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18-months of regional carboschools projects funded by the EU Science in Society programme: a summary of achievements

CarboSchools links researchers from several leading carbon science laboratories in Europe with secondary schools. In these partnerships, young Europeans conduct experiments on the impact of greenhouse gases and learn about climate research and the reduction of emissions. Scientists and teachers co-operate over several months to give young people practical experience of research through true investigations and interactions with real scientists. The pupils also have the opportunity to inform the wider community about climate change by producing a final output of articles, exhibitions, conferences etc.

Since January 2008, nine research institutes in seven countries are exploring how they can best motivate and support such partnerships at the regional level across a wide variety of contexts, topics and age-groups. European co-operation makes it possible to compare results, learn from each other and develop replicable good practice. In support to partnerships, CarboSchools identify, develop and test appropriate materials (descriptions of experiments, activities, project ideas etc.), both at the local and European level, and give access to them through the project's website. Pupils gain European experience by doing comparative measurements through a common "school CO2-web". An in-depth study of impacts on attitudes, beliefs and skills will allow a better understanding of how knowledge and perception of science and global change are evolving, in part as a consequence of these projects.

Started in 2004 by CarboEurope and CARBOOCEAN, two major research projects on the carbon cycle, CarboSchools is currently funded until 2010 by the Science in Society programme of the EU[1] with a target of ca. 100 schools directly involved. Furthermore, in 2008-2011, EPOCA, a new EU research project on ocean acidification, is also joining forces with CarboSchools. **This report summarises the project's achievements mid-way to the current EU contract.**

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In the beginning of 2008 nine regional coordinators (RC) were appointed by the CarboSchools partners and all attended a kick-off meeting and training workshop hosted in Norwich (UK) by the Teacher Scientist Network (TSN) in March. The training workshop generated a "Regional coordinator's handbook" including a brief but readily accessible guide '12 steps to a successful partnership' based on the groups collective experience but guided by discussions with a long-established TSN-partnership.

Regional projects have been further developed and networked through team-building in project meetings and European cooperation (e-mails, visits, phone etc.). The cooperation was open to associated partners in Cluj Napoca, Romania and from TSP, a Comenius-funded teacher-training sister project: Heidelberg, Germany and Uppsala, Sweden. Locally, day after day, regional coordinators visited schools, initiated activities and partnerships, organised training sessions, produced materials and local websites and arranged special days with public presentation of project results. A project meeting in Pistoia, Italy, 25-30 April 2009 gathered up to 100 participants in the first day in common with the TSP final conference. A key question for all RCs is how to increase the number of scientists willing to partner with schools. To respond to this a train-the-trainer workshop was added to the meeting in Pistoia.

Main results to date:

- *40 school projects involving 95 scientists, 110 teachers and more than 1300 pupils demonstrate the vitality of the project with a great variety of approaches and projects of all topics, ages, duration etc.*
- *Teachers involved in CarboSchools now form a very dynamic group of active partners, both locally and at the European level, by active involvement in designing experiments and project ideas, planning Comenius activities (European cooperation between schools), and contributing to the project's final publication.*
- *Going from "learning climate change science" to engaging in sustainability and reducing CO2 emissions at the school level remains a challenge for most projects in CarboSchools.*

Expected final results:

- *Existing school projects will be consolidated and new ones will be set up*
- *In total, more than 250 teachers and scientists and 3000 pupils will have gained experience in working with*

1 Coordinated by the Max-Planck Institute for Biogeochemistry in Jena, Germany, the project receives almost 1 million euro for 36 months, the biggest part of it being used for coordinators' salaries within the 9 partner institutes.

each other.

- *In the partner institutes, scientists involved in education will be more recognized and supported*

The "schoolCO2web", a common CO2 measurement activity has been developed. Most resources and energy so far have been used to set-up the technical infrastructure. Local support labs purchased CO2 sensors & weather stations and installed them in schools, while the central lab:
- provided them will all information needed for installing & calibrating sensors and sending data
- supported them with technical difficulties occuring during set-up & installation
- developed the software needed to set up the visual interface showing data on the web

Main results to date:

- *A total of 12 stations are operational out of 20 planned initially. All operational stations produce and send data to the database which is made available at www.carboschools.org, section* schoolCO_2web *graphically as well as in tabular form by means of a simple web tool. Schools can use this tool to see long term trends, seasonal variations, compare and interpret local situations from a place to another etc.*
- *A first document describing the educational benefits of the project: "Working with atmospheric CO2 levels in the classroom" is available on the website together with video tutorials showing how to access and use data in a spreadsheet program.*

Several regional coordinators have helped teachers and students to work with the measurements - e.g. analysing CO_2 levels and weather parameters within a long period and in one day of different seasons. During the meeting in Pistoia in April 2009, teachers involved in the activity were offered a dedicated group session and a workshop about working with the measurements.

Unexpectedly, the chosen Vaisala CO_2 sensor revealed calibration problems which are still not yet solved and will require new software development. The new version will contain the functionality to perform a calibration in a simple way, in order for schools to do this by themselves. Calibration problems - which form a large part of the typical difficulties met in atmospheric science - so far prevent from comparing/combining data between different stations, but not from using the censors and working with the data locally.

Expected final results:

- *All support labs operational and in total 22 stations (current plan) connected*
- *All calibration & software problems solved*
- *Educational exploitation of the activity fully documented:*
    - *comprehensive examples of activities & ideas for student projects*
    - *examples of good practice & materials produced by participating pupils*

A dedicated work package evaluates the regional projects and measures attitude changes of participating students. Three instruments are under development for that:

- *Self-evaluation tools (SET)* will be used to evaluate CS+ projects, implemented either by regional coordinators or by teachers. SET is a short questionnaire with closed and open questions asking for students' personal information and opinions. SET gives information on the perception of projects by students, and on how students perceive science and school science and whether their opinions and career plans have been affected by CS+ projects. SET makes it possible to correlate students' answers to their characteristics, like sex, school level, grades for science subjects etc. The tools are now available in English, Italian, Norwegian, German, Dutch, Catalan and French.
- *Attitude questionnaires* will be developed to measure students' attitude changes towards science, school science and climate change. The attitude instrument will be administered twice to selected groups as pre-test and post-test.
- *Interviews* with participating pupils and teachers.

Expected final results:

- *SET implemented in all regions & reports of evaluation results sent to all regions*
- *Attitude questionnaire revised, translated in regional languages and implemented in selected regions*
- *Additional evaluation information provided by interviews with teachers, students and scientists*
- *All results analysed and reported to regional coordinators and in external reports & academic papers in international conferences and international journals.*

CarboSchools produce materials both for direct participants and the broader teaching community:

1) local materials: although a multitude of websites offer information on various aspects of climate change, very little

is existing in the concrete work with schools on the marine carbon cycle, the CO2 exchange as a part of agricultural methods or the CO2 uptake of forests. At the first meeting in Norwich (March 2008) the partners contributed the materials they had available locally, but these required adaptation for use in schools and testing in the classroom. On this ground regional projects developed several experiments and procedures suitable for schools, and their application in actual teaching situations. The meeting in Pistoia (April 2009) provided a platform for presentations of these materials by and to the school teachers involved in the project, thus allowing some refinement, and today the first completed versions start to be made available in English to the other regional projects.

2) the central website of the project was launched on 30 september 2008 at www.carboschools.org, providing an overview over the whole project and the regional projects, a library of teaching resources, data from SchoolCO2web and links to the individual websites of the regional projects. The structure of the website, particularly the library, was critically reviewed at the meeting in Pistoia, and a number of issues have been identified that should help to make it more user-friendly particularly for teachers.

3) in February-March 2009 a group of teachers was identified to contribute to the project's final publication with their experience in project work, experiments and methods. In Pistoia together with other potential authors (RCs and work package leaders) they designed a table of contents and a timetable for production of this publication identifying individual authors for different chapters. Collecting the best materials produced throughout the project, this book will be focused on *how to integrate authentic science learning & project teaching about climate change in secondary education.* Primarily targeting science teachers all over Europe, it will offer ideas and examples of activities for the main phases/components of a project integrated to the curriculum: learning about the scientific context, designing & running experiments & science activities, partnering with a scientist, cooperating with other schools abroad, developing sustainability at school.

Main results to date:

- *multi-langage website operational with first library of resources available*
- *experiments & activities designed & presented at the interim project meeting in Pistoia*
- *group of authors, table of contents & calendar defined for the final publication*

Expected final results:

- *revised, more teacher-friendly website lay-out, interface & library structure*
- *rich library contents with tested & commented resources (experiments, project ideas etc.)*
- *final publication widely disseminated in schools in Europe & worldwide*

To continue to involve and stimulate the broader scientific community, CarboSchools sessions have been organized at all CarboEurope, CarboOcean, and EPOCA project meetings, mixing oral & poster presentations by scientists, teachers, pupils and CarboSchools members. In November 2008 CarboOcean PhDs were trained in communication of their research results to schools in a dedicated session.

The project's final conference will be hosted by MPI-BGC in Jena, from 14.04.-17.04.2010. Results of the regional projects, including a science festival with demonstrations of experiments as well as evaluation findings will be presented and new institutes will be encouraged to replicate the approach. In parallel, a **summer school** for students involved in CarboSchools projects will be held from 10.04.-16.04.2010. Three thematic workshops (ocean, ecosystems, and atmosphere) will be offered with science presentations by pupils, scientists and CarboSchools regional coordinators. Group work will focus on producing joint outputs illustrating an aspect of the carbon issue to be presented at the science festival, e.g. a video, game, poster, newspaper, webpage, new experiment etc. All groups will also work on the question: "How can we reduce CO2 emissions in our school and local community?"

In addition each regional project prepare 'final' events to present CarboSchools and its products so that they can be exploited on a national school level through teachers' networks and associations. Early planning of these events has been encouraged by email and discussions at CarboSchools meetings. Several RCs already organised similar events at the end of the school year 2008-2009.

External communication with all stakeholders interested in climate change science education lead to an impressive list of press releases, public talks, conferences, publications, movies etc. at all geographical scales - including a key contribution to the UNESCO World conference on Education for Sustainable Development in Bonn in March 2009.

All efforts combined, the overall main expected result is a contribution to equipping EU education systems with new tools, methods and resources for promoting inquiry-based and society-based science education in a perspective of sustainable development through the challenge of climate change.