



CERN Open Days 14-15 September 2019

CLOUD Experiment's Planning

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15/07/2019

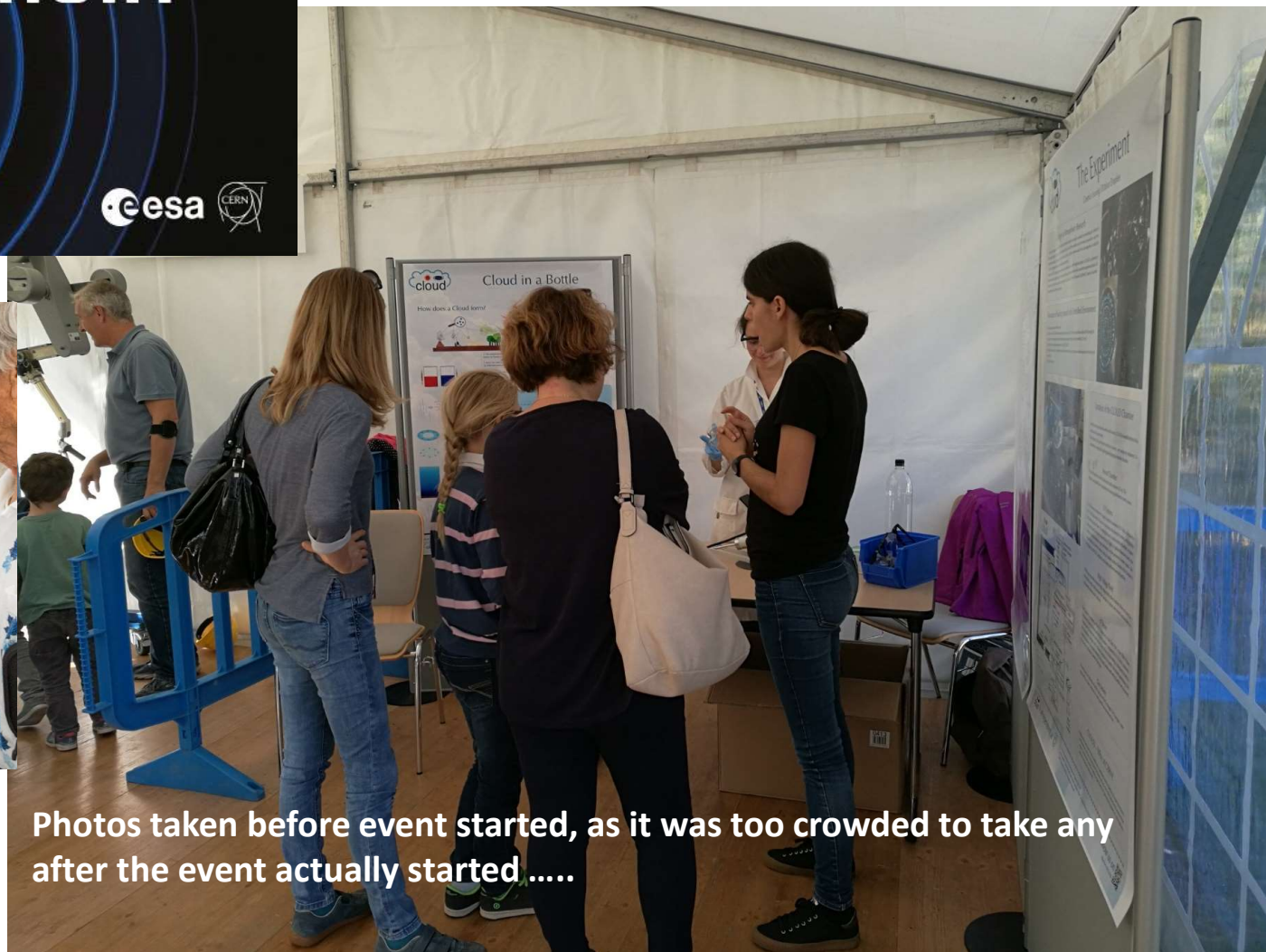
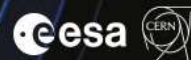


CLOUD activity plan

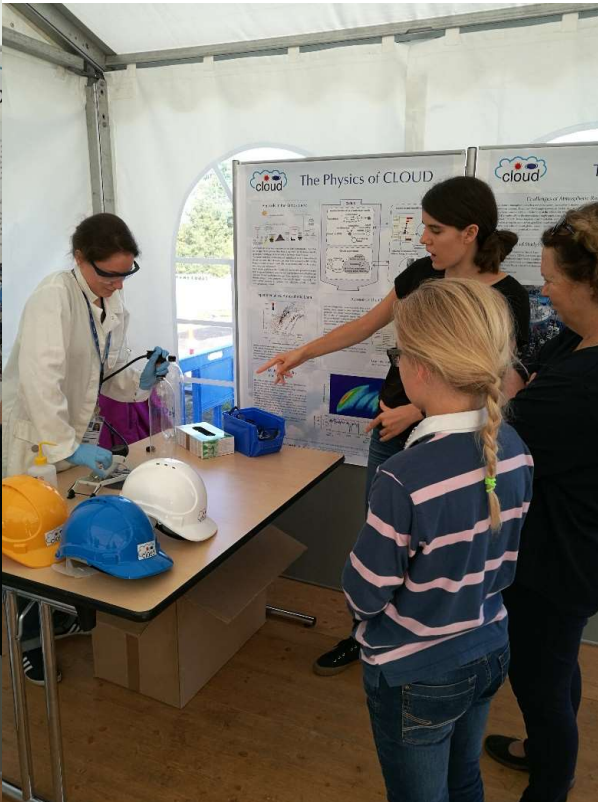
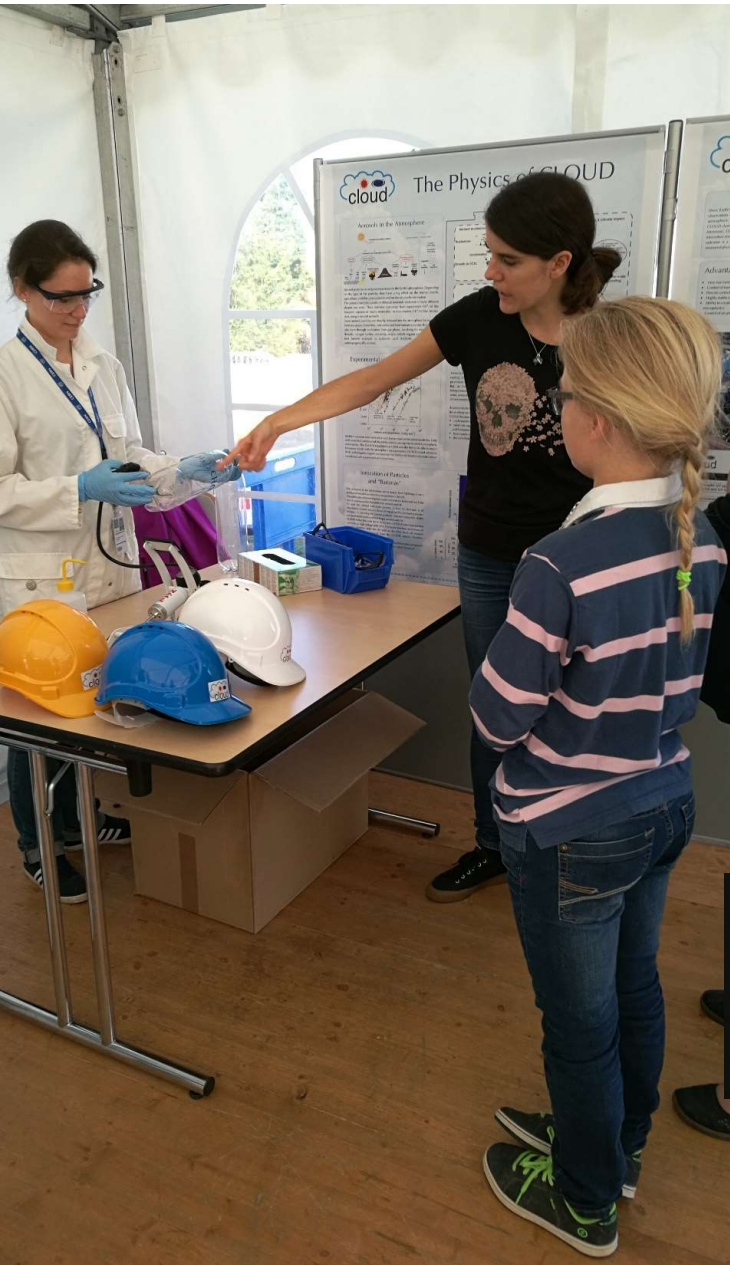
- For two years now, we have had a stand with the other small experiments at that Researcher's Night. We enjoyed the experience very much. We would like to participate to the CERN OpenDays 2019.
- CLOUD activity space needs: 5 x 5 m
- We will have 3-4 A0-sized posters to present. We will have 3-4 CLOUD people standing all times at our stand. All times at least one of us speaks fluent French. We will plan to place our demo kit to a table to show people how aerosol particles and clouds are formed.
- In addition, we are collaborating with an artist Helen Cawley. To improve outreach, we could have arty-science posters, videos with headphones for visitors, and some demos (e.g. small cloud chamber or small sculptures explaining CLOUD) for the public to see/ interact with.

// RESEARCHERS' NIGHT AT CERN //

FRIDAY 29 SEPTEMBER 2017
5PM - 11PM



Photos taken before event started, as it was too crowded to take any after the event actually started



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The Physics of CLOUD

Aerosols in the Atmosphere

Aerosol particles are of great importance in the Earth's atmosphere. Depending on the type of the particle, they have a big effect on the human health, agriculture, visibility, precipitation, and on the whole climate system. The aerosol particles consist of different materials and occur in many different shapes and sizes. Their diameter can range from nanometers 10^0 up to the biogenic vapours or soot molecules, to micrometers 10^6 of the smoke, dust, sea spray or volcanic ash.

Some aerosol particles are already released into the atmosphere for example from sea spray, forest fires, volcanic ash and from human activities, but they can also form through reactions from gas phase, including for example sulfur dioxide, nitrogen oxides, ammonia, and volatile organic compounds. The best known example is sulphuric acid (H₂SO₄), which is largely anthropogenically emitted.

CLOUD

Aerosol nucleation & growth experiments
Nucleation, condensation, evaporation, growth to CCN, coagulation, wet deposition, cloud condensation nucleus (CCN), scavenging (rain)

Cloudy microphysics
activation, charged aerosol particles, ice particles, wet deposition, Predicted scavenging / removal phase of the life cycle

Aerosol/cloud modelling & climate impact
High-resolution weather-scale aerosol-cloud modelling, reduction of aerosol-cloud radiative forcing uncertainties

Experimental vs. Atmospheric Data

But there are even more and not so well known sources for aerosol particles. Only with controlled and detailed laboratory studies can explain the direct atmospheric observations. The CLOUD experiment at CERN was the first to be able to match laboratory results with the atmospheric measurement. CLOUD studied aerosols (NA) with biogenic organic components that can be formed in natural conditions such as present in pine forest areas.

Aerosols in the Climate System

Aerosols influence the climate. As a whole, they have a cooling effect, which is even intensified by their potential role as cloud condensation nuclei. In the 2nd assessment report (AR2) by the Intergovernmental Panel on Climate Change (IPCC) states, aerosols are still the biggest uncertainty in global climate models.

To reduce these uncertainties and better understand the working mechanisms of aerosol particle formation, CLOUD focuses on the following research questions:

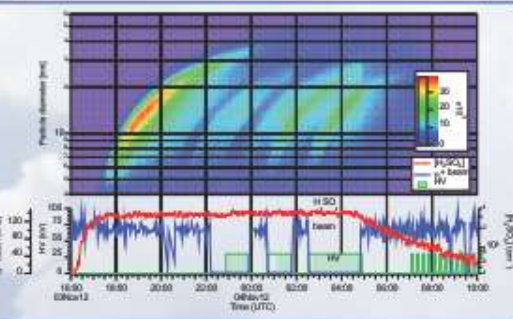
- understanding how natural particles form
- what role organic vapour play in the composition and formation of aerosols
- how cosmic rays influence the whole process, and
- the contribution of aerosols to the climate system.

Learn more about cloudy climate change on <http://www.cloudc4.eu>

Ionization of Particles and "Bananas"

The aerosols in the atmosphere come largely from splitting or are a product of molecules to ions or ions in the soil. The molecules of these biogenic vapours can start to cluster and reach the so-called critical particles (the birth of aerosol particles). To start the aerosol formation process, a kind of kick start is of importance. Cosmic rays can have an impact on this, by having electric charges, i.e. ionizing the aerosol particles. Natural radiation causes and governs many and biological aerosol particles.

CLOUD tested this with the IT beam line CERN's Proton Synchrotron and with an HV electrode (HV). The beam simulates an increase of cosmic radiation. With the HV field on the other hand, all charged molecules can be removed from the CLOUD aerosol chamber, removing the effects of cosmic rays. By switching the beam on the HV on or off, aerosol formation and growth can be influenced in the measurement station so-called "Bananas".



EP-DT and CERN Open Days logos still to be added

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Poster made by Eva Leypold, CERN CLOUD trainee



Cloud in a Bottle

How does a Cloud form?



8. These gas molecules collect around particles. Water vapour and an aerosol particle form a droplet.



9. Many droplets form a cloud.

7. The ideal surface for the water vapour can be small particles from many different sources like dust, salt, soot, bacteria, pollen, or volcanic eruptions.



6. Surfaces help the water vapour condense – like it can be observed on a glass filled with ice water.



5. As air rises, water vapour wants to condense and becomes liquid water again.



4. Expanding air also cools down.



3. Less air pressure means the air is compressed.



2. Because of the Earth's gravity there are more air molecules near the surface and less higher up in the atmosphere. So higher up, the air pressure gets lower.



1. Warm air rises upwards.

Now, do you want to make your own Cloud? All you need is ...



How does the "Cloud in a Bottle" work?

This cloud in the bottle was created by imitating the processes of the air pressure within the Earth's atmosphere. By using the hot party, the air inside of the bottle is compressed and the air pressure and temperature is rising. Being compressed, the water vapour will rise to the Earth's surface. When the cork is removed quickly, the air will escape very fast to adjust to the ambient pressure. This means, that the air pressure and temperature drop rapidly and also the temperature of the water will drop. This represents the rising of warm air and water vapour into higher atmospheric layers with lower air pressure and temperature. The drop point of the vapour is reached and it wants to condense. Aerosols inside the atmosphere allow the condensation, so many droplets inside the forming cloud in the bottle have a small particle inside as a condensation nucleus. Since alcohol evaporates faster than water, it evaporated for any other highly concentrated alcohol is used as the super to replace the water vapour.

cloud is an experiment at

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still to be added

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CERN logo

Poster made by Eva Leypold,
CERN CLOUD trainee

Nucleation experiment:

CLOUD was the first to discover pure biogenic nucleation.

Maybe we could show "pure biogenic nucleation" with limonene from orange peels and ozone ?

This illustrates how the compounds in the atmosphere react to form aerosols, we would "only" need an ozone generator, and I understood that we could bring it from Univ. Frankfurt.

<https://www.youtube.com/watch?v=fkjEm-sPfoE>



Orange peels form aerosols.

2,255 views 5 1 SHARE SAVE ...



Orange peels form aerosols.

2,255 views 5 1 SHARE SAVE ...



Orange peels form aerosols.

2,255 views 5 1 SHARE SAVE ...



Orange peels form aerosols.

2,255 views 5 1 SHARE SAVE ...

Cloud in the bottle experiment:

This illustrates how the clouds are formed in the atmosphere. We would not have clouds without aerosol particles.

<https://www.youtube.com/watch?v=cXpuo3YHOn0>

This is the same principle as how we create a cloud inside the CLOUD chamber to study cloud properties.



Cloud in the Bottle - The Spangler Effect

239,030 views

2.1K 50 SHARE SAVE ...



Cloud in the Bottle - The Spangler Effect

239,030 views

2.1K 50 SHARE SAVE ...



Collaboration with artist Helen Cawley



Helen's plans:

Having attended La Nuit des Chercheurs, and worked a lot in public engagement, I believe that visitor experience will be improved at the Open Day with immersive artworks, since East Hall where the experiment takes place will not be open to the public. Tangibility and object oriented narrative is an important tool in conveying complex information in a short time frame, to audiences of all ages. Visual and interactive cues will prompt conversations and questions that CLOUD scientists and I will be there to take on.

The proposed works are:

The official CLOUD video from the CERN website, then a video by myself inspired by CLOUD, both on a loop.

An alpha-Pinene station; a plinth upon which various related objects will be situated to support a conversation about chemicals and clouds, the discoveries of CLOUD, and transition of states. This will consist of a small sculpture made from tree resin. A pot containing a sponge saturated with pine oil that the audience can smell, and pine needles. This station will constantly be manned for safety, and the natural oil safe for use.

A small scale model of the CLOUD chamber.

A series of drawings I have been working on that depict the environments where the chemicals used in the experiment come from.

A small illuminated cloud sculpture on a plinth. Purely for aesthetics, and photograph opportunities. Social media #'s and public uploads are an important consideration for an open day, and outreach in general. CERN's online presence would benefit from such objects.



www.helencawley.com

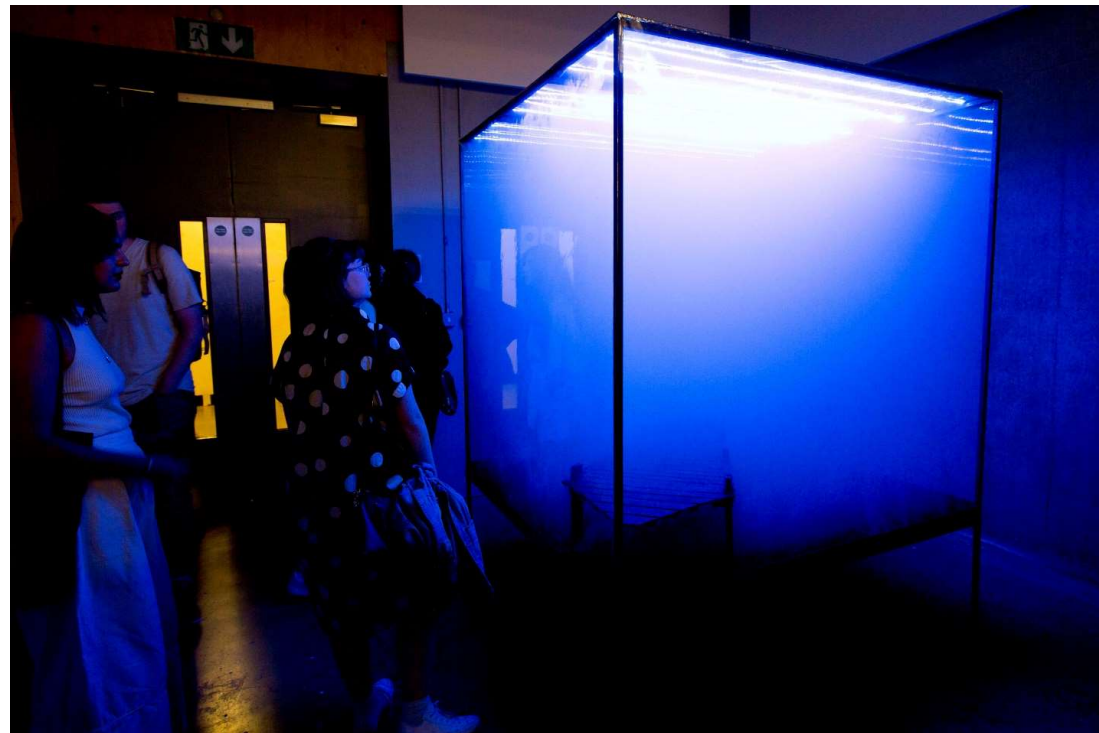
Instagram: @helen__cawley

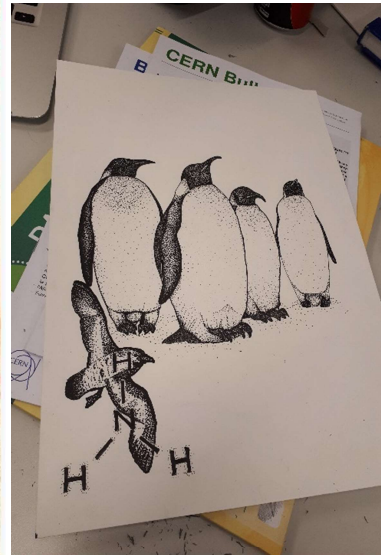
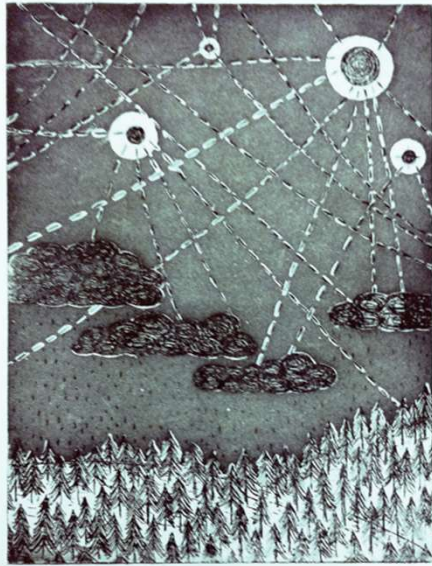
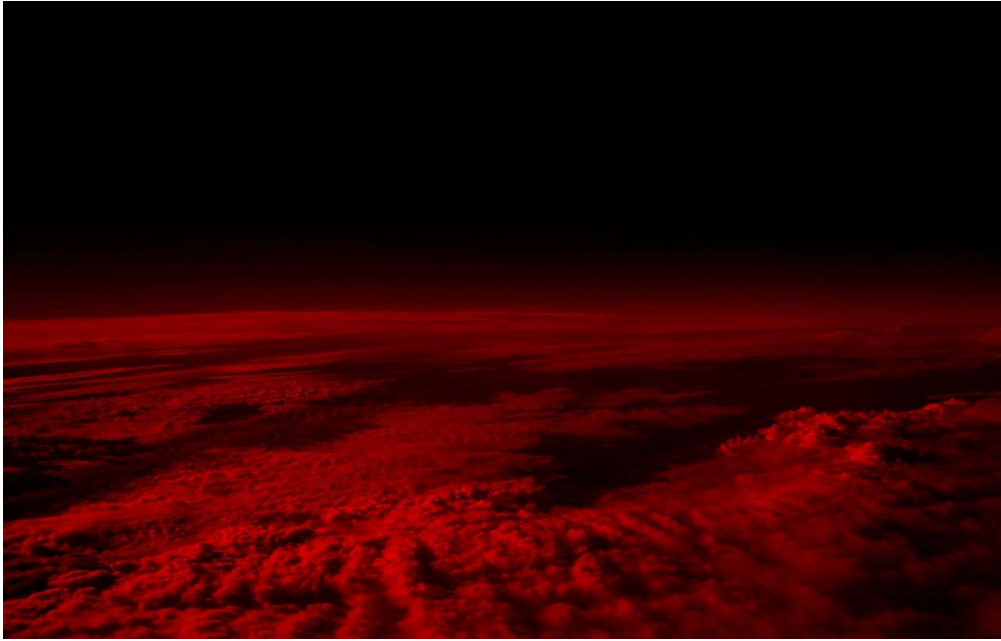
Helen's artwork will not be these pieces but much smaller ones.

Helen Cawley

The CLOUD Project fellowship ends in June with and the PhD begins in October.

Exhibitions, new artworks, talks and blog posts will be updated on website in due course.







OpenDays CLOUD Volunteers:

- Ruby Marten (MPA User, Paul Scherrer Institut; English)
- Victoria Hofbauer (MPA User, Carnegie-Mellon Univ.; German, English)
- Loic Gonzalez Carracedo (MPA User, Univ. Vienna; French, English, Spanish)
- Lucía Caudillo (MPA User, Univ. Frankfurt; Spanish, English)
- Guillaume Marie (MPA User, Univ. Frankfurt; French, English and little Italian)
- Tatjana Müller (MPA User, Univ. Frankfurt; German, English)
- Steffen Bräkling (MPA User, TOFWERK; German, English)
- Wiebke Scholtz (MPA User, Univ Innsbruck; German, English)
- Birte Rörup (MPA User, Univ Helsinki; German, English)
- Surdu Mihnea (MPA User, Univ Helsinki; Arabic, English)
- Helen Cawley (MPA PJAS, artist; English, some French)

CLOUD Activity Organizer:

- Hanna Manninen (MPE Fellow, EP-DT-CO; English, Finnish)

CERN CLOUD Team Leader:

Antti Onnela, EP-DT



Space and material needed:

Space needed: Approximately 5 x 5 m of indoor/undercover space is needed due to heavy flow of people through the space.

Furniture and other: One long table and bench is needed for CLOUD volunteers to carry out CLOUD in a bottle experiment and showcase that aerosol particles exist everywhere and are in constant interaction with the surroundings.

One table or plinth is needed for a TV screen or a computer screen, is needed to show videos on a loop. 2 sets of headphones would be needed for people to hear the video. Power will be needed for the screen and computer.

3 x A0 size wall for CLOUD science posters

3 x A0 size wall or 3 m long grid wall for 2D artworks by Helen Cawley

3 x plinths (approximately 1m height, and 50 x 50 cm): 1 plinth for a miniature model sculpture, 1 plinth for a small sculpture and 1 plinth for an artwork with a light.

Electricity: 4 plugs 220V: 1 for a laptop, 1 for a screen, 1 for light and 1 for aerosol monitor.

Safety issues

- **Chemicals:** Only hazardous material we will bring is a small closed bottle of isopropanol (about 100 mL). We will have safety glasses for us and the guests who follow the demo (but they don't really need any). There will be only very small amount of isopropanol vapour (no liquid) that guests may be in contact with. We (CERN volunteers) will also wear safety gloves and lab coats. Here is a link to the demo that you see what how we use the isopropanol: <https://www.youtube.com/watch?v=cXpuo3YHOn0>
- We will use both water and isopropanol to create a vapour cloud inside the limonade bottle. We will not use matches nor smoke.
- Volatile organic compounds (e.g. orange peel). One of the sculptures is made from plinth and we will have a small pot of pine oil that people can smell, and another pot of pine needles. There products people can collect from nature or buy from a normal shop.
- We will need **electricity**, 4 plugs 220V: 1 for a laptop, 1 for a screen, 1 for light and 1 for aerosol monitor.