Database Project : **COOPERATE**

Common database for field sites dedicated to experimental studies on climate change in of Southern France

Appel d'offre interne – ECCOREV 2011

Partners - Research units:

CEREGE-Aix-en-Provence – UMR6635 – Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement
OHP-St Michel l'Observatoire – USR2207 – Observatoire de Haute Provence
IMEP-Marseille – UMR6116 – Institut Méditerranéen d'Ecologie et de Paléoécologie

Introduction and Aims

The determination of meaningful parameters, that allow predictions of changes in ecosystem structure and functioning in the light of climate change, are constraining current (modelling) approaches aiming at understanding and simulating future scenarios. The reliable estimation of existing and novel parameters is limited by the availability of experimental data for the evaluation of their impact and the sensibility of the model outputs.
A recent submission of the ANR blanc 'SEC-PRIME[2]' (decision pending) by O_3HP-partners has already shown that the **network** around the **O_3HP** (Oak Observatory at the OHP) **lacks competence in modelling** *and* relations to entities in environmental and ecological modelling. This is a crucial factor, as the primary question being addressed at the O_3HP: 'How the ecosystem changes in relation to predicted climate scenarios' cannot simply be resolved by pure experimental investigations. The research analysing and predicting changes in vegetation has developed rapidly in the last 25 years. During this period, **demands by modellers to integrate mechanistic physiological processes** that allow to determine the ability of plants to distribute/compete have become increasingly evident (Cramer et al. 2001; Pearson & Dawson 2003; Elith et al. 2006; Araújo & Guisan 2006; Hijmans & Graham 2006; Araújo & Luoto 2007; Kearney & Porter 2009; Chown et al. 2010; Chevin et al. 2010).
A **standardised interface to compile and communicate such data,** as to validate model output or to calibrate model parameters, is conducive to advance research and funding in relation to the primary question. This interface has to be defined to comply in an attractive way with the needs of the users/ research community that generate experimental data. In parallel, the exploitability of the database has to be designed so that the database can establish itself as a relevant scientific tool for the long-term. On the one hand, this calls for investments into hardware, but far more importantly, these tasks require efforts for vis-à-vis communication and workshops - among different mindsets and modes of operation **- to facilitate cooperation, and eventually funding for a successful approach towards complex scientific questions on climate change scenarios**.

(1) Technical aim: Create a common database for field sites experimentally simulating climate change scenarios in Southern Mediterranean France (i.e. O_3HP & CLIMED, open to other partners).

(2) Scientific aim: Tuning of the database to evaluate experimental climate change scenarios, and identification & complementation of missing links & parameters. This will function as an interface between field experimentators and modellers.
An interesting aspect of the COOPERATE project the integration of **data on primary *and* secondary plant metabolism**. Special **emphasis** will be on **belowground** analyses and **processes**

related to the spatial compartmentation of water and nutrient resources (cf. submitted dossier ANR SEC-PRIME[2]). The database will provide means to calculate and extract plants' characteristics (Grams et al. 2002) that describe their survivability, vulnerability and competitiveness for specific experimental scenarios (cf. Reiter et al. 2005).

(3) Functioning: The hardware and maintenance requirements for the common database need to be précised. Based on the current knowledge, a complete independent database, comprised of a server, a data storage device and a backup system, would require an investment of 20 k€ plus additional maintenance costs. Part of these costs are currently buffered by local solutions where installations are shared or borrowed (data back-up at the OHP, test server and PC interfacing data acquisition and upload to the database). A strategy has to be evolved to assure functioning on the long-term.

Work packages:

I. Fathom requirements & specifications for a database as a common, user-friendly platform allowing:

(i) to rapidly enter and/or **upload** field measurements
(ii) to easily **visualise** data
(iii) data **manipulation**
 to easily validate data
 to perform standard and user-defined calculations
 to apply gap-filling procedures
 to condensate data to desired time steps
(iv) to **exploit** the data in an efficient manner
(iii) to fix clear **access** restrictions
… (non-exhaustive)

This demands financing for frequent meetings among the project leaders of the field sites and the team and partners responsible for the technical realisation of the database. Additionally invitations and meetings with specific experimentators and consultants, as well as modelling entities are essential to interface field and modelling work to improve the efficiency of the use of acquired field data.

II. Structural realisation of the database

(i) incorporate **requirements** of all the partners **providing data** to the database
- acquired parameters - data input interfaces - data visualisation - data storage capacity - standard and user-interfaced calculations - (auto)validation procedures - import of reference data- gap-filling procedures
(ii) incorporate **statistical** methods for data **validation** as to identify faulty data and exceptional events and phenomena
(iii) incorporate **functioning** that respects the intended data **exploitation**
- data extraction procedures - calculations & simulations - graphs & figures - reports
(iv) **evolution and optimisation** of the **database search algorithms** based on monitoring of user requests and activity
(v) enable and adapt **interfacing/exchanges with other databases**, e.g. phenology (GDR Montpellier), ozone data (PAES network), trace gases (ICOS), dendrology, reference climatic data etc.
(vi) assure that the database **structure** allows **to integrate further sites and projects**

This demands financing for meetings, primarily for exchanges of the team programming the database and the server, with consultants and database developers. At the stage of testing the communication between programmers and users will take over.

III. Hardware: development and maintenance

(i) Depending on the dataload, calculations, data requests, database complexity ... a server has to be defined in terms of hardware and expected traffic, to be sufficiently fast for convenient use. Data upload, visualisation, validation and condensing must outcompete standard spreadsheet applications so that it is attractive to upload data to the server.

(ii) A strategy must be developed to finance the server of interest, and to foresee a budget for maintenance issues.

(iii) A location with sufficient network traffic capacity must be chosen.

This demands financing to participate in costs in terms of soft- and hardware for use and expansion of existing installations throughout the database development.

IV. Human resources

(i) Currently a team has been assembled that fulfils all the requirements for a basic database development. In the course of the development, strengths and weaknesses of the database project will be discovered. Best solutions to these weaknesses are likely to require competences which go beyond the capacity of the current team members. Collaborators (commercial or non-commercial) need to be identified to overcome limits in the database development.

(ii) Current team members are potentially not available on the long term due to changes in affiliation (Gerard CASTAGNOLI) or redefinition of activities. Identification and recruiting of potential future partners needs to be envisaged.

This demands financing for invitations and meetings.

Current state of database development

The development of a database for the O_3HP project has been started mid 2010. The current **Consortium** (cf. organigram, Fig. 1, p4) consists of:

Armand ROTEREAU (**CEREGE**, IE-CNRS BAP-E) experienced developer for databases and programmer for interfaces and webapplications

Gerard CASTAGNOLI (**OHP**, IR1-CNRS BAP-E) long-standing experience in network and server setups, data and system back-up, and security management

Cyril BLANPAIN (**CEREGE**, System and Network Engineer) specialist for hardware and software solutions of demanding system applications

Laure BERTI-EQUILLE (**CEREGE**, DR-IRD, Computer Science) research & development of databases with emphasis on statistical analyses, visualization & treatment of large data volumes, and on optimization of search algorithms based on user-monitoring

Nicolas MONTES (**IMEP**, MCF-HDR) field ecologist on ecosystem functioning and biodiversity in diverse Mediterranean landscapes on the European and African continent

Ilja REITER (**CEREGE**, IR2-CNRS BAP-A) field ecologist experienced with the setup of sensing and data acquisition networks, experience in modeling and strong background in ecophysiological analyses of forest ecosystems

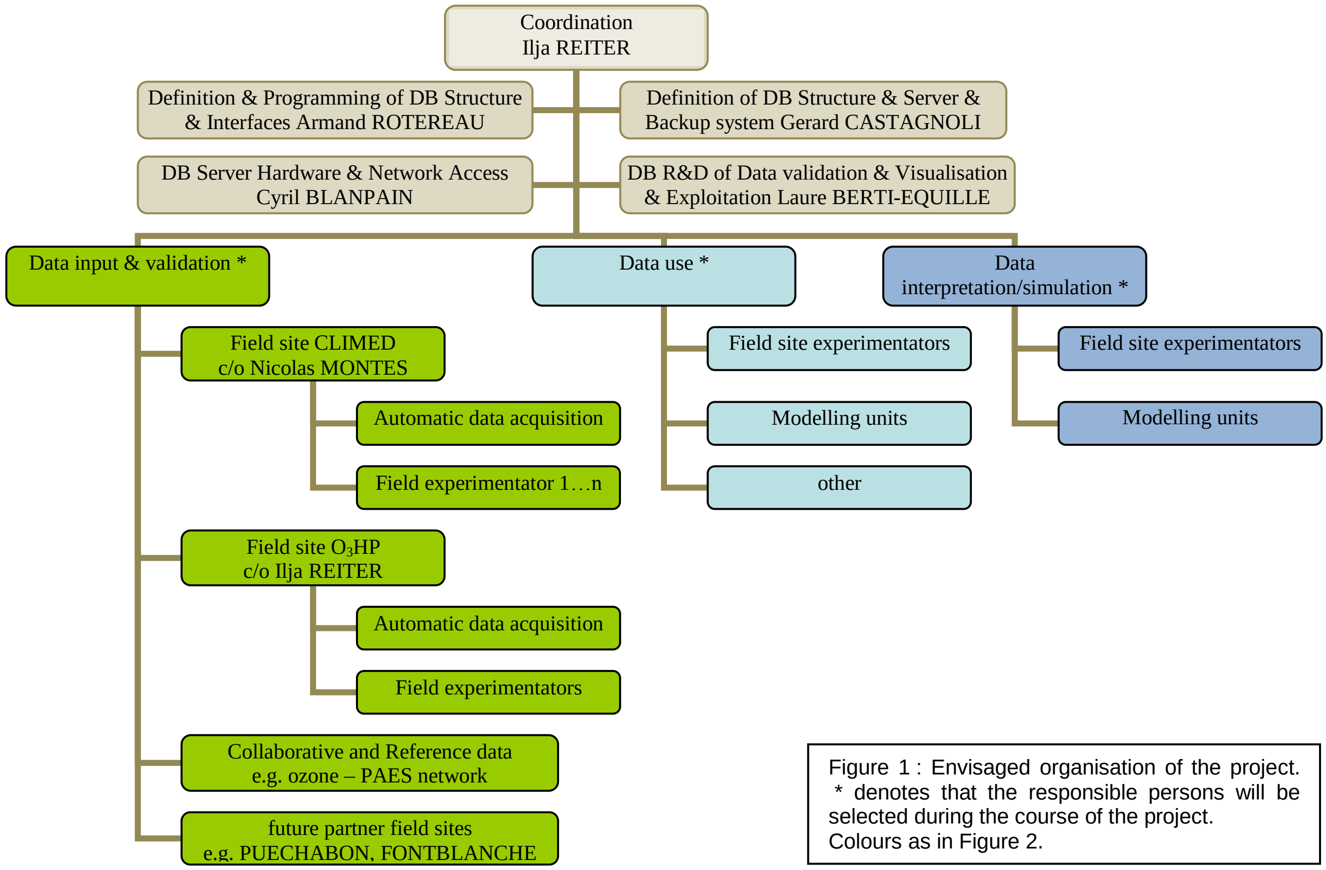

Figure 1 : Envisaged organisation of the project. * denotes that the responsible persons will be selected during the course of the project. Colours as in Figure 2.

Hard and Software

The database structure for the administrative part and a structure for the continuously acquired data have been well advanced (AR, GC, IR) and are due for testing. The database software POSTGRES has been chosen and AR & GC have absolved POSTGRES-training. A test-server has been set up (CB) and installed on the network of the OHP (GC). A system to automatically transfer sensor-data to the OHP-intranet and the database server has been designed and successfully tested (GC & IR). A website hosting the user-database interfaces has been created based on the CMS Joomla (GC).

Perspectives for integration of further sites

Besides the O_3HP (Pubescent oak forest, managed by Ilja REITER) and the CLIMED (Garrigue, managed by Nicolas MONTES, IMEP) site, two other sites have been established in Southern France: **Fontblanche** (coordinated by INRA Avignon c/o Roland HUC, Aleppo Pine and Holm Oak forest) and **Puechanbon** (c/o Jean-Marc OURCIVAL, Holm Oak forest), which are complementary in terms of typical ecosystems for the Mediterranean region and which both host rain exclusion devices to experimentally approach future climate scenarios (cf. organigram). The Fontblanche site is a member of the SOERE network, large internal efforts are ongoing to incorporate site data into the F-ORE-T database, which extends over 15 field sites. Therefore an immediate collaboration is not manageable, however, interfacing of the databases is aspired. The Puechabon site has a long standing history, and is already integrated in to the ICOS and other database. Participation in the COOPERATE database is currently undecided. However, once the functioning and advantages of the database can be demonstrated, new efforts are foreseen to merge data in a common sense.

Planning

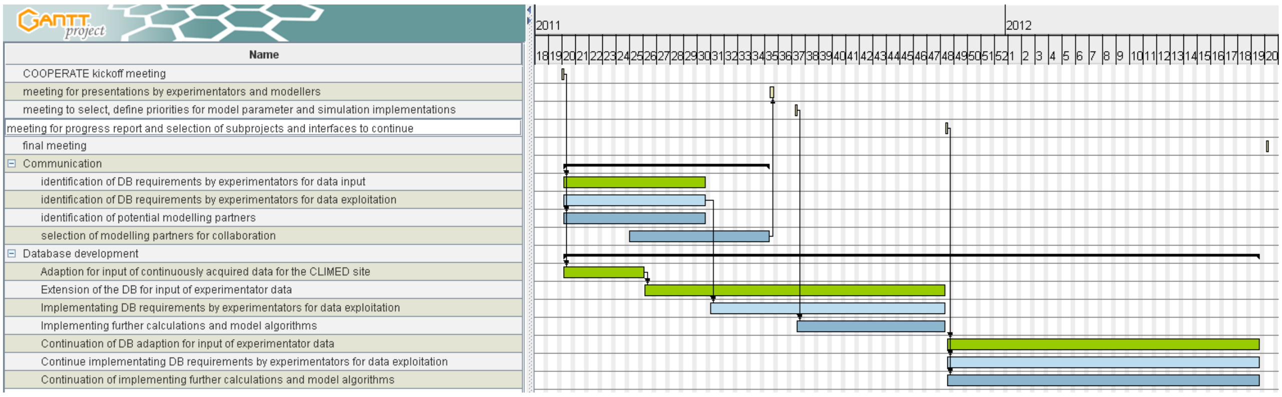

Figure 2: Project planning (green denotes - data input, light blue - data exploitation and dark blue - data interpretation and simulation; cf. organigram, Fig.1) .

The database development has been started mid 2010 (see above). During the course of the interaction between partners, we will analyse the potential for common research, with the purpose to find and to respond to calls relevant to the gained competences in the network.

Budget

Action/Purchase	**Workpackage**	
4 General Assemblies, 5 days	WP-I & II	€ 2000
Missions for O_3HP members	WP-I & II	€ 2000
Server, hard- & software	WP-III	€ 2500
Invitations of collaborators/partners	WP-II & IV	€ 1500
Sum		€ 8000

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