

Deliverable D6.6: *New Material for Education and Training*

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Table of contents

D6.6.1. Specific objectives for this deliverable	3
D6.6.2. Production of online teaching resources to explain major scientific issues	4
D6.6.3. Information flyers and other supporting materials, e.g. demonstration kits	5
D6.6.4. Easy-to-understand short movie clips	6

6.6.1. Specific objectives for this deliverable

Work Package 6 (Outreach, communication and education) contained in sub-task 6.3 training and education activities.

Since many of the EUROCHAMP-2020 partners are educators (professors/lecturers) at universities across Europe, with vast experience of teaching atmospheric science and training young researchers, it has been planned in the EUROCHAMP-2020 Work Programme to produce a range of novel educational materials to aid the teaching of atmospheric science, air quality and climate. Such educational material should include:

- the production of online teaching resources to explain major scientific issues
- information flyers and other supporting materials, e.g. demonstration kits
- easy-to-understand short movie clips that explain the EUROCHAMP-2020 research infrastructure and its role in supporting European research.

The development of educational material is often very time consuming and distribution among consortium partners requires clarification of copyright. However, some material has been developed and is presented in this deliverable.

It is worth mentioning that the development of new teaching material is a continuous process through the life of the project. Accordingly, an updated version of this deliverable will be provided at the end of the project in month 48.

In addition to the activities described in the following sections, it should be pointed out that members of the EUROCHAMP-2020 consortium organised several “teaching events” for different interest groups such as:

- Practical training of master students at the AIDA chamber (in German). In this training the master students in meteorology develop a research objective, plan and perform corresponding AIDA chamber experiments (typically one week), analyse and present their results.
- Training in atmospheric chemistry for students during the 8th Georgian-German School and Workshop in Basic Science (GGSWBS) in Georgia (<http://collaborations.fz-juelich.de/ikp/cgswhp/cgswhp18/index.shtml> and <http://collaborations.fz-juelich.de/ikp/cgswhp/cgswhp18/program/program.shtml>).
- Compact course involving a dedicated session on simulation chambers given by the EUROCHAMP-2020 Coordinator at the institute IEK-8 of the ForschungszentrumJülich, jointly organised by the University of Cologne and the University of Wuppertal, from September 24th to September 28th, 2018. (http://www.fz-juelich.de/iek/iek-8/EN/Expertise/Education/Summerschool/Summerschool_node.html).

6.6.2. Production of online teaching resources to explain major scientific issues

Simulation chamber platforms are high-technology labs where access for the wide public is not always easy for safety reasons. Even if there are opportunities of visits during so-called “Science Day Events”, it seemed necessary to give more people the possibility to discover such labs and facilities through *virtual* visits. Accordingly, several partners have provided the wider public with full immersion 3D movies allowing interested people to virtually walk around the EUROCHAMP-2020 facilities.

Eight movies have been produced up to now by using a 3D 360° camera. They are available online through the project’s [YouTube channel](#) or through [the website](#). They can be used by anyone on YouTube (equipped with a virtual reality helmet or even only with a smartphone)



For students and young scientists it is key for understanding atmospheric chemistry to translate experimental results, e.g. from an experiment in a lab course or from a more complex experiment in a simulation chamber, into chemical processes occurring in the atmosphere. This is commonly performed by chemistry models, which are complex and difficult to handle.

At Leeds University (UK) – the home of the Master Chemical Mechanism (MCM), a widely used model to describe complex chemical processes in the atmosphere by using experimental data as input – an “Atchem labclass online tutorial” has been developed. With the help of this tutorial, which is available at http://mcm.leeds.ac.uk/MCM/atchem/tutorial_intro.htm students and young scientists can learn to handle simple atmospheric chemical processes in a model. The output of the model can be handled in commonly used spreadsheet programs e.g. Microsoft Excel.

At Wuppertal University, a model experiment for the simple reaction $C_2H_4 + OH (+NO)$ is under development using the freely available Kintecus® software (<http://www.kintecus.com>) for a

student's lab course, which gives the students the opportunity to do sensitivity analyses in this system.

6.6.3. Information flyers and other supporting materials, e.g. demonstration kits

Within a master thesis at the Institute of Atmospheric and Environmental Research at the University of Wuppertal, a simple experiment has been developed and tested to give students the opportunity to study scattering processes such as Mie and Rayleigh scattering of sunlight in the atmosphere and the corresponding colour change of the sun during the day in a documented school experiment.¹

As a “real world” experiment, the formation of secondary organics aerosols can be studied, which are generated through the reaction of limonene with ozone. The equipment for the experiments is now available in a suitcase, which can be borrowed from schoolteachers together with a manual for educational purposes, to be used in schools.



Figure 6.3.1: Set-up of the experiment with a xenon lamp, a diaphragm and an achromatic lens. In between a filter holder is placed. The aquarium is illuminated and the transmitted light is shown on a wall.

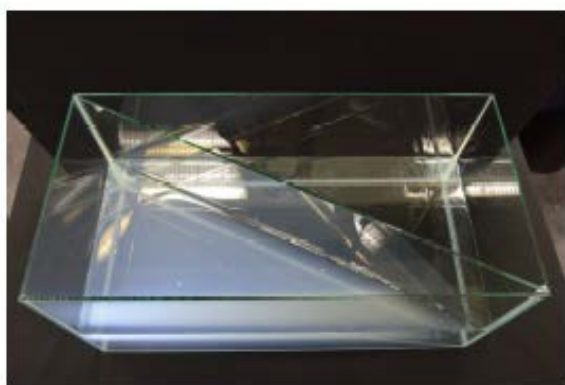


Figure 6.3.2: Aquarium with diagonal partition (picture taken from above).

¹ Carina Salven: Entwicklung eines Experiments zur Demonstration von Himmelsfarben Master, Thesis, University of Wuppertal, July 2018 (in German)

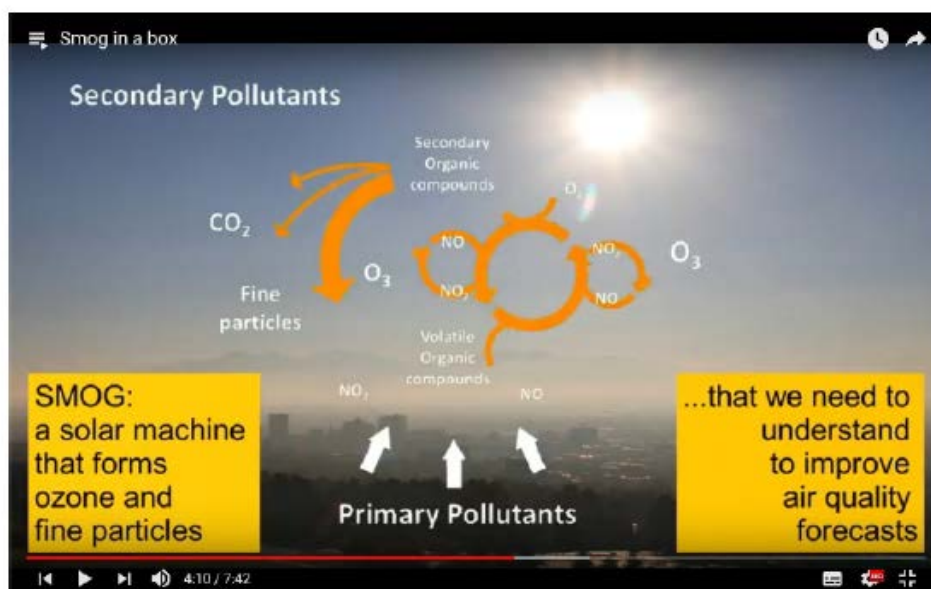


Figure 6.3.3: Stray light in limonene: 90° to the direction of light propagation the fog is the rather white, contrary to the propagation direction where a blue colour is visible (all pictures taken from ¹⁾).

6.6.4. Easy-to-understand short movie clips

During the first two years of the project, two educational movies were produced and widely distributed. Both of them target more specifically undergraduate students but can be used by educators with less expert audience.

The first one – entitled “Smog in a box” – is rather focussed on the experimental simulation approach and its benefits for the understanding of air pollution chemistry. It illustrates how smog events are linked non-linear processes that mix the effect of primary emissions with solar radiation to generate secondary pollution. It demonstrates, thanks to a real experiment carried out in a simulation chamber, how researchers from the EUROCHAMP-2020 consortium are able to reproduce it in a chamber to study such complex phenomena.



The second one – entitled “Clouds soot and Light” – aims at explaining the concept of hygroscopicity of aerosols, its link with cloud formation and how it can change during the

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atmospheric transit of particles due to atmospheric chemistry. Using a small table-top experiment (that can be reproduced by the educator if needed), it demonstrates how the formation of free radicals under the effect of UV light can change the affinity of water to soot.



Currently, additional short movie clips are under discussion and creation. Both videos are freely accessible through the EUROCHAMP-2020 YouTube channel (see above) or directly at:

<https://www.youtube.com/watch?v=FGXHkJADfxM> and

<https://www.youtube.com/watch?v=xxjJWnykHkE>.

These movie are so far available in English and in Spanish. They have been seen online ca. 500 times each so far and have also been used in public exhibitions (EGU...), or during science fairs and schools events (eg. in Valencia in October 2019).