31 march2006

Chapter 7

EOP integrative studies on the Ouémé meso-scale site

–TT5–

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1. Scientific justification and objectives

The aim of this document is to present the scientific consistency of the observing strategy on the Ouémé meso-scale site in Benin during the EOP, with respect to the objectives of AMMA detailed on the AMMA-EU and AMMA-API documents, to coordinate instrument deployment and address the associated logistic issues. These aspects are extended to the Cotonou site.

Some aspects are also relevant to Task team 1 (Radio-soundings), 2a (Fluxes), 6 (oceanic campaigns) and 7, 8, 9 (SOP).

Most of the instruments are deployed on the Upper-Ouémé catchment, (14600 km^2, centred on 9,5°N, 2°E), with average yearly rainfall of 1200 mm (one single season).

These instruments document processes in the soudano-sahelian domain of the AMMA experiment.

2. Observing strategy

2.1 Overall strategy

The observing strategy on the Ouémé meso-scale site is based on a multi-scale approach, associating LOP, EOP and some of the SOP instruments. Even if this TT is limited to EOP, some SOP instruments are considered in the observation strategy, when they complement LOP/EOP set-up.

The observing strategy has been conceived for the documentation of:

1) climatic forcing and atmospheric parameters,
2) the continental water cycle, from local to meso scale, and feed backs
3) aerosol and atmospheric chemistry processes.

2.2 Climatic forcing and atmospheric parameters

Spatial and temporal variability of rainfall fields is documented on the long term by a network of 46 automatic raingauges (CL.Rain_O and CL.Rain_Od 1) operating since 1997 as part of the LOP component of AMMA (labelled as the AMMA-CATCH ORE 2). In EOP and SOP periods, these data will be of primary importance for most of the instruments, as a quantification of rain inputs to the hydrologic and vegetation systems, and for aerosol deposition and surface emissions.

This network will be improved in EOP and SOP periods with the deployment of two Doppler, polarized meteorological radars: Xport (AE.RadX_O) and RONSARD (AE.Ronsard_Or, SOP). They will provide essential high resolution, 3D description of rainfall events, and contribute to a better estimation of rainfall fields to force hydrological models, as well as to link storm-scale processes to larger dynamical signatures. They are associated with one disdrometer (AE.Dsd_Or), one optical spectro-pluviometer (AE.OSP_Od) and one bi-static receptor (AE.BIST_RADAR). They are completed by a microrain radar (AS_RADK_Od) during SOP. To validate radar rainfall estimations, two raingauge lines (eastwards and north-eastwards), and two high-resolution target made of a series of locally denser raingauges located 12km and 30-km east of Djougou have been designed (see Appendix A1.2).

During EOP two sites bring together a noticeable collection of instruments :

The Djougou site, located downtown, with oil fired power supply bring together atmosphere survey instruments : the Xport Radar, a GPS (AE.GPS_1), a meteorological station (AE.Met_Od), a disdrometer (AE.OSP_Od).

The Nangatchori site will be the SOP supersite for atmospheric column documentation. Located, 10 km SE from Djougou (see Appendix A1.2), it offers a non polluted area with power supply but possible power cut. During the EOP the implemented instruments concerns aerosol, chemistry and flux instrument (AE.Van_O, CL.Depot_RW , see below), a disdrometer (AE.Dsd_Or), the VHF and UHF Profiler (AE.VHF_O). This equipement will be completed during the SOP by a dust impactor (AS.Dust_Od), a lidar-ceilometer (AE.CT25K), a micro-wave temperature and humidity profiler (AE.PROF_T)) a micro-rain radar (AE.RADK_T) to help characterizing the state of the atmospheric column (wind, water vapour profile, integrated water vapour content, cloud bottom height,...) see Appendix A1.2.

The Beninese site contributes, for some instruments, to regional observations systems: the GPS in Djougou is part of a network of two meridian transects: Djougou-Niamey-Gao, operated during the EOP, and Tamale-Ouagadougou-Tombouctou, operated only during the SOP (May-Sept 2006). This network provides continuous (1-hourly) monitoring of total column water vapour in the atmosphere, which is one of the key components of the water cycle.

As well, the Parakou and Cotonou radio-sounding (AE.RS_Q1), in EOP and SOP periods, are part of a West African RS network (see TT 1 “Radiosoundings” document), and complement the documentation of the state of the atmosphere over Ouémé and Benin (Appendix A1.3). Specifically these stations are two of the five RS stations of the quadrilateral window stretching over Nigeria, Benin, Togo, Ghana and Niger, and documenting large scale atmospheric forcing, to help constraining analyses and re-analyses. This quadrilateral is a pilot window, including the upper Ouémé watershed, for integrated surface-atmosphere water budget studies (WP1.2 of AMMA-EU and AMMA-API). Within this network, the combinaison of UHF and VHF in Nangatchori will give an extra point for wind profile .The ozone radio-sounding in

[1] In this section the instrument code is mentioned besides the instrument name for clarity. Refer to Appendix 1 for instrument list and nomenclature.
[2] Observatoire de Recherche en Environnement, French Ministry of Research.

Cotonou (AE.RSO3_O), documents ozone concentration profile up to the troposphere, and contribute to the studies of ozone dynamics in tropical areas.

These instruments and related issues are handled by Task Team 1 (Radio-soundings and GPS).

2.3 Continental water cycle and feed backs

Observation of the continental water cycle is based on a multi-scale (spatial and temporal) approach, associating local sites (transects), super-sites (Donga Watershed) and meso-scale watershed (upper Ouémé basin), and combines long-term (LOP) and enhanced (EOP) observation periods.

Local scale observations are dedicated to elementary processes studies. Detailed measurements of the water cycle components will be performed on three transects (or catena) representative of an increasing part of the woody layer (herbaceous fallow, fallow bush and forest) (see Appendix A1.1). These sites include soil water monitoring stations (*CE.SW_Odc*), piezometers (*CE.GWat_Odc*), runoff on small gullies (*CE.Run_Odc*), vegetation monitoring (*CE.Veg_Odc*) and fluxes stations (*AE.Flux_Odc*).

The three fluxes stations are also part of a regional network documenting the meridian gradient of decreasing rainfall from south Benin (one station), upper Ouéme (four stations), the Niger Site (four stations), and the Gourma site (four stations).

As well, superficial geophysical surveys with electric soundings (*CC.Geophy_Odc)* or Protons Magnetic Resonance (*CC.RMP_Odc*) will document the geometry of the sub-surface reservoir, and the piezometric level fluctuations in relation with the river discharge. Chemical composition of surface, subsurface, and ground water on transects will be analysed (*CE.WChem_Odc*), and compared to chemical composition of water in river to determine water origins, flow paths and transfer time.

A particular effort is made on the observation of the feed-back term of the water cycle (evapo-transpiration), with the deployment of a flux station (*AE.Flux_Odc*) on each transect (one additional is associated to the mobile laboratory) and one infra-red scintillometer (*CC.Scintill_Od*) on the fallow site. The strategy is to locally document the fluxes dynamic in relation with the evolution of vegetation and the hydric resource, and to find spatial integration method on a limited area using the scintillometer. Larger up-scaling of fluxes is foreseen using satellite-derived images, and -if relevant- airborne fluxes measurements during SOP.

The local-scale observation strategy is adapted to the super-site scale (Donga catchment), with the documentation river runoff (*CL.Run_Od*), water table levels (*CL.GWat_Od*) and water chemical composition in wells, boreholes and river (*CL.GWat_Od*) and flux stations (*AE.SHFlux_Odc* and *AE.H2OFlux_Odc*). These data, associated to knowledge and processes captured at local scale, will be used in a hydrologic modelling framework to test and validate water cycle processes, characterize the water cycle compartments and quantify the water balance components, at intra-seasonal to inter-annual time scales.

The Aguima catchment, located south of the upper-Ouémé meso-scale site (see Appendix A1.3), is been intensively surveyed by the German project IMPETUS[3], to document meteorological, hydrologic and environmental processes. Collaborations and data sharing agreements have been developed with this project,

[3] IMPETUS is not formally associated with AMMA, but a few of IMPETUS teams are also involved in the AMMA European Project.

and this site can be considered as a secondary super-site, on a geologically contrasted area, as compared to the Donga basin.

The previous observation strategy is also transposed at the meso-scale, with observations of river flow on 20 stations (*CL.Run_O*), water table levels (*CL.GWat_O*), and chemical composition of water in rivers (*CE.WatChem_O*). As the large basin integrates contributions from various geological areas and spatial variability of rainfall, the chemical signature of water helps understanding the flow paths and transfer time at the meso-scale. Based on processes identified at the super-site scale, meso-scale hydrologic data combined with satellite-derived vegetation maps (land cover, LAI dynamics) will be used in a modelling framework to validate the continental water cycle processes and calculate the water budget components. These efforts contribute to water budget studies (WP 1.2).

2.4 Aerosol and atmospheric chemistry processes

As a component of the aerosol and atmospheric chemistry part of the AMMA experiment, a series of instruments (formerly part of the mobile laboratory of Laboratoire d'Aérologie, Toulouse, France) will be deployed as from march 2005. For convenience they are all included in the unique instrument *AE.Van_Od*. They will be deployed in the Nangatchori site, 10 km SE from Djougou (see Appendix A1.2). The objectives are:

- to gather a precise documentation on biogenic emissions (processes and seasonal variability). This will be done through the development of a methodology allowing for a better quantification of the different types of emissions. Modules of biogenic emissions and deposition of reactive trace gases (NOx, COV, O3) will be developed and validated directly through field experiments. These modules will eventually be integrated in chemistry-climate interaction models focused on the West-African region.

- to build and emission inventories of biogenic sources (NOx, COV), biomass combustions (savannah and domestic fires) and urban sources with a spatial and temporal resolution adapted to the chemistry-climate models

- to link existing networks and observatories with ground-based data obtained in Djougou to study inter-annual and seasonal variations of combustion tracers (BC, CO) and aerosols optical properties. Later, this work will be used to build a 3D data base over two years for assimilation and validation in regional and global models. These models will help to conduct regional studies (like deposition-transport of aerosol impact and processes-Meso-NH-Chimie, and seasonal scale studies-RegCM), as well as large scale studies (TM4, MOCAGE). Models will be used to constrain emission inventories and study the species redistribution influenced by the main dynamical phenomena (convection, transport) associated to the monsoon, and study their impact on the chemistry and climate.

To document dry and wet deposition, as well as aerosol composition, an IDAF station (*CL.Depot_RW*) and dust impactors (*AS.Dust_Od*), will be deployed on the Nangatchori site. Incidentally, chemical analyses of rainfall water produced for IDAF studies will be also used to detect noise in chemical tracing of flow paths (see hydrology section above) due to unexpected atmospheric inputs in river water.

This setup is complemented by a sun photometer (*CL.Photometer*) of the PHOTON-AERONET network, deployed 7 km N from Djougou since January 2003.

Together with AMMA-CATCH, IDAF and PHOTON-AERONET (labelled as OREs) observing systems are part of the LOP component of AMMA.

2.5 Modelling and satellite observations

These instruments provide data for calibration, validation and data assimilation in atmospheric, hydrologic and chemistry models, as well as validation data for satellite products (vegetation cover , fluxes). Refer to AMMA documents for more details.

A particular need concerns the estimation of annual land cover maps, intraseasonal LAI (or NDVI) dynamics of the different land cover of the basin, and the large scale fluxes (evapotranspiration) from local tower and scintillometer measurements, and satellite images, using models.

2.6 List of sites, instruments and relevant maps

Site maps and LOP/EOP instrument location are given in Appendix 1 : Local scale A1.1, super-site A1.2, meso-scale site A1.3. SOP instruments are mentioned for information on the meso-scale map in A1.4.

The full list of instruments is provided in Appendix 2. Some SOP instruments are considered, when they complement the LOP/EOP and campaigns set-up (ex. RONSARD Radar).

The coordinates of the main instruments and/or sites are in Appendix 4.

2.7 Priorities

Most of the instruments cited in this document have secured funding from either French-API or EU (or other sources). There is therefore no need to attribute priorities among them, except in case of competition for funds.

Some instruments, **of significant interest**, are not funded:

- Geophysical Surveys (*CC.Geophy_O*) **Priority 1**
- Magnetic Proton Resonance (*CC.RMP_O*) **Priority 2**

Concerning the risk issue, no particular aspect is to be mentioned, except unexpected delays in material shipping, which may delay field deployment. These risks are normally anticipated by instruments PI's by early shipping.

The political situation in Benin has been very stable for years. Next presidential elections will be held in March 2006. In principle, this political event gives no cause for concern for the course of the experiment.

3 Deployment

Deployment, operation and maintenance of these instruments imply a number of logistical constraints, detailed below.

3.1 Planning

The periods of deployment of the various EOP and LOP instruments is foreseen following the planning given in Table 1a, next page, the related SOP instrument are indicated Table 1.b

The set-up, operation and maintenance of these instruments require regular mission in the field, either for people permanently in Benin (IRD teams and Beninese partners) or people coming in mission for a limited stay. A planning of missions reviewed by instrument PI is presented in Table 2 for 2005 and 2006.

The deployment and operation programs shown in the tables below impose a number of logistical needs: human resources, buildings, vehicles, and communications.

Table 1a. Planning of EOP and LOP instrument deployment

			2004	2005												2006												2007												2008	PI
Sheet #	**Inst. Code**	**Description**	exist	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	contd.	
EF2	AE.RadX_O	Radar Xport																																							√
EF3	AE.Dsd_ Or	Disdrometer																																							√
SF02	AS.Ronsard_O	Radar Ronsard																																							
SE10	AS.BISTat_Od	Bi-static radar																																							√
LF18	CL.Rain_0	30 recording raingauges																																							√
LF19	CL.Rain_Od	18 recording raingauges																																							√
LF21	CL.Run_O	14 recording streamgauge																																							√
LF22	CL.Run_Od	6 recording streamgauges																																							√
LF23	CL.ADCP_O	ADCP																																							√
LF25	CL.Gwat_Od	21 surveyed wells																																							√
LF26	CL.Depot_RW	1 IDAF station																																							
LF3	AL.Met_Od	Meteo Station Campbell																																							√
L-	CL.Photometer	photometer																																							
EE1	AE.RS_Q1	2 RS Stations																																							
EB3/EF9	AE.H2OFlux_Od	1 H2O flux stations																																							
LE2/LF9	AE.SHFlux_Od	2 SH flux stations																																							√
EB4	AE.H2OFlux_Po	1 H2O flux station																																							
EF1	AE.GPS_1	1 GPS station in Djougou																																							
EF10	AE.scintil_Od	Scintillometer																																							√
EF24	CE.Run_Odc	runoff on 1 transects: Nalohou																																							√
EF25	CE.WChem_O	surf/ground water chem. Anal.																																							√
EF26	CE.WChem_Od	surf/ground water chem. Anal.																																							√
EF27	CE.Gwat_Odc	Network of 27 piezometers																																							√
EF28	CE.SW_Odc	9 SW stations																																							√
EF29	CE.Veg_Odc	vegetation surveys																																							√
EF31	AE.RSO3_Od	Ozone radiosoundings																																							√
EF33	AE.VAN_Od	Labo Van + aérodynamique																																							
EF4	AE.OSP_Od	Opt, Spectro Pluviometer																																							√
EF5	AE.VHF_O	Radar ST																																							
CF?	CC.RMP_Odc	RMP surveys																																							
CF1	CC.Geophy_Odc	geophysical surveys																																							

instrument deployment not funded delayed updated 20/01/06

Table 1b. Related instruments (tentative)

Instruments SOP

Sheet #	Inst. Code	Description	2004 exist	2005 1 2 3 4 5 6 7 8 9 10 11 12	2006 1 2 3 4 5 6 7 8 9 10 11 12	2007 1 2 3 4 5 6 7 8 9 10 11 12	2008 contd.	k P
SE11	AS.lightning_O	lightning detectors						
SE12	AS.PROF_O	Microwave Profiler						√
SE6	AS.CT25K_Od	Lidar Ceilometer						√
SE9	AS.RADK_Od	Micro Rain Radar						√
SF12	AS.Dust_Od	Atm. deposition						√
S-	AS.GPS_1	1 GPS station in Djougou						
S-	AS.BVC_T2	Ballon Volume Constant						
SE1	AS.RS_1	5 P1 RS stations (Cotonou, Parakou, Niamey, Tamale, Abuja)						
SE2	AS.RS_2	4 P1_EOP RS stations (Parakou, Agadez, Tombouctou, Niamey), 2 P1_SOP (Tahoua, Ouaga) and 2 P2 (Birni, Kano)						
SE10	AS.BISTAT_Od	Bistat. Radar (Wind field)						
SB3	AS.TMS_O	TMS – tube microsampler: temperature and flow controlled adsorption tube sampling for collection of volatile organic compounds.						
SF02	AS.Ronsard_O	C-band Doppler polarimetric radar						
SF13	AS.RSO3_Od	Radiosondes (PTU and ozone) from Vaisala						
SF18	AS.UHF_O	UHF Windprofiler						

instrument deployment not funded delayed updated 20/01/06

Table 2a. Planning of missions 2005

EOP			2005 january				february				march				april				mai				june				july				august				sept.				october				nov.				dec.				PI
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
EF2, EF3	AE.RadX_O, AE.Dsd_Or	Radar Xport											2P																																						
EF4	AE.OSP.O	Spectro-pluvio																																																	
-	AS.Ronsard_Og	Radar Ronsard														2P																											2P							
	AS.Bist_radar	bi-statique																																															√
EF5	AE.VHF_O	Radar ST								1P																																	2P						√
	AE.RADK_T	Micro Rain Radar																														1P																	√
	AE.CT25K	Lidar Ceilometer																														1P																	√
	AE.PROF_T	Microwave Profiler																														1P																	√
LF18, LF 19	CL.Rain_O, CL.Rain_Od	Raingauge network (*)																																															√
LF21, LF22, LF23, EF24	CL.Run_O, CL.Run_O, CL.Run_Odc,	River runoff network (*)																																															√
LF25, EF27	CL.Gwat_Od, CE.Gwat_Odc	Piezometer network (*)																																															√
EF25, EF26	CE.WChem_O, CE.WChem_Od	surf/ground water chem. Anal.																																															√
LF3	AL.Met_Od	Meteo Station (*)																																															√
EF28	CE.SW_Odc	Soil Water stations (*)																																															√
CF1	C_geophy_Odc	Geophysical surveys																																															√
EF29	CE.Veg_Odc	Veget. surveys on transects																																															√
EF33	AE.VAN_Od	Mobile Lab (**)												2P			1P							1P		P/15D+1P/30																									
LF26	CL.Depot_RW	1 IDAF station (**)																								1P																									
SF12	AS.Dust_O	Atm. Deposition																																															√
-	CL.Photometer	sun photometer (*)																																															
EE9, EF9	AE.Flux_Od, AE.Flux_Odc	Flux stations																	1P/8D																										2P/8D						√
CF2	CC.scintil_Od	Scintillometer						1P											1P/8D																										1P/10D						√
EF31	AE.RSO3_Od	Ozone Radio-sounding		1P																																											1P			√
EF1	AE.GPS_1	1 GPS (Djougou)																			2P												2P																	
EE1	AE.RS_Q1	2 RS Stations																																															
-	AS.BVC_T2	Ballon Volume Constant																																															

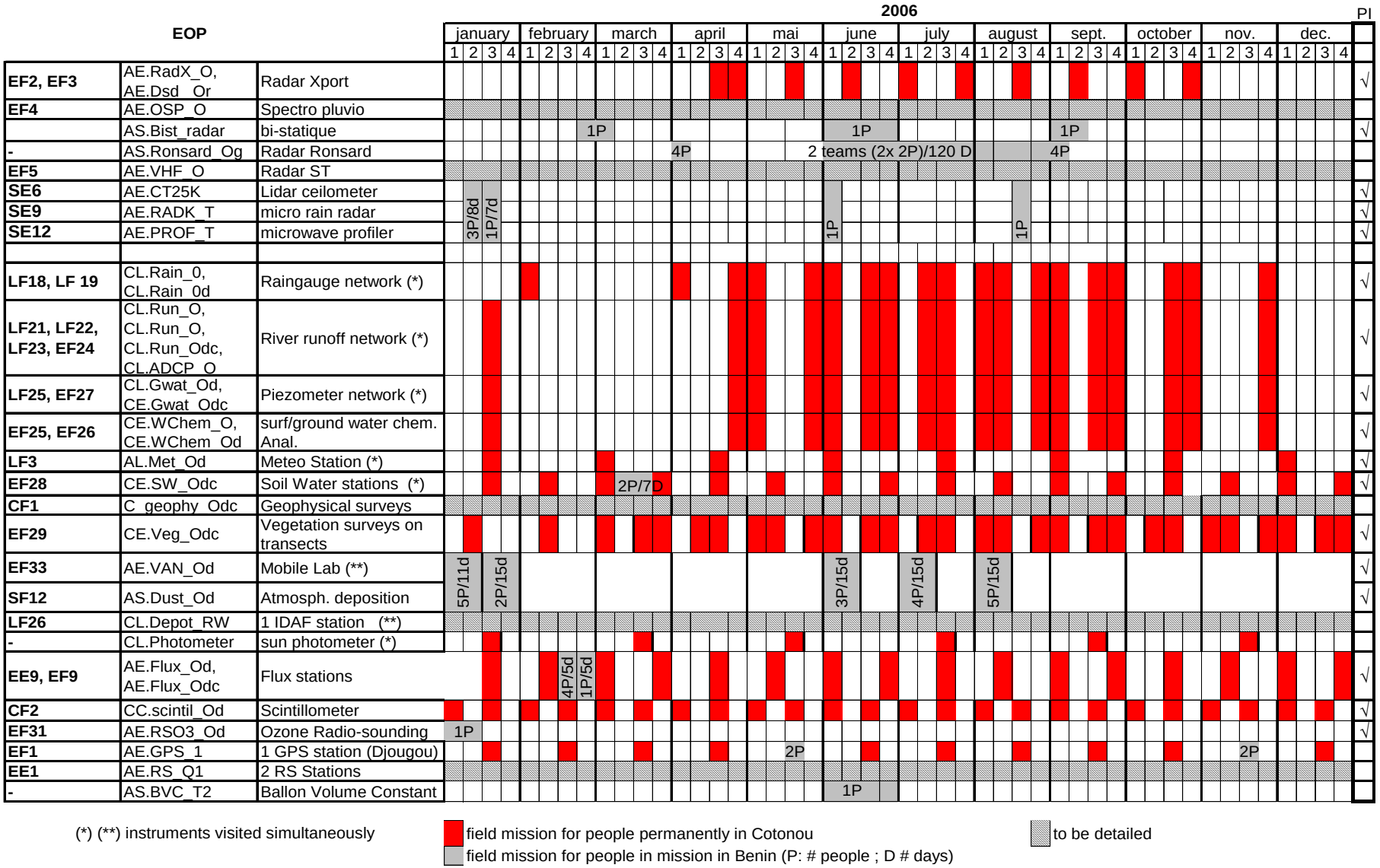
(*) (**) instruments visited simultaneously

field mission for people permanently in Cotonou

field mission for people in mission in Benin (P: # people ; D # days)

to be detailed

Table 2b. Planning of missions 2006



(*) (**) instruments visited simultaneously

field mission for people permanently in Cotonou

field mission for people in mission in Benin (P: # people ; D # days)

to be detailed

3.2 Human resources

3.2.1 IRD Research Team

Permanent IRD staff working for AMMA in Cotonou in December 2005 is 16 persons (6 researchers, 3 engineers, 3 french technicians, 4 local technicians) and 6 students (4 PhD, 2 masters).

3.2.2 Beninese AMMA Operating Center (BAOC)

The Beninese AMMA Operating Center (BAOC) is in charge of administratif and logistic support for AMMA teams, permanently and temporarily in Benin during the EOP and SOP.

The support the BAOC can provide to AMMA teams is :

- Receipt and processing of requests for participating teams (mail, email, fax, phone calls, in French and English)
- Planning of instrument deployment operations
- Support for foreign missions (hotel, travel, vehicles booking)
- Support for field missions
- Air or sea freight operations, custom procedures
- Support for site preparation
- Secretary support for AMMA teams in Benin
- Relationships with beninese authorities, including regulation issues (authorization requests, …)
- Information and communications
- Updating of the implementation web page
- Support to events organisations (seminars, workshops…)

The Benin AOC works in collaboration with and under the responsibility of the Benin AMMA site coordinators : Drs. Christophe Peugeot and Sylvie Galle. It has no authority nor possibility to make scientific choices or perform instrument implementation or fixing.

The tasks of the Benin AOC (BAOC) are taken in charge by a team of three persons :

- 1 coordinator, also responsible for administrative aspects (Dr Ariane Borgstedt)
- 1 Engineer (IRD agent), responsible for technical aspects (Jean-Michel Bouchez),
- 1 administrative secretary

The coordinator and the secretary are contracted in the framework of the AMMA-EU.

The BAOC is expected to be maintained from October 2005 to March 2007

3.2.3 Technical maintenance in the field

A number of teams have not planed to have permanent staff in the field to watch their instrument(s). Considering that breakdowns or incidents are very likely events, due to the particular context (frequent

electric power cuts, fuel penuries, lightning…), the Task Team coordination strongly suggest that one or two technician(s) could be locally contracted, trained, and then stay on the site and permanently watch and maintain a series of instruments during the whole operation period (vehicles such as motorcycles should be provided). They could warn teams in Cotonou in case of incident with cellular phones.

Decisions on this point must be taken by instruments PI's (EOP and SOP), with the support of TT5 coordination.

Rough costs estimates: Gross annual salary 5000€; motorcycle 3000 €

3.3 Infrastructures

3.4.1 Offices in Cotonou

AMMA teams are housed in three location in Cotonou

- Direction de la Météorologie Nationale, near the airport (radar and atmospheric chemistry teams)
- Direction Générale de l'Hydraulique (hydrology teams), in a neighbourhood of 5 km.
- AMMA building, near IRD headquarter provide extra housing capacities for the BAOC office, permanent (hydrology) and temporary AMMA teams, one meeting room; one secured storage area; one office for teams in mission and one office for the Benin AMMA National Committee, all equiped with usual telecommunication facilities including full internet. This house renting is funded by AMMA-EU.

3.4.2 Housing in Djougou during field missions

Housing in Djougou for people in mission in the field is possible in the existing IRD house (basic facilities), depending on availabilities, or in hotels. Housing in remote sites (Copargo, RONSARD Radar) has not been considered here, and must be addressed specifically. The Task Team coordination can provide help in that concern.

See also logistics thumbnail of the web site : http://www.lthe.hmg.inpg.fr/AMMA_International/

3.4 Vehicles

IRD in Cotonou dispose of a pool of 7 4-wheel-drive vehicles, including two bought in 2004; 2 new cars are available since mid-2005, and 2 additional "urban" cars, amongst which one is dedicated to people in mission. The 4WD vehicles are primarily dedicated to IRD teams in Benin (50% involved in AMMA), but also to AMMA teams depending on availability. In case of extra needs, renting solutions are possible, with a reliable institution in Cotonou offering good conditions.

3.5 Internet Communications

3.5.1 Cotonou sites

All the buildings where AMMA people will stay in Cotonou, are equipped with a full-internet connection (satellite connection), with a remote administration by Direction des Systèmes d'Information (DSI) at IRD-Montpellier (France). Internet equipment for the DMN has been achieved in February 2006.

3.5.2 Field sites

Internet Communication needs in the fields concerns the sites of Djougou (Xport Radar, GPS), Copargo (Ronsard Radar), Nangantchori (atmospheric chemistry and aerosols, VHF-UHF, lidar), and Kolokondé (BiStatic). It is essential for coordination of aircraft flight (aircraft base and main operation center –OC- in Niamey) that near-real-time quick-looks of RONSARD data (image) be available for the Niamey OC. As well, transmission of Xport images to Cotonou is essential for near-real-time analyses. The other instruments settled next to Xport will also benefit from the link for data transmission.

Other communication need is identified for the Parakou RS station, and a solution using classical telephone network and modem will be implemented (RS task Team).

The Task Team core group has made an inventory of all the possible technical solutions available in Benin, with a rough cost estimate (see appendix 5). The final choice has to be made when the precise technical requirements will be established, and the funding issue solved. This has to be done in strong coordination with SOP Task Teams and Principal Operation Centre coordination.

A list of available technical solutions, with rough costs estimates, is given in Appendix 5.

4 Partnership

4.1 Field observations

Partnerships for field observation mainly involve:

- Direction Générale de l'Hydraulique/Service de l'Hydrologie : meso-scale runoff-data on the Ouémé and Donga basin
- Direction de la Météorologie Nationale : Radio-soundings (Cotonou and Parakou), RS Ozone (Cotonou), Xport Radar (test phase in Cotonou)
- Département de Physique, Faculté des Sciences et Techniques (FAST), Université d'Abomey Calavi (UAC): Radars, atmospheric physics, fluxes, Maths Dept.
- Institut National des Recherches Agricoles du Bénin (INRAB) : fluxes
- Centre de Recherches Hydrographiques et Océanographiques Béninois (CRHOB) : oceanographic campaigns. EGEE cruises and in charge of an autonomous thermometer in the Cotonou port, at their disposal in the scope of EGEE.
- IMPETUS, German integrated project with shared field activities on water cycle observations (monitoring of the Aguima watershed, included in the upper-Oueme basin).

4.2 Training program

Students from UAC (FAST, Faculté des Sciences Agronomiques : 2 master, 1PhD in 2005), technicians from DMN :RS and RS-ozone training, and radar acquisitions. Flux Worshop devoted to field measurement and data first analysis.

5 Organisation of the TT.

5.1 Leaders, core group

5.1.1 Task team leaders are :

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5.1.2 The Core Group members are :

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Frédéric CAZENAVE	cazenave@ird.fr	Telecommunication resources
Marielle GOSSET	marielle.gosset@hmg.inpg.fr	radar representative
Serge JANICOT	jslod@lodyc.jussieu.fr	TT Radiosoundings representative
Cathy LIOUSSE	lioc@aero.obs-mip.fr	aerosols/chemistry representative
Colin LLOYD	crl@ceh.ac.uk	TT2a Fluxes representative
Alain PROTAT	protat@cetp.ipsl.fr	TT9 Representative
Luc SEGUIS	luc.seguis@ird.fr	Donga coordination
Dominique SERÇA	serd@aero.obs-mip.fr	Aerosols/chemistry representative

The full list of TT member is given in Appendix 3

5.2 Internal coordination

5.2.1 Scientific information

Diffusion of information is made by email using the member list in appendix 3.

5.2.21 Mission prepration

To help local organization of missions in Benin, the scientific request must be addressed to the TT5 leaders (C. Peugeot and S. Galle), while the logistical informations must be sent to the Benin AOC coordinator (A. Borgstedt).

In any case

- 3 months prior mission, preliminary information (period, duration, field trip, ..) must be

provided **to BAOC coordinator AND TT coordinators**.

- detailed information on mission must be transmitted **to BAOC** 1 month prior arrival (dates, housing, specific needs...)

5.3 How are handled requests for new instruments ?

All requests are received by the TT coordinator, and are transmitted to the relevant TT members and BAOC.

Request for new instruments must be transmitted at least 6 month prior installation, with detailed information on instrument relevance to AMMA scientific objectives, integration in the existing implementation plan, local partnership, technical characteristics, logistic needs, technical supports. **Instrument and logistic sheets** must be provided.

Then the information procedure proposed for missions (previous section) must be applied

5.4 External diffusion of the information and reporting

External diffusion of the information and reporting should follow a procedure common to all the task teams. This procedure, to be defined,should involve mailing lists and web pages support.

6 Coordination with other TTs

Coordination with other task teams is foreseen through diffusion of information (email), and meetings of leaders outside IP or API meetings (no marginal travel costs).

The leaders of the TT in inter-relation with TT5 are part of the core group, namely B. Bourles (oceano. campaigns), S. Janicot (RS), C. Lloyd (Fluxes). Coordination with SOP TT must be clarified, one the one hand for aircraft operation (flight plan coordination), and on the other hand for Ground-SOP activities, to avoid overlapping (RONSARD relevant to SOP TT and this one, RS relevant to EOP and SOP TT depending on RS frequencies...).

Coordination with LOP Support Team remains unclear. For TT 5, IDAF and PHOTON PIs are members of the TT, as well LOP/Ouémé coordinators.

7 Status of the field program (Décember 2005)

7.1 AOC-Bénin setup

The **AOC- Benin** (**A**MMA **O**peration **C**entre in Benin) has started working in October 2005. The AMMA-house is rented since the same date. AOC-Benin is a secondary operational centre, working in coordination with the principal AOC based in Niamey

Their first task is the administrative and logistic support for AMMA teams, permanently and temporarily in Benin during the EOP and SOP. Their next task will be to prospect and organise installation of satellite communication during SOP.

7.2 Communication

7.2.1 Official presentation of AMMA in Cotonou

On September 2nd, 2005 a seminar was organised in Cotonou by Dr M.T. Lamizana representative of IRD in Benin and AMMA team, to widely present AMMA and its objectives to the ministries, the interested institutions, the public and to the press.

Apart from the IRD-crew, all the national scientific and technical partners were present as well as resource persons of various implied ministries, and representative of foreign embassies, gathering a hundred of participants.
A short speech of the Principal Private Secretary of the Minister of Education closed the ceremony. He exhorted the Beninese young scientists to seize the opportunity that AMMA offers through doctoral education, summer school and training in the field. He also promised unconditional assistance of him and his ministry to help AMMA to carry out their activities. The seminar was completed by a diner cocktail.

The event have been reported in national and local press (17 papers), as well as on radio and TVs broadcasts.

7.2.2 Presentation of AMMA to local authorities in Djougou

As a follow-up of the presentation of AMMA in Cotonou in September, a presentation of the programme and its experimental activities on Upper Ouémé valley was organized by the Benin-AOC (J.-M. Bouchez, IRD) on the site of the XPort Radar, in Djougou, on the 8th November 2005.

In the presence of the administrative (1st assistant of Djougou's Mayor) and traditional (king of Djougou) authorities, this presentation brought together representatives of Beninese and European teams involved in the programme, members of the Benin-AMMA operational centre (AOC) and members of the AMMA-Benin committee. Regional delegates of the Ministry of Public Building and of the Ministry of Hydraulics were present, as well as a representative of the European Commission, the director of electricity and water supply in Djougou. The local observers and the major of the main villages involved in AMMA were also invited

The local press and a local radio broadcast reported the event.

7.3 Action carried out in 2005

At the end of 2005, the majority of the instruments to be deployed in Benin are currently in operation (see table 1a).

EOP

Some instruments still remain to install.

- automatic water conductivity probes on 10 stations (upper-Ouémé meso-scale site). *Scheduled April 06.*

- southern site flux station (CO2/H20). *Scheduled Feb. 06*
- VHF/UHF profiler. *To be shipped to Benin within 2 months. Site preparation under way.*

SOP

Instruments not yet installed:
- RONSARD radar. *To be shipped to Benin within 2 months. Site preparation under way.*
- Bistatic receptor, associated to RONSARD (PI : M. Hagen, DLR) *Reconnaissance planed in feb-march 06.*
- Lightning detector network (PI H. Hoeller, DLR) ; *reconnaissance done*
- Optical spectro-pluviometer (PI. L. Barthès, CETP). *Installation in April 06, as scheduled.*

Burning issues:

- The geophysics campaigns (EOP), necessary to document the underground structure, with consequences on water storage, are still not funded.

- Data backup problem for the IR scintillometer (EOP) associated with the flux station on the filed-fallow site (Donga super-site)

- Constant volume balloon (SOP, PI P. Drobinski, SA). *No reconnaissance neither installation scheduled.*

- Flux station were installed beginning of november but the two HFS are not working because of software mismatch. The problem should be corrected within 2 months. The gaz analyser of the H2O/CO2 flux is not working : not flux data will be available for 2005 on the Donga supersite.

Appendix1

Maps

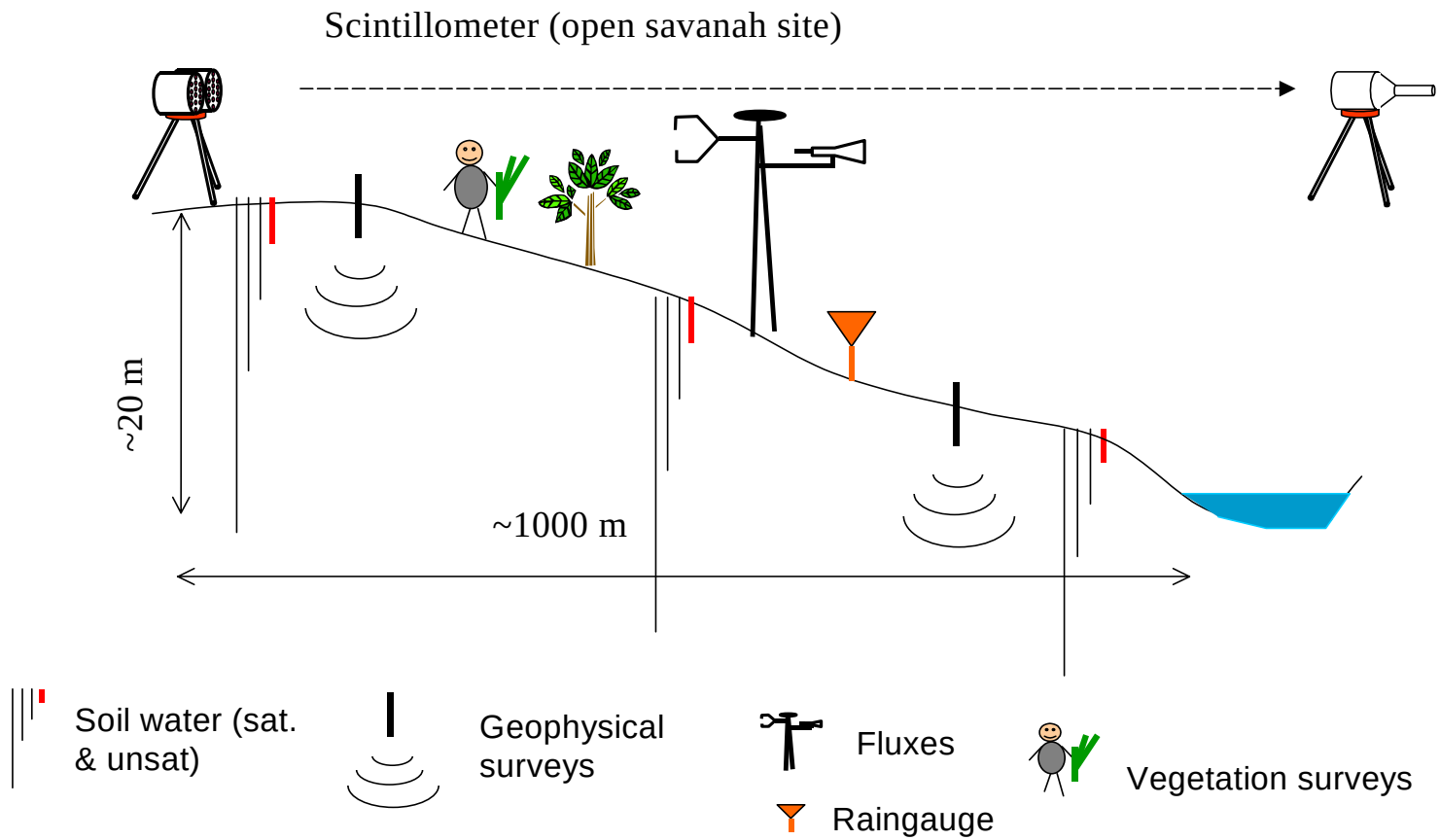
A1.1 Local scale (transect) EOP equipment

A1.2 Donga super site LOP/EOP equipment

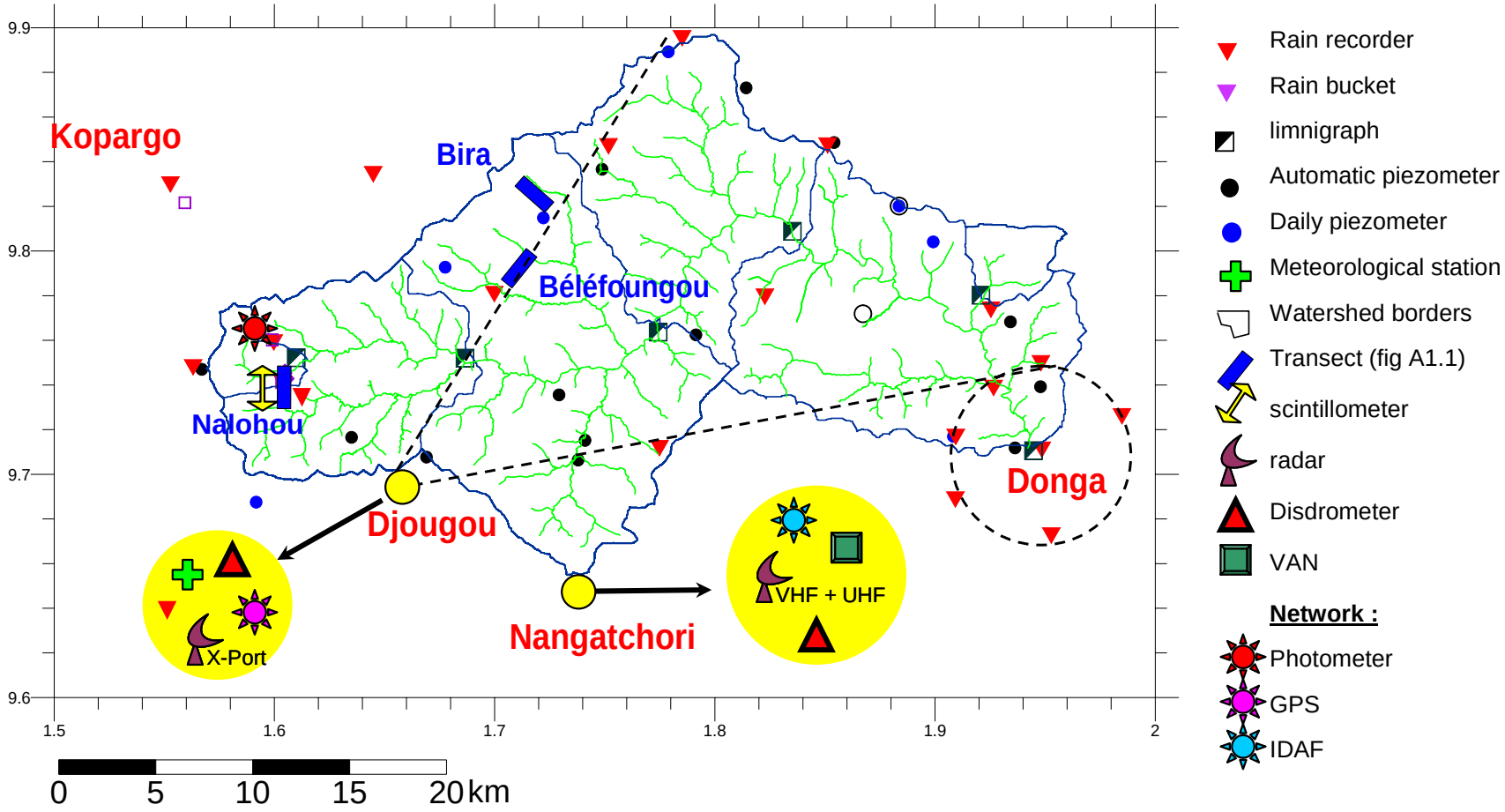
A1.3 Mesoscale Ouémé site LOP/EOP equipment

A1.4 Mesoscale Ouémé site SOP equipment

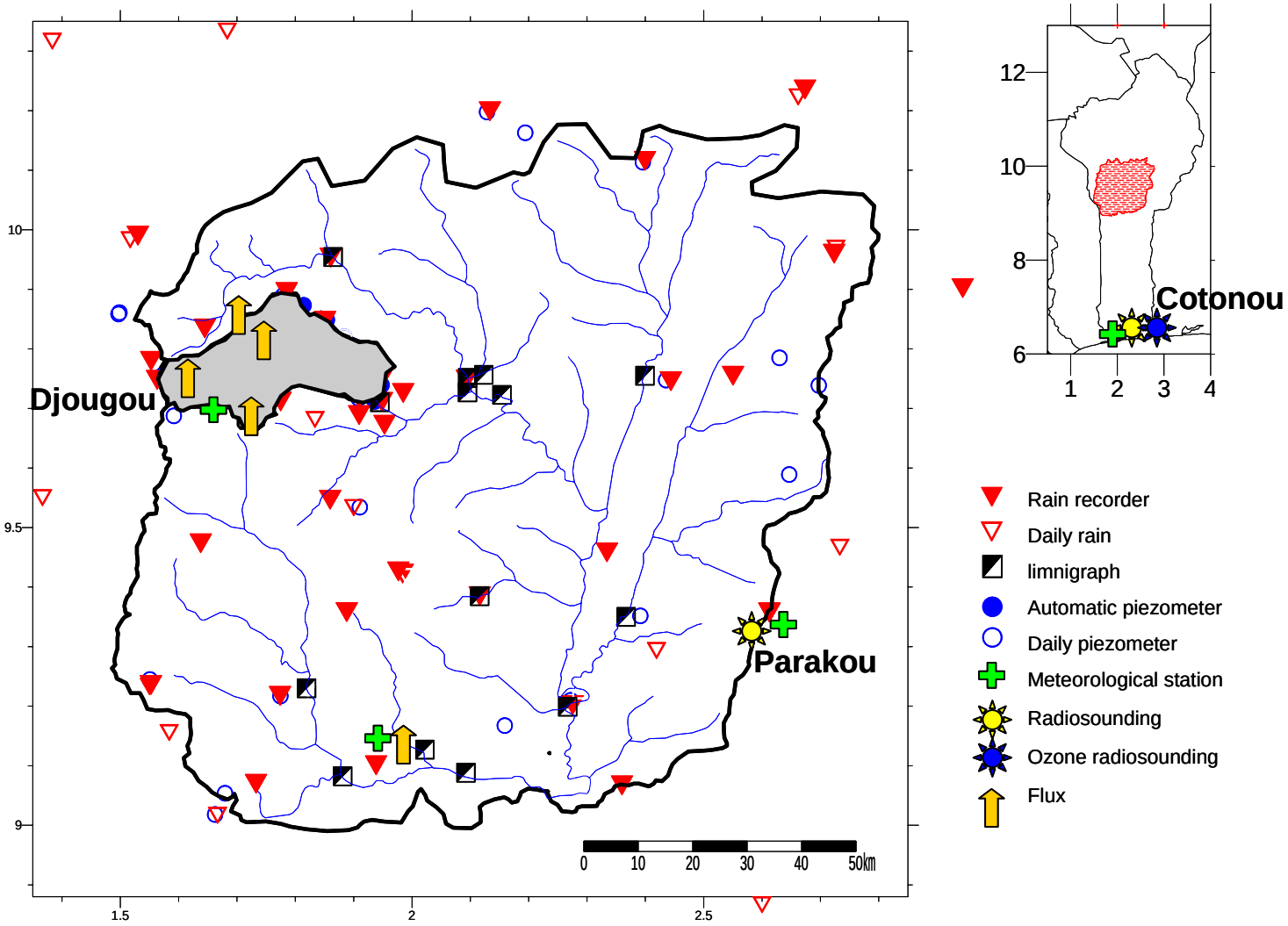
A1.1 Local scale (transects) EOP equipment



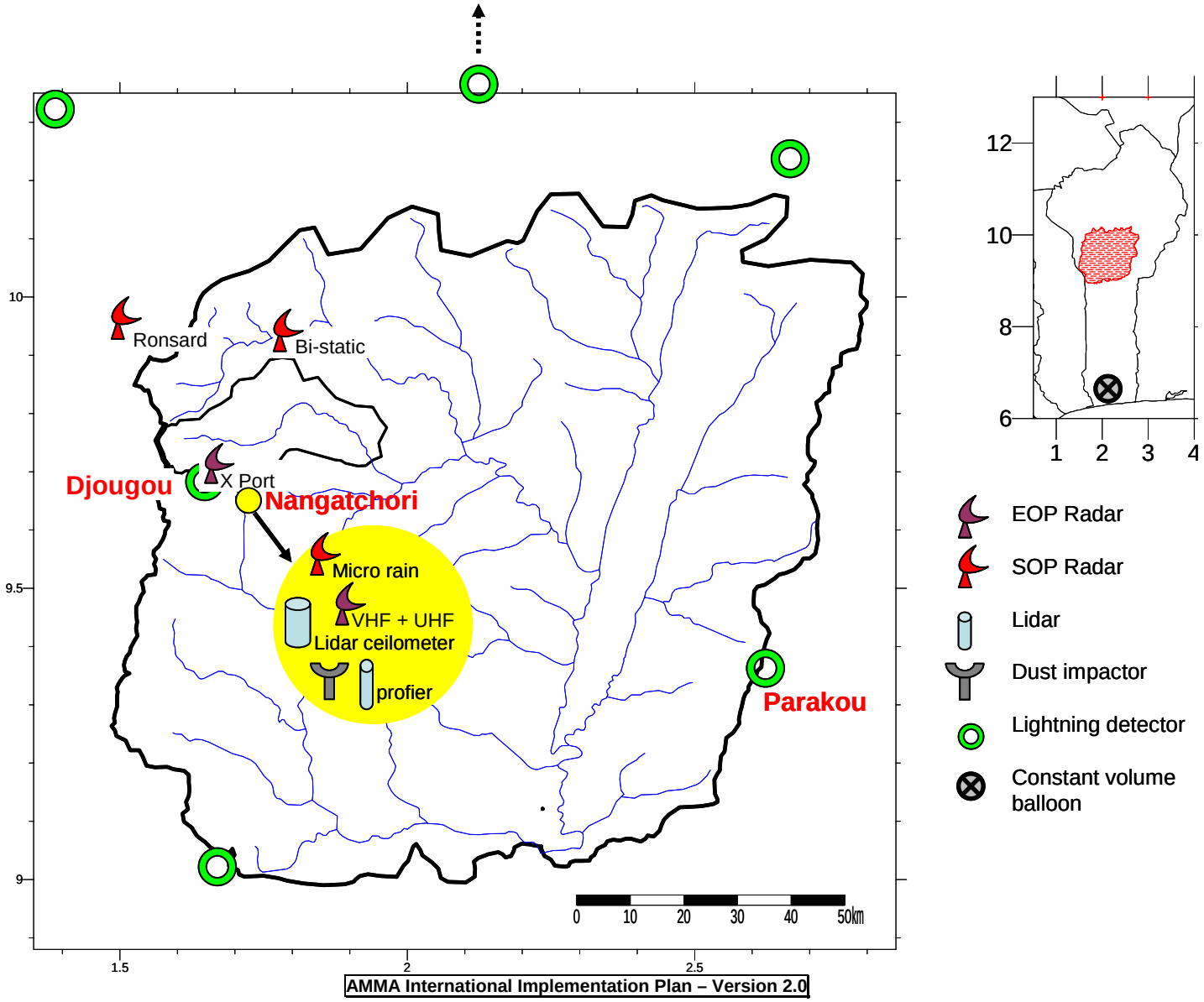
A1.2 Donga super site LOP/EOP equipment



A1.3 Mesoscale Ouémé site LOP/EOP equipment



A1.4 Mesoscale Ouémé site SOP equipment



Appendix2

List of TT5 and related instruments

Nomenclature:
Form #: XY# with X=L(*LOP*)/E(*EOP*)/S(*SOP*)/C(*Campaign*) ; Y=F(*French*)/E(*European*) instrument
Instrument code XY.name_O(d)(c): X=A(*Atmosphere*)/C(*Continent*)/O(*Ocean*) ; Y=L/E/S/C, idem form # ; O(d)(c)=O(Ouémé site)/(d)(Donga supersite)/(c)(catena=local)

Instruments EOP

#	Code	PI Name	E-Mail Address	Instrument	Platform	TT
EF2	AE.RadX_O	Marielle Gosset	Marielle.Gosset@hmg.inpg.fr	X Band Hydromet. Radar	Djougou	5
EF3	AE.Dsd_Or	Marielle Gosset	Marielle.Gosset@hmg.inpg.fr	Disdromètre Parsival	Nangatchori	5
EF4	AE.OSP_Od	Laurent Barthès	barthes@cetp.ipsl.fr	Optical Spectro Pluviometer	Dakar puis Djougou	5
EF24	CE.Run_Odc	Luc Seguis	seguis@ird.fr	1 seuil jaugeur on 1 transects: Nalohou	Donga, transects	5
EF25	CE.WChem_O	Christophe Peugeot	peugeot@ird.fr	Chemical Analysis: surf/ground water	Ouémé	5
EF26	CE.WChem_Od	Luc Seguis	seguis@ird.fr	Chemical Analysis: surf/ground water	Ouémé-Donga	5
EF27	CE.Gwat_Odc	Luc Seguis	seguis@ird.fr	Network of 27 piezo in drilled wells	Donga, transects	5
EF28	CE.SW_Odc	Sylvie Galle	galle@ird.fr	3 soil moisture stations on 3 transects: 9 in total	Donga, transects	5
EF29	CE.Veg_Odc	Josiane Seghieri	seghieri@ird.fr	Vegetation survey	Ouémé-Donga	5
EF31	AE.RSO3_Od	Valérie Thouret	thov@aero.obs-mip.fr	Ozone Radio-sounding	Cotonou	5
EF33	AE.VAN_Od	Dominique Serça	serd@aero.obs-mip.fr	NOx measurements + 1 flux station	Nangatchori	5
EF5	AE.VHF_O	Bernard Campistron	camb@aero.obs-mip.fr	CNRM VHF: l = 6.7 m ; m = 45 MHz	Nangatchori	1
EB3/ EF9	AE.H2OFlux_Odc	Colin Lloyd	crl@ceh.ac.uk	1 Water Vapor and CO2 Flux stations	Ouémé-Donga	2a
EB4	AE.H2OFlux_Po	Colin Lloyd	crl@ceh.ac.uk	1 WV/CO2 flux station in a Southern Benin (Pobè)	South Benin	2a
LE2/LF9	AE.SHFlux_Odc	Sylvie Galle	sylvie.galle@ird.fr	2 Sensible Heat Flux stations (OSIL)	Ouémé-Donga	2a
EF10	AE.Scintil_Od	Jean-Martial COHARD	Jean-martial.cohard@hmg.inpg.fr	Scintillometer for Sensible Heat Flux measurement on a 1km transect	Ouémé-Donga-Ara	2a
EE1	AE.RS_1	Andreas Fink	fink@meteo.uni-koeln.de	8 P1 RS stations (Conakry, Abidjan, Cotonou, Douala, Tamale, Parakou, Abuja, *Niamey* ,) and 1 P2 (Bangui)	Monsoon Array	1
CF1	CC.geophy_Odc	JM Descloitre?		Geophysics with SYSCAL Pro and R2	Donga, transects	5
CF?	CC.RMP_Odc	JM Descloitre?		Geophysics with RMP	Donga, transects	5
EF1	AE.GPS_1	Marie-Noëlle Bouin, Olivier Bock	bock@aero.jussieu.fr bouin@ensg.ign.fr	4 GPS stations	regional window including Djougou	1

Instruments LOP

#	Code	PI Name	E-Mail Address	Instrument	Platform	TT
LF3	AL.Met_Od	Sylvie Galle	galle@ird.fr	Campbell Met. Station	Djougou (Ouémé)	5
LF18	CL.Rain_0	Luc Le Barbé	Luc.Le-Barbe@ird.fr	30 recording raingauge network	Ouémé meso site	5
LF19	CL.Rain_Od	Luc Le Barbé	Luc.Le-Barbe@ird.fr	Network of 18 recording raingauges	Ouémé-Donga	5
LF21	CL.Run_O	Christophe Peugeot	peugeot@ird.fr	14 recording streamgauge network	Ouémé meso site	5
LF22	CL.Run_Od	Luc Seguis	seguis@ird.fr	Network of 6 recording streamgauges	Ouémé-Donga	5
LF23	CL.ADCP_O	Christophe Peugeot	peugeot@ird.fr	Accoustic Doppler Current Profiler	Ouémé	5
LF25	CL.Gwat_Od	Luc Seguis	seguis@ird.fr	21 village sites (11 recorders)	Ouémé-Donga	5
LF26	CL.Depot_RW	C. Galy-Lacaux	lacc@aero.obs-mip.fr	5 stations IDAF (4 avec aethalomètre)	Regional Window	5
	CL.Photometer	Philippe Goloub	goloub@loa630.univ-lille1.fr	ORE PHOTON (aérosols)	Regional Window	

Instruments relevant to other Task teams (p.m.)

p.m. Technical stop of oceanographic ship for EGGE EOP campaigns in Cotonou Port

Appendix3

List of TT5 members

Name	Surname	E-Mail Address	Affiliation	Country	Function	Instrument / position
Afouda	Simon	Simon.afouda@ird.fr	IRD	Benin	Technical support, networks	CL.Rain_O CL.Rain_Od, CE.GWat_Odc,CL.GWat_Od, CL.GWat_O, CE.Run_Od, CL.Run_O
Afouda	Abel	afoudabel@yahoo.fr	UAC/FAST	Benin	Hydrological studies	AMMA Benin
Agbossou	Euloge	agbossou2001@yahoo.fr	UAC/FSA	Benin	President Benin AMMA committee	AMMA Benin
Akpo	Aristide	akpoarist@yahoo.fr	UAC/FAST	Bénin	Ozone Radiosounding	AE.RSO3_Od
Alloganvinon	Simon	salloganvinon@yahoo.com	IRD	Bénin	Technical support fluxes	AE.Flux_Odc, CE.SW_Odc, AL.Met_Od, CC.scintil_Od
Arjounin	Marc	arjounin@ird.fr	IRD/LTHE	Benin	Rainfall data monitoring and processing	CL.Rain_O,CL.Rain_Od
Adisso	Pierre	padis.lmedh@intnet.bj	DGH	Benin	Head of Hydrology Service	AMMA Benin
Azonsi	Félix	felixazonsi@gmail.com	DGH	Bénin	Head of Water Resources	AMMA Bénin
Barthès	Laurent	barthes@cetp.ipsl.fr	CNRS/CETP	France	Optical Spectro Pluviometer	AE.OSP_Od
Blarel	Luc	blarel@loa.univ-lille1.fr	Uni-Lille/LOA	France	Sun Photometer	CL.Photometer
Bock	Olivier	bock@aero.jussieu.fr	CNRS/SA	France	GPS stations	AE.GPS_1, AS.GPS_1
Borgstedt	Ariane	Ariane.Borgstedt@ird.fr	PACE consult.	Bénin	BAOC Coordinator	
Bouchez	Jean-Michel	jean-michel.bouchez@ird.fr	IRD/LTHE	Benin	EOP Logistics Rainfall and runoff ,network supervision	CE.Run_Od, CE.Rain_Od, CL.Run_O, CL.Run_Od,
Bouin	Marie-Noëlle.	bouin@ensg.ign.fr	IGN/ENSG	France	GPS stations	AE.GPS_1, AS.GPS_1
Bourles	Bernard	bourles@ird.fr	IRD/LEGOS	France	Coord oceanographic campaigns	Coord TT6
Campistron	Bernard	camb@aero.obs-mip.fr	CNRS/LA	France	VHF profiler	AE.VHF_O, AS.UHF_O
Cazenave	Frédéric	cazenave@ird.fr	IRD/LTHE	Benin	Engineer, X Band Hydrometeo. Radar,	AE.RadX_O
Cohard	Jean-Martial	Jean-Martial.Cohard@hmg.inpg.fr	UJF/LTHE	France	Scintillomètre flux de chaleur sensible	CC.scintil_Od

Name	Surname	E-Mail Address	Affiliation	Country	Function	Instrument / position
Crewell	Suzanne	crewell@meteo.physik.uni-muenchen.de	Uni-Muenchen /meteo	Germany	Ground SOP coord AMMA-IP Instr. PI	AS.CT25K_Od, AE.RADK_Od, AE.PROF_O
Depraetere	Christian	Christian.Depraetere@inpg.fr	IRD/LTHE	France	Meso-scale raingauge network, rainfall data analysis	CL.Rain_O
Dide	Francis	dide_fral@yahoo.com	DMN	Benin	Secretary Benin AMMA committee	AMMA Benin
Drobinski	Philippe	drobinski@aerov.jussieu.fr	CNRS/SA	France	Constant Volume Baloon	AS.BVC_T2
Durbe	Roger	roger.durbe@meteo.fr	Meteo-France	France	VHF profiler	AE.VHF_O
Faroux	Jacques	Jacques.faroux@cetp.ipsl.fr	CNRS/CETP	France	Radar Ronsard	AS.Ronsard_Og
Galle	Sylvie	sylvie.galle@ird.fr	IRD/LTHE	Benin	H2O flux station, soil moisture stations, Meteo station	TT co-leader AE.Flux_Odc, AE.H2OFlux_Po, AE.SHFlux_Odc , CE.SW_Odc, AL.Met_Od
Galy-Lacaux	Corinne	lacc@aero.obs-mip.fr	LA	France	IDAF station	CL.Depot_RW
Gignoux	Karine	ginoux@dr5.cnrs.fr	CNRS/IPSL	France	AMMA Project Office	PO
Goloub	Philippe	goloub@loa630.univ-lille1.fr	Uni-Lille/LOA	France	Sun Photometer	CL.Photometer
Gosset	Marielle	Marielle.Gosset@hmg.inpg.fr	IRD/LTHE	Benin	X Band Hydrometeo.. Radar, Disdro Parsival	AE.RadX_O, AE.Dsd_ Or
Hagen	Martin	martin.hagen@dlr.de	DLR	Germany	Bi-static receptor	AS.Bist_Radar
Hoeller	Hartmut	hartmut.hoeller@dlr.de	DLR	Germany	Coord. Deployment WP 4.23 Lightning detector	AS.lightning_Od
Hottier	Jack	hottier@aero.jussieu.fr	CNRS/SA	France	Radar Ronsard - Logistics	AS.Ronsard_Og
Houngninou	Etienne	houngnb@yahoo.fr	UAC/FAST	Benin	Atmospheric Physics	AE.VHF_O, AS.UHF_O, AS.Ronsard_Og, AS.PROF_O, AS.lightning_Od, AE.RadX_O
Janicot	Serge	jslod@lodyc.jussieu.fr	IRD/LOCEAN	France	RS Stations	AE.RS_Q1
Kane	Cheikh	citizenkane@ird.ne	IRD	France	AMMA Project Office	PO
Kounouhewa	Basile	kbbasile@yahoo.fr	UAC/FAST	Bénin	Flux stations	AE.Flux_Odc, AE.H2OFlux_Po, AE.SHFlux_Odc
Kuntzman	Harald	harald.kunstmann@imk.fzk.de	IMK-IFU	Germany	Coord. Deployment WP 4.23	Coord
Lamizana T.	Moumouni	lamizana@ird.fr	IRD	Benin	Head IRD in Benin	Coord
Lebel	Thierry	lebel@ird.ne	IRD/LTHE	France	Coord deployment French API, ISSC member	Coord
Lloyd	Colin	crl@ceh.ac.uk	CEH/Wallingford	UK	2 SH and 2 H2O flux stations TT2a leader	AE.Flux_Odc, AE.H2OFlux_Po, AE.SHFlux_Odc
Luc Le Barbé	Luc	Luc.Le-Barbe@ird.fr	IRD/LTHE	Benin	Super-site scale, rainfall data analysis	CL.Rain_Od

Name	Surname	E-Mail Address	Affiliation	Country	Function	Instrument / position
Malinur	Fred	malinur@ird.fr	IRD/LTHE	Benin	Groundwater data monitoring and processing	CE.GWat_Odc, CL.GWat_Od, CL.GWat_O
Mariscal	Armand	mariscal@ird.fr	UPS-IRD/LA	Benin	Mobile Laboratory operations, Ozone Radiosoundings Op. Sun photometer maintenance	AE.VAN_Od, AE.RSO3_Od CL.Photometer
Ney	Richard	Richard.Ney@cetp.ipsl.fr	CNRS/CETP	France	Radar Ronsard	AS.Ronsard_Og
Nodichao	Leifi	nleifi@yahoo.fr	INRAB	Bénin	Physiologie palmier à huile Station de flux de Pobè	AE.H2OFlux_Po
Ouani	Théodore	Theodore.ouani@ird.fr	IRD	Benin	Technical support, networks	CL.Rain_O CL.Rain_Od, CE.GWat_Odc,CL.GWat_Od, CL.GWat_O, CE.Run_Od, CL.Run_O
Peugeot	Christophe	Christophe.peugeot@ird.fr	IRD/HSM	Benin	Meso-scale Chemical Analysis: surf/ground water, streamgauge network, Acoustic Doppler Current Profiler	TT Leader CE.WChem_O, CL.Run_O, CL.ADCP_O
Pont	Valérie	ponv@aero.obs-mip.fr	CNRS/LA	France	Impacteur, CCN, HTDMA, VTDMA	AS.Dust_Od
Pospichal	Bernhard	bernhard@meteo.physik.uni-muenchen.de	Uni-Muenchen /meteo	Germany	Atmospheric column	AS.CT25K_Od, AE.RADK_Od, AE.PROF_O
Protat	Alain	protat@cetp.ipsl.fr	CNRS/CETP	France	Ground SOP French AMMA-API coord.	Coord
Robain	Henri	Henri.Robain@bondy.ird.fr	IRD/Geovast	France	Résistivimètres SYSCAL Pro et R2	CC.geophy_Odc
Scialom	Georges	scialom@cetp.ipsl.fr	CNRS/CETP	France	Radar Ronsard	AS.Ronsard_Og
Seghieri	Josiane	Josiane.Seghieri@ird.fr	IRD/CESBIO	Mali	Vegetation surveys (biomass, phenology, LAI)	CE.Veg_Odc
Seguis	Luc	Luc.seguis@ird.fr	IRD/HSM	Benin	Local and Super-site scale : water chemical analyses, ground water networks, streamgauge networks, Meso-scale groundwater monitoring	CE.Run_Odc, CL.Run_Od, CE.WChem_Od,CE.Gwat_Odc, CL.Gwat_Od CL.Gwat_O
Serça	Dominique	serd@aero.obs-mip.fr	CNRS/LA	France	Atmo. Chemistry and aerosols Mobile Laboratory	AE.VAN_Od
Soula	Serge	sous@aero.obs-mip.fr	CNRS/LA	France	5 field mills	AS.Field_Mills_O
Thouret	Valérie	thov@aero.obs-mip.fr	CNRS/LA	France	Ozone Radio-sounding	AE.RSO3_Od
van den Akker	Elisabeth	Elisabeth.vandenAkker@ipsl.jussieu.fr	CNRS/IPSL	France	AMMA Project Office	PO
Vouillamoz	Jean-Michel	Jean-Michel.Vouillamoz@hmg.inpg.fr	IRD/LTHE	France	Protons Magnetic Resonance	CC.RMP_Od

Name	Surname	E-Mail Address	Affiliation	Country	Function	Instrument / position
Zannou	Arnaud	Arnaud.zannou@ird.fr	DGH	Bénin	Hydrological studies AMMA-DGH focal point	CE.WChem_O, CL.Run_O, CL.ADCP_O, CL.Rain_O

Appendix 4

Location of sites and instruments

Site	UTM-Est	UTM-Nord	long E	lat N	long E	lat N	confirmed by PI
Djougou-TP	353158	1071649	1° 39' 41.4"	9° 41' 31.2"	1.66150	9.69200	yes
Spectro-photometer	346336	1079217	1° 35' 56.6"	9° 45' 36.5"	1.59905	9.76019	yes
Ronsard			1° 33' 34"	9° 49' 17"	1, 55944	9, 82139	yes
Bistatic	366117	1093400	9°53'20.89"	1° 46' 44.01"	1.77889	9.88914	Yes
Scintilllo-emetteur	345648	1079248					yes
Scintilllo-récepteur	346763	1077103	1° 36' 11.9"	9° 44' 27.8"	1.6033	9.74109	yes
Nangatchori	361879	1066676	1° 44' 28.1"	9° 38' 50.4"	1.74114	9.64733	yes
Catena_Nalohou (center)	347016	1077575	1° 36' 19.1"	9° 44' 43.3"	1.60531	9.74536	yes
Catena_Béléfoungou (center)	359017	1083023	1° 42' 52.2"	9° 47' 42.1"	1.71451	9.79506	yes
Catena_Bira (center)	359297	1086533	1° 43' 01."	9° 49' 36.5"	1.71694	9.82681	yes

Djougou-TP : Météo, Xport, GPS

Nangatchori : VAN, UHF+VHF, disdrometer, microrain radar, lidar ceilometer, microwave profiler, dust impactor, IDAF

Catena : Raingauge, Soil water probes, Piezometers, Flux station, Vegetation surve

Appendix 5

Telecommunication solutions
Djougou, Kopargo and Nangatchori

Data transmission needs

Site	Duration	Type of data	Quantity
NANGATCHORI			
UHF radar	SOP 1,2	Daily transmission of a quick-look (250Kb/day) + archiving of data every week on DVD, the DVD is sent to France by post mail.	2 MB/day
VHF radar	18 months : Mar. 2006 - Aug. 2007	UHF+VHF : hourly transmission of 2 MB minimum	48 MB/day
MW profiler	1 year : Jan.- Dec. 2006	If high-speed connection is not available, then data transferred from on-board PC to laptop every month (20 MB / day). If possible some of the products (about 100 kB) should be transmitted to LMU via internet daily.	100 kB/day
Ceilometer	1 year : Jan.- Dec. 2006	Data transferred from laptop every month (230 kbytes a day) to CD and mailing to LMU (out of SOP period) by operator	
Micro rain radar	1 year : Jan.- Dec. 2006	Data transferred from laptop every month (approx. 300 MB in one month in rainy season) to CD and mailing to LMU (by operator out of SOP period, someone there during SOP)	
Cimel Lidar	1 year : Jan.- Dec. 2006	an average lidar vertical profile every half an hour (100 Kb/hour) + Data transferred from laptop every week to CD and mailing to SA by operator	20MB/day
		TOTAL NANGATCHORI	**70MB/day**
DJOUGOU			
X-Port	EOP (Mai 2005 -		
GPS station	EOP instrument (2 years 2005-2006)	300-500 KB/day to be transferred daily to the analysis center in Paris	Existing Satellite connection
Optical Spectro-pluviometer 1	SOP1,2 and 2007.	transferred daily to CETP, Vélizy. Instrument status is checked remotely using VNC (so a permanent connection is required).	1 MB/day
		TOTAL DJOUGOU	**1 MB/day**
KOPARGO			
RONSARD	15 June – 15 Sept. 2006	200 kO every 15 minutes, but only when there's convection → 800 kB/hour→ 20 MB/day	20 MB/day (average 10MB/day)
Optical Spectro-pluviometer 2	SOP 1, 2	Taken care of by the Ronsard technicians	
		TOTAL KOPARGO	**10 MB/day**
KOLOKONDE			

bistatic receiver	Id Ronsard	stored on the computer, regular archiving	BLR to Ronsard

Data Transmission solutions

AOC Benin opted for independent communication facilities via satellite for the sites of Nangatchori and Kopargo. For satellite connection, there are three options: communication via satellite modem (e.g. BGAN) via a mini satellite antenna, or via Satellite antenna GEOLINK (antenna exists in Cotonou). BAOC studies costs and facilities.

Nangatchori

As can be seen above, the biggest communication need is in Nangatchori. Note also that the need extend to august 2007 for UHF-VHF.

Kopargo

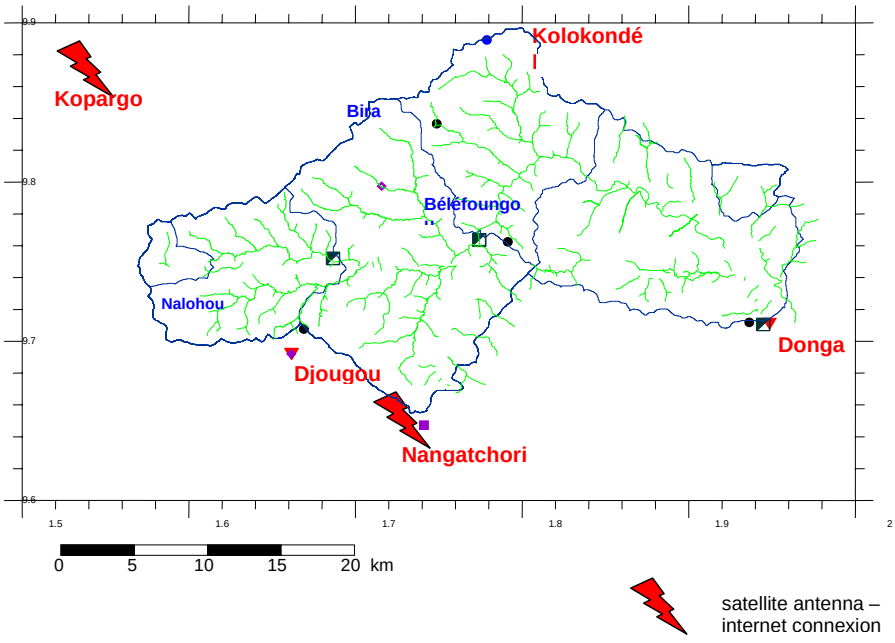
The transmission of the RONSARD data is of main interest for SOP. It is funded by the AOC. It stops at the end of september 2006.

Djougou

The GPS allready has its own inmarsat connection. Marginal other data may be transmitted through this connection. Djougou won't have a satellite connection as other data can be transmitted via the existing "internet café"-connection.

Kolokondé

Local need covered by BLR.



Djougou Data Tansmission scheme

Voice communication

Existing GSM telephone network

- Djougou → GSM is working (telecel + areeba), telephone network, internet connection with modem, no DSL available, research site is not connected to the telephone network
- Nangatchori → GSM is working (telecel + areeba), no existing telephone network
- Kopargo → limit of GSM covering, no telephone network
- Kolokondé → no GSM, no telephone network

The GSM-Net Telecel and BeninCell are covering Djougou and Nangatchori. Kopargo is at the limit of the GSM covering. The network of fixed telephones just exists in Djougou.

Satellite telephone

As GSM communication may be weak or overbooked, some additional satellite telephones will secure permanent communication for internal coordination during SOP and EOP.

The different available satellite telephones in Benin are Thuraya, Inmarsat or Iridium.

IMPETUS can lend 2 INMARSAT telephones. There's the possibility to connect a fax without additional costs.

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The International Implementation Plan

Version 3.0
May 2006

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Any further information : **www.amma-international.org**

AMMA International Project Office
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AMMA International Implementation Plan (IIP)

The IIP is composed out of an Introduction chapter and 10 TT-documents written within different time periods due to project development.
This document is dated May 2006 and will still undergo necessary changes following the development of AMMA.

The following versions of the whole document or of TT-documents were subsequently published:

Version 1.0	September 2005
Version 1.1	December 2005
Version 2.0	March 2006
Version 3.0	May 2006

Note: The version indicated at the footnote of each TT-document indicates the version incorporating the latest changes.