2.4: Aerosols and Chemical Processes in the Atmosphere

Laboratories: CNRM, IRD, LA, LAMP, LISA, LPCE, LSCE, LOA, SA, ELICO

General objectives:

This WP is devoted to the study of the processes which control the ozone and aerosol budgets and the oxidising capacity of the atmosphere within the West African Monsoon region.

We know that West Africa is a major source region for natural and anthropogenic aerosols. Depending on the season aerosols particles are a mixing, in variable proportion, of soil dust coming from the Sahara/Sahel and carbonaceous aerosols. Other types of aerosols are present as well: emissions of sulfate and carbonaceous aerosols from the large urban areas which exist in this region, aerosol particles of marine origin advected by the monsoon flow and secondary organic aerosols formed by the biogenic gas emissions. The mixing state of the aerosols, their chemical component, microphysical and radiative properties are contrasted between the dry and wet seasons and remain highly uncertain. Quantification of the sources of aerosols over Western Africa is a key objective of AMMA: it is crucial for biomass burning and fossil fuel emissions and dust. During the wet season, the nature of the interactions between the WAM convective environment and these aerosols is not yet understood. Aerosols can affect the chemical and physical properties of cloud particles, their radiative properties and, thus, precipitation mechanisms. These interactions could have implications for regional hydrological budgets. For example recent studies suggest that mineral dust can suppress precipitation in clouds. Thus increased dust during drought cycles could have the effect of exacerbating drought and propagating drought conditions over larger areas. AMMA will give the opportunity to observe the differential cloud response to very different aerosols (mineral dust, biomass burning, secondary organic aerosols from the vegetation). In this WP, we aim at investigating the effects of the dry and moist convection (including wet deposition) on the aerosols sources, transport and vertical layering. In turn, we intend to understand the way by which the aerosols can modify the convective-synoptic systems through their optical and hygroscopic properties.

Due to the combination of the existence of major sources of ozone precursors and aerosols with an intense convective activity over WA, it is likely that this region is making a significant contribution to the global atmosphere oxidising capacity. Indeed, once emitted the chemical constituents and their degradation products can be rapidly uplifted into the free troposphere and the TTL by deep convection where they are transported over long distances away from the source regions. The quantification of the HO_x budget is a key objective in AMMA as convective injection of species present in the atmospheric boundary layer can be one of the main sources of HO_x in the upper troposphere. Another important objective relates to the ozone distribution and its budget. In the vicinity of tropopause, ozone is a particularly active greenhouse effect gas and it strongly influences photochemistry as it is a source of HO_x in the presence of UV radiation and water vapor. Therefore, there is a need to determine the contribution of emissions over West Africa to the budget of ozone over this region and beyond. The task is not easy as West Africa is an unique superimposition of contributions from different African sources that will enter the ITCZ convection: monsoon moist air passing over South Atlantic ocean and the tropical rain forest (biogenic emissions), harmattan dry air flowing over arid areas, polluted air from urban areas.

The quantification of the sources of trace gases over Western Africa is also a key objective of AMMA. The emissions from soil and vegetation in natural and disturbed ecosystems still need to be quantified. These processes yield emissions of hydrocarbons from vegetation and nitrogen compounds from soils. There is a large variability in emissions depending on the vegetation species and the vegetation and soil response to rainfall and evaporation related to the monsoon. Anthropogenic pollution resulting from the use of fossil fuels and human activities has increased in

the high population density areas over West Africa. It is clear that there are also important but still unquantified emissions from the large urban areas which exist in this region. Finally, West Africa is one of the most electrically active region of the world and the production of nitrogen monoxide by lightning in convective clouds is an important source of NOx in the troposphere. Large uncertainties surround the estimates of the magnitude and spatial/temporal distribution of this source.

In order to evaluate the impact of the WAM on the global atmospheric composition and climate, process studies are needed at a variety of scales, from the cloud system to the regional scale.

In this WP, we aim at integrating the scientific understanding of the aerosol and chemical processes obtained from the cloud to the regional scale and to feed this knowledge into the Integrative Science on the WAM impacts on global budget of aerosols and ozone and global climate (WP 1.1). To achieve this goal, this WP is divided into a management structure and 4 scientific sub-WPs:

WP2.4.1 Aerosol radiative properties and hygroscopicity is concerned with the physico-chemical characteristics, hygroscopic, optical/radiative properties and regional and vertical distributions of the main aerosol types in the WA region.

WP2.4.2 Gas and particle phase chemistry deals with the chemical composition and aging of air masses at local and regional scale including the impact of VOCs, water vapor, NOx and secondary organic aerosols.

WP2.4.3 Surface processes addresses the emissions and deposition fluxes of gases and aerosols in the WAM region including emissions of aerosols due to wind erosion or biomass-burning activity, and of trace gases from soils and vegetated surfaces.

WP2.4.4 Effect of convection on chemical and aerosol budgets is concerned with the details of the impact of cloud systems on the redistribution and budgets of aerosol and ozone precursors in the mid-, upper- troposphere and TTL.

2.4.1: Aerosol radiative and hygroscopic properties

Laboratories: CNRM, ELICO, IRD, LA, LAMP, LISA, LSCE, LOA

2.4.1a 5 years plan

Objectives

Depending on location and season, aerosols over West Africa (WA) result from a mixing of mineral dust coming from the Sahara and/or the Sahel, biomass/domestic burning aerosols, aerosols produced from biogenic emissions, or sulfates coming from urban and industrial regions along the gulf of Guinea, North Africa or Europe. The direct radiative effect of aerosols can go from a warming effect to a cooling effect depending on surface albedo and aerosol absorption. The evolution of the aerosol properties along their transport path can lead to modifications of their indirect and semi-direct impact on the cloud properties.

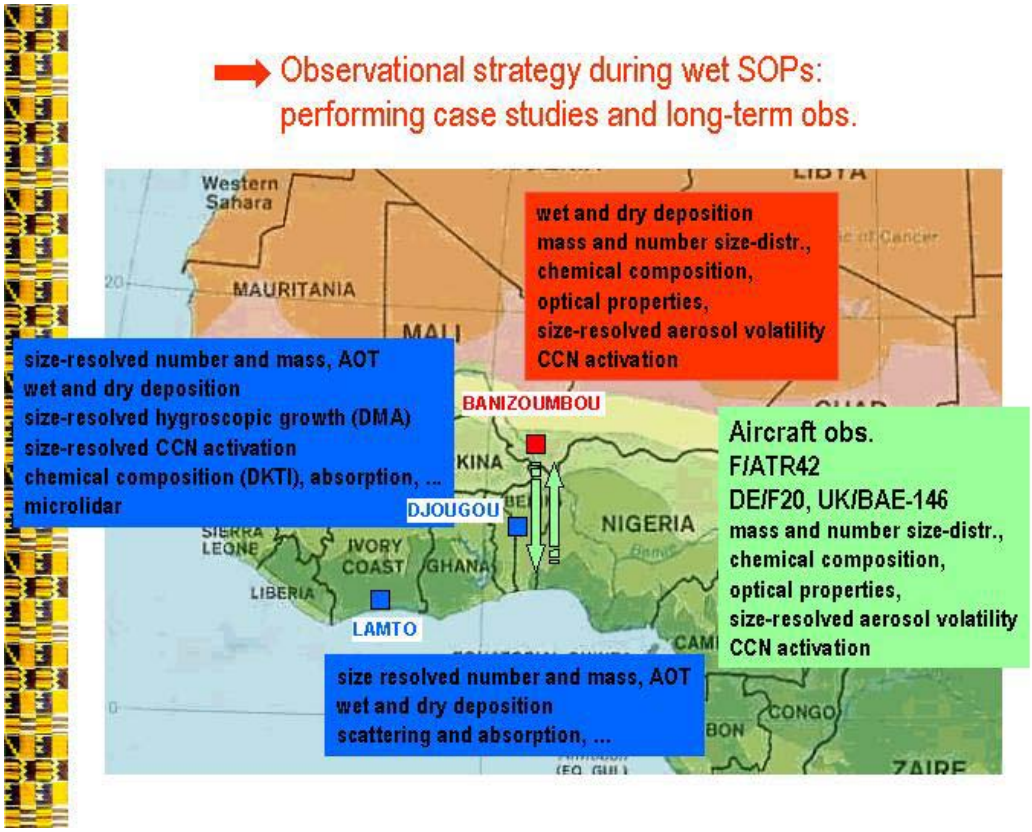
The main objective of this sub-WP is to provide the basic scientific understanding of the physico-chemical characteristics, hygroscopic and optical/radiative properties, and regional and vertical distributions of the main aerosol types in the WA region. This knowledge is necessary to determine the aerosol radiative effects, required to predict their impact on the dynamics and convection in the

WAM correctly, and to quantify the export of material over the Atlantic Ocean. Much of the improved understanding obtained by this sub-WP will be built on the interpretation of new data collected during the EOP and SOPs 0, 1 and 2. It must be noted that SOPs 0 is dedicated to the assessment of the direct radiative effect of mixed aerosols (mineral dust and biomass burning aerosols) during the dry season.

Scientific questions and methodology

Within this sub-WP, the following questions will be addressed:

What is the regional and vertical distribution of the mineral dust aerosols over WA?	
The vertical distribution of mineral dust will be assessed during the SOP 0,1,2 based on in-situ aircraft measurements of aerosol concentration and properties (mass and number size-distribution, chemical composition, optical properties), vertical distribution of the optical properties (lidar measurement on the F/ATR-42 and F/F20 in SOP 0) and from similar ground-based measurements of aerosols concentration (size-resolved number and mass size-distribution) and vertical distribution (lidar measurements SOP0, IP collaboration) performed in Banizoumbou (Niger)) and vertical distribution of the aerosol optical properties (lidar measurements, SOP 0,1) measured in Tamanrasset The regional distribution of the mineral dust will be assessed from continuous measurements of aerosol concentration (PM10), optical thickness (AERONET sunphotometer) and vertical distribution (microlidar, IP collaboration) performed along the "dust sahelian transect" (Banizoumbou-Niger, Cinzana-Mali, M'Bour-Senegal) during the EOP. The location of these stations allows the sampling of mineral dust from different source regions along their main transport pathway. The measured vertical distribution of mineral dust fields will be compared with the three-dimensional mineral dust fields calculated by the CHIMERE and RAMS dust regional model. The simulated dust distribution will be further constrained using satellite derived information available over the ocean (optical thickness, angström coefficient, ...) and the continent (aerosol index). 	P. Formenti, G. Bergametti, F. Dulac, L. Menut, B. Marticorena, J.-L. Rajot P. Chazette, P.Couvert G. Cautenet, C. Bouet

What is the regional and vertical distribution of the mixed aerosols (including sulfate and carbonaceous) over WA?	
The regional distribution of mixed aerosols will be inferred from measurements at three ground based sites: Lamto (Ivory Coast), Djougou (Benin) and Banizoumbou (Niger). The vertical distribution of the mixed aerosols will be derived from in situ-aircraft measurements (F/ATR-42 during SOP 0,1,2) and lidar measurements (F/ATR-42 and F/F20 in SOP 0). Flights will be conducted on North-South at different altitudes in order to resolve the 3D variation of mixed aerosols concentrations and to look at the vertical and horizontal gradients of aerosol properties. A geographical extension of the N-S transects is proposed with further North up to Tamanrasset (Algeria) to sample the "pure" mineral aerosols in the heat-low and up to the ocean to measure the aerosol composition of the monsoon flux (sea-salt and sulfate). During the EOP, the columnar aerosol content and size distribution in the three ground stations will be derived from AERONET photometer measurements, and the vertical distribution will be available in Djougo-Benin (micro-lidar, Italian contribution, IP). The regional distribution of the different aerosols components and state of mixing will be further constrained from the satellite derived aerosol optical thickness and size distribution (AQUA-Train, MODIS, ...). Process studies at cloud scale will be performed (Meso-NH) to improve the parameterisations used in regional (RegCM3, RAMS) and global scale modelling (TM4, MOCAGE, LMDz) to study mixed aerosol formation, aging and transport (see WP1.1.2). 	C. Liousse, V.Pont C.Galy, R.Rosset J. Pelon, P. Chazette, P. Couvert, H. Cachier, J. Sciare, P. Laj, A. Schwarzenboeck, L. Gomes, P. Tulet, Grini, S. Crumeyrolle, J.-C. Roger, C. Coeur, P. Dubuisson, D. Tanre, J.F. Leon, I.Chiapello, G. Cautenet, C. Bouet

How does this distribution of aerosols depend on the seasonal and interannual cycle of the monsoon?	
In the troposphere, aircraft observations will be repeated during the dry season (SOP0) and two stages of the monsoon cycle (SOP1 and 2) in order to precisely document the variability of the aerosol distribution and properties for the two seasons. At the surface, ground-based measurements (Lamto-Ivory Coast, Djougou-Benin and Banizoumbou-Niger) will be operating during the EOP and LOP to capture seasonal, intraannual and interannual changes in mixed aerosols distribution. Similarly, the continuous ground-based measurements (mass concentration, wet and dry deposition, lidar vertical profiles and aerosol optical thickness) performed during the EOP in the "dust sahelian transect" sites will be used to capture the seasonal intra-annual and interannual changes of the dust distribution. Regional simulations from CHIMERE-dust model including the influence of the seasonal vegetation on the dust emissions will be used to investigate their relationship between the variability of the dust content over the WA and the variability of the monsoon.	Liousse, V.Pont C.Galy, R.Rosset J. Pelon, F. Dulac, H. Cachier, J. Sciare, P. Laj, L.Gomes, P.Tulet, S. Crumeyrolle, G.Bergametti P.Formenti, B. Marticorena, J.L. Rajot, J.-C. Roger, C. Coeur, P. Dubuisson
How do the physical-chemical properties of mineral dust depend on source region (Sahara/Sahel)?	
Physical-chemical properties of mineral dust will be characterized at the ground based station of Banizoumbou during the dry season SOP0, where the main expected dust sources are located north of the Chad lake (Bodélé Depression) and during the rainy season SOP1,2, where local emissions may occur. Variations in the dust compositions between these two periods will be connected to differences in the soil composition in the source region.	K. Deboudt, P.Formenti, S. Alfaro, A. Gaudichet, J.L. Rajot, P.Flament, K. Deboudt
How does the single scattering albedo of dust aerosols depend on their iron oxide?	
Iron oxide content has recently been found to correlate with the absorption properties of mineral dust. Iron oxide content of natural dust will be quantified on dust samples collected at the Banizoumbou station simultaneously with measurements of the dust spectral optical properties (scattering with a nephelometer and absorption with an aethalometer)	S. Alfaro, A. Gaudichet, J.L. Rajot
How does the single scattering albedo of mixed aerosols depend on their black carbon/organic carbon (BC/OC) content?	
Aerosol absorption and scattering are monitored at Lamto and Banizoumbou during the whole EOP period. Simultaneous measurements of the optical and chemical properties of mixed aerosols made at these two sites will be used to determine the sensitivity of the single scattering albedo to the BC/OC content.	C. Liousse, V.Pont, C.Galy, R.Rosset, J.C. Roger, C.Coeur, J. Sciare
How does mixing change the surface, hygroscopic, and optical properties of dust and biomass aerosols?	

Measurements of the hygroscopic properties will carried out during SOPs 0-2, as a function of the chemical composition and state of mixing of aerosols provided by in situ ground-based aerosol, rainwater collection and aircraft sampling. Ground-based measurements will be conducted at Lamto-Ivory Coast, Djougou-Benin and Banizoumbou-Niger. In Djougou and Lamto, size-resolved chemical information will be linked to size distributions (SMPS), size-resolved hygroscopic growth (DMA) and size-resolved CCN activation (CCNC). The privileged platform is the F/ATR42. During SOP0, the CVI probe is proposed onboard the french ATR-42. It will allow for measurements of cloud water content and residual particles properties. Modeling studies on selected episodes will be performed with mesoscale meteorological models coupled with aerosol and chemistry module. Global modeling will be accomplished in WP1.1.2.	J.C Roger, C.Coeur, P. Dubuisson, K. Desboeuf, P. Formenti, A.Gaudichet, S. Alfaro F. Dulac P. Laj, A.Schwarzenboeck, L.Gomes, P.Tulet, S. Crumeyrolle, C. Liousse, V.Pont, C.Galy, R.Rosset, J. Sciare G. Cautenet, C. Bouet
How does the aerosol vertical layering control its radiative impact?	
Typical aerosol flights on F/ATR42 will include vertical profile to determine the vertical structure of aerosol properties but also direct measurements of the vertical distribution of aerosols optical properties (lidar during SOP 0). The measured vertical-resolved aerosol properties will serve as an input of radiative transfer codes in order to evaluate the direct radiative forcing at a local and regional scale. Parameterisation of the aerosol optical properties will be developed based on detailed radiation schemes. Radiative transfer modelling will allow an assessment of the radiative impacts of West African aerosols at the local and regional scales. The impact of the aerosol horizontal heterogeneity on the radiative heating profiles and actinic fluxes will be tested in the RAMS model. Intercomparison of assimilated aerosol parameters and radiation budget with satellite remote sensing will be carried out. These process study may improve the assessment of the aerosol radiative impact on the radiative budget and the atmospheric dynamics.	J.C Roger, P. Dubuisson, P. Formenti, S. Alfaro, L.Gomes, S. Crumeyrolle, J. Pelon, C. Liousse, V.Pont, C.Galy, R.Rosset G. Cautenet C. Bouet
What is the role of aerosols on the dynamics of the heat low?	
Aerosols through their radiative impact affect the dynamics of the heat low. Preliminary results from WP21 have shown that changes in aerosols payload or aerosols radiative properties can change the location of the heat low. Although there is no researcher working directly on this question in WP24, input from this WP on the mineral dust emissions and distribution, size distribution and optical properties will be valuable for WP21. In particular, aerosols measurements onboard the F/ATR-42 and DLR/F20 are crucial. Modeling activities will be conducted jointly with WP21 on this question.	coll. WP21: JP Lafore et C.Flamant

Foreseen deliverables

- To characterise the physical, chemical, hygroscopic and optical (radiative) properties of the aerosols from WA, as a function of source region and mixing state
- To provide experimental evidence on the temporal evolution and vertical variability of the aerosol properties needed to characterise their transport processes

- To implement optical modelling algorithms in order to interpret aerosol optical parameters in terms of aerosol composition and microphysics
- To evaluate their radiative forcing and climatic impact over West Africa at the local and regional scale, in order to provide insights on their impact on the dynamics of the WAM.
- To validate retrievals from new satellites (e.g., the AQUA-Train, CALIPSO)
- To develop validated parameterisation schemes for atmospheric models

2.4.1a 1 year plan

Objectives

This subWP highly relies on the analysis and interpretation of the Special Observation Periods (SOP), mostly SOP 0 in the dry season, and SOP 1, at the onset of the monsoon season. The first months of the project will be largely devoted to the evaluation of the experimental, observational, modeling, and logistic tools necessary for achieving WP2.4 scientific objectives during SOPs: (i) developing the observational tools for effective use of the observations collected in the Enhanced Observing period (EOP) and SOP, (ii) providing the relevant model results, pre-SOP case studies and theoretical ideas to help to planning atmospheric observations within WP4.2

Work content

- Refine the experimental procedure to measure aerosol physico-chemical, hygroscopic and optical properties.
- Refine preliminary flight planning, and ground-airborne coordination, to be used during SOPs.
- Define actual tools and needs in terms of optical modelling algorithms

Foreseen deliverables

A report on algorithms to be used for optical modelling of aerosols
A report on the required observational deployment and modelling priorities for input to WP4.2 and WP 4.3

2.4.2: Gas and particle phase chemistry

Laboratories: CNRM, IRD, LA, LAMP, LISA, LSCE, LOA, SA, ELICO

2.4.2a 5 years plan

Objectives

The main objective of this sub-WP is to provide the basic scientific understanding of the gas phase and particle chemistry required by the other sub-WPs in this WP that are designed to address more specific targets. Specifically it is to characterise (locally and regionally) the trace gas chemical composition and the rates of gas phase and heterogeneous processing in different air masses within the WAM region. This knowledge is necessary to determine the impact of emissions from West Africa on the chemical processing of air as it is transported through the WAM system and exported globally. Much of the improved understanding will be built on the interpretation of new data collected in WP4.2 during the EOP and SOPs and by satellites (WP4.3).

Scientific questions and work Content

The aim will be to answer questions such as the following:

How does the distribution of water vapour produced by the WAM circulation affect oxidant budgets (O_3 and OH)?	
The role of water vapour as precursor of OH will be deduced from the analysis of airborne measurement (O3, OH, NOx, VOCs, H2O) made by the F/F20, UK/BAe146 and DE/F20 for different episodes. Observationally constrained zero-dimensional models will be used in the determination of the rates of processing and the model diagnostics from WP2.1 will be used to describe the transport pathways. Model analysis at mesoscale and large scale of OH production will be related to variable O3, NOx and H2O content depending on the age and geographical location of the studied mesoscale convective systems.	K. Law, G. Ancellet, A. Kukui C. Mari M. Leriche S. Cautenet
What is the net impact of biogenic VOCs on the oxidative capacity?	
Improved emissions of biogenic VOCs accounting for their dependence with relevant meteorological and ecosystems parameters (see 2.4.3) will be used by regional and global models to test the sensitivity of ozone and OH production to this newly developed emissions. The use of chemical diagnostics to act as indicators of source types, concentrations of unmeasured species and the rate of processing will be tested. This will feed into the evaluation of the chemical mechanisms of chemical transport models (WP4.1).	D. Serça, C. Delon, R. Dupont, J. Lathiere, S.Cautenet, F. BouoBella
What are the major sources and sinks of the oxidants?	
Emissions inventories of the main oxidant precursors (NOx and VOCs) will be established over West Africa (see 2.4.3), based on flux measurements performed in Djougou-Benin. In addition, ground-based measurements of O3 concentration and deposition fluxes (O3-vegetation will be performed in the same site. The vertical distribution of oxidants precursors (NOy compounds and primary and secondary VOCs) will be obtained from aircraft measurements during SOP1 and 2. These observations will be used as constrains on chemical models to evaluate their the capability to reproduce the sources and sinks of the oxidants. Concentrations of O3 and OH in the free troposphere will be deduced from P(O3) and P(OH) calculated using chemical measurements and using chemical fields from chemistry-transport model. A box model (M2C2) will help to understand the importance of this aqueous chemistry on the budget of O3 and radicals.The comparison between the two approaches will identify the possibly missing or ill-represented chemical processes in the ozone budget.	K. Law, G. Ancellet, A. Kukui, D. Serça, C. Delon, A. Borbon, C. Jambert, P. Perros V.Thouret, B.Sauvage, S. Cautenet, M. Leriche
What are the lifetimes of chemical species within the WAM?	
Aircraft observations during SOP 1 and 2 in the upper atmosphere of chemical organic compounds as well as OH and O_3 composition will provide the lifetime evaluation of selected compounds either by a kinetic approach or by ratio determination. The kinetic approach and ratio determination could be also carried out in the intermediate layers based on O_3 concentrations. Relative hydrocarbon concentrations, which can act as 'clocks', will be used to determine the time since emission. This will be useful in the evaluation of the characteristic timescales of transport process of the different chemical species and thus of the geographical extent of their transport domain (WP2.1).	P. Perros, P. Coscia,
Is there sufficient NOx emitted from soil and lightning for net O_3 production to occur?	

Improved inventory of NOx emitted by soil will be provided in the framework of AMMA(see 2.23). Regional and global models using this new inventories will be used and compared to pre-AMMA inventories for NOx. Total column of NO2 from ground-based SAOZ, measurements of NOx from the balloons and instrumented van near Djougou will provide informations on the production of NOx by lightning. Simulations of the O3 concentration with and without lightning source will be performed to test the sensivity of modeled ozone to this source. Finally the net O3 production due to these two NOx sources will be estimated.	D.Serça, C. Delon, JP Pommereau, F. Goutail, C. Mari, JP Pinty coll WP21 S. Soula
How much secondary organic aerosol is produced from anthropogenic and biogenic species in the WAM region?	
At ground level, particulate carbonaceous aerosol (black carbon and total organic carbon) and gaseous VOCs will be measured at Lamto-Ivory Coast, Djougou-Benin and Banizoumbou-Niger. Aircraft measurements during SOP 1 and 2 will provide anthropogenic and biogenic volatil organic compounds and their gas phase oxidation intermediate products at low and mid altitude. The oxidation intermediate products of interest will be identified using an explicit scheme for tropospheric VOC oxidation. This explicit scheme will be produced by automatic generator using as input the main primary VOC emitted in the WAM region as documented in the available emission inventories. Gaseous phase characterisation could be completed by the chemical characterisation of secondary organic aerosol (SOA) produced to provide a qualitative link between emitted COV and photochemistry. Moreover, a correlation study between CNN and secondary organic products could provide a quantitative assessment of VOC oxidation implication in SOA formation. The ground based and aircraft measurements will be used to constrain local, regional and global modeling of secondary organic aerosol formation, aging and transport will be achieved with dedicated aerosol module and specific emission inventories.. The interaction of anthropogenic and biogenic VOCs with other aerosols (biomass burning, pollution and mineral dust) and their effect on aging will be examined using a range of aerosol schemes within dynamical models.	C. Liousse V. Pont, C.Galy, R.Rosset, D.Serça, C. Delon, A. Borbon, C. Jambert,
What is the potential for new particle production in the free troposphere from biogenic and anthropogenic gas-phase precursors?	
Both the formation of the secondary organic aerosol and the interactions with their gaseous precursors will be parameterized in dedicated aerosol module and included in local, regional and global using the emissions inventories of anthropogenic and biogenic precursors developed for WA (see 2.4.3). The new particles production in the free troposphere will be evaluated using aerosol models treating the binary or ternary nucleation processes. The comparison of the modelled secondary aerosol distribution with observations (aerosol composition and CCN distribution mainly) will allow an evaluation of the capability of the model to reproduce quantitatively the new particle production process.	D.Serça, C. Delon, C. Liousse, R. Dupont

- The origin of the vertical layering of CO and ozone over major cities of West Africa will be inferred from the ozone soundings, aircraft (e.g. MOZAIC), ground based data, data assimilation through regional modelling and comparison with total tropospheric ozone from satellite
- The volatile organic compounds (VOC) degradation mechanisms in chemical models will be tested against observed concentrations of emitted VOCs and gas phase oxidised products.

Foreseen deliverables

- To characterise the trace gas chemical composition of the different air flows within the WAM
- To determine the impact of emissions of biogenic NOX and VOCs and transport pathways on the rates of chemical processing (e.g. O3 and HOx budgets, lifetimes)
- To link the secondary organic aerosols to emitted VOCs and photochemistry
- To assess the contribution of biogenic and anthropogenic emissions to new particle formation in the free troposphere
- To determine the spatial and temporal variations of O3, CO, NO2, SO2 and HCHO over West Africa
- To determine chemical diagnostics useful in the evaluation of transport timescales and chemical processing
- To create a sub-module to treat the aerosol dynamics of mineral dust including heterogeneous chemistry

2.4.2a 1 year plan

Objectives

Much of the work in 2.4.2 relates to new data from the SOPs. Therefore the work in the first months includes providing advice to WP4.2 regarding the observational strategy and preliminary analysis of data from the EOP.

- To provide a preliminary statistics of ozone vertical layering
- To provide a preliminary estimation of secondary aerosol formation from anthropogenic and biogenic origins.
- To identify the main reactive products of VOC oxidation.

Description of work

- The vertical layering of ozone and CO over West Africa will be inferred from the MOZAIC program ozone and CO data, ozone soundings, back-trajectories and regional modelling. Total tropospheric ozone will be derived from satellite data.
- The formation of secondary organic aerosols and the hygroscopicity of mixed aerosols will be inferred from IDAF network and from ground-based measurements from AMMA super-sites (Lamto and Djougou), satellite, regional modelling (Models: Meso-NHC, RegCM3 with aerosol modules included).
- Work on the parameterization of the relevant heterogeneous reactions of mineral dust.
- The identification of VOC oxidation products will be provided by the use of an automatic generator of explicit chemical schemes for tropospheric VOC oxidation

Foreseen Deliverables

- Preliminary results of aerosol modelling
- Preliminary results on the chemical origin of ozone vertical layering over selected WA cities
- Preliminary results on relevant oxidative products of VOC

2.4.3: Surface processes

Laboratories: IRD, LA, LAMP, LISA, LSCE, LOA

2.4.3a 5 years plan

Objectives

The main objective of this sub-WP is to assess and quantify the emissions and deposition fluxes of the chemical compounds present in the West African atmosphere. The natural emissions of gas and aerosols over West Africa are strongly influenced by the climatic conditions at various time scales, either directly via meteorological parameters or indirectly via the vegetation and soil properties. One of the key issue of this sub-WP is thus the assessment of the variability of the emissions of aerosols over West Africa due, in particular, to wind erosion and biomass burning activity, and of trace gases from soils and vegetated surfaces. The final objective is to establish the degree to which their variability is related to human activities or to climatic parameters. In addition to natural and biomass burning emissions, estimations of the anthropogenic emissions over West Africa are necessary to fully investigate the atmospheric chemistry in WA region. Estimations of the emission and deposition of trace gas and aerosol are required as input for modelling of atmospheric chemistry at various time and spatial scale in order to improve the assessment of their impacts. Much of the improved understanding obtained by this sub-WP will be based on the interpretation of new data collected the EOP and SOPs and on the analysis of data obtained from satellite group (AMMA-Sat).

Scientific questions and methodology

Within this sub-WP, questions such as the following will be addressed:

What is the magnitude of surface emissions of aerosols and trace gases from WA?

The magnitude of the gaz and aerosol emissions from WA will be assessed through (1) the establishment of inventories of anthropogenic emission and (2) the improvement of explicit model for the natural emissions. The GEIA database emission inventories of anthropogenic emissions and biogenic emissions currently available over Africa will be preliminary used for modelling purpose. These emissions are representative of the year 1995 and calculated at resolution 1°x1°. Specific inventories will be established in order to provide updated emissions for the years 2000-2001 and 2006 with a relevant spatial resolution for regional models. Emission inventories for biomass burning (savanna, forest, agricultural fires); domestic fires (charcoal, wood, dung..), fossil fuel combustion (trafic, industry…) and biogenic emissions will be established for both aerosol and trace gases. Emissions factors for the various species and activities will be derived from a critical analysis of measurements and estimations available in the literature. Additional measurements for domestic and urban aerosols will be derived from in-situ and combustion chamber measurements. Biomass burning inventories will be provided for 2005 and 2006 based on burnt areas and vegetation characteristics derived from satellite data. Horizontal resolution will be 25 km x 25 km with a timestep of 10 days except during the dry season SOP0 (1-3 days). Anthropic emissions (urban and domestic fires) for particles, CO, HAP, VOC, NOx, SO2 will be derived from emission factors, population density, fuel consumption at 1°x1° resolution for 2005 on a annual basis and for typical scenarii (pre-industrial or future situations). Emissions of NOx by soil will be treated explicitely using the state-of-art emission fluxes parameterizations. These parameterization will be improved to account for the local conditions of agriculture fertilizers, soil humidity, type of vegetation. Ground-based measurements of isoprene (and potentially monoterpenes) fluxes and oxygenated compounds (methanol, ethanol, acetone) will be performed at Djougou-Benin during the EOP and SOP. The seasonal variability of the emission fluxes will be assessed through intensive periods of measurements during the dry and wet seasons (about two weeks). This variability will be correlated with relevant parameters (meteorology and ecosystems…). Emissions will be derived from in-situ measurements and extrapolated using vegetation map from satellite observation (access to the SPOT data at high resolution is upon request for the AMMA community). Soil and vegetation characteristics will be analysed to derive emission factors for naturally emitted NOx and VOCs and related to local and regional planetary boundary layer concentrations. Analysis of satellite data on chemical species will further constrain the identification of sources of NO2 and HCHO and the inter-annual variability of these emissions.	C.Liousse V. Pont, C.Galy, R.Rosset, D.Serça, C.Delon L. Menut, B. Marticorena, C.Schmechtig, JL Rajot, C. Granier, J. Lathière

Mineral dust emission will be quantified using a physically explicit dust emission scheme. The main process (erosion threshold, saltation, sand-blasting) involved in the dust production will be monitored on two agricultural parcels in Banizoumbou-Niamey. A special attention will be paid to the critical process of this model : dust production by sandblasting. To further constrain the modelling of this process, specific measurements of the size-resolved dust emission fluxes (in mass and in number) will be performed in Niamey during the SOP 1 and 2 using a new experimental procedure. The application of the dust emission model over West Africa will require meteorological data fields and input data on the superficial soil size-distribution and surface roughness. The increase of surface roughness due to the seasonal vegetation in the early stages of vegetation growth will be derived from modelling (STEP model) and satellite observations. For comparison, it will be experimentally determined over an agricultural site in Banizoumbou. A regional validation of this approach will be done by comparing the dust concentrations simulated by the CHIMERE-DUST transport model to ground and aircraft measurements from SOP 0,1, 2 in Banizoumbou-Niger and concentration, optical thickness and vertical distribution EOP in Banizoumbou-Niger, Cinzana-Mali and M'Bour-Sénégal.	
How do these emissions vary at the seasonal and interannual timescales in relation with the variability of the monsoon system?	
Emissions inventories for combustion aerosols and trace gases will be realised at the EOP/LOP time scale. Variations of the meteorological parameters controlling natural gaseous emissions and of the amount of biomass available for burning will directly impact the variability of the emissions of VOCs, NOx and carbonaceous aerosols. Biogenic emissions are highly sensitive to season. NOx emissions from soils are known to be dependant on soil water content and hence on precipitations. VOC emissions are correlated to the annual variability of emitting biomass and to fluctuation in basal emission factors that can be impacted by water stress for example. An idea of emission seasonal variations and of driven parameters will be deduced from in situ measurements performed during the different season (dry, wet, transition). The mineral dust cycle will be simulated for a 10 years period to investigate the influence of variability of the wind and precipitation pattern on the dust emissions. The simulations will be constrained by the dust measurements performed during the EOP in the 3 stations of the "dust sahelian transect". Modelling will be the integrative tool allowing the assessment of this balance at the regional scale. The simulations will be further constrained by the long-term measurements of the aerosol concentration, optical thickness, deposition and vertical stratification performed during the EOP.	C. Liousse V. Pont C.Galy, R.Rosset, D.Serça, C. Delon, R. Dupont, G. Bergametti, B. Marticorena, C. Schmechtig J.L. Rajot, C. Granier
What are the respective contributions of the climatic and anthropogenic factors in the variability of the aerosol (mineral dust and biomass burning aerosols)?	

Interannual estimate of emission inventory for biomass burning aerosol and gases will allow to test climatic and anthropogenic relative contributions. The anthropogenic fraction of the mineral dust emissions will be assessed based on land use data and on specific parameterization of the influence of agricultural practice on dust emissions (fraction of bare surfaces and exposure period for agricultural surfaces; decrease of vegetation cover and soil crusting due to trampling by livestock). These "anthropogenic" emissions will be compared to the "natural" contribution simulated on a long term period (~10 yrs).	C.Liousse, V. Pont, C.Galy, R.Rosset, G. Bergametti, B. Marticorena, J.L. Rajot
What are the respective contributions of the climatic and anthropogenic factors in the variability of trace gas emissions (Volatile Organic Compounds, VOCs and Nitrogen Oxides, NOx)?	
Contribution of climatic factors will be given through the biogenic emissions inventory and anthropogenic factors will be taken into account through measurements of urban and domestic fires sources (Cotonou and Djougou) Anthropogenic factors will be taken into account through measurements of urban and domestic fires sources (Cotonou and Djougou)	D.Serça, C.Delon, R. Dupont, C. Granier
What are the regulating factors of the wet and dry deposition of aerosols?	
IDAF-LOP set of measurements (chemical speciation, size discrimation, gaseous measurements, rain chemical composition …) will allow to determine key processus of deposition and deposition modeling improvement. Sensitivity studies on the wet and dry deposition parameterizations for mineral dust and improvements will be done with the CHIMERE-DUST model. The simulated deposition flux will be compared to the dust dry deposit measured on the "dust sahelian transect" during the EOP. Mineral dust being coarser than other aerosol types in WA, the size dependence of the dry deposition may be a critical process. The size distribution of the deposition fluxes would constitutes a strong constrain on the deposition parameterization, it will thus be tentatively determined.	C. Liousse, V. Pont, C.Galy, R.Rosset, L. Menut, C. Schmechtig, D. Goosens, JL Rajot
Are the African cities a significant source of aerosols and trace gases compared to the natural and biomass burning emissions?	
The development of specific inventories for both biomass burning and anthropogenic activities will allow an estimation of the relative weight of African cities in the emissions of trace gaz and aerosols. This estimation would greatly benefit of local measurement of emissions factors. An emerging proposition would be to compare the individual composition of aerosols collected downtown at Dakar and Cotonou to the individual composition of aerosols collected by other contributors at Banizoumboun (Niger) and on a site dedicated to biomass burning emissions studies (see also the document "Emissions urbaines" in appendix)	C. Liousse, V. Pont, C.Galy, R.Rosset,
Is the Sahelian belt a net source of mineral dust or a deposition area for Saharan dust ?	

Squall lines are the main responsible of both dust production and dust deposition in the vegetated Sahel. High resolution simulations of the mineral dust cycle during squall lines will be performed with the RAMS model and constrained by the SOP ground and aircraft measurements to estimate the balance between emissions and deposition at the scale of the event. The simulations will be extended to the EOP period with the CHIMERE-Dust model using the dust concentrations, deposition fluxes, optical thickness and vertical distribution measured along the "dust sahelian transect*". The balance between local dust emission and deposition will be established from the seasonal to interannual time scales.*	C. Schmechtig, D. Goosens, JL Rajot, L. Menut, B. Marticorena, G. Cautenet

Foreseen deliverables

- To assess the variability of aerosol and trace gas emissions over West Africa due, in particular, to wind erosion and biomass burning activity and how this relates to human activity and to climatic parameters, as an example, the monsoon intensity
- To establish the meteorological processes in WA that result in such close linking of dust transport to rainfall deficits in the region
- To evaluate the contributions of the different types of vegetation to natural emissions of nitrogen and organic species and to relate this to the annual cycle and seasonal variability of vegetation and soil wetness

2.4.3b 1 years plan

Objectives

During the first 12 months of the project, preliminary versions of emissions inventories will be established and sensitivity tests on emissions and deposition parameterisations to be implemented in regional models will be performed. Preliminary runs of available models should help the precise definition of the surface emission and deposition measurements deployed during the SOP

Description of work

- Definition of the experimental procedure to measure the size resolved mineral dust emission fluxes and the dry deposition fluxes
- Sensitivity tests on the factors regulating the mineral dust cycle at regional scale with a focus on the role of squall lines on mineral dust emission.
- Development of emission factors data base for trace gases and aerosols from biomass burning and anthropogenic activities
- Analysis of ground-based data on wet and dry deposition of trace gases and aerosols

Foreseen deliverables

- Mesoscale database of emission factors for Nitrogen oxides and Volatile Organic Compounds for natural and human disturbed ecosystems provided
- Preliminary version of biomass burning emission inventory over savanna-like areas and using the forest fires distribution of the year 2000 including monthly variations
- Preliminary version of biogenic and industrial emission inventory : mesoscale emission factor measurements for gases and particles
- Preliminary regional distribution of wet and dry deposition fluxes

- Preliminary estimation of the mineral dust emissions in the Sahara and Sahel for the year 2000.

2.4.4: Effect of convection on chemical and aerosol budgets

Laboratories: CNRM, LA, LAMP, LISA, LPCE, LSCE, SA

2.4.4a 5 years plan

Objectives

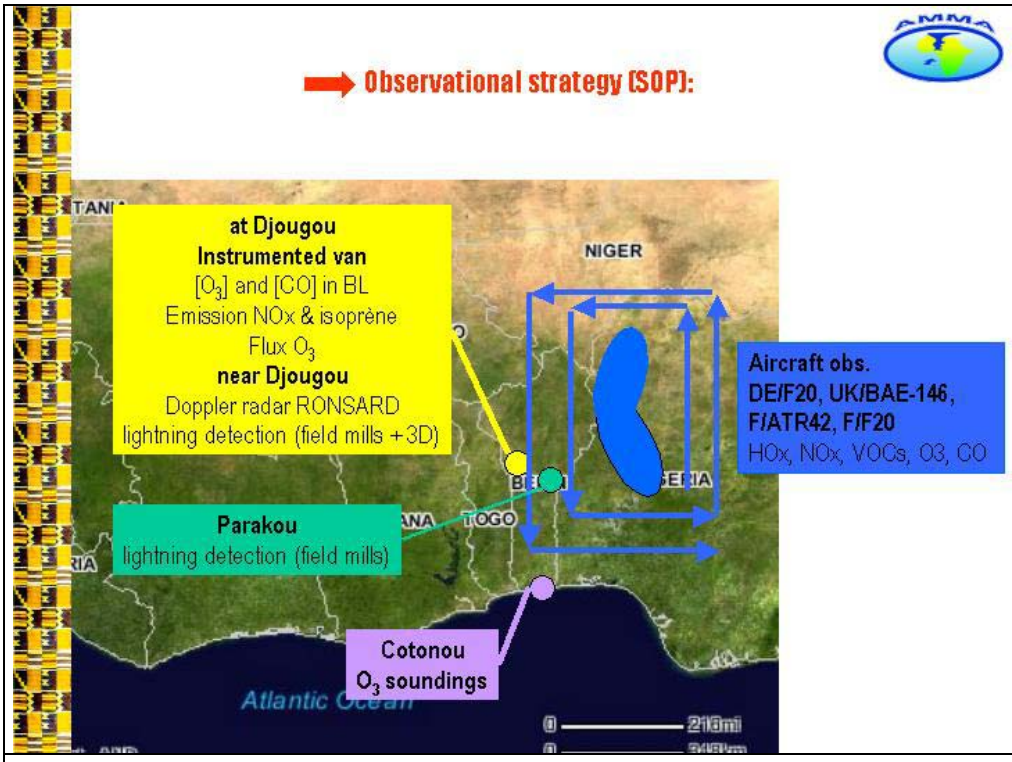
The main objective of this sub-WP is to quantify the impact of WAM convective processes on distributions and budgets of aerosol and chemical in the free troposphere. This sub-WP focuses on the impact of processes related to convection (vertical exchange, convective precipitation, lightning production) on the variability of aerosol and chemical species due to transport, mixing, and chemical reactions. Improved understanding will be gained following the interpretation of new data collected in WP4.2 during the EOP and SOPs, modelling effort supported in WP4.1, and satellite data analysis of the TTL (Tropical Tropopause Layer). The subWP will provide input into up scaling of water cycle closure studies (WP1.2) and quantification of export of oxidants and aerosols from West Africa and their impact on global climate (WP1.1).

Scientific questions and methodology:

The main questions addressed by this sub WP are:

What is the role of convective physical processes vertical transport, mixing, deposition on the budget of major oxidants and aerosols in the free troposphere over West Africa ?

Aircraft observations are planned to document the chemical composition • of the convective cloud outflows by 3 aircrafts (F/F20, DE/F20, UK/BAe-146) in the mid-troposphere and upper troposphere, • of the air mass entering the convective system by 1 aircraft (F/ATR42) At ground level, determination of water vapor budget will be deduced from the radiosounding network (see also WP2.1). The radars X-Port and RONSARD located near Djougou-Benin will document the precipitations and dynamics of the mesoscale convective systems up to the tropopause. Complementary measurements of ozone and CO content of the boundary layer air mass near or entering the convective system will also be available at Djougou-Benin. Chemical emissions will be derived from the ground-based determination of the emissions factors of NOx and VOC from vegetation and soils (see also WP2.4.3). Comparison of VOC vs a stable tracer (CO) ratios in the air mass inflows out outflows as an indicator of the convective processing. Simultaneous observations of heat, moisture and chemical profiles from SOP2 will be used to estimate the mean convective flux of trace constituents into the free troposphere and to constrain modelled entrainment and detrainment flux components using a cloud resolving model and a single column model coupled with chemistry. Cloud and local scale modeling of sampled convective systems (incl. explicitely resolved convection, aqueous-phase chemistry and scavenging, high spatial resolution) will allow to estimate the local scale budget of ozone and HOx. Extension to regional scale modeling (West Africa window) will be possible with the ozone-soundings at Cotonou-Benin and measurements from the MOZAIC program aircrafts. Global models with improved convection parametrisations, will be used to determine the role of dynamical and physical processes (e.g. washout, mixing) associated with convective systems on regional trace gas budgets (e.g. ozone). The interaction of convective outflows with air masses of different origin will be investigated using combined photochemical trajectory and global models and data on the photochemical reactivity of air masses in convective outflow regions obtained in 2.4.2. In particular, the possibility for interesting interactions with dry air masses which may be polluted, having been uplifted from the continental boundary layer in mid-latitudes. The mixing of these air masses which are dry and possibly containing aged pollutants and fresh injection of convectively uplifted air containing O3/HOx precursors will be studied.	C.Mari, F. Said, M. Lothon, F. Lohou K. Law, G.Ancellet, A.Borbon, C. Jambert, P. Perros, P.Tulet, B. Josse V.Thouret, B. Sauvage, M. Pham S. Cautenet M. Leriche coll WP21 D. Ramond et R. Rocca.



How do deep convective processes influence the distributions of chemical constituents in the upper troposphere and the TTL compared to other transport processes ?

Tracer measurements (airborne, ozone soundings) and satellite data (e.g. ENVISAT, CALIPSO, METEOSAT) will be explored to assess the perturbation to chemical composition in the upper troposphere. A combination of cloud-scale, mesoscale and trajectory modelling will be used to characterise the TTL. Additional information will be obtained by promoting the synergy with the SCOUT-AMMA balloon campaign planned during the AMMA campaign phase. Observations in the upper troposphere/lower stratosphere by small and large balloons in cloud and no-cloud conditions (NOx, O3, H2O, CH4, CO, HNO3, ...) is expected during the SOPs of AMMA (the launch of large balloons during the wet SOPs is not yet secured) . Further understanding of the UTLS dynamics could be provided by a ST radar based at Djougou-Benin. The funding of this instrument however is not yet secured.	C. Mari, D. P. Perros V. Marecal, M. Pirre, N. Huret, J.P. Pommereau

What is the role of lightning activity in NOx production ?

Observations of NOx and boundary layer tracer (CO2, CO) will be performed at different altitudes by the F/F20, D/F20 and UK/BAE-146. The experimental determination of the contribution of lightning NOx to total will be derived from NOx/CO2 ratios. Cloud scale modeling of lightning NOx using parameterised source (based on cloud morphology) or fully explicit production (modeling of electrical charges and lightning flash length) will be done. Additional constrain at regional scale will be provided by a field mills network (for the electrostatic and total electric field changes) based near Djougou-Benin. A 3D lightning system will be operated by the DLR near Djougou and will allow the distinction between IC and CG flashes. The SAOZ-NO2 instrument will provided the NO2 integrated column and NO2 variations in the troposphere due to ligthning; the instrument will operate in Djougou-Benin. The total lightning NOx emission for West Africa will be estimated using the information for the single thunderclouds and lightning/thundercloud statistics for the region of interest and compared to global models.	C.Mari, B. Josse, JP Pommereau, F.Goutail, S.Cautenet coll API-WP21 S. Soula
What is the role of photochemical reactivity and heterogeneous chemistry on air masses transported over West Africa from large-scale convective outflow ?	
Aircraft observations of the chemical composition of air masses are proposed during SOP1 and 2 for different primary compounds and their intermediate products. Determination of secondary oxidised organic products (COVO) to primary COV ratios at mid-latitude and at various distances from the convective cell will provide an indication of the photooxidation processing rate. The transformation, mixing, and impact on microphysical and optical properties of particle layers during their transport will be determined using regional-scale models and input from 2.4.1. The impact of heterogeneous chemistry (e.g. reactions on dust) on chemical composition from convective outflow will be investigated.	A.Borbon, C.Jambert, S. Cautenet, F. Bouo Bella

Foreseen deliverables

- To determine the role of deep convective processes (transport, deposition, heterogeneous chemistry) in the budgets of major oxidants in the free troposphere over West Africa
- To establish the chemical characteristics of the upper troposphere and TTL region over West Africa and to evaluate the mass exchanges, and associated humidity and trace gas fluxes, between the tropical troposphere and stratosphere in relation to deep convection
- To determine the photochemical reactivity and aerosol properties in air masses transported in large-scale convective outflow over West Africa relative to air masses of other origin (e.g. dry tropospheric intrusion) on regional scales
- To evaluate the role of the monsoon circulation and other flow patterns, including Mesoscale Convective Systems, in the transport and mixing of gases and aerosols within the WAM region

2.4.4b 1 year plan

Objectives

Since this subWP is based on the analysis and interpretation of the Special Observation Period during the wet monsoon season, few tasks will be achieved during the first 12 months. This WP

will ensure that during the first 12 months of the project, the tools necessary for achieving WP2.4 scientific objectives will be ready and available at the beginning of the Special Observing Period (SOP) and to provide scientific guidelines for SOP planning readiness of the model tools for effective use of the observations collected in the Enhanced Observing period (EOP) and SOP providing the relevant model results, pre-SOP case studies and theoretical ideas with which to plan atmospheric observations in WP4.2

Description of work

Analysis of historical data and simulations for observation planning. Two cases of squall lines have been chosen as tests for the high resolution models: the HAPEX-SAHEL and COPT81 cases. These two cases will be simulated using tracers to follow the redistribution of pollutants.
Definition of needs and priorities for the atmospheric components of WP4.2

Deliverables

Report on available historical data and simulations used for observation planning

DOCUMENTS COMPLEMENTAITES A LA DEMANDE API AMMA 2005 WP24

1. Bilans des actions en 2004

La priorité du groupe de travail WP24 a été pour 2004 de définir l'instrumentation aéroportée et sol nécessaire à la réalisation des objectifs scientifiques affichés en terme d'étude des processus. Le résultat de ces travaux sont disponibles sur les comptes-rendus des réunions.

Les études préparatoires (simulations de cas types de lignes de grain, détermination des facteurs d'émission pour les composés carbonés, développement d'un algorithme pour le calcul des propriétés optiques des aérosols, études des mélanges de panaches aérosols minéraux et combustion anthropiques...) sont en cours et se poursuivront en 2005. Il est important de noter que ce sont souvent les mêmes chercheurs qui réalisent les études scientifiques et l'installation des sites instrumentés. Depuis Juillet 2004, date d'obtention des crédits API 2004, ces chercheurs ont privilégié l'implémentation des expériences au Niger, Mali, Côte d'Ivoire et Bénin.

Le groupe de travail WP24 s'est réuni à trois reprises en 2004:

1. Compte rendu de la réunion du 30 Mars 2004 à Toulouse
Ce compte rendu ainsi que les présentations des participants sont disponibles sur le site
http://www.aero.obs-mip.fr/marc/wam/meeting_tlse/index_310304.htm
Cette réunion a en particulier permis d'évaluer les besoins en heures de vol pour les avions français pendant les SOP. Ces propositions devront être affinées notamment par un meilleur couplage avec les vols dédiés à la dynamique.

2. Compte rendu des réunions des ateliers AMMA 2004 des 20 au 24 Septembre 2004 à Dijon
Les comptes-rendus détaillés des trois sessions de travail autour du WP24 sont accessibles sur le site Web: http://www.aero.obs-mip.fr/marc/wam/AMMA_Ateliers_talks.htm
Les sessions étaient consacrées aux thèmes suivants

- WP24 Emissions: une approche intégrée (voir aussi §2.4.3 de ce document API 2005)
- Liens entre WP24 et WP21

Résumé:

Les discussions ont permis de relever plusieurs points importants pour la chimie et les aérosols: l'importance de la partie stratiforme des MCS dans le bilan de masse et donc dans le bilan des espèces chimiques, l'existence de plusieurs zones d'alimentation des MCS dans les parties stratiformes et convectives, la nécessité de comprendre le rôle des aérosols comme noyaux de condensation liquide ou solide, l'importance de considérer les intrusions d'air sec troposphérique arrivant des moyennes latitudes et pouvant se charger en ozone en passant au dessus de l'Europe et qui constituent l'environnement des lignes de grain, la nécessité de mieux coordonner les études sur l'influence des aérosols sur la dynamique de la dépression thermique saharienne et les mesures de la VAG à Tamanrasset et Assekrem en Algérie.

- Rôle du WP24 dans les actions de modélisation WP4.1.3 (préparation de profiles de flux depuis les CRM pour forçage version 1D modèle climat / laboratoire numérique: cas COPT 81 et HAPEX-SAHEL disponibles au CNRM)

3. Compte-rendu de la réunion du 7 Octobre 2004 à Toulouse

2. Actions prévues en plus pour 2005

- Lien entre impact radiatif des aérosols sur la dynamique de la dépression thermique saharienne, complémentarité des mesures à Tamanrasset (coll WP21, JP Lafore, C. Flamant)
- Rôle des intrusions d'air sec troposphérique sur la composition chimique de l'environnement des lignes de grains (coll. R. Rocca, D. Ramond)
- Lien électricité atmosphérique-production de NOx par les éclairs (coll WP21 S. Soula et DLR)

Fiche complémentaire: Les émissions urbaines

Motivations:
La pollution atmosphérique est un problème émergent dans de nombreux pays d'Afrique de l'Ouest depuis une dizaine d'années. La sévérité de ce problème ainsi que son impact sur l'environnement et la santé sont très largement méconnus. Très peu d'études de terrain ont été réalisées à ce jour.
La pollution atmosphérique provient principalement des feux de végétation, des émissions par les véhicules et les industries mais également des feux domestiques (cf. exp. EXPRESSO). Les premières études portant sur les émissions futures par les véhicules qui devraient être multipliées par 5 dans les 10 années à venir, montrent l'émergence d'une source de pollution comparable à celles des pays occidentaux (Liousse et Cachier; 2004). Les émissions polluantes par les véhicules à essence avec plomb préoccupent les institutions sanitaires de ces pays, d'autant que la pollution au plomb est amplifiée par l'utilisation de véhicules agés de plus de 15 ans. Ces derniers émettent environ 5 fois plus d'hydrocarbures et de monoxide de carbone et 4 fois plus de NOx que des véhicules récents. Aussi, l'utilisation future de véhicules diesel non soumis à des normes de réduction constituera une source d'émission importante de particules. Malgré ces inquiétudes, les états d'Afrique de l'Ouest ne disposent pas ou peu de standards de qualité de l'air alors que les citadins sont de plus en plus exposés aux maladies respiratoires comme l'asthme ou les bronchites. Par ailleurs, les cadastres d'émissions urbaines pour les gaz et les particules existant aujourd'hui sont inspirés de sources statistiques globales et pour la plupart, inappropriés.

Objectifs:
Mener une étude exploratoire en 2004-2005 de caractérisation de la pollution urbaine. Dans ce cadre il s'agit de connaître la distribution des composés atmosphériques par catégorie de source (pollution automobile, usage domestique des fuels fossiles, …) et par composés chimiques (NOx, VOC, aérosols).
Améliorer les cadastres d'émissions urbaines existants. Estimer la contribution de ces émissions urbaines par rapport aux émissions par les feux de biomasse.

Méthodologie:
1.*Mesures terrain du contenu en gaz précurseurs d'ozone (COV et NOx) et de la granulométrie et de la composition chimique des aérosols urbains avec le camion instrumenté du laboratoire d'Aérologie à Cotonou. Mesures similaires à Abidjan et Brazzaville.* Les mesures de Djougou et d'Abidjan sont prévues dans le cadre de l'EOP

d'AMMA. Par ailleurs les chercheurs des différentes universités africaines présenteront à leur ministère de l'Environnement respectif un programme de caractérisation de la pollution urbaine (que ce soient en Côte d'Ivoire, au Cameroun, au Bénin, au Sénégal, au Mali et au Niger).

- Mesures de facteurs d'émission de gaz et de particules pour les sources urbaines (véhicules, feux domestiques…).
- *Agrégation des mesures terrain en tenant compte des données primaires (population, indices de production, ...), de données complémentaires (socio-économiques, températures, facteurs d'émission, ...) et de données structurantes (limites administratives, topographie, ...) afin de créer les cadastres d'émissions urbaines.* Les mesures de facteurs d'émission ainsi que la construction d'un premier cadastre amélioré d'émissions urbaines pour l'Afrique de l'Ouest sont prévues dans le cadre de l'EOP d'AMMA.

Permanents impliqués:

C. Liousse, J.P. Lacaux, C. Galy-Lacaux, D. Serça, V. Pont, A. Mariscal, C. Delon, (LA) H. Cachier (LSCE), V. Yoboué, A. Konaré (Côte d'Ivoire), L. Sigha (Cameroun), I. Modi (Niger) et B. Diop (Mali). Un étudiant effectuera une thèse pour mener à bien ce projet là.