Workplan Tables

Project number

263218

Project title

PLASMON—A new, ground based data-assimilative modeling of the Earth's plasmasphere - a critical contribution to Radiation Belt modeling for Space Weather purposes

Call (part) identifier

FP7-SPACE-2010-1

Funding scheme

Collaborative project

WT1
List of work packages

Project Number [1]	263218	Project Acronym [2]	PLASMON

LIST OF WORK PACKAGES (WP)

WP Number [53]	WP Title	Type of activity [54]	Lead beneficiary number [55]	Person-months [56]	Start month [57]	End month [58]
WP 1	Automatic retrieval of equatorial electron densities and density profiles by AWDANet	RTD	1	52.00	1	42
WP 2	Retrieval of equatorial plasma mass densities by magnetometer arrays and cross-calibration	RTD	4	81.00	1	42
WP 3	Data assimilative modeling of the Earth's plasmasphere	RTD	8	34.00	1	42
WP 4	Modeling REP losses in radiation belts based on AARDDVARK network	RTD	2	57.00	1	42
WP 5	Dissemination and exploitation of the results	OTHER	6	20.00	1	42
WP 6	Management of the consortium	MGT	1	10.00	1	42
			Total	254.00		

WT2:
List of Deliverables

Project Number [1]	263218	Project Acronym [2]	PLASMON

List of Deliverables - to be submitted for review to EC

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	Installation and setup of three new AWDA stations	1	1	6.00	R	PU	12
D1.2	Development of computer algorithm of AWA	1	1	24.00	R	PU	24
D1.3	Installation of AWA on AWDANet nodes	1	1	8.00	R	PU	24
D1.4	Setup of quasi-real-time mode of operation of AWDANet nodes	1	1	14.00	R	PU	42
D2.1	Installation and setup of three new EMMA ULF stations	2	4	7.00	R	PU	12
D2.2	Installation and setup of two new EMMA and two Southern Africa ULF stations	2	4	8.00	R	PU	24
D2.3	Computer algorithm of FLRID	2	4	20.00	R	PU	24
D2.4	FLRINV running on central server	2	4	12.00	R	PU	24
D2.5	Setup of quasi-real-time mode of operation of the ULF array	2	4	14.00	R	PU	42
D2.6	Cross-calibration method for whistlers and FLRs	2	4	20.00	R	PU	42
D3.1	A data assimilation code written in C++ and	3	8	10.00	R	PU	24

WT2:
List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
	parallelized with MPI						
D3.2	Plasma density maps as a function of time for interesting study periods selected by the project.	3	8	12.00	R	PU	24
D3.3	A set of instruction that allows users to run the assimilation code	3	8	12.00	R	PU	42
D4.1	Installation and setup of one new AARDDVARK site	4	2	2.00	R	PU	12
D4.2	Installation and setup of two new AARDDVARK sites	4	2	4.00	R	PU	24
D4.3	Build event database of characteristics of REP	4	2	12.00	R	PU	42
D4.4	Development of REP model	4	2	23.00	R	PU	42
D4.5	Development of model of on/inside/outside plasmapause precipitation	4	2	16.00	R	PU	42
D5.1	Project website set-up, then used and updated throughout the project	5	6	3.00	O	PU	3
D5.2	Conference presentations I.	5	6	1.50	R	PU	12
D5.3	Conference presentations II.	5	6	2.00	R	PU	24
D5.4	Conference presentations III.	5	6	2.50	R	PU	42

WT2:
List of Deliverables

Delive-rable Number [61]	Deliverable Title	WP number [53]	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D5.5	Run PLASMON Workshop to disseminate results	5	6	1.00	O	PU	42
D5.6	Papers published in scientific journals	5	1	10.00	R	PU	42
D6.1	Quality assurance plan	6	1	0.50	R	PU	1
D6.2	Annual reporting	6	1	2.50	R	PU	12
D6.3	Annual reporting	6	1	2.50	R	PU	24
D6.4	Final report	6	1	4.50	R	PU	42
			Total	254.00			

WT3:
Work package description

Project Number [1]	263218	Project Acronym [2]	PLASMON

One form per Work Package

Work package number [53]	WP1	Type of activity [54]	RTD
Work package title	Automatic retrieval of equatorial electron densities and density profiles by AWDANet		
Start month	1		
End month	42		
Lead beneficiary number [55]	1		

Objectives

1.extend the AWDANet to have better MLT and latitudinal coverage,
2.develop an automatic whistler analyzer (AWA) method based on our new whistler inversion method,
3.implement the AWA in AWDANet nodes and
4.develop AWDANet to work in quasi-real-time mode of operation

Description of work and role of partners

T1.1 The nodes in the existing AWDANet are distributed over a range of latitudes in both the northern and southern hemisphere, affording reasonable coverage in geomagnetic latitude. However, their distribution in longitude, and hence MLT, is non-uniform, being dictated principally by the location of the continents and the availability of sites with suitable facilities for hosting an AWDA receiver. Depending on the nature of the data requirements, the longitudinal gaps may or may not be a source for concern. If one is simply concerned with longer term variations then the diurnal rotation of the Earth will provide full coverage in MLT. However, if one hopes to achieve a snapshot of the plasmasphere at a given instant then a denser longitudinal network is required. In order to achieve improved MLT coverage it will be necessary to install additional receivers in longitude sectors not presently well covered by the network. Specifically, both the Asian and Pacific sectors are poorly represented. We are planning to setup three stations: a. a North American (Seattle) , b. a North-West European (Scotland), and c. a North-Asian (Russia). Because the possible locations are limited by the requirements for a site that are high (geomagnetic location over land in L=1.4-5 range, secure place, power, Internet connection and low electromagnetic noise in VLF range) and they are contradictory in the same time (power, Internet vs. low noise), thus the actual location may vary. As a result of the upgrade, we will have stations covering all the main MLT sectors (day, night, afternoon, morning) and the targeted L-range (1.4-5) in Europe, and covering the most important L-range (2.5-5) in the rest of the world. ELTE will setup the Russian station, NERC-BAS will setup the Scottish and UW the Seattle station. ELTE will integrate the new stations into AWDANet. An AWDA station consists of two magnetic loop antennas (area of 100m2), a high time precision VLF data logger and a data processing PC. The procurement of the equipments, the fabrication of the antenna and the setup will be made by the assigned (see above) consortium member.

T1.2 The derivation of an improved whistler inversion method, based on enhanced models for wave propagation and magnetospheric density distribution, will provide the basis for the development of an automated system for whistler analysis. Once whistlers have been identified by the AWD system, magnetospheric characteristics must still be extracted via detailed analysis of the frequency-time structure of the whistler traces. This analysis is both a time consuming and error-prone task if performed by hand. However, an automatic whistler analyzer (AWA) would be able to perform the analysis autonomously, yielding plasmaspheric parameters. Based on the new, extended whistler inversion method [Lichtenberger, 2009], we will develop a computer algorithm for AWA by ELTE.

T1.3 The algorithm developed in 2. will be implemented at AWDANet nodes located at different magnetic latitude.. Following installation, a period of validation will be required to ensure that the analysis is performing optimally at each site. The installation will be done by ELTE, HMO takes part in testing and porting the algorithm to data recorded at different magnetic latitudes NERC-BAS (Rothera, Halley, and the new Scottish station), SGO (Tvarminne, Oulu), UO (Dunedin), HMO (SANAE, Marion Island, Grahamstown and Sutherland) and

UW (Seattle) provide local technical assistance at sites run by them. Notice, that implementation will not be a real-time implementation!

T1.4 Each AWDANet node produces a significant quantity of data each day. At some remote locations, for example the sites in Antarctica, the network connection is not sufficiently reliable nor does it have enough bandwidth for the transfer of the raw or even partly processed and/or compressed data to a central location for further processing. This suggests that in order to produce results in quasi-real-time, the detailed processing of the raw data should take place at each of the network nodes. This processing, however, is currently immensely expensive in terms of computing resources. Therefore, in order to practically achieve this, it would require the installation of supercomputing facilities at each of the nodes. According to the preliminary tests and calculations based on non-automatic processing, the analyzes of a multiple path propagation whistler group may take up to 24-48 hours (!) on a recent Intel Core 2 Duo CPU using a single core only. Our goal is to be able to process an MP group within 30 minutes on average (this we call 'quasi-real-time'). To be able to reach the quasi-real-time mode of operation, massive parallel processing (PP) has to be used. Fortunately, the nature of the problem allows us to use PP. To date, there are two ways to achieve PP: clusters or Graphical Processing Units (GPU). For our purposes, taking into account the occurrence rate of MP groups and the quasi-real-time mode of operation, we need PP units with 100 Core 2 Duo equivalent computing capacity. The cost of such a PP roughly the same for a cluster or a GPU/few GPUs. Both solutions have advantages and disadvantages: clusters can be based on open architectures (Linux), the necessary operating and application software is easily available, but they are large and consumes high power; while GPUs are compact, but the application software may not be easily available and their usage requires code translations. In any case, First, the decision on the PP architecture has to be made, then the installation and setup of the PP unit at the site followed by the test and validation of installation. Once an operational version of the AWA has been developed, it can be deployed at each of the AWDANet nodes. Finally, the test and validation of the quasi-real-time mode of operation of the AWDANet has to be performed. ELTE is responsible for the installation and setup of all the European (except the Scottish one), the Russian and the Brazilian and US Antarctic (Commandante Ferraz and Palmer) stations; NERC-BAS is responsible for the installation and setup of the stations at Rothera, Halley and Scotland; UO is responsible for the installation and setup of the stations at Dunedin; HMO is responsible for the installation and setup of the stations at SANAE, Marion Island, Grahamstown and Sutherland; UW is responsible for the installation and setup of the stations at Seattle. The procurement of the equipments and the setup will be made by the assigned (see above) consortium member.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ELTE	36.00
2	NERC-BAS	2.00
3	ELGI	2.00
5	UOULU	1.00
6	UO	2.00
7	HMO	7.00
10	UW	1.00
11	LANL	1.00
	Total	52.00

WT3:
Work package description

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	Installation and setup of three new AWDA stations	1	6.00	R	PU	12
D1.2	Development of computer algorithm of AWA	1	24.00	R	PU	24
D1.3	Installation of AWA on AWDANet nodes	1	8.00	R	PU	24
D1.4	Setup of quasi-real-time mode of operation of AWDANet nodes	1	14.00	R	PU	42
		Total	52.00			

Description of deliverables

D1.1) Installation and setup of three new AWDA stations: The nodes in the existing AWDANet are distributed over a range of latitudes in both the northern and southern hemisphere, affording reasonable coverage in geomagnetic latitude. However, their distribution in longitude, and hence MLT, is non-uniform, being dictated principally by the location of the continents and the availability of sites with suitable facilities for hosting an AWDA receiver. In order to achieve improved MLT coverage it will be necessary to install additional receivers in longitude sectors not presently well covered by the network. e will have stations covering all the main MLT sectors (day, night, afternoon, morning) and the targeted L-range (1.4-5) in Europe, and covering the most important L-range (2.5-5) in the rest of the world. At the end of the period we will install the new stations and put them into operational mode. [month 12]

D1.2) Development of computer algorithm of AWA: An automatic whistler analyzer (AWA) would be able to perform the analysis autonomously, yielding plasmaspheric parameters. Based on the new, extended whistler inversion method [Lichtenberger, 2009], we will develop a computer algorithm for AWA by ELTE. [month 24]

D1.3) Installation of AWA on AWDANet nodes: The algorithm developed in 2 will be implemented at AWDANet nodes located at different magnetic latitude. Following installation, a period of validation will be required to ensure that the analysis is performing optimally at each site. [month 24]

D1.4) Setup of quasi-real-time mode of operation of AWDANet nodes: In order to produce results in quasi-real-time, the detailed processing of the raw data should take place at each of the network nodes. First the decision on the PP architecture has to be made, then the installation and setup of the PP unit at the site followed by the test and validation of installation. Once an operational version of the AWA has been developed, it can be deployed at each of the AWDANet nodes. Finally, the test and validation of the quasi-real-time mode of operation of the AWDANet has to be performed. [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS1	Decision on PP architecture	1	6	Documentation available
MS2	Decision of AWA implementation method	1	12	Documentation available

WT3:
Work package description

Project Number [1]	263218	Project Acronym [2]	PLASMON

One form per Work Package

Work package number [53]	WP2	Type of activity [54]	RTD
Work package title	Retrieval of equatorial plasma mass densities by magnetometer arrays and cross-calibration		
Start month	1		
End month	42		
Lead beneficiary number [55]	4		

Objectives

1.unify and extend the SEGMA, MM100 and IMAGE networks into EMMA (including South African stations maintained by HMO) to have better latitudinal coverage,
2.develop an automatic FLR identification (FLRID) method based on previous experience and recent improvements,
3.develop an automatic FLR inversion (FLRINV) method based on most recent achievements including error estimations,
4.develop all EMMA stations to work in quasi-real-time mode of operation,
5.evaluate relative abundances of heavy ions in the plasma composition from simultaneous determinations of mass density (FLR method) and electron density (whistler method)

Description of work and role of partners

T2.1 The distribution of existing magnetometer arrays in Europe does not allow for the monitoring of the whole plasmasphere. Both the latitude coverage and the density of the network is insufficient especially at mid latitudes. Therefore our primary goal is to unify and complete the SEGMA, MM100 and IMAGE arrays (Finnish part) to form a quasi meridional European magnetometer array (EMMA) covering the whole plasmasphere available with FLR-method (starting at about L=1.5) up to the plasmapause and beyond. While the density of the high and low latitude networks are close to sufficient, several new stations have to be installed in the mid latitude (L = 2–3) range. Similarly to VLF observations, the diurnal rotation of the Earth will provide a partial coverage in MLT (daytime). As a conclusion we will be able to follow the local time variations of the plasmasphere in a fixed magnetic meridian but not to map the longitudinal variation at a given instant. We are planning to setup five EMMA plus two Southern African ULF stations: a. one in South Pannonia in Hungary, b.one in Middle Slovakia, c. one in South Poland near Krakow, d. one between BEL and SUW stations in Poland, e. one in Latvia or Lithuania and finally f. two in Namibia. The actual locations will be chosen on the grounds of strict criteria (low EM noise in the ULF range, power and Internet access, security). As a result of the upgrade, we will have stations uniformly distributed in a wide L-range (1.6-6.7) in Europe including the plasmasphere and the inner part of the plasmatrough up to geosynchronous orbit. Since the daily data amount at a site is a few MByte, data will be transferred at every 15 minutes from the observation site to central data servers for processing. IGFPAS will setup and maintain the two stations in Poland and one in Lithuania or Latvia, while ELGI will setup and maintain one station in South Pannonia in Hungary and another in Slovakia. A ULF station consists of a three component magnetometer and a high time precision ULF data logger. The instruments will be purchased, the installation will be made by the assigned consortium members.
T2.2 The identification of FLRs will be primarily based on the cross phase technique, but will make use of other information (amplitude ratio, polarization), as well. Both UNIVAQ and ELGI use a semiautomated identification method, which will be further developed to a fully automated process (FLRID). The applied criteria may depend on local circumstances (magnetic latitude, ground conductivity), therefore the method has to be fine tuned for all station pairs. FLRs are common phenomena of the dayside magnetosphere, they can be observed practically at any time, when a driver source is present covering their frequency range. Apart from some inactive periods, mainly during the declining phase of the solar cycle and especially at solar minimum, FLRs can be observed every day from sunrise to late afternoon hours. Using the FLRID, the FLR frequency can be measured with a 10-20 minutes time resolution (or even more frequently taking overlapping time windows). The FLRID will be implemented by UNIVAQ for SEGMA stations and by ELGI for MM100 and IMAGE stations.

T2.3 The inversion algorithm (FLRINV) will make use of the recent developments in MHD theory, will be based on realistic geomagnetic and plasma distribution models. The inversion will be implemented in the data centre. The inversion method and the computer algorithm will be developed by UNIVAQ, ELGI and IGFPAS. We will be able to monitor the plasma density of the whole plasmasphere and to locate the plasmapause, as well. We will also develop methods to evaluate the error in the plasma density estimates.
T2.4 The monitoring system should work in near real time. We have to transfer the observed magnetic data, to implement FLRID and FLRINV algorithms for all station pairs within 30 minutes. To achieve this goal, all the observed data should be transferred at every 15 minutes to a server, where FLRID is implemented. Therefore at all stations the real-time accessibility of the data should be solved. This goal can be achieved by upgrading the DAQ hardware and software. This upgrade will be done by UNIVAQ for all SEGMA stations, by ELGI and IGFPAS for MM100 stations, by FMI for the Finnish IMAGE stations, and by HMO for South African stations. The FLR frequencies identified by FLRID will be inverted (FLRINV) to infer the equatorial plasma mass densities at the corresponding L-shells. This procedure is not so time consuming as in the case of whistlers, and can be executed on a simple PC connected to the central data server.
T2.5 We will evaluate the relative abundances of heavy ions in the plasma composition from simultaneous determinations of mass density (FLR method) and electron density (whistler method). In order to assimilate the data from whistler and FLR techniques, which are based on distinct physical principles, it will be necessary to have reasonable estimates of the uncertainties associated with the respective methods. It will be necessary to develop a procedure for weighting the data from the two methods, and indeed from different locations implementing each method, in the case that there is a significant overlap in the associated confidence intervals. A protocol will also need to be developed for resolving conflicts in which the confidence intervals from the respective methods do not overlap. In both cases, an assessment of realistic confidence limits will be required, which will necessitate characterization of the statistical distribution of results based on each technique.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ELTE	4.00
2	NERC-BAS	2.00
3	ELGI	20.00
4	UNIVAQ	28.00
5	UOULU	1.00
6	UO	2.00
7	HMO	7.00
9	IGFPAS	16.00
11	LANL	1.00
	Total	81.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D2.1	Installation and setup of three new EMMA ULF stations	4	7.00	R	PU	12
D2.2	Installation and setup of two new EMMA and two Southern Africa ULF stations	4	8.00	R	PU	24

WT3:
Work package description

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D2.3	Computer algorithm of FLRID	4	20.00	R	PU	24
D2.4	FLRINV running on central server	4	12.00	R	PU	24
D2.5	Setup of quasi-real-time mode of operation of the ULF array	4	14.00	R	PU	42
D2.6	Cross-calibration method for whistlers and FLRs	4	20.00	R	PU	42
		Total	81.00			

Description of deliverables

D2.1) Installation and setup of three new EMMA ULF stations: As a first step in the achievement of objective 1, three new EMMA ULF stations will be made operational. The choise of the location of these stations will be made among those listed in the work description (T2.1) on the basis of easier fulfilment of the required criteria (low EM noise in the ULF range, power and Internet access, security). [month 12]

D2.2) Installation and setup of two new EMMA and two Southern Africa ULF stations: As a final step in the achievement of objective 1, the remaining planned EMMA ULF stations and two Southern Africa ULF stations will be made operational. As a result, we will have stations uniformly distributed in a wide L-range (1.6-6.7) in Europe including the plasmasphere and the inner part of the plasmatrough up to geosynchronous orbit. [month 24]

D2.3) Computer algorithm of FLRID: The semiautomated identification methods of FLRs (presently applied by UNIVAQ and ELGI on measurements recorded at several station pairs of the SEGMA, MM100 and IMAGE arrays) will be developed to a fully automated process (FLRID). For each station pair of the EMMA array a suitable version of the computer algorithm of FLRID will be produced to take into account local peculiarities (magnetic latitude, interstation separation, ground conductivity, etc.). The method will produce estimates of the FLR frequency of the field line located halfway between each station pair with a 1 (or less) mHz frequency resolution and 20 minutes (or even less) time resolution in the daytime hours. D2.2 is the operating FLRID. [month 24]

D2.4) FLRINV running on central server: The inversion algorithm FLRINV, based on realistic geomagnetic and plasma distribution models, will convert the FLR frequencies provided by FLRID (D2.2) into estimates (and corresponding uncertainties) of the equatorial plasma mass density in the L-shell range 1.6- 6.7. FLRINV will be developed by UNIVAQ, ELGI and IGFPAS and will be implemented in the data centre. D2.3 is the operating FLRINV. [month 24]

D2.5) Setup of quasi-real-time mode of operation of the ULF array: We have to transfer and process the observed magnetic data for all station pairs within 30 minutes. To achieve this goal, all the observed data should be transferred at every 15 minutes to a server, where FLRID and FLRINV are implemented. This goal will be achieved by upgrading the DAQ hardware and software to ensure real-time accessibility of the data. This upgrade will be done by UNIVAQ for all SEGMA stations, by ELGI and IGFPAS for MM100 stations, by FMI for the Finnish IMAGE stations, and by HMO for South African stations. FLRID and FLRINV are not so time consuming procedures as in the case of whistlers, and can be executed on a simple PC connected to the central data server. As a result the whole monitoring system (stations, data centre, processing) should operate in near real time. [month 42]

D2.6) Cross-calibration method for whistlers and FLRs: In order to assimilate the data from whistler and FLR techniques, which are based on distinct physical principles, it will be necessary to have reasonable estimates of the uncertainties associated with the respective methods. A procedure will be then developed for weighting the data from the two methods (and indeed from different locations implementing each method) in the case that there is a significant overlap in the associated confidence intervals. A protocol will be also developed for resolving conflicts in which the confidence intervals do not overlap. In both cases, an assessment of realistic confidence limits will be required, which will necessitate characterization of the statistical distribution of results based on each technique. D2.5 will be a report on this activity. [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS3	Decision on ULF station instrumentation and DAQ system	4	6	Documentation available
MS4	Decision on calibration method	4	18	Documentation available
MS5	Decision on FLRID and FLRINV implementation	4	24	Documentation available

WT3:
Work package description

Project Number [1]	263218	Project Acronym [2]	PLASMON

One form per Work Package

Work package number [53]	WP3	Type of activity [54]	RTD
Work package title	Data assimilative modeling of the Earth's plasmasphere		
Start month	1		
End month	42		
Lead beneficiary number [55]	8		

Objectives

1.Develop a particle filter based data assimilation framework for plasmaspheric data assimilation and compare it with a Kalman filter.
2.Create data ingestion functions for FLR data, whistler data and in-situ density measuremners.
3.Test the assimilation by comparing with in-situ observations.
4.Provide plasmasphere density maps to WP 4.

Description of work and role of partners

T3.1 Data assimilation framework We will develop a data assimilation framework for combining a plasmasphere model with observations. Our approach combines the Dynamic Global Core Plasma model (DGCPM) (Ober and Horwitz [1997]) with a data assimilation approach called particle filtering. Particle filtering has been used in space physics previously Nakano et al. [2008], and is probably superior to the more common Kalman filter for systems which possess significant time-history. The DGCPM incorporates the basic physics of the the plasmasphere: 1) drift according to an externally imposed electric field model. 2) ionospheric outflow on the dayside and downward flow on the nightside, 3) plasmaspheric density saturation. The current model does not incorporate composition information, but this is a relatively simple addition to the model, simply requiring parallel model runs for each species with the appropriate refilling and decay time and saturation levels. The particular implementation of the DGCPM which we will use is flexible and easy to use in data assimilation. It allows for the easy incorporation of any magnetic and electric field models. The particle filter is an approach to data assimilation which allows for the incorporation of future data into a model run, or equivalently, to adjust past input parameters to a model run. Adjustment of past inputs is important because the effect of a past change in the input driver may not be visible in data until at a later time. For example, the input drivers could be solar wind parameters, and the effect is not visible in data until much later. Practically, if a past input needs to be changed, the model is rolled back to the beginning of the assimilation, the change applied, and the model run forward in time again. For the plasmasphere, the primary driver is the electric field which can be parameterized, as explained below. The input data set would be a time-series of the parameters to the electric field model. The remaining work to be carried out includes code refinements (in particular implementation as object-oriented code base to make it easier to use and update), and various tests to determine optimal run parameters. These tests will be carried out using simulated data. We will also implement a simple single-pass Kalman filter to be used as a comparison baseline.

T3.2 Whistler data ingestion. We will use both approaches mentioned in 1.1.B.3 for whistler data ingestion to find the optimal method of integration whistler data into the plasmasphere model. In the first approach, we will take the plasmaspheric electron densities in the case of single whistler events or the equatorial electron density profiles obtained by analyzing multiple-path whistler groups as described in WP1and will adjust the plasmasphere model parameters to match with the external (whistler) data. In the second approach, we will take instants of plasmasphere model and compute the waveforms of model whistlers assuming propagation along various L and MLT paths taken from the plasmasphere model. Then, the pattern of the real whistler will be compared to the patterns of model whistlers spectrogram to find the best match.

T3.3 Field line resonance data ingestion. We will use a similar approach for ingestion of FLR data to the ingestion of whistler data. First we will derive plasmaspheric mass densities from FLR data as described in WP2 and adjust the model parameters of the plasmasphere to match with experimental data. In the second approach, the plasmasphere model will be used to compute FLR periods for a large set of L and MLT values; and these outputs of the models are compared with the real data. As a result, the optimal method will be chosen.

T3.4 Satellite plasma data ingestion. The in-situ plasma density can be measured by a variety of methods. As long as the uncertainties are available they are readily ingested simply by sampling the model plasma density and transforming to the appropriate latitude. We will use partial density measurements from LANL/MPA, which are available from CDAWeb. The MPA data will be most useful during quiet time and to constrain plumes. We also anticipate some calibration issues. However, because the primary parameter of interest is the plasmapause the exact density calibration is somewhat secondary. An important use for the LANL data is also as a check on the assimilation of the Whistler and FLR data.

T3.5 Electric field model. The electric field is the crucial driver of the plasmaspheric dynamics. We will experiment with several different E-field model parametrizations. The Ober and Horwitz [1997] model includes a two-cell convection pattern model parametrized by KP . This will be sufficient for testing purposes and may even be sufficient for initial use with real data. For later use a more sophisticated model is required. This can take several forms. The simplest form is a Volland-Stern type electric field modified by a set of orthogonal polar harmonic functions, such as the Zernike polynomials. We intend to experiment with using such functions when dense data sampling is available. An even more sophisticated approach which we will consider is using a data assimilation derived ionospheric electric field from the AMIE procedure and modify it with the same set of Zernike polynomials. The expectation is that the AMIE-derived electric field is useful [Boonsiriset et al., 2001] but that some minor corrections may be required.

T3.6 Magnetic field model. We will use standard magnetic field models. Because we are interested in accurately reproducing density gradients an accurate magnetic field model is required as well, even relatively deep inside the plasmasphere [Tsyganenko et al., 2003]. We will pick from the Tsygnaneko series of models with Tsyganenko and Sitnov [2007] modeling being the primary candidate.

T3.7 Time line and Milestones. Initial code development will occupy the first six months of the project. This consists of implementing both the particle filter and a simple Kalman filter. The data comparison and logging functions are nearly identical between the particle filter and the Kalman filter, resulting in significant code reuse. The important difference is that the particle filter implements model backtracking and rerunning which is significantly more complicated. At the end of the six months we will have both a particle filter and a Kalman filter scheme. Over the following six months we will run both models with a variety of simulated data using simple electric and magnetic field models to demonstrate the differences between them, and in particular evaluate how much model backtracking in the particle filter can improve the assimilation accuracy. During the second year of the project we will pursue two paths in parallel. We will begin to incorporate more sophisticated magnetic and electric field models with denser simulated data. We will also begin to use the models with whistler data obtained from work package 1 and field line resonance data obtained from work package 2. As we run the model with real data we will provide time-series of plasma density maps to the radiation belt modeling in WP 4. Feedback from that effort will be used to improve the modeling and determine the best parametrization to use for the given data density. This work will begin during the second year and continue until the end of the project.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ELTE	4.00
3	ELGI	4.00
7	HMO	2.00
8	NMT	20.00
9	IGFPAS	2.00
11	LANL	2.00
	Total	34.00

WT3:
Work package description

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D3.1	A data assimilation code written in C++ and parallelized with MPI	8	10.00	R	PU	24
D3.2	Plasma density maps as a function of time for interesting study periods selected by the project.	8	12.00	R	PU	24
D3.3	A set of instruction that allows users to run the assimilation code	8	12.00	R	PU	42
		Total	34.00			

Description of deliverables

D3.1) A data assimilation code written in C++ and parallelized with MPI: The code will implement the particle filter as well as the Kalman filter. The code will use the Dynamic Global Core Plasma model and will incorporate simple parametrization of the electric field and a dipole magnetic field. The code will ingest VLF data and produce plasma density maps as a function of time. [month 24]

D3.2) Plasma density maps as a function of time for interesting study periods selected by the project.: In consultation among the participants we will select interesting intervals to analyze. Interesting intervals include both quiet and active periods with sufficient density of measurements. [month 24]

D3.3) A set of instruction that allows users to run the assimilation code: We will strive to make the code usable by non-developers. The package includes a manual for configuring and using the code, and descriptions of parameters. A description of the input and output data formats will also be included. [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead benefi-ciary number	Delivery date from Annex I [60]	Comments
MS6	Basic particle filter and Ensemble Kalman filter	8	6	Documentation available
MS7	Compare particle and Kalman filter with simulated data	8	12	Documentation available
MS8	Demonstrate use of data assimilation with whistler and FLR data	8	24	Documentation available
MS9	Begin delivering plasma density maps to work package 4	8	24	Documentation available

WT3:
Work package description

Project Number [1]	263218	Project Acronym [2]	PLASMON

One form per Work Package

Work package number [53]	WP4	Type of activity [54]	RTD
Work package title	Modeling REP losses in radiation belts based on AARDDVARK network		
Start month	1		
End month	42		
Lead beneficiary number [55]	2		

Objectives

1.Extend AARDDVARK network to have a better L-shell, MLT coverage.
2.Analyse the characteristics of REP, case by case, and at different L-shells.
3.Develop a model which identifies the size, location, MLT zone, geomagnetic conditions, and flux characteristics of the REP.
4.Refine the REP model to describe on/inside/outside plasmapause precipitation using input from the WP3 model.

Description of work and role of partners

T4.1 Although the current AARDDVARK network consists of 10 receivers logging ~6 transmitter signals each there is still a need to increase the L-shell and MLT coverage. We plan to install three new sites and have identified southern Greenland, Boston, Fairbanks, Japan, and Kerguelen Islands as potential sites which are well placed to allow quasi constant L-shell data analysis. The installation of the systems will be done by personnel from NERC-BAS. Data provision from the current AARDDVARK sites will continue, and the accumulated datasets will be investigated for REP signatures during the period that the new sites are coming on line. Data provision, system maintenance of the current sites will be undertaken by all participants named for this work package.

T4.2 To date only a few REP periods have been studied and identified with specific wave-driven loss processes. We will extend the event data base by carefully examining current AARDDVARK datasets, and the data from the new sites when they become available – this work will be lead by NERC-BAS. We will need detailed modeling of the propagation conditions for each transmitter-receiver great circle path influenced. This detailed analysis will provide us with the time varying flux levels for each event, something that has not been achieved to date. This will be lead by UO, and supported by NERC-BAS, who already have an excellent track record in this type of analysis.

T4.3 Once we have identified, and investigated REP events in detail we will build up a model which identifies the size, location, MLT zone, geomagnetic conditions, and flux characteristics of the REP. We will add in the capability to estimate low earth orbit radiation dose due to the precipitation bursts. This work will be undertaken by both NERC-BAS and OU.

T4.4 When the work package 3 plasmaspheric model is able to provide some information on the structure of the plasmasphere, we will further develop our REP model to describe precipitation that occurs from inside the plasmapause and from regions on, inside the plasmapause, and from outside of the plasmapause respectively. The large differences in electron number density and gradients in these regions will drive very different wave-particle interactions, and hence different precipitation characteristics. The extension of the AARDDVARK network to increase the number of quasi-constant L-shell information will allow this work to be undertaken more accurately than currently possible. This work will be lead by NERC-BAS with support from OU.

WT3:
Work package description

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ELTE	2.00
2	NERC-BAS	18.00
5	UOULU	1.00
6	UO	30.00
7	HMO	2.00
8	NMT	2.00
9	IGFPAS	1.00
11	LANL	1.00
	Total	57.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D4.1	Installation and setup of one new AARDDVARK site	2	2.00	R	PU	12
D4.2	Installation and setup of two new AARDDVARK sites	2	4.00	R	PU	24
D4.3	Build event database of characteristics of REP	2	12.00	R	PU	42
D4.4	Development of REP model	2	23.00	R	PU	42
D4.5	Development of model of on/inside/outside plasmapause precipitation	2	16.00	R	PU	42
		Total	57.00			

Description of deliverables

D4.1) Installation and setup of one new AARDDVARK site: Extend AARDDVARK network to have a better L-shell, MLT coverage. Although the current AARDDVARK network consists of 10 receivers logging ~6 transmitter signals each there is still a need to increase the L-shell and MLT coverage in order to provide the best dataset for this workpackage. We plan to install three new sites and have identified southern Greenland, Boston, Fairbanks, Japan, and Kerguelen Islands as potential sites which are well placed to allow quasi constant L-shell data analysis, both inside and outside of the plasmaspause. Phase 1. [month 12]

D4.2) Installation and setup of two new AARDDVARK sites: Extend AARDDVARK network to have a better L-shell, MLT coverage. Although the current AARDDVARK network consists of 10 receivers logging ~6 transmitter signals each there is still a need to increase the L-shell and MLT coverage in order to provide the best dataset for this workpackage. We plan to install three new sites and have identified southern Greenland, Boston, Fairbanks, Japan, and Kerguelen Islands as potential sites which are well placed to allow quasi constant L-shell data analysis, both inside and outside of the plasmaspause. Phase 2. [month 24]

D4.3) Build event database of characteristics of REP: Analyse the characteristics of REP, case by case, and at different L-shells.To date only a few REP periods have been studied and identified with specific wave-driven loss processes. We will extend the event data base by carefully examining current AARDDVARK datasets, and the data from the new sites when they become available. We will make detailed modeling of the propagation conditions for each transmitter-receiver great circle path influenced. This detailed analysis will provide us with the time varying flux levels for each event, something that has not been achieved to date. [month 42]

D4.4) Development of REP model: Develop a model which identifies the size, location, MLT zone, geomagnetic conditions, and flux characteristics of the REP.Once we have identified, and investigated REP events in detail we will build up a model which identifies the size, location, MLT zone, geomagnetic conditions, and flux characteristics of the REP. We will add in the capability to estimate low earth orbit radiation dose due to the precipitation bursts. [month 42]

D4.5) Development of model of on/inside/outside plasmapause precipitation: Refine the REP model to describe on/inside/outside plasmapause precipitation using input from the WP3 model.When the work package 3 plasmaspheric model is able to provide some information on the structure of the plasmasphere, we will further develop our REP model to describe precipitation that occurs from inside the plasmapause and from regions on, inside the plasmapause, and from outside of the plasmapause respectively. The large differences in electron number density and gradients in these regions will drive very different wave-particle interactions, and hence different precipitation characteristics. The extension of the AARDDVARK network to increase the number of quasi-constant L-shell information will allow this work to be undertaken more accurately than currently possible. [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS10	Installation of new AARDDVARK sites	2	24	Documentation available
MS11	Characterisation of precipitation signatures in AARDDVARK data	2	42	Documentation available
MS12	Model of precipitation developed	2	42	Model code available
MS13	Refined model of precipitation completed using WP3 output	2	42	WP3 model code integrated into precipitation code and code available

WT3:
Work package description

Project Number [1]	263218	Project Acronym [2]	PLASMON

One form per Work Package

Work package number [53]	WP5	Type of activity [54]	OTHER
Work package title	Dissemination and exploitation of the results		
Start month	1		
End month	42		
Lead beneficiary number [55]	6		

Objectives

The objective of this WP is to provide the maximum diffusion of the relevant results achieved in the project and the preparation of an exploitation plan. To this purpose, the following activities will be carried out:
1. Publication of the project results and achievement in scientific journals and conferences.
2. Publication of popular papers in national and international newspapers and magazines.
3. Setting up the PLASMON website, which will be continuously updated.
4. Definition of the exploitation plan of the project
5. Organization of a dedicated workshop to present the results of the project to target audience

Description of work and role of partners

T5.1. Publication of the project results and achievements in scientific journals and conferences.
By the end of the collaborative project 5 papers are to have been published in international peer-reviewed scientific journals, detailing the initial scientific findings produced during the project. Yearly publication plans will be created in months 12, 24, and 42 (to describe the future papers). We will publish the results in major journals in upper atmospheric physics, space weather and space research, such as Journal of Geophysical Research, Geophysical Research Letter, Space Weather, Journal of Atmospheric and Solar-Terrestrial Physics and Advances in Space Research.
A significant amount of the scientific findings will not be produced until close to the end of the collaborative project. For this reason we plan for an additional 5 papers describing the final results, with the writing of these papers to be started in the closing period of the project.
A vital part of disseminating scientific results comes through presentations at scientific workshops, meetings and conferences. This becomes more important as the publication and uptake process can be very slow. We aim to produce 30 such presentations - coordination will be undertaken to ensure that this includes a wide range of different international meetings. We are planning to present the results obtained in the project, both on large meeting such as URSI, IAGA, EGU, AGU and also at topical meetings such as VERSIM and HEPPA.

T5.2. Publication of popular papers in national and international newspapers and magazines.
We will publish popular papers in the local media of participating countries, we foresee 10-12 such a publication and we will also present our results to general audience on various events. In addition, where possible we will also incorporate the results into lectures at university courses.

T5.3. Setting up the PLASMON website, which will be continuously updated.
We will setup a web page for the project, it will contain general information about the project and the summary of the results obtained in different phases of the project. The web page will serve for internal communication and data sharing during the project. At the end of the project, selected data will also published for the scientific community.

T5.4. Definition of the exploitation plan of the project.
The exploitation of the results can be complex and diverse. The first exploitation will be immediately inside the project, the data provided as an output of WP1 and WP2 will be used by the models in WP3 and WP4, the plasmasphere model itself, developed in WP3 will also be used as an input for understanding the drivers and occurrence of the losses of the radiation belts as described in WP4. The results in science will be utilized by the whole scientific community as well as the data themselves, they will be used in forthcoming studies related to plasmasphere, magnetosphere, radiation belts, upper atmosphere and space weather. The another major area

of exploitation is expected to be the incorporation of the results and data into the space security programs, first of all, the European ESA SSA program, that could be the first beneficiary of an operational service built on the results of the project.

T5.5. Organization of a dedicated workshop to present the results of the project to target audience.
The collaborative project-plan includes a dedicated workshop specific to the results of the project, and aimed at a targeted audience. This should increase the effectiveness of the dissemination. In month 12 of the project, we will agree on the timing and location of the workshop, expected in the 2nd half of the project term, and open to the wider scientific community. Fine-tuning of the exact dates may be required to avoid other scientific events. We we plan to organize this workshop as an additional day at the VERSIM-community workshop (held every 2-3 years) or the IAGA Scientific Assembly (held every 2 years), or by organizing a workshop through ISSI (Bern, CH) making use of their facilities.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ELTE	2.00
2	NERC-BAS	2.00
3	ELGI	2.00
4	UNIVAQ	2.00
5	UOULU	1.00
6	UO	4.00
7	HMO	2.00
8	NMT	2.00
9	IGFPAS	1.00
10	UW	1.00
11	LANL	1.00
	Total	20.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D5.1	Project website set-up, then used and updated throughout the project	6	3.00	O	PU	3
D5.2	Conference presentations I.	6	1.50	R	PU	12
D5.3	Conference presentations II.	6	2.00	R	PU	24
D5.4	Conference presentations III.	6	2.50	R	PU	42
D5.5	Run PLASMON Workshop to disseminate results	6	1.00	O	PU	42
D5.6	Papers published in scientific journals	1	10.00	R	PU	42
		Total	20.00			

Description of deliverables

D5.1) Project website set-up, then used and updated throughout the project: We will setup a web page for the project, it will contain general information about the project and the summary of the results obtained in different phases of the project. The web page will also serve for internal communication and data sharing during the project. At the end of the project, selected data will also published for the scientific community. [month 3]

D5.2) Conference presentations I.: 8 conference presentations both on large meeting such as URSI, IAGA, EGU, AGU and also at topical meetings such as VERSIM and HEPPA. [month 12]

D5.3) Conference presentations II.: 10 conference presentations both on large meeting such as URSI, IAGA, EGU, AGU and also at topical meetings such as VERSIM and HEPPA. [month 24]

D5.4) Conference presentations III.: 12 conference presentations both on large meeting such as URSI, IAGA, EGU, AGU and also at topical meetings such as VERSIM and HEPPA. [month 42]

D5.5) Run PLASMON Workshop to disseminate results: The collaborative project-plan includes a dedicated workshop specific to the results of the project, and aimed at a targeted audience. This should increase the effectiveness of the dissemination. In month 12 of the project, we will agree on the timing and location of the workshop, expected in the 2nd half of the project term, and open to the wider scientific community. Fine-tuning of the exact dates may be required to avoid other scientific events. We we plan to organize this workshop as an additional day at the VERSIM-community workshop (held every 2-3 years) or the IAGA Scientific Assembly (held every 2 years), or by organizing a workshop through ISSI (Bern, CH) making use of their facilities. [month 42]

D5.6) Papers published in scientific journals: 5 papers published in international peer-reviewed scientific journals. At the end of the project report will be delivered which identifies the topics of 5 more papers to be written up and submitted after the project has terminated, based on the scientific results of the project. [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS14	The project web page is up and running	6	3	The web page is available on-line
MS15	Decision is made on special workshop date and place	6	12	Documentation available
MS16	Yearly publication plan is made	6	12	Documentation available
MS17	Yearly publication plan is made	6	24	Documentation available
MS18	Yearly publication plan is made (for future publications)	6	42	Documentation available
MS19	Efficient dissemination of project results	6	42	Papers and documents available

WT3:
Work package description

Project Number [1]	263218	Project Acronym [2]	PLASMON

One form per Work Package

Work package number [53]	WP6	Type of activity [54]	MGT
Work package title	Management of the consortium		
Start month	1		
End month	42		
Lead beneficiary number [55]	1		

Objectives

This work package aims at implementing a Project management adapted to the specific requirement of the PLASMON project and to animate the Consortium.
To ensure an efficient project management, the consortium will rely on ELTE and its staff and that will be in charge of the operational day-to-day management allowing the partners to focus on the technical tasks. ELTE will be aided by NERC-BAS, UNIVAQ, NMT, UO , HMO and IGFPAS (Project Management Committee, PMC) and a Program Management Office (PMO) will be established at ELTE.

Description of work and role of partners

T6.1 Reporting (ELTE, PMO). PMO will ensure an efficient organization for the reporting by:
ensure proper use of resources (compare planned versus actual),
ease processing of certificates on financial statements whenever relevant,
anticipate any deviations (over or under consumption)
PMO will notify the due dates to the partners for financial reporting, provide support for the completion of the yearly financial reports (and certificates on financial statements if relevant) and will collect the documents for submission to the REA. PMO will be a day-to-day contact for the whole consortium to provide answers regarding costs eligibility, financial reporting, official process for fund transfer etc... PMO will pay attention that EC rules are respected for cost reporting on the basis of the information provided by the partners

T6.2 Financial aspect (ELTE, PMC). The Technical Committee is in charge of the whole consortium's budget and the financial allocation of the EU grant between the participants by providing a time schedule (defined in the Consortium Agreement) for the transfer of funds within the Consortium and between activities in accordance with the contract. ELTE as coordinator will ensure that all the appropriate payments are made to contractors in accordance with the Consortium Agreement, without unjustified delay. The work will be done in close collaboration with PMO. PMO will implement "easy-to-use" templates for time and cost reporting adapted to the PLASMON Project. PMO will consolidate and analyze financial data on a 6-monthly basis to:
proposing common templates adapted to the PLASMON project and partners for official reporting towards REA,
notifying due dates and reminding deadlines,
assisting partners to respect indications and guidelines given by the REA.
collecting the WP leaders contributions (WP leaders will consolidate data at each WP level and PMO will consolidate all WP leaders inputs)
being the partners contact point for checking that the data provided are in line with the EC rules and requirements.
The PMO and the PMC will consolidate the progress, deliverable and milestone reports to be submitted to the Technical Committee for formal approval before submission to the REA. In addition, as a yearly reporting is not sufficient for a good internal follow-up, WP leaders will be requested to up-date the coordinator every 6 months with a short written report. It is their responsibility to track any deviation and delay and propose appropriate solutions. In order to keep informed the whole partners about the progress of the project.

T6.3 Day-to-day follow-up (ELTE, PMC). ELTE will be the Project Coordinator. ELTE will be also the chairman of the Technical Committee and the official intermediary for communication between the beneficiaries or consortium and the REA. The Technical Committee will carry out most of the contractual tasks related to the implementation of the EU contract and the project.

The project coordinator is responsible for the technical, financial and administrative management on a day-to-day basis. In order to ensure an efficient and active management of these tasks, the Coordinator will be supported by the Project Management Committee. As a support to the Project Coordinator, PMO aided by PMC will be mainly in charge of:
Managing the delivery and the follow-up of administrative and financial documents,
Being a permanent contact point for all the partners regarding their participation in the project, responding to any relevant requests ,
Easing the Coordinator of administrative tasks/notifying the consortium of due dates,
Preparing the official meetings,
Following up of actions and decisions,
Creating common working and reporting tools,
Following and updating the project indicators (Gantt chart, man power matrix, deliverables list)
The aim is to ensure that the technical objectives are followed but also to ensure that the project is completed within the approved budget. For the control of costs, the consortium will follow the Commission requirements, including:
Monitoring cost performance to detect deviations from plan (regular follow up by PMO).
Ensuring that all appropriate changes are recorded accurately in the cost baseline.
Preventing incorrect, inappropriate, or unauthorized changes (toward contract).
Informing the REA.
In accordance to the accounting system, and using the audit certificates system, PMO will follow-up the project expenses and track deviations. In particular, ELTE will be in charge of obtaining audit certificates when relevant.

T6.4 Animation of the consortium (ELTE, PMO) PMO will help the partners in their decision-making process and in difficult situations. They will create a group dynamics within the project, promote exchanges between partners and prevent lack of involvement of the partners through regular contacts. To stimulate communication, the consortium will use a dedicated interactive web site that enables them to share and stock documents, follow the execution plan, organize meetings and discuss special issues online.

Person-Months per Participant

Participant number [10]	Participant short name [11]	Person-months per participant
1	ELTE	10.00
	Total	10.00

List of deliverables

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D6.1	Quality assurance plan	1	0.50	R	PU	1
D6.2	Annual reporting	1	2.50	R	PU	12
D6.3	Annual reporting	1	2.50	R	PU	24
D6.4	Final report	1	4.50	R	PU	42
		Total	10.00			

Description of deliverables

D6.1) Quality assurance plan: A quality plan for the project will be created, with input from the PMC This documentation will be maintained and updated during the project lifetime. Regarding deliverables, the first level of quality will be exercised by the WPL. Each deliverables will be reviewed and checked by at least 2 partners assigned during the kick-off meeting. [month 1]

D6.2) Annual reporting: Annual reporting including periodic activity report, periodic financial report and financial statements collected from the partners [month 12]

D6.3) Annual reporting: Annual reporting including periodic activity report, periodic financial report and financial statements collected from the partners [month 24]

D6.4) Final report: Final reporting including periodic activity report, periodic financial report and financial statements collected from the partners [month 42]

Schedule of relevant Milestones

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS20	Delivery of management Tools	1	1	Documentation available

WT4:
List of Milestones

Project Number [1]	263218	Project Acronym [2]	PLASMON

List and Schedule of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS1	Decision on PP architecture	WP1	1	6	Documentation available
MS2	Decision of AWA implementation method	WP1	1	12	Documentation available
MS3	Decision on ULF station instrumentation and DAQ system	WP2	4	6	Documentation available
MS4	Decision on calibration method	WP2	4	18	Documentation available
MS5	Decision on FLRID and FLRINV implementation	WP2	4	24	Documentation available
MS6	Basic particle filter and Ensemble Kalman filter	WP3	8	6	Documentation available
MS7	Compare particle and Kalman filter with simulated data	WP3	8	12	Documentation available
MS8	Demonstrate use of data assimilation with whistler and FLR data	WP3	8	24	Documentation available
MS9	Begin delivering plasma density maps to work package 4	WP3	8	24	Documentation available
MS10	Installation of new AARDDVARK sites	WP4	2	24	Documentation available
MS11	Characterisation of precipitation signatures in AARDDVARK data	WP4	2	42	Documentation available
MS12	Model of precipitation developed	WP4	2	42	Model code available
MS13	Refined model of precipitation completed using WP3 output	WP4	2	42	WP3 model code integrated into precipitation code and code available
MS14	The project web page is up and running	WP5	6	3	The web page is available on-line

WT4:
List of Milestones

Milestone number [59]	Milestone name	WP number [53]	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS15	Decision is made on special workshop date and place	WP5	6	12	Documentation available
MS16	Yearly publication plan is made	WP5	6	12	Documentation available
MS17	Yearly publication plan is made	WP5	6	24	Documentation available
MS18	Yearly publication plan is made (for future publications)	WP5	6	42	Documentation available
MS19	Efficient dissemination of project results	WP5	6	42	Papers and documents available
MS20	Delivery of management Tools	WP6	1	1	Documentation available

WT5:
Tentative schedule of Project Reviews

Project Number [1]	263218	Project Acronym [2]	PLASMON

Tentative schedule of Project Reviews

Review number [65]	Tentative timing	Planned venue of review	Comments, if any
RV 1	12	Brussels	Annual review
RV 2	24	Brussels	Annual review
RV 3	42	Brussels	Final review

WT6:
Project Effort by Beneficiary and Work Package

Project Number [1]	263218	Project Acronym [2]	PLASMON

Indicative efforts (man-months) per Beneficiary per Work Package

Beneficiary number and short-name	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	Total per Beneficiary
1 - ELTE	36.00	4.00	4.00	2.00	2.00	10.00	58.00
2 - NERC-BAS	2.00	2.00	0.00	18.00	2.00	0.00	24.00
3 - ELGI	2.00	20.00	4.00	0.00	2.00	0.00	28.00
4 - UNIVAQ	0.00	28.00	0.00	0.00	2.00	0.00	30.00
5 - UOULU	1.00	1.00	0.00	1.00	1.00	0.00	4.00
6 - UO	2.00	2.00	0.00	30.00	4.00	0.00	38.00
7 - HMO	7.00	7.00	2.00	2.00	2.00	0.00	20.00
8 - NMT	0.00	0.00	20.00	2.00	2.00	0.00	24.00
9 - IGFPAS	0.00	16.00	2.00	1.00	1.00	0.00	20.00
10 - UW	1.00	0.00	0.00	0.00	1.00	0.00	2.00
11 - LANL	1.00	1.00	2.00	1.00	1.00	0.00	6.00
Total	52.00	81.00	34.00	57.00	20.00	10.00	254.00

WT7:
Project Effort by Activity type per Beneficiary

Project Number [1]	263218	Project Acronym [2]	PLASMON

Indicative efforts per Activity Type per Beneficiary

Activity type	Part. 1 ELTE	Part. 2 NERC-BA	Part. 3 ELGI	Part. 4 UNIVAQ	Part. 5 UOULU	Part. 6 UO	Part. 7 HMO	Part. 8 NMT	Part. 9 IGFPAS	Part. 10 UW	Part. 11 LANL	Total
1. RTD/Innovation activities												
WP 1	36.00	2.00	2.00	0.00	1.00	2.00	7.00	0.00	0.00	1.00	1.00	52.00
WP 2	4.00	2.00	20.00	28.00	1.00	2.00	7.00	0.00	16.00	0.00	1.00	81.00
WP 3	4.00	0.00	4.00	0.00	0.00	0.00	2.00	20.00	2.00	0.00	2.00	34.00
WP 4	2.00	18.00	0.00	0.00	1.00	30.00	2.00	2.00	1.00	0.00	1.00	57.00
Total Research	46.00	22.00	26.00	28.00	3.00	34.00	18.00	22.00	19.00	1.00	5.00	224.00
2. Demonstration activities												
Total Demo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Consortium Management activities												
WP 6	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
Total Management	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
4. Other activities												
WP 5	2.00	2.00	2.00	2.00	1.00	4.00	2.00	2.00	1.00	1.00	1.00	20.00
Total other	2.00	2.00	2.00	2.00	1.00	4.00	2.00	2.00	1.00	1.00	1.00	20.00
Total	58.00	24.00	28.00	30.00	4.00	38.00	20.00	24.00	20.00	2.00	6.00	254.00