Part B

FP7-SPACE-2010-1

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

PLASMON

Collaborative Project
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Work programme topics addressed:

SPA.2010.2.3-1: Security of space assets from space weather events

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5 UOULU	University of Oulu	Finland
6 UO	University of Otago	New Zealand
7 HMO	Hermanus Magnetic Observatory	South Africa
8 NMT	New Mexico Institute of Mining and Technology	USA
9 IGFPAS	Institute of Geophysics, Polish Academy of Sciences	Poland
10 UW	University of Washington	USA
11 LANL	Los Alamos National Laboratory	USA

B1.3 S/T methodology and associated work plan

B1.3.1 Overall strategy of the work plan

The science part of work plan consists of three layers. The first layer is the data source layer, the already existing ground based VLF and ULF measuring networks providing plasmaspheric densities. In this layer, which is the union of WP1 and WP2 we will

1. extend AWDANet and form EMMA network from MM100 and SEGMA networks to achieve enhanced latitudinal and MLT coverage of density observations,
2. develop and implement automatic algorithm for whistler method (AWA),
3. develop and implement automatic algorithm for FLR method (FLRID and FLRINV),
4. enhance both networks to reach the quasi-real-time mode of operation, the mode required for a data service in operational space weather applications.
5. cross-calibrate whistler and FLR methods to achieve flawless integration into plasmasphere model.

The second layer, the data-assimilative model of the Earth's plasmasphere plays a central role in the work plan. We will

1. develop methods for the integration of data sources from WP1 and WP2 into a physics based model of the plasmasphere to enhance its temporal and spatial evolution scheme,
2. apply a feedback loop to adjust model parameter making data sources and model consistent,
3. use a sophisticated electric field model, also derived through a data assimilation approach.

The plasmasphere model developed in this layer can be used directly in various space weather applications from radiation belt models to the estimation of spacecraft surface charges. However we will immediately utilize the model capability to identify and map specific wave-driven losses in the radiation belts in the third (application) layer.

The third layer (WP4) is based on the model developed in WP3 (second layer) and on a third global network (AARDDVARK). In this layer we will

1. extend AARDVARK to achieve better latitudinal and MLT coverage of REP events,
2. identify and model REP events,
3. combine AARDDVARK data based map of REPs with plasmasphere model developed in the second layer to identify the region of loss mechanisms near the plasmasphere boundary layer.

The final goal of the project is to achieve a pre-operational state in all the three layers that can be converted to a complex operational space weather predicting and forecasting service in a next step.

The results achieved in the core development layers (WP1-4) are distributed by a dissemination and exploitation work package (WP5), where all the achieved scientific results will be communicated to the public at various levels: from scientific forums (journals, workshops) through integration of the results to university courses to popular papers and talks.

The project coordination and management will be done in a separate work package (WP6).

B1.3.2 Timing of the different WPs and their components

The planning indicates that many tasks and works will be done in parallel, minimizing the required time to achieve the objectives. The simplified Gantt chart on Figure 5 summarizes the information from Table WT1-WT8

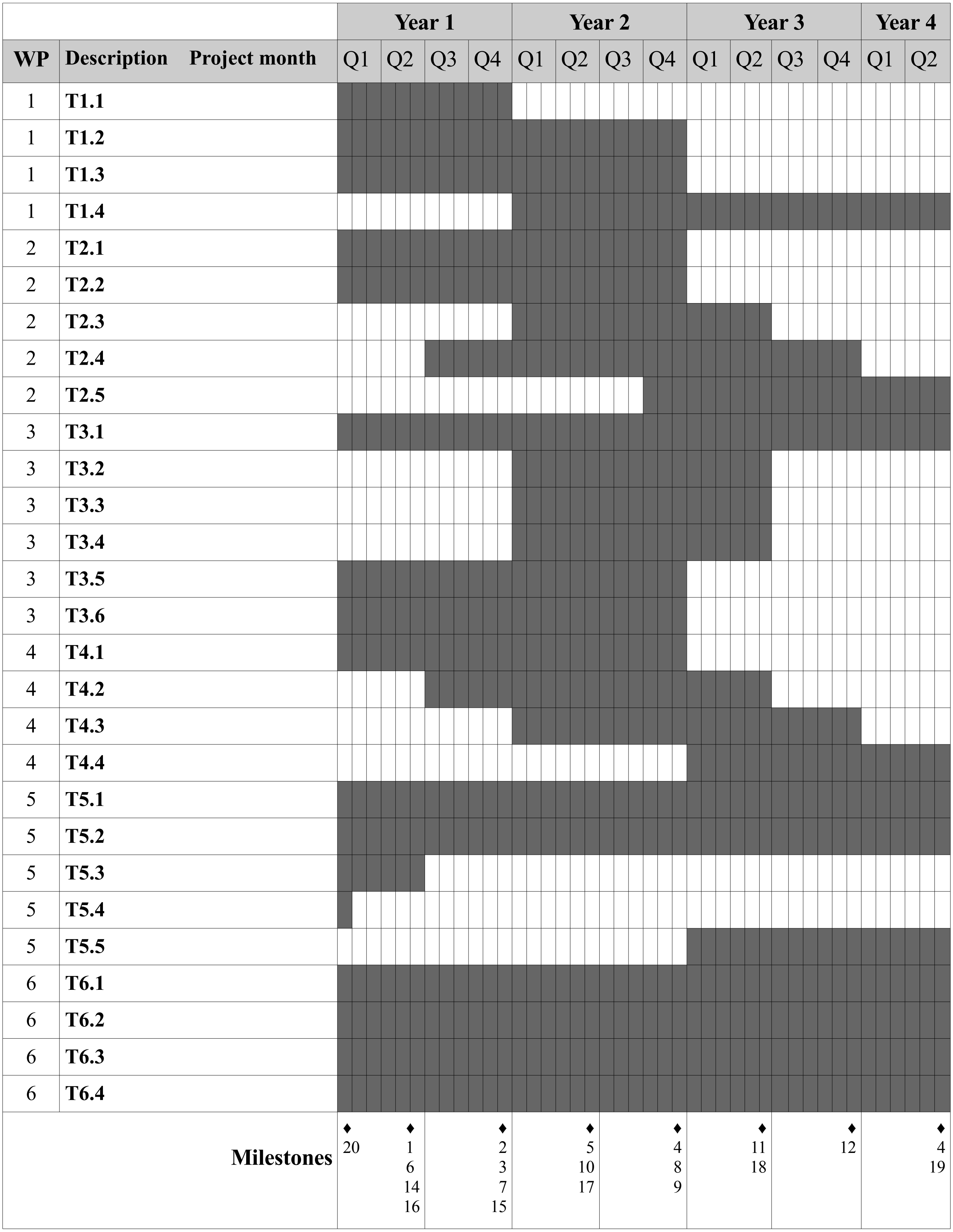

Figure 5. Gantt chart summarizing activities from Table WT1-WT8.

B1.3.3 Interdependencies

Figure 6 shows how the connections and interdependencies of work packages.

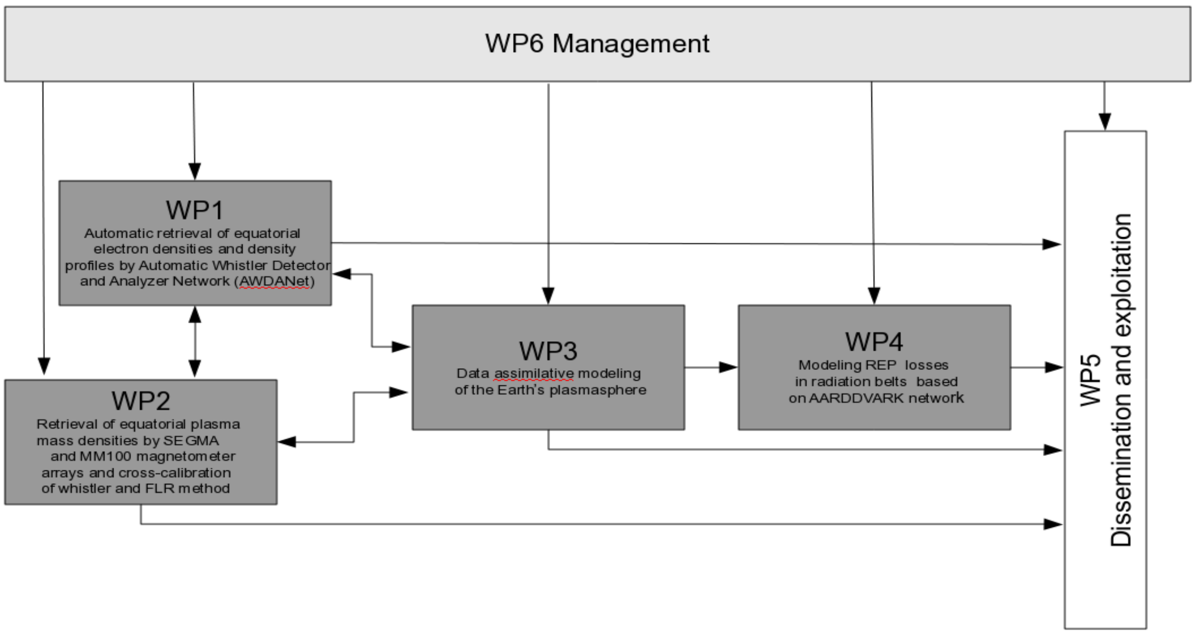

Figure 6. Pert diagram of PLASMON indicating interrelated activities

B1.3.5. Risks and contingency plans.

We have identified 3 potential risks in the projects, however none of them can prevent the project to be fulfilled. These are:

1. The communications with the 'far' measurement sites in Antarctica, Marion and Kerguelen Islands, Alaska and Greenland may be broken for certain period of time. During this periods, the data transfer is stopped and quasi-real-time mode of operation cannot be maintained. However, the models we will implement both for the plasmasphere and radiation belts will have forecasting capability and will be able to bridge the gap missing data.
2. The equipments at the above mentioned 'far' sites can fail. Replacement and repair may be delayed till the arrival of the next expedition, which may happen in a year. Therefore we plan to place spare systems at these sites.
3. Simultaneous data for the cross-calibration of plasma densities obtained from whistlers and FLRs may net be available. We plan to use VLF-Doppler data first for inter-calibration. If this also fails due to missing data, we can examine on statistical basis their ratio to get insights about the heavy ions contribution for different magnetospheric activity conditions and provide an estimate to average ion masses

Even if these major risk will become reality, most of the milestones can be fulfilled according to plan.