and at Dantokpa site in Cotonou (Benin), domestic fires at Yopougon site (Abidjan) and waste burning at Akouedo (Abidjan).

The experiment was successfull and now more than 20 people are working on the data in France, Côte d'Ivoire and Benin.

Objectives are:
(1) to calculate in situ dose-inflammatory response ratios for each studied source. Air pollution experiments include three impactors running in parallel three times in each campaign in the same conditions, in order to determine aerosol chemical composition and their pro-oxidant capacity by size as well as in vitro inflammatory biomarkers to derive inflammatory response. As an example, the picture below shows collection of filters after sampling and more specially the black-coloured filter linked to ultra fine size collection.

Filters with aerosol impactors

News from the field

DACCIWA City campaign (cont.)

(2) to assess personal exposures to PM2.5 and aerosol chemistry emitted from domestic fire emissions for housewife, waste burning emissions for student and motor vehicle emissions for drivers. Participants are equipped with personal impactors and followed three consecutive days (night and day).
(3) to measure emission factors for gases and particles for the main African specific urban sources (domestic fires with different woods and charcoal, charcoal making and many representative two and four wheels) in real ground conditions.
(4) to establish spatial distribution of gaseous components (NO2, Ozone) in Abidjan and Cotonou during the dry seasons 2015 and 2016 with multi sites deployment of passive samplers.
In parallel to these intensive measurements, long-term experiments were also active during the july 2016 campaign including on the four sites: air pollution measurements with weekly aerosol collection for PM2.5 mass, black carbon and organic carbon, pro-oxydant aerosol capacity, bimonthly gas collection for ozone, nitrogen dioxide, ammonia, nitric acid and sulphur dioxide and aerosol optical depths (AOD) and epidemiological survey with census of hospital admission for respiratory diseases and morbidity at the hospital or health centers close to our four experimental sites.

WP2 Team in Cotonou

The experiment was successfull and now more than 20 persons working on the collected data in France, Côte d'Ivoire and Benin including 4 PhD students, looking forward to the next and last campaign in January 2017.
Contact: Cathy Liousse
(Cathy.Liousse@aero.obs-mip.fr)

Meet the DACCIWAs

Winifred Ayinpogbilla Atiah

I am a PhD student under the supervision of Dr. Leonard K. Amekudzi at the Kwame Nkrumah University of a Science and Technology. I come from Bolgatanga, the Upper East Region of Ghana. I obtained my bachelors degree in Meteorology and Climate Science in 2013, and was later maintained at the Department of Physics, KNUST as a teaching assistant in 2014. For my MSc. in Mathematical Sciences I had the opportunity to go to Mbour-Senegal sponsored by the Next Einstein Initiative (NEI), African Institute of Mathematical Sciences (AIMS-Senegal). I worked on "the variability of wet and dry spells over the Savannah zones of Ghana applying the wavelet approach" for my masters thesis.

I have always been motivated to study the atmosphere. Since I was a young girl, I was so fascinated by weather forecasts and many others that had to do with the atmosphere and I have always loved to go this direction.

Secondly, the challenge alone is great inspiration for me as I have always longed to inspire the younger generation (especially young women) mostly from where I come from to help them snap out of their shelves and choose their own paths not regarding the challenge or how difficult it may be.

I chose to work under the WP 6 of the DACCIWA Project firstly because I am enthusiastic about the topic "Precipitation Process" and its core objectives and secondly because of the exposure of working with people from all over the world. I believe that research becomes excellent with collaborations and exposure. DACCIWA through the field campaign afforded me the opportunity to work with teams from Leeds UK and KIT, Germany and I learnt a great deal from this exposure.

Working on the broad topic, "Precipitation Processes", my key objectives are to validate satellite rainfall products and to investigate the rainfall types over Ghana. I have good results for the validation study and working closely with Dr. Leonard Amekudzi and Prof. Andreas Fink to publish them soon.

Contact: winifred.a.atiah@aims-senegal.org

News from the field

The DACCIWA radiosonde campaign

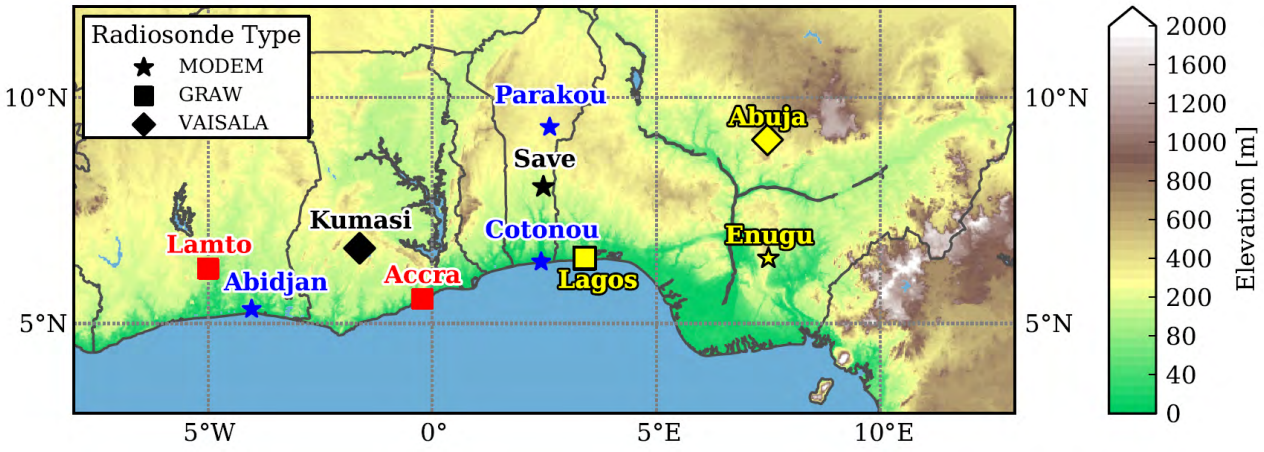
Within the DACCIWA campaign, some 750 extra meteorological sondes have been released into the West African sky in June-July 2016. Not only have these sondes provided temperature, humidity, wind, and pressure measurements every second from the ground to altitudes of 20 km to the DACCIWA research data base, but coarser resolved vertical profiles of these variables were successfully submitted in real time to the weather forecasting centres worldwide. This success story would not have been possible without the grand support of African Weather Services, African academic colleagues, and students from Europe and Africa.

Radiosonde launch at Lamto (Côte d'ivoire)

Compared to the planned network as shown in the spring DACCIWA newsletter, two changes occurred. First, the enhancement of launches at Abuja from one to four could not be realized, but in collaboration with the German Weather Service (DWD), real-time submission of the operational 12 UTC sounding has been achieved. Outside the responsibility of DACCIWA, Douala (Cameroon) was silent due to missing consumables. The resulting DACCIWA radiosonde network is shown in the map. The first DACCIWA radiosonde went into the African sky in Kumasi on 11 June 2016, with Savé following on 13 June. Accra started soundings just a few days later. Between 20 and 27 June 2016, Abidjan, Cotonou, and Parakou slowly increased launching frequency to the planned four-times daily ascents. Between 29 June and 17 July 2016, the period of aircraft operations, all stations were fully active, except Lamto that started not until 06 July 2016. The last DACCIWA sonde was launched on 31 July 2016 at Accra.

A cohort of KNUST meteorology students went on an internship to GMET Headquarters and took part in DACCIWA soundings

High priority was given to submit the radiosonde data in real-time into the GTS such that the data are used at ECMWF (European Centre for Medium-Range Weather Forecast), Météo France, UK MetOffice and DWD in data assimilation of operational numerical weather prediction models. This turned out to be another success story, not at least due to the great support from Bernd Richter (DWD) and his team. In the meantime, feedback from all the above-mentioned weather services was obtained, clearly showing that the DACCIWA observations had a substantial positive impact on their operational analyses. Currently the data are uploaded



DACCIWA Radiosonde network and deployed sonde types. Blue: Operational or re-activated AMMA stations with enhanced sounding frequency; Black: DACCIWA super-sites; Red: DACCIWA stations operated by KIT, GMet, and UFHB; Yellow: Operational ASECNA and NWS stations outside the DACCIWA network

DACCIWA Radiosonde Campaign (cont.)

to the DACCIWA data base for usage by DACCIWA and associated partners, and will be freely available after the agreed two-year embargo period. As a cautionary note, it must be stated that at low levels, some quality issues with relative humidity at near saturation environments at Accra and Lamto have been identified. Pending on finding a solution for a posteriori correction, these parameters will be updated for these stations.

The DACCIWA radiosonde campaign was not only a science success, but also tightened collaborations between African and European researchers and students.

A great experience at several sites was the collaborations with local colleagues and the involvement of African students. They showed a great interest and engagement to help in sounding preparations and timely real-time submissions. For example, at Lamto and Accra, altogether about 10 students from Karlsruhe Institute of Technology (KIT) worked together with African colleagues and students and very positive experiences were received from all of them. At Accra a cohort of KNUST meteorology students went on an internship to GMET Headquarters and took part in DACCIWA soundings. From the photo, it is clearly apparent that a high interest was shown by the KNUST students. Thus, the DACCIWA RS campaign was not only a science success, but also tightened collaborations between African and European researchers and students, thus contributing to capacity development and human networking.

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

DACCIWA special session at EGU

AS4.3/CL2.21—EGU 2017 Atmospheric composition, weather and climate in Sub-Saharan Africa

Session description:

This session is open to a wide range of contributions on atmospheric sciences in Sub-Saharan Africa, with a focus on tropical regions.

Contributions are invited on various relevant topics, related to Sub-Saharan Africa, including:
* dynamical meteorology;
* atmospheric chemistry, aerosols and health impacts
* cloud microphysics and precipitation
* climate variability and change
* radiative processes

One ***focus of the session is*** the ongoing DACCIWA project and its large international field campaign in June-July 2016 in Southern West Africa.

Young scientist/student presentations are especially encouraged and we will reserve several oral units for such papers in this session.

Abstract submission deadline: 11 Jan 2017, 13:00 CET.
Conveners: C. Mari, J. Marsham, P. Hill and V. Yoboue
Venue: Vienna from 23-28 April

DACCIWA Publication

Why do global climate models struggle to represent low-level clouds in the West African summer monsoon?

Content in short

- Global climate models still show substantial problems in realistically reproducing low clouds and winds over southern West Africa during the summer monsoon
- Most models have a too weak diurnal cycle and overall too elevated clouds, particularly during the night.
- Models also tend to have too strong low-level jets but their impact on clouds is not clear due to competing effects on temperature and moisture advection, and mixing.
- Simulated tendencies of temperature and moisture differ greatly during the day with most models being too dry and sunn

Reference:

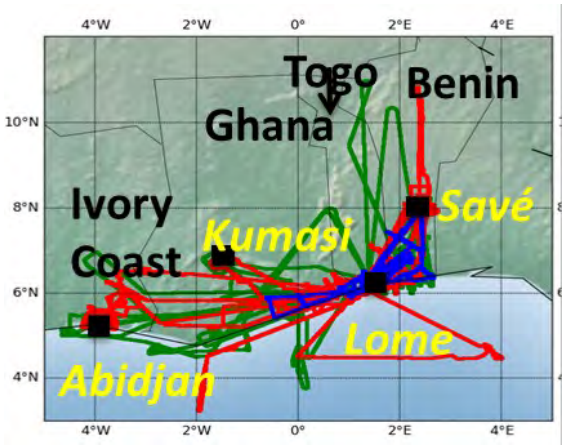
Hannak, L.; Knippertz, P.; Fink, A. H.; Kniffka, A.; Pante, G., 2016: Why do global climate models struggle to represent low-level clouds in the West African summer monsoon? J. Climate, in press, doi:10.1175/JCLI-D-16-0451.1.

The DACCIWA Aircraft campaign

Aircrafts for the DACCIWA campaign in Lomé, Togo

The main objective for the aircraft detachment was to build robust statistics of cloud properties in Southern West Africa in different chemical landscapes: from the background state over the Gulf of Guinea (marine aerosols or mix between marine aerosols and biomass burning aerosols) to ship/flaring emissions to the coastal strip of polluted megacities to the agricultural areas and forest areas further north, and eventually dust from Sahel/Sahara.

The project brought together three research aircrafts from three countries: the German Deutsches Zentrum für Luft- und Raumfahrt (DLR) Falcon 20, the French Service des Avions Français Instrumentés pour la Recherche en Environnement (SAFIRE) ATR 42 and the British Antarctic Survey (BAS) Twin Otter. The aircraft component of the field phase of DACCIWA started on 27 June (first scientific flight on 29 June) and concluded on 16 July 2016 (last scientific flight). The three research aircrafts were deployed from the Lomé Military Airport and conducted a total of over 155 science flight hours, including hours sponsored through 3 European Facility for Airborne Research (EUFAR) projects. The aircrafts were used in different ways based on their strengths, but all three had comparable instrumentation with the capability to do gas-phase chemistry, aerosol and clouds, thereby generating a rich dataset of atmospheric conditions across the region.



Flight routes: blue BAS TwinOtter, green: Safire ATR, red: DLR Falcon

DACCIWA operations were coordinated from the DACCIWA Operations Center (DOC) located in Hotel Onomo in Lomé, ~15-20 minutes away from the Lomé Military Airport. The DOC began operations on 25 June to prepare forecasts for the first potential flight operations and to test communications with the 2 ground-based supersites (Savé, Benin and Kumasi, Ghana) as well as with the ground-based site in Ile-Ife (Nigeria). Forecasting support for the project was resumed on 15 July 2016. Two daily briefing meetings were organized at the DOC during the period of the aircraft detachment, at 1100 and 1900 UTC between 25 June and 15 July.

The overarching objective of the airborne component of the DACCIWA project was to accommodate the objectives of work packages WP3 (Chemistry), WP4 (cloud-aerosol interactions) and WP5 (Radiation) as thoroughly as possible, but also contribute to the experimental strategy of WP1 (Section 3) and WP2 (Section 5). For that purpose, six types of flight objectives were conducted over Togo (detachment base) and surrounding countries (Ivory Coast, Ghana, Benin and Nigeria): (i)

DACCIWA operation center, briefing meeting

News from the field

The DACCIWA Aircraft campaign

Left: SAFIRE ATR scientist during research flight, middle: city of Lomé from aircraft, right: instrumentation inside the aircraft

Stratus clouds, (ii) Land-sea breeze clouds, (iii) Biogenic emission, (iv) Megacities emission (v) Flaring emission and (vi) Dust and biomass burning aerosol. The focuses of the 3 EUFAR projects were: (i) Ship tracks in the Gulf of Guinea, (ii) Mid-level clouds over Benin and (iii) Low-level atmospheric circulation in the Gulf of Guinea. Flight Plans were engineered so that they could accommodate several objectives.

Contact: Cyrille Flamant
(cyrille.flamant@latmos.ipsl.fr)

DACCIWA publications

The South Atlantic Anticyclone as a key player for the representation of the tropical Atlantic climate in coupled climate models

Content in short

- Role of the South Atlantic Anticyclone (SAA) on the seasonal cycle of the tropical Atlantic is investigated with a regionally coupled atmosphere–ocean model.
- In boreal winter, a too weak SAA in the coupled experiments weakens the winds over the southeastern tropical Atlantic, deepens the thermocline and prevents the local coastal upwelling of colder water, causing a warm sea surface temperature bias.
- In boreal summer, the deeper thermocline and atmospheric fluxes are probably the main warm biases sources. Biases in incoming solar radiation and thus maritime cloudiness seem to be a secondary effect and are only observed in boreal summer.
- External prescription of the SAA south of 20°S in the simulation improves the seasonal cycle over the tropical Atlantic, revealing the fundamental role of this anticyclone in shaping the climate over this region including adjacent Africa.

Reference:

William Cabos, Dmitry V. Sein, Joaquim G. Pinto, Andreas H. Fink, Nikolay V. Koldunov, Francisco Alvarez, Alfredo Izquierdo, Noel Keenlyside, Daniela Jacob, Climate Dynamics, Published online August 2016, doi: 10.1007/s00382-016-3319-9

Validation of TRMM and FEWS Satellite Rainfall Estimates with Rain Gauge Measurement over Ashanti Region, Ghana

Content in short

- Comparison of TRMM and FEWS satellite-based rainfall estimates with standard analog rain gauges (SRG) and automatic rain gaugeS (ARG) data in the Ashanti region (Ghana)
- Validation results showed good agreement with correlation coefficients of 0.6 and 0.7 for TRMM and FEWS with SRG, and 0.87 and 0.86 for TRMM and FEWS with ARG respectively.
- Probability Of Detection (POD) and Volumetric Hit Index (VHI) were found to be greater than 0.9.
- The biases were less than 1.3 and 0.8 for TRMM and FEWS respectively.
- Both TRMM and FEWS were able to capture the onset, peak and cessation of the rainy season, as well as the dry ***spells.***

Refercence:

Amekudzi, L.K., Osei, M.A., Atiah, W.A., Aryee, J.N.A., Ahiataku, M.A., Quansah, E., Preko, K., Danuor, S.K. and Fink, A.H. (2016) Atmospheric and Climate Sciences , 6, 500-518.
http://dx.doi.org/10.4236/acs.2016.64040

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Next Newsletter

Spring 2017

Contact us

Project Coordinator:
Prof. Dr. Peter Knippertz
Professor of Meteorology
Karlsruhe Institute of Technology
76128 Karlsruhe, Germany
Phone: +49 721 608-43565
E-mail: peter.knippertz@kit.edu

Web: www.dacciwa.eu
@DACCIWA
www.instagram.com/dacciwa
www.facebook.com/dacciwa.eu/

DACCIWA Newsletter coordination:
Cornelia Reimann (KIT)
cornelia.reimann@kit.edu

DACCIWA publications

The onset and cessation of seasonal rainfall over Africa

Content in short

- Variation in the seasonal cycle of African rainfall is of key importance for agriculture.
- We diagnose onset and cessation of the rainy seasons across Africa.
- Our technique is adapted to represent regions experiencing two rainy seasons such as the coastal region of Ghana and the Ivory Coast.
- We find consistent onset and cessation characteristics in satellite -based rainfall datasets but deficiencies in the widely used ERA -Interim reanalysis.
- Future work will apply our methods in the evaluation of climate model simulations.

Refercence:

Dunning, C. M., E. C. L. Black, and R. P. Allan (2016),
J. Geophys. Res. Atmos., 121, 11,405–11,424,
doi:10.1002/2016JD025428.

A multisatellite climatology of clouds, radiation, and precipitation in southern West Africa and comparison to climate models

Content in short

- Document the climatology of clouds, precipitation and radiation and their interconnections by combining satellite observations and simulations in June-July over Southern West Africa.
- Large differences between mean cloud cover observations, ranging from 68 to 94%.
- Clouds, radiation and precipitation are linked in an analysis of the regional energy budget, showing strong connection between inter-annual variability of precipitation and dry static energy divergence.
- Models tend to underestimate low cloud cover, leading to a large spread in outgoing shortwave radiation.
- Models also show signs of convection developing too early in the diurnal ***cycle***

Refercence:

Hill, P. G., R. P. Allan, J. C. Chiu, and T. H. M. Stein (2016),
J. Geophys. Res. Atmos., 121,
doi:10.1002/2016JD025246.

DACCIWA

Project Partners

- Karlsruher Institut für Technologie (DE)
- University of Leeds (UK)
- University of York (UK)
- The University of Reading (UK)
- The University of Manchester (UK)
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DE)
- Université Paul Sabatier Toulouse III (FR)
- Université Blaise Pascal Clermont-Ferrand II (FR)
- Université Paris Diderot - Paris 7 (FR)
- European Centre for Medium-Range Weather Forecasts (UK)
- Eidgenoessische Technische Hochschule Zürich (Switzerland, CH)
- Kwame Nkrumah University of Science and Technology Kumasi (Ghana, GH)
- Obafemi Awolowo University (Nigeria, NGR)
- Université Pierre et Marie Curie - Paris 6 (FR)
- Met Office (UK)
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